SLOVENSKO AKADEMSKO ČEBELARSKO DRUŠTVO

Kmetijski inštitut Slovenije

5. ZNANSTVENO POSVETOVANJE O ČEBELAH IN ČEBELARSTVU

POKLUKARJEVI DNEVI 2024

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Ljubljana, 29. november 2024

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POKLUKARJEVI DNEVI 2024

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PROGRAM
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Življenje in delo doc. dr. Janeza Poklukarja

Marjan Papež*[1] *(marjan.papez@t-2.si)

Z eno besedo doc. dr. Janeza Poklukarja najbolje opiše beseda vsestranskost. Preden predstavimo pomen Janeza Poklukarja, ki je začel s profesionalnim delom v čebelarstvu leta 1984, poglejmo, kakšno je bilo stanje v slovenskem čebelarstvu pred približno štiridesetimi leti. V času slutnje prihajajočega razpada Jugoslavije v drugi polovici osemdesetih let je bil položaj zelo resen. Varoa je desetkala čebelje družine, cene medu so bile nizke, država je imela mačehovski odnos do čebelarstva, namenskih sredstev za panogo skoraj ni bilo, Čebelarska zveza Slovenije je bila kadrovsko in finančno podhranjena, znanstveno in strokovno delo v čebelarstvu je temeljilo le na nekaj posameznikih.

Panoga je bila prepuščena stihiji in v tem obdobju je nastala *Sekcija za čebelarstvo pri društvu kmetijskih inženirjev in tehnikov*, katere gonilna sila je bil inž. Dušan Kresal. Sekcija, iz katere se je leta 1996 razvilo *Slovensko akademsko čebelarsko društvo* (SAČD), je s prostovoljnim delom pripravila *Strategijo razvoja slovenskega čebelarstva* (1992).

V zaključnem obdobju se je pripravi tega dokumenta priključil tudi Janez Poklukar, ki je tako dobil celovit vpogled v vse razsežnosti težav slovenskega čebelarstva. To je verjetno še toliko bolj vzpodbudilo njegovo vsestranskost. Kamorkoli je pogledal, je videl delo in je zanj tudi poprijel. Lep primer je vključitev v pripravo *Strategije trženja slovenskega medu* (1997), saj je bila ekonomika čebelarjenja v devetdesetih letih prejšnjega stoletja porazna.

Bogata znanstveno-strokovno-poljudna zapuščina

Obseg in širino delovnih področij lahko razberemo iz njegove bibliografije, ki obsega od leta 1982 do leta 2004 več kot 250 enot, s poudarkom, da je bila takrat digitalna doba še v povojih!

Bil je znanstvenik, strokovnjak in praktik. Pričakovano je največ raziskav namenil vzreji in selekciji kranjske čebele, kar je bilo tudi njegovo osnovno poslanstvo, saj se je za to področje leta 1984 zaposlil na Kmetijskem inštitutu Slovenije. Obsežnejši sklopi raziskav in objav se nanašajo še na bolezni čebel (predvsem varoa in nosema)

[1] Slovensko akademsko čebelarsko društvo (SAČD)

in kakovost čebeljih pridelkov (kakovost in sortnost medu, raziskave cvetnega prahu). Čebelarstvo je jemal kot celoto, o čemer pričajo različne objave o številnih drugih področjih: o čebelah in okolju, tveganjih za čebele pri uporabi sredstev za varstvo rastlin, sajenju medovitih rastlin, boleznih medovitih rastlin (hrušev ožig, kostanjev rak), o pomenu opraševanja … Ukvarjal se je tudi z gozdnim medenjem, kar je raziskoval sam, pa tudi tri diplomske naloge so bile pri njem opravljene na to temo.

Čebelarska zakonodaja

Pomemben temelj, ki je opredelil pravila pridelave in trženja medu ter jasno opredelitev porekla, je bil *Pravilnik o medu* iz leta 1999, ki je temeljil na ugotovitvah iz *Strategije trženja slovenskega medu*.

Za ureditev statusa kranjske čebele je bila izrednega pomena Poklukarjeva utemeljitev zaščite Slovenije kot domovine kranjske čebele (*Deklaracija št. 42 o kranjski čebeli*), ki je bila sestavni del pristopne pogodbe Slovenije k Evropski uniji (EU).

Ne smemo pozabiti tudi drugih prenovljenih in novih pravilnikov, ki so urejali področje priznane rejske organizacije v čebelarstvu, pašnih redov in pašnega katastra, paket zootehniških standardov ter Zakon o živinoreji, ki je čebelarstvo, tudi po Poklukarjevi zaslugi, primerno umestil v živinorejsko dejavnost, kamor tudi sodi.

S približevanjem Slovenije EU je Janez Poklukar, oborožen z izkušnjami kmetijskih kolegov, ki so že dodobra poznali in uporabljali evropske pristope za črpanje sredstev EU, zelo aktivno sodeloval pri pripravi P*rograma ukrepov na področju čebelarstva v Sloveniji v letih 2005–2007*. To je bil prvi čebelarski program ukrepov, ki ga je Slovenija začela izvajati skladno z zakonodajo EU, in je popolnoma spremenil koncept dotedanjih podpor v čebelarstvu. Končni program je Evropska komisija potrdila štiri mesece po Poklukarjevi smrti – avgusta 2004.

Prenos znanja

Janez se je z veliko srčnostjo posvečal prenosu znanja. Bil je predavatelj na Biotehniški fakulteti Oddelku za zootehniko. O tem, da je znal pritegniti študente, priča to, da jih je od leta 1997 do 2004 pri njem diplomiralo dvanajst, od tega kar enajst od leta 2000 do 2004, nekaj študentov pa je diplomiralo pri drugih mentorjih.

Menimo, da je Janez Poklukar načrtno gradil strokovno čebelarsko ekipo, ki bi lahko celovito odgovarjala na vse izzive slovenskega čebelarstva. Žal je njegova prezgodnja smrt 5. aprila 2004 ta načrt prekinila, ga upočasnila, mu spremenila smer ali pa so

nekateri deli celo zamrli.
Veliko je pisal za *Slovenskega čebelarja* (92 prispevkov!), objavljal v *Kmečkem glasu*, *Sodobnem kmetijstvu*, bil je reden gost *Kmetijskih nasvetov* Radia Slovenija. Izjemno delo je opravil pri urejanju knjige *Od čebele do medu* leta 1998 (472 strani, 18 avtorjev!). Neznano število ur je porabil tudi za neposreden prenos znanja čebelarjem v okviru čebelarskih društev, na raznih lokalnih posvetih in seveda – bil je redni referent na letnem posvetu čebelarjev v Celju. Ocenjevanje medu v Semiču je zaživelo tudi z njegovo pomočjo. Odlične organizacijske in motivacijske sposobnosti so prišle do izraza pri pripravi in izvedbi kongresa Apimondia 2003 v Ljubljani. Družno z dr. Jožetom Starcem sta pripravila in uredila vsebino kongresa, ekipa pod Poklukarjevim vodstvom pa je tudi kongres izpeljala z odliko.

