68. Jahrestagung der Arbeitsgemeinschaft der Institute für Bienenforschung e.V.

24. März 2021

GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN

ASSOCIATION OF THE GERMAN BEE RESEARCH INSTITUTES E.V.

INHALT

68. Jahrestagung
der Arbeitsgemeinschaft der Institute für Bienenforschung e.V.

09:00 *Zoomraum 1*	**Grußworte** **Marina Meixner, Arbeitsgemeinschaft der Institute für Bienenforschung e.V.** **Torsten Ellmann, Präsident des Deutschen Imkerbunds** **Catrin Westphal, Universität Göttingen, Funktionelle Agrobiodiversität**
09:15 - 10:00 *Zoomraum 1*	**Eröffnungsvortrag** **A matter of taste? - Does the nutritional quality of floral resources play a role for bee health and performance?** **Sara Diana Leonhardt**
10:00 - 10:15	Pause
	PARALELLE SESSIONS
10:15 - 13:15 *Zoomraum 1*	**Session 1: Ökologie, Bestäubung, Wildbienen** **Chair: Catrin Westphal**
10:15 - 13:05 *Zoomraum 2*	**Session 2: Genetik und Zucht** **Chair: Marina Meixner**
10:15 - 12:15 *Zoomraum 3*	**Session 3: Bienenpathologie** **Chair: Elke Genersch**
13:15 - 14:15	Mittagspause
	PARALELLE SESSIONS
14:15 - 14:35 *Zoomraum 1*	**Session 1: Ökologie, Bestäubung, Wildbienen (continue)** **Chair: Catrin Westphal**
14:15 - 17:20 *Zoomraum 2*	**Session 5: Physiologie und Verhalten** **Chair: Bernd Grünewald**
14:45 - 17:55 *Zoomraum 1*	**Session 4: Bienenschutz und Pflanzenschutz & Bienenprodukte** **Chair: Jens Pistorius**
15:30 - 15:55	Kaffeepause
18:00 - 18:30 *Zoomraum 1*	**Abschlusspodium mit Session Highlights**

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9:00 ***Zoomraum 1***	**Grußworte**
9:15 - 10:00 ***Zoomraum 1***	**Eröffnungsvortrag** **A matter of taste? - Does the nutritional quality of floral resources play a role for bee health and performance?** **Sara Diana Leonhardt**
10:00 - 10:15	Pause

PARALELLE SESSIONS

10:15 - 14:35 ***Zoomraum 1***	**Session 1: Ökologie, Bestäubung, Wildbienen** **Chair: Catrin Westphal**
10:15	**V1.1: Perennial wildflower mixtures providing energy for humans and flower visiting insects** Ina Heidinger, Bayerische Landesanstalt für Weinbau und Gartenbau, Institut für Bienenkunde und Imkerei
10:30	**V1.2: The bees are buzzing in the air: Is the bioenergy crop Sorghum bicolor an attractive pollen source for honey-bees (*Apis mellifera* L.)?** Johanna Lill, Landesbetrieb Landwirtschaft Hessen, Bieneninstitut Kirchhain
10:45	**V1.3: Past and present mass-flowering crop cultiva-tion effects on bee pollinators and their pollination services** Nicole Beyer, Georg-August Universität Göttingen, Department of Crop Science, Functional Agrobiodiversity
11:00	**V1.4: Landscape and crop identity effects on trap nesting bees** Margaux Tréguy, Georg-August Universität Göttingen, Department of Crop Science, Functional Agrobiodiversity
11:15	**V1.5: Vergleich von Blühmischungen für Wild- und Honigbienen in der Agrarlandschaft** Felix Klaus, Julius Kühn Institute (JKI), Institut für Bienenschutz
11:30	**Pause**
11:45	**V1.6: Chronicle exposure to a new classe of pesticide may imposes severe risks to foragers of wild bee** Samuel Boff, Julius-Maximilians-Universität Würzburg
12:00	**V1.7: The effects of fertilization, arbuscular mycorrhiza-fungi (AMF), and pollination in strawberries** Carmen Kirsch, Georg-August Universität Göttingen, Department of Crop Science
12:15	**V1.8: Zur Situation von Wildbienen in urbanen Räumen am Beispiel des Forschungsmodellprojekts „Bienenstadt Braunschweig“** Henri Greil, Julius Kühn Institute (JKI), Institut für Bienenschutz
12:30	**V1.9: Impact of different anthropogenic land use and impervious surface on urban wild bee communities** Monika Weber, Julius Kühn Institute (JKI), Institut für Bienenschutz
12:45	**V1.10: Practical approaches to promote pollinator diversity in urban areas by using perennials** Vera Joedecke, Staatliche Lehr- und Versuchsanstalt für Gartenbau Heidelberg & Manuel Treder, Universität Hohenheim, Landesanstalt für Bienenkunde
13:00	**V1.11: Occurrence of wild bees in the city of Stuttgart and ornamental plants as a potential food source** Melanie Marquardt, Universität Hohenheim, Landesanstalt für Bienenkunde
13:15 - 14:15	**Mittagspause**
14:15	**BV1.1: Insektenfreundliche Bioenergieerzeugung auf dem Acker: Mischanbau von Sorghumhirsen mit blühenden Untersaaten** Reinhold Siede, Landesbetrieb Landwirtschaft Hessen, Bieneninstitut Kirchhain
14:20	**BV1.2: Floral resources in urban and agricultural environments – Influences on the nest-growth of *Bombus terrestris*** Lydia Rongstock, Goethe-Universität Frankfurt am Main, Institut für Bienenkunde Oberursel
14:25	**BV1.3: Attractivity of native and non-native *Acer* and *Tilia* species for bees** Julia Grauberger, Julius-Maximilans-Universität Würzburg
14:30	**BV1.4: Silver linden trees and bumblebee mortality** Florian Loidolt, Julius-Maximilians-Universität Würzburg

10:15 - 13:05 *Zoomraum 2*	**Session 2: Genetik und Zucht**	**Chair: Marina Meixner**
10:15	**V2.1: Use of *Apis mellifera* drone's olfactory sensitivity towards pathological odours as a selection trait in the breeding against *Varroa destructor***	
	Ivelina Ivanova, Länderinstitut für Bienenkunde Hohen Neuendorf e.V.	
10:30	**V2.2: Mechanisms of Varroa-resistance – from biological principles to practical usage**	
	Martin Gabel, Julius-Maximilians-Universität Würzburg, Biozentrum	
10:45	**V2.3: Challenges in heritability estimations for honey bees**	
	Manuel Du, Länderinstitut für Bienenkunde Hohen Neuendorf e.V.	
11:00	**V2.4: SETBie: Innovative combination of classical breeding, genetic analysis and evaluation in the practice**	
	Birgit Gessler, Universität Hohenheim, Institut für Nutztierwissenschaften	
11:15	**V2.5: Validating Genomic Selection for Honey Bees**	
	Richard Bernstein, Länderinstitut für Bienenkunde Hohen Neuendorf e.V.	
11:30	**Pause**	
11:45	**V2.6: Substantial genetic progress in the international *Apis mellifera carnica* population since the implementation of genetic evaluation**	
	Andreas Hoppe, Länderinstitut für Bienenkunde Hohen Neuendorf e.V.	
12:00	**V2.7: Europe's First Gene Bank for Honeybees**	
	Victoria Viert, Länderinstitut für Bienenkunde Hohen Neuendorf e.V.	
12:15	**V2.8: Delayed flight-time as an alternative method of controlled honeybee mating**	
	Jakob Wegener, Länderinstitut für Bienenkunde Hohen Neuendorf e.V.	
12:30	**V2.9: A comparative study of survival, colony performance and disease levels in the endemic honeybee *A. m. ruttneri* and the introduced *A. m. ligustica* in Malta**	
	Marina Doris Meixner, Landesbetrieb Landwirtschaft Hessen, Bieneninstitut Kirchhain	
12:45	**V2.10: Insights into Ethiopian honey bees based on morphometric and genetic analyses**	
	Teweldemedh Gebretinsae Hailu, Universität Hohenheim, Institut für Nutztierwissenschaften	
13:00	**BV2.1: Investigation of two honeybee sugar receptors with CRIPSR/Cas9**	
	Laura Degirmenci, Universität Würzburg, Biozentrum, Lehrstuhl für Verhaltensphysiologie und Soziobiologie	

