



## **Izvečki referatov / *Abstract volume***

**11. SLOVENSKO POSVETOVANJE O VARSTVU RASTLIN  
Z MEDNARODNO UDELEŽBO  
(in okrogla miza o zmanjšanju tveganja zaradi rabe FFS v  
okviru projekta CropSustaIn)**

11<sup>TH</sup> SLOVENIAN CONFERENCE ON PLANT PROTECTION WITH  
INTERNATIONAL PARTICIPATION  
(and the round table of risks reduction in phyto-pharmaceutical  
products use in the frame of CroSustaln project)

**5.–6. marec 2013, Bled, SLOVENIJA**

**Društvo za varstvo rastlin Slovenije  
Plant Protection Society of Slovenia**

**Izvečki referatov 11. Slovenskega posvetovanja o varstvu rastlin z mednarodno udeležbo (in okrogla miza o zmanjšanju tveganja zaradi rabe FFS v okviru projekta CropSustaIn), Bled 2013**

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## **Uvodni referati**

## **IPM – Danish experiences and ongoing EU research activities**

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The first Danish pesticide action plan setting targets for a reduction in pesticide use was adopted by the Parliament back in 1986. Since then four more pesticide action plans setting quantitative targets for pesticide use reductions were passed, hence focus of research as well as the advisory service has very much been on devising ways how to reduce pesticide use. As herbicides are routinely apply to almost all fields and most farmers will not omit the use of herbicides the focus has been on optimising herbicide use by adjusting doses to the prevailing field conditions such as weed flora, weed growth stage and climatic conditions. A web-based decision support system 'Crop Protection Online-Weeds' that can identify suitable herbicide solutions and estimate the necessary dose using data collected by the farmer was developed. For diseases and insect pests focus was more on developing monitoring og forecasting models and exploit host resistance although the possibilities to adjust the doses was alos studied. The models are now an integrated part of 'Crop Protection Online-Diseases and pests', the other part of the web-based decision support ssystem. At EU level IPM was introduced with Directive 128/2009 that requires that all professional users of pesticides follow the general principles of IPM stipulated in the directive. In most EU countries confusion reigns when it comes to defining what IPM is and how it distinguish itself from what is considered good agricultural practice. EU has supported two major initiatives intended to support the implementation of IPM in member states namely ENDURE and PURE. ENDURE was a network of excellence focusing primarily on putting together existing knowledge and dissemination to end-users in the form of e.g. training material and information database. In contrast PURE is a research project aimed at generating new knowledge and solutions. PURE was initiated in 2011 and runs for 4 years.



## **Achievements and challenges in Swiss organic agriculture**

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Currently, there are 6300 organic farms in Switzerland, which manage 117.800 hectares biologically (Federal Statistical Office). That is 11% of the total agricultural area. Nearly 6,000 organic farms are a member of the Bio-Suisse. In 2006 in Switzerland Organic Products were implemented in a total of 1.2 billion francs. That's about 4.5 percent of the food market and corresponds to a consumption of 170 Swiss francs per person. This calculation shows, that Switzerland is world champion in the use of organic products. The organic market currently growing about twice as fast as the overall market. The principal benefit for organic farms is the label premium, i.e. the 15-50% higher prices that organic farmers earn for their products. Secondly, they benefit from the measurable progress in improving market access for the labeled products. The label "Suisse Garantie" specifies our bio-products. The label sets clear standards for production and processing and ensures



a continuous, independent inspection and certification system. “Bio Suisse”, a private-sector organization, is the federation of Swiss organic farmers. This umbrella organization counts 32 organic farmers' associations among its members, as well as the Research Institute of Organic Agriculture, FiBL.” Bio Suisse is standing for natural diversity on the organic farm, ethologically sound livestock management and feeding, no use of chemically synthesized pesticides or fertilizers, No use of genetic engineering, no use of unnecessary additives. The Swiss Research Institute of Organic Agriculture (FiBL) was founded in 1973 and is situated in Frick since 1997. It is one of the world’s leading information and documentation center for organic agriculture and employs over 135 experts. The close links between different fields of research and the rapid transfer of knowledge from research to advisory work and agricultural practice are FiBL’s strengths. Still, we found stagnation since 2009 of new farms changing to organic farming. There are some top problems in plant protection to be solved. Many trials have been conducted on resisting pests and diseases by promoting beneficial organisms, applying direct control measures, and improving cultivation techniques. New alternatives and achievements in the scientific research will be discussed.



### **Genetic factors affecting invasion success**

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Invasion by alien species is considered to be among the major threats to biodiversity. Invasive pest species affect not only biodiversity but also economics of agriculture and forestry. Our ability to predict invasion is however rather poor. This is partly due to the fact that predictions have been made usually from purely ecological data, whereas we should also consider evolutionary potential of species to respond to changing conditions. I will give a broad review of the genetic factors which can promote introductions of new pests to new environments and how we could try to incorporate evolutionary thinking in our pest management strategies in the future.



### **The 3<sup>rd</sup> German action plan on sustainable use of plant protection products – continuity and new challenges**

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The EU requirements concerning plant protection have been supplemented by comprehensive national regulations. The core element of IPM, namely the reduction of risks to human health and the environment, is already addressed by the strict requirements

for approval and proper use of PPPs. The main quantitative targets of the national action plan implemented 2008 are: (1) to reduce the risks that may arise from PPPs by 25% compared to baseline (1996-2005), and (2) to reduce the rate of exceeding maximum residue levels in domestic and imported food to less than 1% in each product group by 2021. The current results are published in the 1<sup>st</sup> report for the years 2008 to 2011 (with a 6-pages summary in English; [www.nap-pflanzenschutz.de](http://www.nap-pflanzenschutz.de)). Those obligatory and voluntary provisions ensure that the key target of reducing the risks associated with PPPs will be achieved. Important elements are (1) applied research and demonstration mainly based on federal programs, (2) resistant cultivars, (3) biological and biotechnical control, (4) decision support systems, (5) thresholds, (6) certification and inspection of sprayers, (7) training, (8) control schemes, (9) incentives and (10) efficient advisory services. Key technical tools of the action plan are reference farms and demonstration farms. Both networks are valuable sources of robust data about plant protection in Germany. Furthermore, IPM is strongly driven by crop- or sector-specific guidelines which are mainly developed, implemented and controlled by producer associations. Based on the subsequent input from the federal states and interested groups and associations, the new action plan will be finished at the end of 2012 and will come into force in spring 2013.

## **Referati na okrogli mizi o zmanjšanju tveganja zaradi rabe FFS**

## **Ensuring sustainable use of PPPs and national action plans**

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The implementation of the Framework Directive on Sustainable Use involves major challenges for Member States finding the most suitable means to achieve the sustainable use of pesticides and sustainable and competitive agriculture. As stated in the title itself, the Directive establishes a Framework to achieve the sustainable use of pesticides and comprises legal requirements and provisions to be implemented at national level. The nature of the Directive means that the principle of subsidiarity is taken into account, leaving room for Member States to identify the best means and measures to implement the provisions considering the specific country situation. Furthermore, one of the main effort for Member States is surely the constitution of a National Action Plan to further reduce risks and impacts of pesticide usage and enhance the implementation of the principles of Integrated Pest Management. The presentation will provide an overview on how Member States have addressed the implementation of the key provisions and the National Action Plans.

*IZVLEČEK*

### **Zagotavljanje trajnostne rabe FFS in nacionalni akcijski plani**

Direktiva o določitvi okvira za ukrepe Skupnosti za doseganje trajnostne rabe fitofarmaceutskih sredstev (FFS) predstavlja za države članice EU izziv za doseganje trajnostnega in kokurenčnega kmetijstva. Kot je razvidno že iz imena direktive, le ta določa okvirje za trajnostno rabo fitofarmaceutskih sredstev in vključuje zahteve, ki jih je potrebno zakonsko predpisati. Bistvo direktive je načelo subsidiarnosti - državam članicam dopušča, da same presodijo in določijo bistvene cilje in ukrepe za njihovo doseganje. Osrednji namen direktive v državi članici je priprava nacionalnega akcijskega plana z namenom zmanjšanja tveganja pri uporabi FFS in določitev okvirjev za uvedbo integriranega varstva rastlin. V predstavitvi bo prikazan pristop posameznih držav članic EU in osnovne usmeritve njihovih nacionalnih akcijskih planov.



### **Registracijski postopki FFS v Evropski uniji in na območju bivše Jugoslavije - primerjava**

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Registracijski postopki na območju Evropske unije so že od leta 1991 zakonsko urejeni z enotno zakonodajo (Smernica 91/414/EEC in Uredba 1107/2009). Kot posledica so registracijski postopki se bolj usklajeni in harmonizirani, posamezne države članice pa vse tesneje sodelujejo. Kot rezultat opažamo v zadnjem času tudi povečano število uspešno pridobljenih registracijskih dovoljenj po postopku vzajemnega priznavanja. Države z območja bivše Jugoslavije so začele s prilagajanjem evropske zakonodaje v lastni pravni

sistem v različnih časovnih obdobjih oz. pri njih implementacija ustrezne zakonodaje še poteka. Iz tega razloga so razlike v registracijskih postopkih, kakor tudi zahtevani dokumentaciji na tem področju, veliko večje. Večina držav s tega območja pa se pri svojem delu vendarle poskuša opirati tudi na evropske postopke v smislu, da priznavajo evropska dovoljenja, na podlagi katerih izdajajo lokalna dovoljenja za promet FFS.

## **ABSTRACT**

### **Registration procedures of plant protection products in European Union and in the territory of Ex-Yugoslavia**

Registration procedures in the territory of European Union are regulated with uniform legislation since 1991 already (Directive 91/414/EEC, Regulation 1107/2009). As a consequence the registration procedures are being more and more uniform and harmonized, individual EU Member States are co-operating more and more. As a result we are seeing more and more successful placing on the market of the products following mutual recognition procedure. Countries from the territory of Ex-Yugoslavia have started to introduce the EU legislation into their own legislative frame in different time periods or those are being implemented as we speak. For that reason the differences in registration procedures as well as data requirements differ in this territory in a much greater degree. Most of the countries from this region however are trying to rely on European evaluation procedures in the way that they recognize EU registration certificates, based on which they issue national registration certificates for placing plant protection products on the market.



### **Analiza stanja rabe fitofarmaceutskih sredstev v Sloveniji**

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V prispevku predstavljamo rezultate raziskave o rabi fitofarmaceutskih sredstev (FFS) v Sloveniji. Analiza rabe FFS temelji na obdelavi anketnih odgovorov in strokovne ocene izvajalcev projekta. Škropilni programi za leti 2009 in 2010, ki smo jih dobili od kmetijskih pridelovalcev (poljedelci, zelenjadarji, sadjarji, vinogradniki), predstavljajo orientacijske vrednosti rabe FFS. S pomočjo baze podatkov o subvencioniranju kmetijske pridelave smo natančno opredelili obseg posamezne pridelave in tudi večje in manjše pridelovalce, kot kazalnik intenzivnosti rabe FFS. Pri pridelavi poljščin in vrtnin smo glede na pridobljene podatke ocenili, da raba FFS v povprečju bistveno ne odstopa od priporočil stroke, čeprav so razlike med pridelovalci precejšnje. Podobno je tudi pri pridelavi hmelja. Pri pridelavi jabolk, breskev in grozdja so razlike večje, v povprečju je raba FFS v trajnih nasadih zelo intenzivna. Pri pridelavi jabolk porabijo pridelovalci v povprečju 25,5 kg aktivnih snovi FFS/ha na leto, pri breskvah 29,5 kg, pri oljkah 6,6 kg in pri pridelavi grozdja 24,5 kg aktivnih snovi/ha na leto. Kljub temu, da je zanesljivost dobljenih

vrednosti zaradi razmeroma majhnega števila vrnjenih anket slabša, je raba FFS v trajnih nasadih marsikdaj pretirana in bi jo bilo mogoče zmanjšati.

## **ABSTRACT**

### **Analysis of the use of plant protection products in Slovenia**

The analysis of the use of plant protection products (PPP) in Slovenia is presented in the article. The results are based on the data, collected by questionnaire and evaluated by the experts of the project team. The questionnaires were sent to the farmers, producers of field, vegetable, fruit and wine crops. The spray programmes for the years 2009 and 2010 were acquired. The database of agricultural subsidies was used to exactly determine the crops produced and also to categorize the farms as big or small. The intensity of PPP use for each crop was evaluated. The difference of PPP use between big and small farms was compared. Based on the analyses, the average use of PPP in field crops, vegetables and hop is not essentially different from professional recommendations although the differences between farmers are considerable. The differences in PPP use among farmers which produce apple, peach and grape are substantial. In general, the use of PPP in perennial crops is very intensive. The farmers spend on average 25,5 kg active ingredients per ha per year in apple production, 29,5 kg in peach production, 6,6 kg in olive production and 24,5 kg in grape production. Despite the lower reliability of survey data that is connected to small number of questionnaires returned, we can conclude that the use of pesticides in perennial crops is too intensive and could be reduced.



### **Primerjava rabe fitofarmaceutskih sredstev v Sloveniji in v izbranih evropskih državah**

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Za izdelavo realne ocene rabe fitofarmaceutskih sredstev (FFS) v Sloveniji smo naredili primerjavo z rabo FFS v sosednjih državah članicah EU, poleg tega pa smo v primerjavo vključili tudi rabo FFS v Franciji, Nemčiji in na Nizozemskem. Dostopnost podatkov o porabi FFS po glavnih skupinah je med obravnavanimi državami zelo različna. Ob primerjavi skupne porabe FFS na ha obdelovalnih zemljišč, smo ugotovili, da je tovrsten kazalnik zavajajoč in ne odraža realnega stanja rabe FFS. Države z večjim deležem trajnih nasadov v strukturi obdelovalnih zemljišč, kot sta na primer Italija in Slovenija, so v takšnem primeru prikazane kot države s prekomerno porabo FFS. Zaradi tega smo uvedli normaliziran indeks porabe, s katerim smo želeli podati obseg rabe FFS po vrstah gojenih rastlin na skupni imenovalec. Poraba FFS v sadjarstvu in vinogradništvu ter ostalih intenzivnejših pridelavah, je neprimerno večja od porabe FFS v poljedelski pridelavi in je navadno večja tudi za več kot dvajsetkrat. Zaradi tega smo za posamezno vrsto gojenih rastlin najprej izdelali škropilne programe oziroma določili tisto količino porabe FFS, ki še zagotavlja kolikor toliko stabilno pridelavo. Tako smo določili, da je poraba v povprečnem

poljedelskem kolobarju 1 kg aktivnih snovi (a.s.), v pridelavi jabolk 22 kg, v vinogradništvu 20 kg, breskvah 27 kg in oljkah 1,5 kg a.s., medtem ko smo vse ostale pridelave v trajnih nasadih, vključno s pridelavo vrtnin in cvetja v steklenjakih na Nizozemskem, obremenili s povprečno porabo 10 kg aktivnih snovi na hektar. Nato smo površino s posamezno pridelavo v obravnavanih državah pomnožili s porabo a.s. na ha ter sešteli vse tako dobljene površine v državah in jih delili s skupno porabo a.s. v državi. Tako dobljeni indeks primerja porabo FFS ne glede na strukturo pridelave in kot takšen realno oceni prekomerno ali zmanjšano rabo FFS. Tovrstna primerjava pokaže, da je na Nizozemskem poraba FFS zelo velika oziroma prekomerna ter da je poraba FFS na ha obdelovalnih zemljišč v Avstriji najmanjša od vseh obravnavanih držav.

## **ABSTRACT**

### **Comparison of the use of plant protection products in Slovenia and in selected European countries**

To create a realistic assessment of the use of plant protection products (PPPs) in Slovenia we compared the use of PPPs in SLO and neighboring EU Member States. In addition, we also include a comparison of the use of PPPs in France, Germany and the Netherlands. Accessibility of information on the use of pesticides by major groups among the countries is very different. When comparing the total consumption of pesticides per hectare of cultivated land, we have found that such an indicator is misleading and does not reflect the reality of the use of pesticides. Countries with a higher proportion of permanent crops in the structure of cultivated land, such as Italy and Slovenia, show excessive use of PPP. For this reason, we introduced normalized index of PPP consumption, with which we wanted to give the extent of PPPs use for individual cultures to a common denominator. Consumption of PPPs in horticulture and viticulture and other intensive cultivation is much higher than PPPs use in arable production and is usually greater for longer than twenty times. For this reason, spray programs to determine the quantity of PPP use which enable more or less stable production and present a sustainable use of PPPs have been developed for each culture. Thus, we determined that in the average arable rotation the PPP use is 1 kg of active substance (a.s.) per hectare, in the production of apples 22 kg, 20 kg in wine, 27 kg of a.s. in peaches production and 1.5 kg of a.s. in olives production, while for all other production of permanent crops, including the production of vegetables and flowers under glass in the Netherlands, the average use of 10 kg of active ingredient per hectare was decided. After that PPP consumption per culture per hectare were multiplied by the surface area of each culture. Obtained surface area for different production was summed and divided by the total use of a.s. in each country. The resulting index compares the use of PPP regardless of the structure of production and as such represents realistic assessment of excessive or reduced use of pesticides. Such a comparison showed that the use of PPP in the Netherlands is very high or excessive, and that the use of pesticides per hectare of cultivated land in Austria smallest among the countries involved in comparison.



### **Pomen kazalnikov za spremljanje rabe fitofarmaceutskih sredstev**

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V Sloveniji je potrebno v skladu z direktivo 2009/128/ES pripraviti načrt ukrepov za zmanjševanje tveganj in vplivov uporabe fitofarmaceutskih sredstev (FFS) na zdravje ljudi in okolje. Potrebno je čim bolj natančno opredeliti cilje začrtanih ukrepov in pripraviti transparenten sistem spremljanja in poročanja o uspehih doseganja teh ciljev. V ta namen je potrebno opredeliti ustrezne kazalnike za spremljanje rabe FFS. V omenjenem prispevku obravnavamo kazalnike, ki smo jih pripravili v okviru priprave nacionalnega akcijskega plana (NAP) za zmanjšanje tveganj zaradi rabe FFS. Omenjeni kazalniki se nanašajo na obseg rabe FFS, pogostnost rabe FFS in indeks obremenitve, ki temelji na izračunu razmerja med prodano količino neke aktivne snovi v določenem časovnem obdobju in zmnožkom med skupno obdelovalno površino in odmerkom ali koncentracijo, ki povzroči smrt pri 50 odstotkih izpostavljenih organizmov (LD<sub>50</sub> oz. LC<sub>50</sub>). Za ta kazalnik smo opravili tudi simulacijske izračune za integrirano in ekološko pridelavo jabolk, pšenice in krompirja. Ugotovili smo, da je za popolnejšo oceno oziroma primerjavo med različnimi strategijami pridelave/varstva rastlin potrebno v analizo tveganja vključiti celo vrsto drugih parametrov oz. kazalnikov, in da se je zmanjševanja tveganja zaradi rabe FFS potrebno lotiti preudarno, celovito in predvsem na oprijemljivih, strokovnih ocenah.

#### **ABSTRACT**

#### **The importance of indicators to monitor the use of pesticides**

In accordance with Directive 2009/128/EC, it is necessary to prepare a contingency plan in Slovenia to reduce the risks and impacts of pesticide use (PPP) on human health and the environment. It is also necessary to define the objectives of planned activities to reduce the risk of pesticide use more precisely and to prepare a transparent system of monitoring and reporting on the successful attainment of planned goals. Therefore, an approach of establishing of indexes and tools for the monitoring of the use and risks of pesticides has to be made. In this paper, the indicators that has been prepared for the purpose of the National Action Plan (NAP) to reduce the risks from the use of pesticides are discussed. These indicators related to the extent of the use of pesticides, treatment frequency of pesticide use and finally to the load index that is based on the calculation of the ratio between the sold quantity of an active substance in a certain period of time (one year) and product between the total arable area and LD<sub>50</sub> and/or LC<sub>50</sub> (dose or concentration causing death of 50 percent of exposed organisms). To illustrate the usability of load index, a simulation for different approaches to plant protection in the organic and integrated (based on IPM) apple production are presented. For a complete assessment and comparison between different strategies of plant production/plant pest management some other parameters or indicators should be followed. The risk reduction due to the use of pesticides should be undertaken prudently, comprehensive and above all on the concrete, expert estimates.





## **Možnosti in ukrepi za zmanjšanje tveganja zaradi rabe fitofarmaceutskih sredstev**

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V prispevku predstavljamo nekatere možnosti in ukrepe za zmanjšanje tveganja zaradi rabe fitofarmaceutskih sredstev (FFS). Predlagamo stalno spremljanje in analiziranje kazalnikov, ki se nanašajo na zmanjševanje tveganja zaradi rabe FFS. Mnenja smo, da je za doseganje cilja zmanjšanja rabe FFS izredno pomembno spodbujanje in izvajanje strokovno raziskovalnega dela, vezanega na obvladovanje škodljivih organizmov. V ta namen priporočamo vzpostavitev poskusnih demonstracijskih centrov, v okviru katerih bi potekale različne raziskave in poskusi, tudi demonstracijski, ki bi pripomogli k razvoju in optimizaciji strategij za varstvo rastlin. Na teh centrih bi se lahko pridelovalci prek ogledov, organiziranih predavanj in prikazov neposredno seznanjali z novostmi, vezanimi na zdravstveno varstvo rastlin. Glede izbire FFS na slovenskem trgu bi bilo potrebno pospešiti postopke uvajanja alternativnih pripravkov, ki niso uvrščeni v kategorijo klasičnih (organskih) FFS in spodbuditi zastopnike oziroma proizvajalce teh sredstev, da pristopijo k postopkom registracije in spodbudijo ponudbo in trženje ekoloških pripravkov, ki se na temelju biotičnih preskusov izkažejo kot ustrezno učinkoviti (davčne olajšave, subvencioniranje itn.). K zmanjšanju rabe FFS bo v prihodnosti zagotovo v veliki meri doprinesel tehnološki razvoj in optimizacija tehnoloških procesov (kolobar, sortni izbor, izbira ustreznih leg naših nasadov, vzgojne oblike, prehrana rastlin, obdelava tal, mehansko zatiranje škodljivih organizmov, tehnološko posodabljanje naprav za nanos FFS, alternativne oblike varstva rastlin, biotično varstvo rastlin, antirezistentna strategija itn.), ki bo temeljil na domačem in tujem znanju. Poleg navedenega bo k zmanjšanju rabe FFS pripomoglo žlahtnjenje in sortni izbor na škodljive organizme odpornih oz. manj občutljivih rastlin, trženje pridelkov kot tudi spodbude za modernizacijo ali izgradnjo energetske učinkovitih infrastrukturnih objektov, potrebnih za čim bolj učinkovito pridelavo kmetijskih rastlin. Izpostaviti je potrebno nemoteno delovanje javne opazovalno napovedovalne službe. Sprejeti je treba ukrepe za zmanjšanje zanašanja FFS, ki se nanašajo na posodabljanje škropilne tehnike in stalno izobraževanje uporabnikov FFS.

### **ABSTRACT**

#### **Options and measures to reduce the risk due to the use of pesticides**

In this paper we present some options and measures to reduce the risk due to the use of pesticides. Continuous monitoring and analysis of indicators relating to the reduction of risk from the use of pesticides are suggested. To our opinion, promotion and implementation of applied and developmental research linked to pest control is extremely important to reduce the risk of pesticide use. Establishment of experimental demonstration centres, in frame of which research and various experiments would be conducted, would contribute through the transfer of research results into practice to development and optimisation of plant protection strategies. In these centres the producers could get direct approach to novelties related to health protection of plants by means of visits, organised

lectures and demonstrations. Administration obstacles should be eliminated in order to allow a quicker and more rational registration of pesticides which will allow the producers to reach a more reliable and environmentally friendlier plant protection. Technological development based on the local and foreign knowledge is a basis, needed for the introduction of appropriate technologies of health protection of plants (e.g. crop rotation, selection of appropriate growing sites, improve growers education, plant nutrition, soil treatment, mechanical pest control, technological modernization of machinery for application of pesticides and, biological plant protection agents, anti-resistant strategy, etc.). According to our estimations breeding and selection as well as introduction of resistant varieties into practice is also necessary. Marketing of crops and incentives for modernization or construction of energy-efficient infrastructure needed for the most efficient production of agricultural crops are also important and help us indirectly in reducing of risk of pesticide use. Public forecasting and warning service for pests and diseases must be well organized (high professional level and independence should be maintained), and its activities must run smoothly. A continuous promotion of new environmentally friendlier technological approaches to plant protection and permanent and efficient providing of information to producers with the latest knowledge in agriculture is recommended.



### **Ugotavljanje in ocena vplivov različnih kmetijsko-pridelovalnih območij na pojavljanje ostankov fitofarmaceutskih sredstev v čebeljih pridelkih ter njihov vpliv na razvoj in zdravstveno stanje čebel**

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Na kmetijskih pridelovalnih območjih se za varstvo rastlin uporabljajo fitofarmaceutska sredstva (FFS), ki lahko onesnažijo cvetni prah kmetijskih in okoliških rastlin. Oprasovalci zbirajo kontaminiran cvetni prah, ki lahko negativno vpliva na njihov razvoj in zdravstveno stanje. Vplivi so še zlasti opazni na čebeljih družinah. V triletni raziskavi smo ocenjevali kmetijske dejavnike, ki vplivajo na zdravstveno stanje in razvoj čebeljih družin. V okviru raziskave smo spremljali razvoj 90 čebeljih družin (zastopanost spor *Nosema* spp. in virusov ABPV, SBV, DWV, BQCV) postavljenih na 30 lokacijah ter ugotavljali ostanke FFS v cvetnem prahu, pašnih čebelah in mrtvicah. Lokacije so bile razdeljene glede na tip prevladujoče kmetijske pridelave: a) intenzivne poljedelske lokacije (10 lokacij); b) intenzivne vinogradniške lokacije (4 lokacije); c) intenzivne sadjarske lokacije (6 lokacij) in d) lokacije z ekstenzivno kmetijsko pridelavo (10 lokacij). Z uporabo GC/MS in LC/MS/MS smo v letu 2009 analizirali 50 vzorcev cvetnega prahu na vsebnost 880 kemijskih spojin, v letu 2010 in 2011 pa 50 vzorcev cvetnega prahu na vsebnost 713 kemijskih spojin. V letu 2009 smo ostanke FFS v cvetnem prahu ugotovili na 12 lokacijah (40,0 %), v letu 2010 na 4 (13,3 %), v letu 2011 pa na 3 lokacijah (10 %). V letu 2009 smo ugotovili 15 različnih kemijskih spojin, v letu 2010 zgolj 2, v letu 2011 pa 5. Koncentracije ugotovljenih kemijskih spojin so bile od 0,011 mg/kg do 76,0 mg/kg. Največ različnih kemijskih spojin smo ugotovili na sadjarskih (12) in vinogradniških lokacijah (8). Glavnina ugotovljenih kemijskih spojin je pripadala fungicidom (69 %). Aktivne spojine iz skupine insekticidov (klorpirifos-etil, metoksifenoimid in tiakloprid) so bile ugotovljene na šestih preiskovanih lokacijah.

## ABSTRACT

### **Estimating the influence of different agricultural production areas on the appearance of pesticide residues in the bee products and their influence on the development and health of honey bees**

Plant protection in agricultural areas is performed using pesticides which could contaminate pollen of agricultural plants and that of plants in the surroundings. Pollinators collect contaminated pollen which may have negative impact on their development and health. The consequences are easily seen on honey bees. In a three-year investigation we estimated agricultural factors influencing honey bee health and colony development. In the investigation we monitored 90 honey bee (*Apis mellifera carnica*) colonies situated on 30 different locations for the presence of *Nosema* spp. and viruses (ABPV, SBV, DWV, BQCV) in the workers and for pesticide residues in pollen, old workers and dead bees. The locations were grouped with regard to the main agricultural production practice: a) intensive field production (10 locations); b) intensive viticulture production (4 locations); c) intensive fruit growing (6 locations); d) extensive agricultural production (10 locations). By means of GC/MS and LC/MS/MS, 50 pollen samples were analyzed for 880 chemicals in 2009 and 50 samples for 713 chemicals in 2010 and 2011. In 2009, residues were found in the pollen samples from 12 locations (40%), in 2010 they were found in those from 4 locations (13.3%) and in 2011 in those from 3 locations (10%). Fifteen different residues in pollen were found in 2009, only 2 of them in 2010 and 5 in 2011. Residues found in the pollen samples ranged from 0.011 mg/kg to 76.0 mg/kg. The highest number of residues (12) was found in the pollen from fruit growing and vineyard locations (8). The majority of the residues belonged to the fungicide group (69%). Insecticide residues (chlorpyrifos-ethyl, methoxifenocid and thiacloprid) were found in the pollen samples from six locations.



### **Fungistatični učinek izbranih herbicidov in fungicidov na entomopatogeno glivo *Beauveria bassiana***

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V *in vitro* razmerah smo preučevali fungistatične učinke štirih herbicidov (metribuzin, flurokloridon, pendimetalin, prosulfokarb) in šestih fungicidov (propineb, klorotalonil, bakrov hidroksid, mankozeb, metiram, fluazinam) na rast micelija entomopatogene glive *Beauveria bassiana* (ATCC 74040). Preučevana fitofarmacevtska sredstva (FFS) se pogosto uporabljajo v pridelavi krompirja. Fungistatične učinke izbranih herbicidov in fungicidov na rast micelija smo ocenjevali v laboratorijskih razmerah pri različnih koncentracijah: 100, 75, 50, 25, 12,5 in 6,25 % priporočenega poljskega odmerka, na PDA agarnih ploščah pri 20 °C. Glede na inhibicijo rasti micelija smo po toksikoloških testih preučevana FFS razvrstili v štiri razrede: 1 = neškodljiv (< 25 % inhibicija), 2 = malo škodljiv (25-35 %), 3 = zmerno škodljiv (36-50 %), 4 = škodljiv (> 50 %). Vsa preučevana FFS so imela fungistatičen učinek na glivo *B. bassiana* v odvisnosti od njihove koncentracije v mediju. Raziskava je pokazala, da je gliva *B. bassiana* zelo občutljiva na vse preizkušane herbicide, posebej pri priporočenih poljskih koncentracijah, pa tudi pri manjših odmerkih. Vsi preizkušani herbicidi in fungicidi (razen klorotalonila pri 50 %

odmerku) so imeli pri 100, 75 in 50 % odmerku izrazit fungistatični učinek (inhibicija rasti > 50 %, inhibicijski razred 4). Poleg laboratorijskih testov s FFS bi morali izvajati vzporedne poskuse na pridelovalnih zemljiščih, da bi dejansko ovrednotili njihov ekološki vpliv na entomopatogeno glivo *B. bassiana*.

#### ABSTRACT

#### **The fungistatic effect of selected herbicides and fungicides on entomopathogenic fungus *Beauveria bassiana***

The *in vitro* fungistatic effect of four herbicides (metribuzin, flurochloridone, pendimethalin, prosulfocarb) and six fungicides (propineb, chlorothalonil, copper hydroxide, mancozeb, metiram, fluazinam) on mycelial growth of entomopathogenic fungus *Beauveria bassiana* (ATCC 74040). Tested pesticides are frequently used in potato crop production. Fungistatic effects of selected herbicides and fungicides on mycelial growth were evaluated at different concentrations: 100, 75, 50, 25, 12.5, 6.25 and 0% of recommended field application rate on PDA agar plates at 20°C under laboratory conditions. The pesticides tested were classified in 1-4 scoring categories based on reduction in mycelial growth: 1 = harmless (< 25% reduction), 2 = slightly harmful (25-35%), 3 = moderately harmful (36-50%), 4 = harmful (> 50%) in toxicity tests. All pesticides tested had fungistatic effect to *B. bassiana* at varying intensities depending on their concentrations in medium. The present study showed that *B. bassiana* was very sensitive to the herbicides tested, particularly at recommended as well as lower field dosage. All herbicides and fungicides (except of chlorothalonil at 50% dosage rate) tested at 100, 75 and 50% dosage rate showed strong fungistatic effect (inhibition of growth > 50%; inhibition class 4). However, extensive field studies complemented by parallel laboratory experiments should consider assessing the interaction between selective herbicides and entomopathogenic *B. bassiana* isolates to evaluate their ecological impact in cropped environments.

## **Varstvo gozdnega drevja in drugih lesnatih rastlin**

## Deset let nadzora fitoftorne sušice vejic (*Phytophthora ramorum*) v Sloveniji

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Tujerodna gliva *Phytophthora ramorum* (PR), ki povzroča fitoftorno sušico vejic, ima širok krog gostiteljev med lesnatimi okrasnimi rastlinami, okužuje pa tudi drevesa. Po Evropi se je razširila z okrasnimi rastlinami. Z namenom preprečevanja vnosa, se je v Sloveniji v letu 2003 začel nadzor nad boleznijo in v istem letu smo odkrili prve okužene rastline. V desetletnem obdobju je bilo opravljenih 1895 pregledov okrasnih rastlin v drevesnicah, centrih za distribucijo, na prodajnih mestih, v parkih in vrtovih in tudi 2488 ogledov gozda. Analiziranih je bilo 1336 vzorcev rastlin, vode in tal. Do konca leta 2012 je bila PR 69-krat najdena v centrih za distribucijo okrasnih rastlin ali na prodajnih mestih. Vedno je šlo za rastline, ki niso bile pridelane v Sloveniji. Letno se je pojavila na dveh do 20 lokacijah, največkrat v letu 2007. Z letom 2009 je število najdb začelo upadati. Trikrat se je bolezen pojavila v parku, dvakrat v drevesnici in enkrat na zasebnem vrtu, v gozdu nikoli. Največkrat so bile okužene rastline iz rodu *Rhododendron*, sledijo *Viburnum* spp., *Pieris japonica*, *Kalmia latifolia* in *Quercus rubra*. Vsaki pozitivni najdbi na rastišču so sledili fitosanitarni ukrepi; odstranitev in uničenje okuženih rastlin in njihovih ostankov ter po potrebi razkuževanje tal. Po ukrepih smo dve leti spremljali stanje na mestu najdbe in testirali tudi tla in vodo v okolici. PR v vodi nismo zaznali. V vseh primerih je bila eradikacija uspešna in bolezen se ni širila. Ponovne najdbe na istih lokacijah so bile povezane z novim vnosom okuženih rastlin, zato je uradni status PR v Sloveniji: prehodni: dejaven, pod nadzorom. Na okrasnih rastlinah smo zaznali okužbo še z 10 drugimi vrstami iz rodu *Phytophthora*. Med njimi ni bilo vrste *Phytophthora kernoviae*. Pogostost najdb kaže na slabo učinkovitost predpisanih ukrepov za omejevanje PR na mestu pridelave okrasnih rastlin in veliko verjetnost nadaljnjega vnosa okuženih rastlin.

### ABSTRACT

#### Ten years of *Phytophthora ramorum* survey in Slovenia

The oomycete *Phytophthora ramorum* (PR) can infect a wide range of different woody ornamental plants and trees. It causes leaf blight, dieback or bleeding cankers on trees. It spread over Europe by horticultural trade. The survey for PR was initiated in 2003 to prevent its introduction into Slovenia. First infected plants were found in the same year. There were 1895 inspections in nurseries, garden centres, plant distribution centres, parks and gardens as well as 2488 inspections in forests over the ten-year period; 1336 plant, soil and water samples were analysed. PR was found 69 times in distribution or garden centres. All infected plants originated from other European countries. The number of locations with infected plants ranged yearly from 2 to 20 with the highest number of findings in 2007. The number of positive findings started to decrease in 2009. PR was three times detected in parks, two times in nurseries, once in a private garden but never in forests. *Pieris japonica*, *Kalmia latifolia*, *Quercus rubra* and various *Rhododendron* and *Viburnum* species were infected, most often rhododendrons. Prompt phytosanitary actions followed after PR was positively identified, including destruction of plants and debris. Soil was disinfected in some cases. Subsequently, the PR positive locations were monitored for two years. Nearby water sources were also tested by baiting or filtration techniques but PR could not be detected there. The eradication was successful but disease reappeared

on some locations due to new introductions. A status of *P. ramorum* can be described as transient: actionable, under eradication. Ten other *Phytophthora* species were also found on ornamental plants, but a tree pathogen *P. kernoviae* was not among them. The frequency of infected ornamental plants found in Slovenia reveals that PR is insufficiently controlled in the countries where the plants are produced for trade. Further introduction of infected plants can be expected.



## Ogroženost jesenov zaradi jesenovega ožiga v Sloveniji

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Jesenov ožig ogroža sestoj velikega jesena (*Fraxinus excelsior*) in poljskega jesena (*F. angustifolia*) v Sloveniji. Povzročiteljica bolezni, ki je pri nas zastopana od leta 2006, je tujerodna invazivna gliva *Chalara fraxinea* (teleomorf: *Hymenoscyphus pseudoalbidus*). Bolezen prizadene jesene vseh starosti, mortaliteta je pogosta med mlajšimi drevesi, intenziteta bolezni pa je večja na rastiščih z visoko relativno zračno vlago in nižjimi temperaturami. Pri propadanju jesenov imajo poleg jesenovega ožiga zelo pomembno vlogo tudi glive iz rodu *Armillaria*, predvsem v zadnjem času pa dodatno škodo povzročajo tudi jesenovi podlubniki. Možnosti za zatiranje bolezni ali za zaviranje njenega širjenja so zaradi izjemno velikega infekcijskega potenciala glive zelo omejene in predvidevamo obsežne sečnje poškodovanih jesenov v slovenskih gozdovih. Individualna odpornost dreves velikega in poljskega jesena na bolezen je zelo različna, zato je velika verjetnost, da bo z naravnim izborom ali z usmerjenim križanjem mogoče zagotoviti obstoj jesena pri nas. Gliva je izjemno občutljiva za višje temperature in zaradi tega bodo morda škode zaradi bolezni v Sloveniji manjše kot v hladnejših predelih Evrope, kjer že potekajo obsežne sečnje obolelih dreves. Predstavljeni bodo rezultati naših raziskav, ki omogočajo navedene domneve.

### ABSTRACT

#### Endangerment of ash species due to ash dieback in Slovenia

Common ash (*Fraxinus excelsior*) and Narrow-leaved ash (*F. angustifolia*) stands in Slovenia are endangered by ash dieback disease. Causal agent of the disease, which was in Slovenia for the first time found in 2006, is alien invasive fungus *Chalara fraxinea* (teleomorph: *Hymenoscyphus pseudoalbidus*). Ashes of all ages are diseased, mortality is common amongst saplings and young trees, and the severity of the disease seems to be higher on sites with high relative air humidity and lower temperatures. Apart from *C. fraxinea*, fungi from genus *Armillaria* play an important role as secondary pathogens in ash decline. Lately it has been observed that also ash bark beetles can cause some additional damage. Control of the disease or mitigation of its spread are very limited because of high infection potential of the fungus and comprehensive felling of damaged trees in Slovenian forests is foreseen. Resistance of individual trees against the disease is very diverse and high probability exists that with natural selection or with controlled breeding the existence of ash in our forests could be assured. The fungus is very sensitive to higher temperatures and because of this the damages in Slovenia could be lower than

in cooler parts of Europe, where large scale felling of diseased ash is in course. The results of our research which enable these assumptions are presented.



## **Bolezni borovih iglic v Sloveniji, ki jih povzročajo glive iz rodu *Mycosphaerella***

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Bore (*Pinus* spp.) pri nas pogosto okužujejo številne avtohtone bolezni ali jih napadajo škodljivci, posebno velika nevarnost pa jim grozi zaradi vnosa tujerodnih škodljivih organizmov. Predvidena škoda ob vnosu le-teh bo seštevek neposrednih škod zaradi poškodb in rigoroznih ukrepov za njihovo zatiranje ali preprečevanje širjenja, ki lahko dodatno izjemno negativno vplivajo na gozd. Določeni škodljivi organizmi so že prepoznani in uvrščeni na sezname Direktive Sveta št. 2000/29/ES in Evropske in sredozemske organizacije za varstvo rastlin (EPPO). Med njimi najdemo tudi dve bolezni: rjavenje borovih iglic, ki ga povzroča gliva *Mycosphaerella dearnessii* (anamorf *Lecanosticta acicola*) in rdečo pegavost borovih iglic, ki jo povzročata morfološko podobni vrsti *Dothistroma septosporum* (teleomorf *M. pini*) in *D. pini* (teleomorf ni znan). Povzročiteljici rdeče pegavosti borovih iglic so identificirali šele leta 2004 in ločiti ju je mogoče le s primerjavo molekularnih podatkov. Vse tri vrste gliv niso splošno razširjene v Evropi. V zadnjem času sta se povečali obseg razširjenosti in intenziteta bolezni zaradi vrst iz rodu *Dothistroma*, predvsem v Angliji in severnih državah. Novejše genetske analize kažejo, da je za nadaljnji razvoj bolezni pomembno, ali bo v evropski prostor vnesen do sedaj neodkrit paritveni tip *D. pini*, kar bi povzročilo večjo genetsko variabilnost in večjo možnost nastanka bolj patogenih oblik te glive. V letu 2012 smo zato v okviru posebnega nadzora spremljali zastopanost in vrstno sestavo gliv iz rodu *Dothistroma* in glive *M. dearnessii* v Sloveniji. Rezultati se ujemajo z izsledki podobnih raziskav v Evropi in dopolnjujejo poznavanje razširjenosti glive *D. pini*. Poleg tega so rezultati nakazali, da je spremljanje škodljivih organizmov pomembna osnova za ukrepanje ob najdbi bolezni oziroma pri njenem zatiranju.

### **ABSTRACT**

#### **Pine needle diseases in Slovenia, caused by fungi from the *Mycosphaerella* genus**

In Slovenia, pines (*Pinus* spp.) are frequently damaged by vast autochthonous diseases and pests, but introductions of alien harmful organisms represent even higher dangers for pine trees. Estimated loss as a consequence of these introductions will be a sum of direct losses connected to the disease or damages and losses connected to rigorous measures taken to eradicate or to prevent the disease expansion, which could additionally negatively affect our forests. Some of these harmful organisms are already recognized and listed on the lists of the Council Directive 2000/29/EC and of the European and Mediterranean Plant Protection Organization (EPPO). Among them the following two diseases are found: brown spot needle blight caused by *Mycosphaerella dearnessii* (anamorph *Lecanosticta acicola*) and red band needle blight caused by two morphologically similar species *Dothistroma septosporum* (teleomorph *M. pini*) and *D. pini* (teleomorph unknown). The latter two species were identified in 2004 and can only be identified based on molecular data. All three mentioned species are not widely spread in Europe. But in the recent years



the extent and the intensity of the disease, caused by *Dothistroma* species have increased, especially in England and Nordic countries. Latest genetic analyses have shown that for further disease development in Europe import of a not yet present mating type would be critical. This would trigger a higher genetic variability and the possibility of new pathogenic strains would be enhanced. Subsequently, a monitoring of the presence and diversity of *Dothistroma fungi* and *M. dearnessii* has been performed in 2012 in Slovenia in the context of the National survey program. The results of this survey are in accordance of the similar surveys performed in Europe and supplement the existing knowledge about the *D. pini* distribution. Also, the results indicate the value of regular monitoring, which could serve as an important basis for possible actions at disease outbreaks or to limit the disease spreading.



### **Insekticidna mreža za zatiranje škodljivcev v gozdarstvu in skladiščih**

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Nemško podjetje BASF je razvilo nov način zatiranja škodljivcev, ki se že uporablja v gozdarstvu in skladiščih kmetijskih rastlin. V družini proizvodov, imenovanih Complion®, je bila razvita posebna mreža za zatiranje lubadarjev. V umetna vlakna mreže je s posebnim postopkom vgrajena aktivna snov alfa-cipermetrin, ki je na slovenskem trgu znana v insekticidu Fastac. Aktivna snov prehaja iz notranjosti vlaken na površje, sorazmerno z izgubo le te na površju vlaken. Mreža vsebuje 100 mg aktivne snovi na m<sup>2</sup> mreže. Škodljivec mora ostati na mreži nekaj sekund. To je dovolj za učinkovito delovanje. V vlaknih je dovolj aktivne snovi za učinkovitost mreže vsaj 6 mesecev. Uporaba mreže na prostem nima negativnih stranskih učinkov na okolje. Storanet® je ime za enega od proizvodov iz družine Complion®, namenjenega za varovanje skladiščene hlodovine. Z mrežo pokriti hlodi ali tudi posamezen hold, so mehansko in kemično zaščiteni pred napadom lubadarjev. Smiselno je pokriti tudi z lubadarji že napadeno hlodovino. S tem preprečimo širjenje škodljivca na zdrav les.

