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of Agriculture
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-

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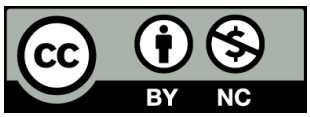

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Preface

This issue of Proceedings of abstracts offers all features of the XXIII. Slovak and Czech Plant Protection Conference hosted by Slovak University of Agriculture (SUA) on September 10-12, 2024 in Nitra, Slovakia. The conference is held once every three years alternatively in Prague, Brno and Nitra. Assembling specialist with different perspectives, all focused on the common theme "Current problems in plant protection" provides a stimulating environment for exchanging ideas, and connecting with colleagues. The main objectives of conference are:

• establish and strengthen collaboration between scientific and educational institutions and organizations acting in the field of plant protection at international level;

• facilitate dialogue between the groups of interest and identify challenging research problems in the field of plant protection;

• provide forum to disseminate and exchange new findings, advanced control trends and technologies, modern equipment and other relevant scientific achievements.

The Conference's official website is at the following address: http://cskor2024.uniag.sk. It contains all the information about conference, and will remain active even after conference closure.

We hope you will enjoy the rich program, and you will be inspired to move the field of plant protection further.

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PLENARY SESSION

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Aktuálne problémy v ochrane lesa s dôrazom na vývoj sekundárnych škodlivých činiteľov po extrémnom suchu 2022

Andrej Kunca, Juraj Galko, Jozef Vakula, Milan Zúbrik, Andrej Gubka, Michal Lalík, Roman Leontovyč, Slavomír Rell, Valéria Longauerová, Bohdan Konôpka, Christo Nikolov

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Abstrakt: Zdravotný stav lesov je v posledných rokoch určovaný extrémami klímy. Najviac ohrozovanou drevinou je smrek a škodlivými činiteľmi lykožrút smrekový a vietor. Avšak sú tu aj iné faktory, ktoré zvyšujú dopady klimatických zmien na lesné porasty. Ide najmä o obmedzenia a zákazy vyplývajúce zo zákona č. 543/2002 Z. z. o ochrane prírody a krajiny, kvôli ktorým sú stromy napádané sekundárnymi biotickými činiteľmi bez obmedzenia. Následne po zvýšení svojej početnosti tieto škodce napádajú aj stromy nepoškodené a v pôvodných biotopoch. Cieľom manažmentu lesov je úprava drevinového zloženia lesov tak, že sa zníži zastúpenie smreka, ktorý sa nakoniec bude vyskytovať na stanovištne vhodných biotopoch, čo môže byť ešte menšia celková výmera ako výmera smreka na pôvodných biotopoch. Avšak napĺňanie tohto cieľa nemá prebiehať cez vytváranie holín vznikajúcich po veľkoplošnom poškodení lesov škodlivými činiteľmi, ale cez Programy starostlivosti o lesy, teda cez plánované ťažby na malých plochách. Plánovaná obnova lesov so stanovištne vhodným drevinovým zložením na malých plochách účinnejšie zabezpečuje ochranu pôdy, vody, biodiverzity a ostatných funkcií lesov ako obnova lesov po veľkoplošných kalamitách.

Kľúčové slová: ochrana lesa, škodlivé činitele, podkôrny hmyz, vietor, smrek

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60th anniversary of journal Plant Protection Science

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In 2024, the journal **Plant Protection Science** (PPS) completes 60 years of publication (1965 - 2024). However, its roots extend back to the year 1921. In recent years, PPS has developed into an international scientific journal focused on all aspects of plant protection science, fully published in English, and with international Editorial Board. The publisher is the Czech Academy of Agricultural Sciences (CAAS) which this year celebrates its 100 years anniversary (1924-2024). PPS is part of eleven agricultural journals published by CAAS. On the occasion of its 50th anniversary, PPS published a detailed overview of its history and development (Lebeda et al., 2014). Recent review summarizes developments during last ten years. During this period PPS made enormous and fast progress. The journal's present place among the world's scientific journals is documented by analyses in the international citation databases (BIOSIS CI, SCOPUS, and WOS). From 2014 PPS has had an impact factor (for 2014 IF=0.597); during the last few years PPS's IF has ranged between 1.3 – 1.4, and there is the possibility for further increase. Every year PPS publishes quarterly with a total of around 40 papers (original papers, reviews, short communications), per year about 85-90% of papers are from abroad (Europe, America, Africa, Asia, Australia and Oceania). In the final part of this presentation, I summarize in detail some recent achievements of the journal, and discuss some key topics related to its future development (Lebeda, 2024).

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Plant pathosystems – structure, variability and interactions; great challenge for plant pathology research

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Plant pathology is a highly complex biological scientific discipline. Initially, its focus was on the study of practical aspects related to plant–pathogen interactions in agricultural, horticultural and forestry production systems (agroecosystems). However, during recent decades the research has been increasingly focused on the development and elaboration of the systems concept in plant pathology, i.e. concept of plant pathosystems (PPs). In these studies, host–pathogen interactions are seen to be more complex and are considered at different levels of biological hierarchy (molecular, biochemical and physiological, cellular, tissue, organ, plant, population, community, ecosystems). Recently we have considered two main categories of PPs, i.e. natural or wild (WPP) and crop plant pathosystems (CPP). That presentation introduced the principles of a general theory of plant pathosystems, provided a basic critical overview of current knowledge of host–pathogen interactions in WPP and CPP, and showed how this knowledge is important for future developments in plant pathology, including a more advanced understanding host-pathogen interactions, their ecology and evolutionary biology, as well as application in cropping systems. From the viewpoint of control, WPPs are autonomous, CPPs are deterministic. WPPs are characterised by the disease triangle and closed-loop (feedback) controls, CPPs are characterized by the disease tetrahedron and open-loop (non-feedback) controls. Until recently we lacked a focus on long-term observations and research of diseases and their dynamics in WPPs, and their direct or indirect relationships to CPPs. As a case study, the differences and connections between WPPs and CPPs, and why these are important for agriculture, is demonstrated on interactions of lettuce (*Lactuca sativa*) and wild *Lactuca* spp. (e.g. *L. serriola, L. saligna, L. virosa* etc.) and lettuce downy mildew (*Bremia lactucae*). The implications and applications of this knowledge for plant breeding, crop management and disease control measures is considered (Lebeda and Burdon, 2023).

Reference

Lebeda, A., Burdon, J.J. (2023). Studying wild plant pathosystems to understand crop plant pathosystems: Status, gaps, challenges and perspectives. Phytopathology 113: 365-380.

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SECTION

Mycology

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Sledovanie efektu účinných látok proti peronospóre viničovej (*Plasmopara viticola*) v pestovateľskom ročníku 2023 v Nitrianskom vinohradníckom rajóne

Monitoring the effects of active substances used to treat *Plasmopara viticola* in Nitra wine district during the 2023 growing year

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Downy mildew (*Plasmopara viticola*) is grapevine's most severe fungal disease. The purpose of this study was to test the ability of active substances (AS) to provide chemical protection of the Veltlín green variety during the 2023 growing year, in Nitra wine district, in the area of Nitrianske Hrnčiarovce, plot number 979/5. The plot was divided into 2 sections, each containing 120 vines of their respective variant. The vineyard was 52 years old and the technique used was simple curtain with the K5BB rootstock.
Dates and AS used in the treatment of variant 1: 4.6.2023 Azoxystrobin 93.5 $g.l^{-1}$ + folpet 500 $g.l^{-1}$.; 12.6.2023 metalaxyl-M 40 $g.kg^{-1}$ + mancozeb 640 $g.kg^{-1}$; 23.6.2023 mandipropamide, 250 $g.kg^{-1}$ + zoxamide, 240 $g.kg^{-1}$.; 9.7.2023 copper oxychloride 658 $g.kg^{-1}$ and benalaxyl 37.5 $g.kg^{-1}$ + folpet 480 $g.kg^{-1}$.
Dates and AS used in the treatment of variant 2: 4.6.2023 copper hydroxide 770$g.kg^{-1}$.; 12.6.2024 mancozeb 750 $g.kg^{-1}$; 23.6.2023 metiram 550 $g.kg^{-1}$ + pyraclostrobin 50 $g.kg^{-1}$; 9.7.2023 cooper oxychloride 658 $g.kg^{-1}$.
The method utilising a combination of contact and systemic AS proved to be reliable (variant 1). However, direct contact AS failed to suppress the tremendous infectious pressure of downy mildew in the 2023 growing year. The use of contact AS in the treatment of variant 2 caused severe damage to the inflorescences during the BBCH 60-69 phenophases. The systemic mixture was administered during the second treatment due to the acute symptoms present on the inflorescences and leaves. By this point, the administration of systemic AS no longer yielded any desired effects. Variant 2 suffered additional indirect damage caused by the so-called peak downy mildew, as a result of exposure to a contact mixture on 9.7.2023 (BBCH 77 – 79), which decreased the wood's assimilation and maturation rates. Gentle protection regimens applied during critical growing years require that the vines be treated every 7 days, at the bare minimum, using suitable combination of approved AS, in addition to auxiliary substances. In the future, gentle protection regimens will likely be succeeded by the cultivation of PIWI varieties.

This publication was created thanks to the support of an international research and education project Initiative project funding AT/SK No. 2023-05-15-004: „Evaluation of the status of the implementation of interspecific grape varieties in cultivation systems, from the point of view of the application of nature-friendly agrotechnical processes.

Genetická variabilita entomopatogénnej huby *Entomophaga maimaiga* v populáciách mníšky veľkohlavej (*Lymantria dispar* L.)

Genetic variability of entomopathogenic fungus *Entomophaga maimaiga* in populations of the gypsy moth (*Lymantria dispar* L.)

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Entomophaga maimaiga je entomopatogénna huba, ktorá je troficky viazaná iba na mníšku veľkohlavú (*Lymantria dispar* L.). Mníška veľkohlavá patrí k najvýznamnejším škodcom listnatých drevín v Európe a rozšírená je aj v Severnej Amerike a Ázii. *E. maimaiga* bola pôvodne popísaná v Japonsku a na začiatku 20. storočia bola zámerne introdukovaná do USA na boj proti mníške, kde sa postupne rozšírila. Do Európy (Bulharska) bola *E. maimaiga* introdukovaná infikovanými húsenicami z USA v roku 1999 a rýchlo sa rozšírila vo väčšej časti kontinentu. Cieľom bolo potvrdiť vyššiu príbuznosť európskych vzoriek *E. maimaiga* so vzorkami z USA, v porovnaní so vzorkami z východnej Ázie. Analýza genetickej štruktúry sa uskutočnila na základe 8 primerov ISSR. Výsledky ukázali, že Európska línia (Rumunsko, Bulharsko, Rakúsko, Slovensko) predstavuje jeden z dvoch hlavných klastrov, jasne separovaného od USA a Ázie (Rusko, Čína, Japonsko). Priame odvetvenie od Amerických či Japonských vzoriek sme nepozorovali. Naopak, Európska línia divergovala podstatne skôr ako nastalo štiepenie medzi USA a Japonskom, čo indikuje vyššiu príbuznosť s Ruskými alebo Čínskymi populáciami. Všetky klastre pritom vykazovali vysokú bootstrap podporu. Topológia stromu nepodporuje hypotézu introdukcie huby z USA do Európy.

Entomophaga maimaiga is an entomopathogenic fungus with strict trophic specificity to the gypsy moth (*Lymantria dispar* L.). The gypsy moth is a major pest of deciduous forests in Europe and is also distributed in North America and Asia. *Entomophaga maimaiga* was originally described in Japan and was intentionally introduced into the USA to control gypsy moth populations in the early 20th century, where it subsequently spread. In 1999, *E. maimaiga* was introduced into Europe (Bulgaria) via infected gypsy moth caterpillars collected in the USA and has rapidly spread across most of the continent. The aim of this study was to confirm the higher relatedness of the European *E. maimaiga* samples with those from the USA, relative to East Asia. The genetic structure analysis was done using eight ISSR primers. The results showed that the European line (Romania, Bulgaria, Austria, Slovakia) represents one of the two main clusters, thus clearly separated from the USA and Asia (Russia, China, Japan). We found no direct branching off from the USA or Japanese samples. Instead, we found the European line diverging much earlier than the split between the USA and Japan, suggesting closer relatedness to the Russian and Chinese populations. All these clusters were also strongly supported by bootstrap values. In summary, the tree topology does not support the introduction hypothesis from the USA to Europe.
The research was supported by the Slovak Research and Development Agency, project no. APVV-19-0119.

Potenciál „karpatskej rezistencie“ nájdenej u *Triticum dicoccum* v ochrane pšenice proti múčnatke trávovej

The potential of „Carpathian resistance“ which was discovered in *Triticum dicoccum* in defence against wheat powdery mildew

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K najvýznamnejším hubovým patogénom pšenice patrí aj múčnatka trávová na pšenici (*Blumeria graminis* f.sp. *tritici* DC Speer). Zrno zo silne napadnutých rastlín má zníženú kvalitu a výnos môže byť redukovaný až o 60 %. Najúčinnejšou a najekologickejšou ochranou proti múčnatke je pestovanie rezistentných odrôd. Riešitelia projektu majú k dispozícii genetický zdroj (GZ1) domestikovanej tetraploidnej pšenice *Triticum dicoccum* Schrank ex Schübl. GZ1, má typ rezistencie podmienený dvoma lokusmi na chromozómoch 2A a 7A a zatiaľ nebol nájdený žiadny izolát múčnatky, ktorý by tento typ rezistencie prekonal. GZ1 bol nájdený na Slovensku v Karpatoch, preto bola jeho rezistencia nazvaná „karpatská rezistencia“. Cieľom výskumu bolo zistiť efektívnosť jednotlivých génov „karpatskej rezistencie“ pomocou fenotypovania reakcií homozygotných efektívnych línií (HEL) po inokulácii izolátmi múčnatky trávovej. Odolnosť HEL bola hodnotená aj v poľných podmienkach v rokoch 2023 a 2024. Sledovaným parametrom bola hodnota AUDPC, Area Under Disease Progressive Curve. Vo výsledkoch získaných fenotypovaním reakcií sa nevyskytla senzitívna reakcia u HEL s efektívnymi alelami na 2A chromozóme (D29, D226, D291 a E57). Takmer u všetkých HEL s efektívnymi alelami na 7A chromozóme (E86,D268,E45) sa senzitívne reakcie ojedinele vyskytli v rozsahu 1 až 9 %. Hodnoty AUDPC v rokoch 2023 a 2024 u HEL boli štatisticky významne nižšie ako hodnoty u náchylných kontrolných odrôd. Priemerné hodnoty AUDPC náchylných odrôd boli v rozsahu 674 až 836, priemerné AUDPC jednotlivých sublínií HEL boli od 0,0 do 429. Päť sublínií HEL nevykazovalo v poľných pokusoch žiadne symptómy napadnutia, zhodne ako genetický zdroj GZ1. Vždy to boli HEL s efektívnym génom na 2A chromozóme (E120-17; D29-12; D29-15; D29-17 A D291-11).

The pathogen *Blumeria graminis* f.sp. *tritici* DC Speer causes powdery mildew disease of wheat, can reduce the yield by up to 60% in sensitive varieties. Cultivation of resistant varieties is one of the most effective and economical remedy to eliminate yield losses. The researchers of the project have at their disposal the genetic resource of domesticated emmer wheat (GZ1), which has a type of resistance conditioned by two loci on chromosomes 2A and 7A. The resistance was named according to the location of the find, „Carpathian resistance“.
The aim of the research is to verify the effectiveness of individual genes of "Carpathian resistance", by fenotyping of HELs (homozygous effective lines) after inoculation with powdery mildew isolates. No sensitive reactions were detected in HELs carrying an effective locus on chromosome 2A (D29, D226, D291 and E57). Sporadic incidences of a sensitive reaction ranging from 1% to 9% have occurred in HELs with an active locus on chromosome 7A. Similarly, in 2023 and 2024, the AUDPC (Area Under Disease Progress Curve) parameter was evaluated on field plots. AUDPC values of HELs were significantly different and lower compared to susceptible emmer cultivars. The range of susceptible varieties AUDPC was from 674 to 836 and AUDPC of HELs was from 0.0 to 429. Five sublines showed no symptoms of powdery mildew like GZ1. They were HELs with an active locus on chromosome 2A (E120-17; D29-12; D29-15; D29-17 AND D291-11).

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Výskyt čiernej škvrnitosti slnečnice v podmienkach Slovenska

Occurrence of Black stem diseases of sunflower in Slovakia

Peter Bokor

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Výskyt čiernej škvrnitosti slnečnice, ktorú spôsobuje huba *Phoma macdonaldii*, bol hodnotený v rokoch 2004 – 2017 na viacerých lokalitách v rôznych podmienkach Slovenska. Bolo zistené, že priemerný počet napadnutých rastlín slnečnice patogénom *P. macdonaldii* bol štatisticky preukazne ovplyvnený pestovateľským rokom a miestom pestovania slnečnice. Vysoký výskyt čiernej škvrnitosti slnečnice bol zaznamenaný v oblasti juhozápadného Slovenska, hlavne v okresoch Nitrianskeho a Trnavského kraja. Vysoký výskyt rastlín infikovaných patogénom *P. macdonaldii* bol pozorovaný v okresoch Zlaté Moravce (82,73 %), Dunajská Streda (69,74 %), Galanta (62,59 %), Levice (56,27 %) a Hlohovec (56,08 %). Nízky počet rastlín so symptómami čiernej škvrnitosti slnečnice bolo zaznamenaných v okresoch Sobrance (11,00 %), Michalovce (16,69 %) a Trebišov (21,23 %) v oblasti východného Slovenska.
Vyšší priemerný počet rastlín so symptómami čiernej škvrnitosti v porastoch slnečnice v podmienkach Slovenska bol zaznamenaný v rokoch s vyššími úhrnmi zrážok v letných mesiacoch, hlavne v júni. Výskyt ochorenia v podmienkach Slovenska negatívne ovplyvňujú vyššie teploty počas letných mesiacov, najmä v auguste.
Môžeme konštatovať, že v rokoch s vysokými teplotami a nízkymi zrážkami v letných mesiacoch je možné predpokladať nízky výskyt čiernej škvrnitosti v porastoch slnečnice.

The occurrence of Black stem diseases of sunflower, which is caused by the fungus *Phoma macdonaldii*, has been evaluated in the years 2004-2017 at several locations in different conditions in Slovakia. It was found that the average number of infected sunflower plants by *P. macdonaldii* was statistically significantly influenced by the growing year and the place where the sunflower was grown. The highest occurrence of Black stem diseases of sunflower was recorded in southwestern Slovakia, especially in the districts of Nitra and Trnava regions. The high incidence of plants infected by the *P. macdonaldii* pathogen was recorded in the districts of Zlaté Moravce (82,73 %), Dunajská Streda (69,74 %), Galanta (62,59 %), Levice (56,27 %) and Hlohovec (56,08 %). A low number of plants with symptoms of black stem diseases of sunflower were recorded in the districts of Sobrance (11.00%), Michalovce (16.69%) and Trebišov (21.23%) in the region of eastern Slovakia.
A higher average number of plants with Black stem diseases symptoms of sunflower was recorded in years with high precipitation during the summer months, especially in June, in Slovak conditions. The occurrence of Black stem diseases in Slovak conditions is negatively affected by higher temperatures during the summer months, mainly in August.
We can conclude that in years with high temperatures and low precipitation in the summer months, it is possible to assume a low incidence of Black stem diseases of sunflower.

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Citlivost izolátů *Leptosphaeria maculans* k vybraným fungicidním látkám

Sensitivity of *Leptosphaeria maculans* isolates to selected fungicidal substances

Olufadekemi Fajemisin & Jana Mazáková

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Jednou z nejvýznamnějších chorob řepky olejky je fomové černání stonků řepky. Choroba je způsobena komplexem hemibiotrofních hub *Leptosphaeria maculans*/ *Leptosphaeria biglobosa*. Používání fungicidů k minimalizaci dopadu těchto patogenů se stalo nedílnou součástí strategie ochrany řepky proti původcům této choroby. Účinnost fungicidní ochrany však nemusí být obvykle trvalá a po několika letech aplikace fungicidů může vést k riziku vzniku rezistence v populaci patogena. Tato studie si kladla za cíl zlepšit naše znalosti o citlivosti *L. maculans* k fungicidům v ČR. V rámci této studie byly v letech 2014–2020 získány izoláty *L. maculans* z 10 krajů ČR. U těchto izolátů byla zjišťována jejich citlivost k některým účinným látkám a k některým komerčním fungicidům ze tří skupin fungicidů běžně používaných v ČR k regulaci patogenů řepky olejky (DMI, QoI a SDHI fungicidy), a to pomocí *in vitro* testů na agaru a v mikrotitračních destičkách. Výsledky ukázaly, že boskalid, který patří do skupiny SDHI fungicidů a trifloxystrobin, který patří do skupiny QoI fungicidů, jsou nejúčinnějšími fungicidními látkami inhibující růst izolátů *L. maculans*, zatímco DMI fungicidy (např. tetrakonazol) jsou nejméně účinné fungicidní látky. V této studii byla rovněž pozorována i křížová rezistence vyskytující se mezi DMI fungicidy.