10:15 - 12:15 *Zoomraum 3*	**Session 3: Bienenpathologie**	**Chair: Elke Genersch**
10:15	**V3.1: Abundanz verschiedener Viren in der Königinnenzucht**	
	Hannes Beims, LAVES, Institut für Bienenkunde Celle	
10:30	**V3.2: Prevalence of viruses in black honey bee colonies on the Canary Islands with or without a conservation programme**	
	Viktoria Walther, Martin-Luther-Universität Halle-Wittenberg, Allgemeine Zoologie	
10:45	**V3.3: Experimental infection reveal viral spill-over from honey bees to bumble bees but no spill-back**	
	Anja Tehel, Martin-Luther-Universität Halle-Wittenberg, Allgemeine Zoologie	
11:00	**V3.4: Happy hive – happy life: state of knowledge about Lithium Chloride as a new Varroa treatment**	
	Carolin Rein, Universität Hohenheim, Landesanstalt für Bienenkunde	
11:15	**V3.5: Varroa sensitive hygiene (VSH) and recapping behaviour are not triggered by the reproduction status of the Varroa mite (*Varroa destructor*)**	
	Lina Sprau, Universität Hohenheim, Institut für Nutztierwissenschaften	
11:30	**Pause**	

10:15 - 12:15 *Zoomraum 3*	**Session 3: Bienenpathologie**	**Chair: Elke Genersch**
11:45	**BV3.1: Presence of RNA viruses in Africanized honey bees and a native stingless bee species of the Yucatan Peninsula, Mexico** Fernando Amin Fleites-Ayil, Martin-Luther-Universität Halle-Wittenberg, Allgemeine Zoologie	
11:50	**BV3.2: Comparison of different varroa treatments in summer and winter** Marius Blumenschein, Universität Hohenheim, Landesanstalt für Bienenkunde	
11:55	**BV3.3: Ergebnisse einer Proteomanalyse des Ektoparasiten *Varroa destructor* nach einer Ameisensäurebehandlung** Antonia Genath, Freie Universität Berlin, Institut für Veterinär-Biochemie	
12:00	**BV3.4: A new method for the extraction of hemolymph from adult honeybees to analyze lithium contaminations after Varroa treatment** Markus Grünke, Universität Hohenheim, Landesanstalt für Bienenkunde	
12:05	**BV3.5: Looking for a needle in a haystack – production, selection and characterization of specific monoclonal antibodies for detection and distinction of American and European foulbrood** Sandra Ehrenberg, Friedrich-Loeffler Institut	
12:10	**BV3.6: Molecular diagnostic test for detection of *Malpighamoeba mellificae* PRELL** Marc Oliver Schäfer, Friedrich-Loeffler-Institut, Institute of Infectology	

14:15 - 17:20 *Zoomraum 2*	**Session 5: Physiologie und Verhalten**	**Chair: Bernd Grünewald**
14:15	**V5.1: Verhaltensuntersuchungen zur Häufigkeit und Dauer des Ausfliegens der Bienenkönigin zum Begattungsflug** Martin Ziron, Fachhochschule Südwestfalen Agrarwirtschaft Soest	
14:30	**V5.2: Live imaging of *Apis mellifera* embryogenesis - Investigating the role of acetylcholine in honey bee development** Paul Siefert, Goethe-Universität Frankfurt am Main, Institut für Bienenkunde, Polytechnische Gesellschaft	
14:45	**V5.3: Effect of tergal gland esters on honey bee worker fertility** Anika Meyer, University of Münster, Institute for Evolution & Biodiversity, Molecular Evolution and Sociobiology Group	
15:00	**V5.4: The dose makes the poison: supplementary feeding with probiotics/vitamins and longevity/body weight of winter honey bees, *Apis mellifera*** Gina Retschnig, University of Bern (Switzerland), Vetsuisse Faculty, Institute of Bee Health	
15:15	**V5.5: AmOctα2R: Charakterisierung eines Honigbienen-Octopamin-Rezeptors, der die Adenylatzyklase-Aktivität hemmt** Wolfgang Blenau, Universität Leipzig, Institute of Biochemistry	
15:30	**Pause**	
15:55	**BV5.1: Variation of cuticular hydrocarbon profiles among honeybee workers with different social roles and between different *Apis mellifera* subspecies** Daniel Rodríguez, Julius-Maximilians-Universität Würzburg, Biozentrum	
16:00	**V5.6: Honey bee foraging behavior during and after mass-flowering in agricultural landscapes** Svenja Bänsch, Zoologisches Forschungsmuseum Alexander König, Zentrum für Biodiversitätsmonitoring	
16:15	**V5.7: Do intruders modify the foraging behaviour of the socially polymorphic orchid bee *Euglossa viridissima*?** Anna Friedel, Martin-Luther Universität Halle-Wittenberg, Allgemeine Zoologie	
16:30	**V5.8: Understanding the Influence of the Environment on the Formation of Melezitose** Victoria Seeburger, Universität Hohenheim, Landesanstalt für Bienenkunde	
16:45	**V5.9: Differences in the feeding preference of summer and winter bees toward nectar and honeydew** Thais Chaves, Universität Hohenheim, Landesanstalt für Bienenkunde	
17:00	**V5.10: Olfactometer for honeybee drones in a flight-like scenario** Eduard Musin, Länderinstitut für Bienenkunde Hohen Neuendorf e.V.	
17:15	**BV5.2: Anomalieerkennung auf Grundlage von Sensordaten** Diren Senger, Universität Bremen	

14:15 - 18:00 *Zoomraum 1*	**Session 4: Bienenschutz und Pflanzenschutz & Bienenprodukte**	**Chair: Jens Pistorius**
14:45	**V4.1: The current status of the *Apis mellifera* subspecies in their native range** Alina Komm, Länderinstitut für Bienenkunde Hohen Neuendorf e.V.	
15:00	**V4.2: Honigbienenvitalitätsmonitoring in Raum und Zeit** Harmen Pieter Hendriksma, Julius Kühn Institute (JKI), Institut für Bienenschutz	
15:15	**V4.3: Improved method for routine honey analysis by FTIR-spectroscopy** Norman Tanner, Länderinstitut für Bienenkunde Hohen Neuendorf e.V.	
15:30	**Pause**	
15:55	**BV4.1: Bee Warned – the monitoring system for exotic bee pests in Bavaria – what´s next?** Nicole Höcherl, Landwirtschaftliche Lehranstalten Triesdorf , Tierhaltungsschule, Bienenhaltung	
16:00	**BV4.2: Contaminants in bee pollen – is that still healthy?** Andreas Schierling, Tiergesundheitsdienst Bayern e. V.	
16:05	**BV4.3: Pesticide Residues in Bee Pollen from Baden-Wuerttemberg** Carolin Friedle, Universität Hohenheim, Landesanstalt für Bienenkunde	
16:10	**BV4.4: Bienenschutz: Risikobewertung von Pflanzenschutzmitteln** Nadine Kunz, Julius Kühn Institute (JKI), Institut für Bienenschutz	
16:15	**V4.4: The potential of adjuvants to increase insecticidial effects on honey bees in laboratory contact toxicity tests** Anna Wernecke, Julius Kühn Institute (JKI), Institut für Bienenschutz	
16:30	**V4.5: Assessment of the impacts of microbial plant protection products containing *Bacillus thuringiensis* on the gut microbiome and the survival of honeybees** Charlotte Steinigeweg, Technische Universität Braunschweig	
16:45	**V4.6: Nutritional conditions modulate responses of different bee species to exposure of plant protection products** Denise Castle, Julius Kühn Institute (JKI), Institut für Bienenschutz	
17:00	**BV4.5: Comparative exposure of honey bee brood (*Apis mellifera* L.) to pesticides under semi-field and field conditions** Jakob H. Eckert, Julius Kühn Institute (JKI), Institut für Bienenschutz	
17:05	**BV4.6: Risk to honeybee colonies during control of the gypsy moth (*Lymantria dispar)* with Mimic®?** Andreas Schierling, Tiergesundheitsdienst Bayern e. V.	
17:10	**BV4.7: Chronic high glyphosate exposure delays individual worker bee development under field conditions** Richard Odemer, Julius Kühn Institute (JKI), Institut für Bienenschutz	
17:15	**V4.7: Large scale study comparing the exposure level of honeybees, bumblebees and solitary bees after application of a tank mixture of thiacloprid-prochloraz** Abdulrahim Alkassab, Julius Kühn Institute (JKI), Institut für Bienenschutz	
17:30	**V4.8: The Digital Beehive project – using sensor data to understand side effects of plant protection products on honey bees** Silke Andree-Labsch, Bayer Crop Science	
17:45	**BV4.8: Effects of multiple stressors on honeybees** Sarah Manzer, Julius-Maximilians-Universität Würzburg	
17:50	**BV4.9: Effects of chronic radiofrequency electromagnetic radiation (RF-EMF) on honey bees** Manuel Treder, Universität Hohenheim, Landesanstalt für Bienenkunde	
18:00 - 18:30 *Zoomraum 1*	**Abschlusspodium mit Session Highlights**	

SESSION 1: Ökologie, Wildbienen und Bestäubung

V1.1: Mehrjährige Wildpflanzenmischungen liefern Energie für Mensch und Blütenbesucher

Perennial wildflower mixtures providing energy for humans and flower visiting insects

Ina Heidinger[1], Kornelia Marzini[1], Elena Krimmer[2], Ingrid Illies[1]

[1]Bayerische Landesanstalt für Weinbau und Gartenbau, Institut für Bienenkunde und Imkerei

[2]Julius-Maximilians-Universität Würzburg, Biozentrum

Due to the increasing demand for renewable energy, about 13% of the farmland in Germany is used for the cultivation of energy plants. The most frequently grown plants are *Zea mays* and *Brassica napus*. Beside those, also mixtures of late flowering, herbaceous perennials can be used, providing pollen and nectar for honeybees and other flower visitors from midsummer until late autumn. In this study, we evaluated the suitability of plant mixtures as substrate for biogas production under practical conditions. In addition, we also evaluated the mixtures as food sources (pollen and nectar) for insects.