#### **ABSTRACT**

### **Insecticidal fine-meshed net for controlling forest and stored timber pests**

BASF is introducing a new range of products to support forest protection that adopts totally different approaches. Under the Complion® product family, BASF has developed a fine-meshed net aimed at combating bark beetles. Its polyester fibres contain a formulation consisting of alpha cypermethrin and a polymer binder system which allows the active ingredient to be discharged at the surface of the material in a controlled manner. The active ingredient has a concentration of 100 mg per m<sup>2</sup>, which is sufficient to kill the beetles after contact of only a few seconds. At the same time, the application has no undesired side effects and has virtually no environmental impact. Storanet®, is one of products from family, use to protect stored timber. This light netting is stretched over individual trunks of woodpiles and prevents bark beetles from penetrating by creating a physical and chemical barrier. Moreover, tests have shown that the use of Storanet® over timber that has already been infested can prevent the beetles from spreading.



## **Kratkoročna prognoza pojavitve pooglenitve bukve (*Biscogniauxia nummularia*) v Sloveniji**

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Pooglenitev bukve povzroča gliva *Biscogniauxia nummularia*, ki je v običajnih razmerah neškodljiv endofit skorje navadne bukve, parazit pa postane ob višji temperaturi in sušnem stresu. V Sloveniji je gliva *B. nummularia* povzročila odmiranje navadne bukve na večjih zemljiščih na območju Lendave, Brkinov in Reštanja po ekstremno vročem in sušnem letu 2003. Podobne razmere so bile v letu 2012. Zato v letu 2013 pričakujemo povišano stopnjo intenzitete okužb navadne bukve zaradi omenjene glive. Cilj raziskave je bil izdelati kratkoročno napoved potencialne pojavitve poškodb zaradi *B. nummularia* na navadni bukvi v Sloveniji za leto 2013. Kratkoročno napoved pojavitve pooglenitve bukve za leto 2013 smo izvedli na podlagi modela, ki upošteva korelacijo pojavljanja pooglenitve bukve in klimatskih parametrov, tj. temperature in padavin. Rezultati modela so pokazali, da bo verjetnost pojavitve pooglenitve bukve največja v jugozahodnem, osrednjem, severovzhodnem in jugovzhodnem delu Slovenije. V predavanju bomo razpravljali o prednostih in pomanjkljivostih modela ter možnostih za njegovo izboljšavo.

### **ABSTRACT**

#### **Short-term forecast for occurrence of strip-cankering of beech (*Biscogniauxia nummularia*) in Slovenia**

Strip-cankering of beech is caused by *Biscogniauxia nummularia* that in normal conditions acts as endophyte of beech bark; the parasitic phase is initiated by higher temperatures and drought stress. Records of *B. nummularia* in Slovenia comes from Lendava, Brkini and Reštanj, which are related to unusually hot and dry weather in year 2003. Similar weather conditions were in year 2012. Therefore, we expect higher intensity of damages caused by strip-cankering of beech in year 2013. We performed short-term forecast for occurrence of strip-cankering of beech in year 2013 with a model that considers correlation of strip-cankering with weather conditions, i.e. temperature and precipitations. The results of model showed that the highest probability for *B. nummularia* occurrence is in southwest, central, northeast and southeast part of Slovenia. We discuss about benefits - deficiencies of the model and possibilities for its improvement.



#### **Assessing the non-target effects of the Trinet™ system**

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The Trinet system was developed for controlling the European spruce bark beetle (*Ips typographus* L.) and the six toothed spruce bark beetle (*Pityogenes chalcographus* [L.]). However, the setup of the control method has some potential side effect on non-target species, species other than *I. typographus* and *P. chalcographus*. Our aim was to investigate the potential effects of the Trinet system on non-target organisms. The catch of non-target organisms was compared between Trinet system, malaise trap and window trap in order to see the difference between the catch of Trinet and what actually flies around the vicinity. This was done on five locations: Kranj, Ljubljana, Kamnik, Nazarje and Prevalje. It was collected over three periods (June, July and August) during the summer of 2012. The results showed that in the window trap and the malaise trap was twice to 26 times higher catch than in the Trinet. The same pattern was found for several important ecosystem service agents. There were not many important pollinators like bees and hoverflies on the Trinet system. The same patterns were found for natural enemies of pest insects like parasitic wasps and predatory beetles. This indicates that a low proportion of beneficial animals is affected by Trinet.

## IZVLEČEK

### Ocenjevanje vpliva sistema Trinet™ na neciljne organizme

Sistem Trinet je bil razvit za nadzor osmerozobega smrekovega lubadarja (*Ips typographus* L.) in šesterezobega smrekovega lubadarja (*Pityogenes chalcographus* L.). Metode zatiranja določenih vrst pa imajo potencialne stranske učinke na druge, t.j. neciljne vrste. Namen naše raziskave je bil raziskati morebitni vpliv sistema Trinet na neciljne organizme. Da bi ugotovili kolikšen delež žuželk, ki leta na določenem območju, se ulovi v sistem Trinet, smo primerjali ulov neciljnih organizmov med sistemom Trinet, pastjo 'malaise' in okensko pastjo. Pasti smo postavili na petih lokacijah, in sicer v Kranju, Kamniku, Ljubljani, Nazarjah in Prevaljah. Žuželke smo spremljali v treh obdobjih (junij, julij in avgust) poleti 2012. Rezultati so pokazali, da je ulov neciljnih organizmov v okenskih pasteh in pasteh 'malaise' od dva dva do 26-krat večji od ulova v sistemih Trinet. Podobno razmerje ulova smo ugotovili za nekaj vrst, za katere je znano, da imajo pomembno vlogo v ekosistemu. Tako v ulovu sistema Trinet nismo ugotovili veliko oprashaevcev, kot so čebele in muhe trepetavke. Podobno je bilo ugotovljeno za nekatere naravne sovražnike, kot so parazitske ose in plenilski hrošči. Rezultati kažejo, da sistem Trinet negativno vpliva le na majhen delež koristnih organizmov, ki se nahajajo na nekem območju.

*Izvečki referatov 11. slovenskega posvetovanja o varstvu rastlin z mednarodno udeležbo  
(in okrogla miza o zmanjšanju tveganja zaradi rabe FFS v okviru projekta CropSustaIn), Bled 2013*

## **Varstvo sadnega drevja in jagodičevja**

## **Virusne okužbe malin in robid**

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Maline in robide so kot večletne rastline močno izpostavljene okužbam z virusi. Prav zaradi večletne pridelave v simptomatičnih rastlinah navadno najdemo mešane okužbe z virusi. Te zmanjšujejo kakovost in količino pridelka, vplivajo na rast rastlin in posledično tudi na hitrejše obnavljanje nasadov. Na pridelavo malin in robid vplivajo tri pomembne virusne bolezni; malinov mozaik in drobljenje plodov pri malinah ter bolezen rumenenja žil pri robidah. Za vse omenjene bolezni je značilno, da so povezane z virusnimi kompleksi, torej s sočasnimi mešanimi okužbami več virusov. Rastline, okužene le z enim virusom iz kompleksa, navadno ne kažejo bolezenskih znamenj. Široka uporaba metod molekularne biologije v raziskavah in diagnostiki rastlinskih virusov je v zadnjem desetletju omogočila pridobitev novih znanj tudi o virusih, ki povzročajo virusne bolezni malin in robid. Ugotovitve kažejo, da se vsaj nekateri povzročitelji teh bolezni v Evropi in Severni Ameriki med seboj razlikujejo. V prispevku bomo predstavili najnovejše ugotovitve o virusnih boleznih malin in robid ter naše izkušnje na tem področju, saj se z raziskavami virusnih okužb malin in robid v Sloveniji že nekaj let intenzivno ukvarjamo.

### **ABSTRACT**

#### **Virus diseases of raspberries and blackberries**

Raspberries and blackberries, like all perennial crops are usually found to be infected with more than one virus. Virus infections, especially mixed virus infections, influence the yield, quality of the fruits, plant growth and decline of productivity. Three important virus diseases are influencing the production of raspberries and blackberries; raspberry mosaic and crumbly fruit in raspberries and blackberry yellow vein disease in blackberries. All of them are associated with mixed virus infections. Single viruses usually cause no symptoms in infected plants. After a wide use of molecular biology methods in plant virus research and diagnostic, more knowledge was obtained on the viruses associated with these diseases. The results show differences between some of the viruses found in affected plants in Europe and North America. The most recent information on virus diseases of raspberries and blackberries and our experience with these diseases will be presented.



#### **Odziv malin na okužbo z malinovo sušico (*Didymella applanata* in *Leptosphaeria coniothyrium*)**

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Namen poskusa je bil preveriti, kako se med seboj razlikuje fenolni profil zdravih in okuženih malinovitih rozg z malinovo sušico, ki jo povzročata glivi *Didymella applanata* in *Leptosphaeria coniothyrium*. Rozge smo vzorčili na treh sortah, 'Autumn Bliss', 'Himbo Top' in 'Polka'. Vsebnost skupnih fenolov in taninov smo določili spektrofotometrično, medtem ko smo posamezne fenole analizirali z metodo HPLC-MS. Okužba z obema glivama, ki povzročata sušico, je značilno spremenila vsebnost fenolnih snovi. Z okužbo se je povečala zlasti vsebnost flavanolov in taninov. Ravno nasprotno pa se je z okužbo zmanjšala vsebnost derivatov hidroksicimetnih kislin in elagne kisline ter flavonolov. Sorti 'Himbo Top' in 'Polka' sta vsebovali višje vsebnosti derivatov hidroksicimetnih kislin in elagne kisline v zdravih in obolelih rozgah v primerjavi s sorto 'Autumn Bliss'. Sorta 'Polka' je imela tudi najvišje vsebnosti flavanolov in taninov v primerjavi z ostali dvema sortama. Kljub visokim vsebnostim individualnih in skupnih fenolov so bile rozge sorte 'Polka' močno okužene z glivama *D. applanata* in *L. coniothyrium*. Rezultati zato nakazujejo, da je mogoče povezati vsebnost fenolov z občutljivostjo malin na okužbo z malinovo sušico.

#### ABSTRACT

#### **Changes in phenolic pattern due to raspberry spur and cane blight (*Didymella applanata* and *Leptosphaeria coniothyrium*)**

The phenolic profile of healthy and infected raspberry canes was investigated on three raspberry cultivars: 'Autumn Bliss', 'Himbo Top' and 'Polka'. The content of total phenols and tannins was determined spectrophotometrically, while individual phenolics were analyzed using HPLC-MS analysis. Moreover, *Didymella applanata* and *Leptosphaeria coniothyrium* infection significantly altered the metabolism of phenolic compounds. Spur and cane blight diseases caused an increase of flavanols and tannins. Contrary, the levels of hydroxycinnamic acid derivatives, conjugates of ellagic acid and quercetin glycosides were significantly reduced. 'Himbo Top' and 'Polka' cultivars contained higher levels of hydroxycinnamic acid and ellagic acid derivatives in healthy and infected canes compared to 'Autumn Bliss' cultivar. 'Polka' cultivar also contained the highest level of flavanols and tannins compared to other two cultivars. However, despite high content levels of flavanols and total phenols measured in 'Polka' cultivar the canes were extremely infected with *D. applanata* and *L. coniothyrium*. The results of the study suggest that the level of phenolic compounds could be linked to the differences in disease susceptibility.



#### **Razvoj novih metod za spremljanje biotičnega agensa *Gliocladium catenulatum* J1446 za zatiranje sive plesni na jagodah**

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Siva plesen, ki jo povzroča gliva *Botrytis cinerea*, je ena od najpogostejših in najpomembnejših bolezni jagod. Za njeno zatiranje se uporabljajo različni fungicidi, ki lahko hitro izgubijo svojo učinkovitost. Tako je v zadnjih letih veliko pozornosti

namenjeno tudi biotičnemu zatiranju sive plesni na jagodah. Na tržišču v nekaterih evropskih državah je na voljo pripravek PrestopMIX (Verdera Oy, Finska), kjer aktivno snov predstavlja biotični agens (BA) - izolat glive *Gliocladium catenulatum*, J1446, ki deluje na povzročiteljico sivo plesni. V okviru evropskega ERA net projekta Bicopoll, ki je eden od projektov CORE Organic II, preverjamo morebitne ostanke BA v medu in cvetnem prahu in sledimo njenemu raznosu na cvetove jagod s pomočjo čebel. V ta namen smo razvili novo, za BA izolat specifično metodo PCR v realnem času, ki nam omogoča zaznavo izolata v različnih vzorcih in njegovo kvantifikacijo. Predstavili bomo razvoj nove metode in njeno aplikacijo.

#### ABSTRACT

#### **The development of new methods for monitoring biocontrol agent, *Gliocladium catenulatum* J1446, to control gray mold on strawberries**

Gray mold, caused by the fungus *Botrytis cinerea*, is one of the most common and serious diseases affecting strawberries. Different fungicides are used to manage this disease but can quickly lose their effectiveness and their ability to suppress the disease. Therefore, much attention is devoted to biological methods of control in recent years. Preparation PrestopMIX (Verdera Oy, Finland) is available in some European countries. It contains a biocontrol agent (BCA), isolate J1446 of the fungus *Gliocladium catenulatum*, active against grey mold. In the project Bicopoll, a project of European transnational research cooperation project CORE Organic II, we are checking for residues of BSA in bee products (honey, pollen) and following BCA distribution to strawberry flowers by bees. For this purpose, we developed a new, BCA specific real time PCR, which allows us to detect BCA in different samples and quantify it. Development of a new method and its application will be presented.



#### **Vrednotenje tolerantnosti sort in tipov marelice na leptonekrozo koščičarjev (ESFY)**

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Koščičaste sadne vrste iz rodu *Prunus* v Evropi ogroža nevarna bolezen klorotičnega zvijanja listov koščičarjev ali leptonekroza koščičarjev, ki jo povzroča fitoplazma European stone fruit yellows (ESFY) in se na gostiteljske rastline širi s prenašalcem češpljevo bolšico (*Cacopsylla pruni*). Marelica (*P. armeniaca*) je za okužbo s fitoplazmo dovzetna in občutljiva sadna vrsta, ki kaže izrazita bolezenska znamenja in postopno odmiranje dreves, predvsem pri občutljivih sortah. Pojav propadanja dreves pri marelici je v našem okolju pogost in vpliva na opuščanje pridelave te sadne vrste. V Sloveniji je na nekaterih območjih še prisotnih nekaj domačih, lokalnih tipov oziroma avtohtonih sort marelice s kakovostnimi plodovi, ki so se uspeli ohraniti do danes. V okoljih z velikim infekcijskim pritiskom fitoplazme, kar je značilno tudi za pridelovalna območja koščičarjev v Sloveniji, lahko sajenje tolerantnih sort marelice omogoči pridelavo te občutljive sadne vrste. Namen tega prispevka je priprava navodil za vrednotenje tolerantnosti različnih sort in tipov marelice na okužbo s fitoplazmo ESFY. S tem želimo



opozoriti na pomen izbire tolerantnejših sort marelic in prispevati k povečanemu zanimanju za pridelavo te sadne vrste.

#### ABSTRACT

### **Tolerance assessment of different *Prunus armeniaca* cultivars to European stone fruit yellows phytoplasma**

Stone fruit species (genus *Prunus*) in Europe are affected by severe disease associated with the European stone fruit yellows (ESFY) phytoplasma. The pathogen is transmitted to the host plants by the vector *Cacopsylla pruni*. Among *Prunus* species, apricot *P. armeniaca* is one of the most susceptible and sensitive to ESFY phytoplasma infection, which shows characteristic symptoms and decline of the trees, particularly on sensitive cultivars. In Slovenia the decline of apricot trees is evident and causes the drop of apricot production. There are some old local cultivars or types of apricot which are still present in some areas in Slovenia and have fruits of good quality. In areas with high infection pressure of phytoplasma, which is also typical for our areas where stone fruits are grown, the use of tolerant cultivars can help to maintain the production. The aim of this paper is the preparation of guidelines to evaluate the tolerance of different apricot cultivars and types to ESFY infection. The choice and cultivation of more tolerant cultivars may contribute to enhance the apricot production.



### **Možnosti za preprečevanje škod zaradi virusnih okužb**

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Rastlinski virusi povzročajo gospodarsko škodo zaradi zmanjšanja količine in kakovosti pridelka, okrnjenega razvoja tkiv in organov, propada rastlin ter zaradi izvajanja ukrepov za preprečevanje njihovega vnosa in širjenja. Viruse lahko odstranimo iz rastlin s pomočjo meristemske kulture, termoterapije, kemoterapije oz. kombinacij teh tehnik. Navedene tehnike so drage in jih uporabljamo za pridobivanje brezvirusnega materiala le v primerih, ko so z virusi okuženi dragoceni genotipi. V praksi se proti virusnim boleznim borimo s preventivnimi ukrepi, in sicer s pridelavo in uporabo zdravega sadilnega materiala, karantenskimi ukrepi, gojenjem odpornih ali tolerantnih sort in odstranjevanjem dejavnikov, ki povzročajo naravno širjenje virusov, torej odstranjevanjem okuženih gostiteljskih rastlin in zatiranjem prenašalcev virusov. Najbolj učinkovita je seveda hkratna uporaba več preventivnih ukrepov. V prispevku so predstavljene možnosti za preprečevanje škod na primerih iz sadjarstva.

#### ABSTRACT

### **Measures for prevention of damages caused by viruses**

Plant viruses cause economically important losses due to diminished yield quality and quantity, reduced growth and development of tissues and organs, decline and dieback of plants and due to the costs of prevention and control measures. Viruses can be eliminated from plants using meristem culture, thermotherapy, chemotherapy or combination of these techniques, which is costly and therefore used only for production of virus-free plants of

valuable genotypes. In practice, only preventive control measures such as the use of virus-free propagation material, quarantine measures, the use of resistant or tolerant cultivars and elimination of factors causing natural transmission of viruses, i.e. infected host plants and vectors, can be used for protection against virus diseases. Combination of several preventive measures is the most effective way of protection. Measures for prevention of damages due to virus infections, using examples from fruit growing, are presented.



### **Študija raznolikosti populacij *Agrobacterium tumefaciens* na osnovi zaporedij gena *recA* na kmetijskih zemljiščih v Sloveniji**

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Raznolikost populacij v kompleksu vrste *Agrobacterium tumefaciens* smo preučevali v sadovnjakih, vinogradih ter njivskih, travniških in gozdnih zemljiščih v Sloveniji. Vzorčili smo na štirih območjih Slovenije (Savinjska, Gorenjska, Spodnjeposavska in Podravje), kjer se nahaja večina slovenskih sadovnjakov. Predstavnike iz kompleksa vrste *A. tumefaciens* smo izolirali iz 63 od 72 vzorcev tal (87,5 %), nobenega pa iz vzorcev gozdnih tal. Vseh 69 izolatov iz kompleksa vrste *A. tumefaciens* smo z biotičnimi testi določili kot nepatogene. Na podlagi zaporedja gena *recA* smo jih uvrstili v genomski vrsti G1 (43 izolatov) in G4 (26 izolatov). Izolati genomskih vrst G1 in G4 so se na gojiščih 1A and KB razlikovali v morfologiji kolonij. Izolati G4 so imeli mukoiden fenotip, ki so ga predhodno opazili pri kliničnih izolatih vrste *A. radiobacter*. Naši rezultati kažejo, da na kmetijskih zemljiščih v Sloveniji prevladuje genomski vrsta G1, še posebno v sadovnjakih, kjer je kar 60% vseh izolatov pripadalo skupini G1. Pri obeh genomskih vrstah smo določili nove alele: 12 novih pri G1 (z oznakami od G1-10 do G1-21) in 5 novih alelov pri G4 (od G4-7 do G4-11). V vzorcih tal sta prevladovala dva alela: *recA*-G4-7 in *recA*-G1-10. Pričakujemo, da bodo nadaljnje študije razkrile še večjo raznolikost alela *recA* pri okoljskih populacijah kompleksa vrst *Agrobacterium tumefaciens*.

#### **ABSTRACT**

#### **Study of *Agrobacterium tumefaciens* soil population based on *recA* gene sequence diversity from agricultural lands in Slovenia**

The soil population diversity of *Agrobacterium tumefaciens* species complex was surveyed in orchards, fields, meadows, vineyards and forest soils. Sampling was carried out in four regions of Slovenia (Savinjska, Gorenjska, Spodnjeposavska in Podravje), where majority of fruit tree plantations are situated. Members of *A. tumefaciens* species complex were detected in 63 out of 72 soil samples (87.5 %), but none were detected in forest soil. All 69 isolates of *A. tumefaciens* species complex were determined as non-pathogenic by biotests, and assigned to genomic species or genomovars based on *recA* allele sequence analysis. Forty-three isolates were determined as genomic species G1 and 26 isolates as G4. Different colony morphology between isolates of genomic species G1 and G4 was observed on 1A and KB media, with mucoid phenotype of G4 isolates previously noted in clinical isolates of *A. radiobacter*. According to our results, isolates of genomic species G1 were prevalent in agricultural lands, particularly in fruit tree orchards at which 60 % of isolates were allocated into G1 group. Among both genomic species new

alleles of recA gene were recognized: 12 new alleles in G1 (denominated G1-10 to G1-21) and five in G4 (G4-7 to G4-11). Two alleles dominated in Slovenian soil isolates, recA-G4-7 and recA-G1-10. We expect that further studies would reveal even greater recA allelic diversity within environmental populations of *Agrobacterium* species complex.



### **Bakterijski ožig aktinidije *Pseudomonas syringae* pv. *actinidiae* (Takikawa et. al., 1989) – Psa, prihajajoča nevarnost za slovensko sadjarstvo**

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Bakterijski ožig aktinidije in njen povzročitelj, *Pseudomonas syringae* pv. *actinidia* - *Psa*, sta bila prvič opisana na Japonskem leta 1984. Bolezen je bila v Aziji zelo škodljiva, v Italiji pa dolgo (20 let) ni povzročala večjih izgub pridelka. Od leta 2008 se v Italiji ponavljajo zelo škodljive in nenadne epidemije, in sicer predvsem na rumenem kiviju v srednji Italiji, od leta 2009 pa tudi na sorti Hayward v vseh pridelovalnih območjih kivija v Italiji. V letu 2011 je bil *Psa* opažen tudi v pokrajini Furlaniji - Julijski krajini, v neposredni bližini naše zahodne meje. Tako lahko pojav bolezni kmalu pričakujemo tudi v Sloveniji. Ker se bolezen prenaša tudi z okuženim sadilnim in razmnoževalnim materialom, obstaja nevarnost vnosa z okuženih območij v Italiji, kjer so do nedavno pridelovali glavino sadik aktinidije in cvetnega prahu za potrebe oprave v EU. Aktinidija je sicer v Sloveniji manj pomembna sadna vrsta, ki je v intenzivnih nasadih zasajena le na Primorskem, samostojno pa jo gojijo v vrtovih in ohišnicah praktično na celotnem območju Slovenije. V letu 2012 v Sloveniji še nismo opazili niti potrdili sumov okužb z bakterijskim ožigom aktinidije. V prispevku so opisana bolezenska znamenja, ukrepi ob pojavu in možnosti za obvladovanje bolezni.

#### **ABSTRACT**

### **Bacterial canker of kiwi *Pseudomonas syringae* pv. *actinidiae* (Takikawa et. al., 1989) – Psa, the upcoming danger for Slovenian fruit production**

Bacterial canker of kiwi and his agent, *Pseudomonas syringae* pv. *actinidia* – *Psa*, were first described in Japan in 1984. The disease was very destructive in Asia, while in Italy for a long time (20 years) has not caused serious losses. From 2008 onwards, in Italy repeated devastating and sudden epidemics mainly in yellow kiwi in central Italy, from 2009, as well as the Hayward variety in all growing areas of kiwifruit in Italy. In 2011, the *Psa* was also observed in the region of Friuli - Venezia Giulia, in the immediate vicinity of our western border. We can expect the occurrence of the disease also in Slovenia. Because the disease is transmitted by infected planting and propagating material, there is a risk of introduction of infected areas in Italy, where until recently the majority of seedlings and pollen for pollination of kiwi in the EU. Kiwi in Slovenia is less important fruit species, which is in the form of intensive crops planted only in the Primorska region. As individual plants the kiwi is present in gardens and croft virtually the entire territory of Slovenia. In 2012 in Slovenia had not been seen or confirmed suspected bacterial infections of Bacterial canker of kiwi. The article describes the symptoms, measures after the occurrence and the potential for disease control.



## Vloga fenolnih spojin pri odpornosti orehov na orehovo črno pegavost (*Xanthomonas arboricola* pv. *juglandis*)

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Orehova črna pegavost (*Xanthomonas arboricola* pv. *juglandis* [*Xaj*]) je gospodarsko najpomembnejša bolezen domačega oreha (*Juglans regia* L.), ki lahko povzroči do stodontni izpad pridelka. Domnevo, da imajo pri odpornosti nekaterih sort pomembno vlogo fenolne snovi, smo preverili s primerjavo vsebnosti fenolov v zdravih orehih brez bolezenskih znamenj in orehih z bolezenskimi znamenji *Xaj* pri šestih različno občutljivih sortah, ob vzporednem ocenjevanju stopnje napadenosti plodov s *Xaj* v nasadu. V fenofazi Gf+30 smo z metodo HPLC v zeleni lupini zdravih in naravno okuženih plodov določili deset fenolov iz skupin fenolnih kislin in flavonoidov. Na naravno okužbo s *Xaj* so se plodovi odzvali s povečano sintezo posameznih fenolov. Najbolj izrazit učinek smo ugotovili pri bolj odporni sorti Fernette, kjer se je v simptomatičnem tkivu plodov akumuliralo 48-krat več katehina kot v zdravih plodovih. Pri tej sorti smo v času določanja fenolov opazili le manj izrazita bolezenska znamenja, posamezne nekrotične pege, ki niso presegle 8% površine ploda, kar je verjetno povezano s povečano vsebnostjo katehina. Naknadno sintezo fenolnih spojin kot odziv na okužbo smo ugotovili tudi po umetni inokulaciji orehov s španskim izolatom bakterije *Xaj* v nadzorovanih razmerah, le da je bila jakost odziva šibkejša. Bolezenska znamenja so bila najbolj izražena pri sorti Šampion, ki za razliko od ostalih sort ni imela značilno preseženega floroglucinola. Iz tega lahko sklepamo, da imajo lahko fenolne spojine v obrambni strategiji orehov proti *Xaj* poleg post-infekcijske tudi konstitutivno vlogo.

### ABSTRACT

#### Involvement of phenolic compounds in defence mechanism to walnut blight (*Xanthomonas arboricola* pv. *juglandis*)

As an economically important disease of common walnut (*Juglans regia* L.) bacterial blight (*Xanthomonas arboricola* pv. *juglandis* [*Xaj*]) can cause up to hundred percent crop loss. The hypothesis that partial resistance of some cultivars may be related to phenolic compounds was tested with a comparison of the phenolics' content in healthy (asymptomatic) and *Xaj*-infected (symptomatic) nuts of six cultivars with different susceptibility to the disease. In parallel, blight severity of the same cultivars was assessed in the orchard. Using HPLC analysis, ten phenolic compounds of phenolic acids and flavonoids group were quantified in green husks of healthy and naturally infected nuts at the phenophase Gf+30. Increased contents of phenolics were observed as a response to the natural infection. The effect was the most evident in the less susceptible cultivar Fernette in which symptomatic husk tissue contained 48 times higher content of catechin than healthy husks. At the time of phenolic determination, Fernette nuts exhibited only

minor symptoms, some separated spots on the husks not exceeding 8 % surface area, which may be linked to the increased content of catechin. A smaller increase in phenolics was observed upon artificial inoculation of the nuts with a Spanish bacterial isolate under controlled conditions. Disease symptoms were the most pronounced in the Šampion cultivar, the only cultivar that did not show an increase in floroglucinol levels. Based on results we can conclude that phenolic compounds may have both post-infection and constitutive role in walnut defence strategy against *Xaj*.



## Presence and distribution of brown rot in stone fruits in Serbia

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Species of the genus *Monilinia* are well-known plant pathogens that cause brown rot of pome and stone fruits worldwide. Two species of this genus, *M. laxa* and *M. fructigena*, are widely distributed in Serbia. Considering that *M. fructicola*, EPPO A2 quarantine pathogen, has recently been detected on stored apple and nectarine fruits in Serbia, the aim of the paper was to investigate presence and distribution of brown rot-causing pathogens in stone fruits in Serbia. During 2011 and 2012, over 260 samples with symptoms of twig blight and fruit rot were collected at 119 locations in 15 districts of Serbia. The pathogens were isolated from diseased plant parts using standard phytopathological methods, and pathogenicity of the isolates was confirmed by inoculation of injured apple fruits. Identification was done according to pathogenic, morphological and ecological properties, and confirmed by Multiplex PCR and amplification and sequencing of the ribosomal internal transcribed spacer (ITS) region of rDNA. Based on morphological characteristics, the vast majority of isolates (234 out of 243) formed rosetted non-sporulating colonies with lobed margins and were identified as *M. laxa*. Six isolates with light yellow colonies and lobate margins are identified as *M. fructigena*, while tree isolates producing an abundant, grayish-white colonies with even margins and concentric rings of sporogenous mycelium are identified as *M. fructicola*. Morphological identification was confirmed by Multiplex PCR amplification of products of expected size. Sequence analysis of ITS region of one of the *M. fructicola* isolates (JX127303) revealed 100% nucleotide identity with 18 isolates of *M. fructicola* from different parts of the world. According to this study, *M. laxa* was by far most prevalent (96.30%) followed by *M. fructigena* (2.47%) and *M. fructicola* (1.23%). Funded by the projects III46008 and III43001 of the Ministry of Education Science and Technical Development of the Republic of Serbia.



## **Načini spremljanja in izzivi pri napovedovanju pojava jablanovega škrlupa (*Venturia inaequalis* Wint.)**

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Jablanov škrlup (*Venturia inaequalis* Wint.) je gospodarsko najpomembnejša in najtežje obvladljiva bolezen jablan (*Malus domestica*). Obvladovanje bolezni je usmerjeno na spolno obliko glive, ki povzroča primarne okužbe in se razvija na okuženem odpadlem listju v psevdotecijih. Napoved pojava jablanovega škrlupa temelji na spremljanju razvoja glive in njenega infekcijskega potenciala na odpadlem listju jablan v naravi ter spremljanju in vrednotenju agrometeoroloških spremenljivk, ki predstavljajo vhodne podatke za delovanje prognostičnega modela za napoved bolezni. Delovanje modela temelji na spremljanju osnovnih agrometeoroloških podatkov, kot so temperatura, padavine, omočenost listov in relativna zračna vlaga ter spremljanju razvoja jablane. V naravi spremljamo izbruhe askospor z uporabo biotehničnih pripomočkov, kot sta lovilec spor in mikroskopska objektna stekelca, ter štejemo spore pod mikroskopom. Z opazovanjem v naravi dobimo podatke o začetku in koncu trajanja izbruhov askospor, kar sočasno napove obdobje nevarnosti za primarne okužbe. Pridobljeni podatki z opazovanji v naravi nam podajo tudi število in dinamiko izbruhov, iz katerih je mogoče prav tako sklepati na razpoložljivi infekcijski potencial glive v naravi. Za napoved pojava jablanovega škrlupa uporabljamo prognostični model Apple scab programskega paketa addVantage, ki napoveduje čas in trajanje izpolnjenih razmer za okužbo z jablanovim škrlupom ter jakost infekcije. Integracija opisanih načinov spremljanja je osnova za uspešno strategijo varstva jablan proti jablanovemu škrlupu, ki temelji na preprečevanju razvoja primarnih okužb v prvem delu rastne dobe, s ciljem ohraniti zdrave liste ter onemogočiti razvoj sekundarnih okužb. Ta strategija varstva je osnova za biotični pristop varstva jablanovega škrlupa v drugem delu rastne dobe.

### **ABSTRACT**

#### **Methods for monitoring and challenges in forecasting the occurrence of apple scab (*Venturia inaequalis* Wint.)**

Apple scab (*Venturia inaequalis* Wint.) is the most serious and difficult to manage disease of apple (*Malus domestica*). Disease control focuses on sexual form of the fungus, pseudothecia, which develop on fall infected leaves that causes primary infections. Forecast of the occurrence of apple scab is based on monitoring the development of the fungus and its infectious potential in fall leaves of apple trees in the nature. Monitoring and evaluation of meteorological data are input for the operation of prognostic model for disease. Prediction model based on meteorological data such as temperature, precipitation, leaf wetness, relative humidity and continuous monitoring of the apple trees phenology. In nature outbreaks of ascospore monitored with biotechnical tools such as air spore traps and microscopic object glass and counting spores with microscope. In nature observations disease give us information about the beginning and end of the ascospore incidence of outbreaks, which simultaneously predict risk period for primary infection. The data obtained by observations in environment give us the number and dynamics of outbreaks, of which it is also possible to infer the available potential infectious in nature. For predict the occurrence of apple scab using prognostic model from software package addVantage, which predicts time, duration infection apple scab and intensity. Integrating describe methods of monitoring is the basis for the successful protection strategy against

apple scab, which is based on the development of primary prevention of infections in the first part of the growing season, in order to maintain a healthy leaf mass and to prevent the development of secondary infections. This protection strategy is the basis for biological protection approach apple scab in the second part of the growing season.



Preučevanje bionomije češpljeve bolšice (*Cacopsylla pruni*) na Primorskem

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Leptonekroza koščičarjev - European stone fruit yellows (ESFY) - je postala ena najpomembnejših boleznih koščičastega sadja na Primorskem pa tudi drugod po Sloveniji. Ta bolezen je postala ena glavnih težav pri vzdrževanju matičnih dreves za rez cepičev in ovira pri obnovi in širjenju nasadov koščičastega sadja na Primorskem. Stanje je kritično zlasti pri breskvah, nektarinah, marelicah in slivah kitajsko-japonskega porekla, ki so na splošno zelo občutljive na to bolezen. Črni trn (*Prunus spinosa* L.) in evropska češplja oz. sliva (*P. domestica* L.), ki sta tolerantna na ESFY, sta najpomembnejši naravni infekcijski potencial za širjenje ESFY, med drugim tudi zato, ker sta najustreznejša gostitelja češpljeve bolšice (*Cacopsylla pruni* [Scopoli, 1763], Hemiptera, Psylloidea, Psyllidae). Ta je najpomembnejši naravni prenašalec fitoplazme ESFY. Zatiranje prenašalcev in odstranjevanje okuženih dreves sta edina načina za upočasnjevanje širjenja boleznih. Dobro poznavanje načina in kritični čas prenosa boleznih je zato temeljnega pomena za učinkovito ukrepanje. To pa je neposredno povezano z bionomijo in obnašanjem prenašalcev. Preučevanje bionomije češpljeve bolšice na Primorskem (okolica Nove Gorice, Brkini) v letu 2012 v veliki meri pojasnjuje razloge za epifitotično širjenje ESFY. Prezimitvena populacija se v razmerah Goriške z zimskih gostiteljev (smreka, jelka, bori) začne seliti na primarne gostitelje iz rodu *Prunus* v zadnji dekadi februarja, z viškom sredi marca in v začetku aprila, v Brkinih približno od dva do tri tedne pozneje. Zadnji osebki tega rodu (izključno samice) so se na rumene plošče ulovili še sredi maja, ko so se že razvile prve odrasle bolšice poletnega rodu. Višek pojavljanja imagov novega rodu je bil v drugi polovici maja in v juniju. Zadnji osebki tega rodu so bili na črnem trnu ulovljeni v začetku julija. Odrasle bolšice poletnega rodu se na prezimitvene gostitelje preselijo najpozneje v dveh tednih po pojavu. Na podlagi teh ugotovitev lahko sklepamo, da traja obdobje, ko češpljeva bolšica lahko prenese fitoplazmo ESFY na koščičarje, neprekinjeno od konca februarja do konca junija, skupaj torej cele štiri mesece.

**ABSTRACT**

### **Bionomics study of *Cacopsylla pruni* in the Primorska region**

European stone fruit yellows (ESFY) have become a key disease of stone fruit trees in Primorska region as well as in other parts of Slovenia. It causes serious problems in the maintenance of healthy mother plants of various stone fruit species. It is also one of the major obstacles in reconstruction and new plantations of stone fruit orchards. The situation is particularly critical in peaches, nectarines, apricots and plums of Sino-Japanese origin, which are generally highly susceptible to this disease. *Prunus spinosa* and *P. domestica*, tolerant to ESFY, are the main natural sources of ESFY phytoplasma.

This is also because they are the preferable host plants for *Cacopsylla pruni* (Scopoli 1763) [Hemiptera, Psylloidea: Psyllidae], the main vector of ESFY phytoplasma. Suppressing vector populations and removing diseased trees is the only way to stop or slow-down the spread of this disease. For an effective action, a good knowledge of mode and critical time of the disease transmission as well as bionomics and behaviour of main vectors is essential. Preliminary studies of bionomics of *C. pruni* in the Primorska region (Nova Gorica, Brkini) in 2012 explain quite well the causes for epiphytotic appearance and spread of ESFY in the recent time. In the Nova Gorica region the first reimmigrants (overwintering forms returned from shelter plants) of *C. pruni* on primary hosts were detected in the last decade of February. The population peak was achieved in March and at the beginning of April. In Brkini a delay of about two to three weeks was noticed. The last reimmigrants (females only) on *Prunus* plants were caught in mid-May when the first adults of the new generation already appeared. The adults of this summer generation were found on *Prunus* in May and June. The last specimens of the summer generation were caught on *Prunus spinosa* plants at the beginning of July. The new generation adults migrate to shelter plants at latest within two weeks after their appearance. On the basis of these results can be concluded that the possibility for an active transmission of ESFY by the vector *C. pruni* on *Prunus* plants is continuous for a period of more than four months, from late February to early July.



### **Napovedovanje razvoja ameriškega kaparja (*Diaspidiotus perniciosus* Comst.)**

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Ameriški kapar (*Diaspidiotus perniciosus* Comst.) iz skupine Coccoidea je polifagna škodljiva vrsta, ki pogosto napada predstavnike rožnic (Rosaceae). Pri obravnavi vrste smo prišli do ugotovitve, da so dosedanji opisi bionomije za Slovenijo nepopolni. Po zastopanosti in stopnji napada najbolj izstopajo intenzivni nasadi jablan. V raziskavi smo spremljali vrsto v naravi, jo dokumentirali ter beležili vremenske dejavnike na mikrolokacijah s sistemom Adcon. Spremljanje razvoja ameriškega kaparja smo vrednotili v desetletnem obdobju gradacije. Na podlagi vsot efektivnih temperatur pri različnih pragovih smo obravnavali izmerjene okoljske dejavnike in ugotovili sorazmerno skladnost razvoja v naravi s stopnjami, predvidenimi pri efektivnih temperaturah za prag 7,3 °C. Temperaturni prag, ki je najbolj približan razmeram značilnim za srednjo Evropo, omogoča dokaj dobro izhodišče za napovedovanje razvoja tudi v prihodnje. Za nadaljnjo modifikacijo metode in razvoj napovedovalnega modela pa je potrebno več pozornosti nameniti beleženju posameznih mejnikov v časovnici razvoja.

#### **ABSTRACT**

### **Forecasting development of San Jose scale (*Diaspidiotus perniciosus* Comst.)**

San Jose scale (*Diaspidiotus perniciosus* Comst.) from the Coccoidea taxonomic group is polyphagous harmful species, which often attacks rose family (Rosaceae) representatives. When revising species bionomics, we found out that existing studies covering area of Slovenia are incomplete. Attacks are significant and high graded in intensive apple orchards. In research we observed and documented species in nature and tracked weather parameters on micro locations with Adcon Telemetry agro meteorological



system. Development was evaluated in ten years interval of San Jose scale gradation. According to effective temperature sum at several threshold temperatures, we processed measured environmental parameters and confirmed equilibrium of species development in nature with stages predicted at effective temperature sums for threshold temperature of 7.3 °C. Threshold temperature which is most common to climate conditions in Central Europe enables good starting point for forecasting San Jose scale development in the future. For further method modifications and development of prognosis model more attention is required for tracking milestones in species development timeline.



### **Suppression of Mediterranean fruit fly by sit over the 4000 ha of fruit orchards in Neretva river valley**

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Medfly - *Ceratitidis capitata* (Wied.) is a pest of high economic importance in Neretva valley, affecting production of several fruit species, specially mandarins, *Citrus reticulata* grown mainly for export to EU, former Yugoslavia countries and Russia. The export reach up to 75% of total yield valued to over 20 million of euros per year. Medfly infestation in mandarin's fruits is estimated to be 10-30% without any control measures and also causes major problems to exports due to quarantine restrictions and pesticide residues on fruits. After two years (2010-2011) of successfully suppression trough an Sterile Insect Technique (SIT) pilot project integrated with other suppression methods, conducted with cooperation of the FAO/IAEA, the Croatian Ministry of Agriculture expand the project to the whole lower part of the Neretva valley in 2012, covering over 4000 hectares of fruit orchards, mainly mandarines. For this reason, a fly emergence and release facility in Opuzen with capacity of handling 20 million of sterile flies/week was additionally equipped. Releases are performed mainly with two ground release machines, using chilled flies, mounted on vehicles. Trapping system is set and geo-referenced over the whole SIT treated and non-treated area of the valley (additional 4000 ha) with 3C lures Tephri Traps. Captured flies are checked by fluorescent lamps to separate sterile from the wild flies and provide information on the insect population level. Routine fruit sampling is undertaken to evaluate fruit infestation and suppression efficacy. Results of the two years of pilot project showed that medfly population, measured as number of larvae per kg of fruit, was reduced annually from 75.9-93.2% in figs and 75.9-99.2% in mandarins in SIT treated area compared with non-treated area. Results of the 3<sup>rd</sup> year of the project showed high level of the suppression medfly population, measured as number of larvae per kg of fruit for 73.9% in figs, 92.4% in peaches and 96.8% in mandarins.



## **Inventarizacija resarjev v cvetovih koščičarjev na Primorskem, potencialnih povzročiteljev porjavenja kože plodov**

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Resarji so gospodarsko pomembni škodljivci koščičarjev. Najpogosteje povzročajo škodo pri pridelavi sliv in nektarin. Poškodbe, ki jih povzročajo ličinke s prehranjevanjem na plodnici, se pozneje odražajo v obliki porjavenja pokožice plodov. Da bi ugotovili, katere vrste resarjev so najbolj verjetni povzročitelji teh poškodb, smo v letih 2011 in 2012 izvedli inventarizacijo resarjev v cvetovih koščičarjev na 7 lokacijah na Primorskem. V pregled so bile vključene vse pridelovalno pomembne vrste koščičarjev. V obdobju cvetenja smo zbrali 14 vzorcev, v katerih je bilo ugotovljenih 13 različnih vrst resarjev. Vse najdene vrste pripadajo družini Thripidae. Najpogostejša in najbolj številčna je bila vrsta *Thrips meridionalis* (Priesner 1926), ki smo jo našli v cvetovih vseh koščičarjev, razen na cibori. Pri večni sadnih vrst so bili poleg vrste *T. meridionalis* zastopane še naslednje vrste: *Thrips major* Uzel 1895, *Taeniothrips inconsequens* (Uzel 1895) in *Frankliniella intonsa* (Trybom 1895), ki so znane kot povzročiteljice porjavenja kože plodov. V cvetovih višenj, marelic in cibore je bila najdena tudi vrsta *Thrips minutissimus* L. V majhnem številu in na posameznih gostiteljskih rastlinah so bile identificirane vrste *Thrips flavus* Schrank 1776, *Thrips fuscipennis* Haliday 1836, *Thrips atratus* Haliday 1836, *Thrips alni* Uzel 1895, *Thrips tabaci* Lindeman 1889, *Thrips physapus* L. in *Taeniothrips picipes* (Zetterstedt 1828), ki jih obravnavamo kot priložnostne obiskovalce cvetov koščičarjev. V cvetovih večine koščičarjev se je pojavljal tudi resar *Thrips brevicornis* Priesner 1920. Ta vrsta je v Evropi splošno razširjena, v Sloveniji pa do sedaj še ni bila evidentirana.

### **ABSTRACT**

#### **Thrips inventory in stone fruit flowers in Primorska region, as a potential cause of fruit russeting.**

Thrips are pests of economic importance on stone fruit. Fruit damage related to thrips is most common in plum and nectarine production. Injuries done by larvae feeding on ovary is later seen as russeting of fruit skin. In order to find out which are the species that may cause fruit injuries, an inventory was carried out on 7 locations in Primorska region in years 2011 and 2012. All major stone fruit species were involved in the survey. During bloom stage 14 samples were collected and examined. 13 different species of thrips were found, all belonging to the family Thripidae. The most frequent was *Thrips meridionalis* (Priesner 1926), which was found in the flowers of all stone fruit except on *Prunus instititia*. In almost all samples *Thrips major* Uzel 1895, *Taeniothrips inconsequens* (Uzel 1895) and *Frankliniella intonsa* (Trybom 1895) were recorded. All these species are known as pests of stone fruits. *Thrips minutissimus* L. was found in flowers of sour cherry, apricot and *Prunus instititia*. In addition the following thrips species were found: *Thrips flavus* Schrank 1776, *Thrips fuscipennis* Haliday 1836, *Thrips atratus* Haliday 1836, *Thrips alni* Uzel 1895, *Thrips tabaci* Lindeman 1889, *Thrips physapus* L. in *Taeniothrips picipes* (Zetterstedt 1828). They were recorded in low number and can be considered as occasional visitors of stone fruits flowers. In several samples *Thrips brevicornis* Priesner 1920 occurred. This species is widespread in Europe, but has not been recorded in Slovenia yet.