One of the most important diseases of oilseed rape is phoma stem canker or blackleg disease. It is caused by hemibiotrophic fungi, a *Leptosphaeria maculans*/ *Leptosphaeria biglobosa* complex. The use of fungicides to minimise the impact of these pathogens has become an integral part of phoma stem canker management strategy. However, fungicide control may not be usually durable and after a few years of fungicide application it may lead to the risk of developing resistance in the pathogen population. This study focuses on improving our understanding of fungicide sensitivity of *L. maculans* populations in the Czech Republic. During this study, *L. maculans* isolates were collected from 10 regions across the Czech Republic between 2014 and 2020. The fungicide sensitivity of *L. maculans* isolates to some active ingredients, and commercial fungicides representing three fungicide classes commonly used in the Czech Republic to control oilseed rape pathogens (Demethylation inhibitors, Quinone outside inhibitors, and Succinate dehydrogenase inhibitors) were tested *in vitro*, using the mycelium growth plate, and microtitre plate assays. The results showed that boscalid which belongs to the SDHI fungicide group and trifloxystrobin which belongs to the QoI fungicide group are the most effective fungicides in controlling *L. maculans* populations, while DMI fungicides (e.g. tetraconazole) are the least effective fungicides. In addition, cross resistance occurring between DMI fungicides was observed in this study.

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Změny v populacích rzí na pšenici

Changes in wheat rust populations

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Rzi na pšenici způsobily v posledním desetiletí značné hospodářské škody. Dynamické změny proběhly zejména v populaci rzi plevové (*Puccinia striiformis*), která způsobila na pšenici několik epidemických vln. Změny se však týkají i rzi pšeničné (*Puccinia triticina*) a rzi travní (*Puccinia graminis* f.sp. *tritici*). Tyto změny mají dopad na rezistenci odrůd a jejich výnos. Populace rzí se vyznačují rychlým vývojem, vznikem nových mutací a schopností přizpůsobení se měnícímu se prostředí. Výsledky z průzkumů populace patogena ukazují, že mezi regiony jsou rozdíly ve variabilitě virulence. Regionální populace se vzájemně mohou lišit v převládajících fenotypech virulence, i když dochází k migraci variant na velké vzdálenosti. Variabilní genotypy, nové virulence a různé kombinace virulencí komplikují kontrolu šíření patogenů. Pravidelné monitorování populací patogena pomáhá odhalit aktuální stav genotypové a fenotypové variability, která umožňuje predikovat závažnost výskytu a rozšíření nemoci, vybrat odolné odrůdy a určit efektivitu genů odolnosti vůči rzím. Výsledky z monitorování virulence jsou také využitelné jako zdroj informací při výběru zdrojů rezistence, ve šlechtění a ochraně rostlin a ke studiu populační biologie patogena. Nepřetržité monitorování šíření patotypů rzí a změn v populaci má potenciál zabránit překonávání odolnosti odrůd a výnosovým ztrátám.

Wheat rusts have caused significant economic damage in the last decade. Dynamic changes took place especially in the population of yellow rust (*Puccinia striiformis*), which caused several epidemic waves on wheat. However, the changes also apply to leaf rust (*Puccinia triticina*) and stem rust (*Puccinia graminis* f.sp. *tritici*). These changes have an impact on the resistance of cultivars and their yield. Rust populations are characterized by rapid development, emergence of new mutations and ability to adapt to changing environments. Results from pathogen population surveys show that there are differences in virulence variability between regions. Regional populations may differ from each other in predominant virulence phenotypes, even when variants migrate over long distances. Variable genotypes, new virulences, and different combinations of virulences complicate the control of pathogen spread. Regular monitoring of pathogen populations helps to reveal the current state of genotypic and phenotypic variability, which makes it possible to predict the severity of disease occurrence and spread, select resistant varieties and determine the effectiveness of rust resistance genes. Results from virulence monitoring can also be used as a source of information in the selection of resistance sources, in plant breeding and protection, and for the study of population biology of the pathogen. Continuous monitoring of the spread of rust pathotypes and population changes has the potential to prevent cultivar resistance overcoming and yield losses.
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Rychlá a spolehlivá analýza koncentrace patogenu pomocí pluginu pro ImageJ

Fast and reliable pathogen concentration analysis using the ImageJ plugin

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Ve fytopatologii je klíčové znát koncentraci patogenu pro hodnocení míry infekce a tvorbu suspenzí pro infekční experimenty. Ačkoliv existují přístroje schopné kvantifikovat koncentraci patogenu v suspenzích, jedná se často o drahá zařízení. Tradičně jsou proto stále využívány Burkeho a Neubauerova komůrka-podložní sklíčka s vyhloubeným dnem o známém objemu a narýsovanou mřížkou, která umožňuje manuální počítání buněk pod mikroskopem. Tento postup je však časově náročný. S rozvojem obrazové analýzy je možné počítat objekty automaticky ze snímků. Nejčastěji používaným programem pro obrazovou analýzu mikroskopických snímků je ImageJ, který je volně dostupný, napsaný v Javě a umožňuje tvorbu vlastních pluginů a maker. V naší práci jsme vyvinuli plugin pro imageJ, který rozpozná mřížku, spočítá objekty uvnitř mřížky a stanoví jejich rozměry. Plugin byl navržen tak, aby analyzoval všechny snímky ve vybrané složce a výsledné hodnoty délek a počty objektů zapsal do tabulky ve formátu CSV. Základní postup algoritmu spočívá v převedení snímku do formátu v odstínech šedi a následné detekci vodorovných a svislých linek mřížky, na jejichž základě je mřížka identifikována. Tyto linky slouží jako měřítko pro identifikaci částic na základě jejich velikosti. Plugin byl úspěšně testován na měření koncentrace zoospor v zoosporové suspenzi a koncentrace sporangií.

In phytopathology, it is essential to know the concentration of the pathogen in order to assess the level of infection and to create suspensions for infection experiments. Although there are instruments capable of quantifying pathogen concentration in suspension, these are often expensive devices. Traditionally, therefore, Burke and Neubauer chamber slides are still used, with a hollowed-out bottom of known volume and a grid drawn to allow manual counting of cells under the microscope. However, this procedure is time-consuming. With the development of image analysis, it is possible to count objects automatically from images. The most commonly used program for microscopic image analysis is ImageJ, which is freely available, written in Java, and allows the creation of custom plug-ins and macros. In our work, we have developed a plugin for imageJ that recognizes the grid, counts the objects inside the grid and determines their dimensions. The plugin was designed to parse all images in the selected folder and write the resulting object lengths and counts to a CSV table. The basic procedure of the algorithm is to convert the image to a grayscale format and then detect the horizontal and vertical lines of the grid, based on which the grid is identified. These lines serve as a scale for identifying particles based on their size. The plug-in has been successfully tested for measuring zoospore suspension and sporangia concentration.

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Genetický polymorfizmus vzoriek hrdze trávovej na pšenici

Genetic polymorphism of wheat stem rust samples

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Stem rust (*Puccinia graminis* Pers.) was once the most feared disease of cereal crops. It is not as damaging now due to the development of resistant cultivars, but outbreaks may occur when new pathogen races arise against which the existing kinds of resistance are ineffective. Characterization of genetic diversity within the pathogen population may help to predict and minimize adverse impact of spreading infection. This study aimed to use microsatellite markers (simple sequence repeat, SSR) to assess genetic variability among 10 isolates of *Puccinia graminis* f.sp. *tritici* Pers collected from wheat grown in Slovakia and the Czech Republic.
We used nine microsatellite markers (simple sequence repeat, SSR) to detect genetic polymorphism of 10 leaf rust samples (*Puccinia graminis* f.sp. *tritici* Pers). One SSR primer pair amplified PCR product only in 1 sample and therefore was excluded from the evaluation. The remaining eight primer pairs amplified an average of 6.25 alleles per locus but the mean number of effective alleles was 4.67. The highest number of alleles was detected at the PGTG06623 locus and the lowest at PgSUN42 (8 and 5 alleles, respectively). The mean observed and expected heterozygosity were 0.229 and 0.777, respectively. The mean Shannon's information index was 1.661 and the mean polymorphic information content (PIC) was 0.7475. It was sufficient to use at least 5 primer pairs to individually differentiate each sample. The probability of identity (PI) value was 0.000681% by using 5 random primer pairs and 0.0000395% when the 6th pair of primers was added. The PI values indicate the probability that two individuals in a population have the same multilocus genotype. Evaluation of the results using principal component analysis and cluster analysis confirmed the polymorphism ability of selected microsatellite markers and the resulting ability to distinguish each sample from a given set. In conclusion, the use of 5 random primers or SSR markers was sufficient to differentiate each sample of leaf rust collected in Slovakia and the Czech Republic. It has been shown that together with a suitable statistical evaluation of the results obtained the molecular identification, based on microsatellites, proved a very suitable tool for evaluating genetic relationships between individuals or populations.

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Využitie dronov v ochrane pšenice proti listovým chorobám

Drone (UAV) exploitation in wheat protection against leaf diseases

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Technológie precízneho poľnohospodárstva a využitia dronov nachádzajú čoraz väčšie uplatnenie v agronomickej praxi a ochrane rastlín. Drony sú vo svete čoraz viac využívané aj na foliárnu aplikáciu pesticídov. Otvorenou otázkou tejto technológie je jej účinnosť vzhľadom na nízke dávky postrekovej kvapaliny. V rokoch 2022 a 2023 bol za týmto účelom realizovaný pokus na overenie účinnosti dronových aplikácií fungicídov pri rôznych dávkach vody (10, 50, 100, 200, 300 l/ha) v porovnaní s aplikáciou s motorovým postrekovačom (300 l/ha). Modelovým fungicídom bol prípravok Elatus Era (benzovindiflupyr + prothioconazole), aplikovaný v rastovej fáze BBCH 39 na pšenicu ozimnú proti listovým chorobám (*Mycosphaerella graminicola*, *Pyrenophora tritici-repentis*). Pri aplikácii dronom pri vyšších teplotách vzduchu (26-28 °C) bola dávka postrekovej kvapaliny 10 l/ha nedostatočná, nakoľko fungicídna účinnosť dosahovala iba 30-32 % v porovnaní s účinnosťou pri aplikácii motorovým postrekovačom. Porovnateľná účinnosť bola dosiahnutá až pri dávke vody 50 l/ha a vyššej. Naopak, pri nižšej teplote vzduchu (16-20 °C) v čase aplikácie bola účinnosť dronovej aplikácie porovnateľná už pri dávke 10 l/ha (87 % účinnosti motorového postrekovača). Z výsledkov pokusu vyplýva, že účinnosť dronovej aplikácie fungicídov v optimálnych podmienkach (do 20 °C) je mierne nižšia (87-91%), ale porovnateľná s aplikáciou motorovým postrekovačom už pri dávke postrekovej kvapaliny 10 l/ha. Pri vyšších teplotách vzduchu (nad 26 °C) je však účinnosť pri dronovej aplikácii porovnateľná s motorovým postrekovačom až pri dávke postrekovej kvapaliny 50 l/ha.

The technologies of precise farming and drones (UAV) exploitation are more and more used in agronomical practice and in plant protection. The UAV are used for pesticide application in many countries, but open question is the efficacy of this kind of application, due to low dose of water per hectare. The field experiment, aimed to assessment of the efficacy of UAV application was conducted in years 2022 and 2023. The UAV application was realised by the water dose of 10, 50, 100, 200, 300 l/ha in comparison with back motor boom sprayer with water dose of 300 l/ha. The model fungicide was Elatus Era (benzovindiflupyr + prothioconazole), applied in growth stage BBCH 39 on winter wheat against major foliar diseases (*Mycosphaerella graminicola*, *Pyrenophora tritici-repentis*). By UAV application under higher air temperature (26-28 °C during application), the water dose of 10 l/ha was insufficient, because of fungicide efficacy of Elatus Era achieved only 30-32% of efficacy achieved by boom motor sprayer application (300 l/ha). The comparable fungicide efficacy of UAV application was achieved as much as 50 l/ha and higher. By contraries, under lower air temperature (16-20°C during application) the UAV application was comparable with boom motor sprayer already by dose of 10 l/ha (87% efficacy of motor boom sprayer). The results showed, that the efficacy of AUV application in optimal condition (air temperature until 20°C) is slightly lower (87-91%), but comparable with motor boom sprayer application already by dose of 10 l/ha. By higher temperatures (above 26°C), the comparable efficacy is achieved by 50 l/ha.

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Morfotypová diverzita mikroskopických húb spojených s ESCA syndrómom

Morphotypic diversity of microscopic fungi associated with ESCA syndrome

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ESCA syndróm ohrozuje pestovanie viniča vo všetkých vinárskych krajinách sveta. Škodlivosť ochorenia spočíva v postupnom rozklade drevnej hmoty viničového kra a apoplexii jeho nadzemných orgánov. Cieľom práce bolo porovnať morfotypovú diverzitu mikroskopických húb osídľujúcich kmienky asymptomatických krov a apoplektické časti kmienkov symptomatických krov. Pre účely mikrobiologických analýz sme odobrali vzorky viničových kmienkov bielej muštovej odrody Sauvignon z lokality Kobylí, ktorá je súčasťou vinárskej oblasti Morava. Získané čisté kultúry húb z viničových kmienkov sme na základe makroskopických vlastností zatriedili do morfologických skupín. Získali sme 84 izolátov mikroskopických húb, ktoré sme rozdelili do 41 morfotypových skupín. Izoláty húb z asymptomatických krov sme zatriedili do 28 morfotypových skupín. Z apoplektických častí symptomatických krov sme izoláty húb zatriedili do 19 morfotypových skupín. Len 14,63 % morfotypov mikroskopických húb získaných z dreva asymptomatických krov sme zistili aj v dreve symptomatických krov. Zistili sme, že viničové kmienky symptomatických a asymptomatických krov osídľujú rozdielne mikroskopické huby.

ESCA syndrome threatens the cultivation of grapevines in all wine-growing countries in the world. The damage of the disease consists of the progressive decomposition of the grapevine wood and apoplexy of its above-ground organs. The aim of this study was to compare the morphotypic diversity of microscopic fungi colonizing the trunks of asymptomatic grapevines and the apoplectic parts of the trunks of symptomatic grapevines. For the purpose of microbiological analyses, we collected samples of grapevine trunks of the white wine variety Sauvignon from the Kobylí locality, which is part of the Moravian Wine Region. The pure fungal cultures obtained from grapevine trunks were classified into morphological groups based on macroscopic characteristics. We obtained 84 isolates of microscopic fungi, which were divided into 41 morphotype groups. From asymptomatic grapevines, we classified fungal isolates into 28 morphotype groups. From the apoplectic parts of symptomatic grapevines, we classified fungal isolates into 19 morphotype groups. We also detected the occurrence only of 14.63% of the morphotypes of microscopic fungi obtained from the wood of asymptomatic grapevines in the symptomatic grapevines. We can conclude that the grapevine trunks of symptomatic and asymptomatic grapevines are colonized by different microscopic fungi.

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Sadzovité ochorenie kôry javora – *Cryptostroma corticale*

Sooty bark disease of maples (SBD) - *Cryptostroma corticale*

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Sadzovité ochorenie kôry javorov je spôsobené hubou *Cryptostroma corticale*, ktorá je považovaná za pôvodnú vo východnej časti severnej Ameriky, kde bola popísaná ako saprofyt nachádzajúci sa na mŕtvom dreve jeden až dva roky po úhyne stromov. Primárnou hostiteľskou drevinou v Európe je *Acer pseudoplatanus*. V menšej miere môžu byť poškodené aj iné druhy javorov (*A. campestre, A. platanoides*), ako aj jasene (*Fraxinus sp.*). Huba *C. corticale* bola náhodne zavlečená do Spojeného kráľovstva okolo roku 1945, následne bola sporadicky zaznamenaná aj v iných európskych krajinách. V Európe bolo toto ochorenie častejšie hlásené po roku 2000 (napr. Česká republika, Francúzsko, Nemecko, Švajčiarsko) a to aj so závažnejším poškodením drevín (EPPO, 2022). Výskum z Európy ukázal, že spóry *C. corticale* môžu klíčiť na poranenom dreve počas celého roka. Z miesta infekcie sa patogén šíri do cievnych zväzkov (xylém a floém) pohybujúc sa z horných konárov smerom nadol do kmeňa. Od tejto chvíle môže *C. corticale* zostať v latentnej forme ako endofyt bez toho, aby vyvolával vonkajšie symptómy mnoho rokov. Symptómy *C. corticale* sú typické pre choroby cievneho vädnutia, pri ktorých sú narušené vodivé pletivá, čo vedie k vädnutiu listov na jednom alebo na viacerých konároch, odumieraniu vetiev, zafarbeniu vodivých pletív a úhynu dreviny do 1–7 rokov. Plodnice sa formujú ako tmavé, suché, niekedy práškovité a sadzovité fľaky zapustené do kôry stromu, ktoré sa zvyčajne tvoria ako pásy alebo škvrny, ktoré prebiehajú paralelne so stonkou. Okrem poškodenia drevín je *C. corticale* nebezpečná aj pre ľudí. Môže spôsobiť alergické reakcie a u pracovníkov spracúvajúcich infikované drevo sa môže vyvinúť hypersenzitívna pneumonitída. Ohrození môžu byť aj jednotlivci, ktorí intenzívne pracujú s drevom produkujúcim spóry, a zrejme aj tí, ktorí majú oslabenú imunitu, zatiaľ čo zdraví jedinci, ktorí nie sú často v kontakte s infikovanými pletivami stromov, sa za ohrozených nepovažujú.

Sooty bark disease of maples is caused by *Cryptostroma corticale*, a fungus considered to be native to Eastern North America, where it has been described as a saprophyte fruiting on dead wood a year or two after tree mortality. *Acer pseudoplatanus* is the primary host plant in Europe. Other species of maples (*A. campestre, A. platanoides*), as well as ash trees (*Fraxinus sp.*) may also be affected to a lesser extent. *C. corticale* was accidentally introduced into the UK around 1945 followed by sporadic records in other European countries. After 2000, the disease has been more frequently reported in Europe (e.g. Czech Republic, France, Germany, Switzerland) with more severe damage (EPPO, 2022). Research from Europe has shown that airborne spores of *C. corticale* may germinate on injured wood throughout the year. From this infection point, the pathogen spreads into the tree's vascular tissues (xylem and phloem), normally moving from upper branches down into the stem. At that moment, *C. corticale* can remain latent as an endophyte within a tree without producing external symptoms for many years Symptoms of *C. corticale* are typical of vascular wilt diseases, in which vascular tissues are compromised leading to wilting of leaves on one or more branches, branch die back, staining in vascular tissues and mortality within 1–7 years. Fruiting bodies are observed as dark, dry, sometimes powdery and sooty-like patches sunken into the bark of the tree, which typically appear as bands or patches that run parallel to the stem. In addition to impacts on maples, *C. corticale* spores

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are allergenic in humans, workers processing infected wood can develop hypersensitivity pneumonitis (maple bark strippers' lung). Individuals who have intensive occupational contact with spore-producing wood, and possibly those who are immuno-compromised, may be at risk, while healthy individuals not working extensively with infected tree tissues are not considered to be vulnerable.

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Teplotná adaptácia parazitických húb *Lecanosticta acicola* a *Fusarium circinatum*

Thermal adaptation in fungal pathogen *Lecanosticta acicola* and *Fusarium circinatum*

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Očakáva sa, že expanzia väčšiny druhov ako reakcia na kolísanie klímy bude v kontexte klimatickej zmeny získavať čoraz väčší význam. Preto sú inváze a šíriace sa druhy dobrou príležitosťou na štúdium súčasných evolučných procesov. *Lecanosticta acicola* a *Fusarium circinatum* sú významnými ochoreniami rôznych druhov borovíc. Huba *L. acicicola* je na Slovensko zavlečená a prvýkrát zaznamenaná od polovici 90. rokov 20. storočia, *F. circinatum* sa zatiaľ na našom území nevyskytuje, avšak je pravdepodobné, že sa pod vplyvom klimatickej zmeny môže rozšíriť až sem. Na sledovanie teplotnej adaptácie húb sme použili niekoľko rôznych kultúr huby pochádzajúcich z rozličných oblastí. Kultúry sme sledovali pri striedavej teplote (deň/noc) 21/14°C a 24/17°C. Z každej kultúry sme spravili 15 opakovaní pre obe teploty. Dve kultúry *L. acicola* pochádzali z Litvy a dve zo Slovenska. Kultúry *F. circinatum* pochádzali z troch rôznych oblastí Francúzka a jedna zo Španielska. Pokus sme vyhodnotili pomocou ANOVA. Potvrdili sme, že obe huby rastú štatisticky významne lepšie pri vyššej teplote. V rámci vnútrodruhových pozorovaní sme zistili, že sa jednotlivé kultúry húb pri rôznych teplotách chovajú odlišne. Pri nižšej teplote rástli obe slovenské kultúry *L. acicola* rýchlejšie prvé 4 týždne než kultúry z Litvy. Po štvrtom týždni sa rast jednej SR kultúry spomalil. Toto sa zopakovalo aj pri vyššej teplote. Pri oboch teplotách bola vysoká variabilita rýchlosti rastu medzi jednotlivými kultúrami. Španielska a dve francúzske kultúry huby *F. circinatum* rástli pri vyššej teplote rovnako rýchlo, jedna kultúra zo severu Francúzka rástla najpomalšie. Táto kultúra rástla najpomalšie aj pri nižšej teplote, rozdiely medzi prírastkami medzi vyššou a nižšou teplotou v poslednom meraní neboli pri tejto kultúre štatisticky významné, čo naznačuje lokálnu adaptáciu na nižšie teploty. Medzi ostatnými kultúrami sa prejavila vysoká variabilita v raste. Vysoká variabilita rastu kultúr oboch húb naznačuje ich vysoký evolučný a adaptačný potenciál.

