



DRUŠTVO ZA VARSTVO RASTLIN SLOVENIJE

**14. SLOVENSKO POSVETOVANJE
O VARSTVU RASTLIN
z mednarodno udeležbo**

**14TH SLOVENIAN CONFERENCE
ON PLANT PROTECTION
*with international participation***

**5. - 6. marec 2019 / March 05-06 2019
Maribor, Slovenija**

Društvo za varstvo rastlin Slovenije
Plant Protection Society of Slovenia
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Izvečki referatov / Abstract volume

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Ocena posledic zmanjšanja izbora fitofarmaceutskih sredstev

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Fitofarmaceutska sredstva oziroma sredstva za varstvo rastlin (v nadaljevanju FFS) – varujejo gojene rastline pred boleznimi in škodljivci. Omogočajo doseganje visokih in kakovostnih pridelkov - dva ključna elementa, ki zagotavljata obstoj pridelave hrane v EU. Brez dostopa do širokega nabora fitofarmaceutskih sredstev v Evropi ne bi mogli zagotoviti varstva rastlin in s tem cenovno dostopne hrane za 500 milijonov potrošnikov. Kljub temu se je zadnjih 20 leti izbor registriranih aktivnih snovi v EU zelo zmanjšal. Leta 2015 je Evropsko združenje za varstvo rastlin naročilo pri konzultanskem podjetju Steward Redqueen, ki je specializirano za presojo učinkov politike na socio-ekonomske vplive, študijo o oceni posledic izgube 75 aktivnih snovi. Študija se je osredotočila na oceno vpliva na štiri ključna področja: višino pridelka, evropsko gospodarstvo, trgovino in okolje. Vsi podatki, ki so bili posredovani avtorjem študije so posredovali, strokovnjaki s področja kmetijstva, predstavniki univerz, kmetijske svetovalne službe in kmetijska združenja. V študiji so analizirani podatki 17 držav članic EU. Ocenjen je vpliv na 7 najpomembnejših pridelkov, ki se pridelujejo na 70 % površin v EU in predstavljajo 82 % tržne vrednosti v EU. Prav tako je v študiji prikazan še vpliv na 38 manjših kultur. Ugotovljeno je, da ima izguba omenjenih 75 aktivnih snovi zelo pomemben vpliv na višino pridelka in s tem na možnost obstoja kmetijske pridelave v EU. Brez obravnavanih aktivnih snovi bi EU postala neto uvoznik osnovnih kmetijskih pridelkov. Poleg tega je prikazan tudi izredno veliko izpad pridelka manjših kultur. Te kulture imajo zelo velik pomen za kmetijstvo v južnih članica EU. Študija poskuša opozoriti politike na pomen FFS za kmetijsko proizvodnjo in zagotoviti, da se oblikovalci politike zavedajo negativnih posledice izgube registracij aktivnih snovi za kmetijstvo še zlasti takrat, ko ni na voljo drugih možnosti varstva rastlini.

ABSTRACT

Impact Assessment on the consequences of reducing the choice of plant protection products

Farmers need access to pesticides in order to protect their crops from pests and diseases. Pesticides provide an enormous benefit for farmers in that they allow the farmer to achieve high yields and quality crops- two elements which ultimately play a vital role in ensuring the viability of agricultural production in Europe. Without access to a broad toolbox of crop protection solutions, farmers in Europe would not be able to meet the goals of ensuring a safe and affordable supply of food for 500 million consumers. Nevertheless, the past 20 years has seen a significant reduction in the amount of active substances registered on the market. In 2015, the European Crop Protection Association commissioned a study written by Steward Redqueen, a consultancy specializing on the social-economic impacts of policies, to conduct an impact assessment on the consequences of removing a selected 75 active substances from the market. The study focused on the possible impact for 4 key areas: yield, the European Economy, trade and the environment. All data transmitted to the authors of the study was given by Farm Unions, crop experts, agricultural universities as well as agricultural advisory services. The study covers a total of 17 member states across the EU and looks at the impact on 7 staple crops covering about 70% of the EU area covering those crops as well as 82% of their market value. In addition it also looks at 38 specialty crops. The study found that the 75 substances selected have a tremendous benefit for EU agricultural production as well as its viability. Without the selected 75 substances, the EU would essentially become a net importer of some of its most basic staple crops. Furthermore, it also found extremely high yield decreases in minor and specialty crops, which has a very disproportional impact on the Southern member states due to the type of crops produced. In the end, the study seeks to underline and highlight to policymakers the benefits of pesticides for agricultural production as well as make sure that policymakers are aware of the

negative consequences for farmers when active substances are removed from the market, especially when there are no viable alternatives in the farmers' toolbox.



Velika variabilnost v razgradnji herbicida glifosata – ali jo lahko pojasnimo z lastnostmi tal?

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Glifosat in njegov glavni metabolit aminometilfosfonska kislina (AMPA) sta pogosto detektirana v površinskih in podzemnih vodah. Ker lahko učinkovita razgradnja glifosata v tleh zmanjšuje njegove izgube v okolju, je nujno boljše razumevanje dejavnikov, ki vplivajo na njegovo mineralizacijo v tleh. V prispevku bodo predstavljeni rezultati študij, kjer smo iskali povezavo med lastnostmi tal in mineralizacijo glifosata (Nghiah s sod., 2018; Suhadolc s sod., 2010). Preučili smo veliko število vzorcev kmetijskih tal, ki so se razlikovali v teksturi (vsebnost peska 8% - 86%), vsebnosti organske snovi tal (1.2 % - 4,5%), pH (5,0 - 7,1), ter kationski izmenjalni kapaciteti (7,5 - 32,9 mmol_c100g⁻¹). Ugotovili smo, da je razpon v mineralizaciji glifosata v različnih kmetijskih tleh kar od 7 do 70% prvotno uporabljene količine v obdobju meseca dni. Razgradnja glifosata se je v večini preučevanih tal začela takoj po nanosu, hitrost mineralizacije pa je bila največja prve štiri dni. Zanimivo je, da je skupna izmenljiva kislost (H⁺ in Al₃⁺) parameter, ki je imel največji vpliv na mineralizacijo glifosata. Zelo značilna negativna korelacija med mineraliziranim glifosatom in ostanki, ki jih je mogoče ekstrahirati z NaOH, je pokazala, da bi lahko to metodo uporabili kot preprost in zanesljiv parameter za vrednotenje sposobnosti tal za njegovo mineralizacijo. Nadalje rezultati kažejo na potrebo po prilagajanju uporabe glifosata in tudi drugih fitofarmaceutskih sredstev okoljskim danostim, posebno lastnostim tal. Potencialna tveganja bi tako morali ocenjevati in zmanjševati že pred uporabo FFS, ne le v postopkih registracije pripravkov, ampak predvsem kot del dobre kmetijske prakse na ravni polja.

ABSTRACT

Large variability in herbicide glyphosate degradation – could it be explained by soil properties?

Glyphosate and its main metabolite aminomethylphosphonic acid (AMPA) have frequently been detected in surface and ground waters. Since adequate glyphosate mineralization in soil may reduce its losses to environment, improved understanding of factors underlying pesticide mineralization in soils is needed for more effective protection strategies. The results of the studies (Nghiah s sod., 2018; Suhadolc s sod., 2010), investigating the relationship between soil properties and glyphosate mineralization, will be presented. A large number of agricultural soils, differing in a variety of soil parameters, such as soil texture (sand content 8% – 86 %), soil organic matter content (1.2% - 4.5%), pH (5.0 - 7.1), exchangeable ions (7.5 – 32.9 mmol_c100g⁻¹) were examined. The results showed that the mineralization of glyphosate in different agricultural soils varied to a great extent, from 7 to 70% of the amount initially applied. Glyphosate mineralization started immediately after application, the highest mineralization rates were in general observed within the first 4 days. Interestingly, exchangeable acidity (H⁺ and Al³⁺) was the influential soil parameter governing glyphosate mineralization. A highly significant negative correlation between mineralized glyphosate and NaOH-extractable residues in soils suggests that this method could be used as a simple and reliable parameter for evaluating the glyphosate mineralization capacity of a certain soil. Furthermore, the results indicate the need for adapting glyphosate as well as other pesticides

usage to environmental conditions, especially soil properties. Potential risk should be evaluated and reduced before pesticide application, not only through registration procedures, but above all as part of best agricultural practice on the field level.



Razširjenost in obvladovanje populacij ščira *Amaranthus retroflexus* in divjega sirka *Sorghum halepense* odpornih na herbicide v Srbiji

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Preveč pogosta uporaba herbicidov, ki v plevelih zavirajo acetolaktat sintazo (ALS), v obdobju zadnjih dveh desetletjih, je v Srbiji povzročilo nastanek populacij biotipov ščira (*Amaranthus retroflexus* L. = A.r.) in divjega sirka (*Sorghum halepense* (L.) Pers. = S.h.) odpornega na ALS herbicide. Dolgotrajna ponavljajoče se uporaba nekaterih herbicidov, ki delujejo kot zaviralci encima ACCase, v posevkih soje, gojene v monokulturi, je povzročila pojav navzkrižno odpornih populacij S.h. odpornih na ariloksifenoksipropionatne herbicide (FOPs) in ALS herbicide. Cilj te študije je bil raziskati razširjenost in možnosti obvladovanja populacij sirka odpornih na ALS in ACC-ase inhibitorje, in ščira, odporne na zaviralce ALS. Rezultati so potrdili, da so skoraj vse testirane populacije S.h. bile odporne na nikosulfuron in skoraj vse populacije A.r. odporne na imazamoks. Razlike v občutljivosti na delovanje herbicida med rastlinami občutljivih in odpornih populacij so bile od nekaj sto do več tisočkratne. Ocenjujemo, da sta omenjeni dve vrsti, odporni na prevladujoče herbicide v uporabi v Srbiji iz skupne ALS, razširjeni na več deset tisoč hektarjih in sta zelo pomembni za kmetije v severnem delu Srbije. Zaradi tega se povečuje pomen gojenja hibridov koruze, ki so tolerantni na cikloksidim. Setev različnih drugih poljščin odpornih na herbicide je uporabna strategija samo kot del širših strategij zatiranja plevelov odpornih na herbicide, ki ne smejo temeljiti preveč na dolgoročni pogosti uporabi herbicidov z enakimi mahanizmi delovanja. Podobno kot sirek je poseben izziv upravljanja plevelnih populacij ščir, odporen na ALS inhibitorje pri proizvodnji soje, sončnic tolerantnih na herbicide in sladkorne pese; to je poljščin, ki so odvisne predvsem od uporabe sulfonilsečnine in imidazolinonskih herbicidov. V splošno široko uporabo je potrbno vplejati raznolike prakse zatiranja z vključevanjem herbicidov z veliko različnimi mehanizmi delovanja in z metodami nekemičnega zatiranja.

ABSTRACT

Distribution and Management of Herbicide-resistant *Amaranthus retroflexus* and *Sorghum halepense* in Serbia

Overreliance on acetolactate synthase (ALS)-inhibiting herbicides for weed control during last two decades, has resulted in an emergence of biotypes of redroot pigweed (*Amaranthus retroflexus* L. = A.r.) and johnsongrass (*Sorghum halepense* (L.) Pers. = S.h.) resistant to ALS herbicides in Serbia. The continuous use of some ACCase-inhibiting herbicides in soybeans grown in monoculture has resulted in occurrence of cross-resistant populations of S.h. resistant to aryloxyphenoxypropionate (FOPs) and ALS herbicides. The objective of this study was to investigate the distribution and management of herbicide resistant S.h. to ALS and ACC-ase inhibitors, and A.r. populations resistant to ALS inhibitors. The results have confirmed that nearly all tested populations of S.h. were resistant to nicosulfuron, and almost all

populations of *A.r.* were resistant to imazamox. The differences in sensitivity between plants of susceptible and resistant populations were from several hundred to several thousand times. Based on our research, it is estimated that these two species, with the characteristic of being resistant to the most often used dominant ALS inhibitors, are widespread over tens of thousands of hectares, with the greatest importance for farmers in the northern part of Serbia. The importance of growing maize hybrids tolerant to cycloxydim is increasing because of this. The use of this or other herbicide-tolerant crops is useful only as a part of the broader herbicide resistant weed management strategies, without excessive reliance over a long period, to herbicides of the same modes of action. Similar to the previous, a special challenge is management of populations of *A.r.* resistant to ALS inhibitors in the production of soybean, herbicide-tolerant sunflowers and sugar beet, which depends mostly on sulfonyleurea and imidazolinone herbicides. Diversifying weed management practices, using multiple herbicide modes of action and non-chemical measures need to be more widely implemented.



Uporaba geoinformacijskih sistemov v kmetijstvu kot pomoč pri varovanju voda

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Preprečevanje onesnaženja voda s kmetijskimi inputi iz razpršenih virov igra pomembno vlogo pri varovanju kakovosti voda. Najpomembnejša dejavnika onesnaževanja voda iz razpršenih virov sta erozija in površinsko odtekanje onesnažene vode s kmetijskih površin. Slednje se pojavi še pred erozijo, zato ga včasih niti ne opazimo. Inovacije na področju računalništva omogočajo kmetom in svetovalcem tudi možnost vplivanja na zmanjšanje površinskega odtoka /erozijo s kmetijskih površin in s tem tudi varovanje voda in optimiziranje kmetijske proizvodnje. Podjetje Bayer je v sodelovanju z Univerzo v Hamburgu in inženirji podjetja Geoinformationsservice iz Göttingena ter podjetja Feldwish razvilo program za natančno predvidevanje površinskega odtoka vode s kmetijskih površin, kar omogoča izvajanje ukrepov za zmanjšanje tveganj za onesnaževanje voda. Z uporabo metod SAGA (sistem za avtomatsko geoprostorsko analizo) upoštevamo in ocenimo z natančno prostorsko-časovno ločljivostjo najpomembnejše dejavnike, ki vplivajo na tveganje površinskega odtoka vode s kmetijskih površin. Modeliranje poteka s pomočjo računalniško podprtega geografsko informacijskega sistema, ki je namenjen kmetom/svetovalcem kot pomoč pri odločanju za najboljšo kmetijsko prakso. Uporabnik lahko vnese v program natančne podatke glede rabe zemljišča in tako poveča natančnost napovedi. Omenjeni program za varstvo voda je že bil predstavljen na tako imenovanih "Bayer Forward farms" v Belgiji, Nemčiji in na Nizozemskem. V prihodnje podjetje Bayer načrtuje predstavitev in uporabo modela z dodanim širokim nizom ukrepov, specifičnih za posamezno območje, še v Franciji, Avstriji, Švici, Španiji, Italiji, Poljski in v ZDA s posebnim prilagojenim modulom. Začetni rezultati kažejo, da lahko s pomočjo omenjenega programa omogočimo napredno in okolju prijazno kmetijsko proizvodnjo.

ABSTRACT

Use of a Geoinformation system (Gis) in Agriculture to Protect Water Quality

Avoiding diffuse-source entry of agricultural inputs can play an important role in protecting water quality. The two most important factors determining diffuse inputs into water bodies are erosion and runoff.

The latter usually occurs before erosion begins and thus often fails to be identified. Digital innovations can support farmers and/or advisors in reducing the impact of runoff/erosion on water quality and in optimizing agricultural production. In partnership with the University of Hamburg, the Geoinformation Service Göttingen and Feldwisch engineers, Bayer AG has developed a water protection advisory tool that allows precise estimations of runoff risk and supports risk mitigation measures. Using a SAGA-based physical-parametric modeling approach (System for Automated Geospatial Analysis), the major factors influencing runoff (topography, soil properties, site-specific weather conditions and crop coverage) are captured in order to evaluate runoff risk with precise spatio-temporal resolution. The model framework is embedded in a comprehensive Web-GIS environment. It is intended for use as a decision-support tool, offering best-practice recommendations to advisors / farmers. Using the data entry option, the user can enter plot-specific land use details in order to increase the accuracy of the forecasts. The water-protection advisory tool is already being demonstrated at Bayer Forward Farms in Belgium, Germany and the Netherlands. In a stepwise process, Bayer envisages the extension of the tool to further EU countries (France, Austria, Switzerland, Spain, Italy and Poland) and a modulation to US agro-environmental conditions including a broad set of site-specific Risk Mitigation Measures. Initial results indicate that the water-protection advisory tool can contribute significantly to resource-efficient and environmentally friendly agricultural production.

Varstvo poljščin in krmnih rastlin

Prvi rezultati poljskega preučevanja vpliva bakterijskega pospeševalca rasti (*Pseudomonas fluorescens* x *Azospirillum brasilense*) na pojav škodljivih organizmov in pridelek krompirja in paradižnika

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V letih 2017 in 2018 smo v poljskih poskusih prvi v Evropi preučevali vpliv bakterijskega pospeševalca rasti (*Pseudomonas fluorescens* in *Azospirillum brasilense*) na pridelek krompirja in paradižnika in njuno občutljivost na okužbo z glivama *Phytophthora infestans* in *Alternaria solani*. Pri krompirju smo preučevali tudi občutljivost na napad koloradskega hrošča (*Leptinotarsa decemlineata*). V enem obravnavanju smo gomolje krompirja oz. sadike paradižnika pred sajenjem pomočili v bakterijsko suspenzijo, v drugem pa smo suspenzijo na gomolje/korenine sadik nanесли s škropljenjem ob sajenju. Delovanje bakterijskega pospeševalca rasti smo preučevali v primerjavi z netretiranimi gomolji/sadikami. V nadpovprečno vročem in suhem letu 2017 smo pri vseh treh sortah krompirja v obravnavanju, kjer smo gomolje pred sajenjem namočili v bakterijsko mešanico, potrdili pozitiven vpliv na pridelek (17-31 %). Med rastlinami v različnih obravnavanjih (namočeni gomolji, škropljeni gomolji, netretirani gomolji) nismo ugotovili pomembnih razlik v odpornosti/dovzetnosti na škodljive organizme, so se pa razlike v tem pogledu izrazile med sortami. V nadpovprečno mokrem letu 2018 smo na njivi, ki je bila dlje poplavljena že pred vznikom, prav tako ugotovili pozitiven vpliv (32 %) bakterijske suspenzije na pridelek. Na paradižniku, katerega sadike smo pred sajenjem pomočili v bakterijsko suspenzijo, smo v letu 2018 ugotovili za 9 (obravnavanje s fungicidi, brez bakterije) do 13 % (obravnavanje brez fungicidov, brez bakterije) večji pridelek kot v drugih obravnavanjih, leto prej pa smo v obeh obravnavanjih z bakterijskim pospeševalcem rasti ugotovili skoraj dvakrat večji pridelek kot v obravnavanju 'netretirano' in za 1,3-1,5x manjšega kot v obravnavanju 'pozitivna kontrola', a zaradi neizenačenosti pridelka med obravnavanji (z izjemo med obravnavanjema 'pozitivna kontrola' in 'negativna kontrola') nismo potrdili signifikantnih razlik. V obeh letih je bil paradižnik, ki je bil pred sajenjem tretiran v bakterijsko suspenzijo signifikantno bolj okužen z glivo *A. solani* kot škropljeni paradižnik, a signifikantno manj kot paradižnik v obravnavanju 'netretirano', enaka razmerja med obravnavanji pa smo v letu 2018 ugotovili tudi pri okužbi z glivo *P. infestans*, ki se sicer v letu 2017 ni pojavila. Na podlagi rezultatov naših raziskav ugotavljamo, da ima preučevana bakterijska mešanica velik potencial pri zagotavljanju zadovoljivega pridelka krompirja v sušnih razmerah in nizki stopnji okužbe z glivičnimi boleznimi listov in napada škodljivih žuželk, medtem ko smo v mokrem letu 2018 pri paradižniku, katerega sadike smo pred sajenjem pomočili v bakterijsko mešanico, ugotovili večji skupni pridelek kot v ostalih treh obravnavanjih, v suhem letu 2017 pa je mešanica vplivala na manjšo okužbo listov in plodov z glivo *A. solani*, v primerjavi z obravnavanjem 'netretirano'.

ABSTRACT

First results of field investigation on the impact of plant growth-promoting bacteria (*Pseudomonas fluorescens* x *Azospirillum brasilense*) on the yield of potato and tomato, and occurrence of diseases and pests

In 2017 and 2018, we conducted field experiments to test the influence of a mixture of two plant growth-promoting bacteria (*Pseudomonas fluorescens* and *Azospirillum brasilense*) on the yield of potato and tomato. In addition, the influence of the mixture on potato and tomato susceptibility to infection by the pseudofungus *Phytophthora infestans* and fungus *Alternaria solani* was investigated. We also studied the susceptibility of potato to attacks by the Colorado potato beetle (*Leptinotarsa decemlineata*). In one of the treatments in the experiments, the potato tubers and tomato seedlings were soaked in the suspension

of bacteria, while in the other treatments the bacterial suspension was applied to the tubers and seedlings by spraying in the time of planting. The activity of plant growth-promoting bacteria was investigated in comparison with non-treated tubers/seedlings. In the unusually hot and dry year 2017, a positive influence on the yield (17-31 %) was found in all three varieties of potato, when the tubers were soaked in the bacterial mixture prior to planting. We observed no significant differences in potato resilience/susceptibility to harmful organisms among the different treatments (soaked tubers, sprayed tubers, untreated tubers); however, there were significant differences in the productivity between the varieties. In the unusually wet year 2018, we confirmed the positive impact (32 %) of bacterial mixture on the yield also in the field, which was flooded before emergence of potato plants. In the tomato, which seedlings were soaked in the suspension of bacteria before planting, we established from 9 (treatment with fungicides without bacterial suspension) to 13 % (treatment without fungicides and bacterial suspension) higher yield of fruits than in other treatments in 2018, while in 2017 in both treatments with bacterial mixture we confirmed almost twice higher yield than in treatment 'non-treated', and 1.3-1.5-fold lower yield than in treatment 'positive control'. However because of the unequalized yield among the treatments (with the exception between the treatments 'positive control' and 'negative control') we did not confirm significant differences. In both years, the tomato, which were treated before planting with bacterial mixture, were significantly more infected with the fungus *A. solani* in comparison with the plants, which were sprayed with fungicides, however the same plants were significantly less infected than non-treated plants. The same relations among the treatments were confirmed for the fungus *P. infestans* in 2018, which did not occur in 2017 otherwise. Based on the results of our investigations the can establish that the bacterial mixture used in this study has a high potential to support satisfactory potato yields under dry conditions and under low levels of infection by foliar fungal diseases and attacks by foliar insects. In rainy year 2018, we confirmed the higher yield of tomato in the plants, which were soaked in the bacterial suspension before planting, while in dry year 2017, compared to non-treated plants, the bacterial mixture showed an impact to lower infection of the leaves and fruits of tomato with the fungus *A. solani*.



Okuženost koruze z virusi v Sloveniji

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Koruza je najbolj razširjena kmetijska rastlina v Sloveniji. To poljščino okužuje več kot 25 virusov, vendar do nedavno nismo imeli nobenih podatkov o virusnih okužbah koruze pri nas. V Evropi sta na koruzi najbolj razširjena virus pritikavosti in mozaika koruze (*Maize dwarf mosaic virus*, MDMV) in virus mozaika sladkornega trsa (*Sugarcane mosaic virus*, SCMV). Težave povzročajo tudi okužbe z virusi rumenenja in pritikavosti žit (yellow dwarf virusi oz. YDVs), ki se zaradi vse milejših zim iz južne Evrope širijo proti severu. V Sloveniji smo leta 2017 v okviru strokovnih nalog pričeli s serološkim testiranjem koruze na navzočnost MDMV, SCMV in treh serotipov YDVs. V prvem letu smo odvzeli 20 vzorcev koruze na 7 lokacijah v okolici Ljubljane. Vzorčili smo ob robovih njiv, večinoma rastline nižje rasti z blagim rumenenjem listov ter ponekod tudi nekaj rastlin brez znamenj okužbe. Okužb z virusi nismo potrdili. V letu 2018 smo vzorčili na 7 njivah v severovzhodni Sloveniji, kjer smo opazili rdečenje posameznih rastlin. Vzorčili smo simptomatične rastline in na nekaj lokacijah tudi posamezne zelene rastline brez sumljivih znamenj. Ponovno smo odvzeli 20 vzorcev. Na eni lokaciji smo potrdili navzočnost BYDV-PAV (virus PAV rumenenja in pritikavosti ječmena, *Barley yellow dwarf virus*-PAV), ki je

uvrščen v skupino virusov rumenenja in pritlikavosti žit. Okužbo smo potrdili s serološkimi (DAS-ELISA) in molekularnimi tehnikami (RT-PCR, sekvenciranje namnoženih produktov in analiza nukleotidnih zaporedij). To je bila prva potrditev okužbe z virusi na koruzi v Sloveniji. BYDV na koruzi povzroča rdečenje, vendar podobna znamenja povzročajo tudi drugi biotski in abiotski dejavniki, zato ne preseneča, da v drugih vzorcih iz rdečih rastlin koruze nismo potrdili navzočnosti virusov.

IZVLEČEK

Viral infections of maize in Slovenia

Maize is the most widespread agricultural crop in Slovenia. It is a host of more than 25 viruses, but until recently data about maize viral infections in Slovenia were not available. *Maize dwarf mosaic virus* (MDMV) and *Sugarcane mosaic virus* (SCMV) are the most important viruses on maize in Europe. Yellow dwarf viruses (YDV's) are also gaining importance, since they are spreading towards north of Europe due to increasing winter temperatures. In Slovenia, serological testing of maize for the presence of MDMV, SCMV and three serotypes of YDVs started in 2017. Samples were taken from 7 locations around Ljubljana. Mostly smaller plants with different degrees of yellowing from the field borders were sampled. On some locations samples of neighbouring symptomless plants were also collected. Viral infections were not detected in any of 20 samples tested. In 2018, 20 samples were collected in north-eastern part of Slovenia where reddening was observed on individual plants. Plants exhibiting reddening and a smaller number of neighbouring plants without symptoms were taken. BYDV-PAV (*Barley yellow dwarf virus*-PAV), a member of yellow dwarf viruses group, was detected in one location. Infection was confirmed using serological (DAS-ELISA) and molecular methods (RT-PCR and sequencing). This is the first report of viral infection of maize in Slovenia. BYDV is known to cause reddening in maize, but other biotic and abiotic factors can cause similar symptoms. The absence of infection with viruses in the majority of samples from red maize plants is thus not surprising.



Občutljivost hibridov koruze na napad koruzne vešče (*Ostrinia nubilalis*)

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V SV Sloveniji na koruznih njivah opazamo čedalje večjo gospodarsko škodo nastalo zaradi koruzne vešče (*Ostrinia nubilalis*). Koruzna vešča povzroča škodo na steblih koruze, v katere se gosenica zavrtja, rastline koruze se posledično lomijo. Gosenice se zavrtajo v storže koruze, zaradi ran se na storžih pojavijo različne plesni. Na različnih hibridih koruze smo ovrednotili napadenost od koruzne vešče na steblih in na storžu na Ptujsko- Dravskem polju in v Slovenski Bistrici. V letu 2017 je bil ovrednoten poskus na Ptujju, kjer je bilo posejanih 36 hibridov koruze. Povprečen napad na steblih je bil 26 %, na storžih pa 31 %. Rezultati poskusa so pokazali, da obstajajo razlike pri posameznih hibridih. V letu 2018 smo ovrednotili hibridni poskus koruze v Rošnjah na Dravskem polju, kjer so lažja tla in je bila setev koruze opravljena pozno. Rezultati so pokazali razlike med posameznimi hibridi, povprečen napad na steblih je bil 88 %, ter na storžih 83 %, ocenjenih je bilo 40 hibridov koruze. V Slovenski Bistrici je bil napad koruzne vešče na različnih hibridih koruze manjši, povprečje napadenih stebel je bilo 20 %, ter povprečje napadenih storžev je bilo 23 %, ocenjenih je bilo 49 hibridov koruze. Na tej lokaciji so tla težja in setev je bila opravljena v optimalnem času. Pri opazovanju njiv koruze v jesenskem času na Ptujsko - Dravskem polju

na lahkih tleh je ogromno posevkov koruze polomljenih, kar so prvi znaki napada zaradi večše. Pridelovalcem priporočamo naj koruzne ostanke, dobro zmulčijo, zaorjejo, ter naj ne puščajo koruze na poljih še v spomladanskem času, ko prihaja do izleta večše.

ABSTRACT

Sensitivity of maize hybrids to the attack of European corn borer (*Ostrinia nubilalis*)

In the NE Slovenia we noticed the increased rate of economic damage caused by European corn borer due to the presence of corn moths. The damage is mostly present on the stems and on the ears, where the various different infections are possible. In years 2017 and 2018 we evaluated the level of attack of European corn borer on different maize hybrids on location Turnišče near Ptuj and in year 2018 on locations Rošnja and Slovenska Bistrica. We have evaluated the level of attack on stems and ears. In the year 2017 36 hybrids of the maize and in 2018 40 in location Rošnja and in Slovenska Bistrica 49 hybrids were evaluated. In the year 2017 the average attack on the stem was 26 % and on the ear was 31%. In 2018 on location Rošnja, where the soil is sandy loam, the average attack of the stems was 88 %, and on the ears 83 %. In the location Slovenska Bistrica the attack on the stem was 20%, and the on the ears 23%. The main reason that for the low percentage of attack, was that the soil on location Slovenska Bistrica is loamy clay and according to our experience the level of attack is usually smaller as on the fields with sandy loam type of soil.



Prva najdba ambrozijevega lepenca (*Ophraella communa* LeSage, 1986) v Sloveniji

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Pelinolistna ambrozija (*Ambrosia artemisiifolia* L.) se pojavlja predvsem na njivah in travnikih, pogosto pa uspeva tudi ob prometni infrastrukturi. Invazivka je trdovraten plevel na kmetijskih površinah v zadnjih desetletjih pa je vzbudila zanimanje med strokovno in laično javnostjo zaradi alergeni lastnosti. V večini evropskih držav smo plevelno vrsto do sedaj zatirali mehansko ali kemično z uporabo herbicidnih pripravkov. Pri uporabi slednjih pa se vse pogosteje srečujemo z omejitvami tako na pridelovalnih površinah še posebej pa v urbanem okolju. V tujini se za zatiranje invazivne vrste uporablja tudi metode biotičnega varstva. Med bolj učinkovite organizme, ki pripomorejo k omejevanju širitve rastline spada vrsta hrošča ambrozijevega lepenca (*Ophraella communa* LeSage) iz družine lepencev (Chrysomelidae). Vrsta izvira iz severne Amerike in se je v preteklosti nenamerno razširila še na druge celine. V Evropi so hrošča prvič opazili leta 2013 v Padski nižini v Italiji in v južnem delu švicarskega kantona Ticino. Na površinah, kjer so hrošča prvič opazili, beležijo obsežnejše poškodbe na listih ambrozije ter hkrati ugotavljajo nižjo koncentracijo alergena cvetnega prahu. V Sloveniji je bil hrošč prvič najden konec avgusta leta 2017 na Goriškem, populacijo pa smo nato spremljali še v letu 2018. Za vrsto je značilno, da je oligofag. Letno razvije dva do tri rodove, pri nas najbrž le dva. Hrošč prezimi kot odrasel osebek. Na Goriškem in v Vipavski dolini smo leta 2018 prve odrasle osebe opazili konec aprila in v maju. V zadnji dekadi maja so se pojavile še ostale razvojne stopnje. Imagi in ličinke se pojavljajo istočasno in se prehranjujejo z nadzemnimi deli gostitelja. Najbolj so prizadeti listi in socvetja. Zaradi teh poškodb rastline veliko manj semenijo. Gostitelji ambrozijevega lepenca so tudi nekatere druge rastlinske vrste kot so laška repa ali

topinambur (*Helianthus tuberosus*) in sončnica (*Helianthus annuus*), a poškodb na omenjenih rastlinah na Goriškem in v Vipavski dolini doslej nismo opazili. Glede na trenutno vedenje bo ambrozijev lepeneč (*Ophraella communa* LeSage) obetavna dopolnitev pri zatiranju pelinolistne ambrozije.

ABSTRACT

First finding of the ragweed leaf beetle (*Ophraella communa* LeSage, 1986) in Slovenia

The common ragweed (*Ambrosia artemisiifolia* L.) grows mostly on crop fields and meadows but it can also be found next to transport infrastructure. Despite the fact that the invasive species mainly represents a weed of cultivated areas, in the last decades, it raised the interest of the public and scientists due to its allergenic characteristics. In most European countries, the common ragweed has so far been controlled with mechanical approaches and chemically - with the use of herbicides. However, there is an increase in the limitation of chemical weed control in agriculture and especially in urban areas. In some countries biological control methods are used too. One of the more effective organisms to limit the spread of the ragweed is the ragweed leaf beetle (*Ophraella communa* LeSage) that belongs in the family of the leaf beetles (Chrysomelidae). Originating in North America, in the past the insect species was unintentionally spread to other continents. In Europe it was firstly noticed in 2013 in the Po valley, Italy, and in some locations in the southern Swiss canton Ticino. Greater damage on ragweed leaves was noted on the locations where the beetle was found. At the same time, a lower rate of allergenic pollen concentration was reported. In Slovenia, the first ragweed leaf beetle was found in August 2017 in the Goriška region, and since then the beetle population has been monitored. The ragweed leaf beetle is an oligophagous species. It has two to three generations per year, in our region probably two. In Slovene region of Goriška and in the Vipava valley, which are both in the western part of the country, the first adults were discovered at the end of April and in May 2018. In the last decade of May, other insect growth stages emerged. Both the adult and larvae feed on the upper parts of the host at the same time. Leaves and flowers suffer the most. Because of the damage lower seed is produced. There are other beetle hosts such as the Jerusalem artichoke (*Helianthus tuberosus* L.) and the common sunflower (*Helianthus annuus* L.). However, we did not find any damage on these hosts in the Goriška region and the Vipava valley. Considering current knowledge, the ragweed leaf beetle (*Ophraella communa* LeSage) is a promising addition in ragweed control.



Ocena stopnje učinkovitosti insekticidov za zatiranje repičarja in ogrščičnega kljunotaja

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V letih 2017 in 2018 sta bila izvedena poljska poskusa v posevku oljne ogrščice v katerih smo testirali učinkovitost insekticidov za zatiranje repičarja (*Meligethes aeneus*) in ogrščičnega kljunotaja (*Ceutorhynchus napi*). Insekticidi na podlagi snovi tiakloprid, deltamtrin, tau-fluvalinat in lambda-cihalotrin so bili nanoseni v dveh razvojnih stadijih ogrščice pri 100 % odmerkih in pri povečanih odmerkih. V sezoni 2017 odmerki insekticida (100 proti 200 %) v večini ocenjevalnih obdobjih ni imel vpliva na stopnjo učinkovitosti insekticida. Pri vseh testiranih insekticidih je učinkovitost po šestih dneh padla pod 45 %. V sezoni 2018 smo izvedli primerjavo učinkovitosti med 100 % in 300 % odmerkom in prišli do podobnih zaključkov kot v letu 2017. Učinkovitost testiranih insekticidov je občutno nižja, kot je bila pred leti, ko smo jih pričeli uporabljati, kljub temu pa ne moremo trditi, da je testirana populacija repičarja in kljuno-

taja razvila odpornost na testirane insekticide. V našem poskusu ugotovljena učinkovitost insekticidov ne zagotavlja več ustreznega nivoja preprečevanja nastajanja izgub pridelka oljne ogršnice.

ABSTRACT

Assessment of Insecticide Efficacy in Controlling Canola Beetle and Rape Stem Weevil

In seasons 2017 and 2018 two field experiments were carried out in a rape seed crop in which we evaluated the degree of insecticide efficacy for controlling the canola pollen beetle (*Meligethes aeneus*) and the rape stem weevil (*Ceutorrhynchus napi*). Insecticides based on thiacloprid, deltametrin, tau-fluvalinate and lambda-cihalotrin were applied at two rape development stages. Evaluation of the efficacy was done for a 100% dose and for increased doses. In season 2017 the increase of insecticide dose (100% vs. 200%) in most assessment periods did not have an effect on the degree of insecticide efficacy. For all tested insecticides, the efficacy after six days had fallen below 45%. In the 2018 season, we performed an efficacy comparison between 100% and 300% of doses and reached similar conclusions as in 2017. The effectiveness of the tested insecticides is considerably lower than it was years ago when we started using them; however, we cannot claim that the population of pollen beetle and rape weevil has developed a resistance to the tested insecticides. Efficacies of insecticides established in our experiment do not provide any more adequate levels of prevention of oilseed rape yield loss generation.



CORTEVA Agriscience TM, novo podjetje na kmetijskem trgu

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Corteva AgriscienceTM temelji na bogati dediščini podjetij Dow AgroSciences, DuPont in Pioneer. V letu 2017 je prišlo do združitve podjetij Dow AgroSciences in DuPont in tako je bilo ustanovljeno podjetje DowDuPontTM. V februarju 2018 je bila napovedana ustanovitev podjetja Corteva Agriscience, kot kmetijska divizija DowDuPont. To je edino veliko podjetje, ki se v celoti posveča kmetijstvu. Z združitvijo najboljših prednosti podjetij DuPont Pioneer, DuPont Crop Protection in Dow AgroSciences smo pridobili najboljše izkušnje ter strokovnost, ki je bila pridobljena v dveh stoletjih znanstvenih dosežkov. Corteva Agriscience je v celoti usmerjena v obogatitev življenja tistih, ki pridelujejo hrano kot tistih, ki jo konzumirajo ter zagotavlja napredek za generacije, ki prihajajo. Zato razumemo, da je kakovostna hrana temelj uspešnih skupnosti in tesno sodelujemo s kmetovalci, da lahko z najnovejšim načinom razmišljanja in tehnologijo pridelajo kakovostnejšo hrano, hkrati pa ohranjajo okolje in naravne vire. Naša ambicija je postati vodilno podjetje in zaupanja vreden partner v pridelovanju hrane in v kmetijstvu. Sedaj vam lahko ponudimo integrirane in razširjene rešitve, ki združujejo genetiko, kemijo in natančno pridelavo (kmetijstvo). Na ta način pomagamo kmetovalcem povečati vrednost svojih naložb na osnovi visoko zmogljive genetike in učinkovitimi znanstveno utemeljenimi rešitvami, ki optimizirajo donos in kakovost pridelkov. Do sredine leta 2019 načrtujemo, da bomo objavili globalno podjetje. Corteva Agriscience bo na slovenskem trgu prisotna s predstavništvom Pioneer (semena) in našimi nacionalnimi distributerji v Sloveniji (varstvo rastlin).

ABSTRACT

CORTEVA AGRISCIENCE, new Company on Global Agricultural Market

Corteva Agriscience™ is founded on the rich heritages of Dow, DuPont and Pioneer. In 2017, occurred merger of companies Dow and DuPont and founded company DowDuPont™. In February 2018, was announced company Corteva Agriscience, the agriculture division of DowDuPont. This is the only major agriscience company completely dedicated to agriculture. By combining the strengths of DuPont Pioneer, DuPont Crop Protection and Dow AgroSciences, we've harnessed agriculture's brightest minds and expertise gained over two centuries of scientific achievement. Corteva Agriscience is fully driven to enrich the lives of those who produce and those who consume, ensuring progress for generations to come. Therefore, we understand that quality food is the foundation of thriving communities and we work closely with farmers to ensure that the latest thinking and technology are used to grow better food, while sustaining the land and conserving resources. Our ambition is to become a trusted leader in food and agriculture through open, honest engagement that reflects our purpose. We can now bring you integrated and greatly expanded solutions that combine genetics, chemistry and precision agriculture. This way we help farmers maximize the value of their investment through high-performing genetics and effective science-based solutions that optimize yield and crop quality. By the mid of 2019, we are planning to announce global company spin off. Corteva Agriscience will be present on Slovenian market through Pioneer Representation Office (seed business) and our national distributors in Slovenia (Crop protection business).



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ELATUS® Era je robusten in persistenten fungicid z najnovejšo SDHI aktivno snovjo SOLATENOL™ v koformulaciji s protiokonazolom. Zahvaljujoč komplementarnosti obeh aktivnih snovi pripravke ELATUS® Era zagotavlja močan nadzor nad boleznimi, dosledno delovanje fungicida in popolno varstvo lista. Z nadstandardnim varstvom listne površine in notranjosti lista ELATUS® Era zagotavlja zeleno/zdravo površino lista, kar omogoča dokazano večje pridelke pri različnih vrstah in sortah žit ter pri različnih pritiskih bolezni. ELATUS® Era v primerjavi s trenutnimi standardnimi fungicidi zagotavlja za 7–10 dni daljšo kontrolo nad boleznimi žit. V članku je podrobneje prikazana nova aktivna snov SOLATENOL™. SOLATENOL™ (ISO ime: benzovindiflupyr) spada v četrto SDHI (zaviralci sukcinata dehidrogenaze) generacijo fungicidov iz kemijske skupine pirazol-karboksamidov in je zaščitena blagovna znamka družbe Syngenta. Predstavljena nova aktivna snov prinaša nov način delovanja, ki se v praksi izrazi kot izredno močno delovanje proti širokemu spektru patogenov, vključno z dolgotrajnim delovanjem na glavne glivične bolezni v žitih. Aktivna snov SOLATENOL™ omogoča dolgotrajnejšo ohranjanje zelene listne površine in s tem povečuje fotosintetsko aktivnost, kar zagotavlja višje pridelke in posledično boljše ekonomsko upravičenost nakupa pripravka. Izredno fungicidno delovanje in močna vezava na voščene plasti listov gojene rastline, od koder aktivna snov SOLATENOL™ počasi (dolgotrajno) prodira v rastlinsko tkivo, zagotavlja dolgotrajno delovanje na zaviranje razvoja bolezni in odpornost proti spiranju s padavinami. Aktivna snov SOLATENOL™ je varna za uporabo, tako v solo kot v kombinirani rabi z DMI in Qol fungicidi. SOLATENOL™ je izjemno močna, dosledna in popolna aktivna snov, ki predstavlja dobrodošlo dopolnitev v fungicidnih programih varstva žit. Ključne prednosti so

izjemno delovanje na *Septoria tritici* in rje.

ABSTRACT

ELATUS® Era - Syngenta's new fungicide for cereals protection

ELATUS® Era is a robust, persistent fungicide, supplying novel SDHI active ingredient SOLATENOL™ in co-formulation with prothioconazole. The combination ensures powerful disease control, consistent performance and complete leaf protection thanks to the complementarity of these two active ingredients. By protecting the inside and outside of the leaf, ELATUS® Era delivers enhanced green leaf area and proven yield benefits across different cereal crops, varieties, and disease situations. It provides long-lasting control, around 7-10 days additional control compared to current standards. The article focuses on a more detailed presentation of new active ingredient SOLATENOL™ which is a fourth-generation SDHI (succinate dehydrogenase enzyme inhibitor) from the 'pyrazole carboxamide' chemical group. SOLATENOL™ is the trademarked active ingredient (ISO name: benzovindiflupyr) from Syngenta. This innovative new chemistry brings a new mode of action fungicide that shows very high potency against a broad range of pathogens, including long-lasting control against major fungal diseases in cereals. SOLATENOL™ allows preservation of green leaf area, increase photosynthetic activity thanks to longer protection, which ultimately delivers higher yields and an excellent return on investment for the grower. SOLATENOL's™ high intrinsic activity combined with strong binding to the plant's wax layer from where it slowly penetrates into the plant tissue results in excellent duration of disease control and high rain fastness. SOLATENOL™ is safe to the crop when applied alone or when mixed with DMI or QoI fungicides. SOLATENOL™ fungicide is a welcome addition to cereals fungicide programmes. Its key strengths include activity on *Septoria tritici* and rusts.