For several years, we placed honeybee colonies at different sites with mixtures of flowering, herbaceous perennials and determined the pollen intake, the honey yield, and the amount of winter food of each colony. To identify the spectrum of flower visiting insects we used coloured pan traps and directly observed the inflorescence of different plant species. We also determined the yield of dry mass and methane after harvesting of the mixtures.

Our plant mixtures were intensively visited by different bees and other insects. In total, we identified 58 bee species from 11 different genera including 19 species of the German red list of endangered species. Depending on year and plant mixture, the honey yield of our colonies ranged between 5.2 and 21.7 kg per colony. The yield of dry mass was about 8 to 11 tDM/ha and methane yield ranged from 1790 to 2364 m^3CH_4/ha.

Mixtures of flowering, herbaceous perennials may not yield the same quantity of dry mass and methane as maize. However, they provide some important ecological benefits. In contrast to maize, flowering energy plants provide a diverse diet of pollen and nectar for insects until harvesting in autumn. In addition, they reduce the nitrogen and ammonium content of the soil, leading to a remarkable reduction of the nitrogen pollution of the ground water. They are less labour intensive than maize and can be harvested for several years without resowing.

Keywords: foraging behaviour, flight performance, offspring, pesticides, pollen collection, wild bees

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SESSION 1: Ökologie, Wildbienen und Bestäubung

V1.2: Ein Summen erfüllt die Luft: Ist die Bioenergiepflanze *Sorghum bicolor* für Bienen eine attraktive Pollenlieferantin?

The bees are buzzing in the air: Is the bioenergy crop *Sorghum bicolor* an attractive pollen source for honeybees (*Apis mellifera* L.)?

Johanna Lill[1,2], Reinhold Siede[1]

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[2]Philipps-Universität Marburg

Germany's climate protection plan calls for fossil fuels to be replaced by renewable energies. Bioenergy crops are promising. In Middle Europe, usually the plant of choice is maize. Maize's presumed low ecological significance gave rise to a joint project: The aim was to breed a stress-tolerant alternative to maize (*Sorghum bicolor*) with benefits for insects.

To test the benefits of Sorghum for honeybees (*Apis mellifera*), a field trial was conducted at an experimental station in Bad Hersfeld (Germany) in 2018. Six colonies were positioned at a *Sorghum* field and equipped with pollen traps. The botanical origin of the collected pollen was identified by subsequent light microscopy. During the two weeks when most Sorghum pollen was collected, *Sorghum*-pollen accounted for 6 % of the total pollen mass. Besides the field trial, feeding trials were established. The bees were caged in an incubator and different pollen pastes (Mix, *Sorghum*, Balsaminaceae, none) were offered. Physiological properties e. g. bodyweight, lifespan and vitellogenin gene expression were evaluated. The individual bees in the Sorghum-fed group weighed significantly more than all other bees (Kruskal-Wallis, $H = 102.83$, $p < 0.001$). Bees with a diet consisting of mix pollen lived longer than bees with a *Sorghum*-pollen supply (Kaplan-Meier, $df = 1$, $p = 0.003$). There was a significant difference in the expression of vitellogenin gene between bees fed only sugar water and bees fed a supplementary pollen diet (Welch's ANOVA, $F (3, 30.221) = 66.245$, $P < 0.001$). Between the pollen supplements no significant differences were observed.

The present results confirm that bees readily collect *Sorghum*-pollen. The pollen, as proved in the feeding trials, provides a supplement to the scarce pollen supply in late summer and can be used to raise vital winter bees. *Sorghum*-pollen was not of higher quality than other types of pollen, but neither was it harmful.

Keywords: bioenergy, *Sorghum bicolor*, pollen, nutrition, feeding experiments

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SESSION 1: Ökologie, Wildbienen und Bestäubung

V1.3: Der Einfluss des Anbaus von Massentrachten in der Vergangenheit und in der Gegenwart auf Bestäuber und deren Bestäubungsleistung

Past and present mass-flowering crop cultivation effects on bee pollinators and their pollination services

Nicole Beyer[1], Catrin Westphal[1], Doreen Gabriel[2]

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[2]Julius Kühn Institute (JKI) - Federal Research Centre for Cultivated Plants, Institute of Crop and Soil Science

Mass-flowering crops provide food resources for bees in agricultural landscapes and in turn benefit from insect pollination as important ecosystem service. It is however widely unknown, whether the long-term cultivation of mass-flowering crops within the past years influences wild bees and their pollination services in the actual year. We hypothesized a positive effect of high covers of mass-flowering crops in the preceding years on wild bee densities and their contribution to crop yields. Contrary, we expect high covers of co-flowering crops to dilute wild bees in crop fields with negative implications for crop yields.

We conducted a pollinator exclusion experiment in oilseed rape (*Brassica napus* L.) fields in 22 different landscapes in Central Germany to measure the contribution of insect pollination to yield. We bagged whole oilseed rape plants within each field and compared different yield components of bagged plants with open pollinated plants. Moreover, we recorded the density of wild bees and honeybees with standardized transect walks in each oilseed rape field.

Our results show that insect pollination enhanced the seed number per pod by on average 8.1 % and decreased the thousand-seed weight by approx. 5.5 %. Wild bee densities and seed weight per plant of open pollinated plants were enhanced in landscapes with high past mass-flowering crop covers, while we found lower bee densities in landscapes with a high current oilseed rape cover. We provide some evidence for positive carry-over effects of the cultivation of mass-flowering crops in the past on bee densities in the present year. We conclude that the long-term cultivation of flowering crops can benefit wild bees and their pollination services independent of potential negative dilution effects arising from high covers of co-flowering crops. Further research needs to address the interaction between landscape metrics in the past and the present year and how this shapes crop yields.

Keywords: honeybees, wild bees, pollination, ecosystem services, landscape history, landscape composition, carry-over effects

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SESSION 1: Ökologie, Wildbienen und Bestäubung

V1.4: Landscape and crop identity effects on trap nesting bees

Margaux Tréguy, Catrin Westphal, Nicole Beyer

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Within pollinator species, bees are the most predominant and important group in most regions, contributing to agricultural production. However, due to massive habitat conversion, the presence of wild bee in agricultural landscapes is often limited by the lack of suitable nesting sites and food resources. It is therefore a main concern to understand the impact of local and landscape variables on the dynamics between bees, their environment and their antagonists. We expect an effect of the bordering habitat on the abundance and richness of solitary bees and their antagonists. Moreover, we expect an effect of the landscape composition and configuration on the insects.

Using a landscape-scale approach, we selected 15 landscapes in Germany, which varied in their landscape composition (i.e. area cover of oilseed rape, of faba bean and cropland) and landscape configuration (edge density). For each landscape, 6 trap nests were set up at 3 locations with different bordering habitats (in direct vicinity to oilseed rape, to a non-flowering-crop or to semi-natural habitat structure) in 2018. We counted the number of brood cells, the number of aborted cells and of parasitized cells and identified bees and their parasites. In total, we recorded 4296 brood cells (68,8% of *Osmia bicornis*) off 952 single bee nests (48.3 % of *Osmia bicornis*). 5.4 % of the brood cells died because of parasitism and 17.2% died of other reasons.