Range expansions, which have been observed recently of most species in response to climate fluctuations, are expected to gain increasing importance in the context of climatic change. Invasive species and range-expanding species provide a great opportunity to study contemporary evolution processes. *Lecanosticta acicola* and *Fusarium circinatum* are important needle diseases on *Pinus* species. *L. acicola* was introduced to Slovakia in mid- 90's of 20th century. *F. circinatum* has not been recorded in Slovakia yet. Climate change may affect the spread of the fungus to this country. To observe the thermal adaptation plausibility several cultures from different localities were used. Cultures were planted on 15 replicates of each at an alternating temperature (day/night) of 21/14°C and 24/17°C. Two cultures of *L. acicola* were from Lativa and two from Slovakia. Three cultures of *F. cicrcinatum* originated from different parts of France and one was from Spain. It was confirmed that both fungi grow better at higher temperatures significantly. Intraspecific variation of growth of the cultures was observed. Both Slovak cultures grew faster for the first 4 weeks than cultures from Lithuania at the lower

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temperature. The growth of one Slovak culture slowed down the growth after the fourth week. This was same at the higher temperature. High variability in growth rate was observed between individual cultures at both temperatures. The Spanish and two French cultures of the *F. circinatum* grew equally at higher temperatures, the north France culture grew the slowest. This culture grew the slowest even at the lower temperature, the differences between the increments between the higher and lower temperature at the last measurement were not statistically significant for this culture, which strongly suggests local adaptation to lower temperatures. High variability of growth was shown in all cultures. The high variability of the growth of the cultures of both fungi indicates their high evolutionary and adaptive potential.

The research was supported by The Ministry of Education, Science, Research and Sport of the Slovak Republic, project no. VEGA 2/0132/22.

Fomitopsis pinicola v urbánnom a rurálnom prostredí Slovenska

Fomitopsis pinicola in urban and rural areas of Slovakia

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The basidiomycetous wood-decaying fungus *Fomitopsis pinicola* (Polyporales, Basidiomycota) formerly classified under the genus *Fomes*, was selected as the type species for the genus *Fomitopsis* by Karsten. This classification has been widely accepted by contemporary researchers. It is characterized by perennial basidiomata with a corky to woody consistency, ranging in color from gray, orange-brown to black, with an orange to brown marginal band. The pore surface is white to cream-colored, turning lemon-yellow when bruised. The fungus varies in size, with younger specimens as small as 5 cm wide and larger ones reaching up to 45 cm across.

Since 1954, a total of 96 records of this fungus have been recorded in urban and rural areas within the Slovakia. Most records stem from our systematic field surveys conducted between 1982 and 2024, supplemented by herbarium collections, scientific publications, and records from other researchers. The distribution maps show the spread of this fungus across the entire territory of Slovakia. Out of the total 96 findings, 68 were on living trees, 5 on dead trees and for 23 findings, the status was not specified. The findings show that *Fomitopsis pinicola* predominantly affects deciduous trees (71.88%), followed by conifers (19.79%), with the tree type not identified in 8.33% of the cases. The results indicate a higher incidence of this fungus in cities, particularly in the central and southeastern parts of the country, suggesting increased distribution in urban environments (77 records) compared to rural areas (19 records). This phenomenon may be primarily due to the larger and more diverse tree populations in cities and the higher risk of infection resulting from improper maintenance. The most frequently infected tree species were those of the genus *Prunus* (56 records). The fungus most commonly fruited on tree trunks (50% of findings). A significant number of the findings (34 records) were recorded in the "planted street" category, accounting for 35.41% of the total number. These results provide information on the distribution of *Fomitopsis pinicola* in Slovak settlements, highlighting the need for preventive measures and management principles for these areas, such as regular monitoring of trees in high-risk areas or the removal of infected trees. Regular monitoring and preventive measures are essential for reducing the risk of infections and ensuring the desired vitality of trees in settlements.

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Studium distribuce padlí na planých druzích *Lactuca* spp. a kulturním salátu (*L. sativa*) a jejich taxonomická identifikace

Study of powdery mildew distribution on wild *Lactuca* spp. and lettuce (*L. sativa*) and their taxonomic identification

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Plané druhy *Lactuca* spp. a kulturní salát (*Lactuca sativa*) jsou infikovány třemi rody padlí (řád *Erysiphales*), t.j. *Golovinomyces*, *Podosphaera* a *Leveillula*. V období 1995–2021 jsme nasbírali 201 vzorků listů se symptomy padlí ve 23 zemích na čtyřech kontinentech. Cílem naší studie byla taxonomická identifikace druhového spektra padlí na vzorcích herbarizovaných listů, ověření druhové specifikace patosystému *Lactuca* – padlí a úrovně intraspecifické variability patogenů. Předběžné výsledky analýz ukazují výraznou převahu druhu *Golovinomyces bolayi.* Na základě morfologických a molekulárních dat byla *G. bolayi* identifikována u 190 vzorků, zatímco *Podosphaera xanthii* byla identifikována u 11 vzorků *Lactuca* spp. (z Číny, Japonska, Jižní Koreje). U *P. xanthii* byl identifikován jediný ribotyp (přítomen u vzorků z asijských zemí) a čtyři ribotypy *G. bolayi*, avšak bez konkrétního geografického vzoru. Získaná morfologická a molekulární data jsou statisticky analyzována.

Wild *Lactuca* spp. and cultivated lettuce (*Lactuca sativa*) are infected by three genera of powdery mildews (order *Erysiphales*), i.e. *Golovinomyces*, *Podosphaera*, and *Leveillula.* In the period of 1995–2021, we collected 201 *Lactuca* spp. leaf samples with symptoms of powdery mildew in 23 countries from four continents. The aims of our study were taxonomically identify the powdery mildew species on herbarium leaf samples, to verify the species specification of the *Lactuca* **–** powdery mildews pathosystem, and to verify the level of intraspecific variability of pathogens. Preliminary results show a significant prevalence of *Golovinomyces bolayi* among the analysed samples. Based on both morphological and molecular data, *G. bolayi* was identified on 190 samples, whereas *Podosphaera xanthii* was identified only on 11 *Lactuca* spp. samples (from China, Japan, South Korea). We identified a single *P. xanthii* ribotype (present in samples from Asian countries) and four *G. bolayi* ribotypes, however, without a specific geographical pattern. Obtained morphological and molecular data are analysed statistically.

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Esenciální oleje jako zdroj účinných látek pro prostředky ochrany skladované zeleniny proti skládkovým patogenům

Essential oils as a source of active compounds for the protection of stored vegetables against storage pathogens

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Zelenina, i když je to velmi rozmanitá skupina rostlin, je obecně vysoce citlivou komoditou pro skladování. Konzumní části jsou plné vody, jednoduchých i složitých sacharidů, které z nich dělají vynikající živný substrát pro mnohé houbové organismy a bakterie a zároveň je velice obtížné je chránit chemickou cestou. Na překážku jsou při použití konvenčních přípravků, jak ochranné lhůty, tak například i křehkost některých druhů zeleniny. Proto je důležité hledat nové cesty ochrany ať již z hlediska aplikace, tak skupin účinných látek. Jednou z možných alternativ je i použití esenciálních olejů (EO), které dává dobrý předpoklad pro využití, jak při přímé aplikaci, tak například ve formě odparníků, neboť jednou z jejich vlastností je i těkavost. V této práci byla nejprve testována účinnost 20 EO v „*in vitro"* podmínkách v koncentraci 0,1 %, které byly vybírány také z hlediska jejich senzorických vlastností a dobré kombinovatelnosti s většinou druhů zeleniny na 16 izolátů 7 rodů skládkových patogenů. Ti byli izolování z pletiv různých druhů zeleniny. V tomto experimentu dosáhly statisticky významného rozdílu EO z *Thymus vulgaris* (TV), *Satureja montana* (SM), *Origanum vulgare* (OV) a *Thymus serpyllum* (TS). V následujícím „*in vitro*" experimentu byly testovány nižší koncentrace těchto 4 EO. V tomto experimentu nejlépe vyšly oleje z obou druhů rodu *Thymus*, ty pak byly použity v in vivo experimentu, kde byla testována i formulace EO. Nejlepších výsledků dosáhla formulace pomocí odparníků a oleje z *T. vulgaris*.

Vegetables, although a very diverse group of plants are generally a highly sensitive commodity for storage. The consumable parts are full of water, and simple and complex carbohydrates, which make them an excellent feeding substrate for many fungal organisms and bacteria, and they are also very difficult to protect chemically. For example, the protection period and thinness of some vegetables, are obstacles to the use of conventional products of protection. It is therefore important to look for new ways of protection, as forms of application, so groups of active compounds. One of the possible alternatives is the use of essential oils (EOs), which provide a good basis for use, as in direct application and, so, in the form of vaporisers, since one of their properties is their volatility. In the present work, the efficacy of 20 EOs was first tested under „*in vitro*" conditions at a concentration of 0.1%, which were also selected for their sensory properties and good combinability with most vegetable species, on 16 isolates of 7 genera of storage pathogens. These were isolated from the tissues of different vegetable species. In this experiment, the EOs from *Thymus vulgaris* (TV), *Satureja montana* (SM), *Origanum vulgare* (OV) and *Thymus serpyllum* (TS) reached statistical significance. In the following „*in vitro*" experiment, lower concentrations of these 4 EOs were tested. In this experiment, the oils from both species of the genus *Thymus* performed best, these were then used in an in vivo experiment where the EO formulation was also tested. The best results were obtained with the evaporator formulation and the oils from *T. vulgaris*.

The research was supported by the Czech Ministry of Agriculture, project number QK21010064.

Tracing endophytic fungus in model plant species *Brachypodium distachyon*

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Our research focuses on the endophytic fungus *Microdochium bolleyi* originating from wheat and barley roots. As a plant model we are using *Brachypodium distachyon*. Endophytic fungus *M. bolleyi* and plant *B. distachyon* create an optimal model for studying plant-fungal interactions because the fungus grows readily in *B. distachyon* tissues. The inoculation method is simple, and chlamydospores of *M. bolleyi* are readily visible in host tissues using light microscopy. In addition, we have developed and optimized species-specific primers for standard PCR and also quantification of *M. bolleyi* by qPCR. The course of plant colonization by *M. bolleyi* was thoroughly studied. The colonisation of plants by *M. bolleyi* begins with germinating seeds, where the seed coats are initially heavily colonised. The endophyte then spreads to surrounding areas, including the stem base and roots near the basal parts of the stem. In the lower distal parts of the roots, the DNA concentration of *M. bolleyi* did not change significantly over time. However, there was a significant increase in roots 1 cm below the stem base and in the stem base. The endophyte reaches the stem base 2-4 cm in height but does not colonise leaf blades or ears.

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Využití esenciálních olejů v biologické kontrole padlí rajčat (*Erysiphe neolycopersici*)

Use of essential oils in biological control of tomato powdery mildew (*Erysiphe neolycopersici*)

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Původce padlí rajčat (*Erysiphe neolycopersici*), který se začal v Evropě šířit v 80. letech 20. století, je závažným patogenem zejména ve skleníkových kulturách rajčat. Nejzásadnějšími způsoby, jak jeho výskyt a šíření omezit, je využívání chemické ochrany, ale i šlechtění odrůd rajčat odolných k tomuto patogenu. Poměrně novým způsobem, stojícím na pomezí chemické a biologické ochrany, je využití esenciálních olejů (EO) získaných z rostlin, které potlačují výskyt patogena. V našich experimentech jsme sledovali účinek pěti esenciálních olejů (skořicový, hřebíčkový, kajeputový, citronelový a tymiánový) při různých koncentracích (0,01; 0,025; 0,05; 0,075 a 0,15 %). Cílem experimentů bylo zjistit, který esenciální olej a při jaké koncentraci má nejlepší ochranné vlastnosti vůči padlí na listech rajčat a zároveň způsobuje nejmenší zasažení fytotoxicitou. Hodnocení stupně napadení padlím bylo provedeno makroskopicky (SN 0-3), a bylo doplněno mikroskopickým studiem vývoje patogena. Na základě realizovaných experimentů bylo zjištěno, že nejvhodnějším EO je emulze skořice a tymiánu v koncentraci 0,025 % (nejmenší stupeň napadení patogenem a malý stupeň zasažení fytotoxicitou), naopak některé esenciální oleje se jevily jako neúčinné (kajeput ve všech koncentracích) a některé projevovaly fytotoxické účinky (např. citronela ve všech testovaných koncentracích a tymián v koncentracích 0,05 % a vyšších).

The causative agent of tomato powdery mildew (*Erysiphe neolycopersici*), which began to spread in Europe in the 1980s, is a serious pathogen especially in greenhouse tomato cultures. The most fundamental ways to limit its occurrence and spread is the use of chemical protection, but also the breeding of tomato varieties resistant to this pathogen. A relatively new method, standing on the border between chemical and biological protection, is the use of essential oils (EO) obtained from plants, which suppress the infection of the pathogen. In our experiments, we studied the effect of 5 essential oils (cinnamon, clove, cajeput, citronella and thyme) at different concentrations (0.01; 0.025; 0.05; 0.075 and 0.15%). The aim of the experiments was to find out which essential oil and what concentration has the best protective effect against powdery mildew on tomato leaves and concurrently causes the least impact of phytotoxicity. Evaluation of the infection degree of powdery mildew was carried out macroscopically (ID 0-3), and was supplemented by a microscopic study of the development of the pathogen. On the basis of the realized experiments, it was found that the most suitable EO are cinnamon and thyme emulsions in a concentration of 0.025% (the smallest infection degree and a small degree of phytotoxicity), on the contrary, some essential oils appeared ineffective (cajeput in all concentrations) and some showed phytotoxic effects (e.g. citronella in all concentrations, thyme in concentration 0.05 % and higher).

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Rozšírenie a charakteristika *Mycosphaerella dearnessii* M.E.Barr na Slovensku

Distribution and characteristics of *Mycosphaerella dearnessii* M.E.Barr in Slovakia

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Lecanosticta acicola bola zaradená do zoznamu karanténnych organizmov A2 (EPPO 2015), spôsobuje hnedú škvrnitosť ihličia (BSNB) na ihliciach borovíc. Ochorenie bolo doteraz zaznamenané v 31 krajinách (17 v Európe). V Európe bola prvýkrát zdokumentovaná začiatkom 40. rokov v Španielsku, neskôr v 70. rokoch v juhovýchodnej, v 90. rokoch v západnej a na prelome tisícročí bola choroba pozorovaná v severnej Európe. Počiatočnými príznakmi sú žlté škvrny, ktoré následne v strede stmavnú. Škvrna sa rozrastá, rozširuje a vytvára pás, ktorý obopína ihlicu dookola. Distálna časť ihlice zostáva nekrotická. Na odumretých častiach sa tvoria plodnice (stromata) huby *L. acicola*. Báza ihlice zostáva zelená ale objavujú sa na nej škvrny. Silné napadnutie spôsobuje nekrózu celých ihlíc. Rastúci počet záznamov z celej Európy naznačuje nedávne rýchle rozšírenie choroby.

Na Slovensku bolo na výskyt BSNB celkovo preskúmaných 84 lokalít. Vyhodnotili sme 163 vzoriek DNA, aby sme určili distribúciu, rozsah hostiteľov a štruktúru populácie s ohľadom na párovacie typy a vybrané gény. Huba *L. acicola* bola prítomná v 17 vzorkách z 13 lokalít v urbánnom prostredí a arborétach. Ako hostitelia hnedej sypavky na Slovensku boli identifikované štyri druhy borovíc. Tri z nich sú tiež etablovanými hostiteľmi *L. acicola* v Európe. Je známe, že invazívnosť patogénu v nových prostrediach je spojená so sexuálnou reprodukciou v rámci populácie. Prítomnosť jediného párovacieho typu huby na Slovensku naznačuje absenciu sexuálneho rozmnožovania v tejto oblasti a pravdepodobnosť nepohlavného spôsobu rozmnožovania.

Po morfologickom posúdení vzoriek bolo správne zaradenie izolátov k druhu *L. acicola* podporené aj molekulárnymi analýzami a sekvenovaním rôznych génových regiónov. ITS sekvencie slovenských izolátov boli identické, avšak analýza génu *TEF* 1 odhalila určitý stupeň variability medzi slovenskými izolátmi. Analyzované vzorky patrili k jednej línii a pochádzajú z rovnakej zdrojovej populácie ako vzorky zo Severnej Ameriky.

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Lecanosticta acicola has been assigned as an A2 quarantine organism (EPPO 2015), which causes Brown spot needle blight disease (BSNB) on pine needles. The disease has been reported in 31 countries (17 in Europe). In Europe, it was documented for the first time in the early 1940s in Spain, later in the 1970s in South-Eastern, in the 1990s in the West and at the turn of the millennium, the disease was observed in the Northern Europe. The initial symptoms are yellow spots, subsequently they darken in the middle. The spot grows, expands and forms a band that encircles the needle. The distal part of the needle remains necrotic. Fruiting bodies (stromata) of *L. acicola* are formed on the dead parts. The base of the needle remains green with spots appearing. Severe infestation will cause necrosis of entire needles. An increasing number of reports from around Europe indicate a recent rapid spread of disease.

A total of 84 locations in Slovakia were inspected for the occurrence of the BSNB. We assessed 163 DNA samples to determine distribution, host range and population structure concerning mating type and selected gene pattern. *L. acicola* were present in 17 samples from 13 localities of urban areas and arboreta. Four pine species were identified as hosts of BSNB in

Slovakia. Three of them are already established hosts of *L. acicola* in Europe. The invasiveness of the pathogen in new environments is known to be associated with sexual reproduction within a population. The presence of only a single mating type of fungus in Slovakia indicates the absence of sexual reproduction in this region and the probability of asexual reproduction mode.

After the morphological assessment of the samples, the correct assignment of the isolates to the species *L. acicola* was also supported by molecular analyses and sequencing of different gene regions. All ITS sequences of Slovak isolates were identical, the analysis of the TEF 1 gene revealed a certain degree of variability among Slovak isolates. Analysed samples belonged to a single lineage as these were from the same source population in North America.

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Druhy rodu *Lophodermium* a ich hostitelia na Slovensku

Lophodermium species and their hosts in Slovakia

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Lophodermium je rod húb z čeľade Rhytismataceae. Rod infikuje mnoho rôznych rastlinných čeľadí, avšak s pozoruhodné zastúpenie má v čeľadi *Pinaceae*. *Lophodermium* sp. sú na *Pinus* všadeprítomné, mnohé z nich sú endofyty alebo sapróby, ale sú medzi nimi aj patogény, ktoré spôsobujú sypavkové odumieranie ihlíc borovíc. V Európe sa v súčasnosti vyskytuje na ihliciach borovíc sedem druhov *Lophodermium*. *L. pinastri* sa hojne vyskytuje na mnohých druhoch borovíc. V rámci tohto druhu sa našli tri sesterské fylogenetické vetvy, ktoré preukazujú určité rozdiely v charakteristikách hubových kultúr. Druh *L. seditiosum* je dôležitým patogénom borovice. Spôsobuje vážne škody a opad ihličia u mladých sadeníc v lesných škôlkach alebo vianočných plantážach. Niekoľko po sebe nasledujúcich atakov môže spôsobiť vysychanie stromov, zníženie ekonomickej a okrasnej hodnoty drevín.

Malé bledé alebo žlté chlorotické škvrny, neskôr chlorotické pásiky na ihliciach sú prvými príznakmi, ktoré na jar vedú k hromadnému červeno-hnedému zafarbeniu ihličia. Ihlice môžu opadnúť zo stromu, alebo môžu zostať na strome. Na odumretých ihliciach sa objavujú čierne, lodičkovité, vyčnievajúce plodnice, z ktorých sa počas vlhkého počasia uvoľňujú spóry a infikujú nové ihličie.

Prieskum výskytu *Lophodermium* sp. v mestskej zeleni, arborétach, prirodzených porastoch, lesných plantážach a v lesných škôlkach na 75 lokalitách Slovenska preukázalo, že druh *L. pinastri* bol potvrdený v 56 % a *L. seditiosum* v 32 % všetkých vzoriek. Oba druhy boli zaznamenané na širokom spektre hostiteľov. Väčšina vzoriek bola zaznamenaná na hostiteľoch *Pinus nigra*, nasledovali *P. sylvestris*, *P. mugo* a menej často sa vyskytovali v ďalších dvanástich borovicových hostiteľoch. Osem hostiteľských druhov *P. aristata, P. densiflora, P. holdreichii, P. parviflora, P. rigida, P. strobus, P. uncinata* a *P. wallichiana* bolo pre Slovensko nových. Okrem toho bol zo slovenskej lokality vo Vysokých Tatrách na *P. mugo* zaznamenaný druh *L. corconticum* opísaný len z vysokohorského prostredia Poľska.
Práca bola finančne podporená projektami VEGA 2/0132/22 a MVTS COST 20132.