## **Izkušnje z zatiranjem orehove muhe (*Rhagoletis completa* Cresson) v SV Sloveniji v letih 2011 in 2012**

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V letu 2011 smo v proizvodnem nasadu oreha v Razvanju pri Mariboru preizkušali učinkovitost delovanja pripravkov Calypso 480 SC, Ulmasud B in Lithovit, v letu 2012 pa pripravka Calypso 480 SC + Nutrel. V obeh letih je bila v primerjavi s kontrolo preizkušena tudi metoda mehaničnega zatiranja s pokrivanjem tal pod krošnjami orehov s kopreno Vrteks. V letu 2011 smo škropili celo drevo, v letu 2012 pa samo spodnjo tretjino krošnje. V kontrolnem (neškropljenem) obravnavanju je bil delež napadenih plodov 77,42% (2011) oz. 88,98% (2012). Pri metodi prekrivanja tal smo v letu 2011 zabeležili 42,42% napadenih plodov, v letu 2012 pa samo 28,93%. Podobno učinkovitost z 49,93% napadenih orehov smo ugotovili pri kombinaciji pripravkov Calypso 480 SC + Nutrel, sledi Calypso 480 SC z 61,66% napadenih plodov. Alternativna pripravka Lithovit in Ulmasud B sta bila neučinkovita s 74,22% oz 86,32% napadenih orehov.

### **ABSTRACT**

#### **Experiences with walnut husk fly (*Rhagoletis completa* Cresson) control in NE Slovenia in years 2011 and 2012**

Different products, such as an insecticide Calypso 480 SC and plant strengtheners Ulmasud B and Lithovit, were used to control walnut husk fly (*Rhagoletis completa* Cresson) in the commercial walnut orchard Razvanje near Maribor in 2011. In 2012, only Calypso 480 SC combined with Nutrel was tested. Additionally, a mechanical protection method with covering the under-canopy surface with fine veil Vrteks was compared with the control and chemicals in both years. Whole walnut trees were sprayed in the first year of the experiment, whilst in the second year, only the inferior third part of the trees were treated. Untreated trees gave 77.42 % (2011) and 88.89 % infested nuts (2012), respectively. The lowest percentage of the infested nuts was recorded when covering the under-canopy surface was used (42.42% in 2011 and 28.93% in 2012). Similar efficiency with 49.93 % of infested nuts were recorded after spraying with Calypso 480 SC + Nutrel, which was followed by Calypso 480 SC (61.66 % of infested nuts). Considering 74.22 % and 86.32 % of infested nuts, the alternative products Lithovit and Ulmasud B were shown as inefficient against walnut husk fly.



## Prve izkušnje zbežanja metuljkov jabolčnega zavijača z metodo RAK 3 v velikih sadovnjakih podjetij skupine Evrosad

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V letu 2012 smo v večjih nasadih jablan skupine Evrosad, z namenom zmanjševanja škodljivosti jabolčnega zavijača (*Cydia pomonella*), uporabili metodo zbežanja z dispenzorji RAK3. V več nasadih na lokacijah Kostanjevica (34 ha), Loka (19 ha), Libanja (15 ha) in Savci (30 ha) smo takoj ob začetku leta metuljkov 1. rodu (med 25. in 30. aprilom) izobesili dispenzorje RAK3 v priporočeni gostoti 500 kosov na hektar. V nasadih smo med rastno dobo izvedli prilagojeni program zatiranja jabolčnega zavijača s pripravki za varstvo rastlin (v povprečju smo izvedli dve škropljenji proti gosenicam 1. rodu in eno škropljenje proti gosenicam 2. rodu) ter dodatna škropljenja z virusom granuloze (pripravek Madex – v poprečju 5 škropljenj z nizkim odmerkom 25 ml/ha). Za preučitev uspešnosti metode zbežanja smo v vseh obravnavanih nasadih spremljali ulov metuljkov na feromonske vabe. Uspešnost zatiranja smo ob koncu 1. rodu ter dvakrat v času 2. rodu preučili z natančnim ocenjevanjem poškodovanosti plodov. Ob tem smo bili pozorni tudi na poškodbe gosenic breskovega zavijača (*Cydia molesta*) in zavijačev lupine sadja (*Adoxophyes orana*, *Archips podana*, *Pandemis heparana*). Rezultati ocenjevanj so pokazali, da smo bili v vseh nasadih uspešni (98% nasadov s poškodovanostjo jabolk od 0 in 1% ter le 2% nasadov s poškodovanostjo 1-2%). Ob tem smo dosegli tudi zastavljeni cilj - zmanjšanje ostankov fitofarmaceutskih sredstev na plodovih (število aktivnih snovi in količinsko določljivi ostanki). Ob zmanjšani rabi insekticidov pa pričakujemo tudi dolgoročne pozitivne učinke pri vzpostavljanju naravnega ravnovesja med škodljivimi in koristnimi organizmi v nasadih.

### ABSTRACT

#### First experiences with the method of mating disruption with RAK3 dispensers in some bigger apple orchards of Evrosad group

In 2012, we applied in some bigger apple orchards of Evrosad group the method of mating disruption with RAK3 dispensers to prevent damage caused by codling moth (*Cydia pomonella*). In several plantations on locations Kostanjevica (34 ha), Loka (19 ha), Libanja (15 ha) and Savci (30 ha) was right from the start of the first butterflies generation flight (between 25<sup>th</sup> and 30<sup>th</sup> of April) dispensers RAK3, at the recommended density of 500 units per hectare, were hanged out. The plantations were during the growing season protected with adapted codling moth suppression program (on average we performed two sprayings against first generation and one to second generation) and additional sprayings to infect the population with the granulose virus (Madex - on average 5 sprayings with a low dose of 25 ml/ha) were done. For the supervision of the mating disruption method performance in all plantations pheromone traps were installed. For the monitoring of the performance of suppression, at the end of the first generation and twice during the second generation we performed precise control of damaged fruits. At the same time we made sure about the damage caused by peach fruit moth (*Cydia molesta*) and fruit-tree peel tortrix (*Adoxophyes orana*, *Archips podana*, *Pandemis heparana*). The results of evaluations show that we were successful in all plantations (98% of the area with damaging between 0 and 1%, and only 2% of the area with damaging 1-2%). In addition,

we also achieved the intended aim - reducing pesticide residues on fruits (as the number of identifiable and quantifiable residues). With the reduced use of insecticides we expect long-term positive effects in creating natural balance between pests and beneficial organisms in the plantations.



### **Pojavnost rilčkarjev (Curculionidae) in naraščanje gospodarske škode v ekoloških sadnih nasadih**

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Ekološki nasadi jabolane so v zadnjih letih čedalje pogosteje izpostavljeni napadom nekaterim vrstam hroščkov iz skupine rilčkarjev (Curculionidae). Od škodljivih vrst najbolj izstopata bukov rilčkar skakač (*Rhynchaenus fagi* Linnaeus) in jablanov cvetožer (*Anthonomus pomorum* Linnaeus). Občasno so škodljive tudi večje populacije navadnega rjavčka (*Phyllobius oblongus* Linnaeus). Gradacije bukovega rilčkarja skakača so v tesni povezavi z okoljskimi razmerami, predvsem s podnebnimi razmerami, ki sprožajo migracije iz primarnih gostiteljskih rastlin na sadne drevesne vrste. Zaradi morfoloških in vedenjskih lastnosti je hrošček težje opazen. Njegov nalet v sadnih nasadih lahko od prvega pojava poteka od 3 do 10 dni, medtem ko je jakost napada nepredvidljiva. Jablanov cvetožer je v naravnem razvoju vezan na jablano in lahko v primeru ugodnih razmer, ki jih najde v ekoloških nasadih, povzroči izredno gospodarsko škodo. V letih 2011 in 2012 smo v večini ekoloških nasadov beležili naraščajoče škode, ki so se gibale med 85 in 100% izpada cvetnega nastavka. Omenjenim vrstam je skupno, da je intenzivnost njihovega napada težko napovedati, saj je povezana z ekološkimi razmerami v začetku rastne dobe. Dosedanji ukrepi zmanjševanja njihovega gospodarskega pomena temeljijo predvsem na odvratalnem delovanju sredstev na podlagi žvepla, kalcijevega polisulfida ali mineralnih glin, ki pa ob intenzivnem napadu ne zadoščajo. Ob naraščajoči škodi so brez ustreznega varstva izgube v ekoloških nasadih velike in iz gospodarskega vidika nesprejemljive.

#### **ABSTRACT**

### **Occurrence of weevils (Curculionidae) and rise of economic damage in ecological fruit plantations**

Ecological apple orchards are over a period of recent years increasingly exposed to attacks of certain species of beetles from the group of weevils (Curculionidae). Of harmful weevil species are most important beech flea weevil (*Rhynchaenus fagi* Linnaeus) and apple blossom weevil (*Anthonomus pomorum* Linnaeus). Occasionally harmful are also European snout beetle (*Phyllobius oblongus* Linnaeus) abundant populations. Gradation of beech flea weevil is in correlation with environmental conditions, in particular climatic conditions which give rise to migration from areas of the primary host plant to fruit tree species. Because of morphological and behavioral features, beetle is tough to be noticed. His swoop in fruit plantations can last from 3 to 10 days, while the intensity of the attack is

unpredictable. Apple blossom weevil's natural development is bound to apple tree, and in the case of favourable conditions, which are found in organic plantations, it can cause extreme economic damage. In the years 2011 and 2012, we recorded increasing yield losses in organic plantations where the damage of flower buds ranged between 85 and 100%. The intensity of these weevils' species attacks is hard to predict because of their correlation with ecological factors within the beginning of the growing period. Current protective measures are based mainly on the repellent effects of active substances on the basis of sulphur, lime sulphur or mineral clays that are insufficient in case of intense attack. Without suitable protection for ecological plantations the losses are increasing, are too big and therefore from economic point of view unacceptable.

## **Varstvo poljščin**

## **Pojav viroidne zakrnelosti hmelja v Sloveniji**

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Avgusta 2007 smo v hmeljišču na območju Šempetra v Savinjski dolini odkrili žarišče močno zakrnelih hmeljnih rastlin sorte Celeia. Bolezenska znamenja rastlin so zajemala izrazito zaostajanje v rasti, krajšanje vmesnih členkov glavnih trt in lateralnih poganjkov, nepravilen razvoj listov, slabo razvite storžke ter suho trohno koreninskega sistema. Na podlagi obsežne diagnostične analize simptomatičnih rastlin, ki je zajela detekcijo gliv plesnivk, ogorčic, fitoplazem, virusov in viroidov je bil kot povzročitelj identificiran »hop stunt viroid (HSVd)«. Omenjen viroid povzroča nevarno obolenje hmelja, ki smo ga poimenovali viroidna zakrnelost hmelja, ki je bilo doslej omejeno na območje Japonske, Južne Koreje, ZDA in Kitajske. Z namenom preprečevanja širjenja in popolne eradikacije je Fitosanitarna uprava RS izdala Odločbo o nujnih ukrepih za preprečevanje vnosa in širjenja viroidne zakrnelosti hmelja (Uradni list RS, št. 64/2011), s katero je bil določen posebni nadzor, določitev okuženih območij, fitosanitarni ukrepi, ter dolžnosti imetnikov hmeljišč. V prispevku predstavljamo rezultate sistematičnega nazora hmeljišč v obdobju 2007-2012, nove diagnostične pristope, izkušnje z ukrepi eradikacije in prve epidemiološke analize te bolezni v Sloveniji.

### **ABSTRACT**

#### **Occurrence of hop stunt disease in Slovenia**

In August 2007, a severe outbreak of stunted hop plants of variety Celeia was observed in hop garden located in Šempeter in the Savinja valley. Affected plants showed symptoms of severe stunting, shortening of the internodes of the main bine and lateral branches, leaf curling, small cone formation and dry root rot. Based on extensive diagnostic analysis of symptomatic plants which included detection of fungi, oomycetes, nematodes, phytoplasma, viruses and viroids, »hop stunt viroid (HSVd)« was identified as a casual agent. This viroid causes severe disease on hop designated as »hop stunt« which has been limited to Japan, South Korea, USA and China. With the aim of total eradication and preventing further spreading Phytosanitary Administration of the Republic of Slovenia (PARS) release the legislation act »Decision of urgent measures for preventing spread of hop stunt disease (Official Gazette RS, no. 64/2011)« that define monitoring survey, phytosanitary measures and obligations of hop farmers. The presentation presents results of monitoring survey in the period 2007-2012, new diagnostics approaches, experiences with eradication process and first epidemiological analysis of this disease in Slovenia.





## Mehke gnilobe rastlin ali kaj je v imenu?

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Pektinolitične bakterije rodov *Pectobacterium* in *Dickeya* (ex *Erwinia chrysanthemi*) povzročajo gnitje rastlin in njihovih plodov in lahko resno ogrozijo donosnost pridelave in skladiščno kakovost krompirja. Rezultati novejših raziskav iz Nizozemske in Belgije kažejo na to, da se te bakterije lahko v velikem obsegu pojavljajo tudi v pridelavi semenskega krompirja. V zadnjem desetletju so bili na krompirju najpogostejši izolati vrste *D. dianthicola*, poleg nje pa so se pojavljali tudi agresivnejši izolati, ki so zaenkrat neuradno poimenovani kot '*D. solani*' in so se z distribucijo semenskega krompirja razširili po večjem delu EU. Pojavljajo se tudi bakterije rodu *Pectobacterium*, med katerimi so tudi vrste, ki so bile izvorno izolirane iz drugih gostiteljskih rastlin in za katere se je predvidevalo, da imajo ozek krog gostiteljev. Takšni so na primer izolati vrst *Pectobacterium wasabiae* (izolirani iz rastline *Eutrema japonica*) in *Pectobacterium brasiliense*. Velik delež semenskega krompirja, ki se uporablja v Sloveniji, izvira iz držav, ki imajo težave z bakterijskimi mehкими gnilobami, zato ni presenetljivo, da so gnilobe pogostejše tudi pri nas. V prispevku predstavljamo informacije o bakterijah, ki se pojavljajo pri nas in o njihovem pomenu.

### ABSTRACT

#### Bacterial soft rots of plants or what is in a name?

Pectinolytic bacteria of *Pectobacterium* and *Dickeya* spp. (ex *Erwinia chrysanthemi*) cause rotting of plants and their fruits and can seriously affect the profitability of production and storage quality of potatoes. Results of recent research from the Netherlands and Belgium suggest that these bacteria occur and are spread in seed potato production. *D. dianthicola* used to be the most common species occurring in potato. In the last decade, more aggressive isolates occurred that are tentatively and informally named as '*D. solani*' and have been spread across much of the EU by seed potatoes trade. Genus *Pectobacterium* also seems to be gaining in its importance in potato production. Bacteria once thought to have a narrow and specific host range and infecting other plants have now been detected in potatoes e.g. *Pectobacterium wasabiae* isolates (originally isolated from *Eutrema japonica*) and *Pectobacterium brasiliense* (originally occurring on peppers). A large proportion of seed potatoes that is used in Slovenia come from countries that have problems with bacterial soft rots and so it is not surprising that soft rots are becoming more frequent and pronounced also in our country. In this contribution we present the knowledge of bacteria occurring in Slovenia and their significance.



## Naravne protimikrobne snovi in mikroorganizmi kot sredstva za varstvo rastlin

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Ljudje se vse bolj zavedamo, kako pomembna je zdrava prehrana, saj vpliva na naše zdravje in kakovost življenja. Naravna sredstva za varstvo rastlin pred boleznimi pripomorejo k zmanjšanju rabe fitofarmaceutskih sredstev ter posledično njihov vpliv na človeka in okolje. V naravi najdemo številne vire protimikrobnih snovi, kot so na primer rastline, glive in bakterije, varstvo pa lahko rastlinam nudijo tudi mikroorganizmi sami, saj z njihovo zastopanostjo preprečujejo razvoj bolezni in celo vzpodbujajo rast rastlin. Na trgu je registriranih že kar nekaj biotičnih pripravkov, ki nadomeščajo ali dopolnjujejo konvencionalna fitofarmaceutska sredstva in s tem varujejo rastline na naraven in okolju prijazen način. Razvoj naravnih sredstev za varstvo rastlin je še posebno pomemben v primeru, ko ne poznamo učinkovitega sredstva za zatiranje škodljivega organizma ali pa je škodljivi organizem razvil odpornost na obstoječa fitofarmaceutska sredstva. V naši raziskavi preučujemo vpliv ekstraktov višjih (bazidiomicetnih) gliv oziroma gob na rastlinske patogene bakterije, med drugim na bakterijo *Ralstonia solanacearum*, ki povzroča rjavo gnilobo krompirja in bolezen na številnih drugih gospodarsko pomembnih rastlinah. Z *in vitro* ter *in vivo* testi smo preverjali protibakterijsko aktivnost več kot 180 ekstraktov iz 90 vrst gob. Več ekstraktov je v *in vitro* testih delno ali popolnoma inhibiralo rast bakterij, nekateri od njih pa so zavirali napredovanje bolezni tudi na testnih rastlinah paradižnika in krompirja. Gobe tako predstavljajo pomemben vir aktivnih snovi, ki jih je tudi v prihodnosti smiselno vključiti med raziskave učinkovitosti naravnih sredstev za varstvo rastlin.

### ABSTRACT

#### **Antimicrobial substances from natural sources and microorganisms can be used for plant protection against pathogens**

Healthy food and diet are essential for better human health and quality of life. Substances for plant protection from natural sources can lower the amount of pesticides used as well as their influence on human and environment. Natural sources of antimicrobial substances, such as plants, fungi and bacteria, can prevent disease development and even promote plant growth. There are several biopesticides already registered on the market and even more pending. They can replace or complement existing pesticides and protect plants without any major effect on the environment. Development of biopesticides is especially important in cases where there are no pesticides available for the control of the pest or pests developed resistance to the existing control agents. Our objective was to test over 180 proteinaceous extracts of more than 90 basidiomycete species against *Ralstonia solanacearum*, the causative agent of a quarantine brown rot disease of potatoes and other plants, and several other plant pathogenic bacteria. Antibacterial activity was tested *in vitro*, followed by selection of active extracts, which were screened in *in vivo* (pathogenicity tests). Results have shown strong antibacterial activity of several proteinaceous mushroom extracts *in vitro* and delay in bacterial wilting or lower disease

occurrence tomato and potato plants. Therefore mushrooms are an important source of active substances and should be taken into consideration in the further research of natural plant protection agents.



### Zatiranje talnih rastlinskih patogenih organizmov z uporabo biofumigacije

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Uporaba podora v rastlinski proizvodnji ugodno vpliva na povečanje mikrobiološke aktivnosti tal, ki lahko prek kompeticije, parazitizma in antagonizma, negativno vpliva na talne povzročitelje bolezni. Biofumigacija predstavlja eno od smeri uporabe podora, ki je poleg gnojenja, ciljno namenjena zatiranju talnih škodljivih organizmov. Ukrep temelji na vnašanju ostankov križnic z visoko vsebnostjo glukozinulatov ter cianogenih rastlin iz rodu *Sorghum* v tla, pri čemer prihaja do sproščanja hlapnih toksičnih kemičnih snovi (izotiocianati, cianovodik), ki negativno vplivajo na talne škodljive organizme. V prispevku predstavljamo rezultate dvoletnih poljskih in lončnih poskusov v okviru katerih smo proučevali procese biofumigacije v tleh, rastni potencial biofumigantnih rastlin ter učinkovitost nižanja infekcijskega potenciala gliv *Fusarium solani*, *Verticillium dahliae*, *V. albo-atrum*, bakterije *Erwinia carotovora* in ogorčice *Xyphinema rivesi*.

#### ABSTRACT

#### Control of soilborne plant pathogens using biofumigation

The use of green manure in plant production have substantial influence to soil microbial activity, which could trough competition, parasitism and antagonism negatively influence to soil-borne pathogens. Biofumigation represent one of the approaches in green manure application which have beside fertilisation the main purpose in the suppression of soil borne pathogens. It is based on soil incorporation of cruciferous plants with high content of glucosinolates or cyanogenic plants from genus *Sorghum*, which during tissue breakup release volatile biocidal compounds (isotiocyanates, hydrogen cyanide), toxic to the pathogens. The presentation presents the results of two year field and pot trials which were focused to study biofumigation process in the soil, growing potential of biofumigation plants and their efficacy to suppress the infection potential of fungi *Fusarium solani*, *Verticillium dahliae*, *V. albo-atrum*, bacteria *Erwinia carotovora* and nematode *Xyphinema rivesi*.



## **Biotična učinkovitost nekaterih insekticidov za zatiranje strun iz rodu *Agriotes* v krompirju**

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V zadnjih letih opazamo vse večji nalet hroščev pokalic iz rodu *Agriotes* (Elateridae), katerih ličinke (strune) povzročajo škodo na različnih gojenih rastlinah. Razvojni krog pokalic iz rodu *Agriotes* traja od 3 do 5 let. Strune so najbolj škodljive v zadnjih dveh letih razvoja. Zatiranje strun je zelo zahtevno, med drugim tudi zato ker ni na voljo dovolj učinkovitih insekticidov. Nova sredstva tudi zaradi okoljskih omejitev pogosto ne dobijo potrebnega dovoljenja za uporabo. V letu 2010 smo preučevali zatiranje strun v krompirju, na katerem veliko gospodarsko škodo povzročajo zlasti na poznih sortah na težkih tleh. Za poskus smo izbrali njivo, kjer so strune povzročale gospodarsko škodo. Za napovedovanje pojava strun oziroma intenzivnosti napada smo na izbrani njivi v predhodnem letu posadili radič in ugotavljali poškodbe, ki so jih povzročile strune. Poskus je bil zasnovan v štirih ponovitvah po shemi popolnih naključnih blokov. Ob saditvi krompirja smo uporabili aktivne snovi fipronil (0,5 %), foksim (5 %) in teflutrin (0,15 %) ter glivo *Baeauveria bassiana*, soj ATCC 74040 (7,16%). Poškodovanost gomoljev smo ocenili na temelju smernice EPPO PP 1/46 (3) po izkopu krompirja in izračunali učinkovitost posameznih insekticidov. Opravili smo tudi analizo variance in LSD razvrstitveni test. Med posameznimi postopki smo ugotovili statistično značilne razlike. Najučinkovitejša je bilo sredstvo z aktivno snovjo fipronil, poškodovanih je bilo le 22,75 % gomoljev, medtem, ko je bilo pri kontroli poškodovanih 94,5 % gomoljev. Ostala sredstva so bila precej slabša. Pri postopkih z aktivno snovjo teflutrin je bilo poškodovanih 82,25 %, foksim 88 % in *B. bassiana* 92,5 % gomoljev.

### **ABSTRACT**

#### **The biological efficacy of some insecticides for suppression of *Agriotes* wireworms in potato**

In recent years, the number of adult wireworms (click beetles) of the genus *Agriotes* (Elateridae) is increasing in Slovenia. Wireworms cause damage on different agricultural crops. Their life cycle has been variously reported and may require from 3 to 5 years to complete. Wireworms are very serious pests that caused severe damages in the last two years of their life cycle. Wireworm management is very complex and difficult, because very limited range of effective insecticides is available. The number of registered insecticides is decreasing due to very complex and complicated registration process, based on environmental restrictions. Since severe wireworm damages are reported on potato crops on heavy soils, wireworm management experiment was conducted in 2010 in the potato field. The field with high population of wireworms was selected according the infestation of chicory planted in previous year. Four different active substances were applied at planting: fipronil (0.5 %), foxim (5 %) and tefluthrin (0.15 %) and fungus *Baeauveria bassiana* strain ATCC 74040 (7.16 %) in a complete randomized block design with four repetitions. The tuber damage and insecticides efficiency were estimated after harvest according to EPPO PP 1/46 (3) guidelines. The analysis of variance and least significant difference (LSD) test were performed. There were significant differences between treatments. The most effective substance was fipronil where 22.75 % of tubers

were damaged compared to untreated control where 94.5 % of tubers were damaged. The remaining treatments were significantly less effective. In the treatments of tefluthrin, foxim and *Baeauveria bassiana* 82.25 %, 88 % and 92.5 % of tubers were damaged, respectively.



### **Ali smo pripravljeni na nove vrste ogorčic iz rodu *Globodera*?**

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V tem delu razpravljamo o naši pripravljenosti na nove vrste ogorčic iz rodu *Globodera*, ki ogrožajo pridelavo krompirja v Sloveniji. Ogorčice vrst *Globodera pallida* in *G. rostochiensis*, znane pod skupnim imenom krompirjeve ogorčice (PCN), resno ogrožajo pridelavo krompirja po svetu. Prva najdba krompirjevih ogorčic v Sloveniji datira v l. 1971, ko so našli eno cisto *G. rostochiensis*. V zadnjem desetletju smo vrsto *G. rostochiensis* zasledili še večkrat, predvsem v osrednji in severni Sloveniji. Med uradnim nadzorom PCN smo jeseni 2011 prvič v vzorcih iz slovenskih njiv našli vrsto *G. pallida*. Dve cisti smo izločili iz vzorca tal z njive za jedilni krompir v bližini Ivančne Gorice v osrednji Sloveniji. Ogorčico smo identificirali z morfometrijskimi analizami ter potrdili s tremi neodvisnimi molekularnimi metodami. Z metodama PCR-RFLP in sekvenciranje smo ogorčico identificirali kot evropski tip. Krompir in krompirjeve ogorčice izvirajo iz Južne Amerike. Razpon virulence pri PCN na tem območju je veliko večji kot pri evropskih populacijah. Vnos nove populacije PCN iz Južne Amerike v Evropo bi predvidoma vodil v zmanjšanje odpornosti proti evropskim genotipom PCN v evropskih sortah krompirja. Orodja za karakterizacijo populacij PCN so v razvoju in večinoma temeljijo na razlikah v mtDNA. V letu 2012 je bila opisana nova vrsta *G. ellingtonae*. Vrsta je sorodna in podobna PCN, našli pa so jo v Oregonu in Idaho (ZDA) na njivah, kjer so gojili krompir in druge poljščine. PCR-RFPL metodo, ki smo jo razvili na KIS, uporabljamo za identifikacijo PCN kot tudi vrst *G. tabacum* in *G. achilea*. S to metodo bi predvidoma ločili tudi vrsto *G. ellingtonae*, saj je bilo to možno z in silico verzijo te metode.

#### **ABSTRACT**

#### **Are we ready for the new nematode species of the *Globodera* genus?**

In this work we discuss our readiness to identify the new *Globodera* nematodes potentially endangering potato production in Slovenia. *Globodera pallida* and *G. rostochiensis*, commonly known as potato cyst nematodes (PCN), are considered to be the most important nematode threat to potato production worldwide. The first report of the PCN in Slovenia dates back to 1971, when a single cyst of *G. rostochiensis* was detected. In the last decade, *G. rostochiensis* was detected several times, mainly in the central and northern parts of the country. During the official PCN systematic survey in autumn 2011, *G. pallida*, was found for the first time in a soil sample in Slovenia. Two viable cysts were extracted from the infested soil sample originated from a ware potato field near Ivančna Gorica, central Slovenia. The nematode was identified by morphometrical analyses and confirmed by three independent molecular methods. PCR-RFLP method and sequencing identified this population as the European type. South America is the origin of potatoes as well as PCN. The range of virulence of PCN present in that area is far greater than that

present in European populations. Introduction of a new PCN population from South America to Europe would very likely lead to a break of resistance to European PCN genotypes. Tools for characterization of populations of PCN are now starting to become available, mainly based on differences in mtDNA. A new species *G. ellingtonae* was described in 2012. This species, similar and closely related to PCN was found in Oregon and Idaho (USA) from agricultural fields, where potato and other crops have been grown. With the PCR-RFLP method developed and used at KIS for identification of PCN as well as *G. tabacum* and *G. achilea*, we should be able to differentiate *G. ellingtonae* as we have shown with the in silico version of this method.



PALLAS® 75 WG - novi herbicid za zatiranje plevelov v pšenici, rži in tritikali

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Pallas® 75 WG je novi triazolopirimidin-sulfonamidni herbicid za zatiranje širokega spektra enoletnih ozkolistnih in širokolistnih plevelov v pšenici, rži in tritikali po vzniku plevelov. Pallas® 75 WG vsebuje učinkovino piroksulam, ki jo je razvilo podjetje Dow AgroSciences. Piroksulam inhibira rastlinski encim acetolaktatsintazo (ALS), ki je bistven za sintezo razvejanih verig aminokislin valina, levcina in izolevcina. Inhibicija tvorbe aminokislin posledično inhibira delitev celic in povzroči propad občutljivih plevelov. Piroksulam je sistemčen, floemsko in ksilemsko mobilen herbicid, ki se absorbira prek listov, stebela in korenin. Piroksulam zatira ključne travne plevela, kot so *Alopecurus* spp., *Apera spica-venti*, *Avena* spp., *Bromus* spp., *Lolium* spp. in ostale. Piroksulam prav tako dobro zatira širokolistne plevela v žitih (razen ječmena in ovs), kot so *Amaranthus* spp., *Anthemis arvensis*, *Brassica* spp., *Capsella bursa-pastoris*, *Galeopsis tetrahit*, *Galium aparine*, *Geranium* spp., *Helianthus annuus*, *Matricaria* spp., *Myosotis arvensis*, *Polygonum persicaria*, *Raphanus raphanistrum*, *Senecio vulgaris*, *Stellaria media*, *Veronica* spp., *Vicia* spp., *Viola tricolor* in ostale. Optimalno delovanje na plevela se doseže, ko so le ti v razvojnem stadiju 1-5 razvitih listov pa do prvega kolenca (enoletni travni plevel). Pallas® 75 WG se priporoča za uporabo v odmerku 125-250 g/ha, skupaj z dodanim močilom (NU-FILM-17) za izboljšanje delovanja. Količina aktivne snovi piroksulam na hektar je zelo nizka, samo 9-18,75 g, odvisna pa je od zastopanosti vrst plevelov. Pallas® 75 WG je herbicid z zelo ugodnim okoljskim in toksikološkim profilom.

#### ABSTRACT

#### **PALLAS® 75 WG - new herbicide for weedcontrol in wheat, rye and triticale**

Pallas® 75 WG is a new triazolopyrimidine-sulfonamide herbicide that provides broadspectrum postemergence annualgrass and broadleaf weedcontrol in wheat, rye and triticale. Pallas® 75 WG contains activeingredient pyroxsulam, developed by Dow AgroSciences. Pyroxsulam inhibits the plant enzyme acetolactate synthase (ALS), which is essential for the synthesis of branched-chain aminoacids valine, leucine and isoleucine. Inhibition of aminoacid production subsequently inhibits celldevison and causes death in susceptible weeds. Pyroxsulam is a systemic, phloemandxylemmobile herbicide that is

absorbed via leaves, shoots and roots. Piroxsulam provides control of key annual grasses including *Alopecurus* spp., *Apera spica-venti*, *Avena* spp., *Bromus* spp., *Lolium* spp., and others. Pyroxsulam also provides control of key broadleaves weeds in cereals (except barley and oats) including *Amaranthus* spp., *Anthemis arvensis*, *Brassica* spp., *Capsella bursa-pastoris*, *Galeopsis tetrahit*, *Galium aparine*, *Geranium* spp., *Helianthus annuus*, *Matricaria* spp., *Myosotis arvensis*, *Polygonum persicaria*, *Raphanus raphanistrum*, *Senecio vulgaris*, *Stellaria media*, *Veronica* spp., *Vicia* spp., *Viola tricolor* and others. Optimum weed control occurs when grassweeds are in the 1-5 leafstage, to one tiller growthstage (annual grassweeds). Pallas® 75 WG is recommend in rate 125-250 g/ha, together with additional adjuvant (NU-FILM-17) to improve weeds control. The use rate of active ingredient pyroxsulam is very low, only 9-18,75 g/ha depending upon target weed species. Pallas® 75 WG is a herbicide with a favorable environmental and toxicological profile.



### **Fitosanitarno ustrezne poljščine v kolobarjih pred pšenico (*Triticum aestivum* L. emend. Fiori et Paol.)**

Darja KOCJAN AČKO

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Premišljen in dosledno izpeljan kolobar lahko pomembno zmanjša epifitocijski pojav okužb s povzročitelji bolezni na bilih, listih in klasih pšenice (*Triticum aestivum* L. emend. Fiori et Paol.) v primerjavi s setvijo v ozkem kolobarju in za fitosanitarno neustreznimi poljščinami. Glede na strukturo in razporeditev poljščin v Sloveniji ter prevladujoč kolobar kuruza-pšenica je vrstenje pšenice že desetletja daleč od fitosanitarne ustreznosti. V biotično uravnoteženih kolobarjih se morajo zvrstiti vse skupine poljščin, kot so žita, okopavine in metuljnice v ustreznih deležih posamezne skupine. Praviloma bi morala biti pred pšenico v kolobarju listanka oziroma poljščina, ki zapusti njivo dovolj zgodaj, da je mogoče zemljišče pravočasno in ustrezno obdelati. Biotično najbolj ugodne predhodnice pšenice so krompir, enoletne metuljnice in oljnice. Z anketo smo analizirali sestavo kolobarjev s pšenico na sto kmetijah po Sloveniji in ugotovili, da je v pretežno žitne kolobarje potrebno vključiti listanke, se čim bolj izogniti setvi pšenice po kuruži (večja možnost pojava fuzarioz klasa, pridelek zrnja pšenice pa je onesnažen z mikotoksini) in po ječmenu (pojav nožnih bolezni pri pšenici, ki se kažejo z lomljenjem bili). V dvopolje kuruza-pšenica bi kazalo pred pšenico umestiti bodisi rž, tritikalo ali oves, kar sočasno pomeni njihov večji obseg v pridelavi in prehrani. Povečati bi morali tudi setev metuljnic in okopavin, ki jih je vse manj ali pa so neenakomerno in regionalno razporejene. Ker analizirani kolobarji s pšenico kažejo, da je treba uvrstiti pšenico v daljši in biotično bolj uravnotežen kolobar, smo sestavili nekaj vzorčnih kolobarjev. Vloga kmetijskih strokovnjakov je, da še naprej opozarjajo pridelovalce pšenice na ustrezno kolobarjenje, na prednosti in pomanjkljivosti posameznih zaporedij. Prepričani smo, da bo z izboljšanim kolobarjem sčasoma dosežen večji izkoristek genskega potenciala visokoproduktivnih sort, pri manjši porabi fitofarmaceutskih sredstev bo pridelava pšenice bolj trajnostna, povečala pa se bo tudi samooskrba s pšenico in drugimi poljščinami s slovenskih njiv.

**ABSTRACT**

### **Phytopathological relevant crops in crop rotations before wheat (*Triticum aestivum* L. emend. Fiori et Paol.)**

Thoughtful and consistently executed crop rotation can significantly reduce epiphytotic occurrence of infections by pathogens on stems, leaves and ears of wheat (*Triticum aestivum* L. emend. Fiori et Paol.) compared with sowing in narrow crop rotation and with phytopathological inadequate crops. Depending on the structure and arrangement of arable crops in Slovenia and the dominant corn - wheat crop rotation is crop rotation with wheat far from the phytopathological adequacy for decades now. In biologically balanced crop rotations must be rotated all the crops, such as cereals, root crops and legumes in correct proportions of each group. A general rule in crop rotation should be wheat earlier than leaf crop or arable crop, which leaves a field early enough, it is possible on time and properly treated the land. Most biologically relevant crops before wheat are potatoes, annual legumes and oil crops. With the questionnaire, we analyzed the structure of crop rotations with wheat on a hundred farms in Slovenia and found that in mainly cereal crop rotations must be included leaf crops, and as much as possible to avoid sowing wheat after corn (greater possibility of fusariosis on ear, grain yield of wheat is contaminated with mycotoxins) and after barley (occurrence of root disease in wheat, which is reflected by breaking stalk). In two - field corn - wheat it would be useful to sow rye, triticale or oats before wheat, which means at the same time enhancing their extent in production and human nutrition. We should also increase the sowing of legumes and root crops, which are always less or which are unequally and regionally arranged. We put together some sample crop rotations, because analyzed crop rotations with wheat show that wheat should be placed in a longer and more biologically balanced crop rotation. The mission of agricultural experts is to continue warning the wheat producers on the proper crop rotation, and on the advantages and weaknesses of individual sequences. We are certain that with improved crop rotation will be eventually achieved higher advantage of genetic potential of high - productivity cultivars, wheat production with less plant protection products will be more sustainable, and self-sufficiency with wheat and other crops from Slovenian fields will be increased.



### **ElumisPeak – nova trojna kombinacija za zanesljivo zatiranje plevelov v koruzi**

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ElumisPeak je nova rešitev za zatiranje celotnega spektra plevelov v koruzi. Edinstvena kombinacija treh aktivnih snovi zagotavlja odlično delovanje na že vznikle plevelove, hkrati pa z svojim rezidualnim delovanjem preprečuje naknadni vznik plevelov. Kombinacija zagotavlja odlično delovanje tudi na trajne, trdovratne širokolistne in ozkolistne plevelove, zaradi prilagodljivega časa aplikacije pa je zelo uporabna za širok krog uporabnikov. Zaradi modernejše formulacije aktivnih snovi in OD formulacije pa je pripravek tudi okoljsko sprejemljivejši, zato postavlja nove standarde v zatiranju plevelov v koruzi.

#### **ABSTRACT**

### **ElumisPeak - a new triple combination for reliable weed control in maize**

ElumisPeak is a new solution for the entire spectrum of weed control in maize. A unique combination of three a.s. provides excellent performance on the emerged weeds, but with



its residual action prevents the subsequent emergence of weeds. The combination provides outstanding performance even on permanent, persistent broadleaf and grass weeds. With our flexible application time is very useful for a wide range of users. Due to modern formulation is also environmentally acceptable, therefore it sets new standards in weed control in maize.



### **Preučevanje učinkovitosti različnih biotičnih agensov za zatiranje ogrcev (Scarabaeidae) na travinju – izkušnje s Kočevskega**

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V letu 2012 smo izvedli 5-bločni poljski poskus zatiranja ogrcev na travinju v Gotenici. V poskusu smo preučevali insekticidno delovanje različnih pripravkov, katerih aktivno snov predstavljajo biotični agensi (*Beauveria brongniartii*, *B. bassiana*, *Bacillus thuringiensis* var. *kurstaki*, *B. thuringiensis* var. *tenebrionis*, *Heterorhabditis bacteriophora*). Biotične agense smo nanegli dvakrat, in sicer 17. aprila ter 31. Avgusta. Entomopatogene ogorčice (*H. bacteriophora*) smo nanegli dva tedna po nanosu ostalih biotičnih agensov. S standardno metodo talnih izkopov smo 16. aprila., 24. maja, 20. junija, 10. julija, 9. avgusta, 10. septembra, 22. oktobra in 20. novembra spremljali populacijsko dinamiko ogrcev v tleh. Analiza je pokazala, da gre predvsem za ogrce junijskega hrošča (*Amphimallon solstitiale*), julijskega hrošča (*Anomala dubia*), vrtnega hrošča (*Phyllopertha horticola*) in v manjšem obsegu tudi poljskega majskega hrošča (*Melolontha melolontha*) ter gozdnega majskega hrošča (*Melolontha hippocastani*). Rezultati so pokazali, da se je povprečno število ogrcev (L1 in L2) po nanosu vseh biotičnih agensov v tleh zmanjšalo pod gospodarski prag škodljivosti (od 30 do 40 ogrcev/m<sup>2</sup>; od 20 do 30 ogrcev/m<sup>2</sup>), medtem ko smo zmanjšanje ogrcev razvojne stopnje L3 pod gospodarski prag škodljivosti (10 ogrcev/m<sup>2</sup>) dosegli le ob uporabi pripravkov, katerih aktivno snov so predstavljale entomopatogene glive v kombinaciji z entomopatogenimi ogorčicami.

#### **ABSTRACT**

#### **Testing the efficacy of different biological control agents against white grubs (Scarabaeidae) on grassland – the experiences from Kočevska**

In 2012 we conducted a 5-block field experiment in Gotenica in which we tested different control methods of white grubs on grassland. In an experiment we studied the insecticidal activity of different products whose active ingredients are biological agents (*Beauveria brongniartii*, *B. bassiana*, *Bacillus thuringiensis* var. *kurstaki*, *B. thuringiensis* var. *tenebrionis*, *Heterorhabditis bacteriophora*). During the time period we applied biological agents twice, namely 17<sup>th</sup> April and 31<sup>st</sup> August. Entomopathogenic nematodes (*H. bacteriophora*) were applied two weeks after the usage of biological agents. With a standard methods of soil excavation on 16<sup>th</sup> April, 24<sup>th</sup> May, 20<sup>th</sup> June, 10<sup>th</sup> July, 9<sup>th</sup> August, 10<sup>th</sup> September, 22<sup>nd</sup> October and 20<sup>th</sup> November we monitored the population dynamics of white grubs in the soil. The identification analysis of white grubs showed the major presence of June beetle (*Amphimallon solstitiale*), margined vine chafer (*Anomala dubia*), garden chafer (*Phyllopertha horticola*) and in smaller extent also of common cockchafer (*Melolontha melolontha*) and also forest cockchafer (*Melolontha hippocastani*).

Results showed that the average number of white grubs (L1 and L2) after the application of biological agents into the soil, decreased under the economical threshold of noxiousness (from 30 to 40 white grubs/m<sup>2</sup>, from 20 to 30 white grubs/m<sup>2</sup>, respectively), meanwhile the reduction of developmental stage L3 of white grubs only was attained when products with active ingredients of entomopathogenic fungus in a combination with entomopathogenic nematodes were used.



### **Preučevanje insekticidne učinkovitosti samostojne in kombinirane uporabe različnih naravnih snovi pri zatiranju črnega žitnega žužka (*Sitophilus granarius*)**

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V laboratorijskih razmerah smo preučevali insekticidno delovanje različnih okoljsko sprejemljivih snovi na smrtnost odraslih osebkov črnega žitnega žužka (*Sitophilus granarius*). Ugotavljali smo insekticidno delovanje diatomejske zemlje (pripravek SilicoSec<sup>®</sup>), kremenovega peska, azadirahatina (pripravek Neem listni prah), lesnega pepela, kombinacije diatomejske zemlje in lesnega pepela, kombinacije azadirahatina in lesnega pepela, kombinacije kremenčevega peska in lesnega pepela, kombinacije diatomejske zemlje, pesnega pepela, azadirahatina in kremenčevega peska. Prašnate pripravke smo aplicirali v različnih koncentracijah. Zrnje pšenice smo z diatomejsko zemljo in kremenovim peskom tretirali v koncentracijah 450 in 900 ppm, z lesnim pepelom v 2,5 in 5 utežnih odstotkih [u%], z azadirahatinom pa v 1,25 in 2,5 u%. Nekatera obravnavanja so predstavljala kombinacije pripravkov – SilicoSec 450 ppm in lesni pepel 2,5 u%, azadirahatin (2,5 u%) in lesni pepel (2,5 u%), kremenov pesek 450 ppm in lesni pepel 2,5 utežni % ter kombinacijo, kjer smo uporabili SilicoSec (225 ppm), pepel 1,25 u%, azadirahatin 0,625 u% in kremenov pesek 225 ppm. Kontrola (netretirano žito) je predstavljajo samostojno obravnavanje. Posamezno obravnavanje je predstavljalo 500±0,01 g žita, tretiranega z izbrano koncentracijo pripravka in je bilo izvedeno v treh ponovitvah. Smrtnost imagov smo ugotavljali 7., 14. in 21. dan po nastavitvi. Poskus je potekal pri treh različnih temperaturah (20, 25 in 30 °C) in dveh vrednostih relativne zračne vlage (55 in 75 %). Rezultati generalne analize kažejo visoko smrtnost odraslih osebkov črnega žitnega žužka v obravnavanju, kjer smo uporabili kombinacijo lesnega pepela in pripravka SilicoSec<sup>®</sup> (66,38±264%), medtem ko je samostojna uporaba lesnega pepela (2,5 u%) vplivala na 63,35±2,74% smrtnost hroščev. Povprečna smrtnost hroščev v poskusu je po 21. dnevu dosegla 48,52±0,01%, smrtnost pa je bila signifikatno višja pri nižji relativni zračni vlagi (46,02±1,66%). V prispevku bodo natančno prikazane interakcije med različnimi dejavniki v poskusu in podani predlogi za uporabo najučinkovitejše snovi v kmetijski praksi.