Laboratorijsko preizkušanje egerolizinskih proteinov iz gliv rodu *Pleurotus* kot potencialnih biopesticidov

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Nedavno so odkrili, da se glivni egerolizinski proteini iz rodu *Pleurotus* vežejo z membranskim sfingolipidom, ceramid fosfoetanolaminom, ki je specifičen za membrane nevretenčarjev. Nadalje, genomi nekaterih gliv, ki proizvajajo egerolizine, vsebujejo tudi nukleotidne sekvence, ki kodirajo proteine z domeno proteinskega kompleksa, ki napadajo membrano (perforini; MACPF). MACPF proteini lahko v kombinaciji z egerolizini tvorijo transmembranske pore v umetnih in bioloških membranah, ki vsebujejo za egerolizin specifičen lipidni receptor. O bakterijskih egerolizinskih proteinskih kompleksih so že poročali, da delujejo kot selektivni insekticidi in so jih s pomočjo genetske transformacije že vnesli v rastline. Cilj naše raziskave je bil proučiti, če podobni egerolizinski kompleksi iz *Pleurotus* spp. delujejo kot biopesticidi. Tri rekombinantne egerolizine iz rodu *Pleurotus*, ostreolizin A6 (OlyA6), pleurotolizin A2 (PlyA2) in erilizin A (EryA) in partnerski MACPF-protein, pleurotolizin B (PlyB), smo izolirali in okarakterizirali. Preučevali smo insekticidne učinke omenjenih egerolizinov, samih ali v kombinaciji s PlyB,

na ličinkah koloradskega hrošča (*Leptinotarsa decemlineata*), ličinkah in odraslih osebkih koruznega hrošča (*Diabrotica v. virgifera*), odraslih osebkih plodove vinske mušice (*Drosophila suzukii*), ličinkah in hroščih mokařev (*Tenebrio molitor*), nimfah in odraslih osebkih velike řitne uši (*Sitobion avenae*) in gosenicah velike vošćene vešće (*Galleria mellonella*). Od vseh testiranih vrst řuželk so OlyA6/PlyB, PlyA2/PlyB in EryA/PlyB kompleksi pokazali toksićni vpliv le na koloradskega in koruznega hrošća. Prehranjevanje koloradskega hrošća na listnih diskih tretiranih s proteinsko mešanico je znaćilno povećalo smrtnost lićink in zniřalo njihovo prehranjevanje v 5-dnevem poskusu. Prehranjevanje koruznega hrošća na umetnem gojišću, ki je vseboval OlyA6/PlyB je znaćilno povećalo smrtnost lićink in hrošćev v 5- in 7-dnevem poskusu. Zmořnost egerolizinov iz roda gliv *Pleurotus*, da se tarćno veřejo na CPE in tvorijo transmembranske pore skupaj s PlyB, nakazuje njihovo potencialno uporabnost kot biopesticidi za zatiranje koloradskega in koruznega hrošća.

ABSTRACT

Laboratory evaluation of aegerolysin proteins from the fungal genus *Pleurotus* as potential bioinsecticides

Aegerolysin proteins from the fungal genus *Pleurotus* have recently been found to interact with ceramide phosphoethanolamine (CPE), a membrane sphingolipid specific to invertebrates. Additionally, the genomes of these fungi harbour nucleotide sequences that encode proteins with a membrane attack complex/perforin (MACPF) domain. When combined, aegerolysins and MACPF proteins can perforate artificial and biological membranes that contain the specific lipid receptor, by forming transmembrane pore complexes. Several bacterial aegerolysin protein complexes have been reported to have selective insecticidal properties, and have been successfully introduced into plants *via* genetic transformation. Accordingly, our aim was to investigate whether similar aegerolysin complexes deriving from *Pleurotus* spp. exhibit potential as biopesticides. Three recombinant *Pleurotus* aegerolysins, namely ostreolysin A6 (OlyA6), pleurotolysin A2 (PlyA2) and erylysin A (EryA), and their MACPF-protein partner pleurotolysin B (PlyB) were purified and characterized. The insecticidal properties of these aegerolysins, either alone or in combination with PlyB, were studied on Colorado potato beetle (CPB; *Leptinotarsa decemlineata*) larvae, Western corn rootworm (WCR; *Diabrotica v. virgifera*) larvae and beetles, spotted wing drosophila (*Drosophila suzukii*) flies, mealworms (*Tenebrio molitor*), grain aphid (*Sitobion avenae*) and greater wax moth (*Galleria mellonella*) caterpillars. OlyA6/ PlyB, PlyA2/ PlyB and EryA/ PlyB complexes have shown a selective toxic effect to CPB and WCR, but not to other tested insect pests. Exposure of CPB to leaf disks treated with protein mixtures significantly increased larval mortality and decreased larval feeding during the 5-day experiment. Exposure of WCR to artificial food containing OlyA6/ PlyB resulted in a significant increase of larval and beetles' mortality during the 5- and 7-day experiments. The ability of aegerolysins from the fungal genus *Pleurotus* to target CPE, and to form transmembrane pores with PlyB, suggest their potential use as biopesticides for controlling CPB and WCR.



Citrus bark cracking viroid (CBCVd) na hmelju: poti prenosa in izkušnje s preprečevanjem širjenja v Sloveniji

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Slovensko hmeljarstvo se od leta 2007 srečuje s pojavom nevarne bolezni imenovane »huda viroidna zakrnелost hmelja«, ki jo povzroča citrus bark cracking viroid (CBCVd). CBCVd je bil pred tem opisan kot gospodarsko nepomemben viroid na agrumih, zato so bile okužbe hmelja izven pridelovalnih območij agrumov povsem nepričakovane. CBCVd se podobno kot ostali viroidi večinoma širijo z mehanskim prenosom, na daljše razdalje pa z okuženim sadilnim materialom in ostanki rastlin. Predvidevamo, da je pojav CBCVd v Sloveniji posledica zelo redkega dogodka izpostavljenosti hmeljnih rastlin z ostanki okuženih plodov agrumov na območju odkritja primarnega žarišča. Po prenosu se je pokazalo, da hmelj predstavlja slabega gostitelja za CBCVd v biološkem smislu, saj okužene rastline hitro propadejo, še posebej tiste, ki so okužene tudi s hmeljevim latentnim viroidom (HLVd). Nasprotno pa z vidika širjenja hmelj kot kulturna rastlina predstavlja idealnega gostitelja, saj spada med zeljate trajnice z intenzivno agrotehniko pridelave, ki tekom vegetacije povzroča obilo mehanskih poškodb in s tem vstopnih mest za nastanek okužb. Tako lahko napredovanje CBCVd ob neukrepanju v hmeljiščih po 3 letih okužbe doseže več kot 40% rastlin. Ker so okužbe s CBCVd neozdravljive osnovno preprečevanje širjenja temelji na izvajanju eradikativnih fitosanitarnih ukrepov, pri čemur izkušnje s kmetij kažejo na različno uspešnost izvedbe. V prispevku predstavljamo rezultate raziskav poti prenosa in širjenja CBCVd v hmeljiščih, ki lahko predstavljajo nadaljnje usmeritve pri izvajanju ukrepov.

ABSTRACT

Citrus bark cracking viroid (CBCVd) on hop: transmission pathways and disease management experiences in Slovenia

Since 2007, Slovenian hop production has been faced with appearance of dangerous disease called »severe hop stunt disease«, caused by citrus bark cracking viroid (CBCVd). Before that CBCVd was described as economically not important viroid on citrus plants, therefore infections on hop and appearance outside of citrus production regions were totally unexpected. Like other viroids CBCVd spreads mainly mechanically, longer distance spreading is possible only by infected planting material and plant remains. It is assumed that the appearance of CBCVd in Slovenia is a consequence of rare transmission event in which hop plants were exposed to remains of infected citrus fruits in primary outbreak location. After the transmission it was realised that hop is not ideal host for CBCVd from biological sense of view since infected plants die relatively quickly, especially those co-infected with hop latent viroid (HLVd). In opposite view from the sense of cultivated plants, hop as green perennial presents ideal host for CBCVd due to the specific and intensive agro-technic techniques which causes frequent mechanical plant injuries. On this way CBCVd infections can reach more than 40% of plants in hop gardens in three successive years. Since the CBCVd infected plants are incurable basic management depends mainly on eradication phytosanitary measures, however experiences from farms show different level of success. In the presentation we presented results of transmission pathways studies which are important for upgrading directions and future disease management strategy.



Testiranje prosastih plevelnih trav glede tolerantnosti na nekatere herbicide

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V poljskem poskusu smo testirali učinkovitost aktivnih snovi tienkarbazon-metil, foramsulfuron, me-zotrion, S-metolaklor, dimetenamid-P in nikosulfuron za zatiranje prosastih trav. Herbicidi so bili naneseni na populacije rastlin, ki smo jih na poskusnem polju koruze ustvarili s setvijo semen, ki smo jih nabrali na različnih območjih Slovenije (Mursko polje, Dravsko in Ptujsko polje, Krško polje, Savinska in Vipavska dolina). Semena smo nabirali na njivah, kjer so bili neuspešni pri zatiranju. Preučevali smo naslednje vrste: *Panicum dichotomiflorum*, *P. capillare*, *P. miliaceum*, *Setaria faberi*, *S. glauca*, *S. viridis*, *Echinochloa crus-galii* in *Sorghum halepense*. Pri več populacijah smo ugotovili občutno znižanje učinkovitosti herbicidov na raven med 60 do 80 %, vendar o odpornosti preučevanih trav na preučevane herbicide ne moremo govoriti. Na več območjih Slovenije se kažejo znaki segregacije tolerantnih populacij. Ker so semenske banke preučevanih plevelov velike, kljub srednje visoki učinkovitosti herbicidov že prihaja do velikih izgub pridelkov koruze, še posebej v sušnih razmerah.

ABSTRACT

Testing Panicoid Grass Weeds for Herbicide Tolerance

In the field experiment, the efficacy of the active substances thien carbazone-methyl, foramsulfuron, mesotrione, S-metolachlor, dimethenamide-P and nicosulfuron for the control of panicoid grass weeds was tested. Herbicides were applied to the populations of plants that were in an experimental maize field established by sowing seeds collected in various regions of Slovenia (Mursko polje, Dravsko and Ptujsko polje, Krško polje, Savinska and Vipava valleys) and then planted in the mentioned field. We harvested grass seeds in the fields where farmers were unsuccessful in their suppression. We studied the following species: *Panicum dichotomiflorum*, *P. capillare*, *P. miliaceum*, *Setaria faberi*, *S. glauca*, *S. viridis*, *Echinochloa crus-galii* and *Sorghum halepense*. In several populations, a significant reduction in the effectiveness of herbicides was found. Efficacy fell to a level of 60 to 80%, but the resistance of the studied grasses to the herbicides tested cannot be proven. There are signs of segregation of tolerant populations in several regions of Slovenia. Since soil seed banks of the studied weeds are big, despite the medium-high efficacy of herbicides, massive losses of corn yields are encountered, especially in arid conditions.



Analiza učinkovitosti herbicidov za zatiranje srakoperca (*Apera spica-venti* (L.) P. Beauv.)

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V poljskem poskusu smo testirali učinkovitost pripravkov na podlagi kombinacij aktivnih snovi tienkarbazon-metil, iodosulfuron, mezosulfuron, pinoksaden, piroksulam, duflufenikan, klorotoluron in pendimetalin za zatiranje srakoperca v pšenici. Herbicidi so bili naneseni na populacije rastlin srakoperca, ki smo jih na poskusnem polju ustvarili s setvijo semen, ki smo jih nabrali na 20 območjih v severovzhodni in vzhodni Sloveniji. Semena smo nabirali na njivah, kjer so bili neuspešni pri zatiranju in se je razvilo nad 100 rastlin na m². Učinkovitosti herbicidov so se gibale od 50 do 95 %. Na večini lokacij in pri večini testiranih herbicidov je učinkovitost znašala med 75 in 90 %. Rezultati raziskave ne kažejo na odpornost srakoperca na herbicide. Ugotovljena je nekoliko znižana učinkovitost, ki v primeru velike gostote plevela, napak glede izbire termina za nanos herbicida in slabe aplikacijske tehnike povzroči veliko zapleveljenost s srakopercem (pogosto nad 150 rastlin na m²). Močno zapleveljene njive so pogosto rezultat uporabe herbicidov, ki niso učinkoviti in ne odpornosti na herbicide, ki imajo deklarirano učinkovitost na ta plevel. Razpoložljivi registrirani herbicidi nudijo dober nivo zatiranja (90-95 %), dokler semenske banke niso prevelike in ne naredimo napak pri nanosu.

ABSTRACT

Analysis of herbicide efficacy for the control of windgrass (*Apera spica-venti* (L.) P. Beauv.)

In a field experiment, the efficacy of herbicides for the control of the common windgrass in wheat crop based on combinations of active substances such as thien carbazole-methyl, iodosulfuron, mesosulfuron, pinoxaden, piroxulam, duflufenican, chlorotoluron and pendimethalin was tested. The herbicides were applied to the populations of windgrass plants that were established by planting seeds which had been collected in 20 locations in north-eastern and eastern Slovenia. We harvested seeds in fields, where farmers were not successful in suppressing windgrass, and where over 100 plants per m² were developed. The efficacy of herbicides ranged from 50 to 95%. In most of the tested windgrass populations, the efficacy of most of the tested herbicides ranged between 75 and 90%. The results of the study did not confirm the resistance of windgrass to herbicides. A somewhat reduced efficiency was found in our trial which can in case of high windgrass density, mistakes in the timing of application of herbicide and unsuitable application techniques, cause a significant increase in population of windgrass (often above 150 plants per m²). Highly infested fields are often a result of use of non-effective herbicides that are not registered for windgrass control and not due to resistance to herbicides that have a declared efficacy for the control of this weed. The available, registered herbicides enable a good level of control (90-95%) until the amount windgrass seed in the soil is not too large, and assuming that we apply the herbicide correctly.



Zatiranje divjega sirka (*Sorghum halepense* L.) v koruzi (*Zea mays* L.) na VVO1

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V letu 2018 smo preizkušali učinkovitost herbicidov in ožiganja plevelov za zatiranje divjega sirka (*Sorghum halepense* L.) v koruzi (*Zea mays* L.). Bločno zastavljen poskus, s sedmimi obravnavami, smo izvedli v treh ponovitvah, kjer smo preizkušali dva herbicida dovoljena na vodovarstvenih območjih (VVO1) in ožiganje plevela s plinskim ožigalcem. Uporabili smo: Equip (foramsulfuron), Monsoon active (foramsulfuron + tienkarbazon), ožig plevela samostojno 1-krat, Equip (foramsulfuron) + ožig plevela 1-krat, Monsoon active (foramsulfuron + tienkarbazon) + ožig plevela 1-krat in ožig plevela samostojno 2-krat. Poskus smo ocenili po enem, štirih in po osmih tednih po prvem škropljenju/ožiganju. Učinkovitost in fitotoksičnost posameznih obravnav smo ocenjevali z vizualno procentualno metodo. V prispevku bodo prikazani podatki o učinkovitosti posameznih obravnav za zatiranje divjega sirka. S herbicidi, katere imamo v Sloveniji registrirane za zatiranje divjega sirka v koruzi na VVO1, in z ožiganjem plevela, ni mogoče zagotoviti učinkovitega zatiranja divjega sirka. Pri nobenem herbicidu in uporabi plinskega ožigalca nismo opazili znakov fitotoksičnosti na rastlinah koruze.

ABSTRACT

Control of Johnson grass (*Sorghum halepense* L.) in maize (*Zea mays* L.) on water protection areas

In 2018, in a one-year experiment, we tested the efficiency herbicides and burning Johnson grass (*Sorghum halepense* L.) in maize (*Zea mays* L.). The experiment was set in a block, in three repetitions. In an experiment, in seven different treatments, we tested two herbicides permitted in water protection areas and burning weeds with a gas. Equip (foramsulfuron), Monsoon active (foramsulfuron + thien-carbazone), once solo burning the weed, Equip (foramsulfuron) + once burning the weed, Monsoon active (foramsulfuron + thien-carbazone) + once burning the weed and twice solo burning the weed were used. The experiment was evaluated after one, four and eight weeks after the first spraying/burning. The efficacy and phytotoxicity of individual treatments were assessed using a visually percentage method. Data on the efficacy of individual treatments for the control of Johnson grass are presented. With herbicides, which we have registered in Slovenia for control Johnson grass in maize on water protection areas and with burning weeds, it is not enough effective control of Johnson grass. Phytotoxicity on maize plants was not observed in any treatment.



Učinkovitost izbranih herbicidnih kombinacij pri dveh medvrstnih razdaljah v soji

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V letu 2018 smo v poljskem poskusu v Jabljah (osrednja Slovenija) preučevali biotično učinkovitost

herbicidnih kombinacij v posevku soje. Poskus smo zasnovali kot tro-faktorski bločni poskus z naključno razporeditvijo v štirih ponovitvah. Preučevani faktorji so bili sorta soje (ES Mentor, PR91M10), medvrstna razdalja (25 in 50 cm) ter način varstva pred pleveli (brez, kombinacija pred in po vzniku, aplikacija po vzniku). V poskusu smo uporabili herbicide Dual gold (1 l/ha, a.s. S-metalaklor), Pulsar (0,7 l/ha, a.s. imazamox) in Basagran 480(2 l/ha, a.s. bentazon). Za nanos smo uporabili nahrbtno škropilnico na stisnjen zrak, s porabo škropilne brozge 300 l/ha. Med vegetacijo smo izvedli dve ocenjevanji, kjer smo na podlagi neškropljenih kontrol ocenili biotično učinkovitost herbicidnih kombinacij na naravno plevelno vegetacijo. Učinek herbicidov na agronomske lastnosti in pridelke soje smo ocenili s primerjavo izbranih morfoloških deskriptorjev med obravnavanji in kontrolnimi (neškropljenimi) posevki. Rezultati kažejo, da je na plevelno floro značilno vplivala samo uporaba herbicida, razlike v pridelku soje med načinoma uporabe herbicida (pred ali po vzniku) nismo ugotovili. Največjo skupno učinkovitost (97%) je imela herbicidna kombinacija pred vznikom (a.s. S-metalaklor) in po vzniku (a.s. imazamox + bentazon) in je bila značilno večja kot pri uporabi herbicidov samo po vzniku (90%). Nekoliko večje učinkovitosti (oz. manj plevelne biomase) pri aplikaciji herbicidov po vzniku smo opazili pri sorti PR91M10, saj ima omenjena sorta zaradi boljše pokrovnosti tudi večjo tekmovalno sposobnost s pleveli kot ES Mentor. V okoljih s primerljivo plevelno vegetacijo bi lahko s kombinacijo a.s. imazamox in bentazon po vzniku soje zmanjšali potrebo po uporabi talnih herbicidov pred vznikom. Tudi v sistemih pridelave soje z večjo medvrstno razdaljo je kombinacija učinkovito zatrla večino naravne plevelne vegetacije. Ugotovili smo le nekoliko slabše delovanje na travne plevelne, kjer lahko omenjeno kombinacijo po potrebi dopolnimo z uporabo graminicida.

ABSTRACT

Efficacy of selected herbicide combinations in two row spacings on control of weeds in soybean

Biological efficacy of pre- and post-emergence herbicides and their combinations for weed control were evaluated in soybean. In 2018, a field trial in Jablje (central Slovenia) was conducted. Trial was arranged as a three factor randomised factorial block design in four repetitions. Factors studied were the soybean cultivar ('ES Mentor', 'PR91M10'), row spacing (25 and 50 cm) and the application of herbicides (without, a combination of pre- and post-emergence, only post-emergence). Pre-emergence herbicide Dual gold (1 l/ha, a.i. S-metolachlor), and post-emergence herbicides Pulsar (0.7 l/ha, a.i. imazamox) and Basagran 480(2 l/ha, a.i. bentazone) were used. Application of herbicides was performed using the knapsack sprayer powered by the compressed air with spray volume 300 l/ha. In the field experiment, herbicide efficacy and the effect of herbicides on weed flora, agronomic traits and yields of soybean were visual assessed twice in the growing season. Statistical analysis showed that the herbicide use was the only significant factor in terms of soybean yields and the level of weed control, when compared to untreated control. Highest level of weed control (97 %) was observed in the combination of the pre-emergence (a.i. S-metolachlor) and post-emergence (a.i. imazamox + bentazone) while the efficacy of only post-emergence herbicides was decreased to 90%. A slightly higher efficacy (less weed biomass) was observed with the 'PR91M10', suggesting that the variety is more competitive against weeds compared to cultivar 'ES Mentor'. Herbicide application significantly increased soybean yields, however no differences in yields between the combination of pre- and post-emergence and only post-emergence herbicide use were observed. In environments with similar weed vegetation, this combination could represent alternative to pre-emergence herbicide application also in the systems with soybean wide row spacing. The only weakness shown in the field trial is decreased efficacy on grass weeds, where additional herbicide for grass control should be applied if needed.

Varstvo gozdnega drevja

Zdravstveno stanje ozkolistnega jesena na Hrvaškem

Danko DIMINIĆ, Jelena KRANJEC ORLOVIĆ

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Gozdni ekosistemi z ozkolistnim jesenom (*Fraxinus angustifolia*) so med najpomembnejšimi na Hrvaškem z ekološkega in ekonomskega stališča. V Poročilu o poškodbah gozdnih ekosistemov Republike Hrvaške v letu 2017, ki ga izvaja ICP Forests (Hrvaški raziskovalni inštitut za gozdove), je bila poudarjena visoka poškodovanost ozkolistnega jesena. V raziskavi, ki je bila izvedena v letu 2017, je bilo ugotovljeno, da je ozkolistni jesen najobčutljivejša gozdna vrsta s 75% poškodovanostjo (defoliacijo) krošnje. V obdobju 2007-2013 je bila ugotovljena defoliacija krošnje 8-23 %, v obdobju 2014-2017 pa je defoliacija pokazala negativen trend z 49-75 % defoliacijo. Ta trend kaže na morebitno povezavo s pojavom nove bolezni jesena na Hrvaškem, ki jo povzroča gliva *Hymenoscyphus fraxineus* in z njeno prvo ugotovitvijo v letu 2011 na ozkolistnem jesenu. Nadaljnje raziskave in analize odmiranja jesenovih dreves so odkrile več vrst fitopatogenih gliv v prizadetih tkivih. Prevladujoče vrste v okuženih poganjkih in vejah so bile *Hymenoscyphus fraxineus*, *Hysterographium fraxini*, *Bionectria ochroleuca*, *Botryosphaeria stevensii* in *Fusarium* spp. Na koreninskem sistemu in dničjih dreves na lokacijah odmiranja ozkolistnega jesena je bila ugotovljena značilna raznovrstnost gliv. Najpogostejše vrste so bile *Hymenoscyphus fraxineus*, *Armillaria* spp., *Ganoderma adspersum*, *Trichoderma* spp., *Ilyonectria robusta*, *Absidia* sp., *Fusarium solani*, *Cladosporium cladosporioides*, *Diaporthe cotoneastri*, *Talaromyces ucrainicus* in *Coprinellus micaceus*. Prevladujoča povzročiteljica nekroz poganjkov in vej, lesnih tkiv debel in koreninskega sistema je bila gliva *Hymenoscyphus fraxineus*. Njena ugotovitev je omogočila sklep o pomembnem negativnem učinku patogena na ozkolistni jesen z ekološkega in ekonomskega stališča na Hrvaškem.

ABSTRACT

Health status of narrow-leaved ash in Croatia

Forest ecosystems of the narrow-leaved ash (*Fraxinus angustifolia*) are among the most significant ones in Croatia from the ecological and economic point of view. In the 2017 Report on the Damage of Forest Ecosystems of the Republic of Croatia by the ICP Forests (Croatian Forest Research Institute), it was emphasized that with regard to the narrow-leaved ash a high level of damage was reported. In the research conducted for 2017, the narrow-leaved ash was found to be the most sensitive forest species with crown defoliation of 75%. In the period 2007-2013 crown defoliation 8-23 % was recorded, while in the period 2014-2017 recorded crown defoliation 49-75 % revealed its negative trend. This trend suggests a possible correlation with the occurrence of a new disease of ash caused by the fungus *Hymenoscyphus fraxineus* in Croatia, and its first finding in 2011 on narrow-leaved ash. Up-to-day research and analyses of declining ash trees revealed several phytopathogenic fungi in affected tissues. The dominant species in the infected twigs and branches were *Hymenoscyphus fraxineus*, *Hysterographium fraxini*, *Bionectria ochroleuca*, *Botryosphaeria stevensii* and *Fusarium* spp. On the root system and base of the tree trunks in the declining stands of the narrow-leaved ash, an indicative fungal biodiversity was obtained. The most frequent species were *Hymenoscyphus fraxineus*, *Armillaria* spp., *Ganoderma adspersum*, *Trichoderma* spp., *Ilyonectria robusta*, *Absidia* sp., *Fusarium solani*, *Cladosporium cladosporioides*, *Diaporthe cotoneastri*, *Talaromyces ucrainicus* and *Coprinellus micaceus*. The most dominant as cause of dieback of twigs, branches, wood tissue of stems and root system was *Hymenoscyphus fraxineus*. Its findings lead to conclusion of significant negative effect of the pathogen on the narrow-leaved ash from the ecological and economic point of view in Croatia.



Kostanjev bakterijski skorjemor (*Pseudomonas syringae* pv. *aesculi*) in ukrepi v Sloveniji

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Kostanjev bakterijski skorjemor (*Pseudomonas syringae* pv. *aesculi*) je pri nas nova bolezen divjih kostanjev (*Aesculus* spp.). Značilno zanjo je odmiranje skorje debel in vej, izcejanje rjasto rjavega izcedka ter včasih oblikovanje rakavih ran, kar lahko povzroči hiranje drevesa in njegov propad. Prva znamenja bolezní so bila v Ljubljani ugotovljena že v letu 2014 na novo posajenih divjih kostanjih (*A. hippocastanum*), ki so bili prineseni iz severne in zahodne Evrope. Bakterije, izolirane iz odmirajoče skorje in izcedka, so imele značilno morfolologijo za bakterije iz rodu *Pseudomonas* in so fluoresciralne na gojišču King B. Na podlagi LOPAT testov smo jih uvrstili v skupino Ia. Delno nukleotidno zaporedje gena *gyrB* se je ujemalo z referenčnim izolatom *P. syringae* pv. *aesculi*. Patogenost izolatov smo potrdili z inokulacijo rastlin divjih kostanjev in reizolacijo bakterije iz bolezenskih znamenj, ki so se razvila. V severni in zahodni Evropi je kostanjev bakterijski skorjemor povzročil propadanje divjih kostanjev v urbanih predelih, ki dosega v nekaterih predelih že alarmanten obseg in ogroža uporabo te drevesne vrste za okrasne namene. V Sloveniji je divji kostanj postalo modno drevo konec 19. stoletja, številni ostanki teh zasaditev imajo pomemben mestotvoren pomen in so zavarovani kot spomeniki naravne dediščine ali kot posamična drevesa. Zato odmirajoča ali hirajoča stara drevesa pogosto nadomeščajo s sadikami iste drevesne vrste, ki pa pogosto izvirajo iz okuženih območij. Dosledno izvajanje ukrepov za preprečevanje širjenja bolezní je nujno za obstoj divjega kostanja kot urbane drevnine pri nas. Brez tega je in bo nadomeščanje okuženih dreves z isto drevesno vrsto neuspešno. V okviru projekta Euphresco 2018-C-285 bomo v naslednjih letih ugotavljali razširjenost te bolezní v Sloveniji, s pomenom nakupa zdravih rastlin seznanjali upravljavce parkovnih zasaditev in iskali rešitve.

ABSTRACT

Bleeding canker of horse chestnut (*Pseudomonas syringae* pv. *aesculi*) and its control in Slovenia

Bleeding canker of horse chestnut (*Pseudomonas syringae* pv. *aesculi*) is newly discovered disease of horse chestnuts (*Aesculus* spp.) in Slovenia. It's characteristics comprise dieback of bark on trunks and branches, oozing of rusty-red liquid from necrotic bark and occasionally canker wounds are formed. These damages can cause tree withering and death. The first symptoms of the disease were observed in Ljubljana in 2014 on newly planted horse chestnuts (*A. hippocastanum*), which originated from Northern and Western Europe. Bacterial cultures, isolated from necrotic bark and oozing liquid, had typical morphology for the genus *Pseudomonas* and were fluorescent on King's medium B. Based on LOPAT tests we classified them in group Ia. Partial sequences of the *gyrB* gene were identical to the reference sequence of *P. syringae* pv. *aesculi*. Pathogenicity of the isolates was confirmed by inoculation in horse chestnuts and re-isolation of the bacterium from the developed symptoms. In Northern and Western Europe, the bleeding canker of horse chestnut has caused the decline of horse chestnut trees in urban areas, which in some areas already has alarming proportions and threatens the use of this tree for decorative purposes. In Slovenia, horse chestnuts have become a fashionable tree at the end of the 19th century, and many of these trees have important urban significance and are protected as monuments of natural heritage or as single trees. Therefore, the dying and withering trees are often replaced by saplings of the same tree species, which are often infected due to supplies from countries where the disease is widespread. Consistent implementation of measures to prevent the spread of the disease is indispensable for the existence of horse chestnut as an urban tree in our country, and without this, replacing infected trees with the same tree species is and will be inappropriate. Within the framework of the Euphresco 2018-C-285 pro-

ject, we will investigate the distribution of this disease in Slovenia in the following years; we will inform park managers about the importance of purchasing healthy plants, and investigate possible solutions.



Ukrepanje ob najdbi karantenske glive v slovenskih gozdovih – primer doline reke Soče

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Slovenija je ena izmed najbolj gozdnatih držav v Evropi. Ekstremne vremenske razmere in globalizacija spreminjajo naše gozdove, kar se odraža tudi v pojavljanju številnih novih invazivnih tujerodnih vrst. Pripravljenost držav in njenih služb na morebitne izbruhe teh organizmov se kaže v proaktivni politiki, ki mora zaobjeti vrsto aktivnosti: nadzor na mejah, programi preiskav škodljivih organizmov, vzpostavljeni nacionalni in referenčni laboratoriji za izvajanja diagnostičnih analiz, podpora raziskavam, pripravljene komunikacijske strategije in načrti ukrepanja. Pojavi karantenskih gliv v gozdovih predstavljajo svojevrsten izziv, saj so sanacije izbruhov v gozdarstvu obsežne in težavne. Ukrepanje obsega posek, ustrezno ravnanje z materialom ter razkuževanje mehanizacije in opreme. Izvedbo ukrepov otežuje težavnost terena, še bolj pa administrativne prepreke. V Sloveniji smo leta 2016 poročali o najdbi karantenske glive *Lecanosticta acicola* (sin. *Scirrhia acicola*) v naravnih sestojih in nasadih črnega bora v dolini reke Soče. Poškodbe črnih borov so se v letih stopnjevale, opazamo tudi odmiranje odraslih dreves. Nedavne genetske analize so pokazale, da je na tem območju prisotna populacija glive, ki je geografsko še vedno omejena in domnevamo, da je virulentnost te populacije za črni bor večja v primerjavi z drugimi populacijami na območju Slovenije in Hrvaške. Predlagamo izvajanje ukrepov, ki bi upočasnili širjenje bolezni na druga območja ter izvajanje ozaveščanja tako strokovne kot širše javnosti.

ABSTRACT

Actions after finding a quarantine fungus in Slovene forests – case of Soča river valley

Slovenia is one of the most forested countries in Europe. Extreme weather events and globalisation are changing our forests, which is reflected also in outspread of numerous new invasive alien species. The willingness of countries and their administration to suppress possible outbreaks is reflected in a proactive policy that must encompass a range of activities: border control, pest survey programs, established national and reference laboratories for performing diagnostic analyses, support for research, prepared communication strategies and action plans. The emergence of a quarantine fungus in forests poses a unique challenge, since the suppression of the disease outbreak in forestry is extensive and difficult. The action involves cutting, proper handling of cut materials and disinfection of machinery and equipment. The implementation of measures is difficult because of demanding topography, and even more so, due to administrative barriers. In Slovenia, in 2016 we reported the finding of the quarantine fungus *Lecanosticta acicola* (sin. *Scirrhia acicola*) in natural stands and plantations of black pine in the Soča river valley. Damages to black pine have been increasing over the last years, and the death of adult trees has also been observed. Recent genetic analyses have shown that a population of the fungus, present in Soča river valley, is still present in a geographically limited area, and we suppose that the virulence of this population towards black pine is higher compared to other populations in the territory of Slovenia and Croatia. We propose the implementation of measures that would slow down the spread of the disease and the awareness rising campaign for the professional and general public.



Holandska brestova bolezen: trenutno stanje in napoved

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Holandska brestova bolezen (*Ophiostoma ulmi* in *O. novo-ulmi*) je v Sloveniji prisotna od 1929. Njeno trenutno stanje smo ocenili na podlagi sanitarnega poseka 1995–2017, ki ga beleži Zavod za gozdove Slovenije. Od 1995 do 2013 je bilo sanitarno posekanega bresta zaradi holandske brestove bolezn 51–59 % od vsega posekanega bresta. Trend sanitarnega poseka bresta se je prekinil med 2014 in 2016 zaradi katastrofalnega žledoloma v 2014. Najbolj poškodovana območja so v južnem delu Slovenije, kjer je bilo poškodovane 11–75 % lesne zaloge bresta v gozdnogospodarski enoti zaradi holandske brestove bolezn. Vendar v večini primerov je bilo povprečno sanitarno posekanih le do 2 % lesne zaloge bresta na leto. Napoved za stanje bresta se izboljšuje, ker se sanitarni posek bresta skozi leta počasi zmanjšuje in lesna zaloga bresta se je med 2007 in 2013 povečala in od takrat ostala na enaki ravni. Kaže, da se stanje bresta počasi izboljšuje. Vendar ga ogrožajo drugi škodljivi dejavniki (žled in neznani dejavniki). Beležimo kronično pomanjkanje raziskav za to zelo pomembno bolezen, ki ogroža breste – ekološko pomembne drevesne vrste.

ABSTRACT

Dutch elm disease: Current situation and prospects

From 1995 to 2013, between 51 and 59% of elms was sanitary felled due to Dutch elm disease (*Ophiostoma ulmi* in *O. novo-ulmi*). Trend of sanitary felling was disturbed between 2014 and 2016 because of the catastrophic ice damage that happened in 2014. The most damaged areas are in the southern part of Slovenia, where 11–75% of elms wood stock per forest management unit was damaged due to Dutch elm disease. However, in the most cases, only up to 2% of elm wood stock was sanitarily felled. The prospect for elms is becoming better over the years as sanitary felling due to Dutch elm disease is slightly lower, and the total wood stock of elms has risen from 2007 to 2013 and remained on that level since then. Therefore, we believe that elms are slowly recovering from Dutch elm disease. However, other damaging factors threaten elms (ice storm, unknown factors). Research is urgently needed to focus on this very important disease which threatens elms – ecologically important tree species.



Brestova rumenica in njen pomen v Sloveniji

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Bresti (*Ulmus glabra* Huds., *U. minor* Mill., *U. laevis* Pallas) so avtohtone drevesne vrste naših nižinskih in montanskih območij, kjer gradijo dobovo-jesenovo-brestove loge (npr. *Quercus robur*-*Ulmus laevis* in druge). Bresti povečujejo estetsko vrednost gozda in so cenjeni zaradi kvalitetnega lesa. Predstavljajo približno 0,1% lesne zaloge naših gozdov. V jugozahodni (Beka, Kastelec, Gabrovica, Podsabotin) in severni Sloveniji (Ruše) so leta 2016 odkrili simptome rumenenja listov *U. glabra* in *U. minor*, in jih leta 2017 povezali s prisotnostjo fitoplazme 'Candidatus Phytoplasma ulmi' (16SrV-A podskupina), ki povzroča brestove rumenice (Mehle in sod., Plant Disease 2017, 101(10): 1819). Novembra 2018 je bila potrjena tudi v osrednji Sloveniji (Bled) na *U. laevis*. 'Ca. P. ulmi' je uvrščena na EPPO A1 seznam in njeni vektorji so škržatki (*Macropsis glandacea*, *Philaenus spumarius*). Jakost posledic okužb se spreminja glede na vrsto in provenienco brestov. Evropski in azijski bresti in njihovi hibridi, pri katerih je pogosta latentna okužba, so manj dovzetni za 'Ca. P. ulmi' v primerjavi z ameriškimi vrstami brestov. Na evropskih brestih povzroča rumenenje in sušenje listov, zmanjšuje njihovo rast, izzove razvoj čarovniških metel v območju korenovca, na deblih in vejah. Nekateri avtorji navajajo, da lahko povzroči tudi propadanje brestov, vendar je splošna umrljivost evropskih brestov manjša v primerjavi z ameriškimi vrstami. Novi podatki nakazujejo, da je domorodna v Evropi (najdena v Italiji, Franciji, Nemčiji, Češki republiki, Srbiji in Hrvaški) in tu ne povzroča večjih poškodb brestov, čeprav je močno razširjena. Komercialni bomo pomen boleznin za Slovenijo.

ABSTRACT

Elm yellows and its importance in Slovenia

Elms (*Ulmus glabra* Huds., *U. minor* Mill., *U. laevis* Pallas) are indigenous tree species of our lowland and montane areas, where they build oak-ash-elms stands (e.g. *Quercus robur*-*Ulmus laevis* and other). They increase the aesthetic value of the forest and are known for its high-quality wood. They constitute about 0.1% of wood stock. In 2016, the symptoms of yellowing of the leaves of *U. glabra* and *U. minor* were detected in southwestern (Beka, Kastelec, Gabrovica, Podsabotin) and northern Slovenia (Ruše), and has been associated for the first time in Slovenia with 'Candidatus Phytoplasma ulmi' (16SrV-A subgroup) (Mehle et al., Plant Disease 2017, 101(10): 1819). In 2017 the presence of were confirmed. This phytoplasma was additionally confirmed in central Slovenia (Bled) in *U. laevis* in November 2018. 'Ca. P. ulmi' is an EPPO A1 listed organism and its vectors are leafhoppers (*Macropsis glandacea*, *Philaenus spumarius*). Severity and outcome of elm yellows disease can vary significantly according to elm provenance and species. European and Asian elms and their interspecific hybrids, in which symptomless infections often occur, are considered less susceptible to 'Ca. P. ulmi' infection compared to American elms. If present, symptoms on European elms are leaf yellowing and drying, reduced growth and stunting and development of witches' broom on trunks and branches. Even tree decline can occur in European elms, but overall tree mortality is lower when compared to American elms. New data suggest that it is indigenous in Europe (found in Italy, France, Germany, Czech Republic, Serbia and Croatia) and does not cause major damage, although it is widespread. Phytosanitary significance of the disease for Slovenia will be discussed.



Preliminarni rezultati vpliva treh skupin ekoloških dejavnikov na pojavnost javorovega raka (*Eutypella parasitica*) v Sloveniji

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Javorov rak povzroča gliva *Eutypella parasitica*, ki jo prepoznamo po značilnih, navadno pravilno eliptičnih, rakavih ranah in deformiranemu deblu. Okužuje vse vrste javorov (*Acer* spp.). Pri nas sta najpogostejše okužena gorski javor (*Acer pseudoplatanus*) in maklen (*Acer campestre*), bolezen pa se pojavlja tudi na ostrolistnem javoru (*Acer platanoides*) in ostalih vrstah javorov. Gliva okuži gostitelja skozi odmrle veje ali rane na deblu. Bolezen povzroča relativno veliko ekološko in ekonomsko škodo. Poškodovani del debla z rakavo rano je namreč tehnično razvrednoten. Navadno je okuženih 3–5 % javorov v sestoji, ponekod tudi do 50 %. S pomočjo posplošenega linearnega modela (ang. general linear model; GLM) smo preverjali vpliv izbranih sestojnih, klimatskih in talnih neodvisnih spremenljivk na pojav javorovega raka v Sloveniji. Uporabili smo podatkovno zbirko Gozdarskega inštituta Slovenije o potrjenih najdiščih javorovega raka. Z dvosmerno stopenjsko metodo (ang. stepwise) in na podlagi vrednosti Akaikejevega kriterija (ang. Akaike Information Criterion; AIC) smo izbrali model, ki se najbolje prilega našim podatkom. Preliminarni rezultati so pokazali, da verjetnost za pojav javorovega raka narašča z naraščanjem deleža javorov v lesni zalogi, zračne vlažnosti, povprečne višine snega, standardiziranega padavinskega indeksa (SPI), ekspozicije, pH, točke venenja in izmenjalne kapacitete tal. Verjetnost pojava javorovega raka se zmanjšuje z naraščanjem temperature zraka, količine padavin, nadmorske višine, vodne kapacitete tal, stopnje nasičenosti z bazami in razdalje do naslednjega osebka z javorovim rakom. Raziskovanje vpliva ekoloških spremenljivk na pojavnost javorovega raka nam zagotavlja številne uporabne informacije za razumevanje ekologije *E. parasitica*. Razumevanje te pa nam lahko pomaga pri določitvi prednostnih območij za iskanje novih primerov in ukrepanju v primeru potrjenih okužb.

ABSTRACT

Preliminary results of influence of the three groups of ecological factors on the occurrence of Eutypella canker of maple (*Eutypella parasitica*) in Slovenia

Eutypella canker of maple is caused by the fungus *Eutypella parasitica*, which is recognized by typical elliptical, cankerous wounds and deformed trunks. It infects all species of maples (*Acer* spp.). In Slovenia sycamore maple (*Acer pseudoplatanus*) and field maple (*Acer campestre*) are the most commonly infected, but the disease also occurs on the Norway maple (*Acer platanoides*) and other species of maple trees. Fungus infects the host through dead branches or wounds on the trunk. The disease causes relatively high ecological and economic damage. The injured part of the trunk with a canker is technically devalued. Usually 3–5 % of the maples are infected in the stand, in some cases up to 50 %. Using the general linear model (GLM), we examined the influence of the selected stand, climatic and edaphic independent variables on the occurrence of Eutypella canker of maple in Slovenia. We used a database of the Slovenian Forestry Institute on confirmed sites of Eutypella canker of maple. Using the both direction stepwise method and the Akaike Information Criterion (AIC) value, we have chosen a model that best fits the data. Preliminary results have shown that the likelihood of Eutypella canker of maple increases with the increase in the proportion of maple trees in the wood stock, air humidity, average snow height, stan-

standardized precipitation index (SPI), exposition, pH, wilting point and cation exchange capacity. The likelihood of Eutypella canker of maple is decreasing with the increase in air temperature, precipitations, elevation, field water capacity, base saturation and distance to the next specimen with Eutypella canker. Researching the impact of ecological variables on the emergence of Eutypella canker of maple provides us several useful information to understand the ecology of *E. parasitica*. Understanding this can help us identify priority areas for finding new cankers and taking appropriate measures in the case of confirmed infections.



Problemi z jesenovim ožigom (*Hymenoscyphus fraxineus*) in jelševo sušico (*Phytophthora alni*) v severovzhodnem delu Slovenije

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Jesenov ožig smo ugotovili leta 2006 in sicer najprej v severovzhodnem delu Slovenije. Gozdarji v Prekmurju smo opazili, da mladje velikega jesena (*Fraxinus excelsior*) in ozkolistnega jesena (*Fraxinus angustifolia*) naglo propada, posameznim odraslim drevesom pa so odmirale veje. Spomladi 2007 je sušenje mladja in odmiranje delov krošenj starejših dreves zajelo celotni vzhodni del Slovenije. Ob koncu poletja 2007 je bilo odmiranje jesena opazno v vsej državi. Posek se je zaradi jesenovega ožiga na Območni enoti Murska Sobota od leta 2013 do danes povečal za 5 krat. V letu 2017 je 35 % sanitarnega poseka oz. dobrih 13 % celotnega letnega poseka odpadlo na račun odmiranja jesena. Če jesen ne bo razvil odpornosti na glivo, lahko pričakujemo močno zmanjšanje deleža jesena v gozdu, na nekaterih predelih pa lahko jesen celo izgine. Jelševa sušica je v Sloveniji na novo odkrita bolezen na jelši. V letu 2002 je bila opažena in determinirana in v letu 2016 je bilo odmiranje jelše že obsežno. Bolezen povzroča glivolika alga *Phytophthora alni*. Jelševa sušica povzroči več škode na jelšah, ki so pod vplivom poplav, saj se na poplavljenem območju zmanjša prenos vode, dušika in drugih hranil iz korenin (onemogočena je rast korenin). Odmirajo kambij in vsa živa tkiva skorje in lesa v deblu in koreninah. Prvotno so na osnovi morfolologije in izocimskih testov *P. alni* razvrstili v tri podvrste, ki pa so na osnovi DNA analiz nedavno reklasificirane v tri nove vrste. V Sloveniji smo do sedaj nedvoumno potrdili prisotnost dveh vrst, in sicer *P. uniformis* in *P. ×multiformis*. Ko opazimo, da je jelša okužena z jelševo sušico, poškodovano drevo takoj posekamo. Obnova posekanega sestoja je mogoča le s sadnjo sadik gozdnega drevja, ker zaradi bujne pritalne vegetacije oz. zeliščnega sloja naravna obnova ni mogoča. V novo osnovanih sestojih se razvoj usmerja v sestoj črne jelše s primesjo vrbe, doba in črnega topola.