Lophodermium is a genus of fungi within the family Rhytismataceae. The genus infects many different plant families but also with a notable concentration in the family *Pinaceae*. *Lophodermium* sp. are ubiquitous on *Pinus,* many of them are endophytes or saprobes but also pathogens which cause *Lophodermium* needlecast of conifers. Seven species of *Lophodermium* occur on pine needles in Europe to date. *L. pinastri* occurs widely on many pine species. Within this species three well-supported sister clades, in which some fungal culture differences were found. Only one species *L. seditiosum* is a serious pine pathogen. It causes serious damage and needle loss in young seedlings, nurseries or Christmas plantations. Several consecutive attacks can cause the trees drying even reduce their economic and ornamental value.

Small pale or yellow chlorotic spots and later chlorotic bands on needles are the first symptoms which lead to mass red-browning of needles in spring. Needles may fall from trees or stay attached to trees. Black, boat-shaped, protuberant fruiting bodies appear on dead needles and during wet weather the spores are released and infect new needles.

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A survey of the incidence of *Lophodermium* sp. in urban greenery, arboretums, natural regeneration, forest plantations and nurseries of 75 localities in Slovakia showed, that *L. pinastri* was detected in 56% and *L. seditiosum* in 32% of all sampled pine trees. Both species were recorded on a wide host range. The majority of samples were from *Pinus nigra*, followed by *P. sylvestris, P. mugo* and less frequently in the other twelve pine hosts. Eight host species *P. aristata, P. densiflora, P. heldreichii, P. parviflora, P. rigida, P. strobus, P. uncinata P. wallichiana* were new for Slovakia. In addition, a species *L. corconticum* described only from the high-altitude environment of Poland was recorded from a Slovak location in the High Tatras on *P. mugo*.

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Nejvýznamnější listové skvrnitosti obilnin

The most important leaf spot diseases of cereals

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Listové skvrnitosti obilnin se vyskytují každoročně a mohou způsobit až 40% ztráty na výnosech, které souvisejí se ztrátou asimilační listové plochy. Nejvýznamnějšími původci listových skvrnitostí na pšenici jsou v ČR i v dalších evropských státech *Zymoseptoria tritici* (septoriová skvrnitost pšenice), *Pyrenophora tritici-repentis* (pyrenoforová skvrnitost pšenice) a *Phaeosphaeria nodorum* (feosferiová skvrnitost pšenice). Od roku 2000 je ve VÚRV pravidelně sledováno zastoupení jednotlivých patogenů na území ČR. V posledních letech byla dominantní *Zymoseptoria tritici*, pouze v extrémně suchých ročnících převažovala *Pyrenophora tritici-repentis*. Na ječmeni jsou nejhojnějšími původci listových skvrnitostí *Pyrenophora teres* (síťovitá skvrnitost ječmene), *Pyrenophora graminea* (pruhovitost ječmene), *Rhynchosporium secalis* (spála ječmene) a *Ramularia collo-cygni* (tmavohnědá skvrnitost ječmene). Většina pěstovaných odrůd ozimé a jarní pšenice a ozimého a jarního ječmene je středně až méně odolná ke komplexu listových skvrnitostí. V letech 2022–2024 byl hodnocen stupeň odolnosti u rozsáhlého souboru ozimého a jarního ječmene k *Pyrenophora teres* v polních podmínkách. Obecně lze říci, že pozdnější odrůdy jsou odolnější k listovým skvrnitostem.

Leaf spot diseases of cereals occur annually and can cause up to 40% yield losses due to loss of assimilative leaf area. The most important causal agents of leaf spots in wheat in the Czech Republic and other European countries are *Zymoseptoria tritici* (Septoria tritici blotch), *Pyrenophora tritici-repentis* (tan spot) and *Phaeosphaeria nodorum* (Stagonospora nodorum blotch). The presence of each pathogen has been regularly monitored in the Czech Republic since 2000. In recent years, *Zymoseptoria tritici* has been dominant, while *Pyrenophora tritici-repentis* has been prevalent in extremely dry years. In barley, the most common causal agents of leaf spots are *Pyrenophora teres* (net blotch), *Pyrenophora graminea* (barley leaf stripe), *Rhynchosporium secalis* (scald of barley) and *Ramularia collo-cygni* (Ramularia leaf spot). Most cultivated winter and spring wheat and winter and spring barley varieties are moderately to less resistant to leaf spot complex. In 2022-2024, the level of resistance to *Pyrenophora teres* in a large set of winter and spring barley varieties was evaluated under field conditions. In general, later varieties are more resistant to leaf spots.

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Mykoflóra spojená s listovými škvrnitosťami a hnilobou ľubovníka bodkovaného (*Hypericum perforatum* L.) na Slovensku

Association of fungal species with leaf spot and blight of St. John's-Wort (*Hypericum perforatum* L.) in Slovakia

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Významný potenciál liečivých rastlín ako prírodných a genetických zdrojov bol v poslednom čase rozpoznaný aj na Slovensku, avšak štúdium pôvodcov ochorení zo skupiny mikromycét napádajúcich liečivé rastliny nie je doposiaľ dostatočne poznaný. V tejto štúdií sme analyzovali 50 vzoriek ľubovníka bodkovaného (*Hypericum perforatum* L.) z rôznych lokalít na území Slovenska, ktoré sme získali zberom po roku 2009. Identifikácia húb bola uskutočnená na základe morfológie ich kolónií a priamom pozorovaní morfológie reprodukčných útvarov za pomoci stereomikroskopie a v súčasnosti používaných mykologických manuálov. Mykologickou analýzou stoniek a listov ľubovníka sme vyhodnotili viac ako 297 izolátov mikromycét, ktoré reprezentovali 24 rodov. Symptómy infekcie múčnatkotvarej huby *Erysiphe hyperici* na vrchnej časti listu sme zaznamenali veľmi často na kvitnúcich jedincoch. Na nekrotických škvrnách nájdených na stonkách sme najčastejšie zaznamenali mikromycéty z rodov: *Diploceras* (47%), *Colletotrichum* (29%), *Septoria* (25%) a *Mycosphaerella* (17%). Medzi menej často zaznamenané mikromycéty patrili do rodov: *Ascochyta*, *Botrytis*, *Coniothyrium*, *Colletotrichum*, *Clathrospora*, *Fusarium*, *Melanconium*, *Microdiplodia*, *Phaeosphaeria*, *Phoma*, *Phomopsis*, *Pleospora* a *Scopinella*. Štúdium pôvodcov ochorení liečivých rastlín zo skupiny mikromycét je významné pre zachovanie a stabilnú produkciu týchto úžitkových rastlín.

A great potential of medicinal plants as natural and genetic resources has also been recognized in Slovakia, however, the study on diseases and their causal fungi on medicinal plants has not been conducted sufficiently. In the surveys since 2009, over 50 diseased plant samples were collected from a different localities in Slovakia. The identification was made by the characteristics of the colonies, and direct observation of their conidia morphology in a stereoscopic microscope and in recent used mycological manuals. A total of 297 fungal isolates representing 24 genera were isolated along with dark septate and sterile fungi in 50 samples of *Hypericum perforatum* plants. The symptoms of powdery mildew caused by fungus *Erysiphe hyperici* have been recorded very often. The most common fungi detected in necrotic lesions on stems were *Diploceras* (47%), *Colletotrichum* (29%), *Septoria* (25%), and *Mycosphaerella* (17%). Other frequently isolated fungi were *Ascochyta*, *Botrytis*, *Coniothyrium*, *Colletotrichum*, *Clathrospora*, *Fusarium*, *Melanconium*, *Microdiplodia*, *Phaeosphaeria*, *Phoma*, *Phomopsis*, *Pleospora*, and *Scopinella*. The study on fungal diseases of medicinal plants is significant for conservation and stable production of such useful plants.

This work was supported by the R&D project „Molecular-biological approaches in the solution of plant adaptation to climate change and diagnosis of phytopathogens for ecologically acceptable and sustainable agriculture (contract 1092/2022/MPRVSR–930)“.

Mykoflóra spojená s listovými škvrnitosťami a hnilobou ovsa siateho (*Avena sativa* L.) na Slovensku

Mycoflora associated with leaf spots and blights in oats (*Avena sativa* L.) in Slovakia

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Obilniny sú najdôležitejšou potravinou človeka. Produkcia zrna ovsa siateho (*Avena sativa* L.) je na území Slovenska najčastejšie ovplyvňovaná hubovými patogénmi ako hrdzou (*Puccinia coronata* f. sp. *avenae*, FO=*88%*) alebo listovou škvrnitosťou spôsobenou nekrotrofnou hubou rodu *Drechslera* (*Drechslera avenae*, FO=84%). V posledných rokoch boli na listoch ovsa zaznamenané iné nezvyčajné symptómy listových škvrnitostí a hniloby, ktoré ovplyvňovali jeho produkciu. Preto sme uskutočnili v roku 2021 zber listov z 25 produkčných lokalít ovsa v štádiu plnej zrelosti (BBCH 89) na území Slovenska. Identifikácia húb bola uskutočnená na základe morfológie ich kolónií a priamom pozorovaní morfológie reprodukčných útvarov za pomoci stereomikroskopie a v súčasnosti používaných mykologických manuálov. Medzi identifikované parazitické druhy húb patrili: *Alternaria alternata* (FO=80%), *Bipolaris sorokiniana* (44%), *Stagonospora nodorum* (60%), *Fusarium* sp. (68%), *Colletotrichum* sp. (68%), *Cladosporium* sp. (56%), saprotrofné druhy *Epicoccum purpurascens* (72%), *Myrothecium* sp. (24%) a *Periconia* sp. (32%), a hyperparazitická huba *Sphaerellopsis filum* (20%). Frekvencia výskytu (FO) fytopatogénnych húb bola odlišná v závislosti od študovanej lokality, ale ich prítomnosť na lokalitách predstavuje potencionálne riziko, spojené s infekciou listov alebo zrna, či už počas uskladnenia alebo ak bude zrno použité ako osivo.

Cereals grain represent the most important human food. The seeds production of oats (*Avena sativa* L.) in Slovakia, is mainly affected by crown rust fungus (*Puccinia coronata* f. sp. *avenae*, FO=*88%*) and leaf spots caused by necrotrophic pathogen from genus *Drechslera* (*Drechslera avenae*, FO=84%). In recent years, other symptoms were observed on the territory of Slovakia, such as leaf spots and blights, which also limit the productivity of the oats varieties. In order to identify the fungi associated with these symptoms, leaves with blights and leaf spots were collected in 2021 from 25 different fields in Slovakia, when the crop had reached full maturity (BBCH 89). The identification was made by the characteristics of the colonies, and direct observation of their conidia morphology in a stereoscopic microscope and in recent used mycological manuals. The identified pathogenic fungi were: *Alternaria alternata* (FO=80%), *Bipolaris sorokiniana* (44%), *Stagonospora nodorum* (60%), *Fusarium* sp. (68%), *Colletotrichum* sp. (68%), *Cladosporium* sp. (56%), the saprophytes *Epicoccum purpurascens* (72%), *Myrothecium* sp. (24%), *Periconia* sp. (32%), and the hyperparasitic fungus *Sphaerellopsis filum* (20%). The frequency of occurrence of phytopathogenic fungi was different depending on studied localities, but its existence in this localities is a potential risk, as these fungi affect the foliage, and, if the grain is contaminated.

This work was supported by the R&D project „Molecular-biological approaches in the solution of plant adaptation to climate change and diagnosis of phytopathogens for ecologically acceptable and sustainable agriculture (contract 1092/2022/MPRVSR–930)“.

Huby prenášané lykožrútom lesklým (*Pityogenes chalcographus*) na borovici lesnej na Slovensku

Fungi transmitted by six-toothed bark beetle (*Pityogenes chalcographus*) on Scots pine in Slovakia

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Podkôrny hmyz (Coleoptera: Scolytinae) napádajúci ihličnaté dreviny je známy tým, že prenáša na svojom tele špecifické huby, hlavne ophiostomatoidné druhy, ktoré spôsobujú modré sfarbenie dreva. Je málo informácii o týchto hubách na borovici lesnej (*Pinus sylvestris*) na Slovensku. V súčasnosti bol zaznamenaný zvýšený výskyt lykožrúta lesklého (*Pityogenes chalcographus*) v borovicových porastoch v regióne Spiša. Tento škodca napáda oslabené, chradnúce a vyvrátené stromy, premnožuje sa aj v ťažbových zvyškoch v porastoch, kde nebola dostatočne vykonaná porastová hygiena. Cieľom tejto štúdie bolo určiť spektrum húb prenášaných lykožrútom lesklým. V roku 2022 bola analyzovaná mykobiota imág lykožrúta lesklého zbieraných spod kôry borovíc na lokalite Spišský Hrhov. Celkovo bolo izolovaných a molekulárne identifikovaných 15 druhov húb zo 6 čeľadí: Aspergillaceae (4 druhy rodu *Penicillium*), Bionectriaceae (*Clonostachys rosea*), Cladosporiaceae (*Cladosporium cladosporioides*), Cordycipitaceae (*Beauveria bassiana*, *Lecanicillium fusisporum*), Ophiostomataceae (2 druhy rodu *Grosmannia*, *Leptographium piceaperdum*, 3 druhy rodu *Ophiostoma*) a Pleosporaceae (*Alternaria alternata*). V mykobiote imág *P. chalcographus* dominovali druhy *Ophiostoma minus*, *O. fuscum* a *L. piceaperdum*, ktoré sa môžu spolu s činnosťou tohto chrobáka aktívne podieľať na chradnutí napadnutých stromov.

Bark beetles (Coleoptera: Scolytinae) infesting conifers are known to be associated with fungi, especially with ophiostomatoid fungi that cause blue staining of wood. Very little is known about these fungi colonizing Scots pine (*Pinus sylvestris*) trees in Slovakia. Currently, *Pityogenes chalcographus* is causing local outbreaks in pine stands in the Spiš region. This bark beetle affects weakened, withering, and uprooted trees; it also reproduces in logging residues in stands where stand hygiene has not been properly maintained. The aim of this study was to identify fungi transmitted by *P. chalcographus*. In 2022, the mycobiota of *P. chalcographus* adults collected from bark beetle galleries of infested pine trees in Spišský Hrhov was examined. A total of 15 species of fungi from six families were isolated and molecularly identified: Aspergillaceae (four *Penicillium* species), Bionectriaceae (*Clonostachys rosea*), Cladosporiaceae (*Cladosporium cladosporioides*), Cordycipitaceae (*Beauveria bassiana*, *Lecanicillium fusisporum*), Ophiostomataceae (two *Grosmannia* species, *Leptographium piceaperdum*, three *Ophiostoma* species), and Pleosporaceae (*Alternaria alternata*). *Ophiostoma minus*, *O. fuscum*, and *L. piceaperdum* isolates dominated the mycobiota of *P. chalcographus* adults, and together with the beetle's activities, can actively contribute to the withering of attacked trees.
The research was supported by the Scientific Grant Agency of the Ministry of Education of the Slovak Republic and of Slovak Academy of Sciences, project no. VEGA 2/0122/22.

Dissecting the biochemical background of plant tissues colonization by fungal pathogen *Leptosphaeria maculans*

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Oilseed rape (*Brassica napus*) is one of the most economically important crops in the world, but there is a big problem in the field with the fungal pathogen *Leptosphaeria maculans*, which causedblackleg disease and this leads to yield losses. *L. maculans* is a hemibiotrophic pathogen - it has a biotrophic and necrotrophic life cycle. In autumn, the pathogen causes primary infection of young plants with sex spores, ascospores. In the spring after that, there is a secondary infection where plants are infected with non-sexual spores, pycnidiospores. Mycelium infects hosts through stomataor wounds and blocks veins of the plant, interrupting the transport of water and nutrients.

Some ecotypes of *A. thaliana* have been found to be susceptible to this pathogen, although it is nota host plant of *L. maculans*. Our goal is to investigate the gene locus in *A. thaliana*, which may be involved in resistance to this pathogen, and then to find the orthologs of these genes in *B. napus.*
We work with *in vitro* organisms to monitor infection through the roots using a stereomicroscope and a confocal microscope, where we study GFP mycelium of the pathogen and its spread by the plant. We know from our pilot experiments that *L. maculans* can infect a plant through roots, from which it then spreads to the hypocotyl, where it causes severe necrosis.

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Studium účinnosti esenciálních olejů vůči padlí a plísni dýňovitých

Study of essential oils efficacy against powdery and downy mildews on cucurbit plants

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Účinnost jedenácti esenciálních olejů (EO) byla sledována u dvou izolátů padlí dýňovitých (PM) (původce: *Podosphaera xanthii* /Px/, 7/23Px, 24/22Px) pocházejících z České republiky (ČR). Jednalo se o EO z těchto rostlin: *Zingiber officinale, Valeriana officinalis, Ormenis multicaulis, Satureja hortensis, Acorus calamus, Illicium verum, Coriandrum sativum, Artemisia dracunculus, Artemisia absinthium, Pogostemon cablin, Citrus reti*culata. A také byla u dvou izolátů plísně dýňovitých (původce: *Pseudoperonospora cubensis* /PC/: OL PC 1/23 3, PC 22/23 2) pocházejících z ČR studována účinnost deseti dalších EO. Jednalo se o EO z těchto rostlin: *Picea abies, Abies alba, Abies alba* šišky, *Larix decidua, Pinus mugo* var. *pumilio, Pinus sylvestris, Thuja orientalis, Pseudotsuga menziesi, Cupressus sempervirens, Citrus sinensis.* K testování účinnosti EO u obou patogenů (PM, PC) byla využita modifikovaná metoda listových disků podle Sedlákové et al. (2024). Listové disky byly připraveny z listů vysoce náchylné odrůdy okurky seté (*Cucumis sativus*) Perzeus F1. U všech EO bylo testováno sedm koncentrací (0,025%, 0,04%, 0,05%, 0,06%, 0,075%, 0,085%, 0,090%). Účinnost sledovaných EO vůči izolátům PM a PC se signifikantně lišila, a to jak vzhledem k jednotlivým testovaným EO, tak rovněž i mezi oběmi studovanými skupinami biotrofních patogenů (PM, DM). Také byly zaznamenány rozdíly v míře fytotoxicity mezi studovanými EO.
Tento projekt byl podpořen těmito granty MŠMT: NAZV, project č. *QK21010064 a NPGZ-M/03-023 a IGA - PrF - 2024-001.*

Efficacy of eleven essential oils (EO) were screened on two powdery mildew /PM/ isolates (causal agent: *Podosphaera xanthii* /Px/, 7/23 Px, 24/22 Px) originated from Czech Republic (CR). There were tested EOs from: *Zingiber officinale, Valeriana officinalis, Ormenis multicaulis, Satureja hortensis, Acorus calamus, Illicium verum, Coriandrum sativum, Artemisia dracunculus, Artemisia absinthium, Pogostemon cablin, Citrus reticulate*. There were also screened efficacy of other eight EOs at two cucurbit downy mildew isolates (causal agent: *Pseudoperonospora cubensis* /PC/: OL PC 1/23 3, PC 22/23 2) originated from CR. There were tested EOs from: *Picea abies, Abies alba, Abies* alba cones, *Larix decidua, Pinus mugo* var. *pumilio, Pinus sylvestris, Thuja orientalis, Pseudotsuga menziesi, Cupressus sempervirens, Citrus sinensis.* A modified leaf discs bioassay by Sedláková et al. *(2024)* was used for screening EOs at both pathogens (PM, PC). A highly susceptible *Cucumis sativus* cv. *Perzeus* F1 served for preparation of leaf discs. There were screened these seven concentrations (0,025%, 0,04%, 0,05%, 0,06%, 0,075%, 0,085%, 0,090%*) a*t all EOs. Efficacy of screened EOs towards PM and PC isolates varied significantly in relation to tested EOs and as well in comparison to both studied biotrophic groups of pathogens (PM, DM). Screened EOs also differed in fytotoxicity degree.

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Plíseň slunečnice v ČR

Sunflower downy mildew in Czechia

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Výnos slunečnice může být extrémně snížen infekcí plísně slunečnice, jejíž monitoring jsme prováděli v ČR intenzivně v letech 2007-2017, od roku 2018 extenzivně. Při studiu patogenní variability původce plísně (*Plasmopara halstedii*) bylo dosud zaznamenáno celosvětově přes 50 fyziologických ras, z nichž rasy 705 a 715 byly poprvé nalezeny na jižní Moravě v oblasti Podivína. Dosud jsme v české populaci *P. halstedii* nezaznamenali rezistenci k metalaxylu M. V polních podmínkách je výskyt plísně slunečnice při použití certifikovaného mořeného osiva a zachování agrotechnických postupů (patogenem nezamořené a nepodmáčené půdy, střídání plodin) vzácný. Výskyt *P. halstedii* byl v minulých letech v ČR spojen s přenosem patogenu osivem (mycelium přežívající pod osemením při latentních infekcích), s podmáčenými půdami a se zamořením půdy oosporami (na rostlinách z výdrolu nebo nemořeného osiva). Se zákazem použití některých účinných látek v EU (např. od r. 2024 acibenzoar-S-methyl) jsou předmětem našeho studia alternativní látky na rostlinné bázi.