#### **ABSTRACT**

#### **Research on insecticidal efficacy of single and combined use of different natural substances against the granary weevil (*Sitophilus granarius*)**

Laboratory experiment was carried out to evaluate the impact of different environmentally acceptable substances on the mortality of the granary weevil (*Sitophilus granarius*). We

tested the insecticidal properties of diatomaceous earth (commercial formulation SilicoSec<sup>®</sup>), quartz sand, azadirachtin (commercial formulation Neem listni prah), wood ash, combination of SilicoSec<sup>®</sup> and wood ash, combination of azadirachtin and wood ash, combination of quartz sand and wood ash, combination of 4 different substances (SilicoSec<sup>®</sup>, wood ash, azadirachtin and quartz sand). Natural substances in a form of dust were mixed with wheat grain in different dose rates. Wheat was treated with 450 and 900 ppm SilicoSec as self-based formulation, wood ash (5 weight (w)% and 2.5 w%) as self-based formulation, azadirachtin (1.25 w% and 2.5 w%). Individual treatments were evaluated as mixtures of SilicoSec<sup>®</sup> (450 ppm) and wood ash (2.5 w%); azadirachtin (2.5 w%) and wood ash (2.5 w%); quartz sand (450 ppm) and wood ash (2.5 w%); SilicoSec<sup>®</sup> (225 ppm), wood ash (2.5 w%), azadirachtin (0.625 w%) and quartz sand (225 ppm). Control treatment was presented as untreated grain. Specific treatment was composed from 500±0.01 g of wheat and concentration of natural substance and it was replicated three times. Mortality of adults was evaluated seventh, fourteenth and twenty-first day after exposure. Insecticidal efficacy was tested at three different temperatures (20, 25 in 30°C) and two different relative humidity levels (55 in 75%). Significantly the highest mortality of the beetles was evaluated in treatment with formulation consisting of wood ash and SilicoSec<sup>®</sup> (66.38±2.64%), meanwhile wood ash (2.5 w%) provoked 63.35±2.74 % mortality. In general, mortality after 21 days reached 48.52±0.01% and it was also higher at lower humidity level (46.02±1.66%). Interactions between different factors of experiment will be presented, and suggestions for the practical use of the most effective substance will be given.



## **Proizvod, rešitev, uspeh - koncept in rezultati Bayerjevih poskusov na koruzi in pšenici**

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Ustrezno varstvo rastlin pred pleveli, boleznimi in škodljivci je le eden, a zelo pomemben agrotehnični ukrep za doseganje visokih in kakovostnih pridelkov. Z uporabo najprimernejših pripravkov za varstvo rastlin omogočimo doseganje genetskega potenciala posamezne sorte ali hibrida, z napačno izbiro pripravka za varstvo rastlin pa količino in kakovost pridelka močno zmanjšamo, stroške pridelave pa povečamo. V Sloveniji je odločitev o uporabi fitofarmaceutskih sredstev za varstvo rastlin prepuščena kmetovalcem, ki pa se za nakup največkrat odločajo na podlagi oglasnih sporočil, ne pa dejanskih sposobnostih posameznega pripravka. Da bi dokazali oziroma ovrgli določene trditve o varstvu rastlin smo v letu 2012 izvedli poskusa varstva koruze pred pleveli in poskus varstva pšenice pred boleznimi. V koruzi smo primerjali dva načina varstva pred pleveli: zatiranje plevela pred vznikom in po njem. Za zatiranje plevela po vzniku smo uporabili pripravek Laudis, ki vsebuje aktivno snov tembotrion iz skupine triketon herbicidov, varovalo in močilo. Pri poskusih na pšenici smo primerjali vpliv različnih programov varstva pred rastlinskimi boleznimi na količino in kakovost pridelka ter vsebnost mikotoksina deoksinivalenol.

**ABSTRACT**

**Product, solution, success: concept and results of Bayer's experiments on corn and wheat**

Proper crop protection against weeds, diseases and pests is only one, but a very important agricultural measure for achieving high yields and high quality. By applying the most appropriate products for crop protection, we make it possible to attain genetic potential of the respective variety or hybrid; however, wrong choice of a crop protection product results in considerably reduced yield and poorer quality of crops, whereas production costs are higher. In Slovenia, the decision as to which crop protection product to use is left to farmers, who make their decisions mostly based on advertisements and not on the actual features of such products. In order to prove or reject certain arguments relating to crop protection, we conducted in 2012 an experiment to protect corn against weeds and another one to protect wheat against diseases. We compared two methods of protecting corn against weeds: pre-emergence and post-emergence weed control. For post-emergence weed control we applied Laudis, which contains the active ingredient tembotrione from the triketone group, the safener and the wetting agent. In wheat experiments, we compared the impact of various programs applied to protect wheat against plant diseases on quantity and quality of the yield and mycotoxin deoxynivalenol content.



### **Daljinsko zaznavanje s feromonsko vabo na zgledu koruzne večče (*Ostrinia nubilalis* Hübner)**

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Uvajanje novih tehnologij v opazovalno napovedovalno dejavnost je neizbežen proces, ki ga zahteva racionalizacija postopkov. Dosedanja uporaba feromonskih in drugih privabilnih vab predvideva terenske vizualne preglede, ki so zamudni, omogočajo človeške napake in so materialno potrošni. Z uporabo video kamer visoke ločljivosti, prenosa podatkov na daljavo prek GSM omrežja in razvijanjem računalniškega prepoznavanja nadzorovanih objektov, postaja dostopnejše tudi daljinsko zaznavanje škodljivih organizmov. Pri razvoju tovrstnih tehnologij smo v vlogi uporabnika med oblikovanjem naprave ePestAlert sodelovali s podjetjem EFOS informacijske rešitve d.o.o.. Naprava je bila v preizkušanju in razvijanju v rastni dobi 2012. Njeno funkcionalnost smo vrednotili s spremljanjem pojava metuljev koruzne večče (*Ostrinia nubilalis* Hübner), ki se kot polifagni škodljivci pojavlja na različnih vrstah gojenih rastlin. Med poljščinami v našem okolju napada koruzo, hmelj, proso, konopljo, medtem ko jo na vrtninah najdemo na papriki. Obstajajo tudi znamenja napadov jablane, a jih do sedaj še nismo potrdili. Izbor opazovanega organizma je temeljil na njegovem gospodarskem pomenu, zahtevnosti oblikovanja lovilnih ohišij in morfoloških lastnosti vrste, ki omogočajo hitrejše prepoznavanje z uporabo metod računalniškega vida.

#### **ABSTRACT**

### **Remote sensing with pheromone trap on example of European corn borer (*Ostrinia nubilalis* Hübner)**

Introduction of new technologies in agricultural forecasting service is inevitable process, which is required by rationalisation of procedures. Present use of pheromone and others attractant traps anticipates field visual inspections, which are delaying, allow human mistakes and are material consumable. With high resolution video cameras thru GSM data transfer integration and development of computerized recognition of monitored objects, also remote sensing of harmful organisms becomes available. As an operator of such technologies we teamed up with EFOS informacijske rešitve d.o.o. to design ePestAlert device. We tested the appliance through growing season 2012. Its functionality was assessed by monitoring of European corn borer (*Ostrinia nubilalis* Hübner) moths, which occurs as a polyphagous harmful organism in different crop types. In agriculture of our region it attacks corn, hops, millet, hemp, while in vegetables gives preference to pepper. There are some indications of apple tree and -fruit attacks, however not yet confirmed. Selection of monitored organism is established on economic significance, difficulty of trap designing and species morphological characteristics allowing faster recognition using computer vision.



### **Kombinacijske sposobnosti Lj- linij koruze in tolerantnost njihovih križancev na glivo *Fusarium subglutinans***

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Fuzarioze na koruzi, ki jih povzročajo glive iz rodu *Fusarium*, so ene od najpogostejših in najbolj razširjenih boleznih koruze. Zato si žlahtnitelji z različnimi metodami žlahtnjenja prizadevajo vzgojiti genetsko odporne sorte. Ena od najbolj razširjenih metod preizkušanja žlahtniteljskega materiala je proučevanje kombinacijskih sposobnosti (KS) z dialelnim križanjem. Cilj raziskave je bil ugotoviti splošno (SKS) in specifično (PKS) KS 15 linij in njihovih križancev iz genske banke koruze na Oddelku za agronomijo Biotehniške fakultete v Ljubljani za tolerantnost na glivo *Fusarium subglutinans* (FS). V proučevanje je bilo vključenih 50 novih Lj- križancev koruze F1 generacije, vzgojenih po metodi nepopolnega dialelnega križanja, pri čemer smo 10 linij (P1–P10) uporabili kot materine linije, 5 (P12–P16) pa kot očetne linije. Poljski poskus je bil izveden v letih 2011 in 2012 na poskusnem polju Biotehniške fakultete v Jablah pri Trzinu po metodi naključnega bloka v 3 ponovitvah. Umetno okužbo smo izvedli na naključno izbranih 5 storžih na vsaki parcelici. Za okužbo smo uporabili glivo FS, ki smo jo izolirali iz storžev naravno okužene koruze iz predhodnega leta. Ob zrelosti smo na vsakem storžu posebej ocenjevali okuženost po lestvici od 1 (brez znakov okužbe) do 7 (močna okužba). V obeh letih smo ugotovili statistično značilne razlike med novimi križanci v tolerantnosti na glivo *F. subglutinans* ter za SKS za tolerantnost materinih linij. Za SKS testerjev (očetne linije) pa smo statistično značilne razlike dobili samo v letu 2012, za PKS pa le v letu 2011. Med materinimi linijami sta imeli najboljšo SKS liniji P10 in P6, med očetnimi linijami pa P15, ki se v letu 2012 statistično značilno loči od vseh ostalih očetnih linij. Pri križancih, v katerih je očetna linija P12, glede ocene okuženosti med leti skoraj ni bilo razlik; medtem ko so križanci, v katere je vključena linija P15, zelo različno reagirali med leti, odvisno od materine linije.

**ABSTRACT**

**Combining ability and tolerance of Lj- maize genotypes to *Fusarium subglutinans***

The fungal diseases caused by *Fusarium* species are widespread in all maize-growing areas, including Europe. The plant breeders attempt to develop genetic tolerant cultivars with many selection methods. For this purpose, the investigation of combining ability (CA) based on diallel crosses are widespread in testing the value of breeding materials. The aim of our investigation was to determine general (GCA) and specific (SCA) combining ability of 15 maize inbreds and evaluate their F1 hybrids, and to determine their tolerance to *Fusarium subglutinans* (FS). The material was maintained in maize gene bank of the Biotechnical Faculty in Ljubljana. Fifty new F1 hybrids were developed by using the scheme of incomplete diallel and involved 15 inbreds (P1–P10 as female parents and P12–P16 as male parents). The field trial was conducted on the experimental station of the Biotechnical Faculty at Jable near Ljubljana in 2011 and 2012, and was based on randomized complete blocks. The inoculation by the fungus took place in the middle of 5 randomly chosen ears, on each plot, 7–10 days after pollination. The disease assessment was performed during the harvest time according to the ranking scale from 1 to 7. In both years, significant differences in tolerance to FS were determined for hybrids and for GCA of female lines. Regarding testers (male parents) significant differences in GCA were determined only in 2012, while significant differences for SCA were established only in 2011. P10 and P6 (as female parents) and P15 (as a male parent) had the highest value of GCA. The hybrids with the highest value of SCA did not always include the inbreds with the highest value of GCA. In our investigation some inbreds and their hybrids showed different response to the existing growing conditions in association with the scored tolerance to FS.



## Rezultati preizkušanja herbicidov v koruzi v pridelovalni sezoni 2012

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V poljskem poskusu smo preučevali biotično učinkovitost herbicidov na plevela v posevku koruze v pridelovalni sezoni 2012. Poskus je bil zasnovan na eksperimentalni postaji Fakultete za kmetijstvo in biosistemske vede v Hočah pri Mariboru v bločni zasnovi s 14 obravnavanji v štirih ponovitvah. Uporabili smo herbicidne kombinacije na podlagi naslednjih aktivnih snovi: tritosulfuron, dikamba, S-metalaklor, dimetanamid, bentazon, terbutilazin, mezotrion, foramsulfuron, jodosulfuron-metil natrij, 2,4-D, nikosulfuron, tembotrion, izoksaf lutol, rimsulfuron, florasulam, prosulfuron in pendimetalin. Nanos je bil izveden z nahrbtno škropilnico na stisnjen zrak Gloria proizvajalca BASF v štirih različnih terminih. Poraba škropilne brozge je znašala 350 l/ha. Predstavljeni bodo podatki o učinkovitosti herbicidov.

### ABSTRACT

#### Efficiency trials of herbicide mixtures for 2012 maize growing season

The field trial was carried out at the experimental station of the Faculty of Agriculture and Life Sciences in Hoče near Maribor to study the efficiency of herbicides for weed control in

maize stand. Trial was designed as randomized block design with 14 treatments in four replications. We tested combinations of herbicides based on the following active substances: tritosulfurone, dicamba, S-metalachlor, dimethanamid, bentazone, terbuthylazine, mesotrione, foramsulfurone, iodoflurofen methyl-sodium, 2,4-D, nicosulfurone, tembotrione, isoxaflutole, rimsulfurone, florasulame, prosulfurone, and pendimethaline. Herbicides were applied by knapsack sprayer Gloria BASF at four different periods in spray volume of 350 l/ha. The data on efficacy of individual herbicide mixtures for the control of individual weeds species will be presented.



## **Potencial različnih strniščnih dozevkov za zatiranje plevela**

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Strniščni dosevki predstavljajo tehnološki ukrep v integrirani pridelavi poljščin v smislu ohranjanja rodovitnosti, preprečevanja erozije in varovanja podtalnice pred izpiranjem hranil. Poleg pozitivnih okoljskih učinkov pa je manj znano, da setev dozevkov predstavlja tudi del integrirane tehnologije za zatiranje plevelov. S svojo hitro rastjo in pokrovnostjo dosevki preprečujejo razvoj plevelov in tekmovanje za hranila, svetlobo in vodo. Med letoma 2010 in 2012 smo na zemljiščih Kmetijskega inštituta v Jabljah kot strniščne dosevke posejali ajdo, sončnice, oves, mnogocvetno ljujko, abesinsko gizotijo, riček, oljno redkev, krmno ogrščico, inkarnatko in facelijo. Spomladi smo rastlinske ostanke zadelali v tla z oranjem in posejali jaro pšenico, jari ječmen, oves in koruzo. V rastni dobi smo opravili več vzorčenj pokrovnosti in biomase plevelov. V jesenskem terminu vzorčenja so vsi dosevki močno zmanjšali zapleveljenost v primerjavi z neposejano kontrolo. Podobno je bila tudi spomladi pred zadelavo rastlinskih ostankov pokrovnost statistično značilno nižja pri vseh dosevkih razen inkarnatki in sončnicah. Pozneje v rastni dobi nismo ugotovili učinka dozevkov na zapleveljenost glavnih dozevkov, saj sta bila tako biomasa kot pokrovnost plevelov podobna. V letu 2012 smo najvišje pridelke ugotovili pri gizotiji, oljni redkvi in sončnicah z 28,7, 31,8 in 36,5 t sveže gmote ter 4,3, 4,8 in 5,5 t suhe gmote na hektar. Na podlagi naših rezultatov smo ugotovili, da dosevki pozitivno vplivajo na zmanjšanje zapleveljenosti predvsem v jesenskem in spomladanskem času pred obdelavo tal, medtem ko bodo za ugotavljanje njihovega dolgoročnega učinka potrebne nadaljnje raziskave.

### **ABSTRACT**

#### **Potential of various cover crops for weed suppression**

Beside beneficial environmental effect in aspect of nutrients, soil and water preservation, cover crops can serve as a potential tool in the integrated weed and pest management systems. With their fast, vigorous growth and establishment, cover crops impose strong competition to weed species for nutrients, water and light. From 2010-2012 buckwheat, sunflower, oats, ryegrass, niger seed, camelina, radish, rape, crimson clover and lacy phacelia were planted in the wheat stubbles as cover crops in the experiment conducted at Agricultural Institute of Slovenia. Plant residues were incorporated in the spring of the following year, after which spring wheat, barley and maize were planted as main crops. In the growing season several assessments of weed species coverage and biomass was

performed. Cover crops significantly reduced weed coverage in the fall sampling period. Similarly, in the spring of 2011 and 2012, before incorporation of cover crops residues, weed coverage in all experimental plots was significantly reduced compared to control treatment with exception of sunflower and crimson clover. However, later in the season, no effect of cover crops on weed infestation in main crops spring wheat, spring barley and maize was determined as suppressive effect diminished and weed coverage and biomass were similar in all experimental plots. In the 2012 the greatest yields were determined in nigerseed, radish and sunflower with 28.7, 31.8 and 36.5 t of fresh and 4.3, 4.8 and 5.5 t of dry matter per hectare respectively. Based on our results, cover crops strongly reduce weed infestation in the growing season and the following spring, while further research will be needed to investigate its long term effect on weed control.



## **ADENGO – najnovejši herbicid za varstvo koroze**

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Adengo je nov sistemski herbicid za varstvo koroze iz družbe Bayer. Vsebuje učinkovini izoksafutol in tienkarbazon-metil in varovalo ciprosulfamid. Izoksafutol je preizkušena učinkovina, ki zatira enoletne širokolistne in nekatere ozkolistne plevela s tem, da zatira sintezo karotenoidov in poznejšo izgubo klorofila (beljenje). Tienkarbazon-metil je nova učinkovina iz skupine sulfonil sečnin, ki zavira sintezo aminokislin v rastlinah in prepreči delitev celic. Obema snovema je dodano novo varovalo ciprosulfamid, ki nudi korozi izredno zaščito pred herbicidnim stresom. Koroza, poskropljena s herbicidom Adengo, ima občutno hitrejši mladostni razvoj, brez zastojev v rasti in pojavov fitotoksičnosti, zato z njim dosegamo višje pridelke. Adengo lahko uporabljamo zelo fleksibilno, saj lahko škropimo pred vznikom koroze kot tudi po vzniku koroze do razvojnega stadija treh listov koroze (BBCH 00-13). Z enim samim škropljenjem zatremo več kot 85 gospodarsko pomembnih plevelov v korozi, kar poenostavi in poceni pridelavo koroze.

### **ABSTRACT**

## **ADENGO – the latest corn herbicide**

Adengo is a new systemic corn herbicide by Bayer. It contains active ingredients isoxaflutole and thien carbazon-methyl and safener cyprosulfamide. Isoxaflutole is a powerful substance which controls annual broad-leaved weeds and some grass weeds by blocking carotenoid synthesis and successive loss of chlorophyll (bleaching). Thien carbazon-methyl is the latest innovation in the sulfonylamino-carbonyl-methyl herbicide group which acts via inhibition of the acetolactase synthase enzyme. Both active ingredients are accompanied by a new safener cyprosulfamide, which relieves corn from herbicide stress. Adengo-treated corn has a significantly faster development with no growth blocking and phytotoxicity; therefore it achieves higher yields. Adengo's strength is its flexibility: it can be applied from pre-emergence to early post-emergence (three-leaf stage of corn; BBCH 00-13). A single pass controls more than 85 economically important weed species in corn, which enables cheaper and simpler corn production.





## **Možnosti uporabe mehanskega zatiranja plevela in sistema reducirajoče obdelave v pridelovanju koruze**

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Večina intenzivne kmetijske pridelave v Sloveniji poteka na ravninskih predelih z rodovitnimi aluvialnimi tlemi. Hkrati se skozi intenzivno obdelana plitka tla obrečnih nanosov napajajo tudi podzemni vodonosniki, ki predstavljajo glavni vir pitne vode pri nas. Konzervirajoča tehnologije obdelave tal je dokazano pokazala pozitivne okoljske učinke. Ti se kažejo ne samo v varovanju tal pred erozijo, ampak tudi pred izpiranjem hranil in fitofarmaceutskih sredstev. V letu 2012 smo v poljskem poskusu na zemljiščih Kmetijskega inštituta v Jabljah primerjali pridelavo koruze v konvencionalni, pasovni (strip-till) obdelavi in mehanskih postopkih zatiranja plevelov. V konvencionalni pridelavi smo uporabili standardno pridelavo s plugom, predsetveno obdelavo in herbicid po vzniku, za razliko od mehanskega sistema, kjer smo plevel zatirali le z mehansko obdelavo. V pasovni pridelavi smo koruzo sejali v obdelane pasove na njivo, na kateri so bili v prejšnjem letu posejani dosevki oljna redkev (*Raphanus sativus* L.), mnogocvetna ljuljka (*Lolium multiflorum* Lam.) in inkarnatka (*Trifolium incarnatum* L.). Pred setvijo smo mnogocvetno ljuljko tretirali z glifosatom in zmulčili, inkarnatko pa smo samo poškopili z glifosatom. Zatiranje plevela je bilo najbolj učinkovito v konvencionalnem sistemu, kjer smo na koncu rastne dobe ugotovili le 2,5 % pokrovnost s pleveli. Mehanska in pasovna pridelava sta z 11% in 15 % pokrovnosti s pleveli statistično značilno manj učinkoviti. Naši preliminarni rezultati so pokazali, da smo z vsemi tremi načini pridelave dosegli podobne pridelke, in sicer z 9,1, 8,9 in 7,7 t suhega zrnja na hektar pri konvencionalni, mehanski in pasovni pridelavi. Kljub povečani zapleveljenosti pri pasovni in mehanski pridelavi koruze, so se pridelki rahlo zmanjšali predvsem zaradi manjšega števila rastlin na hektar. Naši rezultati nakazujejo, da tako pasovna obdelava kot tudi mehanski postopki zatiranja plevela predstavljajo dodatno možnost doseganja primerljivih pridelkov v pridelavi koruze.

### **ABSTRACT**

#### **Implementation of mechanical weed control and reduced tillage system in maize production**

Majority of the intensive agricultural production in Slovenia is concentrated on the fertile arable land in the lowlands. However, the source for most of the Slovenian drinking water are groundwater aquifers recharged through intensively cultivated shallow alluvial soils. Conservation tillage management practices where main crops are planted in the plant residues exhibited positive environmental implications not just in protecting soils from erosion, but also from preventing of leaching agrochemicals into groundwater. In 2012, a field experiment was conducted in Slovenia, where conventional, mechanical and strip till management systems were compared in maize production. In conventional plots standard technology with ploughing, seed bed preparation and post emergence herbicide was applied, whereas only physical weed control measures were applied in the mechanical weed control plots. In the strip till system maize was planted in the dead mulch of cover crops radish (*Raphanus sativus* L.), crimson clover (*Trifolium incarnatum* L.) and ryegrass (*Lolium multiflorum* Lam.) terminated in the spring with glyphosate. Weed control was the most effective in conventional system, where at the end of the growing season significantly lower weed coverage of 2.5 % compared to mechanical weed control

methods (11 %) and strip till system (15 %) was determined. Our preliminary results indicate that similar dry maize grain yields of 9.1, 8.9 and 7.7 tons per hectare were obtained in conventional, mechanical and strip-till systems, respectively. Regardless of greater weed infestation in mechanical and strip till systems, yields were mainly decreased due to reduced maize plants stand. Based on our initial results, mechanical and strip-till maize production systems represent alternative technology with comparable maize yields.

## **Splošna sekcija**

## **AGROMET - podpora pri sistemu odločanja v prognozi varstva rastlin**

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V zadnjih dveh desetletjih se je prognoza v varstvu rastlin usmerila v uporabo vseh razpoložljivih informacijskih tehnologij, ki so pripomogle k natančnejšim in v realnem času podanim meritvam biotskih in abiotskih parametrov, spremljanju, napovedim in nasvetom o pojavu in ukrepanju proti škodljivim organizmom v rastlinski pridelavi. Varovanje okolja postaja vedno večja prioriteta tudi pri rastlinski pridelavi, saj lahko pravilna in pravočasna prognoza ter obveščanje o pojavu, širjenju, preprečevanju in zatiranju škodljivih organizmov zmanjšajo uporabo fitofarmaceutskih sredstev ter omogoči kakovosten pridelek. Za Ministrstvo za kmetijstvo in okolje je bil v okviru fitosanitarnega informacijskega sistema v letu 2012 kot temelj prilagajanja podnebnim spremembam vzpostavljen agrometeorološki portal Slovenije – AGROMET, ki lahko združuje različne informacije na področju kmetijske agrometeorologije (prve informacije so dostopne za varstvo rastlin in namakanje). Eden od ključnih namenov sistema je posredovanje kakovostnih informacij strokovnih služb na področju varstva rastlin v realnem času, ki bodo pridelovalcem omogočile sprejemanje najboljših odločitev za izvedbo ukrepov. Osnovni gradnik podatkov je agrometeorološka lokacija, na kateri avtomatske meteorološke postaje izvajajo meritve, opazovalci pa spremljajo fenologijo kmetijskih rastlin in škodljivih organizmov. V prispevku so opisani spletni moduli za prikaz podatkov na portalu po lokacijah, vsote efektivnih temperatur pri različnih pragovih za posamezno lokacijo, vključno z modulom za pomoč pri napovedi jabolčnega zavijača.

### **ABSTRACT**

#### **AGROMET – a support at decision making in plant protection prognosis**

Over the past two decades, the prognosis in the plant protection has focused on the use of all available information technologies that have contributed to a more precise and real-time given measurements of biotic and abiotic parameters, monitoring, forecasting and advice on the occurrence and spread of pests in plant production. Protecting the environment is becoming increasingly a priority in the area of plant production, namely a correct and timely prognosis and informing on the occurrence, spread, prevention and control against harmful organisms can reduce the use of plant protection products and enable quality yield. In the frame of phytosanitary information system as a starting point of adjustment to the climate changes, a Slovenian agrometeorological portal - AGROMET was developed for the Ministry of Agriculture and the Environment in 2012. It may combine a variety of information in the field of agricultural agrometeorology (firstly for plant protection and irrigation). One of the key purposes of the system is a delivery of qualitative information from professional services in the field of plant protection in real time, which will enable the grower to make the best decision for taking proper measures. The basic data unit is an agrometeorological location where the measurements from automatic meteorological stations and monitoring of plant and pests phenology by experts take place. In the following contribution web modules are presented: module for displaying

basic data units, module for displaying the growing degree-day at different temperature thresholds for each location and module to assist in the prediction of codling moth.



## **An overview of alien Diptera in Slovenia**

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An overview of alien flies and mosquitoes was made for Slovenia. Databases, literature and internet were used to obtain the information about their occurrence and bionomics of species discovered till 2011. Information was gathered about the time of arrival, habitat, country of origin, hosts and status of invasiveness. In total 18 alien species were identified for Slovenia. The first one, *Ceratitis capitata*, was firstly recorded in 1959, however most of them were recorded in the last two decades. Most of the species originated from North America and Continental Asia. This is the same climatic belt as Europe. Most of the species were introduced by transport or were introduced in another European country and dispersed to Slovenia. The habitats of the alien Diptera are mostly connected with human activities. They occur mainly in agricultural land and urban areas. Most of the species are phytophagous and are known pests in agriculture and forestry. Regarding the invasiveness of the species on basis of literature it was found that species were spreading rapidly in Slovenia. However most of the species, the nowadays status is not known, because mostly only the first finding were recorded. The species will be discussed on basis of their effects on forestry and agriculture.

### **ABSTRACT**

#### **Pregled tujerodnih dvokrilcev (Insecta: Diptera) v Sloveniji**

Narejen je bil pregled tujerodnih muh in komarjev v Sloveniji. Informacije o pojavljanju in bionomiji posameznih vrst, ki so bile ugotovljene do leta 2011, smo pridobili z uporabo baz podatkov, literature in interneta. Za vsako vrsto smo zbrali podatke o času najdbe, habitatih, državi izvora, gostiteljih in statusu invazivnosti. Ugotovljenih je bilo 18 tujerodnih vrst. Prva tujerodna vrsta, *Ceratitis capitata*, je bila v Sloveniji prvič zabeležena leta 1959, večina drugih pa je bila prvič prvič zabeležena v zadnjih dveh desetletjih. Večina vrst izvira iz Azije in Severne Amerike, iz območij s podobnim podnebjem kot v Evropi. Večina vrst je bila v Slovenijo vnesena s transportom ali pa so bile vnesene v drugo evropsko državo, od koder so se potem razširile v Slovenijo. Habitati tujerodnih vrst so povezani z človekovim delovanjem, saj se pojavljajo predvsem na kmetijskih in urbanih zemljiščih. Večina vrst je rastlinojedih in so znani škodljivci kmetijskih in gozdnih rastlin. Na podlagi literature je bilo ugotovljeno, da vrste kažejo invazivno sposobnost, saj so se v Sloveniji hitro razširile. Vendar pa status večine vrst ni znan, saj je pogosto zabeležena le prva najdba. V prispevku bomo razpravljali o vplivu tujerodnih dvokrilcev na kmetijstvo in gozdarstvo v Sloveniji.



## **The one fungus / one name concept and new rules for regulating the use of fungal names**

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Significant nomenclatural changes becoming effective on 1 January 2013 and having a great impact on the usage of fungal names by plant pathologists are reviewed. Article 59 of the International Code of Botanical Nomenclature is drastically revised in the newly drafted code, now called International Code of Nomenclature for algae, fungi, and plants. The separate naming of different morphs of many pleomorphic ascomycetes and basidiomycetes is not permitted anymore for establishing the »one name for one fungus« principle. For selecting this single name, the principle of earliest publication of a legitimate name applies (principle of priority). Different names given earlier either for an anamorph, synanamorph or teleomorph of the life cycle of a single fungus compete equally for the establishment of its correct name. If necessary, the oldest species epithet available is to be newly combined in the genus name that has priority. The selection of younger names is permitted, however, through conservation proposals to the Nomenclature Committee for Fungi in order to protect important names in current use. If the teleomorph- and anamorph-typified names of a taxon were both in common use, it is recommended to use the former of these, even the teleomorph name is younger, or the anamorph name must be proposed for acceptance. The clarity of the genus concept is another criterion for selecting the correct single name of a taxon through conservation proposals. In some cases, the use of too broadly applied earliest names, e.g., of form-taxa, will not be encouraged in favour of names linked to more narrowly defined taxon concepts. The presentation discusses a set of examples of fungi relevant for plant pathologists as post harvest disease agents, plant pathogens and biological control agents.

### **IZVLEČEK**

#### **Koncept ena gliva-eno ime in nova pravila o uporabi imen gliv**

V prispevku so obravnavane velike spremembe v poimenovanju gliv, ki so začele veljati 1. januarja 2013 in bodo zelo vplivale na uporabo imen na področju fitopatologije. Mednarodni kodeks botanične nomenklature, ki je v 59. členu močno spremenjen, je preimenovan v Mednarodni kodeks nomenklature alg, gliv in rastlin. Ločeno poimenovanje različnih oblik pri mnogih vrstah pleomorfnih askomicet in bazidiomicet ni več dovoljeno, s čimer bo zagotovljeno načelo »eno ime za eno glivo«. Izbor enotnega imena temelji na načelu prve objave imena (pravilo prioritete). Različna imena, dodeljena bodisi anamorfu bodisi teleomorfu v življenjskem krogu posamezne glive, enakopravno tekmujejo pri izboru imena. Po potrebi se najstarejši epitet (del imena, ki označuje vrsto) kombinira z imenom tistega rodu, ki ima prednost. Izbor novejših imen je dovoljen z namenom, da se obdržijo pomembna in pogosto uporabljana imena gliv, vendar le, če bo predlog za ohranitev imena odobrila Komisija za nomenklaturu gliv. V primeru splošne uporabe imen teleomorfa in anomorfa neke vrste je priporočljiva uporaba imena teleomorfa, četudi je leto ime novejše, oziroma je kot veljavnega potrebno predlagati ime anomorfa. Jasnost koncepta rodu je pomemben kriterij za izbor enotnega imena pri predlogu za ohranitev poimenovanja nekega taksona. V nekaterih primerih starejša imena taksonov, ki so uporabljena preveč široko, ne bodo imela prednosti pred ožje definiranimi koncepti taksonov.

Predstavljeni bodo primeri novega poimenovanja gliv, ki so za fitopatologe pomembne kot rastlinski patogeni, povzročitelji skladiščnih bolezni ali se uporabljajo v biotičnem varstvu rastlin.



### **Hitri diagnostični testi in njihov pomen za terensko delo**

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Prepoznavanje bolezni in njihovih povzročiteljev na terenu poteka predvsem z vizualnim pregledom. Za potrditev suma pa je največkrat potrebna še dodatna laboratorijska diagnostika. Še posebno je to pomembno v primeru mikrobnih povzročiteljev bolezni, kjer je potrebno za njihovo potrditev uporabiti serološke, molekularne in druge laboratorijske tehnike. Da bi skrajšali čas prvega prepoznavanja navzočnosti patogenih mikrobov, so se na terenu že pred leti začeli uporabljati hitri diagnostični testi, sprva serološki, v zadnjem času pa tudi molekularni. Velik korak k učinkoviti diagnostiki na terenu pa je prispeval razvoj hitre, molekularne metode LAMP, ki poteka v razmerah konstantne temperature in se zato za njeno izvedbo uporablja enostaven fluorimeter. Poleg analiz posameznih patogenih mikrobov pa LAMP omogoča tudi sočasno določanje RNA in DNA. Metoda LAMP je manj občutljiva na inhibitorje v vzorcih, zato je priprava vzorca za analizo enostavnejša. Teste razvijamo v okviru dveh evropskih projektov, Vitisens in Qdetect. Razvite teste bo mogoče prilagoditi za enostavno uporabo tako v laboratoriju kakor tudi pri pridelovalcih, v skladiščih, letališčih, pristanišču in mejnih prehodih.

#### **ABSTRACT**

#### **The relevance of fast diagnostic tests for on-site detection**

Discovery of diseases and their causes in the field is performed with visual inspection. To confirm the presence, the laboratory diagnostics is often required. This is specially unavoidable in the case of plant pathogens, where use of serological, molecular or other laboratory methods is needed. To shorten the time of first plant pest recognition, fast, serological and later molecular on-site detection methods were developed. The major progress was reached with the development of fast, molecular method LAMP, which can be performed under constant temperature, therefore simple fluorimeter is used for detection of LAMP product. The method could be used for simultaneous detection of DNA and RNA molecules and is less prone to inhibitors; therefore the sample preparation could be faster and simple. The test are developed in the frame of two European projects Vitisens and Qdetect. Developed test could be adapted for easy use in the laboratory, at the production site, warehouses, airports, ports and country borders.



## **Pomen obvladovanja vektorjev v epidemiologiji fitoplazemskih bolezni**

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V Evropi ugotavljajo povečano pojavnost fitoplazemskih bolezni v poznih 1990-ih letih in v prvem desetletju 21. stoletja, tako v kmetijski pridelavi in gozdu, kot v drugem naravnem okolju. Delno je to lahko posledica razpoložljivosti molekularnih diagnostičnih metod, ki so bile razvite v tem obdobju. V zadnjih dveh desetletjih smo tudi v Sloveniji zabeležili pomembne gospodarske škode zaradi fitoplazemskih bolezni sadnih rastlin (Apple proliferation, European stone fruit yellows, Pear decline) in vinske trte (Bois noir, Flavescence dorée). Ker je veliko povzročiteljev fitoplazemskih bolezni in njihovih prenašalcev v Evropi domorodnih, je pri obvladovanju razširjenih bolezni temeljno vprašanje, kateri parametri dinamike razvoja bolezni so se v zadnjem času spremenili, da so prispevali k epifitocijam. Fitoplazme so biotično gledano edinstvene, saj jih ni mogoče gojiti v umetnih medijih kot bakterije, parazitirajo pa lahko raznolike vrste gostiteljskih rastlin in žuželk. Fitoplazme naseljujejo floemske celice rastlin in žuželke, ki se prehranjujejo iz floema. Naravno širjenje med rastlinami omogočajo žuželčni prenašalci, v glavnem škržatki (Hemiptera: Cicadellidae, Cixiidae, Delphacidae in Derbidae) in bolšice (Psyllidae). Razmnožujejo se v tkivih svojih prenašalcev in se med hranjenjem prenesejo iz žlez slinavk na nove gostiteljske rastline. Fitoplazemska epidemiologija vključuje tritrofično razmerje med patogenom ter pogosto več rastlinskimi gostitelji in prenašalci. Najnovejše raziskave poudarjajo pomen okoljskega vidika epidemiologije, v katerem je razumevanje tristranskih interakcij med gostiteljsko rastlino, rastlinskim patogenom in fitofagim vektorjem ključnega pomena za uspešno zatiranje rastlinskih bolezni. Modelna analiza (Nakazawa et al., 2012) kaže, da se lahko bolezen po ustalitvi na območju trajno obdrži, čeprav je njena začetna zastopanost nizka. Ugotovili so namreč, da okužba izboljšuje hranilno kakovost rastlin, tako da se fitofagi vektorji raje hranijo na okuženih rastlinah kot na zdravih. Vedno več empiričnih dokazov podpira idejo, da posredni mutualizem med prenašalci in povzročitelji bolezni s pozitivno povratno informacijo prispeva k uspešnosti invazije in bolezenski pandemiji. Pri tem velika populacija prenašalcev niti ni nujno potrebna. V prispevku so podani nekateri vidiki pojava in obvladovanja fitoplazemskih bolezni sadnih rastlin in vinske trte v Sloveniji. Vedno več vektorskih vrst, ki potrjeno ali domnevno prenašajo *Ca. Phytoplasma mali*, *Ca. Phytoplasma prunorum*, *Ca. Phytoplasma pyri* in *Ca. Phytoplasma vitis* zahteva večje znanje in celosten pristop v epidemiologiji fitoplazemskih bolezni. Pojavnost bolezni pri gojenjih večletnih rastlinah ob slabem zatiranju vektorjev v zadnjih letih povečuje inokulum in onemogoča pridelavo npr. marelic, breskev in ponekod tudi grozdja. Fitoplazemske bolezni je težko obvladovati, ko se ustalijo na območju pridelave. Teoretično se za njihovo obvladovanje navajajo integrirane tehnike zatiranja z uporabo koristnih organizmov, biotehnologije in odpornosti rastlin (odpornost sorte lahko temelji na odpornosti rastlin na hranjenje vektorja). V praksi pa so glavne metode obvladovanja karantenski (preventivni) ukrepi, certificiranje rastlinskega reprodukcijskega materiala in tretiranje vektorjev z insekticidi. Pri upočasnjevanju širjenja in gospodarskega vpliva bolezni sta najpomembnejša dejavnika zmanjševanje fitoplazemskega inokuluma in učinkovito zatiranje vektorjev. Pri zmanjševanju uporabe insekticidov pa sta



najpomembnejša elementa izboljšano spremljanje vektorjev in napovedovanje ustreznih tretiranj žuželčjih prenašalcev fitoplazem.

## **ABSTRACT**

### **The importance of vector control in the epidemiology of phytoplasma diseases**

In Europe, an increased incidence of phytoplasmatic diseases has been reported in the late 1990s and in the first decade of the 21st century in many agricultural crops, forest and wild nature. This could be partly a consequence of the availability of molecular diagnostic methods, which were developed in this period. In the last two decades, phytoplasma diseases of fruit crops (e.g. Apple proliferation, European stone fruit yellows, Pear decline) and grapevine (Bois noir, Flavescence dorée) have caused important crop losses also in Slovenia. Since many phytoplasmatic causal agents and their vectors are native to Europe, the fundamental question is: Which parameters of the disease development dynamics have changed recently and contributed to the epiphytocy? Phytoplasmas are biologically unique since they cannot be cultured in artificial media, but they can parasitise a diverse range of plant and insect hosts. Phytoplasmas reside endocellularly within plant phloem and within insects that feed on the phloem. Naturally, they are spread among plants by insect vectors, mainly leafhoppers (Hemiptera: Cicadellidae, Cixiidae, Delphacidae and Derbidae), and psyllids (Psyllidae). They multiply within the tissues of their insect vectors and are transferred during feeding by salivary secretions to new host plants. Phytoplasma epidemiology involves a tritrophic relationship between the pathogen and, usually, several plant hosts and vectors. The latest research highlights the importance of the eco-epidemiological perspective, where understanding of tripartite interactions among the host plant, plant pathogen and herbivore vector is crucial for the successful control of plant diseases. The Nakazawa et al. (2012) model analysis suggests that the disease may persist once established, even though the initial prevalence was low. This was established on the basis of the finding that infection improves the plant nutritive quality, and thus herbivore vectors prefer feeding on infected plants. An increasing number of empirical evidence supports the idea that the indirect vector–pathogen mutualism relationship contributes to the invasion success and disease pandemics through a positive feedback. Some aspects of the occurrence and management of phytoplasma diseases of fruit crops and grapevine in Slovenia are given. An increasing number of vector species confirmed or suspected to transmit *Ca. Phytoplasma mali*, *Ca. Phytoplasma prunorum*, *Ca. Phytoplasma pyri* and *Ca. Phytoplasma vitis* requires an increased knowledge and holistic approach in the phytoplasma epidemiology. The disease occurrence in growing perennial plants along with a weak vector control has increased the inoculum in the area over the years. Phytoplasma diseases are difficult to manage, once they are established in the production area. Theoretically, integrated pest management techniques using beneficial organisms, biotechnology, and plant resistance are emerging control strategies (resistant varieties may be based on the resistance of plants to feeding by the phytoplasma vector). In practice, quarantine measures, plant reproductive material certification schemes and insecticides treatments are the main control methods. In the reduction of disease spread, suppression of phytoplasma inoculum and vector control are the most important factors. In the reduction of the use of insecticides for vector control, an improved insect-vector monitoring and forecasting of appropriate treatments are the most important elements of control.



## **Rastlinski virusi in viroidi v vodi – preživetje in pomen za širjenje okužbe**

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V hidroponski pridelavi kmetijskih rastlin in pri intenzivnem namakanju se povzročitelji bolezni hitro širijo, saj lahko okužba ene rastline povzroči okužbo celotnega nasada. V vodnem okolju se nahajajo številni rastlinski virusi (pregledni članek: Mehle in Ravnkar objavljen v *Water research*, 2012), vendar za mnoge možnost preživetja v vodi in njihovo širjenje z vodo oziroma s hranilno raztopino ni preučeno, predvsem zaradi dolgotrajnih in težavnih poskusov, ter zaradi pomanjkanja občutljivih diagnostičnih metod in učinkovitih načinov koncentriranja vodnih vzorcev. Poznavanje teh možnosti je nujno za uspešno preprečevanje širjenja bolezni in s tem povezanih velikih izgub za prehrano pomembnih kmetijskih rastlin. V prispevku bomo predstavili nove rezultate o preživetju gospodarsko pomembnih povzročiteljev bolezni paradižnika in krompirja, krompirjevega virusa Y (nekrotičen različek), virusa mozaika pepina (genotip Ch2) in viroida vretenatosti gomoljev krompirja ter njihov prenos z vodo.

### **ABSTRACT**

#### **Plant viruses and viroids in aqueous environment – survival and importance of water mediated transmission**

In horticulture widely used hydroponic systems and intensive irrigation hold the potential for rapid and efficient spread of water-transmissible plant pathogens throughout the whole plantation. Although numerous plant viruses have been detected in aqueous environment (reviewed by Mehle and Ravnkar, 2012 in *Water research*), for many of them, the survival in water and the potential for direct transmission through irrigation water or nutrient solution are still unknown, mainly due to the long lasting, complicated and extensive experiments needed and due to a lack of sensitive diagnostic methods and efficient concentration steps. However, this knowledge is necessary for effective prevention of disease spreading that otherwise can lead to huge economical losses. The new results on survival and transmission through water of Potato virus Y (NTN strain), Pepino mosaic virus (Ch2 genotype) and Potato spindle tuber viroid will be presented. These three pathogens are relatively stable and contagious, and constitute a serious threat to tomato and potato production.



#### **Karakterizacija bioaktivnih sekundarnih metabolitov gliv zaprtotrošnic iz reda Capnodiales**

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Klasifikacija gliv zaprtotrosov iz reda Capnodiales (Ascomycota) obsega saprofite, endofite in na rastlinskem površju naseljene epifitske glive sajavosti in mušje pegavosti. Te glive po dosedanjem vedenju niso rastlinski patogeni. Na površju naravnih substratov je pogosto lepo vidno, da kolonije različnih gliv sajavosti in mušje pegavosti ovirajo druga drugo, na primer njihova interakcija se izrazi v demarkacijski črti, znotraj katere se glive druge vrste ne morejo širiti. Predvidevamo, da nekatere vrste teh gliv producirajo bioaktivne sekundarne metabolite v kontekstu antibioze, ki lahko predstavljajo nove antibiotike ali fungicide. Bioaktivni metaboliti iz teh vrst gliv še niso znani. Testi *in vitro* dvojnih kultur kažejo antibiotični potencial številnih gliv sajavosti in mušje pegavosti. Takšne glive smo gojili na različnih tekočih gojiščih. Glivne ekstrakte smo testirali s tekočinsko kromatografijo visoke ločljivosti sklopljeno z detektorjem z diodnim nizom in masno spektrometrijo (HPLC-DAD/MS). Nato smo z različnimi bakterijskimi in glivnimi testnimi sevi izvedli bioteste za določevanje antibiotične aktivnosti, in sicer z disk difuzijsko metodo in s serijo dilucijskih testov. Ekstrakte, ki so pokazali najvišjo intenziteto antimikrobne aktivnosti, smo frakcionirali s semipreparativno HPLC na mikrotitrski plošči s 96 vdolbinicami. Z dobljenimi frakcijami smo za iskanje potencialnih, biotično aktivnih spojin izvedli številne dilucijske teste bioaktivnosti. Izbrane frakcije iz najbolj obetavnega seva smo uporabili za povečevanje obsega metabolitov v 10 l mešalnem fermentorju. Micelij smo ločili od fermentacijske brozge in iz obeh pripravili organske ekstrakte. Dodatni poskusi so vključevali preparativno HPLC. V nadaljevanju bomo izolirali aktivne substance do njihove čistosti in jim določili strukturo in elementno sestavo s spektroskopskimi metodami, kot sta jedrska magnetna resonančna spektroskopija (NMR) in masna spektrometrija (MS). Predstavljene bodo biotične in fizikalno-kemične lastnosti aktivnih komponent potencialnega seva.

