

Final report for the project 74p4

Economic impact of winter losses of honey bee colonies and research on honey bee immunity

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Main project outcomes

1. Honey bee colony losses were quantified in the Czech Republic and in Austria. The results are published in the impacted Journal of Apicultural Research (Impact factor 2.084 in 2015).
2. We studied changes in gene expression and production of antimicrobial peptides based on nutrition, the scientific paper was submitted to Archives of Insect Biochemistry and Physiology, it is under review since October 2016.
3. The pilot research of economic impact of honey bee losses started in 2016.
4. Beekeepers and students evaluated the seminars given in Austria and in the Czech Republic very positively, this is a key point for stimulating them for participation in further studies.

Additional project outcomes and achievements

- 1) The master student Silvie Dostálková learned laboratory skills for honey bee research under *in vitro* conditions, she applied obtained knowledge for her master thesis.
- 2) State Veterinary Administration in the Czech Republic became a partner of the project.
- 3) Common public, media like press, TV and radio are interested in honey bee colony losses what resulted in several media coverages.
- 4) The participating teams established as strong partners.

Final report

Honey bees have ecological and economic impact because of pollination of wild plants and cultivated crops and bee products like honey, propolis and royal jelly. The cooperation between the teams from Palacký University Olomouc and Karl-Franzens University Graz started in 2015 thanks to the AKTION support (project 71p6). Our research is based on the Citizen Science concept of crowdsourcing, we obtained data for our scientific analysis from volunteers – beekeepers in our case. Every year we up-date an internationally standardized questionnaire which contains around 20 questions about the number of wintered and lost colonies, problems observed on apiaries, treatments used to prevent diseases etc. The monitoring of honey bee colony losses is an international project guided by the association COLOSS which publishes up-dated international questionnaire every year. Thanks to this, the survey is unified for all participating countries. Our Czech-Austrian cooperation is not only focused on honey bee losses but also to honey bee nutrition and economical value of losses.

The monitoring of honey bee colony losses took place in the spring 2016 (March – May). We collected 968 answers to our questionnaire from Czech beekeepers who monitored 17350 colonies and 1289 beekeepers from Austria where 23418 wintered colonies were involved in our study. We disseminated information about the survey by the Internet, beekeeping magazines, at lectures and meetings for beekeepers and by media like TV or radio. Costs for advertisement were paid from other sources. In general, the loss rate (without queen problems) was lower compared to the winter 2014/15. Austria detected 4.5 % loss (95% CI, Confidence Interval, 4.0-5.2 %), the Czech Republic lost 4.1 % of colonies (95% CI 3.6-4.7). The losses were low in general in the central Europe. The comparable data from other countries was published in the Journal of Apicultural Research (Brodschneider et al., 2016). Czech official authorities are interested in our results, e.g. State Veterinary Administration became a partner of the project in the Czech Republic in 2016. Also in Austria, official authorities respect and support the investigation.

The results of the Czech and Austrian cooperation were also published at an international COLOSS conference in Cluj in Romania between 10th –11th September 2016. We prepared a poster with detailed analysis of our results. The poster showed the difference in treatment against *Varroa* mites, our

countries have different treatment strategy, whereas in Austria mainly organic acid treatments are applied, the synthetic Gabon strips are very popular in the Czech Republic (poster Brodschneider et al., 2016).

Honey bee colony losses can be compensated by splitting colonies or purchasing new livestock material. In both countries, Austria and the Czech Republic, compensation is mainly accomplished by home-growing own queens and colonies. This is labour intensive and also includes a reduction in the amount of honey that can be harvested. The restoration of lost colonies is mostly achieved voluntarily by beekeepers as part of their annual work cycle. We therefore aim to an estimation of the costs of honey bee colony losses, an investigation that is not finished yet. In a preliminary investigation at a seminar at the University of Graz including students from environmental sciences with a focus on economy, the cost of honey bee colony losses for Austrian society was estimated.

Patrick Kloiber visited Olomouc between 29th August – 1st September, he discussed his research with Jiří Danihlík who is also a beekeeper with approx. 60 colonies. He was interested in the differences in Czech and Austrian beekeeping, prices of tools, colonies, swarms, winter food etc. Patrick Kloiber travelled also to Leopold Matela to Krnov, who is the president of Czech Beekeeping Association for detailed discussion on the situation in Czech beekeeping.