Sunflower yield can be extremely reduced by sunflower downy mildew infection, which we monitored intensively in the Czech Republic within years 2007-2017, and extensively since 2018. During the study of pathogenic variability of its causal agent (*Plasmopara halstedii*) more than 50 physiological races have been identified worldwide, of which races 705 and 715 were for the first time ever found in South Moravia in area of Podivín. So far, we have not recorded resistance to metalaxyl M in the Czech population of *P. halstedii*. In field conditions, the occurrence of sunflower fungus is rare when certified fungicide-treated seed is used and agrotechnical procedures are followed (pathogen-free soil with low water level, crop rotation). In recent years, the occurrence of *P. halstedii* in the Czech Republic was associated with the transmission of the pathogen by seed (mycelium surviving under seed coat during plant latent infections), with water-logged soils contaminated with oospores (on plants growing from seed left on the field from preceding year). With the ban on the use of some active substances in the EU (e.g. acibenzoar-S-methyl from 2024), alternative plant-based substances are subjected to our study.

The research was supported by the Ministry of Agriculture of the Czech Republic (The National Programme on Conservation and Utilization of Plant, Animal and Microbial Genetic Resources Important for Food and Agriculture), TAČR (NCK 2 BIOCIRTECH, č. TN02000044) and Internal Grant of Palacky University (IGA UP PrF-2024-001).

Monitoring incidencie hubových ochorení viniča hroznorodého v Malokarpatskej a Južnoslovenskej vinohradníckej oblasti.

Monitoring of fungal disease incidence on grapevines in the Small Carpathian and South Slovak wine-growing regions

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Základným princípom ochrany *Vitis vinifera* je schopnosť dopestovať zdravé a zrelé hrozno. Ochrana listov a plodov je najdôležitejšia v období pred a po kvitnutí. Medzi najznámejšie choroby vyskytujúce sa každoročne na listov a plodoch zaraďujeme hubové ochorenia peronospóra viničová spôsobená *Plasmopara viticola* a múčnatka viničová spôsobená *Uncinula necator*. Tieto hubové choroby dokážu v nepriaznivých ročníkoch spôsobiť vysoké straty na úrode. Cieľom práce bolo zhodnotiť výskyt peronospóry viničovej a múčnatky viničovej na výsadbách odrôd Veltlínske zelené, Dunaj, Svätovavrinecké a Rulandské biele, ktoré sa nachádzajú vo vinohradníckych obciach Dechtice a Horné Orešany (Malokarpatská vinohradnícka oblasť) a Mužla (Južnoslovenská vinohradnícka oblasť). Výsledky ukázali, že najväčšie percento výskytu peronospóry viničovej v lokalite Dechtice bolo pri odrode Dunaj – 8.66% a múčnatky viničovej – Veltlínske zelené – 3.66%. V lokalite Mužla percento výskytu peronospóry viničovej – Dunaj 5.17% a múčnatky viničovej – Dunaj 12.17%. V lokalite Horné Orešany – najvyššie percento výskytu peronospóry viničovej pri odrode – Svätovavrinecké – 17.50% a múčnatky viničovej pri odrode Svätovavrinecké – 12.83%. Vplyv zrážok a vlhkosti vzduchu má významný vplyv na prejav a efektivitu výskytu sledovaných patogénov.

The basic principle of *Vitis vinifera* protection is the ability to grow healthy and ripe grapes. Leaf and fruit protection is most important in the period before and after flowering. Among the most well-known diseases that occur annually on leaves and fruits are the fungal diseases downy mildew caused by *Plasmopara viticola* and powdery mildew caused by *Uncinula necator*. These fungal diseases can ensure high losses in unfavourable years. The aim of the work was to evaluate the occurrence of downy mildew and powdery mildew on the plantings of the Grüner Veltliner, Dunaj, Saint Lauren, and Pinot Blanc varieties, which are in the wine-growing villages of Dechtice and Horné Orešany (Small Carpathian wine-growing region) and Mužla (South Slovak wine-growing region). The results showed that the highest percentage of downy mildew in the Dechtice area was in the Dunaj variety (8.66%) and the grape downy mildew (Grüner Veltliner) (3.66%). In the Mužla location, the percentage of downy mildew is Dunaj 5.17%, and powdery mildew is Dunaj 12.17%. In the location of Horné Orešany, the highest percentage of downy mildew in the variety Saint Lauren is 17.50%, and powdery mildew in the variety Saint Lauren is 12.83%. The influence of precipitation and air humidity has a significant impact on the manifestation and effectiveness of the occurrence of the monitored pathogens.

Key words: downy mildew, powdery mildew, Pinot Blanc, Dunaj, Saint Lauren, Grüner Veltliner

SECTION

Animal pests

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Hodnotenie výskytu Fyloxéry viničovej (*Dactylosphaera vitifoliae*) vo fenofázach BBCH 13 – 71 vo vegetačnom roku 2024

Evaluation of grape phylloxera's (*Dactylosphaera vitifoliae*) occurrence during the BBCH 13-71 phenophases in the 2024 vegetation year

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The phylloxera pest is spreading rapidly nowadays. Factors contributing to this phenomenon likely include climate change, resistance to insecticides, and the use of gentle cultivation practices, which limit the use of active ingredients significantly. Regarding the severity of the harm caused, the root form is the most dangerous, as evidenced by the extensive damage the pest caused to European viticulture at the end of the 19th century. The aim of this research was to study the temporal dynamics of the overwintering population's migration and to correlate this data to the climatic factors and the phenology of the vine. The research was conducted in Nitra, belonging to the Nitra wine-growing region, during the phenophases BBCH 13 to 71. The variant used during the study was Cabernet Sauvignon, rootstock SO4, in a 16-year-old vineyard. The monitoring of the pest's root form was executed via the bucket emergency traps method of Powell et al. (2007), for the duration of 13 weeks. Conversely, the monitoring of the pest's leaf form was executed via regular visual assessment of the leaves, once every seven days. The captured insects were evaluated by a microscope with a camera, and by assessing meteorological factors in relation to soil moisture and temperature.
No trace of the pest's root form was detected on the vines during the 13 weeklong monitoring process using 9 bucket traps. These findings are related to weather fluctuations present during the spring of 2024, which experienced multiple alternations of severely hot and cold temperature periods. Moreover, the atmospheric precipitation volume was above average, and the rootstock used possessed roots resistant to the pest. During the BBCH 57 phenophase, the leaf form of the pest began to proliferate in the area, specifically on the rootstocks SO4, K5BB, and even on the interspecific variety Hibernal. The proliferation was prominent during the subsequent phenophases as well. The number of leaf galls on a single leaf averaged 32 and the number of eggs in a single leaf gall averaged 57. The second generation of phylloxera's leaf form invades the soil as well and infests the roots of the noble vine. The pest's infestation of interspecific grapevine hybrids (PIWI) has not yet been thoroughly researched, while mainly table varieties are often sold as straight rooted without resistant rootstock.

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Druhová diverzita entomopatogénnych húb (Ascomycota, Hypocreales) v populácii kohútika pestrého (*Oulema melanopus* L.)

Species diversity of entomopathogenic fungi (Ascomycota, Hypocreales) in population of the cereal leaf beetle (*Oulema melanopus* L.)

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V júni v roku 2023 sme sledovali prevalenciu entomopatogénnych húb v populáciách kohútika pestrého (*Oulema melanopus*) v porastoch jačmeňa siateho v okolí mesta Nitry. Chrobáky sme zberali šmýkacou sieťou a odchytené jedince sme inkubovali päť dní pri 25°C, kedy sme sledovali rozvoj entomopatogénnych húb. Celkovo sme odchytili 3 536 dospelých jedincov a z nich 58 (1,64%) vykazovalo symptómy mykotickej infekcie. Infikované jedince sme použili na izoláciu *in vitro* kultúr a získali sme 56 izolátov entomopatogénnych húb. Identifikovali sme nasledovné druhy: *Beauveria pseudobassiana* (33 izolátov), *Beauveria bassiana* (19 izolátov), *Isaria fumosorosea* (3 izoláty) a *Metarhizium pemphigi* (1 izolát).

Izoláty produkujúce sporulujúce kultúry (49 izolátov) sme použili na testovanie patogenity proti imágam kohútika v laboratórnych podmienkach. Imága sme ošetrili suspenziou spór (2×10^6 spór ml^{-1}) a inkubovali 10 dní pri 25°C a fotoperióde 12/12 h (L/D). Všetky testované izoláty preukázali patogenitu voči kohútikovi a priemerná mortalita kolísala od 27,00 ± 2,55% do 54,00 ± 5,10%, v závislosti od izolátu. Rozdiely v mortalite medzi izolátmi však neboli štatisticky významné ($F_{(48,196)} = 0{,}943$; $p = 0{,}58$).

In June 2023, the prevalence of entomopathogenic fungi in populations of adult *Oulema melanopus* was studied in barley crops near the city of Nitra. The beetles were collected by sweeping, and the captured adults were incubated at 25°C for five days to screen for fungal infection. Dead individuals with symptoms of fungal infection were processed for the isolation of *in vitro* cultures. A total of 3536 adults of *O. melanopus* were collected and 58 individuals (1.64%) displayed symptoms of fungal infection. They were used for isolation of fungal cultures and 56 *in vitro* isolates were obtained. The isolates were identified as *Beauveria pseudobassiana* (33 isolates), *Beauveria bassiana* (19 isolates), *Isaria fumosorosea* (3 isolates) and *Metarhizium pemphigi* (1 isolate).

Isolates of sporulating cultures (49 isolates) were used for pathogenicity testing against *O. melanopus* in laboratory conditions. The beetles were treated by a suspension of conidia (2×10^6 conidia ml^{-1}), then incubated for 10 days at 25°C and a 12/12 h (L/D) photoperiod. All isolates demonstrated pathogenicity to *O. melanopus* and the mean mortality varied between 27.00 ± 2.55% and 54.00 ± 5.10%, depending on the isolates. However, the difference in the mortality among isolates was not statistically significant ($F_{(48,196)} = 0.943$, $p = 0.58$).

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Možnosti ochrany zeleniny proti háďátku zhoubnému (*Ditylenchus dipsaci*)

Ondřej Douda

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Háďátko zhoubné (*Ditylenchus dipsaci*) patří stále mezi významné škůdce zvláště cibulové zeleniny. Tato skutečnost je dána zejména vysokou odolností tohoto druhu fytoparazitického háďátka a nedostatkem přímých metod ochrany. Klíčové je hlavně ošetření sadbového česneku před výsadbou. Z tohoto důvodu byl proveden výzkum mající za cíl vyhodnotit vliv aplikace rostlinných esenciálních olejů na životaschopnost háďátek druhu *Ditylenchus dipsaci* v in vitro podmínkách a potvrdit tak možnost aplikace alternativních metod ochrany zeleniny vůči tomuto škodlivému organismu. Hodnocení účinků aplikovaných rostlinných olejů probíhalo aplikací testovaných látek v koncentracích 2 000 ppm, na suspenzi háďátek extrahovaných z napadeného česneku. Experimenty byly vyhodnoceny po 4 a 24 h po aplikaci, kdy byla stanovena mortalita háďátek. Následně bylo provedeno porovnání s neošetřenou kontrolní variantou a statistické vyhodnocení. Výsledky ukazují na statisticky významný vliv některých aplikovaných esenciálních olejů na mortalitu háďátka *Ditylenchus dipsaci*.
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Hodnotenie repelentných a atraktívnych zvláštností esenciálnych olejov

Evaluation of repellent and attractant peculiarities of essential oils

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Mnoho výskumníkov venuje značnú pozornosť štúdiu repelentných a atraktívnych vlastností esenciálnych olejov, vrátane analýzy chemického zloženia ich hlavných zložiek. Jednoduché experimenty, ako je ″most″, použitie čuchometra alebo použitie plastových boxov, zároveň stále nestrácajú na aktuálnosti a inovatívnej zložke. Preto sme sa rozhodli študovať a analyzovať vlastnosti 20 esenciálnych olejov z hľadiska ich účinku na vošku makovú (*Aphis fabae*) pomocou [1]mostového experimentu, ako aj účinok rovnakých olejov na vošku skorocelovú (*Dysaphis plantaginea*) a vošku jabloňovú (*Aphis pomi*) pomocou pokusu v [2]plastových boxoch.

Počas prvého experimentu ([1]most) sa teda zistilo, že esenciálny olej *Cinnamomum verum* a *Zingiber officinale* vykazujú veľmi slabé atraktantné vlastnosti: RI = -10 % pre škoricu a RI = -20 % pre zázvor. Esenciálny olej z mäty piepornej (*Mentha piperita*) vykazoval stredne atraktívny účinok s RI = -50 %. Zvyšné oleje vykazovali repelentné vlastnosti.

V druhom experimente s použitím [2]plastových boxoch a éterických olejov na vošku skorocelovú (*Dysaphis plantaginea*) veľmi atraktívne vlastnosti vykazoval bergamot (*Citrus bergamia*) EO s RI = -86,67 % a mäta pieporná (*Mentha piperita*) EO vykazovala atraktívne vlastnosti s RI = -73,33 %. Len šesť EO zo všetkých 20 skúmaných vykazovalo rozsah repelentných vlastností: čierne korenie, mäta, pelargónie, klinček, borovica a kajeput; ostatné oleje vykazovali rôzne úrovne atraktívnych vlastností.

V prípade vošky jabloňovej (*Aphis pomi*) preukázali repelentné vlastnosti čajovník, borovica a ruta; stredne repelentné vlastnosti zabezpečili bergamotové a citronelové esenciálne oleje Java. Vo všeobecnosti pre Aphis pomi 11 EO vykazoval repelentnú aktivitu; preto deväť EO fungovalo ako atraktanty.

Many researchers pay considerable attention to studying the repellent and attractant properties of essential oils, including analyzing the chemical composition of their main components. At the same time, simple experiments, such as a [1]″bridge″, the use of an olfactometer, or the use of plastic boxes, still do not lose their relevance and innovative component. Therefore, we decided to study and analyze the properties of 20 essential oils regarding their effect on black been aphid (*Aphis fabae*) using a bridge experiment, as well as the effect of the same oils on rosy apple aphid (*Dysaphis plantaginea*) and green apple aphid (*Aphis pomi*) using an experiment in [2]plastic boxes.

Thus, during the first experiment ([1]″bridge″) it was established that essential oil *Cinnamomum verum* and *Zingiber officinale* show very weak attractant properties: RI = -10% for cinnamon and RI = -20% for ginger. Peppermint (*Mentha piperita*) essential oil showed moderately attractive effect with RI = -50%. The remaining oils showed repellent properties.

In the second experiment with using [2]plastic boxes and essential oils on rosy apple aphid (*Dysaphis plantaginea*) very attractive properties showed bergamot (*Citrus bergamia*) EO with RI = -86.67% and peppermint (*Mentha piperita*) EO showed attractive properties with RI = -

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73.33%. Only six EO from all 20 investigated showed the range of repellent properties: black pepper, spearmint, geranium, clove, pine and cajeput tree; the rest oils showed different levels of attractive properties.

For green apple aphid (*Aphis pomi*) repellent properties were demonstrated by tea tree, pine and rue; moderately repellent properties were provided by bergamot and citronella Java essential oils. Generally, for *Aphis pomi* 11 EO showed repellent activity; accordingly, nine EO were working as attractants.

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Degradace insekticidů v jablkách

Dissipation of insecticides in apples

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V letech 2020 až 2023 byla v experimentálních výsadbách dvou odrůd jabloní (Selena a Rosana) hodnocena degradace 10 insekticidů (acetamiprid, chlorantraniliprole, cyantraniliprole, flonicamid, flupyradifurone, pirimicarb, pyriproxyfen, spinosad, spirotetramat a tebufenozide). Rezidua pesticidů v plodech byla stanovena kapalinovou chromatografií ve spojení s tandemovou hmotnostní spektrometrií (LC-MS/MS). První dva roky byly insekticidy aplikovány v termínech 44 až 55 dnů před sklizní pro ověření možnosti dodržet 30 % maximálního limitu reziduí (MRL) pro integrovanou produkci jádrovin. V následujících dvou letech byly zvoleny termíny aplikace 84 až 101 dnů před sklizní, aby bylo ověřeno dosažení limitu 0,01 mg/kg (bezreziduální produkce). Nejrychleji degradoval spinosad (průměrný poločas rozpadu 4,5 dne) a nejdéle flonicamid v sumě s metabolity TFNA a TFNG (průměrný poločas rozpadu 66,4 dne). Obsah reziduí pyriproxyfenu a flonicamidu v jablkách po pozdních aplikacích přesáhl při sklizni práh 30 % MRL. Bezreziduální produkci ve všech termínech aplikace splňovaly při sklizni látky spinosad a cyantraniliprole, naproti tomu bezreziduální produkce nebyla dosažena v žádném z hodnocených termínů aplikace pro acetamiprid, flonicamid, pirimicarb a tebufenozide.

From 2020 to 2023, the dissipation of 10 insecticides (acetamiprid, chlorantraniliprole, cyantraniliprole, flonicamid, flupyradifurone, pirimicarb, pyriproxyfen, spinosad, spirotetramat and tebufenozide) was evaluated in an experimental orchard on two apple varieties (Selena and Rosana). The determination of pesticide residues in apples was performed using liquid chromatography-tandem mass spectrometry (LC-MS/MS). In the first two years, insecticides were applied 44 and 55 days before harvest to test the possibility of complying with the 30 % maximum residue limit (MRL) for integrated pome fruit production. In the following two years, application dates from 84 to 101 days before harvest were selected to test the feasibility of meeting the limit of 0.01 mg/kg (zero-residue production). Spinosad dissipated the fastest (mean half-life 4.5 days) and flonicamid (sum of flonicamid, TFNA and TFNG expressed as flonicamid) dissipated the longest with a mean half-life of 66.4 days. Residue levels of pyriproxyfen and flonicamid in apples after late applications (44-55 days before harvest) exceeded the 30 % MRL at harvest. Zero-residue production at harvest was met by spinosad and cyantraniliprole at all application dates. On the other hand, zero-residue production was not achieved for acetamiprid, flonicamid, pirimicarb and tebufenozide at any of the application dates evaluated.

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Safeguarding Pollinators: Addressing Challenges of Insecticide Exposure and Honey Bee Olfactory Learning Behavior to Promote Ecosystem Resilience

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Pollinators, particularly honey bees play a pivotal role in ecosystem stability and ensuring global food security. Nevertheless, their populations are increasingly vulnerable to environmental stressors, particularly pesticide exposure. There has been a growing focus on investigating both the impact and underlying mechanisms by which insecticides disrupt the behavior of honey bees, particularly in relation to olfactory learning and memory formation, within the context of the complex challenges posed by insecticide exposure. This research domain highlights the necessity to preserve pollinator populations and ensure the sustainability of ecosystems. It is important to explore the effects of both lethal and sublethal concentrations of insecticides on the survival, and learning, and memory capabilities of honey bees, as these capabilities are crucial for the foraging process. In addition, there is a need to explore the broader implications of insecticide-induced changes in honey bee olfactory behavior on pollinator health, ecosystem functioning, and agricultural productivity. Integrating perspectives from behavioral ecology, toxicology, and pollinator biology highlightsthe necessity of promoting interdisciplinary dialogue and collaborative efforts to address the
threats to the bee population induced by insecticides. Implementation of evidence-based strategies and policy regulations is imperative to mitigate the detrimental impacts of insecticides on honey bees, and to promote a sustainable coexistence between pollinators and agricultural practices. Researchers, policymakers, and stakeholders must prioritize pollinator conservation and environmental preservation. Through collaborative efforts, we can navigate beyond geographical borders to safeguard pollinators, thereby ensuring ecosystem resilience and global food security.

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Mechanismy rezistence mšice broskvoňové k insekticidům a vývoj rezistence v ČR v letech 2018 až 2023

Mechanisms of *Myzus persicae* resistence to insecticides and development of resistence in Czechia in 2018 – 2023

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Rezistence *Myzus persicae* k pyretroidům a karbamátům byla monitorována v českých populacích od roku 2018 do roku 2023 pomocí biologických testů a metodou PCR. Mšice byly každoročně odebírány z řepky z několika lokalit z celého území ČR. U populací rezistentních k pyretroidům byly sekvenováním potvrzeny čtyři různé mutace receptoru v místě působení: kdr L1014F, s-kdr M918L, s-kdr M918T, L932F a u populací rezistentních ke karbamátům byla metodou RFLP detekována mutace MACE S431F. U populací mšice broskvoňové vychovaných z jednotlivých vajíček přezimujících na broskvoni byla detekována rezistence k pyretroidům (mutace s-kdr M918L) a rezistence ke karbamátům (mutace MACE S431F). To je první důkaz pro přenos genů rezistence přes pohlavní generaci mšice broskvoňové. Podle biologických testů zůstává za sledované období u populací mšice broskovňové vysoký stupeň rezistence k pyretroidům a pomalý návrat citlivosti ke karbamátům. Vysoká účinnost na rezistentní populace k pyretroidům a karbamátům byla zjištěna pro přípravky na bázi flupyradifuronu, spirotetramatu a acetamipridu a také pro sulfoxaflor, jehož registrace byla ukončena.