#### ABSTRACT

#### Characterization of bioactive secondary metabolites of Capnodiales (Ascomycota)

The Capnodiales (Ascomycota) comprises saprotrophs, epi- and endophytes, and fruit colonizing sooty blotch and fly speck (SBFS) fungi. SBFS fungi are not known to be plant pathogenic. Because they interfere with each other on the plant surface, for example, by forming demarcation lines, we postulate that some of them can produce bioactive secondary metabolites in the context of antibiosis that may present novel antibiotics or agrochemical fungicides. However, currently, no bioactive secondary metabolites are known to be produced by these species. *In vitro* dual culture tests showed that several SBFS fungi can be antibiotic. Several SBFS fungi showing activity in the initial dual culture tests were cultured on liquid media. Their extracts were studied by high performance liquid chromatography coupled with diode array and mass spectrometric detection (HPLC-DAD/MS). In addition, bioassays for antibiotic activities were performed using several bacterial and fungal test strains in agar diffusion and serial dilution assays. Extracts showing highest intensity of antimicrobial activity were fractionated by semi-preparative HPLC onto 96 well plates. To locate potentially bioactive substances, serial dilution assay bioactivity tests were repeated with obtained fractions. Selected fractions were then used as standards for the scale-up of metabolites in a 10 litre stirring fermentor on the most promising strain. The mycelium was separated from the culture fluid and organic extracts were prepared from both. Additional experiments will adopt preparative HPLC. Active substances will be isolated to purity and studied by spectral methods, such as nuclear magnetic resonance spectroscopy (NMR) and mass spectrometry (MS). The

characteristics of the producer strain, the workflow of the screening and the biological and physico-chemical characterisation of the active components will be described.



### **Novosti pri daljinskem zaznavanju škodljivcev**

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Klasični proces spremljanja pojava škodljivih žuželk je časovno potraten ter hkrati od osebja, ki izvaja spremljanje, zahteva številne ogleda na terenu, kar ima za posledico precejšnje potne stroške. Poleg tega je eden ključnih dejavnikov v modernem kmetijstvu za možnost pridobitve podatkov s terena v realnem času, kar s klasičnim pristopom praviloma ni možno, oz. za to navadno nimamo dovolj človeških in finančnih virov. Sistem trapview, omogoča vpogled v stanje na terenu v realnem času, kar bistveno olajša in izboljša odločanje o ukrepih, povezanih z zatiranjem škodljivcev. V prispevku se bomo osredotočili na ključne izboljšave, ki zajemajo izboljšano ločljivost slik, možnost avtomatičnega in ročnega označevanja škodljivcev ter povezavo podatkov, povezanih z ulovom škodljivcev, z vremenskimi podatki.

#### **ABSTRACT**

#### **Remote pest monitoring**

Pest monitoring is time and labor intensive process, which requires lots of field visits and generates significant travel costs. One of key elements of precision agriculture is availability of real time data. This is something that is nearly impossible to achieve with classic field scouting approach since it would require too many human and financial resources. Trapview system enables real-time monitoring of pests which can significantly simplify and improve pest management decisions. This article focuses on key improvements of the system – significant increase of image resolutions, automatic and manual marking of pests and seamless pest and weather data integration.

## **Varstvo vinske trte**

## **Ameriški škržatek (*Scaphoideus titanus* Ball) v vinorodni deželi Posavje**

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V obdobju 2011-12 smo v okviru izvajanja Uredbe o izvedbi ukrepov za preprečevanje širjenja zlate trsne rumenice in zatiranju ameriškega škržatka (*Scaphoideus titanus* Ball) na območju vinorodne dežele Posavje pristopili k podrobnejšemu spremljanju bionomije in učinkovitosti ukrepov zatiranja ameriškega škržatka. Razvoj ameriškega škržatka smo sledili z vizualnimi pregledi na vinski trti in beleženjem ulova odraslih osebkov na rumene lepljive plošče. Spremljanje je potekalo na lokacijah v žariščih zlate trsne rumenice in zunaj njih, pri čemer smo zabeležili zastopanost 13 novih vrst škržadov (Cicadidae). Obravnavani so bili vinogradi v integrirani in ekološki pridelavi. V letu 2011 smo izvajanje ukrepov zatiranja ameriškega škržatka spremljali s 433 in v 2012 s 376 pregledi. Vrednotenje rezultatov nam je omogočilo nove ugotovitve glede odzivanja vinogradnikov in nakazalo na dolgoročne stranske učinke ukrepov za zatiranje prenašalcev trsnih rumenic. Pridobljene ugotovitve lahko služijo za prihodnje kompleksnejše načrtovanje ukrepov v primeru pojava novih škodljivih organizmov na vinogradniških območjih.

### **ABSTRACT**

#### **American grapevine leafhopper (*Scaphoideus titanus* Ball) in wine growing region Posavje**

In the period of 2011-12 we conducted in the context of Decree on the implementation of measures for the suppression and spread of Grapevine flavescence dorée and suppression of the leafhopper (*Scaphoideus titanus* Ball) in the wine-growing region of Posavje detailed study of the bionomics and the success of the suppression measures of the American grapevine leafhopper. To monitor instar development stages we implemented visual checks on the vine leaves and yellow sticky plates to monitor adult specimens. Monitoring was conducted at locations in the foci of the Grapevine flavescence dorée and delimited area during which we recorded 13 new species of cicadas (Cicadidae). Observed were vineyards in organic as integrated production. In 2011, we overviewed the efficiency of suppression on the American grapevine leafhopper of 433, and in 2012 of 376 inspections. Evaluation of results delivers new findings concerning the response of vine growers and indicates the long term side effects of the measures for the control of vectors of grapevine yellows. Acquired findings can serve for future complex planning actions in the event of emergence of new harmful organisms in the vine growing areas.



#### **Razvoj modela za napovedovanje zatiranja ameriškega škržatka (*Scaphoideus titanus* Ball) – preliminarni rezultati**

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Ameriški škržatek (*Scaphoideus titanus*) je glavni naravni prenašalec zlate trsne rumenice, bolezni vinske trte, ki jo povzroča karantenska fitoplazma Grapevine Flavescence dorée (FD). Eden od pomembnih ukrepov za uspešno preprečevanje širjenja FD v vinogradih je pravočasno zatiranje ameriškega škržatka. V ta namen smo začeli z razvojem modela, ki bo pripomogel k pravočasnemu napovedovanju uporabe insekticidov za zatiranje ličink in odraslih škržatkov. Najpomembnejši podatki za razvoj modela so: začetek izleganja ličink, dolžina izleganja ličink, trajanje razvojnih stopenj ličink in nimf ter razvoj odraslih škržatkov. V prispevku bodo predstavljeni podatki o bionomiji ameriškega škržatka, ki so bili pridobljeni v letu 2012, tako v nadzorovanih razmerah, rastni komori, kot tudi na prostem, v vinogradih. Podatki bodo prispevali k razvoju modela za napovedovanje zatiranja ameriškega škržatka.

#### ABSTRACT

#### **Development phenology model for management American leafhopper (*Scaphoideus titanus* Ball) - preliminary results**

*Scaphoideus titanus* is a leafhopper, the natural vector of the phytoplasma that causes "flavescence dorée" (FD), the most important causer of grapevine yellow diseases. The most important measure for successful prevention of FD in vineyards is timely management of *Scaphoideus titanus*. For this purpose we began to develop a phenology model that will contribute to predict timely application of insecticides to control larva and adult leafhoppers. The most important data which are necessary to include into phenology model are: post-dormancy egg development, patterns of egg hatching, duration of developmental stages of larvae and nymphs and development of adult leafhoppers. In the following contribution present the bionomics data of American leafhopper, which were obtained in 2012, under controlled conditions, growing chamber, as well as outdoors in vineyards. The data will contribute to development of phenology model for predict the management of American leafhopper.



#### **Izkušnje z zatiranjem ameriškega škržatka (*Scaphoideus titanus* Ball) v obdobju 2008-2012 v severovzhodni Sloveniji**

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Ameriški škržatek (*Scaphoideus titanus* Ball) je glavni prenašalec zlate trsne rumenice, bolezni na vinski trti, ki jo povzroča karantenska fitoplazma Grapevine Flavescence dorée (FD). Preprečevanje širjenja in zatiranje zlate trsne rumenice (FD) je mogoče le z uspešnim zatiranjem ameriškega škržatka. V prispevku prikazujemo rezultate petletnih preizkušanj nekaterih insekticidov za zatiranje ameriškega škržatka v severovzhodnem delu Slovenije. V poskusih smo preizkušali učinkovitost delovanja insekticidov za zatiranja ameriškega škržatka z enim oz. dvema škropljenjema v dveh različnih terminih (prvi termin je bil po končanem cvetenju vinske trte, drugi termin pa v času zatiranja grozdnih sukačev 2. rodu), uporabljeni so bili naslednji insekticidi: Actara 25 WG, Decis 2,5 EC, Kenyatox verde,

Pyrinex 25 CS, Reldan 22 EC in Steward. Najvišjo učinkovitost so pokazali postopki, v katere sta bila vključena insekticida Actara 25 WG in Reldan 22 EC.

#### **ABSTRACT**

#### **Experiences with controlling the American leafhopper (*Scaphoideus titanus* Ball) in the period 2008-2012 in northeastern part of Slovenia**

American grapevine leafhopper is a main vector of the grapevine phytoplasma that causes »Flavescence dorée« (FD). Prevent the spread and control of FD is possible only with the successful control of American grapevine leafhopper. In the article we present the five-year results of testing some insecticides against American grapevine leafhopper in northeastern part of Slovenia. In trials we are testing efficacy of insecticides against American grapevine leafhopper with one or two sprayings in two different times of spraying (first spraying was performed after flowering of grape vine and second in the time of controlling the second generation of European grapevine moth and vine moth). In the trials were used insecticides Actara 25 WG, Decis 2,5 EC, Kenyatox verde, Pyrinex 25 CS, Reldan 22 EC and Steward. The highest efficacy was shown by variants with insecticides Actara 25 WG and Reldan 22 EC.



#### **Prostorska in časovna razporeditev fitoplazme FDp v vinski trti**

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V raziskavi, ki je del evropskega projekta VITISENS, in je bila objavljena v reviji Plant Pathology, 2012, Doi: 10.1111/j.1365-3059.2012.02693.x, smo z uporabo kvantitativnega PCR v realnem času sledili sezonskim spremembam titra fitoplazme flavescence dorée (FDp) v kultivarjih modra frankinja in refošk v dveh vinogradih v dveh podnebno različnih območjih Slovenije. Poleg znane prisotnosti FDp v listnih žilah, smo to fitoplazmo zasledili tudi v cvetovih, jagodah in viticah. V rastlinah, kjer je bila koncentracija FDp visoka v simptomatičnih tkivih, smo fitoplazmo detektirali tudi v nesimptomatičnih tkivih. Zaznali smo trend zmanjševanja titra FDp v vseh pregledanih nesimptomatičnih tkivih od junija do avgusta in sočasno povečevanje v simptomatičnih. V skladu s tem je bila pozno spomladi FDp prisotna v določljivih količinah v cvetovih, pecljih in žilah skoraj vseh okuženih rastlin in poleti določena v vseh pregledanih tkivih. Najvišji titer smo določili avgusta v jagodah. Raziskava je pokazala, da se ob odsotnosti ustreznih ukrepov okužba s FDp širi eksponentialno, letno s faktorjem 40.

#### **ABSTRACT**

#### **Spatiotemporal distribution of FD phytoplasma in grapevine**

In this study, which is part of the EU project VITISENS, and has been published in the journal Plant Pathology, 2012, Doi: 10.1111/j.1365-3059.2012.02693.x, quantitative real-time PCR was used to follow the seasonal changes of flavescence dorée phytoplasma (FDp) titre in grapevines of cv. Modra frankinja and cv. Refošk from two vineyards located in climatically different vine-growing regions of Slovenia. Besides its known presence in



the leaf veins, FDp was also detected in flowers, berry tissues and tendrils. In plants with high concentrations of FDp in tissues with symptoms, phytoplasma was also detected in symptomless tissues. A trend of decreasing FDp titre in all examined symptomless tissues from June to July and an increasing one throughout the growing season in tissues with symptoms was recorded. Accordingly, FDp was present in detectable amounts in flowers, petioles and veins of almost all infected plants in the late spring, and was detected in all examined tissue types in summer, with the highest titre in berries in August. The study showed that in the absence of plant health measurements an FDp infection may spread exponentially by a factor of 40 per year.



### **Uvajanje metode daljinskega zaznavanja pri nadzoru zlate trsne rumenice (*Flavescence dorée*)**

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Zlato trsno rumenico (Grapevine *Flavescence dorée*) povzroča karantenska fitoplazma vinske trte, ki se vztrajno širi po Sloveniji in je v različnem obsegu zastopana že v vseh treh vinorodnih deželah. V nadzor in obvladovanje širjenja zlate trsne rumenice je vključeno obsežno terensko delo, ki ga je zaradi omejenih človeških zmogljivosti in razpoložljivih finančnih sredstev ter nenazadnje velikosti terena, težko izvajati v obsegu, kot ga pojav bolezni narekuje. V želji, da terensko delo izvajamo bolj usmerjeno, tudi na lokacijah, ki so težje dostopne, je bilo v letu 2011 naročeno satelitsko snemanje varnostnega območja na Primorskem ter dela območja na Dolenjskem. Posnetki so bili narejeni s satelitom WorldView 2, za katerega je značilna visoka prostorska in spektralna ločljivost. Senzorji na satelitu merijo odboj sončnega sevanja pri različnih valovnih dolžinah vidnega spektra ter bližnjega infrardečega spektra. Ker objekti na zemeljskem površju v različnem obsegu odbijajo, vpijajo ali prepuščajo posamezne valovne dolžine elektromagnetnega valovanja, lahko z analizo odbitega dela valovanja, ki ga beležijo senzorji satelita, ločimo objekte ali različne lastnosti istega objekta. To zakonitost želimo izkoristiti pri določanju rastlin, ki imajo potencialna znamenja okužbe s fitoplazmo. V prispevku bodo prikazani dosedanja rezultati iskanja ustreznega algoritma, ki bi omogočil zadovoljivo ločevanje zdravih in potencialno okuženih rastlin. Delo je v prvi fazi omejeno na žarišče Viližan z okolico, kjer je bilo v času snemanja narejeno tudi obsežno terensko mapiranje rastlin v okuženih vinogradih.

#### **ABSTRACT**

#### **Application of remote sensing in Grapevine yellows (Grapevine *Flavescence dorée*) control**

Grapevine yellows (Grapevine *Flavescence dorée*) is a quarantine phytoplasma on grapevine, which has grown steadily in the Slovenian territory and, it is in varying degrees already present in all three wine regions. Extensive field work is included in control and containment of the grapevine yellows which is due to limited human capacity and financial resources available and ultimately the size of the terrain, difficult to apply to the extent dictated by the disease. In an effort to carry out field work more focused, even in locations

that are difficult to access, satellite images recording of safety zone of Primorska and part of delimited area in Dolenjska region have been provided. Recordings were made by Worldview 2 satellite, which is characterized by high spatial and spectral resolution. Sensors on the satellite measured reflected solar radiation at different wavelengths of the visible spectrum and near-infrared spectrum. Since objects on the earth's surface to varying degrees, reflect, absorb or transmit specific wavelengths of electromagnetic radiation, the analysis of the reflected wave recorded by the satellite sensors is possible to distinguish among different objects or properties of that object. We want to use this phenomenon to determine the plants that have the potential signs of infection with phytoplasma. In this paper, the results of the right algorithm definition that were obtained so far and would allow a satisfactory separation of healthy and potentially infected plants, will be presented. The work in the first phase is limited to focus Viližan and surroundings where during the satellite recording also extensive field mapping in plants infected vineyards was done.



### **Prepoznavanje in možne zamenjave zgodnjih simptomov na vinski trti**

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Določeni organizmi so patogeni že v zgodnjih razvojnih stadijih vinske trte. V času intenzivne rasti mladik prihaja do pogostejših zamenjav med posameznimi povzročitelji. Določitev je zahtevnejša tudi zaradi njihove manjše izrazitosti. Posledice napačnega prepoznavanja se kažejo v zgrešeni in pogosto pretirani uporabi fitofarmaceutskih sredstev. Ključ za uspešno in racionalno varstvo je v pravilnem in pravočasnem ločevanju zgodnjih simptomov. V prispevku želimo predstaviti simptomatiko akarinoze (*Calepitrimerus vitis* Nalepa), antraknoze (*Elsinoë ampelina* Shear) in črne pegavosti vinske trte (*Phomopsis viticola* Saccardo). Hkrati obravnavamo tudi simptome fitotoksičnosti, do katerih prihaja bodisi zaradi uporabe sredstev za varstvo rastlin ali po uporabi kemičnih pripravkov na trsnih cepljenkah. Izhajali smo iz obravnave vzorcev laboratorija za varstvo rastlin, kakor tudi terenskih fitosanitarnih pregledov Službe za varstvo rastlin na KGZS – Zavodu NM.

#### **ABSTRACT**

### **Recognition and possible misconceptions of early symptoms on grape vine**

Pathogenicity of certain organisms on grapevine is present already in the early phenological stages. During intensive growth of young shoots we are often facing with misconceptions of causal agents. Identification is demanding because of their lower intensity. Consequences are noticeable within misplaced and often overused plant protection products. Correct recognition of early symptoms is the key for successful and rational protection. We are pointing out the symptoms of grape rust mite (*Calepitrimerus vitis* Nalepa), grapevine anthracnose (*Elsinoë ampelina* Shear) and dead-arm of grapevine (*Phomopsis viticola* Saccardo). At the same time we cover the symptoms of phytotoxicity caused by plant protection products or other substances used on grapevine rootstock material. Data for the study is gained during laboratory analyses of grapevine samples and vineyard inspections of Plant protection service at Regional Agricultural and Forestry Institute of Novo mesto.



## Grapevine Pinot gris virus na vinski trti tudi v Sloveniji

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Že leta 2001 smo na Primorskem prvič zasledili pojavljanje nenavadnih bolezenskih znamenj na vinski trti, katerih vzrok bi lahko bila tudi virusna okužba. Ta so se kazala kot zbitost poganjkov, slabši razvoj listov, lisavost in deformacije listov ter posledično slabša rast trsov. Največ bolezenskih znamenj smo v začetku opazili pri sortah Sivi pinot in Zeleni sauvignon, pozneje pa smo le-ta opazili tudi pri večini ostalih sort vinske trte na Primorskem. V analiziranih vzorcih nismo uspeli dokazati virusov. Glede na opisana bolezenska znamenja in odsotnost virusnih okužb smo domnevali, da gre za Petrijevo bolezen, ki je največkrat povezana z glivami iz rodov *Phaeoacremonium* in *Phaeomoniella*. Podobno bolezen so opazili tudi v severni Italiji in v nedavni raziskavi z novimi metodami sekvenciranja v vinski trti našli nov virus, poimenovan Grapevine Pinot gris virus (GPgV). Raziskave o povezanosti virusne okužbe s pojavom bolezni pri njih še potekajo. V raziskavah opravljenih v letu 2012 na obolelih trsah v Vipavski dolini smo ugotovili visok delež okužb z GPgV. Zaradi širjenja bolezni v primorskih vinogradih moramo nujno čim prej ugotoviti, za katero bolezen gre, kateri so njeni povzročitelji in kakšne so možnosti za njeno obvladovanje.

### ABSTRACT

#### Grapevine Pinot gris virus was found on grapevine also in Slovenia

Unusual virus-like symptoms were first observed on grapevine in Primorska region in 2001. On grapevine varieties Pinot Gris and Sauvignon Vert shortened internodes, poor development of leaves, mottling and deformations of leaves and consequently poor development of vines were observed. Later on the symptoms were observed also on majority of other grapevine cultivars grown in this region. No common grapevine viruses were detected in analyzed samples. According to disease symptoms and absence of viruses we assumed the disease to be the Petri disease. It is usually associated with the fungi of the genus *Phaeoacremonium* in *Phaeomoniella*. Similar disease was observed also in northern Italy. A new virus, named Grapevine Pinot gris virus (GPgV) was found recently using deep-sequencing. Studies on the association of the virus with the disease are under way. The research on symptomatic vines conducted in 2012 in Vipava valley revealed a high incidence of GPgV. The beforementioned disease is spreading in Primorska region and is causing big problems in grapevine production. It is therefore necessary to discover the cause of the disease and the methods for its control.



## **Epidemiologija antraknoze vinske trte s povzročiteljem *Elsinoë ampelina* [Shear])**

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Antraknoza vinske trte, ki jo povzroča gliva *Elsinoë ampelina*, je bolezen, ki je na našem območju zastopana že daljše časovno obdobje. Ob redni uporabi fungicidov se je njen pojav dokaj uspešno omejeval in posledično pri pridelavi grozdja ni predstavljala resne gospodarske škodljivosti. Posebnosti posameznih vremenskih dejavnikov v zadnjem petletnem obdobju so začele omogočati razmere, ki ugodno vplivajo na razvoj patogena. Izstopajo leta 2009, 2010 in 2011, v katerih je začel obseg škode hitro naraščati, a je še vedno ostajal omejen na ljubiteljsko pridelavo, značilno za območje vinorodne dežele Posavje. V tem obdobju smo sledili razvoju in širjenju bolezni ter beležili razmere, ki omogočajo njen intenzivnejši pojav.

### **ABSTRACT**

#### **Epidemiology of grapevine anthracnose with pathogen *Elsinoë ampelina* (Shear)**

Grapevine anthracnose caused by *Elsinoë ampelina* is a disease, which is present in our region for a long time period. Regular practice of fungicides effectively constrained its incidence and consequently didn't represent serious economic harm for grape production. Specifics of different weather parameters in last five year period enabled conditions which favourable influence pathogen progress. Emphasized are years 2009, 2010 and 2011, when notable economic damage started to increase, yet was still constrained to low level production distinctive for winegrowing region of Posavje. In this period we followed disease development, as well as expansion and tracked conditions suitable for its intensity.



#### **Vpliv metode ocenjevanja stopnje napada pri določanju učinkovitosti fungicidov za zatiranje oidija vinske trte (*Uncinula necator*).**

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Ocenjevalci na terenu uporabljajo različne metode za ocenjevanje stopnje napada bolezni na vinski trti. Da bi ugotovili, ali metode ocenjevanja stopnje napada bolezni vplivajo na dobljene rezultate pri določanju učinkovitosti fungicidov za zatiranje oidija vinske trte, smo na Fakulteti za kmetijstvo in biosistemske vede v Mariboru izvedli praktičen in teoretičen poskus. V okviru teoretičnega poskusa smo izbrali več nizov podatkov, na katerih smo opravili statistične izračune na različne načine. Potem smo preverili, ali smo dobili primerljive rezultate pri različnih načinih izračuna stopnje napada bolezni. Praktični poskus smo izvedli v letu 2007, in sicer v vinogradu na lokaciji Nebova pri Mariboru, kjer

smo ocenjevali stopnjo napada oidija vinske trte na trsih sorte 'Laški rizling'. Stopnjo napada boleznimi smo vizualno ocenjevali po prilagojeni ocenjevalni lestvici 0-5 (Thownsend-Heuberger metoda), katera se v praksi pogosto uporablja. Dobljene rezultate smo primerjali z rezultati, pridobljenimi po neposredni metodi ocenjevanja odstotka napadene površine. Z analizo variance smo ugotavljali statistično značilne razlike med rezultati, dobljenimi z obema metodama. Ugotovili smo, da je bolj smiselno neposredno ocenjevanje (% površine) kot uporaba lestvic.

#### **ABSTRACT**

#### **Influence of the disease rate scouting method on the evaluation of efficacy of fungicides for control of grape wine powdery mildew (*Uncinula necator*)**

Evaluators use various methods for assessing infection rates of grapevine diseases in the field. To determine whether the disease rate assessment methods have any influence in determining the effectiveness of fungicide treatments on the degree of grapevine powdery mildew control, theoretical and practical experiments were performed at the Faculty of Agriculture and Life Sciences in Maribor. Several data sets were chosen on the basis of which the degree of disease rate was calculated according to different methods. Later results of different methods were compared to determine whether they yielded comparable results. Theoretical part of the experiment served as a basis for practical part, i.e., for the field experiment carried out on 'Laški rizling' vineyard in 2007 at Nebova. The degree of disease infection was firstly assessed visually according to adjusted bonitur scale 0-5 (Thownsend-Heuberger calculation), which is commonly used in practice. Results were compared to those obtained by direct method of assessment of percent diseased area. Analysis of variance was used to determine statistically significant differences between results obtained by aforementioned methods. The results show that the direct assessment method could be more suitable than different scouting scales for the assessment of percent diseased area.



#### **Dynali - zanesljiv in prilagodljiv – za trajnostno varstvo pred pepelovko vinske trte**

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Dynali je nov fungicidni pripravek za zatiranje pepelovke vinske trte v vašem vinogradu v najbolj občutljivem obdobju. Odlikuje ga edinstvena kombinacija dveh načinov delovanja, preventivnega in kurativnega, ki skupaj s translaminarnim delovanjem in tako imenovanim parnim delovanjem, nudi sinergistični učinek in zagotavlja najboljše varstvo in kakovost grozdja.

#### **ABSTRACT**

#### **Dynali – reliable and flexible - for sustainable protection against powdery mildew on grapevines**

Dynali is a new benchmark grape powdery mildew fungicide mixture dedicated to protect vineyards in the highest disease sensitive period. It has the unique combination of two mode of action, preventive and curative, combined with translocation and vapour phase activity, it delivers a synergistic effect to secure the quality of bunches.



## Traheomikoze v vinogradih vinorodne dežele Posavje

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S traheomikoznimi obolenji na vinski trti se pogosteje srečujemo zlasti v letih z izrednimi vremenskimi razmerami. Označujemo jih kot kap vinske trte. K lažjemu izražanju bolezenskih znamenj na vinski trti pripomorejo stresne razmere s pomanjkanjem vode in intenzivnejšo evapotranspiracijo. Po zunanjih bolezenskih znamenjih lahko opisujemo različne pojave eske, petrijeve bolezni, trsne metličavosti,... ki jih povzročajo v glavnem glive iz kompleksa *Phaeoacremonium*. S spremljanjem zdravstvenega stanja vinogradov na območju vinorodne dežele Posavje smo dobili vpogled v stopnjo okuženosti vinske trte z omenjenimi traheomikozami.

### ABSTRACT

#### Tracheomycotic diseases in vineyards of wine growing region Posavje

The incidence of tracheomycotic diseases is frequent mainly in the years with extraordinary weather conditions. They are characterized as grapevine trunk diseases. Symptoms are easily expressed during grapevine stress conditions considering water deficiency and intense evapotranspiration. After visual signs of disease we can describe different types of Esca, Petri disease, *Eutypa* disease,... which are caused mainly by fungi from *Phaeoacremonium* complex. Supervision of vineyards health condition gives assessment in grade of infection in the Posavje wine growing region.

## **Varstvo vrtnin in okrasnih rastlin**

## Laboratory bioassays of entomopathogenic or potentially plant growth promoting fungal strains for the control of cabbage root fly (*Delia radicum* L.) and their rhizosphere competence

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Entomopathogenicity of 9 entomopathogenic or potentially plant growth promoting fungal species was assessed against cabbage root fly (CRF) in soil and *in-vitro* laboratory bioassays. The fungal strains were isolated from various substrata in Slovenia. The soil experiments mimicked natural exposure pathways of the various insect life stages to the fungal strains. Spore concentrations used in soil tests were comparable to economic rates for in-furrow application ( $3.85 \times 10^6$  spores/g dry soil). The *in-vitro* tests were designed to screen aggressiveness of the various isolates to CRF. In *in-vitro* tests, 50  $\mu$ l of spore suspensions with a concentration of  $1 \times 10^8$  spores/ml were directly applied to CRF eggs. The following fungal species were tested: *Trichoderma atroviride* (2 strains), *T. koningiopsis* (1), *T. gamsii* (3), *Beauveria brongniartii* (1), *B. bassiana* (2), *Metarhizium robertsii* (1), *M. anisopliae* (4), *Purpureocillium lilacinum* (2) and *Clonostachys solani* (2). All isolates tested were infective to one or more life stages of CRF (eggs, larvae, pupae or imago). Abbott's corrected mortality in soil experiments ranged from  $2.4 \pm 13.0\%$  to  $68.2 \pm 21.5\%$  and in the *in-vitro* experiments from  $8.7 \pm 5.0\%$  to  $47.6 \pm 9.0\%$ . The 7 most pathogenic isolates (*T. atroviride*, *T. koningiopsis*, *T. gamsii*, *B. bassiana*, *M. anisopliae* (2 isolates) and *C. solani*) were further tested for their rhizosphere competence. The preliminary results showed that rhizosphere competence varied considerably, possibly due to the ecological preferences of the different fungal species. The use of these fungi as an alternative to chemical insecticides in organic and integrated management programs is discussed.

### IZVLEČEK

#### Laboratorijski poskusi entomopatogenih ali potencialno rast spodbujajočih gliv za zatiranje kapusove muhe (*Delia radicum* L.) in njihova rizosferna kompetenca

Ocenjevali smo entomopatogeni potencial devetih entomopatogenih ali potencialno rast spodbujajočih vrst gliv za zatiranje kapusove muhe (KM). Opravili smo laboratorijske 'substratne' in 'in vitro' poskuse. Vse glive so bile izolirane iz različnih substratov iz Slovenije. V okviru substratnih poskusov smo posnemali naravne poti izpostavitve različnih razvojnih stadijev KM glivam: konidije preskušanih gliv smo vnesli v testni substrat. Uporabljene koncentracije konidijev so bile primerljive z realnimi koncentracijami komercialnih pripravkov na podlagi gliv ( $3,85 \times 10^6$  konidijev na gram zračno suhega testnega substrata). Testi *in vitro* so bili zasnovani za hitro preskušanje agresivnosti različnih izolatov gliv za KM. V testih *in vitro* je bilo 50  $\mu$ l suspenzije konidijev s koncentracijo  $1 \times 10^8$  spor / ml neposredno nanese na jajčeca KM. Preskušali smo naslednje vrste gliv: *Trichoderma atroviride* (2 seva), *T. koningiopsis* (1), *T. gamsii* (3), *Beauveria brongniartii* (1), *B. bassiana* (2), *Metarhizium robertsii* (1), *M. anisopliae* (4), *Purpureocillium lilacinum* (2) in *Clonostachys solani* (2). Vsi testirani izolati so uspešno okuževali eno ali več razvojnih stadijev KM (jajčeca, ličinke, bube ali imago). Smrtnost po



Abbottovemu popravku v substratnih poskusih je bila od  $2,4 \pm 13,0\%$  do  $68,2 \pm 21,5\%$ , v poskusih *in-vitro* pa od  $8,7 \pm 5,0\%$  do  $47,6 \pm 9,0\%$ . Sedem najbolj patogenih izolatov (*T. atroviride*, *T. konigiopsis*, *T. gamsii*, *B. bassiana*, *M. anisopliae* [2 izolata] in *C. solani*) je bilo dodatno testiranih za njihovo rizosferno prilagojenost. Prvi rezultati nakazujejo, da se rizosferna prilagojenost precej razlikuje, verjetno zaradi specifičnih okoljskih zahtev različnih izolatov gliv. V zaključkih razpravljamo o preskušanih glivah kot alternativni kemičnim insekticidom v ekološki in integrirani pridelavi.



## Spremljanje pojavljanja in možnosti napovedovanja kapusove muhe (*Delia radicum*) v Sloveniji

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Kapusova ali koreninska muha (*Delia radicum* L.) je znan in v Sloveniji zelo razširjen škodljivec v pridelavi kapusnic. Namen raziskave je bil preučiti sezonsko dinamiko odlaganja jajčec kapusove muhe v različnih pridelovalnih območjih kapusnic in ugotoviti, kako se terenski podatki ujemajo z napovedmi nemškega simulacijskega modela SWAT. Slednji za napoved dinamike populacije kapusove muhe potrebuje najmanj srednjo dnevno temperaturo zraka. Terenske podatke o odlaganju jajčec smo v letih 2011 in 2012 zbirali na treh lokacijah, v dveh podnebno različnih območjih Slovenije: v Jabljah v osrednji Sloveniji in Kovorju na severozahodu, ki pripadata zmernemu celinskemu podnebjju, ter v Bertokih (v 2011) oz. Škofijah (v 2012), ki ležita na jugozahodu Slovenije oz. v območju s submediteranskim podnebjem. Odlaganje jajčec smo spremljali tako, da smo v kapusnicah (cvetača in brokoli) okoli koreninskega vratu mladih rastlin namestili pasti iz filca. Med rastno dobo smo pasti pregledovali tedensko, v času vrha ovipozicije tudi 2-krat tedensko. Prva jajčeca kapusove muhe smo v obeh letih v Jabljah našli v 3. dekadi aprila, v Kovorju pa v 2. dekadi aprila. Na Primorskem je muha začela odlagati jajčeca v 2. dekadi aprila v letu 2011 oz. že v 3. dekadi marca v letu 2012. Prvi vrh ovipozicije je bil v 3. dekadi aprila (Primorska v obeh letih, Kovor v letu 2011) oz. v 1. dekadi maja (Jablje in Kovor v letu 2012). Kapusova muha je odlagala jajčeca tudi še v 1. dekadi oktobra, ko smo s spremljanjem zaključili. Rezultati potrjujejo, da ima kapusova muha pri nas tri rodove na leto. Prve primerjave terenskih podatkov kažejo razmeroma dobro ujemanje s simulacijo modela SWAT.

### ABSTRACT

### Monitoring and forecasting possibility of the cabbage root fly (*Delia radicum*) in Slovenia

The cabbage root fly, *Delia radicum* (L.), is a well known and widespread pest in the production of cole crops in Slovenia. The purpose of this study was to investigate a seasonal dynamics of oviposition of the cabbage root fly in different cole crop production areas and to determine how the field data correspond with the predictions of the German simulation model SWAT. The latter needs at least the mean daily air temperature for the

prediction of the population dynamics of the cabbage root fly. Field data on laying eggs were collected in 2011 and 2012 at three locations in two climatically different regions of Slovenia: Jablje in the central Slovenia and Kovor in the northwest belong to the moderate continental climate, Bertoki (in 2011) or Škofije (in 2012) in the southwest are situated in the sub-Mediterranean climate. The oviposition was monitored by installing a felt trap around the stem base of young plants of the cole crops (cauliflower and broccoli). During the growing season the felt traps were inspected weekly, during the oviposition peak they were inspected 2 times per week. The first eggs of the cabbage root fly in Jablje were found in both years in the third decade of April and those in Kovor in the second decade of April. In Primorska (the littoral region in the southwest of Slovenia) the cabbage root fly started to lay eggs in the second decade of April in 2011 and already in the third decade of March in 2012. The first oviposition peak happened in the third decade of April (in both years in Primorska and in 2011 in Kovor) and in the first decade of May (Jablje and Kovor in 2012). The cabbage root fly still laid eggs in the first decade of October when the monitoring was completed. The results obtained confirm the fact that the cabbage root fly in Slovenia has three generations per year. The first comparisons of the field data show a relatively high degree of agreement with those of the SWAT simulation model.



### **Je z mešanicami križnic kot privabilnimi rastlinami mogoče zmanjšati škodljivost kapusovih bolhačev (*Phyllotreta* spp.) na zelju?**

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Dvoletni poljski poskus (2009-2010), kjer smo preučevali obseg škodljivosti kapusovih bolhačev (*Phyllotreta* spp.), je potekal na dveh lokacijah v Sloveniji. Želeli smo preizkusiti ustreznost krmne ogrščice, bele gorjušice in oljne redkve kot potencialne privabilne posevke za kapusove bolhače, z namenom varovanja zelja. Na obeh lokacijah smo potrdili signifikanten vpliv vrste križnice na dovzetnost hranjenja omenjenih žuželk. Indeks poškodb na oljni redkvi je bil v večini rastne dobe signifikatno najvišji, medtem ko so kapusovi bolhači kazali preferenco do hranjenja na krmni ogrščici in beli gorjušici le v določenem obdobju rastne dobe. Ugotovili smo, da so se prve poškodbe kapusovih bolhačev začele pojavljati v prvi polovici maja, največji njihov obseg pa smo ugotovili v začetku julija. Rezultati raziskave dokazujejo, da lahko z metodo privabilnih posevkov uspešno nadzorujemo obseg poškodb kapusovih bolhačev na glavnem posevku – zgodnjem in srednjem poznem hibridu zelja, vendar obstajajo razlike v njuni dovzetnosti. V prispevku bo predstavljena analiza spremljanja obsega poškodb zaradi kapusovih bolhačev na različnih vrstah križnic.

#### **ABSTRACT**

### **Is sowing mixtures of *Brassica* species as trap crops effective against cabbage flea beetle (*Phyllotreta* spp.) injury on cabbage?**

Two-year field experiment (2009-2010) in which we studied the extent of damage done by cabbage flea beetles (*Phyllotreta* spp.) to four different species of Brassicas was carried out at two locations in Slovenia. We wished to establish adequacy of oilseed rape, white mustard and oil radish as possible trap crops for the purpose of protecting cabbage

against injury of cabbage flea beetles. The damage index on oil radish was almost throughout the growth period significantly the highest, while cabbage flea beetles showed preference to feed on oilseed rape and white mustard only during a certain part of growing period. Cabbage flea beetles began appearing in the first half of May, while the highest extent of damage was established in the beginning of July. Our survey established the fact, that trap cropping as a plant protection method can be effective against *Phyllotreta* spp. injury on two different cabbage hybrids – early and medium late hybrids. The differences between their susceptibility was detected. Complete analysis of *Phyllotreta* spp. feeding on different *Brassica* species will be presented in this paper.



## **Izsledki ugotavljanja zastopanosti paradižnikovega molja (*Tuta absoluta* Povolny) v Sloveniji v obdobju 2009-2012**

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Paradižnikov molj (*Tuta absoluta* Povolny) je invazivna južnoameriška vrsta, ki lahko na rastlinah (predvsem paradižniku) iz družine razhudnikovk (Solanaceae) povzroča veliko škodo. V Evropi se je paradižnikov molj prvič pojavil v letu 2006, v Sloveniji pa je bil škodljivec prvič ugotovljen v zavarovanih prostorih v letu 2009, od koder se je razširil na vsa območja v Sloveniji, kjer pridelujemo paradižnik. Z uporabo feromonskih vab ('delta traps') in masovnega lovljenja, smo v letih 2010-2012 ugotavljali dejansko zastopanost in razširjenost škodljivca na pridelovalnih območjih v Sloveniji, čas in dinamiko pojavljanja ter njegovo bionomijo. Spremljali smo zdravstveno stanje listov in plodov paradižnika, iskali poškodbe na drugih potencialnih gostiteljih iz družine razhudnikovk in preučevali možnosti za zatiranje oziroma omejevanje škodljivca. Nekateri podatki kažejo, da paradižnikov molj v Sloveniji predstavlja resno grožnjo predvsem tistim pridelovalcem, ki gojijo paradižnik v rastlinjakih pozno poleti in v začetku jeseni. V prispevku so predstavljeni izsledki posebnega nadzora v letih 2010-2012 po posameznih letih in njihova primerjava.

### **ABSTRACT**

#### **The results of determining the presence of tomato leafminer (*Tuta absoluta* Povolny) in Slovenia in the period 2009-2012**

Tomato leaf miner (*Tuta absoluta* Povolny) is an invasive South American species and could cause extensive damages on plants from family Solanaceae (especially on tomatoes). In Europe, it was first time identified in 2006, its presence was confirmed for the first time in greenhouses in Slovenia in 2009 as well. Now it is widespread on all areas in Slovenia, where tomato production is present. Presence and geographical distribution of tomato leaf miner in Slovenia with help of pheromone traps (delta traps) and mass trapping were examined from 2010 to 2012. During these years the time, dynamics of its appearance and bionomics also has been followed. Possible damage on leaves and fruits of tomato and injuries on potential host plants from family Solanaceae were observed. Some studies of its suppression were done. Some of results in Slovenia show, that tomato

leaf miner represent serious threat for farmers, who produce tomato in greenhouses during late summer and early autumn. The results of specific survey of tomato leaf miner in Slovenia in years 2010-2012, by single years and its comparison are presented in the article.



### **Raziskave ogorčic koreninskih šišk za namene izdelave modela napovedovanja škode**

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Ogorčice koreninskih šišk rodu *Meloidogyne* uvrščamo med gospodarsko najpomembnejše škodljivce med rastlinsko-parazitskimi ogorčicami. So obligatni zajedavci višjih rastlin, ki lahko napadajo eno- in dvokaličnice, lesnate in zelnate rastline. Vrsta *M. ethiopica* je bila prvič ugotovljena v Evropi ravno v Sloveniji leta 2004 in je bila pred kratkim uvrščena med 12 najpomembnejših škodljivih vrst ogorčic koreninskih šišk za kmetijsko pridelavo. V letu 2011 je bila vrsta uvrščena tudi na opozorilni seznam škodljivih organizmov EPPO. Opravili smo več raziskav s to škodljivo vrsto, z namenom pridobitve podatkov, ki bi jih lahko uporabili za izdelavo modela napovedovanja škode. Dolžina razmnoževalnega kroga je pri ogorčicah koreninskih šišk zelo odvisna od temperature tal. Pri vrsti *M. ethiopica* je ta znašala 67 dni pri 18,3 °C, 48 dni pri 22,7 °C in 36 dni pri 26,3 °C v razmerah rastne komore. Pri 13,9 °C se vrsta ni razmnoževala. V drugem eksperimentu smo določili bazalno temperaturo, ki še omogoči ogorčicam vstop v korenino gostitelja in nadaljnji razvoj. To smo zaznali pri 14 °C. Dobljene podatke smo uporabili za izračun korelacije med temperaturo in dolžino razmnoževalnega kroga. Izračunali smo matematično funkcijo za temperaturno območje med 14 in 26,3°C. Opravili smo tudi poskus, kjer smo testirali uporabnost dobljene funkcije v poljskih razmerah, kjer temperatura niha. Kot gostiteljsko rastlino smo uporabili rastline paradižnika, ki smo jih inokulirali z jajčeci ogorčic. Dobljeni podatki so potrdili uporabnost razmnoževalne krivulje v poljskih razmerah in jih bomo uporabili za izdelavo modela škode.

#### **ABSTRACT**

### **Research on the root-knot nematodes to develop the model for damage prediction**

The root-knot nematodes (RKNs) of the genus *Meloidogyne* belong to the economically most important group of the plant parasitic nematodes. They are obligate parasites that attack numerous higher plant species including mono- and dicotyledons, herbaceous and woody plants. *M. ethiopica* was found in Europe for the first time in Slovenia in 2004. The species was recently included in a group of the 12 most important RKNs for agricultural production. It was listed on the EPPO Alert list of the harmful organisms in 2011. We have performed several experiments with this pest species in order to obtain data which could be used for development of the damage prediction model. The length of the reproduction cycle of RKNs is highly dependent on the soil temperature. *M. ethiopica* required 67, 48 and 36 days to complete the reproduction cycle at the mean daily temperatures of 18.3, 22.7 and 26.3 °C, respectively, at a growth chamber controlled conditions. At 13.9 °C the species was not able to reproduce. Additionally, the base temperature of the nematode entry into the host roots and further development was established at 14 °C. The data were used for calculating the correlation between the temperature and the reproduction cycle

duration. The obtained mathematical equation covered the temperatures ranging between 14 and 26.3 °C. An additional experiment was set up to test the applicability of the reproduction curve in the open field conditions where soil temperatures vary. The tomato plants which were used as host plants were inoculated with *M. ethiopica* eggs. The obtained data proved the usefulness of the reproduction curve in the open field conditions and will be used for the development of the damage prediction model.