Preliminary results suggest that trap nests bordering a neighboring semi-natural habitat structure had highest bee abundances. Moreover, we found the cover of faba bean, cropland and edge density to affect the bee abundances, but this effect was modulated by the bordering habitat. We provide evidence that local and landscape-scale factors interact modulating the abundance of trap-nesting bees. Hence, we should consider landscape composition and landscape configuration in landscape management and promote semi-natural habitats as food and nesting resource for wild bees.

Keywords: wild bees, trap-nest, landscape configuration, landscape composition

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SESSION 1: Ökologie, Wildbienen und Bestäubung

V1.5: Vergleich von Blühmischungen für Wild- und Honigbienen in der Agrarlandschaft

Comparing flower mixes for solitary wild bees and honeybees in the agricultural landscape

Felix Klaus, André Krahner

Julius Kühn Institute (JKI) - Federal Research Centre for Cultivated Plants, Institute for Bee Protection

Das Projekt FInAL untersucht die Förderung von Bienen in einer ackerdominierten Agrarlandschaft. Um die Verfügbarkeit von Nektar und Pollen für Wild- und Honigbienen zu verbessern, wurden in der Umgebung von Braunschweig im Frühjahr 2020 Blühflächen mit verschiedenen Saatgutmischungen angelegt. Zwei Mischungen wurden auf Grundlage der zulässigen Arten auf für Honigpflanzen genutztem brachliegendem Land (Anlage 5 zu § 32a Absatz 2 Satz 1 und Absatz 3 Direkt-ZahlDurchfV) für Honig- bzw. Wildbienen optimiert. Die dritte Mischung wurde ohne entsprechende Auswahlbeschränkung zur Förderung von Wildbienen erstellt. An elf Standorten wurden jeweils 500 m² der drei Mischungen nebeneinander angelegt. Zu drei Zeitpunkten der Saison wurden Vegetationsaufnahmen durchgeführt und Bienen mit Hilfe von verschiedenfarbigen Farbschalen erfasst. Insgesamt wurden etwa 1200 Bienen-Individuen, v.a. aus den Gattungen *Lasioglossum*, *Andrena*, sowie *Bombus*, *Halictus* und *Osmia*, gefangen. Die intensiv bewirtschaftete Landschaft war mit mehr als 50 verschiedenen Bienenarten relativ artenreich. Im ersten Untersuchungsjahr zeigte sich, dass sowohl die Pflanzen- (dominiert von spontaner Vegetation aus den lokalen Samenbanken) als auch Bienengemeinschaften eher standorttypisch waren. Unterschiede zwischen den verschiedenen Blühmischungen an den einzelnen Standorten waren weniger stark ausgeprägt. Mit der Etablierung der Zielpflanzen und der Blüte der mehrjährigen Pflanzen erwarten wir ab der kommenden Saison ausgeprägtere Unterschiede zwischen den Saatmischungen. Außerdem lieferten unsere Ergebnisse Hinweise darauf, dass eine höhere Saatstärke zu höherer Blütendeckung führt und geeignet ist, das Auflaufen von Beikräutern im ersten Jahr zu mindern. Gefördert durch: Bundesministerium für Ernährung und Landwirtschaft aufgrund eines Beschlusses des Deutschen Bundestages.

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SESSION 1: Ökologie, Wildbienen und Bestäubung

V1.6: Chronicle exposure to a new classe of pesticide may imposes severe risks to foragers of wild bee

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Sulfoxaflor is a competitive modulator of nicotinic acetylcholine receptors in insects. Despite structural differences with neonicotinoids, sulfoxaflor was found to impact activities of bees, including reproduction. In this presentation I will explain recent findings on the effects of this new class of pesticide on foraging activities of bumble bees and red mason bees, two major pollinators of crops and wild plants in Europe.

Keywords: foraging behaviour, flight performance, offspring, pesticides, pollen collection, wild bees

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SESSION 1: Ökologie, Wildbienen und Bestäubung

V1.7: Die Wirkung von Düngung, arbuskulären Mykorrhiza-Pilzen (AMF) und Bestäubung auf Erdbeeren (*Fragaria ananassa*)

The effects of fertilization, arbuscular mycorrhiza-fungi (AMF), and pollination in strawberries (*Fragaria ananassa*)

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Strawberries (*Fragaria ananassa*) are well known to be pollinator sensitive in terms of fruit yield and quality. Another important factor that affects fruit quality and high yields is nutrient supply which can be enhanced by symbiosis with arbuscular mycorrhiza-fungi (AMF). Further, plant nutrition can affect flower size and reward quality which might affect pollinators foraging preferences. In our study we examine the effects of AMF abundance and fertilizer level on pollinator preferences and the interactive effects on strawberry fruit yield and quality. Following research questions were pursued to answer: (i) Do pollinators show a preference for different AMF and fertilizer treatments? (ii) Do AMF-inoculation, fertilizer levels and insect pollination effect fruit yield and quality?

We designed a block experiment with 480 potted strawberry plants in 2020 and applied following treatments: high and low fertilization, with and without additional AMF, access and no access to pollinators and all interactions. Pollinator abundance was investigated during transects. Flower cover was counted and open flowers were marked at each transect walk. We measured fruit weight (in g per berry) and quality (commercial grades and sugar-acid-ratio).

Preliminary results show that pollinators do not prefer plants of different AMF- or fertilization levels. Instead, the flower cover is rather decisive for them. In general, insect pollinated fruits show greater yield and quality. We found evidence that strawberry fruit weight and quality were highest when fertilizer level was high and the plants were AMF-inoculated, but did not differ between low fertilization and high AMF and high fertilization without AMF due to higher nutrient uptake by the plants. We conclude that AMF and fertilizer levels did not influence flower attractiveness in our set-up. However, symbiosis with AMF seems to compensate stress caused by nutrient shortage resulting in a good yield and quality of strawberry fruits.

Keywords: strawberry, AMF, pollinators, fertilization

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SESSION 1: Ökologie, Wildbienen und Bestäubung

V1.8: Zur Situation von Wildbienen in urbanen Räumen am Beispiel des Forschungsmodellprojekts „Bienenstadt Braunschweig“

The status of wild bees in urban areas, using the research model project ‘Bee city Braunschweig’

Henri Greil, Benjamin Arlt, Anke Dietzsch, Tobias Jütte, André Krahner, Monika Weber, Jens Pistorius

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Verschiedene Studien der letzten Jahre zeigen Bestandsrückgänge bei Fluginsekten (z.B. Schwebfliegen, Schmetterlingen und Wildbienen) in naturnahen Räumen und Agrarlandschaften. Städte und Gemeinden werden dagegen als Rückzugsräume für Wildbienen diskutiert. Urbane Räume könnten sich jedoch auch als Senken herausstellen, da anthropogene Faktoren wie z.B. Verkehr, häufige Pflegemaßnahmen und Nachverdichtung Bienen direkt und indirekt schädigen können. Daher ist eine fortlaufende Untersuchung der Bestandsituation, sowie daraus abgeleitete artspezifische Maßnahmen zur Sicherung und Verbesserung der Lebensgrundlagen, entscheidend zur Förderung von Wildbienen in urbanen Räumen. Wir haben im Stadtgebiet Braunschweig und der umgebenden Agrarlandschaft in den Jahren 2019 und 2020 an 59 bzw. 105 Standorten Wildbienen erfasst. Dies erfolgte jeweils im April, Juni und August, für 24 Stunden mit Hilfe von Farbschalen. Analysen zeigen im Siedlungsraum für beide Erfassungsjahre eine Halbierung der erfassten Individuenzahlen von April zu Juni und eine erneute Halbierung im August. Im Agrarraum ist die Anzahl der erfassten Individuen dagegen über alle drei Erfassungstermine konstant. Weitere Analysen zeigen eine starke räumliche Korrelation zwischen den sehr individuenstarken Frühjahrsarten, wie z.B. der Großen Weidensandbiene *Andrena vaga* mit der Anwesenheit ihr Hauptnahrungsquelle (Weiden), im Umkreis von 750 m um die Erfassungsstandorte. Kartierungen belegen zahlreiche große Aggregationen von *Andrena vaga* fast im gesamten Stadtgebiet, z.B. in Parks, auf Rasenflächen in Wohngebieten, Wendeschleifen der Straßenbahn und Sportplätzen. Die Ergebnisse belegen, dass urbane Räume geeignete Rückzugsorte für die untersuchten Frühjahrsarten darstellen können und geben Hinweise zur Wirksamkeit artspezifischer Fördermaßnahmen in Städten sowie zur Verbesserung der Agrarlandschaft.