ABSTRACT

Problems with ash dieback (*Hymenoscyphus fraxineus*) and alder dieback (*Phytophthora alni*) in Northeast Slovenia

The first record of ash dieback caused by *Hymenoscyphus fraxineus* was found in Northeast Slovenia in 2006. Foresters in Prekmurje noticed that the *Fraxinus excelsior* and *F. angustifolia* seedlings and branches of individual old trees were dying away. In the spring of 2017 those symptoms were observed in the whole eastern part of Slovenia. At the end of summer 2017, ash dieback was observed already in the whole country. Felling ash has risen for five times in Murska Sobota forest management region since

2013. In 2017, 35 % of sanitary felling or 13 % of a whole annual felling was due to ash dieback. If ash does not develop resistance towards ash dieback, we can expect heavy drop in the share of ash in the forest and it may also disappear in some areas. The first record of *Phytophthora alni* was confirmed in Slovenia in 2002. In 2016 alder dieback due to *P. alni* was already extensive. *P. alni* causes more damage on alders due to floods, because transmission of water, nitrogen and other nutrients from roots is limited and the growth of the roots is not possible. Cambium and all live tissues of bark and wood in the trunk and roots die off. Originally, researchers had determined three subspecies of *P. alni* based on morphological and exoenzymatic tests. However, later those three subspecies were reclassified into three species based on DNA tests. We have unambiguously identified two species in Slovenia: *P. uniformis* and *P. ×multiformis*. When we notice a symptomatic alder, the damaged tree is immediately sanitary felled. Regeneration of felled forest stand is exclusively artificial or with planting because of dense ground vegetation rejuvenation of the stand is not possible. The new formation of stand is expected to have slightly more mixed tree species composition; however, emphasis would still be on alder, to which we would add *Salix* spp., *Quercus robur* and *Populus nigra*.



Zgodovina upravljanja z gozdovi je pomemben dejavnik pri izbruhih podlubnikov: lekcije za prihodnost

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Gozdovi so bili v zadnjih stoletjih močno spremenjeni; zgodovinske prakse upravljanja pa bi lahko močno vplivale na današnje stanje gozdov. Preverili smo, ali zgodovinsko načrtovanje upravljanja z gozdovi in aktivno gospodarjenje z navadno smreko vpliva na potencial izbruha lubadarjev po velikih motnjah. Poleg tega smo preverili vpliv deleža smreke v razmerah ob izbruhu in na različnih nadmorskih višinah. Zaznali smo močno povezavo med spreminjanjem naravne gozdne sestave, deležem smreke in sanitarno sečnjo zaradi podlubnikov. Zaznali smo negativen povezavo nadmorske višine in pozitiven vpliv deleža navadne smreke na sanitarno sečnjo. Skupaj z obdobjem izbruha je bila sanitarna sečnja večja na nižjih nadmorskih višinah, na območjih z višjim deležem navadne smreke in v obdobju po abiotskem stresu. Dodatno je bila zaznana negativna povezava med deležem realizirane glede na načrtovano sečnjo ter sanitarno sečnjo v obdobjih po abiotskem stresu.

ABSTRACT

Forest management history is an important factor for bark beetle outbreaks: lessons for the future

Forests were changed strongly in the last centuries; however historical management practices could have strong effect on nowadays status of the forests. We tested whether the forest management history and forest tending with Norway spruce is affecting the potential the outbreak of bark beetles after large disturbances. Furthermore, the effect of percentage of spruce under outbreak situations and different altitudes were checked. There was a strong association with the change of the naturalness of the forest composition and the percentage of Norway and sanitary felling because of spruce bark beetles. There was a negative influence of altitude and a positive influence of percentage of Norway spruce on the sanitary

felling. Together with the outbreak period, the sanitary felling was amplified in lower altitude, in areas with higher percentage of Norway spruce and in periods after abiotic stress. In addition, there was a negative association between the percentage of realized cut in the planned cut and the sanitary felling in periods after abiotic stress.



Namnožitve podlubnikov na Kočevskem

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V prispevku predstavljamo vpliv naravnih ujm na stanje podlubnikov v gozdnogospodarski enoti Kočevje v zadnjih desetletjih. Na Kočevskem do leta 1985 ni bilo večjih naravnih ujm. Decembra je to leto območje prizadel žledolom. Naslednje leto so sanirali poškodovano drevje v količini za celotni letni posek. Podlubniki se niso prenamnožili. V začetku devetdesetih let so bila prva sušna leta. 1993/94 je bila namnožitev jelovih podlubnikov. Od leta 2000 do 2003 so bila zelo sušna leta. Leta 2002 so se namnožili jelovi podlubniki, naslednje leto pa smrekovi podlubniki. Gradacija slednjih je trajala do konca desetletja. V letu 2014 je zahodni del območja prizadel žledolom od Kolpske doline do Loškega potoka in polomil vrhove smrekovih drogovnjakov po Kočevski in Kočevsko Reški dolini. Naslednje leto so se podlubniki močno namnožili v zgornjem delu Kolpske doline na levem in desnem bregu rek Čabranke in Kolpe. Hitrost in kvaliteta sanacije je potekala zelo različno, večinoma žal prepozno. Vzrokov za to je veliko, predvsem pa so povezani z zasebnim lastništvom gozdov, pomanjkljivimi gozdnimi prometnicami in gozdarsko zakonodajo, ki ne dovoljuje potrebnih sprememb procesov v izrednih razmerah. V Kočevsko Reški dolini je bila samo delno opravljena sanacija polomljenih vrhov smrek (gozdna higiena), zato so se v naslednjih letih namnožili predvsem osmerozobi smrekovi lubadarji (*Ips typographus*). V letih 2016 in 2017 so se tam pojavila velika žarišča podlubnikov. Konec leta 2017 je vetrolom na Kočevskem območju porušil več kot milijon m³ drevja, predvsem smreko in jelko. V letu 2018 še ni bilo večjih žarišč. Sanacija lubadark se je izvajala ob poseku vetroloma. Lubadarji so zasedali predvsem od vetra porušene smreke v okolici nekdanjih žarišč.

ABSTRACT

Bark beetles outbreaks in Kočevska Region

We present the influence of natural disasters on the populations of bark beetles in the last decades in the Kočevje forest management unit. Until 1985 there had been no major natural disasters in the Kočevje region. In December 1985 the area was hit by an ice storm. The following year, the damaged trees were harvested in quantities of a total normal annual harvest. Bark beetles were not in gradation. In the early nineties, the first drought years appeared. In 1993/94 we were confronted with gradation of fir bark beetles. From 2000 to 2003 there were very dry years. In 2002, fir bark beetles multiplied, and the next year spruce bark beetles were in gradation. The gradation of the latter lasted till 2010. In 2014, the western part of the Kočevska region was hit by an ice storm in the area from the Kolpa Valley to the Loški Potok. This strong ice storm resulted in fallen trees and broken crowns along the Kočevska valley and the Kočevska Reka valley. The following year, the bark beetles greatly spread in the upper part of the Kolpa valley on the banks of the rivers Čabranka and Kolpa. The speed and quality of the harvesting of attacked trees proceeded, was not everywhere the same, because of private forest ownership, deficient

forest road network and forestry legislation, which does not allow for necessary changes in processes in emergency situations. In the Kočevje Reka valley the outbreak of the bark beetles, mainly European spruce bark beetles (*Ips typographus*), was multiplied in the years 2016 and 2017 for the same reason. Large bark beetle infestation spots appeared there. At the end of 2017, over one million cubic metres of trees, mainly spruce and fir trees, were thrown by wind in the Kočevje region. In 2018, there was no gradation of bark beetles. The harvesting of attacked trees and damaged ones was carried on at the same time. Bark beetles attacked mainly the trees felled by wind in the surrounding of bark beetle infestation spots from the previous years.



Najdba nove vrste podlubnika v Sloveniji

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Leta 2017 je bila v Sloveniji najdena nova vrsta podlubnika, t.j. azijski ambrozijski podlubnik, *Xylosandrus crassiusculus* (Motschulsky) (Coleoptera: Curculionidae, Scolytinae). Vrsta izvira iz JV Azije, s pomočjo človeka pa se je razširila po celem svetu in je danes ena najbolj razširjenih vrst podlubnikov. Azijski ambrozijski podlubnik je ekstremen polifag. Njegovi gostitelji so lesnate rastline več kot 120 vrst listavcev. *X. crassiusculus* se pojavlja v drevesnicah, v nasadih, v urbanih območjih in v naravnih habitatih. *X. crassiusculus* ponekod po svetu povzroča znatne ekonomske izgube, zato predstavlja pomembnega gospodarskega škodljivca. Ker predstavlja tveganje za zdravje rastlin po celem svetu, ga je Evropska in mediteranska organizacija za varstvo rastlin (EPPO – European and Mediterranean Plant Protection Organisation) leta 2009 uvrstila na Opozorilni seznam (EPPO Alert List) kot vrsto, ki potencialno predstavlja tveganje za zdravje rastlin na območju EPPO. V Sloveniji smo leta 2016 začeli z izvajanjem programa preiskav za *X. crassiusculus*, katerega cilj je zgodnje odkrivanje te vrste na območju Slovenije, hitro obveščanje o pojavu in hitro ukrepanje z namenom preprečevanja škodljivih vplivov, ki bi jih vrsta potencialno lahko imela na tem območju. V Evropi je bil *X. crassiusculus* prvič najden leta 2003 v Italiji, kasneje pa še v Franciji in v Španiji ter nazadnje v Sloveniji. Najdbi nove vrste podlubnika v Sloveniji leta 2017 je sledilo intenzivno spremljanje navzočnosti te vrste na celotnem ozemlju Slovenije. Najdbe v gozdovih v Z delu države kažejo, da je vrsta v Sloveniji najverjetneje že prisotna v naravnih habitatih. Analiza tveganja, ki je bila izdelana za *X. crassiusculus* za območje Slovenije kaže, da ima vrsta pri nas ugodne pogoje za ustalitev in širjenje. Ker se hrošči najverjetneje v Slovenijo širijo po naravni poti iz SV Italije, fitosanitarni ukrepi za preprečevanje vnosa in širjenja vrste niso bili predlagani. V prispevku je predstavljena prva najdba *X. crassiusculus* v Sloveniji, skupaj z rezultati spremljanja te vrste pri nas v prvem letu po najdbi.

ABSTRACT

Finding of a new bark beetle species in Slovenia

In 2017, a new bark beetle species was found in Slovenia, namely the Asian ambrosia beetle, *Xylosandrus crassiusculus* (Motschulsky) (Coleoptera: Curculionidae, Scolytinae). *X. crassiusculus* originates in SE Asia. Due to human-assisted spread the beetle is now present all over the world. In fact, it is one of the most widespread bark beetle species. The Asian ambrosia beetle is extremely polyphagous, being able to attack more than 120 species of broadleaved woody plants. It is common in nurseries, plantations, urban areas and in various natural habitats. Due to significant economic losses that it causes in some parts

of its non-native range, this bark beetle represents a serious pest. Because it poses serious risk to plant health worldwide, the European and Mediterranean Plant Protection Organisation (EPPO) included *X. crassiusculus* in the EPPO Alert List of invasive alien species potentially harmful for plant health in the EPPO region. Slovenia has been conducting yearly survey programmes for *X. crassiusculus* since 2016. These are intended for early detection of this pest, early warning of the occurrence and rapid response to prevent damage that the beetle might cause. The Asian ambrosia beetle was first found in Europe in 2003 in Italy, where it has established. Later, reports of the species's occurrence came from France and Spain. In 2017, the Asian ambrosia beetle was recorded in the W part of Slovenia. An intensive monitoring that followed suggests that the new bark beetle already occurs in natural habitats in Slovenia. According to the pest risk analysis that has been carried out, environmental conditions in Slovenia favour the establishment and spread of *X. crassiusculus* in this territory. Since the beetle is presumably spreading to Slovenia naturally from Italy, no phytosanitary measures to prevent introduction and spread of the species have been proposed. First finding of *X. crassiusculus* in Slovenia is presented, together with the results of the monitoring in the first year after it was first found.



Razširjenost tujerodnega ambrozijskega podlubnika *Xylosandrus germanus* (Blandford, 1894) v Sloveniji in njegov vpliv na gozdne ekosisteme

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Ambrozijske podlubnike (Coleoptera: Curculionidae, Scolytinae) uvrščamo med najpomembnejše tujerodne invazivne organizme. Dober primer je vrsta *Xylosandrus germanus* (Blandford, 1894), ki sicer izvira iz Vzhodne Azije, danes pa je razširjena tudi v večjem delu Severne Amerike in Evrope. V Sloveniji je bila vrsta prvič najdena leta 2000 na pravem kostanju (*Castanea sativa* Mill.) v bližini Solkana. Od leta 2008 naprej smo vrsto večkrat našli tudi v drugih predelih Slovenije, največkrat smo hrošče ujeli v pasti, namenjene spremljanju hroščev iz rodu *Monochamus* spp., zabeležili pa smo tudi nekaj primerov napadenih dreves. Prvo večjo škodo smo zabeležili leta 2016, ko je vrsta napadla večje količine sveže posekanega lesa pri Lovrencu na Pohorju. V letu 2017 smo ugotavljali prisotnost vrste s pastmi z etanolom v širši okolici Ljubljane. Ugotovili smo, da je vrsta splošno prisotna v različnih gozdnih sestojih, znakov napada na drevju pa nismo odkrili. V prispevku bomo natančneje predstavili rezultate spremljanja vrste in razpravljali o možnih vplivih, ki bi jih ta vrsta lahko imela na naše gozdne ekosisteme.

ABSTRACT

Distribution of non-native ambrosia bark beetle *Xylosandrus germanus* (Blandford, 1894) in Slovenia and its impact on forest ecosystems

Ambrosia bark beetles (Coleoptera: Curculionidae; Scolytinae) are one of the most important non-native invasive organisms. A good example is species *Xylosandrus germanus* (Blandford, 1894), an East Asian species, which is now widely spread in much of North America and Europe. In Slovenia, *X. germanus* was first time recorded in 2000. It was found on infested sweet chestnut tree (*Castanea sativa* Mill.) near Solkan. Since 2008, the species began to appear also in other parts of Slovenia. It was often caught in traps intended for monitoring of *Monochamus* beetles, and in few cases, infestations of trees were also found. The first major damage was recorded in 2016 when the species attacked larger quantities of freshly

harvested timber at Lovrenc na Pohorju. In the wider area of Ljubljana, monitoring of the species with ethanol-baited traps was conducted in 2017. We have found that the species is generally present in different forest stands, but we have not detected any attacked trees. In the article we will present more detailed results of the monitoring and discuss the impact that this species could have on our forest ecosystems.



Invazivne rastlinske vrste in poskusi njihovega zatiranja v gozdovih v Gozdnogospodarskem območju Maribor

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V gozdovih Gozdnogospodarskega območja Maribor se je že v šestdesetih letih prejšnjega stoletja začelo načrtno gospodariti s tujerodnimi drevesnimi vrstami. Najpogosteje so vnašali duglazijo, zeleni bor, sudetski in japonski macesen, črni bor, rdeči hrast, črni oreh in navadno robinijo. V nekaterih primerih so te vrste postale dominantne in celo invazivne (predvsem navadna robinija in rdeči hrast). Pri gospodarjenju z njimi je potrebno izpostaviti koristi in probleme, ki jih te vrste prinašajo. Tujerodne invazivne rastlinske vrste (TIV) so se v gozdovih v večji meri razširile po žledu leta 2014. V zadnjih letih se v gozdovih na večjih posekah, ki so nastale kot posledica ujm, žarišč lubadarja in tudi rednih pomladitvenih sečenj, vse bolj uveljavljajo. Velikemu vdoru TIV so izpostavljeni še gozdni robovi in gozdovi ob vodotokih. Metode za zatiranje TIV ter njihova učinkovitost so odvisne od vrste rastline, obsega razširjenosti ter stroškov zatiranja. Načine zatiranja je potrebno graditi na primerih dobre prakse. Z ukrepi omejevanja in odstranjevanja lahko njihovo populacijo bistveno zmanjšamo. Zelo pomembno je hitro ukrepanje, ko je osebkov malo oziroma so mlajši. Pri invazivnih tujerodnih drevesnih vrstah poskušamo gozdarji z gozdnogojitvenimi ukrepi zmanjšati njihov delež ter preprečiti širjenje teh vrst na nove površine. V mlajših fazah gozda to počnemo predvsem z negovalnimi deli in redčenji, pri obnovi gozdov pa s predhodnim posekom invazivnih drevesnih vrst in uravnavanjem svetlobe. Največji gozdnogojitveni problem v našem območju trenutno predstavlja oteženo pomlajevanje gozdov zaradi velike pokrovnosti navadne barvilnice, delno tudi pavlovnije in žlezave nedotike. Zaradi velike številčnosti teh vrst v gozdovih je zatiranje s puljenjem predrago. Zadnja leta poskušamo v mladih fazah gozda te vrste zatirati z obžetvijo dvakrat letno. S tem ukrepom želimo pomagati naravnim vrstam, da čim prej ustvarijo strnjen sestoj, saj je znano, da so invazivne vrste v pogojih zasenčenosti manj konkurenčne. Kako uspešni bomo pri tem, bo pokazal čas.

ABSTRACT

Invasive plant species and their suppression in the Maribor forest management region

As far back as in the sixties of the previous century we began systematic planting of alien tree species in the Maribor forest management region. Among them the most popular were Douglas Fir, White Pine, Sudetian and Japanese Larch, Austrian Pine, Red Oak, Eastern Black Walnut and Black Locust. In some cases, some of them became dominant and even invasive (predominantly the Black Locust and the Red Oak). When managing the alien tree species, it is necessary to highlight the benefits and problems that these species are bringing. After the ice storm in 2014, the invasive alien species (IAS) have expanded primarily in forests. In recent years, IAS have become more and more conspicuous in the forest clearings, which were caused as a result of natural disasters, bark beetle hot spots and regular cuts. Additionally,

the forest edges and the forests along the watercourses are also exposed to great intrusion of IAS. The methods of suppressing IAS and their effectiveness depend on the type of plant, extent of distribution and costs of suppression measures. They should be based on examples of good practice. By reducing and removing measures we can greatly reduce their number. It is important to act quickly while they are still rare or while they are still young. In the case of invasive alien tree species, we try with silvicultural measures to reduce their lot in the forest and therefore prevent them spreading to new areas. We do this by thinning in the early stages of forest stands and by removing invasive tree species and regulating light. At present, the main silvicultural problem in our area presents difficulties with the regeneration of forests due to large coverage of American Pokeweed, partly due to Princess Tree and Himalayan balsam. Because they are wide spread, suppression of these species by pulling them out is too expensive. In the past few years, we have tried to suppress them in the early stages of forests by harvesting twice a year. With this treatment, we want to help the native species to reach higher density as soon as possible, because it is known that invasive species are less competitive in conditions of shading. In the years to come it will become evident how successful we have been.

Varstvo sadnega drevja in oljk

Propadanje lesk (*Corylus avellana*) v Sloveniji zaradi okužbe s fitoplazmami

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S 118 ha leska (*Corylus avellana*) zavzema sedmo mesto med sadnimi vrstami in predstavlja 2,9% površine intenzivnih sadovnjakov v Sloveniji. V dveh nasadih v vzhodni Sloveniji, ki skupaj pokrivata 5 ha s približno 1.600 grmov, zasajenih pred 12 do 15 leti, so leta 2012 opazili propadanje posameznih grmov. Do oktobra 2018 je skupno propadlo 5-8% lesk, pri 14-17% grmov pa smo opazili propadajoče posamezne veje ali neobičajne metlaste izrastke iz vej. Propadli in simptomatični grmi so bili razpršeni po celotnem nasadu brez očitnega vzorca. Med sortami posajenimi v teh dveh nasadih je bila najbolj pogosto prizadeta Istrska dolgoplodna leska. Z molekularnimi analizami smo v propadajočih grmih dokazali okužbo s tremi različnimi vrstami fitoplazem. Prisotnost fitoplazem je bila v letu 2018 nato potrjena tudi v propadajočih leskah vzorčenih v drugem nasadu v vzhodni Sloveniji, ter v vzorcih iz osrednje, jugo-vzhodne in zahodne Slovenije. V prispevku bomo predstavili rezultate raziskav in odprta vprašanja glede te pereče problematike.

ABSTRACT

Declining of *Corylus avellana* (hazelnut) in Slovenia due to infection with phytoplasmas

With 118 ha, hazelnut (*Corylus avellana*) occupies the 7th place among fruit species and represents 2.9% of the area of intensive fruit orchards in Slovenia. In two plantations located in eastern Slovenia that together cover 5 ha with around 1,600 trees planted 12 to 15 years ago, decline of some of the trees appeared in 2012. By October 2018, up to 5-8% of these trees had died, and an additional 14-17% of trees showed symptoms. These symptoms included dead branches and unusual proliferation of thin twigs from the branches ('witches broom' symptoms). The dead and symptomatic trees were scattered throughout the plantations, with no apparent pattern. Among the cultivars in these plantations, the most affected was 'Istrska dolgoplodna leska'. Using molecular diagnostic methods, we have proven an infection of symptomatic trees with three different types of phytoplasmas. In 2018, the presence of phytoplasmas were confirmed also in declining hazelnut trees sampled in other plantation in eastern Slovenia, and in samples from central, southeastern and western Slovenia. The results of recent study and open questions regarding this burning issue will be presented.



Izkušnje spremljanja sezonske dinamike leta orehove muhe (*Rhagoletis completa*) z rumeni lepljivimi ploščami

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Orehova muha (*Rhagoletis completa*) se je v zadnjem desetletju razširila po vsej Sloveniji in povzroča pridelovalcem orehov veliko gospodarsko škodo. Za uspešno obvladovanje in zatiranje orehove muhe je zelo pomembno spremljanje prisotnosti in številčnosti populacije, z namenom pridobitve informacije o sezonski dinamiki leta, kar je osnova za določanje optimalnih rokov zatiranja. Spremljanja smo izvajali s pomočjo rumenih lepljivih plošč (RLP) z dodanim atraktantom, proizvajalca Rebell in Trece. V letu 2017 smo v okviru Opazovalno napovedovalne službe Slovenije na območju Celjske in Koroške regije, na treh lokacijah (Dramlje, Buče, Ruše), spremljali vpliv različne višine RLP na prisotnost in številčnost populacije orehove muhe. V vsak nasad orehov smo izobesili 2 RLP proizvajalca Rebell, na dveh različnih višinah (2 in 6 metrov). V letu 2018 smo na lokaciji Dramlje nadaljevali s spremljanjem; na lokaciji Buče pa smo orehovo muho spremljali z RLP ploščami proizvajalca Trece na obeh višinah. V prispevku bodo predstavljeni rezultati spremljanja, ki nakazujejo, da različna višina postavitve RLP ne vpliva na dinamiko leta orehove muhe, temveč vpliva na velikost populacije, ki je številčno večja na višini 6 metrov. V letu 2017 smo na vseh treh lokacijah posredno ugotavljati še razliko med uporabo dveh različnih tipov vab, proizvajalca Rebell in Trece, na višini 2 metrov, kjer prav tako nismo zabeležili razlik v dinamiki leta orehove muhe.

ABSTRACT

Experience with monitoring the seasonal dynamics of the walnut husk fly (*Rhagoletis completa*) flight using yellow sticky traps

Walnut husk fly, *Rhagoletis completa*, has spread all over Slovenia in the last decade. It causes great economic damage to producers of walnuts. Monitoring the occurrence and frequency walnut husk fly is very important for successful forecasting and control. This is the basis for a set of optimum periods of control with plant protection products. Monitoring the occurrence of walnut husk fly is done using yellow sticky traps with lure by different producers, Rebell or Trece. In 2017, the occurrence of walnut husk fly, the framework of the Observational Forecasting Service of Slovenia, in the area of the Celje and Koroška regions, in three locations (Dramlje, Buče, Ruše) was investigated. We determined the influence of the height of the trap placement on the number of pest catch. In each orchard, we set up two traps Rebell, on two different height, 2 and 6 m. In 2018, we continued monitoring at the location Dramlje. In the same year, at the other location (Buče) we were monitoring catches at both heights of the Trece producer. The results of the monitoring indicate that the different height of the trap has no effect on the monitoring of the seasonal dynamics flight but it has effect on size of population. The number of catches was bigger at the height of six meters. In 2017, on all three locations, we indirectly determined the difference between two types of traps (Rebell and Trece), on two meters height; we did not record the difference flight dynamics of walnut husk fly.



Marmorirana smrdljivka (*Halyomorpha halys* (Stål, 1855) [Hemiptera, Pentatomidae]); pojav in razširjenost nove invazivne, tujerodne stenice v Sloveniji

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Marmorirana smrdljivka (*Halyomorpha halys* (Stål, 1855); [Hemiptera, Pentatomidae]) je predstavnik družine ščitastih stenic. Gre za še eno invazivno, tujerodno in polifagno vrsto, ki izvira iz Vzhodne Azije. Sredi 90-ih je bila vnesena v ZDA ter leta 2004 v Evropo. V novih okoljih se hitro prilagaja in uspešno razmnožuje, pri čemer razvije najmanj eno popolno generacijo letno. Promet in sposobnost aktivnega letenja na daljših razdaljah ji omogočata hitro osvajanje novih območij. Njen pojav in širjenje sta tako v ZDA kot v Evropi povezana z nastankom velike gospodarske škode v pridelavi sadja, poljščin in vrtnin. Zaradi specifičnega načina prezimovanja, ki poteka v zavarovanem prostoru, v bližini človeških bivališč, je postala izjemno moteč dejavnik v urbanem okolju. Marmorirana smrdljivka je prisotna tudi v Sloveniji, prvič je bila najdena v Šempetru pri Gorici, pomladi 2017. Istega leta je bila najdena še na več lokacijah v okolici Nove Gorice. Sistematičen monitoring *H. halys* v letu 2018 je pokazal, da je vrsta že naselila celotno območje Primorske, od Posočja do Slovenske Istre ter se razširila vzhodno do Postojne. V letu 2018 smo zabeležili posamezne najdbe tudi v Ljubljani, Kranju, Lescah, Brdu pri Lukovici ter na Otočcu na Dolenjskem. Na območju Primorske smo jeseni 2018 že zaznali velike populacije marmorirane smrdljivke ter gospodarsko škodo v pridelavi jablan in hrušk. V prispevku predstavljamo rezultate sistematičnega monitoringa *H. halys*, osnovne morfološke in biološke značilnosti vrste ter potencialno nevarnost za nastanek škode v kmetijski pridelavi.

ABSTRACT

Occurrence and distribution of Brown marmorated stink bug (BMSB) – (*Halyomorpha halys* (Stål, 1855) [Hemiptera, Pentatomidae]); new invasive alien stink bug in Slovenia

Brown marmorated stink bug (BMSB) (*Halyomorpha halys* (Stål, 1855) [Hemiptera, Pentatomidae]) is an invasive, alien and polyphagous species, native to East Asia. In the mid-1990s was introduced into the USA and in 2004 in Europe. BMSB has shown high adaptability to the new environments and ability to reproduce successfully, producing at least one complete generation per year. By traffic and own capacity for long distance flight can rapidly spread to new areas. Occurrence and spreading of new species in both USA and Europe resulted in severe yield losses in fruit, vegetable and cereal production. Due to its overwintering habits accompanied by invasions of adults to human-made structures, it is considered a nuisance pest in urban areas. BMSB has been present also in Slovenia, first time was recorded in Šempeter pri Gorici in spring 2017. In the same year was found in some other locations around Nova Gorica. Ongoing spread of BMSB in Slovenia was confirmed by methodical monitoring carried out in 2018. The pest already invaded Primorska region, from Soča Valley to Slovenian Istria and eastern to Postojna. In 2018 single specimens of BMSB were detected for the first time in Ljubljana, Kranj, Lesce, Brdo pri Lukovici and Otočec in Dolenjska region. High populations of *H. halys* were observed in Primorska region in autumn 2018 and also an economic important damage was registered in apple and pear production for the first time. The results of BMSB methodical monitoring will be presented in the paper, basic morphological and biological data, crop damage and increasing threat for agricultural production will be discussed.



Spremljanje pojava breskove muhe (*Ceratitis capitata* [Wiedemann]) na Primorskem v obdobju 2016-2018

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Breskova muha (*Ceratitis capitata* [Wiedemann], Diptera, Tephritidae) je polifagni škodljivec, ki v tujini povzroča veliko gospodarsko škodo. Območje njene razširjenosti obsega sredozemske države, Srednji vzhod, Južno in Srednjo Ameriko, Avstralijo in nekatere druge predele sveta. V Sloveniji se pojavlja že od leta 1958, njeno število pa se v zadnjih letih povečuje. Slovenija predstavlja severno mejo pojavljanja breskove muhe. Jajčeca odlaga v plodove nekaterih sadnih vrst, izlegle ličinke se v plodovih hranijo in povzročajo občutno škodo. Površine zasajene s kakijem (*Diospyros kaki*), ki je v Sloveniji glavna gostiteljska rastlina breskove muhe se večajo. Posledično ima breskova muha ugodne pogoje za nadaljnje širjenje. Z uporabo različnih feromonskih in prehranskih vab smo v obdobju 2016-2018 spremljali pojav breskove muhe na različnih lokacijah na Primorskem. V prispevku so predstavljeni rezultati nadzora v letih 2016-2018 ter njihova primerjava.

ABSTRACT

Monitoring of mediterranean fruit fly (*Ceratitis capitata* [Wiedemann]) in Primorska region in the period of 2016-2018

Mediterranean fruit fly (*Ceratitis capitata* [Wiedemann], Diptera, Tephritidae) is a polyphagus pest, which causes a lot of damage abroad. It is found in the Mediterranean, Middle east, South America, Mesoa-merica, Australia and other places. In Slovenia, medfly was first found in 1958, its population steadily growing since then. Slovenia represents the most northern border of its appearance. Medfly lays eggs in fruits of some species. Hatched larvae then feed on fruit and cause significant damage. Land under persimmon orchards, which is the main host plant for medfly is increasing, which improves the conditions formed by continuous expansion. In the period of 2016-2018 we used different types of pheromone and food based traps to monitor the appearance of Medfly in different locations in the Primorska region. The results of the survey of Mediterranean fruit fly in the years of 2016-2018 and its comparisons are presented in this article.



Figov mozaik v Sloveniji - razširjenost bolezní ter zastopanost virusov in viroidov

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Figov mozaik je pomembna virusna bolezen fig, ki je razširjena po vsem svetu. V simptomatičnih rastlinah so doslej odkrili vsaj 10 virusov in tri viroide. Med temi je virus mozaika smokvovca (*Fig mosaic virus* – FMV) iz rodu *Emaravirus* najtesneje povezan z boleznijo. Figov mozaik se prenaša predvsem z vegetativnim razmnoževanjem, s cepljenjem, dokazan pa je tudi prenos s pomočjo pršice šiškarice *Aceria ficus*. V letu 2017 so bili na figah z znamenji figovega mozaika prvič v Sloveniji potrjeni štirje virusi: fig mosaic virus (FMV), fig leaf mottle-associated virus 1 (FLMaV-1), fig mild mottle-associated virus (FMMaV) in fig badnavirus-1 (FBV-1). Z namenom ugotavljanja razširjenosti figovega mozaika ter virusov in viroidov, ki se v povezavi z boleznijo pojavljajo v Sloveniji, smo v letu 2018 opravili preglede figovih nasadov na Primorskem, kjer je gojenje te sadne vrste najbolj razširjeno. V septembru in oktobru smo pregledali 20 nasadov fig na Primorskem, od tega 6 na območju Vipavske doline, 4 na območju Goriških Brd ter 10 v Slovenski Istri. V vsakem nasadu je bil opravljen vizualni pregled, pri čemer smo prešteli skupno število dreves ter število dreves z izraženimi znamenji mozaika fig. V kolikor je bilo mogoče, smo zabeležili tudi podatke o sortimentu. Ugotovili smo, da so znamenja figovega mozaika prisotna v vseh pregledanih nasadih. Najmanjši delež simptomatičnih dreves je bil 22,2%, v enem nasadu pa so bila simptomatična vsa drevesa. V 11 nasadih so bili odvzeti kumulativni vzorci figovih listov z znamenji figovega mozaika. Vzorce smo z molekularnimi metodami testirali na 9 virusov in tri viroide. V vseh vzorcih smo ugotovili mešane okužbe z vsaj dvema virusoma in enim viroidom. V okviru opravljene raziskave smo ugotovili, da je figov mozaik v slovenskih figovih nasadih zelo razširjen, v simptomatičnih drevesih pa smo poleg v letu 2017 potrjenih virusov našli še fig fleck associated virus (FFkaV), citrus exocortis viroid (CEVd) in hop stunt viroid (HSVd).

ABSTRACT

Fig mosaic in Slovenia – disease prevalence and viruses present

Fig mosaic is an important virus disease occurring on figs worldwide. At least 10 viruses and three viroids were found in association with the disease. *Fig mosaic emaravirus* (FMV) was found as a virus in the closest correlation with the disease. Fig mosaic is transmitted by vegetative propagation, grafting and by a natural vector, eriophyoid mite *Aceria ficus*.

In 2017 four viruses were found for the first time in Slovenia in figs showing fig mosaic symptoms: fig mosaic virus (FMV), fig leaf mottle-associated virus 1 (FLMaV-1), fig mild mottle-associated virus (FMMaV) and fig badnavirus-1 (FBV-1). To assess the prevalence of fig mosaic in Slovenian fig orchards and the viruses associated with the disease a survey was conducted in 2018 in Primorska region where the figs are mostly grown. In September and October, 20 fig orchards in Primorska region were surveyed, 6 of them in Vipavska dolina, 4 in Goriška Brda and 10 in Slovenska Istra. All orchards were visual inspected, total number of trees and symptomatic trees were counted and where available the information on cultivars was recorded. The results showed the presence of symptomatic trees in all locations between 22,2% and 100%. Cumulative leaf samples were taken from 11 locations and they were tested for nine viruses and three viroids by RT-PCR. Mixed infections with at least two viruses and one viroid were found in all analysed samples. The results of this research showed the widespread presence of fig mosaic in Slovenian fig orchards. In addition to the viruses found in 2017, the presence of fig fleck associated virus (FFkaV), citrus exocortis viroid (CEVd) and hop stunt viroid (HSVd) were found in analysed symptomatic samples.



Spinetoram, sodobna, današnjim smernicam za varstvo rastlin primerna insekticidna učinkovina za zatiranje gosenic škodljivih metuljev na sadnem drevju, vinski trti in oljkah, kakor tudi hruševe bolšice

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Učinkovina spinetoram (višja vsebnost spinosin J in nižja vsebnost spinosin L) je bil v Evropi uvrščen na aneks I v letu 2014. Prva registracija je bila v Franciji leta 2016, v letu 2017 pa že tudi v Sloveniji. Spinetoram, tako kot njegov predhodnik spinosad spada v novejši kemični razred insekticidov, ki se imenuje spinosini (razred 5). Spinetoram ima poseben način delovanja, ki se razlikuje od vseh drugih insekticidov. Povzroči vzburljanje živčnega sistema, ki vodi k nenadzorovanemu krčenju mišic, izčrpanosti in tresavici, na koncu sledi paraliza. Ti učinki so skladni z aktivacijo nikotinskih receptojev acetilholina (nAChR), vendar z mehanizmom, ki je povsem nov in edinstven med vsemi znanimi insekticidnimi spojinami. Zaradi svojega delovanja je spinetoram zelo zaželen v anti-rezistenčnem programih. Karenca za pečkarije je le 7 dni, le za oljko je 21 dni. Zelo pomembni dejavniki so tudi MRLji, ki so v primeru upoštevanja GAP pod vrednostjo 0,01 ppm, v primeru uporabe 25 dni pred spravilom pa zagotovo 0,00 ppm. Spinetoram deluje predvsem na škodljivce iz rodu Lepidoptera, Thysanoptera, Diptera in Coleoptera. Ima ovi-larvicidno delovanje, nanj so občutljivi vsi razvojni stadiji škodljivca, deluje pa dotikalno in preko prebavil. Deluje izredno hitro, že nekaj minut po izpostavitvi učinkovine, smrt pa nastopi v času od 1 do 24 ur. Spinetoram ima tudi izrazito translaminarno delovanje v mezofilnih ali stebričastih tkivih, zato ima tudi delovanje na nekatere škodljivce, ki se prehranjujejo s sesanjem sokov. V letu 2017 sta pridobili registracijo FFS DELEGATE® 250 WG in RADIANT. DELEGATE 250 WG vsebuje 25 % aktivne snovi spinetoram in ima dovoljenje za uporabo na jablanah, hruškah, kutini in našijih za zatiranje jabolčnega zavijača (*Cydia pomonella*), breskovega zavijača (*Cydia molesta*), pasastega sadnega lupinarja (*Pandemis heparana*), sadnega zavijača (*Adoxophyes orana* in *Argyrotaenia pulchellana*), na hruškah za zatiranje navadne hruševe bolšice (*Cacopsylla pyri*), na breskvah, nektarinah in marelicah za zatiranje breskovega zavijača (*Cydia molesta*), breskovega molja (*Anarsia lineatella*) in cvetličnega resarja (*Frankliniella occidentalis*), na slivah in češpljah za zatiranje češpljevega zavijača (*Cydia funebrana*) in sadnega zavijača (*Adoxophyes orana*), na oljkah za zatiranje oljčnega molja (*Prays oleae*). RADIANT vsebuje 12 % aktivne snovi spinetoram in ima dovoljenje za zatiranje na trti za pridelavo vinskega grozdja za zatiranje križastega grozdnega sukača (*Lobesia botrana*), pasastega grozdnega sukača (*Eupoecilia ambiguella*), listnega zavijača na trti (*Argyrotaenia ljungiana pulchellana*) in vinsko mušico (*Drosophila melanogaster*), trtnega resarja (*Drepanothrips reuteri*), cvetličnega resarja (*Frankliniella occidentalis*) in trsnega sukača (*Sparganothrips pilleriana*).

ABSTRACT

Spinetoram, a modern, for today's plant protection guidelines, an very appropriate insecticidal active ingredient to control caterpillars of harmful butterflies on fruit trees, vines and olives and also pear psyllid

The active ingredient (a.i.) of spinetoram (a higher content of spinosyn J and a lower spinosyn L content)

was listed in annex I in Europe in 2014. The first registration was in France in 2016 and in 2017 already in Slovenia. Spinetoram, like its predecessor spinosad, belongs to a newer chemical class of insecticides, called spinosins (class 5). Spinetoram has a specific mode of action that differs from all other insecticides. It causes the excitement of the nervous system leading to uncontrolled muscle contraction, exhaustion and trembling, followed by paralysis. These effects are consistent with the activation of nicotinic receptors of acetylcholine (nAChR), but with a mechanism that is completely new and unique among all known insecticidal compounds. Due to its performance spinetoram is highly desirable in anti-resistance programs. The PHI period is only 7 days, only for the olive 21 days. MRLs are also very important factors, which are below 0.01 ppm if GAP is taken into account, and in the case of use 25 days before harvest, they are certainly 0.00 ppm. Spinetoram works mainly on pests from the genus Lepidoptera, Thysanoptera, Diptera and Coleoptera. It has ovi-larvicid activity, all development stages of the pest are sensitive and it works through the contact and through the gastrointestinal tract. It works extremely fast, a few minutes after exposure to the active substance, and death occurs between 1 and 24 hours. Spinetoram also has a pronounced translaminar action in mesophilic or posterior tissues, therefore it also acts on some pests that feed on juices. In 2017 obtained the registration two PPP containing spinetoram, DELEGATE 250 WG with 25 % of a.i. and RADIANT with 12 % of a.i. DELEGATE 250 WG is registered for control *Cydia pomonella*, *Pandemis heparana*, *Adoxophyes orana* and *Argyrotaenia pulchellana* on some pome fruits, *Psylla piri* on pears, *Cydia molesta*, *Anarsia lineatella*, *Frankliniella occidentalis*, *Cydia funebrana* and *Adoxophyes orana* on some stone fruits and *Prays oleae* on olives.



Vpliv protitočne mreže na obseg zanašanja škropilne brozge zunaj nasada jablan

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V nasadu jablan z gojitveno obliko vitko vreteno je bil izveden poskus v katerem smo merili obseg zanašanja škropilne brozge zunaj nasada do razdalje 10 m od roba v razmerah brez protitočne mreže in takrat, ko je bila protitočna mreža (Frustar 7 × 3 mm črna standard) razprta. Medvrstna razdalja sajenja dreves je znašala 3,2 m, razdalja v vrsti 0,9 m, TRV 9400 m³ in LAI 2,90. Meritve zanašanja smo izvedli po standardnem protokolu z uporabo barvnega sledilca tartrazin (E102, Etol Celje) z uporabo sedimentacijske metode s plastičnimi kolektorji, ki so bili položeni na tleh, in fotospektrometrično določitev količine depozita na kolektorjih. Uporabili smo radialni pršilnik Andreoli Eco Simplex 1000 s 5+5 izvodi zraka. Pršilnik je deloval s kapaciteto 15.000 m³/h in je imel vgrajene standardne šobe Lechler TR80 oranžna. Testirali smo vpliv petih različnih načinov škropljenja zadnjih 4 robnih vrst sadovnjaka. Prekritost nasada s protitočno mrežo je zmanjšala zanašanje na razdalji 5 m od roba za 25 % in na razdalji 10 m od roba nasada za 45 %. Če smo zadnje 4 vrste škropili samo enostransko navznoter smo pri razprti mreži na 10 metrih od roba nasada izmerili 80 % zmanjšanje zanašanja.

ABSTRACT

Influence of anti-hail net on the extent of spray drift from apple plantation

A field trial was carried out in an apple plantation with slender spindle training system in order to evaluate the extent of spray drift emitted to the plantation surrounding to a distance of 10 m from the edge, under conditions with unfolded or folded anti-hail net (Frustar 7 × 3 mm black standard). The tree planting density was 3.2 m between rows and 0.9 m within rows, TRV was 9400 m³ and LAI 2.90. Drift

measurements were carried out according to the standard protocol using the tartrazine colorant (E102, Etol Celje), sedimentation method with plastic tray collectors placed on the ground, and a photo-spectrometric determination of the amount of deposits on collectors. We used a radial Andreoli Eco Simplex 1000 sprayer with 5 + 5 air spouts operated at a fan capacity of 15,000 m³/h and with mounted standard nozzles Lechler TR80 orange. We tested five different systems of spraying the last 4 tree rows of the plantation. The coverage of the plantation with anti-hail net reduced spray drift at a distance of 5 m from the edge by 25% and at a distance of 10 m from the plantation edge by 45%. If the last 4 rows were sprayed only one-sided inwards and plantation was covered by net, we determined an 80% drift reduction at a distance of 10 meters from the edge of the plantation.



Antagonistična aktivnost kvasovkam podobnih gliv rodu *Aureobasidium* proti fitopatogenim glivam

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Nekdanji kompleks vrst *Aureobasidium pullulans* (de Bary) Arnaud (red Dothideales, Ascomycota) predstavljajo kvasovkam podobne kosmopolitske glive, ki jih najdemo v filiosferi ali karposferi številnih zelenjadnic in sadnih rastlin brez povzročanja bolezni, pa tudi v drugih ekstremnih okoljih, kot so ledeniki, soline, konzervirana hrana, hišni prah, gospodinjski pripomočki itn. Taksonomska nejasnost vrste je bila rešena ko so bile njene varietete, *A. pullulans* var. *pullulans*, var. *melanogenum*, var. *subglaciale* in var. *namibiae*, na podlagi fizioloških razlik ter velikih razdalj med poravnanimi genomi povzdignjene na nivo ločenih vrst. Gre za poliekstremotolerantne vrste, saj jih karakterizira visoka toleranca na različne okoljske strese (slanost, kislost, bazičnost, nizke temperature in oligotrofno). Poleg tega ima vrsta *A. pullulans* izjemen biotehnološki pomen kot komercialno izkoriščen proizvajalec različnih biomolekul in kot biotično sredstvo za preprečevanje bolezni pred in po obiranju pridelkov. Mikrobiološka zbirka Ex (Infrastrukturni center Mycosmo, MRIC UL) v Sloveniji hrani bogat repertoar sevov *Aureobasidium* spp. iz ekstremnih okolij, ki smo jih pregledali za antagonistične aktivnosti proti problematičnim glivnim patogenom, kot so *Botrytis cinerea* (siva plesen), *Penicillium expansum* (modra plesen) in *Colletotrichum acutatum* (grenka gniloba) z *in vitro* ter *in situ* testi na plodovih jablane. Dobljeni rezultati so razkrili več sevov *A. pullulans* in *A. subglaciale* z obetavno antagonistično aktivnostjo proti izbranim fitopatogenim glivam. Poleg tega smo analizirali fiziološke lastnosti in genomska zaporedja izbranih sevov in identificirali številne lastnosti, povezane z njihovo antagonistično aktivnostjo. Ta študija potrjuje primernost uporabe *A. pullulans* v biokontroli in razkriva novo vrsto *A. subglaciale*, ki bi se lahko uporabljala kot biotično sredstvo za varstvo rastlin po obiranju.