## **Varstvo kapusnic pred škodljivci – stanje, možnosti in izzivi v integrirani pridelavi v Sloveniji**

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V prispevku bomo razpravljali o trenutnem stanju pri pridelavi kapusnic v Sloveniji, s poudarkom na zatiranju škodljivcev. Opozorili bomo na najbolj pereče težave, povezane s škodljivci kapusnic, in predstavili obstoječe prakse integriranega varstva pri nas. Predlagali bomo nekatere možnosti za izboljšanje obstoječih praks ter razpravljali o pomenu iskanja celovitih rešitev za obvladovanje škodljivcev. Kapusnice so v Sloveniji najbolj razširjena skupina zelenjadnic. V naših okoljskih razmerah največ težav povzročajo škodljivci, saj se na kapusnicah in njim sorodnih plevelih hrani prek 20 gospodarsko pomembnih fitofagnih vrst. Najpogosteje škodo povzročajo različne vrste kapusovih bolhačev (*Phyllotreta* sp.), kapusova muha (*Delia radicum*) in kapusova sovka (*Mamestra brassicae*). Vse bolj razširjena sta kapusov molj (*Plutella xylostella*) in kapusova hrčica (*Contarinia nasturtii*), lokalno pa lahko večje škode povzročajo tudi kapusova uš (*Brevicoryne brassicae*), kapusov belin (*Pieris brassicae*), repni belin (*Pieris rapae*) in kapusove stenice (*Eurydema* sp.). Zaradi številnosti in raznolikosti vrst je varstvo kapusnic pred škodljivci zahtevna naloga. Majhen izbor insekticidov to nalogo še otežuje in hkrati predstavlja izziv za iskanje nekemičnih oz. alternativnih načinov zatiranja škodljivcev. Pri nas integrirano varstvo kapusnic pred škodljivci temelji predvsem na uporabi dovoljenih kemičnih sredstev, vendar zaradi različnih vzrokov pogosto ni dovolj uspešno. Ugotavljamo, da je pri obstoječih praksah še veliko možnosti za izboljšave, temelj za te pa je predvsem dobro poznavanje bionomije posameznih vrst škodljivcev, njihovo natančno spremljanje in poznavanje delovanja posameznih sredstev. Le to nam namreč omogoča pravočasno in ustrezno ukrepanje. Poleg tega je tako pri kemičnem varstvu kot pri drugih načinih bistveno, da je pristop celovit in ne usmerjen le v zatiranje ene vrste škodljivca. K iskanju celovitih okolju prijaznih rešitev zatiranja škodljivih organizmov na kapusnicah so usmerjene raziskave v okviru PURE projekta 7. okvirnega programa EU, ki jih izvajamo tudi v Sloveniji.

### **ABSTRACT**

#### **Cole crops protection against insect pests – situation, possibilities and challenges in integrated production in Slovenia**

Paper describes the current situation in the cole crops production in Slovenia with a focus on the control of insect pests. The main problems are pointed out and existing practices of integrated pest management described. Some possibilities for the improvement of the

existing practices are suggested and the importance of comprehensive solutions is discussed. Cole crops are the most important group of vegetables in Slovenia. In our ecological conditions the main problems in pest management are caused by insects since more than 20 economically important fitofagous species feed on cole vegetables and related weeds. The damage is frequently caused by different cabbage flea beetles (*Phyllotreta* sp.), cabbage root fly (*Delia radicum*) and cabbage moth (*Mamestra brassicae*). The damage by diamondback moth (*Plutella xylostella*) and Swede midge (*Contarinia nasturtii*) is increasing. Locally, large damage can be caused also by cabbage aphid (*Brevicoryne brassicae*), large and small white (*Pieris brassicae* and *Pieris rapae*) and stink bugs (*Eurydema* sp.). Due to number and diversity of species, the management of harmful insects in cole crops is a challenging task. Limited assortment of fitofarmaceutical products makes this task even harder and, at the same time, possesses a challenge to search for alternative techniques for insect pest management. In Slovenia, integrated pest management in cole crops is based on application of permitted chemical substances; nevertheless it is often not successful enough for various reasons. By our opinion there are several possibilities for improvement of existing management practices, the basis for them being good knowledge of insect's biology, their precise monitoring and good knowledge of particular substance action. Only then can the measures be taken on time and properly. Beside that it is essential that the management, chemical or/and by other techniques, is comprehensive and not pointed only towards single pest. The comprehensive and environmental friendly solutions for pest management are the subject of research of the PURE project of the 7<sup>th</sup> Framework Programme, which are conducted also in Slovenia.



### **Bakteriofagi kot alternativni način zatiranja povzročiteljev boleznih orhidej**

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Mehka gniloba na orhidejah je bakterijska bolezen, ki pri pridelovalcih orhidej povzroča veliko izgubo. Proti bakterijskim boleznim rastlin ne poznamo učinkovitega kemičnega varstva, zato je razvoj učinkovitih alternativnih načinov zatiranja bakterijskih boleznih zelo pomemben. Odstranjevanje okuženih rastlin sicer pomembno prispeva k zmanjšanju širjenja boleznih, vendar je za učinkovit nadzor boleznih boljše preventivno varstvo. Namen naše raziskave je razvoj varstva orhidej z bakteriofagi, ki so specifični za bakterije mehkih gnilob. Prednost uporabe bakteriofagov za zatiranje boleznih je v tem, da ne poškodujejo rastlinskih celic in okužujejo le ciljne bakterije. Za uspešno izolacijo učinkovitih bakteriofagov je pomembna izolacija ciljnih bakterij, ki povzročajo mehko gnilobo orhidej. Bakterije smo izolirali iz listov orhidej z bolezenskimi znamenji gnitja, njihovo patogenost za orhideje pa smo preverili z okuževanjem orhidej v rastlinjaku. Vse bakterije smo določili z metodami BOX-PCR, sekvenciranjem gena *fliC* in PCR v realnem času. Za izolacijo bakteriofagov smo ekstrakte listov orhidej z bolezenskimi znamenji gnitja obogatili z mešanico bakterijskih izolatov, ki se glede na PCR v realnem času uvrščajo v skupino bakterij mehkih gnilob (ex *Erwinia chrysantemi*, *Dickeya* spp.). Izolirali smo 5 ras bakteriofagov, ki v *in vitro* razmerah uspešno razgrajujejo bakterijske celice. Nadaljne

raziskave so usmerjene k *in vivo* preverjanju učinkovitosti izoliranih bakteriofagov na orhidejah v rastlinjaku. Razvoj uporabe bakteriofagov lahko predstavlja učinkovit način varstva orhidej pred boleznijo mehkih gnilob.

#### ABSTRACT

#### **Bacteriophages as alternative control of orchids disease**

Soft rot of orchids is bacterial disease, that causes huge loss in commercial orchid production. Effective chemical protection for bacterial diseases of plants is not known. Elimination of diseased plants is ineffective, therefore the research of effective alternative disease control is needed. Our aim is to develop a plant protection with bacteriophages, that are specific for soft rot bacteria. The advantages for bacteriophage application are that they do not harm plant cells and that they attack only target bacteria. For successful isolation of effective bacteriophages, the isolation of target bacteria is significant. Bacteria were isolated from rotten orchid leaves, the pathogenicity test on orchids in greenhouse was performed to confirm the pathogenicity of isolates. All bacterial isolates were characterized by BOX-PCR, *fliC* sequencing and real-time PCR. For bacteriophage isolation the rotten orchids leaves extracts were enriched by mix of isolates, that based on real time PCR classify into soft rot bacteria group (ex *Erwinia chrysantemi*, *Dickeya* spp.). 5 bacteriophages were isolated, all successfully lyse bacterial cells *in vitro*. Further research is oriented in confirming bacteriophage efficiency *in vivo* on orchids in greenhouse. Development of bacteriophage application can represent the effective soft rot disease protection.

*Izvečki referatov 11. slovenskega posvetovanja o varstvu rastlin z mednarodno udeležbo  
(in okrogla miza o zmanjšanju tveganja zaradi rabe FFS v okviru projekta CropSustaIn), Bled 2013*



## **Posterji**

## Possibility of quick detection of *Leptinotarsa decemlineata* (Say) sensitivity to insecticides

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The sensitivity of 10 field populations of Colorado potato beetle (*Leptinotarsa decemlineata* Say) - CPB (Žednik, Vrbas, Mikićevo, Ljutovo, Đurđin, Alibunar, Banatski Brestovac, Gloganj, Kačarevo and Pančevo) was determined in laboratory conditions. Bioassay was performed using screening test that allows rapid assessment of sensitivity of overwintered adults to insecticides. Sensitivity to four insecticides most commonly used in CPB control in Serbia (chlorpyrifos, cypermethrin, thiamethoxam and fipronil) was assessed. Insecticides were applied by soaking method at label rates, and two, five and 10 fold higher rates. Insect mortality was assessed after 72 h. Sensitivity of CPB adults was determined according to modified IRAC method (2009) using 1-5 scale (1- highly sensitive populations /E = 100%/; 2 - sensitive /100> E ≥ 95%/; 3 - slightly resistant /95> E ≥ 90%/; 4 - resistant /90> E ≥ 50%/; 5 - highly resistant /E <50%/). The aim of the study was the creation of simple and rapid test for assessment of sensitivity levels of CPB to insecticides and confirmation of resistance, as well as providing simplified presentation of results. Out of 10 monitored populations of CPB, one was highly sensitive, four were sensitive, three slightly resistant and two resistant to chlorpyrifos label rate. Three populations were highly sensitive, three sensitive and four slightly resistant to cypermethrin. To thiamethoxam applied label rate, six populations were highly sensitive, one was sensitive and two slightly resistant. Regarding fipronil, two populations were highly sensitive, five were sensitive, one was slightly resistant and two were resistant. Analyzing the efficacy of recommended application (label) rates of insecticides, we tended to simulate the effects that persist in field. The application of two, five or 10 fold higher rates aimed to verify that individuals from the same population survive higher rates of insecticides. The abovementioned indicate which part of CPB population is not sensitive, tolerates or demonstrates reduced sensitivity to the label rates, or indicates that individuals have developed resistance.



## Prvi rezultati ulova poljskega majskega hrošča (*Melolontha melolontha* L.) s svetlobnimi in alkoholno-feromonskimi vabami

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Škode zaradi prerasnožitve poljskega majskega hrošča (*Melolontha melolontha* L.) na travinju se v Sloveniji pojavljajo že od leta 2002. Zatiranje škodljivca je oteženo, ker v Sloveniji nimamo registriranih insekticidov zoper ogrce majskega hrošča na travinju. V poskusu smo primerjali dve različni svetlobni in devet alkoholno-feromonskih vab, z namenom ugotavljanja številčnosti in dinamike populacije poljskega majskega hrošča ter z namenom iskanja ustrezne in cenovno sprejemljive metode zatiranja odraslih osebkov majskega hrošča. Primerjali smo ulov odraslih osebkov na belo in zeleno svetlobo, pri čemer smo ugotovili večji ulov na svetlobni vabi, ki je oddajala belo svetlobo. Pri preizkušanju alkoholno-feromonskih vab smo zabeležili največji ulov na vabi z mešanico feromonov in alkohola 1,4-benzokinon + tolokinon + cis-3-heksanol, sledili pa sta vabi s cis-3-heksanolom in tolokinonom posamično. Uspešna je bila tudi vaba z 3-etil acetatom. Preizkušanje omenjenih metod bomo nadaljevali v rastni dobi v letu 2013 in tako preverili njihovo ustreznost za zatiranje majskega hrošča v praksi.

#### ABSTRACT

#### First results of capturing the common cockchafer (*Melolontha melolontha* L.) adults using light traps and alcohol-pheromone traps

Since 2001 several outbreaks of common cockchafer (*Melolontha melolontha* L.) have been detected and caused damages on Slovenian grassland. The control of common cockchafer grubs is even more difficult because no insecticides are registered in Slovenia for this purpose. In order to monitor pest population dynamics and to find out cost-effective control methods of adult cockchafers, two different light traps and nine alcohol-pheromone traps were tested in our field trail. We compared white and green light traps and it was noticed that a larger number of adults were trapped on the white one. In alcohol-pheromone traps the most attractive to adult cockchafers was the trap filled with the mixture of 1,4 benzoquinone + toluquinone + cis-3-hexen-1-ol, followed by the traps filled with cis-3-hexen-1-ol and toluquinone individually. Besides, also trap filled with 3-ethyl acetate was successful. In the growing season 2013, we intend to upgrade the testing methods in order to verify their suitability for the control of common cockchafer in practice.



#### Hrošči iz družin pahljačnikov (Scarabaeidae) in lepenjcev (Chrysomelidae) – vse pomembnejši škodljivci travinja na območju Savinjske in Koroške statistične regije

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Na različnih območjih v Sloveniji smo v zadnjih letih pogosto zabeležili škodo na travnikih in njivah, povzročeno od ogrcev poljskega majskega hrošča (*Melolontha melolontha* L.). Tudi pridelovalci na območju Savinjske in Koroške statistične regije vedno pogosteje opozarjajo na škodo na travinju, povezano z delovanjem ogrcev. V posameznih letih beležimo poškodbe nadzemskih delov rastlin v travni ruši konec aprila oziroma v začetku maja. Poškodbe koreninskega sistema travne ruše smo v letih 2011 in 2012 opazili v času od konca avgusta do konca oktobra. V prispevku predstavljamo hrošča *Galeruca tanacetii* L. iz družine lepenjcev (Chrysomelidae) in vrtnega hrošča (*Phyllopertha horticola* L.) iz družine pahljačnikov (Scarabaeidae), ki postajata vse pomembnejša škodljivca

travinja na širšem celjskem območju. Predstavljeni bodo tudi rezultate naših spremljanj na terenu in rezultati identifikacije ličink hroščev na nekaterih lokacijah.

#### ABSTRACT

#### **The beetles of the families Scarabaeidae and Chrysomelidae – more and more important pests in grassland in Savinjska and Koroška statistical regions**

In the last years on different regions in Slovenia we often noticed the damage on grasslands and fields that was caused by larvae of the common cockchafer (*Melolontha melolontha* L.). The producers in the statistical regions of Savinjska and Koroška are warning about the damage connected with activity of grubs on grasslands. The damage on the above ground plant parts in the grass were found in the end of April or in the beginning of May. In the period 2011-2012 the damage of grass root system was established from the end of August until the end of October. The beetle *Galeruca tanacetii* L. from the family Chrysomelidae and garden chafer (*Phyllopertha horticola* L.) from the family Scarabaeidae, which can become important pests on grassland on the statistical regions of Savinjska and Koroška, are presented in the paper. The results of our observations on the field and identification results of beetle larvae in some locations are also presented.



#### **Prve najdbe treh vrst naravnih sovražnikov v Sloveniji: plenilske pršice *Neoseiulus californicus* (Arachnida, Acari, Phytoseiidae) in parazitoidnih os *Neochrysocharis formosus* (Insecta, Hymenoptera, Eulophidae) in *Dibrachys microgastri* (Insecta, Hymenoptera: Pteromalidae)**

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V letu 2012 smo v Sloveniji prvič ugotovili zastopanost plenilske pršice *Neoseiulus californicus*, in sicer na listih lubenic v rastlinjaku, na listih jablane (obakrat na Laboratorijskem polju Biotehniške fakultete v Ljubljani) in na listih jajčevca, gojenega na prostem, v Kortah. Na jablanah se je masovno pojavljala rdeča sadna pršica (*Panonychus ulmi*), na obeh poljščinah pa navadna pršica (*Tetranychus urticae*). Zastopanost parazitoidne ose *Neochrysocharis formosus* smo potrdili v dveh rastlinjakih v Slovenski Istri, in sicer v Sečovljah, kjer smo na paradižniku zabeležili izredno močan pojav paradižnikovega molja (*Tuta absoluta*) in v dolini Dragonje na istem gostitelju naravnega sovražnika (manjša številčnost) in isti rastlinski vrsti. Drugo parazitoidno oso, vrsto

*Dibrachys microgastri* smo našli v entomološkem laboratoriju na Odd. za agronomijo Biotehniške fakultete v Ljubljani, in sicer na zrnju pšenice, namenjene laboratorijskemu namnoževanju črnega žitnega žužka (*Sitophilus granarius*). Omenjena parazitoidna vrsta se je v laboratoriju sicer pojavljala že nekaj let. Med najdenimi vrstami naravnih sovražnikov ima največji biotični potencial plenilska pršica, ki je v tujini že tržno dostopna v namen zatiranja vseh razvojnih stadijev navadne pršice in rdeče sadne pršice. Zanj bomo v letu 2013 izvedli postopek za uvrstitev na Seznam domorodnih vrst organizmov za namen biotičnega varstva rastlin. Vrsta *Neochrysocharis formosus* je kozmopolit, generalist, primarni solitarni ali gregarni parazitoid. Ta larvalni endoparazitoid se razvija v številnih vrstah listnih zavrtalk ali zavrtačev stebela iz redov Coleoptera, Diptera in Lepidoptera, ki se hranijo z gojenimi in samoniklimi rastlinskimi vrstami. Ta parazitoid je najbolj znan kot naravni sovražnik žerk listnih zavrtalk (*Liriomyza* spp.). Njen pojav na paradiznikovem molju je bil doslej potrjen v Italiji, in sicer na različnih gostiteljih v rastlinjakih in na prostem (Neapelj, Sicilija). Osa *Dibrachys microgastri* je prav tako kozmopolit (v nam bližnjih državah je bila najdena tudi na Hrvaškem, Madžarskem in v Italiji) ter fakultativni hiperparazitoid vrst iz reda Hymenoptera in Diptera, lahko pa je omenjena vrsta tudi fakultativni terciarni parazitoid. Največkrat napada bube, doslej pa je bil njen pojav v bubah hroščev ugotovljen le pri mavretanskem mokaču (*Tenebroides mauritanicus*). Močan pojav tega parazitoida v laboratorijski populaciji črnega žitnega žužka ima zato precejšen pomen, saj kaže na širitev izbora gostiteljev tega naravnega sovražnika. Obe parazitoidni vrsti nista uvrščeni na Appendix II Seznama biotičnih agensov, ki so pogosto uporabljani v državah EPPO (orig. List of biological control agents widely used in the EPPO region), zato nista tudi del Seznama tujerodnih vrst organizmov za namen biotičnega varstva rastlin v Sloveniji. Njuna glavna hiba je preširok spekter gostiteljev, zato ju tudi v prihodnje ne bo mogoče uporabljati v biotičnem varstvu rastlin.

#### ABSTRACT

**First records of three natural enemies in Slovenia: predatory mite *Neoseiulus californicus* (Arachnida, Acari, Phytoseiidae) and parasitoid wasps *Neochrysocharis formosus* (Insecta, Hymenoptera, Eulophidae) and *Dibrachys microgastri* (Insecta, Hymenoptera: Pteromalidae)**

In 2012, a predatory mite *Neoseiulus californicus* was first recorded in Slovenia. The mites were found on the leaves of watermelon grown in the greenhouse, on the leaves of apple tree (in both cases at the Experimental field of Biotechnical Faculty in Ljubljana) and on the leaves of eggplant grown in the field in the vicinity of Korte. The apple trees were heavily attacked by the European red mite (*Panonychus ulmi*), while on both field crops two-spotted spider mite (*Tetranychus urticae*) occurred in large numbers. The occurrence of parasitoid wasp *Neochrysocharis formosus* was confirmed in two greenhouses in Slovenian Istria – in Sečovlje and in Dragonja valley, in both cases in tomato plants, which were attacked by the tomato leafminer (*Tuta absoluta*). Second parasitoid wasp, *Dibrachys microgastri*, was recorded at the Entomological laboratory of Dept. of Agronomy (Biotechnical Faculty, Univ. of Ljubljana) on wheat grains, destined for laboratory rearing of the granary weevil (*Sitophilus granarius*). This parasitoid occurred at the same place already for some years, but the identification of the species was not performed earlier. Among the three mentioned biological control agents the highest biological potential has the predatory mite, which is already commercially available in some foreign countries for the purpose of controlling all developmental stages of two-spotted spider mite and European red mite. In 2013, we will carry out the procedure for placing the *Neoseiulus californicus* to the List of indigenous organisms for the purpose of biological control in Slovenia. *Neochrysocharis formosus* is a generalist parasitoid with a

cosmopolitan distribution. It develops as primary solitary or gregarious larval endoparasitoid of a wide range of leafmining or stem-boring Coleoptera, Diptera and Lepidoptera associated to various cultivated and spontaneous plants. This parasitoid is probably the most known as natural enemy of the larvae of *Liriomyza* leaf miners. Its association with tomato leafminer was up to now confirmed in Italy, namely on different host plants in the greenhouses and in the field (Naples, Sicily). Wasp *Dibrachys microgastri* is also cosmopolitan (among our neighbouring countries it was found in Croatia, Hungary and Italy) and facultative hyperparasitoid of different species from the orders Hymenoptera and Diptera. The same wasp was mentioned also as facultative tertiary parasitoid. The females lay eggs into the pupas, but up to now the association between the wasp and the pupas of Coleopteran species was established only with cadelle beetle (*Tenebroides mauritanicus*). For this reason the massive occurrence of the wasp in the laboratory population of the granary weevil is an important entomological event, which shows on the spreading of this natural enemy to the new hosts. Both parasitoid wasps presented in this paper are not ranged into the Appendix II of the List of biological control agents widely used in the EPPO region, therefore they were not the parts of the List of exotic organisms for the purpose of biological control in Slovenia. Their the most important fault is too wide spectrum of hosts, therefore the both wasps will not be able to use in biological control of insect pests also in the future.



### Izbor križnic kot biofumigantov za zatiranje talnih škodljivih žuželk

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V zadnjih dveh letih smo v poljskem poskusu, z namenom zmanjšanja škodljivosti izbranih vrst talnih škodljivih žuželk, na okolju prijaznejši način preučevali biofumigantne učinke različnih vrst strniščnih dosevkov, ki so bili posejani kot predsevki krompirja. V izbor preučevanja smo vključili 5 vrst križnic, za katere smo iz literature dobili podatke, da imajo biofumigantni učinek. Zaradi slabše raziskanosti tematike smo v poskus vključili sorte rastlin, ki smo jih dobili na tržišču kot semensko blago in med katerimi so nekatere namenjene tudi pridelovanju krme. Uporabljeni dosevki so bili v letu 2011 posajeni spomladi pred saditvijo krompirja in za preučevanje v letu 2012 že v jeseni predhodnega leta. V bločnem poskusu v treh ponovitvah smo sejali krmno ogrščico (*Brassica napus* var. *napus*), krmni ohrov ( *Brassica oleracea* L. convar. *acephala*), krmno repico (*Brassica rapa* var. *silvestris*), belo gorjušico (*Sinapis alba*) in oljno redkev (*Raphanus sativus* var. *oleiformis*). Setvena norma dosevka je bila od priporočene povečana za 30 %, saj smo želeli pridelati čim več nadzemske listne mase. Cilj poskusa je bil ob ustrezni agrotehnik (priprava tal, osnovno gnojenje) in ugodnih vremenskih razmerah (dovolj padavin) doseči čim več količino nadzemske mase dosevkov, ki jo je potrebno pred saditvijo krompirja zmulčiti in zadelati v vlažna tla. Zatem ob razpadu njihovega zelinja (glukozinulati) nastajajo substanci (izocianati), ki zaviralno vplivajo na talne škodljive žuželke. V prispevku bodo podani rezultati agronomskih lastnosti posameznih dosevkov, tako pri spomladanski kot tudi jesenski prezimni setvi in pomanjkljivosti ter napake, zaradi katerih strnišči dosevki ne dosežejo svojega učinka.

### ABSTRACT

## Selection of Brassicas as biofumigants in controlling soil pest insects

In last two years we studied in field experiment the biofumigant efficiency of *Brassica* species as an environmentally friendly measure to control and reduce the damage, which soil pest insects cause to potato tubers. As a cover crop we used 5 *Brassica* species, for which we got literature data that they have a biofumigant effect. Due to the poor domestic research background of their biofumigant activity we included in both experiments commercial varieties of brassicas, which are also used for forage production. In 2011 experimental year we seeded Brassicas as a spring cover crops and in 2012 experimental year we seeded Brassicas already in autumn of previous year. In a three block experiment we seeded oilseed rape (*Brassica napus* var. *napus*), fodder kale (*Brassica oleracea* L. convar. *acephala*), turnip rape (*Brassica rapa* var. *silvestris*), white mustard (*Sinapis alba*) and radish (*Raphanus sativus* var. *oleiformis*). Seeding rates of Brassicas was 30 % higher as the recommended one as we wanted to get as high biomass as it was possible. The aim of the experiment was taking into account the proper soil cultivation and bed preparation and favourable weather conditions (enough participation) to attain large quantity of Brassicas biomass, which is supposed to be mulched and incorporated into the moist soil before the potato planting. Being incorporated into and covered by soil layer the processes in biomass commence (glucosinolate transformation to isocyanate substances) which in suitable soil conditions reduce the abundance of soil pest insects. The paper will present the agronomic characteristics of cover crops development in spring time as well as in autumn period and prior to the biofumigant activity and possible deficiencies and mistakes, which must be taken under control if we want to get a satisfying biofumigation.



## Preučevanje učinkovitosti biofumigacije za zatiranje strun (*Agriotes* spp., Coleoptera, Elateridae) v krompirju

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V poljskem bločnem poskusu v letih 2011 in 2012 smo na Laboratorijskem polju Biotehniške fakultete (LP BF) v Ljubljani preučevali biofumigantno učinkovitost različnih vrst križnic za zatiranje strun na njivi s krompirjem. V prvem letu smo na njivo posadili krompir cv. Avalon, v drugem letu pa cv. Stirling. V prvem letu smo pred sajenjem krompirja zaorali zmulčeno zeleno gmoto krmne repice (*Brassica rapa* var. *silvestris*), oljne redkve (*Raphanus sativus* var. *oleiformis*) in bele gorjušice (*Sinapis alba*), v drugem letu pa zeleno gmoto omenjenih treh vrst ter krmnega ohrovta (*Brassica oleracea* L. convar. *acephala*) in krmne ogrščice (*Brassica napus* var. *napus*). Pozitivno kontrolo so predstavljale parcele, na katerih smo v tla vnesli talni insekticid teflutrin (pripravek Force), negativna kontrola pa so bile parcele brez insekticida in križnic kot predposevkom. V prvem letu smo najvišji skupni pridelek (30,1 t/ha) ugotovili v obravnavanju z belo gorjušico, najmanjšega pa v obravnavanju s krmno repico (24,5 t/ha). Pridelek največjih gomoljev (> 5 cm) je bil največji v obravnavanju z belo gorjušico (17,5 t/ha), najmanjši pa v obravnavanju s krmno repico (12,5 t/ha). Največjo maso najmanjših gomoljev (< 4 cm)

smo ugotovili v obravnavanju z oljno redkvijo (5,8 t/ha), najmanjšo pa v obravnavanju z belo gorjušico (4,7 t/ha). Največje število poškodb (lukenj) zaradi strun smo ugotovili v največjih gomoljih, pri čemer med križnicami in negativno kontrolo nismo ugotovili signifikantnih razlik. Oddaljenost od roba njive je imela v letu 2011 pomemben vpliv na število poškodb na gomoljih, saj je bilo lukenj v neposredni bližini travnika na gomoljih v povprečju največ (6,8/gomolj), z oddaljevanjem od roba pa se je njihovo število zmanjševalo (1,5/gomolj v oddaljenosti od 3,75 do 7,5 m od roba njive in 0,4/gomolj v oddaljenosti od 7,5 do 11,25 m od roba njive). Rezultati poskusa nakazujejo možnost zatiranja strun le na robnem območju njive, s čimer bi bila gospodarnost pridelave krompirja večja, pridelava pa bi bila bolj okoljsko sprejemljiva. V letu 2012 smo največji skupni pridelek (53,8 t/ha) in največji pridelek največjih gomoljev (45,2 t/ha) ugotovili v obravnavanju z oljno redkvijo, najmanjši skupni pridelek (46,8 t/ha) in najmanjši pridelek največjih gomoljev (38,7 t/ha) pa v obravnavanju s krmno ogrščico. V tem letu je bilo poškodb v gomoljih zelo malo, največ pa v največjih gomoljih (0,2 luknji/gomolj) in v obravnavanju pozitivna kontrola (0,16 luknje/gomolj). Rob njive v tem letu ni vplival na število poškodb. Ugotavljamo, da se gojene vrste križnic, ki smo jih uporabili v naši raziskavi, niso izkazale kot najustreznejša alternativa za zatiranje strun v krompirju (eden od vzrokov je tudi premajhna količina zaorane listne gmote), kar pa ne zmanjšuje njihove ustreznosti v optimalnih razmerah (dovolj listne gmote, zaoravanje rastlinske gmote takoj po mulčenju ali celo ob enkratnem prehodu, dovolj vlažna tla) in pa ustreznosti „divjih“ vrst križnic, takšnih z višjo vsebnostjo glukozinolatov (npr. rjava gorjušica [*Brassica juncea*], abesinska ogrščica [*Brassica carinata*], njivska gorjušica [*Sinapis arvensis*] idr.), ki so se v tem pogledu dokazale na različnih območjih sveta.

#### ABSTRACT

#### Research on the efficacy of biofumigation in controlling wireworms (*Agriotes* spp., Coleoptera, Elateridae) in potato

In 2011 and 2012, we studied the biofumigation efficacy of different *Brassica* species in controlling wireworms on the potato field in field block experiment on Laboratory field of Biotechnical Faculty in Ljubljana. In the first experimental year we planted potato variety Avalon and in the second year variety Stirling. Before the start of the potato planting in the first year we ploughed the mulched green biomass of turnip rape (*Brassica rapa* var. *silvestris*), oilseed radish (*Raphanus sativus* var. *oleiformis*) and white mustard (*Sinapis alba*) and the second year beside the green biomass of first three cover crops also fodder kale (*Brassica oleracea* L. convar. *acephala*) and oilseed rape (*Brassica napus* var. *napus*). Positive control was presented by subplots in which soil insecticide tefluthrin (insecticide Force) was incorporated and negative control was presented by subplot with no insecticide and brassicas as cover crops. In the first experimental year we gained the highest yield of potato (30.1 t/ha) in treatment with white mustard and the lowest one in treatment with turnip rape (24.5 t/ha). Yield of largest tubers (> 5 cm) was attained in treatment with white mustard (17.5 t/ha) and the lowest in treatment with turnip rape (12.5 t/ha). The largest yield of smallest tubers (< 4 cm) we determined in treatment with oilseed radish (5.8 t/ha) and the lowest one in treatment with white mustard (4.7 t/ha). The highest extent of injuries (holes) due to the wireworms activity we established in largest tubers with no significant differences when compared brassicas and negative control. The distance from the field edge had in 2011 an important influence on the number of holes on tubers as in the vicinity of grassland the number of holes on tubers was in average the highest (6.8/tuber) and with going away from the edge their number decreased (1.5/tuber in the distance from 3.75 to 7.5 m away from the field edge and 0.4/tuber in the distance from 7.5 to 11.25 m from the field edge). Results of the experiment indicate the possibility of controlling wireworms only on the edge area of the field and this could also lead to



better economical output of potato production and its environmental acceptability. In 2012, we gained the highest total potato yield (53.8 t/ha) and the highest yield of largest tubers (45.2 t/ha) in treatment with oilseed radish and the lowest ones (46.8 t/ha, and 38.7 t/ha, respectively) in treatment with oilseed rape. In this year tubers damage was very low with the highest number (0.2 holes/tuber) in largest tubers and in treatment positive control (0.16 holes/tuber). Field edge did not have any influence on the extent of injuries and damage. We determine that cultivated varieties of brassicas which were used in our research did not demonstrate as the most suitable alternative in controlling wireworms in potato field as one of the possible reasons can be also to small cover crops biomass which was ploughed before the potato planting. But this fact does not reduce their importance in the case if optimal conditions are given (soil preparation, cultivation, proper biomass quantity, corresponding mulching) and also using »wild« brassicas, which also have higher content of glucosinolates (i.e. brown mustard [*Brassica juncea*], Abyssinian mustard [*Brassica carinata*], field mustard [*Sinapis arvensis*] etc) and proved to be effective in different parts of the world.



### **Vpliv varstvenih ukrepov proti koruznemu hrošču (*Diabrotica virgifera virgifera* [LeConte]) na gradacijo strun (Elateridae) in drugih talnih škodljivih vrst v pridelavi koruze**

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Koruza spada v Sloveniji že vrsto let med najbolj razširjene poljščine. Pri pridelavi se poljedelci vse pogosteje srečujejo s škodo zaradi talnih škodljivcev, med katerimi je tudi koruznih hrošč (*Diabrotica virgifera virgifera* LaConte). V Sloveniji je bil ta škodljivec ugotovljen leta 2003 v Prekmurju, na območju JV Slovenije pa smo prve osebkke ulovili leta 2007. Spremljanje pojavljanja odraslih osebkov smo izvajali s feromonskimi vabami, in sicer s tedenskimi pregledi v obdobju od julija do septembra. Na podlagi dosedanjih spremljanj smo ugotovili, da se gostota populacije koruznega hrošča povečuje. V letu 2011 smo na njivah s koruzo zaznali tudi prvo škodo. Glede na nabor razpoložljivih insekticidov za zatiranje koruznega hrošča, se je posledično začela pojavljati tudi večja škoda zaradi delovanja drugih talnih škodljivih vrst. Med temi izstopajo strune (Elateridae), ki so na območju JV Slovenije v letu 2012 povzročale škodo v obsegu med 20 do 30%. Zabeležili smo tudi povečan pojav sovok (Noctuidae) ter švedske mušice (*Oscinella frit* Linnaeus). Vzrok na naraščanje številčnosti talnih škodljivcev pripisujemo uporabi z insekticidi netretiranega semenskega materiala. Dodatna okoliščina, ki je vplivala na večji pojav talnih škodljivcev v koruzi, pa so bile tudi specifične vremenske razmere.

#### **ABSTRACT**

**Effect of plant protection measures against western corn rootworm (*Diabrotica virgifera virgifera* LeConte) on wireworms (Elateridae) gradation and others soil pests in corn production**

Corn has been in Slovenia for several years one of the most widespread field crops. Growers are during production frequently confronted with damage caused by soil pests, among which is also western corn rootworm (*Diabrotica virgifera virgifera* LaConte). Its presence in Slovenia was first confirmed in 2003 in Prekmurje region, and in 2007 in the area of South east Slovenia. In 2011 we have also detected the first damage. Monitoring of adult beetles was carried out by pheromone lures throughout weekly inspections in the period from July to September. Current findings indicated that density of population is increasing and in 2011 the first damage on the cornfields was noticed. According to the set of available insecticides for controlling western corn rootworm later on also damage from other soil pests started to appear. Important are wireworms (Elateridae), which caused in 2012 in southeastern part of Slovenia damage within 20 to 30%. We also recorded increased damage from noctuid moths (Noctuidae) and frit flies (*Oscinella frit* Linnaeus). As a reason of growing abundance of soil pests we recognize the use of untreated seed material. An additional factor in the development of other harmful soil species and corn were also the specific weather conditions.



### **Insekticidno delovanje petih eteričnih olj na odrasle osebke fižolarja (*Acanthoscelides obtectus*, Coleoptera, Chrysomelidae)**

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V laboratorijskih razmerah smo preučevali insekticidno delovanje eteričnih olj navadnega rožmarina (*Rosmarinus officinalis*), bergamota (*Citrus bergamia*), kafre (*Cinnamomum camphora*), navadnega lovorja (*Laurus nobilis*) in žajblja (*Salvia officinalis*) na odrasle osebke fižolarja. Delovanje eteričnih olj smo preučevali pri dveh vrednostih relativne zračne vlage (55 in 75°C) in pri treh temperaturah (25, 30 in 35 °C). Smrtnost izpostavljenih odraslih osebkov fižolarja smo ugotavljali 1., 2. in 3. dan po nastavitvi. Poskus je potekal pri 4 različnih koncentracijah eteričnih olj (24,5; 98; 245 in 980 µl/ l zraka). Eterično olje navadnega rožmarina je vplivalo na najvišjo smrtnost fižolarja (79,23±0,99 %), medtem ko je bila smrtnost hroščev, tretiranih z eteričnim oljem žajblja (71,13±1,08 %), lovorja (66,28±1,16%), kafre (46,49±1,30 %) in bergamota (35,80±1,18 %) nižja. Glede na podatke generalne analize ugotavljamo, da je bila smrtnost hroščev najvišja pri 30 °C (63.84±0.91 %), pri 75 % relativni zračni vlagi (61,84±1,23) ter pri koncentraciji 980 µl/ l zraka (89.97±0.16%). V prispevku bodo natančno prikazane interakcije med različnimi dejavniki v poskusu in podani predlogi za uporabo najučinkovitejše snovi v kmetijski praksi.

#### **ABSTRACT**

### **Insecticidal efficacy of five essential oils against bean weevil (*Acanthoscelides obtectus* Coleoptera, Chrysomelidae) adults**

Laboratory experiment was carried out to evaluate the insecticidal efficacy of five different essential oils - rosemary (*Rosmarinus officinalis*), bergamot (*Citrus bergamia*), camphor tree (*Cinnamomum camphora*), bay laurel (*Laurus nobilis*) and common sage (*Salvia officinalis*) - on the mortality of bean weevil (*Acanthoscelides obtectus*) adults. Insecticidal efficacy was tested at two different relative humidity levels (55 in 75 %) and at three

different temperatures (25, 30 and 35°C). Mortality of adults was evaluated first, second and third day after exposure. Essential oils were tested at four different dose rates (24.5, 98, 245 and 980 µl/ l air). Essential oil of rosemary showed the highest efficacy against the bean weevil (79.23±0.99 %), meanwhile mortality in treatments exposed to common sage (71.13±1.08 %), bay laurel (66.28±1.16%), camphor tree (46.49±1.30 %) and bergamot (35.80±1.18 %) was lower. In general, the highest mortality was evaluated at 30 °C (63.84±0.91 %), at 75 % level of relative humidity (61.84±1.23) and at 980 µl/ l air (89.97±0.16%). Interactions between different factors of experiment will be presented, and suggestions for the practical use of the most effective substance will be given.



### **Morfološke karakteristike ogrcev s travinja, potrebne za hitro determinacijo**

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Ogrci različnih vrst skarabejev (Scarabaeidae) lahko ob prerasmnožitvi povzročijo gospodarsko škodo na travinju. V prispevku predstavljamo pomembnejše morfološke karakteristike, s katerimi lahko hitro ločimo med seboj ogrce in odrasle osebkje junijskega hrošča (*Amphimallon solstitiale*), julijskega hrošča (*Anomala dubia*), vrtnega hrošča (*Phyllopertha horticola*), zlate minice (*Cetonia aurata*), poljskega majskega hrošča (*Melolontha melolontha*) ter gozdnega majskega hrošča (*Melolontha hippocastani*).

#### **ABSTRACT**

### **Morphological characteristics of white grubs on grassland, important for quick determination**

White grubs of different species of scarab beetles (Scarabaeidae) can, when they overmultiply, cause economical damage on grassland. In this paper we present some important morphological characteristics, which help us in quick distinguishing of white grubs and adults of June beetle (*Amphimallon solstitiale*), margined vine chafer (*Anomala dubia*), garden chafer (*Phyllopertha horticola*), rose chafer (*Cetonia aurata*), common cockchafer (*Melolontha melolontha*) and also forest cockchafer (*Melolontha hippocastani*).



### **Preučevanje kompatibilnosti izbranih insekticidov z entomopatogenimi ogorčicami (Nematoda: Rhabditida)**

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V laboratorijskem poskusu smo preučili kompatibilnost šestih ras entomopatogenih ogorčic (Rhabditida) vrst *Steinernema feltiae*, *S. carpocapsae*, *S. kraussei* in *Heterorhabditis bacteriophora* z 8 izbranimi pripravki z insekticidnim delovanjem. Vpliv

direktne izpostavitve infektivnih ličink insekticidom smo preverjali po 1, 6 in 24 urah v petrijevkah pri 15, 20 in 25 °C. Število preživelih infektivnih ličink je bilo po 6 urah pri 15 °C (82 %) in 20 °C (80 %) statistično značilno najvišje, medtem ko je bilo pri 25 °C (76 %) statistično značilno najnižje. Po 24 urah med 15 °C (55 %) in 20 °C (55 %) ni bilo statistično značilnih razlik, medtem ko je pri 25 °C (59 %) preživel statistično značilno največ infektivnih ličink. Med preučevanimi insekticidi je po 6 urah statistično značilno najmanj infektivnih ličink preživel v obravnavanjih Vertimec 1,8 % EC (61 %), Match 050 EC (75 %) in Delfin WG (76 %), medtem ko je bila stopnja preživetja infektivnih ličink pri ostalih obravnavanjih višja od 80 %. Po 24 urah je bila smrtnost infektivnih ličink v poskusu višja. Med preučevanimi insekticidi sta poleg kontrole (67 % živih infektivnih ličink) kompatibilnost izkazala le pripravka Neemazal T/S (68 % preživelih infektivnih ličink) in Pirimor 50 WG (63 % preživelih infektivnih ličink), medtem ko je bila stopnja preživelih infektivnih ličink pri ostalih obravnavanjih nižja, najnižja pa pri pripravku Vertimec 1,8 % EC (42 %). Vrsta *S. feltiae* je bila v našem poskusu kompatibilna s pripravki Neemazal T/S, Pirimor 50 WG in Chess50 WG. Vrsta *H. bacteriophora* je bila kompatibilna z vsemi pripravki, razen z insekticidoma Vertimec 1,8 % EC in Match 050 C, medtem ko vrsti *S. carpocapsae* in *S. kraussei* nista bili kompatibilni z nobenim od preučevanih insekticidnih pripravkov.

#### ABSTRACT

#### Testing the compatibility of different insecticides with entomopathogenic nematodes (Nematoda: Rhabditida)

In a laboratory experiment we studied the compatibility of six strains of entomopathogenic nematodes (Rhabditida) *Steinernema feltiae*, *S. carpocapsae*, *S. kraussei* and *Heterorhabditis bacteriophora* with 8 selected plant protection products with insecticidal activity. The influence of direct exposure of infective juveniles to insecticides was tested after 1, 6, and 24 hours in Petri dishes at 15, 20 and 25 °C. The number of survived infective juveniles was after 6 hours at 15 °C (82 %) and 20 °C (80 %) statistically significantly higher, while at 25 °C (76%) was statistically significantly the lowest. After 24 hours no statistically significant differences were present between 15 °C (55 %) and 20 °C (55 %), meanwhile at 25 °C (59%) statistically significantly highest number of infective juveniles survived. Among studied insecticides after 6 hours statistically significantly the lowest number of live infective juveniles was found in treatments Vertimec 1,8 % EC (61 %), Match 050 EC (75 %) and Delfin WG (76 %), while the survival rate of infective juveniles in other treatments was higher than 80%. After 24 hours of a trial the mortality of infective juveniles was higher. Beside control treatment (67% survived infective juveniles) only two products, Neemazal T/S (68 % survived infective juveniles) and Pirimor 50 WG (63 % survived infective juveniles), showed compatibility. Meanwhile the survival rate of infective juveniles was in other treatments lower with the lowest one in product Vertimec 1,8 % EC (42%). *Steinernema feltiae* was in our experiment compatible with products Neemazal T/S, Pirimor 50 WG and Chess 50 WG. *H. bacteriophora* was compatible with all products except with Vertimec 1,8 % EC and Match 050 C, while the other two studied EPNs (*S. carpocapsae* and *S. kraussei*) showed no compatibility with none of the studied products.



## Laboratory bioassays of entomopathogenic fungi for control of *Agriotes* sp. (L.) larvae

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Wireworms, soil-burrowing larval stages of click beetles (Coleoptera: Elateridae), are major pests of crops including wheat, maize, sugar beet, vegetables (particularly root vegetables such as carrots and potatoes) in many parts of the world. An effective chemical control is possible with granular organophosphates, but usually high application rates are required. Additional drawback of chemical control is the withdrawal of these products in many countries. This and the increasing consumer health awareness are pushing forward the market and research of biological control agents for wireworm control. The aim of the study was to assess the entomopathogenic potential of several fungal species isolated from various substrata in Slovenia: *Beauveria brongniartii* (1 isolate), *B. bassiana* (1), *Metarhizium robertsii* (1), *M. anisopliae* (2), *Purpureocillium lilacinum* (1) and *Clonostachys solani* (1). In the experiments, the conidia were added to the soil as a water suspension. The soil was thoroughly mixed to reach a final concentration of  $3.85 \times 10^6$  g/l air dried soil. The larval mortality was observed on a weekly basis for a total duration of 90 days. Dead or immobile larvae lacking a coat of sporulating mycelium were removed from the test vessels and placed in sterile 24-well plates to confirm that the cause of death was fungal infection. The mortalities observed exhibited a linear trend with slopes ranging from  $0.33 \pm 0.06$  to  $1.15 \pm 0.07$  for the fungal treatments and  $0.13 \pm 0.02$  to  $0.22 \pm 0.05$  for the control treatments. Abbott's corrected mortality at day 90 ranged from 26.7 to 84.3%. The results indicate that one *Metarhizium anisopliae* isolate could, provided further successful field tests were performed, eventually be considered as an environmentally friendly alternative for wireworm management in conventional as well as organic farming systems.