Iz znanosti v prakso

Bil je velik praktik. Tu se je izkazal s pisanjem mesečnih čebelarskih nasvetov, preizkušal je različne tipe panjev, ukvarjal se je s proučevanjem in sajenjem medovitih rastlin … Le nekaj mesecev pred smrtjo je bil izvoljen tudi v upravni odbor Čebelarske zveze Slovenije (ČZS), saj se je zavedal, da preko ČZS vodi pot, po kateri bo možno najbolj učinkovito izboljševati stanje v slovenskem čebelarstvu.
Poklukar se je zelo zavedal tudi pomena neformalnega druženja, ki se je začelo že v Sekciji za čebelarstvo, nadaljevala pa v SAČD. Izmenjava mnenj na debatnih večerih v Ljubljani in drugod po Sloveniji, ekskurzije, Ambrožev ples, postavitev kapelice svetega Ambroža na brdu pri Lukovici … so bile priložnosti, kjer smo oblikovali zamisli, kovali načrte in jih tudi izvajali. Brez razpisov, projektov in proračunskih sredstev. Res smo bili prismuknjeni, ampak če bi bilo možno, bi to še enkrat storil(i).

Kaj ostane?

Janez Poklukar je razumel znamenja časa. Bil je vedoželjen organizator, motivator, strateg, diplomat in zaveden Slovenec. Znanstven, strokoven in praktičen, dostopen slehernemu človeku, ne glede na izobrazbo ali stan. Do vseh je imel enak odnos. Imel je veliko vero v ljudi in še večjo v Boga. In še ena vrednota je, ki mu je bila kažipot v življenju. Ta na dolgi rok ostane in gre naprej. To je bila Janezova družina, njegovi bližnji, žena Mira in otroci, ki so morali zaradi njegove izjemne vpetosti v čebelarske tokove tedanjega časa tudi kdaj potrpeti. Slovenski čebelarji smo vam za razumevanje zelo hvaležni.

Life and work of Assist. Prof. Dr Janez Poklukar

In one word Dr Janez Poklukar best describes the word versatility.

Before we discuss the significance of Dr. Janez Poklukar, who began his professional career in beekeeping in 1984, let us take a look at the situation of Slovenian beekeeping some forty years ago. When the collapse of Yugoslavia became apparent in the second half of the 1980s, the beekeeping situation was very serious. Varroa was killing bee colonies, honey prices were low, the state was neglecting beekeeping and there was hardly any funding for beekeeping. The Slovenian Beekeepers' Association was understaffed and underfunded, and the scientific and professional work in beekeeping was based on only a few enthusiastic people.

In these difficult times, a section for beekeeping was founded within the Association of Agricultural Engineers and Technicians, with the engineer Dušan Kresal as the driving force. This section developed in year 1996 into the *Slovenian Academic Beekeeping Society* (SAČD), which worked out a strategy for the development of *Slovenian beekeeping on a voluntary basis* (1992).

Janez Poklukar joined the group in the final phase of drafting this document and thus gained a comprehensive insight into all dimensions of the problems of Slovenian beekeeping. This probably contributed to his versatility. Wherever he looked, he saw the work and tackled it. A good example is his involvement in the development of the marketing *strategy for Slovenian honey* (1997), when the beekeeping was at its lowest point in the 1990s.

A rich scientific and professional heritage

Poklukar's bibliography, which includes more than 250 works from 1982 to 2004, shows how extensive and wide-ranging his fields of work are, although it should be emphasized that the digital age was still in its infancy!

He was a scientist, expert and practitioner. As you would expect, most of his research was concerned with the breeding and selection of Carniolan bee, which had been his main task since he took up a position at the Slovenian Agricultural Institute in 1984. A large part of his research and publications also relate to bee diseases (especially varroasis and nosemosis) and the quality of bee products (quality and variety of honey, pollen research). Poklukar looked at beekeeping as a whole, as various publications on many other areas: bees and the environment, risks for bees when using pesticides, planting honey plants, diseases of honey plants (pear blight, chestnut cancer), on the

importance of pollination… He also dealt with forest honey, which he researched himself, and was the mentor of three diploma theses on this subject.

Legislation for beekeeping

An important foundation that laid down the rules for the production and marketing of honey and a clear definition of its origin was the *Honey Decree* of 1999, which was based on the results of the Slovenian honey marketing strategy. Poklukar's justification for the protection of Slovenia as the home of the Carniolan bee (*Declaration No. 42 on the Carniolan bee*), which was part of Slovenia's accession treaty to the European Union, was extremely important in regulating the status of the Carniolan bee.

Not to be forgotten are the other revised and new regulations that govern the area of the recognized beekeeping organization, the pasture regulations and the pasture register, a package of animal breeding standards and the Animal Husbandry Act, which, also thanks to Poklukar, places beekeeping appropriately in the area of livestock breeding, where it belongs.

In the course of Slovenia's rapprochement with the EU, Janez Poklukar, with the experience of agricultural colleagues who already knew and used European approaches to the use of EU funds, was very actively involved in drawing up the program of measures for beekeeping in Slovenia in 2005-2007.

This was the first program of measures for beekeeping that Slovenia implemented in accordance with EU legislation and it completely changed the concept of support for beekeeping. The final program was approved by the European Commission in August 2004, four months after Poklukar's death.

Sharing knowledge

Janez was a passionate advocate of knowledge transfer. He was a lecturer at the Biotechnical Faculty, Department of Animal Breeding. His ability to attract students is evidenced by the fact that twelve students graduated from 1997 to 2004, eleven from 2000 to 2004, and several students graduated with other mentors after his death.

We believe that Dr. Janez Poklukar's intention was to build a professional beekeeping team capable of responding comprehensively to all the challenges of Slovenian beekeeping. Unfortunately, this plan was interrupted, slowed down, steered in a different direction or even partially destroyed by his untimely death on April 5, 2004.

He wrote a lot for *Slovenski čebelar* (92 articles!), published in *Kmečki glas*, *Sodobno*

kmetijstvo and was a regular guest on Radio Slovenija's beekeeping tips. He did an excellent job in publishing the book From Bees to Honey in 1998 (472 pages, 18 authors!). In addition, he spent an unknown number of hours passing on his knowledge directly to beekeepers in beekeeping associations and at various local conferences, and of course he was a regular speaker at the annual beekeeping conference in Celje. The evaluation of honey in Semič was also launched with his help.

His excellent organizational and motivational skills came to the fore during the preparation and implementation of the Apimondia 2003 congress in Ljubljana. Together with Dr. Josef Stark, he prepared and edited the content of the congress, and the team under Poklukar's leadership also conducted the congress perfectly.

From science to practice

He was a great practitioner. Here he proved himself by writing monthly tips for beekeeping, he tested different types of beehives, he studied and planted honey plants... A few months before his death, he was also elected to the board of the Slovenian Beekeepers' Association (ČZS), because he was aware that ČZS would show the way to effectively improve the situation of Slovenian beekeeping.

Poklukar was also aware of the importance of the informal contacts that had already begun in the Beekeeping Section and continued in the SAČD. The exchange of opinions at discussion evenings in Ljubljana and elsewhere in Slovenia, excursions, the Ambrose dance, the construction of the chapel of St. Ambrose in front of Beekeeping center Brdo pri Lukovici ... were opportunities where we developed and implemented ideas and plans. Without tenders, projects and budgets! We were really crazy, but if possible, we would do it again.