ABSTRACT

Antagonistic activity of yeasts *Aureobasidium* spp. against phytopathogenic fungi

Former species complex *Aureobasidium pullulans* (de Bary) Arnaud (order Dothideales, Ascomycota) comprise yeast-like cosmopolitan fungi found in phyllosphere and carposphere of numerous fruits and vegetables without causing diseases and also in a variety of other extreme environments such as glacial ice, salterns, preserved food, house dust and household appliances etc. Its taxonomic ambiguity was resolved when varieties *A. pullulans* var. *pullulans*, var. *melanogenum*, var. *subglaciale*, var. *namibiae*

were elevated to separate species based on their physiological differences and large distances between the aligned genomes. The species are referred as polyextremotolerant due to their high tolerance to variety of environmental stresses (hypersaline, acidic, basic, cold and oligotrophic conditions). Next, *A. pullulans* is of substantial biotechnological importance as a commercially exploited producer of various biomolecules and is a biocontrol agent used in pre- and postharvest plant disease prevention. The Ex Culture Collection (Infrastructural centre Mycosmo, MRIC UL) in Slovenia possess a rich repertoire of strains of *Aureobasidium* spp. from extreme environments that were screened for their antagonistic activity against the most problematic postharvest fungal pathogens such as *Botrytis cinerea* (grey mould), *Penicillium expansum* (blue mould), and *Colletotrichum acutatum* (bitter rot) by *in vitro* and *in situ* tests on apple fruits. The obtained results uncovered several strains of *A. pullulans* and *A. subglaciale* with promising antagonistic activity against selected phytopathogenic fungi. Additionally, the physiology and genome sequences of the selected strains were analysed and numerous traits involved in their antagonistic activity were identified. This study further confirms the suitability of use of *A. pullulans* and uncovers novel species *A. subglaciale*, applicable in postharvest biocontrol of plant pathogens.



Digitalno vrednotenje naravnih lastnosti krošenj dreves v sadovnjaku

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V prihodnosti bo mogoče zmanjševanje odmerkov fitofarmaceutskih sredstev, pomešanih z vodo (škropilna brozga) v predpisanih koncentracijah, v sadovnjakih samo z upoštevanjem naravnih lastnosti krošenj dreves. V praktičnem eksperimentu v sadovnjaku smo vrednotili listno površino sorte jablan ('*zlata delišes*') na različnih segmentih z leve in desne strani krošenj dreves. Primerjali smo rezultate ročnih meritev, laserske merilne tehnologije (LIDAR) in programskega algoritma, s katerim smo omogočili digitalno rekonstrukcijo krošnje drevesa. Z uporabo regresijske metode smo ocenili zvezo med odvisno spremenljivko (digitalno število točk v oblaku) ter neodvisno spremenljivko (ročno izmerjena listna površina). Analiza na petih naključno izbranih krošnjah dreves v sadovnjaku je pokazala, da znaša maksimalna vrednost korelacijskega koeficienta $r=0,906$ za levo polovico ter $r=0,862$ za desno polovico krošnje.

ABSTRACT

Digital evaluation of the natural characteristics of tree canopies in the orchard

In the future, the reduction of the plant protection product dosage, mixed with water (spray mixture) in a prescribed concentration will be possible only by sensing the natural characteristics of the tree canopy in the orchard. In practical experiment in the orchard, the leaf area of apple trees ('*golden delicious*') was evaluated on different tree canopy segments. The results of manual measurements were compared with laser (LIDAR) measurements and those from software algorithm, which enabled digital reconstruction of individual tree canopy. By using regression method the relationship between the dependent variable (digital number of point clouds) and an independent variable (leaf area, manually measured) were evaluated for five segments of tree canopies. The analysis on five randomly selected tree orchards in the orchard showed that the maximum value of the correlation coefficient $r = 0.906$ for the left half and $r = 0.862$ for the right half of the crown.



Sezonska dinamika in čas zatiranja oljčnega molja (*Prays oleae* Bern.) v Slovenski Istri

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Oljčni molj (*Prays oleae* Bern.) je poleg oljčne muhe (*Bactrocera oleae* Rossi) najpomembnejši škodljivec oljk v Sredozemlju. Letno ima tri razvojne generacije. Prva (antofagna generacija) napada cvetne brste in cvetove, druga (karpofagna generacija) napada plodiče in povzroča škodo na plodovih, tretja generacija (filofagna generacija) pa poškoduje liste oljk. Največjo škodo naredi karpofagna generacija, saj ličinke ob izhodu iz plodov lahko povzročijo njihovo intenzivno odpadanje. Najbolj razširjena sorta v Slovenski Istri – 'Istrska belica' je zelo občutljiva na oljčnega molja zato so lahko v nekaterih letih izgube pridelka zelo velike. Priporočila za ukrepanje proti temu škodljivcu se od države do države nekoliko razlikujejo. Z raziskavo smo želeli preučiti najprimernejši čas zatiranja oljčnega molja v Slovenski Istri glede na razpoložljiva priporočila. Preliminarni rezultati raziskave so pokazali, da je prisotnost oljčnega molja na cvetnih brstih, cvetovih in plodičih neodvisna od dinamike leta oljčnega molja na feromonski vab. Zato je za učinkovito zatiranje oljčnega molja poleg dinamike leta na feromonskih vabah priporočljivo spremljati tudi prisotnost oljčnega molja na sami rastlini.

ABSTRACT

Seasonal dynamics and the time of treatment against the olive moth (*Prays oleae* Bern.) in Slovenian Istria

Olive moth (*Prays oleae* Bern.) is the second most important pest of olives in the Mediterranean region, right after the olive fly (*Bactrocera oleae* Rossi). During the year it can develop three generations on various plant organs. The first (anthophagous) generation consists of larvae that attack flower buds and flowers, the second (carpophagous) generation consists of larvae, that attack olive fruits and the third (phyllophagous) generation when the larvae feed on olive leaves. The larvae of the second generation enter the olive fruit stone and when in autumn leave the fruit, they can cause heavy fruit drop. The most diffused cultivar in Slovenian Istria – 'Istrska belica' is very sensitive to the attack of olive moths, causing huge losses in some years. The recommendations for controlling this pest slightly vary from country to country. With this research we wanted to address the most opportune time to spray against the olive moth in our region, based on various recommendations. Preliminary results show that the occurrence of the olive moth larvae on flower buds, flowers and fruits is not correlated with the population dynamics of the olive moth on pheromonal traps. For an affective pest control of the olive moth, it is necessary to monitor the presence of larvae on the plant as well as the usage of pheromonal traps.



Razvojna dinamika in življenjske strategije navadne slinarice – *Philaenus spumarius* (Hemiptera, Cicadomorpha: Aphrophoridae), naravne prenašalke bakterije *Xylella fastidiosa* v Evropi.

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Navadna slinarica - *Philaenus spumarius* (Linnaeus, 1758) dobiva izjemen fitosanitarni pomen v Evropi, ker je glavni naravni prenašalec bakterije *Xylella fastidiosa* v južni Italiji in drugih okuženih območjih Sredozemlja. Dobro poznavanje njene bionomije in prehranskih strategij je temeljnega pomena pri oblikovanju učinkovitih ukrepov za omejevanje njenih populacij v primeru, da bi se nevarna bolezen razširila na ozemlje Slovenije. Navadna slinarica je izjemno polifagna ter splošno razširjena po vsej Evropi v najrazličnejših habitatih. V Sloveniji jo najdemo skoraj povsod od morja pa do nadmorske višine 1800 m. Raziskava v letih 2017 in 2018 je pokazala, da bionomija navadne slinarice pri nas ni bistveno drugačna kot drugod po Evropi. Bili pa so zaznani znatni časovni zamiki pojavljanja mladostnih razvojnih stopenj kot posledica specifičnih okoljskih dejavnikov ali nadmorske višine. Vrsta ima en sam rod na leto. V razmerah nižinske Primorske se ličinke začnejo izlegati v začetku aprila, njihov razvoj se nato zaključi do začetka junija. Odrasle slinarice se pojavljajo od druge dekade maja dalje in živijo do jeseni, nekateri osebkovi vse do novembra. Samice odlagajo jajčeca od avgusta do oktobra pri osnovi gostiteljskih rastlin ali na njihovih ostankih in preidejo v zimsko diapavzo. Mladostni razvojni stadiji se razvijajo samo na intenzivno rastočih zeleh. Med njihovimi gostiteljskimi rastlinami so najbolj zastopane vrste iz družin košaric in metuljnic, med najbolj priljubljenimi so tudi nekatere vrste iz družin rožnic in broščevk. Sicer je bilo v raziskavi ugotovljenih 143 gostiteljskih rastlin iz 25 družin. Odrasle slinarice se prehranjujejo tudi na celi vrsti lesnatih rastlin. Bakterijo *X. fastidiosa* lahko med rastlinami prenašajo le odrasle slinarice. V primeru pojava te bakterije v Sloveniji bi bilo učinkovito zmanjševanje populacij navadne slinarice v ogroženih kmetijskih habitatih izvedljivo predvsem z zatiranjem njenih mladostnih razvojnih stopenj.

ABSTRACT

Development dynamics and life strategies of meadow spittle bug - *Philaenus spumarius* (L.) (Hemiptera, Cicadomorpha: Aphrophoridae), a natural vector of *Xylella fastidiosa* in Europe

The meadow spittlebug - *Philaenus spumarius* (Linnaeus, 1758) is gaining phytosanitary relevance because it is the main natural vector of bacteria *Xylella fastidiosa* in southern Italy and some other infected Mediterranean regions. A good knowledge of its bionomy and feeding behaviour is of paramount importance in devising efficient strategies and management for limiting its populations in case of disease introduction to Slovenia. *P. spumarius* is extremely polyphagous and widely distributed across Europe in an almost unlimited variety of habitats. In Slovenia, this species occurs almost everywhere from the sea level up to an altitude of 1800 m. Our study in 2017 and 2018 showed that the bionomy of *P. spumarius* is similar as in other parts of Europe. However, significant difference was observed in the times of occurrence of larval stages, related to specific environmental factors or altitude. It develops one generation a year. In the lowland Primorska region, larvae start hatching at the beginning of April and conclude their development by early June. Adults occur from the second decade of May and live until autumn, some specimen until November. The females lay eggs on the base of host-plants or their debris from August to October, after which they enter the winter diapause. Larval stages occur almost exclusively on actively growing herbaceous plants. They show a clear prevalence for Asteraceae, Fabaceae, and some species of Rosaceae and Rubiaceae. In our study, 143 plant species belonging to 25 families were found to host immatures of *P. spumarius*. Adults also use a wide range of woody plants as their food source. Only adults of *P. spumarius* are capable to transmit bacteria *X. fastidiosa* between plants. In the event of occurrence of *X. fastidiosa* in Slovenia, the most efficient reduction of populations of *P. spumarius* in agricultural habitats at risk could be achieved by suppressing its immature stages.



Programi preiskav bakterijskega ožiga oljk – *Xylella fastidiosa* (Wells & Raju) od 2014 do 2018 v Republiki Sloveniji

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Bakterija *Xylella fastidiosa* (Wells & Raju) je pomemben rastlinski patogen, ki v zadnjih letih predstavlja resno grožnjo za evropsko kmetijstvo in okolje. *X. fastidiosa* okužuje več kot 350 rastlinskih vrst, med katerimi so številne gojene in prosto rastoče rastline. V Evropi je bila navzočnost te bakterije prvič potrjena v jeseni leta 2013 v Apuliji v južni Italiji v provinci Lecce v povezavi s kompleksom hitrega propadanja oljk. V naslednjih letih so sledili večji izbruhi na različnih rastlinah v Franciji in Španiji, posamezne okužene okrasne rastline so bile odkrite v Nemčiji, bakterija pa je bila ugotovljena tudi na rastlinah v trgovini. *X. fastidiosa* je v Evropski uniji karantenski škodljiv organizem, uvrščena je v priložo I.A.II Direktive Sveta 2000/29/ES. Znotraj vrste *X. fastidiosa* so za zdaj znane štiri podvrste z različnim spektrom gostiteljskih rastlin. Skladno z izvedbenim sklepom Komisije št. 2015/789/EU se tudi v Sloveniji od leta 2014 izvaja program preiskave za ugotavljanje navzočnosti *X. fastidiosa*. Cilj programa preiskave je zgodnje odkrivanje morebitnih okužb z namenom izkoreninjenja. Program preiskave se izvaja na celotnem ozemlju Slovenije s poudarkom na območjih z večjim tveganjem za vnos in širjenje. Od 2014 do konca 2018 je bilo izvedenih 2299 pregledov na približno 1200 ha površin, ki zajemajo oljčnike, sadovnjake, vinograde, vrtove in javne površine. Z laboratorijskimi metodami je bilo testiranih več kot 850 rastlinskih vzorcev. Petletni rezultati izvajanja programa preiskav kažejo, da na območju Slovenije *X. fastidiosa* ni prisotna, uradni status tega škodljivega organizma pri nas je »odsoten, potrjeno s preiskavo«. Z leti se je skladno s podatki o novih najdbah večalo tudi število pregledanih vrst gostiteljskih rastlin bakterije. Nadgradili smo tudi postopke diagnostičnih preiskav, pri katerih imamo sedaj na voljo vrsto molekularnih presejalnih testov, teste za določanje podvrste *X. fastidiosa*, kar je posebnega pomena za sprejemanje morebitnih ukrepov v primeru najdbe in tudi teste za določanje te bakterije v potencialnih žuželčnih prenašalcih. Skupaj z vizualnimi pregledi in vzorčenjem rastlin brez bolezenskih znamenj nam sodobna diagnostika omogoča zanesljivo analizo večjega števila vzorcev različnih gostiteljskih rastlin.

ABSTRACT

Surveys on *Xylella fastidiosa* (Wells & Raju) from 2014 to 2018 in Slovenia

Bacterium *Xylella fastidiosa* (Wells & Raju) is an important plant pathogen and has been a serious threat to European agriculture and environment in recent years. *X. fastidiosa* can infect more than 350 different plant species which are cultivated as well as wild plants. In Europe, the presence of this bacterium was first confirmed in autumn 2013 in Apulia, in southern Italy, in the province of Lecce, causing olive quick decline. In the following years, major outbreaks of bacteria were observed in France and Spain on several plants and a minor outbreak was reported from Germany. The bacterium was also intercepted several times on plants in trade. *X. fastidiosa* is a quarantine pest in the European Union and listed in the Annex I.A.II of Council Directive 2000/29/EC. For now, four subspecies are commonly recognized and

occurring more extensively on a variety of host plants. In accordance with Commission Implementing Decisions No. 2015/789 / EU, as of 2014, yearly surveys have been carried out in Slovenia with the objective to early detect the potential occurrence of *X. fastidiosa* and eradicate it. The survey is carried out in the whole territory of Slovenia, with emphasis in the areas with higher risk due to Mediterranean climate. From 2014 to the end of 2018, 2299 inspections were carried out on approximately 1.200 ha of land in olive groves, fruit orchards, vineyards, gardens and urban areas and more than 850 plant samples were analyzed using a laboratory test. The five-year results of the survey show that *X. fastidiosa* is not present in the territory of Slovenia and the official status of this harmful organism is »absent, confirmed by survey«. Together with the data on new findings, the number of plant species tested has increased. Over the years, we have also improved a selection of diagnostic tests, for which we now have a range of molecular screening tests, tests for determination of the subspecies of *X. fastidiosa*, which are of particular importance for the adoption of appropriate measures in case of findings, as well as tests for determining this bacterium in potential insect vectors. Together with intensive visual checks and latent sampling, modern diagnostics provide a reliable analysis of a large number of samples of different host plants.

Varstvo vrtnin in jagodičja

Modra ovsova pršica (*Penthaleus major* Dugés, 1834) – prve poškodbe na vrtninah

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Leta 2018 smo v bližini kraja Renče našli večje število imagov modre ovsove pršice (*Penthaleus major* Dugés, 1834). Prizadeta sta bila posevka peteršilja (*Petroselinum crispum* Mill.) in motovilca (*Valerianella oleria* L.) gojena v zavarovanem prostoru. Gre za škodljivo tujerodno vrsto iz družine Penthalidae, ki v Sloveniji do sedaj še ni bila opažena. Med pomembe gostitelje pršice poleg motovilca in solate spadajo tudi žita kot so oves, ječmen in pšenica. Po navedbah tujih avtorjev škodljivi organizem prizadene še poljščine in vrtnine gojene tako na prostem kot v zavarovanih prostorih. Za razliko od drugih fitofagnih pršic, ki se v Evropi povečini pojavljajo v pomladanskem in poletnem obdobju se odrasli osebkovi modre ovsove pršice razvijejo od jeseni pa do konca pomladi. Poleti vrsta preide v diapavzo. V zavarovanem prostoru v bližini Renč je modra ovsova pršica povzročila škodo na manjšem posevku motovilca in peteršilja. Najbolj prizadeti so bili zunanji listi rastlin, ki so se postopoma razbarvali in dobili srebrnosiv izgled. Pridelek je bil neprimeren za uporabo. Na ostalih površinah s katerimi razpolaga vrtnarija modre ovsove pršice nismo našli. Da bi škodljivca omejil ter bi se preprečilo dodatno izgubo pridelka se je zelenjadar odločil za mehansko uničenje posevka. Po omenjenem ukrepu predvidenega drugega rodu pršice, ki naj bi se pojavil v jeseni nismo zasledili.

ABSTRACT

Blue oat mite or winter grain mite (*Penthaleus major* Dugés, 1834) – first injuries on vegetables

In the year 2018 we have found a large number of adults of the blue oat mite or winter grain mite (*Penthaleus major* Dugés, 1834) near the town of Renče. The affected crops were corn salad (*Valerianella oleria* L.) and parsley (*Petroselinum crispum* Mill.) both cultivated indoors. The mentioned pest belongs to the Penthalidae family and was not yet recorded in Slovenia. Among the important pest hosts there are corn salad and lettuce and some grain crop such oat, barley and wheat. According to foreign authors the pest affects several field crops and vegetables grown indoor and outdoor. In contrast with other phytophagous mites in Europe which predominantly appear as adults in spring and summer, the adults of the blue oat mite appear from autumn to the end of spring. During summer the pest species is in diapause. In the greenhouse near to the town of Renče the blue oat mite made some injuries on corn salad and parsley crops. The most damaged were the outer leaves which tend to be chlorotic and at the end became silver-grey. Because of the injuries the yield was not marketable. However, we did not find any blue oat mite population on other facility cultivation areas. In order to limit the pest and prevent additional crop loss the producer decided for mechanical destruction of the affected crop. Since this measure was taken, we did not find any adults of the second generation that were suspected to emerge in autumn.



Ali lahko paradižnikova rjasta pršica (*Aculops lycopersici*) ogrozi pridelavo paradižnika v Sloveniji?

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Paradižnikova rjasta pršica (*Aculops lycopersici*), ki spada v družino Eriophyidae, se največkrat navaja kot škodljivec paradižnika (*Lycopersicon esculentum*), napada pa lahko tudi druge rastline iz družine Solanaceae. Razširjena je na vseh območjih, kjer se prideluje paradižnik. Prva prereznožitev tega škodljivca v Sloveniji je bila zabeležena v letu 2001 v poskusnih rastlinjakih na Laboratorijskem polju Biotehniške fakultete V zadnjih letih jo občasno pogosteje zasledimo pri pridelavi paradižnika v zavarovanih prostorih tako pri profesionalnih pridelovalcih, kot pri pridelavi na vrtovih. Pršice naselijo rastline kmalu po presajanju. Razvoj od jajčeca do odraslih osebkov v optimalnih razmerah traja od 6 do 7 dni. V eni rastni dobi ima do 7 rodov. Populacija pršic v optimalnih pogojih za razvoj (temperatura zraka 21 - 27°C, relativna zračna vlaga približno 30 %) hitro narašča. Pršice se hranijo na listih, steblih, cvetovih in plodovih. Raziskave kažejo, da lahko ta pršica zmanjša pridelek paradižnika tudi do 65 %. Za obvladovanje tega škodljivca je pomembno, da dosledno preventivno izvajamo nekemične ukrepe (vzgoja in sajenje škodljivca prostih rastlin, zatiranje plevelov, vzdrževanje fitosanitarnih higienskih ukrepov,...). V nasadu je potrebno redno izvajanje monitoringa. Ob pojavu prvih znamenj napada opravimo tretiranje z registriranimi akaricidi. Zaradi omejenega nabora akaricidov, upoštevanja karenc in hitrega razvoja odpornosti pršice na akaricide se iščejo možne rešitve za obvladovanje škodljivca tudi v uporabi koristnih organizmov. Številni raziskovalci v laboratorijskih pogojih preizkušajo različne koristne vrste, ki se prehranjujejo in razvijajo na pršici, vendar se v praksi preizkušane vrste niso izkazale tako uspešne, kot v laboratorijskih pogojih. Na območju Slovenije so razmere za razvoj tega škodljivca ugodne. Glede na kratek čas, ki je potreben za razvoj od jajčeca do odraslih osebkov ter število rodov, ki jih pršica lahko oblikuje v eni rastni dobi, lahko v primeru vnosa te pršice v zavarovani prostor in ob prepoznavanju prvega znamenja ter prepoznavanju prvih znamenj napada pričakujemo občutno škodo na paradižniku. Ta predpostavka se žal že potrjuje v praksi v Sloveniji.

ABSTRACT

Can tomato russet mite (*Aculops lycopersici*) undermine the production of tomatoes in Slovenia?

Tomato russet mite (*Aculops lycopersici*) (family Eriophyidae) is most often quoted as tomato (*Lycopersicon esculentum*) pest. The mite can also attack other plants. Widespread in all the areas where grown tomatoes. In the year 2001 tomato russet mite had increased to devastating number in experimental greenhouses of Biotechnical Faculty. In recent years, occasionally more frequently found in the cultivation of tomatoes in protected spaces, both for professional producers, as in the production in the gardens. The infestation of the mite occurs soon after the plants are transplanted. The development from egg to adult lasts 6 to 7 days under optimal conditions. The population of mites in optimal conditions for the development of (air temperature 21 - 27°C, relative humidity about 30 %) is growing fast. Mites are feeding on the leaves, stems, flowers and fruits. Research suggests that this mite reduce the yield of tomatoes up to 65 %. To cope with this pest it is important that a consistent precaution, we use non chemical measures (planting pests free plants, suppress weed, maintenance of crop fitosanitary hygiene,...). In the grove is to be regularly monitoring. Upon the occurrence of the first signs of the attack, we are using acaricides. Due to the limited set of acaricide, compliance with the registered dose and the rapid development of resistance of the mites on the acaricide are searching for the possible solutions for the management of pests also in the use of beneficial organisms. Many of researches in the laboratory conditions tests different useful species, which eat up and develop the spider mite, but in practice, tried types did not proved as successful

as in laboratory conditions. On the territory of Slovenia are conditions for the development of that pest a favorable. For development from egg to adult specimens and number of genera is required short time in this period pests may develop in one growing period. In the case of entry of mites into the protected space and at late detecting and identifying first signs of attack, we expect significant damages on tomato. This assumption is unfortunately also confirms in practice in Slovenia.



Kronologija akaroloških aktivnosti v Sloveniji, ki imajo pomen v biotičnem varstvu rastlin

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V prispevku bo predstavljena kronologija najdb plenilskih pršic (Phytoseiidae in Stigmaeidae) v Sloveniji med leti 2001 in 2018. Na seznamu doslej najdenih plenilskih pršic najdemo 28 vrst, od tega eno vrsto uvrščamo v družino Stigmaeidae, 27 vrst pa v družino Phytoseiidae. Predstavili bomo njihove gostiteljske rastline ter žrtve (žuželke in fitofagne pršice), s katerimi se hranijo. Izpostavili bomo vrste plenilskih pršic, ki so pomembne v sistemih biotičnega varstva gojenih rastlin.

ABSTRACT

Chronology of acarological activities in Slovenia, important for the field of biological control

Chronology of new records of predatory mites (Phytoseiidae, Stigmaeidae) in Slovenia between 2001 and 2018 will be presented. In this period 28 species have been recorded; one species belongs to Stigmaeidae family, while twenty-seven species are the members of Phytoseiidae family. We will present the host plants and the prey (insects and phytophagous mites) of predatory mites. Detailed description will be given on Phytoseiids, important to augmentative biological control.



Preučevanje učinkovitosti insekticidov za zatiranje tobakovega resarja (*Thrips tabaci* Lindeman) v čebuli

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V poljskem poskusu smo preučevali učinkovitost insekticidov na podlagi snovi deltametrin, spinosad,

spirotramat in dimetoat za zatiranje tobakovega resarja v nasadu čebule. Insekticidi so bili naneseni v 100 % in 300 % odmerku trikrat zapored (23.5., 1.6. in 21.6.). Testirali smo tudi učinek dodajanja biostimulatorja Cirkon® (izločki *Echinacea purpurea*) pri obravnavanjih s 100 % odmerkom insekticida. S štetjem števila osebkov na 10 cm² površine lista pod lupo pri naključno izbranih rastlinah smo izvedli oceno velikosti populacije 7 dni po nanosu insekticida in še dvakrat pozneje. Za izračun učinkovitosti smo uporabili Abbotovo formulo. Pri snoveh deltametrin in spirotramat povečanje odmerka iz 100 na 300 % ni značilno povečalo učinkovitosti. Pri snoveh spinosad in dimetoat je povečanje odmerka imelo značilen učinek na učinkovitost. Dodajanje pripravka Cirkon je povečalo učinkovitost insekticidov za 8 do 20 odstotkov. Učinek dodajanja je bil pri vseh testiranih insekticidih podoben in domnevamo, da ima sredstvo repelentni učinek. Pri vseh pripravkih je prišlo do občutnega padca učinkovitosti pri tretjem zaporednem nanosu (- 30 %). Poskus kaže na popuščanje učinkovitosti testiranih insekticidov, ki pri večkratni uporabi ne presežejo praga učinkovitosti 60 %.

ABSTRACT

Assessment of Insecticide Efficacy in Controlling tobacco trips (*Thrips tabaci* Lindeman) in onion

In the field experiment, the effectiveness of insecticides based on deltamethrin, spinosad, spirotramat and dimethoate for controlling the tobacco trips in the onion plantation was studied. Insecticides were applied at 100% and 300% dose three times successively (23.5., 1.6. and 21.6.). We also tested the effect of adding a biostimulator Cirkon® (compound of *Echinacea purpurea*) in the treatments with 100% insecticide doses. By counting the number of trips individuals per 10 cm² of leaf surface under the magnifying glass in randomly selected plants, an estimation of the size of the population was carried out 7 days after the insecticide application and two more times later. Abbot's formula was used to calculate the efficiency. In the deltamethrin and spirotramat, the increase in dose from 100 to 300% did not significantly increase the efficacy. In the case of spinosad and dimethoate, the increase in dose had a significant effect on efficacy. Adding the preparation Cirkon has increased the efficiency of insecticides by 8 to 20 percent. The effect was similar in all tested insecticides, and it is assumed that the active compound has a repellent effect. At all insecticides, there was a significant drop in efficiency noticed after the third consecutive application (- 30%). The experiment demonstrates the decrease in efficacy of tested insecticides, which, when insecticides are used three times successively, do not exceed the 60% efficiency threshold.



Preliminarni rezultati preizkušanja pripravkov z nizkim tveganjem za zmanjševanje populacije kapusovih bolhačev (*Phyllotreta* spp.) na glavnatem zelju (*Brassica oleracea* var. *capitata* L.)

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Kapusovi bolhači iz rodu *Phyllotreta* so gospodarsko pomembni škodljivci na rastlinah iz družine križnic (Brassicaceae). Škodo povzročajo z objedanjem listov, še posebej na mladih rastlinah. Na glavnatem zelju (*Brassica oleracea* var. *capitata* L.) v spomladanskem času, v mesecu maju in juniju, najpogosteje najdemo vrsti *P. atra* in *P. nemorum*, v manjšem deležu pa *P. nigripes* ter *P. undulata*. Zaradi omejevanja uporabe insekticidov s kontaktnim delovanjem, je uporaba pripravkov z nizkim tveganjem neizogibna. V letu 2018 smo na njivi v Savinjski dolini, kjer je bilo posajeno glavnato zelje sorte 'Expect F1' (140

dnevno), za zatiranje kapusovih bolhačev preizkušali različne biostimulante (Algoplasmin, PlanTonic, CutiSan, Boundary BX) in bukov lesni pepel. Njihove učinkovitosti smo primerjali z insekticidnimi snovmi: lambda-cihalotrin (Karate Zeon 5 CS), spinosad (Laser plus) in naravni piretrin (Flora verde). Vse pripravke smo v poskusu uporabili 4-krat. V poskusu smo ocenjevali delež poškodovane listne površine zelja, ob koncu rastne sezone smo tehtali tudi pridelek. Karate Zeon 5 CS in Laser plus sta imela v povprečju pri vseh ocenjevanjih statistično značilno najmanjši delež poškodovane listne površine. Poškodbe na listih glavnatega zelja od kapusovih bolhačev so bile, v primerjavi s standardnima insekticidoma, najmanjše pri obravnavanjih, kjer smo uporabili bukov lesni pepel ali Flora verde. Največji delež poškodovane listne površine smo opazili pri pripravku CutiSan (kaolinska glina). Največji pridelek zelja smo dosegli na parcelah, kjer smo uporabili Karate Zeon 5 CS, Laser plus, Flora verde in Algoplasmin.

ABSTRACT

Preliminary results of testing plant protection products with low risk for diminishing the population of cabbage flea beetles (*Phyllotreta* spp.) on cabbage (*Brassica oleracea* var. *capitata*)

Cabbage flea beetles (*Phyllotreta* spp.) are important economically pests on plants from Brassicaceae family. Cabbage flea beetles cause damage on leaves, especially on young plants. In the spring time, on May and June, are most commonly pests on cabbage (*Brassica oleracea* var. *capitata* L.) species *P. atra* and *P. nemorum*, in a smaller proportion are present *P. nigripes* and *P. undulata*. In order to limit the use of insecticides by contact action, the use of low risk products is inevitable. In 2018 we were in the field in the Savinja valley, where the seedlings cabbage of the 'Expect F1' variety (140 daily) was planted, for the control of cabbage flea beetles, we tested biostimulants (Algoplasmin, PlanTonic, CutiSan, Boundary BX) and beech wood ash. We compared their efficacy with insecticidal active ingredients, lambda-cyhalothrin (Karate Zeon 5 CS), spinosad (Laser plus) and natural pyrethrins (Flora verde). The all products were used 4 times in the experiment. In the experiment, we evaluated the percentage of damaged leaf surface on the cabbage, and at the end of the growing season, we also weighed the crop. On average, Karate Zeon 5 CS and Laser plus had a statistically significant the smallest percentage of damaged leaf area in all assessments. The injuries on the leaves from cabbage flea beetles, in comparison with the standard insecticides, were the lowest where we used beech wood ash or Flora verde. The largest part of the damaged leaf was observed where used the product CutiSan (kaolin clay). The highest yield of cabbage was achieved on plots where used Karate Zeon 5 CS, Laser plus, Flora verde and Algoplasmin.



Uporabnost invazivnih tujerodnih rastlin pri zatiranju polžev

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Pri nas in drugod po svetu je zaradi cene in drugih prednosti najbolj razširjena uporaba fitofarmaceutskih sredstev (FFS) v varstvu rastlin pred škodljivimi organizmi. Zaradi negativnih vplivov na okolje, njihovega ne-ciljnega delovanja, pojava rezistence škodljivih organizmov na FFS in vse strožje okoljske politike raziskovalci iščejo nove, okoljsko bolj sprejemljive načine varstva rastlin pred škodljivimi organizmi. Eden od tovrstnih ukrepov je tudi preučevanje rastlinskih izvlečkov pri zatiranju gospodarsko pomembnih škodljivih organizmov. V raziskavi, ki smo jo opravili v okviru projekta ApPLAuSE, smo

preučevali limacidni učinek 7 rastlinskih vrst: japonski dresnik (*Fallopia japonica* [Houtt.] Ronse Decr.), češki dresnik (*Fallopia x bohemica* [Chrtek & Chrtková] Bailey), veliki pajesen (*Ailanthus altissima* [Mill.] Swingle), kanadska zlata rozga (*Solidago canadensis* L.), orjaška zlata rozga (*Solidago gigantea* Aiton), octovec (*Rhus typhina* L.) in navadna amorfa (*Amorpha fruticosa* L.) na polže iz rodu *Arion*. Cilji naših laboratorijskih in poljskih poskusov so bili ugotoviti (1) kontaktni učinek preučevanih rastlinskih vrst na lazarje; (2) uporabnost izbranih rastlinskih vrst kot ovira za lazarje; (3) učinek preučevanih rastlinskih vrst na stopnjo hranjenja lazarjev. Rezultati raziskav so pokazali, da na zmanjšano stopnjo hranjenja v največji meri vplivata obe rozgi. V poljskem poskusu smo ob hkratni uporabi ovire ter škropljenju listov solate z vodnim izvlečkom orjaške zlate rozge beležili 8 % škodo na rastlinah v primerjavi s 75 % deležem poškodb na kontrolnih rastlinah. V Sloveniji je danes pridelava mnogih gojenih rastlin ob zadovoljivi kakovosti mogoča le z uporabo FFS. Trenutni trendi v Sloveniji kažejo na zmanjševanje količine porabljenih FFS in potrebo po razvoju, optimizaciji in implementaciji novih, nekemičnih načinov zatiranja škodljivih organizmov. Mednje sodijo tudi rastlinski izvlečki invazivnih tujerodnih rastlinskih vrst, ki imajo sodeč po rezultatih dosedanjih raziskav določen potencial v okoljsko sprejemljivem varstvu rastlin.

ABSTRACT

Applicability of invasive alien plants in controlling slugs

In Slovenia, as well as worldwide, the use of pesticides in plant protection programmes is the most widespread method due to price and other benefits. Researchers are looking for new, environmentally more acceptable ways of protecting plants against harmful organisms due to adverse environmental effects of pesticides, their non-target activity, the occurrence of resistance to pesticides, and increasingly stringent environmental policies. One such measure is also the study of plant extracts in the control of economically important harmful organisms. In a study carried out within the ApPLAuSE project, we examined the molluscicidal effect of 7 plant species: knotweeds (*Fallopia japonica* [Houtt.] Ronse Decr., *F. x bohemica* [Chrtek & Chrtková] Bailey), goldenrods (*Solidago canadensis* L., *S. gigantea* Aiton), staghorn sumac (*Rhus typhina* L.), tree of heaven (*Ailanthus altissima* [Mill.] Swingle), and false indigo (*Amorpha fruticosa* L.) against *Arion* slugs. The aims of laboratory and semi-field studies were (1) the contact control efficacy of an individual use of tested substances; (2) the barrier effect of tested substances; and (3) an effect on slug eating ability of tested substances. The results of the studies have shown that the reduced rate of feeding is largely influenced by both goldenrods. In a field experiment, combined use of barriers and sprinkling of lettuce leaves with water extract of the *Solidago gigantea* resulted 8 % damage to the plants compared to 75 % of the damage in control plants. Nowadays in Slovenia, the cultivation of many plants is satisfactory only with the use of pesticides. Current trends in Slovenia indicate a decrease in the amount of spent pesticides and the need to develop, optimize and implement new, non-chemical ways of controlling harmful organisms. Among them are plant extracts of invasive alien plant species, which, according to the results of our studies, have a certain potential in environmentally acceptable plant protection.



Izkušnje pri obvladovanju ogorčic koreninskih šišk *Meloidogyne sp.* v vrtnarstvu

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Ogorčice koreninskih šišk povzročajo največ škode v Sloveniji v zaprtih prostorih, saj za svoj razvoj potrebujejo toplo okolje. Najbolj razširjena vrsta je *Meloidogyne incognita*, ki ima širok nabor gostiteljskih rastlin, med katere spadajo vse pomembnejše zelenjadnice, ki jih gojimo v plastenjakih; parazitirajo tako eno kot dvokaličnice. Zatiranje ogorčic koreninskih šišk je težavno, še posebno, če je pridelovalec vključen v ekološko pridelavo zelenjave. Naše dosedanje izkušnje obvladovanja teh škodljivcev so pokazale, da jih je izjemno težko oz. praktično nemogoče izkoreniniti iz okuženega zemljišča. Na manjših površinah, kot so zaprti prostori (plastenjaki, rastlinjaki), so na voljo nekemični ukrepi npr. parjenje zemlje, medtem ko je pridelovalcem, ki so vključeni v integrirano pridelavo zelenjave, na voljo registrirano kemično sredstvo z aktivno snovjo Dazomet. V praksi se je izkazalo, da omenjena ukrepa ne učinkujeta 100% in zato določen delež jajčec v zemlji (verjetno v globljih plasteh) preživi. Ker pa imajo ti škodljivci lahko tudi več generacij v rastni sezoni, lahko že manjše število preživelih jajčec v kombinaciji z dobrim gostiteljem še v isti rastni sezoni povrne populacijo ogorčic na predhodno raven. Uspešno obvladovanje lahko dosežemo tudi z uporabo odpornih sort paradižnika (odpornostni gen *Mi*) in paprike (gen *Me*), vendar je tu potrebna večja previdnost zaradi možnosti pojava populacij škodljivca, ki zaobidejo naravno odpornost. Od leta 2016 je v Sloveniji registriran nematocid nove generacije »Velum® Prime« (Bayer), z aktivno snovjo fluopiram. Uporablja se ga lahko v integrirani pridelavi plodovk tekom rastne dobe. Rezultati naših raziskav so pokazali, da je uporaba pripravka znatno zmanjšala nivo napada ogorčic koreninskih šišk vrste *M. incognita* pri paradižniku. Kljub vsem zgoraj naštetim ukrepom pa velja, da so najboljši ukrepi ustrezna higiena in zdrav sadilni material, ki preprečijo vnos in nadaljnje širjenje teh škodljivcev na pridelovalnih površinah.

ABSTRACT

Experiences in management of root-knot nematodes (*Meloidogyne spp.*) in vegetable production

Root-knot nematodes are causing major economic damage in Slovenian crop production in protected areas because warm environment enhances their development. The most widespread species is *Meloidogyne incognita* which has a wide host range comprising the most important vegetable crops which are cultivated in greenhouses; it can parasitize monocotyledons as well as dicotyledons. Root-knot nematodes are difficult to control especially in organic farming systems. According to our experience the pest species is difficult or practically impossible to eradicate them from the infested fields. At the smaller production areas such as protected areas (greenhouses, glasshouses) non-chemical measure of soil steaming is available, while the registered chemical agent with the active substance Dazomet is available to the growers in integrated vegetable production. It has been shown that both measures are not 100% efficient therefore a certain proportion of nematode eggs in the soil may survive (probably in deeper layers). Since these pests can have several generations in a growing season even few surviving eggs combined with a good crop host may render the nematode population to the previous level. Successful management can be achieved with cultivation of resistant tomato (*Mi* gene) and pepper (*Me* gene) varieties, however great caution is needed because emergence of virulent nematode populations that overcome the resistance is possible. The new generation nematocide "Velum® Prime" (Bayer) with an active substance fluopyram has been registered in Slovenia since 2016. It can be used in integrated production of fruit vegetables during the growing season. Our results have shown significant reduction of *M. incognita* infestation on tomatoes after Velum Prime application. Among all the management practices for RKN control, the most successful measures are still considered use of the appropriate phytosanitary measures and use of

healthy propagation material which prevent introduction and further spread of these pests at cultivated areas.



Pregled učinkovitosti delovanja apnenega dušika na koristne in patogene mikroorganizme v tleh

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Apneni dušik (kalcijev cianamid) je najstarejše dušično mineralno gnojilo. Vsebuje okrog 20 % dušika in 50 % kalcija. Zaradi njegovega značilnega delovanja se ga uvršča med specialna mineralna gnojila. Za gnojilo je značilno počasno sproščanje dušika in fitosanitarno delovanje. Veliko raziskav dokazuje, da cianamid, ki se tvori pri razgradnji gnojila do neke mere deluje v tleh insekticidno, fungicidno, herbicidno in proti mehkužcem (polžem). Mikroorganizmi so različno dovzetni na apneni dušik. Znano je, da lahko glive vrste *Aspergillus* in *Penicillium* koristijo molekule cianamida kot vir dušika pri razgradnji organskih snovi v tleh. Uporaba apnenega dušika ohranja strukturna tla in preprečuje zakisanje tal. Tako se ustvarja naravno stimulatívno okolje za delovanje in razvoj koristnih mikroorganizmov, ki zatirajo oziroma omejujejo delovanje in razvoj škodljivih organizmov. Ugotovljeno je, da običajna raba apnenega dušika ohranja raznovrstnost talnih organizmov in vpliva na njihovo sestavo in množino populacij.

ABSTRACT

Review of efficiency of calcium cyanamide on beneficial and pathogenic microorganisms in soil

Calcium cyanamide was the first artificial nitrogen fertilizer to be manufactured on an industrial scale. It contains approximately 20% nitrogen and 50% calcium. Due to its characteristic performance it is classified as special mineral fertilizer. The fertilizer is characterized by slow release of nitrogen and phytosanitary activity. Many studies prove that cyanamide, which is form during the decomposition of fertilizer, works to some extent in soil, insecticidal, fungicidal, herbicidal and against molluscs (sludge). However, microorganisms are different susceptible to calcium cyanamide. It is known that fungus *Aspergillus* and *Penicillium* can use cyanamide molecules as a source of nitrogen in the decomposition of organic matter in the soil. The use of calcium cyanamide keeps the structural soil and prevents soil acidification. This creates a natural stimulating environment for the functioning and development of beneficial microorganisms, which inhibit the functioning and development of harmful organisms. It is established that the usual use of lime nitrogen preserves the diversity of soil organisms and affects their composition and the plurality of populations.



Pri iskanju rastlinskih virusov v rastlinah z nepojasnenim vzrokom bolezenskih znamenj je postalo nepogrešljivo orodje visokozmogljivo sekvenciranje (HTS)

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Visokozmogljivo sekvenciranje HTS je generična metoda, ki omogoča sekvenciranje vseh nukleinskih kislin v najrazličnejših vzorcih (rastlinski material, vodni vzorci, zemlja, zrak). Pri pripravi vzorcev za detektiranje virusnih in viroidnih nukleinskih kislin uporabljamo različne načine obogatitve in različne tehnologije HTS. V preteklih letih smo analizirali predstavnike različnih rastlinskih vrst z nepojasnenim vzrokom bolezenskih znamenj, pri katerih s klasičnimi diagnostičnimi metodami nismo zaznali patogenih mikroorganizmov. Z uporabo bioinformatičnih orodij in postavitvijo avtomatskega delotoka, za analizo HTS smo razkrili okužbe z različnimi virusi, ki jih bomo predstavili v prispevku. Ena najpomembnejših najdb je bil virus mozaika črnega zobnika (HNV), ki je bil odkrit na novem gostitelju – paradizniku z močno izraženimi bolezenskimi znamenji, prvič v Sloveniji. Tehnologije HTS uporabljamo tudi v raziskavah okoljskih voda. Zanima nas prisotnost in infektivnost rastlinskih virusov v vodi, ki bi lahko predstavljala epidemiološko pot za okužbo rastlin v primeru uporabe takšne vode za namakanje. Virusi so v vodah prisotni v nizkih koncentracijah, zato smo pri pripravi teh vzorcev viruse v vodi najprej skoncentrirali z uporabo monolitne kromatografije CIM® (Convective Interaction Media). Bioinformatične analize rezultatov sekvenciranja vode iz čistilne naprave so pokazale širok spekter različnih virusnih nukleinskih kislin, med njimi smo zaznali nukleotidna zaporedja patogenih virusov za človeka, rastline in bakterije. Med prisotnimi rastlinskimi virusi smo potrdili infektivnost virusa blage lisavosti paprike (PMMoV), virusa mozaika paradiznika (ToMV) in virusa blagega zelenega mozaika tobaka (TMGMV) iz rodu *Tobamovirus* (družina *Virgaviridae*) na mehansko okuženih testnih rastlinah. Infektivnost teh virusov smo potrdili tako pri vzorcu vtoka kot tudi iztoka iz čistilne naprave, ki se izliva v reko iz katere se zajema voda za namakanje. HTS je v diagnostiki virusov postalo neprecenljivo orodje, ki se uporablja tako v diagnostiki in raziskavah kot tudi v certificiranju sadilnega materiala.

