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Hrvatska znanost i struka u poljoprivredi pred novim ciklusom ZAP-A 2021-2027

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Prošireni sažetak

Agronomski fakultet i Fakultet biotehničkih znanosti kao domaćini ovog simpozija već se pripremaju za novo razdoblje koje donosi i novo financiranje znanosti. EU znanost će nastaviti još intenzivnije s konceptom Europskih sveučilišta koji je razvijen s državama članicama, visokoškolskim ustanovama i studentskim organizacijama, a u tekućem razdoblju je prijave iz 54 saveza u koje je uključeno više od 300 visokoškolskih ustanova iz 28 država članica i drugih programskih zemalja Erasmus +. Obzor program za razdoblje 2021-2027 je vrlo ambiciozan i cilj mu je ozbiljno jačanje znanstvenih i tehnoloških baza EU-a i Europskog istraživačkog prostora, jačanje europskih inovacijskih kapaciteta, konkurentnosti i radnih mjesta. Sva tri osnovna područja izvrsno se uklapaju u naše područje djelovanja – kao temeljne znanosti, spremne nuditi tehnološka rješenja za globalne izazove i sposobne isporučivati inovativne tehnologije. U svim dijelovima istraživanja naglašen je otvoreni pristup - otvorenost velikih baza podataka i odgovorno korištenju podataka istraživanja. Promicanje i poticanje raznih oblika otvorene znanstvene prakse jedno je od ključnih postavki pretpostavljene mreže suradnje unutar i izvan sveučilišta. Visoko obrazovanje na suvremenom, prepoznatljivom i u svojim aktivnostima konkurentnom visokom učilištu kakva su naša morat će jače djelovati u pravcu osmišljavanja i ispitivanja inovativnih modela poučavanja u uvjetima što potpunije fakultetske, međufakultetske i sveučilišne suradnje. Dodana vrijednost takvih modela integracije bit će razvoj i realizacija zajedničkih politika i akcijskih planova kojima se ispunjavaju ciljevi Obzora 2021-2027. Znanost se u predstojećem razdoblju bavi novim tranzicijama suvremenog svijeta, a obuhvaćene su klimatskim promjenama, socijalnim promjenama društva, te bioekonomijom. Mjesto znanosti u Hrvatskoj i u našem dijelu „life science“ ili STEM područja bi trebalo biti prije svega u ispitivanju suvremenih naprednih tehnologija kao što je digitalna i podatkovna poljoprivreda koja bi koristila velike baze podataka za vođenje poljoprivredne proizvodnje, a preko držanja istih na javnim servisima i održavanjem od znanstvenih institucija iz cijele zemlje bili bi dostupni svim proizvođačima u sustavu potpore te vjerodostojni s obzirom na metodologiju uzimanja uzoraka i obrade podataka. Slijedi prijenos novih tehnologija proizvodnje sukladno klimatskim promjenama i globalnom zatopljenju te usmjerenosti na mala lokalna tržišta i izvorne pasmine, sorte i proizvode u ruralnom prostoru. U oba područja djelovanja znanstvenih institucija vrlo je važno da postavljanje i realizacija znanstvenih projekata budu usmjereni na cjelovito rješenje na relaciji resorno ministarstvo, lokalna zajednica (uprava), udruga proizvođača s jasnom dodanom vrijednosti na razini proizvođača i tržišnog lanca opskrbe. Sve navedeno u znanstvenom području djelovanja fakulteta treba biti pretočeno u nove studijske programe, metode i načine učenja, kako bi zaista mogli sukladno ciljevima ZAP-a i razvojnih strategija ne samo poljoprivrede nego cijelog društva omogućiti razvoj poljoprivrede temeljene na znanju. Poduzetništvo u ruralnom prostoru, posebice kod mladih poljoprivrednika, potaknuto učinkovitim sustavom edukacije dodatno treba djelovati na održivost, konkurentnost i otpornost poljoprivrednih gospodarstava. I hrvatska poljoprivreda se priprema za novo razdoblje ZAP-a pripremajući strategiju koja bi trebala objektivnom analizom trošenja javnih sredstava u sektoru poljoprivrede, ribarstva i ruralnog razvoja, konzultacijama sa svim dionicima u sektoru trebala biti osnova za planove djelovanja za ovo razdoblje. Osmišljavanje sustava aktivnosti za ispunjavanje ciljeva strategija te mjera nadzora njihove provedbe glavni su činitelji ostvarenja strategije bez kojeg bi ona opet bila sama sebi svrha. Za uspješnu provedbu strategije potrebno je razraditi i provesti inovativne pilot projekte radi ispitivanja održivosti predloženih rješenja. U svakoj navedenoj aktivnosti nužno je aktivno djelovanje hrvatske znanosti i struke, pri čemu moramo težiti cjelovitim rješenjima, a ne

usko specijalističkim kako smo to do sada najčešće radili. Da bi svi dokumenti i aktivnosti (strategija u ciljevima, provedbi i nadzoru provedbe s ispravicima do sigurne realizacije, inovativna rješenja i pilot projekti) mogli poslužiti kao osnova za proces izrade operativnih programa za EU financijski okvir EU 2021.-2027. potrebno je uskladiti djelovanje puno više dionika nego što smo do sada uključivali. Jedino na taj način konačno ćemo postati proaktivni u vođenju agrarne politike sukladno okviru i uspješni u korištenju nama primjerenih mjera i aktivnosti, a time i sredstava za poljoprivredu i ruralni razvoj. Sa stajališta struke važno je da je operativno naslonjena na znanstvenu komponentu, što uključuje edukaciju i korištenje rezultata znanstvenih istraživanja, ali ne i njome opterećena. Nositelji provedbe i nadzora operativnih programa u ostvarenju strategije trebaju biti mreže ovlaštenih agronoma i srodnih disciplina biotehničkog znanstvenog područja s naglaskom na kvalitetu i dinamiku provedbe, a ne na inspekcijski nadzor i poslovično zaustavljanje ili obustavljanje procesa. Svi ovi činitelji opet trebaju činiti jedan učinkoviti sustav. U protivnom dogodit će nam se da će razina korištenja sredstava za znanstvene projekte u poljoprivredi i ruralnom razvoju biti višestruko niže od onih kod razvijenih zemalja članica, kao i njihov utjecaj u razvoju ovog sektora. Digitalizacija poljoprivrede i ustrojavanje te održavanje velikih baza podataka za potporu poljoprivrednoj proizvodnji su preduvjet zadržavanja koraka s naprednim tehnologijama u razvijenim zemljama EU. Daljnje zaostajanje Hrvatske za ovim kretanjima trajno bi nas u ovom sektoru učinile nekonkurentnim, a našu znanost i struku manje utjecajnim i vjerodostojnim bez obzira na pojedinačne uspjehe i struke i znanosti.

Ključne riječi: poljoprivredna znanost i struka, zajednička agrarna politika, Obzor 2021-2027

Croatian science and profession in agriculture before the new CAP 2021-2027

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Extended abstract

The Faculty of Agriculture and the Faculty of Biotechnical Sciences, as hosts of this symposium, are already preparing for a new period that also brings new funding for science. EU science will continue to intensify with the concept of European Universities developed with Member States, higher education institutions and student organizations, and in the current period applications from 54 federations involving more than 300 higher education institutions from 28 Member States and other Erasmus + Program Countries. The horizon program for the period 2021-2027 is very ambitious and aims to seriously strengthen the scientific and technological bases of the EU and the European Research Area, strengthen Europe's innovation capacity, competitiveness and jobs. All three core areas are a great fit for our field of activity - as basic sciences, ready to offer technological solutions to global challenges and capable of delivering innovative technologies. Open access is emphasized in all parts of the research - openness of large databases and responsible use of research data. Promoting and encouraging various forms of open scientific practice is one of the key settings of an assumed network of collaboration within and outside the university. Higher education in a modern, recognizable and competitive institution of higher education, such as ours, will have to work harder to design and test innovative teaching models in the fullest possible faculty, inter-university and university cooperation. The added value of such integration models will be the development and implementation of common policies and action plans that meet the objectives of Horizon 2021-2027. Science is addressing new transitions in the modern world in the coming period, and these include climate change, social change, and bioeconomy. The place of science in Croatia and in our part of the life science or STEM field should primarily be in the examination of modern advanced technologies such as digital and data agriculture, which would use large databases to run agricultural production, and by holding them at public services and maintenance from scientific institutions from all over the country would be accessible to all manufacturers in the support system and credible with regard to the sampling and data processing methodology. This is followed by the transfer of new production technologies in line with climate change and global warming, and a focus on small local markets and native breeds, varieties and products in rural areas. In both fields of activity of scientific institutions, it is very important that the setting up and realization of scientific projects be focused on a complete solution in the line ministry, local community (administration), producer association with clear value added at the producer level and supply chain. All of the above in the scientific field of the faculty's work needs to be translated into new study programs, methods and ways of learning, so that they can truly enable the development of knowledge-based agriculture in accordance with the goals of the CAP and development strategies not only of agriculture but of the whole society. Entrepreneurship in rural areas, especially for young farmers, driven by an effective education system, should additionally affect the sustainability, competitiveness and resilience of farms. Croatian agriculture is also preparing for a new CAP period, preparing a strategy that should form the basis of action plans for this period through consultation with all stakeholders in the sector, agriculture, fisheries and rural development. Designing a system of activities to meet the goals of the strategies and measures to monitor their implementation are the main factors for achieving the strategy without which it would again be an end in itself. Successful implementation of the strategy requires the development and implementation of innovative pilot projects to test the sustainability of the proposed solutions. In each of these activities, active participation of the Croatian science and profession is necessary, whereby we must strive for complete solutions, not narrowly

specialist ones, as we have done so far most often. In order that all documents and activities (strategy in goals, implementation and monitoring of implementation with corrections to safe realization, innovative solutions and pilot projects) can serve as a basis for the process of developing operational programs for the EU financial framework EU 2021-2027. much more stakeholder action than we have included so far needs to be coordinated. Only in this way will we finally become proactive in pursuing agrarian policy in accordance with the framework and successful in using the appropriate measures and activities, and thus the resources for agriculture and rural development. From the point of view of the profession, it is important that it is operationally reliant on the scientific component, which includes, but is not burdened with, the education and use of scientific research results. Implementation and control agents of operational programs in the implementation of the strategy should be networks of authorized agronomists and related disciplines of the biotechnical scientific field, with emphasis on the quality and dynamics of implementation, rather than on inspection and proverbial stoppage or suspension of the process. All of these factors, again, should constitute one effective system. Otherwise, it will occur to us that the level of utilization of funds for scientific projects in agriculture and rural development will be many times lower than in developed Member States, as well as their impact in the development of this sector. Digitization of agriculture and the establishment and maintenance of large databases to support agricultural production are prerequisites for keeping up with advanced technologies in developed EU countries. Croatia's continued lag in these trends would permanently make us in this sector uncompetitive and make our science and profession less influential and credible, regardless of individual successes and professions and sciences.

Keywords: Agricultural science and profession, Common agricultural policy, Horizon 2021-2027

Adaptability assessment of soybean cultivars of Croatia in the function of breeding for drought tolerance

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Extended abstract

Among all extreme weather conditions caused by climate change, drought has the greatest economic impact on society worldwide. According to global and local climate change scenarios, more frequent and severe drought events are expected in the near future, which will affect the sustainability of the most strategically important crops. The drought is the main and the most common cause of unprofitable yields of soybean and other agricultural crops in the Republic of Croatia. Within the research activities of the AGRO-DROUGHT-ADAPT project, the genetic adaptability of economically relevant soybean cultivars in Croatia have been examined during two consecutive years (2017 and 2018) in term of their drought tolerance to identify superior germplasm and selection methods for breeding purposes. The experiment included field trials over 19 locations around Croatia (continental and coastal areas) to grasp "random drought" and evaluate selected genotypes in different climatic scenarios in order to assess their reactions to optimum and drought conditions, through different growth stages as reflected to the most important agronomic traits. Simultaneously, laboratory physiological and molecular genetic testing have been conducted as possible alternatives for fast detection of tolerant genotypes through their validation by the actual results from field trials. For the purpose of precise estimate of drought stress, at all field locations micrometeorological data have been collected by automated weather stations and analyzed in order to precisely estimate the appearance, intensity and duration of the drought stress. In addition, these data have been compared with the data of closest National Meteorological Service (DHMZ) official stations. Advanced statistical analysis of meteorological and biological data has been performed in order to identify the best drought tolerant soybean genotypes and the best discriminating testing methodology, which might improve the production and selection for this trait in the current breeding programs. The comparison of recorded weather variables (air temperature, air humidity and precipitations) between weather stations located in the field experiments and nearest official DHMZ stations that were distant between 0.5 up to 10 km showed rather similar values. Considering the observed rhythm of change of drought parameters (variation of air temperature and humidity, as well as precipitation amounts and intervals) and rather slow reaction of plants to them we have concluded that meteorological data recorded right in the field experiments as used to compute different drought indices did not show significant advantage over standard DHMZ data. Consequently, the rather dense grid of the DHMZ weather stations in Croatia can deliver reliable meteorological data to estimate drought parameters of sufficient precision for the purpose of plant breeding experiments. In order to quantify and determine drought stress intervals we have used weather variables to calculate several parameters such as Palmer Drought Severity index (PDSI), Standard Precipitation Index (SPI), Hydro-thermal Coefficient (HTC) and Vapor Pressure Deficit (VPD) for varying time intervals (days, decades and months). These data have been used to analyze and classify locations of field experiments according to drought stress level within each of two years. According to values of these parameters particular locations have been considered as either "without drought stress", "drought semi-stressed" or "drought stressed locations". Validation of this classification has been done by correlation with level of average reduction for various agronomic traits such as plant height, yield components and grain yield (32 genotypes, 128 plots of 10 m² per location). The VPD has shown best discrimination ability in measuring "drought stress" which was relevant for reaction of various soybean genotypes to drought

stress. The analysis of variance for overall field experiment data (32 genotypes in four replicates, 19 locations, 2 years) showed the main source of variation was attributed to effects of locations. Consequently, Genotype x Environment Interaction (GEI) was also very significant while effects of genotypes rather modest. The grain yield was the trait most affected by the drought. The analysis of reduction of various agronomic traits caused by level of drought stress within groups of similar locations has been performed for each of 32 genotypes tested. The results show different reactions of genotypes to particular stress levels. Regarding GEI different reaction norms have been observed for different genotypes what influenced genotypes' performance ranking over locations. In first place, most of the genotypes showed "cross-over interaction", meaning they changed ranking position with the change of environmental gradient (primarily level of drought stress). However, several genotypes showed good performance (high yield) and high-ranking position (among top 5 best yielding) over both non-stressed and stressed locations. We believe such genotypes possess desirable genetic basis for breeding new cultivars with increased tolerance to drought associated with good performance. Several commercially very successful cultivars showed in this experiment rather modest adaptability to drought stress. It is not quite clear how these cultivars achieved their market position in the past, but it can be expected that their future market position will be affected by pure performance in drought conditions. For the sake of farmers' benefit, it would be reasonable to improve new soybean cultivars' VCU testing for official registration by screening for drought tolerance. By using methodology from this research and historical DHMZ meteorological data several locations with high probability of chance drought appearance were extracted. It would be desirable to include at least one of them as an official VCU testing site. Furthermore, accidental occurrence of drought at any location used for VCU testing (as measured in this experiment) should be used to analyze for "level of drought tolerance" and use as an additional official characterization of new cultivars prior to final registration (release).

This paper is an outcome of the AGRO-DROUGHT-ADAPT project (<http://ada.agr.hr>), supported by the Environmental Protection and Energy Efficiency Fund with the support of the Croatian Science Foundation of the Republic of Croatia.

Keywords: Glycine max, genetic adaptability, yield, drought index, abiotic stress

Biofortifikacija lisnatog povrća selenom – nanobiotehnološki pristup

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Sažetak

Biološka raspoloživost selena varira ovisno o nekoliko čimbenika, uključujući kemijski oblik Se, druge hranjive komponente u hrani, fiziološki status i status Se u organizmu. Glavne zapreke u postizanju optimalnog unosa Se su visoko varijabilni sadržaj u različitim vrstama hrane i uska sigurnosna granica unosa različitih oblika Se. Danas, nanotehnologija omogućuje primjenu selen nanočestica (SeNPs) koje posjeduju jaču antioksidativnu aktivnost i nižu toksičnost u odnosu na druge oblike Se. Potrebno je utvrditi djelotvornost i sigurnost inovativnih nutraceutika i funkcionalne hrane na bazi SeNPs i to primjenom nanobiotehnoloških metoda. To se može postići razvojem inovativnog Se-nutraceutika kao što je funkcionalno povrće biofortificirano sa SeNPs (FBVegs). Ovaj tip Se-nutraceutika će biti podvrgnut *in vitro* i/ili *in vivo* ispitivanjima kako bi se istražila njegova biokompatibilnost, sigurnost, farmakokinetička svojstva i farmakološka aktivnost u usporedbi s biljkama biofortificiranim selenatom. Osim toga, moguća je pojava sinergističkog djelovanja SeNPs i specifičnih bioaktivnih spojeva iz biljaka što će biti istraženo. Rezultati dobiveni istraživanjem ovakvog pristupa biofortifikacije će biti od velike koristi za potrošače, poljoprivredne proizvođače i prehrambenu industriju kao krajnje korisnike ishoda istraživanja. Ovo istraživanje je financirano od strane Hrvatske zaklade za znanost u sklopu projekata HRZZ IP-2018-01-8119 i HRZZ IP-2016-06-2436.

Ključne riječi: selen, nanobiotehnologija, biofortifikacija, lisnato povrće

Selenium biofortification of leafy vegetables - nanobiotechnological approach

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Abstract

Selenium bioavailability varies depending on several factors including chemical form of Se, other dietary components, physiological status and selenium status of the organism. The major obstacles in achieving optimal Se intake are highly variable Se content in different food types and narrow safety margin of supplemental Se forms. Today, nanotechnology enables application of selenium nanoparticles (SeNPs) which possess enhanced antioxidant activity and lower toxicity as compared to other Se forms. There is a need to investigate the efficacy and safety of innovative SeNPs-based nutraceuticals and functional food using nanobiotechnological tools. This can be achieved by following development of innovative class of Se-nutraceutical such as functional SeNPs biofortified vegetables (FBVegs). This kind of Se-nutraceutical will be subjected to *in vitro* and/or *in vivo* testing to investigate their biocompatibility, safety, pharmacokinetic properties and pharmacological activity compared to biofortification with selenate. In addition, possible synergistic action of SeNPs and specific bioactive compounds that can be found in plants will be investigated. Results obtained within this approach of biofortification will be of great interest for consumers, agricultural producers and food industry as final beneficiaries of this research outcomes. This work was supported by the Croatian Science Foundation (HRZZ) within the projects HRZZ IP-2018-01-8119 and HRZZ IP-2016-06-2436.

Keywords: selenium, nanobiotechnology, biofortification, leafy vegetables

African Swine Fever, a threat to wildlife and livestock

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Abstract

African swine fever (ASF) is a devastating infectious disease of pigs that has high lethality also in the Eurasian wild boar. It has a high economic impact because of the losses it causes in the affected pig farms, the costs of control and eradication, and due to the restrictions in the pig trade within and outside the involved countries. It is estimated that around 20% of the world pig production will be lost to ASF by the end of 2019.

ASF entered the Caucasus in 2007 and later spread to neighbouring countries, including Russia. In 2014 the disease entered the EU, with the first reported cases in Lithuania and Poland. It later included wild boar in its epidemiological cycle, infecting Lithuanian, Latvian, Estonian and eastern Polish populations. In 2017 ASF expanded throughout Ukraine and reached North-western Romania and Moldova and jumped 400-500 km from the closest known infected areas into the Czech Republic. In 2018 the disease reached Hungary, Bulgaria, Belgium (1000 km away from the closest known ASF area) and Serbia (close to Belgrade). This pattern demonstrates the importance of human activities, responsible for outbreaks far away from known infected areas, and the difficulties of controlling ASF in wild boar and in Europe. In China, where ASF was first reported in summer 2018, the disease has involved six provinces in a few weeks' time and, over the past year, has expanded to include Mongolia, the Philippines and countries from Burma to the Korean peninsula. The outbreaks are sometimes thousands of kilometres apart, highlighting the importance of illegal import by individuals but, mostly, of biosecurity measures for farms and vehicles transporting both live animals and pork products. This emergency situation has led to a lockdown of China's pig industry that led to an increase in prices and imports to ensure the food supply, with important consequences on the country's economy, once a major importer/exporter of pork products. The control and eradication of ASF remains a major global challenge, highlighting the importance of international cooperation, prompt reaction after detection and preventive measures such as biosecurity and wildlife disease surveillance network. In Czech Republic, the most successful European example, they established concentric areas with increasing risk with different level of activities to prevent further spread. A fence was set up around the core area, while the high-risk zone was initially classified as no entrance. Hunting activities were strictly regulated, and active monitoring of carcasses was implemented. This successful example also shows the need to have a participatory approach, with all parts of society actively contributing to prevention and monitoring.

Keywords: African swine fever, wild boar, domestic pig, *Sus scrofa*



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Effect of digestate fertilization on the silage maize yield and the load of heavy metals in maize

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Abstract

Maize is one of Croatia's largest single commodities with a production of 2147275 t in 2018, which was produced on approximately 235352 ha. Mostly it is produced for grain (harvest time), but it is also used as a fresh (dent stage) animal feed or as a feedstock for biogas production. Nowadays fertilization with synthetic fertilizers can lead to several issues such as high cost and nitrate pollution. Digestate, as a by-product of anaerobic digestion (AD), might have a potential to be used as an alternative fertilizer for sustainable agriculture. Therefore, this study aimed to: i) assess the use of digestate as a fertilizer and its effect on silage maize yield, and ii) determine the heavy metal accumulation in the plant. This was done in a field experiment in Croatia during one growing season where eight different treatments (i. solid fraction of digestate (SFD), ii. liquid fraction of digestate (LFD), iii. NPK fertilizer (with top dressing of CAN), iv. liquid cattle manure (LCM), v. SFD+LFD, vi. LFD+NPK, vii. SFD+NPK and viii. unfertilized control (C)) in four repetitions were compared and assessed. Results have shown significant differences ($p < 0.05$) among the treatments regarding the maize yield. The highest average yield was observed in NPK+CAN, SFD+NPK, LFD+NPK, SFD and SFD+LFD treatments, whereas unfertilized C resulted in lowest yield. Furthermore, heavy metal content in plant for Zn (50 mg kg^{-1}) and Cu (20 mg kg^{-1}) did not exceed the permitted limit concentration, whereas in NPK+CAN, SFD+NPK and LFD+NPK treatments the exceedance for Mn (30 mg kg^{-1}) occurred. Digestate derivatives, LFD and SFD, showed similar effect on yield as compared to NPK+CAN treatment. This might lead to economic benefits by reducing consumption of expensive synthetic fertilizers.

Keywords: silage maize, digestate, yield, heavy metals in plant

Utjecaj gnojidbe dušikom na fenolni sastav lista masline

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Sažetak

Fenolni spojevi lista masline, uz pozitivan utjecaj na samu otpornost masline prema biljnim patogenima, imaju mogućnost primjene i u proizvodnji funkcionalne hrane i nutraceutika. Iako se općenito smatra da intenzivna ishrana dušikom (N) ima negativan utjecaj na koncentraciju fenola u biljkama kod nekih biljnih vrsta zabilježen je i suprotan učinak. Cilj ovog rada bio je utvrditi utjecaj različitih razina gnojidbe N na fenolni sastav lista masline. Istraživanje je provedeno u grijanom plasteniku, po shemi slučajnog bloknoeg rasporeda s tri različita gnojidbena tretmana: tretman N0 (standardna Hoaglandova hranjiva otopina bez N), tretman H (standardna Hoaglandova hranjiva otopina) i tretman N5 (standardna Hoaglandova hranjiva otopina s dvostrukom koncentracijom N). Tijekom 240 dana sadnice masline sorte 'Istarska bjelica', posađene u lonce od 3,5 L napunjene kvarcnim pijeskom i perlitom, zalijevane su odabranim hranjivim otopinama. Koncentracija N u listu masline bila je značajno viša u tretmanu N5 u odnosu na sve ostale tretmane, dok je koncentracija dušika u tretmanu H bila viša od koncentracije N u tretmanu N0. Koncentracije ukupnih fenola u listu masline, kao i koncentracije oleuropeina i verbaskozida, značajno su se razlikovale između tretmana. Najviša koncentracija oleuropeina zabilježena u H tretmanu (10182 mg/100g ST), a najniža u N5 tretmanu (4210 mg/100 g) (H > N0 > N5). Koncentracija tirosola u listu masline bila je najviša u N5 tretmanu u odnosu na H i N0 tretmane. Ipak, snažna pozitivna korelacija ($r = 0.88$, $p < 0.05$) zabilježena je samo između koncentracije N i tirosola dok nije bilo statistički značajne korelacije između koncentracije N i ostalih fenolnih spojeva u listu masline.

Ovaj rad je sufinancirala Hrvatska zaklada za znanost projektom "Bilinogojstvom do sekundarnih biljnih metabolita: primjena mineralnih hraniva i elicitora za povećanje koncentracije fenola u listu masline" (UIP-2017-05-8464). Rad doktorandice Kristina Grozić sufinanciran je iz „Projekta razvoja karijera mladih istraživača – izobrazba novih doktora znanosti“ Hrvatske zaklade za znanost (DOK-2018-09-1841).

Ključne riječi: 'Istarska bjelica', ishrana bilja, oleuropein, tirosol, verbaskozid

Impact of nitrogen fertilization on olive leaf phenolics

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Abstract

Olive leaves phenolics, beside their important role in plant resistance to fungal pathogens, may have potential in the production of functional food and nutraceuticals. High N-nutrition often negatively affects plant phenolic accumulation but also reverse effect can be noticed in some plant species. The objective of this work was to determine impact of different nitrogen fertilisation rate on olive leaf phenolics. The experiment was conducted in the heated greenhouse as random block design with three different fertilization treatments: N0 (standard Hoagland solution without N), H (standard Hoagland solution) and N5 (standard Hoagland solution with doubled N concentration). For 240 days 'Istarska bjelica' olive plantlets, planted in 3.5 L plastic pots filled with quartz sand: perlite substrate, were irrigated with selected nutrient solutions. As it was expected our results had shown that olive leaf N concentration was significantly highest for N5 treatment compared to all other treatments, while in H treatment N leaf concentration was higher than in N0 treatment. For total phenolic as well as oleuropein and verbascoside leaf concentration significant differences between treatments were noticed. The highest leaf oleuropein concentration was recorded in H treatment (10182 mg/100 g DW) while the lowest one was in N5 treatment (4210 mg/100 g DW) (H>N0>N5). On the other hand tyrosol leaf concentration was highest for N5 treatment followed by H and N0 treatment respectively. However, only strong positive correlation ($r = 0.88$, $p < 0.05$) between N and tyrosol leaf concentration was noticed while there were no significant correlations between N leaf concentration and other phenolic compounds.

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Keywords: 'Istarska bjelica', plant nutrition, oleuropein, tyrosol, verbascoside

Resistance of the Colorado potato beetle to organophosphorus insecticides and pyrethroids in Croatia

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Abstract

Colorado potato beetle (CPB; *Leptinotarsa decemlineata*, Say) is the most important potato pest in Croatia and worldwide and is resistant to 56 active ingredients of insecticides; more than 300 cases of resistance are registered. During the 1990s, systemic monitoring of CPB resistance was conducted in Croatia. The appearance of resistance to organophosphates (OP) was shown after 16 years, and resistance to pyrethroids (P) after 7 years of their widespread use. Of current interest is whether populations from resistant locations are still resistant to OP and P insecticides. From 2017 - 2019, laboratory experiments were used to investigate the resistance of CPB to organophosphorus insecticides (chlorpyrifos) and pyrethroids (cypermethrin). Insecticide efficiency was determined in 27 populations of beetles collected from central and north-western Croatia. Efficiency of recommended dose, half and 1/5 of the dose were determined. Classification of populations was undertaken according to the IRAC method, no. 1132, where populations were classified into 5 categories on the basis of the efficiency of recommended dose determined 72 hours after treatment as: 1) highly susceptible ($E = 100\%$); 2) susceptible ($100 > E \geq 95\%$); 3) slightly resistant ($95 > E \geq 90\%$); 4) resistant ($90 > E \geq 50\%$); and 5) highly resistant ($E < 50$). Results of the experiment showed that CPB resistance to OP and P insecticides has not changed in the last 25 years.

Keywords: Colorado potato beetle, resistance, chlorpyrifos, cypermethrin.

This study was funded by the Croatian Science Foundation project 'Monitoring of Insect Pest Resistance: Novel Approach for Detection and Effective Management Strategies'.

Kartiranje poljoprivrednog zemljišta metodama daljinskih istraživanja na području Republike Hrvatske – problemi i rezultati

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Sažetak

Za potrebe utvrđivanja područja s prirodnim i drugim ograničenjima u poljoprivrednoj proizvodnji potrebni su podaci o korištenom poljoprivrednom zemljištu. Kako u RH ne postoje službeni prostorni podaci o poljoprivrednom zemljištu cilj ovog rada je bio izraditi kartu korištenog poljoprivrednog zemljišta RH. U okviru projekta „Određivanje područja s ograničenjima za poljoprivrednu proizvodnju u Hrvatskoj“ jedan od koraka bio je utvrđivanje površine poljoprivrednog zemljišta koja se koristi za poljoprivrednu proizvodnju. Jedan od mogućih načina je upotreba LPIS podataka za područje Republike Hrvatske. No, prijašnji projekt izveden prije nekoliko godina s istom tematikom pokazao je da je tamo navedena samo polovica korištene poljoprivredne površine. U tom je projektu dodatno mapiranje rađeno ručno i bilo je iscrpljujuće. Ovog puta, zbog satelitskih podataka visoke rezolucije iz programa Copernicus, bilo je moguće koristiti procese strojnog učenja i automatske klasifikacije za mapiranje klasa poljoprivrednog zemljišta. Glavni koraci obrade obuhvaćali su predobradu multitemporalnih Sentinel 1 (radar) i Sentinel 2 (multispektralni) rasterskih snimaka. Preostala obrada i klasifikacija snimaka provedene su unutar softvera R-studio s klasifikatorom Random Forest (RF). Ulazni podaci za obuku bili su podaci LPIS-a. Izazovi prepoznati navedenim pristupom, osim potrebne snage obrade i pohrane podataka, uglavnom su se odnosili na točnost ulaznih podataka. Kartirano je poljoprivredno zemljište u 6 najčešćih kategorija (oranice, voćnjaci, vinogradi, maslinici, pašnjaci te travnjaci) s ukupnom točnošću klasifikacije iznad 90 %. Kartiranje je provedeno korištenjem satelitskih snimaka Sentinel 1 i Sentinel 2 te digitalne ortofoto snimke. Snimke su interpretirane metodom umjetne inteligencije „random forest“. Izuzetno usitnjene i mozaične poljoprivredne površine sjeverozapadne i primorske Hrvatske dodatno su interpretirane objektom metodom segmentacije snimaka. Na temelju rezultata obje primijenjene metode izrađena je karta korištenja poljoprivrednog zemljišta RH u mjerilu 1: 5.000. Osim toga izračunato je da je točnost izrađene karte između 90 i 95 % ovisno o kategoriji poljoprivrednog zemljišta.

Ključne riječi: daljinska istraživanja, Sentinel, kartiranje poljoprivrednih kultura, područja s ograničenjima u poljoprivredi

Mapping the agriculture land for the whole Croatian area with remote sensing methods - problems and results

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Abstract

For the purpose of identifying areas with natural and other restrictions on agricultural production, information of the utilized agricultural land is required. Since there is no official spatial data on agricultural land in the Republic of Croatia, the aim of this project was to draw up a map of used agricultural land in the Republic of Croatia. Within the project “Determining Areas with Restrictions for Agricultural Production in Croatia”, one of the steps was to determine the area of agricultural land used for agricultural production. One possible way is to use LPIS data for the territory of the Republic of Croatia. But a previous project conducted several years ago with the same subject showed that only half of the utilized agricultural area was listed there. In that project, the additional mapping was done manually and was exhausting. This time, due to the high resolution satellite data from Copernicus, it was possible to use machine learning and automatic classification processes to map agricultural land classes. The main processing steps included preprocessing of multitemporal Sentinel 1 (radar) and Sentinel 2 (multispectral) raster images. The remaining image processing and classification was performed within R-studio software within the Random Forest (RF) classifier. The training input was LPIS data. The challenges identified by this approach, in addition to the required processing and storage power, were mainly related to the accuracy of the input data. Agricultural land was mapped into the 6 most common categories (arable land, orchards, vineyards, olive groves, pastures and grasslands) with an overall classification accuracy above 90%. Mapping was performed using satellite imagery Sentinel 1 and Sentinel 2 and digital orthophoto. The raster data was interpreted using the machine learning “random forest” algorithm. The extremely fragmented and mosaic agricultural areas of northwestern and coastal Croatia were further interpreted by the object based method of image segmentation. Based on the results of both methods used, a map of agricultural land use in the scale of 1: 5,000 was drawn up. In addition, it was calculated that the accuracy of the map produced was between 90 and 95% depending on the category of agricultural land.

Keywords: Remote Sensing, Sentinel, Crop Mapping, Areas with natural constraints in agriculture

Utjecaj tri tipa različite obrade tla na zbijenost tla

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Sažetak

Intenzivna poljoprivredna proizvodnja često dovodi do degradacije tla i pada produktivnosti. Neadekvatna obrada umanjuje plodnost tla, dok promjenom konvencionalnih u konzervacijske sustave možemo zaštititi resurse, bez umanjenja prinosa. U tu svrhu proveden je trofaktorijalni pokus (Pokušalište Šašinovec, Zagreb) na praškasto-glinastim ilovačama (fluvisolima) u split-plot dizajnu gdje je glavni faktor – obrada tla (CT – oranje, tanjuranje; RT1 – gruber; RT2 – podrivanje, gruber), s podfaktorom: sa slamom ili bez, a treći faktor predstavlja dubina uzorkovanja: 0-10 cm i 10-20 cm. Cilj istraživanja je utvrditi utjecaj obrade na volumnu gustoća tla, otpore tla i trenutnu vlažnost tla. Rezultati pokazuju da je volumna gustoća tla na svim dubinama i tretmanima iznosila između 0,95 – 1,52 g cm⁻³. Značajno veća volumna gustoća na dubini 0-10 cm je na CT i RT2 tretmanima, nego na RT1. Trenutna vlaga tla na dubini 0-10 cm varirala je od 29,93 do 35,04 %, dok na dubini 10-20 cm od 30,64 do 42,25 %. Mehanički otpori tla rasli su sa porastom dubine, no dobivene vrijednosti nisu statistički značajne. S obzirom da se radi o mjerenjima na početku pokusnog razdoblja, u ovom radu tretmani sa slamom nisu uzeti u obzir. Dobiveni rezultati ukazuju na potrebu nastavka istraživanja kako bi fizikalna konsolidacija tla uslijed različitih sustava obrade došla do izražaja pojavljivanjem značajnih razlika u većini istraživanih čimbenika.

Ključne riječi: obrada tla, volumna gustoća tla, mehanički otpor tla, vlaga tla

The impact of three different tillage treatments on soil compaction

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Abstract

Intensive agricultural production often leads to soil degradation and productivity decline. Inadequate cultivation reduces soil fertility while changing conventional to conservation systems can protect resources without decreasing yields. For this purpose, a three-factorial experiment (Experiment Station Šašincevec, Zagreb) was conducted on silty-clay loam (Fluvisols) in a split-plot design where the main factor was soil tillage (CT - plowing, disc harrowing; RT1 - multitiller; RT2 - subsoiling, multitiller), with subfactor: with straw or without, and the third factor was the sampling depth: 0-10 cm and 10-20 cm. The study aims to determine the effect of tillage on soil bulk density, soil resistance, and soil water content. The results showed that the bulk density of soil at all depths and treatments ranged between 0.95 - 1.52 g cm⁻³. Significantly higher bulk density at 0-10 cm depth was on CT and RT2 treatments than on RT1. Soil water content at a depth of 0-10 cm varied from 29.93 to 35.04 %, while at a depth of 10-20 cm varied from 30.64 to 42.25 %. Penetration resistance increased with increasing soil depth, but obtained values were not statistically significant. Since these are measurements at the beginning of the trial period, straw treatments were not considered in this work. The obtained results indicate the need to continue the research because of the soil physical consolidation to take effect due to different tillage systems, which will, later on, provide significant differences in most of the investigated factors.

Keywords: soil tillage, penetration resistance, bulk density, soil water content

The influence of agriculture on surface water status Lithuania

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Abstract

The negative impact on the status of surface water bodies of the Baltic Sea and Baltic Sea region is caused by both diffuse pollution, which is essentially due to the pollution load caused by agricultural activities, as well as concentrated pollution, which results in an urgent problem - pollution with biogenic materials. By reducing pollution from agriculture, ensuring adequate domestic and individual wastewater management, lakes may require additional means to achieve their good status: to apply biological methods to improve water bodies (macrophytes, duckweeds). Hydrochemicals are increasingly being promoted in the world to reduce eutrophication of water bodies by using a method of chemical bonding/precipitation of excess phosphorus without removing the accumulated sludge. However, there is a strong public resistance. The aim of this research was to evaluate the influence of agricultural activities on the state of surface water in Lithuania. Based on the studies conducted in 2014-2018, only 20 % of the studied lakes (total of 40 lakes studied) do not meet the criteria for good ecological status (0.100–0.140 mg/l) according to the phosphorus (P_b) concentration in water. At lakes Latežeris and Luksnėnai the concentration of P_b indicated a bad ecological class (0.231–0.470 mg/l), while at lakes Draudeniai, Paežeriai and Mastis these indicated very bad class (0.231–0.470 mg/l). The lake Talkša and in ponds Bubliai and Stepanioniai were in average ecological class (0.141–0.230 mg/l). Only significant higher amounts of phosphorus concentrations were found in the sludge of lakes Mastis and Draudeniai, but both of these lakes are shallow (average depth is 2.6 and 1.5 m, respectively), therefore the chemical phosphorus binding method cannot be applied. In the analysis of phosphorus concentrations in the sludge of other lakes, it was found that the highest concentrations of P_b were recorded in lakes: Spira, Kiemėnta, Antakmenas, Gauštvinis, Veisiejai and in the pond Vaitiekūnai. The average depth of these lakes was also low, but none of them had a bad status according to P_b . Laboratory studies of additional phosphorus release from sludge sediments have shown that no release occurs and the main source of pollution is still significant diffuse pollution. In this situation, the chemical treatment of lakes analyzed in this study cannot be justified.

Keywords: water quality, phosphorus concentrations, ecological status, lakes

Water Quality Monitoring at the On-Farm Root Vegetables Packhouses in Lithuania

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Abstract

Wash water and wastewater quality control in the on-farm packhouses is of great importance by means of the quality of the agricultural production as well as environment.

In Lithuania, the typical farms were chosen that represent different root vegetables, such as carrots and beetroots, and use different washing and wastewater treatment systems. All farms transferee the wash water used to the settling ponds or settling tank. Settled water continuously is used for the first wash. Drinking water from well is used for the final wash of vegetables. Excess of water is treated in the natural treatment systems, and, finally is discharged to the surface water bodies. The aim of this research was to assess the contamination of the root vegetable wash water at different stages of the technological processes and to evaluate the efficiency of the natural treatment system of constructed wetland and biological ponds. Quality of the wash water as well as wastewater was monitored monthly over a 12-month period at the marked points. Temperature was monitored in-situ. The collected samples were analysed for the water quality parameters, such as colour, suspended solids, pH, BOD₅, dissolved organic carbon, total nitrogen, total phosphorus and others. Chemical analysis of the water samples investigated showed that wash water of root vegetables is greatly contaminated and exceeds the limit values 10-50 times for suspended solids, 10-25 times for organic matter, 3-5 times for dissolved organic carbon, 3-7 times for total nitrogen, 3-12 times for total phosphorus. Therefore, wash water quality monitoring and proper wastewater treatment is of great importance. Natural wastewater treatment systems are suitable for farms in Lithuania, that wash and produce root vegetables, but before releasing wastewater to the environment, it has to be settled.

Keywords: on-farm packhouses, wash water, wastewater, quality control.

Utjecaj tipa dodatka na probavljivost škroba različitih hibrida visokovlažnog zrna kukuruza

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Sažetak

Enzimi, bakterije mliječne kiseline (BMK) i kiseline dodaju se prilikom siliranja da bi optimizirali sadržaj mliječne kiseline (MK). Enzimatska i kiselinska aktivnost u silažama tijekom stanjanja silaže djeluje na proteinsko-škrobnu matricu koja se razlikuje između hibrida. Cilj istraživanja je bio istražiti utjecaj hibrida i silažnih dodataka na *in vitro* probavljivost škroba (IVSD) u silaži visokovlažnog zrna kukuruza nakon godinu dana skladištenja. Zrno tri hibrida različitog tipa endosperma proizvedena su u split-plot poljskom pokusu u 5 replikacija. Siliranje zrna sa 68-72 % ST provedeno je u laboratorijskim silosima. Jedan dio silaža bio je inokuliran s Bio-Sil BMK (*Lactobacillus plantarum*; 300000 CFU/g svježeg materijala), drugi tretiran s MK (15 g/kg ST) dok ostatak nije tretiran. U uzorcima zrna prije siliranja i nakon godine dana skladištenja silaža odredila se IVSD. U odnosu na zrno prije siliranja, silaže skladištene godinu dana su imale bolje parametre IVSD; lag faza bila je kraća (od 7,37 do 5,43 sati; $P < 0,001$), udio brzorazgradive frakcije je bio viši (od 0,28 do 0,54; $P < 0,001$), kao i brzina razgradnje (od 0,051 h^{-1} do 0,098 h^{-1} ; $P < 0,001$) te efektivna razgradivost (od 0,53 do 0,78; $P < 0,001$). Manje caklavi hibrid imao je bolje parametre IVSD, numerički za sve ali bez signifikantnosti za brzinu i lag fazu. Primjena BMK imala je pozitivan učinak dok dodatak MK nije imao utjecaja. Zaključno, istraživanje je potvrdilo da izbor tipa dodatka i hibrida kukuruza imaju utjecaj na IVSD silaže, međutim, sam period skladištenja ima utjecaj najvećeg obima.

Ključne riječi: silaža, vrijeme skladištenja, dodatci, hibridi, probavljivost škroba

Influence of additives on starch digestibility during production of high moisture grain silage from various corn hybrids

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Abstract

Lactic acid bacteria (LAB) additives, enzymes and acid additives are added in order to optimize LA content. Enzymatic and acid activity in silage material has influence on starch protein matrix that defines starch availability. The purpose of the study was to investigate the effect of hybrid and silage additives (LAB and lactic acid) on high moisture corn *in vitro* starch digestibility (IVSD) after one year of ensilage. Three hybrids of different endosperm texture were grown in 5 replicates in split-plot experimental fields. Silages were ensiled at 68-72 % DM in laboratory silo with one part ensiled with Bio-Sil LAB inoculant (*Lactobacillus plantarum*; 300000 CFU/g fresh material), second was untreated while third was treated with LA (15 g/kg DM). Samples were taken in green material and after one year of ensiling after which silage IVSD was evaluated. In ensiled material all IVSD parameters showed improvement; Lag phase was shorter (from 7.37 to 5.43 hours; $P < 0.001$), rapidly degradation fraction was higher (from 0.28 to 0.54; $P < 0.001$) as well as the rate of starch degradation (from 0.051 h⁻¹ to 0.098 h⁻¹; $P < 0.001$) and effective degradability (from 0.53 to 0.78; $P < 0.001$). The softer hybrid showed somewhat better IVSD parameters however without significance for degradation rate and lag phase. Inoculant application had positive effect on IVSD, and LA application showed no effect. In conclusion, hybrid and type of additive used are important however time of ensiling shows paramount effect on starch digestibility in silages.

Keywords: silage, ensiling time, additives, hybrids, starch digestibility

Razlike u ukupnim fenolima i antioksidativnom kapacitetu lista masline ovisno o kultivaru i lokaciji

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Sažetak

U prošlosti se list masline smatrao prvenstveno nusproizvodom poljoprivredne proizvodnje, dok su njegove vrijedne komponente poput bioaktivnih spojeva tek u novije vrijeme utvrđene. Međutim, nedavna su istraživanja ukazala na mogućnost primjene lista masline u različitim industrijama, dok bi se uloga fenolnih spojeva u razvoju otpornosti prema patogenima mogla primijeniti za uspješnije suzbijanje različitih bolesti masline. Navedene, ali i mnoge druge činjenice, svakako su doprinijele povećanju broja istraživanja kako na temu lista masline općenito, tako i na temu fenolnog sastava i antioksidativnih svojstva, u novije vrijeme.

Ovim su radom istražene promjene ukupnih fenolnih spojeva (UF) i antioksidacijskog kapaciteta (FRAP, DPPH) listova pet sorata masline prikupljenih na tri lokacije u zimskom periodu (studeni). Uzorkovanje je provedeno na jednom alohtonom ('Leccino') i četiri autohtona ('Levantinka', 'Oblica', 'Drobnica', 'Istarska bjelica') kultivara maslina uzgojenih u maslinicima na području Krka, Paga i Zadra. Unutar istraženih autohtonih sorata, 'Istarska bjelica' je pokazala najveći sadržaj UF (2386.61 mg/100g suhe tvari), dok je najveći antioksidativni kapacitet, prikazan kao FRAP, utvrđen na kultivarima 'Drobnica' (14,60) i 'Istarska bjelica' (13,06). Iako je DPPH pokazao vrlo slične vrijednosti unutar istraženih sorata, značajno je veći za Pag (319,69) u odnosu na ostala uzgojna područja. Nadalje, interakcija 'Drobnica' x 'Zadar' je pokazala značajno veće FRAP vrijednosti u usporedbi sa svim ostalim kultivarima na istoj lokaciji.

Ovaj rad je sufinancirala Hrvatska zaklada za znanost projektom "Bilinogojstvom do sekundarnih biljnih metabolita: primjena mineralnih hraniva i elicitora za povećanje koncentracije fenola u listu masline" (UIP-2017-05-8464). Rad doktorandice Kristine Grozić sufinanciran je iz „Projekta razvoja karijera mladih istraživača – izobrazba novih doktora znanosti“ Hrvatske zaklade za znanost DOK-2018-09-1841.

Ključne riječi: DPPH, fenolni profil, FRAP, list masline, sorta masline

Changes in total phenolics and antioxidant capacity in olive leaves owing to cultivar and location

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Abstract

Olive leaves were considered mainly an agricultural byproduct in the past and their valuable constituents such as bioactive compounds were foremost unknown until recently. However, recent studies demonstrated that olive leaves can be exploited in numerous industries, while the involvement of phenolic compounds in the expression of resistance toward pathogens could contribute to their improved control in olive disease management. For these and other reasons the number of studies that comprehend olive leaves in general, as well as their phenolic and antioxidant properties, has increased. The changes in the total phenolic content (TPC) and the antioxidant capacity (FRAP, DPPH) of leaves from five olive cultivars, collected on three locations during November, were investigated. Samples were collected from one allochthonous ('Leccino') and four autochthonous ('Levantinka', 'Oblica', 'Drobnica', 'Istarska bjelica') olive cultivars grown in three dislocated olive yards in Krk, Pag and Zadar. Among the examined autochthonous cultivars, 'Istarska bjelica' had the highest TPC (2386.61 mg/100g dry mass), while the strongest antioxidant capacities expressed as FRAP were observed for 'Drobnica' (14.60) and 'Istarska bjelica' (13.06). Despite the similarities between the antioxidant capacities expressed as DPPH between the studied cultivars, significantly higher values were found for the growing locations where samples from Pag had the highest values (319.69). Furthermore, 'Drobnica' x 'Zadar' interaction resulted with significantly higher FRAP values compared to all other cultivars at the same location.

This work has been supported in part by Croatian Science Foundation (CSF) under the project "Phytochemical Farming: Mineral Nutrients and Elicitors Application to Enhance Olive Leaf Phenolics" (UIP-2017-05-8464). The work of doctoral student Kristina Grozić has been supported in part by the "Young researchers' career development project – training of doctoral students" under the CSF project DOK-2018-09-1841.

Keywords: DPPH, FRAP, olive leaf, olive variety, phenolic profile

Novi nalazi entomopatogenih nematoda (Rhabditida, Steinernematidae) u Republici Hrvatskoj

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Sažetak

Entomopatogene nematode (EPN) su letalni obligatni paraziti kukaca. One su ubikvisti koji pripadaju u porodice Steinernematidae i Heterorhabditidae. Postoji više od 30 vrsta EPN. Stotine izolata prikupljeno je sa svih kontinenata i testirano je za potrebe biološkog suzbijanja štetnih kukaca, sve u svrhu poboljšavanja njihove virulentnosti, spektra domaćina i stabilnosti u okolišu. Dosadašnjim istraživanjima u Hrvatskoj, EPN iz roda *Steinernema* utvrđene su na lokalitetu Karane (46°01'08.8"N 16°31'31.7"E) u Koprivničko – križevačkoj županiji tijekom 2017. godine. Cilj istraživanja je utvrditi nove vrste ili sojeve EPN potencijalno učinkovitije u odnosu na komercijalne vrste. Tijekom 2019. godine prikupljeno je 60 uzoraka tla iz 12 lokaliteta s područja 5 županija (Bjelovarsko – bilogorska, Međimurska, Virovitičko – podravska, Vukovarsko – srijemska, Zagrebačka) u voćnjacima višnje i jabuke, vrtu, pašnjaku i lucerištu. Primjenom metoda „Galleria bait“ i „White trap“ te molekularne dijagnostike, EPN iz roda *Steinernema* utvrđene su u jednom uzorku tla prikupljenom u voćnjaku jabuke u lokalitetu Đeletovci (45°10'31.3"N 18°59'39.9"E) u Vukovarsko – srijemskoj županiji. Izolat iz navedenog lokaliteta izazvao je 100 % mortalitet gusjenica voskovog moljca u postupku izolacije iz uzorka tla. Radi utvrđivanja učinkovitosti primjene izolata u suzbijanju drugih vrsta štetnika, istraživanje je potrebno nastaviti.

Ključne riječi: biološko suzbijanje štetnika, entomopatogene nematode, poljoprivredne površine

New findings of entomopathogenic nematodes (Rhabditida, Steinernematidae) in the Republic of Croatia

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Abstract

Entomopathogenic nematodes (EPNs) are lethal obligatory parasites of insects. They are ubiquitously distributed and comprise the families Steinernematidae and Heterorhabditidae. More than 30 EPNs species exist and hundreds of isolates have been collected from every continent and tested for biological control of insects, in order to improve their virulence, host range and environmental stability. In previous studies in Croatia, EPNs from the genus *Steinernema* have been identified in the Karane locality (46°01'08.8"N 16°31'31.7"E) in Koprivničko – križevačka county in 2017. The aim of this investigation is to isolate new species or strains of EPNs, which could be more effective than commercial strains. In 2019, 60 soil samples from 12 localities were collected in 5 Croatian counties (Bjelovarsko – bilogorska, Međimurska, Virovitičko – podravska, Vukovarsko – srijemska, Zagrebačka) in apple and cherry orchard, garden, pasture and alfalfa field. Using „Galleria bait method“ and „White trap“ and molecular biology analysis, EPNs belonging to genus *Steinernema* were recovered from one soil sample, taken in apple orchard in the locality Đeletovci (45°10'31.3"N 18°59'39.9"E) in Vukovarsko – srijemska county. Isolate caused 100 % mortality of wax caterpillars in the process of isolation from soil samples. In order to determine its effectiveness in the control of other pest species, the investigation needs to be continued.

Keywords: biological pest control, entomopathogenic nematodes, agricultural land

Conflicts in the marshes: agriculture production versus nature conservation in east Poland

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Abstract

In recent years in Poland was recorded an increase in the intensification of agricultural production, particularly significant changes occurred after Poland's accession to the EU. Development of agricultural sector at areas with high nature values generated many conflicts, especially related to marsh areas. It is true also that in Poland currently there is not extensive drainage of marsh areas to be used for agricultural purposes now. In the past, drainage has led to the degradation of many valuable wetlands in Poland (e.g. Krowie Bagno Marsh, Kramskie Marshes, Polesie Marshes). The aim of this study was to evaluate present status conflicts between agriculture production and protection needs of rare wetland birds in the area of East Poland by comparing the population trends of rare wetland species with trends described animal and plant production in important bird areas. Currently, the conflict between the agricultural sector and the needs of protection of marshes is quite different. First of all, fertilizers used in Polish agriculture are not good quality which is a serious threat to biota of valuable wetland areas. Secondly, many rare wetland species (Eurasian Curlew *Numenius arquata*, Black-tailed Godwit *Limosa limosa*, Ruff *Calidris pugnax*, Black-tailed Godwit *Limosa limosa*, White Stork *Ciconia ciconia*, Marsh Harrier *Circus aeruginosus*, Montagu's Harrier *Circus pygargus*) foraging on the ecotone of marshes and meadows or nearby intensively grazed or mown areas. Unfortunately, currently there is a lack of grazing and mowing of meadows around many valuable wetlands. Paradoxically enough, even a small increase in agricultural production particularly related to husbandry will be good for the protection of biota marsh area. There is a need for support through subsidies a moderate grazing in areas directly adjacent to protected swamp areas.

Keywords: agricultural sector, wetlands, grazing, rare birds

Impact and importance of potato cyst nematodes on different potatoes varieties

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Abstract

The main goal of this research was to determine the influence of the potato cyst nematodes *Globodera pallida* (Stone, 1973) Behrens and *Globodera rostochiensis* (Wollenweber, 1923), Skarbilovich on growth and development of potato (*Solanum tuberosum* L.). The following varieties of seed and mercantile potatoes were taken as test material: Casablanca, Desiree, Agatha, Agria, Isle of Jura and the tests were conducted in the State Phytosanitary Laboratory. In addition to the seed and mercantile potato tests, the soil samples were also taken from location intended for potato cultivation and production. The extraction procedure of *Globodera* spp. from the soil sample and plant material was carried out by means of Baermann method. The results showed that Casablanca, Agria and Isle of Jura are resistant towards *G. rostochiensis*, but sensitive toward *G. pallid*, while Desiree and Agatha are sensitive towards both potato cyst nematode *G. rostochiensis* and *G. pallid*. These two potato cyst nematode *Globodera pallida* (Stone, 1973) Behrens and *Globodera rostochiensis* (Wollenweber, 1923) Skarbilovich, are of great significance stems belong to the group of quarantine organisms and are on the A2 list of European and Mediterranean Plant Protection Organization.

Keywords: cyst nematode, *Globodera pallida*, *Globodera rostochiensis*, potato

Establishment of Brown Marmorated Stink Bug (*Halyomorpha halys* Stål) in Serbia and possibilities in its control

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Abstract

Brown marmorated stink bug (BMSB), *Halyomorpha halys* Stål, is one of the most important invasive insect pest specimens worldwide. The species is native to East Asia, but it established its populations in USA during mid-1990s, and, in last decade, in almost every country in Europe. Besides being an important agricultural pest, this species, due to its behavior to enter houses and other manmade structures to hibernate, is also an important nuisance pest in urban areas. The aim of this research was to monitor the species in the region of Serbia, to follow its possible spread and establishment all together with testing of suitable methods for its control. Since its first occurrence in Serbia, in October 2015, in two independent locations, Serbian – Romanian border near town called Vršac and Belgrade, the capitol, species was monitored in four consecutive years. Monitoring included records from the field, citizens' records via email or social networks and use of dead-inn pyramid traps set mostly close to urban and semi-urban areas. Results of monitoring revealed spreading of BMSB populations almost all over the country, and also, increase of population densities at firstly invaded areas. Although BMSB specimens are very active and adults are strong fliers, the first occurrence was most probably connected to the transport of people and cargo, while records close to the borders suggest the natural spread from surrounding countries. Thousands of cars and trucks that pass through the most important highway during the summer season, connecting Central and South Europe, most probably also contribute to the spread of specimens. The first damage were observed in 2018 and 2019, on different crops among which are soybean, apples, peaches, raspberries, hazelnuts, pepper, tomato and ornamentals. In order to find the best suitable way to control named pest trials were done in laboratory and in field conditions. Good efficiency was record in trials with bifenthrin, deltamethrin, acetamiprid and phosmet in higher rates than registered. Deltamethrin used in 6-10 ml/10 l water was efficient for both nymph and adult control.

Keywords: *Halyomorpha halys*, invasive species, monitoring, control

Doprinos Programa ruralnog razvoja zaštiti okoliša i prirode

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Sažetak

Cilj rad je bio utvrditi kako Program ruralnog razvoja (PRR) Republike Slovenije utječe na neke sastavnice okoliša i na prirodu. Osim toga cilj je bio i utvrditi stanje provođenja i razinu dosegnutih ciljeva na polovici razdoblja te dati preporuke za eventualno poboljšanje rada. Program ruralnog razvoja (PRR) je osmišljen na način da mnogim planiranim mjerama i operacijama izravno i neizravno doprinosi zaštiti okoliša i prirode. Periodična vrednovanja provedbe PRR-a uključuju i analizu utjecaja pojedinih mjera i operacija na sastavnice okoliša i prirode: vode, biološku raznolikost, tlo, eroziju, održivo upravljanje prirodnim resursima te klimatske promjene. Godine 2019. je napravljena evaluacija PRR-a za Republiku Sloveniju, a koje je uključivala izračun skupnih pokazatelja rezultata i učinaka; kontekst pokazatelja i pokazatelja utjecaja zajedničke poljoprivredne politike (CAP - common impact/context indicators) te drugih specifičnih pokazatelja prilagođenih za pojedinu državu. Za analizu su korišteni prostorni podaci „poljoprivrednih upisnika/korisnika“ te isplaćene potpore za mjere i operacije. Ti podaci su uspoređeni s rezultatima monitoringa pojedinih sastavnica okoliša (fauna, voda, tla, zemljišni pokrov i dr.). Za evaluaciju su korištene različite prostorne i statističke analize (opisna statistika, propensity score matching, regresijske analize) te ekspertna procjena (npr. metoda triangulacije). Rezultati analiza su pokazali da je PRR na većinu sastavnica okoliša imao pozitivan utjecaj, a za neke sastavnice nije bilo moguće utvrditi utjecaj. Analize također pokazuju da nema dovoljan broj podataka te da često nedostaju dovoljno duge vremenske serije monitoringa okolišnih parametara te da monitorinzi sastavnica okoliša (vode, tla, biološke raznolikosti) određeni na nacionalnoj razini nisu uvijek prostorno određeni i prikladni za ovakve evaluacije. Za jasnije pokazatelje o uspješnosti primjene pojedinih mjera PRR-a potrebno je provoditi monitoring prilagođen prostornoj implementaciji agro-okolišnih mjera (Mjera 10, 11 i 13).

Ključne riječi: Zajednička poljoprivredna politika, GIS, Natura 2000, program ruralnog razvoja

Contribution of the Rural Development Program to environment and nature protection

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Abstract

The aim of the project was to determine how the Rural Development Program (RDP) of the Republic of Slovenia affects within environmental components and nature. In addition, the aim was to determine the state of implementation and the level of goals achieved halfway through and make recommendations for possible improvements to the work. The Rural Development Program (PRR) is designed to contribute directly and indirectly to the protection of the environment and nature through many of the planned measures and operations. Periodic evaluations of the implementation of the RDP also include an analysis of the impact of individual measures and operations on environmental and nature components: water, biodiversity, soil, erosion, sustainable management of natural resources and climate change. In 2019 an evaluation of the PRR for the Republic of Slovenia was made, which included the calculation of aggregate indicators of results and effects; the context of the Common Agricultural Policy (CAP) and other country-specific indicators. The spatial data of the “agricultural registers/beneficiaries” and the grants paid for measures and operations were used for the analysis. These data are compared with the results of monitoring of individual environmental components (fauna, water, soil, land cover, etc.). Various spatial and statistical analysis (descriptive statistics, propensity score matching, regression analysis) and expert judgment (triangulation method) were used for the evaluation. The results of the analysis showed that PRR had a positive impact on most environmental components, and for some components it was not possible to determine the impact. Analysis also show that there is an insufficient data and that long enough time series of monitoring of environmental parameters are often lacking and monitoring of environmental components (water, soil, biodiversity) determined at national level is not always spatially determined and appropriate for such evaluations. For the better indicators of the success of the implementation of individual RDP measures, monitoring adapted to the spatial implementation of agri-environmental measures should be carried out (Measure 10, 11 and 13).

Keywords: Common Agricultural Policy, GIS, Natura 2000, Rural Development Program

Laboratorijsko testiranje DZ SilicoSec® i Celatom Mn-51® u suzbijanju žitnog kukuljičara

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Sažetak

U sažetku se opisuje laboratorijsko testiranje insekticidne učinkovitosti dijatomejskih zemalja (DZ) SilicoSec® i Celatom Mn-51® u suzbijanju žitnog kukuljičara *Rhyzopertha dominica* (Fab.) na pšenici s tri doze (250, 500 i 750 ppm) pri dvijema ekspozicijama (7 i 14 dana). Cilj rada je bio utvrditi insekticidnu učinkovitost testiranih DZ na žitnog kukuljičara te utvrditi optimalnu dozu. Pšenica (100 g) vlage 13,5 % zaprašena je dijatomejskom zemljom (svaka DZ pojedinačno) u staklenkama volumena 200 ml, nakon čega je introducirano 20 jedinki žitnog kukuljičara različitog spola po tretmanu, starosti 7-21 dan. Svi tretmanu su postavljeni kroz četiri ponavljanja. Najviši mortalitet (82,5 %) postignut je u tretmanu sa SilicoSec® pri dozi od 750 ppm nakon 14. dana ekspozicije. Statistički značajno viši mortalitet u odnosu na kontrolni tretman postignut pri ekspoziciji od 7 dana pri dozi od 500 ppm za obje dijatomejske zemlje. Produljenjem ekspozicije i povećanjem doze zabilježen je statistički značajno viši mortalitet. Navedeni rezultati ukazuju na visoku učinkovitost istraživanih DZ u suzbijanju žitnog kukuljičara na pšenici. Potrebna su daljnja istraživanja utjecaja navedenih DZ na razvoj potomstva žitnog kukuljičara.

Ključne riječi: dijatomejska zemlja, SilicoSec®, Celatom Mn-51®, žitni kukuljičar, insekticidna učinkovitost

Laboratory testing of DE SilicoSec® and Celatom Mn-51® against lesser grain borer

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Summary

The summary describes laboratory testing of insecticidal efficacy of diatomaceous earths SilicoSec® and Celatom Mn-51® against lesser grain borer *Rhyzopertha dominica* (Fab.) on wheat. Research was conducted using three doses (250, 500 and 750 ppm) through two exposures (7 and 14 days). The aim of the study was to determine insecticidal efficacy of the tested DEs against lesser grain borer and to determine the optimal dose. Wheat (100 g) with moisture content of 13.5 % was treated with diatomaceous earth (each DE separately) in 200 ml glass jars followed by the introduction of 20 adults of lesser grain borer of different sexes aged 7-21 days. All treatments were set up in four repetitions. The highest mortality rate (82.5 %) was achieved in treatment with SilicoSec® with 750 ppm after day 14 of exposure. Significantly higher mortality rate compared to control treatment was achieved at the 7th day of exposure at 500 ppm for both diatomaceous earths. A significantly higher mortality rate was observed by prolonging the exposure and dose increase. The results indicate on high efficiency of the investigated DEs in suppression of lesser grain borer on wheat. Further research is required on the impact on offspring development.