Resistance of *Myzus persicae* to pyrethroids and carbamates was monitored in Czech populations of aphids in 2018-2023 in bioassays and PCR analysis. Aphids were collected from oilseed rape fields originated from various localities throughout Czechia. Sequencing of partial para gene for paratype voltage-gated sodium channel detected different SNPs leading to four amino acid substitutions (kdr L1014F; s-kdr M918L; s-kdr M918T; and L932F). RFLP analysis found the S431F amino acid substitution in the populations resistant to carbamates. Resistance to pyrethroids with s-kdr mutation M918L and resistance to carbamates (S431F mutation) was proved in the aphids selected from individual eggs surviving on peach trees. For the first time transfer of resistance genes through the sex generation of *M. persicae* was proved. According to results of the bioassays, high level of resistance to pyrethroids and slow comeback of sensitivity to carbamates was observed in the observed time period. High efficacy against populations resistant to pyrethroids and carbamates was proved for flupyradifuron, spirotetramat and acetamiprid and also for sulfoxaflor, which registration was finished.

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Insekticidní účinnost vybraných komponentů esenciálních olejů a jejich binárních směsí na *Metopolophium dirhodum* a její 2 predátory

Insecticidal efficacy of selected essential oil components and their binary mixtures on *Metopolophium dirhodum* and its 2 predators

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V naší studii jsme se věnovali testování insekticidní účinnosti 4 majoritních komponentů esenciálních olejů (carvacrol, β-citronellol, isoeugenol, a linalool) proti neokřídleným dospělcům *Metopolophium dirhodum* a zároveň bylo testováno, zda u jejich binárních směsí dochází k synergickému působení zvyšujícímu insekticidní aktivitu. U všech 4 testovaných látek byla při testech na akutní toxicitu prokázána významná aphicidní aktivita. Při následujících testech zjišťující synergismus mezi těmito čtyřmi látkami se jako nejefektivnější ukázala binární směs β-citronellolu a linaloolu, pro kterou byla LC_{50} odhadnuta na 0,56 mL L^{-1} a LC_{90} na 1,58 mL L^{-1}.
U β-citronellolu, linaloolu a jejich binární směsi byla následně testována jejich bezpečnost pro 2 významné predátory mšic, *Aphidoletes aphidimyza* a *Chrysoperla carnea*. Larvy obou predátorů byly ošetřeny zmíněnými látkami (resp. binární směsí) v koncentracích rovných odhadnutým LC_{90} pro *M. dirhodum*. U *A. aphidimyza* nebyla ani v jednom případě pozorována mortalita vyšší než 3,3 %. U *C. carnea* byla pozorována mortalita pro β-citronellol 35,3 %, pro linalool 4,8 % a pro jejich binární směs 19,6 %. Lze tedy říci, že binární směs linaloolu a β-citronellolu vykazuje silný insekticidní účinek pro *M. dirhodum* a zároveň je bezpečná pro predátory mšic *A. aphidimyza* a *C. carnea*, což odpovídá současné poptávce po zelenějších a environmentálně bezpečnějších pesticidy.

In our study, we tested the insecticidal efficacy of 4 major components of essential oils (carvacrol, β-citronellol, isoeugenol, and linalool) against apterous adults of *Metopolophium dirhodum*. It was also tested whether their combination within a binary mixture resulted in a synergistic increase in insecticidal activity. For all 4 tested compounds, significant aphicidal efficacy was demonstrated in acute toxicity tests. Subsequent tests determined the synergistic activity between the four substances within binary mixtures. The binary mixture of β-citronellol and linalool was found to be the most effective, with LC_{50} and LC_{90} estimated at 0.56 and 1.58 mL L^{-1}, respectively. The safety of β-citronellol, linalool and their binary mixture was then tested on two major aphid predators, *Aphidoletes aphidimyza* and *Chrysoperla carnea*. The larvae of both predators were treated with the above mentioned substances (respectively binary mixture) at concentrations equal to the estimated LC_{90} for *M. dirhodum.* No mortality higher than 3.3% was observed for *A. aphidimyza.* In tests with *C. carnea*, mortality was observed to be 35.3% for β-citronellol, 4.8% for linalool and 19.6% for their binary mixture. Thus, it can be said that the binary mixture of linalool and β-citronellol exhibits a strong insecticidal effect on *M. dirhodum* and is also safe for aphid predators such as *A. aphidimyza* and *C. carnea*, which is in line with the current demand for greener and environmentally safer pesticides.
Financial support for this work was provided by the Technology Agency of the Czech 405 Republic (Project no. FW06010376).

Výskyt a mykofágní aktivita brouka *Sericoderus lateralis* (Coleoptera: Corylophidae) v porostu rajčat ve skleníku

Occurrence and mycophagy activity of the beetle *Scricoderus lateralis* (Coleoptera: Corylophidae) in the greenhouse tomato crop

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V provozu hydroponického skleníku (Farma Bezdínek, Dolní Lutyně) se provádí detailní pravidelný monitoring výskytu škůdců a chorob v porostu rajčat (*Solanum lycopersicum*) jako součást integrované ochrany rostlin. V roce 2022 a 2023 byl zaznamenán výskyt černě rajčatové (*Cladosporium fulvum*) v létě a na podzim. Přechodné zvýšení vlhkosti ve skleníku nad 90 % vedlo k rychlému rozvoji symptomů této choroby na listech. Při důkladné kontrole lézí (skvrn) na spodní straně listů byla pozorována přítomnost dospělců drobných brouků (1 mm). Druh byl determinován jako *Sericoderus lateralis* na pracovišti Ústavu zoologie, rybářství, hydrobiologie a včelařství na Mendelově univerzitě v Brně. Následná pozorování in situ ve skleníku a také in vitro v Petriho miskách potvrdilo aktivní mykofágní chování dospělců i larev, které požírali mycelia *C. fulvum*. Díky tomuto aktivnímu mykofágnímu žíru došlo k významné redukci plochy některých lézí. Zároveň bylo pozorováno kladení vajíček *S. lateralis* přímo do lézí černě rajčatové. V souvislosti s tímto pozorováním vyvstává otázka, zda *S. lateralis* může napomoci snížit rozvoj černě rajčatové ve skleníku, nebo naopak roznášením spor na další rostliny přispívá k šíření této choroby?

In the hydroponic greenhouse (Farm Bezdínek, Dolní Lutyně), regular monitoring of the pests and diseases in the tomato (*Solanum lycopersicum*) crop is standard part of IPM strategy. In 2022 and 2023, the presence of tomato leaf mould (*Cladosporium fulvum*) was recorded in summer and autumn. A temporary increase of humidity in the greenhouse above 90% led to the rapid development of symptoms of this disease on the leaves. During a detailed visual check of the lesions (spots) on the underside of the leaves, the presence of tiny beetle (1 mm) was observed. The species was identified as *Sericoderus lateralis* at Department of Zoology, Fisheries, Hydrobiology and Apiculture of the Mendel University in Brno. Subsequent observations in situ in the greenhouse as well as in vitro in Petri dishes confirmed the active mycophagic behaviour of both adults and larvae that consumed *C. fulvum* mycelia. Thanks to this active mycophagy, there was a significant reduction in the area of some tomato leaf mould lesions. The *S. lateralis* eggs were also laid directly into the lesions of tomato leaf mould. In the relation with this observation, the question arises whether *S. lateralis* has potential to reduce the development of tomato leaf mould in the tomato greenhouse crop, or on the contrary, by spreading spores to other plants it contributes to the spread of this disease?

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BIOLOGICKÁ OCHRANA ROSTLIN: antagonistické a synergistické vztahy mezi dravými druhy hmyzu a parazitickými vosičkami na příkladu *Anaphes flavipes*

BIOLOGICAL CONTROL: antagonistic and synergistic relationships between predatory insects and parasitic wasps on the model species *Anaphes flavipes*

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Dravé druhy hmyzu, včetně parazitických vosiček jsou nedílnou součástí zemědělské krajiny, kde se podílejí na potlačení škodlivých organismů a udržení celkové rovnováhy. K redukci škůdců mohou být jak dravé druhy hmyzu, tak parazitické vosičky úmyslně vypouštěny na konkrétní pozemky nebo lze zemědělskou krajinu upravit tak, aby podporovala přirozený výskyt těchto prospěšných organismů. Vztahy mezi samotnými prospěšnými organismy však mohou být nejen synergistické (pozitivní), ale i antagonistické (negativní). Mezi jeden z hlavních antagonistických vztahů patří tzv. *intraguild predation* (IGP). Při tomto typu predace dochází pod tlakem dravých druhů hmyzu nejen k redukci škodlivého organismu, ale také parazitoida, který se uvnitř škůdce vyvíjí. Rozdílná potravní preference dravých druhů k ne/parazitovaným škůdcům a různé typy adaptací parazitických vosiček v souvislosti s IGP mohou proměnit tento antagonistický vztah na synergistický. V naší práci jsme se zaměřili na studium IGP u vybraných dravých druhů hmyzu, škůdce kohoutka (*Oulema* spp.) a parazitické vosičky *Anaphes flavipes*. Při detailním studiu IGP u tohoto modelu byl prvotně popsán antagonistický vztah a posléze bylo nalezeno několik synergistických vztahů, které nejen že umožňují výskyt dravých druhů hmyzu a parazitické vosičky na stejných lokalitách, ale také mohou zefektivnit využití těchto organismů při biologické ochraně rostlin.

Predatory insects, including parasitic wasps, are an inherent part of the agricultural landscape where they contribute to pest control and maintain the overall balance. To reduce pests, both predatory insects and parasitic wasps can be deliberately released on specific sites or the agricultural landscape can be modified to support the natural occurrence of these beneficial organisms. However, the relationships between the beneficial organisms themselves can be synergistic (positive) as well as antagonistic (negative). One of the main antagonistic relationships is intraguild predation (IGP). In this type of predation, not only is the pest reduced under the pressure of predatory insects, but also the parasitoid that develops inside the pest. The different food preferences of predators to non/parasitic pests and the different types of adaptations of parasitic wasps in the context of IGP can transform this antagonistic relationship into a synergistic one. In our work, we focused on the study of IGP in several selected predatory insect species, the pest cereal leaf beetle (*Oulema* spp.) and the parasitic wasp *Anaphes flavipes*. In a detailed study of IGP in this model, an antagonistic relationship was first described and subsequently several synergistic relationships were found that not only allow predatory insects and parasitic wasps to occur on the same sites, but also may make the use of these organisms more effective for biological control.

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Mohou rostliny potlačovat výskyt hraboše polního (*Microtus arvalis*)?

Can plants reduce the occurence of the common vole (*Microtus arvalis*)?

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Hraboš polní je významným škůdcem na rostlinné produkci. Pro potlačování jeho početnosti a omezování škod se využívá řada metod. Jednou z potenciálních možností je využití plodin nevhodných pro přežívání hrabošů, které by mohly omezit jeho výskyt a distribuci. Na základě dlouhodobého monitoringu výskytu hrabošů v České republice (2000-2018), byla hodnocena početnost v jedenácti plodinách (jednoleté, dvouleté, víceleté), pomocí indexu aktivních nor. Z víceletých a dvouletých byly vybrány plodiny referenční. S nimi byly srovnávány jednoleté plodiny jako potenciálně repelentní (omezující výskyt hrabošů). Víceletým referenčním porostem byly jeteloviny, kde hraboši přežívají v nejvyšších hustotách a odkud se šíří do okolních plodin. Z dvouletých byla vybrána ozimá řepka, kde hraboši dobře přezimují a dále pšenice ozimá. Oproti jetelovinám a řepce byla zjištěna průkazně nižší početnost hrabošů v cibuli, máku a kukuřici, oproti jetelovinám pak i v hořčici. Oproti pšenici měla průkazně nižší početnost jen cibule. Testované jednoleté plodiny jsou pro hraboše i potravně neatraktivní a díky technologii pěstování neposkytují ani dostatek potravy v podobě plevelů. Díky ekonomickým benefitům mohou být pěstovány na dostatečných plochách, které tak mohou zpomalit šíření hrabošů do okolních plodin, zejména v letech přemnožení.

The common vole is one of the most serious pests within agriculture. A number of methods are used to suppress its numbers and to limit damage. One option is growing crops that are not suitable for voles, this might limit their numbers and their distribution. During long-term monitoring of the abundance of voles throughout the Czech Republic, their abundance in eleven crops (annual, biennial and perennial crops) was evaluated through active burrow counts. Reference crops were selected from perennials and biennials and annual crops were selected as potential repellent comparators. The perennial control was clover with alfalfa, where the voles can be found in the highest densities and from where they spread to the surrounding crops during periods of high abundance. The biennial winter rape was selected as it provides favourable conditions for voles to overwinter. When compared to clovers and winter rape, significantly lower numbers of voles were found in onions, poppy seeds and maize. In addition, when compared to clover, fewer voles were also found in mustard. Onion was the only crop to show a significantly lower abundance of voles in comparison to wheat. The annual crops tested are unattractive to voles and due to the cultivation practices used, they do not even have enough weeds as food. As profitable crops they can be cultivated over sufficiently large areas to potentially prevent the spread of voles to surrounding crops, especially during outbreak years.

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Monitorig kováčikov (*Elateridae*) feromónovými lapačmi na juhu západného Slovenska ako súčasť integrovanej ochrany zemiakoch proti drôtovcom

Monitoring of the click beetles (*Elateridae*) with pheromone traps in south part of western Slovakia as part of integrated pest managment system of potatoes wireworm

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Drôtovce, larvy kováčikov (čeľaď *Elateridae*), patria medzi najnebezpečnejších pôdnych škodcov mnohých pestovaných plodín v ostatných rokoch. Príčiny zvýšených škôd súvisia so zákazom používania účinných pôdnych chemických insekticídov, ale aj zmenou technológie pestovania plodín s využívaním minimalizačných spôsobov spracovania pôdy. Ochrana citlivých plodín, ako sú napríklad zemiaky, je pomerne problematická. Proti drôtovcom je nutné bojovať v rámci celého osevného postupu, v ktorom sa odporúčajú využívať metódy integrovanej ochrany rastlín (IPM). Významným opatrením v tomto procese je monitoring škodcov. Táto metóda prognózovania poškodenia nám poskytuje informácie potrebné pre plánovanie ďalších zásahov ako sú aplikácie insekticídov proti imágam (samičkám) v čase ešte pred nakladením vajíčok na parcelách, kde sa plánuje výsadba zemiakov. V práci sú uvedené výsledky monitoringu drôtovcov na juhu západného Slovenska. Dominantnými druhmi na tomto území sú *Agriotes brevis, A. sputator a A. ustulatus*.

Wireworms, larvae of click beetles (Family *Elateridae*), are the most dangerous soil pests of many cultivated crops in recent years. Reasons for increased damages are related to ban of effective soil insecticides as well as use of minimal/no-till practices. Protection of sensitive crops such as potatoes can be relatively problematic. Effective wireworms control requires complex approach in crop rotation systems, with introduction of integrated pest management systems (IPM). Important measure is a pest monitoring. This method provides information needed for proper planning of effective insecticidal treatments against *imago* (female beetles) still prior laying their eggs on fields intended for potato planting. The work presents results of the wireworms monitoring in the south-west part of Slovakia. Dominant species were *Agriotes brevis, A. sputator and A. ustulatus.*

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SECTION

Virology and bacteriology

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Survey of raspberry viruses in the Czech Republic and in Norway

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In 2021- 2024, a survey of viral diseases of raspberry (*Rubus*) was conducted in the Czech Republic and Norway. A total of 870 shrubs were sampled (299 at the BC CAS, 297 at RBIP Holovousy, 274 at NIBIO in Norway) and 168 arthropods were sampled in the Czech Republic. RNA was isolated from plant leaves and insects, transcribed into cDNA and tested for the presence of viruses and phytoplasmas using molecular methods (PCR, qPCR, HTS). Screening was performed for the presence of viruses black raspberry necrosis virus (BRNV), raspberry leaf mottle virus (RLMV), raspberry vein chlorosis virus (RVCV), Rubus yellow net virus (RYNV), raspberry leaf blotch virus (RLBV), raspberry bushy dwarf virus (RBDV), arabis mosaic virus (ArMV), raspberry ringspot virus (RpRSV), strawberry latent ringspot (SLRSV), cherry leaf roll virus (CLRV), tomato black ring virus (TBRV), apple mosaic virus (ApMV), cucumber mosaic virus (CuMV), newly discovered raspberry enamovirus 1 (RaEV1), raspberry rubodvirus (RaRV1) and carrot red leaf associated RNA (satelite). Both RBDV (47%) and BRNV (37%) were the most frequently detected in samples processed by BC CAS; RYNV (51%) and RBDV (36%) were the most frequently detected in samples processed by RBIP. BRNV (61%) was the most frequently detected virus in plants from Norway.

Morphological and molecular identification of arthropods was completed in the Czech Republic. Although *Amphorophora rubi idaei* is a known vector of BRNV and RLMV, some specimens were also positive for RBDV and RaEV1 in RT-PCR. Similarly, *Aphis idaei* is a known vector of RVCV, but in our survey, a lot of aphid batches were positive for BRNV, RLMV, RBDV, RaEV1 and RaRV1. Other interesting potential vectors were detected by molecular methods, e.g. a single bug *Adelcophoris lineolatus* was positive for three raspberry viruses: BRNV, RBDV and RLMV. Transmission studies are required to confirm these findings.

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První výsledky výzkumu virů brusnice chocholičnaté na území České republiky

First results from research on blueberry viruses in the Czech Republic

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Pěstování brusnice chocholičnaté (*Vaccinium corymbosum* L.) je v Evropě stále populárnější. V r. 2024 jsme proto začali řešit projekt "Vývoj diagnostických metod pro detekci patogenů rodu *Vaccinium* pro omezování jejich výskytu v množitelském materiálu“. Jedním z cílů projektu je provedení prvotní analýzy výskytu virových patogenů v České republice s cílem zjistit aktuální stav jejich rozšíření. V průběhu léta 2024 odebíráme vzorky z rostlin *V. corymbosum* z produkčních výsadeb ze sedmi lokalit v Jihočeském, Plzeňském a Karlovarském kraji. Zaměřujeme se na rostliny, které vykazují příznaky podobné virovým onemocněním. Doposud jsme pozorovali příznaky různých mozaik, proužkování, červené kroužky, puchýřovitost, stáčení a strakatost listů, i odumírání celých rostlin. Proužkování a strakatost listů byla dříve popsána u rostlin borůvky infikovaných virem tomato ringspot virus. Červeno-hnědé kruhové skvrny na listech jsou dle literatury typické pro infekci virem blueberry red ringspot. Z odebraných listů je postupně izolována RNA, přepsána do cDNA a testována na přítomnost dosud známých virů pomocí PCR. V příspěvku budou prezentovány první výsledky molekulární identifikace virů nalezených na *V. corrymbosum*.

Cultivation of northern highbush (*Vaccinium corymbosum* L.) is becoming increasingly popular in Europe. In 2024, we started solving the project " Development of diagnostic methods for the detection of pathogens of the *Vaccinium* genus for limiting their presence in a propagation material". One of the goals of the project is to carry out an initial analysis of the occurrence of viral pathogens in the Czech Republic with the aim of determining the current state of their distribution. During the summer of 2024, we are taking samples from *V. corymbosum* plants from production plantings from seven locations in the South Bohemian, Pilsen and Karlovy Vary regions. We are focusing on plants, which show symptoms similar to viral diseases, various mosaics, strapping, red rings, blistering, curling and mottled leaves, even the death of entire plants. Leaf-strapping and mottling symptoms was previously described in blueberry plants associated with the tomato ringspot virus. Reddish-brown circular leaf spots are according to the literature typical for blueberry red ringspot virus infection. RNA is gradually isolated from the collected leaves, transcribed into cDNA and tested for the presence of previously known viruses using PCR. The contribution will present the first results of the molecular identification of viruses found on *V. corrymbosum* in the Czech Republic.

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Enterobacter cloacae, možný patogen rajčat?

Is *Enterobacter cloacae* a possible tomato pathogen?