ABSTRACT

High-throughput sequencing became an invaluable tool for detection and discovery of plant viruses in the plants with unexplained infection symptoms

High-throughput sequencing (HTS) is a generic method, enabling sequencing of all nucleic acids in the broad range of different samples (e.g. plant material, water samples, soil and air samples). In the sample preparation process, different enrichment approaches could be used for virus and viroid nucleic acid enrichments and different HTS platforms for their detection. In past year's several plants were analysed due to unexplained infection symptoms using conventional diagnostic methods. However, no pathogenic microorganisms were detected, but with using bioinformatics tools and an automatic bioinformatics pipeline, the results of the HTS analysis revealed infections with several viruses. One of the most important findings was Henbane mosaic virus (HNV), which was found on a new host – tomato (showing severe infections symptoms) and for the first time in Slovenia. HTS technology is also used for the analysis of environmental waters. We are interested in the presence and infectivity of the plant viruses in the water, since the latter could represent a potential pathway for plant virus transmission, in the case of using that water for irrigation purposes. Viruses in water are present in low concentration, so firstly we need to concentrate them using CIM® monolithic chromatography (Convective Interaction Media). Bioinformatics analysis of the sequencing results from wastewater treatment plants revealed a broad range of different viral nucleic acids, among them; we detected nucleic acids belonging to humans, plants and bacteria viruses. Among present plant viruses, we confirmed the infectivity of Pepper mild mottle virus

(PMMoV), Tomato mosaic virus (ToMV) and Tobacco mild green mosaic virus (TMGMV) from *Tobamovirus* genus (family *Virgaviridae*) on mechanically inoculated test plants. The infectivity of those viruses was confirmed using influents and effluents of the wastewater treatment plant; the later flows into the river from which the water for irrigation purposes is used. HTS became an invaluable tool for plant virus diagnostic, and currently is used not only for the diagnostic and research but also for the certification of planting material.



Vpliv izbranih insekticidov na populacijo češpljevega kaparja (*Parthenolecanium corni* Buche) v nasadu ameriških borovnic (*Vaccinium corymbosum* L.)

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Obseg pridelave ameriških borovnic v Sloveniji narašča. V zadnjem obdobju je v določenih nasadih prišlo do prerazmnožitve češpljevega kaparja (*Parthenolecanium corni* Buche). Ker se škodljivcu v preteklosti ni posvečalo dovolj pozornosti, je zatiranje ob vedno bolj omejenem naboru insekticidov postalo zahtevno. Kaparji lahko zaradi sesanja rastlinskih sokov ob veliki populaciji povzročajo propadanje grmov, gospodarska škoda pa nastaja tudi zaradi onesnaženja pridelka z glivami sajavosti, ki se naselijo na izločeno medeno roso. Raziskava je bila izvedena v nasadu ameriških borovnic na Ljubljanskem barju, kjer je bila v zadnjih nekaj letih opažena povečana populacija češpljevega kaparja. V poskusu smo primerjali učinkovitost različnih insekticidov za zatiranje kaparja na podlagi različnih aktivnih snovi: žvepleno apnena brozga - Curatio, parafinsko olje - Frutapon, piretrin in olje navadne oljne ogrščice - Raptol koncentrat, piriprosifen - Admiral 10 EC, spirotetramat - Movento SC 100, fosmet - Spada 200 EC. Škropljenje smo opravili v pomladanskem času, takoj po koncu migracije nimf kaparjev, ko so bile borovnice v fenofazi BBCH 55-59 (prvi cvetni brsti vidni, vsi cvetovi v grozdiču so ločeni). Pred škropljenjem smo na grmih označili poganjke in na njih prešteli žive kaparje, po enem mesecu smo štetje ponovili. Iz razlike v številu kaparjev smo izračunali učinkovitost sredstev na zmanjšanje števila kaparjev, preračunanega na kontrolno obravnavanje. V obeh letih je na zmanjšanje kaparjev najbolje učinkovalo sredstvo Spada (95 in 98 % zmanjšanje). Najmanjšo učinkovitost sta imeli sredstvi Curatio (5 in 20 % zmanjšanje) ter sredstvo Admiral 10 EC (5 in 20 %). Dobro učinkovitost je imelo v nasprotju s pričakovanji tudi sredstvo Movento SC 100, ki je v prvem letu poskusa delovalo slabše, kot v drugem (71 in 98 %). Frutapon in Raptol koncentrat, sredstvi na oljni osnovi, sta v obeh letih na zmanjšanje populacije kaparjev učinkovali zadovoljivo (65-70 % učinkovitost).

ABSTRACT

Effect of selected insecticides on European fruit lecanium population (*Parthenolecanium corni* Buche) in a northern highbush blueberry (*Vaccinium corymbosum* L.) orchard

Highbush blueberry production is increasing in Slovenia. In recent years an outbreak of European fruit lecanium occurred in some orchards. Control of European fruit lecanium has become challenging due to lack of attention to the pest in past and ever smaller list of allowed insecticide substances. Large scale insect population can cause plant death and commercial value of crop is greatly reduced if covered by sooty mold growing on scales' honeydew secretion. A study was conducted in an orchard in Ljubljana marshes where a large population of European fruit lecanium was reported. Different insecticide sub-

stances- products were tested for their efficacy: lime sulphur - Curatio, paraffin oil - Frutapon, pyrethrin and rapeseed oil - Raptol koncentrat, pyriproxifen - Admiral 10 EC, spirotetramat - Movento SC 100, fosmet - Spada 200 EC. Spraying was done in spring, when plants were in BBCH stage 55 – 59. Before spraying, shoots of plants in experiment were marked and live scales were counted. The counting was repeated one month after spraying. Difference in scale number on individual shoots was translated as a proxy of insecticide efficacy. Spada showed highest efficacy in both years of the study (95 and 98 % efficacy). Lowest reduction in scale population was observed in Curatio (5 and 20 % efficacy) and Admiral 10 EC (5 and 20 % efficacy) treatments. Movento SC controlled scale insects better than expected; efficacy was higher in first year than in second (71 and 98 % respectively). Both oil based products, Frutapon and Raptol koncentrat, had decent efficacy against European fruit lecanium.



Odpornost sive plesni (*Botrytis* sp.) proti fungicidom v slovenskih nasadih jagod

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Pri pridelovanju jagod je siva plesen (*Botrytis* sp.) najbolj pogost vzrok gnitja plodov, tako v nasadih kot po obiranju. Večina pridelovalcev jagod fungicide nanaša večkrat v rastni dobi. Preprečevanje boleznih v nasadih jagod v Evropi je postalo težje zaradi pojavljanja sevov glive, ki so hkrati odporni na več aktivnih snovi iz različnih kemijskih skupin in z različnimi načini delovanja. Želeli smo ugotoviti ali je ta pojav značilen tudi za nasade pri nas. V maju in juniju 2018 smo pregledali sedem intenzivnih nasadov jagod in en nasad z ekološko pridelavo. V vsakem nasadu smo vzeli pet podvzorcev okuženih plodov in pripravili skupno 40 izolatov glive v čisti kulturi. Odpornost proti fludioksonilu (FDL) in ciprodinilu (CDL) smo določali z merjenjem prirasta gliv v mikrotitrskih ploščah v tekočem gojišču z dodatkom fungicidov različnih koncentracij, vpliv fenheksamida (FH) pa smo ocenjevali z merjenjem dolžine hif pri kalitvi trosov glive. S probit analizo smo izračunali koncentracijo EC_{50} pri kateri fungicid zavre rast glive za 50 %. Odpornost proti CDL je bila ugotovljena v vseh nasadih, razen pri ekološki pridelavi. Od 40 analiziranih izolatov je bilo 23 odpornih in 4 srednje odporni, štirje nasadi so bili brez izolatov občutljivih za CDL. Proti FDL je bila odporna ali srednje odporna polovica izolatov (19 od 38), v dveh nasadih so bili takšni vsi. Odpornost ali srednje odpornost proti CDL in FDL hkrati smo izmerili pri 19 izolatih iz sedmih nasadov, 16 od teh je bilo odpornih tudi proti FH. V enem od nasadov so bili vsi izolati odporni proti vsem trem aktivnim snovem. Hkratna odpornost proti več aktivnim snovem je torej pogosta tudi v Sloveniji zato ta pojav zahteva skrbno načrtovanje in omejitev rabe fungicidov in bolj dosledno izvajanje nekemičnih ukrepov za preprečevanje širjenja sive plesni, vključno z uporabo biotičnih pripravkov.

ABSTRACT

Resistance of *Botrytis* strains to fungicides in strawberry fields in Slovenia

Gray mold (*Botrytis* sp.) is a major pathogen in strawberry production, causing severe yield losses before and after harvesting. Fungicides against *Botrytis* are commonly applied several times per season. Disease control in European strawberry fields has become difficult due to distribution of strains resistant to more active ingredients from different chemical classes with different modes of action. Strawberry fields in Slovenia were examined to find out whether such strains occur. In May and June 2018 infected

fruits were sampled in seven fields with integrated production and in one field with organically grown strawberries. Five subsamples were collected from each field and 40 isolates in pure culture were obtained. Resistance to fludioxonil (FDL) and cyprodinil (CDL) was analysed with microtiter plate assay, where fungal growth of isolates at different concentrations of fungicides was measured. Resistance to fenhexamid (FH) was evaluated by measuring germ tube length of spores on agar plates. The concentration at which fungal growth was inhibited by 50% (EC_{50}) was calculated with probit analysis. In all fields except the field with organic production, resistance to CDL was detected. Out of 40 isolates there were 23 resistant and four intermediately resistant to CDL. In four fields no isolates sensitive to CDL were found. Half of tested isolates (19 out of 38) were resistant or intermediately resistant to FDL and in two fields no sensitive strains were detected. Resistance or intermediate resistance to both CDL and FDL was measured for 19 isolates from seven fields and 16 of them were resistant also to FH. In one field all tested isolates were resistant or intermediately resistant to all three active ingredients. *Botrytis* strains with resistance to more active ingredients were found to be distributed in Slovenian strawberry fields, therefore careful planning of the fungicide use is required. Preventive control measures need to be implemented, including biological control of gray mold.



Laser® plus, nadgradnja dobro znanega insekticida z dvakrat večjo vsebnostjo učinkovine spinosad, z razširjeno možnostjo uporabe na več kmetijskih kulturah kot tudi v ekološki pridelavi

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Učinkovina spinosad (spinosin A in spinosin B) je v slovenskem kmetijstvu dobro poznana učinkovina fitofarmaceutskih sredstev (FFS) LASER 240 SC in GF-120. Spada v novejši kemični razred insekticidov, ki se imenuje spinosini (razred 5). Učinkovina spinosad se pridobiva iz bakterije *Saccharopolyspora spinosa*, preko fermentacije njenih metabolitov. To je insekticid, ki združuje učinkovitost sintetičnih pripravkov in je hkrati dovoljen v ekološki pridelavi. Spinosad deluje dotikalno in preko prebavil. Deluje tudi na jajčeca, če so neposredno poškropljena. Čeprav je dotikalno delovanje zelo učinkovito, je delovanje preko prebavil še 5-10-krat močnejše. Spinosad ima poseben način delovanja, ki se razlikuje od vseh drugih insekticidov. Povzroči vzburljanje živčnega sistema, ki vodi k nenadzorovanemu krčenju mišic, izčrpanosti in tresavici, na koncu sledi paraliza. Ti učinki so skladni z aktivacijo nikotinskih receptojev acetilholina, vendar z mehanizmom, ki je povsem nov in edinstven med vsemi znanimi insekticidnimi spojinami. Zaradi svojega delovanja je spinosad zelo zaželen v anti-rezistenčnem programih. V letu 2018 je pridobilo registracijo sredstvo LASER® PLUS, ki vsebuje dvakrat večjo vsebnost učinkovine spinosad in ima dosti širšo registracijo in bo nadomestilo sredstvo LASER 240 SC. Dovoljenje ima za uporabo na zelenjadarskih kulturah, predvsem za zatiranje cvetličnega resarja (*Franklinella occidentalis*) in gosenic sovč iz rodu *Spodoptera* in *Heliotis*, na krompirju za zatiranje koloradskega hrošča (*Leptinotarsa decemlineata*), na pečkarih za zatiranje jabolčnega zavijača (*Cydia pomonella*), na koščičarjih za zatiranje cvetličnega resarja (*Franklinella occidentalis*), breskovega molja (*Anarsia lineatella*) in breskovega zavijača (*Cydia molesta*), na vinski trti za zatiranje cvetličnega resarja (*Franklinella occidentalis*), križastega grozdnega sukača (*Lobesia botrana*), lisaste minice (*Oxythyrea funesta*) in plodove vinske mušice (*Drosophila suzukii*), na orehah za zatiranje orehove muhe (*Rhagoletis completa*), na jagodičevju za zatiranje plodove vinske mušice (*Drosophila suzukii*) ter na okrasnih rastlinah za zatiranje cvetličnega

resarja (*Franklinella occidentalis*).

ABSTRACT

Laser® plus, the upgrade of a well-known insecticide with double content of active ingredient spinosad, with a widespread use on several agricultural crops as well as in organic production

Active ingredient spinosad (Spinosyn A and Spinosyn B) is a well-known active ingredient (a.i.) in Slovenian agriculture. It belongs to a new chemical class of insecticides called spinosyns (Class 5). A.s. Spinosad is derived from the bacterium *Saccharopolyspora spinosa*, through fermentation metabolites. This is an insecticide that combines the effectiveness of synthetic preparations and is also permitted in organic production. Spinosad works by contact and by ingestion. It's effective also on eggs, if they are treated directly. Although the contact functioning is very effectively, the ingestion functioning is 5-10 times stronger. Spinosad has a specific mode of action that is different from all other insecticides. It causes excitation of the nervous system leading to uncontrolled contraction of muscles, exhaustion and shivering, in the end followed by paralysis. These effects are consistent with the activation of nicotinic acetylcholine receptors, but with the mechanism that is completely new and unique among all known insecticidal compounds. Because of his operation spinosad is highly desirable in anti-resistant programs. Plant protection product LASER® PLUS was registered acquired the registration in 2018, with double content of the a.i. spinosad and has a much wider registration and will replace the product LASER 240 SC on the market. It has permission to be used on vegetable crops, especially for control of *Franklinella occidentalis* and caterpillars genus *Spodoptera* and *Heliotis*, *Cydia pomonella* on pome fruits, *Franklinella occidentalis*, *Anarsia lineatella* and *Cydia molesta* on stone fruits, *Franklinella occidentalis*, *Oxythyrea funesta*, *Drosophila suzukii* and *Lobesia botrana* on vine grapes, *Rhagoletis completa* on walnut, on berries and small fruits to control *Drosophila suzukii* and *Franklinella occidentalis* on ornamentals.

GIS, fitofarmacevtska sredstva in okolje

Okoljsko optimizirano upravljanje z onesnaženimi vodami na kmetijah

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Sistem Phytobac® omogoča zbiranje in mikrobiološko razgradnjo sredstev za varstvo rastlin v odpadnih vodah, ki nastanejo med polnjenjem in notranjim ter zunanjim pranjem škropilnic. Onesnaženo vodo zbiramo v zbirnem rezervoarju, iz katerega jo postopoma dovajamo v bazen za mikrobiološko razgradnjo Phytobac® sistema. Sistem Phytobac® je zaprt sistem, sestavljen iz neprepustnega bazena (betonski, kovinski ali plastičen), v katerem je mešanica substrata iz slame (zemlje) do višine približno 60 cm. Slama predstavlja vir energije za mikroorganizme, ki razgrajujejo sredstva za varstvo rastlin. Razmerje med slamo in zemljo v mešanici je 70 % zemlje in 30 % (volumski odstotek) sesekljanе slame. Za pravilno delovanje Phytobac-a® in učinkovito razgradnjo aktivnih snovi je ključnega pomena vlažnost mešanice. Optimalna vlažnost (niti presuho niti prevlažno) spodbuja mikrobiološko aktivnost. Najprimernejša vlažnost znaša 60–75 % vodne kapacitete mešanice. Sonda za merjenje vlažnosti, povezana z elektronsko krmilno enoto, omogoča optimalen dotok onesnažene tekočine iz zbirnega rezervoarja v bazen z mešanico. Enakomerno razporeditev onesnažene tekočine po bazenu izvedemo s kapljičnim sistemom. Redno mikrobiološko aktivnost ohranjamo tudi z dodajanjem organske snovi (slame). Slamo dodajamo, glede na okoljske razmere, vsakih 1–2 leti. Sistemi Phytobac® so nameščeni v več državah sveta, večino pa jih je v državah Evrope. V Franciji je sistem Phytobac® uradno priznan že od leta 2006, nameščenih pa je že 4500 sistemov Phytobac®. Poleg tega so sistemi Phytobac® nameščeni še v Avstraliji in nekaterih državah Azije in Amerike. Partnerska podjetja ponujajo že pripravljene Phytobac® sisteme za takojšnjo uporabo.

ABSTRACT

Environmental optimized on-farm effluent management with phytobac® system

The Phytobac® system allows the retention and the microbial degradation of plant protection chemicals in waste water effluents generated during filling, cleaning and washing activities of agricultural spraying equipment. The liquid remnants are captured and collected in a storage tank before entering the microbial degradation module of the Phytobac® system. The Phytobac® is a closed system consisting of a sealed container made with waterproof walls (concrete, metal or plastic) filled with a substrate composed of soil and straw to a level of about 60 cm. The straw component provides a source of energy for the microorganisms living in the substrate. By volume the mix consists of 70% soil and 30% of chopped straw. Moisture control is a key factor for the proper functioning of the Phytobac® and ensures the efficient degradation of the chemicals. The substrate is kept under optimum moisture conditions (neither anaerobic, nor too dry) in order to promote microbial life. It is recommended to maintain moisture levels corresponding to 60–75% of water capacity. A soil humidity probe combined with an electronic steering unit enables the correct effluent input from the storage buffer tank according to the local evaporation conditions. Drip irrigation allows a homogeneous liquid distribution over the substrate. Appropriate microbial activity is maintained by regular recharge of the organic matter (straw). Depending on the environmental conditions the recharge is necessary within 1–2 years. Phytobac® systems are installed on a worldwide level. Most Phytobac® systems are installed in European countries. In France, the Phytobac® concept is recognised by the authorities since 2006. Meanwhile more than 4500 systems are implemented in France. Partner companies offer ready-to-use kits. Meanwhile Phytobac® systems are installed in Asia, Australia and American countries.



Testiranje učinkovitosti Biobed-Biofilter naprave za čiščenje vode od pranja škropilnic

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V letih 2017 in 2018 smo izvedli testiranje delovanja naprave, ki je bila v okviru stewardship programov podjetja BASF Slovenija postavljena na živinorejsko-poljedelski kmetiji. Naprava je klasificirana kod hibridni sistem Biobed-Biofilter. S fitofarmaceutskimi sredstvi (FFS) onesnažena voda, ki se sprosti pri pranju škropilnic, se zbira v rezervoarju in se ciklično vse leto prečrpava skozi kontejnerje, ki so napolnjeni z mešanico zemlje, šote in slame. V mešanici poteka mikrobna razgradnja aktivnih snovi (AS), na površju mešanice pa poteka evaporacija vode. Analizirali smo dinamiko razpadanja 50 AS FFS, obseg tedenske evaporacije vode in opravili izračune kapacitete naprave v pogledu števila pranj škropilnic, ki jih lahko izvedemo letno. Razpad AS je dokaj počasen, saj je pri večini aktivnih snovi stopnja razpada v letu dni bila med 50 in 70 %. Predstavljene so dobre in slabe tehnične plati delovanja naprave.

ABSTRACT

Testing the Biobed-Biofilter Device for Purification of water released at Cleaning of Sprayers

During the years 2017 and 2018, we tested the performance of a plant which was built on a livestock farm as part of a BASF Company stewardship program. The device is classified as the hybrid system Biobed-Biofilter. By plant protection products (PPP) contaminated water released during sprayer washing is collected in a tank and cycled throughout the year through containers filled with a mixture of soil, peat and straw. In the mixture, microbial decomposition of the pesticide active substances (AS) takes place and water evaporates from the surface of the mixture. We analysed the dynamics of the decomposition of 50 AS, the volume of weekly water evaporation and performed calculations of the capacity of the device in terms of the number of sprayer washing cycles that can be carried out annually. The breakdown of AS was fairly slow, as for most active substances, the established rate of decay was between 50 and 70% per year. Strong and weak technical aspects of the device are presented.



»Product stewardship« aktivnosti – skrb za sredstva za varstvo rastlin

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»Product Stewardship« aktivnosti podjetja Bayer obsegajo odgovorno in etično spremljanje sredstev za varstvo rastlin skozi njihov življenjski cikel od razvoja do končne uporabe in odstranjevanja prazne embalaže ter ostankov sredstev za varstvo rastlin. Zagotavljajo razpoložljivost zanesljivih sredstev za varstvo rastlin in najboljše prakso njihove uporabe z namenom, da dosežemo največjo učinkovitost in

preprečimo potencialno onesnaženje okolja ali zastrupitve ljudi na najmanjšo možno stopnjo. Vključujejo obsežno vlaganje v raziskave o varnosti in učinkovitosti sredstev, razvoj najprimernejših pakiranj sredstev in tehnik varstva rastlin, promocijo odgovorne uporabe in aktivnosti na področju preprečevanja uvoza, trgovanja in uporabe ponarejenih in ostalih nedovoljenih sredstev za varstvo rastlin. Aktivnosti so usklajene z mednarodnimi predpisi o odličnosti pri ravnanju med distribucijo in uporabo SVR. So osnova za aktivnosti na področju varstva rastlin po najvišjih standardih kakovosti, kar je eden od pogojev za kmetovanje po načelu trajnostnega kmetijstva.

ABSTRACT

»Product stewardship« activities – care for plant protection products

Product Stewardship is the responsible and ethical management of a product throughout its life-cycle, from its invention through its ultimate use and beyond. Product Stewardship ensures the availability of high quality products and best practices for the product use in order to maximize product potential and to minimize any risks to human health and the environment. Bayer's Product Stewardship activities include: extensive investment in safety and quality testing of products; the development of improved packaging solutions and crop production techniques; the development of new technologies for improved seed varieties; the provision of support services to promote responsible product use and initiatives against production, import, trade and use of counterfeit and illegal Crop Protection Products. The activities are in line with international regulations on excellence in the handling of the distribution and use of the SVR. Bayer, as industry leader, is committed to Product Stewardship as an integral part of activities, in line with the principles of Sustainable Development and responsible care.



Ilustracija potencialne rabe multispektralnega slikanja z brezпилotnim letalnikom pri oceni fungicidnega poskusa v pšenici

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Pri preizkušanju učinkovitosti fitofarmaceutskih sredstev in oceni njihovega delovanja pretežno uporabljamo vizualne ocene pojavnosti določenega škodljivega organizma ali poškodb, ki jih povzroča in le redko merljive lastnosti rastlin. Multispektralno slikanje vegetacije meri odboj posameznega dela svetlobnega spektra in med ostalim omogoča zaznavanje upada fotosintetsko aktivne listne površine, ki je rezultat širjenja določene glivične bolezni na listih rastlin. Uporabnost multispektralnega slikanja pri oceni učinkovitosti fungicidov smo preizkusili na mikro poskusu v pšenici, v katerem smo preverjali učinkovitost devetih fungicidnih kombinacij za zatiranje pšenične listne pegavosti (*Zymoseptoria tritici*) ter fuzarioz klasa (*Fusarium* sp.). Slikanje poskusa smo izvedli 14 dni po zadnji terenski oceni pojavnosti bolezni in hkrati določili položaj poskusnih parcel z GNNS sprejemnikom centimetrske natančnosti. S programsko opremo Pix4D smo posnetke ustrezno obdelali ter izračunali 12 vegetacijskih indeksov. Izračun vrednosti indeksov posamezne poskusne parcele smo opravili z ArcGIS programsko opremo ter jih statistično ovrednotili s programom StatGraphics Centurion XVI. Statistično značilne razlike v pojavnosti pšenične listne pegavosti med fungicidnimi obravnavanji so pokazali vsi obravnavani indeksi, razlike pa so najbolj poudarili odboj v robnem rdečem pasu ter indeksa GNDVI in MSAVI. Razvrstitev učinkovitosti fungicidnih kombinacij na osnovi multispektralnega slikanja je bila enaka razvrstitvi z vi-

zualno oceno. Rezultati multispektralnega slikanja niso uspeli ustrezno oceniti pojavnosti fuzarioz klasa.

ABSTRACT

Illustration of potential use of multispectral imaging by drone in evaluation process of fungicide trial in wheat

When testing the efficacy of plant protection products and assessing their performance, the visual estimates of the occurrence of a particular harmful organism and the rarely measurable properties of plants are used to a greater extent. Multispectral imaging of vegetation measures the reflection of an individual part of the light spectrum, and among other things, it permits detection of a decrease in the photosynthetic active leaf surface resulting from the spread of a certain fungal disease on the leaves of plants. The application of multispectral imaging in assessing the efficacy of fungicides was tested on a micro-trial in wheat. In the micro trial, the effectiveness of nine fungicidal combinations for the control of wheat leaf spot (*Zymoseptoria tritici*) and fusariosis of class were tested (*Fusarium* sp.). The imaging of experiment was carried out 14 days after the final field assessment of the incidence of the disease, on 21 June, and at the same time the position of experimental plots was determined with a GNSS receiver of centimeters accuracy. With the Pix4D software, the recordings were properly processed and 12 vegetation indices were calculated. The calculation of the value of the indices of each experimental plot was performed with ArcGIS software and was statistically evaluated with the StatGraphics Centurion XVI program. Statistically significant differences between fungicidal treatments and the assessment of the appearance of wheat leaf spot were shown by all the indexes analyzed, and the differences were mostly emphasized by the reflection in the red edge belt and by the indices GNDVI and MSAVI. The classification of the efficacy of fungicidal combinations based on multispectral imaging was the same as the field rating. The results of multispectral imaging failed to adequately assess the incidence of fusariosis of the ears of wheat.



Princip rada i primjena automatske agrometeorološke postaje

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Danas su potrebe za proizvodnjom hrane sve veće i taj će se trend nastaviti zbog globalnog rasta populacije. Realno je to bio potreba od kada je i poljoprivrede ali za razliku od nekad, danas se suočavamo s klimatskim promjenama, te smo dostigli do točke gdje sve više shvaćamo negativne posljedice pesticida na ljudsko zdravlje. Također da bi poljoprivredni proizvođači bili što konkurentniji na tržištu, potrebno je postizati veći prinos po jedinici površine i dobivati kvalitetniji proizvod a da pri tome se utroši isto ili manje resursa. S novim tehnologijama dolazi i precizna poljoprivreda koja između ostalog uključuje i agrometeorološke postaje. One su namijenjene vinogradarima, voćarima, ratarima, povrtlarima, rasadničarima a stanice također koriste i savjetodavne službe u poljoprivredi a u svrhu istraživanja, stanice koriste i agronomski fakulteti i instituti. One služe za mjerenje mikroklimatskih parametara kako bi se agrotehnika što racionalnije i pravovremeno primijenila. Ugrađeni algoritmi u software-u izračunavaju mogućnosti razvoja biljnih bolesti, štetnika i vodne bilance u tlu kako bi se što preciznije odredio trenutak zaštite bilja ali i količina vode prilikom navodnjavanja. Tvrtka Pinova d.o.o. je smještena u Čakovcu, Hrvatskoj, a bavi razvojem i proizvodnjom agrometeoroloških postajama (PinovaMeteo).

ABSTRACT

Working principle and application of automatic agrometeorological station in plant protection

The demand for food is increasing each day and the trend will continue as a result of the increasing world population. Demand for food is growing since food production began, but unlike before, we are facing continuing climate change at the same time we have a greater knowledge of the negative effects of pesticide on human health. To make agricultural producers more competitive in the market it is necessary to achieve higher yields per unit area and to obtain a high-quality product while spending the same or fewer resources. With the development of new technologies precision agriculture has gained another decision-making tool that includes agrometeorological stations. They are used by fruit growers, vine producers, vegetable growers, nurseries and farmers, regardless of whether they are in ecological, integrated or conventional farming. Agricultural faculties and institutes without information on microclimatic conditions would not be able to carry out their field research. State advisory services on the basis of measured meteorological data announce warnings and share advice with their users, who further pursue agrotechnical operations. Measured and processed data allows to precisely determinate the time of treatment with pesticides, setting of the time and the amount of water for irrigation, application of agrotechnical measures after frost or other extreme climatic conditions, and also, with proper usage it is possible to achieve significant savings on pesticide as well as tractor and human work rationalization. Forecast models of plant diseases are of great help in plant protection planning. Pinova d.o.o. is a technology company based in Čakovec, Croatia that develops and produces professional agrometeorological stations (PinovaMeteo).



Projekt Applause: informacijski sistem za popis invazivnih rastlin in izvajanje delovnih nalogov

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V projektu Applause se preučuje koristnost uporabe tujerodnih invazivnih rastlin v smislu izvajanja krožnega gospodarstva, z njihovo predelavo v različne izdelke kot so npr. barvila, insekticidi, papirni in lesni izdelki in drugo. Kot projektni partner razvijamo spletne in mobilne aplikacije, ki ažurno posodablajo skupno bazo tujerodnih invazivnih rastlin in delovnih nalogov, preko katerih se izvaja nabiranje, oziroma odstranjevanje rastlin. Aplikacije pomagajo povezovati strokovne popisovalce, izvajalce del zbiranja (odstranjevanja) rastlin, organizatorje delovnih nalog ter javnost. Strokovnjaki preko mobilne aplikacije kartirajo področja tujerodnih invazivnih rastlinskih vrst opisanih s strokovnimi parametri. Organizatorji dela imajo pregled nad opravljenimi popisi, kar omogoča enostavno iskanje potrebnih surovin (vrst rastlin) in tako izvedbo nalog odstranjevanja ali monitoringa rasti invazivnih rastlinskih vrst. Izvajalci odstranjevanja preko mobilne aplikacije označijo izvedenost posega in obseg ter sliko rastišča po izvedenem posegu. K ažurnosti stanja baze in izvajanja nalog poleg strokovnjakov in izvajalcev lahko prispeva tudi javnost. Preko namenske aplikacije je tudi javnosti omogočeno prijavljanje lokacij invazivnih rastlin, ki jih nato pregledajo strokovni popisovalci in nadaljujejo postopek. V prispevku bodo predstavljeni aplikativni moduli, pripravljeni za projekt in tudi druge primere z geografsko vizualizacijo podprtih informacijskih sistemov, ki omogočajo enostavno združevanje dela v pisarni in na terenu.

ABSTRACT

Project Applause: invasive alien plant species information system

Project Applause addresses potential usage of invasive alien plant species for various useful products such as dyes, insecticides, paper and wooden products, all in order to support the concept of circular economy. As a project partner, we develop web and mobile applications that assure up-to-date status of central database of invasive alien plant species and work orders that are used for plant collection and removal. The applications support collaboration of experts doing the plants survey, companies involved in plants removal, managers organising the work and public. Experts use mobile applications to map areas with alien invasive plant species. Organizers are able to find required resources (plant species) for products and create work orders to organize their collections or growth monitoring. When plants are removed, workers enter the new work order status, plant data and photo via the mobile application. To assure completeness and raise the general awareness, citizens may also report locations with alien invasive plants. These data are reviewed by experts before they are added to the database along with other data. The presentation will show application modules prepared for the project and some other examples of information systems with strong geographical support that unify and simplify field and office work.

Varstvo vinske trte

Sivanto prime – nov insekticid na slovenskem trgu

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Na trgu sredstev za varstvo rastlin se soočamo s številnimi izzivi, med njimi pa sta zagotovo največja številne prepovedi uporabe zaradi zaostrene zakonodaje in pomanjkanje novih učinkovin. Registracija pripravka Sivanto Prime je zagotovo dobrodošla novost na slovenskem trgu. Gre za nov sistemski insekticid za zatiranje problematičnih škodljivcev v sadjarstvu, vinogradništvu in vrtnarstvu. Pripada novi kemični skupini butenoidi, aktivna učinkovina pa se imenuje flupiradifuron. Aktivna snov ima nov mehanizem delovanja, ki se bo lepo vključil v programe antirezistentne strategije in programe integriranega varstva. Zagotovo ga bodo najbolj veseli vinogradniki, saj je dobil registracijo za zatiranje ameriškega škržatka (*Scaphoideus titanus*) in zelenega škržatka (*Empoasca vitis*). Ima široko registracijo v več kot 15 kulturah, kratko karenco (tudi 3 dni) pa bodo pozdravili tudi pridelovalci vrtnin, okrasnih rastlin in sadjarji.

ABSTRACT

Sivanto prime – New Insecticide on the Slovenian Market

We are faced with many challenges on the market of plant protection products; ban on the use due to stricter legislation and lack of new active substances are certainly the most important ones. Registration of Sivanto Prime is surely a welcome development on the Slovenian market. It is a new systemic insecticide for pest control in fruit production, wine-growing and horticulture. It belongs to a new chemical group of butenoides and the active substance is called flupyradifurone. It has a new mechanism of action which will fit in our programs of anti-resistant strategies and integrated protection. Winegrowers will definitely be very pleased because it was granted the authorisation for control of American grapevine leafhopper (*Scaphoideus titanus*) and green leafhopper (*Empoasca vitis*); vegetable, ornamental plant and fruit growers will also welcome a broad registration for more than 15 crops, with a short waiting period (also 3 days).



Občasno pojavljanje bakterijskega ožiga vinske trte (*Xylophilus ampelinus*) in vpliv na pridelavo občutljivih sort grozdja v Sloveniji

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S precejšnjo verjetnostjo lahko trdimo, da se je bakterijski ožig vinske trte (*Xylophilus ampelinus*) na Primorskem, predvsem v Vipavski dolini pojavljal že v petdesetih in šestdesetih letih prejšnjega stoletja, čeprav povzročitelj takrat še ni bil znan. Kasneje se je bakterioza pojavljala še večkrat, na območju Goriških Brd (Vedrijan od leta 1985 do leta 2002 in Višnjevnik 1994) in v Vipavski dolini (Brdo pri Dornberku in Šmarje 1986). Primer pojava bakterijskega ožiga vinske trte je bil zabeležen tudi v Beli krajini (Vidošiči 1987 – 1988). Povzročitelj obolenja je bil dokončno potrjen v letu 2004. Z močnejšim pojavom

bakterijskega ožiga na vinski trti smo se ponovno soočili v letih 2017 in 2018 in sicer v Šmartnem in ponovno na območju Višnjevika v Goriških Brdih). Omenjena bolezen negativno vpliva na pridelavo občutljivih vinskih sort, kar je še posebej vidno pri pridelavi sorte rebula.

ABSTRACT

Occasionally occurrence of canker of grapevine (*Xylophilus ampelinus*) and influence on the cultivation of sensitive grape varieties in Slovenia

With a considerable probability we can claim that the canker of grapevine (*Xylophilus ampelinus*) in the Primorska region, especially in the Vipava valley, appeared already in the fifties and sixties of the last century, although the pathogen was not identified at the time. Later, bacteriosis appeared several times in the area of Goriška Brda (Vedrijan from 1985 to 2002 and Višnjevnik 1994) and in the Vipava valley (Brdo pri Dornberku and Šmarje 1986). Occurrence of canker of grapevine was also recorded in Bela krajina (Vidošiči 1987 - 1988). The disease causing agent was finally identified in 2004. The stronger occurrence of canker of grapevine was found in 2017 and 2018 in Šmartno and again in the area of Višnjevnik in Goriška Brda). This disease has a negative effect on the production of sensitive wine varieties, which is particularly evident in the cultivation of the Rebula variety.



Kakovost nanosa pri preizkušanju dveh pršilnikov v sadovnjaku in vinogradu

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Na kmetiji Levak smo v letu 2017 preizkušali pršilnik z aksialnim ventilatorjem Myers DA 600. Ugotavljali smo kakovost nanosa pri škropljenju jablanovega nasada pri različnih hitrostih škropljenja in pri uporabi različnih šob. Sorta je bila Gala na podlagi M9. V članku bodo predstavljeni rezultati glede odstotka pokritosti in števila odtisov kapljic na 1 cm² pri različnih nastavitvah na pršilniku. V letu 2018 smo na kmetiji Karlovček opravili škropljenje s pršilnikom z dvema aksialnima ventilatorjema Zupan DT, ki je bil opremljen z elektrostatiko. Poskuse smo opravljali v vinogradu za pridelavo vina kot tudi za pridelavo namiznega grozdja. V vinogradu z namiznimi sortami grozdja je bila postavljena mreža za varovanje pred insekti. Pri preizkušanju pršilnika smo spreminjali tip šobe, vrtilno frekvenco priključne gredi traktorja, tlak in vozno hitrost škropljenja. Poleg tega smo pri določenih poizkusih imeli vklopljeno elektrostatiko, pri določenih poizkusih pa ne. Preizkusili smo tudi škropljenje vsake druge vrste z uporabo elektrostatike.

ABSTRACT

Deposit quality when testing orchard sprayers in orchard and vineyard

On Levak farm in 2017 we tested orchard sprayer with axial fan Myers DA 600. Deposit quality was determined when spraying apple orchard at different spraying speeds and by the use of different nozzles.

The apple cultivar was »Gala« grown on M9 rootstock. Results regarding coverage value and droplet impression number per cm² will be presented in the article by different adjustments of the orchard sprayer. In the year 2018 spraying was done on the Karlovček farm using two axial fan orchard sprayer Zupan DT, which was equipped with electrostatics. Trials were set in the vineyard for the wine production and in the vineyard for the direct consumption of the fresh grapes. In the vineyard with the cultivars for direct consumption the insect protection net was set. When testing the orchard sprayer the nozzle type, rotational frequency of tractor's p.t.o., spraying pressure and driving speed was changed. Furthermore by some trials the electrostatics was switched on, by other trials not. We also tested the spraying of each second row with the use of electrostatics.



Novosti v prodajnem programu podjetja KARSIA, Dutovlje, d.o.o. za varstvo vinske trte pred boleznimi in škodljivci

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V sezoni 2019 bo podjetje KARSIA, Dutovlje, d.o.o. vinogradnikom ponudila kar nekaj novih sredstev za varstvo vinske trte in to štiri fungicide, en insekticid in metodo konfuzije.

Nova sredstva, ki bodo na razpolago:

CUSTODIA, sistemski fungicid s preventivnim in kurativnim delovanjem, ki vsebuje aktivni snovi azoksistrobin in tebukonazol. Uporablja se na trti za pridelavo vinskega grozdja za zatiranje oidija vinske trte in v oljni ogrščici za zmanjšanje okužb z belo gnilobo.

REBOOT, sistemski fungicid za zatiranje rastlinskih bolezni na trti za pridelavo vinskega in namiznega grozdja in v krompirju. Vsebuje učinkovini *zoksamid* in *cimoksanil*. Uporablja se na trti za pridelavo vinskega in namiznega grozdja za zatiranje peronospore vinske trte in na krompirju za zatiranje krompirjeve plesni.

SPIROX D, sistemski in preventivni fungicid z omejenim kurativnim delovanjem. Vsebuje dve učinkovini, in sicer spiroksamin in difenokonazol. Uporablja se na trti za pridelavo vinskega in namiznega grozdja za zatiranje oidija in črne grozdne gnilobe.

FOLPAN GOLD (prej Ridomil gold combi pepite), sistemski preventivni in kurativni fungicid. Vsebuje učinkovini metalaksil-M in folpet. Njegova izredna možnost peripetalnega premeščanja učinkovine metalaksila omogoča odlično preventivno in kurativno varstvo na novo zraslih mladice oziroma vseh zelenih delov trte. Uporablja se na trti za pridelavo vinskega grozdja za zatiranje peronospore vinske trte.

LASER PLUS, nadgradnja dobro poznanega insekticida z dvakrat večjo vsebnostjo učinkovine spinosad, z razširjeno možnostjo uporabe na vinski trti za zatiranje grozdnih sukačev, lisaste minice in vedno večjega problema – plodove vinske mušice.

ISONET L plus, metoda konfuzije križastega in pasastega grozdnega sukača.

ABSTRACT

New plant protection products in sales program of the company KARSIA, Dutovlje, d.o.o. for protection grape vine from diseases and pests

In the season 2019 the company KARSIA, Dutovlje, d.o.o. will offer vine growers some new products for the protection of the vine grape. In the offer will be four fungicides, one insecticide and one method

of matting disruption. New products that will be available:

CUSTODIA, a systemic fungicide with preventive and curative action, containing the active substances *azoxystrobin* and *tebuconazole*. It can be used on the vine grape against powdery mildew and on oil seed rape to reduce the infection with white rot.

REBOOT, a systemic fungicide for control of plant diseases on the grapevine for the production of wine and table grapes and in potatoes. It contains the active ingredients *zoxamide* and *cymoxanil*. It is used on the vine for the production of wine and table grapes to control downy mildew and on potatoes for control of potato blight.

SPIROX-D, a systemic and preventive fungicide with limited curative action. It contains two active substances, *spiroxamine* and *diphenconazole*. It is used on the vine for the production of wine and table grapes for the control of powdery mildew and black grape rot.

FOLPAN GOLD (formerly Ridomil gold combi pepite), systemic preventive and curative fungicide. It contains the substances *metalaxyl-M* and *folpet*. It has a very strong peripetal movement of the metalaxyl active substance provides excellent preventive and curative care for new grown green parts of the vine. It is used on the vine for the production of wine grapes to control downy mildew.

LASER PLUS, the upgrade of a well-known insecticide with doubled active ingredient *spinosad*, with an extended use on a vine for controlling European grapevine moth, leafy mince and a growing problem - spotted wing drosophila.

ISONET L plus, a matting disruption method of European vine grape moth.



Alternativna metoda za preprečevanje poškodb brstov vinske trte od gosenic rjavega trakarja (*Noctua pronuba* [Linnaeus, 1758])

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Gosenice metuljev sovč so v vinogradih jugovzhodne Slovenije občasni škodljivci, ki lahko v posameznih letih povzročijo obsežne poškodbe brstov. V zadnjem desetletju se je za prevladujočo škodljivo vrsto pokazal rjavi trakar (*Noctua pronuba* [Linnaeus, 1758]), medtem ko sta mali rumeni trakar (*Noctua comes* Hübner, 1813) in blede trakar (*Noctua fimbriata* [Schreber, 1759]) zabeleženi le občasno. Z namenom zmanjšanja prihodnjih škod smo spomladi 2017 in 2018 v vinogradu pri Novem mestu preizkusili učinkovitost metode 'odvrni in privabi'. Pri alternativnem pristopu varstva smo gosenice od brstov odvrčali z zapraševanjem šparonov in debla vinske trte z mešanico žvepla in apna, v hranjene na podrasti medvrstnega prostora pa smo jih privabljali s sladkorno raztopino. V teh letih smo podrobno spremljali tudi razvoj škodljivih vrst.