Keywords: Diatomaceous earth, SilicoSec®, Celatom Mn-51®, Lesser grain borer, insecticidal efficacy

Bacterial-feeding nematodes as pathogens in cultivated mushrooms

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Abstract

The most commonly, fungal-feeding nematodes are reported as principal pests in cultivated mushrooms. Bacterial-feeding nematodes belong to the saprophytic group and they appear in abundant populations in beds of cultivated mushrooms. They multiply quickly and participate in spread of bacterial blotch on sporophores. Bacterial-feeding nematodes may cause distortion of mushrooms and very poor yields or total crop failures. Nematodes may be chemically controlled only prior mushroom cultivation, by disinfection of peat and pasteurization of compost. This study examined nematode population density and impact of bacterial-feeding nematodes on white button mushroom (*Agaricus bisporus*). Nematodes were extracted from samples of compost (spawned with *A. bisporus* strain F56 Italspawn and not spawned) casing material and distorted mushrooms. The samples were collected during production cycle of *A. bisporus* from two mushroom farms in Serbia. Nematodes were extracted only from peat samples, while compost was found to be sterile. Prior casing, nematode populations density from peat samples was low (below 10 nematodes per 100 mL peat). In average 630 nematodes per peat sample were recovered 32 days after casing the compost. *Caenorhabditis* was the most dominant genus found in all samples ranging from 100 to 510 nematodes per sample. Nematodes of the family Cephalobidae comprised second the most dominant group, ranging from 50 to 150 nematodes per sample. Other saprophytic nematodes detected were identified as *Acrobeloides*, *Heterocephalobus*, *Panagrolaimus*, *Plectus* and diplogasterids. From the peat collected 46 days after casing the compost, in average of 880 nematodes per sample were detected. These samples were under suspicion for nematode infestation, since mushrooms grown on this peat were distorted. Only *Caenorhabditis* sp. was recovered, ranging from 490 to 1500 nematodes per sample. Nematode from genus *Caenorhabditis* were also found from the samples of distorted mushrooms, in average of 10 nematodes per 100 g mushrooms. The population dynamics of bacterial-feeding nematodes reveal that during cultivation process this group became dominant, indicating that the conditions in mushroom beds are optimal for their reproduction and survival. *Caenorhabditis* sp. should be considered as major threat in mushroom cultivation, since these nematodes survived pasteurization of compost, disinfection of casing material and sanitation measures on farms; they caused distortion of mushrooms and rapidly multiplied in very abundant populations.

This research was supported by bilateral scientific project Croatia–Serbia 2019/21.

Keywords: *Caenorhabditis* sp., the white button mushroom, distortion, peat

Pathogenicity of entomopathogenic nematodes *Steinernema feltiae* combined with entomopathogenic fungi *Beauveria bassiana* and *B. pseudobassiana*

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Abstract

Insect pest management programs mostly depend on chemical pesticides. Due to increased environmental awareness and withdrawal of many efficient chemicals from the market, new methods and tools of pest suppression are needed. Entomopathogens, such as nematodes and fungi are promising alternative to chemicals. Croatian strains of entomopathogenic nematodes (EPN) and entomopathogenic fungi (EPF) are reported recently. We tested the pathogenicity of EPN Croatian strain *Steinernema feltiae* (ISO 16) and EPF Croatian species *Beauveria bassiana* (isolated from *Dendrolimus pini*, Skradin) and *B. pseudobassiana* (isolated from *Corythucha arcuate*, Spačva). Greater wax moth (*Galleria mellonella*) larvae were treated with 200 IJs insect⁻¹ alone or in combination with one of the tested EPF, and EPF alone in laboratory bioassay. *Beauveria bassiana* was used in dose of 1 ml per Petri dish and 10 insect larvae in a concentration of 7×10^7 spores ml⁻¹ and *B. pseudobassiana* in a concentration of 4.4×10^7 spores ml⁻¹, respectively. Experiment was conducted with three repetitions of each treatment. Mortality of insect larvae was monitored during 96 h after exposure. Single species and combined application of entomopathogens caused 100 % mortality of insect larvae after 48 h, and all insects survived in control dish after 96 h. The antagonisms between tested species of entomopathogens was not detected. Insect cadavers were colored brown from all treatments, except from cadavers treated with EPN and *B. pseudobassiana*, and *B. pseudobassiana* alone. Those cadavers were colored in light brown or beige. Progeny of EPN was abundant, and lower populations were found from combined treatments. Increase in efficacy when combining two entomopathogens was not recognized, since their pathogenicity was identical for all tested combinations. Further investigations are needed, with lower concentrations of EPN and/or EPF and in different environments, and insect hosts. The combined use of *S. feltiae* with *B. bassiana* or *B. pseudobassiana* should be considered as an integrated approach that could increase the efficacy of control of agricultural and forestry pests, all in favor of biodiversity protection and sustainable plant production.

Keywords: entomopathogens, mortality, *Galleria mellonella*, synergetic effect

Soil distribution in Crna river basin and its importance for agricultural production

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Abstract

This paper is a result of many years of field and laboratory research of the soils in Crna river basin, spread out on 497 514,81 ha, ranging from 150 to 2601 m above the sea level in order to gain a better understanding of the productive capacities of the soils and measures for their improvement. The catchment area of Crna River is a spatial area that extends in two states in the southwest of the Republic of North Macedonia and the northern part of the Republic of Greece, whose boundaries are naturally clearly defined. The field research of the soils and preparation of soil samples has been done according to ISO 10381-1 and ISO 10381-2 protocols. In laboratory, the following analyses have been carried out on the soil samples: hygroscopic moisture; mechanical composition; pH of the soil solution; humus content and total nitrogen; content of carbonates; available nutrients P_2O_5 and K_2O . The mechanical composition and chemical properties of the soils have been determined by standard methods.

This area is very heterogeneous, with numerous relief forms, with different expositions and inclinations, and with great differences of altitude. Additionally, there are several geological formations of a very heterogeneous petrographic-mineralogical composition and climate-vegetation zones. Long-term effects of human involvement should also be noted. The vast diversity of the factors required for soil formation in catchment area of Crna River are the reason for the formation of many different soil types as well as the lower taxonomic units. There are 14 (fourteen) different soil types distributed in the Crna river basin together with a considerable amount of subtypes, varieties and forms. The most represented with the largest area are: Fluvisol, Fluvisol (Colluvial Soils) and Cambisol. These types of soils are characterized by different properties (chemical, physical, physical-mechanical and productive). Therefore, they have varied effects on agricultural production (field crop, viticulture and fruit production).

Keywords: soil types, Crna River, agricultural production.

Mogućnosti diverzifikacije mjera za zaštitu biološke raznolikosti u sklopu Programa ruralnog razvoja

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Sažetak

Natura 2000 je ekološka mreža Europske unije sastavljena od područja važnih za očuvanje ugroženih vrsta i stanišnih tipova Europske unije. Mjera 10 Poljoprivreda, okoliš i klimatske promjene Programa ruralnog razvoja (PRR) provodi se kroz različite tipove operacija koje doprinose biološkoj raznolikosti kao i očuvanju ekološke mreže Natura 2000. Ovi tipovi operacija su ključni za zaštitu pojedinih ciljeva očuvanja ekološke mreže (poglavito određenih vrsta ptica i leptira te stanišnih tipova) te je njihova primjena bitna za ostvarivanje povoljnog stanja Natura 2000 vrsta i stanišnih tipova. U sklopu ovog rada analizirani su ekološki, vremenski i tehnički uvjeti koje poljoprivrednici u Hrvatskoj i u Sloveniji moraju zadovoljiti za ostvarivanje poticaja. Analiza fenoloških parametara pomoću satelitskih snimaka pokazuje da za klimatski vrlo bliska područja postoje značajno različiti zahtjevi u vremenu provođenja pojedinih tipova operacija. Zbog neprilagođenosti pojedinih operacija Mjere 10 lokalnim poljoprivrednim praksama, mjere za očuvanje biološke raznolikost često nisu dovoljno atraktivne. Analizirani su podaci o primjeni operacija Mjere 10 vezane za travnjake velike prirodne vrijednosti u drugim EU državama te su predložene promjene mjera vezane za prilagodbu fenološkim prilikama područja.

Ključne riječi: Natura 2000, Program ruralnog razvoja, fenologija, travnjaci visoke prirodne vrijednosti

Opportunities for diversification of biodiversity protection measures under the Rural Development Program

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Abstract

Natura 2000 is an ecological network of the European Union made up of areas important for the conservation of endangered species and habitats of the European Union. Measure 10: Agriculture, Environment and Climate Change under the Rural Development Program (PDP) are implemented through different types of operations that contribute to biodiversity as well as the conservation of the Natura 2000 ecological network. These types of operations are crucial for the conservation of certain ecological network conservation objectives (mainly particular bird and butterfly species and habitat types) and their application is essential for the achieving a favourable status of Natura 2000 species and habitat types.

This paper analysed the ecological, temporal and technical conditions that farmers in Croatia and in Slovenia must satisfy in order to receive incentives. Analysis of phenological parameters using satellite imagery shows that for climatically very close areas there are significantly different requirements in the timing of certain types of operations. Due to the lack of adaptation of individual measures of Measure 10 to local agricultural practices, biodiversity conservation measures are often not attractive enough. Data on the implementation of Measure 10 operations in other EU countries have been analysed and the more phenologically adapted measures are proposed.

Keywords: Natura 2000, Rural Development Program, phenology, high nature value (HNV) grasslands

Bacillus spp. in biological control of cultivated mushroom diseases

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Abstract

The objective of the study was to obtain potential biocontrol agents of green mould disease, caused by *Trichoderma* spp., affecting the most commonly cultivated basidiomycetes: white button mushroom (*Agaricus bisporus*) and oyster mushroom (*Pleurotus* spp.). The isolation of bacterial strains with antagonistic properties against *Trichoderma* spp. was carried out from samples of straw and chicken manure, compost at various stages of the composting process and casing soil used for growing button mushrooms. Bacterial isolates characterized as Gram-positive and catalase-positive were identified based on the hypervariable region of the 16S rDNA as: *Bacillus subtilis*, *B. amyloliquefaciens*, *B. licheniformis* and *B. pumilus*. After a preliminary screening of bacterial isolates for antagonistic activity against *Trichoderma aggressivum* f. *europaeum* further screening was conducted with additional indicator isolates of fungi: *T. harzianum*, *T. koningii* and *T. atroviride*. Growth inhibition of *Trichoderma* spp. ranged from 40 to 70 % depending on the antagonistic strain and fungal indicator. The strains with the strongest antagonistic activity were selected for *in vivo* experiments in which the efficacy of strains in pathogen suppression and their effect on mushroom yield were evaluated, in comparison with a commercial biofungicide based on *Bacillus velezensis* QST 713 and a fungicide based on prochloraz-Mn. In mushroom growing room trials against *T. aggressivum* f. *europaeum*, the most effective treatment in pathogen control was prochloraz-Mn, followed by the native *B. amyloliquefaciens* B-241, *B. velezensis* QST 713, *B. pumilus* B-138 and *B. subtilis* B-233. Strain *B. amyloliquefaciens* B-241 showed the greatest potential for biocontrol of green mould disease in button mushroom production caused by various *Trichoderma* species, which makes it a good candidate for further trials at commercial scale. In addition, antagonistic potential of ten chosen *Bacillus subtilis* strains was evaluated against causal agents of green mould disease of oyster mushroom, *Trichoderma pleuroti* and *Trichoderma pleuroticola*. Based on the *in vitro* method for quantification of antagonistic potential of *Bacillus* spp. strains, growth inhibition of *T. pleuroti* ranged from 55 to 62 % and no significant differences among antagonistic activity of tested *B. subtilis* strains were found. Inhibition of *T. pleuroticola* was slightly higher, ranging from 55 to 70 % and strain *B. subtilis* B-358 induced the highest growth inhibition thus showing promising results for further *in vivo* trials. This research confirmed mushroom substrate to be a good source of antagonistic microorganisms with potentials for use in biological control of green mould control in edible mushroom production. This work was supported by bilateral project 337-00-205/2019-09/21.

Keywords: mushrooms, green mould disease, *Bacillus* spp., antagonistic activity, biocontrol

Evaluacija kvalitete komposta biološkim testom

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Sažetak

Biološki testovi s uzgojem biljaka precizniji su indikatori zrelosti i fitotoksičnosti organskih gnojiva od testa kljavosti zbog izravne sjetve u medij (organsko gnojivo ili smjese s različitim kondicionerima). Tako su biljke pored vodotopivih tvari izložene i tvarima povezanim sa supstratom koje se mogu mobilizirati promjenama vlažnosti, temperature, izlučevinama korijena ili mikroorganizama. Cilj istraživanja je biološkim testom s uzgojem biljaka usporediti zrelost i fitotoksičnost komercijalnog supstrata, komposta i vermikomposta proizvedenih od biljnih ostataka s javnih zelenih površina. Za test su korištene 4 biljne vrste: kres salata (*Lepidium sativum* L.), krastavac (*Cucumis sativus* L.), ječam (*Hordeum vulgare* L.) i pšenoraž (*Triticosecale* Wittmack) i 5 različitih medija (komercijalni supstrat, kompost, vermikompost, smjesa 1:1 komposta i komercijalnog supstrata i smjesa 1:1 vermikomposta i komercijalnog supstrata). Svaki je tretman postavljen u 8 ponavljanja s po 2 (kres salata i krastavac) ili 10 sjemenki (ječam i pšenoraž). Tijekom uzgoja biljke su zalijevane deioniziranom vodom ili otopinom s 400 ili 600 mg NH₄⁺ L⁻¹. U prosjeku svih testnih biljnih vrsta utvrđena je najveća nadzemna masa suhe tvari na komercijalnom supstratu (17,3) i smjesama s kompostom (16,6) i vermikompostom (15,7), a značajno manje mase na kompostu (13,3) i vermikompostu (11,9). Najveću nadzemnu masu proizveo je ječam, značajno manju krastavac i pšenoraž, a najmanju kres salata. Značajno najveće mase ječma utvrđene su na smjesama komposta i vermikomposta s komercijalnim supstratom, značajno manje na komercijalnom supstratu, a značajno najmanje na kompostu i vermikompostu. Slično je bilo i kod ostalih vrsta, ali bez značajnih razlika između smjesa i komercijalnog supstrata. Dodane otopine amonijevog karbonata značajno su povećale nadzemne mase suhe tvari ječma i pšenoraži u odnosu na kontrolu s vodom, nisu značajno utjecale na krastavac, a fitotoksični učinak smanjenjem nadzemne mase utvrđen je samo za kres salatu. Biološkim testom potvrđeno je da su kompost i vermikompost kvalitetne komponente za pripremu smjese za uzgoj s komercijalnim supstratom. Najpogodniji indikator produktivnosti i fitotoksičnosti medija su kres salata i ječam.

Ključne riječi: nadzemna masa, ječam, pšenoraž, kres salata, krastavac

Bioassay in Compost Quality Evaluation

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Abstract

Bioassays with plant growing are more accurate indicators of the maturity and phytotoxicity of organic fertilizers than the germination test due to direct sowing in the medium (organic fertilizer or mixtures with different conditioners). Thus, in addition to water-soluble substances, plants are exposed to substrate related substances that can be mobilized by changes in humidity, temperature, root or microorganism activity. The aim of the study was to use bioassay to compare the maturity and phytotoxicity of commercial substrate, compost and vermicompost produced from plant residues from public green areas. Four plant species were used for the test: garden cress (*Lepidium sativum* L.), cucumber (*Cucumis sativus* L.), barley (*Hordeum vulgare* L.) and triticale (*×Triticosecale* Wittmack) and 5 different media (commercial substrate, compost, vermicompost, a 1:1 mixture of compost and commercial substrate and a 1:1 mixture of vermicompost and commercial substrate). Each treatment was set in 8 repetitions with 2 (garden cress and cucumber) or 10 seeds (barley and triticale). During plant growing, the plants were watered with deionized water or a solution of 400 or 600 mg NH₄⁺ L⁻¹. On average, of all test plant species, the highest aboveground mass of dry matter was determined on commercial substrate (17.3) and mixtures with compost (16.6) and vermicompost (15.7), significantly less mass on compost (13.3) and vermicompost (11.9). Barley produced the highest aboveground mass, significantly smaller cucumber and triticale, and the smallest garden cress. Significantly the highest barley masses were found on compost and vermicompost mixtures with commercial substrate, significantly less on commercial substrate, and significantly the least on compost and vermicompost. The same was also determined for other species, but without significant differences between mixtures and commercial substrate. The added ammonium carbonate solutions significantly increased the aboveground masses of barley dry matter and triticale when compared to control with water, did not significantly affect the cucumber, and the phytotoxic effect by reducing the aboveground mass were found only for garden cress. The bioassay confirmed that compost and vermicompost are good components for preparation the growing medium mixture with a commercial substrate. The most appropriate indicator of productivity and phytotoxicity of the growing media were garden cress and barley.

Keywords: aboveground mass, barley, triticale, garden cress, cucumber

Kontrastna raspodjela makro i mikroelemenata u lišću masline

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Sažetak

Biljkama su potrebni različiti makro- i mikroelementi za normalan rast i razvoj. Navedeni elementi imaju različite uloge u biljnoj stanici, poput tvorbe strukturalnih komponenata u makromolekulama, kofaktori su enzimatskih reakcija ili sudjeluju u osmoregulacijskim procesima biljke. Mineralni sastav lista prvenstveno je povezan s brojnim fundamentalnim procesima kao i sekundarnim metabolizmom biljaka. Maslina (*Olea europaea* L.) je jedna od najznačajnijih kultura, posebice u skupini voćnih vrsta, uzgajanih na području Mediterana. Cilj ovog rada bio je utvrditi distribuciju makro i mikroelemenata u poprečnom prerezu listova sorte 'Istarska bjelica' primjenom protonima inducirane emisije rendgenskoga zračenja (mikro-PIXE), multi-elementne i potpuno kvantitativne tehnike čija je rezolucija < 1 μm. U preliminarnim istraživanjima poprečnog prereza listova masline primjenom mikro-PIXE utvrđen je različit sadržaj kalija (K), fosfora (P), kalcija (Ca), magnezija (Mg), sumpora (S), klora (Cl), mangana (Mn), željeza (Fe) i cinka (Zn). Koncentracije K dostigle su 30.00 g kg⁻¹ suhe tvari (ST) i velikim su djelom bile raspodijeljene u asimilacijskom parenhimu. Najveće koncentracije P utvrđene su u/oko vaskularnog tkiva te asimilacijskog parenhima. Prosječna koncentracija P u cijelom poprečnom prerezu lista iznosila je 2.10 g kg⁻¹ ST. Kalcij je prevladavao u epidermalnom tkivu, dok je prosječna koncentracija Ca iznosila 5.50 g kg⁻¹ ST. Magnezij je bio ravnomjerno raspoređen u listu s prosječnom vrijednosti od 1.78 g kg⁻¹ ST. Distribucija S bila je vrlo slična onoj P, osim u blizini provodnog staničja. Prosječna koncentracija S u cijelom poprečnom presjeku lista iznosila je 0.93 g kg⁻¹ ST. Nakupljanje Cl u većim količinama zabilježeno je u žilnim ovojnicama; prosječna koncentracija u poprečnom prerezu lista iznosila je 1.70 g kg⁻¹ ST. Mangan, Fe i Zn bili su podjednako raspoređeni s prosječnim koncentracijama 25, 62 i 17 mg kg⁻¹ ST.

Ovaj rad je sufinancirala Hrvatska zaklada za znanost projektom "Bilinogojstvom do sekundarnih biljnih metabolita: primjena mineralnih hraniva i elicitora za povećanje koncentracije fenola u listu masline" (UIP-2017-05-8464) i putem „Projekta razvoja karijera mladih istraživača – izobrazba novih doktora znanosti (DOK-2018-09-1841), nadalje Javna agencija za istraživanje Republike Slovenije (ARRS) programima (P1-0212, P1-0112 and I0-0005), projektima (N7-077, J7-9418, J7-9398, N1-0105 I N1-0090) i putem Obzor 2020 projekta RADIATE ugovor broj 824096.

Ključne riječi: MikroPIXE, željezo, cink, mangan, klor

Contrasting allocation of macro and microelements in olive leaves

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Abstract

Plants require several macro- and microelements to successfully complete their life cycle. These elements have different roles in plant cells such as that they are structural components in macromolecules, cofactors in enzymatic reactions or perform osmoregulation roles. Leaf elemental composition is essentially linked with a variety of fundamental processes as well as with the secondary metabolism of plants. Olive (*Olea europaea* L.) is one of the most important crops, particularly fruit ones, grown in the Mediterranean area. The objective of this work was to determine the distribution of macro- and microelements in cross-sections of leaves of 'Istarska bjelica' olive cultivar using micro-particle induced X-ray emission (micro-PIXE), a multi-elemental and fully quantitative technique with resolution <1 µm. In the preliminary experiments using micro-PIXE we detected potassium (K), phosphorus (P), calcium (Ca), magnesium (Mg), sulphur (S), chlorine (Cl), manganese (Mn), iron (Fe) and zinc (Zn) in leaf cross sections. Potassium concentrations reached 30.00 g kg⁻¹ dry weight (DW) and were largely allocated to the palisade mesophyll. The largest P concentrations were detected in/around vascular tissues followed by the palisade mesophyll. The average P concentration in the whole leaf cross section was 2.10 g kg⁻¹ DW. Calcium predominated in the epidermis; average Ca concentrations were 5.50 g kg⁻¹ DW. Magnesium was evenly distributed in the leaf, with average concentration being 1.78 g kg⁻¹ DW. Sulphur distribution was very similar to P distribution, except for the allocation to the vicinity of the vasculature. The average S concentration in the whole leaf cross section was 0.93 g kg⁻¹ DW. Chlorine was accumulated in large quantities in the bundle sheath cells; average concentration in the leaf cross section was 1.70 g kg⁻¹ DW. Manganese, Fe and Zn were evenly distributed with average concentrations 25, 62 and 17 mg kg⁻¹ DW, respectively.

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Keywords: MicroPIXE, iron, zinc, manganese, chlorine

Analiza zrelosti i fitotoksičnosti komposta i vermikomposta

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Sažetak

Zrelost organskih gnojiva kao pokazatelj dovršenosti procesa sazrijevanja u uskoj je vezi s razinom fitotoksičnosti koja se uglavnom neutralizira sazrijevanjem, a najčešće utvrđuje univerzalnim testom klijavosti. Cilj istraživanja bio je usporediti interpretaciju fitotoksičnosti utvrđene testom klijavosti i interpretaciju zrelosti na temelju kemijskih svojstava komposta i vermikomposta proizvedenih od biljnih ostataka s javnih zelenih površina. Za interpretaciju zrelosti ili fitotoksičnosti korišteni su električni konduktivitet (EC), C/N i $\text{NH}_4\text{-N}/\text{NO}_3\text{-N}$ odnosi i koncentracije $\text{NH}_4\text{-N}$. Test klijavosti proveden je u ekstraktima organskih gnojiva i deionizirane vode (omjeri 1:2,5 i 1:10) te u 3 otopine amonijevog karbonata (koncentracije $\text{NH}_4\text{-N}$ 200-600 mg L⁻¹) s po 10 sjemenki kres salate (*Lepidium sativum* L.) ili krastavca (*Cucumis sativus* L.). Male vrijednosti C/N odnosa komposta (9,93) i vermikomposta (14,27), $\text{NH}_4\text{-N}/\text{NO}_3\text{-N}$ (0,044 i 0,067) i koncentracija NH_4^+ (4,04 i 1,59 mg L⁻¹) indiciraju zrelost te su uz niske vrijednosti EC (2,37 i 0,76 mS cm⁻¹) indikatori odsustva fitotoksičnosti, istovremeno pokazujući veću zrelost komposta (niži C/N i $\text{NH}_4\text{-N}/\text{NO}_3\text{-N}$) nego vermikomposta. Navedene interpretacije možemo usporediti s testom klijavosti jer su za kres salatu utvrđeni najmanji indeksi klijavosti (0,29 i 0,37) u ekstraktima vermikomposta_(1:2,5 i 1:10), te ekstraktu_(1:10) komposta (0,37), što je u rangu visoke fitotoksičnosti. Fitostimulativni učinak utvrđen je testom klijavosti krastavca u ekstraktu_(1:2,5) komposta (1,27) i vermikomposta (1,13), dok je umjerena fitotoksičnost (0,70) utvrđena samo u ekstraktu_(1:10) vermikomposta. Otopine rastućih koncentracija NH_4^+ značajno su smanjile indeks klijavosti za krastavac (0,338 do 0,021) i kres salatu (0,085 do 0,0003). Možemo zaključiti da je kres salata osjetljiviji indikator fitotoksičnosti jer je utvrđen širi raspon ocjena (fitostimulativni učinak do visoke fitotoksičnosti) nego istim metodama za krastavac (fitostimulativni učinak do umjerene fitotoksičnosti). Također, utvrđen je prosječno značajno niži indeks klijavosti kres salate (0,29) nego krastavca (0,54), te značajno niži indeks klijavosti u otopinama NH_4^+ .

Ključne riječi: C/N odnos, $\text{NH}_4\text{-N}/\text{NO}_3\text{-N}$ odnos, indeks klijavosti, kres salata, krastavac

Analysis of Compost and Vermicompost Maturity and Phytotoxicity

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Abstract

The maturity of organic fertilizers as an indicator of the completion of the maturation process is closely related to the level of phytotoxicity, which is generally neutralized by maturation and most commonly determined by a universal germination test. The aim of the study was to compare the interpretation of phytotoxicity determined by the germination test and the interpretation of maturity based on the chemical properties of compost and vermicompost produced from plant residues from public green areas. Electrical conductivity (EC), C/N and $\text{NH}_4\text{-N}/\text{NO}_3\text{-N}$ ratios and $\text{NH}_4\text{-N}$ concentrations were used to interpret maturity or phytotoxicity. The germination test was performed in extract of organic fertilizer by deionized water (1:2.5 and 1:10 ratios) and in 3 ammonium carbonate solutions ($\text{NH}_4\text{-N}$ concentrations 200-600 mg L^{-1}) with 10 garden cress (*Lepidium sativum* L.) or cucumber (*Cucumis sativus* L.) seeds. Low values of C/N ratio of compost (9.93) and vermicompost (14.27), $\text{NH}_4\text{-N}/\text{NO}_3\text{-N}$ ratio (0.044 and 0.067) and concentration of NH_4^+ (4.04 and 1.59 mg L^{-1}) indicate mature fertilizer. These properties are showing higher maturity of compost (lower C/N and $\text{NH}_4\text{-N}/\text{NO}_3\text{-N}$) than vermicompost and together with low EC values (2.37 and 0.76 mS cm^{-1}) indicate absence of phytotoxicity. Described interpretations can be compared with the germination test because the garden cress has the lowest germination indexes (0.29 and 0.37) in vermicompost extracts_(1:2.5 i 1:10) and compost (0.37) extract, which means high phytotoxicity. Phytostimulatory effect was determined by the germination test for cucumber in extract_(1:2.5) of compost (1.27) and vermicompost (1.13), while moderate phytotoxicity (0.70) was determined only in extract_(1:10) of vermicompost. Increased concentrations of NH_4^+ significantly decreased the germination index for cucumber (0.338 to 0.021) and garden cress (0.085 to 0.0003). It can be concluded that garden cress is a more sensitive phytotoxicity indicator because a wider range of reaction (phytostimulatory effect to high phytotoxicity) than cucumber reaction in same tests (phytostimulatory effect to moderate phytotoxicity). Also, an average a significantly lower germination index of garden cress (0.29) than cucumber (0.54) was found, and a significantly lower germination index in NH_4^+ solutions.

Keywords: C/N ratio, $\text{NH}_4\text{-N}/\text{NO}_3\text{-N}$ ratio, germination index, garden cress, cucumber

Obnova vegetacije na požarištu travnjaka uskolisne šašike u Natura 2000 području

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Sažetak

U zaleđu Rijeke nekoliko je travnjačkih površina s travom uskolisnom šašikom (*Seslerietum juncifoliae* s. lat.) poharano požarima. U Natura 2000 području „Gornje Jelenje - Platak“ u požaru je 2013. godine izgorio travnjak na brdu Jazvina (952 m n. v.). Godinu dana nakon požara Javna ustanova „Priroda“ započela je praćenje sukcesije na opožarenoj površini. Cilj istraživanja je pratiti promjene biljnog svijeta na požarištu i utvrditi dinamiku regeneracije pojedinih vrsta. Vegetacija je istraživana metodom ciriško-monpelješke fitocenološke škole, a flora je određivana standardnim botaničkim priručnicima. Rezultati praćenja regeneracije vegetacije na dvije trajne plohe (jedna izvan i druga unutar požarišta) ukazuju da je uskolisna šašika potpuno potisnuta požarom i nije se ni tijekom šest godina nakon požara oporavila. Ostale vrste zajednice različito su reagirale na požar, neke se obnavljaju brže, neke sporije, a prvih godina nakon požara primijećeno je bujnije širenje lepirnjača (*Coronilla*, *Anthyllus*, *Lotus*). Opažano je i eksplozivno širenje pojedinih mahovina, terofita i potencijalno invazivnih vrsta (primjerice *Cirsium candelabrum* Griseb., širi se od 2017. godine), koje nisu uobičajeni članovi istraživane biljne zajednice. Pojavljuju se i pionirske drvenaste vrste. Natura 2000 vrsta *Genista holopetala* dobro se oporavila nakon požara, ali nije primijećen razvoj klijanaca. Istraživanja sukcesija na požarištima mogu stoga imati i praktičnu važnost jer mogu usmjeriti načine upravljanja Natura 2000 područjima i vrstama.

Ključne riječi: travnjačka vegetacija, „*Seslerietum juncifoliae*“, Natura 2000, sekundarna sukcesija, *Genista holopetala*

Natural regeneration of narrow-leaved moor grass vegetation on post-fire site in the Natura 2000 area

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Abstract

In the hinterland of Rijeka, several significant grassland areas with narrow-leaved moor grass (*Seslerietum juncifoliae* s. lat.) have been affected by fires. In the Natura 2000 area "Gornje Jelenje - Platak" in 2013 a narrow-leaved moor grass grassland was affected by fire in the locality of Jazvina hill (952 m a s l). One year after the fire, the Public Institution "Priroda" began with monitoring of the actual succession on the burned area. The aim of the study was to monitor changes in flora and vegetation at the post-fire site and to determine the regeneration dynamics of individual species. Vegetation was investigated using the method of the Zürich-Montpellier Phytocenological School (Braun-Blanquet), and the flora was determined using standard botanical manuals. The results of monitoring on two permanent plots (one outside and the other inside the fire site), indicate that the narrow-leaved moor grass was completely suppressed by the fire and did not recover significantly during the six years after the fire. Other species of the plant community responded differently to the fire, some renewing faster, some slower, and in the first years after the fire, a more extensive spread of leguminous species was observed (for example: *Coronilla*, *Anthyllus*, *Lotus*). An explosive spread of some mosses, therophytes and potentially invasive species (for example *Cirsium candelabrum* Griseb., spreading from 2017), which are not members of the studied plant community, has also been observed. Some woody species also occur. The Natura 2000 species *Genista holopetala* (W. D. J. Koch) Bald. recovered well after the fire, but no seedlings emerged. Researches on post-fire succession plots may therefore also be of practical importance to provides some answers regarding possible management measures for Natura 2000 sites and species.

Keywords: grassland vegetation, "*Seslerietum juncifoliae*", Natura 2000, secondary succession, *Genista holopetala*

Održivi razvoj poljoprivrede: inovativna tehnologija za oporabu otpadnog mulja

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Sažetak

Obrada i zbrinjavanje mulja sastavni je dio pročišćavanja otpadnih voda i iz tog razloga razvoj tehnologije za pročišćavanje otpadnih voda mora uključivati rješenja za obradu i zbrinjavanje nastalog mulja. Uporaba mulja u poljoprivredi ima za cilj ponovnu uporabu hranjivih tvari sadržanih u mulju kao i dodatak organske tvari iz mulja u tlo. Mondo Pulito d.o.o., kao tvrtka s višegodišnjim iskustvom u okolišnom sektoru svjesna problema zbrinjavanja mulja u Hrvatskoj, želi uvesti novu patentiranu tehnologiju za pretvorbu tekućeg i krutog otpadnog mulja u poboljšivač tla komercijalnog naziva Biosulfat. Istraživanje utjecaja Biosulfata na prinos zrna, mineralni sastav i sadržaj teških metala u zrnu kukuruza te na biljno hranidbeni kapacitet i sadržaj teških metala u tlu provedeno je na pokušalištu Sveučilišta u Zagrebu Agronomskog fakulteta tijekom 2019. godine. Pokus je postavljen po slučajnom bloknom rasporedu sa 8 varijanti u 4 ponavljanja. Varijante u pokusu bile su: kontrola (bez gnojidbe), mineralno gnojivo (250 kg N/ha), poboljšivač Biosulfat u tri doze (150, 200 i 250 kg N/ha) te kombinacija (50:50 %) poboljšivača i mineralne gnojidbe u tri doze (150, 200 i 250 kg N/ha). Pozitivan učinak Biosulfata na prinos zrna kukuruza kao i na količinu dušika, odnosno proteina u zrnu u odnosu na kontrolnu varijantu utvrđen je na svim varijantama na kojima je primijenjen Biosulfat (kod sve tri doze tretmana), bilo samostalno ili u kombinaciji s mineralnom gnojidbom. Također, nisu utvrđene negativne posljedice primjene Biosulfata na kemijska svojstva tla kao ni na sadržaj teških metala u tlu.

Ključne riječi: otpadni mulj, oporaba, poboljšivač, kukuruz, teški metali

Sustainable Agriculture: Innovative Technology for Waste Sludge Recovery

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Abstract

Sludge treatment and disposal is an integral part of waste water treatment. For this reason, the development of waste water treatment technology must include solutions for processing and disposal of sludge. The use of sludge in agriculture aims at the re-use of nutrients contained in sludge as well as the addition of organic matter from sludge to soil. Mondo Pulito Ltd., as a company with years of experience in the environmental sector, aware of the problem of sludge disposal in Croatia, wants to introduce new patented technology for the conversion of liquid and solid waste sludge into a soil improver of the commercial name Biosulfate. The research on effect of application of Biosulfate on yield, mineral composition and content of heavy metals in corn grain was conducted on the experimental field of University of Zagreb Faculty of Agriculture, during 2019. The effect on chemical properties of soil and content of heavy metals in soil was investigated as well. Eight treatments were established in four replicates including: control (without fertilization), mineral fertilizer (250 kg N/ha), Biosulfate in three doses (150, 200 and 250 kg N/ha) and combination of Biosulfate with mineral fertilizer (50:50) in three doses (150, 200 and 250 kg N/ha). The positive effect of Biosulfate on maize grain yield as well as on the amount of nitrogen i.e. protein content in the corn grain in regard to the control variant were determined on all variants where Biosulfate was applied (at all three doses of treatments), either alone or in combination with mineral fertilizer. Also, there were no negative effects of application of Biosulfate on the chemical properties of soil as well as on the content of heavy metals in the soil.

Keywords: waste sludge, recovery, soil improver, maize, heavy metals

Svojstva tla i potencijalna raspoloživost mangana i bakra

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Sažetak

Obvezne agrokemijske analize poljoprivrednih tala obuhvaćaju analize pH vrijednosti tla, sadržaja organske tvari i koncentracije raspoloživih fosfora i kalija, ali ne uključuju analize ukupnih koncentracija i raspoloživih frakcija esencijalnih mikroelemenata mangana (Mn) i bakra (Cu). Međutim, raspoložive koncentracije Mn i Cu u oraničnim tlima značajno ovise o pH vrijednosti tla, teksturi i sadržaju organske tvari pa postoji mogućnost predviđanja raspoloživih frakcija Mn i Cu na temelju dostupnih podataka o tlu. Cilj ovog rada je utvrditi točnost regresijskih modela predviđanja raspoloživih frakcija Mn i Cu na temelju dostupnih osnovnih svojstava tla. Regresijski model kreiran je setom podataka s rezultatima analize koncentracije ukupnih i raspoloživih frakcija Mn i Cu u 229 uzoraka tla (ukupni Mn ekstrahirano zlatotopkom u rasponu 228,4-1.024,0 mg kg⁻¹; raspoloživi Mn ekstrahirano otopinom EDTA u rasponu 5,38-131,40 mg kg⁻¹; ukupni Cu 10,24-39,45 mg kg⁻¹ i raspoloživi Cu 1,91-13,93 mg kg⁻¹). Navedeni je model validiran novim setom od 30 uzoraka tla (raspoloživi Mn 5,38-131,40 mg kg⁻¹ i Cu 1,49-6,03 mg kg⁻¹). Utvrđena je pouzdanost modela u predviđanju raspoloživosti Mn samo 64,12 % i raspoloživosti Cu 76,28 %. Predviđanjem raspoloživosti Mn i Cu na temelju dostupnih rezultata analiza (pH_{H₂O}, pH_{KCl}, sadržaj humusa) 22.616 uzoraka tala istočnohrvatskih županija utvrđena je prosječna raspoloživost Mn 37,44 mg kg⁻¹, što je u rangu srednje opskrbljenosti tla (30-40 mg kg⁻¹) i Cu 4,76 mg kg⁻¹, što je u rangu visoke opskrbljenosti (>3 mg kg⁻¹). Predviđena je nedovoljna raspoloživost Mn (< 30 mg kg⁻¹) u 4.735 uzoraka s 20.035,40 ha (22,6 % analiziranih površina), srednja raspoloživost Mn u 8.819 uzoraka s 34.073,19 ha (38,41 % površina) i visoka raspoloživost (>40 mg kg⁻¹) u 9.063 uzoraka s 34.605,88 ha (39,01 % površina). Nije predviđena nedovoljna raspoloživost Cu niti u jednom uzorku, a visoka raspoloživost Cu modelom je predviđena u čak 21.924 uzorka (97 % uzoraka). Provedeno modeliranje može rezultirati vrlo korisnim podacima predviđene raspoloživosti Mn pošto je modelirana potencijalno nedovoljna raspoloživost na jednoj četvrtini površina. Istovremeno, nema indikacija nedovoljne raspoloživosti Cu. Potrebno je povećati točnost modela, posebice za tla ekstremnih vrijednosti analiziranih svojstava.

Ključne riječi: regresijski modeli, ukupni Mn, ukupni Cu, EDTA ekstrakcija, kiselost tala

Soil Properties and Potential Manganese and Copper availability

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Abstract

Mandatory agrochemical analyzes of agricultural soils include analyzes of soil pH, organic matter content and concentrations of available phosphorus and potassium, but do not include analyzes of total concentrations and available fractions of essential microelements manganese (Mn) and copper (Cu). However, the available concentrations of Mn and Cu in arable soils depend significantly on soil pH, texture and organic matter content, so it is possible to predict the available Mn and Cu fractions based on available soil data. The aim of this paper was to determine the accuracy of the regression models for prediction of the available Mn and Cu fractions based on the basic soil properties. The regression model was created by a data set with concentration of total and available Mn and Cu fractions in 229 soil samples (total Mn extracted with aqua regia in the range 228.4-1024.0 mg kg⁻¹; available Mn extracted with EDTA in 5.38 -131.40 mg kg⁻¹; total Cu 10.24-39.45 mg kg⁻¹ and available Cu 1.91-13.93 mg kg⁻¹). The model was validated with a new set of 30 soil samples (available Mn 5.38-131.40 mg kg⁻¹ and Cu 1.49-6.03 mg kg⁻¹). The reliability of the model in predicting Mn availability was only 64.12 % and Cu availability 76.28 %. Predicting the availability of Mn and Cu based on the available data (pH_{H₂O}, pH_{KCl}, humus content) of 22,616 soil samples in eastern Croatia, the average availability of Mn was found to be 37.44 mg kg⁻¹, which is in the range of medium soil supply (30-40 mg kg⁻¹) and Cu 4.76 mg kg⁻¹, which is in the high supply range (> 3 mg kg⁻¹). Insufficient Mn availability (<30 mg kg⁻¹) was predicted for 4,735 samples representing 20,035.40 ha (22.6 % of analyzed areas), mean Mn availability for 8,819 samples (34,073.19 ha; 38.41% area) and high availability (> 40 mg kg⁻¹) for 9,063 samples (34,605.88 ha; 39.01% area). Insufficient Cu availability was not predicted in any sample, and a high Cu model availability was predicted in as many as 21,924 samples (97% of samples). The modeling can result in very useful Mn predicted availability data, since potentially insufficient availability on one quarter of the arable land is modeled. At the same time, there are no indications of insufficient availability of Cu. It is necessary to increase the accuracy of the model, especially for soils with extreme values of analyzed properties.

Keywords: regression models, total Mn, total Cu, EDTA extraction, soil acidity

Tradicijske i izvorne pasmine u službi održivog razvoja

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Sažetak

Park šuma Marjan predstavlja jedinstvenu zelenu površinu nadomak centru grada Splita, izuzetne prirodne i kulturne vrijednosti. Marjan je 1964. godine zaštićen u skladu sa Zakonom o zaštiti prirode u kategoriji park šume, a zbog svog značaja i vrijednih povijesnih građevina trajno je zaštićen i kao kulturno dobro 2014. godine.

Osnivanje Zoološkog vrta kao Edukacijskog centra s tradicijskim i izvornim pasminama domaćih životinja započelo je 2016. revitalizacijom i prenamjenom prostora ZOO vrta i sklopa zgrada Prirodoslovnog muzeja na prvom vrhu Marjana. Glavni ciljevi ZOO vrta, kao Edukacijskog centra, su držanje matičnih stada različitih pasmina s ciljem njihove daljnje selekcije i reprodukcije radi očuvanja genetskog fonda, suradnja s bankom gena domaćih životinja Republike Hrvatske radi pohrane genetskog materijala izvornih pasmina, zaštita i promocija izvornih i tradicijskih pasmina, podizanje svijesti javnosti o potrebi i važnosti njihovog očuvanja te iznalaženje novih načina upotrebe tradicijskih i izvornih pasmina domaćih životinja u 21. stoljeću.

Životinje koje su smještene u Edukacijskom centru na Marjanu odgovaraju klimatsko-geološkim obilježjima prostora. Radi se isključivo o životinjama karakterističnim za primorsko područje, mirne naravi, prihvatljivim za druženje s djecom svih uzrasta (ovce, koze, kokoši, purani, goveda, magarci i konji). Trenutno centar ima 70 % posto popunjenih kapaciteta, a u konačnici je planirano ukupno 9 vrsta s maksimalno 16 pasmina.

Upotreba tradicijskih pasmina, posebno magaraca, doprinosi održivom razvoju upotrebom prirodnih gnojiva u eko proizvodnji voća i povrća, terapijskom radu s djecom i odraslima s posebnim potrebama, mobilnim solarnim stajama za domaće životinje, upotrebom kultiviranju zapuštenih poljoprivrednih zemljišta, te upotrebom u razvoju eko-turizma.

Ključne riječi: Zoološki vrt, edukacijski centar, eko turizam, buša, primorsko-dinarski magarac, hrvatska šarena koza

Traditional and authentic domestic animal breeds in service of sustainable development

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Summary

Marjan Park Forest represents a unique green ground near the center of Split, a remarkable natural and cultural value. Marjan was protected in 1964 according to Nature protection Law in the Park Forest category and because of its significance and valuable historic structures was permanently protected also as a cultural good in 2014.

Establishing of the Educational center with traditional and authentic domestic animal breeds began in 2016, by revitalizing and conversing of the ZOO space and buildings complex of the Natural History Museum at the first Marjan peek. Main goals of the ZOO as an Educational center are: keeping of parent herds of different breeds with a goal of further selection and reproduction to sustain the genetic fond, cooperation with the gene bank of domestic animals in Croatia for storage of genetic material of authentic breeds, protection and promotion of authentic and traditional breeds, rising of public awareness about the need and importance of their preservation and finding new ways for using traditional and authentic domestic animal breeds in the 21st century.

Animals that are accommodated in the Educational center on Marjan conform to the climate-geological attributes of the space. These are solely animal that are specific to the coastal area, calm nature, acceptable for playing with children of all ages; sheep, goats, chicken, turkeys, cows, donkeys and horses. At the moment the center is full up to 70 % of its capacities, and ultimately it is planned a total of 9 species with a maximum of 16 breeds. Usage of traditional breeds, especialy donkeys, contribute to sustainable development by means of using natural fertilizer in production of fruits and vegetables, therapeutic work with children and adults with special needs, mobile solar stables for domestic animals and usage of traditional breeds in development of eco-tourism,

Keywords: Educational center, traditional and authentic domestic animal breeds, renewable energy sources, eco-tourism

Modeliranje raspoloživosti željeza u tlima istočne Hrvatske

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Sažetak

Željezo (Fe) je esencijalni mikroelement čija raspoloživost u tlu značajno ovisi o ukupnoj koncentraciji Fe u tlu, pH vrijednosti tla i teksturi, a može limitirati proizvodnju na siromašnim, posebice karbonatnim tlima. Cilj ovog rada je utvrditi mogućnost korištenja dostupnih podataka za predviđanje raspoloživosti Fe regresijskim modelima. Regresijski model kreiran je setom podataka s rezultatima analize koncentracije Fe u 229 uzoraka tla (ukupni Fe ekstrahirani zlatotopkom u rasponu 20,21-38,88 g kg⁻¹ i raspoloživi Fe ekstrahirani otopinom EDTA u rasponu 17,39-4.478,00 mg kg⁻¹). Navedeni je model korišten za predviđanje raspoloživog Fe na temelju dostupnih rezultata analiza (pH_{H2O}, pH_{KCl}, sadržaj humusa) 22.616 uzoraka tala istočnohrvatskih županija. Ukupna je analizirana proizvodna površina 88.714,46 ha. U setu 229 uzoraka tla utvrđena je prosječna koncentracija raspoloživog Fe ekstrahiranog s EDTA 615,65 mg kg⁻¹, pri čemu je u 3 % uzoraka utvrđena vrlo niska (< 50 mg kg⁻¹) i u 8,3 % uzoraka niska koncentracija (50-100 mg kg⁻¹) Fe, dok je u 40,2 % uzoraka utvrđeno > 500 mg kg⁻¹ raspoloživog Fe. Modeliranjem raspoloživog Fe u velikom setu s 22.616 uzoraka predviđeno je da će vrlo niska koncentracija raspoloživog Fe biti na samo 1,35 % analiziranih površina, što je ipak značajnih 1.199,3 ha. Niska raspoloživost Fe predviđena je na 1.280 ha (1,44 % površina), a srednja na 7.443 ha (8,39 % površina). Visoka raspoloživost Fe predviđena je na 47,37 % površina, tj. na 42.027,7 ha.

Ključne riječi: regresijski modeli, ukupni Fe, raspoloživi Fe, EDTA ekstrakcija, kiselost tala

Modelling Iron Availability in Soils of Eastern Croatia

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Abstract

Iron (Fe) is an essential microelement which availability in soil depends on total concentration, soil pH and texture, and can limited crop production on poor soils, especially poor calcareous soils. The aim of these paper was to determine possible regression models for prediction of Fe availability in soils using only regular available soil data. The regression model was made by data set of 229 soil samples including results of total Fe content extracted by aqua regia (in range 20.21-38.88 g kg⁻¹) and available Fe extracted by EDTA (in range 17.39-4.478.00 mg kg⁻¹). The model was used for prediction of available Fe according to available data (pH_{H2O}, pH_{KCl}, soil organic matter content) for 22.616 soil samples from eastern Croatia. The total area of analysed soils was 88.714.46 ha. Analyses of 229 soil samples resulted in available Fe concentration 615.65 mg kg⁻¹ in average, in 3 % samples was determined very low and in 8.3 % samples low Fe concentrations, since in 40.2 % samples was determined high level of available Fe extracted by EDTA. Modelling available Fe in big data set with 22.616 samples predicted very low concentration of available Fe on only 1.35 % of analysed area which are stil considerable 1.199.3 ha of arable land. Low Fe availability was predicted on 1.280 ha (1.44 % of analysed area), and medium availability on 7.443 ha (8.39 % of analysed area). High Fe availability was predicted on 47.37 % analysed area, i.e. on 42.027.7 ha.

Keywords: regression models, total Fe, available Fe, EDTA extraction, soil acidity

Uticaj biofortifikacije selenom i cinkom na fiziološki aktivne komponente kupusa (*Brassica oleracea* L.)

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Sažetak

Biofortifikacija predstavlja oplemenjivačke i agronomske postupke obogaćivanja jestivih dijelova biljaka esencijalnim elementima poput selena i cinka. Nedostatak mikroelemenata u prehrani ljudi smatra se jednim od vodećih svjetskih problema koji se pokušava riješiti postupcima biofortifikacije povrtlarskih i ratarskih kultura koje su visoko zastupljene u ishrani ljudi. Obzirom da je kupus kultura široke proizvodnje i značajnih nutritivnih vrijednosti cilj ovog istraživanja je bio istražiti neke od fizioloških mehanizama kupusa kao odgovor na gnojidbu selenom i cinkom u svrhu biofortifikacije. Pokus je proveden na dva slavonska lokaliteta u istočnoj Hrvatskoj gdje su prije sadnje kupusa mikroelementi plitko uneseni na proizvodne površine u obliku vodenih otopina. Uzorci lista kupusa prikupljeni su tijekom dvije razvojne fenofaze kupusa tijekom svibnja i lipnja 2017. godine. Aplikacija selena rezultirala je statistički značajnim smanjenjem sadržaja vitamina C dok je aplikacija cinkom rezultirala statistički značajnim povećanjem sadržaja fenola u odnosu na kontrolu. Lokalitet i fenofaza uzorkovanja, u prosjeku za sve tretmane, značajno su utjecali na sadržaj vitamina C, vodikovog peroksida, prolina, fenola, karotenoida, klorofila A i B, intenzitet lipidne peroksidacije te na sadržaj vode u listu (RWC i WSD). Na oba lokaliteta utvrđene su statistički značajno veće koncentracije vitamina C, fenola, klorofila i karotenoida u uzorcima lista kupusa u svibnju u odnosu na lipanj. RWC i WSD značajno su se razlikovali između lokaliteta. Pokus je pokazao kako biofortifikacija selenom i cinkom nije nepovoljno utjecala na fiziološke mehanizme kupusa dok su ekološki činitelji (lokalitet i fenofaza) imali vrlo značajan utjecaj.

Ključne riječi: povrće, kupus, mikroelementi, agronomska biofortifikacija, fiziološki odgovor

Selenium and zinc biofortification effect on the physiologically active components content in cabbage (*Brassica oleracea* L.)

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Abstract

Biofortification is a breeding and agronomic process of enriching the edible plant parts with essential elements such as selenium and zinc. The lack of trace elements in human nutrition is considered to be one of the world's leading problems that is being tried to solve with the biofortification of vegetable and field crops that are important in human nutrition. Since the cabbage is a crop of broad production and significant nutritional value, the aim of this study was to investigate some of the physiological mechanisms of cabbage as response to Se and Zn fertilization in purpose of biofortification. The experiment was set up at two Slavonian sites, where microelements were shallowly incorporated in soil as sulphate or selenate solutions prior to planting cabbage. Samples of leafs were collected during two stages of cabbage growth in May and June of 2017. The application of Se resulted in a statistically significant decrease in vitamin C content while Zn application resulted in a statistically significant increase in phenol content compared to the control group. Locality and growth stage, in average for all treatments, did significantly influenced the content of vitamin C, hydrogen peroxide, proline, phenols, carotenoids, chlorophyll A and B, the intensity of lipid peroxidation, and the water content in leaf (RWC and WSD). At both sites, statistically significant higher concentrations of vitamin C, phenols, chlorophylls and carotenoids were found in cabbage leafs in May compared to June. RWC and WSD differed significantly between sites. The experiment showed that biofortification with Se and Zn did not adversely affect the physiological mechanisms of cabbage, while environmental factors (locality and growth stage) had a very significant effect.

Keywords: vegetables, cabbage, microelements, biofortification, physiological response

Jednosupnice ili dvosupnice u testu fitotoksičnosti?

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Sažetak

U testu klijavosti koji se koristi za utvrđivanje fitotoksičnosti organskih gnojiva, kao indikatori koriste se različite biljne vrste, najčešće kres salata i druge vrste povrća (krastavac, mrkva, rajčica, kupus), a nešto rjeđe jednosupnice (ječam, talijanski ljulj, riža, pšenica, raž, pšenoraž). Navedene su vrste različito osjetljive na pojedine toksične komponente, s većom osjetljivošću na konduktivitet (kres salata), organske kiseline (ječam), fenole (rajčica) ili nezrelost (salata). Cilj istraživanja bio je usporediti osjetljivost dvosupnica i jednosupnica u testu fitotoksičnosti kompostiranih biljnih ostataka s javnih zelenih površina. Test klijavosti proveden je u ekstraktima komposta i deionizirane vode (omjeri 1:2,5 i 1:10) te u 3 otopine amonijevog karbonata (koncentracije $\text{NH}_4\text{-N}$ 200, 400 i 600 mg L^{-1}) s po 10 sjemenki kres salate (*Lepidium sativum* L.), krastavca (*Cucumis sativus* L.), ječma (*Hordeum vulgare* L.) i pšenoraži (\times Triticosecale). Analizirana su kemijska svojstva na temelju kojih je kompost determiniran kao zrelo i stabilno gnojivo nešto povećane pH vrijednosti (8,66) i srednjeg konduktiviteta (2,37 mS cm^{-1}). Stabilnost indicira intenzitet disanja (0,267 $\text{mg CO}_2 \text{ g}^{-1} \text{ ST dan}^{-1}$), a zrelost nizak C/N odnos (9,93), $\text{NH}_4\text{-N/NO}_3\text{-N}$ odnos (0,044) i koncentracija $\text{NH}_4^+\text{-N}$ (4,04 mg L^{-1}). Testom klijavosti utvrđena je visoka fitotoksičnost (prosjeak za sve 4 vrste biljaka indikatora) otopina amonijevog karbonata s 400 i 600 $\text{mg NH}_4\text{-N L}^{-1}$ (indeks klijavosti – GI = 0,159 i 0,015), umjerena fitotoksičnost utvrđena je za otopinu s 200 $\text{mg NH}_4\text{-N L}^{-1}$ i za ekstrakt_(1:10) komposta, a nije utvrđena fitotoksičnost za ekstrakt_(1:2,5) komposta. Odvojenom interpretacijom jednosupnica i dvosupnica, utvrđena je prosječna umjerena fitotoksičnost ekstrakta_(1:10) za dvosupnice (GI 0,66) i jednosupnice (GI 0,64) te istovremena visoka fitotoksičnost ekstrakta_(1:2,5) za jednosupnice (GI 0,39), a fitostimulativno djelovanje (GI 1,29) na dvosupnice. Međutim, utvrđene su velike razlike pšenoraži i ječma zbog umjerene fitotoksičnosti ekstrakta_(1:2,5) na pšenoraž (GI 0,71) i visoke fitotoksičnosti na ječam (GI 0,07). Istovremeno velika je razlika između kres salata i krastavca zbog visoke fitotoksičnosti (GI 0,37) ekstrakta_(1:10) na kres salatu dok nema fitotoksičnosti na krastavac. Možemo zaključiti da su najbolji indikatori fitotoksičnosti ječam i kres salata. Ječam je stabilan indikator fitotoksičnosti amonijevog iona i fitotoksične komponente u ekstraktu komposta, na što je pšenoraž značajno otpornija. Kres salata je osjetljivija od ječma na toksičnost amonijevog iona, ali nešto manje na fitotoksične komponente u ekstraktu komposta.

Ključne riječi: indeks klijavosti, kres salata, krastavac, ječam, pšenoraž

Monocotyledons or Dicotyledons in a Phytotoxicity Test?

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Abstract

In the germination test used to determine the phytotoxicity of organic fertilizers, various plant species are used as indicators, most commonly garden cress and other vegetables (cucumber, carrot, tomato, cabbage), slightly less common monocots (barley, italian ryegrass, rice, wheat, rye, triticale). These species are differently sensitive to individual toxic components, with greater sensitivity to conductivity (garden cress), organic acids (barley), phenols (tomato) or immaturity (lettuce). The aim of the study was to compare the sensitivity of dicotyledon and monocotyledon in the phytotoxicity test of composted plant residues from public green areas. The germination test was performed in compost and deionized water extracts (1:2.5 and 1:10 ratios) and in 3 ammonium carbonate solutions ($\text{NH}_4\text{-N}$ concentrations 200, 400 and 600 mg L^{-1}) with 10 seeds of garden cress (*Lepidium sativum* L.), cucumber (*Cucumis sativus* L.), barley (*Hordeum vulgare* L.) and triticale (\times Triticosecale). Analysed chemical properties of compost determine compost as a mature and stable fertilizer of slightly increased pH (8.66) and medium conductivity (2.37 mS cm^{-1}). Also, respiratory intensity (0.267 $\text{mg CO}_2 \text{ g}^{-1} \text{ DM day}^{-1}$) indicate stable fertilizer and maturity was indicated by a low C/N ratio (9.93), $\text{NH}_4\text{-N/NO}_3\text{-N}$ ratio (0.044) and $\text{NH}_4^+\text{-N}$ concentration (4.04 mg L^{-1}). Germination test showed high phytotoxicity (average for all 4 indicator plant species) of ammonium carbonate solution with 400 and 600 $\text{mg NH}_4\text{-N L}^{-1}$ (germination index - GI = 0.159 and 0.015), moderate phytotoxicity was determined for solution with 200 $\text{mg NH}_4\text{-N L}^{-1}$ and for extract_(1:10) of compost, and no phytotoxicity for extract_(1:2.5) of compost was determined. Separate interpretation of monocotyledons and dicotyledons revealed an average moderate phytotoxicity of the extract_(1:10) for dicotyledons (GI 0.66) and monocotyledons (GI 0.64) and a simultaneous high phytotoxicity of the extract_(1:2.5) for monocotyledons (GI 0.39), and phytostimulatory effect (GI 1.29) on dicotyledons. However, large differences were found between triticale and barley due to moderate phytotoxicity of extract_(1:2.5) for triticale (GI 0.71) and high phytotoxicity for barley (GI 0.07). At the same time, there is a big difference between garden cress and cucumber due to the high phytotoxicity (GI 0.37) of the extract_(1:10) on garden cress while there was no phytotoxicity on cucumber. It can be concluded that the best indicators of phytotoxicity were barley and garden cress. Barley is a stable indicator of the phytotoxicity of ammonium ion and the phytotoxic component in compost extract, to which triticale is significantly more resistant. Garden cress is more sensitive from barley to the toxicity of ammonium ion, but slightly less to the phytotoxic components in the compost extract.

Keywords: germination index, garden cress, cucumber, barley, triticale

Diversity and ecology of non-target invertebrate fauna in Integrated and Ecologically based Pest Managements in agricultural sites within MEDITERATRI project

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Abstract

Agricultural ecosystems are very complex regarding predator and prey dynamics depending on crop types and management intensity. Prey availability can affect the number and diversity of predators that are part of higher trophic niches. To analyse diversity of ground active predatory arthropods (Insecta, Carabidae and Arachnida, Araneae) and their potential prey (Malacostraca: Isopoda, Mollusca: Gastropoda and Hexapoda: Collembola) samples were collected using pitfall traps that were exposed during vegetation season, from May till November, in 2018. Five locations were selected, olive groves in ecological production (EO), olive groves in integrated production (IO), a vineyard in integrated production (IV), a vineyard in ecological production (EV) and untreated sites on karst (C), and for each location, community composition of predators and their prey were analysed and compared in respect with applied management. Moreover, predator abundance was compared with prey density in order to predict how prey availability affects carabids and spiders sustainability in the field. Results showed differences in community composition between managed and the control site, and between two types of management. Moreover, a positive correlation between the abundance of predators and potential prey was recorded. Based on these results factors that might enhance diversity and abundance of predatory arthropods as important for natural pest control will be discussed.

The work was supported by the HRZZ UIP 05-2017-1046 and DOK-01-20181-03/04-18-72 projects and co-financed by the European Social Fund and Interreg IPA Pescar Project.

Keywords: carabids predators, prey, spiders, Zadar County

Characterization of plant growth promoting rhizobacteria and their benefits on soybean growth

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Abstract

The study presents the results of genotypic and phenotypic characterization of plant growth promoting (PGP) bacteria isolated from various soybean cultivars. A total of 18 isolates were isolated from two different soybean cultivars (AFZG Ana and Gabriela). Morphological characterisation has shown that all of the isolates were rod-shaped gram negative bacteria. The sequencing has shown that 12 out of 18 isolates belong to the genus *Pseudomonas*, four of which belong to *P. fluorescens* species. Isolates which belong to the *Pseudomonas* genus have shown the highest ability of indole-3-acetic acid synthesis, phosphorous solubilization, and along with isolates SGN6, SGN7 and SGS4 (*Sphingomonas sanguinis*) potassium solubilisation too.

All the isolates from *Pseudomonas* genus as well as those belonging to *B. japonicum* species have shown the protease synthesis abilities while amylase synthesis abilities was observed only in the isolate SAK2 (*P. chlororaphis*). The most efficient strains in *in vitro* biological nitrogen fixation assay belong to *Pseudomonas* and *Rhizobium* genera. Most of the isolates were positive to the acetic acid production while all of them have shown the ability of the exopolysaccharide production.

Keywords: PGPR, soybean, *in vitro* assay, characterization, *rrs* gene sequencing

Utjecaj organske gnojidbe na količinu i dinamiku mikroelemenata u lišću vinove loze na karbonatnom tlu

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Sažetak

Cilj ovog istraživanja bio je utvrditi utjecaj različitih doza organskih gnojiva na količinu i dinamiku mikroelemenata u lišću vinove loze na karbonatnom tlu tijekom tri vegetacije. U istraživanje je bilo uključeno šest varijanti gnojidbe (kontrola-bez gnojidbe, 20 t ha⁻¹ zrelog stajskog gnoja, 40 t ha⁻¹ zrelog stajskog gnoja, 20 000 l ha⁻¹ kiselog treseta, 40 000 l ha⁻¹ kiselog treseta i 500 kg NPK 5:20:30 ha⁻¹ s dvije prihrane UREOM po 100 kg ha⁻¹) u četiri repeticije. U svakoj vegetaciji izvršena su tri uzorkovanja (cvatnja, 2 tjedna poslije cvatnje, šara). Statistički značajna razlika u količini željeza u lišću utvrđena je u prvoj godini uzorkovanja (šara). Pri tome je najveća količina u šari utvrđena na tretmanu s 40 t ha⁻¹ stajskog gnoja (94 mg kg⁻¹ Fe), a najmanja pri gnojidbi mineralnim gnojivima (79 mg kg⁻¹ Fe). Statistički značajna razlika u količini mangana zabilježena je u drugoj godini istraživanja (cvatnja). Pri tome je najveća količina mangana utvrđena na kontrolnom tretmanu (30,5 mg kg⁻¹ Mn), a najmanja količina pri gnojidbi mineralnim gnojivima (18,50 mg kg⁻¹ Mn). Kod cinka i bakra u sve tri godine istraživanja nisu utvrđene statistički značajne razlike.

Ključne riječi: stajski gnoj, treset, mikroelementi, vinova loza, karbonatno tlo

Microelements content and dynamics in grapevine leaves affected by organic fertilization on calcareous soil

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Abstract

The aim of this study was to determine the effect of different doses of organic fertilizers on the content and dynamics of microelements in vine leaves on carbonate soil during three vegetation. The trial was performed according to randomized complete block design with 6 treatments (unfertilized, farmyard manure 20 t ha⁻¹ and 40 t ha⁻¹, peat 20 000 L ha⁻¹ and 40 000 L ha⁻¹, NPK (5-20-30) 500 kg ha⁻¹+2x100 kg UREA kg ha⁻¹) in 4 repetitions. Samples of vine leaves were taken three times during the growing period: at the flowering, 2 weeks after flowering and veraison stage. Statistically significant difference in iron leaf content was determined in the first vegetation year (veraison). The highest amount was determined in the treatment with 40 t ha⁻¹ of farmyard manure (94 mg kg⁻¹ Fe) and the lowest in the treatment with mineral fertilizers (79 mg kg⁻¹ Fe). Statistically significant difference in the content of manganese was recorded in the second year of research (flowering). The highest amount was determined in control treatment (30.50 mg Mn kg⁻¹), and the lowest amount in the treatment with NPK fertilizer 500 kg ha⁻¹+2x100 kg UREA (18.50 mg Mn kg⁻¹). In three years of research there were no significant differences between average values of zinc and copper.