What has remained?

Janez Poklukar understood the signs of the times. He was a curious organizer, motivator, strategist, diplomat and deluded Slovenian. Scientific, professional and practical, accessible to all, regardless of their education or status. He had the same attitude towards everyone. He had great faith in people and even greater faith in God. And there is another value that guided him in life. This value remains in the long term and goes on. That was Janez's family, his relatives, his wife Mira and his children, who sometimes suffered from his extraordinary commitment to the beekeeping currents of his time. We Slovenian beekeepers are very grateful for your understanding.

Spomin na doc. dr. Janeza Poklukarja

Peter Kozmus[1] *(peter.kozmus@czs.si)*

Na doc. dr. Janeza Poklukarja me vežejo zelo lepi spomini, tako iz časov, ko sem obiskoval njegov predmet čebelarstvo, kot kasneje, ko me je kot mentor vodil pri pripravi diplomskega dela. Najbolj nepozabni trenutki pa so bili tisti, ki smo jih preživeli ob organizaciji kongresa Apimondia 2003. Po zaključku mojega dodiplomskega študija se je sprostilo delovno mesto generalnega sekretarja tega kongresa. Čeprav sem sprva dvomil, ali sem kos tej odgovornosti, me je prav dr. Poklukar spodbudil, naj se prijavim, rekoč, da bo to najboljša odskočna deska v svet čebelarstva.

Spomnim se intervjuja, kjer me je Franc Šivic spraševal o mojih izkušnjah v svetovnem čebelarstvu. Nisem blestel, a sem bil izjemno motiviran, predvsem zaradi podpore dr. Poklukarja, ki je verjel vame. Imeli smo redne tedenske sestanke in številne pogovore, iz katerih sem črpal modrost. V tem času sva z dr. Poklukarjem postala ne samo odlična ekipa, temveč tudi prava prijatelja. Skupaj sva pripravila zanimiv znanstveni program za kongres in stkala široko mrežo poznanstev.

Po kongresu sem začel z delom kot mladi raziskovalec na Kmetijskem inštitutu Slovenije, kjer sem pisarno delil z dr. Poklukarjem. Najini pogovori in sodelovanje so bili dragoceni, saj sem v tem obdobju pridobil ogromno znanja. Nato nas je šokirala novica o smrti dr. Josefa A. Starka, s katerim smo se srečali pred kongresom v Ljubljani. Janez je pripravil prispevek v njegov spomin za Acta agriculturae Slovenica.

Le mesec kasneje pa je prišla še hujša novica o tragični smrti dr. Janeza Poklukarja. Ta dogodek me je globoko pretresel in potreboval sem čas, da sem se soočil z izgubo. Kmalu sem napisal prispevek »In memoriam doc. dr. Janez Poklukar (1960–2004)« in oba zapisa, mojega in Janezovega, so združili v decembrsko izdajo revije.

Ko pogledam nazaj, sem izjemno hvaležen, da sem imel priložnost preživeti dragocen čas z dr. Janezom Poklukarjem. Naučil me je veliko in brez njegovega mentorstva ter prijateljstva gotovo ne bi bil tukaj, kjer sem danes.

[1] Čebelarska zveza Slovenije

Remembering Assist. Prof. Dr Janez Poklukar

I have very fond memories of Dr Janez Poklukar, both from the time when I took his course in beekeeping and later when he mentored me in the preparation of my thesis. The most unforgettable moments were those we spent organising the Apimondia Congress 2003. After my undergraduate studies were completed, the post of Secretary General of this Congress became vacant. Although at first I doubted whether I was up to the responsibility, it was Dr Poklukar who encouraged me to apply, saying that it would be the best stepping stone into the world of beekeeping.

I remember an interview where Franc Šivic asked me about my experience in world beekeeping. I did not shine, but I was extremely motivated, mainly because of the support of Dr Poklukar, who believed in me. We had regular weekly meetings and many conversations from which I drew wisdom. During this time, Dr Poklukar and I became not only a great team, but also true friends. Together we prepared an interesting scientific programme for the congress and built a wide network of acquaintances.

After the congress, I started working as a young researcher at the Slovenian Agricultural Institute, where I shared an office with Dr Poklukar. Our discussions and cooperation were valuable, as I gained a lot of knowledge during this period. Then we were shocked to hear of the death of Dr Josef A. Stark, whom we had met before the Congress in Ljubljana. Janez prepared an article in his memory for Acta agriculturae Slovenica.

Only a month later, however, came the even worse news of the tragic death of Dr Janez Poklukar. I was deeply shaken by this event and needed time to come to terms with my loss. Soon I wrote an article »In memoriam Assist. Prof. Dr Janez Poklukar (1960-2004)« and both my and Janez's articles were combined in the December issue of the journal.

Looking back, I am extremely grateful to have had the opportunity to spend precious time with Dr Janez Poklukar. He taught me a lot and without his mentorship and friendship I would certainly not be where I am today.

Biomonitoring okolja z medonosno čebelo: primer pilotne študije ob deponiji odpadne sadre v Kutini, Hrvaška

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Biomonitoring z medonosno čebelo je lahko pomembno orodje za spremljanje onesnaženosti okolja, še posebej na industrijsko onesnaženih lokacijah. Pašne čebele pogosto prenašajo onesnažila v panje, kjer jih lahko analiziramo in kvantificiramo v čebelah in čebeljih pridelkih. V pilotni študiji smo ovrednotili uporabnost medonosnih čebel za biomonitoring deponije odpadne sadre v Kutini (Hrvaška). Dve čebelji družini sta bili nameščeni v neposredno bližino deponije, štiri kontrolne družine pa v oddaljenosti 6 in 14 km. Z ICP-MS metodo smo merili koncentracije 20 makroelementov in elementov v sledovih v čebelah, medu, propolisu in cvetnem prahu, prisotnost naravnih radionuklidov v medu in cvetnem prahu pa z uporabo metode spektrometrija gama. Tako smo želeli ugotoviti, kateri vzorec v panju je najbolj uporaben za detekcijo onesnažil v okolju. Preučili smo tudi učinke sadre na zdravje čebel. Naši rezultati kažejo, da je analiza čebel in medu dejansko uporabna v namen monitoringa emisij sadre. Natančneje, koncentracije niklja, molibdena in urana so bile 2-10-krat višje v vzorcih čebel in medu, vzorčenih iz družin v bližini deponije sadre, v primerjavi z izmerjenimi koncentracijami v kontrolah. V večini vzorcev so bile izmerjene aktivnosti radionuklidov pod mejo detekcije, le izotopa 214Bi and 214Pb je bilo možno zaznati v cvetnem prahu. Izpostavljenost čebel sadri je pokazala negativne fiziološko učinke na pašne čebele, kar smo ugotovili z analizo aktivnosti stresnih encimov glutation S-transferaze in acetilholin esteraze. Zaključimo lahko, da je biomonitoring z uporabo čebel obetavna metoda, ki si zasluži nadaljnji razvoj.