ABSTRACT

Alternative method to prevent grapevine buds damage by the large yellow underwing caterpillars (*Noctua pronuba*) [Linnaeus, 1758])

Noctuid moth caterpillars are in vineyards of south-eastern Slovenia occasional pests, which can in certain years cause an extensive damage on buds. The Large Yellow Underwing (*Noctua pronuba* [Linnaeus, 1758]) appears to be predominant pest through last decade, while the Lesser Yellow Underwing (*Noctua comes* Hübner, 1813) and the Broad-bordered Yellow Underwing (*Noctua fimbriata* [Schreber,

1759]) are recorded only occasionally. To reduce the future damage, we tested the efficiency of ‘push and pull’ method during the spring of 2017 and 2018 in a vineyard near Novo mesto. In this alternative approach to vine protection, we diverted caterpillars from the buds by dusting the canes and grapevine trunks with a mixture of sulphur and lime, while attracted them to feed on undergrowth between the rows with sugar solution. In these years we also closely monitored the development of pest species.



Molekulska raznolikost fitoplazme ‘*Candidatus Phytoplasma solani*’ v slovenskih vinorodnih deželah

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Fitoplazma '*Candidatus Phytoplasma solani*' povzroča navadno trsno rumenico, katere posledica je velika gospodarska škoda v vinogradništvu po vsem svetu. V tej raziskavi smo z večlokusno sekvenčno tipizacijo raziskali molekulsko raznolikost te fitoplazme v vinogradih v slovenskih vinorodnih deželah in določili časovno in geografsko pojavljanje genotipov *tuf*, *secY* in *stamp*. Rezultate smo primerjali z rezultati iz drugih evropskih študij in določili možno pot širjenja navadne trsne rumenice med Slovenijo in okoliškimi državami.

ABSTRACT

Molecular diversity of ‘*Candidatus Phytoplasma solani*’ in Slovenian wine regions

‘*Candidatus Phytoplasma solani*’ is a causing agent of bois noir disease, which causes great global economic loss in viticulture. In this study, detailed insight into the molecular diversity of ‘*Ca. P. solani*’ isolates was estimated by a multilocus sequence typing, based on analysis of the genomic regions of *tuf*, *secY* and *stamp*. By analyzing their occurrence in Slovenia on a geographical and time scale and then comparing the results with similar analyzes in Europe, we determined the possible pathway of spreading of bois noir between Slovenia and its neighboring countries.

Posterji

Biotično zatiranje polžev v solati in kumarah s pripravkom na podlagi parazitskih ogorčic

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Polži v zadnjih letih povzročajo čedalje večjo škodo v kmetijski rastlinski proizvodnji. Zaradi omejevanja rabe pesticidov kot je metaldehid (limacid), je postalo nujno iskanje novih, za okolje varnejših pristopov zatiranja polžev. Metaldehid je na seznamu fitofarmaceutskih sredstev, ki se bodo v EU morala prenehati uporabljati zaradi neželenih učinkov na zdravje ljudi in okolje. Za enega uspešnih načinov biotičnega zatiranja polžev se je v tujini že izkazala uporaba parazitskih ogorčic *Phasmarhabditis hermaphrodita*. Vrsta *P. hermaphrodita* parazitira in ubije več vrst golih polžev. V Sloveniji pripravkov na osnovi *P. hermaphrodita* ni mogoče uporabljati po trenutno veljavni zakonodaji, saj je omenjena vrsta ogorčic uvrščena na seznam tujerodnih vrst koristnih organizmov (Pravilnik o biotičnem varstvu rastlin). V rastni sezoni 2018 smo izvedli poskus zatiranja polžev rodu *Arion* pri populacijski gostoti približno 100 polžev / m². Poskus je bil opravljen v mikroparcelah na rastlinah solate in kumar. V enoletnem preverjanju delovanja je biotični pripravek Phasmarhabditis-System (Biobest, Belgija) pokazal zmanjšanje poškodb na solati in večje preživetje kalic rastlin kumar kot kontrolno obravnavanje brez limacida, vendar manjšo učinkovitost kot kemični limacid na osnovi metaldehida. V mikroparceli z biotičnim pripravkom je vzniknilo 62,5 %, v mikroparceli s kemičnim limacidom 87,5 %, v mikroparceli brez zatiranja polžev pa kumare niso vzniknile. Na kontrolni mikroparceli (brez zatiranja) je bila tako opažena 100 % škoda zaradi polžev, ker so bile vse kalice popolnoma požrte. Statistično značilne razlike v skupni teži pridelka solate niso bile zaznane med biotičnim pripravkom in kemičnim limacidom, so pa bile med biotičnim pripravkom in kontrolo ter tudi med kemičnim limacidom in kontrolo. Statistično značilne razlike v tržni teži pridelka solate so bile zaznane med vsemi tremi obravnavanji: največja je bila tržna teža pridelka solate pri uporabi biotičnega pripravka, najmanjša pa pri kontroli. Zahvala: finančna podpora s strani ARRS in MKGP (V4-1602).

ABSTRACT

Biological control of slugs in lettuce and cucumbers with a commercial product based on parasitic nematodes

Slugs are causing incising damage in agricultural plant production. As chemical pesticides have deleterious effects on human health and environment many are being banned or their use restricted. Chemical limacid metaldehyde is on the list of plant protection products that will soon be banned in the EU. Therefore it is vital to replace it with environment-friendly approach of slug control. Slug parasitic nematodes *Phasmarhabditis hermaphrodita* have already been demonstrated as useful in biological control of slugs. *P. hermaphrodita* can parasite and cause death of several slugs species. In Slovenia products based on *P. hermaphrodita* can't be used in accordance with the current legislation since this species is on the list of non-native species of beneficial organisms. In 2018 we have tested different approaches to control slugs of genus *Arion* at a population density of about 100 slugs / m². The experiment was carried out in microplots on lettuce and cucumber plants. In a one-year performance test the biological product Phasmarhabditis-System (Biobest, Belgium) showed a reduction of damage on lettuce and a greater survival of cucumber plants compared to control treatment without slug control, but was less effective than chemical limacid based on metaldehyde. In the microplot treated with the biological preparation 62.5% of the cucumbers emerged, in the one with chemical limacid 87.5%, while in the microplot without any slug control treatment no cucumbers developed. Hundred percent damage due to the slugs was observed in the control microplot (without slug control), because all the germs were fully eaten. Statistically significant differences in the total weight of the lettuce were not observed between the biological and the chemical treatments, but they were detected between the biological and control treatments, and

also between the chemical and control treatments. Marketable portion of lettuce weights were statistically significantly different among all three treatments: the largest marketable weight of lettuce was in the treatment with biological control, and the smallest in treatment without slug control. Financially supported by ARRS and MKGP (V4-1602).



Spremljanje razširjenosti ogorčic koreninskih šišč v Sloveniji v zadnjem petletnem obdobju (2014-2018)

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Ogorčice koreninskih šišč med vsemi rastlinsko parazitskimi ogorčicami povzročajo največjo ekonomsko škodo. Omenjene ogorčice na koreninah gostiteljskih rastlin povzročajo zadebelitve oz. šiške, kar vpliva tako na rast, kot tudi na razvoj rastlin ter posledično na izpad pridelka rastlin. V svetu beležijo zaradi napada teh škodljivcev kar 5% izpad pridelka na leto. Njihovo zatiranje je zelo težavno; velik nabor gostiteljskih rastlin onemogoča kolobar, nekemične metode niso dovolj učinkovite, varnih kemičnih sredstev-nematocidov pa je malo. Zgodnje odkrivanje ogorčic ter informiranje širše javnosti je ključnega pomena za preprečevanje njihovega širjenja ter ohranjanje številčnosti populacij v tleh na neškodljivi ravni. Od leta 2014 na Kmetijskem inštitutu Slovenije intenzivno spremljamo prisotnost teh škodljivcev tako v zaprtih prostorih, kot tudi na prostem. Vzorčenje je potekalo v sklopu EUPHRESKO projektov ter programa preiskav škodljivih organizmov (UVHVVR). Razširjenost posameznih vrst ogorčic smo spremljali na kmetijskih površinah zasejanih z zelenjadnicami, krompirjem ter v trajnih nasadih kivija v pet letnem obdobju (2014 – 2018). V tem času je bilo analiziranih 646 vzorcev; od tega jih je bilo 192 pozitivnih na prisotnost ogorčic rodu *Meloidogyne*. Raziskava je pokazala, da je pri nas najbolj razširjena vrsta *M. hapla*, sledijo ji vrste *M. incognita*, *M. arenaria* ter *M. luci*; slednja je na EPPO opozorilnem seznamu škodljivih organizmov. Identifikacija vrst je potekala po metodi izoencimske gelske elektroforeze (PhastSystem, Pharmacia). Ugotovili smo, da je vrsta *M. hapla* prisotna na kmetijskih površinah v zaprtih prostorih, kot tudi na prostem po celi Sloveniji. Medtem ko so vrste *M. incognita*, *M. arenaria* in *M. luci* razširjeni le v zaprtih prostorih, kjer poteka intenzivna pridelava plodovk ter drugih vrtnin, ki so dobri gostitelji teh škodljivcev. Opažamo, da skupno število lokacij s prisotnostjo ogorčic koreninskih šišč z leti narašča, vendar znatnega izpada pridelka zaradi napada ogorčic koreninskih šišč v Sloveniji še ne beležimo. Zahvala: finančna podpora s strani ARRS (P4-0072, MR 38128) in MKGP (C2337).

ABSTRACT

Monitoring the distribution of root knot nematodes in Slovenia in the last five-year period (2014-2018)

The group of root knot nematodes (RKN) causes the greatest economic damage among all plant parasitic nematodes. RKN elicit the development of the root-knots or galls on the host plant roots, which effect growth and plant development and consequently cause crop loss. This group of pests is responsible for 5% of the global crop losses every year. Control of RKN is very difficult; large ranges of host plants prevent successful crop rotation; the non-chemical management methods are not very effective, while only few safe chemicals-nematocides are available. The early detection of nematodes and rising awareness of the general public are paramount for preventing their spread and keeping abundance of the pop-

ulations in the soil below economic threshold. Since 2014 an intensive monitoring of these pests at the indoor and outdoor production areas was launched at the Agricultural institute of Slovenia. The sampling was carried out in the framework of EUPHRESKO projects and the UVHVVR program monitoring of harmful organisms. Distribution of RKN species was monitored during a five year period (2014 - 2018) at the agricultural areas planted with vegetables, potato and at the permanent plantations of kiwifruit. During this period 646 samples were analyzed, of which 192 were positive for the presence of RKN. The survey revealed that the most widespread RKN species is *M. hapla*, followed by *M. incognita*, *M. arenaria* and *M. luci*; the latter is included on the EPPO alert list of harmful organisms. The method of isoenzyme gel electrophoresis (PhastSystem, Pharmacia) was used for species identification. Our monitoring revealed that *M. hapla* is distributed across the whole Slovenian territory at the enclosed areas as well as at the open fields. Whereas the species *M. incognita*, *M. arenaria* and *M. luci* are present only at the enclosed areas with intensive production of fruit and other vegetable crops, which are good hosts of these pests. The total number of locations with the RKNs present has been increasing over the years, but substantial yield losses due to root knot nematode infestations are not yet recorded in Slovenia. Financially supported by ARRS (P4-0072, MR 38128) and MKGP (C2337).



Nova metoda zaznavanja in razlikovanja znakov suše in napada z ogorčicami pri paradižnikih z uporabo tehnologije hiperspektralnega slikanja

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Napad talnih škodljivcev kot so tropske ogorčice koreninskih šišk iz rodu *Meloidogyne* je na polju težko zaznati – še posebej v zgodnji fazi širjenja. Podnebne spremembe pospešujejo širjenje teh škodljivcev, zato je potreben razvoj novih tehnologij in aplikacij v kmetijstvu za zgodnje odkrivanje napada škodljivcev. Ena od možnosti je uporaba daljinskega zaznavanja za razlikovanje različnih vrst stresa pri rastlinah. Primer sta biotski stres v obliki napada ogorčic koreninskih šišk (RKN) in abiotski stres v obliki vodnega deficita, ki povzročata podobne simptome suše pri rastlinah. Meritve fiziologije rastlin (stopnja fotosinteze in fluorescenca klorofila *a*) lahko razlikujejo le med zalitimi rastlinami in rastlinami, katerim primanjkuje vode. Ovrednotili smo uporabo hiperspektralnega slikanja za zgodnje odkrivanje napada RKN (*Meloidogyne incognita*) in stresa pri pomanjkanju vode na paradižniku (Susič in sod. 2018 *Sensor Actuat B- Chem* 273, 842-85). Rezultati kažejo, da je mogoče uporabiti podatke hiperspektralnega slikanja in klasifikacijo na podlagi nadzorovanega učenja za razlikovanje med različnimi stresi (biotski / abiotski) pri rastlinah paradižnika. Z uporabo klasifikacije PLS-SVM smo dosegli do 100-odstotno natančnost razlikovanja med dobro zalitimi rastlinami in rastlinami v vodnem deficitu; ter 90–100 % natančnost pri odkrivanju rastlin ob napadu RKN. Najpomembnejša območja spektra za odkrivanje rastlin ob napadu RKN in resnosti okužbe, so bila v kratkovalovnem infrardečem (SWIR) območju, ki je povezano z intervali absorbance O-H in C-H vezi. Analiza je omogočala zanesljivo razlikovanje med različnimi dejavniki stresa v zgodnjih fazah pojava simptomov. Pridobljeni podatki so uporabni za nadaljnji razvoj aplikacij daljinskega zaznavanja za odkrivanje napada z ogorčicami na terenu. Z zgodnjim odkrivanjem je mogoče skrajšati odzivni čas in tarčno zatiranje škodljivcev. Tehnologijo je mogoče dalje razvijati tudi za namene zlahtnjenja rastlin za vrednotenje večjega števila rastlinskih genotipov pri različnih tipih stresa. Zahvala: finančna podpora s strani ARRS in MKGP (MR 38128, P4-0072, C2337).

ABSTRACT

A new method to detect and differentiate between nematode infestation and water deficiency in tomato using hyperspectral imaging technology

Soil-borne pest infestation as the tropical plant-parasitic nematodes of the genus *Meloidogyne* are hard to detect in the field – especially in the early phase of infestation. Climate change facilitates the spread of these pests and novel technologies and applications in agriculture that could detect infestations earlier are warranted. One such novel technology is remote sensing differentiating between different origins of stress for plant. For example, biotic stress in the form of root-knot nematode (RKN) infestation and abiotic stress in the form of water-deficiency lead to similar drought symptoms in plants. Physiological measurements (photosynthetic rate and chlorophyll *a* fluorescence) can only distinguish between well-watered and water-deficient plants. We assessed hyperspectral imaging for early detection of RKN infestation (*Meloidogyne incognita*) and water-deficiency stress in tomato (Susič et al. 2018 *Sensor Actuat B- Chem* 273, 842-85). The results show it is possible to use hyperspectral imaging data and supervised learning classification to discriminate between different stresses (biotic / abiotic) on tomato plants. Using PLS-SVM classification, up to 100 % accuracy could be obtained differentiating between well-watered and water-deficient plants; and 90–100 % when detecting RKN-infested plants. Shortwave infrared (SWIR) range is the most important region of the spectrum to detect RKN-infested plants and severity of infestation, as it is associated with the O-H and C-H stretches. With this analysis we were able to reliably discriminate between stresses shortly after symptoms development. This data is valuable for further development of remote sensing applications to detect nematode infestations in the field. Early detection would shorten response times and enable targeted pest management. Technology could be further used also in breeding programs for evaluation of large number of plant genotypes under different stresses.



Ovrednotenje nematocidne aktivnosti sevov bakterije *Bacillus firmus*

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Ogorčice koreninskih šišek (RKN) iz rodu *Meloidogyne* so najpomembnejša skupina rastlinsko-parazitskih ogorčic, saj zajedajo širok spekter gostiteljskih rastlin. Namnožitve RKN na polju privede do gospodarske škode zaradi zmanjšanja ali izpada pridelka. RKN je mogoče zatirati z različnimi tipi kemičnih nematocidov, ki jih povečini uvrščamo med fumigante, karbamate ali organofosfate. Mnogi kemični nematocidi niso več v uporabi zaradi visoke toksičnosti, nadomeščajo jih nove generacije učinkovin kot so fluopiram, sekundarni metaboliti bakterij (avermektini) ter bionematocidi na osnovi gliv (*Pochonia chlamydosporium*, *Myrothecium verrucaria*, *Purpureocillium lilacinus*, *Trichoderma* spp., *Metarhizium* spp.) in bakterij (*Pasteuria* spp., *Bacillus* spp.). Ovrednotili smo nematocidno učinkovitost bakterijskih sevov *Bacillus firmus* v *in vitro* in lončnih poskusih. Vrednotenje *in vitro* aktivnosti treh sevov *B. firmus* proti RKN vrst *Meloidogyne incognita* in *M. luci* je pri obeh vrstah pokazalo primerljivo zmanjšanje števila izleženih in motilnih ličink. Opazili smo razlike v delovanju različnih sevov *B. firmus* in sicer se je kot najbolj učinkovit izkazal sev *B. firmus* ZZV12-4809 izoliran iz vrtno zemlje. Izleganje jajčec *in vitro* je bilo do 100% nižje v primerjavi s kontrolo v obravnavanju, kjer smo jajčecem ogorčic dodali bakterijsko kulturo, do 77,9% nižje pa ob dodatku spranih bakterijskih celic. V lončnih poskusih smo ovrednotili namatocidno učinkovitost dveh sevov *B. firmus* - ZZV12-4809 ter seva I-1582 izoliranega

iz bionematocida VOTiVO® (Bayer CropScience), ter ju primerjali s kontrolami brez tretiranja ter z delovanjem kemičnega nematicidom Velum® Prime (Bayer) oz. bionematocidom VOTiVO®. V lončnih poskusih smo s štetjem jajčec ob koncu poskusa določali reprodukcijski faktor (R_p) RKN *M. luci*, ki je bil do 62% nižji pri rastlinah paradižnika tretiranih z *B. firmus* v primerjavi z netretirano kontrolo. Vsi testirani sevi *B. firmus* so pokazali nematicidno aktivnost; v *in vitro* poskusih je bil najbolj učinkovit *B. firmus* ZZV12-4809, v lončnih poskusih pa sev I-1582.

Zahvala: finančna podpora s strani ARRS in MKGP (MR 38128, V4-1602, P4-0072, C2337).

ABSTRACT

Assessing the nematicidal activity of *Bacillus firmus* strains

Root-knot nematodes (RKN) from the genus *Meloidogyne* are considered the most important group of the plant-parasitic nematodes, being able to parasitize a wide range of host plants. Field infestations lead to economic damage due to reduction or loss of crop yield. Different types of chemical nematicides are used for RKN control – most of them classified as fumigants, carbamates or organophosphates. Many chemical nematicides are no longer being used due to the high toxicity and are being replaced by the new generation of active ingredients such as fluopyram, bacterial secondary metabolites (avermectins), and biological agents such as fungi (*Pochonia chlamydosporium*, *Myrothecium verrucaria*, *Purpureocillium lilacinus*, *Trichoderma* spp., *Metarhizium* spp.) and bacteria (*Pasteuria* spp., *Bacillus* spp.). We evaluated the nematicidal activity of *Bacillus firmus* strains in *in vitro* and in pot experiments. Assessment of *in vitro* activity of three *B. firmus* strains against *Meloidogyne incognita* and *M. luci* showed comparable reduction in number of hatched and motile larvae for both species. Three different *B. firmus* strains exhibited different rate of nematicidal activity, with strain ZZV12-4809 isolated from garden soil being the most effective. *In vitro* egg-hatching in the presence of bacterial culture was up to 100% lower in comparison to control treatment, while up to 77.9% lower in the presence of washed bacterial cells. In pot experiments we evaluated the nematicidal activity of two most effective *B. firmus* strains - ZZV12-4809 and I-1582 isolated from bionematicide VOTiVO® (Bayer CropScience) and compared them to the untreated control, to the chemical nematicide Velum® Prime (Bayer) and to the bionematicide VOTiVO®. The reproduction factor (R_p) of *M. luci* determined at the end of experiment was up to 62% lower in tomato plants where *B. firmus* was added compared to untreated control. All tested strains showed nematicidal activity; in *in vitro* experiments *B. firmus* ZZV12-4809 was the most effective, while in pot experiments strain I-1582 showed highest nematicidal activity.



Preučevanje vpliva različnih kombinacij pripravkov Mineral na dve vrsti škodljivih organizmov in pridelek čebule (*Allium cepa*)

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V letu 2018 smo na Laboratorijskem polju Biotehniške fakultete Univerze v Ljubljani preučevali delovanje različnih pripravkov Mineral na pridelek čebule. Preučevali smo delovanje pripravkov 'Mineral Zeleni', 'Mineral Modri', 'Mineral Rdeči', 'Mineral Rumeni', 'Mineral Rumeni Forte', dva različna pripravka 'Mineral Oranžni' in dva različna pripravka 'Mineral Rdeči Forte'. Njivo s čebulo smo razdelili v tri bloke, znotraj katerih smo razporedili 6 obravnavanj, kjer smo uporabljali kombinacije pripravkov 'Mineral'.

Dodatni obravnavanji pa sta predstavljali pozitivna in negativna kontrola. S škropljenjem/zalivanjem s pripravki 'Mineral' smo začeli takoj po sajenju čebule. Spremljali smo tudi obseg okužbe s čebulno plesnijo (*Peronospora destructor*) in obseg poškodb tobakovega resarja (*Thrips tabaci*). Ob spravilu pridelka smo stehali maso čebulic. Vpliva uporabe različnih pripravkov 'Mineral' na obseg poškodb tobakovega resarja in obsega okužbe s čebulno plesnijo nismo ugotovili. Na podlagi naše raziskave lahko potrdimo najvišji pridelek čebule v obravnavanjih, kjer smo uporabljali pripravke 'Mineral Zeleni', 'Mineral Modri', 'Mineral Rumeni', 'Mineral Rdeči', 'Mineral Rdeči Forte' in 'Mineral Rumeni Forte'. V prispevku bodo predstavljene povezave med kombinacijami uporabe različnih pripravkov 'Mineral' in njihov vpliv na parametre, ki so bili pomembni v naši raziskavi.

ABSTRACT

Testing the impact of different combinations of products Mineral on two harmful organisms and on the yield of onion (*Allium cepa*)

In 2018, we have tested the efficacy of different products 'Mineral' on yield on onion field at Laboratory Field of Biotechnical Faculty of University of Ljubljana. We have tested the efficacy of products 'Mineral', i.e. 'Mineral Zeleni', 'Mineral Modri', 'Mineral Rdeči', 'Mineral Rumeni', 'Mineral Rumeni Forte', two different products 'Mineral Oranžni', two different products 'Mineral Rdeči Forte'. Onion field was divided into three blocks, within 6 randomized treatments with products 'Mineral' were located. Positive and negative control were also treatments within blocks. We have started with spraying/irrigation with products 'Mineral' on the day that onion was planted. We have evaluated the infection caused by downy mildew (*Peronospora destructor*) and injured area by onion thrips (*Thrips tabaci*). At harvesting, bulb mass was collected for every onion. We haven't detected impact of different products 'Mineral' on injury level caused by onion thrips and level of infection caused by downy mildew. Based on the results of our research, we can confirm the highest yield was detected in treatment, where we have used 'Mineral Zeleni', 'Mineral Modri', 'Mineral Rumeni', 'Mineral Rdeči', 'Mineral Rdeči Forte 2', 'Mineral Rumeni Forte'. Paper will present interactions between applications of different products 'Mineral' and their impact on parameters important to our research.



Preučevanje vpliva izvlečkov in prašiv invazivnih tujerodnih rastlin na škodljive in koristne organizme na gojenih rastlinah – prvo leto projekta Applause

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Na Oddelku za agronomijo v okviru projekta Applause – od škodljivih do uporabnih tujerodnih rastlin z aktivnim vključevanjem prebivalcev (2017-2020), preučujemo vpliv izvlečkov in prašiv iz osmih invazivnih tujerodnih rastlin na škodljive in koristne organizme na gojenih rastlinah. Prašiva in vodne izvlečke pripravljamo iz listov kanadske zlate rozge (*Solidago canadensis*), orjaške zlate rozge (*Solidago gigantea*), japonskega dresnika (*Fallopia japonica*), češkega dresnika (*Fallopia bohemica*), velikega pajesena (*Ailanthus altissima*), octovca (*Rhus typhina*), navadne amorfe (*Amorpha fruticosa*), smrdljive ditrihovke (*Dittrichia graveolens*) in cvetov kanadske zlate rozge. Preučujemo insekticidno, fungicidno, akaricidno, herbicidno in limacidno delovanje vodnih izvlečkov in prašiv. Poleg tega nas zanima vpliv škropljenj na koristne organizme in opaševalce. Tujerodne invazivne rastline nabiramo na območju

Mestne občine Ljubljana. V prispevku bo predstavljeno naše delo na poskusih, ki potekajo na Laboratorijskem polju Biotehniške fakultete v Ljubljani in v Laboratoriju za fitomedicino Oddelka za agronomijo.

ABSTRACT

Testing the impact of plant extracts and powders from invasive alien plant species on harmful and beneficial organisms on cultivated plants – first year of the project

Department of Agronomy and its work within project Applause – from harmful to useful with citizens' led activities (2017-2020), is being involved in testing the impact of extracts and plant powders from eight invasive alien plant species on harmful and beneficial organisms of cultivated plants. Plant powders and water extracts are being prepared from leaves of Canada goldenrod (*Solidago canadensis*), giant goldenrod (*Solidago gigantea*), Japanese knotweed (*Fallopia japonica*), Bohemian knotweed (*Fallopia bohemica*), tree of heaven (*Ailanthus altissima*), staghorn sumac (*Rhus typhina*), false indigo (*Amorpha fruticosa*), stinkwort (*Diuriscia graveolens*) and flowers from Canada goldenrod. We have been testing insecticidal, fungicidal, acaricidal, herbicidal and molluscicidal efficacy of water extracts and plant powders. We are also evaluating impact of spraying on beneficial organisms and pollinators. Invasive alien plant species are being collected in the area of City of Ljubljana. Paper will present research work that was performed at Laboratory Field of Biotechnical Faculty and in Laboratory for Phytomedicine at Chair for Phytomedicine, Agricultural Engineering, Field Crops Production, Pasture and Grassland Management.



Preučevanje insekticidnega delovanja vodnih izvlečkov tujerodnih invazivnih rastlin na kapusove bolhače (*Phyllotreta* spp.) in kapusove stenice (*Eurydema* spp.) na njivi z zeljem

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V letu 2018 smo na njivi z zeljem na Laboratorijskem polju Biotehniške fakultete v Ljubljani preučevali insekticidno delovanje vodnih izvlečkov tujerodnih invazivnih rastlin na kapusove bolhače (*Phyllotreta* spp.) in kapusove stenice (*Eurydema* spp.) na belem zelju, hibrid 'Coronet F1'. Vodne izvlečke smo pripravili iz listov japonskega in češkega dresnika, kanadske in orjaške zlate rozge, octovca, navadne amorfe in velikega pajesena. Poskusno površino smo razdelili v tri bloke, znotraj katerih smo razporedili 9 obravnavanj. Poleg sedmih obravnavanj, kjer smo preučevali učinkovitost izvlečkov iz invazivnih tujerodnih vrst, smo v poskus vključili tudi negativno in pozitivno kontrolo. Škropljenje je potekalo v 14-dnevnih intervalih, vse do sredine julija. Poškodbe kapusovih bolhačev in kapusovih stenic smo spremljali v 14 dnevni intervalih, s pomočjo 5 – stopenjske EPPO lestvice (za bolhače) in 6 – stopenjske lestvice Stonerjeve in Sheltona (za stenice). Na podlagi rezultatov naše raziskave, smo ugotovili potencialno insekticidno delovanje izvlečkov iz velikega pajesena, octovca in navadne amorfe. V prispevku bodo predstavljene podrobnejše statistične analize delovanja pripravkov vpliva škropljenj na indeks poškodb na listih zelja zaradi hranjenja dveh skupin škodljivcev.

ABSTRACT

Research on insecticidal efficacy of water extracts from invasive alien plant species against cabbage

flea beetles (*Phyllotreta* spp.) and cabbage stink bugs (*Eurydema* spp.) in the cabbage field

In 2018, we have insecticidal efficacy of water extracts from alien invasive plant species against cabbage flea beetles (*Phyllotreta* spp.) and cabbage stink bugs (*Eurydema* spp.) on white cabbage (hybrid 'Coronet F1') at Laboratory Field of Biotechnical faculty in Ljubljana. Water extracts were prepared from leaves of Japanese and Bohemian knotweed, Canada and giant goldenrod, staghorn sumac, false indigo and tree of heaven. Field was divided into three blocks, which were divided randomly into 9 treatments. Beside treatments, where we have tested the efficacy of water extracts from alien invasive plant species, negative and positive control were also included into the experiment. Spraying with water extracts was performed in 14- days interval, till middle of July. Damage caused by cabbage flea beetles and cabbage stink bugs was evaluated in 14-days interval, by using 5-grade EPPO visual scale (for cabbage flea beetles), and 6-grade visual scale by Stoner and Shelton (for cabbage stink bugs). Based on the results of our research, we can confirm potentially insecticidal efficacy of water extracts from tree of heaven, staghorn sumac and false indigo. Detailed statistical analysis will be presented in paper.



Bazilikina plesen (*Peronospora belbahrii* Thines) tudi v Sloveniji

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Bazilika (*Ocimum* sp.) je ena izmed gospodarsko najpomembnejših gojenih začimbnic na svetu. »Bazilikina plesen«, ki jo povzroča gliva *Peronospora belbahrii*, je postala v zadnjem desetletju pomembna bolezen navadne bazilike (*O. basilicum*) po vsem svetu. Bolezen izvira iz Ugande, kjer je bila ugotovljena v tridesetih letih prejšnjega stoletja. Pred časom pa se je razširila v Evropo, Srednji vzhod, obe Ameriki in Daljni vzhod. Prenos bolezni s semenom bi bil lahko vzrok za njeno hitro širjenje po vsem svetu. V Sloveniji se je bolezen prvič pojavila v velikem obsegu leta 2018, tako v rastlinjakih kot na prostem. V prispevku je prikazana morfologija in biologija povzročitelja bolezni, bolezenska znamenja, ki jih povzroča na gostiteljski rastlini in nekatere varstvene ukrepe. Predlagano slovensko ime za bolezen je bazilikina plesen.

ABSTRACT

Basil downy mildew (*Peronospora belbahrii* Thines) also in Slovenia

Basil (*Ocimum* sp.) is one of the most economically important and widely grown herbs in the world. Basil downy mildew, caused by *Peronospora belbahrii*, has become an important disease in sweet basil (*O. basilicum*) production worldwide in the past decade. It is originated in Uganda in the 1930s and recently spread to Europe, the Middle East, Americas, and the Far East. Seed transmission may be responsible for its quick global spread. In Slovenia, the disease first emerged on a large scale in 2018, both in greenhouses and outdoors. The paper presents morphology and biology of the causative agent, symptoms on the host plant and some control measures. The proposed Slovenian name for the disease is bazilikina plesen.



Učinek izbranih herbicidov na plevelne vrste v sladkem krompirju

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V poskusu smo preučevali delovanje treh herbicidnih kombinacij na posamezne plevelne vrste v sladkem krompirju (*Ipomoea batatas* L.). Poleg treh herbicidnih kombinacij je bila v poskusu uporabljena še polietilenska zastirka in kontrolna parcela. Prva herbicidna kombinacija je bila 2,5 l/ha Devrinol (a.s. napropamid) in 1,5 l/ha Stomp aqua (a.s. pendimetalin). V drugi herbicidni kombinaciji smo uporabili 3 l/ha Stallion (a.s. klorazon in pendimetalin) in 0,7 l/ha Dual gold (a.s. S-metolaklor), medtem ko v tretji 0,25 l/ha Centium (a.s. klorazon) in 2,5 l/ha Stomp aqua (a.s. pendimetalin). V članku je predstavljen učinek posameznih obravnavanj na pokrovnost posameznih plevelnih vrst v sladkem krompirju.

ABSTRACT

The efficiency of selected herbicides on weed species in sweet potato

In the trial we studied the effect of three herbicide combinations on individual weed species in sweet potato (*Ipomoea batatas* L.). Beside these three herbicide combinations polyethylene mulch and control plot was also used. The first herbicide combination included 2.5 l/ha Devrinol (a.i. napropamide) and 1.5 l/ha Stomp aqua (a.i. pendimethalin). In the second herbicide combination we used 3 l/ha Stallion (a.i. clomazone and pendimetalin) and 0.7 l/ha Dual gold (a.i. S- metolachlor), while in the third 0.25 l/ha Centium (a.i. clomazone) and 2.5 l/ha Stomp aqua (a.i. pendimetalin). In the article the efficiency of treatments on the coverage of individual weed species in sweet potato is presented.



Results of a survey of Japanese flower thrips (*Thrips setosus* Moulton, 1928) in Croatia in 2017 and 2018

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Thrips setosus Moulton, 1928 (Thysanoptera: Thripidae), the Japanese flower thrips, is a highly polyphagous Asian thrips species that can transmit *Tomato spotted wilt virus*. The presence of *T. setosus* in the EPPO region was reported for the first time in the Netherlands in 2014. After that, the EPPO Secretariat decided to add this potentially damaging thrips species to the EPPO Alert list. Subsequently, it was also

recorded in other European countries (France, Germany and the United Kingdom). *T. setosus* was found in Croatia in 2016 on potted *Hydrangea* plants in a nursery in Turanj (N 43°58'18.5" E 15°25'1.5"), a place situated in coastal part of Croatia. The origin of the finding is unknown but could be linked to imports of *Hydrangea* plants from the Netherlands. A survey of *T. setosus* in Croatia was started in 2017 and continued in 2018. Visual inspections and thrips samplings were conducted in protected and outdoor vegetable and ornamental crops in 63 localities in 15 counties. Thrips were collected by beating of infested plants on a white paper surface. Altogether 182 samples of thrips were collected for species identification. Thrips in collected samples were identified to the species level on the basis of morphological characters of adult females, using classical identification method according to relevant morphological keys. Species *T. setosus* was determined in 29 samples. A preliminary risk analysis according to EPPO Standard PM 5/5(1) was conducted and the conclusion was that *T. setosus* presents high phytosanitary risk to production of protected fruiting vegetables, as well as *Chrysanthemum* cultivation in Croatia. Therefore, appropriate phytosanitary measures for pest eradication and prevention of its spreading were recommended to the Sector for Phytosanitary Policy of Ministry of Agriculture. No official measures have been undertaken, but the growers on localities where *T. setosus* was found were advised to take measures for limiting the spread of *T. setosus*, which included foliar insecticide treatments of *Hydrangea* plants.



Biotične interakcije med entomopatogenimi glivami in talnimi škodljivci

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Zaradi naraščajoče človeške populacije bo v prihodnosti potrebno pridelati več hrane, zato so trendi svetovnega kmetijstva v smeri intenzifikacije. To lahko privede do neželenega zmanjšanja funkcionalne biodiverzitete agroekosistema, kar posledično vpliva na porast talnih škodljivcev. Ena izmed rešitev je uporaba konvencionalnih kemičnih insekticidov, vendar pa kmetijska politika in sodobne kmetijske prakse stremijo k zdravju in okolju bolj prijaznemu varstvu rastlin z uporabo t.i. metod varstva rastlin z nizkim tveganjem. Namen raziskave je pridobiti vpogled v glavne talne škodljivce iz razreda žuželk (cl. Insecta) in raziskati njihove interakcije z entomopatogenimi glivami (EPG), saj so le-te najpogostejši naravni mikrobní vzrok obolevanja in smrti žuželk. Številne raziskave se osredotočajo na iskanje sevov EPG, ki bi učinkovito zmanjšali vpliv talnih škodljivcev v agroekosistemi in hkrati ne izvajali prevelikega pritiska na okolje. S pomočjo literaturnih podatkov smo zbrali zapise o več kot 30 skupinah talnih škodljivcev po vsem svetu, in sicer predstavnikov iz redov Coleoptera, Diptera, Hemiptera, Lepidoptera in Orthoptera. V večini primerov največ škode z objedanjem korenin povzročijo v stadiju ličinke, le v primerih predstavnikov iz družine bramorjev (f. Grylotalpidae) in redu polkrilcev (o. Hemiptera) škodo na koreninah povzročajo odrasli stadiji. Najpogostejši glivični bioinsekticidi so osnovani na rodovih *Beauveria*, *Metarhizium* in *Lecanicillium* ter vrsti *Isaria fumosorosea* (prej *Paecilomyces fumosoroseus*). Ne smemo pa zanemariti dejstva, da je veliko vrst talnih škodljivcev v agroekosistemi tujerodnih, torej je to problematika, ki bo močno vplivala na kmetijstvo v prihodnosti.

ABSTRACT

Biological interactions between entomopathogenic fungi and soil pests

Due to human population growth, more food will need to be produced in the future, which is why trends in global agriculture tend to intensify and cause so called »landscape simplification«, which can lead to an increased number of soil pests. One of the solutions is using conventional chemical insecticides, however agricultural policy and modern agricultural practices strive for health and environment-friendly plant protection, using so called low risk plant protection methods. The aim of this study is to gain insight into main insect soil pests (cl. Insecta) and to determine their interactions with fungal entomopathogens (EPF), as EPF are the most common natural microbial pathogens and cause of death among insects. Many studies focus on searching for EPF strains that effectively reduce the negative impact of soil pests in agroecosystems and at the same time do not exert excessive pressure on the environment. Based on literature data we have gathered more than 30 types of soil pests worldwide, namely representatives of orders Coleoptera, Diptera, Hemiptera, Lepidoptera and Orthoptera. In most cases feeding and damage to the roots is caused by larvae, except in representatives of Gryllotalpidae family and Hemiptera order, where damage to the roots is caused by adult insects. The most common fungal bioinsecticides are based on the genera *Beauveria*, *Metarhizium* and *Lecanicillium* and also on species *Isaria fumosorosea* (formerly called *Paecilomyces fumosoroseus*). Also the fact that many soil pest species are invasive will require attention in the future.



***Trichopria drosophilae* (Diapriidae) in *Leptopilina heterotoma* (Figitidae) - prvi najdbi parazitoidov plodove vinske mušice (*Drosophila suzukii*) v Sloveniji**

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Plodova vinska mušica (PVM), *Drosophila suzukii* (Matsumura, 1931) [Diptera, Drosophilidae] je bila prvič ugotovljena v Sloveniji jeseni leta 2010. Kmalu po tem se je izkazalo, da gre za enega najpomembnejših škodljivcev pri pridelavi jagodičastega in koščičastega sadja pri nas in drugod po svetu. V okviru programa strokovnih nalog s področja zdravstvenega varstva rastlin, inventarizacija koristnih organizmov za biotično varstvo rastlin, smo v letu 2018 ugotavljali morebitno navzočnost domorodnih vrst parazitoidov plodove vinske mušice. V ta namen smo uporabljali vabe z ličinkami in bubami *D. suzukii* obogatene s koščki banane. Ugotovili smo, da sta pri nas navzoča larvalni parazitoid *Leptopilina heterotoma* (Hymenoptera: Figitidae) in parazitoid bub *Trichopria drosophilae* (Hymenoptera: Diapriidae). Obe vrsti sta bili ugotovljeni avgusta leta 2018 v osrednji Sloveniji z vabami nastavljenimi v maline.

ABSTRACT

***Trichopria drosophilae* (Diapriidae) and *Leptopilina heterotoma* (Figitidae), native parasitoids of *Drosophila suzukii*, confirmed in Slovenia**

The Spotted-wing drosophila (SWD), *Drosophila suzukii* (Matsumura, 1931) [Diptera, Drosophilidae] was recorded for the first time in Slovenia in autumn 2010. Shortly thereafter, it turned out to be one of the most important insect pests of soft and stone fruit in Slovenia and worldwide. Within the expert work in the field of plant protection, task inventarisation of beneficial organisms for biological control,

the presence of indigenous *D. suzukii* parasitoids was investigated in 2018. Sentinel traps baited with *D. suzukii* larvae and pupae enriched with banana slices were used for sampling of *D. suzukii* parasitoids in raspberries. The pupal parasitoid *Trichopria drosophilae* (Hymenoptera: Diapriidae) and the larval parasitoid *Leptopilina heterotoma* (Hymenoptera: Figitidae) were recorded parasitizing *D. suzukii* for the first time in Slovenia in the summer 2018 in Central Slovenia (Ljubljana).



A faunistic study on mites (Acari) on citrus fruits in Croatia in 2018

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Mites (Acari) are economic pests of citrus crops. Most important citrus mites belong in families: Tetranychidae, Tenuipalpidae, Tarsonemidae and Eriophyidae. The goal of this study was to make a list of citrus mites in Croatia using the scientific literature and to carry out a faunistic research to show their distribution and to make a checklist of all citrus mites in Croatia. Literature search showed eight species of citrus mites present in Croatia. Faunistic research was concluded in 2018., in six counties containing 90 sites and 90 samples using visual inspections and mites sampling with detailed information on localities. Samples were collected from 5 different plant hosts from family Rutaceae. Collected samples were identified to the species level on the basis of morphological characters of adult mites, using classical identification method according to relevant morphological keys. Mites identified in faunistic research belong in 5 families: Tetranychidae, Phytoseiidae, Tydeidae, Cunaxidae i Trombidiidae. *Panonychus citri* was the most frequent plant-feeding species found and was determined in 19 samples. Family Tydeidae showed as the most frequent in total, determined in 40 samples. The most common predatory mite was *Euseius stipulatus* (Athias-Henriot) confirmed in 15 samples. *E. stipulatus* is reported as a new species for Croatian mite fauna along with the species from families Cunaxidae and Trombidiidae. Checklist of mite fauna on citrus fruits in Croatia contains 11 determined species and 7 families.



Vpliv protitočne mreže na populacijsko dinamiko rdeče sadne pršice (*Panonychus ulmi* [Koch])

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V letih 2008-2012 smo na lokaciji Gačnik N 460 61', E 150 69' spremljali vpliv protitočne mreže na pojavnost rdeče sadne pršice (*Panonychus ulmi* (Koch)) v nasadu jablan, pri sortah 'Gala', 'Fuji' in 'Braeburn'. Slednje so bile izbrane po principu boljših ali slabših gostiteljev za rdečo sadno pršico. Želeli smo ugotoviti, ali je vpliv uporabe protitočne mreže na populacijsko dinamiko rdeče sadne pršice enak pri različnih sortah ali pa vpliv mreže ni odvisen od sorte. Enak sklop zaporedja sort se je ponovil v nasadu, pokritem s črno protitočno mrežo, in v nasadu, ki ni bil pokrit s črno protitočno mrežo. Rdeča

sadna pršica velja za pomembnega škodljivca, ki v sušnih letih lahko povzroča ogromno škodo v nasadih jablan. Pršice se hranijo z sesanjem listnega tkiva, ki povzroči fiziološke spremembe v listih, spremeni fotosintezo, transpiracijo, posledično pa lahko povzroči kopičenje dušika. Celotni listi prevzamejo rjavo (»bronasto«) barvo. Ob močnem napadu lahko listje odpade prezgodaj. Spomladi lahko velike kongregacije ličink na mladih poganjkih vodijo v deformacijo cvetov s tem pa se kakovost sadja zmanjša (barva, vsebnost sladkorja). Za ugoden razvoj rdeče sadne pršice (*Panonychus ulmi*(Koch)) je pomembna ugodna temperatura, relativna zračna vlažnost in svetloba. Prehod svetlobe je pod črno protitočno mrežo oviran, po opravljenih meritvah (center) je relativna zračna vlažnost v nasadu pokritim s protitočno mrežo ob visokih temperaturah višja. Mikroklima pod protitočno mrežo so spremenjene in dinamika razvoja rdeče sadne pršice je pod mrežo nekoliko spremenjena od pogojev izven mreže. Mikroklima v nasadu, pokritem s protitočno mrežo, bi lahko imela vpliv na mikromorfološke značilnosti lista in povrhnjice vendar v naši raziskavi ugotovimo ob spremljanju dinamike pojava pršice od jajčec do odraslih stadijev v petih zaporednih letih, le vpliv sorte - sorti 'Braeburn' in 'Fuji' sta ugodnejši gostiteljici za rdečo sadno pršico, rdeča sadna pršica se v nasadu pokritim s črno protitočno mrežo ne razvija bolje kot brez mreže.