Keywords: farmyard manure, peat, microelements, grapevine, alkaline soil

Morfological and spectral analyses of pepper fruits affected by foliar application of calcium amendments

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Abstract

Pepper (*Capsicum annuum* L.) is common fruity vegetable which can be consumed fresh or processed, as well as in both technological and/or physiological maturity. Pepper fruits are especially sensitive on calcium deficiency which can reduce quality and shape of fruits. Therefore the field experiment with two cultivars ('Kurtovska kapija' and 'Šorokšari') was set up as complete randomized block design in three replications with four foliar calcium treatments (control, Ecogreen 3g L⁻¹, Ecogreen 5g L⁻¹, and Zeogreen 5g L⁻¹) applied twice during the vegetation. Morphological (length, width, convex hull, minimal circle etc.) and multispectral (chlorophyll index, anthocyanin index, NIR reflectance, hue, spc green reflectance, fluorescence etc.) analysis of fruits harvested at technological maturity were performed using CropReproter (multispectral imaging chamber). Fruits of cv. Kurtovska kapija contained more chlorophyll (chl indx 1.49) anthocyanins (arid indx 3,3), had higher NIR reflectance (46035), and hue (85,9), and lower far red reflectance (18647) and spc green reflectance (8409) compared to cv. Šorokšari (0,23 chl indx , 00,5 ari indx, 31123 NIR, 60,0 hue, 25476 far red, and 18437 spc green). In addition, as obvious, fruits of cv. Kurtovska kapija were longer (143,7 mm) and narrower (48,2 mm) in comparison with fruits of cv. Šorokšari (7,5 mm and 58,4 mm, respectively). Calcium foliar treatments affected fruit multispectral parameters of cv. Kurtovska kapija, where highest far red (19576) and spc green (8847) reflectance and lowest hue and chl indx were detected in Ecogreen 5g L⁻¹ treatment.

Keywords: *Capsicum annuum* L., fruit morphology, multispectral analysis, vegetable

Resistance of indigenous *Bradyrhizobium japonicum* strains to moisture deficiency stress

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Abstract

Drought is one of the most important factors limiting nitrogen fixation, growth and yield of soybean. In this study, fifteen indigenous *Bradyrhizobium japonicum* strains isolated from different regions of Croatia were subjected to in vitro investigations of different drought conditions (simulated by polyethylene glycol (PEG) 6000 and increased NaCl concentrations). ERIC-PCR method was employed in order to determine genetic variability of strains. At the concentration of 15 % PEG 6000 indigenous strain *B. japonicum* IS1 isolated from eastern Slavonia region was most tolerant to the lack of water. At the concentration of 30 % PEG 6000, *B. japonicum* IS2, was distinctively resistant to osmotic pressure, and the least tolerant was *B. japonicum* IS4, both isolated from eastern Slavonia. For all tested strains, good growth was observed at the concentration of 1 % NaCl and moderate growth was recorded for the strains from Koprivnica region. Indigenous strains isolated from Baranja, Istria and two from eastern Slavonia were very tolerant to high concentration of NaCl (4%). According to results of ERIC-PCR method genetic similarity was not related to location of the isolation. ERIC-PCR fingerprints revealed significant diversity between rhizobial strains regardless their sampling sites.

Keywords: *Glycine max* (L.) Merrill, rhizobia, nitrogen fixation, *in vitro* drought, salt stress, ERIC-PCR

Density and diversity of chironomid larvae fauna in the Mavrovo reservoir

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Abstract

In this paper a seasonal diversity and density of the chironomid larvae fauna in the Mavrovo accumulation (R. Macedonia) was presented for two different periods. The quantitative samples for this research were collected during one year (2017/2018), seasonally from four different localities – Old church (village Mavrovo), middle of the lake, hotel Radika (village Leunovo) and Ulazna and were compared with samples collected in the past (1963/1964) but not determined. In the investigated period 1963/1964, the abundance of 8 species was determined, while in the investigated period 2017/2018, the abundance of 25 species of chironomid larvae fauna was established. In two investigated periods six species were common. The dominant species in the investigated period 1963/1964 were the species from the genus *Procladius*, while the dominant species in the investigated period 2017/2018 were the species from the genus *Tanytarsus*. Also, *Procladius*, *Chironomus plumosus*, *Harnischia*, *Polypedilum*, and *Orthocladius saxicola* were dominant. The highest density of chironomid larval fauna was detected in summer, totaling 101369 ind/m², while afterward, exponential decrease in density was recorded in spring season and it was only 977.9 ind/m². The low values of diversity index in relation to the chironomid larvae fauna are probably due to the high altitude and absence of macrophytic vegetation in the lake.

Keywords: Diptera, Chironomidae, density, diversity

Influence of soil composition on soil microbiome in early stages of soil formation

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Abstract

The interactions between soil microbiota and soil constituents, such as clay minerals and organic matter lead to the formation of highly reactive interfaces, the hotspots of microbial diversity and activity. Since different minerals support different microorganisms, they shape the microbial community and consequently, soil functions. In this study, the effect of clay minerals on microbial diversity, structure and processes involved in macronutrient cycling, such as carbon and phosphorus, during early phases of soil development characterized by nutrient scarcity, were investigated. To that end, two artificial soils (AS) with different clay mineral content (montmorillonite - MT and illite - IL) were studied. AS were inoculated with microorganisms from natural soil (Luvisol) and sterile manure and incubated for 842 days under controlled laboratory conditions. A metagenomic approach revealed the establishment of highly diverse microbiome, dependent on the type of clay mineral present. In addition, both soils have developed different strategies to overcome nutrient depletion. In MT cellulose and chitin and in IL hemicellulose and starch were the prevalent source of C for resident microbiota, whereas the potential for CO₂ fixation was similar in both soils. P depletion lead to the development of high potential for P mineralization and uptake. Inorganic pyrophosphatase gene (*ppa*), exopolyphosphatase gene (*ppx*) and the *pstSCAB* transport system dominated in MT, which indicates effective uptake and the use of internal poly-P storage sources, whilst in IL organic P turnover, alkaline phosphatases (*phoA*, *phoD*) and glycerophosphoryl diester phosphodiesterase were prevalent. Although the majority of identified genes, involved in both carbon and phosphorus cycle, were primarily harbored by highly abundant microbial families typical for agricultural soils, specialists for copiotrophic environments were also present. For example, *Bacillaceae*, *Cytophagaceae* and *Flavobacteriaceae* harboured genes involved in C cycle and *Bacillaceae* and Cyanobacteria genes for P cycle. Overall, this study gave a better insight into the role of clay minerals in selecting and shaping of microbial communities, identified which key microorganisms drive the carbon and phosphorus cycling and which strategies for overcoming nutrient depletion evolve during the early phases of soil development.

Keywords: soil metagenome, phylogenetic and functional diversity, macronutrient turnover, shotgun sequencing

Utjecaj fizikalno-kemijskih svojstava tla na retenciju vode

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Sažetak

Zbog evidentnih klimatskih promjena koje uključuju nepravilnu raspodjelu oborina i povećanje temperatura zraka, neophodna hidrotehnička mjera u intenzivnoj poljoprivrednoj proizvodnji je navodnjavanje. Ključne hidropedološke konstante za određivanje obroka navodnjavanja i potrebne količine vode su poljski vodni kapacitet (PKv), lentokapilarna vlažnost (LKv) i točka venuća (TV). Stoga je i cilj ovog rada utvrditi utjecaj fizikalno-kemijskih svojstava na retenciju vode u tlu i izraditi regresijske modele za retenciju vode u tlu. Za potrebe ovog rada korišteno je 180 oraničnih uzoraka, 8 različitih tipova tala s područja Republike Hrvatske. Na osnovu ulaznih fizikalnih i kemijskih značajki tla koje se koriste za monitoring poljoprivrednog zemljišta izrađeni su regresijski modeli na 4 razine. Povećanjem broja ulaznih varijabli povećava se i preciznost modela na što ukazuje relativno odstupanje od izračunatih i izmjerenih vrijednosti vodnih konstanti tla. Najmanja korelacija utvrđena je u modelu koji uključuje samo jedan ulazni parametar (PKv $R^2 = 0,65$, LKv $R^2 = 0,64$ Tv $R^2 = 0,65$), dok je najviša korelacija utvrđena u modelu koji uključuje četiri ulazna parametra u proračunu (PKv $R^2 = 0,77$, LKv $R^2 = 0,85$ TV $R^2 = 0,86$).

Ključne riječi: fizikalno kemijska svojstva tla, regresijski modeli, korelacija, retencija vode

The effect of soil physical and chemical properties on soil water retention

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Abstract

Due to the evident climate change, which includes unfavourable rainfall distribution and rising air temperatures, irrigation is a necessary hydrotechnical measure in intensive agricultural production. The key hydrological constants for determining the amount of irrigation water and the required soil water content are field water capacity (FWC), lentocapillary humidity (LCP), and wilting point (WP). Therefore, the aim of this paper is to determine the influence of physicochemical properties on soil water retention and create regression models for soil water retention. For the purpose of this paper, 180 soil samples from the territory of the Republic of Croatia with 8 different types of soil were used. Based on the input physical and chemical characteristics of the soil used for monitoring agricultural land, regression models were developed at 4 levels. Increasing the number of input variables also increases the accuracy of the model, as indicated by the relative deviation from the calculated and measured values of soil water constants. The weakest correlation was found in a model that included only one input parameter (FC $R^2=0.65$, LCP $R^2=0.64$, PWP $R^2=0.65$), while the strongest correlation was found in a model that included four input parameters to the calculation (FWC $R^2=0.77$, LCP $R^2=0.85$ WP $R^2=0.86$).

Keywords: soil physical and chemical properties, regression models, correlation, soil water retention

Effectiveness of rapid diagnostic tools in the assessment of nitrogen nutritional status of pea plants (*Pisum sativum* L.)

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Abstract

The pea plants as a legume has the potential to meet nitrogen requirements via biological fixation by bacterial strains *Rhizobium leguminosarum*. The field trial was sown with peas (*Pisum sativum* L.) variety Petit Provençal inoculated with the ten indigenous *R. leguminosarum* strains (isolated from native soil of Herzegovina), one reference strain *R. leguminosarum* 1001 (from the collection of the Institute of Microbiology) located at the Hodbina site (near Mostar, B&H) and the control variant in 2009. The experiment was conducted by random block design in four replication. Ten complete plants from each plot were selected in the phase of full flowering for the determination of nitrogen in aboveground plant parts and the number of pods were determined. In the phase of technological maturity determination of nitrogen content in grain were performed. Measurements by rapid diagnostic tool as Chlorophyll meter and Cardy ion meter were conducted in time before flowering, in full flowering time and the phase of technological maturity. Inoculation of pea by indigenous strains of *R. Leguminosarum* significantly influence the nitrogen content of the aboveground part of the peas and overall yield relative to the control (uninoculated seeds) and reference strain 1001. The determined number of pods per pea plant did not show significant differences between the applied inoculation by the indigenous and the reference strains relative to the control. Cardy-ion meter readings showed significant differences due to the applied indigenous strains and control with value range from 246 to 387 mg NO₃-N kg⁻¹, while readings of chlorophyll meter show opposite results ranging from 42.4 to the 47.6 unit. Measurements with both devices showed significant differences in obtained values due to the vegetation period.

Keywords: Pea variety Petit Provençal, Inoculation, Chlorophyll meter, Cardy ion meter

Utjecaj medija rasta na biološki aktivne spojeve u biljkama

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Sažetak

Zrelost i kvaliteta supstrata najčešće se evaluira uzgojem biljaka izravnom sjetvom u medij uzgoja. Granica toksičnog utjecaja biljnih nutrijenata, osim o kemijskom obliku i koncentraciji, ovisi i o fizikalno kemijskim osobinama uzgojnog medija. Cilj ovog istraživanja je bio utvrditi utjecaj komercijalnog supstrata, komposta i vermikomposta, te njihovih smjesa sa komercijalnim supstratom u omjeru 1:1 zalijevanih otopinama s 400 ili 600 mg $\text{NH}_4^+ \text{L}^{-1}$ na sadržaj kloroplastnih pigmenata, fenola, flavonoida i antioksidativnu aktivnost. U biološkom testu su korištene četiri biljne vrste: kres salata (*Lepidium sativum* L.), krastavac (*Cucumis sativus* L.), ječam (*Hordeum vulgare* L.) i pšenoraž (*Triticosecale* Wittmack). Biljke su uzgajane u kontroliranim uvjetima četiri tjedna tijekom kojih su zalijevane deioniziranom vodom odnosno otopinama NH_4^+ . Medij uzgoja, otopine te njihove interakcije značajno su utjecali na sadržaj kloroplastnih pigmenata. Kod ječma nije utvrđen značajan utjecaj spomenutih tretmana na sadržaj karotenoida. Medij uzgoja je značajno utjecao na sadržaj fenola kod ječma i salate, a interakcija medij \times otopina je za navedeni pokazatelj bila značajna kod ječma i pšenoraži. Sadržaj flavonoida kod ječma je bio pod značajnim utjecajem medija uzgoja, dok je na njihov sadržaj kod salate značajno utjecala primijenjena otopina NH_4^+ . Na ukupnu antioksidativnu aktivnost kod pšenoraži značajno su utjecala oba tretmana. Najviša vrijednost antioksidativne aktivnosti DPPH metodom, utvrđena je kod pšenoraži uzgajane u komercijalnom supstratu (0,023), a najniža u smjesama komposta (0,012) i vermikomposta (0,016) s komercijalnim supstratom. Viša antioksidativna aktivnost utvrđena je kod pšenoraži zalijeivane deioniziranom vodom (0,021) u usporedbi s otopinama 400 mg $\text{NH}_4^+ \text{L}^{-1}$ (0,016) i 600 mg $\text{NH}_4^+ \text{L}^{-1}$ (0,015).

Ključne riječi: antioksidativna aktivnost, fenoli, flavonoidi, kloroplastni pigmenti

Influence of growth media on biologically active compounds in plants

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Abstract

The maturity and quality of the substrate is most often evaluated by the cultivation of plants by direct sowing into the growing media. The limit of the toxic impact of plant nutrients, in addition to chemical form and concentration, depends on the physico-chemical properties of the growing medium. The aim of this study was to determine the effect of commercial substrate, compost and vermicompost, and their mixtures with commercial substrate in a 1:1 ratio, watered using solutions with 400 or 600 mg NH₄⁺ L⁻¹ on the content of chloroplast pigments, phenols, flavonoids and antioxidant activity. Four plant species were used in the bioassay: garden cress (*Lepidium sativum* L.), cucumber (*Cucumis sativus* L.), barley (*Hordeum vulgare* L.), and wheat (*Triticosecale* Wittmack). The plants were grown under controlled conditions for four weeks during which they were watered with deionized water or NH₄⁺ solutions. The growing medium, solutions and their interactions significantly influenced the content of chloroplast pigments. No significant effect of before mentioned treatments on carotenoid content was found in barley. Substrate significantly influenced the phenol content in barley and lettuce, and the interaction medium×solution significantly affect its content in barley and wheat. The content of flavonoids in barley was significantly influenced by the substrate, while their content in salad was significantly influenced by the NH₄⁺ solution. Total antioxidant activity in wheat was significantly influenced by both treatments. The highest value of the antioxidant activity according to DPPH method, was found in wheat grown in commercial substrate (0.023) and lowest in mixtures of compost (0.012) and vermicompost (0.016) with commercial substrate. Higher antioxidant activity was found in wheat watered with deionized water (0.021) compared to watering solutions containing 400 mg NH₄⁺ L⁻¹ (0.016) and 600 mg NH₄⁺ L⁻¹ (0.015).

Keywords: antioxidant activity, phenols, flavonoids, chloroplast pigments



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Slovenian natural spirits and their quality

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Abstract

There are excellent natural resources for the production of fruit and grapes in Slovenia. What is more, the high forest cover of our country enables the collection of various forest fruits. In addition to other purposes, all these crops may also be used for the processing into spirits. Fruit spirits, grape spirits and juniper spirits have a long tradition in Slovenia. However, the consumption of spirit drinks has been reducing, therefore the market only accepts high quality products, and the producers of spirits must pay attention to the high quality of their offer. In this article, we present the findings of the sensory evaluations of the quality of spirits, which took place as a part of the traditional event Specialities of Slovenian Farms in Ptuj. These evaluations mostly include spirits produced on Slovenian farms, most often as a complementary activity of a farm. We included assessments from 2010 to 2016 in the survey. We took the year 2003 as the comparative year, based on the percentage of excluded samples. The study showed that the proportion of spirits with faults has declined, as the percentage of excluded samples, which was 33.77% in 2003 declined to 11.5% (the average of the last seven years). The share of gold awards increased by 40% during the seven-year period under review, which confirms the progress in the quality of products. We believe that the improvement in the quality of spirits is a result of several reasons; one of them is, by all means, an organized and professionally managed sensory evaluation.

Keywords: spirits, technological procedures, sensory quality check

Complementary activity on a farm as a business opportunity

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Abstract

The purpose of this paper is to present the conditions for registration of complementary activities on farms in Slovenia. Each farm owner that implements complementary activities develops and formulates the marketing strategy according to natural environment, rural advantages and the availability of natural resources. Farmers aim to find a niche market that will support the development of their complementary activity. They claim that a good business opportunity is the one that proves both profitable and feasible. A farmer that has at least one hectare of agricultural area in use may register a complementary activity on the farm with the Administrative Unit. One exception is a complementary activity which involves beekeeping activities, with at least ten bee families required to be entered in the register of beekeepers. In this case, the threshold of at least one hectare of comparable agricultural land is not required. Registration of a complementary activity on a farm enables a better use of the production capacities and the workforce of a farm, as well as the acquisition of additional income. There are several types of complementary activities. Furthermore, on a farm, a complementary activity can be carried out either by the complementary activity holder or by the family members employed at the farm, entered in the register of agricultural holdings. Complementary activities may also be carried out by other persons carrying out work which is not classified as undeclared employment in accordance with the regulation governing the prevention of illegal work.

Keywords: complementary activity, farm, registration of a complementary activity, business opportunity

Organizacija i integracija vrijednosnog lanca proizvođača kulena u Slavoniji i Baranji

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Sažetak

Tranzicija malih poljoprivrednih gospodarstava ekonomski održivih odvija se u smjeru nastanka srednjih što predstavlja značajan poduzetnički izazov. Učinkovitost malih dosegla je svoj maksimum s obzirom na njihov opseg poslovanja. U neuravnoteženom i polariziranom poljoprivrednom sektoru između velikih i malih proizvođača nedostaju srednji. Rast njihove učinkovitosti povezan je s prehrambeno-poljoprivrednim vrijednosnim lancem. Konkretnije, stvaranje dodane vrijednosti primarne svinjogojske proizvodnje i prerade u visoko vrijedne proizvode ima snažan potencijal s multiplikativnim učincima na cjelokupno gospodarstvo. Cilj rada je prepoznati poduzetničke izazove pri organizaciji i integraciji vrijednosnog lanca proizvođača kulena/kulina. Za istraživanje su prikupljeni podaci metodom ankete s registriranim i integriranim proizvođačima kulena/kulina (n=24). Rezultati potvrđuju kako je 57,9% proizvođača zadovoljno ovakvim oblikom povezivanja, dok je 42,1% nezadovoljno ili u potpunosti nezadovoljno. Najznačajniju prednost integracije prepoznaju u lakšem pristupu europskim sredstvima (66,7%) dok nedostatke distribuiraju prema skupinama od slabog utjecaja na povećanje prodajne cijene (70,8%) i prodaje (54,2%) te snižavanja proizvodnih troškova (50,2%). Zaključno, istraživanje je rezultiralo smjernicama za jačanje integracija vrijednosnih lanca proizvođača, i to kroz: marketinške aktivnosti, dizajniranje proizvoda, lokalni identitet te standardiziranje kvalitete proizvoda.

Ključne riječi: vrijednosni lanac, proizvođači kulena

Organization and integration of the kulen producer value chain in Slavonia and Baranja

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Abstract

The transition of economic sustainable small farms is directed towards the establishment of medium size farms, which is linked to entrepreneurial challenges. The efficiency of small farms has been maximized in terms of their resources in business. In an unbalanced and polarized agricultural sector with large and small producers, there is a lack of medium sector. The growth in their efficiency is connected to the food and agricultural value chain. More specifically, the added value of primary breeding pigs and processing into high value products has strong potential with multiplier effects on the overall economy. The aim of the paper is to identify entrepreneurial challenges in organizing and integrating the value chain of kulen/kulin producers. Research data are collected by the survey method with registered and integrated kulen/kulin producers (n = 24). The results confirm that 57.9% of producers are satisfied with this form of cooperation, while 42.1% are dissatisfied or completely dissatisfied. The most significant advantages of integration are recognized in more available access to European funds (66.7%), while disadvantages are distributed to the groups from a low impact on the increase of the sales price (70.8%) and sales (54.2%) to lower production costs (50.2%). In conclusion, the research resulted in guidelines for strengthening the integration of value chains, through: marketing activities, product design, local identity and standardization of product quality.

Keywords: value chain, producers of kulen/kulin

Ekonomika proizvodnje začinske paprike prema modelu procesne kalkulacije

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Sažetak

U specifičnim uvjetima proizvodnje začinske paprike, gdje se prepoznaju tri zasebna procesa, primjena tradicionalne metode obračuna troškova sve teže osigurava točne i pouzdane informacije o cijeni proizvodnje. Stoga se javlja potreba za uvođenjem procesnog obračuna utemeljenog na procesnoj kalkulaciji koja se koristi pri višefaznoj proizvodnji. Za svaku fazu proizvodnje utvrđuje se cijena poluproizvoda, a u završnoj fazi izračunava se stvarna cijena dovršenog gotovog proizvoda. U procesu proizvodnje začinske paprike postoji više gotovih proizvoda, a to su u prvoj fazi prijesadnice, u drugoj svježa začinska paprika i u trećoj fazi finalni proizvod: mljevena začinska paprika.

Istraživanje proizvodnje začinske mljevene paprike obavljeno je tijekom 2017. godine na području općine Bilje. Uzgajana je sorta slatke začinske paprike *Szegedi 80* na površini od 0,6 ha. Berba je obavljena ručno pri čemu je ostvaren prinos od 15.500 kg/ha, od čega je nakon sušenja dobiveno 1.500 kg mljevene paprike.

Ekonomskom analizom utvrđeno je da proizvodnja začinske paprike ostvaruje dobre financijske rezultate. Ukupni troškovi proizvodnje iznose 72.960 kn/ha. Neto financijski rezultat iznosio je 62.040 kn/ha. Cijena proizvodnje se kretala od 0,24 kn po jedinici proizvoda u prvoj fazi, preko 1,26 kn u drugoj do 3,88 kn u trećoj fazi. Proizvodnja od 1.500 kg suhe mljevene začinske paprike, te tržišna cijena od 90 kn/kg dovode do visoke vrijednosti proizvodnje od 135.000 kn/ha. Proizvodnja začinske paprike pokazuje visoke vrijednosti ekonomičnosti (1,85) i rentabilnosti (85 %).

Ključne riječi: začinska paprika, procesna kalkulacija, ekonomski rezultati

Economics of spicy peppers production according to the model of process calculation

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Abstract

In the specific production conditions of spice peppers, where three separate processes are recognized, the application of the traditional costing method makes it increasingly difficult to provide accurate and reliable information on the cost of production. Therefore, there is a need to introduce process calculation based on process calculation used in multiphase production. For each production phase, the price of the semi-finished product is determined, and in the final phase, the actual price of the finished product is calculated. In the process of production of spice peppers there are several products: in the first phase those are seedlings, in the second stage fresh spice pepper and in the third phase the final product ground spice pepper.

The research on the production of ground pepper was carried out in 2017 in the territory of the municipality of Bilje. The *Szegedi 80* sweet spicy pepper cultivar was grown on an area of 0.6 ha. The pepper was harvested by hand, yielding 15,500 kg/ha, yielding 1,500 kg of ground pepper after drying. Economic analysis has shown that the production of spicy peppers has good financial results. The total cost of production is 72,960 HKR/ha. The financial result or profit amounted to HRK 62,040 kn/ha. Production price ranged from HRK 0.24 per unit of product in the first phase, HRK 1.26 in the second and HRK 3.88 in the third phase. The yield of 1,500 kg of dried ground pepper and a market price of 90 HKR/kg lead to a high production value of 135,000 HKR/ha. The production of spicy peppers shows high values of sale to cost ratio (1.85) and profitability (85%).

Keywords: spicy pepper, process calculation, economic results

Analiza tržišta pjenušavih vina Republike Hrvatske nakon pristupanja Europskoj uniji

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Sažetak

Republika Hrvatska ima dugu tradiciju vinarstva i vinogradarstva. Kao i svaka poljoprivredna proizvodnja, tako je i vinogradarstvo i vinarstvo izloženo brojnim iskušenjima. No, jedna od najznačajnijih promjena je pristupanje Republike Hrvatske u Europsku uniju, koje je uvelike utjecalo na trendove proizvodnje i prodaje vina. Analiza tržišta temelj je poslovnog odlučivanja te će i u slučaju pjenušavih vina imati važnu ulogu u pozicioniranju ove djelatnosti kao strateške djelatnosti. U radu je analizirano stanje hrvatskog tržišta pjenušavih vina nakon pristupanja u Europsku uniju u razdoblju od 2013. do 2018. godine, temeljeno na podacima Hrvatske agencije za poljoprivredu i hranu.

Unatoč nepovoljnim trendovima u poljoprivredi, padu broja registriranih proizvođača, kao i padu površina pod vinogradima, vinogradarstvo i vinarstvo na nacionalnoj razini je pokazalo visoku razinu održivosti, ali i snalažljivosti u prepoznavanju tržišne niše u proizvodnji vina s visokom razinom dodane vrijednosti.

Iako u ukupnim količinama vina u prometu pjenušava vina imaju nizak prosječni udio, u promatranom razdoblju 0,51%, došlo je do povećanja količina u prometu. U 2013. godini je zabilježen ukupan promet pjenušavih vina od 1.316 hl, a 2018. godine 4.349 hl. U promatranom razdoblju zabilježen je i rast količina vina u prometu prema pojedinim kategorijama vina za koje je potrebna viša tehnološka razina proizvodnje. Ovakav trend pokazuje tendenciju usmjeravanja proizvođača vina k proizvodnji proizvoda visoke razine kvalitete.

Ključne riječi: vinarstvo, pjenušava vina, analiza, tržište

Analysis of the sparkling wine market in the Republic of Croatia after EU accession

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Abstract

The Republic of Croatia has a long tradition of winemaking and viticulture. Like any agricultural production, viticulture and winemaking are also exposed to numerous challenges. However, one of the most significant challenges, is the accession of the Republic of Croatia to the European Union, which has greatly influenced the trends in wine production. Market analysis is the foundation of business decision making and in the case of sparkling wines, it will have an important role in positioning this business as a strategic one.

The paper analyses the Croatian sparkling wine market after accession to the European Union in the period from 2013 to 2018, based on data from the Croatian Agency for Agriculture and Food.

Despite unfavourable trends in agriculture, declining number of registered manufacturers, as well as declining areas under vines, viticulture and winemaking at the national level has shown a high level of sustainability, but also ingenuity in identifying market niches in wine production with high added value.

Although in the total quantities of wine trading, sparkling wines have a low average share, in the observed period 0.51%, there was an increase in quantities on the market. In 2013, the total trade of sparkling wines was 1,316 hl, and in 2018, 4,349 hl. In the observed period, there was also an increase in the quantities of wine according to certain categories of wines that require a higher technological level of production. This trend shows the tendency of wine producers to produce high quality products.

Keywords: winemaking, sparkling wines, analysis, market

How involved are corporations in environmental protection and sustainability? Study-case on Romanian agricultural sector

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Abstract

Being under various pressures, from the high yields demanded by shareholders, to the environmental and social ones from different stakeholders, influenced by global competition or new political realities, companies around the world are trying to reconsider their sustainability profiles. The process includes, in different strides and mixtures, the agricultural sector, since sustainable agriculture aims to harmonize the three factors - economic profitability, social equity and environmental health, i.e. the already known triple bottom line - profit, people and the planet. But do these approaches reach the whole system involved in food production, from local ecosystem to local communities, from small farms and businesses to large corporations? Often, researchers, NGOs, and especially small farmers and final consumers are hesitant to accept the real adherence of large corporations to the principles of sustainable development of agriculture. In fact, many of these transnational corporations have only introduced this concept in their programs and strategies for a couple of decades, and many of these actions, financing and results are still in the area of small-scale testing, laboratories and experiments. In this respect, Romania's agriculture is a blend of contrasts, realities, opportunities and trends. On the one hand, we refer to a considerable agricultural potential but, on the other hand, records show low productivity, disparate investments and uneven development. In terms of ownership and organization, a very large number of small-scale exploitations cohabits with large national or international companies, with considerable investments in production and processing. The paper's goals are to identify to what extent sustainable practices are truly understood and applied within large agricultural holdings. The methods consist in researching the documents and reports issued by these companies, but also reports and studies from national and international bodies referring to sustainable agriculture, statistical data and specialized analyses. In our research we found that sustainable agriculture, understood in an all-encompassing meaning (including therefore environment, social, demographic, economic and educational facets), develops especially at the level of a relatively slight number of small and medium-sized farms. It is more about sustainable agricultural production than sustainable agriculture. Financially or organization-wise these exploitations are based on: the resources of the founders (self-financing and enthusiasm), or on specific European funding programs, or rely on gradual changes in the preferences of the final consumers. If there are steps taken by large corporations in this regard, they are little known, and probably on a small scale. Romania's agriculture is, both for small and medium-sized farms, but especially for large companies, a territory of economic opportunities to be exploited at the present time, of solid incomes that will quickly return on investments, in order to consolidate the market position and capitalize on the advantages of low costs. There are elements that are less suited to a sustainable agriculture, based on long-term objectives and the involvement of a large number of stakeholders in the society.

Keywords: agriculture, sustainability, Romania

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Mišljenja i stavovi potrošača vezano uz potrošnju jabuka

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Sažetak

Cilj istraživanja bio je utvrditi preferencije potrošača prema jabuci. Uzorak se sastojao od 100 potrošača jabuka s područja Požeško-slavonske županije. Najviše ispitanika ističe da im je jabuka najomiljenija voćna vrsta, nakon čega slijede banana, grožđe, mandarina, kruška te na kraju jagoda i naranča. Potrošači u najvećoj mjeri jabuke konzumiraju nekoliko puta tjedno. Kao razlog konzumiranja jabuke, najviše ispitanika navodi njihov zdravstveni aspekt, zatim finoću okusa, te dostupnost jabuka tijekom cijele godine. Ispitanici jabuku konzumiraju između glavnih obroka u danu, a jedu je uglavnom cijelu s koricom. Iako je jabuka voće koje je dostupno cijele godine, ipak statistički značajno najveći broj ispitanika navodi da jabuku konzumira tijekom jeseni i zime. Ispitanici procjenjuju da tjedno konzumiraju 0,75 kg jabuka, što godišnje iznosi 39 kg. Najviše preferiraju sorte Idared, Zlatni delišes, Crveni delišes, Jonagold, Granny Smith, Gloster, Gala i druge sorte. Velika većina ispitanika (89%) zadovoljna je ponudom jabuke na našem tržištu te preferiraju kupiti jabuku direktno od proizvođača. Kao najznačajnije atribute potrošači navode okus i domaće porijeklo, iza čega slijede izgled, boja, krupnoća ploda, tekstura, aroma, dostupnost, sorta i cijena. Rezultati istraživanja mogu doprinijeti razvoju komunikacijskih strategija za poboljšanje prodaje jabuka.

Ključne riječi: jabuka, potrošači, preferencije, atributi, sorte

Consumers' opinions and attitudes regarding apple consumption

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Abstract

The aim of the study was to determine consumer preferences for apple consumption. The sample consisted of 100 apple consumers from the Požega-Slavonia County. Most respondents point out that apples are their favourite fruit, followed by banana, grapes, tangerine, pear and finally strawberry and orange. Consumers mostly consume apples several times a week. The main reason for consuming apples are their health benefits, taste and availability throughout the year. The respondents consume apples between main meals of the day, and they mostly consume whole apple with the crust. Although apple is a fruit that is available throughout the year, the statistically significant number of respondents state that they mainly consume apple during fall and winter. Respondents estimate that they eat 0.75 kg of apples per week, which amounts 39 kg per year. Respondents' most preferred varieties are Idared, Golden Delicious, Red Delicious, Jonagold, Granny Smith, Gloster and Gala. The vast majority of respondents (89%) are satisfied with the apple supply on domestic market and they prefer to buy it directly from a producer. The most important apple attributes for consumers are taste and local origin, followed by appearance, colour, fruit size, texture, aroma, availability, variety and price. The research findings can help apple growers to develop communication strategies to improve their sales.

Keywords: apple, consumers, preferences, attributes, varieties

Explaining the prevalence of obesity in Croatia: The importance of the mediterranean diet

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Extended abstract

The objective of this study is to establish a causal relationship between the Mediterranean diet (MD) and three measures of overweightness: body mass index (BMI), obesity (BMI \geq 30) and waist-to-hip ratio (WHR) using the Croatian Adult Health Survey 2003 data. To reconstruct basic features of the MD we code the individual consumption of ten food variables from the survey such that the value of 1 indicates a beneficial effect (reduction) on obesity and 0 otherwise. By summing up these food dummies we construct a food index (MD10) with the maximum value of 10 that indicates the highest exposure to MD and the minimum value of 0 indicating no exposure to MD. Next, we postulate that in order to investigate the impact of eating on weight, diet needs to be measured not only as a flow but also as a stock variable. Because our survey data is cross-sectional, we only have one-period snapshot of what people reported to have eaten and we cannot measure the duration of the exposure to MD over time. Instead, we used the survey question asking people where they lived during the 1991 Census year and coded the variable as 1 if they lived in the Mediterranean region of the country and 0 elsewhere. The presumption is that somebody who previously lived in the Mediterranean region had some exposure to MD even if she does not live in the Mediterranean region any more. Similarly, the person who lived in the Mediterranean region before and still lives there, had presumably longer exposure to MD than the person who lives in the Mediterranean region now but came from another place.

We use a heuristic approach to modeling of overweightness by starting with the simple model that on the right-hand-side contains only measures of MD in its flow and stock forms and then subsequently adding groups of socio-demographic, lifestyle and cultural variables. We estimated two class of models: one with the MD10 index and another with ten individual food variables (oils, bread, fruits, salads, cabbage, legumes, root vegetables, leafy vegetables, processed meats, and wine). Our results show that in the first class of models, the MD variables retain their correct signs and statistical significance in more complex models with added socio-economic and other variables. The results indicate that, controlling for other characteristics, people who ate MD have on average lower BMIs and WHRs and are less likely to become obese relative to people who do not eat MD. This is true even after including the dummy variable for the Mediterranean region and the full set of regional interaction effects with other covariates. Most of these cross-product effects turned out to be insignificant indicating the fact that the basic model captures the regional difference in BMI, obesity and WHR reasonably well. An important exception is the interaction coefficient between the Mediterranean dummy and origin variables, which in the WHR model ends up being negative and significant confirming our hypothesis that stock effect matters. People with longer exposure to MD have, *ceteris paribus*, lower WHR than those with the shorter exposure. In the second class of models with ten individual food variables, initially most but not all food variables have correct sign and are statistically significant. However, after inclusion of other covariates, the individual food variables lose their statistical significance almost entirely. In this class of models, the MD has virtually no predictive power in explaining the overweightness.

Finally, acknowledging the possibility that the individual's dietary choices could be endogenous and hindered by the lack of good choices for finding instrumental variables, in the second part of the study we rely on the method for estimating average treatment effects based on the selection on observables. We specify the BMI as the outcome and the exposure to MD as the treatment and use the multivalued

treatment effects version of the inverse-probability-weighted regression-adjustment estimator. Based on our 10 food categories determining the essence of the Mediterranean diet, we construct a new four-level variable measuring no (0), low (1), intermediate (2) and high level (3) exposure to Mediterranean diet. The newly defined variable MD10_level = 0 if the sum of all 10 food indicator variables equals 0, 1 or 2; MD10_level = 1 if the sum equals 3, 4 or 5; MD10_level = 2 if the sum equals 6 or 7; and MD10_level = 3 if the sum equals 8, 9 or 10. Our specification of the outcome and treatment equations included all socio-demographic and lifestyle variables in both outcome and treatment equations but no regional interaction effects. The outcome model is linear and the treatment model is multinomial logit. In addition to presenting the parameters estimates of the outcome and treatment equations, we focus on three parameters of interest: the potential outcome mean (POM), the average treatment effects (ATE) and the average treatment effect on the treated (ATET). The POM results indicate that all levels of treated potential outcome mean BMIs are lower than the untreated one (26.6) and the results are monotonically decreasing from 26.5 for level 1 to 26.39 for level 2 and then, unexpectedly, a slight increase to 26.44 for the highest level of the MD treatment. All POMs are statistically different from zero. The estimated ATE of going from no exposure to MD to the first level (MD=low) is a decrease of 0.12 BMI points. The estimated ATE of going from no exposure to MD to the second level is a decrease of 0.22 BMI points and the estimated ATE of going from no MD to the highest level of MD is 0.17 BMI points. Here we saw a non-monotonic decrease in the BMI as one moves from the second to the third level of MD treatment. This means that if one would compare intermediate to high level of exposure to MD, the highest level of exposure to MD would actually increase the BMI compared to having only an intermediate exposure to MD. The results is obviously suspicious but because the estimates are statistically insignificant, no definitive conclusion is possible. When computing ATET, we were interested in finding out how much the exposure to MD reduced the BMI among the people actually exposed to MD. We specify the no exposure Mediterranean diet (MD=0) as the basis for comparison. The results are calculated for the subset of people who actually received the high exposure to Mediterranean food (MD=3). We saw that the estimates are monotonically decreasing. The average treatment effect of the high exposure to MD relative to no exposure (3 vs. 0) on the people who were exposed to high level of MD (3rd level) is -0.17, which means that there BMI has decreased by 0.17 BMI points. However, none of these effects are statistically significant.

Keywords: obesity, Mediterranean diet, flow and stock food variables, treatment effects

Types of Collaborative Consumption and its Potential in Agribusiness

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Abstract

Platform based Economy including Collaborative Consumption and Sharing Economy is a new social and economic system that include exchange of human and physical resources through platforms where access provision is transferred (permanently or not permanently). In agriculture, the phenomenon of “co-operation” is not new, but platform-based implementation, however, has not yet general. By analysing literature and exploratory research, the categories of platform-based community economy were systematized, and then, through examples, the categories of platform-based community economy in the agricultural sector were analysed. The spread of new economic system within agriculture can be achieved in two main ways: by sharing assets and crowdfunding.

In the agricultural sector, platform-based markets are predominantly CC-type and according to the literature they belong to the category of larger farms (> 300 ha). However, in the former socialist countries, the term collaboration is negatively charged because of the former “cooperative” system. As a result, in the current situation, its distribution is confronted with a generation constraint. However, according to the forecast of (PwC, 2015), the financing sector of the community economy is one of the most dynamically developing, by 2025 it may reach 36% of the financial transactions of the new type of economy. For this reason, a detailed examination of its spread in agriculture is not an option, but a necessity!

Keywords: sharing economy, crowdfunding, collaborative consumption, platforms.



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Sažetak

Hrvatska agencija za poljoprivredu i hranu – Centar za sjemenarstvo i rasadničarstvo je nacionalno ovlašteno tijelo za provođenje poslova iz područja sjemenarstva, rasadničarstva i priznavanja sorti poljoprivrednog bilja. Od 2017. godine prema uzoru na razvijene europske zemlje kao nova aktivnost provode se postregistracijski pokusi ozime pšenice i ječma. Pokusi se treću godinu provode na zahtjev prijavitelja na lokacijama Osijek i Kutjevo u tri ponavljanja. Tijekom ispitivanja u pokusima se prate osam najznačajnijih agronomskih svojstava, te otpornost na bolesti. Osim poljskih ispitivanja provode se laboratorijska ispitivanja kvalitete na osnovu čega se radi rangiranje sortimenta. U 2017. godini ispitivanje je provedeno na 32 sorte, u 2018. godini na 38 sorti i u 2019. godini na 36 sorti. Rezultati ispitivanja dostavljaju se podnositeljima zahtijeva i objavljuju se na stranicama Hrvatske agencije za poljoprivredu i hranu – Centra za sjemenarstvo i rasadničarstvo. Dobiveni podatci od koristi su poljoprivrednim proizvođačima kod izbora sortimenta.

Ključne riječi: Postregistracijski pokusi, ozima pšenica, ozimi ječam, poljska i laboratorijska ispitivanja.

Post-registration trials on winter wheat and barley in Republic of Croatia

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Abstract

Croatian Agency for Agriculture and Food – Center for seed and seedlings is a nationally designated body in the field of seed production, seedlings and the recognition of varieties of agricultural crops. Since 2017, based on the practice of European countries, as new activity post-registration trials of winter wheat and barley are being implemented. At the request of the applicant, the experiments are carried out on locations Osijek and Kutjevo in three repetitions. During the conducting of trials the eight most significant agronomic traits and disease resistance are evaluated. In addition to field testing, laboratory quality analysis is conducted, based on which the varieties rankings are made. In 2017 testing was conducted on 32 varieties, in 2018 on 38 varieties and in 2019 on 36 varieties. Test results of post-registration trials are submitted to all applicants, and the results are also published on web pages of Croatian Agency for Agriculture and Food – Center for seed and seedlings. The results benefit farmer's crop production and breeders in the selection of new varieties.

Keywords: Post-registration trials, winter wheat, winter barley, field and laboratory testing.

Učinkovitost fotosinteze u listovima duhana (*Nicotiana tabacum* L.) tijekom razvoja

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Sažetak

Duhan (*Nicotiana tabacum* L.) je gospodarski značajna kultura, a ujedno i često korišteni modelni organizam u biološkim istraživanjima. U ovom radu cilj je bio istražiti dinamiku razvoja fotosintetskog aparata tijekom ontogeneze listova duhana određivanjem koncentracija fotosintetskih pigmenata ključnih za apsorpciju svjetlosti (Chl *a*, Chl *b*) i mjerenjem fluorescencije klorofila *a* u svrhu procjene funkcionalnosti fotosintetskog aparata. Početna mjerenja izvršena su na listovima 14 dana starih presadnica, a sljedeća su obuhvatila pet insercija odnosno pet parova listova starosti 20, 24, 29, 32 i 37 dana. Rezultati su pokazali konstantni porast maksimalnog kvantnog prinosa fotosustava II (TR_0/ABS) i indeksa fotosintetske učinkovitosti (PI_{ABS}) tijekom razvoja, potvrđujući kompetentnost ispitivanih skupina listova za učinkovito apsorpiranje i iskorištavanje energije u fotokemijskim procesima, unatoč različitoj dinamici akumulacije fotosintetskih pigmenata (Chl *a*, Chl *b*, Chl *a+b*). Porast gustoće aktivnih reakcijskih središta (RC/CS_0) i smanjenje apsorpcije (ABS/RC) osigurali su porast učinkovitosti fotosustava II tijekom razvoja listova. Najviše koncentracije pigmenata izmjerene u insercijama 2 i 3 ukazuju na maksimum eksponencijalnog rasta listova u toj fazi razvoja. Degradacija pigmenata u insercijama 4 i 5 nije utjecala na funkcionalnost fotosintetskog aparata što je utvrđeno visokim vrijednostima parametara TR_0/ABS i PI_{ABS} , ali ipak ukazuje na početak senescencije listova.

Ključne riječi: fluorescencija klorofila *a*, ontogeneza listova, učinkovitost fotosustava II (PSII), fotosintetski pigmenti, fotosinteza

Photosynthetic efficiency of tobacco leaves (*Nicotiana tabacum* L.) during development

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Abstract

Tobacco (*Nicotiana tabacum* L.) is one of the most economically important crops and also frequently used model organism in biological researches. The aim of this study was to investigate the dynamics of photosynthetic apparatus development during tobacco leaf ontogenesis. The concentration of photosynthetic pigments crucial for light absorption (Chl *a*, Chl *b*) as well as chlorophyll *a* fluorescence was measured to estimate functionality of photosynthetic apparatus. The measurements were performed on 14-day-old transplants and five insertions (leaf pairs) differing in developing stage (20, 24, 29, 32 and 37 days old). The results showed a constant increase of maximum quantum yield of photosystem II (TR_0/ABS) and performance index (PI_{ABS}) during development, confirming the competence of all studied leaves for efficient utilization of absorbed energy in photochemical processes, despite the different pattern of pigments accumulation. Increasing density of active reaction centers (RC/CS_0) and decreasing absorption (ABS/RC) provided a high photosystem II efficiency in developing leaves. The highest pigment concentrations measured in insertions 2 and 3 indicate that maximum exponential growth has been reached at this stage. The pigments degradation observed in insertions 4 and 5 did not affect the functionality of the photosynthetic apparatus, confirmed by the high values of TR_0/ABS and PI_{ABS} , but nevertheless suggested the onset of leaf senescence.

Keywords: chlorophyll *a* fluorescence, leaf ontogenesis, photosystem II (PSII) efficiency, photosynthetic pigments, photosynthesis

Utjecaj regulatora rasta i fungicida na morfološka i fiziološka svojstva sjemena soje

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Sažetak

Cilj ovoga istraživanja bio je ispitati utjecaj regulatora rasta i fungicida na morfološka i fiziološka svojstva sjemena soje. Istraživanje je provedeno na četiri hrvatske sorte soje - Ema, Lucija, Korana i Sonja. Na sjeme svake sorte primijenjena su četiri tretmana: kontrola, fungicid (Vitavax 200 FF), regulator rasta (Slavol S) i fungicid + regulator rasta, gdje je svaki tretman bio zastupljen s tri ponavljanja. Tretirano sjeme uzgajano je u kljajalištu. Ispitivani su duljina korjenčića, duljina hipokotila, masa biljčice, energija klijanja i klijavost. Istraživanjem je utvrđen statistički značajan utjecaj sorte i interakcije sorta × tretman na duljinu korjenčića, duljinu hipokotila i masu biljčice. Također, utvrđen je statistički značajan utjecaj tretmana na duljinu korjenčića. Kod energije klijanja i klijavosti utvrđen je statistički značajan utjecaj sorte i tretmana.

Ključne riječi: soja, regulator rasta, fungicid

Effect of growth regulator and fungicide on morphological and physiological traits of soybean seed

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Abstract

The aim of this research was to determine the influence of growth regulator and fungicide on morphological and physiological traits of soybean seed. The research was conducted on four Croatian soybean varieties - Ema, Lucija, Korana and Sonja. Four different treatments were applied on seeds of each of the soybean varieties: control, fungicide (Vitavax 200 FF), growth regulator (Slave S) and fungicide + growth regulator, each in three repetitions. Treated seeds were grown in germination chamber. Root length, hypocotyl length, plant mass, germination energy and germination were studied. The study determined statistically significant influence of variety and variety × treatment interaction on root length, hypocotyl length and plant mass. Also, statistically significant influence of treatment on root length was determined. Regarding germination and germination energy, a statistically significant influence of variety and treatment was determined.

Keywords: soybean, growth regulator, fungicide

Utvrđivanje genetske modifikacije u sjemenu i zelenoj masi metodom lančane reakcije polimerazom u stvarnom vremenu (qPCR)

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Sažetak

Praćenje genetski modificiranih organizama regulirano je nacionalnim i EU propisima. Na nacionalnoj razini za sav biljni reprodukcijski materijal primjenjuje se nulta toleranca. Nacionalni programi praćenja sjemena i zelene mase obuhvaćaju: soju, kukuruz, uljanu repicu, šećernu repu i pšenicu. Za praćenje tih kultura i njihovih proizvoda koristi se metoda zasnovana na umnažanju genomske DNA, lančana reakcija polimerazom u stvarnom vremenu (engl. real-time polymerase chain reaction, qPCR). qPCR metoda omogućava umnažanje karakterističnih odsječaka molekule DNA upošljavanjem posebno dizajniranog para nukleotidnih početnica, te fluorescirajuće probe. Takav sustav omogućava praćenje tijekom reakcije u svakom ciklusu mjerenjem promjena fluorescencijskog signala koji stvaraju specifično obilježene probe uslijed nastajanja PCR produkata. Prvi korak analize obuhvaća kvalitativni probir i eliminaciju negativnih uzoraka. Svaki pozitivan nalaz podliježe reakciji identifikacije samog GMO-a, te kvantifikaciji. Kvantitativna qPCR metoda omogućava precizno određivanje količine GMO-a u uzorcima. Sadržaj GMO-a se utvrđuje omjerom izmjerenih vrijednosti za gen od interesa karakterističan za genetski modificirani organizam (transgen) i ukupne biljne DNA utvrđene mjerenjem referentnog gena karakterističnog za biljnu vrstu koja se ispituje. qPCR metoda je metoda vrlo visoke specifičnosti i osjetljivosti, te omogućuje uspješno utvrđivanje prisutnosti strane DNA u biljnom genomu.

Ključne riječi: genetski modificirani organizam, sjeme, zelena masa, qPCR

Detection of genetic modification in seeds and green leaves using real-time polymerase chain reaction (qPCR)

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Abstract

Monitoring of genetically modified organisms is regulated by national and EU regulations. At national level, zero tolerance is applied to all plant reproductive material. National monitoring program of seeds and green leaves include following: soybean, maize, rapeseed, sugar beet and wheat. A method based on genomic DNA amplification, real-time polymerase chain reaction (qPCR), is used to monitor these events and their products. The qPCR method allows multiplication of the characteristic segment of a DNA molecule by employing a specially designed pair of nucleotide primers and fluorescent probes. Such a system allows monitoring of the reaction in each cycle by measuring changes in the fluorescence signal generated by specific labelled probes due to the formation of PCR products. The first step of the analysis involves qualitative screening and elimination of negative samples. Any positive findings are subject to the identification reaction of the GMO itself and to quantification. The quantitative qPCR method allows accurate determination of the amount of GMOs in the samples. The content of GMOs is determined by the ratio of the measured values for the gene of interest characteristic of the genetically modified organism (transgene) and the total plant DNA determined by measuring the reference gene of the plant species being tested. The qPCR method is a method of very high specificity and sensitivity, and allows the successful detection of foreign DNA in the plant genome.

Keywords: genetically modified organisms, seeds, green leaves, qPCR

Oplemenjivanje pšenice na njenu nutritivnu vrijednost

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Sažetak

Pšenica se smatra najznačajnijom žitaricom u svijetu jer se najčešće koristi za proizvodnju kruha. Osim toga pšenica je osnovna hrana velikom dijelu svjetske populacije te samim tim unos hranjivih tvari u organizam ljudi značajno ovisi o nutritivnoj vrijednosti zrna pšenice. Trenutno u svijetu preko tri milijarde ljudi ima zdravstvenih problema zbog nedostatka mikronutrijenata (Fe, Zn, Se, I, Cu i drugi) u svakodnevnoj prehrani. Taj problem je izrazito naglašen u zemljama u razvoju i pogađa sve dobne skupine, a osobito su tom riziku izložene žene i djeca. Uz to, u posljednje vrijeme sve je više istraživanja koja ukazuju na nedostatak određenih mikronutrijenata u prehrani ljudi u razvijenim zemljama. Povećanje sadržaja mikronutrijenata u zrnu pšenice može se postići agronomskom i genetskom biofortifikacijom. U prošlosti su najčešći ciljevi oplemenjivanja pšenice bili kreiranje genotipova s većim prinosom, genotipova s povećanom otpornošću na polijeganje te povećanom otpornošću na bolesti. No, u posljednje vrijeme, s obzirom na problem nedostatka mikronutrijenata u prehrani velikog broja ljudi, kreće se u oplemenjivanje pšenice s ciljem kreiranja zrna s povećanom nutritivnom vrijednošću, što je izuzetno zahtjevan posao s obzirom na nasljednost tih svojstava i kompleksnost genoma pšenice.

Ključne riječi: skrivena glad, biofortifikacija, mikroelementi, antinutrijenti

Wheat breeding for nutritional quality

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Abstract

Wheat is one of the most important cereals in the world because it is most commonly used for bread production. Besides, wheat is a staple food for a large part of the world population, and therefore the intake of nutrients in humans is largely dependent on the nutritional value of wheat grains. Currently over three billion people in the world have health problems due to the lack of micronutrients (Fe, Zn, Se, I, Cu and others) in their daily diet. This problem is especially serious in developing countries and affects all age groups, but women and children are under higher risk. Lately there are numerous research showing that certain micronutrients are lacking in human nutrition in developed countries too. Increasing the micronutrient content of wheat grains could be achieved by agronomic and genetic biofortification. In the past, the most common goals of wheat breeding programs have been to create higher-yielding genotypes, genotypes with increased resistance to lodging and increased resistance to diseases. Regarding the problem of micronutrient deficiencies in the diet of a large number of people, breeding goals are to create grains with increased nutritional value, which is an extremely demanding job given the heritability of these traits and the complexity of the wheat genome.

Keywords: hidden hunger, biofortification, microelements, antinutrients

Mogućnost primjene daljinskog motrenja i korištenje dronova u očuvanju krmnih biljnih genetskih resursa

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Sažetak

Biljni genetski resursi čuvaju se u bankama sjemena, odnosno u *ex situ* kolekcijama, ali i *in situ*, u prirodnom okruženju i *on farm*. Zbog globalne klimatske krize, potrebe za osiguranjem proizvodnje hrane te povećanjem otpornosti agroekosustava u vremenima promjenjivih uvjeta dodatna je pažnja posvećena očuvanju biljnih genetskih resursa *in situ*. Za razliku od sjemena i *in situ* očuvanja tradicionalnih kultivara, divlji srodnici kultiviranog bilja žive slobodno u prirodi u zajednicama s drugim biljnim vrstama u dinamičnim sustavima i interakcijom s okolišem. Kvantifikacija i prostorna distribucija nije laka i procjena statusa takvih populacija predstavlja izazov. Pomoću novih tehnologija daljinskih istraživanja moguće je vršiti monitoring većih područja uz znatne uštede. U ovom sažetku su iznijeti rezultati preliminarnih mjerenja i detekcije biljaka na nivou vrste korištenjem bespilotnog sustava opremljenog multispektralnim senzorom. Dobiveni rezultati pokazuju jasnu delineaciju distribucija ciljnih vrsta na travnjaku čime je omogućena njihova kvantifikacija, inventarizacija i monitoring u budućnosti.

Ključne riječi: *in situ*, biljni genetski resursi, daljinska istraživanja, divlji srodnici kultiviranog bilja, tradicionalni kultivari

Potential applications of remote sensing and the use of drones in conservation of fodder crops genetic resources

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Abstract

Plant genetic resources are stored in gene banks, or in *ex situ* collections, but also *in situ*, in the natural environment and on the farm. Due to the global climate crisis, the need to ensure food production and increase agro-ecosystem resilience in the face of changing weather, additional attention has been paid to conserving plant genetic resources *in situ*. Unlike seeds and *in situ* conservation of traditional cultivars, wild relatives of cultivated plants live freely in nature in communities with other plants in a dynamic system and interact with the environment. Quantification and spatial distribution are not easy and assessing the status of such populations is challenging. New remote sensing technologies make it possible to control larger areas at considerable cost. In this summary, present the results of preliminary measurements and detection of plants on all uses of an unmanned system equipped with a multispectral sensor. The results obtained show a clear demarcation of the distribution of target species on the lawn which shows possibilities of quantification, inventory and monitoring in the future.

Keywords: *in situ*, plant genetic resource, remote sensing, crop wild relatives, landraces

Utjecaj genotipa i okoline na antioksidacijsku aktivnost i sadržaj ukupnih fenola u zrnu kukuruza kokičara

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Sažetak

Kukuruz kokičar je popularna grickalica koja ima značajnu nutritivnu vrijednost. Potencijalni zdravstveni učinci kukuruza kokičara dovode se u svezu s bioaktivnim antioksidacijskim spojevima u zrnu kao što su fenoli. Ciljevi ovoga rada bili su procijeniti učinak genotipa (G), vegetacijske sezone (Y) i lokacije (L) na sadržaj ukupnih fenola (TPC) i antioksidacijsku aktivnost (AA) kukuruza kokičara, te ispitati međuzavisnost TPC i AA. Pokus s devet hibrida kukuruza kokičara postavljen je u Osijeku i Altinovi (Turska) u 2015. i 2016. godini. TPC je određen spektrofotometrijski metodom Singletona i Rossia (1965). AA je određena DPPH metodom neutralizacije slobodnih radikala po Brand-Williamsu i sur. (1995). Utvrđen je visokoopravdani učinak G i Y, te neopravdani učinak L i interakcije G x Y i G x L na oba ispitivana svojstva. TPC je varirao između genotipova kukuruza kokičara od 1,63 to 2,14 mg GAE/gDW. Variranje između genotipova za DPPH iznosilo je od 32,9 do 48,3 % inhibicije. Dobivena je jaka pozitivna korelacija između TPC i AA ($r=0,86$). Rezultati ukazuju da je kukuruz kokičar značajan izvor fenola kao antioksidansa, te da postoji mogućnost selekcije genotipova s višim sadržajem ukupnih fenola u zrnu.

Ključne riječi: kukuruz kokičar, hibridi, kupni fenoli, antioksidacijska aktivnost

Effect of genotype and environment on antioxidant activity and total phenols content in popcorn kernels

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Abstract

Popcorn is a popular snack food with significant nutritional value. The potential health benefits of popcorn are linked to the bioactive antioxidants in grain such as phenols. The objectives of this study were to evaluate the effect of genotype (G), growing season (Y) and location (L) on kernel total phenols content (TPC) and antioxidant activity (AA) and to determine the correlation between TPC and AA in popcorn. Trial with nine popcorn hybrids was set up in Osijek and Altinova (Turkey) in 2015 and 2016. TPC was quantified spectrophotometrically by the method of Singleton and Rossi (1965). AA was determined as DPPH-radical scavenging activity by the method of Brand-Williams et al. (1995). Effect of G and Y was significant for both evaluated traits, while effect of L as well as G x Y and G x L interaction was nonsignificant. TPC varied among popcorn genotypes from 1.63 to 2.14 mg GAE/gDW. Variation among genotypes for DPPH varied among genotypes from 32.9 to 48.3 % inhibition. Significant strong correlation between TPC and AA ($r=0.86$) was found. Results indicate that the popcorn is a significant source of phenolics as antioxidants and a possibility to select genotypes with higher content of kernel total phenols.

Keywords: popcorn, hybrids, total phenols, antioxidant activity

Varijabilnost dormantnosti zrna i embrija u kolekciji sorata ozime pšenice

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Sažetak

Dormantnost zrna (DZ) glavna je komponenta tolerantnosti na prije-žetveno prokljavanje (PŽP), koje uzrokuje degradaciju proteina i škroba u endospermu pšenice. Veća tolerantnost na PŽP povezana je i sa sintezom abscizinske kiseline (AK) ili odgovorom na AK koja inducira dormantnost zrna. Cilj ovog istraživanja bio je utvrditi varijabilnost DZ unutar sorte kolekcije sačinjene od dvjesto deset europskih sorti ozime pšenice, koja se uzgajala dvije uzastopne vegetacijske godine na lokaciji Zagreb, Hrvatska. DZ je mjerena primjenom testova klijanja provedenih na 20 ° C u tami s tri različita tretmana: cijela zrna u vodi (T1), embrij u vodi (T2) i embrij u otopini 20μM AK (T3). Prokljajala zrna/embrij su brojani treći i šesti dan nakon postavljanja pokusa, a dormantnost je izražena indeksom klijanja (GI). Analiza varijance otkrila je značajne učinke godine (Y), genotipa (G), tretmana (T), kao i Y × G, Y × T, G × T i Y × T × G interakcija. Utvrđen je visok stupanj varijabilnosti između genotipova za DZ mjerenu s T1 i T3, pri čemu se GI kretao od 0,015 do 0,990, odnosno od 0,003 do 0,981, dok je za T2 utvrđena niža razina varijabilnosti između genotipova pri čemu se GI kretao u rasponu od 0,402 do 1. Heritabilnost za T1, T2 i T3 bila je 0,62, 0,42, odnosno 0,61. Koeficijent korelacije između tretmana T1 i T2, te T2 i T3 iznosio je 0,55, dok je između T1 i T3 koeficijent korelacije iznosio 0,68.

Ključne riječi: pšenica, priježetveno prokljavanje, dormantnost, abscizinska kiselina

Variability of seed and embryo dormancy in a collection of winter wheat varieties

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Abstract

Seed dormancy (SD) is the main component of tolerance to pre-harvest sprouting (PHS), which causes degradation of protein and starch in wheat endosperm. Higher PHS tolerance is also associated with synthesis of abscisic acid (ABA) or response to the dormancy-inducing hormone ABA. The aim of this study was to deduce variability for SD in a collection of two hundred and ten European winter wheat varieties grown for two years at location Zagreb, Croatia. Dormancy was assessed using germination tests conducted at 20°C in darkness with three germination tests: whole seeds in water (T1), embryos in water (T2) and embryos in 20 µM ABA solution (T3). Germinated seeds/embryos were counted after three and six days from setting up the experiment and dormancy was expressed as germination index (GI). Analysis of variance revealed significant effects of year (Y), genotype (G), treatment (T) as well as Y×G, Y×T, G×T and Y×T×G interactions. A high variability among genotypes was observed for dormancy measured with T1 and T3, with GI ranging from 0.015 to 0.990, and from 0.003 to 0.981 respectively, while for T2 a lower level of variability among genotypes was found with GIs ranging from 0.402 to 1. Heritability of T1, T2 and T3 was 0.62, 0.42, and 0.61 respectively. Correlation coefficients of 0.55, 0.55 and 0.68 was observed between T1-T2, T2-T3 and T1-T3 respectively.

Keywords: wheat, pre-harvest sprouting, dormancy, abscisic acid

Epigenetics in plant breeding

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Abstract

Current farming technology and advanced techniques of plant breeding are tending to enable high yields and cropping intensity, despite the limitations in arable land availability. However, rise in global population and climate changes could strain the ability to provide a stable, high quality food supply. A key for an ever-growing need for better performing and more resilient cultivars could be genetic diversity which might be used for development of these cultivars. With advancements of knowledge in epigenetics, new findings about how genes work and express could allow the advancements in plant breeding methods used for improvement of cultivars, and might provide a new source of variability originating from epialleles. We provide a short synopsis of the most significant epigenetic modifications, and the particularities of plant species that impact epigenetic mechanisms, although the main focus of this paper is the application of current knowledge in the field of epigenetics for current and future plant breeding. A current example of epigenetic breeding is described in the case of *Brassica napus* where yield was increased due to recursive selection for an epigenetic component. Future application might lie in the discovery of epigenetic recombinant inbred lines in *Arabidopsis thaliana*, inhibition of DNA methylation in *Oryza sativa*, discovery of MSH1 system in *Glycine max* and *Solanum lycopersicon*. It also outlines the current issues and limitations of epigenetic breeding such as a lack of understanding of epigenetic mechanisms, interaction of epigenetic and stress responsive mechanisms, and the development of viable and exact statistical models that are able to predict the impact and outcome of epigenetic modifications.

Keywords: epigenetics, plant breeding, epigenetic breeding, epigenetic modifications

Alternativni dizajn poljskih pokusa za ispitivanje gospodarske vrijednosti sorti (VCU)

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Sažetak

Cilj istraživanja je bio utvrditi mogućnost povećanja učinkovitosti poljskih pokusa za ispitivanje gospodarske vrijednosti sorti (VCU) kukuruza primjenom alfa dizajna, u smislu povećanja pouzdanosti usporedbe sorata. Pokusi su postavljeni prema alfa dizajnu s četiri repeticije, na lokacijama: Tovarnik, Osijek, Beli Manastir, Kutjevo i Zagreb u 2019. godini. Analiza podataka o urodu je radi procjene relativne učinkovitosti provedena prema dva modela: slučajnom bloknom rasporedu (RCBD) i alfa dizajnu. Relativna učinkovitost alfa dizajna (u odnosu na RCBD) procijenjena je na temelju omjer pogrešaka usporedaba ta dva modela.

Ključne riječi: VCU pokusi, slučajni blokni raspored, alfa dizajn, kukuruz, Hrvatska

Alternative design of field trials for testing the Value for Cultivation and Use of varieties (VCU)

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Abstract

The aim of the study was to investigate the possibilities for increasing the efficiency of maize VCU (value for cultivation and use) trials by replacing the standard RCBD (randomized complete block design) with the alternative alpha design. The trials were set as alpha design with four replicates, at locations: Tovarnik, Osijek, Beli Manastir, Kutjevo and Zagreb in 2019. Analysis of the yield data was performed using two different models RCBD and alpha, in order to estimate the relative efficiency of the alpha design, based on the ratio of standard errors of cultivar comparisons from two models.