### IZVLEČEK

#### Laboratorijski poskusi entomopatogenih gliv za zatiranje strun (*Agriotes* sp. L.)

Strune, ličinke hroščev pokalic (Coleoptera: Elateridae), so glavni škodljivci rastlin, kot so pšenica, koruza, sladkorna pesa in razne vrste zelenjave (zlasti korenja in krompirja) v mnogih delih sveta. Učinkovito kemično zatiranje je mogoče doseči z visokimi odmerki zrnatih organskih fosforjevih estriov, ki pa so v čedalje več državah prepovedani. To in vse večje zavedanje potrošnikov o kakovostni, zdravstveno neoporečni hrani pospešuje rast trga in raziskav bioloških sredstev za nadzor strun. Namen raziskave je bil oceniti entomopatogenost več vrst gliv, izoliranih iz različnih substratov iz Slovenije. Preskušali smo glive *Beauveria brongniartii* (1 izolat), *B. bassiana* (1), *Metarhizium robertsii* (1), *M. anisopliae* (2), *Purpureocillium lilacinum* (1) in *Clonostachys solani* (1). V poskusih smo konidije dodajali testnim substratom v obliki vodne suspenzije. Substrat smo temeljito premešali, da smo dosegli končno koncentracijo  $3,85 \times 10^6$  g/l zračno suhega substrata. Smrtnost ličink smo opazovali tedensko v skupnem trajanju 90 dni. Mrtve ali negibne ličinke brez plasti micelija s konidiji smo odstranili iz testnih posod in jih dali v sterilne posodice s 24 jamicami. Po petih dneh inkubacije pri 20 °C smo preverili, če je bil vzrok smrti okužba z glivami. Krivulje smrtnosti so izkazovale linearni trend z nakloni od  $0,33 \pm$

0,06 do 1,15 ± 0,07 pri glivnih tretmajih in od 0,13 ± 0,02 do 0,22 ± 0,05 pri kontrolah. Smrtnost po Abbottovemu popravku je na 90. dan znašala 26,7-84,3%. Rezultati kažejo, da bi bil lahko izolat glive *Metarhizium anisopliae* (po uspešno prestalem poljskem preskušanju) potencialno okolju prijazna alternativa za zatiranje strun, tako v konvencionalnem kot tudi v ekološkem kmetovanju.



### **Field testing of entomopathogenic or potentially plant growth promoting fungal strains for the control of Cabbage root fly (*Delia radicum* L.) and their rhizosphere competence**

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The aim of this research was to assess the protection of cauliflower plants against cabbage root fly (CRF) and rhizosphere competence of 6 entomopathogenic or potentially plant growth promoting fungal species in a field experiment. The following fungal species were tested: *Trichoderma atroviride* (1 strain), *T. koningiopsis* (1), *T. gamsii* (1), *Beauveria bassiana* (1), *Metarhizium anisopliae* (2) and *Clonostachys solani* (1). The fungi were isolated from various substrata in Slovenia. A commercial product based on *B. bassiana* (Naturalis) was used as a positive control. The field experiment mimicked semi-normal agronomic practice in cauliflower production.  $2.2 \times 10^7$  conidia were applied to individual 4 weeks old cauliflower plantlets as a drench 8 hours before transplanting to the field. All fungal isolates were infective to one or more CRF life stages (eggs, larvae, pupae or imago), as assessed in laboratory bioassays. *C. solani* and product Naturalis increased the average plant weight at harvest. *T. atroviride* and *M. anisopliae* (1154) treated plants had the lowest mortality. The lowest number of pupae and live larvae were counted in the Naturalis treatment followed by both *M. anisopliae* treatments. The highest number of pupae and live larvae were counted in the control treatment. *C. solani* and all *Trichoderma* species were reisolated from the rhizosphere 85 days after application. The results indicate that rhizosphere competence of the tested fungal species varies considerably, possibly due to different ecological preferences of the fungal species.

#### **IZVLEČEK**

#### **Poljski preskus varstva cvetače pred kapusovo muho (*Delia radicum* L.) z entomopatogenimi ali potencialno rast spodbujajočimi sevi gliv in določanje njihove rizosferne kompetence**

Namena raziskave sta bila v poljskem poskusu a), oceniti učinkovitost varstva rastlin cvetače pred kapusovo muho (KM) in b), oceniti prilagojenost 6 vrst entomopatogenih ali potencialno rast spodbujajočih gliv na rizosfero. Preskušane so bile naslednje vrste gliv: *Trichoderma atroviride* (1 sev), *T. koningiopsis* (1), *T. gamsii* (1), *Beauveria bassiana* (1), *Metarhizium anisopliae* (2) in *Clonostachys solani* (1). Glive smo izolirali iz različnih

substratov v Sloveniji. Za pozitivno kontrolo smo uporabili komercialni insekticid na podlagi glive *B. bassiana* (Naturalis). V poljskem poskusu smo uporabili ukrepe normalne agronomske prakse pri pridelavi cvetače. Štiri tedne stare sadike cvetače smo zalili z  $2,2 \times 10^7$  konidijev 8 ur pred presajanjem. Vsi izolati gliv so bili kužni za eno ali več razvojnih stadijev KM (jajca, ličinke, bube ali imagi), kar smo potrdili v seriji laboratorijskih poskusov. *C. solani* in pripravke Naturalis sta vplivala na povprečno večjo maso pridelka ob spravi. Rastline, tretirane z glivama *T. atroviride* in *M. anisopliae* (1154), so imele najvišjo stopnjo preživetja. Najmanj bub in živih ličink smo ugotovili pri uporabi insekticida Naturalis in pri obeh izolatih glive *M. anisopliae*. Največje število bub in živih ličink smo ugotovili v kontrolnem obravnavanju. Glivo *C. solani* in vse vrste iz rodu *Trichoderma* smo uspeli ponovno izolirati s površja korenin ob koncu poskusa. Ti rezultati kažejo, da se prilagojenost testiranih vrst gliv na rizosfero precej razlikuje, verjetno zaradi različnih okoljskih zahtev posameznih vrst.



### **Vpliv agrotehničnih ukrepov na zmanjševanje škodljivosti kapusove muhe (*Delia radicum* [L.]) na zelju (*Brassica oleracea* L. var. *capitata*)**

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Zelje spada med gospodarsko najpomembnejših vrtnine v Vojvodini, kjer je s to rastlinsko vrsto posajenih približno 3.850 ha. Vpliv zastiranja in gnojenja tal na poškodbe, ki jih na zelju sorte Adema RZ povzroča kapusova muha, smo proučevali na laboratorijskem polju PSS Sombor. Z namenom, da bi izločili predhodni vpliv škodljivcev kapusnic, je zelje v kolobarju sledilo solati. Dvofaktorski poskus s split-plot zasnovno in v treh ponovitvah je potekal v rastni dobi leta 2011. Glavni dejavnik "zastirka" je vseboval dve ravni (polietilenska PE prekrivka in gola tla), medtem ko je drugi dejavnik "gnojenje" imel devet ravni (organsko gnojenje, mineralno gnojenje in kombinacije obeh gnojenj). Varstvo pred boleznimi je temeljilo na priporočenih metodah za integrirano pridelavo. Ob tehnološki zrelosti smo zelje pobrali in vsaki rastlini izmerili maso, hkrati pa ugotavljali obseg poškodb zaradi napada ličink kapusove muhe. Dobljene rezultate smo statistično obdelali z analizo variance za dvofaktorski poskus. Rezultati so pokazali, da je bil najmanjši povprečni indeks poškodb na zelju pri kombinaciji gnojenja s kompostiranim prašičjim gnojem (20 t/ha) in N<sub>55</sub>P<sub>55</sub>K<sub>105</sub>. Zelje, ki je bilo gojeno na golih tleh, je bilo manj poškodovano od tistega na polietilenski PE prekrivki.

#### **ABSTRACT**

### **Influence of different agrotechnical measures in reducing the damage of the cabbage root fly (*Delia radicum* [L.]) on white cabbage (*Brassica oleracea* L. var. *capitata*)**

Cabbage is one of the economically most important vegetable crop in Vojvodina with a cultivated area of around 3.850 ha. The effects of mulching and fertilizers on damage by cabbage root fly in cabbage (variety Adema RZ), were studied in in Research field of PSS Sombor). The trials followed lettuce breakcrops to minimise the detrimental effects of

cabbage insect pests. During 2011 growing season a two-factor trial with three repetitions and split-plot design was set up. Main factor "mulch" had two levels (polyethylene PE film and bare ground), while the sub-factor "fertiliser management" had nine levels (organic fertilizers, mineral fertilizers and combined applications of mineral and organic fertilizers). Crop protection was performed according to basic principles of sustainable crop management system. When technological maturity was reached, we picked out yield and took measurements of weight of every single cabbage plant. We also estimated the harmfulness of the cabbage root fly. Given results were statistically analysed with ANOVA for two-factor experiment. Results showed that cabbage had the lowest index of injury in plot with the combined fertilization with composted pig manure (20 t/ha) and  $N_{55}P_{55}K_{105}$ . Cabbage, which was grown on the bare ground, had less damage than cabbage grown on PE film.



### **Kaparji - prenašalci virusov vinske trte na Primorskem**

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Kaparji predstavljajo precejšen delež tujerodnih organizmov, kateri se v zadnjih 20 letih v vse večjem obsegu pojavljajo na območju Slovenije. Kaparji so se močno razširili predvsem v nekaterih vinogradih na Primorskem, kjer povzročajo precejšnjo gospodarsko škodo. S sesanjem rastlinskega soka oslabijo trse in ob močnejšem napadu lahko povzročijo propad celotne rastline. Posredno škodo povzročajo z izločanjem medene rose, na katero se naselijo glive sajavosti, ki vplivajo na zmanjšano fotosintetsko aktivnost listov ter na manjšo kakovost in tržno vrednost grozdja. Kaparji so znani tudi kot prenašalci virusov, predvsem virusov zvijanja listov vinske trte (*Grapevine leafroll-associated virus - GLRaV*) in virusa vinske trte A (*Grapevine virus A - GVA*). V izbranem vinogradu v bližini Ajdovščine, kjer so imeli velike težave z boleznijo zvijanja listov vinske trte in napadom kaparjev, smo opravili vizualni pregled trsov in laboratorijske analize na zastopanost virusov na izbranih trsih. S testiranjem smo ugotovili močno okuženost vinograda z GLRaV-3, zasledili smo tudi nekaj zgledov okužbe z GLRaV-1. V delu vinograda, kjer je bila okuženost z virusom pogostejša, so bili tudi kaparji zelo razširjeni. Našli smo kaparje iz družin Coccidae in Pseudococcidae. Na podlagi rezultatov in opazovanj domnevamo, da so vzrok za širjenje virusnih okužb v tem vinogradu kaparji, zmožnost izbrane populacije za prenos virusov pa bomo preverili še s poskusi prenosa virusov v laboratorijskih razmerah.

#### **ABSTRACT**

### **Scale insects - vectors of grapevine viruses in Primorska**

Scale insects represent great amount of non-native organisms, which were introduced in greater extent to Slovenia over the past 20 years. They have greatly expanded mainly in vineyards of Primorska region and cause considerable economic damage. These pests weaken the vines by sucking of plant sap and heavy attack may lead to decline of the plant. They cause indirect damage due to honeydew secretion which is a good medium for sooty mold growth. Mold affects the photosynthetic activity and consequently fruit



quality and market value of grapes. Scale insects are also known as plant virus vectors, in particular of *Grapevine leafroll-associated viruses* (GLRaV) and *Grapevine virus A* (GVA). Viruses and scale insects were analysed in a vineyard near Ajdovščina with a heavy outbreak of grapevine leafroll disease. The results of the study showed high infection with GLRaV-3 and only few cases of infection with GLRaV-1. Mealybugs (Pseudococcidae) and/or soft scales (Coccidae) were found regularly in parts of the vineyard with higher rate of virus infection. These results indicate that the spread of GLRaV in this vineyard is associated with dynamics of scale insects. Transmission experiment with the population of scale insects from this vineyard will be made under laboratory conditions.



### **Biotična učinkovitost insekticidov pri zatiranju ameriškega škržatka *Scaphoideus titanus* Ball (1932), v vinorodni deželi Dolenjska v letih 2011 in 2012**

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Ameriški škržatek (*Scaphoideus titanus* Ball, 1932) je edini naravni in tudi najpomembnejši prenašalec karantenske fitoplazme Grapevine Flavescence dorée (FD), povzročiteljice zlate trsne rumenice na vinski trti. Najučinkovitejši ukrep za preprečevanje širjenja FD je zatiranje ameriškega škržatka z učinkovitimi insekticidi. Z namenom določitve biotične učinkovitosti nekaterih insekticidov smo v letih 2011 in 2012 izvedli poskus v vinogradu v Ručetni vasi v Beli krajini, kjer je bila leta 2010 na rumenih lepljivih ploščah ugotovljena številčna populacija odraslih ameriških škržatkov. V obeh letih smo opravili po dve škropljenji. V poskusu smo uporabili naslednje pripravke: Actara 25 WG, Decis 2,5 EC, Kenyatox verde, Pyrinex 25 CS, Reldan 22 EC in Steward WG. Ocenjevanje smo opravili s štetjem ličink različnih razvojnih stopenj in odraslih žuželk. Učinkovitost insekticidov smo izračunali po Abbottu in Henders-Tiltonovi enačbi. Opravili smo analizo variance in Duncanov razvrstitveni test pri 95 % stopnji zaupanja. Med posameznimi postopki smo ugotovili statistično značilne razlike. Najbolj učinkovit je bil insekticid Actara 25 WG, najmanjšo učinkovitost pa je imel pripravek Steward WG.

#### **ABSTRACT**

### **Field efficacy evaluation of several insecticides against *Scaphoideus titanus* Ball (1932) in wine-growing region Dolenjska conducted in years 2011 and 2012**

American grapevine leafhopper (*Scaphoideus titanus* Ball, 1932) is the only natural and the main vector for quarantine Grapevine Flavescence dorée phytoplasma (FD), the causative agent of the Grapevine yellows disease. The most effective measure for prevention of FD spread is vector suppression with effective plant protection products. The purpose of this research was to test several insecticides for their ability to control the population of American leafhopper. The field efficacy trials were conducted in years 2011 and 2012 in a vineyard located in Ručetna vas, Bela Krajina, where high population of adult American leafhoppers was determined in 2010. Two sprayings were performed each year. The following insecticides were used: Actara 25 WG, Decis 2.5 EC, Kenyatox verde, Pyrinex 25 CS, Reldan 22 EC and Steward WG. Their efficacy was assessed by counting different larval stages and adults. The effectiveness of the insecticides was calculated after Abbott and Henders-Tilton equation. ANOVA and Duncan's arrangement test were

performed. Statistically significant differences were found between the different treatments. The treatment with Actara 25 WG was the most effective while the treatment with Steward WG was the least effective.



### **First record of the orange spiny whitefly, *Aleurocanthus spiniferus* Quaintance, 1903 (Hemiptera: Aleyrodidae) in Croatia**

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Orange spiny whitefly, *Aleurocanthus spiniferus* Quaintance, 1903, originated in south-east Asia and has spread widely in tropical and subtropical Asia, and into Africa and the Pacific. *Citrus* spp. are the main hosts of economic importance, but *A. spiniferus* has been recorded from woody hosts of more than 15 plant families. This species is listed as a quarantine threat to Europe and is included in the EU Annex II/A1 and in the EPPO A2 list. In Europe, it was reported for the first time in Italy, in 2008. In May 2012, *A. spiniferus* was first found in Croatia, on ornamental potted orange seedlings (*Citrus x aurantium* L.) from domestic production in one nursery garden in Split. The pest was detected during a regular phytosanitary inspection of a garden centre. Infested orange plants have locally numerous small, brownish to black scales with a short fringe of white wax on the underside of leaves. The identification of the whitefly species was carried out by the Institute's Laboratory for Zoology and the result was confirmed in Plant Protection Service, Wageningen. The origin of the infestation of this alien species is still unknown, but it is assumed that the infection originated from imported plant material from Italy. *A. spiniferus* causes general weakening of seriously infested plants due to sap loss and the growth of sooty mould. Dense colonies of whitefly immature stages develop on leaf undersides, whereas the adults fly actively when disturbed. Leaves and fruits have spots of sticky, transparent honeydew, which become covered in black sooty mould fungus. A heavy infestation gives trees an almost completely black appearance. The potential host range of *A. spiniferus* in the EPPO region would be essentially citrus, with some possibility of establishment on other woody plantation crops growing in the southern part of the region in climatic conditions suitable for the pest. It presents a potential risk to citrus in Croatia, especially to production of mandarin in Neretva river valley.



### ***Thuja occidentalis* L. is commonly a host for cypress jewel beetle (*Ovalisia festiva* L.) in Slovenia**

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White cedar (*Thuja occidentalis* L.) is commonly used as an ornamental plant in cut or free-growing hedges in all parts of Slovenia, regardless of the soil or climate conditions.

The dominant variety is Emerald with a conical crown. A significant drying and dying of white cedars in an older hedge was observed in autumn 2010 in Ljubljana (Vič). When the branches were carefully examined, many were found to be hollow and full of channels filled with sawdust. In the channels pupae were discovered, from which blue-green beetles with a metallic sheen emerged after five days at 20°C. Beetles were morphologically analyzed and classified as cypress jewel beetle (*Ovalisia festiva* L.). Additionally, molecular bar-coding was performed. A segment of mitochondrial DNA, which encodes cytochrome oxygenase I, was amplified by PCR. The sequence obtained was published on the internet. In April and May 2012 similar damage was observed in several gardens in Ljubljana (Trnovo, Bežigrad), Posavje (Žadovinec) and Prekmurje (Lendava). Strongly attacked cedars have dried completely or needed to be removed due to poor condition. We conclude that the native beetle that normally feeds on junipers found a niche in the white cedars growing in permanent sites or in nurseries. Developmental cycle of the pest and ways of its control have not yet been studied in Slovenia according to our knowledge. This suggests a need for regular and professional monitoring of the pest. A possible control measure to slow the insect's spread is a selection of ornamental plants, well accustomed to their growth conditions.

#### IZVLEČEK

#### **Ameriški klek v živih mejah je pogosto gostitelj južnega brinovega krasnika (*Ovalisia festiva* L.) v Sloveniji**

Ameriški klek (*Thuja occidentalis* L.) se je kot okrasna rastlina za žive meje razširil v vseh delih Slovenije, ne glede na ustreznost podnebja in tal. Prevladuje sorta Smaragd. Spomladi 2011 smo v Ljubljani pregledali kleke v starejši živi meji, ki so se sušili že nekaj let. Pri razrezu polsuhih vej smo opazili v lesu rove z žagovino. V izdolbinah smo našli bube, iz katerih so se pri 20°C v laboratoriju po petih dneh izlegli zelenomodri hrošči s kovinskim leskom in temnimi pikami na pokrovkah, dolgi približno 10 mm. Hrošče smo morfološko klasificirali in ugotovili, da je izvrtine povzročil južni brinov krasnik (JBK) (*Ovalisia [Palmar] festiva* L.). Opravili smo molekularno črtno kodiranje. S tehniko PCR smo pomnožili odsek mitohondrijske DNA, ki kodira citokrom oksigenazo I. Pridobljeno sekvenco smo objavili na medmrežju ([www.boldsystems.org](http://www.boldsystems.org)). JBK je domorodna vrsta, ki se sicer prehranjuje na brinu, a je našel prehransko nišo v klekih, ki so predvidoma oslabljeni zaradi stresa, o čemer poročajo tudi drugod po Evropi. V letu 2012 smo v aprilu in maju opazili starejše kleke sorte Smaragd z enakimi poškodbami in ličinkami v lesu na več vrtovih v Ljubljani (Trnovo, Bežigrad), v Posavju (Žadovinec) in v Prekmurju (Lendava). Potrdili smo tudi napad na štiriletnih sadikah v drevesnici v Ljubljani. Sklepamo, da JBK ogroža kleke na stalnem rastišču in v drevesnicah. Močno napadeni kleki se posušijo v celoti ali pa jih je zaradi slabega izgleda potrebno odstraniti. Njegov razvojni krog na klekih pri nas in načini zatiranja še niso preučeni. Možen ukrep za zmanjšanje škode je izbor okrasnih rastlin, ustreznih za določeno rastišče.



#### **First record of the red palm weevil, *Rhynchophorus ferrugineus* (Olivier, 1790) and palm borer, *Paysandisia archon* (Burmeister, 1880) in Croatia**

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It is estimated that in Croatia over one million palm trees are planted. Most of them can be found in the Mediterranean part of the country. Most common species are *Phoenix canariensis* (Canary Date Palm), *Trachycarpus fortunei* (Chusan Palm), *Washingtonia filifera* (Cotton palm or California Fan Palm) and *Chamaerops humilis* (Mediterranean dwarf palm). In 2011, two new quarantine pests of the Croatian entomofauna on palm trees were discovered: *Rhynchophorus ferrugineus* (Olivier, 1790) - red palm weevil and *Paysandisia archon* (Burmeister, 1880) (Lepidoptera) - palm borer. Both, red palm weevil and palm borer, are known to be extremely hazardous palm tree pests which, in most cases, cause a complete destruction of its host. Red palm weevil originates from South Asia and Melanesia, where it causes great damages on the Coconut palm. Therefrom, it spread rapidly westward in the mid-eighties. In the area of the EPPO region, it appeared in 1992 in Egypt. After that, in 1994 in Italy and Spain, 1999 in Israel and Jordan, 2005 in Turkey, 2006 on Cyprus, Greece and in France, 2008 in Morocco, 2009 in Georgia and Slovenia and in 2011 in Croatia. In Asia, it is widespread. It was also registered in few places in Oceania. In Croatia, this pest was first discovered in the County of Zadar in the area of Turanj and after that in Šibenik-Knin County in the area of Šibenik. Palm Borer is a Neotropical species which originates from South America. In the EPPO region, it was first found in Spain in one nursery in Catalonia. After that, it was registered on few localities along the Mediterranean coast. In the same year, it was also discovered in France. Lately, the pest was also found in Italy. Three isolated cases were registered in Great Britain (2002, 2007 and 2008). Based on the oral communication, we are informed that in 2008 it was registered in Slovenia. In Croatia, it was first registered in September 2011 in the area of Split. The main problem with the spreading of these pests lies mainly in the trade of the planting material. Since Croatia does not have its own palm tree production, all the planting material is being imported mostly from Spain and Italy, countries in which these pests are spread. Besides that, since both of these pests fly, the spreading occurs very fast. Based on the latest research conducted in Spain, palm trees can be saved if the control measures are carried out at adequate timing and with the use of adequate plant protection products.



### **Razširjenost favne pravih listnih uši (Hemiptera: Aphididae) na lubenicah (*Citrullus lanatus* L.), gojenih v hrvaški Istri**

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Poljski poskusi z lubenico so bili izvedeni v letih 2008, 2010 in 2011 v Pulju (hrvaška Istra). Cilj raziskave je bil usmerjen v sistematično spremljanje naleta listnih uši. Hkrati pa smo ugotavljali, kako se posamezne vrste uši odzivajo na prekrivke iz črnega polietilena in zastirke iz sena oziroma na gola tla. Od maja do julija smo enkrat tedensko analizirali nalet krilatih uši z lovnimi (Moericikovimi) rumenimi posodami. Med raziskavo smo determinirali 44 vrst uši iz 31 rodov, in sicer je bilo leta 2008 determiniranih 36 vrst iz 24

rodov, leta 2010 18 vrst iz 15 rodov in leta 2011 34 vrst iz 25 rodov. Ugotovili smo, da sta bili vrsti *Aphis fabae* (30,8 % v letu 2008, 46,5 % v letu 2010 in 34,9 % v letu 2011) in *Myzus persicae* (11,2 % v letu 2008, 27,9 % v letu 2010 in 11,8 % v letu 2011) stalno evdominantni, medtem ko so se uši vrste *Acyrtosiphon pisum* (6 % v letu 2008, 5,8 % v letu 2010 in 7,6 % v letu 2011) pokazale kot dominantne. Vrsta *Brevicoryne brassicae* je bila determinirana kot dominantna v letu 2008 (7,11 %) in evdominantna v letu 2011 (22,13 %). Za vrsto *Macrosiphum rosae* je bila dvakrat ugotovljena dominantnost (6,16 % v letu 2008 in 6,9 % v letu 2011), medtem ko je bila vrsta *Phorodon humuli* evdominantna leta 2008 (11,2 %). Vrsta *A. fabae* je bila najštevilčnejša na lubenicah, gojenih na seneni zastirki v letih 2008 in 2011, v letu 2010 pa je bila najbolj številčna na golih tleh.

#### ABSTRACT

#### **Distribution of aphids fauna (Hemiptera: Aphididae) in the watermelon (*Citrullus lanatus* L.) fields of Croatian Istria**

The field experiments with watermelon were conducted during 2008, 2010 and 2011 at Pula (Croatian Istria). The aim of the study was to identify aphid species and to compare the attractiveness of polyethylene black mulch with hay cover and bare soil related to aphid species response. Winged aphids were collected weekly using yellow water metal traps (Moerick) during May - July periods. During the study, 44 species from 31 genera were detected, with 36 species from 24 genera being identified in 2008, 18 species from 15 genera in 2010, and 34 species from 25 genera in 2011. The overall seasonal percentage composition showed that *Aphis fabae* (30.8% in 2008, 46.5% in 2010 and 34.9% in 2011) and *Myzus persicae* (11.2% in 2008, 27.9% in 2010 and 11.8% in 2011) were consistently eudominant species, while *Acyrtosiphon pisum* (6% in 2008, 5.8% in 2010, and 7.6% in 2011) was consistently dominant. *Brevicoryne brassicae* was determined as dominant species (7.11%) in 2008 and eudominant species (22.13%) in 2011. Additionally, *Macrosiphum rosae* (6.16% in 2008 and 6.9% in 2011) was twice recorded as dominant species while *Phorodon humuli* (11.2%) was eudominant in 2008. The hay cover was determined as attractive mulch to *A. fabae* in 2008 and 2011. The number of *A. pisum* was the highest on bare soil in 2010.



#### **Plant-parasitic nematodes of East Herzegovina**

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Nematology research in Bosnia and Herzegovina was carried out in 50-s, 60-s and 70-s years of last century intensively by Olga Klindić. It was mainly focused on root-knot nematodes and PCN. However, since then there was no research on this topic until 2010. This survey was done in autumn in 2012 with an aim to look which genera of plant-parasitic nematodes are present in sampled area. 25 soil samples were taken from

agricultural fields in municipalities of Trebinje and Ljubinja in East Hercegovina. Soil samples were taken from greenhouses where tomato, pepper, salads and cucumber were grown, from open fields from pepper, tobacco and spinach fields, and nursery, cherry and apple orchards and vineyards. Motile stages of nematodes were extracted from soil by Oostenbrink elutriator and identified under dissection microscope. Nematode genera were identified by morphological characters. 12 genera of plant-parasitic nematodes were identified: *Pratylenchus*, *Meloidogyne*, *Tylenchus*, *Aphelenchus*, *Rotylenchus*, *Paratylenchus*, *Xiphinema*, *Tylenchorinchus*, *Helicotylenchus*, *Zygotylenchus*, *Ditylenchus* and *Criconema*. *Meloidogyne* and *Tylenchorinchus* were the most dominant genera, present in 17 and 16 samples respectively. Distribution of nematode genera is presented and discussed in the paper.

## IZVLEČEK

### Rastlinsko-parazitske ogorčice Vzhodne Hercegovine

Z nematološkimi raziskami se je v Bosni in Hercegovini v 50-ih, 60-ih in 70-ih letih prejšnjega stoletja intenzivno ukvarjala Olga Klindić. Glavni poudarek je namenjala ogorčicam koreninskih šišk in krompirjevim ogorčicam. Od tedaj pa do leta 2010 v Bosni in Hercegovini nihče ni delal na področju nematologije. Vzorčenja, katerih rezultate predstavljamo v pričujočem prispevku, so bila izvedena jeseni 2012, z namenom, da bi ugotovili zastopanost rastlinsko-parazitskih ogorčic na preučevanem območju. Na kmetijskih zemljiščih v občinah Vzhodne Hercegovine, Trebinju in Ljubinju, je bilo nabranih 25 talnih vzorcev. Vzorci tal so bili nabrani v rastlinjakih, kjer so pridelovali paradižnik, papriko, solato in kumare, ter na prostem, na njivah s papriko, tobakom in špinačo. Nekaj vzorcev je bilo nabranih tudi v drevesnici, sadovnjakom s češnjami in jabolki ter v vinogradu. Aktivne oblike ogorčic smo pridobili iz tal z Ostenbrinkovim ekstraktorjem, identificirali pa smo jih pod mikroskopom. Ogorčice smo v rodove uvrstili na podlagi morfoloških značilnosti. Skupaj je bilo določenih 12 rodov rastlinsko-parazitskih ogorčic: *Pratylenchus*, *Meloidogyne*, *Tylenchus*, *Aphelenchus*, *Rotylenchus*, *Paratylenchus*, *Xiphinema*, *Tylenchorinchus*, *Helicotylenchus*, *Zygotylenchus*, *Ditylenchus* in *Criconema*. V vzorcih smo največkrat ugotovili rodova *Meloidogyne* v 17 in *Tylenchorinchus* v 16 vzorcih. V prispevku bo predstavljena in obravnana razširjenost rastlinsko-parazitskih ogorčic.



### Morphometric and molecular analysis of potato cyst nematodes from Serbia

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Potato cyst nematodes (PCN) *Globodera rostochiensis* and *G. pallida* belong to the major potato parasites in temperate regions. These quarantine pests are regulated by EU directive 2007/33/EC. The morphological characters of these sibling species may overlap and a precise identification is crucial for the phytosanitary system of every country including Serbia. *G. rostochiensis* and *G. pallida* are present in Serbia since 1999 and 2005 respectively. Both species were detected in soil samples originated from seed potato fields in three districts (Zlatibor, Mačva and Moravica) during official surveys. In accordance

with phytosanitary measures for prevention of their further spreading, an official program for control of ware potato fields has been carried out for the presence of PCN in these quarantine districts since 2009. During 2009-2011, the PCN originated from ware potato fields from Serbia were analyzed by morphometric method and their identity was confirmed using real-time PCR method. The morphometrical characters of five PCN populations from locations of Gojna Gora (district of Moravica), Tabanovići and Ponikve (district of Zlatibor) were studied. Morphometric analyses of ten cysts and ten second-stage juveniles originated from these locations established the presence of *G. rostochiensis*. All morphological values from these different populations are very close. The characters that vary most are J2 body length, hyaline part of tail and distance from vulval basin to anus of cysts. Real-time PCR analyses confirmed morphometric identification of all samples as *G. rostochiensis*.

## IZVLEČEK

### Morfometrična in molekularna analiza krompirjevih ogorčic iz Srbije

Krompirjevi ogorčici (PCN) *Globodera rostochiensis* in *G. pallida* spadata med glavne škodljivce krompirja v zmernem pasu. Njun karantenski status ureja EU direktiva 2007/33/EC. Morfološke značilnosti teh dveh sestrskih vrst se lahko prekrivajo, natančna identifikacija pa je ključna za fitosanitarni sistem v vseh državah vključno s Srbijo. Vrsti *G. rostochiensis* in *G. pallida* sta zastopani v Srbiji od l. 1999 oz. 2005. Obe vrsti sta bili najdeni v vzorcih tal z njiv semenskega krompirja na treh območjih (Zlatibor, Mačva in Moravica) med uradnim nadzorom. Od l. 2009 naprej na teh območjih poteka program pregledovanja njiv jedilnega krompirja na zastopanost PCN v skladu s fitosanitarnimi ukrepi za preprečevanje njihovega nadaljnega širjenja. V obdobju 2009-2011 smo populacije PCN najdene v vzorcih tal z njiv jedilnega krompirja v Srbiji identificirali glede na morfološke značilnosti, identifikacijo pa smo potrdili z metodo PCR v realnem času. Morfološko smo analizirali pet populacij PCN z lokacij Gojna Gora (območje Moravica), Tabanovići in Ponikve (območje Zlatibor). Morfometrična analiza desetih cist in desetih ličink druge stopnje je potrdila zastopanost vrste *G. rostochiensis* na teh območjih. Vrednosti meritev morfoloških značilnosti teh različnih populacij so si zelo podobne. Še najbolj raznolike so meritve za naslednje značilnosti: dolžino telesa in hialini del repa ličink druge stopnje ter razdaljo med vulvinim obročem in anusom pri cistah. Analiza vseh teh vzorcev z metodo PCR v realnem času je potrdila vrsto *G. rostochiensis*.



### Application of the PCR-RFLP method in the system of special surveillance (system control) of potato cyst nematodes in Bosnia and Herzegovina

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Because potatoes in Bosnia and Herzegovina is one of the most important agricultural crops and by the official statistical data on areas under potato is classified as a very important agricultural products for export from Bosnia and Herzegovina. In the control of potato production for growers is very important to know what types of pests threaten their production, and to know their status and distribution. Potato cyst nematodes (PCN),

*Globodera rostochiensis* Woll. and *Globodera pallida* Stone, are very dangerous quarantine pests and are responsible for huge losses in potato production worldwide. These soil pathogens after completing vegetation remain in the soil in the vital condition for many years. In order to take prompt and effective phytosanitary measures with the aim of preventing the entering and spread of these pests is very important, fast and reliable detection of the presence and identification of these pathogens. In this regard, due to high specificity, molecular methods are inevitable in the diagnosis of these pathogens of quarantine in the world. Through a special surveillance program (system control) over the presence of potato cyst nematodes (*G. pallida* and *G. rostochiensis*) in 2012, Federal Institute of Agriculture Sarajevo, authorized by the Administration of Bosnia and Herzegovina for Plant Health, implemented the PCR-RFLP method as an additional test in the diagnosis of these pathogens. Validated reagents and protocol have been used, and selected method was with the internal DNA controls from the Agricultural Institute in Ljubljana, which expert in the organization by FARMA (USAID and SIDA), checked the expertise and competence of our laboratory for PCR test performance. Verification of prescribed methods for detection and identification of PCN in laboratories in BiH, established better control and prevent, the possible entering and spread of these pests, which helps preserve the potato production in BiH.



### **Vpliv bakterije *Agrobacterium tumefaciens* na vstop ličink ogorčice *Meloidogyne ethiopica* v korenine gostiteljske rastline *in vitro***

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V rizosferi gostiteljskih rastlin prihaja do številnih medsebojnih vplivov med različnimi organizmi. Nas je zanimal medsebojni vpliv med bakterijo *Agrobacterium tumefaciens*, znano povzročiteljico raka koreninskega vratu, in tropsko rastlinsko parazitsko ogorčico *Meloidogyne ethiopica*, ki je bila ugotovljena tudi v slovenskih tleh. Vpliv bakterije *A. tumefaciens* na vstop ličink J2 *M. ethiopica* v korenino je bil preučevan *in vitro* na gostiteljski rastlini *Arabidopsis thaliana* s tehniko ločenih korenin. Opazili smo, da zastopanost bakterije *A. tumefaciens* (100 CFU) na eni strani korenine ne vpliva na vstop ličink *M. ethiopica* na nasprotni strani korenine, neodvisno od velikosti inokuluma ličink. Vstop ličink J2 je bil slabši ob zastopanosti vrste *A. tumefaciens* na isti strani korenine, vendar le pri inokulumu 20 ličink na korenino. Predvidevamo, da bakterija *A. tumefaciens* otežuje vstop ličinkam ogorčice *M. ethiopica* v gostiteljsko rastlino zaradi nastanka biofilma okoli korenine. Zmanjšano razmnoževanje ogorčice ob zastopanosti bakterije *A. tumefaciens* je nakazal tudi vzporeden lončni poskus na koreninah paradižnika po 46-ih dneh inkubacije. Rezultati naše preliminarne študije nakazujejo na antagonizem med ogorčicami koreninskih šišek in bakterijo *A. tumefaciens*. Izbrana metoda *in vitro* se je izkazala kot odličen sistem za kratkoročne študije medsebojnih vplivov med omenjenimi organizmi, saj z njo pridobimo informacije, ki so nam v pomoč pri zasnovi dolgoročnih lončnih poskusov.

**ABSTRACT**



### **Penetration of *Meloidogyne ethiopica* juveniles into plant host roots affected by *Agrobacterium tumefaciens* in vitro**

Rhizosphere presents a place of numerous interactions between various organisms. Interaction was studied between the crown gall bacterium *Agrobacterium tumefaciens* and tropical root knot nematode *Meloidogyne ethiopica*, whose presence was determined in Slovenian soil. The effect of *Agrobacterium tumefaciens* on penetration of J2 *M. ethiopica* juveniles into plant host roots was assessed on the host plant *Arabidopsis thaliana* with in vitro split root technique. The presence of *A. tumefaciens* (100 CFU) on one side of the split root had no effect on J2 penetration on the opposite split root, regardless of the nematode inoculum size. However, we noticed a significant decrease in J2 penetration when *A. tumefaciens* was present on the same side of the roots, but only at 20 larvae per root. It is possible that *A. tumefaciens* hinders penetration of J2 larvae into plant roots due to biofilm formation. The *M. ethiopica* co-inoculated with *A. tumefaciens* showed reduced reproduction on tomato roots in parallel pot trial after 46 dpi. Based on this preliminary study the interaction between root knot nematodes and *A. tumefaciens* appears antagonistic. The applied method proved excellent for short-term interaction studies *in vitro* between the studied organisms, as it provides additional information useful in designing long-term pot trials.



### **Morfološke in fiziološke spremembe pri paradižniku po napadu ogorčice *Meloidogyne ethiopica***

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Ogorčice vrste *Meloidogyne ethiopica* se hranijo in razmnožujejo v koreninah rastlin, na katerih posledično povzročajo nastanek koreninskih šišek. Poškodbe, ki jih povzročajo na rastlinah, se odražajo v spremenjenih fizioloških procesih v rastlini in so odvisne od velikost populacije ogorčic in vrste gostiteljske rastline. V raziskavi smo vrednotili hidravlično prevodnost korenin in vodni potencial v listih ter morfološke spremembe na koreninah paradižnika po napadu prvega in drugega rodu ogorčice *M. ethiopica* (74 DPI in 102 DPI). Rastline so bile izpostavljene dvema stopnjama inokuluma jajčec (10 oz. 50 jajčec na cm<sup>3</sup> rastnega medija). Analiza je pokazala, da napad ogorčic povzroči morfološke spremembe koreninskega sistema, spremembe pa so se povečale pri drugem rodu ogorčic. Odstotek drobnih korenin pri kontrolnih rastlinah po prvem in drugem vrednotenju je bil približno 50 % glede na celotno površino korenin, medtem ko se je pri napadenih rastlinah po vstopu drugega rodu ogorčic zmanjšal za 2,1-krat pri manj napadenih rastlinah oz. za 3,2-krat pri močnejše napadenih rastlinah. Delež drobnih oz. debelih korenin je imel velik vpliv na meritve hidravlične prevodnosti korenin ter na vodni potencial v listih, medtem ko število rastnih vršičkov na te meritve ni imelo vpliva. Velikost populacije ogorčic in čas napada sta vplivala na dolžino celotnega koreninskega sistema; z večanjem populacije in daljšim časom napada se je celotni koreninski sistem skrajšal.

#### **ABSTRACT**

## **Morphological and physiological changes in tomato after *Meloidogyne ethiopica* nematode infestation**

The root knot nematodes *Meloidogyne ethiopica* feed and reproduce on the plant roots, which consequently leads to the formation of the root galls. The population size as well as the type of the host plants influences the damage on the plants, which manifests itself as changes in the physiological processes in plants. We evaluated the hydraulic conductivity of the roots, leaf water potential and morphological changes of the roots after the infestation with the first and the second generation of *M. ethiopica* (74 DPI and 102 DPI). The plants were inoculated with two nematode inoculum densities at 10 and 50 eggs per 1 cm<sup>3</sup> of the growth medium. The analysis showed that the nematode infestation induces morphological changes of the root system and these changes intensified with the second nematode generation. The portion of the fine roots in the control plants after the first and second evaluation was approximately 50 % of the total root surface. On the other hand the portion of the fine roots in infected plants after the penetration of the second generation of the nematodes into the plants inoculated with low and high nematode densities reduced for 2.1 and 3.2-times respectively. We showed that the portion of the fine and course roots has a major influence on the hydraulic conductivity and the water potential in leaves, while the number of the root tips had no influence on these measurements. The nematodes population density of and the time of infestation influenced the length of the whole root system; higher nematode density and longer infestation time reduced the length of the whole root system.



## **Raznolikost slovenskih izolatov PPV (*Plum pox virus*)**

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Šarka, ki jo povzroča *Plum pox virus* (PPV), povzroča pri občutljivih sortah koščičastih sadnih vrst znatno znižanje količine in kakovosti pridelka. V Sloveniji je razširjena v vseh pridelovalnih območjih koščičarjev in je ni več mogoče izkoreniniti. Izolati PPV so zelo variabilni in se združujejo v 7 različkov: PPV-M, PPV-D, PPV-Rec, PPV-EA, PPV-C, PPV-W in PPV-T. Ti se razlikujejo po patogenosti, gostiteljskih rastlinah, zmožnosti in učinkovitosti prenosa z listnimi ušmi in navzočnosti v različnih geografskih območjih. Določitev vrste izolata je pomemben in odločilen korak za uspešno obvladovanje in omejevanje širjenja PPV. Za proučevanje populacije PPV v Sloveniji smo v letih 2011 in 2012 na 18 lokacijah zbrali 31 vzorcev koščičarjev. RT-PCR produkte, namnožene iz izolirane celokupne RNA posameznih vzorcev s pari začetnih nukleotidov P3M/PPV1 ali P3D/PPV1, smo sekvenirali. S filogenetsko analizo slovenskih sekvenc in sekvenc iz baze NCBI GenBank dolžine 908 nt na NIb/CP regiji PPV genoma smo 16 slovenskih sekvenc razvrstili v skupino PPV-Rec, 10 v PPV-M in 5 v PPV-D. PPV-Rec izolate smo potrdili na 14 vzorcih iz raznih kultivarjev sliv, enem vzorcu iz koreninskih izrastkov slive in enem vzorcu cibore. Okužbo s PPV-M izolati smo potrdili pri 3 breskvah, 2 marelicah in 5 slivah, okužbo s PPV-D izolati pa pri 3 marelicah in 2 slivah. Rezultati kažejo, da so v Sloveniji zastopani izolati iz skupin PPV-Rec, PPV-M in PPV-D in da so izolati PPV-Rec na slivah prevladujoči. Identičnost nukleotidnih zaporedij slovenskih izolatov je znašala od 83,7 do 100%. Znotraj posameznih skupin izolatov so slovenski izolati pokazali manjšo variabilnost. Identičnost nukleotidnih sekvenc slovenskih izolatov je bila najvišja znotraj

skupine PPV-Rec (98,0 - 100%). Slovenski izolati znotraj PPV- M izolatov so pokazali 97,6 do 99,7% identičnost, medtem ko je identičnost slovenskih izolatov iz skupin PPV-D znašala od 96,1 do 99,4%.

## ABSTRACT

### Diversity of Slovene PPV (*Plum pox virus*) isolates

Sharka, caused by *Plum pox virus* (PPV), significantly reduces yield quality and quantity in susceptible stone fruit cultivars. In Slovenia, sharka is present in all stone fruit growing regions. PPV isolates are very diverse and have been assigned in 7 strains: PPV-M, PPV-D, PPV-Rec, PPV-EA, PPV-C, PPV-W, and PPV-T. PPV strains differ in pathogenicity, host range, aphid transmissibility, and geographic distribution. Strain identification is thus an important and critical step in effective management and control of the spread of PPV. In order to study the population of PPV in Slovenia, 31 samples of stone fruits were collected from 18 locations in the years 2011 and 2012. Total RNA isolated from individual samples was used in RT-PCR using PPV1/P3M and PPV1/P3D primer pairs. Obtained amplicons were directly sequenced. Sequences of a 908 nt fragment corresponding to the N1b/CP region of Slovene isolates were compared with other sequences from the NCBI database using phylogenetic analyses. 16 Slovene sequences clustered with PPV-Rec isolates, 5 with PPV-D isolates and 10 with PPV-M isolates. PPV-Rec isolates were detected in 14 samples taken from plum cultivars, one sample from plum root suckers and one from *P. instititia*. Infection with PPV-M was found in 3 peach samples, 2 apricot samples and 5 plum samples, whereas PPV-D isolates were detected only in apricots (3 samples) and plums (2 samples). Results show that the three major PPV strains occur in Slovenia and that PPV-Rec is predominant in plums. Sequence identity of Slovene isolates ranged from 83.7 to 100 %. Higher identities were detected within each group of isolates. The highest identity of Slovene isolates was detected within PPV-Rec group (98.0 - 100%). The identity of Slovene PPV- M isolates ranged from 97.6 to 99.7% and of PPV-D isolates from 96.1 to 99.4%.