ABSTRACT

Influence of hail-net on the population dynamics of red mite (*Panonychus ulmi* [Koch])

In the years 2008-2012, at the location Gačnik N 460 61', E 150 69' were monitored the influence of the hail-net on the population dynamics of red fruit mite (*Panonychus ulmi* (Koch)) in the apple tree plantations. The research was carried out on three different varieties of apple trees on the varieties 'Gala', 'Fuji' and 'Braeburn'. The varieties were selected on the principle of better and worse hosts for red spider mite. The study confirmed that the influence of the variety was greater than the impact of the coverage of the apple orchards with the net. Red fruit mite is considered to be an important pest, which in the drought years can cause enormous damage in the apple tree plantations. Mites are fed by leaching tissue that causes physiological changes in the leaves, changes photosynthesis, transpiration, and consequently can cause accumulation of nitrogen. The whole leaves take a brown (»bronze«) color. In the event of a strong attack, the foliage may fall off too soon. In the spring, large kongregations of larvae on young shoots can lead to deformation of flowers, thereby reducing the quality of fruit (color, sugar content). For a favorable development of red fruit mite (*Panonychus ulmi* (Koch)), there is an important favorable temperature, relative air humidity and light. Switching light on black upstream network blocked, and after the measurements (fruit center), the relative air humidity in the plantation, which covered with a hail-net, is higher when the temperatures are high. Microclimate below the upstream network are changed, and the dynamics of the development of red fruit mite is the network changed slightly from those outside the net. Microclimate in a plantation covered with a hail-net could have an impact on the micro-morphological characteristics of the leaf and the epidermis, but in our study, we find out, monitoring the dynamics of the occurrence of mites from eggs to adult stages for five consecutive years; only the influence of the variety - the varieties 'Braeburn' and 'Fuji' are more favorable hosts for red fruit mite, red fruit mite is not developed better in the crop covered with a black hail-nets than without a net.



Blue mold of apple fruit caused by mixed infection with *Penicillium expansum* and *Penicillium crustosum*

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Blue mold, one of the economically most important diseases of stored apple fruit worldwide, can be caused by various *Penicillium* species. Among them *Penicillium expansum* Link and *P. crustosum* Thom are dominant. One apple fruit cv. Jonagored with blue mold symptoms was collected from storage in Bavanište, Serbia in December, 2015. Two isolates were obtained (JBA8a and JBA8b) from the same lesion and both were pathogenic on artificially inoculated apple fruit cv. Idared. Isolate JBA8b induced formation of larger lesions (average diameter $23,78 \pm 1,98$ mm) than isolate JBA8a ($13,25 \pm 1,6$ mm). Isolates differed in colony morphology on differential media (MEA, CYA, and YES) after 7 days at 25°C. Also, crusts of conidial masses formed in colonies of isolate JBA8a after 10 days. Conidia of isolates JBA8a and JBA8b were similar in shape and size ($3,1 \pm 0,24 \times 2,76 \pm 0,23$ µm and $3,22 \pm 0,24 \times 2,98 \pm 0,24$ µm, respectively), and conidiophores were terverticillate. Stipes of isolate JBA8a were with rough walls and with smooth walls in isolate JBA8b. In Ehrlich test isolate JBA8a formed faint yellow and isolate JBA8b intense yellow ring. For molecular identification genomic DNA was extracted from 7 days old cultures on PDA. Using *P. expansum* specific primers PEF/PER (Pepg1 gene) PCR product of expected size (404 bp) was obtained only for isolate JBA8b. Using primers Bt2a/Bt2b (partial β tubulin gene) species level identification was completed. Amplification resulted in 511 bp PCR products for both isolates. MegaBLAST analysis of 2X consensus nucleotide sequences of JBA8b and JBA8a showed identity with several sequences of the same region deposited in GenBank of *P. expansum* (i.e. JX91540, KC342828, FJ169223) and *P. crustosum* (e.g. KJ775121, LT559039, KX961239), respectively. *P. expansum* and *P. crustosum* were identified causing a mixed infection on apple fruit in storage. As both are mycotoxin producers, further studies are needed to investigate their interaction and evaluate contamination with mycotoxins. This research was supported by the project III46008, funded by the Ministry of Education, Science and Technological Development, Republic of Serbia.



Pomen spremljanja boleznj metličavosti jablan in izvajanja ukrepov v matičnih nasadih

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Bolezen metličavost jablan (Apple proliferation - AP) štejemo med nevarne bolezni, ki ogrožajo jablane. Bolezen povzročata fitoplazma '*Candidatus Phytoplasma mali*' (APf). Uvrščena je na seznam I.A.II karantenskih škodljivih organizmov Direktive Sveta 2000/29/EC. Na okuženih rastlinah povzročata pomembno gospodarsko škodo zaradi občutnega zmanjšanja količine in kakovosti pridelka. Fitoplazmo prenašajo naravni prenašalci iz skupine boljšic *Cacopsylla picta* in *C. melanoneura*, prenaša se tudi z okuženim

materialom (cepiči, podlage) pri vegetativnem razmnoževanju. Izvajanje preventivnih ukrepov (spremljanje zdravstvenega stanja rastlin, spremljanje žuželčnih prenašalcev in njihovo zatiranje, odstranjevanje okuženih rastlin, sajenje zdravega sadilnega materiala) je ključno pri preprečevanju širjenja bolezni, saj obolelih rastlin ni mogoče zdraviti. Prav zato je bistvenega pomena izvajanje nadzora pri pridelavi razmnoževalnega materiala V proučevanem matičnem nasadu jablan v Selu na Goričkem, namenjenem pridelavi certificiranih cepičev, potekajo redni pregledi zdravstvenega stanja matičnih dreves na znamenja bolezni, kakor tudi redna vzorčenja za laboratorijsko preverjanje prisotnosti APf. Kljub potrditvam okužb v matičnem nasadu v letih 2012, 2013 pa od leta 2014 dalje, z doslednim izvajanjem ukrepov, bolezen ni bila več navzoča, kar dokazujejo tudi latentna preverjanja prisotnosti APf z vzorčenjem korenin. V letih 2016 in 2017 je potekalo tudi sistematično spremljanje prenašalcev z rumenimi lepljivimi ploščami (RLP) v matičnem nasadu ter bližnji okolici nasada, pri čemer so bile ob RLP, vzporedno nameščene še RLP z dodanim atraktantom β -kariofilen. Z rezultati spremljanja ulova je bila ugotovljena zelo skromna populacija bolšic *C. picta* in *C. melanoneura* na proučevanem območju, neodvisno od dodatka atraktanta, kar nakazuje na ustreznost lokacije matičnega nasada ter tudi na ustrezno izvajanje škropljenj z insekticidnimi sredstvi v matičnem nasadu.

ABSTRACT

Significance of controlling the apple proliferation disease in mother plant orchards

Apple proliferation (AP) caused by phytoplasma '*Candidatus* Phytoplasma mali' (APf), is among the most economically important diseases on apples, due to the reduction of total yield, fruit size and fruit quality. It is transmitted from plant to plant by psyllid vectors *Cacopsylla picta* and *C. melanoneura* and it is spread also with infected material in vegetative propagation. Preventive measures, such as monitoring the plant health status, eradication of infected plants, vector control, production of healthy fruit plants for planting, are crucial to prevent the spread of the pathogen, since the disease is not curable. Hence, controlling the production of propagation material is very important. In certified mother plant orchard, located in Selo at Goričko region, visual controls for the symptoms of the disease are performed regularly and samples to control the presence of the pathogen are taken as well. Although the pathogen was confirmed in the mother plant orchard in 2012, 2013, frequent visual controls and testing for hidden infections (root samples) did not reveal the presence of the disease since 2014. Monitoring of the vectors was performed systematically in 2016, 2017 using yellow sticky traps, set in various places in the orchard and its vicinity. Beside them, yellow sticky traps with attractant b-caryophyllene were placed as well. The results obtained from the monitoring showed very low population of *C. picta* and *C. melanoneura* in the studied area, regardless the addition of b-caryophyllene compound, which indicates the proper insecticide treatment program and the suitable location for the mother plant orchard.



Pojavi južne plodovrtke (*Helicoverpa armigera* [Hübner, 1808]) na vinski trti v vinorodni deželi Posavje

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Škodljiv pojav južne plodovrtke *Helicoverpa armigera* (Hübner, 1808) na vinski trti smo prvič zabeležili v vinogradih na Bizeljskem v letu 2014. Kasneje smo v posameznih letih opažali poškodbe tudi na drugih lokacijah vinorodne dežele Posavje. Do poškodb na grozdju pride s prehranjevanjem na povrhnjici grozdnih jagod v mesecu avgustu. Gosenice se pred dnevno svetlobo umikajo v notranjost grozda in so zato težko opazne. Zoreče grozdne jagode so v primeru fizične poškodbe ob deževnem vremenu hitro izpostavljene gnitju. Pri zaznavanju prisotnosti odraslih osebkov smo uporabljali avtomatske daljinske pasti Trapview, s čimer smo primerjali gostoto populacij na območjih z različnimi okoljskimi razmerami.

ABSTRACT

The occurrence of cotton bollworm (*Helicoverpa armigera* [Hübner, 1808]) on grapevine in vine growing region of Posavje

The occurrence of cotton bollworm (*Helicoverpa armigera* [Hübner, 1808]) on grapevine was recorded in vineyards in Bizeljsko in 2014. In later years we noted damage also on other locations in vine growing region of Posavje. Larvae are active generally by night, when feeding on leaves and grapes. Injuries on grapes are created when caterpillar was fed on grape berry skin at the end July and more often August. Caterpillars are withdrawn inside the cluster of grape berries in front of the daylight and are therefore difficult to notice. In detecting the presence of adult insects we used Trapview remote automatic traps, thus comparing population density in areas with different environmental conditions.



First record of the *Prociphilus oleae* (Leach ex Risso, 1826) in Slovenia and Croatia

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Prociphilus oleae (Leach ex Risso, 1826) [Hemiptera, Aphidoidea: Aphididae] is by now the only known aphid that attacks the olive tree (*Olea europaea*). Beside olive tree, primary host plant can be *Phillyrea latifolia*, but less often. In spring compact colonies covered in white wax wool are settled on shoots near base of trunk. The secondary host plant of this pest is a grape vine (*Vitis vinifera*). On grape vine this aphid parasites at the roots. So far it has been recorded in France, Greece, Italy, Spain and Turkey. In these countries, infestation of very high intensity, as well as the presence of these aphid at the primary and secondary hosts were recorded. In Slovenia It was found for the first time in the middle of May 2018 on a garden olive tree in Solkan near Nova Gorica. It is assumed, that this pest was brought by olive plant seedlings from neighbour Italy. There is no significant damages for now, but it can still be considered as a potential but less significant olive pest. *P. oleae* was registered for the first time in Croatia in June 2018 in the olive grove on the Šibensko kninska county in two locations. The infested olives by this aphid, were exposed to low temperatures and adverse climatic conditions over the past winter. In the vicinity of the olive groves there were also vineyards. There is very little information about the bioecology of this pest. The paper will talk about description of species, biology and ecology, its distribution in Europe, Slovenia and Croatia, natural enemies and potential control options.



Optimizacija laboratorijskega testiranja gostiteljskih rastlin za določanje bakterije *Xylella fastidiosa*

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Bakterija *Xylella fastidiosa* (Wells & Raju) je rastlinska patogena bakterija, ki povzroča nevarne boleznine velikega števila različnih rastlin. V EU je bakterija uvrščena med karantenske škodljive organizme. Od prvih najdb v Italiji v letu 2013 se je predvsem zaradi resnosti okužb, neznačilnih bolezenskih znamenj in možnosti prikritih okužb močno povečalo število testiranj rastlin na to bolezen. Tudi v Sloveniji Uprava za varno hrano, veterinarstvo in varstvo rastlin s sodelujočimi institucijami že od leta 2014 izvaja program preiskav na to bakterijo. Prve laboratorijske analize smo sicer uvedli in izvajali testiranje rastlin vinske trte v obdobju od 2006 - 2009, v okviru ciljnega raziskovalnega projekta CRP (V4-0313). Laboratoriji se iz vidika zanesljivega testiranja in števila vzorcev soočamo z izzivom kako oblikovati diagnostično shemo, ki omogoča hitro, zanesljivo in cenovno ugodno hkratno testiranje večjega števila vzorcev in različnih gostiteljskih rastlin z ali brez bolezenskih znamenj z enako učinkovitostjo. V prispevku bomo predstavili shemo testiranja te bakterije, kakor jo izvajamo na Nacionalnem inštitutu za biologijo, ter evalvacijo presejalnih testov, ki smo jih v letu 2018 tudi akreditirali (ISO 17025). Predstavili bomo kako število reakcij v testu PCR v realnem času in število redčitev izolirane DNA vplivajo na zanesljivost določanja te bakterije. Prikazana bo tudi primerjava uporabe različnih pol-avtomatiziranih aparatov ter robotskega in ročnega pipetiranja, ki smo jo izvedli v okviru CRP projekta XylVec (V4-1603). Na osnovi rezultatov smo oblikovali izboljšano diagnostično shemo laboratorijskega določanja bakterije *X. fastidiosa*.

ABSTRACT

Optimization of laboratory testing of host plants for detection of *Xylella fastidiosa*

Xylella fastidiosa (Wells & Raju) is a plant pathogenic bacterium that can infect a large number of different host plants. In the EU, the bacterium is classified as quarantine pests. Since the first findings in Italy in 2013, the number of samples tested for this disease has greatly increased, especially due to the severity of infections, unspecific disease symptoms and the possibility of asymptomatic infections. In Slovenia, the Administration of the Republic of Slovenia for Food Safety, Veterinary Sector and Plant Protection with participating institutions has been conducting a survey of *X. fastidiosa* since 2014. The first laboratory analyses were introduced and carried out in the period 2006-2009 within the targeted research project CRP (V4-0313) on grapevine plants. In terms of reliable testing and the number of samples, the laboratories face the challenge of designing a testing scheme that enables rapid, reliable and cost-effective simultaneous testing of a large number of samples and of different host plants with and without symptoms. In the presentation we will present a scheme for testing this bacterium, which is carried out at the National Institute of Biology, and the evaluation of molecular screening tests, which are accredited since 2018 (ISO 17025). We will present how the number of reactions in the real time PCR and the number of dilutions of isolated DNA affect the reliability of the determination of this bacterium. Results of comparisons of different half-automated devices, robotic and manual pipetting, done within the XylVec project (V4-1603) will be shown. Based on the results, an improved diagnostic scheme is proposed for the laboratory determination of bacteria *X. fastidiosa*.



Records of *Spodoptera frugiperda* (J.E. Smith, 1797) monitoring in Croatia in 2018

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Spodoptera frugiperda (J.E. Smith, 1797), fall armyworm (Lepidoptera: Noctuidae), is a quarantine polyphagous pest widely spread across the American and African continents. It is absent from Europe (EPPO A1 list), but has been intercepted on several occasions in consignments of imported plant material, indicating that the entry of this pest into the EPPO region through international trade presents a real threat. *S. frugiperda* was first recorded in Africa in 2016 in Nigeria, and has since spread throughout majority of African continent, except for northern African countries, and caused severe damages in corn production. According to EPPO, the Mediterranean region would be suitable for establishment of this pest due to its agro climatic conditions and a wide range of suitable hosts. *S. frugiperda* feeds on more than 80 different host plants, but shows a definite preference for maize and species from family Poaceae. Damage is caused by caterpillars who feed on leaves, causing defoliation in older plants or complete destruction of younger plants. After Commission implementing decision (EU) 2018/638 from April 2018, survey on possible presence of *S. frugiperda* was started in Croatia in August 2018. During the set timeframe, 80 visual inspections of field corn in 40 localities in 13 continental and coastal counties have been carried out, conducting two visual inspections per locality. First visual inspection included placing of pheromone lures for *S. frugiperda* on corn plants that were subsequently removed and taken to the Laboratory for zoology in Institute for plant protection for analysis. Results of monitoring with detailed information on localities and collected pest species will be presented.



Laboratorijsko preučevanje odpornosti repičarja (*Meligethes aeneus* F.) na aktivno snov lambda-cihalotrin iz skupine sintetičnih piretroidov

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Repičar *Meligethes aeneus* F. (Coleoptera: Nitidulidae) je eden najpomembnejših škodljivcev oljne ogrščice (*Brassica napus* L.). Za njegovo zatiranje se v praksi najpogosteje uporabljajo insekticidi iz skupine piretroidov, kar povzroča velik selekcijski pritisk in s tem pojav odpornosti škodljivca na določene aktivne snovi. O pojavu odpornih populacij repičarja so v preteklosti že poročali iz številnih Evropskih držav, kjer pridelujejo oljno ogrščico. V letu 2018 smo vzorčili hrošče na štirih lokacijah v osrednji Sloveniji. V laboratoriju smo z uporabo metode IRAC No. 011 preučevali občutljivost hroščev na aktivno snov lambda-cihalotrin iz skupine piretroidov. Glede na rezultate sklepamo na pojav delne odpornosti pri dveh

testiranih populacijah hroščev, medtem, ko pri preostalih dveh populacijah škodljivca, pojava odpornosti nismo zaznali, saj je bila smrtnost testiranih hroščev dovolj visoka.

ABSTRACT

Laboratory testing of pollen beetle (*Meligethes aeneus* F.) resistance to synthetic pyrethroid insecticide lambda-cyhalothrin

Pollen beetle, *Meligethes aeneus* F. (Coleoptera: Nitidulidae) is one of the major pest of oilseed rape (*Brassica napus* L.). Pyrethroid insecticides have been widely used against this insect pest which has resulted in high selection pressure and subsequent development of resistance. So far resistant populations of pollen beetle have been confirmed in many oilseed rape growing parts of Europe. In 2018 samples of the adult pollen beetle were collected from four locations in central Slovenia. Sensitivity of beetles to pyrethroid lambda-cyhalothrin was laboratorically tested using IRAC method No. 011. The obtained results demonstrated some level of resistance by two tested populations which were classified as moderately resistant to resistant. Other two tested populations showed no occurrence of the resistance since adults of the insect were highly susceptible to tested insecticide.



Primerjava leta koruzne vešče (*Ostrinia nubilalis*) na klasični svetlobni vabi in svetlobni vabi Trapview-AURA

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V letu 2018 smo spremljali let koruzne vešče (*Ostrinia nubilalis*) 2. generacije s klasično svetlobno vabo z živosrebrno žarnico in svetlobno vabo Trapview-AURA opremljeno z LED diodami. Let koruzne vešče smo spremljali od konca julija do sredine septembra ob robu hmeljišč na dveh lokacijah in sicer v Žalcu in na Rojah pri Žalcu. Dinamika leta metuljev koruzne vešče na klasični svetlobni vabi je bila enaka na obeh spremljanih lokacijah. Razlika pa je bila v številčnosti populacije, ki je bila večja na lokaciji Roje pri Žalcu. Vrh ulova 2. generacije koruzne vešče je bil v prvi dekadi avgusta. Dinamika leta metuljev koruzne vešče je bila podobna tudi na svetlobni vabi Trapview-AURA, le da je bilo s to vabo ujetih samo 4-10 % populacije v primerjavi s klasično svetlobno vabo. Na obeh vrstah svetlobnih vab je bil večji delež samčkov (60 %) kot samičk (40 %).

ABSTRACT

Comparison of flight of European corn borer (*Ostrinia nubilalis*) on classic light trap and Trapview-AURA light trap

In 2018, we monitored flight of second generation of the European corn borer (ECB) (*Ostrinia nubilalis*) with mercury lamp light trap and Trapview-AURA light trap equipped with LED lights. The flight of ECB monitored from end of July to middle of September on two locations (Žalec and Roje by Žalec) at edge of hop fields. The dynamic of the ECB flight on the classic light trap on both locations was the same. The difference was in the abundance of the population of ECB, which was larger at the location of Roje by Žalec. The peak of the second generation of ECB was in the first decade of August. The dynam-

cs of the flight of ECB was also similar on the trap light Trapview-AURA, but only 4-10% of the population was caught with this trap compared to the classic light trap. On both types of light traps were a higher proportion of males (60%) than females (40%).



Preučevanje vpliva pripravka Rhizoflo Premium na pojavljanje škodljivih žuželk na koruzi (*Zea mays* L.) in pridelek koruze v poljskih razmerah

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Na Laboratorijskem polju Biotehniške fakultete v Ljubljani smo konec aprila 2018 posejali dva različna hibrida koruze – SY Dartona in NK Timic, na katerih smo spremljali sezonsko dinamiko pojavljanja petih škodljivih žuželk: koruzni hrošč (*Diabrotica virgifera virgifera*), pokalica (*Agriotes* spp.), koruzna veščica (*Ostrinia nubilalis*), kapusovi bolhači (*Phyllotreta* sp.) in fižolova muha (*Delia platura*). Koruza je bila posejana v tribločnem poskusu, pri vsakem hibridu smo imeli dve obravnavaji: kontrolo (netretirano zrnje) in zrnje, ki je bilo pred setvijo poškopljeno s pripravkom Rhizoflo Premium. Ta pripravek je razvilo podjetje CKC iz Argentine, ki razvija najnovejše različice bioloških gnojil. Na vseh parcelah je bil maja narejen popis vznika, med izvedbo poskusa pa se je v 10-dnevnih intervalih spremljalo pojavljanje škodljivih žuželk. Koruzni hrošč se je pojavljal od sredine avgusta do žetve, pokalice od konca aprila do sredine avgusta, koruzna veščica od sredine avgusta do žetve, bolhači od konca aprila do žetve ter fižolova muha od konca aprila do začetka septembra. Med izvajanjem poskusa smo v dveh terminih (28. junij in 30. avgust) izvedli tehtanje korenin koruze po posameznih obravnavanjih in parcelah. Povprečna masa korenin pri hibridu NK Timic je bila v obeh terminih, pri obravnavanju s tretiranim zrnjem, večja kot pri kontroli (netretirano zrnje). Pri hibridu SY Dartona pa je bila povprečna masa korenin pri obravnavanju s tretiranim zrnjem večja kot pri kontroli (netretirano zrnje) le v drugem terminu. Konec septembra (20. september) smo koruzo poželi in zrnje iz različnih obravnavanj in parcelic stehtali. Ugotovili smo, da je bil povprečni pridelek zrnja koruze pri obeh hibridih večji pri obravnavanju s tretiranim zrnjem.

ABSTRACT

Investigation the effect of product Rhizoflo Premium on the occurrence of insect pests in maize (*Zea mays* L.) and the yield of maize

At the Laboratory Field of Biotechnical Faculty in Ljubljana, at the end of April 2018, two different maize hybrids were sown – SY Dartona in NK Timic, where we monitored the seasonal dynamics of the occurrence of five insect pests: Western corn rootworm (*Diabrotica virgifera virgifera*), catchfly (*Agriotes* spp.), European corn borer (*Ostrinia nubilalis*), striped flea beetles (*Phyllotreta* sp.) and seedcorn maggot (*Delia platura*). Maize was sown in a three-block experiment. For each hybrid, we had two treatments: control (untreated grains) and grains, which were treated with Rhizoflo Premium before sowing. This product was developed by CKC Company from Argentina, which develops the latest versions of biological fertilizers. In May we evaluated the incidence of maize seedlings on all parcels, while the occurrence of insect pests was monitored in 10-day intervals during the experiment. The Western corn rootworm appeared from middle of June until harvest, catchfly from the end of April to the middle of August, European corn borer from middle of August until harvest, striped flea beetles from late April until harvest, and seedcorn maggot from late April until early September. During the experiment, we weighed

the roots of maize twice (June 28th and August 30th) in individual treatments and parcels. The average root mass in the NK Timic hybrid was greater in treatment with treated grains than in control (untreated grain) at both weighing periods. For SY Dartona hybrid, however, the average mass of the roots in treatment with treated grains was greater than in control (untreated grains) only in the second term. At the end of September (September 20th), maize was harvested and grains from different treatments and parcels were weighed. We found that the average yield of corn grains in both hybrids was higher in treatments with Rhizoflo Premium.



Možnosti uporabe ozona pri zatiranju škodljivih organizmov

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V prispevku bodo predstavljeni izsledki dosedanjih raziskav o uporabnosti ozona pri zatiranju škodljivih organizmov, in sicer: 1) varstvo in stimulacija gojenja rastlin s pomočjo elektro ozonizacije v rastlinjakih (zavarovanem okolju / zavarovanih tleh) - poskusi so bili izvedeni na pšenici, ječmenu, koruzi, grahu, paradižniku..., 2) obdelava semenskega materiala z ozonom pred setvijo.

Ugotovitve: 1) zmanjšanje tveganja za bolezni (virusne in druge), 2) varstvo rastlin pred škodljivci (kot so listne uši, pršice idr.), 3) večja produktivnost rastlin, gojenih v zavarovanih tleh in okolju (do 30 %)

Tehnologije ozoniranja so okolju prijazne in izključujejo rabo kemikalij za varstvo rastlin in pridelkov.

ABSTRACT

Possibilities of the use of ozone in controlling pests and diseases

The results of previous investigations regarding the use of ozone in controlling pests and diseases will be presented: 1) protection and stimulation of cultivation of plants by means of electro-ozonization in greenhouses (protected environment / protected soils) - the experiments were carried out on wheat, barley, maize, peas, tomatoes etc., 2) processing of seed material with ozone prior to sowing.

Findings: 1) reduction of the risk of diseases (viral and other), 2) protection of the plants against pests (such as aphids, spider mites, and others), 3) the productivity of plants grown in protected soil and environment increased (up to 30 %).

Ozone technologies are environmentally friendly and exclude the use of chemicals to protect the crop.



Metagenomska analiza bakterijske združbe orhidej *Phalaenopsis* z bolezenskimi znamenji mehkih gnilob

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Bolezni mehkih gnilob povzročajo občutno ekonomsko škodo pri vzgoji in pridelavi številnih ekonomsko pomembnih poljščin in okrasnih rastlin, kot npr. krompir in orhideje. V razvoj bolezni je običajno vključena populacija patogena ali pa celo mešana populacija, ki lahko vključuje različne vrste rodu *Dickeya* in *Pectobacterium*. Diagnostične metode, ki temeljijo na sposobnosti gojenja bakterij na gojiščih ali detekciji tarčnega organizma, zaradi visoke selektivnosti ne omogočijo realnega pogleda v prisotno bakterijsko združbo. Zato potrebujemo pristop, ki omogoča celosten pogled v bakterijsko združbo povezano z razvojem bolezni in odnose znotraj nje (sinergija, antagonizem). Tak pristop nam omogočajo metode okoljske genomike kot je metagenomika, ki temeljijo na sekvenciranju nukleinskih kislin. Metagenomika omogoča raziskovanje mikrobnih združb neposredno iz naravnega okolja brez predhodnega gojenja v laboratoriju. Cilj naše raziskave je bil ovrednotenje širše bakterijske združbe orhidej *Phalaenopsis* z bolezenskimi znaki mehkih gnilob s pomočjo komercialnega kita za metagenomsko analizo na osnovi 16S rDNA. Predhodno smo z izolacijo bakterij na gojiščih in s pomočjo qPCR analize identificirali bakterijskega povzročitelja mehkih gnilob orhidej *Phalaenopsis* in ga uvrstili v rodo *Dickeya*. Iz tkiva orhidej smo izolirali DNA v različnih fazah bolezni in z uporabo 16STM Metagenomics Kit pomnožili 7 variabilnih regij 16S rDNA. Pomnožene variabilne regije smo sekvencirali na Ion PGM sistemu (316 čip). Sekvenčne podatke smo analizirali z dvema različnima programskima platformama, in sicer Ion Reporter (Life Technologies) and MG-RAST. Čeprav 16STM Metagenomics Kit ni specializiran za metagenomiko rastlin, je omogočil ustrezno analizo bakterijske združbe tkiva orhidej z in brez bolzanskih znamenj. Prisotnost kloroplastne rDNA v rastlinskih vzorcih je vplivala na samo občutljivost metagenomske analize. Delež odčitkov, ki so pripadali kloroplastni DNA je bil občutno višji v zdravem kot v nekrotičnem tkivu, kar sovpada razgradnji kloroplastov v gnilem tkivu. Kljub variabilnim deležem bakterijskih sekvenc je bilo število in kvaliteta odčitkov ustrezna za določitev profila bakterijske združbe testiranem rastlinskem tkivu. V prispevku so predstavljeni pristop, izzivi in rezultati metagenomske analize bakterijske združbe rastlin.

ABSTRACT

Metagenomics analysis of bacterial community in *Phalaenopsis* orchids with soft rots

Soft rots remain an important economical liability in production of various economically important crops and ornamental plants e.g. potato and orchids. Frequently, a population of the pathogen or even mixed populations including various strains of *Dickeya* and *Pectobacterium* spp. can contribute to the development of the soft rot disease. Diagnostic methods, based on the cultivation of the bacteria on artificial media or detection of specific target organisms, are extremely selective and do not provide realistic insight into bacterial community. A holistic approach is required to understand bacterial community involved in the disease development, especially their inter-bacterial relationships acting synergistically and antagonistically. This can be explored through sequenced-based environmental genomics. Metagenomics provides a cultivation-independent approach to study microbial communities directly in their natural environments. The aim of our study was to gain a wider insight in bacterial communities involved soft rot disease of *Phalaenopsis* using commercial 16S rDNA based metagenomics kit. Causative bacteria of soft rot in *Phalaenopsis* orchids, *Dickeya* spp., were characterised as *Dickeya* spp. using isolation on media and qPCR analysis. Following DNA extraction from orchid leaves in different disease stages, sections of 16S rDNA were amplified with 16STM Metagenomics Kit and sequenced on the Ion PGM system (316 chip). Data was analysed with Ion Reporter (Life Technologies) and MG-RAST pipelines.

The 16S™ Metagenomics Kit was suitable for analysis of bacterial community in orchid plant tissues with and without rotting symptoms. The chloroplast rDNA in the analysed tissue samples influenced the sensitivity of the metagenomics analysis. The percentage of chloroplast reads was higher in healthy than in necrotized tissues correlating with the expected chloroplast degradation in rotting tissues. However, number and quality of bacterial reads was sufficient for community profiling. In this article we present approach, challenges and results of metagenomics analysis of plant bacterial communities using commercial metagenomics kit.



Spremljanje pojava bakterijskih bolezní na stročnicah

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V letih 2017 in 2018 smo spremljali pojav bakterijskih bolezní na soji (*Glycine max* L. Merr) in fižolu (*Phaseolus vulgaris* L.). Glavni namen naloge je bila identifikacija povzročiteljev bakterioz na soji zaradi povečane pridelave soje v zadnjih letih. Preglede in vzorčenja smo opravljali v poletnih mesecih (junija-avgust) v Prekmurju in na Gorenjskem. V večini primerov smo bolezenska znamenja opažali na listih, redkeje na steblih in strokih. Opažena bolezenska znamenja so bila podobna bakteriozam na fižolu. Bakterije smo iz rastlinskih tkív izolirali z uporabo standardnih metod ter jih identificirali z analizami MALDI-TOF in metodo določevanja nukleotidnega zaporedja genov *gyrB* in *rpoD* (t.i. barcoding). Iz vzorcev listov, kjer so se pojavljale manjše vodene rumenorjave pege s svetlo obrobo, smo identificirali bakterije iz rodu *Pseudomonas*. Potrdili smo prisotnost *Pseudomonas savastanoi* pv. *glycinea* (bakterijska pegavost soje) ter ostale patogene pseudomonade (*P. savastanoi* pv. *phaseolicola*, *P. viridiflava* in *P. syringae*). Redkeje smo opažali rjavkaste pege z rumenim obročem s prisotnim rumenkastim eksudatom ob listnih žilah na spodnji strani listov. Ponekod so imeli listi videz razcefranosti zaradi združevanja in izpadanja posušenih peg. Opisana znamenja so značilna za bakterijsko mozoljavost soje (*Xanthomonas axonopodis* pv. *glycines*), a prisotne so bile tudi bakterije vrste *X. axonopodis* pv. *phaseoli*, ki povzročajo navadno bakterijsko pegavost fižola. V letu 2018 smo spremljali tudi bakterioze na fižolu. Potrdili smo prisotnost patogenih vrst *P. savastanoi* pv. *phaseolicola* (mastna fižolova pegavost), *P. viridiflava* ter *X. axonopodis* pv. *phaseoli*. V enem samem primeru smo identificirali tudi patogeno vrsto *X. arboricola*. Iz vzorca krmnega graha (*Pisum sativum* L. var. *arvense*) z znamenji mehke gnilobe na stebelu smo identificirali bakterije iz rodu *Erwinia*. Ni znano, da bi omenjene bakterije v Sloveniji povzročale večjo gospodarsko škodo. Ker pa se večina njih prenaša z okuženim semenskim materialom, svetujemo pridelovalcem uporabo zdravega in certificiranega semena.

ABSTRACT

Monitoring of bacterial diseases on legumes

In 2017-2018 we were monitoring bacterial diseases on soybean (*Glycine max* L. Merr) and common beans (*Phaseolus vulgaris* L.). Initially, the goal was to identify bacterial pathogens on soybean as the productions has increased significantly over the last years. Monitoring and sampling were performed in summer months (June-August) in region of Prekmurje and Gorenjska. The symptoms were mainly observed on leaves, less on stems and pods, and resembled those of bacterial diseases on beans. Standard bacterial isolation techniques were used. Isolates were identified with MALDI-TOF and barcode sequence

analysis (*gyrB*, *rpoD*). Leaf samples exhibiting symptoms of small, water-soaked, yellow-to-brown spots surrounded by light halo, were associated with *Pseudomonas* species infection. Bacterial blight of soybean (*Pseudomonas savastanoi* pv. *glycinea*) was common as well as other pathogenic *Pseudomonas* species (*P. savastanoi* pv. *phaseolicola*, *P. viridiflava*, *P. syringae*). Less frequently we observed symptoms of angular brown spots with yellowish exudate on the lower leaf surface. Due to spot merging and drying the infected leaves often had ragged look. These symptoms are characteristic for bacterial pustule disease of soybean (*Xanthomonas axonopodis* pv. *glycines*), but we also isolated *X. axonopodis* pv. *phaseoli* that causes common bacterial blight disease of beans. In 2018 we extended the monitoring to common beans. We confirmed the presence of halo blight disease caused by *P. savastanoi* pv. *phaseolicola*, and other pathogens (*P. viridiflava*, *X. axonopodis* pv. *phaseoli*). There was also one case of infection caused by *X. arboricola*. One sample of fieldpea (*Pisum sativum* L. var. *arvense*) exhibited symptoms of soft rot on stem. We isolated and identified bacteria from genus *Erwinia*. All identified bacterial pathogens of soybean and beans are not economically important in Slovenia. However, most of them are seed transmissible. We therefore encourage producers to use healthy and certified seed material to minimize yield loss.



Spremljanje vznika plevelov kot del strategije integriranega uravnavanja plevelne vegetacije

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Eno od temeljnih načel integriranega varstva rastlin je pravočasno ukrepanje na podlagi spremljanja pojavov škodljivih organizmov. Tudi v integriranem pristopu uravnavanja plevelne vegetacije je prepoznavanje plevelov in spremljanje dinamike njihovega vznika na kmetijskih površinah osnova za sprejemanje odločitev o metodah njihovega obvladovanja. Pri obvladovanju plevelov je treba upoštevati razlike med različnimi lokacijami, vrstami plevelov, podnebnimi in talnimi razmerami, topografijo ter navadami pridelovalca, saj vplivajo na izbor uporabljenih metod zatiranja in posledično tudi njihovo učinkovitost. Ker se uporaba kemičnih pripravkov za zatiranje plevelov vedno bolj omejuje, je njihovo spremljanje še toliko bolj pomembno, saj lahko v nekaterih primerih uporabo herbicidov nadomestimo z drugimi nekemičnimi ukrepi uravnavanja plevelne populacije. Redno spremljanje je pomembno tudi zaradi ugotavljanja pojava morebitne odpornosti plevelov na določeno aktivno snov, saj se ob zmanjševanju nabora sredstev povečuje tveganje za nastanek le-tega. Za preizkus modela spremljanja smo v letu 2018 na štirih lokacijah po Sloveniji, na dveh skupinah poljščin (koruza, žito), spremljali vznik plevelov na stalnih opazovalnih mestih. Periodično smo spremljali vznik in število rastlin ter pokrovnost posamezne plevelne vrste. Na delu opazovalnih mest je bila uporabljena obstoječa tehnologija zatiranja plevela, ki jo uporablja kmetijsko gospodarstvo, preostanek površine pa je bil ob uporabi herbicidov pokrit s folijo (kontrolno obravnavanje). Najbolj so na hitrost vznika plevelov, kakor tudi na razlike v vrstni sestavi plevelov vplivale pedo-klimatske razlike med posameznimi lokacijami. V splošnem smo ugotovili, da je bila uporaba herbicidov ob pravočasni aplikaciji zelo učinkovita pri uravnavanju plevelne vegetacije, najboljše rezultate smo zabeležili pri zmanjšanju pokrovnosti plevelov v koruzi. Pridobljeni rezultati nakazujejo, da je redno spremljanje in evidentiranje plevelnih vrst na kmetijskih površinah osnova za odločitve o pravočasnih in učinkovitih ukrepih za njihovo zatiranje.

ABSTRACT

Weed monitoring as a part of integrated weed management strategy

One of the key components in integrated pest management approach is the selection and optimal use of control methods which are based on pest monitoring. Similarly, identification and monitoring of weed emergence dynamics is a basis for decisions on appropriate weed control methods and has a considerable influence on the outcome of their efficacy. Differences between locations, weed species, climatic and soil conditions, topography and farmers' habits can greatly affect the selection of particular control methods, where in some cases herbicide use can be replaced with non-chemical weed control methods. Weed monitoring is lately of even greater importance due to limited choice of available herbicides and restrictions regarding their use, as well as increasing cases of weed resistance to particular herbicide active ingredients all over the world. In 2018, weed population was continuously monitored in 2018 in maize and cereals at four locations in Slovenia, where weed species identification and its coverage were recorded on designated subplots within the farmer's fields. Local weed management practices were implemented, while control plots were covered with plastic at the time of herbicide application. Peco-climatic conditions were the foremost factor influencing weed species composition and their emergence dynamics, where as expected, more temperate species were found in sites with warmer climate. In general, optimal use of herbicides greatly reduced weed infestation compared to untreated plots in most cases, the most effective results in reducing weed ground cover was determined in maize. Our results indicate that regular monitoring and weed species identification can be a useful tool and basis for farmers' decision on timely and effective weed control measures.



Preživetje semena pelinolistne ambrozije (*Ambrosia artemisiifolia* L.) v silaži

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Pelinolistna ambrozija (*Ambrosia artemisiifolia* L.) je pogosta plevelna vrsta tako na njivskih kakor tudi nekmetskih površinah. Rastline proizvajajo ogromne količine alergenega peloda, ki povzročata pri ljudeh precejšnje zdravstvene težave. Zaradi velike proizvodnje semena na infestiranih območjih pa lahko tudi živalska krma predstavlja pomemben vektor njenega širjenja. Namen preiskave je bil določiti kalivost in preživetje semena ambrozije v travni in koruzni silaži. Semena so bila nabrana jeseni leta 2015 in stratificirana pri 4° C dva meseca. Kalivost stratificiranih semen je znašala 70 %, medtem ko je bilo vitalnih semen na podlagi tetrazol (TTC) testa 98 %. Mrežaste vrečke s 100 stratificiranimi semeni smo položili v 30 L plastične silirne posode, v katere smo natlačili travno in koruzno silažo. Obravnavanja so vsebovala dve vrsti silaže (2 dni uvela travna silaža in že povretna koruzna silaža iz silosa) ter dva obdobja inkubacije semen ambrozije v silaži (4 in 8 tednov). Semena, ki smo jih zatem vzeli iz posod in opravili test kalivosti in vitalnosti. Semena ambrozije iz travne silaže so v celoti izgubile tako kalitveni sposobnost, kakor tudi vitalnost (0 %). V koruzni silaži pa smo ugotovili precejšen delež tako kalivih (29 %), kakor tudi vitalnih semen (48 %). Rezultat je posledica dejstva, da smo uporabili že povretno koruzno silažo. Obdobja inkubacije v silaži je značilno vplivalo na kalivost in vitalnost samo pri koruzni silaži (*P<0.05). Po 4 tednih inkubacije v koruzni silaži smo tako izmerili 57 % in 13 % kalivosti in vitalnosti, v primerjavi s 40 % in 26 % kalivosti in vitalnosti pri 8 tednov trajajoči inkubaciji semena ambrozije.

Naši rezultati so pokazali, da so semena ambrozije po 4 tednih v travni silaži v celoti izgubila kalivost in vitalnost. Kljub precejšnjemu zmanjšanju kalivosti in vitalnosti semen v koruzni silaži, pa je precejšen delež semen ambrozije preživel in le-ta lahko predstavljajo pomemben vektor v procesu njenega širjenja.

ABSTRACT

Viability of common ragweed (*Ambrosia artemisiifolia* L.) seeds in the silage

Common ragweed (*Ambrosia artemisiifolia* L.) is a frequent weed species on non agricultural land, disturbed areas and arable cropping systems. It is also a major allergenic plant due to vast production of pollen, which causes severe health problems in humans. Because of ragweed extensive seed production, animal feed could also be considered as an important spreading vector in extremely infested areas. The objectives of this study were therefore to determine ragweed seeds germination and viability in grass and maize silage. Seeds were collected in autumn 2015 and stratified at 4° C for 2 months. Germination rate of stratified seeds-control was 70 %, while total viability rate with Tetrazolium (TTC) test was 98 %. A samples of 100 stratified seeds were then placed in mesh bags and put inside small 30 L plastic ensilage containers. Treatments consisted out of two different silage types (2 days wilted grass and fermented maize silage) and two periods of ragweed seeds incubation in the silage (4 and 8 weeks). Seeds were then taken out of the silage and subjected to germination and viability test. Ragweed seeds stored in grass silage had completely lost their germination capacity and viability (0 %). In the maize silage, high proportion of germinated (29 %), as well as vital seeds (48 %) was observed. This result could be related to already fermented maize silage being used in the experiment. Time of seed incubation was significant only for the maize silage, (*P<0.05), where germination and non-vital seed rate for 4 weeks stored seeds was 57 % and 13 % compared to 40 % and 26 % in the 8 weeks long storage, respectively. Our results showed that after 4 weeks in the grass silage, ragweed seeds completely lost their germination ability and viability. Despite of significant reduction of germinability and viability in the maize silage, portion of seeds still survived and could represent an important vector for the spread of ragweed.



Pridelek zelja pri različnih strategijah integriranega uravnavanja plevelne vegetacije

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Pravočasno in učinkovito uravnavanje plevelne vegetacije je v primerjavi s poljedelso proizvodnjo v pridelavi zelenjave še toliko bolj pomembno. Čeprav zelje ne spada med najbolj občutljive vrste glede tekmovalne sposobnosti s pleveli, lahko njegovo neučinkovito zatiranje privede do precejšnjega izpada tako količine kakor tudi same kakovosti pridelka. Z namenom primerjave različnih strategij integriranega pristopa uravnavanja plevelne vegetacije s standardno uporabo herbicidov, je bil v letu 2018 v Jabljah izveden poljski poskus v zelju. Obravnavanja so vključevala nezapleveljene parcele, postopek z neškropljeno kontrolo ter različne kombinacije zmanjšane rabe herbicida (herbicid samo v vrsti, herbicid samo pred vznikom) in okopavanja. Zaradi ugodnih vremenskih razmer (dovolj padavin in zmerne poletne temperature) so bili v letu 2018 izmerjeni visoki pridelki zelja. Najbolj učinkovit postopek je bil dvakratna raba herbicida (pred in po vzniku; 97 %), ki mu je sledila uporaba herbicida v vrsti in kasnejše okopavanje (91 %). Pred pobiranjem pridelka smo na teh parcelah izmerili 37 in 74 g/m² suhe mase plevela. Na parcelah, kjer smo uporabili samo herbicid pred vznikom (metazaklor) smo dosegli 83 % učinkovitost in

izmerili 184 g/m² suhe plevelne mase. Najvišji tržni pridelek zelja smo izmerili v obravnavanju z uporabo herbicida v vrsti, ki mu je sledilo okopavanje (87,3 t/ha) in je bil podoben obravnavanju z dvema aplikacijama herbicida (pred vznikom - metazaklor in po vzniku - piridat; 85,6 t/ha) in nezapleveljeno površino (87 t/ha). Neškropljena površina je bilo izjemno zapleveljena, tam smo izmerili precej nižji pridelek, ki je znašal le 40 t/ha. Kljub nekoliko nižji stopnji učinkovitosti zatiranja plevela v nekaterih postopkih z zmanjšano rabo herbicida in okopavanjem, je bilo ugotovljeno le manjše zmanjšanje pridelka. V obravnavanju z uporabo herbicida v vrsti ter postopku s samo enkratno aplikacijo herbicida pred vznikom, (v obeh primerih je kasneje sledilo še okopavanje), smo tako izmerili 75 t/ha in 80 t/ha tržnega pridelka zelja. Naši rezultati nakazujejo, da je v intenzivni proizvodnji zelja mogoče pristop zmanjšane rabe herbicidov uspešno kombinirati z mehanskimi postopki zatiranja plevela.