Personal visits in Graz or in Olomouc are very helpful for our research. Jiří Danihlík and Silvie Dostálková travelled to Graz between 9th – 14th May for common work with Robert Brodschneider. The team processed the data set from follow up survey, which took place in 2015. Jiří Danihlík and Robert Brodschneider mainly worked on writing our scientific manuscript and Silvie Dostálková learned how to maintain honey bees in cages under *in vitro* conditions. She also learned how to dissect mandibular glands from honey bee heads. These glands produce royal jelly and antimicrobial peptides, what was her interest during master studies. Anika Libor from the University of Graz taught her the laboratory protocol used in Graz. She also participated our collaboration in 2015. Silvie Dostálková applied her new knowledge for writing her master thesis, which was successfully defended in June 2016 (name of the thesis: The role of antimicrobial peptides in bee immune responses to infections by bacterial pathogens). She has started studying Ph.D. in September 2016 and is still part of the team. The manuscript that focused on honey bee nutrition and immunocompetence was submitted to a scientific journal Archives of Insect Biochemistry and Physiology. Nowadays, it is under review (2nd January 2017).

Even we planned a visit of Robert Brodschneider plus student in Olomouc during the summer part of the project, only Patrick Kloiber came to the Czech Republic. Robert Brodschneider did not use the opportunity to come because he was working on the scientific paper with the international results. The paper was already published, what is mentioned above (Brodschneider et al., 2016).

The key point of our research is the Citizen Science concept. We are dependent on data which we receive from beekeepers from both countries. We have in the last years established a stable and growing population of beekeepers eager to participate in citizen science studies, what we consider as a success (Fig. 1).

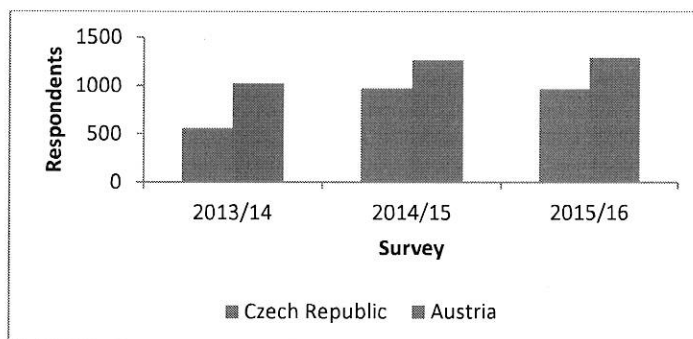


Fig. 1: Response rate in the survey in Czech Republic and Austria since the beginning of the cooperation.

It is essential to stimulate beekeepers in participation, thus we organized seminars in Feldkirchen an der Donau and in Olomouc. Robert Brodschneider and Jiří Danihlík gave talks about honey bee colony losses in Austria and the Czech Republic, they presented possible causes of losses, honey bee pathology knowledge and treatments against the most common parasite – *Varroa destructor*. We got very positive feedback from the audience, we continued in informal discussion after the official part of the meeting. Thanks to this event we had the great opportunity for brainstorming with beekeepers – another important aspect of Citizen Science.

A one day seminar took place on 12th November 2016 in Olomouc. Jiří Danihlík gave a presentation with the results of monitoring since the project started. We planned this talk for Robert Brodschneider in the project application (74p4), but the head of his laboratory at Karl-Franzens University Graz was free to come to Olomouc, thus the university professor Karl Crailsheim spoke about “The economy of honey bees” at the seminar in Olomouc. The second speaker was Philipp Maier from Vienna, he is a veterinarian who is focused on honey bee pathology. He presented “Overview of non-chemical *Varroa* reduction methods“. A brainstorming part was included at the end of the seminar. We got very useful comments and positive critics on the project. All collected notes will be helpful for the whole international research group. All seminar participants had the opportunity to contribute to our results interpretation. This improves the research from the practical perspective even it is a scientific project. Czech beekeeping journal *Moderní včelař* [published a report](#) from this event and also some local beekeeping clubs reported from the seminar, e.g. [ZO ČSV Fryšták](#). We also had the opportunity for discussion with Karl Crailsheim and Phillip Maier during their stay in Olomouc. We presented them our laboratories and research projects, including results from this project.

We see high potential in the data we collected since the project started, thus we invited a new colleague from the Department of Geoinformatics, Faculty of Science, Palacký University Olomouc to cooperate with us. The team is growing up. Our colleague Jan Brus, Ph.D. is an expert in geoinformatics, he will work on further analysis of data during the next year. We are convinced that this research is very useful for practical beekeepers as well as for scientists.

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List of attachments:

- Publication from the Journal of Apicultural Research: Brodschneider et al., 2016
- Czech and Austrian questionnaires
- Poster from the COLOSS conference
- Press release from the association COLOSS
- Detailed financial report from Palacký University Olomouc
- Photo documentation from the project realization
- Articles from *Moderní včelař* with Czech results directed to Czech beekeepers
- Article from *Bienenaktuell - Erhebung der Bienenverluste 2015-16 und Ergebnisse der Vorjahres*
- Participants of the project