Keywords: wild bees, decline, urban ecology, biodiversity, monitoring, landscape factors, conservation actions

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SESSION 1: Ökologie, Wildbienen und Bestäubung

V1.9: Einfluss unterschiedlicher anthropogener Landnutzung und der Versiegelung auf die urbane Bienengemeinschaft

Impact of different anthropogenic land use and impervious surface on urban wild bee communities

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Land cover is mainly dominated by anthropogenic habitats. In recent decades, natural or semi-natural areas decreased markedly in our landscapes. The resulting habitat loss is considered to be one of the main drivers for the decline of diversity across several plant and animal taxa. Often this goes along with negative effects on ecosystem services like pollination provided by wild bees. Therefore, it is important to evaluate possibilities to promote pollinators in anthropogenic environments. Urban habitats are often considered as bee refuges. Incentive measures are currently discussed to improve bee diversity in cities. Examining the urban wild bee community, a baseline monitoring has been conducted at the city of Braunschweig. Pan traps of different colours were set for 24 h each in April, June and August at 53 sites spread across the city, to sample wild bees while foraging. A total of 1910 bees belonging to 103 species were sampled. The majority of the individuals were found in spring, while in early summer, the highest number of species was observed. On average 36 individual bees were caught at the sites all over the year. The average species richness was 13.3 per site, with a range from 1 to 24. With this data set, different landscape factors affecting the bee community in the city will be analysed. Landscape data like impervious density from the Copernicus Land Monitoring Service or different feature types of the Digital Basic-Landscape model will be used for examination. With the resulting findings, incentive measures can be developed to increase the attractiveness of urban areas for wild bees.

Keywords: wild bees, urban, biodiversity, monitoring, landscape factors, anthropogenic land use

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SESSION 1: Ökologie, Wildbienen und Bestäubung

V1.10: Praktische Ansätze zur Förderung der Bestäubervielfalt im urbanen Raum durch Staudenverwendung

Practical approaches to promote pollinator diversity in urban areas by using perennials

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The ongoing decline of insect pollinators demonstrates the need for effective protection strategies. Urban areas can serve as refugia for insect pollinators. Besides native plants also many exotic and bred ornamentals are accepted as food sources. However, the current data about pollinator friendly ornamentals is scarce. To develop effective recommendations for pollinator friendly facilities the following approaches were used:

(I) We evaluate preexisting professional plantings in private, industrial and public settings for their value for pollinators. Over two years regular counts of foraging insects on planting combinations were performed in Heidelberg and Stuttgart and habitat opportunities for bees in the surroundings were assessed. Preliminary results indicate a broad variation in the attractiveness of different ornamental plants. The most attractive plants include both, native as well as exotic plants.

(II) With regard to limited space in urban areas, we also tested a combined system of vertical plantation with integrated cavity nesting sites for bees. Each vertical system is equipped with both, native perennials and bred ornamentals. Pollinator counts and cavity occupancy are used for assessment. Preliminary results indicate that the plants on the vertical wall are visited to a similar degree as the same plants in a horizontal planting.

(III) Considering that the majority of wild bees is ground-nesting, we developed and compare four different systems of ground-nesting sites on our experimental area, which can be included in garden concepts. This work shall help to fill current gaps of knowledge and develop effective recommendations for pollinator friendly plantings directly applicable by garden and landscape constructors, municipalities and citizens.

The project Schutz und Förderung der biologischen Vielfalt in der Stadt und in den Gemeinden - BioVa is funded by the State of Baden-Württemberg: Sonderprogramm zur Stärkung der biologischen Vielfalt.

Keywords: pollinator diversity, species conservation, ornamental plants, urban gardening

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SESSION 1: Ökologie, Wildbienen und Bestäubung

V1.11: Wildbienenvorkommen im Stadtgebiet Stuttgart und Zierpflanzen als potenzielle Nahrungsquelle

Occurrence of wild bees in the city of Stuttgart and ornamental plants as a potential food source

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The urban areas currently amount 15% of the total area in Germany with increasing tendency. But these areas can also provide a suitable habitat for many flower-visiting insect species and should therefore be considered in conservation programs for pollinators. In this study, we investigated whether wild bees use ornamental plants as foraging sources and how environmental factors of different locations within a city affect the composition of bee species. This study was conducted in the years 2017 and 2018 at nine different congested areas in Stuttgart. At each location, a raised flower bed was installed and planted with an identical set of 28 ornamental garden plant cultivars. On six days during the summer months, the foraging wild bees on our ornamental garden plants at all location sites were collected for 20 minutes using a hand net. Additionally, the percentages of paved area in a 250 m and 500 m radius and the environmental parameters (path, soil, herbaceous vegetation, grass, woody plants and wildflower strip) in the adjacent areas (16 m) around the flower beds were assessed at all testing sites. Over the two-year period, we collected 965 wild bee individuals from 73 wild bee species. The species composition varied highly in both years and we also found significant differences in the species composition among the nine locations. Despite many environmental parameters being highly variable among the 9 locations, only the two parameters 'path' and 'woody plants' showed a negative impact on the number of wild bee species. This study shows that many wild bee species even occur at highly congested areas and that ornamental plants can be a suitable foraging resource for them. It further suggests, that the wild bee species composition is not significantly correlated with our tested environmental parameters. This project was funded by the European Agricultural Fund for Rural Development: Europe investigating in rural areas with the participation of the State of Baden-Württemberg.

Keywords: wild bees, ornamental plants, urban ecology, net catching, environmental factors

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SESSION 1: Ökologie, Wildbienen und Bestäubung

BV1.1: Insektenfreundliche Bioenergieerzeugung auf dem Acker: Mischanbau von Sorghumhirsen mit blühenden Untersaaten

Insect-friendly bioenergy production in the field: mixed cultivation of sorghum with flowering undersown crops

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Die Intensivlandwirtschaft gilt als ein Treiber des Insektenrückgangs. Moderne Bioenergiefruchtfolgen bieten blütenbesuchenden Insekten wenige Nahrungsressourcen. Inwiefern der Mischanbau von nektar- und pollenliefernden Untersaaten (US) mit ertragsstarken Deckfrüchten, hier Sorghumhirsen (*Sorghum bicolor* L.), die Situation verbessern kann, haben wir in 2020 in einem fünffaktoriellen Feldversuch mit 2 Standorten (Groß Gerau und Rauischholzhausen), 2 Sorghum-Dualtyphybriden, 2 Sorghumbestandesdichten, 21 US-arten und 1 bis 2 US-sorten in zweifacher Wiederholung untersucht. 21 US-Arten aus den Gattungen *Trifolium*, *Phacelia*, *Fagopyrum, Raphanus*, *Helianthus*, *Camelia*, *Sinapis* und *Medicago* wurden geprüft. Kontrollen waren Parzellen mit Sorghumreinsaat. Je Standort wurden 6 Bienenvölker aufgestellt. Um die 2720 Aufnahmen der Blütenbesuche wurden in den knapp 600 Parzellen über einen Zeitraum von 10 Wochen erhoben. Die Anzahl der Blütenstände je Fläche, der Blütendeckungsgrad, die Bestandeshöhe, die Blühdauer und die Massenerträge wurden wöchentlich erfasst. Besonders attraktiv für blütenbesuchende Insekten waren *P. tanacetifolia*, *F. esculentum* und *H. annus*. Jedoch waren diese Gemenge ertragsschwach. Etwas niedrigere, aber statistisch nicht von der Kontrolle unterscheidbare Erträge wurden u. a. mit den Kombinationen Sorghum und *T. alexandrinum*, *T. hybridcum* und *T. resupinatum* erzielt (α=0,05, Tukey Test). Diese Gemenge belegten im Ranking nach der Insektenattraktivität mittlere Plätze. Positive, signifikante Korrelationen wurden zwischen der Dauer, der Anzahl, dem Deckungsgrad der Blüten sowie der Höhe der US mit der Anzahl Blütenbesuche gefunden ($p<0,05$, Pearson Koeff.). Die Versuche in 2020 waren ein erstes Screening. Weitere Verbesserungen des Mischanbaus werden aktuell durch das vom BMEL auf Grund eines Beschlusses des Deutschen Bundestages geförderten SoBinEn – Verbundprojektes bearbeitet.

Keywords: Sorghum bicolor, mixed cropping, bioenergy, flower-visiting insects, honeybee

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HESSEN

Insektenfreundliche Bioenergieerzeugung auf dem Acker: Mischanbau von Sorghumhirsen mit blühenden Untersaaten

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Einleitung:

Hintergrund: Diversität und Abundanz blütenbesuchender Insekten sind stark rückläufig. Als einer der Haupttreiber gilt die Intensivlandwirtschaft. Maisdominierte Bioenergiefruchtfolgen stehen deswegen in der Kritik.