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Biomonitoring of the environment with honey bee: an example of a pilot study at the waste phosphogypsum deposition site in Kutina, Croatia.

European honey bee can serve as a biomonitoring tool especially at industry polluted locations. Forager bees, exposed to contaminants, are carrying them to their hives where they can be detected and quantified in bees and hive matrices. In this pilot study we evaluated the feasibility of using honey bees for biomonitoring of fine powdery phosphogypsum (PG) stacks at the deposition site in Kutina (Croatia). Two bee colonies were placed in the vicinity of the PG deposition site, and four control colonies at a distance of 6 and 14 km. 20 macro and trace elements levels with ICP-MS method were measured in bees, honey, propolis and pollen, as well as the presence of natural radionuclides in honey and pollen using gamma-ray spectrometry. The experiments aimed to better understand which sample matrix could best be used to measure potential airborne releases of fine PG powdery particles. We investigated also the effects of PG on honeybees' health. Our results indicate that bees and honey can indeed be used to indicate PG stack airborne emission. Specifically, nickel, molybdenum and uranium concentrations were 2-10 times higher in bee and honey samples taken from the colonies in the vicinity of the PG stack, if compared to measured concentrations in the controls. Measured radionuclide activities were below the detection limit in most of the samples. However, in pollen samples, 214Bi and 214Pb were measurable. The bee PG exposure showed negative physiological effects on the bee foragers determined by the stress enzymes glutathione S-transferase and acetylcholine esterase activity analysis. It can be concluded that the bee-based biomonitoring approach is a promising tool and deserves further development.

Monitoring divjih čebel v Sloveniji

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Opraševalci so pomemben del biodiverzitete in zagotavljajo eno ključnih ekosistemskih storitev – opraševanje. Od opraševanja žuželk je odvisnih približno 4/5 kmetijskih in divjih rastlin. Poleg medonosne čebele je zelo pomembna tudi vloga divjih opraševalcev, ki v kmetijstvu opravijo več kot polovico opraševanja. Med divjimi opraševalci so najpomembnejše divje čebele, torej čmrlji in čebele samotarke. Populacije divjih čebel hitro upadajo. Glavni razlogi za to so pomanjkanje hrane, bolezni, pesticidi, pomanjkanje mest za gnezdenje in tujerodne vrste. Medonosna čebela njihove vloge ne more nadomestiti, zato je ob nadaljnjem upadanju lahko ogrožena kmetijska pridelava. Čeprav je poznavanje populacijskih trendov zelo pomembno za varstvo, je upadanje populacij in pestrosti divjih čebel v Sloveniji še vedno slabo dokumentirano. Prvi pilotni monitoring je potekal v letih 2020 – 2022 in sicer na dveh območjih z intenzivnim kmetijstvom (Celjska kotlina in Gorenjska), dveh zavarovanih območjih, kjer že izvajajo ukrepe izboljšanja stanja biotske raznovrstnosti (Ljubljansko barje in Cerkniško jezero) in enem urbanem okolju (Ljubljana). Čebele smo vzorčili s pomočjo modrih, rumenih in belih lovilnih krožnikov ter modrih in rumenih križnih prestreznih pasti. Število ujetih divjih čebel je med leti precej nihalo. Skupaj smo zabeležili 239 vrst čebel. Med njimi je bilo 223 vrst čebel samotark in 16 vrst čmrljev. To je 42 % vseh vrst čebel, ki so bile doslej najdene v Sloveniji. Raziskava je bil prvi obsežnejši sistematičen monitoring divjih čebel v Sloveniji. Dala je dragocene podatke o stanju čebel na petih območjih. Podatki bodo služili kot izhodiščno stanje pri prihodnjih monitoringih. Nič manj niso pomembne pridobljene izkušnje in zlasti krepitev zmogljivosti na področju taksonomije.

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Monitoring of Wild Bees in Slovenia

Pollinators are an important part of biodiversity and provide one of the key ecosystem services – pollination. Approximately 4/5 of agricultural and wild plants depend on insect pollination. In addition to the honeybee, wild pollinators also play a crucial role, performing more than half of the pollination in agriculture. Among wild pollinators, wild bees, including bumblebees and solitary bees, are the most important. Populations of wild bees are rapidly declining. The main reasons for this are a lack of food, diseases, pesticides, shortage of nesting sites, and invasive species. The honeybee cannot replace their role, and continued decline could threaten agricultural production. Although understanding population trends is essential for conservation, the decline in populations and diversity of wild bees in Slovenia is still poorly documented. The first pilot monitoring was conducted from 2020 to 2022 in two areas with intensive agriculture (the Celje Basin and Gorenjska), two protected areas where biodiversity enhancement measures are already being implemented (Ljubljana Marsh and Lake Cerknica), and one urban area (Ljubljana). We sampled bees using blue, yellow, and white pan traps and blue and yellow vane traps. The number of captured wild bees fluctuated significantly between years. In total, we recorded 239 species of bees, including 223 species of solitary bees and 16 species of bumblebees. This represents 42% of all bee species found in Slovenia to date. This study was the first large-scale systematic monitoring of wild bees in Slovenia. It provided valuable data on the status of bees in five areas. These data will serve as a baseline for future monitoring efforts. Equally important are the acquired experiences and especially the strengthening of capacity in the field of taxonomy.

Pomoč opraševalcem v intenzivni kmetijski krajini za podporo biodiverziteti
(predstavitev rezultatov projekta EIP POMOP)

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Opraševanje je ključna ekosistemska storitev, nepogrešljiva za kmetijstvo, pridelavo hrane in ohranjanje biotske raznovrstnosti. Poleg vplivov podnebnih sprememb intenzivno kmetijstvo predstavlja eno glavnih groženj zmanjševanju številčnosti in pestrosti, zlasti divjih opraševalcev. EIP projekt POMOP, z naslovom »Pomoč opraševalcem v intenzivni kmetijski krajini za podporo biodiverziteti«, se osredotoča na izboljšanje pogojev za opraševalce, kot so čmrlji, čebele samotarke, muhe trepetavke in metulji, z uporabo prekrivnih dosevkov. Iz širšega nabora potencialnih vrst smo glede na rastne značilnosti, arhitekturo rastlin in fenologijo cvetenja izbrali 28 vrst prekrivnih dosevkov. Z njimi smo za poljske preizkuse v letu 2023 zasnovali mešanice v dveh nivojih vrstne pestrosti (osnovna in pestra), ki poleg privabljanja opraševalcev nudijo še druge ekosistemske storitve. Tako smo oblikovali kompetitivno mešanico, ki je vključevala agronomske vrste s hitro in visoko produkcijo biomase. Mešanica za slaba tla je vsebovala vrste, prilagojene na pomanjkanje hranil in sušo. Mešanica za vezavo dušika je bila sestavljena izključno iz metuljnic, medtem ko smo v specialno mešanico za opraševalce vključili vrste z velikim potencialom privabljanja opraševalcev. Poljski poskusi so bili izvedeni na petih partnerskih kmetijskih gospodarstvih, ki so zajemala območje Primorske, osrednje in jugovzhodne Slovenije ter Pomurja. Mešanice smo posejali na žitna strnišča v obdobju od druge polovice julija do prve polovice avgusta. Rezultati spremljanja cvetenja so pokazali, da smo v primerjavi z najbolj uspešno monokulturno vrsto, facelijo, ki je cvetela povprečno 49 dni, z večino mešanic zagotovili 20 do 25 dni daljše obdobje cvetenja. Glede na pedoklimatsko raznolikost poskusnih lokacij smo pričakovano ugotovili, da se je povprečna produkcija suhe biomase mešanic med lokacijami značilno razlikovala ($p \leq 0{,}01$). Na posameznih poskusnih lokacijah, kjer smo ugotovili večjo zapleveljenost, so se pokazale razlike v učinku zatiranja plevela med mešanicami, ki so vsebovale bolj hitro rastoče vrste (kompetitivna mešanica in mešanica za slaba tla), ter mešanico za vezavo dušika, ki je vsebovala metuljnice s počasnim začetnim razvojem. Naši rezultati nakazujejo, da so nekatere okrasne rastline in zelišča, ki smo jih preverili posamično in v mešanici za opraševalce, primerne za vključitev v ciljno naravnane vrstno bogate mešanice, saj imajo velik potencial privabljanja divjih opraševalcev. Vendar pa imajo v primerjavi z nekaterimi uveljavljenimi agronomskimi vrstami bistveno slabši