ABSTRACT

Cabbage yield under different integrated weed management strategies

Timing and efficacy of weed control in vegetables is in contrast to arable production of much greater importance. Although cabbage is not extremely sensitive to weed competition, poor weed control can affect the yields, but even more important the quality of the crop. Intergrated weed management (IWM) principles include combination of several control practices for effective and sustainable weed management. With aim to compare various IWM strategies with standard herbicide application, a field trial with five treatment and 3 replications was conducted at experimental farm Jablje in 2018. Treatment consisted of untreated control, season long weed free and combination of herbicide application (herbicide in the row) and mechanical tools. Due to favourable environmental conditions (sufficient precipitation and moderate temperatures), high yields were observed in 2018. The most effective treatments were two applications of herbicides (97 %), followed by combination of herbicide row application combined with hoeing (91 %). Before cabbage harvest, dry weed biomass of 37 and 74 g/m² was measured in this treatments, respectively. Only preemergence application of metazachlor resulted in 83 % of visual weed control efficacy and 184 g/m² of dry weed biomass. The highest cabbage marketable yield was observed in treatment with preemergence broadcast herbicide application followed by hoeing (87, 3 t/ha) and was similar to strategy with two herbicide applications (preem - metazachlor and post - pyridate; 85,6 t/ha) and the weed free treatment (87 t/ha). Untreated control was extremely weedy, which resulted in significant yield reduction to 40 t/ha. Despite of moderate decrease in weed control level in plots with less herbicide input, cabbage yields were however not greatly affected. In treatments with preemergence herbicide row application and preemergence broadcast herbicide application, both followed by hoeing, only minor yield reduction was observed with 75 t/ha and 80 t/ha of marketable cabbage measured in this two treatments, respectively. Our results showed that herbicides can be effectively combined with mechanical tools in intensive cabbage production.



Vpliv različnih strategij integriranega uravnavanja plevelne vegetacije na pridelek ozimne pšenice

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Implementacija integriranega pristopa uravnavanja plevelne vegetacije v slovenski pridelavi žit bi vplivala na razvoj bolj trajnostnih pridelovalnih sistemov, saj zatiranje plevela trenutno večinoma temelji na uporabi herbicidov. Za doseg tega cilja smo v oktobru 2017, v Jabljah izvedli poljski poskus, kjer smo preizkusili različne kombinacije uporabe herbicidov in mehanskih ukrepov zatiranja plevela. Pri tem smo tri alternativne strategije primerjali z dvema standardnima pristopoma. V dveh standardnih postopkih je bila ozimna pšenica posejana v optimalnem roku, herbicide pa smo uporabili v jeseni in zgodaj spomladi v priporočenih odmerkih. V enem alternativnem pristopu smo setev opravili 14 dni kasneje, druga pa je dodatno vključevala še izvedbo slepe setve. Pri obeh posotpkih smo v spomladanskem času opravili še česanje. V tretji alternativni strategiji je bila pšenica posejana v optimalnem roku, česanje smo opravili že v jeseni, herbicid pa uporabili zgodaj spomladi. Zaradi dolge zime je bilo spomladansko česanje opravljeno v neugodnih pogojih in zelo pozno, zato ni bilo učinkovito. Posledično smo namesto znižanih odmerkov, morali uporabiti herbicide v poznejšem roku, v priporočenih odmerkih. Pogoji pri izvedbi slepe setve so bili neugodni (zelo suho), zato le-ta ni bila učinkovita. Zaradi tega smo v pozno spomladanskem roku prav tako uporabili herbicid v priporočenem odmerku. Kasnejša setev ni bistveno vplivala na zapleveljenost, tudi razlike v razvoju pšenice so bile komaj vidne. Glede na izmerjeno suho biomaso plevela, je bila izjemno učinkovita standardna jesenska uporaba herbicida ($0,15 \text{ g/m}^2$). Pozno spomladanska aplikacija herbicida je bila bolj učinkovita v primerjavi z zgodaj spomladansko uporabo, saj smo izmerili le $1,5 \text{ g/m}^2$ suhe biomase plevela. V standardnem zgodnje spomladanskem terminu uporabe herbicida in česanjem smo izmerili $16,2 \text{ g/m}^2$, v kombinaciji tega postopka s česanjem pa $17,5 \text{ g/m}^2$ suhe biomase plevela. Pridelki ozimne pšenice med postopki so bili zelo podobni, izmerili smo od $5,7 \text{ t/ha}$ pri zgodnje spomladanski uporabi herbicida pa do $6,1 \text{ t/ha}$ suhega zrnja ozimne pšenice sorte Vulkan pri standardni jesenski aplikaciji herbicida.

ABSTRACT

Yield of winter wheat influenced by different integrated weed management strategies

Weed control in slovenian cereal production is mainly achieved with the use of herbicides. Implementation of integrated weed management principles can result in more sustainable cropping systems. A winter wheat trial was set in October 2017, where various combinations of chemical and mechanical weed control measures were tested. Three alternative strategies were compared to two standard chemical approaches. In the two standard strategies winter wheat was drilled at optimum sowing date and recommendet doses of herbicides were applied in the autumn and early in the spring. In one alternative strategy winter wheat was drilled 14 days later, while the second one included false seed bed technique in the period of delayed drilling. Both strategies were followed by tine harrowing in the spring. In third alternative strategy winter wheat was drilled at optimum sowing date, followed by autumn harrowing and herbicide application in the early spring. Due to long and cold winter, spring harrowing was performed very late. Consequently, the effect of harrowing was poor and recommendet dose of herbicide was used in late spring application. In the strategy with false seedbed the conditions for promoting weed germination were not suitable (very dry) and similarly recommendet dose was used in the late spring application of herbicide. Delayed sowing did not had any measurable effect on reducing weed infestation and only minor differences in winter wheat development was observed. Autumn herbicide application showed best results in terms of dry weed biomass at the wheat flowering stage, where only $0,15 \text{ g/m}^2$ of dry weed biomass was measured. Late spring herbicide application performed better compared to early spring application with $1,5 \text{ g/m}^2$ of dry weed biomass. In the standard early spring herbicide treatment and combination with autumn harrowing $16,2$ and $17,5 \text{ g/m}^2$ of dry weed biomass was determined, respectively. Winter wheat variety Vulkan yields were very similar between tretaments ranging from $5,7 \text{ t/ha}$ in early spring herbicide treatment, to $6,1 \text{ t/ha}$ in standard autumn herbicide application.



Vpliv različnih strategij integriranega uravnavanja plevelne vegetacije na pridelek koruze

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Koruzi predstavlja našo najpomembnejšo poljščino in večina njene intenzivne pridelave v Sloveniji poteka na ravninskih predelih z rodovitnimi aluvialnimi tlemi, ki so zelo podvržena izpiranju. Zatiranje plevela v intenzivni pridelavi koruze pri nas večinoma temelji na uporabi herbicidov. S ciljem uvajanja inovativnih in učinkovitih praks Integriranega pristopa uravnavanja plevelne vegetacije v pridelavi koruze, je bil leta 2018 v Jabljah izveden poljski poskus. Namen poskusa je bil preizkusiti različne kombinacije zmanjšane rabe herbicidov in mehanskega zatiranja plevela v koruzi. Preizkušene strategije za zatiranje plevela so vključevale zmanjšan odmerek herbicida (60 %) in uporabo le-tega samo v vrsti, v primerjavi s standardno uporabo herbicida in postopkom mehanskega zatiranja plevela (okopavanje). Glede na izmerjeno suho biomaso plevela ob koncu sezone je bilo zatiranje plevela najbolj učinkovito pri standardnem postopku (19 g/m²) in kombinaciji zmanjšane odmerka herbicida, ki mu je sledilo okopavanje (20 g/m²). Pri uporabi herbicida v vrsti, ki mu je sledilo okopavanje, smo izmerili 88 g/m² suhe biomase plevela. Najvišji pridelek je bil izmerjen v standardnem postopku uporabe herbicida zgodaj po vzniku (14,6 t/ha). Na parcelah z zmanjšanim odmerkom herbicida in postopku uporabe herbicida v vrsti, ki mu je v obeh primerih sledilo okopavanje smo izmerili pridelek 12,2 t/ha in 13,2 t/ha suhega zrnja koruze. Pri teh dveh postopkih so bili nižji pridelki predvsem posledica izgube rastlinskega sklopa zaradi zelo agresivnega okopavanja s prstim okopalnikom. Najnižji pridelek je bil izmerjen pri strategiji s samo enim okopavanjem (10,6 t/ha), kjer je bila ob koncu avgusta izmerjena precejšnja suha biomasa plevela (226 g/m²). Naši rezultati so pokazali, da lahko v intenzivni proizvodnji koruze uporabo herbicidov uspešno dopolnjujemo z mehansko postopki zatiranja, z minimalnim vplivom na zmanjšanje pridelka koruze.

ABSTRACT

The effect of different integrated weed management strategies on maize yield

Maize is the most important arable crop in Slovenia with majority of its intensive production concentrated on the fertile shallow alluvial soils in the lowlands, which are highly susceptible to leaching. Maize production in Slovenia is highly dependent on herbicides. In order to support the implementation of innovative and effective Integrated weed management practices in maize production, a field trial was established in 2018 in Jablje. The objective of the experiment was to test various combinations of herbicide treatment and mechanical weed control in maize. Weed control strategies that were tested included reduced herbicide use and herbicide application in the row combined with hoeing, standard broadcast herbicide application and treatment with only mechanical weed control (hoeing). In terms of dry weed biomass at the end of the season, weed control was most effective in the standard treatment (19 g/m²) and reduced herbicide use followed by hoeing (20 g/m²). In treatments with band spraying followed by hoeing and only mechanical weed control, 88 g/m² and 227 g/m² of dry weed biomass was determined. The highest yield was measured in the standard early post broadcast herbicide treatment (14,6 t/ha). In plots with reduced herbicide application (60 % dose) and band spraying, both followed by hoeing dry maize grain yield of 12,2 t/ha and 13,2 t/ha was observed. In treatments with reduced herbicide inputs weed infestation did not have any significant effect on yield loss, lower yields were the consequence of maize stand loss due to very aggressive hoeing with finger weeder. The lowest yield was achieved in strategy with only one hoeing (10,6 t/ha), where substantial dry weed biomass was measured at the end of the season (226 g/m²). Our results showed that in the intensive maize production mechanical tools can be successfully combined with mechanical tools with minimum impact on the maize yield.



Dveletne izkušnje preučevanja uporabe fungicida pri pridelavi koruze za zrnje

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V letih 2017 in 2018 smo v poljskih poskusih v Jabljah (osrednja Slovenija) preučevali učinke uporabe fungicida v posevkih koruze za zrnje. Poskuse smo zasnovali kot dvo-faktorske bločne poskuse z naključno razporeditvijo v štirih ponovitvah. Preučevana faktorja sta bila hibrid (OS 398 in KWS 2323 v letu 2017 ter KWS 2370, KWS Walterino in KWS Solferino v letu 2018) ter fungicid (brez fungicida in z fungicidom). V poskusih smo uporabili fungicid QUILT XCEL (1 l/ha, a.s. azoksistrobin + propikonazol). Fungicid smo aplicirali v začetku julija. V letu 2017 so bile rastline ob aplikaciji velike 140–150 cm (BBCH 33–35), v letu 2018 pa 190–200 cm (BBCH 37–51). Za nanos smo uporabili nahrbtno škropilnico na stisnjen zrak, s porabo škropilne brozge 300 l/ha. Po aplikaciji smo spremljali fenološki razvoj, morfološke značilnosti ter pojav bolezni koruzna progavost (*Setosphaeria turcica* (Luttr.)) in fuzarioze (*Fusarium* spp.). Pred žetvijo smo prešteli število polomljenih in polegih rastlin in po žetvi ovrednotili pridelek zrnja ter vlago. Rezultati kažejo, da aplikacija fungicida v nobenem letu ni značilno vplivala na razvoj rastlin, pridelke in prisotnost bolezni. V letu 2017 je bil povprečni pridelek 10,45 t/ha brez uporabe in 10,28 t/ha z uporabo fungicida. V letu 2018 smo fungicid aplicirali v poznejši razvojni fazi in ob tem opazili malce večji pridelek ob uporabi fungicida. Pridelek je bil 12,86 t/ha brez fungicida in 13,39 t/ha z fungicidom. Vizualne ocene prisotnosti bolezni se v obeh letih niso razlikovale, kar je deloma zaradi manj ugodnih okoljskih pogojev za razvoj glivičnih bolezni v preučevanih letih. Tudi na rastlinah kjer fungicid nismo aplicirali opazili večje prisotnosti glivičnih bolezni. Rezultati poskusov kažejo, da je bil učinek uporabe fungicida premajhen, da bi izboljšal ekonomičnost pridelave koruze za zrnje.

ABSTRACT

Experiences in two year of testing fungicide application in cultivation of grain maize

Effects of fungicide application in grain maize were studied in field experiments at Jablje (central Slovenia) in years 2017 and 2018. The experiments were arranged as two-factor factorial in randomized complete block design with four repetitions. The factors studied were hybrids (OS 398 and KWS 2323 in 2017 and KWS 2370, KWS Walterino and KWS Solferino in 2018) and the application of fungicide (no fungicide and fungicide applied). Fungicide QUILT EXCEL (1 l/ha, a.s. azoxystrobin + propiconazole) was used in trials. Fungicides were applied in early July. At the time of the application plants were approximately 140–150 cm tall (BBCH 33-35) in 2017 and 190–200 cm tall (BBCH 36-51) in 2018. Fungicide was applied using the knapsack sprayer powered by the compressed air; spray mixture usage was set to 300 l/ha. Phenological development, morphological characteristics and severity of fungal diseases *Setosphaeria turcica* (Luttr.) and *Fusarium* spp. were observed after the application, number of broken and lodged plants were counted before the harvest and grain yields and moisture were measured at the harvest. Statistical analysis showed that the application of fungicide had no significant effect on plant development, yields and on presence of the disease. Grain yields in 2017 were 10.24 t/ha without and 10.45 t/ha with fungicide. Small increase in yields with the application of fungicide was observed in 2018 when fungicide was applied at later growth stage. Grain yields in 2018 were 12.86 t/ha without and 13.39 t/ha with fungicide. Environmental conditions for the development of fungal diseases were less favourable in

2017 and 2018 and no significant differences among visual disease estimates were observed between treatments. Results of trials suggests, that the yield increase with the use of fungicide was too small to improve the economics of maize production.



Povezava med uporabljenim fungicidom za zatiranje bolezni listov in klasa pšenice ter vsebnostjo mikotoksinov v zrnju

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V poljskem poskusu smo ugotavljali povezavo med uporabljenimi fungicidi za zatiranje bolezni listov in klasa pšenice ter vsebnostjo mikotoksinov v zrnju. Pri postopkih, kjer so bile za zatiranje pšenične listne pegavosti v prvem terminu škropljenja med kolenčenjem žita (BBCH 33-39) uporabljene aktivne snovi iz skupine zunanjih inhibitorjev kinona (QoI) in/ali inhibitorji sukcinat-dehidrogenaze (SDHI), je bila vsebnosti mikotoksina deoksinivalenol (DON) v pridelanem zrnju večja v primerjavi s kontrolo, kjer fungicid ni bil uporabljen. Pri postopkih, kjer je bilo izvedeno dodatno škropljenje z azolnim fungicidom v klas, ob začetku cvetenja (BBCH 61), je bila onesnaženost zrnja z DON-om manjša, ne glede na to, katere aktivne snovi so bile uporabljene v prvem terminu med kolenčenjem žita. Ugotovljene vrednosti DON-a so bile pri teh postopkih nižje od priporočene mejne vrednosti za zrnje (1,25 ppm) in značilno nižje kot pri neškropljeni kontroli.

ABSTRACT

The link between fungicides used for leaf and ear disease control of winter wheat and the mycotoxin content in grains

In the field experiment the link between fungicides used for leaf and ear disease control in winter wheat and mycotoxin contamination of the grain was studied. At treatments where for *Septoria tritici* control during leaf and stem development (BBCH 33-39), where the fungicide active substances from the group of Quinone outside inhibitors (QoI) and/or Succinate dehydrogenase inhibitors (SDHI) were used, the content of deoxynivalenol (DON) in harvested grains was higher in comparison to the untreated control. Subsequent treatment with azole fungicides at the beginning of wheat flowering (BBCH 61) resulted in significantly reduced content of DON mycotoxin in harvested grains regardless of the fungicide group that was used for first treatment during leaf and stem development. The measured values were below the permitted limit of 1.25 ppm and significantly lower compared to the untreated control.



Analiza zrnja na mikotoksin deoksinivalenol in pridelek izbranih sort ozimne pšenice

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Na Laboratorijskem polju smo v letu 2018 opravili dva poskusa, v katerih smo analizirali vsebnost mikotoksina deoksinivalenol v pšeničnem zrnju in pridelek izbranih sort ozimne pšenice. V prvem poskusu smo uporabili sorto ozimne pšenice Bastide. Pri tem poskusu smo izvedli direktno setev z vlečeno sejnalnico Gaspardo Directa 300. Pri prvem obravnavanju smo izvedli škropljenje proti fuzariozam klasa s fungicidom Prosaro (a.s. protiokonazol in tebukonazol), medtem ko pri drugem obravnavanju tega škropljenja nismo izvedli. Pri obeh obravnavanjih je vsebnost deoksinivalenola močno preseгла največjo dovoljeno vrednost za pšenično zrnje, ki znaša 1250 µg/kg suhe snovi. V drugem poskusu smo analizirali pridelek sedmih sort ozimne pšenice in vsebnost deoksinivalenola v zrnju. V tem poskusu smo uporabili konvencionalen način pridelave in kemičnega varstva rastlin. Pri vseh sedmih sortah ozimne pšenice je bila vsebnost deoksinivalenola v zrnju pod največjo dovoljeno vrednostjo.

ABSTRACT

Grain analysis of mycotoxin deoxynivalenol and yield of selected winter wheat cultivars

In 2018 on the Laboratory field two trials were performed, in which we analyzed the content of mycotoxin deoxynivalenol in winter wheat grain and yield of selected winter wheat cultivars. In the first trial winter wheat cultivar Bastide was used. In this trial we performed the direct sowing using trailed seed drill Gaspardo Directa 300. By the first treatment the spraying with the fungicide Prosaro (a.i. prothioconazole and tebuconazole) against fusarium head blight was applied, while at the second treatment such spraying was not carried out. By both treatments the deoxynivalenol content exceeded significantly the maximum permitted level for the wheat grain, which is 1250 µg/kg of dry matter. In the second trial we analyzed the yield of seven winter wheat cultivars and deoxynivalenol content in the grain. In this trial the conventional way of production and chemical control was used. By all seven winter wheat cultivars the deoxynivalenol content in the grain was below the maximum permitted level.



Učinkovitost slovenskih izolatov entomopatogenih gliv iz rodov *Beauveria* in *Metarhizium* na dveh testnih organizmih

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V raziskavi smo preizkušali učinkovitost gliv iz rodov *Beauveria* in *Metarhizium*. Uporabili smo izolate gliv iz cele Slovenije in iz tal z različno namensko rabo na dveh testnih organizmih, gosenicah voščene vešče (*Galleria mellonella*) in ličinkah mokaarja (*Tenebrio molitor*). Po pričakovanjih je bila smrtnost večja pri bolj občutljivih ličinkah voščene vešče kot pri mokaarju. Največja dosežena smrtnost po 4.

dnevu po okužbi je pri voščeni vešči dosegla 75 % pri 3 izolatih, pri mokarju pa le 45 % pri enem izolatu. Vrsta *Metarhizium guizhouense* je delovala le na ličinke voščene vešče, medtem ko so vse ličinke mokarja preživele.

ABSTRACT

The efficacy of Slovene entomopathogenic fungi (*Beauveria* spp. and *Metarhizium* spp.) isolates on two test organisms

The efficacy entomopathogenic fungi from two common genera *Beauveria* and *Metarhizium* was tested in our research. Isolates of the soil from different locations in Slovenia and with different usage were tested on larvae of the greater wax moth (*Galleria mellonella*) and of the mealworm (*Tenebrio molitor*). As expected, higher mortality was shown at more sensitive larvae of the greater wax moth than at the larvae of mealworm. The highest mortality after 4 days reached up to 75% mortality (3 isolates), meanwhile only 45% at mealworm (only one isolate). Entomopathogenic fungus *Metarhizium guizhouense* was successful infesting the larvae of the greater wax moth, but failed to infest the larvae of the mealworm.



Entomopatogene glive v slovenskih tleh

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V letih 2015-2017 smo na celotnem območju Slovenije vzorčili tla na zemljiščih z različno namensko rabo. Vzorčili smo na 81 lokacijah in izolirali preko 460 izolatov potencialno entomopatogenih gliv. S pomočjo molekularskih analiz smo določili 27 vrst potencialno entomopatogenih (iz rodov *Beauveria*, *Clonostachys*, *Cordyceps*, *Isaria*, *Lecanicillium*, *Metacordyceps*, *Metarhizium*, *Ophiocordyceps*, *Pochonia*, *Simplicillium* ter *Torrubiella*), antagonističnih (iz rodov *Clonostachys*, *Mucor* in *Simplicillium*) in nematopatogenih vrst gliv (iz rodov *Cunninghamella*, *Lecanicillium*, *Metacordyceps*, *Paecilomyces*, *Pochonia* ter *Purpureocillium*).

ABSTRACT

Entomopathogenic fungi in Slovene soil

In years 2015-2017 samples of the soil of different usage were taken throughout Slovenia. Samples were taken in 81 locations and over 460 isolates of potentially entomopathogenic fungi were found. Molecular analyzes showed that there are 27 species of potentially entomopathogenic (from genera *Beauveria*, *Clonostachys*, *Cordyceps*, *Isaria*, *Lecanicillium*, *Metacordyceps*, *Metarhizium*, *Ophiocordyceps*, *Pochonia*, *Simplicillium* and *Torrubiella*), antagonistic (*Clonostachys*, *Mucor* and *Simplicillium*) and nematopathogenic fungi (*Cunninghamella*, *Lecanicillium*, *Metacordyceps*, *Paecilomyces*, *Pochonia* and *Purpureocillium*).



Možnosti uporabe steklokrilke *Pyropteron chrysidiformis* (Esper, 1782) za biotično zatiranje topolistne kislice (*Rumex obtusifolius* L.) na travinju

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Topolistna kislica (*Rumex obtusifolius* L.) spada med najbolj zastopane in trdovratne trajne plevela na travinju v Evropi. Rastlina tvori globok koreninski sistem v katerem kopiči hranilne snovi, ki ji omogočajo hitro regeneracijo in s tem dobro odpornost na pogosto defoliacijo. Zatiranje topolistne kislice na travnikih in pašnikih je brez uporabe herbicidov problematično, še posebej v ekološki pridelavi, kjer zatiranje temelji na uporabi nekemičnih metod. Poleg preventivnih ukrepov in mehanskega odstranjevanja rastlin je možno tudi biotično zatiranje plevela z načrtnim vnosom koristnih organizmov. Domorodna vrsta steklokrilke *Pyropteron chrysidiformis* (Esper, 1782) (Lepidoptera, Sesiidae) je naravni sovražnik topolistne kislice in zato dober potencialni kandidat za njeno biotično zatiranje v Evropi. Eden izmed ciljev projekta IWM PRAISE je tudi razvoj biotičnih postopkov zatiranja te plevelne vrste in njihova vključitev v programe integriranega zatiranja plevela na travinju. Za tovrstno uporabo je med drugim potrebno preučiti učinkovitost tega naravnega sovražnika v različnih okoljskih razmerah. S tem namenom smo v letu 2018 zasnovali poljska poskusa na dveh lokacijah v Sloveniji, kjer bomo preučevali dolgoročno učinkovitost steklokrilke *P. chrysidiformis* pri zatiranju topolistne kislice v danih okoljskih razmerah. V prispevku opisujemo metodo nanosa steklokrilke na rastline topolistne kislice in predstavljamo preliminarnе rezultate uspešnosti vnosa organizma v ciljno okolje.

ABSTRACT

Prospects of biological control of broad-leaved dock (*Rumex obtusifolius* L.) by clearwing moth *Pyropteron Chrysidiformis* (Esper, 1782) on grasslands

Broad-leaved dock (*Rumex obtusifolius* L.) is one of the most widely spread and troublesome perennial weed species in European grasslands. Established plants develop a large and persistent taproot with a large reserve of resources, which allows it to regrow after frequent defoliation. Effective control of dock on pastures and meadows without use of herbicide is often problematic, especially in organic farming where only non-chemical methods are available to control this weed species. Beside mechanical and cultural methods, biological control with targeted release of natural enemies may represent a valuable option. One of the IWM PRAISE project aims is development of biotic based measures for broad-leaved dock control and their implementation in integrated weed management programs for grasslands. Because of its feeding specialization, native clearwing moth *Pyropteron chrysidiformis* (Esper, 1782) (Lepidoptera, Sesiidae) has been proposed as a potential candidate for inundative biological control of *R. obtusifolius* in European grasslands. However, more detailed information on the efficacy of this control measure is required, including application technique and clearwing moth performance under variable environmental conditions. In 2018, field experiments on two different sites in Slovenia were set, to test the application method and evaluate the long term efficacy of this beneficial insect against broad-leaved dock under field conditions. In this paper application technique of the *P. chrysidiformis* and preliminary results of insect establishment rate are presented.



Učinkovitost nanosa pri škropljenju jare pšenice (*Triticum aestivum* L.) s šobo IDTA 120-03 pri različnih tlakih škropljenja

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Na Laboratorijskem polju Biotehniške fakultete v Ljubljani je bil v letu 2017 narejen poskus, v katerem smo uporabili šobo z zmanjšanim zanašanjem z dvojnimi asimetričnimi curki, Lechler IDTA 120-03 C. Pri tej šobi je kot sprednjega curka 30° od navpičnice in kot zadnjega curka 50° od navpičnice. Skozi sprednjo odprtino na šobi gre 60 % volumskega pretoka, skozi zadnjo odprtino na šobi pa 40 % volumskega pretoka škropilne tekočine. Škropljenje smo izvedli v času cvetenja jare pšenice s fungicidom Pro-saro s traktorsko škropilnico AGS 600 EN. V poskusu smo uporabili tlak škropljenja 2,0 bar pri porabi vode 166 l/ha, 5,0 bar pri porabi vode 262 l/ha in 8,0 bar pri porabi vode 333 l/ha. Na klasu in listih jare pšenice smo ugotavljali kakovost nanosa z WSP lističi in količino depozita z UV barvilom. Najboljša kakovost nanosa, tako na listih kot na klasu, je bila dosežena pri tlaku škropljenja 5,0 bar, najslabša pa pri tlaku škropljenja 2,0 bar. Na zadnji strani klasa smo pri tem tlaku dosegli le 12 % pokritost. Pri tlakih škropljenja 5,0 bar in 8,0 bar je bila dosežena precej večja količina depozita tako na sprednji kot tudi na zadnji strani klasa v primerjavi s tlakom škropljenja 2,0 bar.

ABSTRACT

Deposit efficiency of IDTA 120-03 nozzle when spraying spring wheat (*Triticum aestivum* L.) using different spraying pressures

In 2017 the field trial was performed on Laboratory field of Biotechnical Faculty in Ljubljana, in which anti drift nozzle with asymmetric spray yet Lechler IDTA 120 03 C was used. The angle of the front spray yet with this nozzle is 30° from the vertical and the angle of the rear spray yet is 50° from the vertical. 60% of the flow rate goes through the front nozzle orifice and 40% of the flow rate goes through the rear nozzle orifice. Spraying was carried out at the beginning of flowering of spring wheat with fungicide Pro-saro. In the trial three different spraying pressures were used. The first spraying pressure was 2.0 bar with water consumption of 166 l/ha, the second spraying pressure was 5.0 bar with water consumption of 262 l/ha and the last spraying pressure was 8.0 bar with water consumption of 333 l/ha. On wheat head and leaves the deposit quality was analyzed using water sensitive papers (WSP) and deposit quantity of it with UV dye. Both on wheat heads and leaves the highest deposit quality was achieved at the spraying pressure of 5.0 bar and the lowest quality was achieved with the spraying pressure of 2.0 bar. When using spraying pressure of 2.0 bar the coverage of rear side of wheat head was only 12%. Deposit quantity on rear and front site of wheat head was much higher at spraying pressures of 5.0 bar or 8.0 bar instead of 2.0 bar.



Uporaba šob z variabilnim pretokom TD VR 2 pri škropljenju krompirja z insekticidom metaflumizon

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V članku so prikazani rezultati nanosa kontaktnega fungicida metaflumizon pri škropljenju krompirja s šobami z variabilnim pretokom TD VR 2. Značilnost teh šob je, da se volumski pretok v območju tlakov škropljenja 2-8 bar poveča za trikrat, medtem ko pri večini šob le dvakrat. Tako lahko s to šobo dosežemo porabo vode od 200 do 600 l/ha. Škropljenje smo izvedli s tlakom 2, 3, 4 in 5 bar. Uporabili smo nošeno traktorsko škropilnico AGS 600 EN. Analizirali smo pokritost z insekticidom na zgornjem, srednjem in spodnjem delu rastline. S povečanjem tlaka škropljenja se je povečeval odstotek pokritosti z insekticidom metaflumizon na zgornjem in srednjem delu rastline. Poleg tega se je odstotek pokritosti zmanjševal od zgornjega proti spodnjemu delu rastline. Na srednjem in spodnjem delu rastline se je število odtisov kapljic povečevalo s tlakom škropljenja.

ABSTRACT

The use of nozzles with variable flow rate TD VR 2 when spraying potato with insecticide metaflumizone

In the article results of contact fungicide metaflumizone deposit are presented when spraying potato with the variable flow rate nozzles TD VR 2. The characteristic of these nozzles is three times increased volume flow rate in the pressure range of 2 to 8 bar, while by the majority of other nozzles the increase is only two times. In this way using this nozzle we could achieve the water application rate of 200 to 600 l/ha. Spraying was done at the pressures of 2, 3, 4 and 5 bar. Mounted tractor sprayer AGS 600 EN was used. We analyzed the coverage value on the upper, middle and lower part of potato plant. By the increase of spraying pressure the coverage value of insecticide metaflumizone also increased on the upper and on the middle part of potato plant. Furthermore the coverage value decreased from the upper to the lower part of potato plant. On the middle and on the lower part of the plant the droplet impression number increased with the increase of spraying pressure.



Analiza naprav za nanašanje FFS pregledanih v letih 2016 in 2017 v Sloveniji

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Iz podatkovne baze Uprave RS za varno hrano, veterinarstvo in varstvo rastlin je ugotovljeno, da je bilo v letu 2016 pregledanih 7809 naprav za nanašanje fitofarmaceutskih sredstev. Od tega je bilo 5533 škropilnic in 2269 pršilnikov. V letu 2017 so pregledali 8302 naprave, od tega je bilo 66,2% škropilnic in 33,8% pršilnikov. Škropilnice so starejše kot pa pršilniki. Največ škropilnic je bilo izdelanih v obdobju med 1986 in 1990. Med pregledanimi škropilnicami so tudi več kot 50 let stare naprave. V Sloveniji prevladu-

jejo naprave domačih proizvajalcev, izstopa zlasti Agromehanika s 67 % deležem med škropilnicami in pršilniki pregledanimi v letu 2016 in 63,5 % v letu 2017. V obeh analiziranih letih sta na drugem in tretjem mestu med proizvajalci Metalna Rau in Zupan. Zakonsko sicer ustrezne naprave so v pretežni meri dejansko tehnično zastarele. Z njimi se sicer lahko ob pravilni uporabi izvaja varstvo rastlin, vendar bi z novejšimi napravami opremljenimi s sodobnejšimi tehničnimi rešitvami aplikacijo FFS lahko opravili bolj natančno in bolj varno.

ABSTRACT

Analysis of pesticide application equipment inspected in the year 2016 and 2017 in Slovenia

As stated in the database of inspected application equipment of the Administration for Food Safety, Veterinary and Plant Protection 7,809 pieces of equipment were inspected in 2016. 5,533 of them were sprayers and 2,269 were mistblowers. In the year 2017 8302 units of pesticide application equipment were inspected. 66,2 % of them were sprayers and 33,8 % were mistblowers. Sprayers are older than mistblowers. Most sprayers were produced between the years 1986 and 1990. The oldest sprayers have more than 50 years. Most of the equipment in Slovenia is made by local manufacturers, Agromehanika, in particular, stands out with 67 % share of the sprayers and mistblowers in the year 2016 and 63,5 % in the year 2017. Metalna Rau Maribor and Zupan are on the second and third place among the devices are largely technically outdated. They can still be used properly to carry out plant protection, however with newer devices equipped with modern technical solutions, the pesticide application can be done more precisely and more securely.



Uporaba tehnologije geografskih informacijskih sistemov pri načrtovanju programov preiskav

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Izvajanje programov preiskav za ugotavljanje navzočnosti škodljivih organizmov ima pomembno vlogo na področju zdravja rastlin in s tem zagotavljanju prehranske varnosti. Omogoča pravočasno odkrivanje škodljivih organizmov, hitro ukrepanje ter takojšnje izkoreninjanje v primeru njihovega pojava. Kljub temu, da je v primerjavi z ostalimi evropskimi državami Slovenija majhna, jo zaznamujejo velika geografska raznolikost in razdrobljenost ter veliko število kmetijskih zemljišč. Posledica tega je zahtevno izvajanje pregledov (sistematično ali naključno iskanje škodljivega organizma). Slovenijo po drugi strani zaznamuje natančna prostorska in atributna opredelitev kmetijskih in nekmetijskih površin (sistemi GERK, Kataster, Raba zemljišč), ki omogočata dokaj natančno identifikacijo površin in lastnikov teh površin, ki morajo biti podvržene pregledu. Geografski informacijski sistem (GIS) se je kot sestavni del informacijskega sistema na področju zdravstvenega varstva rastlin v zadnjih desetih letih dokazal kot nepogrešljivi člen, zlasti pri analizah in načrtovanju ukrepov za preprečevanje širjenja škodljivih organizmov. V letih 2017 in 2018 smo na primeru programa preiskave na zlato trsno rumenico preverili možnost njegove sistemske uporabe na področju načrtovanja programov preiskav. Območje Slovenije smo prekrili z mrežo z velikostjo celice 2,5 x 2,5 km. Celice smo prekrili s prostorskimi podatki programov prei-

skav, rabe kmetijskih zemljišč in občutljivih sort vinske trte. Na podlagi prostorskih analiz smo izdelali prostorski sloj nepregledanih kvadrantov in prostorski sloj t.i. prednostnih kvadrantov ter naredili načrt izvajanja pregledov glede na dobljene podatke. Prostorske sloje smo vključili v fitosanitarni prostorski portal, kjer lahko pooblaščen izvajalci sproti spremljajo podatke in iščejo ciljne površine. Rezultati so se pokazali že v prvem letu uporabe orodja, saj se je območje pregledov razširilo na do sedaj nepregledana ali tvegana območja. Na ta način so bila odkrita nova žarišča zlate trsne rumenice. Na podlagi spremljanj rezultatov programov preiskav v dveh letih uporabe tega pristopa smo ugotovili, da gre za koristno in uporabno orodje, ki ga bomo v prihodnosti lahko razširili in nadgradili tudi za ostale programe preiskav.

ABSTRACT

Use of geographic information system technology in planning of plant health surveys

Implementation of plant health surveys for the detection of pests plays an important role in the field of plant health, and thus ensuring food safety. It enables timely detection of harmful organisms, rapid response and immediate eradication in the event of their occurrence. Despite the fact that Slovenia is small in comparison with other European countries, it is characterized by great geographical diversity, agricultural land fragmentation and by a large number of small land plots which results in difficult pursuance of surveys (systematic or random search for pests). On the other hand, Slovenia is marked by the precise spatial and attribute definition of agricultural and non-agricultural land (LPIS, Slovenian Land Cadastre, Land use), which enable the precise identification of these areas and of the owners of these areas that must be a subject to inspection. As a part of the information system in the field of plant health, the geographic information system (GIS) has proved to be an indispensable part in the last ten years, especially in analysing and planning measures to prevent the spread of pests. Based on the survey of grapevine flavescence dorée in the 2017 and 2018, the possibility of the use of GIS for its systematic use in planning of plant health surveys was investigated. Grid layer with a cell size of 2.5 km × 2.5 km was used to overlay the area of Slovenia. Cells were overlaid with spatial data of archive surveys data, LPIS, Land use and sensitive varieties of *Vitis vinifera*. Based on spatial analysis data, we created a spatial layer of non-observed cells with vineyards and the spatial layer of i.e. priority cells, and made a plan for carrying out surveys according to the data obtained. Spatial layers were included in the phytosanitary spatial portal, where authorized inspectors can monitor survey data and search for targeted areas. The results showed up already in the first year of using the tool, as the surveyed zone expanded on unchecked vine growing areas and areas with increased risk. In this way, new outbreaks of grapevine flavescence dorée were timely detected. Based on the analysis of the results of the plant pests surveys over the two years of using this approach, we have found that this is a useful tool, which will can be extended and upgraded in the future also for other plant health surveys.



Projekt SMART-Surveillance (EFSA): Spremljanje prisotnosti glivnih spor v zraku kot podpora oceni tveganja za zdravje rastlin

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Uredba EU 2016/2031 narekuje da je preprečevanje in zgodnje odkrivanje navzočnosti škodljivih karantenskih organizmov izjemno pomembno za njihovo pravočasno in učinkovito izkoreninjenje. S širjenjem škodljivega organizma, število težav narašča in možnost izkoreninjenja ali vsaj njegove omejitve se manjša. Bolezni gliv so lahko velik problem, saj se preko spor v zraku relativno hitro razširijo na daljše razdalje. Zato je zgodnja detekcija karantenskih gliv zelo pomembna, saj le tako lahko pravočasno ustrezno ukrepamo in jih omejimo. V okviru EFSA projekta »SMART-Surveillance« sledimo škodljivima karantenskima glivama *Phyllosticta citricarpa* in *Hymenoscyphus fraxineus*. Že vzpostavljeno mrežo vzorčevalnikov zraka in s postavljanjem novih, lovimo spore in s tem opazujemo njuno prisotnost v zraku. Vzorce zraka vzorčenega na Malti, Portugalskem in v Italiji bomo testirali na prisotnost spor *P. citricarpa* in vzorce iz severne Italije na prisotnost spor *H. fraxineus*. Vzorce najprej pripravimo za molekularne analize in nato izolirano DNA testiramo s tarčno specifičnim qPCR testom za karantenski glivi in s splošnim glivnim qPCR testom. Pripravljamo tudi protokol za kapljični digitalni PCR (ddPCR) za kvantifikacijo tarčnih spor. Vzporedno bomo vzorce zraka analizirali tudi z mikroskopijo. Na izbranih vzorcih bomo izvedli tudi ne-tarčni pristop visokozmogljivega sekvenciranja DNA. Tako bomo analizirali metagenom vzorcev zraka ter s tem preverili ali je metoda tudi širše uporabna za nadzor drugih patogenih gliv. Cilj projekta je raziskovanje možnosti, ki nam jih ponuja aerobiologija, za nadzor in oceno tveganj širjenja škodljivih karantenskih mikroorganizmov. Zbrani podatki, ki bodo podprti s prostorskim in matematičnim modeliranjem, nam bodo pomagali pri razumevanju omejitev, prednosti in slabosti takšnega pristopa. Vzpostavljene mreže vzorčevalnikov nam bodo dale vpogled v možnosti njihove uporabe za druge škodljive karantenske mikroorganizme in nam pomagale pri vzpostavljanju možne EU mreže v prihodnosti.

ABSTRACT

EFSA project SMART-Surveillance: Monitoring of airborne fungal spores to support risk based plant health surveillance

For quarantine pests and pathogens early detection is key to successful eradication and containment by Regulation (EU) 2016/2031. As pests spread within a region, the scale of the problems increases and the potential to eradicate or contain the pest is diminished. Fungal diseases can be particularly problematic in this respect, frequently transmitted by air-borne spores. They spread rapidly over large geographical areas and early detection is incredibly important in order to initiate effective eradication action. In the frame of the SMART-Surveillance project we are following two quarantine pathogens Citrus black spot (*Phyllosticta citricarpa*) and Ash die back (*Hymenoscyphus fraxineus*). An aerobiology network is being established and an existing network is employed to collect air samples. Air samples collected in Malta, Portugal and Italy will be tested for the presence of *P. citricarpa* and samples collected in northern Italy for *H. fraxineus*. Samples are firstly prepared for molecular testing and later analysed with target specific qPCR assays and a general fungal qPCR assay. A digital droplet PCR (ddPCR) protocol for quantification of the collected target spores is being prepared. In parallel, air samples will be analysed using microscopy. A non-targeted approach based on high-throughput sequencing will be done on selected samples to analyse the metagenome of the air sample to investigate if this method is useful for broad-spectrum surveillance. The goal of the project is to explore the possibility that data collected using aerobiology methods can be used to support risk based surveillance; supported by using spatial and mathematical modelling approaches, to understand the limitations, uncertainties and benefits of the approaches. Established networks will also enable us to understand how the approaches could be used for other quarantine pathogens and help us establish the characteristics of a feasible EU wide network for the future.



Primerjava različnih postopkov ekstrakcije DNA za uporabo pri diagnostiki podlubnikov

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Podlubniki (Coleoptera: Curculionidae: Scolytinae) so organizmi, ki pomembno vplivajo na strukturo gozdnih ekosistemov. Čeprav se praviloma razvijajo le na oslABLJENEM in svežem odmrlem drevju, nekatere vrste podlubnikov veljajo za najpomembnejše škodljive organizme naših gozdov. V zadnjem obdobju v Evropi beležimo vse več najdb tujerodnih podlubnikov. Morfološke analize hroščev pogosto ne zadostujejo za nedvoumno potrditev novih najdb, zato je pogosto potrebno izvesti molekularne identifikacije. Uporaba molekularnih pristopov je zato koristno orodje pri izvedbi identifikacije. Izbor ustreznega postopka je odvisen od različnih kriterijev, kot so npr. cena, čas, težavnost in uspešnost izvedbe. Za namen identifikacije podlubnikov smo preizkusili pet komercialno dostopnih DNA ekstrakcijskih kitov. Primerjali smo čas potreben za ekstrakcijo, ceno, količino in čistost ekstrahirane DNA ter uspešnost sosledne uporabe ekstrahirane DNA za PCR s končnim ciljem priprave za sekveniranje. Na podlagi izbranih kriterijev smo izbrali najprimernejši postopek za izvedbo molekularne identifikacije podlubnikov v Laboratoriju za varstvo gozdov na Gozdarskem inštitutu Slovenije.

ABSTRACT

Evaluation and comparison of different DNA extraction protocols for identification of bark beetles

Bark beetles (Coleoptera: Curculionidae: Scolytinae) have a significant impact on the structure of forest ecosystems. Although they mostly develop on weakened and freshly dead trees, some bark beetle species are regarded as the most important pests of our forests. In recent years, a growing number of non-native bark beetles have been recorded in Europe. Morphological analyses of the beetles are often not sufficient to unambiguously confirm the new findings; therefore, it is often necessary to perform molecular identification. The choice of an appropriate molecular method depends on disparate criteria, such as price, time, difficulty and success rate of the procedure. Five commercially available DNA extraction kits were tested for their suitability in bark beetle identification, comparing the time needed to perform an extraction, price, extracted DNA quantity and purity as well as success rate of the subsequent PCR in preparation for DNA sequencing. Based on the aforementioned criteria the most suitable method was chosen for use in bark beetle identification in the Laboratory of Forest Protection at the Slovenian Forestry Institute.

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