Lösungsansätze: Mischanbau der alternativen Bioenergiepflanze *Sorghum bicolor L.* mit blühenden Untersaaten (US):

- Zukunftspflanze Klimawandel: Gute Leistungen bei Wassermangel und hohen Temperaturen.
- Nicht-Wirtspflanze des Maiswurzelbohrers (*Diabrotica* spp.)
- Guter Kornansatz, hohe Energiedichte moderner Dualtypen
- Sehr gute Pollenschüttung – hohe Wertigkeit für pollensammelnde Insekten.
- Erweiterung des Nektar- und Pollenangebotes durch Untersaaten (US).

Abb.1: Pollensammlerin (*Apis mellifera)* an Rispe von *Sorghum bicolor*

Ziel:

Identifizierung der besten Sorghum – US Gemenge, bewertet anhand der Biomasseerträge und der Attraktivität für blütenbesuchende Insekten.

Methode: Fünffaktorieller Feldversuch

(2 Standorte, 22 US-arten und – 1-2 US-sorten, 2 Sorghum-bestandesdichten und 2 Sorghumhybriden und 6 Bienenvölker je Standort).

Bonituren:

- Anzahl Blütenbesuche
- Biomasseertrag
- Pollensammelgut Bienen (Bestimmung der botanischen Herkunft durch Metabarcoding durch die Firma AIM, Leipzig).

Abb.2: US Schwedenklee in Blüte (*Trifolium hybridum*)

Ergebnisse:

- Sehr zahlreiche Blütenbesuche wurden beobachtet bei den Varianten Pht, Ha, Fes, Rs und Terralife® .
- Die Erträge der Varianten mit den Untersaaten Lap, Ti, Ovi, Tr, Lands, Tp, Ta, Thy und Terralife® waren statistisch nicht von der Kontrolle unterscheidbar (p=0,05, Tukey Test) .
- Von den ertragsneutralen US waren TerraLife®, Thy und Ta für Insekten am attraktivsten.
- Knapp 50 % der von den Bienen eingetragenen Pollen stammten von Arten, die als US angebaut wurden (Barcoding Analysen Abb. 4).

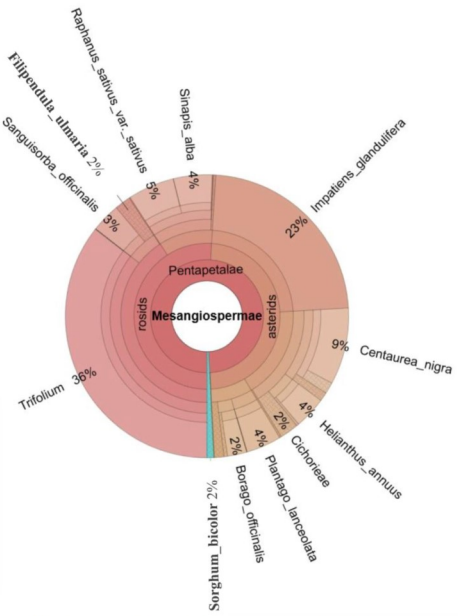

Abb. 4: Krona chart der botanischen Herkünfte der Pollenproben am Standort Rauischholzhausen von KW 30 bis KW 38 2021. Metabarcoding, ITS2.

Tab. 1: Getestete Untersaatenarten, Erträge und Blütenbesuche aggregiert über Standort, Bestandesdichte, Sorghumhybride und US-sorten. Kontrolle= Sorghum ohne US.

Genus	Spezies (Abk.)	Ertrag, TM t / ha		# Blüten-besuche	
Raphanus	*sativus* (Rs)	4,94	f	15,88	c
Phacelia	*tanacetifolia* (Pht)	6,28	f	36,83	a
Fagopyrum	*tataricum* (Fta)	7,18	ef	4,17	ef
Helianthus	*annuus* (Ha)	8,75	e	27,77	b
Sinapis	*alba* (Sal)	9,12	de	10,17	cd
Meliotus	*officinalis* (Mel)	9,26	de	1,58	ef
Fagopyrum	*esculentum* (Fes)	9,75	cd	14,33	c
Medicago	*sativa* (Msa)	10,98	bcd	1,54	ef
Camelia	*sativa* (Cs)	11,24	bcd	7,15	de
Trifolium	*resupinatum* (Trr)	11,29	bcd	4,15	ef
Phaseolus	*vulgaris* (Phv)	11,30	bcd	0,80	ef
Landsberger	Gemenge (Lands)	11,55	abcd	3,12	ef
Trifolium	*incarnatum* (Ti)	12,22	abc	1,60	ef
Trifolium	*pratense* (Tp)	12,22	abc	2,66	ef
Trifolium	*repens* (Tr)	12,30	abc	1,45	ef
Trifolium	*hybridum* (Thy)	12,37	abc	4,86	def
TerraLife®	Mischung der DSV	12,40	abc	15,70	c
Onobrychis	*viciifoli* (Ovi)	12,60	ab	1,26	ef
Vicia	*faba* (Vf)	12,68	ab	0,39	f
Lablab	*purpureus* (Lap)	12,72	ab		
Trifolium	*alexandrinum* (Ta)	12,91	ab	2,75	ef
Vicia	*sativa* (Vs)	14,00	a	1,00	ef
Kontrolle	ohne US	14,08	a		

Abb.3: Hummel auf Phaceliablüte im Sorghumbestand.

Schlußfolgerung: Die US blüten im Sorghumbestand. Sie wurden von den Bienen als Nahrungspflanze genutzt. US können die Wertigkeit des Bioenergieanbaus für Insekten steigern.

Ausblick: Im zweiten und dritten Projektjahr werden wir weitere US prüfen. Das Anbausystem soll ertraglich optimiert werden. Die besten US-Sorghumgemenge werden in Großparzellen getestet werden, um deren Bedeutung für die Entwicklung von Bienenvölkern qualitativ und quantitativ besser abschätzen zu können.

Gefördert durch:

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FNR Fachagentur Nachwachsende Rohstoffe e.V.

Die Studie ist Teil des Verbundvorhabens „Sorghum-Blühmischungen für einen insektenfreundlichen Energiepflanzenanbau (SoBinEn)" mit den Partnern TFZ Straubing, DSV AG, der Justus Liebig Universität, Giessen und als assoziierten Partner die NPZ, Hohenlieth. Das Projekt wird gefördert durch das Bundesministerium für Ernährung und Landwirtschaft auf Grund eines Beschlusses des Deutschen Bundestages und abgewickelt durch die FNR e. V., Gülzow (FKZ 2219NR452).

Kompetenz für Landwirtschaft und Gartenbau LLH

SESSION 1: Ökologie, Wildbienen und Bestäubung

BV1.2: Florale Nahrungsquellen in städtischen und ländlichen Gegenden-Einflüsse auf das Nestwachstum von *Bombus terrestris*

Floral resources in urban and agricultural environments – Influences on the nest-growth of *Bombus terrestris*

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Changes in land-use from more natural to expanding urban or intensified agricultural environments reduce and fragment the habitats of wild pollinators worldwide. Means to support the diversity of insect pollinators have been implemented in both anthropogenic environments. To investigate the success of such measures, we exemplarily compared two areas in and close to Frankfurt am Main, Germany.

Ten hives of *Bombus terrestris* were placed at each site in an urban and rural environment to examine their nest growth depending on the existing floral resources. Each site was characterised with various landscape metrics to describe the proportion of valuable areas: sizes of all green areas (open vegetated spaces), floral areas (green area intended for pollinator support), their distance to the hives and edge density (degree of habitat fragmentation). The quality and condition of all floral areas were determined by identifying the flowering plant species and their estimated diversity.

Additional values contingent on the bumblebee's performance were collected to indicate which flowering spots have been foraged by the test hives and whether the foraging activity relates to the areas' condition. In a systematic search on all floral areas, all individuals of *Bombus terrestris* were recorded and pollen of returning workers was analysed for species identification.

The results show poorly developed meadows in the assessed urban park in Frankfurt but a richer flower supply in surrounding gardens, resulting in an overall high edge density. Rural floral resources were highly confined on cultivated fields of wildflowers which were in a moderate state of quality. This particularly demonstrates the importance of set-aside fields for sustaining pollinators in agricultural areas. Urban workers were larger, and their hives were heavier infected with parasites. Numbers of all imagines were similar at both sites, though tendencies of more new rural queens and more urban drones were detected.