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začetni razvoj in konkurenčno sposobnost, zato jih nameravamo v prihodnjih letih dodatno preveriti v realnih poljskih razmerah.

Supporting Pollinators in Intensive Agricultural Landscapes to Enhance Biodiversity
(Presentation of the EIP POMOP Project Results)

Pollination is a key ecosystem service, essential for agriculture, food production, and biodiversity preservation. In addition to the impacts of climate change, intensive agriculture is one of the main drivers of the decline in abundance and diversity, particularly among wild pollinators. The EIP POMOP project, titled »Supporting Pollinators in Intensive Agricultural Landscapes to Enhance Biodiversity,« focuses on improving conditions for pollinators such as bumblebees, solitary bees, hoverflies, and butterflies through the use of cover crops. From a broad list of potential species, 28 cover crop species were selected for field trials in 2023 based on their growth characteristics, plant architecture, and flowering phenology. These species were used to design cover crop mixtures with two levels of species diversity (basic and diverse), aiming not only to attract pollinators but also to provide additional ecosystem services. A competitive mixture included agronomic species with rapid and high biomass production. The mixture for poor soils consisted of species adapted to nutrient deficiency and drought. The nitrogen-fixing mixture was composed entirely of legumes, while the pollinator-specific mixture included species with high potential to attract pollinators. Field trials were conducted on five partner agricultural holdings across the regions of Primorska, Central, and Southeastern Slovenia, and Pomurje. The cover crop mixtures were sown on cereal stubble between mid-July and mid-August. Monitoring of flowering showed that, compared to the most successful monoculture species, phacelia, which flowered for an average of 49 days, most mixtures extended the flowering period by an additional 20 to 25 days. Due to the pedoclimatic variability of the trial locations, the average dry biomass production of the cover crop mixtures varied significantly between sites ($p \leq 0.01$). Under conditions of higher weed infestation, differences in weed suppression were observed between mixtures containing faster-growing species (the competitive mixture and the mixture for poor soils) and the nitrogen-fixing mixture, which comprised legumes with slower initial growth. Our results suggest that several ornamental plants and herbs have the potential to be included in species-rich cover crop mixtures due to their strong ability to attract wild pollinators. However, compared to some established agronomic species, they exhibited significantly slower initial development and reduced competitive ability. To better understand their performance in specific field conditions, further evaluation is needed in the coming years.

Vzreja in ohranjanje medonosnih čebel: novice iz Italije in projekta EU, BeeGuards

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Komercialna vzreja matic ima v Italiji približno 150-letno zgodovino. Prve profesionalna vzrejališča čebeljih matic so bila ustanovljena v regiji Emilia-Romagna, večinoma v provinci Bologna. Ta regija ima zdaj uradni regionalni zakon, ki prepoveduje vzrejo in vnos čebel, ki se razlikujejo od avtohtone vrste *Apis mellifera ligustica*. Nedavna študija, ki je uporabila morfometrične analize in medgensko regijo mitohondrijske DNK COI-COII, je pokazala, da so populacije avtohtone vrste *A. m. ligustica* dobro ohranjene na italijanskem polotoku, zlasti v osrednjih regijah, medtem ko regije na severu kažejo znake vnosa genov iz vrste *A. m. carnica* in znotrajvrstnih hibridov. Pomemben pristop k ohranjanju avtohtonih podvrst medonosnih čebel je izvajanje vzrejnih programov. Glede na nenehne podnebne spremembe in njihove negativne vplive na čebelarstvo (znižani donosi, širjenje eksotičnih škodljivcev) je ključnega pomena vključitev lastnosti, povezanih z odpornostjo. V projektu BeeGuards se testira koncept, ki vključuje upravljanje z nizkimi vložki in elemente naravne selekcije v vzrejnem načrtu. Inovativno upravljanje vključuje spodbujanje prekinitve zalege, da se zmanjša razmnoževanje in razvoj populacije pršice varoje z namenom 1) zmanjšanja zatiranja s sintetičnimi sredstvi; 2) omogočanja večjega pritiska varoje za spodbujanje naravne selekcije. Čebelje družine, ki uspejo obdržati raven napadenosti pod škodljivim pragom, se uporabljajo za nadzorovano parjenje, z namenom združevanja izbranih merjenih lastnosti z naravno selekcijo. V sklopu projekta bomo raziskovali nove lastnosti, povezane z odpornostjo na podnebne spremembe, za potencialno uporabo v vzrejnih programih.

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Breeding and conservation of honey bees: news from Italy and the EU project BeeGuards

Commercial queen rearing has about 150 years history in Italy. The first professional queen producing operations were established in the Emilia-Romagna region, mostly in the Bologna province. This region now has an official regional law prohibiting rearing and introduction of bees different from the native *Apis mellifera ligustica*. A recent study using morphometric analyses and the mtDNA intergenic region COI-COII showed that populations of the native *A. m. ligustica* are well preserved in the Italian peninsula, especially in the central regions, while regions in the North show signs of introgression from *A. m. carnica* and intra-specific hybrids. An important approach for the conservation of native honey bee subspecies is the implementation of breeding programs. Considering ongoing climate change and the adverse effects on beekeeping (reduced yields, spread of exotic pests) the integration of traits linked to resilience is pivotal. In the BeeGuards project a concept which includes a low-input management and elements of natural selection in the breeding scheme is tested. The innovative management entails fostering brood breaks to reduce Varroa reproduction and population development with the aim of 1) reducing chemical treatments; 2) allowing a higher *Varroa* pressure to foster natural selection. Colonies that manage to keep infestation levels under a damage threshold are used for controlled mating, with the aim of combining measured selected traits with a natural selection approach. New traits linked to resilience to climate change will be investigated for potential use in breeding programs.