### Implementation of PCR method in the system of special surveillance (system control) of quarantine bacterioses on potato in Bosnia and Herzegovina

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Quarantine bacterioses *Ralstonia solanacearum* (Smith) Yabuuchi et al. and *Clavibacter michiganensis* ssp. *sepedonicus* (Spieckermann et Kotthoff) Davis *et al.* on potato (*Solanum tuberosum* L.) are one of the most important limiting factors in production of this culture in the world. Possibilities of decrease of incidence of this pathogen reflects in early identification of latent contamination in tubers, which helps direct prevention of their introduction and spreading. Therefore, aiming undertaking of prompt and efficient phytosanitary measures, it is very important to have reliable and fast detection and identification of pathogen presence. Because of high specificity, sensitivity and performance speed, molecular methods found their place in diagnostics of these quarantine diseases in the world, and they are one of possible recommended methods determined

through legislative regulations. Through special surveillance program (system control) of quarantine bacterioses on potato in 2011., Federal Institute of Agriculture Sarajevo, authorized by Administration of Bosnia and Herzegovina for plant health protection, implemented PCR method as the main test in diagnostics of mentioned pathogens, on around 70 samples. For DNA extraction, Qiagen DNeasy Plant Kit was used. Validated reagents and protocol have been used, and method with internal control was selected. Expertise and competence of our laboratory for PCR test performance, we confirmed with our participation and successful PCR performance in the expert test (Proficiency Test), which was organized during project implementation of (USAID and Sida). Establishment of systemic control of potato bacterioses and verification of prescribed methods for their identification and confirmation in domestic laboratories provides better surveillance of health conditions of imported potato, which protects agriculture and potato producers in BiH.



### **Vpliv rizosfernih bakterij na rast sadik paradižnika (*Solanum lycopersicum* L.)**

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Rizobakterije (Plant Growth Promoting Rhizobacteria - PGPR) so v uporabi za pospeševanje rasti rastlin in za biotično tariranje različnih rastlinskih patogenih mikroorganizmov, tako v kmetijstvu kot gozdarstvu. Paradižnik je gospodarsko pomembna rastlina v Sloveniji, gojimo ga v rastlinjakih, kar je prednost pri morebitni aplikaciji bakterijskih izolatov za pospešeno rast rastlin in varstvo rastlin pred rastlinskimi patogenimi mikroorganizmi. V poskusih smo preverili pozitiven učinek izoliranih bakterij iz rizosfere paradižnika na rast paradižnika in sposobnost inhibicije treh patogenih bakterij, *Ralstonia solanacearum*, *Clavibacter michiganensis* subsp. *michiganensis* in *Xanthomonas vesicatoria* *in vitro*. Pri nekaterih bakterijskih sevih iz rodu *Pseudomonas* smo opazili tako pozitiven učinek na rast sadik paradižnika kot tudi sposobnost inhibicije na nekatere testirane patogene rastlinske bakterije, zato bi bili ti sevi uporabni za nadaljne raziskave inhibicije pred rastlinskimi patogenimi bakterijami *in vivo* in pozneje za ugotavljanje pozitivnega učinka na rast paradižnika v poljskih poskusih. Izolirane bakterije smo identificirali z analizo profila maščobnih kislin, z BIOLOG in sekvenciranjem 16S rRNA ter rezultate primerjali z drugimi identifikacijskimi metodami (rast na gojišču, biokemijski testi). Ugotovili smo, da nobena od preizkušenih metod za identifikacijo ne omogoča zanesljivega razlikovanja med vrstami iz rodu *Pseudomonas*, zato je potrebno za zanesljivo določitev uporabiti kombinacijo metod.

#### **ABSTRACT**

### **Effect of rhizobacteria on growth of tomato plants (*Solanum lycopersicum* L.)**

Plant growth promoting rhizobacteria (PGPR) are used for biocontrol against various plant pathogens and to promote plant growth in both agriculture and forestry. Tomatoes are economically important plants in Slovenia, grown in the greenhouse, which is an advantage in any application of bacterial isolates for accelerated plant growth and protection against plant pathogens. The positive effect on the growth of tomato plants of bacteria isolated from the rhizosphere of tomato was examined and their ability to inhibit three pathogenic bacteria *Ralstonia solanacearum* and *Clavibacter michiganensis* subsp. *michiganensis* and *Xanthomonas vesicatoria* *in vitro* were tested. In some bacterial strains of the genus *Pseudomonas*, we noticed a positive effect on the growth of tomato plants as well as their ability to inhibit some plant pathogenic bacteria tested, so these strains are useful for the further research of inhibition against plant pathogenic bacteria *in vivo* and subsequently to identify a positive effect on the growth of tomato plants in field trials. Isolated bacteria were identified by fatty acid profile analysis, BIOLOG and sequencing of 16S rRNA and the results were compared with other identification methods (growth on different medium, biochemical tests). We found out that none of the tested methods for identification does not allow reliable differentiation between species of the genus *Pseudomonas*. For reliable identification combination of methods should be used.



### **Spremljanje gliv iz rodu *Monilinia* na cvetovih, listih in plodovih breskev in marelic z metodo PCR v realnem času**

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Sadna gniloba je pomembna glivična bolezen koščičarjev. V naših rastnih razmerah povzroča znatne izgube pridelka, tako v času obiranja kot med skladiščenjem in transportom. Škodljivejša je v letih s pogostimi padavinami in zmernimi temperaturami. Bolezen povzročajo glive iz rodu *Monilinia*, bodisi domorodni vrsti *M. laxa* in *M. fructigena*, bodisi vnesena karantenska vrsta *M. fructicola*. Pogoste so tudi mešane okužbe z vsemi tremi glivami. Pojav in jakost bolezní sta v veliki meri odvisna od zastopanosti konidijev, ki povzročijo primarne in sekundarne okužbe. Namen naše raziskave je bil spremljati zastopanost konidijev gliv iz rodu *Monilinia* na površju cvetov, listov in plodov izbranih vrst koščičarjev. Tako smo v letu 2012 v enakomernih časovnih intervalih vzorčili cvetove, liste in plodove v štirih proizvodnih nasadih breskev in marelic na Goriškem. Opravili smo osem vzorčenj, razporejenih skozi vso rastno dobo. Vzorce smo pripravili s spiranjem trosov gliv s površja nabranih rastlinskih delov in jih nato analizirali z metodo PCR v realnem času na podlagi TaqMan kemije. Med analiziranimi 102 vzorci nismo zasledili karantenske glive *M. fructicola*, pri 55 vzorcih pa smo potrdili zastopanost drugih gliv iz rodu *Monilinia*.

#### **ABSTRACT**

### **Monitoring of *Monilinia* sp. on flowers, leaves and fruits of peach and apricot using real-time PCR**

Brown rot is an important fungal disease of stone fruits. In our production region it causes substantial pre- and postharvest losses, particularly in the years with frequent precipitations and moderate temperatures. The disease can be induced either by the two

indigenous species *M. laxa* and *M. fructigena*, or by the newly introduced quarantine species *M. fructicola*. Frequently all three species act together in mixed infections. The incidence and severity of the disease largely depends on the availability of conidia that induce primary and secondary infections. The aim of our study was to monitor the occurrence of *Monilinia spp.* conidia on flower, leaf and fruit surfaces of selected stone fruit species. In 2012 we collected flowers, leaves and fruits in regular intervals in four commercial peach and apricot orchards in the Goriška region. Eight field surveys were conducted during the entire growing season. Samples were prepared by rinsing fungal spores from the surface of collected plant material and further analyzed using real-time PCR based on TaqMan chemistry. The quarantine species *M. fructicola* has not been detected in any of the 102 samples, while the presence of other *Monilinia* species has been detected in 55 samples.



### **Praktični vidik aerobiotičnih meritev izbruhov askospor jablanovega škrlupa (*Venturia inaequalis* [Cooke] Wint.)**

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Primarne okužbe jablanovega škrlupa spremljamo z različnimi postopki, med katerimi so tudi metode za spremljanje sproščenega inokuluma askospor v ozračje. Gliva *Venturia inaequalis* v zimskem času na odpadlem listju jablane oblikuje spolna plodišča - psevdotecije, v katerih se oblikujejo askusi z askosporami. Izbruhi askospor se začnejo ob ugodnih okoljskih razmerah z zadostno vlago in temperaturo, navadno tik pred začetkom obdobja rasti jablane. Kvalitativne metode temeljijo na primerjavi stanja. Izvajamo jih v nasadu na pripravljenem nastavku okuženega odpadlega listja, bodisi z vazelinskimi objektnimi stekelci, bodisi Hirst-ovim tipom lovilca spor. V nastavek med meritvami ne posegamo. Jakost posameznega izbruha primerjamo s predhodnimi meritvami. Količina inokuluma askospor začne ob koncu maja praviloma upadati in se dokončno sprostijo do druge dekade junija. Oba postopka po tej metodi sta časovno zamudna in omogočata napake. Najpogosteje prihaja do zamenjav pri vizualnem prepoznavanju askospor vrste *Venturia inaequalis*. Le tem so na primer zelo podobne spore rodu *Alternaria* z eno septo, ki so pogostejše ob zaključevanju primarnih okužb z jablanovim škrlupom, saj se na odpadlem listju razvije množica drugih saprofitskih gliv. Pogosta je tudi neprepoznavnost askospor vrste *Venturia inaequalis* zaradi deformacije ob izsuševanju ali tvorbi kličnega mešička. Meritve po kvantitativni metodi lahko izvajamo s ciklonskim povzorčevalnikom, ki omogoča dejansko meritev količine delcev v volumnu zraka v določeni časovni enoti. Zajem delcev v kivete omogoča tudi nadaljnje molekularno določanje. Ta metoda je zaradi stroškov in tehničnih ovir lovilne naprave še vedno manj praktična.

#### **ABSTRACT**

### **Practical aspect of aerobiological apple scap ascospore (*Venturia inaequalis* [Cooke] Wint.) outbursts measurements**

Apple scab primary infections are examined with different procedures. Amongst them are methods for detecting atmosphere ascospore inoculum discharge. During winter on fallen apple leaves fungus *Venturia inaequalis* develops fruiting bodies - pseudothecia in which

asci with ascospores are formed. Ascospores outbursts start at favourable environmental conditions with adequate water and temperature, usually just before the apple tree growing season. Qualitative methods are based on comparison of condition and are conducted in orchard on dead apple leaves set with Vaseline slides or Hirst type of spore sampler. Set of leaves must not be bothered during the measurements. The intensity of separate outbursts is compared to previous ones. The quantity of inoculum starts to decrease at the end of May and is lastly released in the second decade of June. Both procedures are time consuming and enable mistakes. Of them, most common is visual misconception of *Venturia inaequalis* ascospores with *Alternaria* single septa spores that are frequent at apple scab primary infections endings. At that time leaf litter is inhabited with many saprophytic microorganisms. We can furthermore miss dried or by germ tube deformed ascospores. Quantitative measurements can proceed by cyclone spore sampler which samples actual quantity of particles in volume of air in specified time unit. Spores are caught in vials and allow further molecular diagnostic methods. This method has still limited application due to operation expenses and technical obstacles of the cyclone sampler.



### **Spremenjen primarni in sekundarni metabolizem jagod zaradi okužbe z glivo *Colletotrichum simmondsii* R. G. Shives & Y. P. Tan**

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Pri sorti jagod 'Clery' smo spremljali učinek okužbe z glivo *Colletotrichum simmondsii* na vsebnost sladkorjev, organskih kislin in posameznih fenolov. Primarne metabolite smo analizirali z metodo HPLC-RI-PDA, fenolne snovi pa z metodo HPLC-PDA-MS. Gliva *Colletotrichum simmondsii* je povzročila zmanjšanje vsebnosti saharoze v plodovih ter povečanje vsebnosti fruktoze in glukoze. V okuženih plodovih je prišlo tudi do zmanjšanja vsebnosti organskih kislin. Tako v živicah kot v plodovih smo ugotovili derivate elagne kisline, flavanole in flavonole. V plodovih smo dodatno identificirali štiri različne antocianine. S primerjavo okuženih in zdravih plodov smo določili značilne razlike v vsebnosti posameznih fenolnih snovi iz različnih skupin. Predvsem se je povečala vsebnost derivatov elagne kisline, flavonolov so bilo v glavnem manj v okuženih plodovih, medtem ko se je vsebnost flavanolov in antocianov povečala z stopnjo okužbe. V živicah se je vsebnost derivatov elagne kisline povečala ali zmanjšala, vsebnost procianidinov se je v večini primerov zmanjšala, vsebnost flavonolov pa se je povečala. Razlike so bile manj izražene kot v plodovih.

#### **ABSTRACT**

**Influence of *Colletotrichum simmondsii* R. G. Shives & Y. P. Tan infection on  
primary and secondary metabolites in strawberry**

The effect of *Colletotrichum simmondsii* infection on the contents of sugars, organic acids, and individual phenolic compounds was investigated in strawberry cultivar 'Clery'. Primary metabolites were determined with the use of HPLC-RI-PDA and secondary metabolites further confirmed with HPLC-PDA-MS. *Colletotrichum simmondsii* caused a decrease in sucrose and an increase in fructose and glucose in strawberry fruit. A significant decrease in the content of organic acids was recorded in infected fruit. Different forms of ellagic acid, flavanols and flavonols were identified in strawberry runners and fruit. In fruit additionally four anthocyanins were identified. Significant differences in individual phenolic compounds in strawberry fruit were detected at the beginning of the infection compared to non-infected fruit. Specifically, ellagic acids significantly increased, flavonols generally decreased, and flavanols and anthocyanins increased with the progression of infection. Similarly, some forms of ellagic acid increased and others decreased in infected runners, procyanidins generally decreased and flavonols, increased but the differences were much less prominent compared to the fruit.



### Hitri diagnostični test za določanje trsne rumenice na terenu

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“Flavescence dorée” (FDp) in “bois noir” (BNp) fitoplazmi sta v Evropi najpomembnejši fitoplazmi, ki sta povezani z boleznijo trsna rumenica. Trenutno je FDp razširjena v Franciji, Italiji, Španiji, na Portugalskem, v Srbiji, Švici in Sloveniji. FDp je uvrščena na seznam EU2000/29 Council Directive on Harmful Organisms in na A2 karantenski seznam EPPO. Trenutno je edini učinkovit in predpisan ukrep za preprečevanje širjenja bolezni izkoreninjanje okuženih rastlin, simptomatičnih rastlin in sosednjih rastlin ter zatiranje prenašalcev. Hitro določanje z nizkocenovnim inštrumentom, ki bi bilo možno tudi na terenu, bi olajšalo in pospešilo odločitev o potrebnih ukrepih. S tem namenom smo razvili izotermalno metodo LAMP, ki specifično določa FDp. Poleg visoke specifičnosti, je metoda zelo občutljiva, saj zazna FDp v 95,5 % vzorcev, v katerih smo predhodno s PCR v realnem času že zaznali FDp. Celoten postopek priprave vzorca in testiranja je bil pripravljen in optimiziran za uporabo na terenu. Homogenizacija rastlinskega materiala se lahko izvede ročno ali z uporabo enostavne aparature. Homogenat nato direktno, brez uporabe ekstrakcijske metode, uporabimo v LAMP reakcijski mešanici. Izotermalno reakcija in branje končnega rezultata nato lahko izvedemo v enostavnem čitalcu. Razvoj celotnega postopka je bil izveden v okviru Evropskega projekta Vitisens.

### ABSTRACT

### Fast diagnostic test for on-site detection of grapevine yellows



In Europe the main phytoplasmas associated with grapevine yellows (GY) diseases are the flavescence dorée (FDp) and bois noir (BNp) phytoplasmas. Nowadays, FDp is spread in France, Italy, Spain, Portugal, Serbia, Slovenia and Switzerland. FDp is listed in the EU2000/29 Council Directive on Harmful Organisms and the EPPO A2 quarantine list of pests, and the destruction of diseased stocks, symptomatic plants and surrounding plants and control of vectors is mandatory. The on-site detection of the FDp with affordable device would contribute to faster and more efficient decision on the measures needed. Therefore, isothermal LAMP assay specific for FDp detection was developed. In addition to specificity, the FD LAMP assay was shown to be extremely sensitive, since it detects FDp in 95.5 % of the samples which were determined to be FDp infected using QPCR. The whole procedure of sample preparation and testing was prepared and optimised for on-site use. Plant sample homogenisation was adopted to be done on-site manually or with simple device. The homogenate can then be directly used in LAMP reaction, without any extraction method. The isothermal reaction and reading of the final result can be done in simple heater/reader. The whole development of procedure was done within the European project Vitisens.



### **Potential vectors of stolbur phytoplasma in bois noir infected vineyards of Montenegro**

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Grapevine yellows (GY) are widespread diseases caused by several different phytoplasmas. In Europe, the most widespread phytoplasmas affecting grapevine are Bois noir (BN) induced by the stolbur phytoplasma of the 16SrXII-A subgroup and Flavescence dorée (FD) of the 16SrV-C and -D subgroups. During a survey in 2008, presence of phytoplasma-like symptoms on grapevine were identified in nine Montenegrin vineyards, on seven locations within the two main viticultural regions (Crnogorsko primorski and Crnogorski basen Skadarskog jezera). Molecular analyses of phytoplasmal 16S rRNA gene revealed the presence of stolbur phytoplasma in all symptomatic plants, while infection rate per vineyard varied from a single plant up to the 20%. The preliminary survey of hemipteran vectors of stolbur phytoplasmas in infected vineyards of Montenegro was conducted. Planthoppers and leafhoppers were collected during June and July using sweep nets and mouth-aspirators from grapevine and herbaceous plants (mostly *Convolvulus arvensis* and *Urtica dioica*) present in vineyards inter-rows and borders. Presence of *Hyalesthes obsoletus*, which is considered as the most important vector of stolbur phytoplasma, was recorded from all seven inspected localities. In addition, presence of another planthopper species, considered as potential vector of stolbur phytoplasma *Dictyophara europaea* was detected in most of the inspected vineyards.



## Allelopathy of some important weeds in Hungary

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The change of weed flora of arable lands has been continuously followed in Hungary for more than 60 years. From the database of the Five National Weed Surveys the weed species detected in wheat, maize and on cereal stubbles are ranked in the order of their dominance. It is believed that allelopathy may play important role in their rapid spreading. This is especially true for invasive alien species (IAS), like *Ambrosia artemisiifolia*, *Sorghum halepense* etc. Out of these dominant weeds the allelopathic inhibitory effect only in case of a few weed species is not known. Based on the results of bioassay, pot and field experiments carried out in Hungary for more decades we can conclude the followings: Inhibitory effect of organic dissolvent plant extracts are generally stronger than water extracts. In bioassay laboratory experiments a dose –response relationship study is necessary, because the stronger inhibitory effect of the higher concentration extracts may be due not only to allelopathy but to the increased osmotic potential as well. In bioassays, inhibitory effect on seedling growth are generally stronger than that on germination rate. Inhibitory effect of allelochemicals greatly depends on donor, recipient (test) species, plant parts, the age of plant parts (living, dead), concentration and type of the dissolvents (water, organic) and physiological process affected (e.g. germination, growth). Bioassay, pot and field experiments generally give different results, suggesting that allelochemicals can be destroyed due to the biological decomposition with the time, especially under field conditions. Therefore in fields rather competition than allelopathy plays a greater role in plant-plant interactions. Today the term allelopathy has been extended, including not only plant-plant but – among others - plant-microorganism interactions also (e.g. some plant extracts can inhibit the virus concentration in the systemic plant hosts). So, it is considered as an alternative way of biological control. Nevertheless an internationally excepted uniform standard method would be essential for allelopathic studies – similar to that of competition methods – because in the lack of this, results achieved in different places and in the different countries are not comparable. This work was supported by the TÁMOP-4.2.2.A-11/1/KONV-2012-0038 and TÁMOP-4.2.2./B-10/1-2010-0023 projects.



## Učinkovitost bioherbicidov očetne in pelargonske kisline za zatiranje pelinolistne ambrozije (*Ambrosia artemisiifolia* L.)

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Biotično zatiranje plevela, še posebno uporaba bioherbicidov, se je pokazala kot alternativa uporabi sintetičnih herbicidov. Poleg uporabe patogenih bakterij in gliv, ki se uporabljajo predvsem za zatiranje določenih vrst plevelov, so zadnje raziskave pokazale, da obstaja

precej naravnih spojin in rastlinskih izvlečkov s herbicidnim delovanjem. Kot rezultat intenzivnih raziskav je bilo v zadnjem obdobju v nekaterih državah registriranih precej naravnih pripravkov in mnogi od njih so dostopni tudi na tržišču. V letu 2012 smo na Kmetijskem inštitutu Slovenije izvedli lončni poskus, kjer smo testirali učinkovitost bioherbicidov očetne in pelargonske kisline na pelinolistno ambrozijo. Seme ambrozije smo po kalitvi razredčili na eno rastlino na lonec. Pripravka smo uporabili v dveh razvojnih stadijih ambrozije (BBCH 14-16 ter 21-25) ter petih koncentracijah (20 %, 30 %, 45 %, 67 % in 100 %). Oba pripravka smo uporabili tudi v deljeni (split) aplikaciji, pri čemer smo uporabili polovični odmerek registrirane doze v 10-dnevem presledku. Po nanosu smo vizualno večkrat ocenjevali učinkovitost delovanja in 4 tedne po uporabi izmerili še končni pridelek suhe snovi. Uporaba velikih odmerkov, tako očetne kot pelargonske kisline, je pokazala visoko učinkovitost v zgodnjih stadijih razvoja ambrozije. Z manjšanjem odmerka se je tudi učinkovitost delovanja na ambroziji močno zmanjšala. Podoben upad učinkovitosti smo ugotovili tudi tedaj, ko smo pripravka uporabili v poznejšem razvojnem stadiju. V primerjavi z očetno kislino je bila pelargonska kislina bolj učinkovita, še posebno pri manjših odmerkih. Deljena aplikacija pripravka je povečala učinkovitost pri obeh pripravkih, kar se je močneje izrazilo pri uporabi v poznejšem razvojnem stadiju ambrozije.

#### ABSTRACT

#### **Efficacy of bioherbicides acetic and pelargonic acid for common ragweed (*Ambrosia artemisiifolia* L.) control**

Among biological weed management, use of bioherbicides is a possible alternative method to synthetic herbicides for weed control. Beside fungal and bacterial pathogen control agents for target plant species control, current research has demonstrated that several natural compounds and plant extracts have herbicidal effects. Furthermore, research efforts resulted in development of several weed biocontrol products which are already registered and commercially available in some countries. In 2012 a pot experiment was conducted at Agricultural Institute of Slovenia to test the efficacy of bioherbicides acetic and pelargonic acid for ragweed (*Ambrosia artemisiifolia* L.) control. Ragweed was sown in the pots and thinned to one plant per pot after germination. Plants were treated at two growth stages (BBCH 14-16, BBCH 21-25) with five dosages (20 %, 30 %, 45 %, 67 % and 100 %). Both bioherbicides were also tested in split application, where one-half rate of registered dose was applied in 10 day time interval between two consecutive treatments. Several visual assessments were performed after application and final dry matter data was collected 4 weeks after application. Application of high doses acetic and pelargonic acid provided complete control, when ragweed was treated at early growth stage. However, ragweed control was reduced, when lower doses of acetic and pelargonic acid were applied. Similar decrease of efficacy was observed at higher growth stage of bioherbicide application. Compared to acetic acid, pelargonic acid displayed greater efficacy, when lower doses were applied, regardless of ragweed growth stage at application time. Split application increased efficacy in case of both herbicides, particularly when bioherbicides were applied at higher ragweed growth stage.



## Prvi rezultati vzorčenja potencialnih naravnih sovražnikov japonskega dresnika (*Fallopia japonica* [Houtt.] Ronse Decraene) v Sloveniji

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V letu 2012 smo na približno 40 lokacijah v Sloveniji preučevali zdravstveno stanje japonskega dresnika, da bi ugotovili, ali se z omenjeno invazivno rastlinsko vrsto hranijo rastlinojedi organizmi. Obenem smo na listih dresnika ugotavljali tudi pojav različnih simptomov, kot posledica delovanja povzročiteljev bolezni in abiotičnih dejavnikov. Oglede smo - večinoma ob vodotokih, v manj primerih pa tudi na drugih tipih ruderalnih zemljišč - izvedli v štirih terminih. 16. julija, ob prvem vzorčenju, smo zdravstveno stanje japonskega dresnika preučevali na obrežjih Save na relaciji Ljubljana - Litija - Boštanj - Krško in ob reki Krki med Kostanjevico na Krki in Novim mestom. Najobsežnejše poškodbe (izjede) na listih smo ugotovili v Zgornjem Logu ob Savi, kjer so bili listi na spodnji tretjini rastlin objedeni od polža *Succinea putris*. V drugem terminu (25. julij) smo zdravstveno stanje dresnika preučevali na obrežjih Kamniške Bistrice, Drete, Mekinjščice in Savinje na relaciji Domžale - Kamnik - Gornji Grad - Celje - Ljubljana, 7. avgusta, v tretjem terminu ocenjevanja, pa smo si isti cilj zadali na obrežjih Save in Sore na relaciji Medvode - Kranj - Lesce - Bled - Bohinj. Zadnje vzorčenje smo 21. avgusta opravili ob rekah Drava, Pesnica in Mura na relaciji Maribor - Ptuj - Ormož - Murska Sobota - Lenart. Na večini vzorčnih mest na dresniku nismo ugotovili izrazitih poškodb ali simptomov, na več lokacijah po vsej državi pa smo na listih opazili drobne vijolične pege (ki pa niso bile povezane s pospešenim rumenjenjem listov), na katerih pa nismo našli povzročitelja bolezni in so verjetno odraz delovanja kakšnega od abiotičnih dejavnikov. Izpostaviti velja tudi najdbo dresnika z značilnimi belimi pegami na listih (maj, Rožna dolina v Ljubljani), v katerih pa z elektronsko mikroskopijo ni bilo dokazanih virusov in viroidov. Ugotavljamo, da japonski dresnik po skoraj 100 letih pojavljanja v Sloveniji še nima učinkovitega naravnega sovražnika ali patogena, zato velja z namenom omejitve njegove širjenja resno preučiti možnost vnosa bolšice *Aphalara itadori* Shinji, naravnega sovražnika, ki izvira iz Japonske. V tej zvezi bi bilo najprej potrebno preučiti bionomijo tega biotičnega agensa v razmerah Slovenije, zlasti njeno zmožnost preživetja zime ter njeno potencialno neciljno delovanje na sorodnike japonskega dresnika.

### ABSTRACT

#### First results on the monitoring of potential natural enemies of Japanese knotweed (*Fallopia japonica* [Houtt.] Ronse Decraene) in Slovenia

In 2012, the health status of Japanese knotweed was established in about 40 locations in Slovenia with the aim to determine the potential occurrence of phytophagous organisms of invasive plant species mentioned. At the same time we monitored different symptoms on the leaves of the plants caused by pathogens and abiotic factors. The monitoring was performed in four dates, in most cases near the rivers, but some assessments were also done in other types of ruderal lands. On July 16, on the day of the first sampling, the health status of the Japanese knotweed was investigated on the banks of Sava river between Ljubljana and Krško and near the Krka river from Kostanjevica na Krki to Novo mesto. The largest injuries on the leaves was recorded in Zgornji Log near the Sava river, where the holes were caused by the snail *Succinea putris*. At the second date of the

monitoring (July 25), the health status of Japanese knotweed was studied on the banks of the rivers Kamniška Bistrica, Dreta, Mekinjščica and Savinja between Domžale and Celje, while the third assessments were performed on August 7 on the banks of the rivers Sava and Sora between Medvode and Bohinj. The last monitoring was done on August 21 between Maribor and Murska Sobota on the streams of rivers Drava and Mura. At the majority of the sampling locations we did not established any distinctive injuries or symptoms on the leaves of the Japanese knotweed. On some locations in different parts of Slovenia we noticed small purple spots (they were not connected with the faster yellowing of the leaves), on which we did not find any pathogens, therefore they are probably the consequence of some of the abiotic factors. It is important to mention the record of the Japanese knotweed with characteristic white spots (May, Rožna dolina in Ljubljana), on which using electron microscopy neither viruses nor viroids were confirmed. We established that almost 100 years after its introduction to Europe the Japanese knotweed still does not have any effective natural enemy or pathogen in our country, for than reason it should be important to study the possibility of introduction the psyllid *Aphalara itadori* Shinji, its biological control agents from Japan, to diminish the spreading of this weed. In this context it would be necessary to investigate the bionomics of the psyllid, especially the possibility of it's overwintering and its potential non-target effect to relatives of the Japanese knotweed.



### **Hitri in enostavni testi za določanje patogenov na terenu**

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Vse hitrejše in vse obsežnejše svetovno trgovanje z zelenjavo in sadjem omogoča vedno hitrejše razširjanje rastlinskih patogenov. Nekateri med njimi lahko povzročijo ogromno gospodarsko škodo in zato je njihovo čim prejšnje odkrivanje ključno za ustavitev širjenja. Metode za detekcijo rastlinskih patogenov naj bi bile prijazne uporabniku in enostavne za uporabo ter hkrati občutljive, specifične, hitre in robustne. Tem karakteristikam ustrezajo molekularni testi, ki smo jih razvili za ugotavljanje patogenov krompirja (*Ralstonia solanacearum* in viroid vretenatosti gomoljev krompirja) na terenu in ne zahtevajo laboratorijske obdelave vzorcev. Edini pogoj za izvedbo omenjenih molekularnih testov je konstantna temperatura (60-65 °C), za kar pa ni potrebna draga laboratorijska oprema. Testi se lahko izvajajo na prenosni aparaturi GenieII, ki omogoča sledenje pomnoževanju tarčnega gena v realnem času in ki poda končni rezultat testiranja v 30 minutah. Dodatno naprava omogoča še potrditev rezultata testiranja z analizo nastalega produkta, kar omogoča ločevanje med resnično pozitivnimi rezultati in morebitnimi lažno-pozitivnimi rezultati.

#### **ABSTRACT**

#### **Fast and simple pathogen detection tests for on-site use**

The increasing global trade in vegetables and fruit enables faster plants' pathogens spread worldwide. Some pests are causing significant economic losses, therefore their timely detection and confirmation is crucial for preventing them from spreading. Desired detection methods should be user friendly and simple to use, but also sensitive, specific,

rapid and robust. In this work we present molecular techniques developed to detect potato pathogens (*Ralstonia solanacearum* and Potato spindle tuber viroid) on-site, with no need for laboratory sample processing. The only condition required by these techniques is a constant temperature (60-65 °C), which enables tests to be performed without expensive laboratory equipment. When using portable Geniell, amplification of a target gene can be followed in real-time and a final result is given in 30 minutes. For excluding false positive results and a reliable confirmation of a plant pathogen, additional analysis of the final product is performed.



### **Vpliv načina gojenja (ekološka, integrirana pridelava) na kemično sestavo fižola (*Phaseolus vulgaris* L. cv. Top Crop)**

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V raziskavi smo preučevali, kako različni načini pridelave (integrirana, ekološka, biodinamična, konvencionalna ter kontrola) vplivajo na kemično sestavo strokov fižola (*Phaseolus vulgaris* L.) cv. Top Crop. Z metodo HPLC smo ugotavljali vpliv načina pridelave na vsebnost organskih kislin in sladkorjev, z metodo HPLC-MS pa smo identificirali fenolne snovi ter spremljali razlike v njihovi vsebnosti. Kemična sestava fižola je bila podobna pri vseh načinih pridelave, je pa imel način pridelave vpliv na vsebnost različnih snovi. Fižol iz konvencionalne pridelave je vseboval najnižje vsebnosti glukoze, fruktoze, askorbinske kisline in številnih fenolnih snovi iz različnih skupin. Stroki fižola, pridelanega na integriran način, so imeli nizke vsebnosti nekaterih sladkorjev, kot na primer glukoze in saharoze, hkrati pa najvišje vsebnosti katehina in njegovih dimerov (procianidini) ter derivatov vanilne kisline. Oba načina ekološke pridelave in kontrolno obravnavanje so se odrazili v višji vsebnosti sladkorjev v strokih ter v manjši vsebnosti katehina in nekaterih drugih fenolnih snovi. S poskusom smo pokazali, da lahko z načinom pridelave vplivamo na snovi v strokih, ki določajo okus ter lahko vplivamo na vsebnost snovi, ki so pomembne za zdravje ljudi.

#### **ABSTRACT**

#### **The effect of different production systems (organic, integrated) on chemical profiles of dwarf French bean (*Phaseolus vulgaris* L. cv. Top Crop)**

The aim of the trial was to test different production systems (conventional, integrated, organic and biodynamic production system and the control) and their impact on composition and content of various chemical compounds of dwarf French beans (*Phaseolus vulgaris* L.) cv. Top Crop. Determination of sugars and organic acids was performed with HPLC system and identification of individual phenolic compounds using HPLC-MS. Chemical composition of the beans was unaffected by the production systems, however, the content levels of individual compounds were changed. Beans from the conventional production system contained lowest levels of fructose, glucose, ascorbic acid and many phenolics from various groups. The pods from integrated production contained

lowest levels of glucose and sucrose and highest levels of catechin, procyanidin dimers and vanillic acid derivative. The control treatment, as well as organic and biodynamic productions positively affected the levels of sugar content and caused a lower content of catechin and some other phenolic compounds. With the trial we were able to show that different production systems can affect the level of compounds that influence the taste of French beans as well as the content of compounds important for human health.



### **Vpliv vozne hitrosti pri škropljenju s fungicidi na pokritost klasov ozimne pšenice**

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Na Laboratorijskem polju Biotehniške fakultete v Ljubljani smo v letu 2011 izvedli poljski poskus, v katerem smo ugotavljali vpliv vozne hitrosti (5.0, 8.5 in 12.0 km/h) ob škropljenju na nanos fungicida Prosaro (aktivni snovi protiokonazol + tebukonazol) na sprednjo in zadnjo stran klasov ozimne pšenice. Škropljenje smo izvedli z injektorskimi šobami z dvojnimi asimetričnim curkom. Prvi curek je bil usmerjen pod kotom 10° naprej, drugi pa pod kotom 50° nazaj glede na smer vožnje. Odstotek pokritosti s škropilno brozgo je bil pri vseh treh vozni hitrostih na sprednji strani klasa nižji kot na zadnji strani klasa, tako na samih rastlinah kot tudi na kolih. Na sprednji strani klasa je bil odstotek pokritosti klasov pri vozni hitrosti 5 in 12 km/h nekoliko višji kot pri vozni hitrosti 8,5 km/h. Na zadnji strani klasa se je odstotek pokritosti s škropilno brozgo zmanjševal pri večji vozni hitrosti, predvsem 12 km/h. Število odtisov kapljic na cm<sup>2</sup> je bilo pri vseh treh vozni hitrostih na zadnji strani klasa višje kot na sprednji strani klasa. Pri večjih vozni hitrostih je bilo število odtisov kapljic na cm<sup>2</sup> na sprednji strani klasa nekoliko večje. Na zadnji strani klasa je bilo pri hitrosti 12 km/h število kapljic na cm<sup>2</sup> manjše kot pri ostalih dveh hitrostih.

#### **ABSTRACT**

#### **The effect of working speed on the fungicide spray deposition of winter wheat ears**

In 2011, a field trial was conducted in the experimental field of the Biotechnical Faculty (University of Ljubljana, Slovenia) to determine the effect of working speed (i.e. 5.0, 8.5 and 12 km/h) on the fungicide Prosaro (active ingredients prothioconazole + tebuconazole) spray deposition on the front and rear parts of winter wheat ears. Asymmetric double flat fan air-injector nozzles were used in the trial. The first spray jet was set at a 10° forward angle and the second one at a 50° backward angle according to the direction of spraying. At all three working speeds, the spray mixture coverage value was smaller on the front part of the ear and bigger on the rear parts of both plants and poles. On the front part of the ear, the coverage value at the working speeds of 5 and 12 km/h was slightly higher than at the working speed of 8.5 km/h. On the rear part of the ear, however, the spray mixture coverage value decreased with an increased working speed (particularly at the speed of 12 km/h). At all three working speeds, the droplet impression number per cm<sup>2</sup> was higher on the rear part of the ear. At higher working

speeds, there was a slight increase in the droplet impression number per cm<sup>2</sup> on the front part of the ear. At the spraying speed of 12 km/h, the droplet impression number per cm<sup>2</sup> on the rear part of the ear was smaller than with the other two spraying speeds.



## **Tehnični ukrepi za zmanjšanje izpostavljenosti traktorista nevarnim snovem**

Tomaž POJE

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V prispevku bodo prikazane tehnične možnosti za zmanjšanje izpostavljenosti traktorista nevarnim snovem. Po novi homologacijski zakonodaji v Sloveniji in Evropi obstajajo štiri kategorije kabin z različno stopnjo zaščite traktorista pred nevarnimi snovmi. Glede na analizo starih in novih traktorjev v Sloveniji, je pri nanosu škropiva potrebno uporabljati tudi osebno zaščitno opremo, če to zahteva uporabljeno fitofarmacevtsko sredstvo. Pri tem pa je pogosto pomanjkljiva raba ustrezne respiratorne zaščite.

### **ABSTRACT**

#### **Technical measures to reduce exposure of tractor driver to hazardous substances**

Technical measures for reducing the exposure of tractor driver to hazardous substances were analysed. The new European and Slovene regulation on EC homologation procedure for agricultural or forestry tractors classifies four categories of tractor cabins according to the level of protection against hazardous substances. The evaluation of cabin protection of old and new tractors in Slovenia proposed that drivers should use personal protective equipment at the application of sprayings. However, appropriate respiratory protection is often inadequate.



## **Vpliv izbire metode normalizacije podatkov pri analizi različno izraženih genov z mikromrežami**

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DNA mikromreže so zbirka različnih molekul DNA, vezanih na mikroskopsko majhna mesta na trdni podlagi, ki se lahko uporablja za sočasno merjenje nivoja izražanja velikega števila genov. Mikromreže za proučevanje izražanja genov krompirja, ki jih proizvaja podjetje Agilent (POCI mikromreže) smo uporabili za določitev nivoja izražanja genov v gomoljih krompirja, okuženega s krompirjevim virusom Y (PVY). POCI mikromreža trenutno predstavlja najpopolnejši transkriptom krompirja in se v zadnjih letih v veliki meri



uporablja v raziskavah krompirja. Za analizo podatkov, pridobljenih z mikromrežami, ne obstaja ena sama splošno sprejeta metoda. V tem delu smo ocenili vpliv metode normalizacije podatkov pri analizi različno izraženih genov z mikromrežami. Normalizacija omogoča popravek sistematičnih razlik med vzorci, ki ne predstavljajo resnične biotične razlike med vzorci. S tremi izbranimi metodami za normalizacijo podatkov med mikromrežami, kvartilno normalizacijo, normalizacijo z uravnoteženjem in normalizacijo s stabilizacijo variance, smo določili 190, 151 oz. 77 genov kot različno izraženih pri analizi 56 biotičnih vzorcev (36 okuženih s PVY in 20 neokuženih). Med njimi je bilo 67 genov določenih z vsemi tremi metodami, medtem ko je bilo dodatnih 78 genov določenih s kvartilno normalizacijo in normalizacija z uravnoteženjem. Z vsemi metodami smo pokazali dobro korelacijo pri določitvi različno izraženih genov, čeprav smo z različnimi metodami določili bistveno različno število genov.

#### **ABSTRACT**

#### **Influence of data normalization method in the analysis of differentially expressed genes with microarrays**

DNA microarrays, a collection of microscopic DNA spots attached to a solid surface, can be used to measure the expression levels of large numbers of genes simultaneously. We have used the Potato Gene Expression Microarray produced by Agilent (POCI microarray) to determine differentially expressed (DE) genes in potato tubers due to infection with potato virus Y (PVY). The POCI microarray is currently the most complete representation of the potato transcriptome and widely used in the potato research community. There is no universal consensus method on how to analyse the microarray data. In this work we have assessed influence of data normalization method in the analysis of differentially expressed genes with microarrays. Normalisation enables correction of systematic differences between samples, which do not represent true biological variation between samples. Three selected methods for data normalisation between microarrays; quantile normalization, scale normalization method and variance stabilizing normalization resulted in 190, 151 and 77 DE genes between 56 biological samples (36 infected with PVY and 20 uninfected), respectively. Among these, 67 genes were determined as DE with all three methods, while further 78 genes were determined as DE with quantile and scale normalization methods. There was in general a good coincidence of genes determines as DE genes with all three methods. However, different normalisation methods revealed substantially different number of DE genes.



#### **Fitosanitarni prostorski portal – GIS podpora pri odločanju: prva izkušnja s spletno prijavo suma na ambrozijo v letu 2012**

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Podajanje prostorskih informacij na svetovnem spletu – spletni GIS, postaja v zadnjih letih vedno bolj razširjen pristop informiranja tudi v Sloveniji. Javnosti omogoča širšo dostopnost in s tem tudi večjo uporabnost prostorskih podatkov v različnih sistemih odločanja. V letu 2012 je bil na spletnem naslovu: <http://fito-gis.mko.gov.si>, z namenom podajanja prostorskih informacij na področju zdravstvenega varstva rastlin in fitofarmaceutskih sredstev, v sodelovanju s podjetjem Sinergise d.o.o., razvit Fitosanitarni prostorski portal. Portal z različnimi nivoji dostopa do podatkov med drugim omogoča javnosti tudi spremljanje širjenja rastlinam škodljivih organizmov in pregled območij izvajanja ukrepov za preprečevanje njihove pojavnosti oziroma širjenja v Sloveniji. Ena od vlog portala je tudi aktivna vključitev širše javnosti pri obvladovanju in preprečevanju širjenja škodljivih organizmov. Za ta namen smo na portalu dodali funkcionalnost, ki posamezniku omogoča oddajo spletne prijave lokacije, za katero sumi, da je na njej zastopan določen škodljivi organizem. V prispevku bomo prikazali prvo izkušnjo s spletno prijavo suma zastopanosti ambrozije v letu 2012, ki v zadnjih letih povzroča vedno večje tveganje za zdravje ljudi in zmanjšanje kmetijskih pridelkov. Pravočasno ukrepanje bo zmanjšalo pritisk alergenov v zraku, hkrati pa zmanjšalo tveganje za povečano rabo herbicidov pri zatiranju ambrozije v razmerah neoviranega širjenja.

#### **ABSTRACT**

#### **Phytosanitary Spatial portal - GIS decision support system: First experience with a web application for the suspicion of common ragweed in 2012**

Presenting spatial information on the Internet - Web GIS approach for data sharing, is becoming in the last years increasingly widespread also in Slovenia. It enables spatial data more widely available to the public, and thus its greater use in different decision-making systems. To share spatial information in the field of plant health and plant protection products with the public, the Phytosanitary Spatial Portal has been developed on the web address <http://fito-gis.mko.gov.si> in 2012 in cooperation with Sinergise Ltd. The portal with different levels of access to information also enables the monitoring of the spread of harmful organisms and review of the areas where measures for the prevention of their appearance and spreading in Slovenia are carried out. One of the roles of the portal is also active involvement of the general public in the management and prevention of the spread of harmful organisms. For this purpose, we added additional functionality on the portal that allows individuals to submit online applications for the sites, for which they suspect of the presence of certain harmful organisms. In this paper, first experience with a web report on the suspicion of common ragweed in 2012 is presented, since common ragweed has caused in the recent years an increased risk to human health and reduction of agricultural production. Timely taken measures will reduce the pressure of allergens in the air, while reducing the risk for an increased use of herbicides in the management of common ragweed in the conditions of unlimited spread.



#### **Determination of some pesticides in drainage water**

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Pesticides used in agricultural production for weeds and pests control can migrate to surface and ground water after application. Their presence in water used for irrigation can cause yield reduction and decrease product quality. This is very important considering importance of water quality for agricultural production, especially organic. Some of commonly detected pesticides in surface water are chloracetanilide herbicides, acetochlor and alachlor. They are herbicides widely used for control of broadleaf weeds and annual grasses in row crops. This study was carried out to evaluate the content of acetochlor and alachlor in drainage water, which is widely used in agricultural production for irrigation. Water samples were collected from drainage canals in agricultural fields in the region of Vojvodina Province, Serbia. This part of Serbia is well-known as region with intensive agricultural production. The sampling was performed during June 2012, on twelve potential risk sites. Solid-phase extraction on a C<sub>18</sub> ENVI<sup>TM</sup> SP disc (47 mm) was used for isolation the investigated pesticides, acetochlor and alachlor, from water samples. Prior to extraction disc was conditioned with 5 ml of methanol and 5 ml of deionized water. Afterward, water sample was filtered through the disc. After drying the disc, acetochlor and alachlor were eluted with mixture of dichloromethane and n-hexane (40/60, v/v) and evaporated to dryness. Finally, the extract was diluted in 1 ml methanol and analyzed. Analysis was performed with a Hewlett–Packard (HP) model 5890 Series II gas chromatograph with EC Ni<sup>63</sup> detector (GC/ECD). Most of the analyzed water samples were found to be contaminated. Content of acetochlor and alachlor were ranged from 0.02-0.41 µg/l and 0.05-0.78 µg/l, respectively. This could be due to the frequent usage of the above-mentioned herbicides in these localities. The authors acknowledge financial support from the Ministry of Education and Science, Republic of Serbia, grant III43005.

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