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V porostu rajčat v hydroponickém skleníku (Farma Bezdínek, Dolní Lutyně) byly dne 9. 6. 2023 indentifikovány rostliny vykazující neurčité chorobné symptomy. Tyto vzorky byly předány k následné analýze na prastoviště Mendelum. Ze vzorků listů rajčat byla vyextrahována kompletní RNA (Spectrum™ Plant Total RNA kit). Následně byly vzorky změřeny fluorimetricky (Quant-iT™ RNA Assay kit) a smíchány na 2 nM koncetraci. Small RNA byla připravena k masivně paralelní sekvenaci kitem NEBNext® Small RNA Library Prep Set for Illumina®. Vzorky byly separovány na PAGE gelu a purifikovány kitem TailorCut Gel Extraction Tool Set (SeqMatic). Kvalita a množství knihovny byly určeny pomocí sady Agilent High Sensitivity DNA Kit (Agilent), Modulus™ Single Tube Multimode Reader (Turner Biosystems) s použitím sady Quant-iT™ dsDNA Assay Kit (Thermo Fisher Scientific) a MCNext™ SYBR® Fast qPCR Library Quantification Kit (MCLAB) na Rotor-Gene 3000 (Corbett Research). Genomová knihovna byla sekvenována na MiniSeq (Illumina, Inc.) kitem MiniSeq High Output Reagent Kit, 75 cyklů (Illumina, Inc.), o délce čtení 36 nukleotidů. Sekvenace poskytla 39,829,845 nukleotidů. Následně vytvořené kontigové sekvence byly porovnány se známými sekvencemi virů proti databázi NCBI s prahovou hodnotou e-value 10^{-6} . BlastN identifikoval 896 kontigů *Pepino mosaic virus*, a 2683 kontigů fagů enterobakterií. Pro potvrzení výskytu enterobakterií byla z rostlinného materiálu extrahována DNA (Macherey-Nagel; Duren DNA extraction kit), která byla amplifikována primery Hsp60-F a Hsp60-R (Hoffmann and Roggenkamp, 2003) specifickými pro rod *Enterobacter*. Výsledný amplikon o délce 341 bp byl osekvenován (Eurofins Genomic). Získaná sekvence byla porovnána se známými sekvencemi v databázi NCBI nástrojem Blast, který potvrdil shodu sekvence se sekvencí druhu *Enterobacter cloacae*. Tento druh byl v roce 2022 idnetifiován jako původce hnilob stonků, listů a plodů rajčat v Číně.

Tomato plants demonstrating undetermined symptoms of pathogen attack were identified in the hydroponic greenhouse (Farma Bezdínek, Dolní Lutyně) on June 9th, 2023. These samples were molecularly analyzed at the Mendelum – Institute of Genetics. Total RNA was extracted using the Spectrum™ Plant Total RNA kit and pooled into a 2nM concentration sample. Small RNA was prepared for high-throughput sequencing using the NEBNext® Small RNA Library Prep Set for Illumina®. High-throughput sequencing was performed on the MiniSeq (Illumina, Inc.), with a single read length of 36 nucleotides. Sequencing yielded 39,829,845 nucleotides out of which 2,683 contigs of Enterobacteriophage. Further detailed analysis confirmed a match with *Enterobacter cloacae*. This species was identified in 2022 as the causative agent of tomato stem, leaf, and fruit rot in China.

Výzkum probíhá v rámci smluvního výzkumu a vývoje mezi Farma Bezdínek s.r.o. a MENDELU, č. OS5240171 a byl podpořen také z projektu TAČR TQ03000088.

Viry žloutenky řepy

Beet yellows viruses

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Termín „virové žloutenky řepy“ je souhrnným názvem pro choroby řepy způsobené perzistentními poleroviry, jmenovitě virem mírného žloutnutí řepy (beet mild yellowing virus) a virem chlorózy řepy (beet chlorosis virus), a dále semiperzistetním closterovirem, virem žloutenky řepy (beet yellows virus). Přítomnost všech jmenovaných virů byla v České republice v minulosti potvrzena. Nejvýznamnějším způsobem ochrany proti těmto žloutenkám je chemická ochrana proti přenašečům, tedy mšicím. Hlavním a nejúčinnějším způsobem bylo moření osiva neonikotinoidy (NN), jejich použití však bylo v roce 2016 Evropskou komisí zakázáno. V České republice však na výjimku probíhalo až do roku 2023. Pěstitelům nyní nezbývá nic jiného, něž využívání jiných, ne zcela účinných pesticidů či pěstování rezistentních odrůd.
Za tímto účelem byla v letech 2023 a 2024 testována odolnost několika vybraných odrůd cukrové řepy vůči viru žloutenky řepy a vůči viru chlorózy řepy v polních podmínkách, konkrétně na polích v okolí Černuce a Opavy. Rostliny řepy byly v květnu každého roku uměle inokulovány pomocí vironosné mšice broskvoňové. V průběhu vegetačního období byly rostliny vizuálně pozorovány a průběžně testovány. Jako diagnostické techniky byly využity sérologické a molekulárně genetické metody (ELISA, RT-PCR). Na konci vegetace byly rostliny sklizeny a byl vyhodnocen jejich výnos a kvalitativní parametry. Na základě těchto výsledků byla charakterizována odolnost/citlivost vybraných odrůd vůči těmto patogenům.

The term "beet yellows virus" is a collective name for beet diseases caused by persistent poleroviruses, beet mild yellowing virus and beet chlorosis virus, and also by a semi-persistent closterovirus, beet yellows virus. The presence of all named viruses has been confirmed many times in the past in the Czech Republic. The most important method of protection against beet yellows is a chemical control against vectors, i.e. aphids. In the past, neonicotinoid (NN) seed staining has been the main and most effective method of crop protection. However, their use was banned in EU in 2016. However, in the Czech Republic an exception allowed it till 2023. Now, there is nothing left but the use of other, less effective pesticides or the use of resistant varieties of sugar beet.
For this purpose, in 2023 and 2024, the resistance of several selected varieties of sugar beet to beet yellows virus and beet chlorosis virus was tested in the field conditions, specifically in the vicinity of Černuc and Opava. Plants were artificially inoculated using virus-carrying peach aphids in May of each year. During the growing season, experimental plants were continuously tested and visually observed. Serological and molecular genetic methods (ELISA, RT-PCR, RT-qPCR) were used as diagnostic techniques. At the end of the growing season, the beets were harvested, and the yield and quality parameters were evaluated. Based on these parameters, the possible resistance of selected varieties to pathogens was determined.

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Charakterizace českého izolátu Prunus necrotic ringspot virus infikujícího myrobalánové podnože

Characterization of Czech isolate of Prunus necrotic ringspot virus infecting myrobalan rootstocks

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Prunus necrotic ringspot virus (PNRSV) a cherry virus A (CVA) jsou dva viry, které infikují především rostliny rodu *Prunus*. Plné délky sekvencí těchto dvou virů byly získány vysokokapacitním sekvenováním (HTS) ze vzorků symptomatických rostlin *Prunus cerasifera* pocházejících z České republiky. Získané sekvence obou virů byly molekulárně charakterizovány pomocí fylogenetické a rekombinační analýzy. Bylo zjištěno, že český izolát PNRSV tvoří sesterský klad k molekulární skupině PV96 s párovou nukleotidovou podobností nižší než 97 % s ostatními molekulárními skupinami, což prokazuje jeho odlišnost. Za účelem zjištění biologických vlastností těchto virů a jim odpovídající symptomatologie byla naočkována sada různých podnoží. Inokulované rostliny vykazovaly různé systémové symptomy, od mírných skvrn u inokulovaného myrobalánu MRS až po nekrotické skvrny u myrobalánu M29C. Semenáčky meruněk zůstaly bez příznaků.

Prunus necrotic ringspot virus (PNRSV) and cherry virus A (CVA) are two viruses that infect mostly plants of the genus *Prunus*. The full-length sequences of these two viruses were obtained by high-throughput sequencing (HTS) from samples of symptomatic *Prunus cerasifera* plants originating from the Czech Republic. The obtained sequences of both viruses were molecularly characterized using phylogenetic and recombination analysis. The Czech PNRSV isolate was found to form a sister clade to the PV96 molecular group with a pairwise nucleotide similarity of less than 97% with the other molecular groups, demonstrating its distinctness. To determine the biological properties of these viruses and their corresponding symptomatology, set of different rootstocks was graft inoculated. Inoculated plants showed different systemic symptoms, ranging from mild spots in inoculated myrobalan MRS to necrotic spots in myrobalan M29C. Apricot seedlings remained symptomless.

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Výskyt směsné infekce viry z čeledi *Tymoviridae* u révy vinné v České republice

Occurrence of mixed infection with viruses of the family *Tymoviridae* in grapevine in the Czech Republic

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V České republice byl již dříve popsán výskyt tymovirů na révě vinné. Nicméně nebylo dosud možné zkompletovat jejich sekvence z důvodu vysoké variability těchto virů a nedostatečného zastoupení těchto virů v databázích.
V současné práci jsme již úspěšně zkompletovali sekvence těchto virů z ČR s využitím nově dostupných světových sekvencí jako srovnávacích.
Byly získány úplné sekvence virů GFkV (grapevine fleck virus) a GRGV (grapevine red globe virus) z rodu *Maculavirus* a sekvence GRVFV (grapevine rupestris vein feathering virus) a GSyV-1 (grapevine Syrah virus 1) z rodu *Marafivirus*. Byly pozorovány smíšené infekce těmito viry, stejně jako několik variant izolátů těchto virů v téže rostlině. Dále byly u českých izolátů GRVFV, GSyV-1 a GRGV nalezeny důkazy o vnitrodruhové rekombinaci. Mezi českými a italskými izoláty GFkV byla pozorována vysoká divergence v ORF3 a ORF4 na úrovni aminokyselin. Poprvé byl v ČR nalezen virus GAMaV (grapevine asteroid mosaic-associated virus).

In the Czech Republic, the occurrence of tymoviruses on grapevines has been described previously. However, it has not yet been possible to complete their sequences because of the high variability of these viruses and the lack of representation of these viruses in databases.
In the present work, we have already successfully sequenced these viruses from the Czech Republic using newly available world sequences as references.
Complete sequences of GFkV (grapevine fleck virus) and GRGV (grapevine red globe virus) from the genus *Maculavirus* and sequences of GRVFV (grapevine rupestris vein feathering virus) and GSyV-1 (grapevine Syrah virus 1) from the genus *Marafivirus* were obtained. Mixed infections with these viruses have been observed, as well as several variant isolates of these viruses in the same plant. Furthermore, evidence of intraspecific recombination was found in our Czech isolates of GRVFV, GSyV-1 and GRGV. High divergence in ORF3 and ORF4 at the amino acid level was observed between Czech and Italian GFkV isolates. GAMaV (grapevine asteroid mosaic-associated virus) was found for the first time in the Czech Republic.

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Molekulární determinace vektorových druhů mer napadajících ovocné stromy

Molecular determination of *Cacopsylla* vectors infecting fruit trees

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Zástupci mer rodu *Cacopsylla* patří mezi významné škůdce ovocných dřevin. Stromy v produkčních výsadbách a školkařské výpěstky poškozují sáním a přenosem patogenních bakterií rodu '*Candidatus* Phytoplasma', které způsobují ve výsadbě neléčitelnou systémovou infekci rostlin vedoucí až k předčasnému odumírání ovocných dřevin. V současné době spočívá účinná ochrana vůči merám ve spolehlivé determinaci, monitoringu těchto škůdců, a následném insekticidním ošetření výsadby. Obvykle se determinace dospělých mer provádí zkušeným entomologem dle morfologických znaků jedince. Nicméně správná identifikace je problematická vzhledem ke značné podobnosti jednotlivých druhů mer.

Pro zjednodušení a zrychlení identifikace mer byly navrženy dva multiplexní real-time PCR systémy s ohledem na převládající druhy v sadech. Pro determinaci mer vyskytujících se v jabloňových sadech jsou v jedné reakci detekovány *C. mali*, *C. melanoneura*, a *C. picta*, a v hrušňových sadech je možné přímo určit *C. pyri*, *C. pyrisuga* a *C. pyricola*. *C. pruni*, která se vyskytuje v sadech meruněk a slivoní, je detekovaná v simplexní PCR reakci, případně může být její detekce zahrnuta do jednotlivých multiplexů. Součástí obou PCR multiplexů je také systém pro univerzální detekci mer pro zachycení i jiných druhů, které nejsou detekovány cíleně. Detekční systémy byly validovány na souboru vzorků dospělců mer, který zahrnoval cílové i necílové druhy mer.

Representatives of the genus *Cacopsylla* are important pests of fruit trees. They affect trees in orchards and in fruit nurseries by sucking and transmitting pathogenic bacteria of the *'Candidatus* Phytoplasma' genus, which cause an incurable systemic infection of plants in orchards, ultimately leading to premature dieback of fruit trees. Currently, effective control of cacopsyllas consists of reliable determination and monitoring of these pests, followed by insecticidal treatment of the orchards. Determination of *Cacopsylla* adult is usually carried out by an experienced entomologist according to the morphological characteristics of the individual. However, correct identification is problematic due to the considerable similarity between *Cacopsylla* species.

In order to simplify and speed up *Cacopsylla* identification, two multiplex real-time PCR systems were designed with respect to the predominant species in the orchards. For the determination of cacopsyllas living in apple orchards, *C. mali*, *C. melanoneura*, and *C. picta* are detected in one reaction; and in pear orchards, *C. pyri*, *C. pyrisuga*, and *C. pyricola* can be directly identified. *C. pruni*, which feeds in apricot and plum orchards, is detected in a simplex PCR reaction, or its detection can be included in both multiplexes. Both PCR multiplexes also include a universal detection system to cover other *Cacopsylla* species as well beyond the ones specifically detected. The detection systems were validated using a set of adult *Cacopsylla* samples that included both targeted and non-targeted cacopsyllas.

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Zkušenosti s HTS, qRT-PCR a RT-PCR diagnostikou virů a viroidu infikujících jabloně

Experience with HTS, qRT-PCR and RT-PCR diagnostics of viruses and viroid infecting apple

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Vysokapacitní sekvenování (HTS) rostlinné RNA bylo navrženo jako alternativa k biologickému testování virům podobných patogenů při certifikaci rozmnožovacího materiálu jabloní. Použili jsme HTS testování certifikovaných podnoží jabloní M9, roubů z matečných stromů kultivarů, komerčních a experimentálních sadů a zahrad a alejí. HTS se nejlépe osvědčila k odhalení nejenom známých (ApMV, ASGV, ASPV, ACLSV) ale i nových virů (CCGaV, SnlV-1, ALV-1, ARWV-1), viroidů (AHVd) a sekvencí potenciálně nových virů. RT-PCR a Sangerovo sekvenování byly využity pro ověření výsledků HTS. Pro rutinní detekci virů byla efektivnější qRT-PCR. Naše výsledky naznačují použití přísnějšího testování HTS pro certifikaci podnoží a roubů jako účinného nástroje pro zlepšení hygienických opatření a vyšší kvalitu rozmnožovacího materiálu jabloní.
High-throughput sequencing (HTS) of plant RNA has been proposed as an alternative to biological indexing of virus-like pathogens, for the certification of propagative apple material. We employed HTS testing of the certified M9 apple rootstocks, budwood (grafts) from mother trees of cultivars, commercial and experimental orchards, and alleys. HTS was proved best to reveal both known (ApMV, ASGV, ASPV, ACLSV) and novel (CCGaV, SnlV-1, ALV-1, ARWV-1) viruses and viroids (AHVd) and sequences of tentative novel viruses. RT-PCR and Sanger sequencing were used for the verification of the HTS results. Nevertheless, qRT-PCR was more effective for a routine detection. Our results suggest application of more rigorous HTS testing for the certification of rootstock and budwood source plants as a powerful tool improve sanitary measures for higher quality of apple propagative materials.
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Holoparasitic plants of the genus *Cuscuta*: potential reservoirs and vectors of phytopathogens

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Cuscuta spp. represent a large genus of widely distributed stem holoparasitic flowering plants in the family Convolvulaceae. Because of their parasitic nature – they extract nutrients from their hosts through a specialized vascular connection, called haustoria – they exert significant negative impact on agriculturally important crops. A single *Cuscuta* plant can simultaneously parasitize many host plants, often from different species, thus forming a link between them, and allowing the movement of macromolecules. Besides organic compounds, this link is also a potential highway for the movement of phytopathogens, including phytoplasma and viruses. To assess the role of *Cuscuta* spp. as vectors of such, we tested by ELISA thirty-six populations, belonging to four *Cuscuta* species from Bulgaria for the presence of four plant viruses. A significant proportion of the populations of the introduced to the country *Cuscuta campestris* were positive for Tomato Yellow Leaf Curl Virus, TYLCV (19%) and Cucumber Mosaic Virus, CMV (30%). Furthermore, the *Cuscuta campestris* was also shown to be effective in transmitting CMV to host plants in laboratory conditions. In the light of these findings, *Cuscuta* spp. proved as an efficient reservoir and vector of plant viruses.

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Real-time PCR pro detekci významných virů infikujících rod *Vaccinium*

Real-time PCR for the detection of important viruses infecting the genus *Vaccinium*

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Zájem o pěstování kanadských borůvek – brusnice chocholičnaté (*Vaccinium corymbosum*) narůstá, jak v oblasti produkčních výsadeb, tak i u zahrádkářů. S tím souvisí i častější výskyt virů a jejich zvýšené riziko přenosů. Protože se jedná o trvalé kultury, pro které jsou náklady na jejich pěstování vysoké, může být přítomnost virů v borůvkách pro jejich produkci ekonomicky významná. Virové choroby se mohou na rostlinách projevovat řadou příznaků, od zcela bezpříznakových až po závažné, kdy mohou způsobit úhyn rostlin. Preventivní ochranou proti těmto patogenům je testování zdravotního stavu rozmnožovacího materiálu dle certifikačního schématu, což vede k produkci zdravého výsadbového materiálu. V rámci naší studie byly pro testování pěti virů borůvek (BRRV, BSSV, BlShV, BlScV a BlMaV), na které se musí dle Prováděcí směrnice Komise (EU) 2020/177 povinně sledovat a testovat rozmnožovací materiál, navrženy simplexní detekční systémy na principu real-time PCR. Na základě literární rešerše a dostupných sekvencí v databázi byly navrženy systémy primerů a sond, pro které byla pomocí syntetických standardů stanovena analytická senzitivita. Limit detekce pro všechny viry byl 5 kopií v reakci. Pro BRRV byl k dispozici pozitivní vzorek pocházející z rostlinného materiálu. Proto byla ověřena specificita navrženého real-time PCR systému pro detekci BRRV porovnáním s dalšími PCR detekčními systémy, jejichž primery byly navrženy v jiné oblasti virového genomu. U všech diagnostických systémů byla doposud zaznamenána 100% specificita. Do budoucna bude všech pět systémů multiplexováno a výsledný multiplexní detekční systém bude validován dle EPPO standard PM 7/98 (5) Specific requirements for laboratories preparing accreditation for a plant pest diagnostic activity.

Interest in growing highbush blueberries (*Vaccinium corymbosum*) is growing, both in production plantings and among gardeners. This is associated with an increased incidence of viruses and their increased risk of transmission. As these are perennial crops for which the cost of cultivation is high, the presence of viruses in blueberries can be economically significant for their production. Viral diseases can show a range of symptoms on plants, from completely symptomless to severe, leading potentially to plant death. Preventive measure against these pathogens is to test the health of the propagation material following a certification scheme, which leads to the production of healthy planting material. In our study, simplex real-time PCR-based detection systems were designed to test for five blueberry viruses (BRRV, BSSV, BlShV, BlScV and BlMaV) for which it is mandatory to monitor and test propagation material according to EU Commission Implementing Directive (EU) 2020/177. Based on a literature search and available sequences in databases, primer and probe systems were designed for which analytical sensitivity was determined using synthetic standards. The detection limit for all viruses was 5 copies per reaction. For BRRV, a positive sample was available from plant material. Therefore, the specificity of the proposed real-time PCR system for BRRV detection was verified by comparison with other PCR systems for which primers were designed in a different region of the viral genome. So far, 100% specificity has been reported for all diagnostic systems. In the future, all five systems will be multiplexed and the resulting multiplexed detection system will be validated according to EPPO standard PM 7/98 (5) Specific requirements for laboratories preparing accreditation for a plant pest diagnostic activity. Výzkum byl financován z projektu Ql24020033 Národní agentury pro zemědělský výzkum MZe ČR.

SECTION

Herbology

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Integrovaná ochrana proti sveřepu jalovému

Integrated control of *Bromus sterilis*

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Sveřep jalový je přísně ozimý trávovitý plevel, který se dokáže uplatnit pouze v ozimých plodinách. Intenzivně se šíří především na pozemcích, kde se uplatňují minimalizační systémy zpracování půdy. K jeho regulaci v ozimé pšenici je registrováno poměrné úzké spektrum herbicidů, přičemž v ozimém ječmenu lze efektivně použít pouze herbicidy obsahující účinnou látku flufenacet, která však bude v EU brzy zakázána. Účinnost herbicidů ze skupiny ALS inhibitorů (metsulfuron, pyroxsulam a propoxycarbazone) se pohybuje mezi 70 a 90 % v závislosti na konkrétním herbicidu, použité adjuvantu a povětrnostních podmínkách před a po jeho aplikaci. Začínají se však postupně vytvářet populace rezistentní k těmto herbicidům. Integrovaný přístupu k regulaci tohoto plevelného druhů je proto z dlouhodobého hlediska nepostradatelný. Důležité je důsledně potlačovat tento plevele v předplodinách, především v ozimé řepce, kde lze použít listové graminicidy inhibující ACCasu, které je však třeba aplikovat při teplotách nad 10 °C. V suchých podmínkách je navíc vhodné kombinovat tyto herbicidy s olejovým adjuvantem. Velmi důležité je také efektivní využití meziporostního období, kdy je vhodné vytvořit příznivé podmínky pro vzejití sveřepu. Vzešlé rostliny sveřepu je pak možné zaorat nebo ošetřit glyphosatovým herbicidem. Mělké kypření není k úplné eliminaci sveřepu vhodné, neboť část rostlin regeneruje. Při vyšší intenzitě výskytu je vhodný pozdní výsev pšenice (druhá polovina října), což přináší tyto výhody: a) prodloužení období, kdy lze sveřep potlačovat mechanicky či glyphosatem; b) snížení intenzity vzcházení sveřepu; c) pomalejší dynamika růstu sveřepu na podzim – snadnější načasování podzimního herbicidního ošetření; d) obvykle lepší vláhové podmínky pro účinnost půdních herbicidů; e) nižší růstová fáze sveřepu při jarním herbicidním ošetření (obvykle duben).