Keywords: VCU testing, RCBD, Alpha lattice design, maize, Croatia

Analysis of the pre-commission maize breeding trials and the germplasm developments in Altinova breeding station from 2015 to 2018

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Abstract

Main goal of the most breeding programs is to develop highly adaptive hybrids in various environments, and the most important limitation are complex interactions between genotype, environment and management. Every hybrid breeding program follows certain strategy for new hybrid development. One possible strategy is to develop hybrids with lower adaptability, achieving best performance in “high input” environments (breeding for “race-horses”). However, another approach is to breed for hybrids with higher adaptability and stable performance across a wide range of environments (breeding for “work-horses”). High stability needs to be accompanied by high yield performance to insure profits, so stability should be monitored along with performance in breeding trials. Aim of this research was to analyze the new germplasm developments and their performances in the pre-registration trials in Turkey by the means of BLUP and GGE models. Heritability estimates for grain yield ranged from 0.58 to 0.85, and relative stability of all hybrids and checks is detected across all years. Cause of the high estimates of $G \times L$ was the unstable environment Altinova. One hybrid was selected as a future check based on stability parameters across environments. As $G \times E$ interaction remains the greatest challenge in modern maize breeding, more research is needed in this field. Therefore mixed-model based approach is a valuable tool for analysis of genotype performances in maize breeding trials.

Keywords: maize, germplasm, breeding, $G \times E$ interaction

Prvi rezultati genotipizacije panela inbred linija kukuruza iz Jugoistočne Europe pomoću Axiom® 600k čipa

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Sažetak

Axiom® 600k čip za genotipizaciju kukuruza opsežno ispituje više od 600.000 odabranih varijanti (većinom biljega polimorfizma jednoga nukleotida (SNP)) za karakterizaciju globalne raznolikosti genoma kukuruza. Predstavljamo prve rezultate genotipizacije panela inbred linija iz Jugoistočne Europe koji uključuje 548 primki iz banke gena Instituta za kukuruz "Zemun Polje", Srbija. Ukupno 616.201 varijanti je sortirano u šest kategorija kvalitete: polimorfne varijante visoke razlučivosti (74,0%), monomorfne visoke razlučivosti (0,2%), koje nemaju rjeđeg homozigota (3,3%), varijante izvan cilja (11,6%), koje imaju stopu odziva ispod praga (1,4%) i ostale (9,4%). Za daljnju analizu korišteni su samo polimorfni biljezi visoke rezolucije dodatno probranih na osnovi vrlo strogih kriterija kvalitete [stopa odziva > 98,5, Fisherova linearna diskriminanta (FLD) > 6, homozigotna FLD > 10, učestalost rjeđeg alela (MAF) > 0.1] rezultirajući ukupno 304.937 filtriranih SNP biljega. Pripremljena je "hapmap" datoteka i SNP varijante su rekdirane prema IUPAC protokolu. Podaci su analizirani pomoću Tassel softwera verzija 5. Analiza glavnih koordinata otkrila je složenu genetsku strukturu koju treba pripisati poznatim genetskim skupinama kukuruza. Očekuje se da bi stare sorte i rase kukuruza prilagođene za određene agroklimatske uvjete mogle biti utočište za poželjne alele za elastičnost na klimatske promjene čineći analizu ove germplazme nužnom za omogućavanje brze integracije u oplemenjivačke programe.

Ključne riječi: kukuruz, genotipizacija, 600k SNP čip, panel inbred linija, Jugoistočna Europa

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First results of genotyping the panel of maize inbred lines from Southeast Europe via Axiom® 600k array

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Abstract

Axiom® maize genotyping array comprehensively interrogates more than 600,000 selected variants (mostly single nucleotide polymorphisms (SNP) markers) to represent the global diversity in the maize genome. Here, we present first results of genotyping the panel of maize inbred lines from Southeast Europe comprised of 548 accessions from maize gene bank at the Maize Research Institute “Zemun Polje”, Serbia. A total of 616,201 variants were sorted into six quality categories: Polymorphic High Resolution (74.0%), Monomorphic High Resolution (0.2%), No Minor Homozygote (3.3%), Off-Target Variant (11.6%), Call Rate Below Threshold (1.4%) and Other (9.4%). For further analysis, only Polymorphic High Resolution markers were used additionally selected according to very stringent quality criteria [call rate > 98.5, Fisher’s Linear Discriminant (FLD) > 6, homozygous FLD > 10, the minor allele frequency (MAF) > 0.1] resulting in 304,937 filtered markers. Hapmap file was prepared, and SNP variants were recoded according to IUPAC protocol. Data were analyzed in Tassel software version 5. Principal co-ordinate analysis revealed a complex genetic structure that needs to be referenced to known genetic groups. It is expected that old landraces adapted to certain agro-climatic conditions might harbor the alleles for resilience to changing climate. Thus, the analysis of this germplasm is necessary to facilitate its fast integration into the breeding programs.

Keywords: maize, genotyping, 600k SNP array, panel of inbred lines, Southeast Europe

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Procjena genetskih parametara svojstava sjemena crvene djeteline

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Sažetak

Procjena genetskih parametara kojima se opisuje struktura oplemenjivačkih populacija od velike je važnosti za učinkovitu selekciju svakog oplemenjivačkog programa. Cilj ovog rada bio je procijeniti genotipsku komponentu varijance, heritabilnost u širem smislu te fenotipske i genotipske korelacije za svojstva sjemena (masu tisuću zrna, udio tvrdog sjemena, površinu, duljinu i širinu sjemena, omjer duljine i širine sjemena) i svojstva vezanih uz sjeme (energija klijanja, klijavost i duljina klijanca) trinaest oplemenjivačkih populacija crvene djeteline. Pokus je bio postavljen po shemi randomiziranog bloka u četiri ponavljanja. Svojstva sjemena izmjerena su uređajem MARVIN (GTA Sensorik GmbH, Germany). Udio tvrdog sjemena i svojstva vezana uz sjeme određena su sukladno ISTA pravilima. Učinak genotipa na sva istraživana svojstva sjemena i svojstva vezana uz sjeme bio je značajan ($p=0,01$). Heritabilnost u širem smislu bila je visoka te se kretala od 0,72 za svojstvo udjela tvrdog sjemena do 0,98 za masu tisuću zrna. Genotipske i fenotipske korelacije između svojstava su se podudarale. Masa tisuću zrna bila je u srednjoj do jakoj negativnoj korelaciji s energijom klijanja i klijanjem. Masa tisuću zrna i druga svojstva sjemena bili su u pozitivnoj korelaciji. Rezultati ukazuju na izvrsnost pet ispitivanih populacija i potvrđuju korisnost procjene genetskih parametara u selekciji.

Ključne riječi: crvena djetelina, oplemenjivačka populacija, sjeme, genetski parametri

Estimation of genetic parameters for seed traits of red clover

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Abstract

Estimation of genetic parameters used to describe structure of breeding populations is of great importance for efficient selection in any breeding program. The aim of this study was to estimate genetic component of variance, broad-sense heritability and phenotypic and genetic correlations for seed traits (thousand seed weight, hard seeds percentage, seed area, width and length, length/width ratio) and seed related traits (germination energy, germination and seedling length) of thirteen red clover breeding populations. The trial was set up as randomised block with four replications. Seed traits were measured by MARVIN (GTA Sensorik GmbH, Germany). Hard seed percentage and seed related traits were determined in accordance with ISTA rules. The effect of genotype on all studied seed and seed related traits was significant ($p=0.01$). Broad-sense heritability was high and ranged from 0.72 for hard seed percentage to 0.98 for thousand seed weight. Genotypic and phenotypic correlations among traits were congruent. Thousand seed weight and germination energy and germination were moderately to strongly negatively correlated. Thousand seed weight and other seed traits were positively correlated. The results indicate the excellence of five investigated populations and confirm the usefulness of genetic parameters estimation in selection.

Keywords: red clover, breeding population, seed, genetic parameters

Gas exchange and photosynthetic parameters in five maize hybrids

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Abstract

Photosynthesis is the fundamental process whereby plants capture and process sunlight and CO₂ to achieve growth and reproduction. To understand the biology behind changes in the net CO₂ assimilation (AN) rate and to allow predictions of environmental and genetic influences on plant productivity, the dissection of biophysical and biochemical factors that determine AN and the calculation of photosynthesis parameters is an important tool. Hence, the aim of our study was to evaluate the influence of particular phenophase on fluctuation in gas exchange and chlorophyll *a* fluorescence parameters. Five maize hybrids of FAO 300 maturity group were analyzed in a small-scale field experiment set up according to Randomized Complete Block Design, in four replications. Multivariate two-way ANOVA has shown that phenophase as a source of variation exhibited significant effect on the majority of parameters observed, being the highest for PI_{ABS} and PI_{total} ($p \leq 0.001$), as performance indices for energy conservation from exciton to the reduction of intersystem electron acceptors, *i.e.* PSI end acceptors. The most discriminative one was terminal vegetative phenophase. Highly significant correlations ($p \leq 0.001$), especially between photosynthetic rate (A) and other parameters evaluated indicated that photoassimilates represent both the substrate for growth, and also energy storage for biochemical activities. Overall performances of maize hybrid G21 indicated well tailored partitioning of these resources towards its improved productivity.

Keywords: chlorophyll *a* fluorescence, performance indices, phenophase, photosynthesis, *Zea mays* L.

Rezultati ispitivanja novih Bc hibrida kukuruza FAO grupe 300 do 600

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Sažetak

Zbog velike konkurencije na tržištu i potražnji za prinosnijim hibridima kukuruza, Bc Institut konstantno radi na kreacijama novih hibrida. Bc Institut svake godine provodi veliki broj mikro i makro pokusa u svrhu testiranja novih hibrida kukuruza. Tijekom 2018. godine, u sortnoj komisiji RH testirani su u FAO grupi 300 dva hibrida (Panon i Agram), jedan hibrid u FAO grupi 400 (Tesla), dva hibrida u FAO grupi 500 (BC 526 i Majstor) te jedan u FAO grupi 600 (BC 601). Panon i Agram su na 4 lokacije ostvarili prosječni prinos od 12,01 t/ha, odnosno, 13,00 t/ha, dok je Tesla ostvario prinos od 12,39 t/ha. U FAO grupi 500 hibridi Majstor i BC 526 ostvarili su prosječni prinos od 11,30 t/ha, a BC 601 u FAO grupi 600 13,29 t/ha. Kad su u pitanju makro pokusi, najrodniji hibrid u 2018. godini bio je hibrid BC 415 koji je ostvario prinos od 13,8 t/ha na 20 lokacija u RH. Hibride Instruktor i Majstor uz visok prinos odlikuje i iznimna kvaliteta zrna dok hibrid BC 601 pokazuje odlične rezultate i u pokusima za silažu.

Ključne riječi: Kukuruz, hibridi, prinos zrna, kvaliteta

Testing results of new Bc maize hybrids of the maturity group 300 to 600

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Abstract

Because of big market competition and demand for high yielding maize hybrids Bc Institute constantly creates new maize hybrids. For those purpose Bc Institute is testing new hybrids in a lot of micro and macro trials each year. During 2018 in official trials in Croatia, we tested two hybrids in FAO 300 maturity group (Panon and Agram), one in FAO 400 maturity group (Tesla), two hybrids in FAO 500 maturity group (Majstor and BC 526), and one in FAO 600 maturity group (BC 601). The average yield of Panon and Agram at four locations in Croatia was 12.01 t/ha and 13.00 t/ha, while hybrid Tesla yielded 12.39 t/ha. Hybrids Majstor and BC 526 achieved an average yield of 11.30 t/ha in FAO 500 maturity group. Hybrid BC 601 in FAO 600 maturity group had average yield of 13.29 t/ha. In macro trials during 2018 hybrid BC 415 achieved average yield of 13.8 t/ha at 20 locations in Croatia. Hybrids Instruktor and Majstor except high yield have an excellent grain quality. Hybrid BC 601 except for grain production achieved high yield in silage production.

Keywords: Maize, hybrids, grain yield, quality

Genotipske razlike u sadržaju mikotoksina u zrnu pšenice nastale uslijed zaraze s fuzarijskim paležom klasa

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Sažetak

Fuzarijski palež klasa (FHB) smanjuje urod i kvalitetu zrna pšenice. *Fusarium* vrste proizvode i mikotoksine od kojih su najzastupljeniji deoksinivalenol (DON) i zearalenon (ZEN). Istraživanje je provedeno na osam genotipova ozime pšenice i njihovih 28 F1 križanaca dobivenih prema shemi dialelnog križanja bez reciproka u uvjetima umjetne inokulacije gljivom vrste *Fusarium graminearum* tijekom tri godine. Intenzitet zaraze genotipova ocijenjen je putem vizualne ocjene postotka površine klasa zaražene s FHB (VRI) i postotka fuzariumom zaraženih zrna (FDK), a na uzorcima brašna je provedena analiza sadržaja mikotoksina DON-a i ZEN-a pomoću HPLC-MS/MS multianalitičke metode. Utvrđeni su signifikantni učinci genotipa i godine na sadržaj DON-a i ZEN-a, dok interakcija godina × genotip za sadržaj ova dva mikotoksina nije bila signifikantna. Sadržaj DON-a varirao je od 222 do 16042 µg/kg, a sadržaj ZEN-a od 0,1 do 273,4 µg/kg, ovisno o genotipu i godini. Utvrđena je visoka pozitivna korelacija između VRI i FDK ($r=0,93$), kao i visoke korelacije između VRI i sadržaja DON-a ($r=0,91$) te VRI i sadržaja ZEN-a ($r=0,91$). Korelacije između FDK i sadržaja DON-a ($r=0,96$) te FDK i sadržaja ZEN-a ($r=0,91$) su također bile visoke kao i korelacija između sadržaja DON-a i sadržaja ZEN-a ($r=0,86$). Visoke pozitivne korelacije utvrđene između navedenih svojstava pružaju nam mogućnost da praćenjem jednog svojstva možemo pouzdano predvidjeti ekspresiju drugog svojstva povezanog s otpornosti na FHB.

Ključne riječi: pšenica, mikotoksini, korelacije, fuzarijski palež klasa (FHB)

Genotypic differences in mycotoxin content of wheat grains resulting from infection with *Fusarium* head blight

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Abstract

Fusarium head blight (FHB) causes a decrease in grain yield and quality. *Fusarium* species produce mycotoxins of which the most widespread are deoxynivalenol (DON) and zearalenone (ZEN). The study was conducted on eight winter wheat genotypes and their 28 F1 crosses, produced according to the diallel mating design without reciprocals, under artificial inoculation with the fungus *Fusarium graminearum* during three years. Genotype infection intensity was assessed as percentage of infected spikelets (VRI) and the percentage of fusarium damaged kernels (FDK). On flour samples content of DON and ZEN were determined by the HPLC-MS/MS multianalytical method. Significant effects of genotype and year for DON and ZEN content were observed, whereas the interaction of year × genotype for the content of these two mycotoxins was not significant. DON content varied from 222 to 16042 µg/kg and ZEN content from 0.1 to 273.4 µg/kg, depending on genotype and year. High positive correlation was observed between VRI and FDK ($r=0.93$), as well as between VRI and DON content ($r=0.91$) and VRI and ZEN content ($r=0.91$). Correlations between FDK and DON content ($r=0.96$) and FDK and ZEN content ($r=0.91$) were also high, as well as the correlation between DON content and ZEN content ($r=0.86$). The high positive correlations observed between the above traits give us the possibility that by monitoring one trait, we can reliably predict the expression of another trait associated with FHB resistance.

Keywords: wheat, mycotoxins, correlations, *Fusarium* head blight (FHB)

Analiza stabilnosti PIO kultivara pšenice i kukuruza u Rumunjskoj

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Sažetak

Osnovni cilj svakog oplemenjivačkog programa je razvoj kultivara viših prinosa i povećane kvalitete, široke adaptabilnosti te visoke stabilnosti svojstva od interesa. Cilj rada bio je analizirati stabilnost prinosa novih kultivara pšenice i kukuruza Poljoprivrednog instituta Osijek (PIO) uzgajanih u Rumunjskoj putem procjene i usporedbe sljedećih parametara stabilnosti: Francis i Kannenberg-ovog koeficijenta varijacije (CV_i), Wricke-ove ekovalence (W_i), Finlay i Wilkinson-ovog koeficijenta regresije (b_i), varijance odstupanja od regresije (S^2_{di}), Shukla-ove varijance stabilnosti (σ_i^2), Huhn i Nassar i Huhn-ove neparametrijske statistike ($S_i^{(1,2,3,6)}$), Thennarasu-ove statistike ($NP^{(1,2,3,4)}$) i Kang-ovog sumarnog ranga (KR). U ovom radu prikazana je analiza po tri PIO kultivara pšenice (Katarina, Tika Taka, Tata Mata) i kukuruza (OS 3114, OS 4014, Kulak) te po inozemni kultivar pšenice i kukuruza koji u agroekološkim uvjetima Rumunjske ostvaruju visoke i stabilne prinose. Pokus je postavljen po shemi randomiziranog bloka u tri ponavljanja na četiri agroklimatski različite lokacije za pšenicu i tri različite lokacije za kukuruz tijekom tri uzastopne godine (sjetve 2016.-2018.). Učinak genotipa, lokacije, godina te njihove interakcije bile su značajne ($p=0,01$) za obje kulture. Niti jedan kultivar pšenice i kukuruza nije ostvario kontinuirano najviši prinos u svim okolinama. Različiti parametri stabilnosti opisali su kultivare različito. Rezultati ukazuju da su Katarina i Tika Taka te OS 4014 kultivari visokog i stabilnog prinosa te široke adaptabilnosti.

Ključne riječi: pšenica, kukuruz, kultivar, stabilnost

Stability analysis of AIO wheat and maize cultivars in Romania

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Abstract

Primary goal of any breeding program is to develop cultivar with higher yield, improved quality, wide adaptability and high stability of trait of interest. The aim of the study was to analyse yield stability of new Agricultural Institute Osijek (AIO) wheat and maize cultivars grown in Romania by estimation and comparison of the following stability parameters: Francis and Kannenberg's coefficient of variation (CV_i), Wricke's ecovalence (W_i), Finlay and Wilkinson's regression coefficient (b_i), variance of deviations from the regression (S^2_d), Shukla's stability variance (σ_i^2), Huhn and Nassar and Huhn's non-parametric statistics ($S_i^{(1,2,3,6)}$), Thennarasu's statistics ($NP^{(1,2,3,4)}$) and Kang's rank-sum (KR). This study shows the analysis of three AIO cultivars of wheat (Katarina, Tika Taka, Tata Mata) and maize (OS 3114, OS 4014, Kulak), and foreign wheat and maize cultivars that obtain high and stabile yields in agro-ecological conditions of Romania. The trial was set up as randomised block with three replications at four agro-climatically different locations for wheat and at three different locations for maize in three consecutive years (2016-2018 sowings). Effects of genotype, location, year and their interactions were significant ($p=0.01$) for both species. None of wheat and maize cultivars obtained continuously highest yield across all environments. Different stability parameters described cultivars differently. Results suggest that Katarina and Tika Taka and OS 4014 are the cultivars with high and stabile yield and wide adaptability.

Keywords: wheat, maize, cultivar, stability

Effect of agrimitin on the spring barley grain germination and seedlings growth under drought condition

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Abstract

Barley (*Hordeum vulgare* L.) is one of the most drought-resistant cereals. Water stress causes a negative effect on crop's seed germination and seedling growth and as a result on the quality and quantity of yield. The rational use of new agrochemicals for seeds pre-treatment is one of the effective techniques to enhance plant tolerance during whole vegetation period under stressful environments. One of the perspective agrochemical named SkQ3 (10-(6'-methylplastoquinonyl decyltriphenylphosphonium) or agrimitin was synthesized at the Moscow State University after M. V. Lomonosov and characterized by mitochondria-targeted antioxidant activity. The aim of our research was to investigate the effect of different doses of agrimitin on the grain germination and seedlings growth of spring barley grains under drought conditions. Treated by 0.5 nM and 2.5 nM of agrimitin 30 grains per variant of the spring barley cv 'Shedriy' were germinated in normal and water deficit condition imitated by 15% aqueous solution of PEG-6000. Plants were grown at 25°C under the illumination of 4-5 klx. The determination of the germination rate and seedlings growth was carried out on 20-days seedlings. Analysis of plants grown in drought stress revealed the significant reduction in growth rate parameters of seedlings in comparison with control plants. It was revealed that pre-treatment the grains by different doses of agrimitin had effects on germination and growth parameters of barley seedlings both in normal and drought condition. In the case of agrimitin with concentration 2,5 nM the significant differences in the fresh and dry weight of sprouts and roots in the drought condition compared with untreated control plants were registered ($P < 0.001$). Based on the obtained data the 2.5 nM concentration of agrimitin is recommended for future field experiments.

Keywords: drought stress, Skulachev-ions (SkQ3) agrimitin, spring barley



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Promjene u sastavu sekundarnih metabolita rukole u odnosu na intenzitet suše

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Sažetak

Mehanizmi akumulacije sekundarnih metabolita povezani su s abiotskim stresom sušom. Hidroponskim uzgojem rukole biljke nisu izložene vodnom stresu pa je njihova koncentracija normalna. Pravilnim upravljanjem vodnim režimom, moguće je povećati sadržaj sekundarnih metabolita poput fenola, flavonoida, glukozinolata te vitamina C, bez utjecaja na prinos. Cilj istraživanja bio je utvrditi promjene u sastavu sekundarnih metabolita rukole pri periodičnom zasušivanju (24 i 48 h) upotrebom sustava plutajućeg hidropona te supstrata različitog vodnog kapaciteta (perlit; mješavina perlita i treseta u omjeru 1:4). Biljni materijal je analiziran kroz tri roka berbe: 27, 34 i 41 dan nakon sjetve (DNS). Biljkama uzgojenim u perlitu i zasušivanim 48 h značajno se povećala koncentracija vitamina C, fenola, neflavonoida te glukozinolata u kasnijim berbama. Nije zabilježeno povećanje koncentracije flavonoida s 34 na 41 DNS, dok je kod biljaka uzgojenih u mješavini supstrata zasušivanim 24 h zabilježeno njihovo značajno smanjenje. Tretmani kraćeg intervala zasušivanja bilježe slična povećanja sadržaja vitamina C, fenola i neflavonoida, ali i dvostruko niže vrijednosti sadržaja glukozinolata. Dobiveni rezultati upućuju na stimulativni učinak stresa sušom (24 h) na sadržaj vitamina C, ukupnih fenola, flavonoida i neflavonoida, dok je na sadržaj glukozinolata značajnije utjecalo intenzivnije zasušivanje (48 h). Primjenom zasušivanja moguće je uzgojiti rukolu veće zdravstvene i nutritivne vrijednosti.

Ključne riječi: sekundarni metaboliti, suša, *Eruca sativa*, nutritivna vrijednost

Changes of rocket secondary metabolites content in relation to drought stress

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Abstract

Mechanisms of secondary metabolites accumulation are related to drought stress. Hydroponically grown rocket does not suffer from water deficiency, so their concentration is normal. Adequate management of irrigation regimes provides a way to increase the content of secondary metabolites such as phenols, flavonoids, glucosinolates and vitamin C, without adversely affecting yields. Aim of this study was to determine the changes in content of these metabolites in relation to different drying intervals (24 and 48 h), using a floating hydroponic system with substrates which differ in water capacity (perlite; mixture of perlite and peat in 1:4 ratio). Plant material was analysed through three harvest periods: 27, 34 and 41 day after sowing (DAS). Plants grown in perlite and exposed to 48 h drought, recorded a gradual increase in concentration of vitamin C, phenols, non-flavonoids and glucosinolates through later harvest periods. No significant increase in flavonoid content was recorded from 34 to 41 DAS, while plants exposed to 24 h drought measured a significant decrease. Treatments with shorter drought exposure recorded similar increases in contents of vitamin C, phenols and non-flavonoids, however glucosinolates concentration was almost halved. Obtained results showed a stimulative effect of 24 h drought stress on vitamin C, phenolic, flavonoid and non-flavonoid content, while the 48 h drought provided higher glucosinolate content.

Keywords: secondary metabolites, drought, *Eruca sativa*, nutritive value

Percepcije i stavovi o ukrasnim karakteristikama i primjeni odabranih zaštićenih biljnih vrsta

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Sažetak

U zadnjih nekoliko desetljeća sve se više radi na istraživanju i uvođenju u uzgoj samoniklih i zaštićenih biljnih vrsta. Primjenom ovih vrsta u gradskim krajobrazima doprinosi se očuvanju biološke i krajobrazne raznolikosti. U nas još vlada trend nedovoljnog uzgoja ovih vrsta. Stoga je i cilj ovog rada bio istražiti percepciju i stavove ispitanika o ukrasnim karakteristikama i primjeni odabranih zaštićenih biljnih vrsta koje rastu na hrvatskom kršu (Por. Caryophyllaceae, Iridaceae, Liliaceae i Ranunculaceae). Kroz opći dio rada obrađuju se uvođenje novih vrsta u ukrasnu hortikulturu s naglaskom na zaštićene biljne vrste, kao i opisi odabranih potonjih vrsta s bioekološkog i zaštitarskog aspekta. Kao izvor primarnih podataka provedeno je anketno ispitivanje, u drugoj polovici 2019. godine. Rezultati pokazuju da ispitanici ukrasne karakteristike i primjenu odabranih vrsta uglavnom vrednuju s ocjenom dobar. Prosječne ocjene po vrstama su donekle približne promatrajući ukrasne karakteristike i primjenu. Razlog tome je kontinuirana uporaba alohtonih vrsta tijekom posljednjih desetljeća. Postoje i izuzetci u pogledu ukrasnih karakteristika i primjene kojima su dodijeljene vrlo dobre ocjene: zvjezdasti ljiljan, velevjetni kukurijek i velika šumarica. Način održavanja gore navedenih vrsta u uzgoju ispitanici percipiraju kao osrednje težak. Ovi preliminarni rezultati mogu se koristiti prilikom uvođenja novih vrsta u ukrasnu hortikulturu.

Ključne riječi: zaštićene biljne vrste, zaštita kroz uzgoj, ukrasne karakteristike, primjena, percepcija

Perceptions and attitudes on ornamental features and the use of selected protected plant species

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Abstract

Over the last several decades, there has been an increase in research of wild and protected plant species and in their introduction into growing. The use of these species in urban landscapes contributes to the conservation of biological and landscape diversity. In our country, there is still a trend of insufficient growing of these species. Consequently, the specific objective of this paper was to explore the perceptions and attitudes of survey respondents concerning ornamental features and the use of selected protected plant species growing in the Croatian karst (Por. Caryophyllaceae, Iridaceae, Liliaceae and Ranunculaceae). The general part of the paper focused on the introduction of new species into ornamental horticulture with an emphasis on protected plant species, as well as the descriptions of the selected latter species from the bio-ecological and the conservation aspect. A survey research was a primary data source and it was conducted in the second half of 2019. According to the findings, the respondents normally evaluated the ornamental features and the use of the selected species with the grade good. The average grades for different species are considerably similar in terms of ornamental features and the use. This is due to a continuous use of allochthonous species during the last several decades. There are also exceptions concerning ornamental features and the use that have been evaluated with very good grades: orange lily, black hellebore and snowdrop anemone. The respondents perceived the maintenance of the above mentioned plant species as medium. These preliminary findings can be used upon the introduction of new species into ornamental horticulture.

Keywords: protected plant species, protection through growing, ornamental features, use, perception

Biofortifikacija nanoselenom – antioksidativni odgovor u lišću rukole

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Sažetak

Upotreba selenovih nanočestica (SeNPs) u biofortifikaciji bilja još nije dovoljno istražena te su u ovom istraživanju prikazani učinci biofortifikacije rukole koristeći SeNPs u usporedbi sa selenatom. Oba oblika selena primijenjena su u četiri različite koncentracije od 40, 80, 160 i 320 $\mu\text{mol m}^{-3}$ te je u pokus uključena kontrolna varijanta – nefortificirane biljke. Istraživanje je provedeno 2019. godine u suvremenom plasteniku u sustavu plutajućeg hidropona. U slučaju primjene SeNPs, u lišću rukole su utvrđene značajno veće koncentracije klorofila *a*, klorofila *b* i karotenoida u usporedbi s nefortificiranim biljkama, dok fortifikacija selenatom nije značajno utjecala na koncentraciju klorofila *a* i *b* u usporedbi s nefortificiranim biljkama. Pri fortifikaciji sa SeNPs je utvrđena značajno najveća antioksidativna aktivnost i to pri koncentraciji 320 $\mu\text{mol m}^{-3}$ SeNPs kao i najveći sadržaj fenola iako ne statistički značajan. Kod primjene selenata, utvrđena je značajno najveća antioksidativna aktivnost i sadržaj fenola pri koncentraciji 80 $\mu\text{mol m}^{-3}$ selenata u usporedbi s ostalim primijenjenim koncentracijama i kontrolnim biljkama. Prema svemu navedenom slijedi da biofortifikacija sa SeNPs direktno utječe na određene fiziološke procese u biljkama rukole poboljšavajući njen ukupni antioksidativni status. Ovo istraživanje je financirano od strane Hrvatske zaklade za znanost u sklopu projekata HRZZ IP-2018-01-8119 i HRZZ IP-2016-06-2436.

Ključne riječi: biofortifikacija, selen nanočestice, rukola, antioksidativni status

Biofortification with nanoselenium - antioxidative response in rucola leaves

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Abstract

The use of selenium nanoparticles (SeNPs) in plant biofortification has not yet been sufficiently investigated and the effects of rucola biofortification using SeNPs compared with selenate are presented in this study. Both forms of selenium were applied at four different concentrations at 40, 80, 160 and 320 $\mu\text{mol m}^{-3}$, and a control variant - unfortified plants were included in the experiment. Investigation was carried out during 2019 in a modern greenhouse in a floating hydroponic system. In the case of SeNPs application, significantly higher concentrations of chlorophyll *a*, chlorophyll *b* and carotenoids were found in rucola leaves compared to unfortified plants, whereas fortification with selenate did not significantly influenced on chlorophyll *a* and *b* concentrations compared to unfortified plants. Fortification with SeNPs also resulted in significantly highest antioxidant activity at concentration of 320 $\mu\text{mol m}^{-3}$ SeNPs in nutrient solution as well as on highest content of phenols, although not statistically significant. Regarding application of selenate, significantly highest antioxidant activity and phenols content were found at a concentration of 80 $\mu\text{mol m}^{-3}$ compared to other concentrations as well as control plants. Accordingly, the biofortification with SeNPs directly affects certain physiological processes in rucola plants, improving their overall antioxidant status. This work was supported by the Croatian Science Foundation (HRZZ) within the projects HRZZ IP-2018-01-8119 and HRZZ IP-2016-06-2436.

Keywords: biofortification, selenium nanoparticles, rucola, antioxidant status

Utjecaj supstrata i gnojidbe na rast i razvoj vrste *Tagetes patula* L.

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Sažetak

Jednogodišnje vrste zauzimaju značajno mjesto u ukupnoj proizvodnji cvijeća u svijetu. Vrsta *Tagetes patula* L. sa širokim asortimanom kultivara različite boje cvata, jedna je od značajnijih. Presadnice proizvedene u plug sistemu sade se na otvoreno nakon prestanka opasnosti od mrazova. Održavanje takvih sadnica tijekom cvatuće sezone ovisi o supstratu te o prihrani. Cilj ovog rada bio je utvrditi utjecaj supstrata i prihrane tekućim mineralnim gnojivom na rast i razvoj kadifice niske. Pokus je postavljen po shemi slučajnog blokno rasporeda u pet repeticija i proveden u vrtu Zavoda za ukrasno bilje, krajobraznu arhitekturu i vrtu umjetnost Agronomskog fakulteta u Zagrebu od svibnja do rujna 2019. godine. Sadnice ujednačenog rasta posađene su u plastične lonce zapremnine 500 ml u dvije različite smjese supstrata: „Flora san“ i „Brill Typ 5 soft“. Prihranjivane su u više navrata otopinom tekućeg mineralnog gnojiva „Plantella“ koncentracije 1,5%, odnosno 3,0%. Mjerena je visina i promjer biljaka, te broj listova, pupova i cvatova po biljci. Na temelju podataka dobivenih mjerenjem provedena je analiza varijance. Nije bilo statistički značajne razlike, ali su biljke uzgajane u supstratu „Brill Typ 5 soft“ postigle bolje rezultate za sva ispitivana svojstva. Na povećanje broja pupova i cvatova utjecala je primjena gnojiva. Uz gnojidbu otopinom mineralnog gnojiva u koncentraciji 1,5% bilo je 11% više pupova i cvatova u usporedbi s kontrolom i s 3%-tnom koncentracijom gnojiva.

Ključne riječi: *Tagetes patula* L., cvatnja, gnojidba, supstrat

Influence of substrate and fertilizer on growth and development of the species *Tagetes patula* L.

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Abstract

Annual species take a significant place in the world flower production. The species *Tagetes patula* L. with a wide range of different colored cultivars is one of the most present. The seedlings are planted outdoors after the frost hazard. The maintenance during the flowering season depends on the substrate and nutrition. The aim of this study was to determine the influence of substrate and fertilization on the growth and development of French marigold. The experiment was designed in a random block design in 5 repetitions and conducted in the garden of the Department of Ornamental Plants, Landscape Architecture and Garden Arts at the Faculty of Agriculture in Zagreb from May to September 2019. The seedlings were planted in 500 ml plastic pots in two different substrate mixtures: Flora san and Brill Typ 5 soft. They were sprayed several times with a solution of liquid mineral fertilizer "Plantella" concentrations of 1.5% and 3.0%, respectively. The height and diameter of the plants and the number of leaves, buds and inflorescences per plant were measured. The analysis of variance was performed. There was no statistically significant difference, but plants grown in substrate "Brill Typ 5 soft" achieved better results for all tested properties. Fertilizer application increased the number of buds and inflorescences. Fertilization with mineral fertilizer at concentration of 1.5%, gave 11% more buds and inflorescences compared to the control and with a 3% concentration of fertilizer.

Keywords: *Tagetes patula* L., flowering, fertilization, substrate

Osjetljivost kalifornijskog tripsa (*Frankliniella occidentalis* Pergande, 1895) na insecticide

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Sažetak

Rezistentnost štetnika na insekticide globalni je problem u proizvodnji poljoprivrednih kultura, a posebno je izražen u proizvodnji povrća u zaštićenim prostorima gdje proizvođači nemaju učinkovita rješenja u suzbijanju štetnika. Jedan od najvažnijih štetnika u zaštićenom prostoru jest kalifornijski trips koji je polifagan štetnik s vrlo visokim potencijalom razmnožavanja, a rezistentnost na insekticide zabilježena je širom svijeta. Program monitoringa rezistentnosti ekonomski najvažnijih štetnih organizama na sredstva za zaštitu bilja, u razdoblju 2017.-2020., razvijen je u svrhu pomoći poljoprivrednim proizvođačima u zaštiti poljoprivrednih kultura. Cilj ovog istraživanja bio je utvrditi osjetljivost populacija kalifornijskog tripsa na različite aktivne tvari koje imaju dozvolu za tu namjenu. Populacije su prikupljene tijekom 2018. i 2019. s 18 različitih lokaliteta, a testiranje je provedeno u laboratorijskim uvjetima prema IRAC metodi broj 10. Populacije kalifornijskog tripsa testirane su na aktivne tvari lambda-cihalotrin, tiametoksam, spinosad i abamektin. Sve testirane populacije bile su rezistentne na aktivne tvari tiametoksam i abamektin, samo jedna populacija bila je osjetljiva na lambda-cihalotrin, a tri populacije kalifornijskog tripsa na aktivnu tvar spinosad. Na lokalitetima gdje je utvrđena rezistentnost na određene aktivne tvari, proizvođačima se savjetuje unos prirodnih neprijatelja kao jedinu učinkovitu kurativnu mjeru suzbijanja kalifornijskog tripsa.

Ključne riječi: kalifornijski trips, insekticidi, rezistentnost

Sensitivity of the Western Flower Thrips (*Frankliniella occidentalis* Pergande, 1895) to insecticides

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Abstract

Insecticide resistance is the global problem in the production of agricultural crops which is particular important in greenhouse production where producers do not have adequate solutions in pest control. The most important pests in greenhouse vegetable production is Western Flower Thrips which is polyphagous organism with high reproductive potential and insecticide resistance of this pest was recorded worldwide. To help producers in pest control, Programme of resistance monitoring of the economically important agricultural pests was developed in Croatia from 2017 until 2020. This programme includes major pests in arable crops, greenhouse production, orchards and vineyards. The aim of this research was to test insecticides susceptibility of the western flower thrips. Populations of this pest were collected during 2018 and 2019 at 18 locations at different part of Croatia and were tested according to the IRAC test methods No. 010 in laboratory conditions. Populations of the Western Flower Thrips were tested on lambda-cyhalotrin, thiamethoxam, spinosad and abamectin. All tested populations were resistant on thiamethoxam and abamectin. Only one population was susceptible on lambda-cyhalotrin and three populations were susceptible on spinosad. According to the obtained results producers should utilize integrated measures in pest control and the only effective measure is biological control using natural enemies.

Keywords: Western Flower Thrips, insecticides, resistance

Potencijalna rasprostranjenost ljekovitih i medonosnih biljnih vrsta roda *Satureja* L. (Lamiaceae) u Hrvatskoj

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Sažetak

Satureja (čubar, modri ili klasoliki vrijesak) je biljni rod koji obuhvaća 30-tak vrsta, a u Hrvatskoj se kao ljekovite i medonosne uglavnom koriste: primorski vrijesak (*S. montana* L.), planinski vrijesak (*S. subspicata* Vis.) i lopatasti vrijesak (*S. cuneifolia* Ten.). Zbog velikog potencijala vrijeska napravljen je model potencijalne rasprostranjenosti u Hrvatskoj metodom maksimalne entropije na temelju 12 klimatskih varijabli u rasterskom obliku s vrijednostima piksela u rezoluciji 1x1 km. Podaci o rasprostranjenosti vrsta utvrđeni su terenskim istraživanjem provedenim tijekom vegetacijske sezone 2018. i 2019. godine, a također su korišteni podaci iz baze podataka *Flora Croatica* (FCD). Svakoj točki prisutnosti vrste pridružena je vrijednost piksela svake klimatske varijable iz *WorldClim* baze podataka. Najveći utjecaj na pogodnost staništa u formiranju modela za vrstu *S. subspicata* imale su sljedeće varijable: oborine najhladnijeg kvartala (Bio19 s 45.5%), sezonska temperatura (Bio4 s 21.3%) te godišnji raspon temperatura (Bio7 s 12.3%). Model pokazuje najveću potencijalnu rasprostranjenost (vrijednosti 0.77-0.85 na skali od 0 do 1) u mediteranskom i submediteranskom dijelu Hrvatske i to na području Čićarije, Velike i Male Kapele, Velebita, Plješevice, Dinare i Biokova. S obzirom na ekologiju roda *Satureja*, pri odabiru varijabli za izradu modela pogodnosti staništa za vrste *S. montana* i *S. cuneifolia* biti će uključena i varijabla geomorfologije staništa prikazana na cijelom arealu rasprostranjenosti vrsta.

Ključne riječi: ekološka niša, maksimalna entropija, *Satureja*, ljekovite biljke, Hrvatska

Potential distribution of medicinal and honey plant species of the genus *Satureja* L. (Lamiaceae) in Croatia

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Abstract

Satureja (savory) is a plant genus that includes about 30 species, and in Croatia it is mainly used as medicinal and honey plant, especially: winter savory (*S. montana* L.), mountain savory (*S. subspicata* Vis.) and wild savory (*S. cuneifolia* Ten.). Due to the high potential of genus *Satureja*, a model of potential distribution in Croatia was made using the maximum entropy method based on 12 climatic variables in raster form with pixel values at 1x1 km resolution. Species distribution data were determined by field research conducted during the growing seasons 2018 and 2019, and data from the *Flora Croatica Database* (FCD) were also used. Each point of species presence is assigned a pixel value of each climate variable from the *WorldClim* database. The greatest influence on habitat suitability, in the formation of models for *S. subspicata*, had the following variables: precipitation of the coldest quarter (Bio19 with 45.5%), seasonal temperature (Bio4 with 21.3%) and annual temperature range (Bio7 with 12.3%). The model shows the highest potential distribution (values 0.77 - 0.85 on a scale of 0 to 1) in the Mediterranean and sub-Mediterranean parts of Croatia, namely in the area of Čičarija, Velika and Mala Kapela, Velebit, Plješevica, Dinara and Biokovo. Considering the ecology of the genus *Satureja*, in the selection of variables for the development of habitat suitability models for *S. montana* and *S. cuneifolia* species, the variable of habitat geomorphology will be included for the whole area of species distribution.

Keywords: ecological niche, maximum entropy, *Satureja*, medicinal plants, Croatia

Otpornost populacija stakleničkog štitastog moljca na insekticide u priobalnom dijelu Hrvatske

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Sažetak

Cilj je bio testirati osjetljivost populacija *Trialeurodes vaporariorum* na insekticide. Populacije štetnika prikupljene su s biljaka iz zaštićenog prostora u priobalnom dijelu Hrvatske, od Zadra do Konavala tijekom 2018. i 2019. godine. Testovi osjetljivosti su provedeni u laboratorijskim uvjetima, a testirano je 20 populacija. U 2018. testirana je osjetljivost štetnika na aktivne tvari: deltametrin, alfa-cipermetrin, piriproksifen, imidakloprid i tiametoksam. U 2019. korištene su iste aktivne tvari, osim što je deltametrin zamijenjen lambda-cihalotrinom, a uvedena je i aktivna tvar spirotetramat. U 2018. sve populacije *T. vaporariorum* bile su rezistentne na deltametrin, alfacipermetrin i piriproksifen. Na imidakloprid jedna populacija (Metković) je bila visoko osjetljiva dok je pet populacija (Duilovo, Imotski, Obod, Podstrana i Turanj) bilo osjetljivo. Na tiametoksam bila je osjetljiva jedna populacija (Imotski). U 2019. sve populacije štetnika bile su rezistentne na lambda-cihalotrin, alfacipermetrin, piriproksifen i spirotetramat. Na imidakloprid dvije populacije (Kaštel Lukšić i Turanj) su bile visoko osjetljive dok su četiri populacije (Metković, Obod, Split-Žnjan i Zadar) bile osjetljive. Na tiametoksam bila je osjetljiva jedna populacija (Split-Žnjan). Rezultati ukazuju na uglavnom slabu učinkovitost navedenih insekticida u suzbijanju *T. vaporariorum* te nužnost uporabe integrirane zaštite od *T. vaporariorum* u cilju smanjenja njegove rezistentnosti na insekticide.

Ključne riječi: *Trialeurodes vaporariorum*, rezistentnost, insekticidi, povrće, ukrasno bilje

Insecticide resistance in greenhouse whitefly populations from coastal Croatia

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Abstract

The aim was to test the susceptibility of *Trialeurodes vaporariorum* populations to insecticides. Pest populations were collected from plants cultivated in greenhouses in the coastal part of Croatia, from Zadar to Konavle during 2018 and 2019. Sensitivity tests were conducted under laboratory conditions, and a total of 20 populations were tested. In 2018, pest sensitivity was tested for the active ingredients: deltamethrin, alpha-cypermethrin, pyriproxyfen, imidacloprid and thiamethoxam. The same active ingredients were used in 2019 except that deltamethrin was replaced by lambda-cyhalothrin and spirotetramat was introduced. In 2018, all *T. vaporariorum* populations were resistant to deltamethrin, alfacipermetrin, and pyriproxyfen. One population (Metković) was highly sensitive to imidacloprid, while five populations (Duilovo, Imotski, Obod, Podstrana and Turanj) were sensitive. Population from Imotski was sensitive to thiamethoxam. In 2019, all populations were resistant to lambda-cyhalothrin, alfacipermetrin, pyriproxyfen and spirotetramate. Two populations (Kastel Luksić and Turanj) were highly sensitive to imidacloprid, while four populations (Metković, Obod, Split-Žnjan and Zadar) were sensitive. One population (Split-Žnjan) was sensitive to thiamethoxam. The results indicate the generally low efficacy of use insecticides in the control of *T. vaporariorum* and the necessity of using IPM against *T. vaporariorum* in order to reduce its resistance to insecticides.

Keywords: *Trialeurodes vaporariorum*, resistance, insecticides, vegetables, ornamental plants

Agronomska i vegetativna svojstva kolekcije hrvatskih lokalnih ekotipova ljutike

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Sažetak

Ljutike su genetski i morfološki različite vrste roda *Allium* koje posjeduju zajednička obilježja: vegetativno razmnožavanje busenom lukovica te morfologija lučica nalik onoj običnog luka (*Allium cepa* L.). Kolekcija primki lokalnih sorti sakupljenih na području Hrvatske čuva se u kolekcijskom nasadu Instituta za poljoprivredu i turizam. Primke iz kolekcije opisane su i grupirane u tri vrste: *A. cepa* Aggregatum sa 22 primke, *A. × proliferum* sa jednom primkom, te *A. × cornutum* sa 7 primki. Praćena su vegetativna svojstva: promjer i visina busena, broj biljaka u busenu te indeks vegetacije i sadržaja klorofila. Nakon berbe zabilježena su agronomska svojstva: masa busena, broj lukovica u busenu, masa lukovice te prinos lukovica. Napravljena je analiza varijance unutar grupa (primke) i između grupa (vrste) te je utvrđena velika varijabilnost između primki u kolekciji za svojstava: vegetacijski indeks, indeksa sadržaja klorofila, promjer i visina busena, masa busena i lukovice i drugo. Primke koje pripadaju vrsti *A. cepa* Aggregatum imaju najveći promjer busena te najviši vegetacijski indeks. Najveću masu busena i broj lukovica po busenu imaju primke *A. × cornutum*. Najviši busen, najveću prosječnu masu lukovice te najviši prinos lukovica ima vrsta *A. × proliferum*. Temeljem praćenih svojstava izdvojene su primke pogodnije za uzgoj i skladištenje te one koje je nužno održati u kolekciji kao izvor biološke raznolikosti.

Ključne riječi: HNT broj, NVDI, škalonja, luk kozjak

Agricultural and Vegetative Properties of Shallot Local Landrace Accessions from Croatia

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Abstract

Shallots are genetically and morphologically different *Allium* species but possess common traits like vegetative propagation with underground bulb clusters and bulb morphology similar to a common onion bulb (*Allium cepa* L.). An ex situ collection of Croatian local is preserved at Institute of Agriculture and Tourism. Landraces in collection are described and divided into three species: *A. cepa* Aggregatum with 22 accessions, *A. × proliferum* with one accession and *A. × cornutum* with seven accessions. During vegetation bush height and diameter was measured, number of plants in the bush and vegetation and chlorophyll index. After harvest agricultural properties were measured: cluster mass, number of bulbs in the cluster, average bulb mass and bulb yield. ANOVA showed a high variability in the properties like vegetation and chlorophyll index, bush height and diameter, cluster and bulb mass and number of bulbs in the cluster between accessions belonging to one species. Accessions belonging to *A. cepa* Aggregatum species have the highest bush diameter and vegetation index values. *A. × cornutum* accessions have the highest cluster mass, number of bulbs in the bush. Highest average bulb mass and bulb yield is found in *A. × proliferum*. Analyses showed which of the accessions are suitable for further agricultural experiments regarding their yield capacity and storage quality. Accessions not suitable for production should be kept as genetic material.

Keywords: HNT, NVDI, potato onion, multiplier onion

Morfometrijska analiza epidermalnih stanica latica odabranih kultivara maćuhice (*Viola × wittrockiana* Gams)

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Sažetak

Adaksijalna epiderma latica je u mnogih kritosjemenjača građena od stanica čunjasta oblika. Smatra se da čunjaste epidermalne stanice povećavaju količinu svjetlosti koju latice apsorbiraju uslijed čega se pojačava i intenzitet boje. Osim toga, površina takvih latica može biti baršunastog izgleda što dodatno doprinosi vizualnoj atraktivnosti cvjetova. Cilj rada bio je analizirati morfometrijske karakteristike epidermalnih stanica latica različitih kultivara maćuhice (*Viola × wittrockiana* Gams) te opisati razlike s obzirom na vizualne karakteristike latica. Analize su provedene na kultivarima koji su u laticama sadržavali karotenoide (žute i narančaste latice), antocijane (plave i ljubičaste latice) ili zajedno antocijane i karotenoide (crvene latice) te na kultivaru s bijelim laticama. Kod svih istraživanih kultivara, stanice adaksijalne epiderme bile su čunjasta oblika, no njihove su se morfometrijske karakteristike među kultivarima znatno razlikovale. Kod cvjetova kojima su boju davali karotenoidi, epidermalne stanice latica bile su značajno više nego kod cvjetova kojima su boju davali antocijani. Polumjer i kut vrha stanica su znatno varirali, čak i među kultivarima koji su sadržavali istu skupinu pigmenta. Baršunastu površinu imale su samo latice tamnih boja koje su sadržavale antocijane ili su uz antocijane bili prisutni i karotenoidi.

Ključne riječi: čunjaste stanice, epiderma, latice, *Viola × wittrockiana*

Morphometric analysis of petal epidermal cells in selected cultivars of garden pansy (*Viola × wittrockiana* Gams)

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Abstract

In many angiosperm species flowers have conical cells on adaxial side of the petals. It is considered that conical epidermal cells increase the amount of light absorbed by the petal, thus enhancing the intensity of their color. However, epidermis composed of conical cells may also give a velvety appearance to the petals which further contribute to the visual attractiveness of the flowers. The aim of this study was to analyze morphometric characteristics of petal epidermal cells in different cultivars of garden pansy (*Viola × wittrockiana* Gams) and to describe differences regarding to the visual characteristics of the petals. The analyses were performed in cultivars in which petal color was due to carotenoids (yellow and orange petals), anthocyanins (blue and purple petals), their combination (red petals) or lack of both classes of pigments (white petals). In all examined cultivars, the adaxial epidermal cells were conical in shape, but their morphometric characteristics differed considerably between the cultivars. In petals containing carotenoids, the epidermal cells were significantly higher than in the petals that contained anthocyanins. The radius and tip angle of the cells significantly varied, even among the cultivars whose petals contained the same class of the pigments. The velvety surface was observed only in dark-colored petals, which contained anthocyanins, or in which carotenoids were present in addition to the anthocyanins.

Keywords: conical cells, epidermis, petals, *Viola × wittrockiana*

Biofortifikacija nanoselenom – utjecaj na mineralni sastav korijena i lista rukole

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Sažetak

U ovom istraživanju je utvrđen utjecaj biofortifikacije rukole nanoselenom na rast i razvoj te mineralni sastav korijena i lista rukole u usporedbi s konvencionalnom biofortifikacijom selenom u obliku selenata (SeO_4^{2-}). Oba oblika selena primijenjena su u četiri različite koncentracije u rasponu od 40 do 320 $\mu\text{mol m}^{-3}$. Istraživanje je provedeno tijekom 2019. godine u grijanom plasteniku s automatskom kontrolom temperature i prozračivanja u sustavu plutajućeg hidropona. Primjena nanoselena i selenata je značajno utjecala na koncentraciju N, K, Fe, Mn, Cu, K i Se u korijenu rukole. Također, oblik selena je značajno utjecao i na koncentraciju N, K i Se u listu rukole. Primjena nanoselena je rezultirala značajnim povećanjem koncentracije selena u korijenu rukole koja je bila prosječno 15 puta veća u usporedbi s biljkama biofortificiranim sa selenatom. Međutim, koncentracija selena u listu rukole je bila prosječno 8 puta veća u slučaju biofortifikacije sa selenatom. Nadalje, primjena različitih koncentracija selena kod oba oblika je statistički značajno utjecala na koncentraciju svih ispitivanih mikro- i makroelemenata u korijenu i listu rukole, osim u slučaju koncentracije K i Cu u listu. Slijedom navedenog se može zaključiti da primijenjeni oblici selena značajno utječu na usvajanje i translokaciju elemenata ishrane u rukoli. Ovo istraživanje je financirano od strane Hrvatske zaklade za znanost u sklopu projekata HRZZ IP-2018-01-8119 i HRZZ IP-2016-06-2436.

Ključne riječi: biofortifikacija, rukola, mineralni sastav, korijen, list

Biofortification with nanoselenium – influence on root and leaf nutrient status of rucola

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Abstract

In this study the influence of rucola biofortification with nanoselenium on growth and development, as well as root and leaf mineral composition compared to conventional biofortification with selenium in form of selenate (SeO_4^{2-}) was determined. Both Se forms were applied in four different concentrations ranging from 40 to 320 $\mu\text{mol m}^{-3}$. Research was carried out during 2019 in a heated greenhouse with automatic control of temperature and ventilation in a floating hydroponic system. The application of nanoselenium and selenate significantly influenced on concentration of N, K, Fe, Mn, Cu, K and Se in the rucola root as well as on the concentration of N, K, and Se in rucola leaf. Therefore, application of nanoselenium resulted in significant increase of Se concentration in the rucola root, which was averagely 15 times higher compared to plants biofortified with selenate. However, the concentration of selenium in the rucola leaf was averagely 8 times higher in the case of biofortification with selenate. Furthermore, the application of different concentrations of selenium in both forms significantly influenced on the concentration of all analysed nutrients in roots and leaves of rucola, except in the case of K and Cu concentration in the leaf. Accordingly, it can be concluded that applied selenium forms significantly influences on nutrient uptake and translocation in rucola plants. This work was supported by the Croatian Science Foundation (HRZZ) within the projects HRZZ IP-2018-01-8119 and HRZZ IP-2016-06-2436.

Keywords: biofortification, rucola, mineral composition, root, leaf

Software assisted solvent screening and extraction of bioactive compounds from Mediterranean plants with green solvents

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Abstract

Choice of an appropriate solvent is among the crucial steps in the development of a liquid liquid extraction method. The procedure can be simplified by using software for modeling and evaluation of thermodynamic properties such as COSMO-RS, which calculates a multitude of solvation parameters in the absence of experimental data. The aim of this study was to extract bioactive components from sage (*Salvia officinalis* L.) and oregano (*Origanum vulgare* L.) by solvent extraction and high power ultrasound extraction and thus experimentally evaluate the predicted solubilities of chosen bioactive components as determined by COSMO-RS and Hansen software. Samples of sage and oregano were treated by means of high power ultrasound with differing amplitude rates. Extraction of treated and untreated samples was performed in various timeframes with the following “green” solvents: water, 25% and 50% ethanol, ethyl acetate, dimethyl carbonate, limonene and α -pinene. The largest yield of total phenolics was obtained with oregano samples that were treated for 3 min, using 100% amplitude in 25% ethanol solution. Antioxidant activity is overall increased with increased ultrasound amplitude, while being highly dependent on temperature, time and extraction solvent choice. Highest antioxidant activity is noticed with 50% ethanol as solvent. The ultrasound-aided extraction method has shown higher antioxidant activity of the samples, as compared to the samples that were subjected to the conventional extraction method.

Keywords: sage, oregano, COSMO-RS, solubility prediction, antioxidant activity

Etnobotanika Istre – medicinsko i aromatično bilje

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Sažetak

Etnobotanička istraživanja u Istri kontinuirano se provode u razdoblju 2015.-2019. godine, s ciljem dokumentacije tradicionalnog ekološkog znanja lokalnih stanovnika te sadašnje upotrebe samoniklog bilja za hranu, narodnu medicinu i dr. Ovdje su izdvojeni rezultati za ljekovito i aromatično bilje 75 dubinskih polustrukturiranih intervjua (47 žena i 28 muškaraca, prosjek godina 68,1), provedenih na području SI Istre (općine Buzet, Lupoglav, Lanišće, Mošćenička Draga i Kršan). Od ukupno zabilježenih 137 vrsta ljekovito-aromatičnog bilja, najčešće spominjane i korištene vrste koje imaju jestivo-medicinsku upotrebu jesu: *Taraxacum* spp., *Urtica dioica* L., *Asparagus acutifolius* L., *Foeniculum vulgare* Mill., *Ruscus aculeatus* L., *Tamus communis* L., *Rubus caesius* L. i *Juniperus communis* L. Najčešće začinsko-medicinske vrste jesu: *Laurus nobilis* L., *Rosmarinus officinalis* L. i *Thymus longicaulis* C. Presl. Ispitanici u velikoj mjeri koriste fitoterapeutske biljke kao pomoć u liječenju simptoma: grlobolje *Salvia officinalis* L., uhobolje *Sempervivum tectorum* L., prehlade *Malva sylvestris* L. i *Sambucus nigra* L., za brže zacjeljivanje rana rod *Plantago*, protiv kožnih bradavica *Ficus carica* L., protiv bolesti kože *Hypericum perforatum* L., za reguliranje krvnog tlaka *Olea europaea* L., za želudac *Achillea millefolium* L. i *Artemisia absinthium* L., protiv dijareje *Sorbus domestica* L., *Rosa canina* L. itd. Spomenute vrste najčešće se koriste kao: čaj ili uvarak, sirup (s šećerom), odstajalo u ulju, kao kuhano jelo (maneštre, fritaje) ili dodatci jelima (začini).

Ključne riječi: tradicionalno ekološko znanje, narodna medicina, začinsko bilje, Mediteran

The ethnobotany of Istria - medicinal and aromatic plants

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Abstract

Ethnobotanical research in Istria is continuously carried out in the period 2015 - 2019, with the aim of documenting the traditional ecological knowledge of the local people, and the present use of wild plants for food, folk medicine, etc. Here are the results for medicinal and aromatic plants of 75 in-depth semi-structured interviews (47 women and 28 males, average age 68.1), conducted in the area of NE Istria (municipalities of Buzet, Lupoglav, Lanišće, Mošćenička Draga and Kršan). Of the 137 species of medicinal and aromatic plants recorded, the most commonly mentioned and used species that have edible-medicinal uses are: *Taraxacum* spp., *Urtica dioica* L., *Asparagus acutifolius* L., *Foeniculum vulgare* Mill., *Ruscus aculeatus* L., *Tamus communis* L., *Rubus caesius* L. and *Juniperus communis* L. The most common spice-medical plants are: *Laurus nobilis* L., *Rosmarinus officinalis* L. i *Thymus longicaulis* C. Presl. Respondents largely use phytotherapeutic plants to help treat the symptoms of: sore throat *Salvia officinalis* L., earache *Sempervivum tectorum* L., cold *Malva sylvestris* L. and *Sambucus nigra* L., for wound healing genus *Plantago*, against skin warts *Ficus carica* L., against skin diseases *Hypericum perforatum* L., for blood pressure regulation *Olea europaea* L., for gastric disorders *Achillea millefolium* L. and *Artemisia absinthium* L., against diarrhea *Sorbus domestica* L., *Rosa canina* L., etc. Most commonly preparations of the mentioned plants are: medicinal tea, syrup (with sugar), in oil, as a cooked meal (maneštra, fritaja) and spices.

Keywords: traditional ecological knowledge, folk medicine, spices, Mediterranean

Volatile compounds of garlic cv. 'Istarski crveni' at different harvesting dates

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Abstract

Garlic (*Allium sativum*) is an important crop grown worldwide. Sulphur-containing compounds responsible for some of its key sensory characteristics and use in gastronomy and medicine can be affected by agricultural practices. The aim of this study was to define optimal harvesting date of garlic cv. 'Istarski crveni' by comparing the amounts of volatile sulphur compounds as quality indicators. Garlic was harvested three times every two weeks during June/July 2018. Seventeen volatile compounds in total were determined by HS-SPME-GC-FID-MS analysis. No significant difference between harvest dates was observed for the major volatiles, such as diallyl trisulfide, diallyl sulfide, methyl allyl disulfide, and diallyl disulfide which represented 98.5% of all of the determined compounds. Significantly higher content of minor allyl mercaptane and thieno[2,3-b]thiophene was found in the last when compared to the first harvest date. The first two principal components PC1 and PC2 explained 78% of the total variance and pointed to certain relations between harvest dates and particular volatiles. However, it was presumed that the technological maturity had probably been reached at the first harvesting date already, since similar amounts of volatiles were found during the monitored period.

This research has been supported by the project KK.01.1.1.01.0005 Biodiversity and Molecular Plant Breeding. The work of PhD student Iva Bažon has been supported by the Croatian Science Foundation.

Keywords: agricultural practice, alliin, cultivar, gas chromatography, organosulfur compounds



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Changes in seed yield and quality resulting from lodging in Italian ryegrass crop

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Abstract

Rainfall accompanied with winds during seed maturation favour lodging of Italian ryegrass crop, which is commonly observed in farmer fields in north-western Croatia. Thus, the main objective was to determine the changes in seed yield and quality resulting from natural lodging of Italian ryegrass crop. Field trial was carried out during one growing season with three nitrogen (N) fertilization levels (60, 120 and 180 kg/ha) along with unfertilized plots. The onset of considerable natural lodging was observed before crop heading (ZCK 51) at the highest N fertilization, while lodging occurrence was delayed at lower N fertilization rates. In contrast, crop lodging was not observed in unfertilized plots during the whole growing season. Number of seeds per unit area significantly improved with N fertilization up to the rate of 120 kg/ha when crop lodging score averaged 96.2%. Lodging severity was similar (97.5%) at the highest N fertilization rate, but seed number per square meter, and consequently, seed yield was significantly reduced, which was associated with the earliest crop lodging occurrence. At harvest, moisture content in seeds as well as in vegetative parts (straw) was increased with higher N fertilization rate. In spite of higher crop lodging at harvest, the 1000-seed weight tended to increase under more intensive N fertilization. Seeds obtained from less fertilized plots had lower germination rate after 8 days, but these differences were not evident at final seedling count (after 15 days) when germination rate averaged 91.9%.

Keywords: 1000-seed weight, moisture content, nitrogen, seed germination

Morphological characteristic of domestic hull-less oilseed pumpkin seedlings regard to different pH of water solution

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Abstract

The aim of this study was to determine the influence of different pH values of water solution (pH 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5, 8.0, 8.5 and 9.0) on domestic hull-less oilseed pumpkin germination and seedlings morphological characteristic (seedling root and stem length) at 15°C. This temperature was chosen because in the time of sowing in Republic of Croatia, the optimum temperature of soil should be above 12°C. The study was conducted in the controlled conditions in the plant growth chamber. The 100 seeds of domestic oilseed hull-less pumpkin cultivar were sown in 4 replicates on the filter paper. The germination energy was determined on the 3rd day and total germination rate and seedlings morphological characteristic was determined on the 7th day. The average germination rate of oilseed pumpkin seed was 92%. The highest germination energy of this study was in acid media (3.0, 3.5 and 4.0, 57, 26 and 20% respectively), which was very significant different ($p < 0.01$) compared to other pH values. Different pH had very significant ($p < 0.01$) influence stem and root length (cm), but also on total length of seedlings. The average root length was 1.7 cm and it varied from 0.6 cm (pH 5.5) to 4.3 cm (pH 3.0), which was very significant ($p < 0.01$) in comparison with other root lengths. The average stem length was 0.6 cm. The longest stem was found at pH 3.0 and 4.0 (1.0 cm) and the shortest at pH 5.0 (0.3 cm). Generally, this study confirm that oilseed pumpkins can germinate on a wide range of pH. The average total length of domestic hull-less oilseed pumpkin was 2.3 cm, with the very significant ($p < 0.01$) differences between the means of different pH media. Gaining an improved understanding of domestic hull-less oilseed pumpkin cultivars in production Croatia can be important factor of choosing soil type for production, but even increase the area of production for improve seed yields.