Keywords: bumblebees, urban and agricultural environments, floral resources

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Floral resources in urban and agricultural environments

Influences on the nest-growth of *Bombus terrestris*

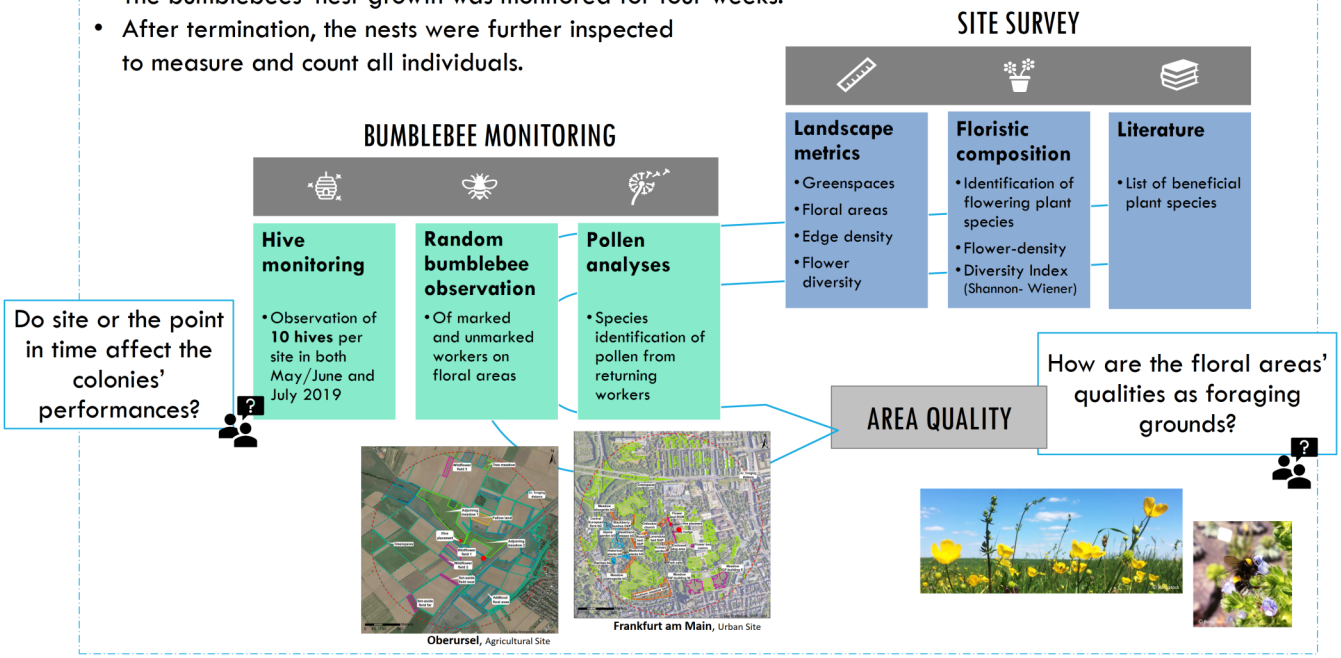
LYDIA RONGSTOCK*, MASSIMO RECCHIUTI AND BERND GRÜNEWALD

INTRODUCTION

- Expanding urbanisation and agricultural intensification **reduce and fragment habitats** of wild pollinators worldwide.
- To support the diversity and **abundance of wild pollinators**, means have been implemented in two anthropogenically altered environments: **urban areas and agricultural landscapes.**
- **Fields** with sown mixed **wildflower seeds** and specifically managed **meadows** with a high number of **native wildflowers** are established in agricultural and urban areas.

METHODS and QUESTIONS

- Detailed biotope mappings of the urban site in Frankfurt am Main and the agricultural site in Oberursel with a radius of 650 m was conducted.
- 10 hives of *B. terrestris* were placed at each's site centre in May/June and again in July 2019.
- The bumblebees' nest-growth was monitored for four weeks.
- After termination, the nests were further inspected to measure and count all individuals.



RESULTS and CONCLUSION

	HIVE PERFORMANCE	AREA QUALITY
Urban	**Larger workers** and higher parasite infestation. Tendency of **more new drones.**	**Low extent** and **quality** of floral areas (despite large proportion of greenspaces). **Decrease** in area quality **over time.**
Agricultural	**More new queen pupae** and tendency of more new queen imagines.	**Larger extent** and **higher quality** of floral areas • High abundance of beneficial plants • Higher competition between pollinators

- Conservation means should be designed **sustainable** to support the needs of many different pollinator species **throughout the entire vegetation period** in consecutive years especially at the **colonies' peak** when the production of new queens requires the most amount of food resources.

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SESSION 1: Ökologie, Wildbienen und Bestäubung

BV1.3: Attraktivität heimischer und gebietsfremder *Acer*- und *Tilia*-Arten für Bienen

Attractivity of native and non-native *Acer* and *Tilia* species for bees

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In urban areas, city trees provide important habitats and food resources for bees. Extreme weather conditions reduce the vitality of native tree species. Therefore, the question arises whether closely related, non-native tree species with higher stress tolerances could be considered as alternatives and whether they provide food sources and habitats for the same diversity and abundance of bees.

In this study, ten different species of *Acer* (N = 45; species: 3 native, 7 non-native) and *Tilia* trees (N = 45; Arten: 2 native, 8 non-native) were examined. Visual observation, net chatches and window flight traps were applied to determine the abundance and diversity of bees (honey- and wildbees) within the tree crown and flowers.

Overall 39 wild bee species were observed in *Acer* sp. and 36 species in *Tilia* sp.. 60 % (*Acer* sp.) and 47.2 % (*Tilia* sp.) of wild bee species were detectet in both, native and non-native trees. Furthermore bees were found at least as often in flight traps of non-native trees as in those of their native relatives. However, in some non-native trees less bees were detected on flowers as in those of the native, closely related trees. This result seems to be effected more by bee populationdynamics and ressource quantitiy, than by ressource quality.

These results indicate that closely related native and non-native trees were mainly visited by the same bee species. Especially with regard to climate change, the high stress tolerance toward weather extremes of non-native, closely related tree species can make a useful complement to urban tree species and contribute to urbam biodiversity.

Keywords: honeybee, wildbees, climate trees, abundance, diversity

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Attraktivität heimischer und gebietsfremder *Acer*- und *Tilia*-Arten für Bienen

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Einleitung

Stadtbäume bieten wichtige Ökosystemdienstleistungen (z.B. Kühlungseffekte, CO_2-Fixierung) für uns Menschen. Darüber hinaus stellen sie in urbanen Regionen ein wichtiges Habitat sowie Nahrungsressource für eine Vielzahl von Tieren, wie beispielsweise Vögel und Insekten dar. Jedoch führen immer häufiger auftretende Wetterextreme wie extreme Hitze- und Trockenperioden zu einer reduzierten Vitalität heimischer Stadtbaumarten.

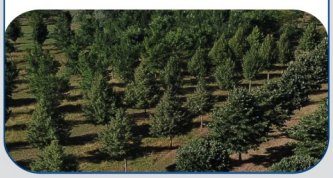
Nahverwandte gebietsfremde Arten scheinen eine höhere Stresstoleranz gegenüber solcher Wetterextreme aufzuweisen. Nun stellt sich die Frage, ob diese gebietsfremden, stressresistenteren Baumarten eine vergleichbare Bienendiversität und -abundanz, wie die nahverwandten heimischen Arten aufweisen können. Im Jahr 2019 wurde dies auf einer Versuchsfläche ("Stutel") bei Würzburg untersucht.

Material und Methoden

Versuchsbäume

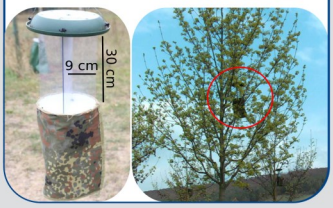
Ahorn (*Acer sp.*):
- 10 Arten
- 3 heimisch, 7 gebietsfremd
- N = 45
- Blühzeitraum: März - Mai

Linde (*Tilia sp.*):
- 10 Arten
- 2 heimisch, 8 gebietsfremd
- N = 46
- Blühzeitraum: Juni - Juli



Lufteklektoren

- Abundanz und Diversität
- Kreuz-Fensterfallen
- nordöstliche Richtung
- mittig Baumkrone
- während Blühperiode
- 14 Tage
- Fanglösung: gesättige Kochsalzlösung



Kescherfänge

- Abundanz und Diversität
- 1 x 1 x 0,2 m der Baumkrone
- während Blühperiode
- 5 min. täglich
- Abfangen blütenbesuchender Wildbienen
- Zählen aller blütenbesuchenden Honig- und Wildbienen

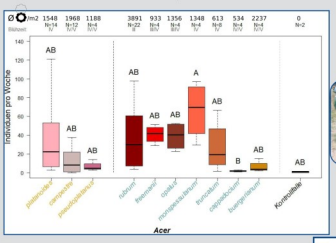
Beobachtungen

- Abundanz
- 1 x 1 x 0,2 m der Baumkrone
- während Blühperiode
- 1 min. 2x täglich
- Zählen aller blütenbesuchenden Honig- und Wildbienen

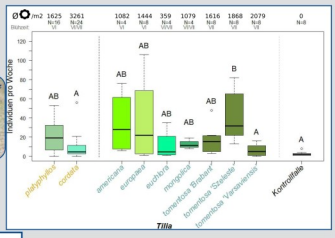
Ergebnisse

Abundanz

Acer sp.