There has been a significant increase in the infestation of *Bromus sterilis* in the Czech Republic, particularly in fields where reduced soil tillage systems are being used. The efficacy of ALS-inhibiting herbicides (such as mesosulfuron, pyroxsulam, propoxycarbazone, etc.) ranges from 70 to 90 %, depending on the herbicide used, the adjuvant, and weather conditions shortly before and after application. Moreover, the first resistant populations of *B. sterilis* to these herbicides have been detected and more are expected to follow. Therefore, integrated methods should be used for long-term effective control of this weed. It is crucial to effectively control *Bromus* in previous crops, particularly in winter rape by herbicides which inhibit ACCase. After harvesting the previous crop, it is important to prepare suitable conditions for *Bromus* emergency by carrying out shallow tillage. The emergent plants of *Bromus* should be controlled by using glyphosate or by plough tillage. Shallow tillage is not an effective method for controlling *Bromus* plants, especially in wet soil conditions, because some plants can survive this treatment. If the soil seed bank of *Bromus* is high, it is better to sow later (at the end of October), which offers many advantages.

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Regulácia zaburinenosti v kukurici siatej *(Zea mays L.)*

Weed control in the corn (*Zea mays* L.)

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Maize is considered the queen of cereals and is one of the most important crops from a global point of view. Every year it is cultivated worldwide an area of 194 million hectares (in Slovakia it is the second most cultivated crop with an area of 150-200 thousand hectares). To achieve the best possible result, it is very important to choose the right variety, location and, of course, the right way of herbicide treatment. The aim of the work was the use of possibilities of chemical control of weeds and their analysis on plots with sown corn. The regulation of weed species was monitored and the effectiveness of used herbicides with specific active substances applied according to variants (pre-emergent, early-post-emergent and post-emergent) was evaluated, as well. The experiment was carried out as part of the entire dissertation at the PPD Inovec Volkovce company. The implementation took place on their standard plots with maize sown according to the sowing plan. After an agreement with the agronomist, an area was set aside to be only sown, and not further treated - neither mechanically or chemically. Chemical treatments were carried out individually with the help of a hand sprayer. The implementation of the experiment was in accordance with the methodology of EPPO PP1/181(5). Each variant had an area of untreated control, which was covered with a sheet during herbicide application. Based on the use of available herbicides and their using strategy, the variants were divided into pre-emergence treatment - immediately after sowing, on the soil, post-emergence up to the 3rd corn leaf and post-emergence treatment up to the 6th corn leaf. These methods of application are used the most in practice and are also sufficiently effective. During the growing season, the weediness and effectiveness of the individual herbicides treatment were evaluated after their application on the variants uniformly for 7, 14, 21 and 28 days, using the EWRS Bonitation scale. In the 2023 and 2024 growing season the herbicides were used in the individual variants as follows: V0: untreated control, V1: Wing P 4.0 $l.ha^{-1}$, V2: Lumax 537.5 SE 4.0 $l.ha^{-1}$, V3: Kelvin Quattro 0.44 $kg.ha^{-1}$ + Dash 0.5 $l.ha^{-1}$, V4: Principal Forte 0.44 $kg.ha^{-1}$+ Dash 0.5 $l.ha^{-1}$, V5: Casper 55 WG 0.3 $kg.ha^{-1}$ + Dash 0.5 $l.ha^{-1}$, V6: Arrat 0.2 $kg.ha^{-1}$ + Dash 0.5 $l.ha^{-1}$, V7: Laudis OD 2.2 $l.ha^{-1}$. In the V8 variant (technology of the PPD Inovec company), Callisto 100 SC 1 $l.ha^{-1}$ + Milagro 4 SC $l.ha^{-1}$ in combination with Šaman 0.5 $l.ha^{-1}$. For all variants, a water dose of 400 $l.ha^{-1}$ was used to obtain the best possible effect. The average yield (2023) achieved from each plot where the experiment was carried out was 8.8 ton per hectare. During the 2023 season, weed species, such as *Chenopodium album , Anthemis arvensis, Echinochloa crus-galli* and winter rapeseed were found in the corn stand. In 2023 the effectiveness of the used herbicides in variants V1 to V8 compared to the control was from 78,57% to 100% and the statistical difference between the variants was not evident, i.e. all used herbicides worked very significantly on the declared spectrum of weeds compared to the untreated control. In 2024 main weed species in the corn stand were *Chenopodium album, Amaranthus retroflexus, Echinochloa crus-galli*, *Veronica persica*, *Poa annua*, *Anthemis arvensis.* Effectiveness of the used herbicides was from 89,13% to 100% compared to the untreated control.

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Distribution and threat of field dodder on arable land in Slovakia

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Field dodder (*Cuscuta campestris*, Convolvulaceae, formerly Cuscutaceae) is an annual stem-parasitic plant that reproduces by seeds, which can remain viable for more than three years. Four species of the genus *Cuscuta* have been documented in Slovakia. The species include *C. epithymum*, *C. europaea*, *C. lupuliformis* and *C. campestris*. The latter is an invasive species native to North America. The first recorded instance of this species in Slovakia (Europe) occurred in 1883. The species is widely distributed throughout Slovakia. A total of 63 localities were identified during the study, which spanned the years 2012 to 2013. The species has been recorded at altitudes ranging from 103 m (in Veľké Trakany) to 241 m (in Gemerský Jablonec). Dodder is a common parasite on several crops grown in Slovakia, including sugar beet (*Beta vulgaris*), alfalfa (*Medicago sativa*), tobacco (*Nicotiana tabacum*), potato (*Solanum tuberosum*), lentil (*Lens esculenta*), parsley (*Pastinaca sativa*) and onion (*Allium cepa*). Additionally, the species has been observed to bloom on common ragweed (*Ambrosia artemisiifolia*) in certain localities. The genus *Polygonum*, particularly *P. aviculare*, represents the primary source of infestation. The infestation of crops by *Cuscuta* sp. has been demonstrated to have a detrimental impact on crop yield, resulting in reduced crop size and quality. This includes an observed decrease in the quantity and quality of the sugar content of sugar beet, because of the interaction between the two. The difficulty in implementing biological control measures and the potential contribution of climate change to its spread and subsequent damage represent significant challenges.

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Dokáže príroda zabrániť tvorbe alergénneho peľu ambrózie?

Can allergenic ragweed pollen be prevented by nature?

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Hmyz viazaný na ambróziu palinolistú sme monitorovali na Slovensku, v Taliansku a Maďarsku v rokoch 2014 – 2023 metódou smýkania a individuálnymi prehliadkami rastlín. Spoločenstvá hmyzu boli veľmi podobné (Coleoptera, Heteroptera, Diptera, Auchenorrhyncha, Arachnoidea) a prevládali nešpecializované druhy. Oligofágna liskavka *Ophraella communa* (Coleoptera: Chrysomelidae) na Slovensku ešte nebola zaznamenaná. Okrem hmyzu sme zaznamenali prvý výskyt vlnovníka *Aceria artemisiifoliae* (Acari: Eriophyoidea) na Slovensku a je to druhý nález vo svete. Ide o monofágny druh s potenciálom pre biologickú reguláciu alergénneho peľu ambrózie palinolistej.

Common ragweed (*Ambrosia artemisiifolia* L., Asteraceae) is a vigorous species that is difficult to stop. Nevertheless, the question was whether and how pollen production could be prevented under natural conditions. The huge screening by sweeping and visual observations was carried out from 2014 to 2023 mainly in Slovakia (17 sites), Italy (4 sites) and Hungary (4 sites). The species composition was quite similar in all sites across countries and habitats (Coleoptera, Heteroptera, Diptera, Auchenorrhyncha, Arachnoidea) with dominance of generalists. Oligophagous *Ophraella communa* was not present in Slovakia. Cicadas (Hemiptera: Auchenorrhyncha) and true bugs (Hemiptera: Heteroptera) were among the most abundant species in most locations. For example, in 2014 – 2023 we recorded 4562 specimens of cicadas and identified 66 species from 9 families, one species was a new record for Slovakia, *Eupteryx florida*: Kameničná-Balvany, 10. 9. 2014, 1 ♀; Buková, 24. 9. 2021, 1 ♂; Malá nad Hronom, 2. 8. 2020, 1 ♂. The second most abundant group were true bugs with 1270 specimens and 30 different species in 2020 – 2021. Most of the species recorded caused negligible damage to the ragweed, but it served as an important alternative food source in the summer after the harvest. In addition to the above insect quilt, a monophagous eriophyid mite, *Aceria artemisiifoliae* (Acari: Eriophyoidea), was found in some localities. Infestation of the plants resulted in delayed development of inflorescences, their reduced length and pollen production. This eriophyid mite, the first recorded in Slovakia and the second in the world, could be considered as a potential biocontrol agent to reduce pollen production. In 2022 and 2023, we monitored the *Ambrosia* airborne pollen concentration in fields with and without eriophyid mite presence using a volumetric Hirst-type pollen sampler. The highest pollen concentrations were recorded in Malá nad Hronom both years, while the lowest concentrations were noted in Veľký Horeš in 2022 and Kameničná-Balvany in 2023. Pollen concentration depended on plant density in the fied.

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Výskyt druhu ambrózia palinolistá – *Ambrosia artemisiifolia* L.

Occurrence of the species ragweed – *Ambrosia artemisiifolia* L.

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In the years 2012 – 2022 a weed survey was conducted on farms in a conventional farming system. The goal was to reveal the most harmful weeds as a significant biotic, environmental stress factor on farms in corn canopies for grain in the corn, beet and potato production areas of Slovakia. Fields were selected in all production regions of Slovakia. Actual weeding was assessed prior to pre-emergence application of herbicides. Each field was screened on an area of 1 m^2 with four replicates. Four randomly determined sample quadrants were located at least 20 m from the edge of the field and from each other. The level of infestation was evaluated according to the average density of weeds per square meter. The obtained data from the farms were statistically analyzed by correlation analysis in Tibco-Statistica-15.3.0. According to the obtained data and the results of the weed survey, the most problematic weed was *Ambrosia artemisiifolia* L., with a medium to stronger level of weeding of the stands in all production regions in the stands of corn, sunflower, legumes and spring cereals. Actual weeding depends on the production area of production. After control with herbicides, significant changes in the weed flora were noted in terms of abundance and share of some weed species in the total weed community. The dynamics of current weeding by *Ambrosia artemisiifolia* L. depends on the climatic conditions of the corn, sugar beet and potato production area, the health status of the pre-crop and the canopy. Weeds are always a problem in cornfields. The occurrence of *Ambrosia artemisiifolia* L. in Slovakia increases with each growing season. Problematic chemical regulation of the species *Ambrosia artemisiifolia* L. was shown in the following order in legumes, sunflower, corn and cereals. The reasons can be found in the regulation of the species with chemical preparations, as well as in the crop cultivation system with reduced tillage and pre-crop. Previous studies on the possible spread of the species in relation to climatic conditions and land management systems have been confirmed. The tendency is increasing, even though we have effective substances available on the market for its chemical regulation. They can quickly reduce yield, but management and control may be considered necessary to ensure crop quality and yields. In all production areas, regulatory interventions of pre-emergent herbicides are insufficiently effective. The originality of the result is in the mapping of the weed *Ambrosia artemisiifolia* L. and its current weeding in the stands. The occurrence of ragweed is on the rise in all regions of plant production in Slovakia. The likely cause of the spread is unsuccessful control with soil herbicides, which have shown little or no effectiveness. Early post-emergence and post-emergence preparations show higher efficiency in all production regions of Slovakia. *Ambrosia artemisiifolia* L. remains a problematic weed in Slovak fields, for now.

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Chemická regulácia jednoklíčnolistových burín v ozimnej pšenici

Chemical control of monocotyledon weeds in winter wheat

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In the years 2021 – 2024 was conducted weed survey on the farms in conventional farming system. The goal was to detect the most harmful weeds, as important biotic, environmental stress factor, on the farms in the canopies of winter wheat in maize and sugar beet production regions of the Slovak Republic. The fields were selected in all production regions of Slovakia. An actual weed infestation was evaluated before preemergence application of herbicides. Screening of each field was made on $1m^2$ area with four replications. The four randomly established sample quadrants were situated minimally 20 m from field margin and apart from each other, respectively. The level of infestation was evaluated according to average density of weeds per square meter. Obtained data from farms was statistically analyzed by correlation analysis in Tibco-Statistica-13.5.0. According to the obtained data and results of weed survey the most troublesome weeds with the heaviest weed infestation level of winter wheat stands were in maize production region: *Apera spica venti* (L.) Beauv., *Bromus* spp., *Avena fatua* L.; in sugar beet production region: *Apera spica venti* (L.) Beauv., *Bromus* spp., *Avena fatua* L. and *Elytrigia repens* (L.) P. Beauv. An actual weed infestation depends on production region. After herbicides control the significant changes in weed flora were noted in term of abundance and share of some weed species on total weed community. The dynamics of actual weed infestation depend on climate conditions of maize, sugar beet production region, fore crop and canopy health condition stands. Weeds are always a problem in winter wheat stands. They can rapidly reduce the yield of winter wheat, but management and control may be considered necessary to safeguard crop quality and yield. In all areas, the regulatory interventions of pre-emergent herbicides are insufficiently effective. It was necessary to carry out spring corrective measures. The effectiveness of the active substances used was evaluated by Abbott's formula before harvesting winter wheat (46.75 to 90.00%). The effectiveness of the regulatory chemical intervention was different. The highest share of efficiency was in applications during autumn and spring treatment when alternating active substances such as: *Mefenpyr* (90.0 $g.kg^{-1}$) + *Mesosulfuron* (43.4 $g.kg^{-1}$) + *Propoxycarbazone* (63.9 $g.kg^{-1}$); *Mesosulfuron* (45.0 $g.kg^{-1}$) + *Thiencarbazone-methyl* (15.0 $g.kg^{-1}$) + *Mefenpyr-diethyl* (112.5 $g.kg^{-1}$); *Propoxycarbazone* 663.0 $g.kg^{-1}$ (66.3 % hm) *Amidosulfuron* (100.1 $g.l^{-1}$) + *Iodosulfuron* (23.3 $g.l^{-1}$) + *Mefenpyr* (212.4 $g.l^{-1}$) and *Iodosulfuron* (8.4 $g.kg^{-1}$) + *Mefenpyr* (135.0 $g.kg^{-1}$) + *Mesosulfuron* (43.74 $g.kg^{-1}$) + *Thiencarbazone-methyl* (21.7 $g.kg^{-1}$). Regulation of *Elytrigia repens* (L.) P. Beauv. was the most effective application of the total preparation after harvest. Based on long-term observations, it can be concluded that the occurrence and weeding of winter monocotyledonous weeds (*Apera spica venti* (L.) Beauv. and *Bromus* spp.) spring monocotyledon weed (*Avena fatua* L.) and perennial monocotyledon weed *Elytrigia repens* (L.) P. Beauv. is closely related to the technology of soil cultivation on the site and the sowing procedure in location farms.

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Struktura vegetace vinic podle ekosystémových a kulturních funkcí

Structure of vineyard vegetation according to ecosystem and cultural functions

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Vinice jsou významným prvkem v kulturní krajině jižní Moravy. Vegetace ve vinicích má velký význam a poskytuje jak půdě, tak i vinicím a lidem ekosystémové funkce, mezi které patří zdroj potravy pro opylovače, produkce kyslíku nebo obohacení půdy o vzdušný dusík. Vegetace také zabraňuje větrným a vodním erozím, předchází nechtěné evaporaci a reguluje výskyt patogenů a škůdců. Některé druhy rostlin je možné využít k lékařským účelům. V neposlední řadě vegetace plní i služby estetické, které zvyšují turistickou atraktivitu lokality. Vegetace ve vinici představuje velmi zajímavý výukový prostor pro vzdělávání a tím poskytuje zajímavou kulturní funkci. K identifikaci druhů rostlin jsou využívány lidské smysly jako zrak, hmat a čich. Fyzický pohyb, poučení o znacích rostlin a využití lidských smyslů motivuje lidskou paměť a vyvolává vzpomínky. Mnohostranná stimulace umožňuje lepší zapamatování nových informací. Poznávání vegetace vinic vyvolává různorodé interakce, které jsou velmi důležité ve vzdělání nejen studentů, odborné veřejnosti, ale i seniorů.

Vineyards are an important element of the cultural landscape of South Moravia. Vegetation in vineyards is very important and provides ecosystem functions to both the soil, the vineyards and people, which include a food source for pollinators, oxygen production or enrichment of the soil with atmospheric nitrogen. Vegetation also prevents wind and water erosion, unwanted evaporation and regulates the occurrence of pathogens and pests. Some types of plants can be used for medicinal purposes. Last but not least, vegetation provides aesthetic services that increase the tourist attractiveness of the locality. The vegetation in the vineyard represents a remarkable teaching space for education and thus provides an interesting cultural function. Human senses such as sight, touch and smell are used to identify plant species. Physical movement, learning about the plant traits and using the human senses motivates human memory and evokes memories. Wide-ranging stimulation enables better memorization of new information. Learning about the vegetation of vineyards provokes diverse interactions, which are crucial in the education of not only students, the professional public, but also elderly citizens.

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SECTION

Abiotic plant stress

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Vplyv superabsorpčného polyméru na účinnosť pesticídov pri ošetrení semien jačmeňa jarného proti helmintospóriovej škvrnitosti

The effect of superabsorbent polymer on pesticide efficacy in spring barley seed treatment against common root rot

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Sucho je jedným z najzávažnejších environmentálnych stresov ovplyvňujúcich produktivitu rastlín. V súčasnosti súvisí nedostatok vody najmä so zmenou klímy a stúpajúcou spotrebou vody spôsobenou rastom populácie a zvýšenými nárokmi v priemysle, poľnohospodárstve a domácnostiach. Superabsorpčné polyméry (SAP) majú potenciál zlepšiť schopnosť pôdy zadržiavať vodu a znížiť vplyv stresu zo sucha na rastliny. SAP pôsobia ako zásobárne vody, ktoré absorbujú vodu zo zavlažovania a zrážok. Ich aplikácia vo forme obalu semena zohráva úlohu najmä počas kritického obdobia klíčenia semien a vzchádzania rastlín. V našej práci sme sa zaoberali hodnotením vplyvu obaľovania semien SAP Aquaholder®Seed na fungicídny účinok moridla proti hubovému patogénu *Bipolaris sorokiniana* (Sacc.) Shoemaker.
Záverom môžeme konštatovať, že ošetrenie semien SAP za účelom zlepšenia klíčenia semien v podmienkach sucha nemalo negatívny vplyv na účinnosť ochrany moridlom proti hubovému patogénu *B. sorokiniana*. Použité moridlo výrazne znížilo prejavy symptómov ochorenia na rastlinách, a to z hľadiska vizuálneho hodnotenia symptómov aj množstva patogénnej DNA v rastlinných pletivách, ale úplne nezabránilo infekcii rastlín. Vizuálne symptómy ochorenia boli slabšie u ošetrených semien oboch kultivarov v porovnaní s kontrolnými semenami, bez rozdielov medzi ošetrením moridlom samotným a moridlom+SAP. Pri kombinovanom ošetrení moridlom+SAP bolo dokonca u jednej z odrôd detegované výrazne nižšie množstvo patogénnej DNA.

Drought is one of the most severe environmental stresses for plant productivity. Currently, the lack of water is mainly related to climate change and rising water consumption caused by population growth and increased demands in industry, agriculture, and households. Superabsorbent polymers (SAP) have the potential to improve soil water-holding capacity and reduce the impact of drought stress on plants. They act as water reservoirs that absorb water from irrigation and rainfall. The application of SAP as a seed coat plays a role during the critical period of seed germination and seedling emergence. In our work, we dealt with the assessment of seed coating SAP Aquaholder®Seed influence on the fungicidal effect of the mordant against the fungal pathogen *Bipolaris sorokiniana* (Sacc.) Shoemaker.
In conclusion, we can summarize, that SAP seed treatment in order to improve seed germination in drought conditions did not have a negative effect on the effectiveness of the mordant in protection against the fungal pathogen *B. sorokiniana*. The used mordant significantly reduced the manifestation of disease symptoms on plants, both in terms of visual assessment of symptoms and the amount of pathogenic DNA in plant tissues, but it did not completely prevent plant infection. Visual disease symptoms were weaker in treated seeds of both cultivars compared to control seeds, with no differences between treatments with mordant alone and SAP

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+ mordant. In the combined treatment with SAP + mordant, a significantly lower amount of pathogenic DNA was even detected in one of the varieties.

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