Keywords: germination, domestic oilseed pumpkin, seedlings, pH, morphology

Use of ZnO nanoparticles and other conventional Zn sources to increase grain yield, grain Zn content and water use efficiency by maize

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Abstract

Zinc deficiency is an important soil constraint to crop production and a well-documented public health issue. Deficiency of Zn is quite common throughout the world in arid and semi-arid regions because solubility of Zn decreases, and fixation increases under such conditions due to high pH and low moisture content. Maize is an important cereal crop all over the world. Maize hybrids are high yielding and require more nutrients as compared to indigenous varieties. Zn is an essential micronutrient required for normal healthy growth of plants, humans and animals. Zinc acts as a co-factor in more than 300 enzymes and is involved in many physiological processes. Gene regulation for the tolerance of environmental stress also depends on Zn in plants. Zinc deficiency is the 5th major factor causing deaths in human beings in developing countries. In countries like Pakistan water scarcity is the major issue now a days, which has reduced the crop production and the quality of the produce as well. A field experiment was conducted to evaluate the effect of ZnO nanoparticles and other conventional Zn sources on yield, grain Zn content and water use efficiency in hybrid maize. Results showed that foliar application of ZnO nanoparticles increases grain yield up to 46% as compared to control treatment. Similarly, maximum increase in grain Zn content (46 mg kg⁻¹ dry matter) was also recorded with foliar applied ZnO nanoparticles under water deficit conditions. It is concluded that ZnO nanoparticles can be used as a Zn fertilizer to enhance the Zn use efficiency in Zn deficient soils. Foliar application of ZnO nanoparticles proved to be a better strategy. Increase in grain Zn content in this study showed that ZnO nanoparticle application to crops can be helpful in reducing Zn malnutrition in human beings.

Keywords: ZnO nanoparticles, maize, grain yield, grain Zn content, water use efficiency

Effect of salinity and temperature on germination and seedling growth of domestic poppy cultivar (*Papaver somniferum* L.)

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Abstract

The effects of NaCl salinity and temperatures on germination and seedlings growth were studied. There were different concentration of NaCl (0 mM (control), 50 mM, 100 mM and 150 mM) and temperatures (10°C, 15°C and 20°C) conducted. The study was conducted in the controlled conditions in the plant growth chamber. The 50 seeds of domestic poppy cultivar were sown in 4 replicates on the filter paper. The germination energy was determined on the 5th day and total germination rate and seedlings morphological characteristic was determined on the 10th day. At the 5th day germination energy was on average 28%. It was interesting to found that at the 10°C there was no germinated seeds after 5 days at all salinity treatments and also, at the salinity level of 150 mM NaCl at every temperature. The average germination rate (10th day) of domestic poppy seed was 52% and it varied from 30% (150 mM NaCl and 20°C) to 90% (0 mM NaCl and 15°C). Different salinity of water solution had very significant ($p < 0.01$) influence on stem, root and total length (cm) of seedlings. The average root length was 0.6 cm and it varied from 0.6 cm (100 mM NaCl) to 1.2 cm (0 NaCl). The average stem length was 0.9 cm. The longest stem was found at control (1,8 cm) and between 50 and 100 mM of NaCl the differences was not significant and stem length averaged 0.9 cm. Total poppy seedlings length of this study was 1.5 cm and it varied from 3.0 cm at the control to 1.6 cm at 50 mM NaCl. Regard to temperatures, there was no significant differences found in root and total length of poppy seedlings, but the differences were very significant ($p < 0.01$) for stem length. The longest poppy seedlings were measured at 20°C and 0 mM NaCl (4.9 cm), while at 10°C and at 0 or 50 mM NaCl, seedlings were less than 0.1 cm. Seeds were not germinate at all on 10°C on both, 100 and 150 mM NaCl. Generally, salinity reduced germination energy and germination rate and seedlings length. This domestic poppy cultivar was very sensitive for relatively high salt concentrations, indicating that seeds are mainly affected by osmotic stress and it is not recommended to cultivate it on soils with excess salts.

Keywords: germination, domestic poppy, seedlings, temperature, NaCl

Utjecaj gustoće sjetve i međurednog razmaka na agronomske značajke bijele lupine (*Lupinus albus* L.)

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Sažetak

Lupine su biljne vrste iz porodice mahunarki (*Fabaceae*) koje karakterizira visok sadržaj bjelančevina u zrnu i velika vrijednost u plodoredu. Na Visokom gospodarskom učilištu u Križevcima (VGUK), za potrebe poboljšanja tla, godinama se uzgaja jedna ekopopulacija bijele lupine (*Lupinus albus* L.). Cilj dvogodišnjeg istraživanja na VGUK bio je utvrditi utjecaj dvije gustoće sjetve (70 i 85 sjemenki/m²) i dva međuredna razmaka (25 i 50 cm) na masu suhe tvari kvržica, sklop biljaka u žetvi, visinu biljaka, visinu biljaka do primarnog cvata, broj mahuna po biljci, broj zrna po mahuni, masu 1000 sjemenki i prinos sjemena. Sjetva je obavljena 3. travnja u 2017. i 9. travnja u 2018. godini. Žetva je bila 8. kolovoza u 2017., a 21. kolovoza u 2018. godini. Vegetacijsko razdoblje lupine u 2017. obilježile su sušnije i toplije vremenske prilike u odnosu na višegodišnji prosjek i 2018. godinu. U obje godine istraživanja utvrđen je značajno ($P < 0,05$) veći broj biljaka u žetvi kod veće gustoće sjetve. Međutim, dok je u 2018. godini veći prinos sjemena zabilježen pri sjetvi 85 sjemenki/m² (3691 kg/ha) u odnosu na manju gustoću sjetve (3239 kg/ha), u 2017. godini su veći prinos sjemena i masa 1000 sjemenki dobiveni sa 70 sjemenki/m² (3961 kg/ha; 334,7 g) u odnosu na sjetvu 85 sjemenki/m² (3533 kg/ha; 316,5 g). U obje godine istraživanja međuredni razmak redova od 25 cm imao je značajno ($P < 0,05$) veći broj biljaka u žetvi i prinos sjemena kod bijele lupine. Gustoća sjetve i međuredni razmak nisu imali značajan utjecaj na ostale istraživane značajke kod bijele lupine. Rezultati su pokazali da gustoća sjetve i međuredni razmak imaju signifikantan ($P < 0,05$) utjecaj na prinos sjemena kod bijele lupine.

Ključne riječi: bijela lupina, gustoće sjetve, međuredni razmak, komponente prinosa

Influence of sowing density and row spacing on the agronomic characteristics of white lupine (*Lupinus albus* L.)

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Abstract

Lupins are plant species of the legume family (*Fabaceae*) characterized by high protein content in seeds and important value in crop rotation. At the Križevci College of Agriculture (KCA), for the needs of soil improvement, an eco-population of white lupine (*Lupinus albus* L.) has been cultivated for years. The aim of the two-year experiment at KCA was to determine the effect of two sowing densities (70 and 85 seeds m⁻²) and two row spacings (25 and 50 cm) on the dry matter mass of nodules, number of plants at harvest, plant height, plant height to primary inflorescence, number of pods per plant, number of grains per pod, seed weight and seed yield. Sowing was done on April 3, 2017 and April 9, 2018. The harvest was on August 8, 2017 and August 21, 2018. Vegetation period in 2017 was characterized by drier and warmer weather compared to the perennial average and the 2018 weather. In both years of the study, a significantly ($P < 0.05$) higher number of harvested plants were identified at higher sowing densities. However, while in 2018 the higher seed yield was recorded at the sowing of 85 seeds m⁻² (3691 kg ha⁻¹) compared to the lower sowing density (3239 kg ha⁻¹), in 2017 higher seed yield and weight of 1000 seeds were obtained from 70 seeds m⁻² (3961 kg ha⁻¹; 334.7 g) compared to the sowing 85 seeds m⁻² (3533 kg ha⁻¹; 316.5 g). In both years, a row spacing of 25 cm had significantly ($P < 0.05$) higher number of plants in harvest and seed yield at white lupine. The sowing density and row spacing did not have a significant influence on the other studied features of the white lupine. The results showed that sowing density and row spacing had a significant ($P < 0.05$) influence on seed yield of white lupine.

Keywords: white lupine, sowing density, row spacing, yield components

Prinos BC hibrida kukuruza u proizvodnim pokusima u 2019. godini

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Sažetak

U proizvodnoj 2019. g. obrađeno je 126 lokacija s prosječno osam BC hibrida kukuruza po lokaciji. Sjetva pokusa obavljena je na gotovo svim lokacijama u optimalnom roku, uvjeti za sjetvu su bili dobri što je dovelo do brzog nicanja i ostvarenja zadanih sklopova. Zaštita od korova, kultivacija i prihrana obavljene su u vrijeme čestih i po količini značajnih oborina, a naročito u Slavoniji. U ovom periodu akumulirane su velike rezerve vode u tlu što je pogodovalo brzom rastu i razvoju kukuruza sve do cvatnje i oplodnje, što je rezultiralo potpunom oplodnjom. U srpnju kukuruz je bio u odličnoj kondiciji i sa solidnim zalihama vode u tlu. Zadnja tri tjedna u kolovozu imamo potpuni nedostatak oborina, uz izostanak ekstremno visokih temperatura, što je bio dobar preduvjet za iznadprosječne urode. Ovakvi uvjeti doveli su do bržeg dozrijevanja kukuruza u Slavoniji i središnjoj Hrvatskoj, dok je u zapadnim dijelovima kukuruz prilično zaostajao u zriobi. Rezultati obrađenih 1179 članova svih pokusa pokazali su prosječni prinos od 11,95 t/ha, prosječni sadržaj vode u zrnu pri berbi od 18,72 % uz ostvarenje prosječnog sklopa od 68080 biljaka/ha. Prosječni sadržaj vode u berbi kod najranijih hibrida bio je 17,40 %, a kod najkasnijih 24,23 %. Što se tiče prinosa zrna zabilježeni su odlični rezultati u svim grupama dozrijevanja. Novi BC hibridi imali su znatno bolje rezultate od starijih komercijalnih hibrida. Najbolji rezultat ostvario je hibrid BC323 u Draškovcu (17,07 t/ha), BC415 u Belajskoj Poljici (17,55 t/ha), Instruktor u Belajskoj Poljici (17,06 t/ha) i Majstor u Belajskoj Poljici (17,75 t/ha).

Ključne riječi: proizvodni pokusi, kukuruz, hibridi, prinos

BC maize hybrids yield in performance trials in 2019

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Abstract

During 2019, trials on 126 locations were processed with an average of eight BC hybrids per location. The sowing of the trials was carried out in almost all locations within the optimum period, the conditions for sowing were good which led to the rapid emergence and realization of the determinate plant densities. Weed protection, cultivation and fertilization were carried out at a time of frequent and, by quantity, significant rainfall, especially in Slavonia. During this period large reserves of water were accumulated in the soil, which favored the rapid growth and development of maize until flowering and fertilization, which resulted by complete fertilization. In July, the corn was in excellent condition and with solid water supplies in the soil. In the last three weeks of August, we have a complete lack of rainfall, without extremely high temperatures, which was a good precondition for above average yields. Such conditions led to faster maize maturation in Slavonia and central Croatia, while in the western parts maize was lagging far behind in maturation. The results of the processed 1179 entries of all trials showed an average yield of 11.95 t ha⁻¹, the average grain moisture at harvest of 18.72 %, with an average plant density of 68080 plants ha⁻¹. The average grain moisture during harvest was 17.40 % for the earliest hybrids, and for the latest 24.23 %. In terms of grain yield, excellent results were reported in all maturation groups. New BC hybrids performed significantly better than older commercial hybrids. The best result was achieved by the hybrid BC323 in Draškovac (17.07 t ha⁻¹), BC415 in Belajska Poljica (17.55 t ha⁻¹), Instruktor in Belajska Poljica (17.06 t ha⁻¹) and Majstor in Belajska Poljica (17.75 t ha⁻¹).

Keywords: production trials, maize, hybrids, yield



Session

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Ribarstvo, lovstvo i pčelarstvo

Održavanje optimalne kvalitete vode u recirkulacijskom sustavu

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Sažetak

Da bi se iskoristile prednosti kontroliranog uzgojnog prostora, organizacija recirkulacijskog proizvodnog sustava zahtjeva integraciju dizajna, opreme, tehnologije i specifičnih metoda menadžmenta. Dizajn tankova treba omogućiti uklanjanje nepojedene hrane i izmeta te osigurati uvjete za prirodno ponašanje ribe. Pumpe moraju omogućiti optimalno kretanje vode, a grijači i rashlađivači održavanje željene temperature. Mehaničke čestice uklanjaju se mehaničkim filtrima, a biofiltri se koriste za aerobnu nitrifikaciju amonijaka i anaerobnu denitrifikaciju nitrata. Kisik potrošen disanjem i bakterijskom aktivnošću, kompenzira se ubrizgavanjem zraka ili čistog kisika. Visoka nasadna gustoća ribe i bakterijska aktivnost na biofiltrima uzrokuje povišenu količinu ugljičnog dioksida. Potrebno ga je ukloniti povećanjem kontaktne površine između zraka i vode što se postiže prokapavanjem vode preko različitih medija. Ugljični dioksid snižava pH pa komponenta koja održava optimalnu pH vrijednost mora biti uključena u dizajn. UV reaktor ili ozon generator su komponente za sterilizaciju neophodno potrebnu u reciklacijskim sustavima. Da bi recirkulacijski sustav efikasno funkcionirao i proizvodio ribu po kompetitivnim proizvodnim cijenama, sve navedene komponente trebaju biti maksimalno efikasne jer će, po jednostavnom pravilu, najslabija i najneefikasnija komponenta određivati učinkovitost i profitabilnost sustava i proizvodnog procesa. Infrastruktura i komponente u pravilno dizajniranom sustavu čine ga skupljim u usporedbi s tradicionalnim i konvencionalnim ribnjacima. Da bi smanjili cijenu mnogi poduzetnici i uzgajivači skloni su kompromisima koji dovode do nepravilnih i neefikasnih dizajna upotrebom neadekvatnih ili potpunim isključivanjem nekih neophodnih komponenti. U radu se navodi nekoliko takvih karakterističnih primjera.

Ključne riječi: RAS, dizajn sustava, kontrolirani uzgoj

Maintaining optimum water quality in the recirculation system

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Abstract

To take the advantage of controlled breeding environment, it is necessary to organize a recirculation system that requires integration of design, equipment and technology with specific management methods. The design of the tanks should allow for the removal of excrement and uneaten food and for natural behavior of fish. The pumps must allow for optimal movement of water, and heaters and coolers should maintain the optimum temperature. Mechanical particles are removed by mechanical filters, and biofilters are used for aerobic nitrification of ammonia and anaerobic nitrate denitrification. Oxygen consumed by respiration and bacterial activity is compensated by the injection of air or pure oxygen. High stocking density of fish and bacterial activity on biofilters causes an elevated amount of carbon dioxide. It must be removed by increasing the contact surface between air and water, which is achieved by trickling water through various media. Carbon dioxide lowers the pH of the water, so a component that adjusts the pH to the optimum value must be included in the design. UV reactors or ozone generators are components for sterilization that are indispensable in water recycling systems. For a recirculating production system to function effectively and produce fish at competitive production prices, all of these components should be maximally efficient, because, by simple rule, the weakest and most inefficient component will determine the efficiency and profitability of the whole production process. The infrastructure and components in a properly designed system make it more expensive compared to traditional and conventional farms. To reduce cost, many entrepreneurs, contractors and growers are prone to compromises that lead to irregular and inefficient designs by using inadequate, or by complete exclusion of some of the necessary components. Several characteristic examples are given in this paper.

Keywords: RAS, system design, controlled farming

Stradavanje divljači u prometu u Varaždinskoj županiji

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Sažetak

Divljač svojim slobodnim načinom života migrira dnevno i sezonski, pri čemu često prelazi preko prometnica, na kojima je svakodnevno sve veći broj motornih vozila. Posljedično tomu, sve su češći naleti vozila na životinje što dovodi do materijalnih šteta, prvenstveno zbog oštećenja na vozilima, ali i zbog stradavanja divljači. S druge strane dolazi i do tjelesnih ozljeda vozača. Navedene stavke uzrokuju znatne financijske izdatke, kako vlasnicima vozila i osiguravajućim društvima, tako i značajne poteškoće u radu lovačkih udruga i saveza, što za posljedicu ima značajne probleme u lovnom gospodarenju. U radu je opisano stradavanje divljači u prometu u razdoblju između 2014. i 2018. godine na području Varaždinske županije. Ukupno je obrađeno 884 prometnih nezgoda u kojima je sudjelovala divljač. Na površini od 127.739 ha istraživanog područja nalaze se 32 lovišta (2 državna i 30 zajedničkih). Najviše stradavanja divljači po kilometru ceste utvrđeno je na županijskim (41,63%) i državnim (35,75%) cestama. Srna obična (*Capreolus capreolus*) najčešće sudjeluje u prometnim nezgodama (80,56%), dok su ostale vrste divljači zastupljene u manjem broju. Najveći broj naleta događa se tijekom proljeća (ožujka i travanj) i tijekom jeseni (studen i prosinac), iako je rizik veliki i u ostalim godišnjim dobima. Ukupna šteta nastala nakon naleta vozila na divljač u analiziranom razdoblju iznosila je 2.613.150,00 HRK. Iz rezultata se može zaključiti da je stradavanje divljači u prometnim incidentima značajan problem koji se često valorizira samo u vidu materijalnih šteta na vozilima, dok se štete na divljači, kao i problematika otežanog lovnog gospodarenja često zanemaruje.

Ključne riječi: cesta, divljač, promet, stradavanje, štete

Game traffic accidents in Varaždin County

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Abstract

The game with free way of life migrates daily and seasonally, often crossing the roads, on which on a daily basis is increasing number of motor vehicles. As a consequence, vehicle crashes on animals are becoming more frequent, leading to property damage, primarily due to damage to vehicles, but also due to wildlife damage. On the other hand, there also driver insures. All this creates considerable financial costs, both for vehicle owners, insurance companies, and significant difficulties in the work of hunting associations and federations. All these create significant problems in hunting management. In this work will be describe the wildlife - vehicle collision in traffic in the period from 2014 to 2018 in Varaždin County. In the analysed period there were recorded 884 wildlife-vehicle collisions. In the analysed area with overall surface of 331.000 hectares there are 32 hunting grounds, 2 state hunting and 30 common hunting grounds. The highest number of wildlife-vehicle collision per road kilometre distance were recorded on state (41,63%) and county (35,75%) roads. The highest incidence of mortality (80,56%) was recorded for roe deer (*Capreolus capreolus*) while the recorded proportion of other species was low. The highest number of collisions is recorded during the spring (March and April) and autumn (November and December) although high risk was recorded in other seasons as well. Total damage to vehicles in analysing period was 2.613.150,00 HRK. We can conclude that game – vehicle collisions are a significant problem, but they are often valorised only in the form of material damage on vehicles, while damage on game, as well as the problems of difficult hunting management, are often neglected.

Keywords: accidents, damage, game, roads, traffic

Zec kao bioindikator onečišćenja okoliša teškim metalima

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Sažetak

Metali su prirodno prisutni u okolišu, ne razgrađuju se, već kruže u prirodi u različitim oksidacijskim i kemijskim oblicima. Antropogeni procesi (urbanizacija, industrijalizacija, promet, poljoprivreda) dovode do povećanja koncentracija teških metala u okolišu. Zbog štetnog utjecaja na zdravlje ljudi, životinja i biljaka, sve više raste zabrinutost zbog povećanja njihovih prisutnosti u okolišu. Posebno su opasni toksični teški metali (As, Cd, Hg i Pb) koji negativno utječu na organizme i izazivaju pojavu bolesti. Kroz hranidbene lance teški metali se prenose s niže na višu hranidbenu razinu i bioakumuliraju se u određenim tkivima. Za provođenje biomonitoringa posebno su korisne divlje životinje koje se hrane prirodnom hranom i zato pružaju najbolje informacije o zagađenosti staništa. Vrste koje su široko rasprostranjene, visokih brojnosti populacija, vjerne staništu te koriste mali životni prostor, poput zeca, pokazale su se najbolje za biomonitoring. U radu se pregledom dostupne literature stavlja naglasak na zeca kao bioindikatora onečišćenja okoliša teškim metalima. Za provođenje biomonitoringa te kao organi za analizu te procjenu zagađenosti najčešće se koriste jetra i bubreg zeca. Literaturni podaci upućuju da zečevi koji obitavaju na zagađenom staništu imaju više koncentracije teških metala u tkivima nego oni s referentnog staništa. Arsen se akumulira najviše u noštima i kosi čovjeka, Cd u bubregu, Hg u mozgu i bubrezima, Pb u mozgu i dijafragmi. Starenjem jedinke povećavaju se koncentracije Cd i Hg u jetri i bubregu zeca, ali ne i Pb. Meso zeca je u većini zemalja sigurno za ljudsku prehranu, dok se korištenje iznutrica ne preporuča.

Ključne riječi: antropogeni utjecaj, bioakumulacija, biomonitoring, teški metali, zec

Hare as a bioindicator of environmental pollution by heavy metals

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Abstract

Metals are naturally present in the environment, do not decompose, but circulate in nature in different oxidation and chemical forms. Anthropogenic processes (urbanization, industrialization, transport, agriculture) lead to increased concentrations of heavy metals in the environment. Due to adverse impact on human, animal and plant health, there is growing concern about their accumulation in the environment. Toxic heavy metals (arsen, cadmium, mercury and lead) negatively affect the organisms and cause disease. Through nutrition chains heavy metals are transferred from the lower to the higher nutritional level and bioaccumulate in certain tissues. Wild animals are useful for biomonitoring because they feed on natural food and therefore provide the best information on habitat pollution. According to other research, species like hare fit the best for the requirements of biomonitoring because they're widespread, of high abundance, site fidelity, and uses a small home range size. The review of available literature emphasizes the hare as a bioindicator of environmental pollution by heavy metals. Liver and kidney are the most commonly used hare tissues for biomonitoring. Hares from contaminated habitats have higher concentrations of heavy metals in tissues than those from the reference habitat. Arsen accumulates mostly in human nails and hair, cadmium in kidney, mercury in brain and kidney, lead in brain and diaphragm. Aging of an individual increases the concentrations of cadmium and mercury in the hare liver and kidney but not lead. Hare meat is safe for a human consumption in the most countries, while offal use is not recommended.

Keywords: anthropogenic influence, bioaccumulation, biomonitoring, heavy metals, hare

Infrared (FTIR) spectral features of honey bee (*Apis mellifera* L.) hemolymph

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Abstract

Hemolymph is a colorless or slightly yellowish liquid of the open circulatory system of the honey bee (*Apis mellifera* L.) which represents a functional equivalent of vertebrate blood and lymph. It has a complex chemical composition and contains water, numerous proteins, amino acids, carbohydrates (glucose, fructose, trehalose) and lipid-based components. Understanding the biochemical features of the hemolymph is of great importance as it reflects the physiological state of honey bee organism. The aim of this study was to determine the overall biochemical composition of honey bee hemolymph based on chemical characterization using Fourier transform infrared (FTIR) spectroscopy. Individual hemolymph samples (~4-5 µL/bee) of two age groups of workers (newly emerged bees-1 day old, n=31; foragers-42 days old, n=18) were collected by extraction from the thorax after removing the legs (to avoid contamination with nectar and/or gut content that often occurs when applying other extraction methods) using 10 µL glass microcapillary tubes. The IR spectra of individual hemolymph samples were analysed by FTIR-ATR (Attenuated Total Reflectance) recording technique. The results have revealed a unique IR chemical fingerprint of honey bee hemolymph. Characteristic age-related spectral features indicating compositional variations between newly emerged bees and foragers were observed. The major differences were reflected in the higher proportion of proteins, amino acids and lipid-based components in the hemolymph of newly emerged bees compared to foragers hemolymph. Contrary, it was observed that foragers hemolymph contains higher amount of water and carbohydrates which can be associated with age/task relating metabolic changes - foraging activity (nectar collection).

Keywords: honey bee, hemolymph, FTIR-ATR spectroscopy, chemical characterization

Conflicts at fishponds: water bird hunting versus nature conservation in Poland

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Abstract

Poland has rich hunting traditions. Currently in Poland, there are 123 thousands hunters gathered in the Polish Hunting Association. They run wildlife management, ecological education, feeding of animals in the winter and manage of population of conflict species. In Poland, the list game animals includes 32 species of animals. Among them are 13 species of birds, including 8 species associated with typical aquatic environments. These are: Greylag goose (*Anser anser*), Bean goose (*Anser fabalis*), White-fronted goose (*Anser albifrons*), Mallard (*Anas platyrhynchos*), Tufted duck (*Aythya fuligula*), Eurasian Teal (*Anas crecca*), Common Pochard (*Aythya ferina*) and Coot (*Fulica atra*). In Poland are culled approximately 100 thousands of wild ducks and 10-15.5 thousands wild geese yearly. In July 2019 appeal to the Ministry of the Environment was addressed to urgently remove: Tufted duck, Eurasian Teal, Common Pochard and Coot from the list of game and to grant them strict species protection. In addition, a many of changes which can seriously make hunting difficult were proposed in Polish Hunting Law. In late August 2019, the Ministry of the Environment, in response to the appeal, stated that introduction of changes in the list of game birds and in the Hunting Law were not intended. Details of this problem which, if escalated, may have very serious impact on wildlife management in Poland on wetlands, will be presented.

Keywords: wildlife management, water birds, game animals, Poland

Application of molecular genetic tools in Hungarian aquaculture and fish gene conservation

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Abstract

Overfishing, stocking, pollution and various human activities are inducing changes in genetic resources (diversity or variation and distribution) of fish species all over the world. Not only the cultured, but the natural and endangered populations are also strongly affected. The molecular genetic studies of wild and bred populations offer the possibility of long term management of fisheries' resources. In Hungary, several molecular genetic marker-based programs were established for cultured, native and invasive species or populations (e.g.: African catfish, pikeperch, Volga perch, Prussian carp) to investigate the genetic background and to establish and maintain live gene banks or production stocks. We are presenting an overview of our most relevant results for Hungarian aquaculture and fish gene conservation.

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Keywords: Molecular genetic markers, gene conservation, population, aquaculture

Trofejna vrijednost srneće divljači na području Osječko-baranjske županije

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Sažetak

U radu su opisani rezultati trofejne analize srnjaka odstrijeljenih u zajedničkim lovištima na području Osječko-baranjske županije. Analizom 1342 odstrijeljena srnjaka starosne dobi od dvije do osam godina utvrđeno je da je najviše srnjaka odstrijeljenih u četvrtoj (280), a najmanje u drugoj (38) i osmoj (40) godini života. Utvrđeno je da su kapitalna grla u prosjeku bila 6,2 godine starosne dobi. Srnjaci koji su osvojili zlato (130+ CIC točaka) prosječno su stari 6,4 g., a najmlađi srnjak je bio star 5 g. Srebrnu medalju (115 - 129,99) osvojili su srnjaci u prosjeku starosti 6,5 g., dok je najmlađi bio star 4 godine.. Srnjaci koji su osvojili broncu (105 - 114,99) bili su prosječne starosti 6,1 g., a najmlađi 4 godine. Prema rezultatima može se zaključiti da je u prosjeku potrebno 6 g. kako bi se uzgojilo kapitalno grlo. Usporedbom prosječne trofejne vrijednosti za pojedinu dobnu skupinu utvrđeno je da srnjaci stari 2 g. imaju prosječnu trofejnu vrijednost 55,67 CIC točaka, srnjaci od 3g. 73,40 točaka, srnjaci od 4 g. 79,56 točaka, srnjaci od 5 g. 86,82 točaka, srnjaci od 6 g. 90,58 točaka, srnjaci od 7 g. 95,66 točaka, te srnjaci od 8 g. imaju prosječnu trofejnu vrijednost 95,91 CIC točke. Rast prosječne trofejne vrijednosti u razdoblju od 2. do 5. godine trostruko je veći u usporedbi s rastom vrijednosti trofeja od 5. do 8. godine života. Analizom je utvrđeno da je 533 srnjaka odstrijeljeno u dobi od 4-5 godina, te 244 u dobi od 3 godine što nam govori da je najmanje 48% odstrijeljenih srnjaka krivo procijenjeno i nisu trebali biti odstrijeljeni prije gospodarske zrelosti koju u Osječko-baranjskoj županiji postižu sa 6 godina. Iz ovoga proizlazi da postoji prostor i potreba za edukaciju o uzgojnom selekcijskom odstrjelju i procjeni dobi kod srneće divljači, u cilju postizanja većeg broja kapitalnih primjeraka divljači na istraživanim staništima.

Ključne riječi: trofejna vrijednost, srneća divljač, Osječko-baranjska županija

Trophy value of roe deer in the Osijek-Baranja County

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Abstract

This paper describes the results of trophy analysis of roe deer killed in common hunting grounds from the Osijek-Baranja County. Based on the analysis of the 1342 roe deer, aged two to eight years, it was found that the most of them were killed in the fourth year of age (280) and least in the second (38) and eight (40) years of age. Capital specimens were found to be 6.2 years of age on average. Deers that won gold (130+ CIC points) were old 6.4-year average, and the youngest deer was 5-year-old. The silver medal (115 - 129,99 CIC points) were won by roe deers on average 6.5 years old, with the youngest being 4 years of age. The bronze medal (105 - 114.99 CIC points) won roe deers of average age 6.1 year, and the youngest one was 4 years old. From this data we can conclude that it takes on average 6 years to grow a capital specimens. Comparing the average trophy value for each age group, it was determined that the roe deer of age 2 years have an average trophy value of 55.67 CIC points, roe deer of age 3 years have average 73.40 points, 4 years roe deer has 79.56 points, 5 year roe deer has 86.82 points, 6 year roe deer has 90.58 points, roe deer of 7 years has 95.66 points, and roe deer of 8 years has an average trophy value of 95.91 CIC points. The growth of the average trophy value in the period from 2 to 5 years is three times higher compared to the growth of the value of trophies from 5 to 8 years of age. Based on the results, of the analysis of the trophy value, 533 roe deer were killed at the age of 4-5, and 244 at the age of 3, which indicates that at least 48% of the roe deer were misjudged and should not have been shot before the economic maturity they reach in Osijek-Baranja County, which is at 6 years old of age. According to this, there is a room and need for education on breeding production and estimation of age in roe deer, in the purpose of obtaining more capital specimens of wild game in researched habitats.

Keywords: trophy value, roe deer, Osijek-Baranja County

Kukci kao izvor bjelančevina u hranidbi lubina *Dicentrarchus labrax*

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Sažetak

Akvakultura značajno ovisi o podrijetlu i kvaliteti hrane namijenjene hranidbi riba. Jedna od glavnih opaski akvakulturi kao industriji jest značajna potrošnja ribljeg brašna i drugih morskih proteinskih izvora. Potičući ekonomsku i okolišnu održivost, potraga za učinkovitim nadomjescima ribljeg brašna glavni je prioritet industrije, s perspektive održivosti zaliha prirodnih ribljih populacija koje se koriste kao izvor ribljeg brašna. Posljednjih godina, novi izvori proteina uključuju i druge sastojke, kao što su nusproizvodi prerade ribe i peradi, insekti i alge, koji su pokazali obećavajuće rezultate usmjerene na optimalni rast ribe. Nakon prihvaćanja Uredbe Europske komisije (2017/893/EU) u kojoj je dopuštena uporaba prerađenih proteina kukaca u hrani za životinje u akvakulturi, nekoliko značajnih istraživačkih projekata EU-a povećalo je znanje o potencijalu novih vrsta kukaca. Lako su probavljivi, bogati proteinima, aminokiselinama, vitaminima i mineralima i ostavljaju mali ekološki trag. Upotreba proteina insekata u marikulturi na području Sredozemlja je još uvijek u ranoj fazi razvoja. U predmetnom istraživanju, djelomična zastupljenost kukca *Hermetia illucens* u stadiju ličinke i/ili nusproizvoda od peradi u hranidbi lubina testirana je u odnosu na svojstva hrane biljnog i ribljeg podrijetla, ocjenjujući performanse rasta i iskorištenje proteina kod lubina tijekom šestomjesečnog pokusa u kontroliranim uvjetima. Dobiveni rezultati pokazali su značajan pozitivan učinak hranidbe hranom koja sadrži proteine kukaca i peradi na rast ribe, upućujući kako istraživani alternativni izvori proteina mogu djelomično zamijeniti riblje brašno bez negativnih učinaka na rast riba u uzgoju. Istraživanje je financirano iz projekta Interreg AdriAquaNet.

Ključne riječi: Marikultura, alternativni izvori proteina, rast, lubin, održivost

Insects as a protein source in the diet of European seabass *Dicentrarchus labrax*

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Abstract

Aquaculture depends significantly on the nature and quality of the fish feed used. One of the main criticisms of aquaculture is the need to use significant amounts of fish meal, and other marine protein sources, in such feed. To cope with the economic and environmental sustainability, search for efficient fishmeal substitutes is a primary priority for the aquaculture industry as far as the sustainability of wild fish stocks used as fishmeal source, is concerned. In recent years, new protein sources include other ingredients such as fish by-products, poultry by-products, insects and algae, which showed promising results toward optimal fish growth. After adaptation of the European Commission Regulation (2017/893/EU) in which use of insect processed animal proteins in feed for aquaculture animals is allowed, several important EU research projects increased knowledge on the potential of new insect species as aquafeed. They are easily digestible, rich in proteins, amino acids, vitamins and minerals, and leave small ecological footprint. Up to now, utilisation of insect meal in the Mediterranean mariculture is still in the early development stage. In present study, partial inclusion of *Hermetia illucens* at the larval stage as insect meal and/or poultry by-products meal in the seabass diet was tested versus vegetable and fish based diet, evaluating fish growth performance and protein utilization during the six month feeding trial in the controlled conditions. The results obtained showed a significant positive effect of diet containing insect and poultry by-products meal on the growth of the fish, pointing that alternative protein sources can partially replace fishmeal without negative effects on the growth efficiency. This work has been financed through the Interreg AdriAquaNet project.

Keywords: Mariculture, alternative protein sources, growth, European seabass, sustainability

Differentiating fish origin with morphometrics toolbox

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Abstract

The initial behavioral response of fish to anthropogenic disturbance in wild is often reflected by greater rates of phenotypic changes that differ in a suite of physiological and morphological traits in comparison to those associated with more 'natural' contexts. Depending on the species, these population level changes can occur over a short period of time and may be observed even after first generation cycle making them more adaptable to the novel environmental circumstances. Morphometrics provide a complementary toolbox for stock identification since it can reveal patterns of life history that vary among subpopulations, indicating limited movement between groups and possible genetic variation. In this study, we validated the application of analytical image processing tools to discriminate external appearance and morphology of gilthead seabream originating from wild and human-mediated environments in the eastern Adriatic Sea. Significant differences in body, otolith and scale shapes were recorded with geometric morphometrics and outline methods whereas intensity-based registration techniques were used to extract dark to silvery-grey colour spectrum as the one that differentiated the most between the origins of gilthead seabream. Such comprehensive approach to the differentiating seabream origin provided the bases upon which better management and conservation of different populations can be established and monitored in the future.

Keywords: morphometrics, fish origin, phenotype

Distribution of anchovy eggs stages during the day along the eastern Adriatic Sea

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Abstract

The aim of the research was to define the spatiotemporal distribution of anchovy eggs which should bring us closer in defining the area of anchovy spawning. Scientific survey was done with research vessel "Bios Dva" along the eastern Adriatic Sea from 24 June - 13 July 2019. Ichthyoplankton samples (n=60) were collected using a WP2 sampler (mouth opening, 0.255 m²; mesh size, 0.2 mm) from 7 AM to 20 PM. Standard vertical plankton tows were made to a depth of 100 m or to 5 m above the seabed in marine areas with less than 100 m depth. Plankton samples were immediately filtered and preserved in 96% ethanol. In the laboratory, under the binocular microscope, anchovy eggs from the ichthyoplankton samples were isolated, staged and counted. Their abundance was standardized to numbers per square metre. Out of 60 collected ichthyoplankton samples, the presence of anchovy eggs was noted in 47 stations, while their abundance per station varied from 3.92 to 188.24 eggs/m². Average time of anchovy egg incubation from fertilization to hatching (Do), due to measured sea temperatures at depth of 5 m (24.6±1.67°C), on the eastern side of the Adriatic was Do=1.28±0.17 days. Distribution of anchovy eggs by the hour of capture was bimodal, revealing that majority of anchovy eggs were obtained in samples collected from 9-10 AM (21.5%) and 17-18 PM (17.5%). In each ichthyoplankton sample containing anchovy eggs, they were usually in several different stages. So, according to analysed data, it seems that anchovy egg stages from I-IV were found before and the stages from V-IX (with exception of stages VIII and X) after the midday.

Keywords: small pelagics, early life stage, eastern Mediterranean

Growth performance of African catfish (*Clarias gariepinus*) fed with low fish-meal feed

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Abstract

Growth performance of African catfish (*Clarias gariepinus*) was investigated in half-industrial scale in a flow-through system. 16 females and 18 males were selected as breeders and offspring were fed with a widely used commercial feed (Feed 1) and an experimental feed with low fish-meal content (Feed 2). Fish weight was measured on 1846 market-sized individuals, 8 month post hatching and data analysis was performed by R version 3.5.3. The effect of feed and sex on body mass was evaluated by Welch two sample t-test ($p < 0.05$) with the following results: the average weight was 1261.43 ± 492.32 g for females and 1244.32 ± 541.35 g for males with no significant difference found between sexes. However, the effect of feed on final fish weight was significant with an average weight of 1461.60 ± 490.34 g and 1180.26 ± 501.58 g for Feed 1 and Feed 2, respectively. Additionally, significant interaction ($p < 0.001$, $r^2 = 0.069$) between feed and sex was found by ANOVA analysis, suggesting that sex might affect the utilization of different feeds. Further research on positive selection for an African catfish line for better utilization of low fish-meal feeds is recommended.

The work is supported by the the ÚNKP-19-3- I new national excellence program of the ministry for innovation and technology, the EFOP-3.6.3-VEKOP-16-2017-00008 project and iFishIENCi project (European Union's Horizon 2020 research and innovation programme under grant agreement No 818036) co-financed by the European Union and the European Social Fund. The work is also supported by the Fisheries Operative Programme III. axis „European Fisheries Fund for Renewable Fisheries” provided by the EU and Hungary.

Keywords: African catfish, *Clarias gariepinus*, low fish-meal, growth, feed

Odnos metilja *Fascioloides magna* i srne obične (*Capreolus capreolus*) kao aberantnog nositelja

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Sažetak

Od prvoga otkrića na europskom tlu u jetrima wapiti jelena, prije gotovo 150 godina, veliki američki metilj (*Fascioloides magna*) je proširio područje svoje rasprostranjenosti. Dolaskom u iznimno pogodnu plavnu nizinu rijeke Dunav, *F. magna* se razmjerno brzo proširio u većinu okolnih zemalja uključujući i Hrvatsku. Za održavanje životnog ciklusa ovaj parazit treba posrednika i nositelja. Pri tome je najpogodniji posrednik barski puž (*Galba truncatula*), a konačni nositelji se dijele na tipične, aberante i nositelje tipa „slijepa ulica“. Pri tome je srna obična jedan od aberantnih nositelja, čiji je odnos s metiljem izrazito nepovoljan te u pravilu rezultira uginućem nositelja već i pri invaziji jednim metiljem. Od prvoga otkrića ovog metilja u jelena običnoga na području Šeprešhat do danas zabilježen je razvidan pad brojnosti srneće divljači koji koincidira sa širenjem metilja, te se predmnijeva kako je upravo *F. magna* jedan od razloga za pad brojnosti srna. Cilj ovoga rada bio je prikazati prevalenciju i značajke fasciolidoze srneće divljači te značajke lovišta u kojima je službeno zatražena obustava lova na srnu običnu. Prema podatcima Ministarstva poljoprivrede u lovnoj sezoni 2019./2020. zatražena je zabrana lova na srnu običnu zbog smanjene brojnosti u 18 lovišta. Od toga je 5 lovišta na području Sisačko-moslavačke županije, 5 na području Bjelovarsko-bilogorske županije, 3 na području Osječko-baranjske županije, 2 na području Brodsko-posavske županije te po 1 na području Zagrebačke, Virovitičko-podravске i Vukovarsko-srijemske županije. Tijekom istraživanja je utvrđena prevalencija od 17,6%. Pri tome treba imati na umu kako je srna kao teritorijalna životinja različito ugrožena u ovisnosti o osobitostima tla, reljefu i prisutnosti vodotoka te zadržavanju jelena na pojedinim područjima u lovištu. Prema prijašnjim istraživanjima fasciolidoza jelenske divljači je u jakoj ovisnosti o klimatskim čimbenicima, primarno količini oborina i prisutnosti vode na tlu. S obzirom na izrazito negativni ishod invazije u srne obične neophodno je pratiti razvoj odnosa nositelj-parazit te poduzeti mjere za kontrolu fasciolidoze jelena običnoga kako bi se smanjio pritisak na okoliš te time posredno i na srnu običnu. Rad je potpomognut sredstvima Hrvatske zaklade za znanost, projekt 8963 "Interakcija nositelj-parazit: odnos tri različita tipa nositelja prema metilju *Fascioloides magna*".

Ključne riječi: srna obična, *Fascioloides magna*, zabrana lova, odnos nositelj-parazit

Relationship between the trematode *Fascioloides magna* and roe deer (*Capreolus capreolus*) as aberrant host

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Abstract

Since its first description on the European soil in the livers of the wapiti deer, almost 150 years ago, large American liver fluke (*Fascioloides magna*) have, not just maintained, spread over substantial part of the continent. Reaching the favourable, flooded valleys of the Danube River, *F. magna* have spread quickly to majority of neighbouring countries, including Croatia. To maintain its life cycle this parasite requires intermediate and final host. The most suitable intermediate host is water snail (*Galba truncatula*), while final hosts can be divided into typical, aberrant and dead-end. Roe deer is aberrant host, whose interaction with parasite is extremely untoward, resulting mainly in death of the host, even in a single-fluke infection. Since the first description of *F. magna* in red deer from Šeprešhat area, a clear decline in roe deer population is observed. This decline coincides with the spread of the fluke, and *F. magna* stands as one of the factors that has led to this situation. Aim of this study was to present the prevalence of infection, characteristics of the roe deer fascioloidosis and characteristics of the hunting grounds where official ban of roe deer hunting was requested. According to the data of the Ministry of Agriculture ban of roe deer hunting was requested in 2019/2020 season in 18 hunting grounds, due to the observed decline in roe deer population. Of that 5 hunting grounds are on the area of Sisak-Moslavina and Bjelovar-Bilogora County, 3 on the area of Osijek-Baranja County, 2 on the area of the County of Brod and Posavina and 1 on the area of Zagreb, Virovitica-Podravina and Vukovar-Srijem County. Recorded prevalence of infection was 17.6%. It must be considered that roe deer as territorial animal is under different risk of infection, depending on the characteristics of the soil, relief and presence of the water streams. According to the previous research red deer fascioloidosis is strongly related to climatic factors, namely precipitation and presence of the water on the ground. Due to the extremely negative outcome of the infection in roe deer it is necessary to follow development of the host-parasite interactions and apply measures to control red deer fascioloidosis in order to reduce environmental pressure and by that the consequent risk for roe deer. Study was fully supported by the Croatian Science Foundation grant 8963 "Host-pathogen interaction: differences in relation between three types of hosts to *Fascioloides magna* infection".

Keywords: roe deer, *Fascioloides magna*, hunting ban, interaction host-parasite

Influence of microplastics on metabolic health of the Mediterranean mussels (*Mytilus galloprovincialis* Lamarck, 1819)

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Abstract

The objectives of this research were to examine the levels of microplastics contamination in Mediterranean mussels (*Mytilus galloprovincialis* Lamarck, 1819) and to examine the impact microplastics have upon its health. In addition to human health, microplastics can provide a cost to aquaculture, by potentially impacting the growth rates of the mussels. The samples were selected from both the wild (Zvončac bay, N=20) and commercially raised populations (Marina bay, N=20) to compare levels of microplastics and indices of metabolic fitness. Activities of two enzymes involved in metabolic energy production, citrate synthase and lactic dehydrogenase were examined. The analysis showed multiple types of microplastics in mussels, including fragments (1,02 MP/g in farmed and 2,2 MP/g in wild) and pellets (0,37 MP/g in farmed and 0.35 MP/g in wild). The results showed that there was no significant difference between the wild and farmed mussels in enzyme activities. More comprehensive research should be conducted on microplastics effect on mussel metabolic health.

Keywords: microplastics, Adriatic Sea, mussels, enzyme activities, *Mytilus galloprovincialis*

Impact of the collectors' position on collected honeybee venom weight

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Abstract

Honeybee venom, a product of honeybees' venom glands, is a complex mixture of proteins, peptides, enzymes, biogenic amines, pheromones and other biologically active components. Honeybee venom is usually collected using collectors placed outside of the hive, at the hive entrance. Honeybee venom collected under these conditions has a significant amount of impurities, and collected venom weight, as well as the concentration of melittin, a major venom component, varies greatly. Therefore, different collecting conditions were investigated in order to increase the quality and the weight of collected venom. The aim of this study was to evaluate the impact of the collectors' position on collected honeybee venom weight. Collection was performed in 12 hives, six collectors were placed outside of the hive and six inside the hive. Period of electrostimulation lasted for 30 minutes and the collection was performed three times within 15 days. The results showed significant differences in collected venom weight depending in the collectors' position. Average collected venom weight on collectors placed inside the hive was 0.13 ± 0.07 g while the collected weight on collectors placed outside of the hives was 0.03 ± 0.03 g. Total weight of honeybee venom collected was 2.40 g on inside collectors and 0.53 g on outside collectors. Further studies should include determination of melittin content in honeybee venom samples collected in different conditions to evaluate possible impact on collectors' position on melittin concentration in venom.

This work has been supported by Josip Juraj Strossmayer University of Osijek under the project UNIOS-ZUP 2018-9

Keywords: bee venom, collecting conditions, collected weight

The use of the hybrid tiger trout as a recipient for interspecific transplantation of spermatogonia

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Abstract

The hybrid tiger trout (*Salmo trutta m. fario* × *Salvelinus fontinalis*) was used as a recipient for the interspecific transplantation of spermatogonia isolated from the rainbow trout (*Oncorhynchus mykiss*). Transplantation of early-stage germ cells such as primordial germ cells, spermatogonia or oogonia offers a viable solution to the conservation of genetic resources in fish, however, finding a suitable recipient can be challenging. The recipient should be related to the donor, easy to spawn and preferably sterile. The hybrid tiger trout is known to comply with these, however, it has never been tested as a recipient. Spermatogonia were isolated from the surgically removed testes of 1 year-old rainbow trout males and microinjected into 5-6 day-old tiger trout larvae in February and March, 2017. Recipient larvae were then grown to sexual maturity. Due to high mortalities, only 15% survived to May, 2017 and 4% until December, 2018 when one male was found spermiating during a routine check-up. Sperm and fin clips were collected from the given individual for genetic analysis. The sperm was also used to fertilize the eggs from a rainbow trout female. The hatch rate of eggs was 75%, while the emergence rate was 58%. Genetic analysis of sperm collected from the tiger trout recipient as well as that of the larvae proved them to be rainbow trout.

The work was supported by EFOP-3.6.3-VEKOP-16-2017-00008 project. The project is co-financed by the European Union and the European Social Fund.

Keywords: trout, spermatogonia, hybrid, transplantation

U društvu pčela

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Sažetak

S ciljem edukacije o tehnologijama u pčelarstvu i metodama biotehnologije koje se primjenjuju kod analize meda osmišljen je muzejski edukativni program „U društvu pčela“ namijenjen različitim ciljnim skupinama. Edukativni program temelji se na muzejskim predmetima Tehničkog muzeja Nikola Tesla (TMNT), prethodno osmišljenim i provedenim edukativnim radionicama TMNT-a te na suvremenim tehničkim i biotehničkim spoznajama o pčelarstvu s posebnim osvrtom na uzgoj medonosnog bilja, laboratorijski rad i analize meda sukladno zakonskim propisima. Ovaj program čine interdisciplinarne pedagoške radionice s temama: sadnja i uzgoj medonosnog bilja, u košnici i vrcanje meda, botaničko i zemljopisno porijeklo meda, formiranje i dizajn deklaracije proizvoda. Tijekom radionica koriste se prostori Muzeja - postav muzeja s košnicama i živim pčelama te vrt s medonosnim biljem koji je uspostavljen u okviru ovog programa. Radionice su osmišljene na način da čine zasebne cjeline, ali se mogu pohađati i kao cjeloviti program. Tako se npr. u prvoj radionici uspostavljanja vrsta medonosnog bilja koriste vrste kao kadulja (*Salvia officinalis* L.), agrumi (*Citrus* spp.), uljana repica (*Brassica napus* L.) i vrijesak (*Calluna vulgaris* L.), a u kasnijim radionicama se med spomenutog botaničkog porijekla koristi za demonstriranje fizikalno – kemijske i peludne analize meda.

Ključne riječi: pčelarstvo, medonosno bilje, muzejski predmeti

In the company of bees

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Abstract

Museum educational programme „In the company of bees“ aimed at different groups of visitors was developed / designed with an objective to educate on beekeeping technologies and biotechnology methods used in honey analysis. Educational programme is based on: museum objects of the *Technical Museum Nikola Tesla* (TMNT) previously designed and implemented educational workshops in TMNT and on modern technical and biotechnical knowledge on beekeeping with special attention on the cultivation of melliferous plants, laboratory work and honey analysis in accordance with Legislation. This programme consists of the interdisciplinary pedagogic workshops on the following themes: Planting and growing of melliferous plants; In the beehive and Harvesting and extracting honey; Botanical and geographical origin of honey; Formation and design of product declaration. During workshops Museum spaces are used - a museum display with hives and live bees and the garden with melliferous plants which was designed in the Museum courtyard within this programme. The workshops are designed to form separate entities but can also be attended as a complete periodical programme covering all of the themes. For example, during the first workshop on creating the garden with melliferous plants, species such a sage (*Salvia officinalis* L.), citrus fruits (*Citrus* spp.), rapeseed (*Brassica napus* L.) and heather (*Calluna vulgaris* L.) are used. In later workshops the honey of the aforementioned botanical origin is used for demonstration of physicochemical and pollen analysis of honey.

Keywords: beekeeping, melliferous plants, museum objects

GPS telemetrija introduciranog jelena običnog (*Cervus elaphus*): rezultati preliminarnog istraživanja u Središnjoj Hrvatskoj

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Sažetak

Telemetrijska istraživanja u Republici Hrvatskoj još nemaju konkretnu primjenu u gospodarenju jelenom običnim *Cervus elaphus* koji ima izuzetno važnu ekološku i socio-ekonomsku ulogu u ekosustavu. U ovom istraživanju analizirani su telemetrijski podaci prikupljeni kroz prvi GPS monitoring introduciranog jelena običnog na području Banije u Sisačko – moslavačkoj županiji. Tijekom 2018./2019. godine, GPS telemetrijskim ogrlicama označeno je 5 farmski uzgojenih jedinki jelena običnog (4 ženke, 1 mužjak) kako bi se dobio uvid u područja obitavanja. Pri usporedbi s ostalim istraživanjima, rezultati ukazuju da su područja obitavanja introduciranih jedinki bila znatno veća, krećući se od 1.773,00 - 5.553,00 ha za ženke i 38.612,00 ha za mužjaka (definirano 95% kernelovom procjenom gustoće). Zanimljivo, sve jedinke su uspostavile stabilna i značajno manja područja obitavanja otprilike 30 dana nakon introdukcije. Mogući razlog takvog neuobičajenog prostornog ponašanja introduciranih jedinki je stres uzrokovan puštanjem životinja iz farmskog uzgoja u otvoreno stanište. Kako bi se dobila objektivnija slika područja obitavanja navedenih jedinki, buduće analize bi trebale obuhvatiti duži vremenski period i uključiti prirodne i antropogene čimbenike koji potencijalno mogu utjecati na ekologiju kretanja jelena običnog.

Ključne riječi: Cervidae, ekologija kretanja, GPS telemetrija, papkari, translokacije

GPS telemetry of introduced red deer (*Cervus elaphus*): results of a preliminary study in central Croatia

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Abstract

The telemetry studies in the Republic of Croatia still haven't found specific application in the management of red deer *Cervus elaphus* which has an extremely important ecological and socio-economical role in the ecosystem. In this research, we analysed the telemetry data obtained from the first GPS monitoring of introduced red deer in the Banija region of Sisak-Moslavina County. During 2018/2019 season, GPS telemetry collars were deployed on 5 farmed red deer individuals (4 females, 1 male) to provide insights into home ranges. The results showed that home ranges of introduced individuals were much larger than obtained in other research, ranging from 1.773,00 - 5.553,00 ha for females and 38.612,00 ha for male (as defined via the 95% kernel density estimate). Interestingly, all individuals established stable and notably smaller home ranges *ca.* 30 days after the introduction. A possible reason for such uncommon spatial behaviour of introduced red deer individuals may be explained by the stress caused while introducing the farm animals to open habitats. To obtain the actual home range estimates of investigated individuals, future analysis should consider longer time scale and include natural and anthropogenic covariates that may potentially affect the movement ecology of red deer.

Keywords: Cervidae, GPS telemetry, movement ecology, translocations, ungulates

Ekosustavni pristup: budućnost upravljanja ribarstvom u Jadranskome moru?

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Sažetak

Ekosustavni pristup prepoznat je kao značajan način ocjene stanja ribolovnih resursa kao i stanja morskog okoliša u cjelini. Jasno je da su svi morski organizmi neodvojivi dio ekosustava i snažno ovisni o stanju populacija u hranidbenom lancu kao i o faktorima koji vladaju u okolišu. Dugoročno održivo upravljanje ribarstvom trebalo bi se bazirati na ekosustavnom pristupu što u praksi nije slučaj te se u većini područja zasniva na procjeni stanja pojedinačnih vrsta što se često pokazalo neučinkovitim. Slična je praksa i u Jadranskom bazenu, ali inicijativa Interreg Italija-Hrvatska u sklopu projekta FAIRSEA (Fisheries in the Adriatic Region - a Shared Ecosystem Approach) mogla bi biti prekretnica u upravljanju ribarstvom na ovom području. Projekt okuplja 12 partnerskih institucija i široku bazu dionika. Glavni cilj projekta je razvoj integrirane platforme za ekosustavni pristup ribarstvu sa svim raspoloživim informacijama koje će se koristiti za testiranje, modeliranje i planiranje održive ribarstvene prakse. Platforma obuhvaća elemente poput cirkulacije vodenih masa, planktonske produkcije, rasprostranjenosti glavnih resursa, ulove i kapacitete flota, prostornu raspodjelu napora, preferentno modeliranje, dinamiku hranidbenih mreža, socio-ekonomske utjecaje te inpute dionika. Nadamo se da će ovaj prvi korak postepeno dovesti do šireg razumijevanja značaja ekosustavnog pristupa kao i promjene perspektive o kvalitetnom upravljanju ribarstvom u Jadranskome moru.

Ključne riječi: ekosustavni pristup, upravljanje ribarstvom, Jadransko more, integrirana platforma, FAIRSEA

Ecosystem approach: future of fisheries management in the Adriatic Sea?

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Abstract

Ecosystem approach has been recognized as an important way of assessing the state of marine resources and health of the marine environment as a whole. It is clear that all marine organisms are inseparable from other parts of the ecosystem and are strongly dependent on the state of populations in the food chain and on environmental factors. Long term sustainable fisheries management should be based on the ecosystem approach which in reality is not the case and currently in most areas relies on the single species assessment which has often been proved as inefficient. Similar has been a practice in the Adriatic basin, but recent Interreg Italy-Croatia initiative through the project FAIRSEA (Fisheries in the Adriatic Region - a Shared Ecosystem Approach) could be a turning-point in the management of fisheries in the area. The project gathers 12 partner institutions and a broad base of stakeholders. The main objective of the project is to develop an integrated platform for ecosystem approach in fisheries encompassing all available information to be further used for testing, modelling and planning of the sustainable fisheries practices. The platform integrates elements as water masses circulation, planktonic production, distribution of main fishery resources, catches and fleet capacity, spatial distribution of effort, food web dynamics, socio-economic impacts and stakeholder's input. Hopefully this initial step will gradually lead to the broader understanding of the importance of ecosystem approach and change the perspective on successful managing of fisheries in the Adriatic Sea.

Keywords: ecosystem approach, fisheries management, Adriatic Sea, integrated platform, FAIRSEA

Genotipizacija *SOD1* kod Bernskih planinskih pasa kao prevencija degenerativne mijelopatije pasa

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Sažetak

Degenerativna mijelopatija pasa (Canine degenerative myelopathy - CDM) je progresivna neurodegenerativna bolest leđne moždine koja se javlja u odrasloj dobi. Bolest je izvorno opisana kod njemačkog ovčara, ali sada se zna da se javlja i kod mnogih drugih pasmina pasa. Mutacija gena za superoksid dismutazu 1 (SOD1: c.118G>A, exon1) povezana je s osjetljivošću na CDM. Kod bernskog planinskog psa CDM je bila povezana s drugom mutacijom gena superoksid dismutaze 1 (SOD1: c.52 A>T, exon2). Brisevi bukalne sluznice uzeti su od 15 bernskih planinskih (BP) pasa u uzgajivačnici "Riomadea Grande" u Vinkovcima. Izolirana je genomna DNA, provedene su dvije lančane reakcije polimerazom (Polymerase chain Reacion – PCR) koje su sadržavale mutacije u oba eksona, PCR produkti su sekvencionirani kako bi se odredio genetski status na obje pozicije u SOD1 koje su povezane s pojavom CDM-a. Tri psa bila su heterozigotna (A/T) na položaju SOD1: c.52, a jedan je bio heterozigotan (A/G) na položaju SOD1: c.118, sva su četvorica označena kao nositelji CDM. Zbog kasnog nastanka CDM-a (kod pasa starijih od 8 godina), genotipizacija obje mutacije jedini je način sprečavanja parenja nositelja bolesti i stvaranja homozigotnih štenaca. Provođenje genetskog testa na obje mutacije traži se za sve uzgojne pse u većini europskih zemalja, ali se ne provodi u Hrvatskoj. Rezultati ovog rada omogućit će vlasniku pasa da nađe najpovoljnije partnere za parenje za svoje pse i proda štence u zemlje u kojima je genotipizacija mutacija SOD1 obavezna.

Ključne riječi: degenerativna mijelopatija pasa, mutacije *superoksid dismutaze 1*, bernski planinski pas

SOD1 genotyping of Bernese Mountain Dogs as a prevention of canine degenerative myelopathy

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Abstract

Canine degenerative myelopathy (CDM) is an adult onset, progressive neurodegenerative disease of the spinal cord. The disease was originally described in the German Shepherd dog (GSD), but it is now known to occur in many other dog breeds. A mutation in the superoxide dismutase 1 gene (*SOD1*:c.118G>A, exon1) is associated with susceptibility to CDM. In Bernese Mountain Dog CDM was connected with another mutation of the superoxide dismutase 1 gene (*SOD1*:c.52 A >T, exon2).

Buccal swabs samples were collected from 15 Bernese Mountain Dogs (BMD) in a kennel "Riomadea Grande" in Vinkovci. Genomic DNA was isolated, two PCR containing mutations in both exons were performed and PCR products were sequenced to determine genetic status on both positions in *SOD1* connected with the onset of CDM. Three dogs were heterozygous (A/T) at the position *SOD1*:c.52 and one was heterozygous (A/G) at the position *SOD1*:c.118, all four have been designated as carriers of CDM.

Because of the late onset of CDM (over 8 years old dogs), genotyping of both mutations is the only way to prevent mating of the disease carriers and producing homozygous mutant puppies. The genetic test on both mutations is required for all breeding dogs in majority of European countries but is not performed in Croatia. The results of present work will enable the dog owner finding most convenient mating partners for his dogs and selling puppies to countries where genotyping of *SOD1* mutations is mandatory.

Keywords: Canine degenerative myelopathy, *Superoxide dismutase 1* mutations, Bernese Mountain Dog

Preliminarni rezultati ispitivanja utjecaja dimenzije vrša na lovnost škampa (*Nephrops norvegicus*)

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Sažetak

Pri usporedbi s drugim alatima kojima se izlovljava škamp, vrša za ribolov škampa je alat relativno niske ribolovne efikasnosti s kojim se češće love veće jedinke škampa, uz malu razinu prilova. Istraživanja koja se bave lovnošću vrša su rijetka, pogotovo na području Mediterana. Poznato je da lovnost ovisi o obliku korištene vrše, ali ostali tehnički parametri koji mogu utjecati na lovnost nisu dovoljno istraženi. Cilj ovog rada je ispitati utjecaj dimenzije vrše na efikasnost ribolova škampa. U tu svrhu je u proljeće 2019. godine proveden eksperimentalni ribolov škampa vršama na području Velebitskog kanala. Testirane su vrše različitih dimenzija koje ribari upotrebljavaju u ribolovnoj praksi. Usporedbom ulova utvrđeno je da postoji statistički značajna razlika u ulovima vrša različitih dimenzija, odnosno da vrša najmanjih dimenzija lovi statistički značajno manje škampa u odnosu na vrše većih dimenzija.

Ključne riječi: škamp, *Nephrops norvegicus*, dimenzija vrše, ribarstvo

The impact of different creel dimensions on efficiency of Norway lobster (*Nephrops norvegicus*) fishing: preliminary results

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Abstract

Norway lobster creels are fishing gear with low fishing efficiency compared to other fishing gears, such as bottom trawls. Creel catches consist mostly of larger Norway lobster individuals, with very small amounts of bycatch. Creel catchability surveys are rarely conducted, especially in the Mediterranean. It is well known that fishing efficiency depends on the creel shape, however, other technical parameters that may have impact on creel catchability are not sufficiently researched. The aim of this paper is to examine the impact of different creel dimensions on efficiency of Norway lobster fishing. In order to test this, experimental fishing with creels was conducted in spring 2019 in Velebit channel. Creels of different dimensions commonly used by fisherman were tested. The catch comparison of the mentioned creels showed statistically significant difference between creels of different dimensions, with smallest creels catching significantly less Norway lobster than creels of larger dimensions.

Keywords: Norway lobster, *Nephrops norvegicus*, creel dimension, fishery

Morphometric characteristics, condition factor and heavy metal concentrations of Atlantic chub mackerel (*Scomber colias*) from the Adriatic Sea

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Abstract

The aim of the study was to determine and describe morphometric characteristics, length–weight relationship, condition factor and heavy metal concentrations in the muscle tissue of Atlantic chub mackerel (*Scomber colias*) from the North Adriatic Sea. Sampling (n=100) was performed during November 2018 by a purse-seine net. Morphometrics were obtained with graph paper and calliper for all sampled fish, while heavy metal concentrations were measured in digested fish muscles (n=10) by high resolution inductively coupled plasma mass spectrometry (HR ICP-MS, Element 2, Thermo Finnigan). The maximum ratio range of body proportion was noted in standard and fork length and the minimum was noted in proportion of body depth and fork length. Length–weight relationships of *Scomber colias* indicate positive allometry growth $W=0.003 \times L^{3.339}$ with condition factor values as noted $CF = 0.88 \pm 0.08$. Measured metals in fish muscle tissue showed the following concentration ranges: a) macro elements: K>Na>Mg>Ca (< 7 mg kg⁻¹); b) essential trace metals/metalloids: Fe>Zn>Se>Cu>Mn (< 5 mg kg⁻¹), Ni (< 0.03 mg kg⁻¹); c) nonessential metals/metalloids: As>Rb>Sr>Cs (< 5 mg kg⁻¹), Cd>Tl>Ag>Sb (< 0.03 mg kg⁻¹). Correlation among various metals and fish morphometry was not significant, so potential metal accumulation with fish growth was not confirmed. Average Cd levels in fish muscle (0.8 µg kg⁻¹) did not exceed maximum permitted levels for Cd in foodstuffs (50 µg kg⁻¹), pointing to safe human consumption of Atlantic chub mackerel from the North Adriatic Sea.