Različni pristopi zatiranja varoj: učinkovitost in vpliv na vitalnost čebeljih družin

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V naših aplikativnih raziskavah smo se osredotočili na dva različna načina pristopa zatiranja varoj v poletnem času, v dveh različnih klimatskih območjih. Vzpostavili smo 30 medsebojno primerljivih čebeljih družin, v Osrednjeslovenski in Obalno – Kraški regiji. Družine smo razdelili v tri skupine; v prvi in drugi skupini smo matice priprli za 24 dni v manjšo (prva skupina) in večjo (druga skupina) kletko ter jih zdravili z enkratno aplikacijo oksalne kisline (OK). Pri tretji skupini družin, ki je imela ves čas prisotno zalego, smo uporabili učinkovino OK na trakovih, ki so bili v družinah prisotni 28 dni. V obdobju od oktobra 2023 do septembra 2024 smo vsako družino 4-krat posamezno vzorčili za mikroskopsko določanje spor *Nosema spp*. in najbolj razširjene čebelje viruse. S tem smo pridobili podatke za vrednotenje stresa, ki smo ji podprli tudi na podlagi določanja aktivnosti encimov acetilholinesteraza (AChE) in glutation – S- transferaza (GST).

V našem poskusu velikost kletke ni imela vpliva na uspešnost metode pripiranja matic, saj družine v poskusu priprtih matic obeh skupin niso prelegale. Podobno, kot že nekaj tujih in domačih raziskav, je tudi naša raziskava pokazala, da postopek prekinitve zaleganja ne vpliva na jakost družin v jesenskem obdobju, v kolikor se natančno sledi protokolu.

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Different approaches to control the Varroa mite: effectiveness and influence on the vitality of bee colonies

In our applied research, we focused on two different types of summer brood interruption techniques in different climatic regions. We placed 30 comparable bee colonies in two different locations, in the Osrednjeslovenska and Obalno-Kraška region. We divided the colonies into three groups; in the first and second group we caged the queens for 24 days in a smaller (first group) and a larger (second group) cage and treated them with a single application of oxalic acid (OA). In the third group of colonies, in which brood was constantly present, we applied the active ingredient OA on the strips, which were present in the colonies for 28 days.

In the period from October 2023 to September 2024, we sampled each colony four times individually to determine microscopically the spores of *Nosema spp*. and the most common bee viruses. In this way, we obtained data to assess stress, which we also supported by determining the activity of the enzymes acetylcholinesterase (AChE) and glutathione S-transferase (GST).

In our experiment, the size of the cage had no effect on the success of the queen caging method, as the colonies in the experiment with caged queens of both groups did not supersede the queen. Like several foreign and domestic studies, our research has shown that brood interruption has no effect on colony strength in the fall, provided the protocol is followed exactly.

SimTROT: simulator čebeljih rejskih programov SIMplyBee

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Namen selekcije je izboljševanje neke lastnosti vrste. Sam postopek selekcije je običajno drag in časovno zamuden. Zato se pri selekcijskih odločitvah pogosto posega po simulacijah rejskih programov. S tem se i) zmanjša število napačnih odločitev in ii) lahko vzporedno preigra več scenarijev, kar v praksi zaradi stroškov ni mogoče.

Razvili smo simulator čebeljih populacij in reproduktivne biologije, ki upošteva posebnosti čebelje reproduktivne biologije. S simulatorjem smo preučevali realistične scenarije z različnim deležem trotov s poznanim rodovnikom na plemenilnih postajah, ter vpliv na genetski napredek. Genetska pestrost znotraj družine je izrednega pomena za zdravje in funkcionalnost družine, še posebno v spremenljivem okolju, zato smo preučili vpliv večih očetovskih linij na plemenilni postaji in ocenili smiselnost take postavitve glede na plemenske vrednosti in simulirani genetski napredek. V zadnjem koraku smo razvili in preizkusili primernost modelov, ki upoštevajo prostorsko razporeditev sorodstva in okoljske variance za izboljšanje genetskega napredka.

Simulator je že v uporabi: na Irskem ocenjujejo vpliv uvoza neavtohtonih podvrst, na Škotskem napovedujejo število patrilinij. V Sloveniji smo interpretirali rezultate povezanih projektov in deleža očetovstva ter to uporabili za podajanje smernic v rejskem programu in povezani zakonodaji.

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SimDRONE: simulator of honeybee breeding programs SIMplyBee

Selection aims to improve a set of selected traits. However, implementing selection is both time- and money-consuming. Thus, we can use simulations of breeding programs designing the selection strategy. Simulations hence decrease the number of wrong decisions by allow testing multiple scenarios in parallel – which in reality is most often not possible due to the costs.

We have developed a simulator of honey bee populations that takes into the account the peculiarities of honey bee reproductive biology. Using the simulator, we investigated different scenarios varying the number of drone lines at the mating stations. Genetic diversity within a colony is of extreme importance for fitness and health of the colony, especially in the unpredictable environment. Additionally, we have simulated scenarios varying the number of drone lines at the mating station and evaluated the genetic gain and breeding values. Last, we have tested scenarios that take into account spatial component of kinship and environmental variance for improvement of genetic gain.

The simulator is already in use: in Ireland, it has been used to evaluate the impact of import of allochthonous subspecies; in Scotland, it has been used to predict the number of patrilines. In Slovenia, we used it to interpret the results of related projects, such as paternity validation. We used these results to advise the national breeding program and legislation.

Spremljanje alternativnih paš in povzročiteljev medenja na 35 lokacijah v Sloveniji

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Podnebne spremembe vplivajo na pašne vire za čebele, kar lahko zmanjša pridelavo medu in oteži oskrbo čebeljih družin. Zaradi teh sprememb postajajo višje lege in manj običajne lokacije zanimivejše za čebelarjenje. Od leta 2022 na 35 lokacijah po Sloveniji spremljamo vire medenja in donose medu. Večina lokacij je letos upravičila naša pričakovanja: od 35 čebeljih družin jih je 29 imelo pozitiven donos, od tega je 13 družin pridelalo več kot 10 kg medu. Največji donos (26,6 kg) je bil zabeležen na Snežniku, sledili sta lokaciji Zgornje Danje – Železniki (23 kg) in Slivnica na Pohorju (23 kg).

V okolici vsake opazovalne postaje smo spremljali prisotnost povzročiteljev medenja ter vzorčili povzročitelje medenja za molekularno analizo DNK za njihovo identifikacijo. Skupno smo identificirali 19 vrst. Največ zaporedij identificiranih povzročiteljev medenja (41 od 93) je pripadalo ušicam rodu *Cinara*. Dobro je bila zastopana tudi javorjeva uš (*Periphyllus testudinaceus*) (21 vzorcev). Na terenu smo našli in vzorčili tudi kaparje, toda nukleotidna zaporedja niso bila ustrezne kakovosti za molekularno identifikacijo.

Vzorčili smo tudi kapljice mane ter vsebino mednih želodčkov čebel ob vhodu v panj. Na vzorcih mane in vzorcih vsebin mednega želodčka smo izvedli kromatografsko analizo sladkorjev z napravo HPLC. Vzorce smo analizirali na vsebnost glukoze, fruktoze, saharoze, melecitoze, trehaloze, maltoze in rafinoze. Rezultati kažejo, da je sestava mane odvisna od povzročitelja medenja, ne toliko od rastline, kar nakazuje na potrebo po nadaljnjem raziskovanju in primerjavah med različnimi lokacijami in povzročitelji.