Keywords: *Scomber colias*, morphometric characteristics, condition factor, heavy metals, North Adriatic Sea

Odnos kutova zglobova kod populacije baraka u Bosni i Hercegovini

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Sažetak

Različiti arheološki nalazi širom svijeta pokazuju da je pas bio prva domesticirana životinja, a procjenjuje se da je proces domestikacije počeo prije približno 15.000 godina. Tijekom dugog perioda zajedničkog života sa čovjekom, domaći pas se razvio kao jedna od fenotipski najvarijabilnijih životinjskih vrsta. Lov, kao preduvjet opstanka a kasnije i zabave ljudi, nametnuo je potrebu za lovačkim psima. Međunarodna kinološka federacija (FCI) vodi bosanskog oštrodlakog goniča baraka pod brojem standarda 155. Važeći standard usvojen je 15.1.1973. Cilj istraživanja je bio utvrditi odnos kutova zglobova kod bosanskog baraka. Istraživanjem je obuhvaćeno 64 mužjaka i 56 ženki starosti do 10 godina. U važne eksterijerne pokazatelje lovačkih pasa spada i odnos kutova zglobova, što i nije česta metoda mjerenja pri fenotipskoj ocjena psa. U radu su mjereni kutovi ramenog, lakatnog, koljenog i skočnog zgloba, te kut vrata i kut sapi. Obrada podataka izvršena je deskriptivnom statistikom. Rezultati indiciraju skoro jednake vrijednosti kutova kod mužjaka i ženki baraka, te, osim kod kuta ramenog zgloba, kod ostalih nije zabilježena statistička značajnost između spolova. Vrlo je važan i kut vrata i sapi u odnosu na horizontalnu ravninu. Kod bosanskog oštrodlakog goniča baraka, kut vrata kod muških jedinki u prosjeku iznosi $32,44^{\circ} \pm 10,49^{\circ}$, dok kod ženki kut vrata ima prosječnu vrijednost od $29,70^{\circ} \pm 9,19^{\circ}$. Kut sapi kod mužjaka iznosi u prosjeku $35,91^{\circ} \pm 7,52^{\circ}$, a kod ženki $33,14^{\circ} \pm 6,90^{\circ}$.

Ključne riječi: odnos kutova, barak, Bosna i Hercegovina

Angularity of the Barak population in Bosnia and Herzegovina

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Abstract

Various archaeological findings around the world show that the dog was the first domesticated animal, with estimated start of the domestication process approximately 15,000 years ago. During the long period of co-habitation with human, the domestic dog developed as one of the phenotypically most variable animal species. Hunting, as a tool of survival and people's entertainment, imposed the need for hunting dog. The World Canine Organisation (FCI) recorded the Bosnian Broken-haired Hound - Barak, under the number of standards 155. A valid standard is adopted on Jan 15, 1973. The aim of the study was to determine the ratio of joint angles of the Bosnian Barak. The research involved 64 males and 56 females up to 10 years of age. Important exterior indicators of hunting dogs include the ratio of joint angles, which is not a common method of measurement when the phenotypic assessment is performed. The angles of shoulder, elbow, knee and hock joints are measured in this paper, as well as the angles of the neck and croup. Data processing was performed using descriptive statistics. The results indicate almost equal values of angles in both males and females, and, except for the angle of shoulder joint, no statistical significance was observed in other angles between the genders. The angles of the neck and croup relative to the horizontal flat are also very important. For Bosnian Broken-haired Hound, the neck angle in males averages $32.44^{\circ} \pm 10.49^{\circ}$, while in females the neck angle has an average value of $29.70^{\circ} \pm 9.19^{\circ}$. The croup angles in males amounts $35.91^{\circ} \pm 7.52^{\circ}$ on average, and in females $33.14^{\circ} \pm 6.90^{\circ}$.

Keywords: angularity, Barak, Bosnia and Herzegovina

Rasprostranjenost i gustoća ribljih populacija na različitim tipovima staništa u Dunavu

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Sažetak

Riblju zajednicu rijeke Dunav u RH danas čini 55 vrsta, od čega je 13 stranih, a sve su svrstane u 18 porodica. Cilj rada je odrediti rasprostranjenost i gustoću ribljih populacija prema različitim geomorfološkim strukturama obale i pedološkim osobinama tla odnosno tipovima staništa Dunava pri različitim razinama vodostaja. Sitni sediment pijeska/mulja s niskom obalom, kakav uglavnom prevladava na Dunavu i „divljim“ otocima, prostorno najviše grupno privlači ukliju (*Alburnus alburnus*) s čak 67,99 % od ukupne gustoće. Sitnija (≤ 180 mm) babuška (*Carassius gibelio*) je zastupljena s 9,07 % udjela, bolen (*Leuciscus aspius*) veličine (≤ 300 mm) je zastupljen s 3,53 %, sitni (≤ 140 mm) jez (*Leuciscus idus*) s 1,19 % udjela te podust (*Chondrostoma nasus*) veličine (≤ 100 mm) zastupljen je s 0,73 % u gustoći, itd. Navedene skupine riba uglavnom se pojavljuju kao kohorta, odnosno kao jedinke iste dobne skupine unutar svake vrste u populaciji. U navedenom priobalnom plitkom pojasu pojavljuju se i predatori različitih uzrasnih kategorija poput štuke (*Esox lucius*), smuđa (*Sander lucioperca*), bolena (*Aspius aspius*) itd. Kamene ili šljunčane dijelove obale i „divljih“ otoka Dunava s nešto manje sitnog sedimenta prostorno naseljavaju vrste iz porodice *Gobiidae* (glavoči) u grupama dok se pojedinačno na tom tipu sedimenta zadržavaju vrste poput mreke (*Barbus barbus*), grgeča (*Perca fluviatilis*) te smuđa (*Sander lucioperca*), manjića (*Lota lota*), vijuna (*Cobitis elangotoides*), prugastog balavca (*Gymnocephalus schraester*) i sl. Na kamenom tipu sedimenta poput „špornjeva“ pojavljuju se, uz već spomenute vrste riba, i slučajni (pojedinačni) primjerci poput potočne pastrve (*Salmo trutta*) i mladice (*Hucho hucho*). Dunav obiluje filofilnim ikrašicama zbog dobro zastupljene makrovegetacijske podloge na kojoj se mrijeste. Limnofilne vrste (deverika, crvenperka) te reofilne vrste (jez, bolen) također kao i fitofili u Dunavu imaju izvrsne preduvjete za reprodukciju. Ipak, rezultati istraživanja sastava pojedinih vrsta u ribljoj zajednici Dunava ukazuju kako je najviše zastupljeno euritropnih vrsta riba (bodorka, grgeč, štuka, šaran, babuška, klen, som i sl.) koji se vrlo dobro prilagođavaju čestim oscilacijama vodostaja i različitim brzinama toka rijeke Dunav. NPUE (number per unit effort) izražen kao broj riba/sat elektroribolovom iznosi 219,6 dok CPUE (catch per unit effort) izražen kao kg/sat elektroribolovom iznosi 4,6. Na migraciju i raspored ribljih populacija Dunava, osim vodostaja, značajno utječe struktura obale i tip sedimenta.

Ključne riječi: ihtiocenoza, Dunav, stanište, migracije, prilagodljivost

Distribution and abundance of fish populations in different types of Danube habitats

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Abstract

Fish population of the Danube River in the Republic of Croatia today comprises 55 species, 13 of which are foreign, while all of them belong into 18 families. The aim of this paper is to determine the distribution and density of fish populations according to various geomorphological structures of the river bank and pedological properties, i.e. types of habitats of the Danube at different water levels. Fine-grained sediment of sand/silt and low bank slopes, which are mostly found in the Danube and its wild islands, attract mostly groups of the common bleak (*Alburnus alburnus*) with as much as 67.99% abundance. Smaller (≤ 180 mm) Prussian carp (*Carassius gibelio*) was represented with 9.07% of abundance, asp (*Leuciscus aspius*) size (≤ 300 mm) was represented with 3.53%, smaller (≤ 140 mm) ide (*Leuciscus idus*) with 1.19% and small (≤ 100 mm) common nase (*Chondrostoma nasus*) with 0.73% abundance etc. The aforementioned fish groups mostly appear as cohorts, i.e. as individuals of the same age within every species of the population. Predators of varying sizes such as pike (*Esox lucius*), pike-perch (*Sander lucioperca*), asp (*Leuciscus aspius*) etc also inhabit mentioned shallow riverside. Stone or gravel parts of the river bank and wild islands of the Danube with some fine-grained sediment are mostly inhabited by the species from the family Gobiidae (true gobies) in groups, while individually, in this type of sediment, species such as barbel (*Barbus barbus*), perch (*Perca fluviatilis*) and pike-perch (*Sander lucioperca*), burbot (*Lota lota*), the Danubian spined loach (*Cobitis elongatoides*), Schraetzer (*Gymnocephalus schraetser*) and others can be found. Apart from the aforementioned fish species, sedimentary rocks, such as those found in river retaining walls, attract some arbitrary individuals, e.g. brown trout (*Salmo trutta*) and huchen (*Hucho hucho*). Danube is rich in phytophilic fish species due to the presence of suitable macrovegetation in which they spawn. Limnophilous species (freshwater bream, rudd) and reophilous species (ide, asp) as well as phytophilous ones have excellent preconditions for reproduction in the Danube. However, the results of the research on particular fish species composition of the Danube fish population indicate that eurytopic fish species are mostly present (roach, perch, pike, common carp, Prussian carp, chub, wels catfish and others), which adapt well to frequent changes in the water level and river flow of the Danube. NPUE (number per unit effort) expressed as the number of fish/hour by electrofishing is 219.6 while CPUE (catch per unit effort) expressed as kg/hour by electrofishing is 4.6. Migration and the distribution of fish species in the Danube are significantly influenced not only by the water level but by the composition of the river bank and the type of sediment as well.

Keywords: ichthyocenosis, Danube, habitat, migration, adaptability

Napadi vuka na lovačke pse u Republici Hrvatskoj

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Sažetak

U zadnjih nekoliko godina sve je više dokaza o napadima vuka (*Canis lupus*) na lovačke pse u Republici Hrvatskoj. Problem upućuje na promjene ponašanja vuka, koji su biološki izrazito zanimljivi i neistraženi. Cilj provedenog istraživanja bio je utvrditi mjesto, vrijeme, učestalost, okolnosti i posljedice napada vuka na lovačke pse te ih povezati s brojnosti domaćih i divljih životinja na području RH. U tu svrhu provedeno je on-line anketno ispitivanje u razdoblju od 15. svibnja do 15. srpnja 2018. godine. Također su traženi dokazi o stradavanju lovačkih pasa u obliku slika te je izrađen zemljovid s mjestima napada. Zabilježeno je 112 slučajeva interakcija vuka i lovačkih pasa, najviše u Splitsko – dalmatinskoj županiji. Iako se ne zna odnos spolova korištenih pasa tijekom lovova, u čak 82,1% slučajeva napadnuti su muški psi. U većini napada nastradali su psi starosti od 1-3 godine (47,3%). Istraživanje je pokazalo da su u 91,9% slučajeva psi napadnuti za vrijeme trajanja lova, a u 70,5% za vrijeme gonjenja divljači. Dobiveni podaci mogu poslužiti za podizanje svijest o važnosti i posljedicama napada vuka na lovačke pse. Brojnost napada može biti uvjetovana brojnosti i intenzitetom uzgoja domaćih životinja na otvorenom, kao i sve značajnijom stopom hibridizacije vuka i psa u RH. Zbog toga, nameće se potreba za daljnjim istraživanjem interakcije vuka i lovačkih pasa, a sve u svrhu boljeg poznavanja ekologije ponašanja vuka na područjima Republike Hrvatske.

Ključne riječi: vuk, divlji papkari, hibridizacija, lovački pas, napadi

Wolf attacks on hunting dogs in Republic of Croatia

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Abstract

In recent years there is more and more evidence of wolf (*Canis lupus*) attacks on hunting dogs in the Republic of Croatia. The problem points to changes in wolf behaviour, which are exceptionally interesting and unexplored from the biological point of view. The research aimed to determine the place, time, frequency, circumstances, and consequences of wolf attacks on hunting dogs and to associate them with the number of domestic and wild animals on the territory of the Republic of Croatia. For this purpose, conducted an online survey, in the period from 15 May to 15 July 2018. In addition to the answers, we searched for the evidence in the shape of photographs taken and created the map with the locations of wolf attacks. We recorded 112 interaction cases between wolves and hunting dogs, with the most cases occurred in the Split - Dalmatia County. Although the sex ratio of dogs was not known during hunting events, male dogs were attacked in 82.1% of cases. In most of the attacks, dogs aged between 1-3 years (47.3%). Research has shown that in 91.9% of cases, dogs were attacked during hunting time and that the highest proportion of hunting dogs was injured during quarry shootings (70.5%). The obtained data can be used to raise awareness of the importance and consequences of wolf attacks on hunting dogs. The number of attacks can be conditioned by the number and intensity of domestic animals in open breed systems, and the increasing rate of wolf and dog hybridization in the Republic of Croatia. Therefore, there is a need to further investigate the interaction of wolves and hunting dogs to improve the knowledge in the field of ecology and behaviour of wolves in the territory of the Republic of Croatia.

Keywords: wolf, hunting dog, hybridization, livestock, attacks

Length-weight relationships and condition between invasive and native populations of topmouth gudgeon *Pseudorasbora parva*

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Abstract

In recent years, fish invasion has become one of the main reasons for the decline of native fish stocks. Topmouth gudgeon *Pseudorasbora parva* (Temminck & Schlegel, 1846) is a small fish native to Eastern Asia and introduced to Europe as well as to Croatia. It typically inhabits small ponds and ditches, but also larger lakes and streams. *P. parva* is considered as one of the major invasive species worldwide, thus it is included in list of Invasive Alien Species of Union concern by EU Regulation 1143/2014 on Invasive Alien Species, which took effect 1 January 2015. High phenotypic plasticity in fitness related traits such as growth, early maturity, fecundity, reproductive behaviour and the ability to cope with novel pathogens has predisposed *P. parva* to being a strong invader. Species-specific length-weight relationships (LWR) and (K) condition factors is important for the study of fish population invasive biology and dynamics, as it allows to estimate the weight corresponding to a given length, condition factors for comparing the condition, fatness, or well-being of fish, based on the assumption that heavier fish of a given length are in better condition. Until today LWR and K parameters for *P. parva* have been restricted only to a certain study area and still there is no any wider analysis provided. Therefore, the aim of the present study was to provide a comparison of LWR and K for *P. parva* stocks from Croatian and Chinese freshwaters from own data as well as based on an extensive collection of literature data. The work was supported by the bilateral research project Croatia-China funded by Ministry of Science and Education.

Keywords: invasive fish, invasive biology, population fitness

Influence of age on the trophy value of antlers at roe deer (*Capreolus capreolus* L.)

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Abstract

Roe deer (*Capreolus capreolus* L.) is the most abundant wild ungulate in Serbia. However, its present abundance and degrees of population utilisation are significantly below natural potentials in the country. Antlers are an indicator of the population's health status, and their quality depends on different genetic and environmental factors. The aim of the paper was to investigate the influence of age on the antlers' branches length, mass, volume and the overall score of the trophy. The length of the left and right branches, the average length of the branches, the mass and the volume of antlers were determined for the trophies of 228 roe deer of different ages from the Hunting district "Barajevska reka". On the basis of the formula prescribed by The International Council for Game and Wildlife Conservation (CIC), the total trophy score was calculated. The most intensive growth of antlers was observed from the second to the fourth year, while the branches were the longest in the period of about six years. The weight of antlers was highest in individuals six and seven years old. A gradual increase in the volume of antlers was observed from the second to the fifth year, while values culminated in the sixth year. Trophy values determined by the number of CIC points followed changes in other parameters. The values of the trophy score parameters were highest for individuals aged seven years, and therefore, the highest quality antlers were found in subject in that age period.

Keywords: *Capreolus capreolus* L., trophy, antlers, age

Assembly of a Complete Mitogenome of Balkan Chamois (*Rupicapra rupicapra balcanica*)

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Abstract

Mitochondrial DNA (mitogenome) is a good genetic marker for genetic variability analysis and for inferring evolutionary patterns. Mitogenome comparisons are used as tools in modern taxonomic studies since the taxonomic relationships between animal taxa have been traditionally defined based on geography and morphology. Northern chamois (*Rupicapra rupicapra*) is a mountain ungulate that is currently categorized into seven subspecies, but some genetic studies contradict this taxonomy. Two subspecies of Northern chamois inhabit Croatia: Balkan (*Rupicapra rupicapra balcanica*) and Alpine chamois (*Rupicapra rupicapra rupicapra*). In this study, we report the assembly of a complete mitogenome sequence of the Balkan chamois. The new sequence was directly assembled from Illumina next-generation sequencing short reads that were aligned to a reference genome of Northern chamois since they share approximately 99.8% mitogenome similarity. The newly assembled mitogenome is 16 443 bp in length and contains 13 protein-coding genes, 22 tRNA genes, 2 rRNA genes and D-loop region. The mitogenome is AT-biased with a nucleotide composition of 33.5% A, 30.0% T, 23.2% C, and 13.4% G. The assembly of the complete mitogenome sequence provided here, along with mitogenomes of other Northern chamois subspecies, is the initial step in resolving the taxonomy of the Genus *Rupicapra*.

Keywords: mitogenome, reference aided assembly, chamois, taxonomy

Registrirane lovačke udruge i lovišta u Republici Hrvatskoj: ekonomski pokazatelji međusobnog odnosa

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Sažetak

Pravni status lovoovlaštenika i njihov udjel u iznosu koncesija/zakupnina prava lova važan su ekonomski pokazatelj koji omogućuje praćenje trenda lovnog gospodarenja i implementiranje u smjernice za buduće djelovanje. Danas su u Republici Hrvatskoj za sektor lovstva relevantna četiri registra u kojima podaci o istovjetnoj pravnoj osobi nisu podudarni, jer u Registru koncesija nema podatka o tri koncesije, a dvije lovačke udruge koje od 2017. g. nisu pravne osobe i danas su lovoovlaštenici. Ta rascjepkanost za lovno gospodarenje otežava uskladivost i praćenje promjena. Stoga je za ovo istraživanje korištena odgovarajuća baza podataka Strukovne udruge Stručnih osoba za provedbu LGO, PUD i PZD koja omogućava brzu i preglednu kronološku usporedivost po županijama i lovnim godinama o lovištima, lovoovlaštenicima, ugovorima i iznosima koncesija/zakupnina, te daje uvid u promjene koje se tijekom odabranog razdoblja događaju u lovištu. U Republici Hrvatskoj su na dan 1. listopada 2019. g. na površini od 5.475.232 ha ustanovljena 1.083 lovišta, od kojih je 5 (0,15%) bez lovoovlaštenika, a 1.078 u koncesiji/zakupu 888 različitih pravnih osoba. Lovišta u kojima je 767 lovačkih udruga lovoovlaštenika ima 907 za koja u naknadi koncesije/zakupa prava lova ostvaruju udjel od 65,30%, po županijama najveći (6,00%) u Sisačko-moslavačkoj i najniži (0,91%) u Krapinsko-zagorskoj. Lovaćkih udruga lovoovlaštenika po županijama je 100% u Krapinsko-zagorskoj i Gradu Zagrebu, a najmanje (56,36%) u Zadarskoj, te je utvrđena značajna razlika prosječne naknade prava lova koja je najniža (5.982,24 kn) u Vukovarsko-srijemskoj i najviša (56.517,96 kn) u Ličko-senjskoj županiji.

Ključne riječi: registri, lovišta, lovačke udruge, ekonomski pokazatelji

Registered hunting associations and hunting grounds in the Republic of Croatia: economic indicators of mutual relation

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Abstract

The legal status of the hunting right holders and their share in the amount of hunting concessions / leases is an important economic indicator that allows the trend of hunting management to be monitored and implemented into guidelines for future action. There are four relevant hunting registers in the Republic of Croatia today, but the data about the same legal entity are not consistent, since there are no data on the three concessions in the Concessions Register, and two hunting associations, which as of 2017 are not legal entities, are still registered as hunting right holders. This fragmentation makes the hunting management coordination and monitoring of changes very difficult. Therefore, an appropriate database of the Professional Association of Experts for the Implementation of LGOs, PUDs and PZD was used for this research, which enables fast and transparent chronological comparability across counties and hunting years of hunting grounds, hunting right holders, contracts and concession / lease amounts, and provides insight into the changes that occur in the hunting area during the selected period. On October 1st, 2019 in the Republic of Croatia 1,083 hunting grounds were established on an area of 5,475,232 ha, of which 5 (0.15%) were without hunting right holders and 1,078 were in the concession / lease of 888 different legal entities. The hunting grounds in which there are 767 hunting associations, hunting licenses have 907 for which they have a share of 65.30% in the fee for the concession / lease. The highest (6.00%) in Sisak-Moslavina County and the lowest (0.91%) in Krapina-Zagorje County. There is 100% hunting associations that are the hunting right holders in Krapina-Zagorje County and in the City of Zagreb, and at least (56.36%) in Zadar County. A significant difference in the average compensation of hunting rights was found and is the lowest (5,982.24 HRK) in the Vukovar-Srijem and the highest (56,517.96 HRK) in the Lika-Senj County.

Keywords: registers, hunting grounds, hunting associations, economic indicators

Level of microplastic contamination in mussels (*Mytilus galloprovincialis*, Lamarck, 1819) in the Adriatic Sea

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Abstract

Microplastic is a large and complex global environmental problem and one of the major aspects of pollution is the occurrence of microplastic in marine ecosystem. As filter feeding organisms mussels process relatively large amounts of water during feeding what maximizes exposure to any harmful material within the water column and can result in the accumulation of chemical pollutants and microplastic available in the environment. Also, the presence of microplastic in seefood could pose a threat to food safety. Here, we investigate the presence of microplastic in farmed - commercially grown and wild grown mussels (*Mytilus galloprovincialis*, Lamarck, 1819) along the Adriatic Sea comprehending shellfish farming sites in the north (Lim bay, N=30), middle (Sibenik bay, N=30) and south (Mali Ston bay, N=30). Microplastic items (fragments, fibers and pellets) were recovered from the soft tissues of mussels and they varied depending on the item from 0.02 to 4.46 items/g in wild and 0.02 to 5.52 items/g in farmed and from 0.033 to 6.36 items/individual in wild and 0.33 to 5.43 items/individual in farmed. This first evaluation of microplastic in mussels in Croatian Adriatic Sea represents a baseline for further research. Results suggest that microplastic presence is widespread in Adriatic Sea and environmental monitoring is advisable.

Keywords: microplastic, Adriatic Sea, mussels, *Mytilus galloprovincialis*

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The effect of inbreeding on birth weight of Saanen goat kids

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Abstract

Inbreeding is practically impossible to avoid in the livestock breeding and it is particularly hard to keep it under control in the populations under a high selection pressure. The main reason is excessive usage of genetically superior sires. The study aimed to examine the effect of inbreeding on the birth weight of Saanen goat kids under the framework of the genetic animal model for maternal traits. All growth traits until weaning are not only influenced by the genes of the individual for growth (direct additive genetic effect), but also by the maternal genetic composition (indirect maternal genetic effect) and by non-genetic environment provided by the dams (permanent environment effect). Ministry of Agriculture provided all the data used in the study. The birth weight (BW) was available for the 17990 among a total of 21118 animals in the pedigree. The estimated ratios of variance components for direct genetic effects, indirect maternal genetic effects, maternal permanent environment, and herd were 0.127, 0.026, 0.163, and 0.373, respectively. According to the estimated coefficient of inbreeding (F), 60% percent of the animals in the pedigree were inbred to some degree. However, the majority of the inbreds (81%) had a really long path ($F \leq 0.05$) to the common ancestors. A higher level of inbreeding ($F > 0.20$) was determined in only 5% of the inbreds. These frequencies, in addition to the average F (0.042 for inbreds and 0.025 for the entire population) implicate that mating of closely related individuals in this population is under control. Inbreeding did not statistically affect BW ($= 0.0001$; $P > 0.05$) but generalization of this effect should be performed with great caution because inbreeding depression could have been masked by positive response to selection and imbalanced non-experimental data.

Keywords: Saanen goat, Kids, Birth weight, Inbreeding

Aktivnosti i terapije pomoću konja

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Sažetak

U Hrvatskoj se koristi nova terminologija za terapiju i rekreaciju uz pomoć konja za djecu s teškoćama u razvoju i osobe s invaliditetom. Hrvatski savez za intervencije pomoću konja pokrenuo je promjene vezane za razvoj cjelokupnog područja uvodeći novo nazivlje, podjelu područja i usklađene standarde prema europskim normama. Terapija i rekreacija za djecu s teškoćama u razvoju i osobe s invaliditetom su ranije imale zajednički naziv, terapijsko jahanje. Bilo je nužno odvojiti terapiju od rekreacije zbog same provedbe programa, korisnika i osoba koji u njemu sudjeluju. Stoga su uvedeni pojmovi „terapija pomoću konja“ (eng. „*equine-assisted therapy*“) i „aktivnosti pomoću konja“. Aktivnosti pomoću konja podrazumijevaju ostale aktivnosti s konjem i u konjskom okruženju koje nisu terapija, već rekreacija za korisnike. Intervencije pomoću konja su sve vrste terapija i aktivnosti u kojima se pomoću konja ostvaruju poboljšanja na psihofizičkom, senzomotoričkom, kognitivnom, emocionalnom i socijalnom razvoju. Terapija pomoću konja je jedna od terapija koja uključuje aktivnosti s konjem i/ili u konjskom okruženju. Sastoji se od strategija i tretmana koje određuje terapeut za što je potreban dugotrajan ciljani trening terapijskog konja. S obzirom na specifične terapijske ciljeve koji zahtijevaju specifične karakterne osobine, terapijski konj treba biti dobroćudan, staložen, strpljiv, poslušan i spreman na suradnju te potpuno desenzibiliziran na okolišne čimbenike. Terapija i rehabilitacija uz pomoć konja se neprestano mijenja, usavršava i prilagođava korisniku u svrhu poboljšanja njegove kvalitete života.

Ključne riječi: terapijski konj, aktivnosti pomoću konja, terapija pomoću konja, intervencije pomoću konja

Equine-assisted activities and therapies

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Abstract

In Croatia new terminology is used for equine-assisted therapy and recreation for children with developmental disabilities and persons with disabilities. The Croatian Association for Equine-assisted Interventions has started the alterations in relation to the development in all fields, from the introduction of a new terminology, field distribution, and harmonization with the standards of the European norms. The therapy and recreation for the people with disabilities was previously known as therapeutic riding. It was necessary to distinguish the therapy from recreation regarding the program implementation, users, and program participants. Thus, the equine-assisted therapy and equine-assisted activities are introduced as the new terms. The equine-assisted activities are other activities with horses in an equine environment for the sake of recreation, not therapy. The equine-assisted interventions are all kinds of therapies and activities, which enhance the psychophysical, sensory, and motoric skills, as well as the cognitive, emotional, and social development. The equine-assisted therapy is a treatment that incorporates the equine activities and/or the equine environment with the strategies and treatments selected by the therapists. The therapy horses should be highly sensitive and, at the same time, desensitized to the environmental factors. Thus, they need a long-term training. Regarding specific therapeutic goals, for which the specific character traits are needed, a therapy horse should be mild-mannered, patient, obedient and ready to participate. The equine-assisted therapy and rehabilitation are being continuously modified, improved, and adapted to the users for the purpose of their quality-of-life improvement.

Keywords: therapy horse, equine-assisted activities, equine-assisted therapy, equine-assisted interventions

Promjene morfoloških svojstava krava Jersey pasmine kao posljedica strojne mužnje

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Sažetak

Strojna mužnja uslijed mehaničkog pritiska sisne gume i razine podtlaka može izazvati veće ili manje promjene na tkivu sisa vimena krava. Promjene koje nastanu ne bi trebale biti veće od 5%, jer je to neka granica do koje se tkivo životinje stigne oporaviti. Sve preko toga povećava rizik od nastanka mastitisa. Odabir pasmine, te postavke muznog uređaja u pogledu visine podtlaka, broja i omjera pulsacija i sl. mogu utjecati na vrijednosti muznih svojstva i jačinu promjena na tkivu sisa vimena krava. Cilj rada bio je utvrditi osnovne muzne parametre, te promjene u duljini i širini sisa nastale kao posljedica strojne mužnje. Prosječne vrijednosti maksimalnog i prosječnog protoka mlijeka iznosile su 1,61 i 2,44 kg/min. Glavne faza mužnje u prosjeku je iznosila 5,41 minutu. Duljina i širina prednjih lijevih sisa prije mužnje iznosila su 4,47 i 2,23 cm, dok su te vrijednosti nakon mužnje iznosile 4,80 i 2,05 cm. Kod stražnjih sisa duljina i širina prije mužnje iznosili su 3,68 i 2,07 cm, odnosno 4,06 i 2,06 cm nakon mužnje. Strojna mužnja značajno ($P < 0,05$) je utjecala na duljinu prednjih i stražnjih lijevih sisa vimena krava nakon mužnje u odnosu na te iste vrijednosti prije mužnje. Nije utvrđena značajna promjena u širini sisa.

Ključne riječi: strojna mužnja, dimenzije sisa, muzna svojstva, Jersey

Machine-induced changes of the morphological traits of Jersey cows

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Abstract

Machine milking can cause major or minor changes in the teat tissue of the udder due to the mechanical pressure of the liner and the vacuum level. The changes that occur should not be more than 5%, because that is the limit to which animal can recover the tissue. Any change above that limit increases the risk of mastitis. Choice of the breed, and the settings of the milking device in terms of the vacuum level, the number and the ratio of the pulsations, etc., may influence the values of the milkability traits and the intensity of the changes on the teats tissue of the cow's udder. The aim of the study was to determine basic milkability traits, and machine-induced changes in length and widths of the udders teats. The average values of the average and maximum milk flow were 1.61 and 2.44 kg/min. The duration of the main milking phase was 5.41 minutes. The length and width of the front left teats before milking were 4.47 and 2.23 cm, while those values after milking were 4.80 and 2.05 cm. For the rear teats, the length and width before and after milking were 3.68 and 2.07, and 4.06 and 2.06, respectively. The machine milking had significant ($P < 0.05$) influence on the length of the both front and rear left teats after milking in comparing to those values before milking. Significant change to the width of the teats was not found.

Keywords: machine milking, dimension of the teats, milkability, Jersey

Utjecaj majčinskog nasljeđivanja na proizvodna svojstva mlijeka kod holstein krava

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Sažetak

Utjecaj cijelog nukleotidnog slijeda mitohondrijskog genoma na proizvodna svojstva mlijeka (količinu mlijeka, mliječne masti i proteina) procijenjen je kod holstein krava. Tehnologijom određivanja nukleotidnih sljedova druge generacije, određeni su nukleotidni sljedovi cijelih mitogenoma koji predstavljaju 109 rodova. MaGelAN 1.0 softverom je omogućeno dodjeljivanje haplotipova mitogenoma 2.373 jedinkama i korištenje njihovih proizvodnih podataka. Ovdje predstavljamo kvantitativno-genetički model koji pruža, pored aditivnih i okolišnih utjecaja, i procjenu komponenata varijanci mitogenoma i spolnih kromosoma. Dob kod prvog teljenja definirana je kao nezavisna kontinuirana varijabla te modelirana kao linearna regresija. Županija je definirana kao fiksni utjecaj. Procijenjeni udjeli fenotipskih varijanci koji su objašnjeni s haplotipovima mitogenoma kretali su se u rasponu od 6% do 7% za proizvodna svojstva mlijeka. Istovremeno, procijenjeni utjecaj spolnih kromosoma bio je zanemariv. Pokazali smo da je za proizvodna svojstva mlijeka značajan udio fenotipske varijance objašnjen s varijabilnošću haplotipova mitogenoma. Iako je nužno potvrditi ovakvu analizu, dobiveni rezultati ukazuju da je utjecaj mitogenoma potrebno uključiti u procjenu kvantitativno genetičkih parametara dodatno potičući poboljšanje postojećih uzgojnih programa.

Ključne riječi: proizvodna svojstva mlijeka, mitohondrijski genom, holstein govedo, komponente varijance, određivanje nukleotidnog slijeda druge generacije

The impact of maternal inheritance on the milk production traits in Holstein cows

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Abstract

The influence of the whole mitochondrial genome sequence on milk production traits (milk, fat and protein yield) was evaluated in Holstein cows. Complete mitogenomes were sequenced representing 109 maternal lineages using NGS technology. MaGelLAn 1.0 software has enabled assignment of mitogenome sequence haplotype information to 2373 cows with their production records. Here, we present quantitative genetic model that provides, in addition to additive and environmental effects, estimates of the mitogenome and sex-chromosome variance components. Age at first calving was used as covariate and was modelled as linear regression. Region (county) was included in model as fixed class effect. The estimated proportions of the phenotypic variances that were explained by mitogenome haplotypes ranged from 6% to 7% for all three milk traits. At the same time, the estimated effects of sex-chromosome loci were negligible. We have shown that for the milk production traits considerable proportion of the phenotypic variance was explained by mitogenome haplotype variation. While more general confirmation is still needed, the results obtained argue for including mitogenome effects in the estimation of quantitative genetic parameters further fostering improvement of existing breeding programs.

Keywords: milk production traits, mitochondrial genome, Holstein cattle, variance components, next generation sequencing (NGS)

Genetska raznolikost i povezanost hrvatski pasmina ovaca

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Sažetak

Procjena genetskih parametara predstavlja vrlo moćan alat u selekcijskim i konzervacijskim programima. Cilj ovog rada je procijeniti razinu genomskog inbridinga i efektivne veličine populacije te analizirati strukturu populacija istarske ovce, paške ovce i dalmatinske pramenke. Genotipizirali smo 199 životinja (96 istarskih ovaca, 75 paških ovaca, 28 dalmatinskih pramenki) koristeći Illumina OvineSNP50 Bead Chip. Procijenili smo razinu genomskog inbridinga (F_{ROH}) i efektivne veličine populacije bazirane na linkage disequilibriumu (N_{eLD}) za svaku istraživanu pasminu. Također za svaku pasminu analizirana je i struktura populacije te razina miješanja populacija. Pozicionirali smo istraživane pasmine u odnosu na europske. U svrhu toga smo sa javno dostupnih repozitorija preuzeli genotipove europskih i azijskih pasmina ovaca te genotipove sardinijskog, europskog i azijskog muflona.

Razina inbridiga je velika kod istarske ovce dok je kod dalmatinske pramenke niska. Procijenjena efektivna veličina populacije za istarsku ovcu je 101 (95% CI: 81-130) dok za pašku ovcu iznosi 222 (95% CI: 161-343), a dalmatinsku pramenku 124 (95%CI: 15-31). Analiza glavnih komponenti pokazala je da se tri pasmine jasno odvajaju. U usporedbi s europskim pasminama, paška ovca i dalmatinska pramenka su se pozicionirale bliže španjolskim i talijanskim ovcama. Istarska ovca je lagano izdvojena no prati isti genetski obrazac.

Ključne riječi: istarska ovca, paška ovca, dalmatinska pramenka, genetska raznolikost

Genomic diversity and relationship of the Croatian sheep breeds

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Abstract

Genetic evaluation represents a powerful tool in breeding selection and conservation programmes. The aim of this study was to evaluate level of genomic inbreeding and effective population size as well as to analyse population structure of the Istrian sheep, Pag sheep and Dalmatian Pramenka. We genotyped 199 animals (96 Istrian sheep, 75 Pag sheep, 28 Dalmatian Pramenka) using Illumina OvineSNP50 Bead Chip. The genomic inbreeding level (F_{ROH}) and linkage disequilibrium effective population size (Ne_{LD}) were estimated for each Croatian sheep breed, as well as genetic population structure and level of population admixture. We also genomically positioned Croatian sheep breeds in European breed context. For this purpose, we used publicly available genotypes from digital repositories, including European and Asian sheep breeds as well as Sardinian, European and Asian mouflon in the analysis. The inbreeding level (F_{ROH}) was high in Istrian sheep populations and low in Dalmatian Pramenka. Estimated Ne_{LD} in Istrian sheep was 101 (95% CI: 81-130) while Pag sheep and Dalmatian Pramenka had higher Ne_{LD} (222 (95% CI: 161-343); 124 (95%CI: 15-31), respectively). Principal component analysis showed that three breeds are clearly separated each forming defined cluster. In comparison with European sheep breeds, Pag sheep and Dalmatian Pramenka are positioned close to Spanish and Italian breeds while Istrian sheep is slightly remote from this cluster following the same genetic pattern.

Keywords: Istrian sheep, Pag sheep, Dalmatian Pramenka, genetic diversity

The effect of storage on the egg quality traits

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Abstract

Table eggs are common and easy to access for all different people. When compared with other foods, eggs have the advantage of being suitable for refrigerator storage over an extended period of time. However, if they are stored for longer period, their internal quality deteriorates. The aim of the current study was to investigate the effects of storage time on the quality traits of table eggs from 48-week old ISA - Brown laying hens, reared in enriched cages. Eggs were collected in the middle of production circle. 60 eggs were collected and obtained after being laid. 30 eggs were stored inside a refrigerator (5°C) for four weeks and 30 eggs were immediately measured. Following external and internal egg parameters were evaluated: egg weight, cleanness of egg, shell color, shell breaking force, shell thickness, USDA, albumen height, Haugh units (HU), yolk color and shell weight. There was a negative effect of storage time on following parameters: egg weight, USDA, albumen height, HU, and yolk color. The weight of eggs, USDA, albumen height, HU, and yolk color significantly decreased with increased storage of four weeks. With the exposure to 5°C storage temperature, albumen height and therefore Haugh units dramatically decreased during the period of storage. Based on these results, we can conclude that the most important parameters of egg traits, examined in current study: egg weight, USDA, albumen height, HU, decrease with the storage period in the middle of production circle.

Keywords: eggs, laying hens, storage

Tovne karakteristike junica i bikova Charolais pasmine

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Sažetak

Pasmina (genotip) važna je odrednica proizvodnje junećeg mesa jer utječe na dinamiku rasta, konformaciju trupa i kvalitetu mesa. Na tovnne karakteristike utječe specifičnost proizvodnog okruženja te proizvodne potencijale pasmina treba istražiti u različitim tehnologijama proizvodnje. Stoga je cilj istraživanja bio utvrditi tovnne karakteristike junica i bikova pasmine Charolais uzgojenih u sustavu krava-tele te tovljenih u zatvorenom stajskom načinu držanja. Istraživanje je provedeno na dvanaest junadi jedne uzgojno-tovne govedarske farme. Telad su uzgojena u jednakim uvjetima u sustavu „krava-tele“ u kojem su do odbića (u dobi sedam mjeseci) držana zajedno s kravama. Potom su odvojena od stada i grupirana u dva boksa te uključena u daljnji tov. Junad su tijekom tova hranjena kompletno izmiješanim obrokom. Vaganje mladih bikova provedeno je u njihovoj dobi od 200 i 490 dana a junica u dobi od 220 i 530 dana. Mladi bikovi u odnosu na junice postigli su veće završne mase (720 kg: 531 kg; $P < 0,01$) i ukupne dnevne priraste (1.470 g : 1.028 g; $P < 0,01$). Mladi bikovi u odnosu na junice imali su povoljni randman te povoljniji udio mišićnog, masnog i koštanog tkiva u rebrenom isječku (66,8 : 16,5 : 16,7). Rezultati provedenog istraživanja pokazuju da je utjecaj spola na dinamiku rasta te konformaciju trupa junadi značajan. Provedeno istraživanje može poslužiti kao poticaj daljnjim istraživanjima tovnih karakteristika junadi Charolais pasmine u aktualnim tehnologijama tova.

Ključne riječi: Charolais, proizvodnja govedine, spol, fenotip

Growth performance of heifers and bulls of Charolais breed

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Abstract

Breed (genotype) is an important determinant of beef production as it affects growth dynamics, carcass conformation and meat quality. These traits are influenced by the specificity of the production environment and the production potential of the breeds should be explored in different production systems. The aim of this study was to determine the growth characteristics of heifers and bulls of Charolais breed reared in the cow-calf system and fattened indoors. The study was conducted on twelve heifers of one breeding cattle farm. Calves were reared on equal terms in a “cow-calf” system in which they were kept together with the cows until weaning (*at the age of seven months*). After weaning they were separated from the herd and grouped in two boxes and further fattened. The beefs were fed a completely mixed meal during the growth period. Weighing of young bulls was performed at their ages of 200 and 490 days and heifers at 220 and 530 days. Young bulls achieved higher final weights (720 kg: 531 kg; $P < 0.01$) and average daily gains (1470 g: 1028 g; $P < 0.01$) compared to heifers. They also had a favorable yield and proportion of muscle, fat and bone tissue in the rib cage (66.8 : 16.5 : 16.7). The results showed that the effect of sex on the growth dynamics and conformation of the carcasses of the young heifers is significant. Conducted research can serve as an impetus for further investigations of the fattening characteristics of Charolais breeds in current growth technologies.

Keywords: Charolais, beef production, sex, phenotype

Selenom biofortificirana soja i kukuruz u hranidbi tovnih pilića

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Sažetak

Selen je esencijalni element za ljude i životinje, a kao građevni element selenoproteina vrlo značajan je za metabolizam organizma životinje. Cilj ovog istraživanja bio je utvrditi utjecaj dodatka selenom biofortificiranog kukuruza i soje u hranidbu tovnih pilića na tjelesnu masu i prirast te kvalitetu pilećeg mesa. Pokus je proveden na 90 jednodnevnih pilića provenijencije Ross 308 ravnomjerno raspoređenih spolova, podijeljenih u 3 skupine (kontrolna i dvije pokusne skupine pilića) u trajanju od šest tjedana. Kontrolna skupina pilića tijekom cijelog istraživanja bila je hranjena standardnom krmnom smjesom, dok je u smjesi P1 skupine pilića korištena selenom biofortificirana soja, a u smjesu skupine P2 korišteni su selenom biofortificirani soja i kukuruz. Istraživanje je pokazalo kako je postojala statistički značajna razlika u tjelesnim masama ($P=0,004$) i prirastima ($P=0,049$) pokusnih skupina u odnosu na kontrolnu skupinu pilića u četvrtom tjednu tova. Istraživanje je nadalje pokazalo kako je postojala statistički značajna razlika u masama prsa pilića pokusnih skupina u odnosu na kontrolnu ($P=0,016$) te kako je postojala statistički značajna razlika u koncentraciji selena u bijelom masu ($P<0,001$) te koncentraciji selena u zabatku ($P<0,001$) između pilića pokusnih i kontrolne skupine. Zaključeno je kako selenom biofortificirana soja i kukuruz pozitivno utječu na proizvodne pokazatelje te kvalitetu mesa tovnih pilića.

Ključne riječi: biofortifikacija, hranidba, pilići brojleri, selen, tov

Selenium biofortified soybeans and corn in chickens feeding

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Abstract

Selenium is an essential element for humans and animals and as an important component of selenoproteins, it is very important for the animals' metabolism. The aim of this study was to determine the effect of selenium biofortified soybeans and corn supplementation on body weight, weight gain, and quality of chicken meat. The experiment was conducted on 90 one-day-old Ross 308 provenance chickens, evenly distributed by sex, divided into 3 groups (control and two experimental groups of chickens) for six weeks. The control group of chickens' was fed a standard feed throughout the study, while P1 experimental group of chickens' was fed feed mixture that contained selenium biofortified soybeans and P2 experimental group of chickens' was fed feed mixture that contained selenium biofortified soybeans and corn. The study showed that there was a statistically significant difference in body weight ($P=0.004$) and weight gain ($P=0.049$) of the experimental groups compared to the control group of chickens in the fourth week of feeding trial. The study further showed that there was a statistically significant difference in chicken's breast weights of the experimental groups compared to the control ($P=0.016$) and that there was a statistically significant difference in the concentration of selenium in the chicken's breast ($P<0.001$) and the concentration of selenium in the chicken's thigh ($P<0.001$) between the experimental groups of chickens and control group. It was concluded that selenium biofortified soybeans and corn had a positive effect on production performance and meat quality of broiler chickens.

Keywords: biofortification, feeding, broiler chickens, selenium, feeding trial

Water-holding capacity and tenderness of „Posavina horse“ meat

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Abstract

Water-holding capacity (WHC) and tenderness of meat are important attributes associated with consumer acceptance and processing technology. Poor WHC results in numerous economic losses recognizable in a lower yield, lower nutritional value of meat, and therefore lower quality of products. Tenderness is the most important attribute influencing acceptability and eating satisfaction of meat products for consumers. However, there is still a lack of knowledge about the quality traits of horse meat and the factors affecting it. Posavina horse represents the recognizable autochthonous cold-blooded breed. The significant income of this breed comes from meat production. However, there is no literature data about the quality traits of Posavina horse meat and factors affecting it. Therefore, this study aimed to determine water-holding capacity (thawing loss – TL and cooking loss – CL) and tenderness (Warner-Bratzler shear force, WBSF) of Posavina horse meat considering sex, age at slaughter and aging period (14 and 28 days). The study was conducted on 12 animals of Posavina horse breed (6 males and 6 females) raised at small farms with similar husbandry practice. The average age of the animals was 18 months and ranged from six to 36 months. Muscle samples for the analysis were taken from the *M. longissimus dorsi* (between 6th and 8th thoracic vertebrae) of each carcass after the aging period of 14 days and 28 days. The WHC and tenderness of Posavina horse meat were analyzed using the SAS/STAT software package version 9.4. The mean values for TL, CL, and WBSF were 8.41%, 19.24%, and 26.04 N, respectively. The results showed that TL, CL, and WBSF of Posavina horse meat were not significantly affected by sex, slaughter age or aging period ($p>0.05$). It could be concluded that this study gave a new insight into the quality traits of Posavina horse meat which could contribute to further necessary research to complete an understanding of horse meat quality.

Keywords: horsemeat, thawing loss, cooking loss, shear force

Koncentracija β -karotena, luteina i zeaksantina u mlijeku krava Jersey pasmine

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Sažetak

Cilj ovog istraživanja bio je utvrditi koncentraciju β -karotena, luteina i zeaksantina u mlijeku krava Jersey pasmine tijekom sezonskih promjena u hranidbi (pašna, prijelazna i stajska sezona) te njihovu korelaciju sa parametrima boje mlijeka. Uzorkovanje mlijeka (200 mL skupnog mlijeka iz laktofriza) provedeno je u razdoblju od svibnja 2018 do travnja 2019 na dan redovite kontrole mliječnosti. Prosječan sadržaj (%) mliječne masti u mlijeku iznosio je $5,74 \pm 0,16$, bjelančevina $3,92 \pm 0,28$, laktoze $4,34 \pm 0,11$ i bezmasne suhe tvari $9,39 \pm 0,26$. Sezona je imala značajan ($P < 0,05$) utjecaj na sadržaj mliječne masti, bjelančevina i bezmasne suhe tvari te su najniže vrijednosti utvrđene tijekom pašne sezone. Koncentracija luteina u mlijeku krava Jersey pasmine značajno ($P < 0,05$) se razlikovala između sezona te su veće koncentracije utvrđene tijekom pašne u odnosu na stajsku sezonu. Najveće koncentracije luteina ($5,94 \pm 0,64 \mu\text{g}/100 \text{ mL}$) i β -karotena ($4,56 \pm 0,57 \mu\text{g}/100 \text{ mL}$) utvrđene su tijekom pašne sezone, slijedila je prijelazna ($3,86 \pm 0,64 \mu\text{g}/100 \text{ mL}$; $4,24 \pm 0,57 \mu\text{g}/100 \text{ mL}$) te stajska sezona ($3,75 \pm 0,45 \mu\text{g}/100 \text{ mL}$; $3,89 \pm 0,41 \mu\text{g}/100 \text{ mL}$). Koncentracije zeaksantina su bile konstantne tijekom sezona te je prosječna koncentracija iznosila $0,97 \pm 0,04 \mu\text{g}/100 \text{ mL}$. Umjerene i pozitivne korelacije su utvrđene između koncentracija β -karotena i luteina sa parametrom b^* boje mlijeka što se očitivalo u izraženijoj žutoj boji mlijeka.

Može se zaključiti da mlijeko krava Jersey pasmine ima visok sadržaj mliječne masti i bjelančevina na koje utječu sezonske razlike u sastavu obroka. Koncentracija β -karotena i luteina u mlijeku krava Jersey pasmine je bila različita tijekom sezona. Veće koncentracije luteina tijekom pašne sezone rezultirale su izraženijom žutom boja mlijeka tijekom toga perioda.

Ključne riječi: mlijeko, karotenoidi, sezona, Jersey pasmina

Concentration of β -carotene, lutein and zeaxanthin in milk of Jersey cows

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Abstract

The aim of this study was to determine concentration of β -carotene, lutein and zeaxanthin in milk of Jersey cows during different seasonal feeding regimes (grazing, transition and farm season) and their correlation with milk colour parameters. Milk sampling (200 mL of bulk tank milk) was done in period between May 2018 and April 2019 on the day of regular monthly milking control. Mean content (%) of milk fat was 5.74 ± 0.16 , protein 3.92 ± 0.28 , lactose 4.34 ± 0.11 and non-fat dry matter 9.39 ± 0.26 . Season had significant ($P < 0.05$) effect on milk fat, protein and non-fat dry matter content, having the lowest values during grazing season. Lutein concentration in milk of Jersey cows was significantly ($P < 0.05$) affected by season, being higher during grazing than farm season. The highest concentrations of lutein (5.94 ± 0.64 $\mu\text{g}/100$ mL) and β -carotene (4.56 ± 0.57 $\mu\text{g}/100$ mL) were found during grazing period, followed by transition (3.86 ± 0.64 $\mu\text{g}/100$ mL; 4.24 ± 0.57 $\mu\text{g}/100$ mL) and farm season (3.75 ± 0.45 $\mu\text{g}/100$ mL; 3.89 ± 0.41 $\mu\text{g}/100$ mL). Zeaxanthin concentrations were consistent through seasons, with mean value of 0.97 ± 0.04 $\mu\text{g}/100$ mL. Moderate and positive correlations were found for β -carotene ($P < 0.05$) and lutein ($P < 0.001$) concentration with colour parameter b^* resulting in more intense yellow colour. In conclusion, Jersey milk has high milk fat and protein content, that is affected by seasonal changes in nutrition. Concentrations of β -carotene and lutein in Jersey milk varied across different seasons. Higher concentration of lutein during grazing season resulted in more intense yellow colour of milk during this period.

Keywords: milk, carotenoids, season, Jersey breed

Utjecaj dodavanja plemenite pečurke (*Agaricus bisporus*) u obroke na oksidativnu stabilnost mesa janjadi ličke pramenke

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Sažetak

Poznato je djelovanje dodavanja plemenite pečurke (*Agaricus bisporus*) hrani za životinje kao promotora zdravlja i proizvodnosti domaćih životinja. Dokazano je da dodavanje plemenite pečurke obrocima za ovce snižava kolesterol, no nije poznat i učinak na kvalitativne osobine mesa. Stoga je cilj ovog rada utvrditi utjecaj dodavanja plemenite pečurke u obroke na oksidativnu stabilnost mesa janjadi. Kao pokazatelj oksidativne stabilnosti mesa koristio se tiobarbiturni test (TBARS). Osamnaest janjadi, pasmine lička pramenka, bilo je podijeljeno u tri jednake skupine (kontrolna, te pokusne skupine s dodatkom 2% svježih i suhih plemenite pečurke). Nakon pokusnog perioda od 35 dana uzeti su uzorci mesa, te je određen udio masti i TBARS 0., 3., i 6. dan. Utjecaj dodavanje svježih : suhih plemenite pečurke imao je statistički značajan utjecaj ($p \leq 0,05$) na količinu masti u mesu janjadi (11,0 : 16,2), no nije se statistički razlikovao od kontrolne skupine. Vrijednosti TBARS-a očekivano su rasle od 0. do 6. dana (0,1 : 1,4), te se značajno se razlikuju u vrijednostima 3. dan, između mesa janjadi hranjenih standardnim obrokom i obrokom sa svježim gljivama (0,97 : 0,86), dok kod obroka sa suhim gljivama nije bilo značajnih razlika između niti jedne grupe janjadi. Zaključujemo da dodavanje plemenite pečurke u obroke janjadi djeluje na promjene oksidativne stabilnosti mesa, no budući da su najmanje vrijednosti TBARS-a bile kod janjadi s najnižim sadržajem masti, te navedene razlike nisu bile statistički značajne između kontrolne skupine i pokusnih, daljnja istraživanja u objašnjenju dobivenih rezultata biti će potrebna.

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Ključne riječi: plemenita pečurka, oksidativna stabilnost mesa, TBARS, lička pramenka

Effect of dietary supplementation of button mushroom (*Agaricus bisporus*) on oxidative stability of Lika pramenka lamb meat

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Abstract

The effect of supplementation of button mushroom (*Agaricus bisporus*) to animal feed as a promoter of the health and productivity of domestic animals is well known. Adding high quality mushrooms to sheep's meals has been shown to lower cholesterol but the effect on the meat's qualitative properties is unknown. Therefore, the aim of this paper is to determine the effect of supplementation of button mushroom in diet on the oxidative stability of lamb's meat. The thiobarbitur test (TBARS) was used as an indicator of the oxidative stability of the meat. Eighteen lambs of the Lika pramenka breed were divided into three equal groups (control and experimental groups with the addition of 2% fresh and dried button mushrooms). After a 35-day trial, meat samples were taken and the proportion of fat and TBARS determined on days 0, 3, and 6. The effect of adding fresh: dried button mushrooms had a statistically significant effect ($P \leq 0.05$) on the amount of fat in lamb meat (11.0 vs. 16.2) but did not differ statistically from the control group. TBARS values were expected to increase from day 0 to day 6 (0.1 vs. 1.4) and differ significantly from day three between lamb meat fed a standard meal and a fresh mushroom meal (0.97 vs. 0.86), while the dry mushroom meal had no significant differences between the two lamb groups. We conclude that the addition of button mushrooms to the lambs' meals has an effect on changes in the oxidative stability of the meat. Since the lowest TBARS values were in the lambs with the lowest fat content, these differences were not statistically significant between the control group and the experimental ones, further investigations in explanation of the obtained results will be required.

This work was been fully supported by Croatian Science Foundation under the project IP-2016-06-3685.

Keywords: button mushroom, meat oxidative stability, TBARS, Lika pramenka lambs

Uzroci i preventiva listerioze na farmama mliječnih koza u Hrvatskoj

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Sažetak

Listerioza je bakterijska bolest opasna za zdravlje životinja i ljudi. Kod domaćih životinja najčešće obolijevaju preživači, dok se kod drugih životinja javlja znatno rjeđe. U intenzivnim uzgojima mliječnih koza u Hrvatskoj listerioza se javlja povremeno najčešće zbog pogrešaka uzgajivača kod hranidbe. Istraživanjem provedenim na četiri farme koza u sjeverozapadnoj Hrvatskoj na kojima je dijagnosticiran živčani oblik listerioze utvrđen je izvor zaraze kao i načini kako se bolest može spriječiti. Mortalitet se kretao od 11 do 30%. Na tri farme utvrđeno je da su koze obolijevale nakon konzumacije sjenaže omotane u valjkaste bale, dok je na jednoj farmi kao izvor zaraze utvrđena sjenaža iz silosa u kojem je bila pohranjena sa kukuruznom silažom. Na tri od četiri farme radilo se o iskusnim uzgajivačima. Istraživanjem je utvrđeno da su u tri slučaja do pojave listerioze došlo nakon hranidbe koza sa sjenažom iz valjkastih bala nabavljenih na ugašenim farmama mliječnih krava. Na farmi na kojoj se koristila sjenaža iz silosa pojava listerioze je posljedica kontaminacije zemljom tijekom košnje. U ovom slučaju pored dijagnoze bolesti na temelju kliničkih znakova, uzročnik je izoliran iz sjenaže. Travnja sjenaža je pripremana nakon sušnog razdoblja gdje se na livadi nalazio veći broj krtičnjaka koji su kontaminirali travu tijekom košnje. U slučaju kontaminacije trave tijekom košnje većom količinom zemlje i preniske kiselosti (pH ispod 5) dolazi do umnažanja *Listeriae monocytogenes* do infektivne razine. Iako hranidba silažom i sjenažom može značajno povećati mliječnost koza i smanjiti troškove hranidbe zbog manje uporabe koncentriranih krmiva, zbog rizika od listerioze uzgajivači koza je vrlo rijetko koriste. Osnovna preventiva bolesti se temelji na kvalitetnoj pripremi travnjaka kako bi se izbjegla pojava krtičnjaka, zatim na korištenju sredstava kojima se regulira odnosno povećava kiselost (pH ispod 5) silaže i sjenaže kao što su inokulanti i propionska kiselina. Nakon baliranja i umatanja bale je potrebno primjereno uskladištiti kako bi se izbjeglo oštećenje omota bala i ulazak zraka. Na temelju ovog istraživanja možemo zaključiti da je temelj preventivne listerioze koza korištenje kvalitetno pripremljenog sijena.

Ključne riječi: koze, listerioza, sjenaža

Cause and prevention of listeriosis on dairy goat farms in Croatia

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Abstract

Listeria is a bacterium which is dangerous for animal and human health. Among the domesticated animals it is more common in ruminants than in other animals. In intensive breeding in Croatia listeriosis occurs due to mistakes made by breeders in feeding. The source of listeria infection and a way of prevention has been identified on four farms in North-West part of Croatia. The mortality rate was between 11 and 30%. It was determined that on three farms the goats got sick after consuming haylage from bales wrapped in plastic, while on one farm the source of infection was found to be haylage from a silo where it was kept alongside corn silage. Three out of four farms were managed by experienced breeders. The research found that in three cases listeriosis was caused by bales of haylage gotten from closed dairy farms. On the farm where listeriosis was caused by haylage from a silo it was a result of soil contamination during harvest. In this case, apart from a clinical based diagnosis the bacteria were isolated from the used haylage. Grass haylage was prepared during the dry season when the field has many molehills which contaminate the grass during mowing. In the case of grass contamination due to soil and low pH (pH lower than 5) the *Listeria monocytogenes* multiplies to an infectious level. Although feeding haylage and silage can increase milk production in goats and reduce the cost of feeding due to less use of concentrated feeds, because of the risk of listeriosis the breeders rarely use it. The cornerstone of disease prevention is based on quality field preparation to avoid molehills and using regulating agents such as inoculants and propionic acid to raise haylage and silage acidity (pH below 5). Following baling and wrapping, the bales should be properly stored to avoid damaging the wrap and letting air inside. Based on this research we can conclude that the foundation of listeriosis prevention in goats is using well prepared hay.

Keywords: goats, listeriosis, haylage

Struktura i funkcija mikrobioma domaćih životinja

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Sažetak

U posljednjih je godina mikrobiom privukao veliku pozornost u istraživanjima domaćih životinja. Populacije mikroorganizama igraju važnu ulogu u većini bioloških procesa, stoga je neophodno razumjeti njihovu strukturu i funkciju tijekom suživota s organizmima domaćinima. Mikrobiom je definiran kao cjelokupno stanište koji uključuje mikrobiotu (sve prisutne mikroorganizme) i njihove genome. Populacije mikrobioma vrlo su raznolike te se razlikuju na razini jedinki, uvjeta uzgoja, hranidbe itd. Kod domaćih životinja (svinje, perad, goveda itd.), ova su istraživanja usmjerena na poboljšanje općeg zdravstvenog statusa jedinki u uzgoju, kao i na utvrđivanje povezanosti mikrobiote s proizvodnim svojstvima. Nedavna otkrića u takozvanim „omiks“ tehnologijama (npr. genomika, proteomika, transkriptomika, metabolomika i dr.), značajno su utjecala na povećanje količine generiranih podataka u animalnim znanostima, s glavnim ciljem da detaljno istraže složenost genoma i svih genskih produkata kao što su transkripti, proteini i metaboliti, te da omoguće nove pristupe u održivom i ekološko prihvatljivom uzgoju domaćih životinja. Cilj ovog rada je istražiti trenutna saznanja te razmotriti perspektivu i buduće izazove u primjeni mikrobioma u animalnim znanostima.

Ključne riječi: mikrobiom, mikrobiota, domaće životinje, „omiks“ tehnologije

The structure and function of microbiome in livestock species

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Abstract

Over the last few years, microbiome has attracted much attention in research of livestock species. As microbial populations play an important role in majority of biological processes, it is essential to understand their structure and function in cohabitation with the host organisms. Microbiome is defined as the entire habitat, including the microbiota (all microorganisms) and their genomes. The microbiome populations are highly diverse that vary on the level of individuals, raising environment, feeding strategies etc. In livestock species (pigs, poultry, cattle etc.), these research are focused towards the raising of healthy individuals as well as the association of microbiota with production traits. Recent discoveries in the so called “-omics” technologies (e.g., genomics, proteomics, transcriptomics, metabolomics etc.), have substantially increased the amount of generated data in animal science, with main aim to deeply explore the complexity of genomes and all gene products such as transcripts, proteins, and metabolites, and to provide new approaches in sustainable and environmental friendly animal production. The aim of this paper is to review the current knowledge and discuss future perspectives and challenges of microbiome application in animal science.

Keywords: microbiome, microbiota, livestock, “omics” technologies

The effect of stress on milkability of dairy ewes

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Abstract

Stress occurred before and during milking causes the reduction of milkability of dairy animals. The aim of this study was to evaluate the effect of social stress on milkability parameters in dairy ewes of two breeds raised in Slovakia. The breeds Tsigai (n=13) and Improved Valachian (n=13) were included in the experiment. During the first morning milking, the milking was performed under normal milking condition (control milking). Before the next morning milking (milking under stress), the following treatment was applied to each ewe: social isolation (free movement alone) in dairy parlour for at least 4 min, and afterwards, the fixation of ewe into a milking stall and milking in presence of unknown person standing in front of the head gently touching it during whole milking. During both milkings, the parameters of milkability (total milk yield, machine milk yield, milking time, milk flow latency, and maximal milk flow rate) were measured using electronic collection jar. The breed has no effect on the tested parameters of the milkability. The significant decline of total and machine milk yield was observed during milking under stress as compared to control milking (0.197 ± 0.018 vs. 0.283 ± 0.018 L, $P < 0.0001$ and 0.100 ± 0.015 vs. 0.160 ± 0.015 L, $P < 0.0001$; resp.). Also maximum milk flow rate was reduced during milking under stress in comparison to control milking (0.528 ± 0.071 vs. 0.686 ± 0.071 L/min, $P = 0.0272$). Milking time and milk flow latency did not differ between control milking and milking under stress. In conclusion, milking under stress can negatively influenced the milkability of evaluated breed. Thus, it is important to identify and reduce the acute stress on ewe during the milking process.

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Keywords: ewe, milkability, stress

Examination of the effect of light sources on meat quality parameters for broilers

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Abstract

In poultry farming, the issue of lighting can be approached from several aspects. Lighting program is one of the most important parameter in the roast chicken production and it can affect the feed intake, gut motility and digestion. Our aim was to investigate the effect of traditional tungsten filament bulbs and light emission diodes (LED) on some meat quality parameters of broiler chickens. Meat quality parameters – pH 45 minutes (pH45) after slaughter, pH 24 hours (pH24) after slaughter, colour (CIELab parameters), kitchen technical losses (freezing, cooking and cooling loss), nutritional parameters (moisture, protein, fat) and shear force - were measured in the breast muscle. One-day-old Cobb500 cockerels (n=400) were divided into two groups (LED – L group and traditional tungsten filament bulbs – I group) during the trial (42 days). There was no difference in pH45, pH24 and in the nutritional parameters between groups. In the case of total kitchen technical loss, the L group had favourable value (38.2%) compare to the I group (40.2%). No significant difference was found in the colour parameters (L*, a*, b*), the samples of L group showed higher b* value (11.86) than the I group (11.56), which is more preferred in the market. The shear force of the breast meat was significantly lower in the L group (1.78 kg) compare the I groups (2.09 kg). The LED lighting systems can replace the traditional tungsten filament bulbs and can even improve some meat quality parameters.