Predstavljeni rezultati izsledkov na terenu ter laboratorijskega dela kažejo na potencial nekaterih lokacij za čebelarjenje ter visoko pestrost povzročiteljev medenja. Za celovit vpogled v situacijo pa je nujno spremljati donose medu, vremenske razmere in medenje skozi večletno obdobje. Le na podlagi zaporednega opazovanja tekom več sezon bo mogoče sklepati, katere lokacije so bolj primerne za čebelarjenje in katere ne. Jasno je, da ena sezona ne zadošča, saj se sezone med seboj lahko močno razlikujejo.

Rezultati so nastali v okviru naloge »Iskanje alternativnih paš in karakteristike medu v povezavi s povzročitelji medenja«, ki jo Kmetijski inštitut Slovenije (izvajalec) in Čebelarska zveza Slovenije

[1] Kmetijski inštitut Slovenije
[2] Čebelarska Zveza Slovenije

(podizvajalec) opravljata za naročnika Ministrstvo za kmetijstvo, gozdarstvo in prehrano. Poročila so dostopna na spletni strani: https://www.kis.si/trzne_raziskave/.

Monitoring of alternative forages and honeydew producing insects at 35 locations across Slovenia

Climate change is impacting forage resources for bees, potentially reducing honey production and complicating beekeeping management. Due to these changes, higher altitudes and less typical locations are becoming more interesting for beekeeping. Since 2022, we have been monitoring honeydew sources and honey yields at 35 locations across Slovenia. Despite these locations being at higher elevations or usually less attractive for beekeepers, most sites met our expectations this year: 29 of the 35 colonies showed a positive yield, with 13 colonies producing over 10 kg of honey. The highest yield (26.6 kg) was recorded at Snežnik, followed by Zgornje Danje – Železniki (23 kg) and Slivnica on Pohorje (23 kg).

In vicinity of each observation station, we monitored the presence of honeydew producing insects and sampled them for DNA molecular analysis for identification. We identified 19 species altogether. The majority of identified honeydew producers (41 of 93 sequences) belonged to aphids of the genus *Cinara. Periphyllus testudinaceus* (common periphyllus aphid) was also well represented (21 samples). Field samples also included scale insects, but the nucleotide sequences were insufficient for molecular identification.

We also sampled honeydew droplets and the contents of honey bee crops at the hive entrance. These samples underwent sugar chromatographic analysis using HPLC. We tested for glucose, fructose, sucrose, melezitose, trehalose, maltose, and raffinose. The results show that the composition of honeydew depends on the honeydew producer rather than the plant, indicating the need for further research and comparison between different locations and producers.

The presented field and laboratory results demonstrate the potential of certain locations for beekeeping and the high diversity of honeydew producers. For a comprehensive understanding, it is essential to monitor honey yields, weather conditions, and honeydew production over multiple years. Only through consecutive observations over several seasons can we determine which locations are more suitable for beekeeping. One season alone is not sufficient, as conditions can vary greatly from year to year.

The results were achieved through the project »Exploring Alternative Forages and Honey Characteristics Related to Honeydew Producers,« conducted by the Agricultural Institute of Slovenia (implementer) and the Slovenian Beekeepers' Association (subcontractor) for the Ministry of Agriculture, Forestry, and Food. Reports are available at https://www.kis.si/trzne_raziskave/.

Bee2Gether: Krepitev čezmejnega inovativnega sistema za izboljšanje biotske raznovrstnosti z monitoringom čebel

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Projekt BEE2GETHER nadgrajuje glavne dosežke projekta ITA-SLO 14-20 BEE-DIVERSITY, z namenom njihovega izboljšanja, širjenja med javnostjo in uporabe na širšem območju. Zasnovan na preteklih izkušnjah, nadaljuje z razvojem inovativnega modela upravljanja, ki temelji na spremljanju čebel. Ta model pomaga identificirati najprimernejše in trajnostne kmetijske prakse z okoljskega, ekonomskega in družbenega vidika. Projekt zbira natančne podatke o zdravju čebel in prisotnosti onesnaževal, kot so težke kovine v cvetnem prahu. Na podlagi teh podatkov prepoznamo potencialna tveganja in razvijemo načine upravljanja, ki ta tveganja zmanjšujejo ter prispevajo k ohranjanju biotske raznovrstnosti. Ključna orodja tega modela so elektronski panji in IKT sistem (aplikacija), ki omogočata čebelarjem optimizacijo dela in zbiranje uporabnih podatkov za učinkovito upravljanje čebelnjakov.

Cilj projekta je tudi prenos znanja, zato v Sloveniji in Italiji organiziramo seminarje za čebelarje in druge strokovnjake o inovacijah, dobrih praksah in biotski raznovrstnosti. Za šole pa postavljamo učne čebelnjake in gnezdilnice za divje čebele. Posebni ukrepi so namenjeni tudi političnim odločevalcem, da bi čezmejni akcijski načrt za trajnostno kmetijstvo, ki je glavni rezultat projekta, vključili v regionalne in nacionalne politike.

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Bee2Gether: Strengthening the cross-border innovative system for improving biodiversity through bee monitoring

BEE2GETHER capitalizes on key outputs of the ITA-SLO 14-20 BEE-DIVERSITY project in order to strengthen them, make them known to a wider audience, and disseminate them to a wider area. Building on past experiences, the project further develops the innovative management model based on bee monitoring from which the most suitable and environmentally, economically and socially sustainable agricultural cultivation techniques are identified.

Through the collection of timely data on the health of bees and the possible presence of heavy metals and other pollutants in pollen, we provide a characterization of the target area, i.e., identify the potential risks present and, consequently, identify management strategies that limit or diminish threats to biodiversity conservation. This management model is based on the use of electronic beehives and an ICT system (APP). These are two innovative tools that can be used by the beekeepers not only to optimize and standardize apiary management, but more importantly, to carry out widespread collection of useful data (through the hives) which, through the APP can be managed and used across borders to define large-scale sustainable environmental management models.

Finally, with the aim of fostering knowledge transfer, we organize in Slovenia and Italy, and also jointly, cycles of seminars aimed at practitioners on innovation in beekeeping, best practices and biodiversity, but also at educational institutions with involvement actions based on the installation of educational apiaries and houses for wild bees. Specific actions are addressed to policy makers in order to have the main output of the project, which is the cross-border action plan for sustainable agriculture, incorporated into regional and national policies.

Koncentracije esencialnih in strupenih elementov pri predelavi voska v satne osnove

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V intenzivnem čebelarjenju se vosek kontinuirano reciklira s predelavo starega satja v satje za izdelavo satnih osnov, ki je nujen material za narejanje produktivnih čebeljih družin, pa tudi za api-biotehnične postopke priprave čebeljih družin za glavno pašo ali uporabo biološko-tehnoloških metod za nadzor nad varozo. Satje v čebeljih panjih je v maščobah topen material, ki kot goba vpija ostanke številnih različnih onesnaževal iz okolja. V priporočilih čebelarskih del je navedena redna letna zamenjava vsaj 30 do 40 % starega satja z novim.