Keywords: broiler, light sources, production, meat quality

Polimorfizam beta kazeina u populaciji buše u Hrvatskoj

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Sažetak

Buša je hrvatska autohtona pasmina goveda manjeg tjelesnog okvira, dobre prilagodljivosti i skromne proizvodnosti. Nedovoljna konkurentnost u proizvodnji mlijeka i mesa razlog su potiskivanja ove pasmine na rub biološkog opstanka. Dugoročna održivost pasmine moguća je isključivo kroz njenu ponovnu gospodarsku reafirmaciju. Skroman mliječni potencijal može gospodarski biti kompenziran proizvodnjom mlijeka dodanih tržišnih bonusa. Zapažena povezanost polimorfni A2/A1 genetskih varijanti beta-kazeina mlijeka sa zdravljem potrošača, gastrointestinalnim i imunološkim smetnjama zadnjih desetljeća pobuđuje interes šire javnosti. Razlika navedenih varijanti beta-kazeina je na 67 poziciji aminokiselinskog proteinskog slijeda i to u zamjeni histidina prolinom. Ranija istraživanja uglavnom navode da je A2 varijanta beta-kazeina izvorna, te da ima povoljniji učinak na zdravlje potrošača. Cilj istraživanja bio je utvrditi zastupljenost alelnih varijanti i genotipova beta-kazeina u populaciji buše. Genotipizacija je provedena na 20 jedinki uz uporabu restrikcijske endonukleaze DdeI. Utvrđena je nazočnost sva tri genotipa u populaciji buše. Zastupljenost A2 alelne varijante beta kazeina je dominantna (67,5%) što čini povoljnu osnovu za profiliranje određenih stada buše prema proizvodnji A2 mlijeka. Osobitu pozornost treba posvetiti riziku od gubitka genetske raznolikosti, budući da preferiranje određenih genetskih varijanti u malim populacijama može narušiti njihovu genetsku varijabilnost.

Ključne riječi: buša, beta kazein, A2 mlijeko, polimorfizam, genotip

Polymorphism of beta-casein in Busa population in Croatia

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Abstract

Busa is a Croatian indigenous breed of small body frame, good adaptability and modest productivity. Insufficient competitiveness in production of milk and meat is the reason for pushing this breed to the brink of biological extinction. The long-term viability of the breed is possible only through its economic re-affirmation. The modest milk potential can be economically offset by the production of milk with added market bonuses. Observed association between polymorphic A2/A1 genetic variants of beta-casein milk with consumer health, gastrointestinal and immune disorders in recent decades has sparked interest in general public. Difference between these beta-casein variants is at 67 position of the amino acid protein sequence in the replacement of histidine by proline. Earlier research has generally stated that the A2 variant of beta-casein is original and more beneficial on consumer health. Aim of this study was to determine the presence of allelic variants and genotypes of beta-casein in the Busa population. Genotyping was performed on 20 individuals using DdeI restriction endonuclease. All three genotypes were determined. Presence of the A2 allelic variant of beta-casein is dominant (67.5%), which provides a favorable basis for profiling certain herds of bushes according to A2 milk production. Particular attention should be paid to the risk of loss of genetic diversity, since preference for certain genetic variants in small populations may impair their genetic variability.

Keywords: busa, beta-casein, A2 milk, polymorphism, genotype

A review an automated cattle grazing in pasture using virtual fencing and sensor systems for nutrition, health and reproduction control

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Abstract

Projections indicate that the world's population will increase from the current 7.2 billion to 9.6 billion by 2050 and 10 billion in 2070, respectively. Population growth puts unprecedented challenges ahead of agricultural production and the food industry. There will be a pronounced increase in the need for food of animal origin. Automated monitoring of management on farms becomes a reality. Improving of cattle reproduction, health, nutrition, yields, welfare using Precision Livestock Farming (PLF) can generate added value for the farmer. The most accurate method for the automatic determination of yield and quality of available pasture would be to use a vehicle-robot to take samples and using a portable NIRS analysis device (Near Infrared Spectroscopy). Other methods can be also useful: towed device (C-Dax Pasture Meter, mounted on a human-driven vehicle) equipped with a light sensor, a vehicle-robot equipped with laser sensors, or the determination of vegetation status by analyzing digital photographs on individual of pastures. Drones are also used very successfully. Utilization of virtual herding – fencing by collar (audio and electrical stimulus level) will successfully keep cattle in specific areas. Numerous parameters important for management in cattle production can be monitored through electronic sensors. The following devices are used for this purpose: boluses, ear smart tags, collars, drones, robots. The purpose of all of the above is to provide the farmer, as soon as possible, with information by each animal when there is an irregularity in the breeding of cattle, so that he can react in a timely manner for the purpose of efficient production of beef and milk.

Keywords: precision dairy farming, virtual herding-fencing, health control, reproduction, nutrition

Utjecaj DGAT1 i TG gena na odlike trupova i mesa junadi križanaca Holstein x Piemontese

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Sažetak

DGAT1 (diacilglicerol-O-aciltransferaza) i *TG* (tiroglobulin) geni imaju važnu ulogu u metabolizmu i odlaganju masti u organizmu. Meso prožeto intramuskularnom masti je sočnije i mekše što utječe na kvalitetu i organoleptička svojstva, odnosno na preferencije potrošača. Cilj istraživanja bio je utvrditi polimorfizam *DGAT1* i *TG* gena te njihov utjecaj na odlike trupova i mesa junadi križanaca Holstein x Piemontese. U promatranom uzorku za *DGAT1* gen ($N=17$) utvrđena je veća zastupljenost alela *K* (0,53) i genotipa *KA* (0,94) dok je za *TG* gen ($N=19$) utvrđena veća zastupljenost alelne varijante *C* (0,92) i genotipa *CC* (0,84). Istraživanjem je zabilježena veća klaonička masa i masa toplih polovica, neto i bruto dnevni prirasti u junadi *KK* genotipa *DGAT1* gena te u junadi *CT* genotipa *TG* gena. Junad *KK* genotipa imala su veći stupanj zamašćenosti trupa i mramoriranosti mesa (*m. longissimus dorsi*). Istovremeno u junadi genotipa *CT* utvrđen je veći stupanj zamašćenosti, dok je veći stupanj mramoriranosti mesa utvrđen u junadi *CC* genotipa. Veći udio mišićnog i masnog te manji udio koštanog tkiva dobiven je disekcijom rebrenog isječka (9.-11. rebro) junadi *KK* i *CT* genotipa. U junadi navedenih genotipova meso je bilo tamnije i crvenije boje. Za objektivniji zaključak o utjecaju polimorfizma *DGAT1* i *TG* gena na proučavane osobine u istraživanje treba uključiti veći broj jedinki sa sličnijim omjerom genotipova.

Ključne riječi: junad, *DGAT1*, *TG*, odlike trupa i mesa

Influence of DGAT1 and TG genes on carcass and meat characteristics of Holstein x Piemontese cattle

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Abstract

DGAT1 (Diacylglycerol-O-acyltransferase) and *TG* (Thyroglobulin) play important roles in metabolism and fat deposition in the organism. Meat marbled with intramuscular fat is juicy and soft which affects the quality and organoleptic properties, that is, consumer preferences. The aim of this study is to determine the polymorphism of *DGAT1* and *TG* genes and their influence on carcass and meat characteristics of Holstein x Piemontese cattle. In the observed sample, the *DGAT1* gene ($N=17$) showed a higher representation of the *K* allele (0.53) and the *KA* genotype (0.94), while a higher *C* allele variant (0.92) and the *CC* genotype (0.84) were found for the *TG* gene ($N=19$). Higher slaughter weight and hot carcass weight, net and gross daily gains were determined in the steers of *KK* genotype (*DGAT1* gene) and of the *CT* genotype (*TG* gene). The *KK* genotype steers had higher carcass fattens and marbling (*m. longissimus dorsi*) scores. At the same time, a higher amount of carcass fattens was present with *CT* steers, while a higher marbling reflected with *CC* steers. A higher proportion of muscle and fat tissue and a smaller proportion of bone tissue were obtained by dissection of the rib clip (9th-11th rib) in the steers of *KK* and *CT* genotypes which have darker and reddish colored meat. For a more objective conclusion on the influence of the *DGAT1* and *TG* gene polymorphisms on the studied characteristics, a larger number of individuals with a similar genotype ratio should be included in the study.

Keywords: steers, *DGAT1*, *TG*, carcass and meat characteristics

Primjena metoda glavnih komponenti muznih karakteristika pri strojnoj mužnji krava

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Sažetak

Glavni cilj ovog istraživanja je bio prikupiti podatke četiri komercijalna izmuzišta tipa riblja kost i paralelno te procijeniti njihovu učinkovitost. Prikupljeni su jednogodišnji podaci sa četiri farme koje su opremljene Afimilk elektroničkim mjeracima količine mlijeka, kao i management programom koji je pohranio podatke svake pojedine mužnje. Priprema vimena za strojnu mužnju se razlikovala na farmama, pa su tako dvije farme imale osam do deset muznih mjesta po muzaču, dok su ostale dvije imale pet muznih mjesta po muzaču. Varijable korištene u analizi su: prosječno trajanje mužnje, protoci mlijeka (0-15 s; 15-30 s; 30-60 s i 60-120 s), trajanje najmanjeg protoka mlijeka, učinkovitost mužnje, količina mlijeka na sat po muznom mjestu i bimodalnost. Primjenom metoda glavnih komponenti utvrđene su dvije glavne komponente PCA1 (za protok mlijeka i trajanje mužnje) sa 53,9% i PCA2 (za učinkovitost strojne mužnje) sa 21,1% objašnjenje ukupne varijabilnosti. Rezultati analize pokazuju da farme sa većim brojem muznih mjesta po muzaču imaju manju učinkovitost nego farme sa manjim brojem muznih mjesta po muzaču. Analizom glavnih komponenti je jednostavno utvrditi farme koje imaju duže trajanje mužnje sa najvećim protokom mlijeka. Zaključno, primjenom glavnih komponenti PCA1 (za protok mlijeka i trajanje mužnje) i PCA2 (za učinkovitost strojne mužnje) moguće je primijeniti za svako izmuzište, te ga analizirati jednostavno i objektivno.

Ključne riječi: strojna mužnja, muzne karakteristike, učinkovitost mužnje, muzne krave, metoda glavnih komponenti

Principle component analysis of the milking characteristics in dairy cows

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Abstract

The objective of this study was to collect and analyse milking data from four commercial farms with herringbone parlour and parallel to evaluate milking efficiency. Data were collected during one year from four farms equipped with Afimilk electronic milk metres and herd management software that recorded data at individual milking sessions. The difference in pre-milking teat preparation was that two farms had more than 8 to 10 milking stalls per operator and two had 5. Variables recorded included average milking duration, milk flow rates (0-15 s; 15-30 s; 30-60 s and 60-120 s), low flow rate duration, milking efficiency, milk per hour per stall and bimodality. Principle component analysis determined two main components PCA1(milk flow and duration) and PCA2 (milking efficiency) that explained 53,9 and 21,1% of total variability respectively. The results of the analysis showed that farms with higher number of stalls per operator had lower efficiency than farms with lower number of stalls per operator. Additionally, farms with higher duration and flow rates could also be clearly determined. To conclude, principle components for flow and duration PCA1 and milking efficiency PCA2 could be used to evaluate every milking parlour easily and objectively.

Keywords: milking, milking characteristics, milking efficiency, dairy cows, principle component analysis

Individual somatic cell counts in milk of ewes at the level of farms and breeds in Slovakia

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Abstract

There is still a discussion about the physiological level of somatic cell counts (SCC) in ewe's milk in the world. Establishing of such level, as it is generally accepted in dairy cows, could be a suitable approach to improve the udder health, milk quality and safety, and payment. SCC is widely accepted as a suitable indicator of udder health. The aim of the study was to analyse SCC of the individual sheep milk samples obtained from practical conditions in Slovakia. Also the effect of breed, farm and season was considered as well. Into the trial the six farms were involved – three farms with Tsigai and another three ones with Lacaune ewes. The ewes were sampled in April, May, June and July. Only ewes with minimum two samples were involved. Thus, 1965 milk samples (1409 Tsigai; 556 Lacaune) were analysed for SCC using Fossomatic 90 (Foss Electric, Hillerød, Denmark). The ewes depending on SCC in their individual milk were divided into five SCC groups: $<0.2 \times 10^6$ cells \times mL⁻¹, between 0.2 – 0.4 $\times 10^6$ cells \times mL⁻¹, between 0.4 – 0.6 $\times 10^6$ cells \times mL⁻¹, between 0.6 – 1 $\times 10^6$ cells \times mL⁻¹, $>10^6$ cells \times mL⁻¹. There was slightly better distribution of milk samples in SCC groups in Tsigai compared with Lacaune from the udder health point of view (Tsigai 43.86%, 20.44%, 6.67%, 7.59% and 21.43% and Lacaune 45.14%, 13.85%, 7.91%, 5.40% and 27.70%, respectively). In three farms with Tsigai the 62%, 62.5% and 76% and in three ones with Lacaune the 47% 55% and 72% samples were in SCC groups below 0.6×10^6 cells \times mL⁻¹. On the other side 23.18%, 22.04% and 13.81% in Tsigai and 34.29%, 34.44% and 18.93% in Lacaune farms were over 10^6 cells \times mL⁻¹. In Tsigai the highest percentage of samples in SCC below 0.6×10^6 cells \times mL⁻¹ was 76.49% in June and in SCC over 10^6 cells \times mL⁻¹ was 27.47% in July. In Lacaune the highest percentage of samples in SCC below 0.6×10^6 cells \times mL⁻¹ was 64.14% in June and in SCC over 10^6 cells \times mL⁻¹ was 30.07% in May. In conclusion, in both breeds the main part of individual milk samples had SCC below 0.6×10^6 cells \times mL⁻¹. The effect of breed was slightly involved in distribution of milk samples in different SCC groups but the main factor influencing distribution of samples was the farm.

This study was supported by the Ministry of Education Science Research and Sports of the Slovak Republic/the Slovak Research and Development Agency (Projects No. APVV-15-0072 and KEGA 039SPU-4/2019).

Keywords: ewe, milk, somatic cells

The occurrence of pathogens in milk of ewes with high somatic cell count at half udder level

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Abstract

The aim of this study was to determine the occurrence of pathogens in ewe's milk with high somatic cell count (SCC) at half udder level. The experiment was carried out on a dairy farm, where main breed was a Tsigai. Milk samples were taken in monthly intervals as part of the milk recording test day from February to July 2019. A total of 289 ewes were included in the survey. Based on SCC in milk, the ewes with $SCC \geq 10^6$ cells/mL at any time of their monthly test day were selected for further sampling three days later. These milk samples were collected at half udder level and analysed on SCC and presence of pathogens. Selected ewes were also repeatedly sampled at half udder level always on third day after monthly recording test days, even if they had low SCC on test day. Thus 95 ewes (438 milk samples, the same ewes were sampled more times if they had already high SCC in earlier recording months) without symptoms of clinical mastitis were involved for evaluation. For bacteriological detection the inoculum of each sample of milk was inoculated onto blood agar (Oxoid LTD, Hamshire, UK). For the identification of pathogens MALDI-TOF MS was used (Bruker Daltonics, Bremen, Germany). From total of 438 examined milk samples tested on the presence of pathogens, 31.7% of samples were as classified positive. Two pathogens were found in 2.9% of bacteriological positive samples. Contaminated samples were detected in 0.9%. The most common pathogens were coagulase-negative staphylococci (CNS). The most frequent CNS were

Staphylococcus (S.) schleifeiri (27.3%), *S. simulans* (23.7%) and *S. epidermidis* (18%). *S. aureus* was identified in 5% of bacteriological positive samples. Other contagious pathogens weren't found in tested group of ewes. 89.2% of bacteriological positive samples had $SCC \geq 0.5 \times 10^6$ cells/mL and 76.2% of samples had $SCC \geq 10^6$ cells/mL. In conclusion, the results showed that the presence of the pathogen had a significant impact on SCC in milk.

This study was supported by the Ministry of Education Science Research and Sports of the Slovak Republic/the Slovak Research and Development Agency (Projects No. APVV-15-0072 and KEGA 039SPU-4/2019).

Keywords: ewes, somatic cell count, pathogens

The electrical conductivity of ewe's milk in mastitis detection

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Abstract

Increased somatic cell counts (SCC) reduce the amount of milk produced in ewes therefore it is necessary to monitor udder health also in these animals. This can be done in three ways in dairy cows: by assessing the SCC, using the California mastitis test (CMT) or measuring the electrical conductivity (EC; mS/cm). The aim of this study was to compare the relationships between these three ways and assess the possibility of using EC as a method for detecting subclinical mastitis in ewes. Samples from each individual teat (n=137) were taken in June and July from ewes, that had at the beginning of lactation (March) $SCC \geq 1 \times 10^6$ cells/mL in milk from the entire udder. Forestripped milk (10 mL) was used for EC measurement with a conductometer Milk Checker N-4L, then the milk sample was poured into the shallow cup on the paddle. When the second sample was taken on the paddle, a CMT was performed and the results were classified into one of the five classes. Afterwards from each udder half 30 mL was taken for SSC analysis. SCC variables were transformed into base 10 logarithms. Data was evaluated by Proc Corr (SAS ver. 9.3). The regularity of the EC increase with the increase in the SCC was confirmed by a strong correlation (Pearson) ($r=0.59$, $P<0.0001$). We also found a strong correlation (Spearman) between CMT and PSBlog ($r = 0.64$, $P<0.0001$) and between CMT and EC ($r=0.56$, $P<0.0001$). In conclusion, we can recommend measuring EC as a suitable alternative for the detection of mastitis in ewes.

This study was supported by the Ministry of Education, Science, Research and Sport of the Slovak Republic/the Slovak Research and Development Agency (Projects No. APVV-15-0072).

Keywords: ewe mastitis, milk conductivity, somatic cell count

Somatic cell counts in bulk milk in Slovakian sheep farms

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Abstract

Although the somatic cell count (SCC) is not considered as factor influencing the price of milk, it is also an important factor determining its yield and quality of the final product. The objective of our research was to evaluate somatic cell count by ewes in the year 2019 in Slovakia. The study was performed in the ten selected herd of purebred Tsigai ewes (5 herds), Lacaune (3 herds) and 2 herds was crossbreds of Lacaune. The ewes were machine milked twice daily after weaning of their lambs at the beginning of April. Regular milk yield recording was performed during the evening milking in around the middle of April, May, June and July. Pool milk samples were obtained from whole milk collection as an average sample. Milk samples were transported to the certificated Central laboratory of the Breeding Services of the Slovak Republic (Plemenárske služby š.p. Bratislava) for somatic cells count analysis. Somatic cells count was determined using a Fossomatic 90 instrument (Foss Electric, Hillerod, Denmark). The highest SCC was found in the Lacaune breed ranging from 2.5×10^6 cells/mL in April to 4.7×10^6 cells/mL in April. Followed by herds of Lacaune crossbreds ranging from 1.8×10^6 cells/mL in July to 3.5×10^6 cells/mL in April. The herds with manual milking achieved ranging from 0.9×10^6 cells/mL in June to 2.9×10^6 cells/mL in July. The lowest values of SCC were reached by herd Tsigai with a range of 0.2×10^6 cells/mL in July to 1.5×10^6 cells/mL in June. The geometric mean of the SCC values for all ten farms was 1.5×10^6 cells/mL. However, more detail study is needed to see relationship between high SCC and presence of microorganisms to better understanding the reasons the physiological and pathological SCC in the ewe's udder. Each farm is specific to technic of ewe's breeding, whether in feeding, milking.

This study was supported by the Slovak Research and Development Agency Projects No. APVV-15-0072.

Keywords: ewe, bulk milk, somatic cells count

Retinol u krvi sisajuće Angus teladi

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Sažetak

Retinol (vitamin A) ima ključnu ulogu u imunitetu mlade teladi. Cilj ovog rada je bio utvrditi sadržaj retinola u plazmi sisajuće angus teladi i krava od poroda do 4. mjeseca starosti držanih u sustavu krava-tele. Pokus je proveden na ekološkoj farmi goveda od siječnja do travnja 2019. godine. Nasumično je izabrano 10 krava i njihovih teladi te je u njihovoj plazmi određena koncentracija retinola. Oteljene krave i njihova telad su provele prvih 60 dana zatvorene u štali gdje su hranjene po volji krmivima različitog prosječnog sadržaja retinol ekvivalenta (RE, µg/kg suhe tvari; $P < 0,001$) koji je iznosio u sijenu 3 651, u sjenaži 12 278 i u kamenoj soli za lizanje s vitaminom A 88 333 RE. Sadržaj retinol ekvivalenta je opadao sa stajanjem sijena i silaže od zime do proljeća ($P < 0,05$). Koncentracije retinola u plazmi teladi su 1., 4., 31., 59. dana iznosile 19,9, 23,1, 16,4 i 19,5 µg/dL, a krava 24,3, 23,5, 24,4 i 25,9 µg/dL. Od 60. do 90. dana krave su zajedno s teladi puštene na mladu ispašu (64 260 RE) koja im je bila jedina krma a razina retinola je porasla u teladi na visokih 34,1 i krava na 39,3 µg/dL plazme ($P < 0,001$). Utvrđena je signifikantna je povezanost sadržaja RE u krmivima i retinola u plazmi krava ($r = 0,74$; $P < 0,001$) te plazmi teladi i krava ($r = 0,43$; $P < 0,001$). Primijenjena hranidba konzerviranom krmom i vitaminsko mineralnim dodatkom u zimskom razdoblju te samo paša u proljetnom osiguravaju dovoljne količine retinola u plazmi krava i njihove teladi.

Ključne riječi: retinol ekvivalent, retinol, plazma, sustav krava-tele

Retinol in the blood of suckling Angus calves

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Abstract

Retinol (vitamin) A has a vital role in the immunity of young calves. The aim of this study was to determine retinol content in the plasma of Angus calves and cows kept in cow-calf operation from birth to 4 months of age. The trial was conducted on organic cow farm from January to April 2019. Ten cows and their calves were randomly selected and used to determine the retinol plasma concentrations. The cows and their calves spent the first 60 postnatal days in a stable where they were fed ad libitum by feeds differing in the average content of retinol equivalents (RE, µg/kg dry matter; $P < 0.001$): hay 3 651, haylage 12 278 and rock salt containing vitamin A 88 333 RE. Content of RE in hay and haylage significantly decreased from January to April ($P < 0.05$). The retinol concentrations in plasma on the 1st, 4th, 30th and 59th day were 19.9, 23.1, 16.4 and 19.5 µg/dL, respectively, in calves, and 24.3, 23.5, 24.4, 25.9. µg/dL, respectively, in cows. From 60th to 90th day, cows and their calves were let out onto lush pasture rich in retinol (64 260 RE) which increased concentrations of retinol in plasma of cows to 39.3 and calves to 34.1 µg/dL. ($P < 0.001$). A high correlation between levels of retinol in plasma and RE in feeds ($r = 0.74$; $P < 0.001$) and retinol in plasma of cow and their calves ($r = 0.43$; $P < 0.001$) was determined. Applied cow's feeding with conserved forages and vitamin A supplied by minerals block during winter and feeding cows and their calves on pasture in spring without retinol supplementation assure adequate levels of retinol in calves' plasma.

Keywords: retinol equivalent, retinol, plasma, cow-calf operation

Utjecaj vremena čuvanja na teksturu i svojstvo škripavosti sira lički škripavac

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Sažetak

Sukladno uvriježenom stavu, sir lički škripavac ima najbolja svojstva škripavosti 5 do 7 dana od dana proizvodnje, a svojstvo škripavosti smanjuje se skladištenjem dužim od 7 dana. Cilj ovog rada bio je istražiti utjecaj vremena čuvanja (28 dana) na svojstvo škripavosti i teksturu sira ovisno o provedenom tretmanu uranjanja u toplu vodu (50 °C/2 min). Proizvedeno je 6 sireva bez uranjanja u toplu vodu (kontrolna skupina), 6 vakumiranih sireva (termo skupljajuće vrećice) uronjeno u toplu vodu po završetku proizvodnog procesa, 6 sireva uronjeno u toplu vodu neposredno prije provedbe analize reoloških svojstava sira i senzorske procjene intenziteta škripavosti od strane potrošača. Čuvanjem sira došlo je do značajnog porasta čvrstoće ($P < 0,01$) te smanjenja kohezivnosti sira ($P < 0,01$). U skladu s time čak 97,56% ispitanika je odgovorilo da sir lički škripavac škripi tijekom cijelog vremena čuvanja, a 92,04% njih je odgovorilo da uočavaju razliku u intenzitetu škripavosti s obzirom na tretman. Najveći broj bodova (11,58 od 15) imao je sir uronjen u toplu vodu neposredno prije konzumacije, iako je uranjanje sira u termo skupljajuću vrećicu po završetku proizvodnje također značajno ($P < 0,01$) poboljšalo svojstva škripavosti sira. Sirevi najniže čvrstoće imaju najizraženije svojstvo škripavosti s obzirom na trajanje čuvanja sira, ali i s obzirom na tretman. Sukladno rezultatima, sir lički škripavac moguće je zaštititi oznakom zemljopisnog podrijetla jer zadržava svoje glavno svojstvo škripavosti tijekom cijelog roka valjanosti.

Ključne riječi: Lički škripavac, tekstura, škripavost, vrijeme čuvanja, senzorska procjena.

Influence of storage time on textural characteristics and squeaking property of Lički škripavac cheese

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Abstract

According to general opinion, Lički škripavac cheese is characterised by the highest squeaking property during consumption, within 5 to 7 days after its production. The aim of this paper was to investigate the influence of storage time (28 days) on texture and squeaking property of cheese, depending on applied treatment - immersion of the cheese into warm water (50 °C/2 min). Six cheeses were produced without immersing into warm water (control group), 6 vacuumed cheeses (thermo-shrink bags) were immersed into warm water after manufacturing and 6 cheeses immersed into warm water before they were analysed. Textural analysis was performed, as well as consumers' sensory assessment of the intensity of squeaking property. Throughout the storage, the hardness of the cheeses increased ($P < 0.01$), while cohesiveness decreased ($P < 0.01$). According to that, even 92.56% of consumers considered that Lički škripavac cheese keeps squeaking property during the whole time of storage, while 92.04% of them distinguish the intensity of this property among cheeses differently treated. The highest score (11.58 of 15) was given to cheese immersed into warm water before consumption, in spite of the fact that immersion of cheese after manufacturing also significantly ($P < 0.01$) improved squeaking property. The cheeses with the lowest hardness had the most expressed squeaking property, taking into consideration the storage time and the type of treatment. According to these results, Lički škripavac cheese could be protected (Geographical Indication Protection) because it keeps its main characteristic (squeaking property) during storage time, up to the end of its shelf life.

Keywords: Lički škripavac cheese, texture, squeaking property, storage time, sensory assessment

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Sanitarni status autohtonih sorata Zlatarica vrgorska i Trnjak (*Vitis vinifera* L.) u vinogorju Vrgorac

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Sažetak

Zlatarica vrgorska i Trnjak hrvatske su autohtone sorte koje se uzgajaju u podregiji Dalmatinska Zagora, posebice u vinogorjima Vrgorac i Imotski. Klonska selekcija spomenutih sorata započela je 2018. godine provedbom masovne pozitivne i sanitarne selekcije. Selekcija je provedena na deset lokacija unutar vinogorja Vrgorac te je izdvojeno 97 klonskih kandidata sorte Zlatarica vrgorska i 27 sorte Trnjak. Odabrani su pozitivni mutanti bez vizualnih simptoma zaraženosti virusima. Bazalni uzorci rozgve uzeti su 2019. godine tijekom zime sa svakog pojedinačno odabranog matičnog trsa. Prikupljeni uzorci testirani su na prisustvo četiri gospodarski najvažnija virusa serološkom metodom ELISA (enzyme linked immunosorbent assay): virus lepažatsog lista vinove loze (GFLV), virus mozaika vinove loze (ArMV), virusi uvijenosti lišća vinove loze 1 i 3 (GLRaV-1 i GLRaV-3). Prema dobivenim rezultatima, u pet uzoraka sorte Zlatarica vrgorska i 6 Trnjaka crnog nije utvrđena prisutnost analiziranih virusa. Najrašireniji virus GLRaV-3 pronađen je u 69,07 % biljaka kod sorte Zlatarica vrgorska te u 37,04 % kod sorte Trnjak. Slijedi ga virus GLRaV-1 koji je prisutan u 55,67 % biljaka sorte Zlatarica vrgorska i 62,96 % sorte Trnjak. Prisustvo drugih virusa je značajno rjeđe pa tako nalazimo GFLV u 11,34 % uzorka sorte Zlatarica vrgorska i u 37,04 % sorte Trnjak. Virus ArMV nije pronađen u populaciji sorte Trnjak, dok je kod Zlatarice vrgorske pronađen u 13,4 % analiziranih uzoraka.

Ključne riječi: Vrgorac, Zlatarica vrgorska, Trnjak, virusi, ELISA test

Sanitary status of autochthonous grapevine varieties Zlatica vrgorska and Trnjak (*Vitis vinifera* L.) in winegrowing region Vrgorac

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Abstract

Zlatica vrgorska and Trnjak are Croatian autochthonous grapevine varieties mostly grown in viticulture subregion Dalmatian Zagora, especially in vineyard areas Vrgorac and Imotski. Clonal selection of these varieties started in 2018 with a mass positive and sanitary selection. Selection was conducted on ten locations within the vineyard area Vrgorac. 97 candidate clones of a variety Zlatica vrgorska and 27 of variety Trnjak were singled out. Throughout the visual selection only vines with a positive agronomic characteristic and without virus-induced symptoms were taken out. The samples from basal part of dormant canes were collected during winter of 2019 out of each individual vine. Collected samples were tested on presence of four economically important viruses using ELISA method (enzyme linked immunosorbent assay): *Grapefanleaf virus* (GFLV), *Arabis mosaic virus* (ArMV), *Grapevine leafroll-associated virus 1* (GLRaV-1) and *Grapevine leafroll-associated virus 3* (GLRaV-3). Results showed that only 5 plants of a variety Zlatica vrgorska and 6 plants of Trnjak were not infected with analysed viruses. The most widespread virus was GLRaV-3 found in 69,07 % of variety Zlatica vrgorska and in 37,04% of Trnjak samples respectively. In Zlatica vrgorska and Trnjak, GLRaV-1 was the second most abundant virus in 55,67 % and 62,96 % samples respectively. Presence of two other viruses was much less frequent and virus GFLV was found in 11,34 % samples of variety Zlatica vrgorska and 37,04 % of variety Trnjak. Presence of ArMV was not confirmed in samples of variety Trnjak, but it was present in 13,4 % samples of a variety Zlatica vrgorska.

Keywords: Vrgorac, Zlatica vrgorska, Trnjak, viruses, ELISA test

In vitro propagation of three indigenous grapevine (*Vitis vinifera* L.) varieties

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Abstract

Main aim of the research is development of a protocol for micropropagation of three indigenous grapevine (*Vitis vinifera* L.) varieties. Initial plant material was obtained from grapevine collection of the Genetic Resources Institute, previously virus tested. Three virus free grapevine varieties - 'Meginovka', 'Surac', and 'Trnjak' were successfully introduced to tissue culture using MS medium supplemented with 1 mg/l of 6-BAP. Multiplication was conducted by using node explants in three eight-week cycles, on MS medium supplemented with 0, 0.5, 1.0 and 1.5 mg/l 6-BAP. After each multiplication cycle, number of healthy explants, length of shoots, number of shoots and number of leaves were noted. Rooting of explants was conducted on MS medium supplemented with 0.5 mg/l 6-BAP and 0, 0.1 and 0.3 mg/l IBA. The effects of IBA on the number of rooted explants, root length and number of roots were evaluated. In the multiplication stage, the best results were obtained in MS medium supplemented with 0.5 mg/l 6-BAP in all three varieties. The best results in rooting stage were obtained with 0.1 mg/l IBA in cv. 'Trnjak', while cv. 'Meginovka' showed the poorest root initiation in all treatments, and cv. 'Surac' showed the best rooting with no IBA present. The results showed that no universal protocol can be obtained even for the varieties of the same species, but rather the concentrations of growth regulators and composition of culture medium should be carefully tailored for each variety.

Keywords: protocol, tissue culture, multiplication, rooting

Acknowledgement: Part of this research was funded by the Ministry for Scientific and Technological Development, Higher Education and Information Society of Republic of Srpska (Bosnia and Herzegovina).

Utjecaj podloga Kober 5BB, 125AA i SO4 na stvaranje drvene mase kod sorte Traminac mirisavi (*Vitis vinifera* L.)

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Sažetak

Istraživanje je provedeno na pokušalištu Fakulteta agrobiotehničkih znanosti Osijek, smještenom u vinogradarskoj regiji Slavonija i hrvatsko Podunavlje, vinogorje Đakovo, lokalitet Mandićevac u 2019. godini. Mjerenja su izvršena na sorti Traminac mirisavi cijepljenoj na tri podloge : Kober 5BB, Kober 125AA i SO4. Prilikom rezidbe izdvojena je orezana rozgva sa navedenih trsova te je pripadajuća rozgva svakog trsa izvagana digitalnom vagom. Cilj istraživanja bio je utvrditi razliku orezanog drva između trsova Traminca cijepljenog na različite podloge. Prosječan uzorak orezane rozgve izmjeren je prije i poslije sušenja u sušioniku do konstantne vlage. Masa uzorka prije sušenja kod podloge Kober 5BB iznosila je 500 g, dok se nakon sušenja smanjila na 283 g što ukazuje na vlagu otpada 43,4 %. Masa uzorka prije sušenja kod podloge SO4 iznosila je također 500 g, a nakon sušenja 273 g odnosno na vlagu otpada 45,4 %. Prije sušenja masa prosječnog uzorka kod podloge Kober 125AA iznosila je kao i kod ostale dvije podloge (500g), a nakon sušenja 279 g, te na vlagu otpada 44,2 %. Kod podloge SO4 masa se kretala u rasponu od najnižih 240 g do najviše izmjerenih 900 g, najniža vrijednost mase kod podloge Kober 5BB iznosila je 250g, a najviša izmjerena vrijednost iznosila je 860 g. Kod podloge Kober 125 AA masa uzorka orezane rozgve se kretala u rasponu od 67 g do najviše izmjerenih 636 g. T-testom nisu utvrđene statistički značajne razlike te je prihvaćena postavljena nulta hipoteza koja potvrđuje da podloge nisu utjecale na masu orezane rozgve kod sorte Traminac mirisavi.

Ključne riječi: podloga, masa orezane rozgve, Traminac

Influence of Kober 5BB, 125AA and SO4 rootstocks on wood mass production of Traminer variety (*Vitis vinifera* L.)

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Abstract

The research was carried out in 2019. on the wine growing and winemaking experimental fields owned by Faculty of Agrobiotechnical Sciences Osijek located in Mandićevac, located in the wine-growing region of Slavonia and the Croatian Danube region, the Đakovo vineyards Measurements were made on the Traminer variety, grafted on three rootstocks: Kober 5BB, Kober 125AA and SO4. During pruning, a pruned cane of each vine was weighed with a digital scale. The aim of the research was to determine the difference between pruned wood mass between different vines of the Traminer variety grafted on different rootstocks. The average sample of pruned cane were measured before and after drying in the oven to constant moisture. The pre-drying weight of the sample Kober 5BB was 500 g, while after drying, it was reduced to 283 g, indicating that the moisture content was 43.4%. The weight of the samples before drying of sample SO4 was also 500 g, and after drying, 273 g or 45.4% was the moisture content. Before drying, the weight of the average sample of Kober 125AA was 500g, and after drying, 279 g, with the moisture content of 44.2%. With SO4, the pruned mass ranged from the lowest 240 g to the highest 900 g. For Kober 5BB, the lowest mass value were 250 g and the highest measured value were 860 g. The weight of samples of Kober 125 AA where in range from 120 g to the highest measured 1140 g.

There were no statistically significant differences were found by T-test. The null hypothesis was confirmed that rootstocks did not affect on the mass of pruned cane of the Traminer variety.

Keywords: rootstock, mass of pruned cane, Traminer

Using cover crops to control *Lobesia Botrana* in organic vineyards

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Abstract

This paper presents a part of the obtained results in the Project BIOVINE, funded by the H2020 program ERA-net, ORGANIC CORE co-fund and the European Commission co-fund, achieved by the two stated research institutes. In one section of the BIOVINE project, we aim to develop new viticultural systems based on increased plant diversity within vineyards intending to plant cover crops species with repulsive or insecticide effect for the control of arthropod pest *Lobesia botrana*. *Lobesia botrana* is a major pest in European vineyards that can cause an economic damage of a quantitative reduction of the harvest in spring due to the consumption of inflorescences and the infestation of berries over the summer, which enhances the risk of the development of pathogens such as *Botrytis cinerea* that decreases considerably the quality of processed wines. An extensive systematic literature search was performed to identify plant species suitable for repelling *Lobesia botrana*, and for conserving and promoting beneficials. SCV identified *Allium sativum*, *A Armoracia rusticana*, *Artemisia absinthium*, *Lavandula angustifolia*, *Tagetes* sp. and *Tanacetum cinerariifolium* as potential candidates to repel *L. botrana* from grapes. In autumn 2018, SCV prepared extracts of these plant species and provided them to Agroscope. Over the winter, Agroscope tested the efficacy of these plant extracts in laboratory settings. The tested extracts had neither a strong effect on the survival of *L. botrana* larvae, nor did they repel larvae from feeding. However, *Allium sativum*, *Artemisia absinthium*, *Lavandula angustifolia*, *Tagetes* sp. and *Tanacetum cinerariifolium* repelled *L. botrana* females from egg laying. Considering the results obtained by Agroscope, plant extracts from *Artemisia absinthium*, *Tagetes* sp. and *Allium sativum* were prepared and tested by SCV in 2019. In an experimental vineyard in Murfatlar (Romania), the three extracts were applied either on their own or in a mixture of all three together at the ripening phase (BBCH 83-85). Pheromone traps were used to observe the impact on the adult pest population of *L. botrana* and observations were made on the bunches in order to calculate infestation level. Treatments in which the *Artemisia absinthium* extract was applied on its own or in the mixture recorded the smallest number of adults. Moreover, only 0.25% of grapes were infested by *L. botrana* in the mixture treatment, whereas 3.8% of grapes were attacked in the treatment with the *Tagetes* sp extract. We therefore conclude that the mixture of *Artemisia absinthium*, *Tagetes* sp. and *Allium sativum* might have an interesting potential to protect vines against by *L. botrana* infestation.

Keywords: biodiversity, pest, biological control, plant extracts

Utjecaj gnojidbe na status makroelemenata u listu sorte 'Škrlet bijeli' (*Vitis vinifera* L.)

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Sažetak

U vinogradarstvu analiza biljnog tkiva je najpouzdanija metoda za procjenu ishranjenosti nasada jer hraniva u listu predstavljaju izvor hraniva za grozd tijekom faze dozrijevanja. Cilj ovog rada je utvrditi utjecaj gnojidbe na status makroelemenata (K, Ca i Mg) u listu sorte 'Škrlet bijeli'. Usporedbom dobivenih vrijednosti s optimalnim rasponima citiranim u literaturi utvrdili smo stupanj ishranjenosti vinove loze navedenim hranivima. K, Ca i Mg su najvažniji kationi u ishrani vinove loze te imaju veliki utjecaj na kvalitetu grožđa/mošta. Primjenjena su četiri gnojidbena tretmana: NPK; NPK + Fertdolomit; NPK + Fertdolomit + Folibor B; NPK + Fertdolomit + Folibor B + Proteoleaf. Uzorkovanje cjelovitih listova (plojka + peteljka) obavljeno je u fazi cvatnje, šare i dozrijevanja tijekom tri godine istraživanja. Vrijednosti K u listu u fazi cvatnje kretale su se od 1,02 % do 1,50 %, u šari od 1,49 % do 1,88 %, a u fazi dozrijevanja od 1,28 % do 1,96 %. Vrijednosti Ca kretale su se u rasponu 0,69-1,24 % u cvatnji, u šari 2,08-2,46 %, a u fazi dozrijevanja 2,36-2,70 %. Vrijednosti Mg u cvatnji bile su u rasponu 0,16-0,27 %, u šari 0,31-0,39 %, a u fazi dozrijevanja 0,30-0,41 %. Najveće prosječne vrijednosti za K, Ca i Mg utvrđene su pri gnojidbi NPK + Fertdolomit. Usporedbom dobivenih vrijednosti s optimalnim rasponom, neovisno o gnojidbi i godini, utvrđeno je da su vrijednosti K i Ca u optimalnom rasponu dok su vrijednosti za Mg ispod donje granice optimuma u listu vinove loze sorte 'Škrlet bijeli'.

Ključne riječi: makroelementi, vinova loza, gnojidba, list

Effect of fertilization on the status of macronutrients in the leaf 'Škrlet bijeli' (*Vitis vinifera* L.)

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Abstract

In viticulture plant tissue analysis is the most reliable method for assessing plant nutrition status because the nutrients in the leaf are a source of nutrient for the cluster during the ripening stage. The aim of this paper is to determine the influence of fertilization on the status of macroelements (K, Ca and Mg) in the leaf of the variety 'Škrlet Bijeli'. By comparing the obtained values with the optimal ranges cited in the literature, we will determine the nutrition level of the grapevine with the specified nutrients. The K, Ca and Mg are the most important cations in the nutrition of the vine and have a great influence on the quality of grape/must. Four fertilization treatments were applied: NPK; NPK + Fertdolomit; NPK + Fertdolomit + Folibor B; NPK + Fertdolomit + Folibor B + Proteoleaf. Whole leaf sampling (blade + petiole) was performed at the flowering, veraison and ripening stages during three survey years. The values of K in leaves at the flowering stage ranged from 1.02 % to 1.50 %, in the veraison from 1.49 % to 1.88 %, and in the ripening stage from 1.28 % to 1.96 %. Ca values ranged from 0.69 %-1.24 % in flowering, in the veraison 2.08 %-2.46%, and in the ripening stage 2.36 %-2.70 %. Mg values in flowering ranged from 0.16 %-0.27 %, in the veraison 0.31 %-0.39%, and in the ripening stage 0.30 %-0.41%. The highest average values for K, Ca and Mg were determined at the NPK + Fertdolomite fertilization treatment. Comparing the obtained values with the optimal range, independently of fertilization and year, it was established that the values of K and Ca are in the optimal range while the values for Mg are below the optimum range in the leaves of grapevine variety 'Škrlet bijeli'.

Keywords: macronutrients, grapevine, fertilization, leaf

The influence of stems and oak chips on the fermentation and color stabilization during maturation of red wines produced by cv. Shesh i Zi.

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Abstract

Wine is a highly complex alcoholic beverage, which contains a high number of components that influence its quality. In Albania the autochthonous cv. 'Shesh i Zi' it is well known for red wine production. During the wine production, the main problem with this variety is the collapse of its colour after alcoholic fermentation. The purpose of this study is to assess the impact of oak chips and stems during alcoholic fermentation. In this study, were used 100 kg grapes of cv. 'Shesh i Zi' from Tirana area. For the production of wines were used three different vinification schemes (classic, oak chips and stems). The wines were analyzed by spectrophotometric methods such total tannins, total anthocyanins, color parameters. The obtained results were statistically analyzed with Statistix 9 software. The addition of oak chips and stems during fermentation not affect the quality parameters of wines produced by cv. Shesh i zi. Oak chips added during fermentation and storage of wines have shown higher content of total tannins compared to wines produced by fermentation with stems and classic fermentation. Wines produced in the presence of stems and oak chips increase the formation of bonds between tannins and anthocyanins preserving the color of the wines.

Keywords: *Shesh i zi*; alcoholic fermentation; oak chips; stems; total tannins; total anthocyanins.

Prilagodba sortimenta vinove loze klimatskim promjenama u RH

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Sažetak

Vinova loza (*Vitis vinifera* L.) klimatski je osjetljiva kultura budući da na njen rast i razvoj znatno utječu atmosferski uvjeti. Klimatski uvjeti određuju je li neko područje prikladno za uzgoj vinove loze, odnosno u kojoj mjeri će neka sorta na određenom području iskazati svoj potencijal. Tip klime na nekom području određuje se mjerenjem i praćenjem meteoroloških elemenata tijekom duljeg razdoblja (barem 30 godina) te statističkom analizom učestalosti pojava, prosječnih vrijednosti, odstupanja od prosjeka i ekstremnih vrijednosti. Optimalni klimatski uvjeti za rast vinove loze ograničeni su zemljopisno, a uobičajeno se smatra da je najpogodnije područje za uzgoj između 30° i 50° paralele sjeverne i južne geografske širine. Za sve biljke postoji raspon temperature zraka pri kojima je njihov vegetativan razvoj moguć i takve se temperature nazivaju aktivne temperature. Porast prosječne temperature zraka dovodi do sve ranijih pojave fenoloških faza kod loze, te sve kraćih intervala između pojedinih fenofaza. Navedeno bi moglo utjecati na znatne promjene u izboru sorte, vinogradarskih položaja, ali i na promjene karakteristika budućih vina. Prema podacima Agencije za plaćanja u poljoprivredi ribarstvu i ruralnom razvoju, u Hrvatskoj je trenutno oko 18.000 ha zasadenih površina pod vinskim sortama, a prosječna starost nasada je preko 30 godina. Cilj ovoga rada je prikazati trendove fenoloških faza Plavca malog i Graševine, kao najzastupljeniju crnu odnosno najzastupljeniju bijelu sortu. U tu svrhu obrađeni su podaci s meteoroloških postaja Državnog hidrometeorološkog zavoda u Hvaru i Daruvaru, te su analizirani trendovi za višegodišnja razdoblja (1962.-2016. za Plavac mali; 1961.-2018. za Graševinu). Izračunat je Huglinov (HI) agroklimatski indeks za dva 30-godišnja razdoblja (1961.-1990. i 1987.-2016.). Rezultati istraživanja ukazuju na sve raniji početak cvatnje i berbe te kasniji početak šare za obje sorte. Zbog porasta HI i do 200–300°C, već su primijećene neke promjene u sortimentu vinove loze. Takav trend porasta temperature zraka, odnosno HI, omogućio bi u budućnosti uzgajanje ranijih vinskih sorti u gorskoj Hrvatskoj (ispod 600 m nadmorske visine), te crnih vinskih sorti kasnije dobi dozrijevanja u kontinentalnoj Hrvatskoj. Za pravovremeno utvrđivanje utjecaja klimatskih promjena na sortiment vinove loze te poduzimanja odgovarajućih mjera prilagodbe, nužno je poboljšanje sustava praćenja razvoja vinove loze i berbe grožđa te njihovo povezivanje s vremenskim uvjetima.

Ključne riječi: klima, fenofaze, agroklimatski indeksi, vinova loza, sorta

Adaptation of grapevine assortment to climate change in the Republic of Croatia

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Abstract

Grapevine (*Vitis vinifera* L.) is a climate sensitive crop, because its growth and development are greatly influenced by the prevailing atmospheric conditions in each region. Climatic conditions determine whether an area is suitable for growing vines, or to what extent a variety will show its potential in a particular area. The type of climate in an area is determined by measuring and observing meteorological elements over a long period (at least 30 years) and by statistical analysis of the occurrence frequency, average values, deviation from average and extreme values. The optimum climatic conditions for grapevine production are geographically limited, with commonly considered suitable areas for its production being between 30 ° and 50 ° of the north and south latitudes. For all plants there is a range of air temperatures at which their vegetative development is possible and such temperatures are called active temperatures. An increase in average air temperature leads to the earlier occurrence of phenological stages in the lineage and to shorter intervals between individual phenophases. This could lead to significant changes in the choice of variety, vineyard positions, as well as changes in the characteristics of future wines. According to the Paying Agency for Agriculture, Fisheries and Rural Development, there are currently about 18,000 ha of planted areas under wine varieties in Croatia, while the average plantation age is over 30 years. The aim of this paper is to present the trends of phenological stages of Plavac Mali and Graševina, as the most represented black and most represented white variety. For this purpose, data from main meteorological stations of the Croatian Meteorological and Hydrological Service in Hvar and Daruvar were processed and trends for several years were analyzed (1962-2016 for Plavac Mali; 1961-2018 for Graševina). The Huglin (HI) agroclimatic index for the two 30-year periods (1961-1990 and 1987-2016) was calculated. The results of the study indicate an earlier start of flowering and harvesting and a later start of patterns for both varieties. Due to the increase in HI up to 200–300 ° C, some changes in the grapevine assortments have already been observed. Such a trend of rising air temperature, ie HI, would enable future cultivation of earlier grapevine varieties in mountainous Croatia (below 600 m above sea level), as well as red wine varieties of later ripening age in continental Croatia. In order to determine a deeper impact of climate change on the grapevine assortment and to take appropriate adaptation measures, it is necessary to improve the system for observation of the grapevine development stages and grape harvest, and their correlation to the weather conditions.

Keywords: climate, phenophases, agro-climatic indices, grapevine, variety

Osjetljivost hrvatskih autohtonih sorata vinove loze na plamenjaču (*Plasmopara viticola*)

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Sažetak

Sorte vinove loze (*Vitis vinifera* L.) osjetljive su na plamenjaču, no ipak postoje razlike u razini njihove osjetljivosti na navedenu bolest. U svrhu određivanja razina osjetljivosti unutar bogate hrvatske germplazme vinove loze, provedeno je istraživanje tijekom 2018. i 2019. godine. Reznice 50 genotipova (46 autohtonih sorata te 'Cabernet sauvignon' i 'Rizling rajnski' kao osjetljive kontrole, a 'Solaris' i *Vitis riparia* kao otporne kontrole) posađene su u posude i uzgajane na vlastitom korijenu u poljskim uvjetima. Praćenje simptoma bolesti započelo je kad su mladice bile u stadiju od 10 razvijenih listova. Evaluacija pomoću modificiranog OIV deskriptora 452 (razina otpornosti listova) provedena je u četiri termina u dvotjednim intervalima tijekom svake vegetacije. Genotipovi su razvrstani u kvartile prema postotku listova sa simptomima bolesti. Genotip, termin evaluacije, kao i interakcija navedena dva faktora statistički se značajno razlikuju tijekom obje godine evaluacije. Iako su gotovo sve autohtone sorte postale potpuno zaražene do kraja vegetacije, kod nekih, kao što su 'Malvazija istarska', 'Teran', 'Trojiščina', 'Ranfol', bolest je sporije napredovala. Naredna istraživanja provodit će se s ciljem definiranja mogućih reakcija na kemijskoj razini koje su odgovorne za obrambeni mehanizam kod različitih genotipova.

Ključne riječi: vinova loza, plamenjača, autohtone sorte

Susceptibility of Croatian native grapevine varieties to downy mildew (*Plasmopara viticola*)

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Abstract

Grapevine (*Vitis vinifera* L.) varieties are susceptible to downy mildew, but still there are differences in the level of their susceptibility to this disease. In order to define susceptibility levels within the rich Croatian grapevine germplasm, a research was conducted during 2018 and 2019. Hardwood cuttings of 50 genotypes (46 native varieties, 'Cabernet Sauvignon' and 'Riesling' as susceptible controls, 'Solaris' and *Vitis riparia* as resistant controls) were planted in pots and grown on their own roots in the field conditions. Monitoring of disease symptoms started when the shoots growth reached 10 adult leaves. Evaluation according to modified OIV descriptor 452 (degree of resistance on leaves) was carried out four times in two-week intervals during each vegetation season. The genotypes were ranked in quartiles considering the percentage of leaves with disease symptoms. The genotype, the time of monitoring as well as the interaction between these two factors were determined as statistically significant during both years of evaluation. Although almost all native varieties became completely infected by the end of vegetation, in some of them, such as 'Malvazija istarska', 'Teran', 'Trojiščina', 'Ranfol', the disease spread slower. Further research will be performed to investigate the possible chemical background responsible for defense mechanism in different genotypes.

Keywords: Grapevine, Downy mildew, Native varieties

Effect of viticultural and winemaking practice on phenolic composition of Feteasca neagra organic wine

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Abstract

The scientific arguments regarding the beneficial effects of the moderate wine consumption, especially of the red wine, have been received positively by the consumers so that, at present, the modern lifestyle is hard to conceive without wine. The objective of this study was to evaluate the influence of the optimization of the fruit load by green pruning in the vineyards, associated with the increase of the period of maceration - fermentation on marc on the phenolic compounds from the wines obtained from the Romanian Feteasca neagra variety organically cultivated in Murfatlar vineyard. The phenolic profiles of the wines produced were determined by liquid chromatography HPLC-DAD, for two consecutive years, 2016 and 2017. The results obtained for phenolic acids (gallic acid, p-benzoic, p-coumaric and ferulic acid), flavanols (catechin and epicatechin), flavonols (miricetin, quercetin), trans-resveratrol and monoglucoside anthocyanins (malvidin, petunidine, delphinidine, peonidine and cyanidin) free, acylated and coupled, showed significant increases in the case of lower vine yields obtained by green pruning. Regarding the period of fermentation maceration, the increases were significant only in the case of phenolic acids, flavanols and flavonols, the content in anthocyanins presenting statistically insignificant variations. Thus, the results of this study clearly showed that grape reduction by green pruning can improve the phenolic quality of the wines. Furthermore, the quality is also improved by a longer maceration time. Even though the yield in the vineyard is reduced, the increased quality of wine can compensate for these losses in quantity.

Keywords: green pruning, HPLC-DAD, maceration-fermentation, Murfatlar vineyard



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Reproduktivne značajke kultivara maslina

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Sažetak

Izbor kultivara maslina i njihove reproduktivne značajke su važan preduvjet za postizanje visokih i redovitih prinosa. Istovremena cvatnja osigurava stranooprašivanje među kultivarima i visok uspjeh zametanja plodova. Kultivari maslina imaju različit broj cvjetova u cvatu koji mogu biti potpuni ili sterilni. U ovom istraživanju, analizirali smo reproduktivne značajke jedanaest kultivara ('Coratina', 'Drobnica', 'Frantoio', 'Itrana', 'Koroneiki', 'Lastovka', 'Leccino', 'Levantinka', 'Oblica', 'Pendolino', 'Santa Catarina'). Cilj istraživanja je bio analizirati strukturu cvata (broj cvjetova u cvatu) te odrediti kvalitetu cvjetova (postotak sterilnih cvjetova u cvatu) kod kultivara koji se koriste za proizvodnju ulja i stolnih maslina. Istovremena cvatnja je zabilježena za većinu kultivara. Najraniji početak cvatnje je zabilježen za kultivare 'Santa Catarina' i 'Koroneiki', a najkasniji za kultivare 'Drobnica', 'Itrana' i 'Leccino'. Najveći broj cvjetova u cvatu imali su kultivari 'Levantinka', 'Oblica' i 'Koroneiki', a najmanji 'Leccino', 'Santa Catarina' i 'Drobnica'. Postotak sterilnih cvjetova u cvatu se kretao od 2.8% ('Koroneiki') do 87% ('Itrana'). Ovim istraživanjem je utvrđeno da stolni kultivari maslina imaju veći postotak sterilnih cvjetova u cvatu u usporedbi s uljaricama. Kod planiranja podizanja novih nasada, poželjno je saditi kultivare s istovremenim intervalom pune cvatnje.

Ključne riječi: *Olea europaea* L., cvatnja, sterilnost cvjetova

Reproductive traits of different olive cultivars

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Abstract

The choice of olive cultivars and their reproductive traits are important prerequisites to achieve high and regular productivity. Simultaneous flowering periods enable cross-pollination and high fruit set in different cultivars. Olive tree produce both perfect (hermaphrodite) and staminate (male) flowers within the inflorescences that contain varying number of flowers. In this study, the reproductive traits were analysed in eleven olive cultivars ('Coratina', 'Drobnica', 'Frantoio', 'Itrana', 'Koroneiki', 'Lastovka', 'Leccino', 'Levantinka', 'Oblica', 'Pendolino', 'Santa Catarina'). The objective of this study was to analyse the architecture of inflorescences (the number of flowers per inflorescence) and flower quality (the percentages of staminate flowers) in different cultivars used for olive oil and table olive production. Simultaneous flowering periods were found for most of the studied cultivars. The earliest start of flowering was recorded for 'Santa Catarina' and 'Koroneiki' and the latest for 'Drobnica', 'Itrana' and 'Leccino'. The highest number of flowers per inflorescence was found for 'Levantinka', 'Oblica' and 'Koroneiki' and the lowest for 'Leccino', 'Santa Catarina' and 'Drobnica'. The percentages of staminate flowers ranged from 2.8% ('Koroneiki') to 87% ('Itrana'). This study has shown that the high level of pistil abortion is characteristic of the table olive cultivars. During the establishing of a new orchard, it is desirable to plant cultivars with simultaneous full bloom periods.

Keywords: *Olea europaea* L., flowering period, staminate flowers

Morpho-pomological characteristics of BIH pear germplasm

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Abstract

Fruit genetic resources represent valuable material in the Balkan region. Bosnia and Herzegovina is recognized as a region with diverse pear germplasm. Investigation of the morpho-pomological characteristics represent the first step in the characterization process. Thirty pear accessions from the *ex situ* fruit field collection of the Institute of Genetic Resources of the University of Banja Luka were subject of the morpho-pomological characterization. Preliminary harvest maturity, relative fruit size, ground and over colour, amount of russet on fruit skin, total soluble solid content and fruit firmness were observed during three years according to the IPGRI descriptor. According to the preliminary harvest maturity, extremely early accessions were the most present, over 50%, than early accessions, medium accessions and the lowest present had very early accessions. Distribution of the fruits according to the relative size was carried out in the following groups: very small fruit (3.3%), small fruit (10%), small to medium fruit (56.7%), medium fruit (23.3%) and large fruit (6.7%). Ground colour of the fruits of the pear accessions were yellow, green yellow and green. Green ground colour was recorded in 40% of accessions, yellow in 16.7% and the most present was green yellow in 43.3% of accessions. Over colours were absent from 56.7% of accessions, while in the remaining 43.3% the most present over colour was red, than orange, pink/red and dark red. The amount of russet on fruit skin was recorded on all fruits. The range of russeting on the fruit skin was: very low (36.7%), low (20%), low to medium (16.7%), medium (13.3%) and high russeting (13.3%). Most accessions had average soluble solid content in the fruit flesh juice (17 accessions), followed by the accessions with increased soluble solid content (9 accessions) and accessions with high soluble solids content in the fruit juice (4 accessions). Based on the fruit firmness, most common accessions were with soft fruit flesh (12 accessions) and medium soft fruit flesh (12 accessions), than with hard fruit flesh (3 accessions) and very hard fruit flesh (1 accession). Based on obtained results, high diversity of morpho-pomological characteristics was confirmed in the *ex situ* fruit field collection what can be a basis for the further evaluation process in order to determine positive agronomically valuable traits and breeding programmes.

Keywords: *ex situ* collection, accessions, characterization

Pathogenicity of fungi isolated from pomegranate (*Punica granatum* L.) in Dalmatia

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Abstract

Pomegranate is a fruit species traditionally grown as a fruit or ornamental tree in gardens in coastal Croatia but is rarely grown commercially. For cultivation of pomegranate, knowledge of diseases in its current population is important. Previously in Dalmatia, it was found that majority of pomegranate trees show symptoms of wood disease and wood of surveyed trees is infected with fungi *Cytospora punicae*, *Penicillium* sp., *Alternaria* sp. and *Aspergillus* sp.. To determine pathogenicity of these fungi and fulfill Koch's postulates, pathogenicity trials were conducted on 1-year-old pomegranate trees (cultivars Glavaš and Barski slatki) by means of artificial stem inoculation. Five plants of each cultivar were inoculated by mycelium of either one of five representative isolates of *C. punicae* or by one isolate of other said fungi. Ten plants inoculated by sterile agar media were used as control. Nine months after inoculation, dimensions of wood necroses were measured and reisolations of fungi were attempted on treated plants. Only the isolates of *C. punicae* consistently caused wood necroses that were significantly larger compared to control, with reisolation success >90%. No significant difference in virulence between *C. punicae* isolates nor sensitivity to this pathogen of the two tested pomegranate cultivars was determined. *C. punicae* is concluded as weak to moderate pathogen of pomegranate and main cause of its dieback in Dalmatia.

Keywords: pomegranate, *Punica granatum*, *Cytospora punicae*, pathogenicity

Razvoj aplikacija za prepoznavanje paunovog oko (*Spilocaea oleaginea* (Castagne) Hughes syn. *Cycloconium oleagineum* Cast.) pomoću RGB slika na listovima maslina (*Olea europaea* L.) u Zadarskoj županiji

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Sažetak

Maslina (*Olea europaea* L.) je zimzelena biljna vrsta i jedna od najproširenije voćne vrste u Jadranskoj regiji i na Mediteranu. Gljivična bolest paunovo oko (*Spilocaea oleaginea* syn. *Cycloconium oleagineum*) najvažnija je bolest lista masline. Primarni simptom paunovog oka je defolijacija lista koja utječe na rast, razvoj i kondiciju stabla, također se negativno odražava na prinos ploda. Pravodobna determinacija i otkrivanje zaraze na listu masline u početnim fazama razvoja gljivice omogućava učinkovito suzbijanje ove bolesti. Intenzitet zaraze kao i vremensko razdoblje, početna faza pojave bolesti, usko je vezana uz vremenske prilike (abiotičke) u nasadu i sortimentu maslinika. Nedovoljno praćenje i nepravodobna ili neodgovarajuća zaštita, izostanak agrotehničkih zahvata koji bi utjecali na smanjenje zaraze, zatim nedovoljno znanje o biološkom procesu razvoja gljive predstavljaju izazov za maslinare. Korištenjem suvremenih tehnologija tzv. „Internet of Things“ (IoT) pomažemo maslinarima u rješavanju gore navedenih izazova pokušavajući im pojednostaviti i ubrzati donošenje odluka. Uzimanje RGB (Red, Green, Blue) slikovnog sadržaja pomoći će u klasificiranju simptoma na listu. Cilj rada je provjeriti učinkovitost izrađene mobilne aplikacije razvijene iz prikupljenih RGB slika u različitim situacijama pojavnosti bolesti na listovima masline. Za potrebe učenja i klasifikacije primjenom RGB slika prikupljeno je nekoliko tisuća slika listova (1.500) kao podatkovna podloga za razvoj modela neuronske mreže. Sustav analize je uspostavljen korištenjem strojnog učenja odnosno umjetnih neuronskih mreža (Faster R-CNN), čijom primjenom je omogućena detekcija i klasifikacija pojedinačnog lista. Za potrebe razvoja modela korišteni su programski jezici Python i C++, te različiti oblici programske podrške (TensorFlow, Scikit, itd.). Primjena za krajnje korisnike je omogućena razvijenom mobilnom aplikacijom. U svrhu razvoja mobilne aplikacije, u sklopu projekta „SAN – Smart Agriculture Network“ (SAN - KK.01.2.1.01.0100), u Zadarskoj županiji odabrane su dvije pilot lokacije (Novigrad i Žman (Dugi Otok)).

Ključne riječi: maslina, neuronska mreža, paunovo oko, RGB, SAN, Zadarska županija

Development of a mobile application for the identification of olive leaf spot (*Spilocaea oleaginea* syn. *Cycloconium oleagineum*) using RGB imaging of olive (*Olea europaea* L.) leaves in Zadar county

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Abstract

Olive (*Olea europaea* L.) is an evergreen plant and one of the most widespread fruits in the Adriatic region and in the Mediterranean. Olive leaf spot (*Spilocaea oleaginea* syn. *Cycloconium oleagineum*) is the most important foliar disease in olives. The primary symptom of the disease is leaf defoliation, which affects the growth, development and the condition of the tree as well as fruit yield. Timely recognition and identification of the infection of the leaf in the early stages of fungal development is essential in effective disease management. Intensity of the infection as well as the time frame and the onset of disease are in close connection with climate conditions (abiotic) in the olive-grove and the olive varieties in the grove. Olive tree growers face the following related risks: irregular control of the grove; delayed or inadequate protection; a failure to implement agrotechnical measures to reduce the infection; and insufficient knowledge of the biological process of fungal growth. Using modern technologies, the so-called. "Internet of Things" (IoT) helps olive growers meet the challenges outlined above, trying to simplify and accelerate their decision making. Taking RGB (Red, Green, Blue) image content will help classify symptoms on a leaf. The aim of this paper is to test the effectiveness of a mobile application developed from the collected RGB images in different situations of disease on olive leaves. For the purpose of the research and the classification based on RGB images, several thousands leaf images were collected. The analysis was performed by the application of machine learning, i.e. artificial neural networks (Faster R-CNN), which enable detection and classification of individual leaves. Python i C++ programme languages and various forms of programme support (TensorFlow, Scikit, etc.) were used in the process of model development. The availability for end users was ensured via a developed mobile application. For the needs of mobile application development, under the "SAN – Smart Agriculture Network project", two pilot-locations were selected in the Zadar county (Novigrad and Žman, Dugi Otok).

Keywords: neural network, olive, olive leaf spot, RGB, SAN, Zadar county

Utjecaj navodnjavanja s različito utvrđenim obrocima vode na sastav i kvalitetu djevičanskog maslinovog ulja sorte „Coratina“ (*Olea europaea* L.) u Zadarskoj županiji

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Sažetak

Maslina (*Olea europaea* L.) je mediteranska voćna vrsta koja se u pravilu uzgaja na plitkom i skeletnom tlu s niskim kapacitetom tla za vodu u zoni korjena. Na takvim tlima je navodnjavanje neizostavna agrotehnička mjera u uzgoju i proizvodnji visoko kvalitetnog maslinovog ulja. Cilj ovog rada je utvrditi kako različiti obroci vode i njihov broj kod navodnjavanja na heterogenom i skeletnom tlu utječe na kvalitetu i sastav djevičanskog maslinovog ulja dobivenog od plodova introducirane sorte maslina Coratina. Poljski pokus je proveden u sklopu projekta „SAN – Smart Agriculture Network“ (SAN - KK.01.2.1.01.0100) na 24 stabla masline sorte 'Coratina' u 2019. godini na lokaciji Žman (Dugi otok). Navodnjavanje je provedeno pomoću sustava kap na kap sa četiri varijante u tri ponavaljanja. Varijante u pokusu predstavljale su primjenjene načine navodnjavanja: K-Kontrola - stabla masline bez navodnjavanja u vegetaciji (0 L vode po stablu), T1 - proizvođačka praksa (obroke je određivao proizvođač prema iskustvu (448 L vode po stablu u pet obroka)), T2 - SAN praksa (obroci su određivani s obzirom na evapotranspiraciju i fenofazu razvoja masline, s do 80 % poljskog kapaciteta tla za vodu, isto kako će ih određivati i SAN tehnologija koja je u razvoju - 560 L vode po stablu u osam obroka) i T3 – dodavanje obroka vode do 100% od izračunate evapotranspiracije (800 L vode po stablu u osam obroka). Određen je poljski kapacitet tla za vodu, a evapotranspiracija je izračunata pomoću meteopostaje tipa Pinova. Plodovi maslina ubrani su s 12 stabala (3 stabla po tretmanu) i prerađeni odvojeno u ulje korištenjem Abencor sustava. Statističkom obradom podataka (jednosmjernom analizom varijance i povratnim testom (Duncan)) istražen je utjecaj navodnjavanja na osnovne parametre kvalitete ulja: antioksidacijska aktivnost, sastav masnih kiselina i udio fenolnih tvari. Mjeranja osnovne analize ulja su pokazala da postoji razlika između peroksidnog broja, slobodnih masnih kiselina, i karatenoidea koji su bili najveći na kontroli, dok kod krolofila i K brojeva nije utvrđena razlika. Antioksidativna aktivnost maslinovog ulja bila je najveća na kontroli u odnosu na ostale tretmane. Utvrđen je utjecaj istraženih praksi navodnjavanja na sedam od petnaest ispitivanih masnih kiselina. Postoje razlike kod polifenolnog sastava ulja i to kod hidroksitirosoila i tirosoila koji su bili najveći na T3, a najmanji na kontroli. Navodnjavanje masline u istraženim praksama utjecalo je na sastav i kemijske parametre maslinovog ulja kod sorte Coratina na lokaciji Žman.

Ključne riječi: djevičansko maslinovo ulje, kvaliteta i sastav ulja, *Olea europaea* L., navodnjavanje, SAN, Zadarska županija

Influence of irrigation with differently determined rations of water on composition in quality of virgin olive oil of the 'Coratina' olive variety (*Olea europaea* L.) in Zadar County

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Abstract

Olive (*Olea europaea* L.) is a Mediterranean fruit usually grown on shallow and skeletal soil with low water capacity in the root zone. On that types of soils irrigation is an indispensable agro-technical measure of the cultivation and production of high quality olive oil. The aim of this paper is to determine how, during heterogeneous and skeletal soil irrigation, different water rations and their number affect quality and composition of virgin olive oil obtained from the fruits of the introduced variety of Coratina olives. The field experiment was conducted as part of the SAN - Smart Agriculture Network project (SAN - KK.01.2.1.01.0100) with 24 olive trees of the Coratina olive variety at the Žman (Dugi otok) in 2019. Irrigation was carried out by using a four-variant drip system with three repetitions. The variants in the experiment represented the applied irrigation methods: K-Control – olive trees without irrigation in vegetation (0 L of water per tree), T1 - manufacturing practice (portions were determined by the manufacturer according to experience (448 L of water per tree with five repetitions), T2 - SAN practice (portions were determined with evapotranspiration and phenophase of olive development taken into consideration, with up to 80% of the field water capacity of the soil, as would be determined by the developing SAN technology - 560 L of water per tree with eight repetitions) and T3 - addition of portions of water up to 100% of evapotranspiration calculated (800 L of water per tree with eight repetitions). The field water capacity of the soil was determined, and evapotranspiration was calculated using a Pinova-type meteorological station. The olive fruits were harvested from 12 trees (3 trees per treatment) and, using the Abencor system, processed into oil separately. Statistical data analyses (one-way analysis of variance and return test (Duncan)) investigated the influence of irrigation on the basic parameters of oil quality: antioxidant activity, fat acid composition and phenolic content. Measurements of basic oil analysis showed that there was a difference between peroxide numbers, free fat acids, and carotenoids, which were the highest on control, whereas no difference was found in chlorophyll and K numbers. The antioxidant activity of olive oil was the highest on control compared to other treatments. The impact of the irrigation practices studied on seven of the fifteen fat acids tested was determined. There were differences in the polyphenolic composition of the oil, with hydroxytyrosols and tyrosols being highest at T3 and lowest at control. Irrigation of olives on the investigated practices influenced the composition and chemical parameters of olive oil on the Coratina variety at the Žman site.

Keywords: irrigation, quality and composition of oil, *Olea europaea* L., SAN, virgin olive oil, Zadar County

Biokemijski i fiziološki odgovori na stres izazvan sušom između komercijalne i starih kultivara jabuke

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Sažetak

Stres izazvan sušom je jedan od najvažnijih abiotskih faktora koji negativno utječe na mnoge metaboličke procese u biljkama i njihov urod. Vrlo važna sposobnost tolerantnih biljaka je sposobnost obrane od oksidativnog stresa kao sastavnog dijela vodnog stresa. U ovom istraživanju ispitivani su biokemijski i fiziološki odgovori tri kultivara jabuke ('Golden Delicious Reinders' kao komercijalni kultivar i 'Crvenka' i 'Dugara' kao stari kultivari), na stres izazvan sušom. Odabrani kultivari uzgajani su u plasteniku, u posudama sa zemljom. Odgovori na oksidativni stres u uzorcima listova eksperimentalnih biljaka (bez navodnjavanja), uspoređivani su sa kontrolnim biljkama, 12 dana. Određen je sadržaj prolina, peroksida (H_2O_2), malondialdehida (MDA), fenola, indeks fotosintetske učinkovitosti, (PI_{ABS}), maksimalni kvantni prinos PS II (F_v/F_m), klorofila i suhe tvari (DW). Nakon 12 dana eksperimenta kultivar 'Golden Delicious Reinders' je pokazao najveće opadanje PI_{ABS} (1.95), F_v/F_m (0.77) i sadržaja klorofila (4.25 mg/g FW). Također je pokazao najviši sadržaj prolina (1.69 $\mu\text{mol/g FW}$), peroksida (5.64 $\mu\text{mol/g FW}$), fenola (25.88 mg GAE/g FW), suhe tvari (47.70 %) i najvišu razinu lipidne peroksidacije (14.19 nmol/g FW) u usporedbi sa 'Crvenkom' i 'Dugarom'. Stoga se može zaključiti da stari kultivari 'Crvenka' i 'Dugara' imaju bolju prilagodljivost na sušu u odnosu na kultivar 'Golden Delicious Reinders'.

Ključne riječi: suša, jabuka, fotosistem II, MDA, prolin, peroksid

Biochemical and physiological responses to drought stress between commercial and old apple cultivars

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Abstract

Drought stress is one of the most important abiotic factors which negatively affects on many metabolic processes in plants and yield. It is very important the ability of tolerant plants to defend against oxidative stress as part of drought stress. In this study the biochemical and physiological responses of three apple cultivars ('Golden Delicious Reinders' as commercial cultivar and 'Crvenka' and 'Dugara' as old cultivars) under drought stress were evaluated. Selected cultivars were grown in the greenhouse, in pots, filled with soil. Oxidative stress responses were compared in leaf samples of experimental plants (without irrigation) and control plants for 12 days. Proline, hydrogen peroxide (H₂O₂) content, malondialdehyde (MDA), phenolic content, photosynthetic performance (PI_{abs}), maximum quantum yield of PS II (F_v/F_m), chlorophyll and dry matter (DW) content were determined. After 12 days of experiment the 'Golden Delicious Reinders' showed the highest decrease of PI_{abs} (1.95), F_v/F_m (0.77) and chlorophyll content (4.25 mg/g FW). Also, it showed the highest proline (1.69 μmol/g FW), peroxide (5.64 μmol/g FW), phenols (25.88 mg GAE/g FW), dry matter (47.70%) content and highest level of lipid peroxidation rate (14.19 nmol/g FW) compared to 'Crvenka' and 'Dugara'. Thus, it can be concluded that old cultivars 'Crvenka' and 'Dugara' have better adaptability to drought than 'Golden Delicious Reinders' cultivar.

Keywords: drought, apple, photosystem II, MDA, proline, peroxide

Mogućnosti smanjena populacije jabukovog savijača na ekološki povoljniji način

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Sažetak

Jabukov savijač ekonomski je štetnik jabuke u čijem se suzbijanju provodi velik broj tretiranja insekticidima. Zbog brojnosti štetnika potrebno je primijeniti višestruko tretiranje dozvoljenim insekticidima istog načina djelovanja što utječe na pojavu rezistentnosti štetnika. Cilj istraživanja je bio utvrditi mogućnost smanjenja populacije jabukova savijača primjenom biološkog preparata Nemapom (*Steinernema feltiae*) u jesenskom tretiranju voćnjaka. Pokus je postavljen u dva voćnjaka, jednom s velikom populacijom jabukova savijača i drugom s umjerenom populacijom savijača. Populacija jabukova savijača praćena je pomoću feromonskih lovki u oba voćnjaka na nematodama tretiranom dijelu i dijelu sa standardnom zaštitom. Ulov savijača u voćnjaku velike populacije na nematodama tretiranom dijelu bio je manji u odnosu na standardni dio, ali još uvijek iznad tolerantnog broja što je rezultiralo velikim brojem tretiranja insekticidima. U voćnjaku s umjerenom populacijom savijača ulov na nematodama tretiranom dijelu je također bio manji u odnosu na standard, ali je i broj tretiranja insekticidima na tom dijelu bio manji. Može se zaključiti da su entomopatogene nematode učinkovite u voćnjacima gdje je populacija savijača niska, dok se u voćnjacima s velikom populacijom trebaju koristiti dodatne nekemijske mjere kao što je konfuzija, protugradne i ostale mreže.

Ključne riječi: *Steinernema feltiae*, *Cydia pomonella*, jabuka, populacija štetnika, učinkovitost

The possibilities for reducing the population of codling moth in environmentally favorable way

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Abstract

The codling moth (CM) is a serious economic pest of apple, and numerous insecticide treatments need to be applied for its control. Due to the abundance of this pest in orchards, it is necessary to apply multiple spray treatments per season; usually with insecticides of the same mode of action, which affects the occurrence of resistance. The aim of the study was to determine the possibility of reducing the pest population during the autumn growing season, using nematodes (Nemapom). The experiment was conducted in two orchards, one with a large pest population and the second with a moderately sized pest population using two control methods (ie, Nemapom and standard chemical control). The codling moth catch in the orchard with large pest population, and that was nematode treated, was lower than the catch from the part of the orchard treated with chemicals. This was however, still above the tolerance number. In the orchard with the moderate pest population, the CM catch in the nematode treated section was also lower than that of the CM catch from the chemical controlled section. This then meant that the required number of insecticide treatments on that section was also lower. It can be concluded that entomopathogenic nematodes are effective in orchards where pest populations are low, while in orchards with large populations' additional non-chemical measures such as mating disruption, anti-hail and -insect proof nets should be applied to enhance control.

Keywords: *Steinernema feltiae*, *Cydia pomonella*, apple, pest population, efficiency

Praćenje biologije trnovitog štitastog moljca agruma *Aleurocanthus spiniferus* (Homoptera: Aleyrodidae) u Dubrovačko-neretvanskoj županiji

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Sažetak

Vrsta štitastog moljca, *Aleurocanthus spiniferus* (Quaintance 1903) (Hemiptera, Aleyrodidae) podrijetlom je iz jugoistočne Azije. Polifagan je štetnik koji uzrokuje probleme na biljnim vrstama iz čak 38 različitih porodica, a najznačajniji domaćini su biljke rodova *Citrus*, *Pyrus* i *Vitis*. Trnoviti štitasti moljac, kod jake zaraze, dovodi do slabljenja stabla direktno gubitkom soka i indirektno naseljavanjem gljiva čađavica. Prisutnost trnovitog štitastog moljca je tijekom 2008. godine prvi put zabilježena na području EPP0 regije u južnoj Italiji u okrugu Lecce. Nakon nalaza u Italiji, ova vrsta je administrativno prebačena s A1 EPP0 na A2 listu. U Hrvatskoj, vrsta *A. spiniferus* je prvi put zabilježena 2012. godine na ukrasnim sadnicama naranče (*Citrus x aurantium* L.) u jednom vrtom centru u Splitu. Nakon uočavanja i determinacije, primijenjene su mjere eradikacije te je vrsta iskorijenjena i nije zabilježena sve do 2018. godine. Tijekom rujna 2018. godine potvrđena je prisutnost trnovitog štitastog moljca u Dubrovačko-neretvanskoj županiji u mjestu Vitaljina (N 42° 26' 8.23" E 18° 28' 57.50"). U Hrvatskoj do sada nisu istraživana obilježja ovog štetnika. Shodno tome, cilj ovog rada je prikazati biologiju te dinamiku i gustoću populacije štetnika u poljskim uvjetima u Vitaljini. Dinamika populacije se provodi na 10 slučajno izabranih listova te stvarni broj razvojnih stadija je izražen na 100 cm² lisne površine. Prisutnost mladih stadija (L-1, L-2, L-3) je bilježena krajem srpnja, početkom kolovoza i krajem rujna, dok je najveći zabilježeni broj odraslih oblika zabilježen početkom kolovoza. Tijekom istraživanja i praćenja životnog ciklusa kukca tijekom kolovoza, ovisno o klimatskim uvjetima, embrionalni razvoj *Aleurocanthus spiniferusa* je trajao 12-15 dana, razvoj ličinke 36 – 43 dana te „kukuljica“ 12 -17 dana. Ukupni razvoj od jaja do pojave odraslog oblika je trajao 60-75 dana. Početkom listopada pojavio se odrasli oblik, te je time završen životni ciklus.

Ključne riječi: trnoviti štitasti moljac, agrumi, Vitaljina, biologija,

Biology of orange spiny whitefly, *Aleurocanthus spiniferus* (Homoptera: Aleyrodidae) in Dubrovnik - Neretva valley

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Abstract

Orange spiny whitefly (OSW), *Aleurocanthus spiniferus* (Quaintance, 1903) (Hemiptera, Aleyrodidae) originated in south-east Asia. OSW is a polyphagous insect which infest plant species belonging to 38 plant families, but the main hosts are plants of the genera *Citrus*, *Pyrus* and *Vitis*. Orange spiny whitefly causes a general weakening of seriously infested plants directly by sap loss and indirectly by the growth of sooty mould. The presence of the orange spiny whitefly, *Aleurocanthus spiniferus* was recorded for the first time on EPPO region on the south of Italy, in the province Lecce during 2008. After this report in Italy, this species was administratively transferred from A1 EPPO to A2 list. In Croatia, *A. spiniferus* was first found in 2012. on ornamental potted orange seedlings (*Citrus x aurantium* L) in one nursery garden in Split. After identification, this pest was eradicated and wasn't recorded till the 2018. During the September of 2018. the presence of OSW was reported in Dubrovnik –Neretva valley, in Vitaljina (N 42° 26' 8.23" E 18° 28' 57.50"). The characteristics of this pest have not been studied in Croatia. Accordingly, the aim of this article is to present the biology, dynamics and density of pest populations in field conditions in Vitaljina. Population dynamics are performed on 10 randomly selected leaves and the real number of developmental stages is expressed per 100 cm² of leaf area. The presence of young stages (L-1, L-2, L-3) was recorded in late July, early August and late September, while the highest recorded number of adult forms was recorded in early August. During the research and monitoring of the life cycle of the insect during August, depending on the climatic conditions, the embryonic development of *Aleurocanthus spiniferus* lasted 12-15 days, the development of the larvae 36 - 43 days and the "puparium" for 12-17 days. The total development from egg to adult form lasted 60-75 days. In early October, the adult emerged, ending the life cycle.

Keywords: Orange spiny whitefly, citrus, Vitaljina, biology

Changing in weight of cherry fruit during storage depending on the cooling treatment

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Abstract

Cherry fruits are classified into non-climactic fruit species, which means that their fruits do not have the capacity to ripen after harvest. Cooling of cherry fruits is a measure that is carried out immediately after harvesting and before entering in the storage, with the aim of reducing the temperature and prolonging storage in order to bring the fruits to the market in the best possible condition. At two localities in Gradiška and Trebinje, in two consecutive years in 2015 and 2016, cooling of cherry fruits was performed of two varieties, Regina and Kordia. Samples at Gradiška are subjected to manual cooling, while samples in Trebinje were processed by an automatic hydrocooler. Fruit samples were divided into three groups: harvest, treatment sample wick subjected to cooling treatment at 0.9 ° C for 10 minutes, and control sample. The treatment and control samples were store in NA chamber for two weeks. Storage conditions were 1 °C and humidity 85 - 95%. Analysis of fruit weight was performed on all three sample groups. Based on the observed results, we conclude that the average weight of the tested samples showed a significantly higher content in the samples from the harvest comparing with samples from storage, respectively, treated and control samples. Comparing the two locations, the average weight of fruits is significantly higher at the Trebinje location compared to Gradiška. This research show positive effect of hydrocooling treatment for cultivar Kordia from both location in examined year. The treated fruits had a higher weight compared to the control group of fruits. Considering other combinations variety/location/treatment no significant change in the weight of the ivestigated samples was notice.

Keywords: hydrocooling, NA chamber, fruit quality

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Morfološka svojstva i kemijski sastav ploda planike s područja Krka, Cresa i Lošinja

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Sažetak

Planika (*Arbutus unedo* L.) je tipična mediteranska vrsta koja u Hrvatskoj većinom raste samoniklo, a rasprostranjena je duž obale Jadranskog mora i otoka. Cilj rada bio je utvrditi morfološka svojstva i kemijski sastav ploda planike s područja Krka, Cresa i Lošinja. Najveća masa, visina i širina ploda utvrđene su kod plodova planike s Cresa, dok su plodovi s Krka i Lošinja imali niže vrijednosti i nisu se međusobno značajno razlikovali u istraživanim svojstvima. Najveći postotak ukupne suhe tvari, topljive suhe tvari i ukupnih kiselina utvrđen je kod plodova s Krka, a najmanji kod plodova s Lošinja. Kod plodova s lokacije Cres utvrđen je najveći pH i omjer topljive suhe tvari i ukupnih kiselina, a najmanje vrijednosti navedenih svojstava utvrđene su kod plodova s Krka. Budući da svi istraživani genotipovi rastu samoniklo kao prirodne populacije dobiveni rezultati ukazuju na utjecaj lokacije i položaja na istraživana svojstva. Kako kvarnerski otoci obiluju ovom vrstom potrebno je provoditi daljnja istraživanja planike u cilju izdvajanja genotipova s pozitivnim gospodarskim svojstvima i njihova uvođenja u uzgoj kako bi iskoristio njen ekološki i ekonomski potencijal.

Ključne riječi: *Arbutus unedo*, genotip, kemijski sastav, morfološka svojstva, plod

Morphological properties and chemical composition of strawberry tree fruit grown on the islands of Krk, Cres and Lošinj

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Abstract

Strawberry tree (*Arbutus unedo* L.) is typical Mediterranean species which is in Croatia usually self-propagated. In Croatia its area of distribution is along coast and on the islands of the Adriatic Sea. The purpose of this research was to determine morphological properties and chemical composition of strawberry tree fruit grown on the islands of Krk, Cres and Lošinj. Highest fruit mass, height and width had fruits of strawberry tree grown on the island of Cres while fruits of strawberry tree grown on the islands of Krk and Lošinj had lower values and did not differ significantly between each other. Content of total dry matter, total soluble solids and titratable acidity was highest in fruits of strawberry tree grown on the island of Krk while lowest in fruits of strawberry tree grown on the island of Lošinj. Fruits of strawberry tree grown on the island of Cres had highest while fruits of strawberry tree grown on the island of Krk smallest pH and total soluble solids/titratable acidity ratio. Since all researched genotypes are grown wild obtained data indicate effect of location and position on researched properties. As strawberry tree is highly widespread on the islands of Kvarner further research is needed in order to determine genotypes with positive properties that could be exploited by cultivation in terms of obtaining additional economic and ecological value.

Keywords: *Arbutus unedo*, chemical composition, morphological properties, fruit

The changes in fruit hardness during storage in three pear cultivars depending on rootstocks

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Abstract

The hardness is a very important characteristic of the fruit, which is evaluated at the optimum moment of harvest pear fruits to be stored. The aim of this research is to study the hardness of the pear fruits after harvest and after storage depending on the rootstock and on the position of the trees on the production plot. The fruits were sampled in a commercial orchards of pear Agroimpex in Jablanica in the municipality of Gradiška. The research was conducted in year 2013 and 2014 on three commercial pear cultivars Williams, Abate Fetel and Conference, grafted on two different rootstocks, wild pear and quince seedlings, with three different positions of trees, top, middle and base on the production plot. Three groups of fruits were sampled for each combination of varieties/rootstocks/positions whereby the first group of fruits was analyzed after harvest, the second group of fruits was placed in a ULO chamber for half period of storage which recommended for the each cultivar and the third group of fruits was placed in full period of storage. The Williams and Conference cultivar were stored for two months while Abate Fetel was stored for three months. After storage, the fruits were left at room temperature for 24 h, followed by analyzes. Based on the results of the research, it can be concluded that the fruit hardness of all analyzed cultivars was highest at the moment of harvest and decreased with longer storage. The fruits of Abate Fetel cultivar were harder than other varieties. In the Williams cultivar, a higher hardness was observed in the seedling than in the quince, while no similar situation was observed in the other two cultivar. No statistically significant differences were observed for fruits from different positions on the production plot. Based on the above, it can be concluded that the analysed cultivars are suitable for longer storage in ULO chambers without significant decrease in fruit quality. When raising new pear orchards at this locality on pseudogley, it is recommended that the Williams grafted on the seedlings, Abate Fetel grafted on the quince until the Conference cultivar no showed significant differences between two rootstocks.

Keywords: penetrometric method, ULO chamber, fruit quality

Acknowledgment: This research was supported through the project "Influence of physiological and histological characteristics of leaf on biochemical composition and storage capacity of pear fruit" cofinanced by the Ministry of Science and Technology of the Republic of Srpska, number of contracts: 19/6-020/964-76-2/12.

Utjecaj mikorize na kakvoću ploda jagode neutralnog dana

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Sažetak

Jagoda (*Fragaria x ananassa*), je najznačajniji je predstavnik jagodastih voćnih vrsta, a uzgaja se širom svijeta. U Hrvatskoj predstavlja važan udio sezonskog voća, posebice u početku sezone te su poznati brandovi Zagrebačka jagoda, Vrgoračka jagoda, Jagodica purgerica i dr. Mikoriza je značajna po svojoj ekološkoj ulozi u usvajanju hranjivih tvari iz tla, zaštiti biljke od biotičkog i abiotičkog stresa, toleranciji protiv patogena, vodnom stresu te utječe na sam urod i kvalitetu ploda. Cilj istraživanja bio je utvrditi utjecaj mikorize na fizikalno-kemijska svojstva ploda jagode neutralnog dana sorte 'Capri'. Istraživanje fizikalno-kemijskih svojstava jagode neutralnog dana sorte 'Capri' uzgojene na lokaciji Botinec provedeno je 2018. godine. Jagode su prilikom sadnje tretirane s 4 tretmana: (1) potapanje korijena u suspenziju mikorize – M, (2) potapanje korijena u suspenziju mikorize i hidrogela – MH, (3) dodavanje hidrogela u sadnu jamu – H, te (4) potapanje korijena u suspenziju huminskih kiselina i mikorize – HUM. Analizirana su sljedeća svojstva kakvoće jagode: masa ploda, visina i širina ploda, tvrdoća ploda, udio topljive suhe tvari u plodu (SSC), udio ukupnih kiselina (TA) u plodu te boja ploda (CIE L*, a*, b*). Na temelju analize najbolja masa ploda je zabilježena kod ne tretiranih (kontrolnih – K) biljaka (7,09 g). Tretmani H i MH pokazali imali su najveći izmjereni udio SSC, ali značajno se razlikovao samo od HUM. Najveći udio ukupnih kiselina imali su netretirani plodovi, zatim plodovi H tretmana dok su svi tretmani koji su sadržavali mikorizu (M, MH i HUM) imali značajno najmanji udio ukupnih kiselina. Omjer topljive suhe tvari i ukupnih kiselina najveći je kod kombinacije MH (20,63.) Najveći udio crvene boje je zabilježen kod netretiranih biljaka. Promatrajući ukupna fizikalno-kemijska svojstva ploda jagode, najbolji su bili netretirani plodovi i MH plodovi.

Ključne riječi: jagoda, fizikalno-kemijska svojstva, mikoriza, hidrogel, huminske kiseline

Mycorrhiza Impact on Neutral Day Strawberry Fruit Quality

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Abstract

Strawberry (*Fragaria x ananassa*), is the most significant representative of berry fruits, and is grown all over the world. In Croatia, it represents an important share of seasonal fruits, especially at the beginning of the season, and the well-known brands are Zagrebačka jagoda (Zagreb Strawberry), Vrgoračka Jagoda (Vrgorac strawberry), Jagodica purgerica and others. Mycorrhiza is important for its ecological role in nutrient uptake from soil, protection of plants from biotic and abiotic stress, tolerance against pathogens, water stress, and affects the yield and quality of the fruit itself. The aim of the study was to determine the effect of mycorrhiza on the physicochemical properties of the fruit of the strawberry of the neutral day of the variety 'Capri'. The investigation of the physicochemical properties of the strawberry of the neutral day of the 'Capri' variety grown at Botinec was conducted in 2018. During planting strawberry plants were treated with 4 treatments: (1) root immersion in suspension of mycorrhizae – M, (2) root immersion in suspension of mycorrhiza and hydrogel – MH, (3) addition of hydrogel in the planting hole – H, and (4) root immersion in a suspension of humic acids and mycorrhizae – HUM. The following properties of strawberry quality were analyzed: fruit weight, height and width of the fruit, fruit firmness, soluble solids content (SSC), total acidity (TA) and fruit color (CIE L*, a*, b*). Based on the analysis, the highest fruit weight was observed in untreated (control – K) plants (7.09 g). The H and MH treatments showed the highest measured content of SSC, but differed significantly only from HUM. The highest content of total acids had untreated fruits followed by H treatments, while all mycorrhizal treatments (M, MH, and HUM) had a significantly lower content of total acids. The soluble solids - total acids ratio was highest with MH (20.63). The most intensive red color was observed in untreated plants. Considering the overall physicochemical properties of strawberry fruit, the best were untreated fruits and MH fruits.

Keywords: strawberry, physicochemical properties, mycorrhiza, hydrogel, humic acid

Morfološka i fiziološka svojstva sadnica Kaštelanske stare masline u uvjetima abiotičkog stresa

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Sažetak

Tolerantnost na sol i sušu važna su agronomska svojstva za oplemenjivanje masline. Cilj istraživanja bio je utvrditi morfološka i fiziološka svojstva stare kaštelanske masline pod utjecajem abiotičkog stresa soli i suše primijenjenih na sadnicama različite starosti. Sadnice (jednogodišnje (1 god.); dvogodišnje (2 god.) i trogodišnje (3 god.)) posađene su u anorganski supstrat (perlit : vermikulit – 1:1 (v/v)) u lonce volumena 3,6 l). Šezdeset dana nakon presađivanja primijenjeni su tretmani: kontrola (polu snažna Hoagland-ova otopina (½ HO)) te sol (150 mM NaCl) i suša (300 mM manitol) dodani u ½ HO u periodu od 21 dan. Kod 1 god. sadnica zabilježeni su duži izboji, veća masa i promjer izboja u usporedbi s 3 god. sadnicama. Manje vrijednosti svih vegetativnih svojstava zabilježene su kod svih sadnica u tretmanu suše. Sadnice u tretmanu soli imaju manju površinu listova u usporedbi s sadnicama uzgajanim u kontrolnoj otopini. U tretmanu suše sadnice su imale najmanji relativan sadržaj vode (57%) i vodni potencijal (-33,6 MPa) u listu. Najveća provodljivost membrana za K⁺ zabilježena je kod tretmana soli (14,6%), a najmanja kod kontrole (6,5%). Suha masa korijena bila je pod utjecajem tretmana i starosti sadnica. Fiziološka svojstva pod utjecajem su primijenjenih tretmana bez obzira na starost sadnice. Sadnice stare 1 i 2 god. ujednačenih su vegetativnih svojstava u usporedbi sa sadnicama 3 god.

Ključne riječi: manitol, NaCl, *Olea europaea* L., vodni potencijal

Morphological and physiological characteristics of old Kaštela olive plants under abiotic stress conditions

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Abstract

Tolerance to salt and drought are important agronomic properties for olive cultivation. The aim of the study was to determine the morphological and physiological characteristics of old Kaštela olive under the influence of abiotic stress of salt and drought applied to plants of different ages. Plants (one year (1 yr.); two years (2 yr.) and three years (3 yr.)) were planted in an inorganic substrate (perlite: vermiculite - 1: 1 (v / v)) in pots with a volume of 3.6 l). Sixty days after transplantation, treatments were applied: control (half-strength Hoagland solution (½ HO)), salt (150 mM NaCl) and drought (300 mM mannitol) added to ½ HO over a 21-day period. 1 yr. plants were recorded with longer shoots, higher mass and diameter of shoots compared to 3 yr. plants. Lower values of all vegetative traits were observed in all plants in drought treatment. Plants in salt treatment have a smaller leaf area compared to plants grown in control solution. In drought treatment, plants had the lowest relative water content (57%) and water potential (-33.6 MPa) in the leaf. The highest membrane conductance for K⁺ was observed in salt treatment (14.6%) and the lowest in control (6.5%). The dry mass of the roots was influenced by the treatment and age of the plants. Physiological characteristics are influenced by the treatments applied regardless of the age of the plants. Plants of 1 yr. and 2 yr. have uniform vegetative characteristics compared to 3 yr. old plants.

Keywords: mannitol, NaCl, *Olea europaea* L., water potential

Preliminarni rezultati suzbijanja krvave uši, *Eriosoma lanigerum* (Hausmann)

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Sažetak

Krvava uš (*Eriosoma lanigerum* Hausmann) je ekonomski značajan štetnik jabuke. Problem suzbijanja ovog štetnika je nastao uslijed nedovoljnog broja učinkovitih preparata prisutnih na našem tržištu. Preliminarno istraživanje učinkovitosti suzbijanja krvave uši provedeno je u 2019. godini u proizvodnom nasadu jabuke, u zapadnom dijelu Baranje, na sorti Golden Delicious klon „Reinders“, podlozi M9 T337. Cilj ovog istraživanja je bio utvrditi prisutnost žive populacije štetnika na površini korijenovog vrata prije i poslije tretmana. Ocjena uspješnosti tretmana rađena je vizualnom metodom prema Boweru (1987) s obzirom na prisutnost voštane prevlake štetnika i promjene u njezinoj boji. Odrađeni su tretmani sa slijedećim aktivnim tvarima; tretman 1 (sulfoksaflor 0,04%), tretman 2 (piriproksifen 0,05%), tretman 3 (spirotetramat 0,15%) i tretmanu 4 (čista voda – kontrolni tretman). Preliminarni rezultati su pokazali da su tretman 1 i 2 imali zadovoljavajuću učinkovitost tj. značajno smanjenje brojnosti štetne populacije nakon tretmana, za razliku od tretmana 3 koji nije ostvario rezultat u skladu s očekivanjima dok se u kontrolnom tretmanu populacija štetnika povećala. Planira se nastavak istraživanja na većoj pokusnoj površini kako bi se dobili što precizniji rezultati koji bi trebali doprinijeti učinkovitijem suzbijanju ovog štetnika.

Ključne riječi: krvava uš, jabuka, suzbijanje, učinkovitost

Preliminary results of woolly aphid, *Eriosoma lanigerum* (Hausmann) control

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Abstract

Woolly aphid, *Eriosoma lanigerum* (Hausmann) is an economically significant pest of the apple. The problem of controlling this pest became bigger due to the lack of effective preparations present on our market. A preliminary study of the effectiveness of the control of woolly aphid was conducted in 2019 in an apple orchard in the western part of Baranja, on the variety Golden Delicious clone "Reinders", rootstock M9 T337. The density of the plantation is 3.2 m x 0.8 m. The aim of this study was to determine the presence of a live pest population on the surface of the root neck before and after treatment. The evaluation of treatment effectiveness was done by visual method according to Bower (1987) considering the presence of the woolly coating of the pest and its changing color. Treatments were made with the following active substances; treatment 1 (sulfoxaflor 0.04%), treatment 2 (pyriproxyfen 0.05%), treatment 3 (spirotetramate 0.15%) and treatment 4 (pure water - control treatment). Preliminary results showed that treatment 1 and 2 had significant efficacy as significantly reducing the number of harmful population after treatment, unlike treatment 3 which did not achieve the result as expected while in control treatment, the pest population increased. It is planned to continue research on a larger test area to obtain as accurate as possible results that should contribute to the effective control of this pest.

Keywords: woolly aphid, apple, control, effectiveness

Preliminarna karakterizacija plodova Iločke višnje

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Sažetak

Iločka višnja je lokalna populacija višnje iz istočne Hrvatske. Lokalne populacije karakterizira značajna fenotipska varijabilnost zbog razmnožavanja korjenovim izdancima. Ovo istraživanje je provedeno kako bi se procijenile neke fizikalne i kemijske osobine plodova Iločke višnje (IV) prikupljenih na terenu Istočne Hrvatske tijekom vegetacijske sezone 2015. i 2016. Fizikalna i kemijska svojstva plodova sedam IV genotipova analizirana su i uspoređena s plodovima sorti Oblačinska, Erdi Botermo i Rexelle. Analiza glavnih komponenti (PCA) uspješno je razlikovala ispitivane genotipove i pokazala korelaciju IV genotipova sa topljivom suhom tvari, ukupnim sadržajem antocijana, ukupnim šećerima, glukozom, fruktozom i sorbitolom, dok je Oblačinska višnja korelirala s parametrima boje, Erdi Botermo s masom ploda, a Rexelle s ukupnim kiselinama i saharozom. Među IV genotipovima, IV1 se ističe s visokom topljivom suhom tvari (20,4 °Brix), omjerom topljive suhe tvari i ukupnih kiselina (17,2), ukupnim sadržajem polifenola (7,34 mg_{GAE}/g_{FW}) i ukupnim sadržajem antocijana (2,45 mg_{CGE}/g_{FW}), stoga je genotip IV1 izvrstan kandidat za komercijalizaciju, kako za tržište svježe potrošnje i prerade, tako i za sadnju u amaterskim voćnjacima. Potrebno je obaviti daljnja ispitivanja glavnih bioloških i pomo-tehnoloških svojstava odabranih IV genotipova u paralelnim pokusima sa standardnim sortama višnje.

Ključne riječi: antocijanini, antioksidativna aktivnost, boja ploda, polifenoli, šećeri

Preliminary characterisation of Iločka sour cherry fruits

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Abstract

Iločka sour cherry is regional domesticated landrace grown in eastern Croatia. Landraces are characterized by significant phenotypic variability because of propagation by root suckers. The present study was undertaken to assess some physical and chemical traits of Iločka sour cherry fruits collected from originated accessions during 2015 and 2016 harvest season. The fruit of seven Iločka sour cherry accessions (IV), altogether with Oblačinska, Erdi Botermo and Rexelle, were analysed for their main physical and chemical attributes. Principal component analysis (PCA) successfully differentiated investigated genotypes correlating IV accessions with soluble solids content, total anthocyanin content, total sugars, glucose, fructose and sorbitol, Oblačinska with colour parameters, Erdi Botermo with fruit weight, whereas Rexelle correlated with titrable acidity and sucrose. Among IV accessions, IV1 stands out with high soluble solids content (20.4°Brix), soluble solids content/titrable acidity ratio (17.2), total polyphenol content (7.34 mg_{GAE}/g_{FW}) and total anthocyanin content (2.45 mg_{CGE}/g_{FW}) therefore IV1 is excellent candidate for commercialization for both, fresh consumption and processing markets, as well as for planting in amateur orchards. Further investigation of main biological and pomo-technological properties of selected IV accessions in parallel trials with standard sour cherry cultivars should be conducted.

Keywords: anthocyanins, antioxidative activity, fruit colour, polyphenols, sugars

Application of zinc microparticles in hydroponic cultivation of strawberries (*Fragaria x ananasa*)

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Abstract

Hydroponic cultivation makes it possible to harvest strawberries (*Fragaria x ananasa*) at a time when this was not possible before. This breeding achieves somewhat earlier fruiting, a longer harvesting period, higher yield and fruit quality. To achieve this, with appropriate microclimatic conditions, an adequate substrate, regular fertigation and protection against disease and pests are required. Zinc is one of the most important trace elements in strawberry flowers and fruits. Zinc deficiency affects the decreased growth of stamens and the growth of pollen tubes, which can result in deformation of the fruit. Zinc microparticles are one way to improve the nutritional properties (total polyphenols, flavonoids, anthocyanins and antioxidant activity) of strawberry fruit. In this study, the experiment was set up according to the split-plot method in three repetitions. The treatment was performed on two different strawberry varieties: Albion and San Andreas. The strawberries were treated with microparticles containing zinc as the active substance and microparticles containing zinc and an additional layer of chitosan. The results showed a positive effect of microparticles on strawberries.

Keywords: microparticles, zinc ions, strawberries, polyphenols, hydroponics

Postharvest quality of ‘Granny Smith’ apple grown under photo-selective red net

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Abstract

Photo-selective anti hail nets present new, innovative and ecofriendly approach in modern fruit growing. The present study was conducted with aim to test the effect of Tenax (Italy) red photo-selective nets on ‘Granny Smith’ apple postharvest quality. The fruits have been harvested on optimal harvest date from orchard near city of Zadar where red photo-selective nets were used. Afterwards fruits were stored in regular air storage at 0°C for 4 months and then kept for 7 days at room temperature (shelf life). After harvest, cold storage and shelf life fruits grown under red net had significantly lower total soluble solid (SSC) content. After cold storage, superficial scald index was significantly higher in fruits grown under red net. Share of fruits with strong and very strong superficial scald severity was significantly higher in fruits grown under red net while regarding share of fruits with low superficial scald severity situation was opposite. After shelf life, fruits grown under red net had significantly lower weight loss and SSC/TA ratio, but higher TA. Despite the nonsignificant difference, fruit mass of harvested fruit grown under red net tended to have higher values. It can be concluded that, due to greater susceptibility to superficial scald, prevention measures (optimal harvest time, 1-MCP and CA storage) should be applied when red photo-selective net is used on superficial scald-susceptible apple varieties.

This study was carried out with a contribution of the LIFE financial instrument of the European Union for the project “Low pesticide IPM in sustainable and safe fruit production” (Contract No. LIFE13 ENV/HR/000580).

Keywords: apple, photo-selective nets, postharvest, fruit quality, superficial scald



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Produkcija biomase, kemijska i energetska karakterizacija Divljeg prosa (*Panicum virgatum* L.) – Studija slučaj Hrvatska

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Sažetak

Divlje proso (*Panicum virgatum* L.), kao energetska kultura, definiraju niska ulaganja u agrotehniku, visoka otpornost na bolesti i štetočine, kao i potencijalno visoki prinosi. Biomasa divljeg prosa može se konvertirati u različite oblike energije, odnosno biogoriva, a jedan od načina pretvorbe je i proizvodnja energije putem termokemijskih procesa pretvorbe. Cilj ovog rada bio je utvrditi produkciju biomase, kemijske i energetske karakteristike trave divljeg prosa s obzirom na različite rokove žetve (jesenski i proljetni) u trećoj godini uzgoja. U odnosu na istraživane rokove žetve utvrđena je signifikantna razlika u produkciji biomase. Udjelima vode, pepela, dušika, ugljika, sumpora i kisika. Nasuprot, signifikantne razlike nisu utvrđene u udjelima vodika, koksa, fiksiranog ugljika i hlapivih tvari kao ni kod ogrjevnih vrijednosti. Rokovi žetve najviše su imali utjecaja na istraživane udjele mikro i makro elemenata jer su kod svih utvrđene signifikantne razlike. Prinos biomase u prvome roku žetve iznosio je 19,08 t S.T. ha⁻¹, a u drugome 13,27 t S.T. ha⁻¹. Prosječne vrijednosti udjela vode, pepela i donje ogrjevne vrijednosti, kao jednih od važnijih istraživanih parametara, u prvom i drugom roku bile su 33,88% i 10,95% za vodu, 4,59% i 3,71% za pepeo te 17,29 MJ kg⁻¹ i 17,42 MJ kg⁻¹ za donju ogrjevnu vrijednost.

Ključne riječi: energetska kultura, prinos biomase, karakteristike izgaranja

Biomass productivity, chemical and energy properties of Switchgrass (*Panicum virgatum* L.) – Case study Croatia

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Abstract

Switchgrass (*Panicum virgatum* L.), as an energy crop, is defined by low investment in agricultural technology, high resistance to disease and pests, as well as potentially high yields. Switchgrass biomass can be converted into different forms of energy or biofuels, and one of the ways of conversion is energy production through thermochemical conversion processes. The aim of this study was to determine the biomass productivity, chemical and energy properties of switchgrass biomass in relation to two different harvesting periods (autumn and spring) in the third year of cultivation. Significant differences in the proportions of water, ash, nitrogen, carbon, sulfur and oxygen were found in relation to the research periods of harvest. In contrast, no significant differences were found in the proportions of hydrogen, coke, fixed carbon, and volatile matter as well as in the heating values. Harvest periods had the greatest impact on the research of micro and macro elements, since significant differences were found in all of them. The average biomass yield in the first harvest season was 19.08 t D.M. ha⁻¹, and in the second 13.27 t D.M. ha⁻¹. The average values of water, ash and lower heating values as one of the most important researched parameters in autumn and spring harvest were 33,88% and 10,95% for water, 4,59% and 3,71% for ash and 17,29 mg kg⁻¹ and 17,42 mg kg⁻¹ for the lower heating value.

Keywords: energy crop, biomass yield, combustion properties

Online crop height and density estimation in grain fields using LIDAR

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Abstract

Influence of the angle and height of the LIDAR mounting on crop height and density estimation in wheat and barley was investigated in this study. Tests were conducted in different crop heights, densities, moisture levels and varieties. It was found that the crop density has a large influence on the distribution of the detections in the crop layer. The sensor height did not influence the measurement as much as the angle does. A higher mounting was found to be preferable as it keeps the viewing angle on the crop in the scanning direction smaller for the same width, resulting in a higher resolution. At high densities, the number of reflections from the ground became very low when the angle of incidence of the laser line deviated more than 10 degrees from the vertical. Different state of the art algorithms were implemented and compared. It was found that methods for estimating the crop height from the LIDAR scans based on percentiles requires that a trade-off is made between robustness and precision. While height estimation from the range was found to be more precise, the method can be made more robust against outliers by using other percentiles. In conclusion, LIDAR based estimation of crop height and density is possible, but the accuracy is highly dependent on the mounting position.

Keywords: small grain, crop height, crop density, lidar, mounting position

This research received funding from the Flemish Agency for Innovation and Entrepreneurship (VLAIO) and CNH Industrial Belgium.

Analiza zapaljivosti novih genotipova roda *Miscanthus*

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Sažetak

Istraživanja energetske kulture unutar roda *Miscanthus* trenutno su usmjerena na razvoj novih genotipova s većom tolerantnošću na abiotički stres, npr. zaslanjenost ili sušu. Takvi, otporni genotipovi potrebni su prvenstveno za proizvodnju biomase na tlima lošije kvalitete, koja posjeduju određena biofizička ograničenja u proizvodnji konvencionalnih usjeva. Mogućnost korištenja biomase u energetske svrhe ovisi, između ostalog o njejoj ogrjevnoj vrijednosti te svojstvima zapaljivosti. U svrhu prikazivanja potencijala korištenja novih genotipova energetske kulture, cilj ovog istraživanja bio je odrediti ogrjevne vrijednosti 4 nova (*M. sinensis* x *M. sacchariflorus*) i 2 kontrolna (*M. sinensis* x *M. sacchariflorus* i *M. x giganteus*) genotipa roda *Miscanthus* te okarakterizirati njihova svojstva zapaljivosti s ciljem uvida u proces izgaranja. Standardnim metodama određene su gornja i donja ogrjevna vrijednost, a u svrhu analize zapaljivosti i toplinske karakterizacije uzoraka korišten je tzv. „*microscale combustion*“ kalorimetar.

Rezultati rada potvrđuju da kvaliteta biomase novih genotipova ostaje nepromijenjena u odnosu na kontrolne hibride, ukoliko se koriste kao sirovina za proces neposrednog izgaranja. Svi analizirani genotipovi pokazali su poželjne ogrjevne vrijednosti usporedive s dosadašnjim istraživanjima. Također, između njih postoji značajna stopa raznolikosti unutar parametara zapaljivosti, što je rezultat različitih sastava biomase.

Ključne riječi: *Miscanthus*, energetske karakteristike, novi genotipovi, „*microscale combustion*“ kalorimetrija

Ovo istraživanje financirala je Europska komisija i *Bio-based Industries* konzorcij putem Obzor 2020 BBI-DEMO projekta br. 745012 „*Growing Advanced industrial Crops on marginal lands for bioRefineries - GRACE*“.

Flammability analysis of new *Miscanthus* genotypes

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Abstract

Energy crops researches within *Miscanthus* genus are currently focused on the development of new genotypes with greater abiotic stress tolerance, for example, salinity or drought. Such resistant genotypes are primarily needed for the production of biomass on poor quality soils, which have certain biophysical limitations in the production of conventional crops. The possibility of using biomass for energy purposes, among others, depends on its heating value and flammability properties. In order to quantify the potential of using new energy crops genotypes, the aim of this paper was to determine 6 new *Miscanthus* genotypes (*M. sinensis* x *M. sacchariflorus*) and control genotypes (*M. sinensis* x *M. sacchariflorus* and *M. x giganteus*) heating values and their flammability properties for the purpose of their combustion process insight. Higher and lower calorific values were determined by the standard methods and a microscale combustion calorimeter was used to analyze the flammability and thermal characterization.

The results of the study confirm that the biomass quality of new genotypes remains unchanged compared to the *Miscanthus x giganteus* hybrid if it's used as a feedstock for the direct combustion process. All genotypes showed desirable heating values comparable to previous researches. Additionally, there is a significant level of difference within the flammability parameters between genotypes, which is the result of different biomass compositions.

Keywords: *Miscanthus*, energy properties, new genotypes, Microscale combustion calorimetry

The research was financed by the European Commission and Bio-based Industries consortium via H2020 BBI-DEMO project No. 745012 „*Growing Advanced industrial Crops on marginal lands for bioRefineries - GRACE*”.

Brnistra (*Spartium junceum* L.) - vrijedna sirovina u proizvodnji biokompozita

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Sažetak

Povećana potražnja za korištenjem održivih i biorazgradivih prirodnih materijala, potaknula je širu proizvodnju biokompozita. Iz tog razloga su se dizajnirali i proizveli kompozitni materijali izrađeni od održivog polilaktidnog (PLA) polimera i stabljičnih vlakana iz brnistre koja su se koristila kao ojačalo cijelog sustava. Brnistra je mediteranska biljka koja se koristi kao sirovinu za dobivanje tehničkih vlakana, zbog svojstava sličnih lanu. Vlakna iz brnistre su modificirana sa svrhom poboljšanja mehaničkih i toplinskih svojstava, a vrsta provedene modifikacije je utjecala na čvrstoću kompozitnog materijala. Kompozitni materijal ojačan vlaknima modificiranim s nanoglinom i limunskom kiselinom pokazuje najveći porast čvrstoće i to za 135% u odnosu na kompozit koji je ojačan vlaknima modificiranim samo s nanoglinom. Prekidno istezanje kompozitnog materijala ojačanog vlaknima modificiranim uz dodatak sredstva za umrežavanje pokazuje povećanje od 43,7% u odnosu na čisti PLA što ukazuje na istovremeni porast žilavosti ovakvih materijala. Dodavanje nanogline u sustav utjecalo je na sniženje vrijednosti otpuštene topline, a time i na manju zapaljivost ovakvih materijala. S obzirom da svaki proizvodni proces podrazumijeva i nastajanje određene količine otpada, kod brnistre se ispitala i mogućnost korištenja ostataka nakon provedenog postupka maceracije kao biomase u proizvodnji biogoriva.

Ključne riječi: brnistra (*Spartium junceum* L.), PLA, biokompoziti, biorazgradnja, biomasa

Ovo istraživanje provedeno je u okviru K.K.01.1.1.04.0091 projekta „Dizajn naprednih biokompozita iz energetski održivih izvora - BIOKOMPOZIT”.

Spanish broom (*Spartium junceum* L.) - a valuable raw material in the biocomposites production

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Abstract

Increased demand for use of sustainable and biodegradable natural materials, thereby reducing environmental pollution, has encouraged wider production of biocomposites. For this reason, composite materials made from sustainable polylactide (PLA) polymer and Spanish broom bast fibres, which were used as a system reinforcement, were designed and manufactured. Spanish broom is a Mediterranean plant that is used for production of technical fibres of flax-like properties. Spanish broom fibres were modified to improve their mechanical and thermal properties. The type of performed modification affected the strength of the final composite material. The fibre-reinforced composite material modified with nanoclay and citric acid shows the highest increase in strength, by 135 % compared to the fibre-reinforced composite material modified with nanoclay only. The elongation at break of the fibre-reinforced composite material modified with the addition of a crosslinker shows an increase of 43.7 % over pure PLA, indicating increase in the toughness of such materials. The addition of nanoclay to the system caused a decrease in the value of the released heat and, consequently, a lower flammability of such materials. As each production process entails the generation of a certain amount of waste, the possibility of using residues after the maceration process as biomass in bioenergy production has been investigated.

Keywords: Spanish broom (*Spartium junceum* L.), PLA, biocomposites, biodegradation, biomass

Ovo istraživanje provedeno je u okviru K.K.01.1.1.04.0091 projekta „Dizajn naprednih biokompozita iz energetski održivih izvora - BOKOMPOZIT”.

Dizajn naprednih biokompozita iz energetski održivih izvora

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Sažetak

Dizajn naprednih biokompozita iz samoniklog bilja brnistre i običnog trsta je projekt kojim će se dizajnirati i izraditi napredni biokompozitni materijali poboljšanih svojstava sa širokom mogućnošću primjene u gospodarskom sektoru uz iskorištavanje sirovine kroz proizvodnju biogoriva temeljenu na razvoju i primjeni novih tehnoloških rješenja. Sirovina za izradu naprednog materijala bit će samoniklo bilje brnistra (*Spartium junceum* L) i obični trst (*Arundo donax* L) koje do sada, unatoč stvaranju velike količine biomase po jedinici površine potrebne za pretvorbu u zelenu energiju i minimalnim zahtjevima uzgoja, nisu korištene u navedene svrhe, dok će baza za izradu polimerne matrice biti PLA polimer. Sama provedba projekta sadrži ciklički povezane aktivnosti s ciljem pripreme za izdvajanje vlakana. Prikupljena sirovina bit će podvrgnuta predobradi inovativnom metodom primjene biokatalizatora i mikrovalova i iz nje će biti izdvojena vlakna (10 %) dok će ostatak sirovine (90%) činiti biomasu za proizvodnju bioplina i peleta. Rezultati provedenih aktivnosti bit će rješenja koja uključuju uvođenje ekološki povoljnih postupaka proizvodnje, razvoj naprednih materijala, izradu vlaknima ojačanog prototipa kompozita, pronalaženje novih izvora biomase, uvođenje samoniklog bilja za proizvodnju biokompozita i biogoriva, razvijenu novu tehnologiju proizvodnje peleta i bioplina te transfer navedenog u akademski i gospodarski sektor.

Ključne riječi: biokompoziti, peleti, bioplin, brnistra, obični trst

Ovo istraživanje provedeno je u okviru K.K.01.1.1.04.0091 projekta „Dizajn naprednih biokompozita iz energetski održivih izvora - BOKOMPOZIT”.

Design of advanced biocomposites from energy-sustainable sources

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Abstract

Design of advanced biocomposites from wild plant Spanish broom and giant reed is a project that will design and manufacture advanced biocomposite materials with improved properties in the economic sector with the use of raw materials through the production of biofuels based on the development and application of new technological solutions. Raw material for development of advanced material will be wild plant Spanish broom (*Spartium junceum* L) and giant reed (*Arundo donax* L), which so far, despite the large amount of biomass per unit area required for conversion to green energy and the minimum cultivation requirements, have not been used in such purposes, while the polymer matrix fabrication base will be a PLA polymer. Project implementation itself has cyclically linked activities to prepare for fiber separation. Raw material will be exposed to pretreatment with an innovative method of application of biocatalysts and microwaves, and fiber (10 %) will be extracted from it, while the rest of the raw material (90 %) will be subjected to biogas and pellet production. Results will be solutions that include the introduction of environmentally friendly production methods, development of advanced materials, production of fiber-reinforced prototype composites, the finding of new sources of biomass, introduction of wild plants for production of biocomposites and biofuels, development of new technology for production of pellets and biogas, and transfer of knowledge to the industry sector.

Keywords: biocomposites, pellets, biogas, Spanish broom, giant reed

The research was conducted within the K.K.01.1.1.04.0091 project „Design of advanced biocomposites from energy-sustainable sources - BIOCOMPOSITES”.

Uzgoj i testiranje biomase *Miscanthus x giganteus* za proizvodnju naprednih biogoriva u Hrvatskoj – INA iskustvo

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Sažetak

U tijeku je provođenje programa INA R&M Novi smjer 2023. usmjerenog na osiguranje održivosti i profitabilnosti Ininog rafinerijskog sustava, koji uz ostale elemente uključuje i konverziju postojeće rafinerije u Sisku u industrijski centar u sklopu kojeg INA razvija projekt biorafinerija – jedan od najvećih projekata za proizvodnju naprednih biogoriva u EU. Cilj projekta je uspostava održive industrijske aktivnosti na lokaciji u Sisku, u što bi bila uključena proizvodnja naprednih biogoriva – bioetanola s negativnim ugljičnim otiskom, u sinergiji s proizvodnjom zelene el. energije i uspostavom lanca opskrbe biomasom.

Miscanthus x giganteus je odabran kao jedna od sirovina za potrebe buduće biorafinerije. Kako bi se testiralo karakteristike usjeva, u suradnji sa BC Institutom INA je tijekom 2017. uspostavila ukupno 8 ha nasada na tri lokacije (demonstracijska farma od 5 ha u Rugvici, te još dva testna polja po 1 ha u okolici Siska). Istovremeno se testiralo dva tipa sadnog materijala, rizome i presadnice, koji su nabavljeni iz četiri različita izvora (Velika Britanija, Poljska, Francuska i Slovenija). Prva žetva je provedena u drugoj godini uzgoja te je prikupljena biomasa poslana na testiranje u tvornicu u Njemačkoj, kao dio H2020 BBI JU projekta GRACE. Ovaj rad daje pregled prikupljenih iskustava i rezultata u periodu od 2017. do 2019. god. Prikupljeni rezultati razlog su optimizmu za uporabu kulture *Miscanthus x giganteus* kao sirovine za proizvodnju naprednih biogoriva.

Ključne riječi: napredni bioetanol, *Miscanthus*, biorafinerija

Miscanthus x giganteus cultivation and testing for advanced biofuels production in Croatia – INA experience

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Abstract

INA Downstream 2023 New Course Program, focused on ensuring sustainability and profitability of INA refining system, includes, among other elements, conversion of existing Sisak oil Refinery to an industrial centre within which INA is developing the Biorefinery project – the single largest advanced biofuels project in the EU. Aim of the project is establishment of sustainable industrial activity at Sisak industrial site, which would consider production of second-generation bioethanol with negative carbon footprint, in synergy with green energy production and biomass supply chain establishment. *Miscanthus x giganteus* is selected as one of the feedstocks for Biorefinery. To be able to test crop performance, in cooperation with BC Institute, INA has established total 8 ha in 2017, on three locations (demonstration farm in Rugvica (5 ha) and two test fields in Sisak vicinity (1 ha each)). Rhizomes and plantlets are simultaneously tested for material supplied from four different sources (UK, Poland, France, Slovenia). First harvest was conducted in second year of cultivation and collected biomass tested for bioethanol production in a facility in Germany, under the EU funded GRACE project. This paper will give an overview of gathered experiences and results in period 2017-2019. Collected results give an optimism in using *Miscanthus x giganteus* as a feedstock for advanced biofuels production.

Keywords: advanced bioethanol, *Miscanthus*, biorefinery

Negativni učinci kavitacije na pumpe za teška opterećenja u aplikaciji gnojovke/digestata

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Sažetak

Kavitacija je pojava koja se događa kada se u tekućini koja putuje stvaraju zračne praznine u područjima s relativno niskim tlakom u tekućini. Nagle promjene tlaka u tekućini pretvaraju tekućinu u paru koja se s okretanjem impelera ponovno pretvara u tekućinu. Kretanjem mjehurića pare kroz tekućinu, mjehurići dolaze do područja povišenog tlaka gdje trenutno implodiraju. Centrifugalne pumpne jedinice za transport/prepumpavanje gnojovke/digestata su najsklonije kavitaciji zbog svog specifičnog dizajna gdje se tekućina gura kroz jedinicu i šalje na velike udaljenosti, suprotno od uvlačenja tekućine u nju, a što je proces koji se odvija istovremeno. Čak i najbolje pumpne jedinice industrijskog dizajna za teška opterećenja sklone su kavitaciji. Kavitacija se događa zbog nedovoljne dostupne neto pozitivne usisne visine ili zbog nedostatka usisnog tlaka na usisnom dijelu pumpne jedinice, a što može biti uzrokovano začepljenjem, gustoćom tekućine/fluida/gnojovke/digestata ili lošim dizajnom cjelokupnog pumpnog sustava. Kavitacija uzrokuje većinu mehaničkih oštećenja na impeleru i kućištu pumpne jedinice, putem nebrojenih implozija koje opterećuju površinu materijala i u konačnici ga mehanički erodiraju/otkidaju. Velika razina kavitacije uzrokuje i značajne vibracije koje mogu uzrokovati ozbiljna oštećenja na ležajevima i brtvilima na pumpnoj jedinici. Sve navedeno vodi do povećanja utroška energije/goriva, smanjenja protoka i/ili pritiska i učestalijih kvarova na samoj pumpnoj jedinici.

Ključne riječi: pumpe za gnojovku, pritisak, kavitacija, mehanička oštećenja

Negative effect of the cavitation on heavy duty pump for manure/digestate application

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Abstract

Cavitation is a phenomenon that occurs when air cavities, sometimes called air pockets or air bubbles, are formed inside the flowing liquid in areas with relative low pressure. Rapid changes of pressure in a liquid, turn the liquid into a vapor and with the rotation of impeller back to liquid again. When vapor bubbles move through the liquid and come to an area where pressure is increased they implode instantaneously. Centrifugal manure pumps are most prone to cavitation due to their specific design in which the liquid is pushed into the unit as opposed to pulling it in. Even the best quality heavy duty industrial design pumps are prone to cavitation. Cavitation occurs because of insufficient Net Positive Suction Head available or due to not enough suction pressure at the suction end of the pump which can be caused due to clogging, density of manure/digestate or poor pumping system design. Most manure application issues such as cavitation are often blamed on the pumps but the reality is that most issues are caused due to operator mistakes, lack of maintenance and poor system design. Cavitation causes most mechanical damage on the impeller and pump housing due to implosions which stress the surface of the material and eventually erode/break it. Major cavitation also causes significant vibrations which can cause serious damage to bearings and seals. All of this leads to increased power/fuel consumption, decreased flow and/or pressure and eventually pump failure.

Keywords: manure pumps, pressure, cavitation, mechanical damage

Bioplinski potencijal iz biootpada grada Zagreba

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Sažetak

Statistički podaci za 2015. godinu pokazuju različite stope recikliranja otpada među EU članicama. Tako je najviša stopa u Njemačkoj (64%), Austriji (58%) i Belgiji (55%), a najniža u Hrvatskoj (21%), Estoniji (18%) i Bugarskoj (2%). Uspostavljanje održivog gospodarenja otpadom u Hrvatskoj i u Zagrebu prvenstveno ovisi o uvođenju odvojenog sakupljanja otpada, sustavu poznatom u zemljama EU već desetljećima. Naime, naglasak tog sustava trebao bi biti na odvojeno sakupljanje biootpada, koji se može koristiti kao sirovina u postrojenjima za proizvodnju bioplina. Direktiva o obnovljivim izvorima energije (EC 2003/30) prepoznaje biootpad kao jedan od primarnih sirovina za proizvodnju „zelene“ energije, a postojeći zakonski okvir u Hrvatskoj ima za obvezu uspostavu odvojenog prikupljanje biootpada. Sve je očitiije da Hrvatska i Zagreb moraju transformirati svoj linearni ekonomski model u kružni, a koji se temelji na smanjenju nastajanja otpada te njegovoj ponovnoj uporabi i recikliranju. Cilj je rada prikazati koristi odvojenog skupljanja i obrade biootpada u mogućem bioplinskom postrojenju. Glavna motivacija za odvajanje otpada je mogućnost smanjenja naknade za otpad, otvaranje novih radnih mjesta, poboljšanje lokalnog gospodarstva i proizvodnja energije. Međutim, građani su uglavnom voljni odvojiti otpad određenih frakcije otpada kao što su papir/karton, staklo i ambalaža, ali ne i biološki otpad koji je za njih obično zahtjevniji zbog nedostatka prostora i neugodnih mirisa.

Ključne riječi: gospodarenje otpadom, održivost, biootpad, bioplin, obnovljivi izvori energije

Biogas potential from biowaste in City of Zagreb

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Abstract

The statistical data from EU in 2015 shows different recycling rates among member countries. The highest rate is in Germany (64%), followed by Austria (58%) and Belgium (55%) and lowest is in Croatia (21%), Estonia (18%) and Bulgaria (2%). Establishing of sustainable waste management in Croatia and primary in City of Zagreb depend on basic introduction of separate waste collection, introduced in EU countries decades ago. Namely, emphasis of that system should be separate biowaste collection which can be used as raw material in biogas plants. Support of that agenda can be found in the Renewables Directive (EC 2003/30) which considers biowaste as one of the primary renewable energy sources. The current legal framework in Croatia also stimulated the obligation for separated collection of biowaste. It has been more evident that Croatia and the city of Zagreb must transform its linear economic model to circular one that is based recycling, reusing and recovery. The aim of this paper is to present benefits of separate biowaste collection and their processing to biogas in Zagreb. The main motivation for waste separation is the possibility to reduce the waste fee, creation of new jobs, local economy improvement and energy production. The presented research shows that citizens are mostly willing to separate waste of suitable waste fractions for them (paper/cardboard, glass, packaging) but no biowaste which is usually more demanding for them due to lack of space and odour problem.

Keywords: waste management, sustainability, biowaste, biogas, renewables