Z uporabo tehnologije vlivanja voska s podaljšano fazo ohlajanja in usedanja je bila ugotovljena možnost, da iz surovega voska odstranimo precejšnje količine težkih kovin ter koncentriramo esencialne elemente, ki se porabljajo med razvojem čebelje zalege v satju. Zato je bil cilj te raziskave ugotoviti prisotnost in gibanje koncentracij 16 esencialnih in toksičnih elementov: Ag, As, Ba, Cd, Co, Cr, Cu, Fe, Hg, Mn, Mo, Ni, Pb, Se, V in Zn v vzorcih voska pri predelavi satja v satne osnove z analizno metodo induktivno sklopljene plazme z masno spektrometrijo (ICP-MS) kot več elementne analize.

Rezultati so pokazali, da je pri večini elementov tehnika dolgotrajnega hlajenja in odlaganja voska med njegovo predelavo dala pozitiven učinek glede znatnega zmanjšanja visokih koncentracij, predvsem težkih kovin in toksičnih elementov, pri odstranitvi četrte sedimentirane plasti voska pred drugo fazo njegove predelave, v primerjavi z drugo fazo predelave pa po sedmih dneh ponovne sedimentacije. Hkrati se je v prvi fazi predelave voska koncentracija iskanih elementov v plasteh voska, ki se uporablja za izdelavo satnih osnov, v primerjavi s plastjo, ki je bila izločena iz nadaljnje predelave, zmanjšala za: Cr 64,02 %; as 88,61 %; Hg 83,94 %; Cd 81,6 %; Pb 86,11 %; Mn 97,14 %; Se 91,70 %; Niti 64,02 %; Co 97,1 %, Ag 93,72 %; Ba 92,89 %; Mo 89,77 % in V 94,54 %.

Iskanje satja in/ali surovega voska s tehniko ICP-MS za ugotavljanje prisotnosti in kvantifikacije težkih kovin in metaloidov je lahko eden izmed indikatorjev onesnaženosti okolja in je čebelarjem v pomoč pri izbiri primerne lokacije za namestitev ali selitev čebelnjaka.

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Concentrations of essential and toxic elements during the processing of wax into honey bee wax foundations

The honey bee wax is continuously recycled in intensive beekeeping by processing old comb into foundation sheets, which are necessary materials for establishing productive honey bee colonies, as well as in api-biotechnical procedures for preparing colonies for main honey flows or for applying biological-technological methods for Varroa control. The combs in hives are lipophilic materials that absorb residues of various environmental pollutants like a sponge. Recommendations for beekeeping practices suggest a regular annual replacement of at least 30 to 40% of the total combs in an apiary, which involves substituting old combs with new wax foundations.

By applying a wax casting technology with an extended cooling and sedimentation phase, the possibility of removing a considerable number of heavy metals from raw wax and concentrating essential elements consumed during bee brood development in the combs has been established. Therefore, this research aimed to determine the presence and movement of concentrations of 16 essential and toxic elements: Ag, As, Ba, Cd, Co, Cr, Cu, Fe, Hg, Mn, Mo, Ni, Pb, Se, V, and Zn in wax samples during the processing of comb into wax foundations, using the analytical method of inductively coupled plasma mass spectrometry (ICP-MS) as a multi-elemental analysis.

Results showed that for most elements, the applied long cooling and sedimentation technique during the processing of wax had a positive effect in terms of significantly reducing high concentrations, particularly of heavy metals and toxic elements, when discarding the fourth sedimented layer of wax before the second phase of processing, and in comparison, with the second phase of processing after seven days of repeated sedimentation. During the first phase of wax processing, the concentration of the searched elements in the layers of wax used for making foundation sheets, compared to the layer discarded from further processing, was reduced by: Cr 64.02%; As 88.61%; Hg 83.94%; Cd 81.6%; Pb 86.11%; Mn 97.14%; Se 91.70%; Ni 64.02%; Co 97.1%; Ag 93.72%; Ba 92.89%; Mo 89.77%; and V 94.54%.

Analysing the comb and raw wax using the ICP-MS technique for the presence and quantification of heavy metals and metalloids can be one of the indicators of environmental pollution and can assist beekeepers in selecting an appropriate location for placing or relocating their beehives.

Nenehne spremembe v kmetijstvu – kakšni so izzivi varstva čebel v prihodnosti?

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Kmetijstvo se nenehno spreminja. Številni vidiki, vključno z ekonomijo, vplivajo na to, katere pridelke gojimo ter koliko in katere vrste vložkov, kot so gnojila in fitofarmacevtska sredstva (FFS), so v uporabi. Tudi varstvo rastlin in dostopnost izdelkov sta v zadnjih desetletjih doživeli številne in velike spremembe.

Medtem ko je uporaba strupenih snovi dandanes na splošno bolj kritična, je veliko snovi prepovedanih na ravni EU. Vendar pa kmetijska pridelava potrebuje rešitve za zaščito rastlin in zagotavljanje donosov, in kljub pogostim spremembam v registraciji in razpoložljivosti FFS, nenehno spreminjanje kmetijskih praks zahteva hkratno preučevanje trenutnih tveganj ter upoštevanje, definiranje in vrednotenje prihajajočih scenarijev tveganja. Uporaba, vzorci uporabe in kombinacije snovi se spreminjajo – in v sodobnem času se zdijo nesintetični pesticidi ugodnejši.

Vendar so za boljšo zaščito vseh čebel potrebne nadaljnje raziskave in metodologije ter dobro obvladovanje tveganja. V pogovoru so predstavljeni podatkovno usmerjeni pomisleki o vplivih na divje in medonosne čebele, prihodnji izzivi za oceno in obvladovanje tveganja ter razprava o idejah za ocenjevanje vplivov na čebele na različnih ravneh.

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Agriculture in a permanent change - what are the challenges to protect bees in the future?

Agriculture is in a permanent change. Numerous aspects, including economics influence which crops are cultivated, and how much and which types of input, such as fertilisers and plant protection products (PPP) are used. Also Plant Protection and the availability of products has undergone numerous and major changes in the past decades.

While the use of toxic substances is nowadays seen more critical in general, many substances have been banned on the EU-Level. However, agricultural production needs solutions to protect the plants and ensure yields, and while there are frequently changes in the autorisation and availability of PPPs, the constant change in agricultural practices requires concurrent investigation of current risks and also demands to consider, define and evaluate upcoming risk scenarios. Uses, use patterns and combination of substances change – and in modern times, non-synthetic pesticides seem more favourable.

However, to better protect all bees, further research and methodologies and good risk management are needed. In the talk, data-driven concerns on impacts on non-apis and apis bees (wild bees and honeybees), future challenges for risk assessment and management are presented and ideas for assessing the impacts on bees on different levels are discussed.

Dr. Janez Poklukar (z mikrofonom) je bil ključna oseba pri izvedbi kongresa Apimondia 2003 v Ljubljani. (Foto: Marjan Papež)

Letni posvet čebelarjev v Celju je vedno združil znanstvenike, strokovnjake in praktike, kjer se je dr. Janez Poklukar (prvi z leve) pojavljal v vseh treh vlogah. (Foto: Marjan Papež)

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