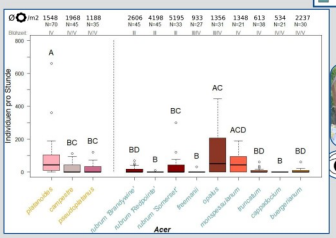
Tilia sp.

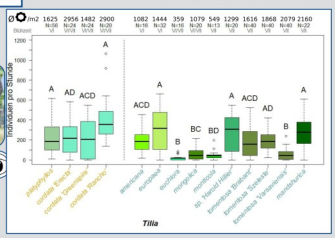


heimisch
gebietsfremd

$p > 0,05$ gleiche Buchstaben

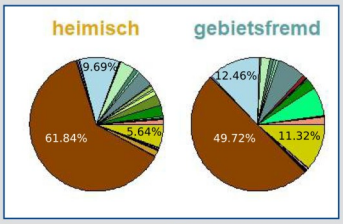
$p < 0,05$ unterschiedliche Buchstaben



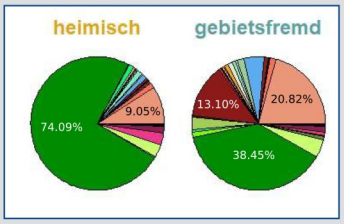


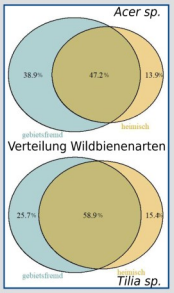
Diversität

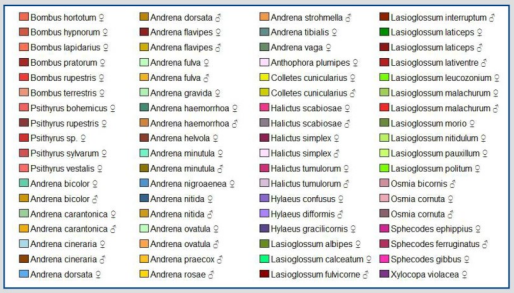
Acer sp.



Tilia sp.







Diskussion

Gebietsfremde, nahverwandte Ahorn- und Lindenbäume werden ebenfalls von Bienen aufgesucht. Mittels Lufteklektor wurden mindestens ebenso viele Bienen in den gebietsfremden Bäumen abgefangen wie in ihren heimischen Verwandten. Die Abunanz der Bienen mit Blütenkontakt wies hingegen zwischen aber auch innerhalb der Baumgruppen (heimisch, gebietsfremd) Unterschiede auf. Der Großteil der Bienenarten wurde sowohl in den heimischen als auch in den gebietsfremden nahverwandten Baumarten detektiert. Bienenabundanz und -diversität scheinen vielmehr in der Populationsdynamik der verschiedenen Bienenarten sowie der Ressourcenquantität als in der Ressourcenqualität und Baumart selbst begründet zu sein. Somit können Klimabäume, insbesondere solche mit einer hohen Stresstoleranz gegenüber Wetterextremen, sinnvolle Ergänzungen zu unseren heimischen Stadtbaumarten sein.

Danke an die Mitarbeiter des Stutels sowie Florian Loidolt,Timo Zippelius und Julia Rothacher für die Mithilfe im Feld.

SESSION 1: Ökologie, Wildbienen und Bestäubung

BV1.4: Silberlinden und Hummelsterben

Silver linden trees and bumblebee mortality

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In summer, accumulations of dead bumblebees are frequently found underneath late-blooming linden trees. This phenomenon is mostly associated with silver linden. The silver linden (*Tilia tomentosa*) originates in South-Eastern Europe and blooms in July and August. Because of its resistance to aridity, surface sealing and air pollution, trees are planted in parks and along streets in Germany. We wanted to identify factors influencing bumblebee death under silver linden trees. Therefore, we quantified dead bumblebees and honeybees under the trees during bloom in the Würzburg area in 2019. Furthermore, flower-visiting bees were recorded at additional *Tilia* species usually not connected to bee mortality in comparison to *T. tomentosa*. Plant traits such as nectar, pollen and floral scent composition were analysed. A total of 464 dead bumblebees and 221 honeybees were found under 14 silver linden trees at 3 different sites varying in number of trees and degree of isolation. Most bumblebees (78.9 %) belonged to the species complex *Bombus terrestris / lucorum*. Another 6 species of bumblebees were identified. Abundance of flower-visiting bumblebees at *T. tomentosa* and *T. cordata* did not clearly differ, thus cannot explain bee mortality under silver linden. Nectar and pollen composition were equal among tree species, while each linden species had a unique floral scent. In general, honeybees, bumblebees and other wild bees attend silver linden trees frequently. We assume that the location of trees might affect bumblebee mortality. Isolated silver linden trees in an area without many alternative blooming species seem to cause more bumblebees dying due to higher competition for the limited nectar. A combination of several silver linden trees at the same site together with plant species offering resources contemporaneously (e.g. *Sedum, Echium, Malva, Trifolium*), could decrease bee mortality because of sufficient resource availability.

Keywords: silver linden, *Tilia tomentosa*, bumblebee mortality

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Silver linden trees and bumblebee mortality

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Introduction

In summer, accumulations of dead bumblebees are frequently found under late-blooming linden. This phenomenon is mostly associated with silver linden (*Tilia tomentosa*). Silver linden originate in South-Eastern Europe and bloom during July and August. Because of their resistance to aridity, surface sealing and air pollution, silver linden trees were introduced to parks and roads in Germany.
Over the past decades, various hypotheses have been posed and tested to explain bumblebee mortality underneath *T. tomentosa*. Speculations ranged from the toxity of trees to predation, age of bees, floral scent as trap or death by starvation. However, since the topic is complex including a multitude of influencing parameters, a final explanation is still lacking.
In this study, we analysed the bee mortality under linden trees from a new perspective. Therefore, linden trees in the area of Würzburg, Germany, were sampled in summer of 2019. We compared silver linden, large-leaved and small-leaved linden regarding traits such as floral scent and their attractiveness for bees. Our aim was to identify factors influencing bumblebee mortality and thereby contribute to the efforts of unravelling this long-investigated topic.

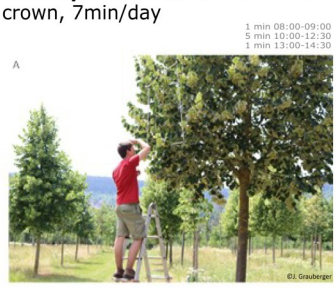
Methods

Collection of dead bees under *T. tomentosa* trees every 48h during bloom (July)
3 study sites: decreasing landscape complexity → increasing isolation between trees



Thüngersheim Lengfeld Thüngen

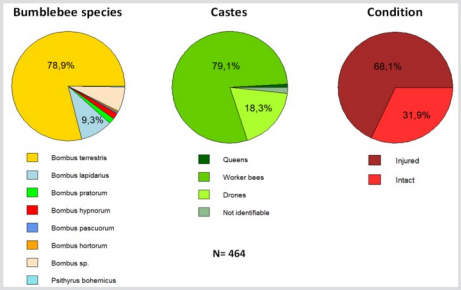
Treetop observations of 1m² tree crown, 7min/day

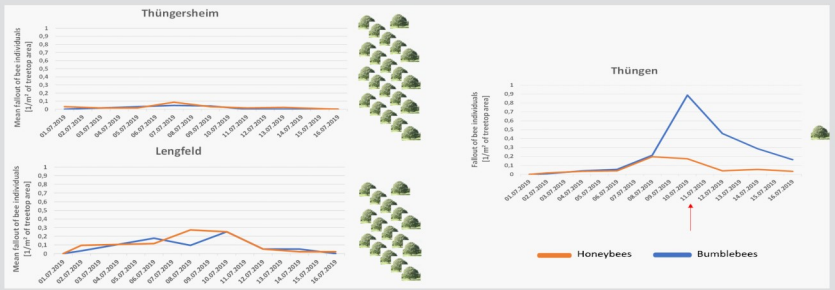


In vivo dynamic headspace sampling of **floral linden scent**

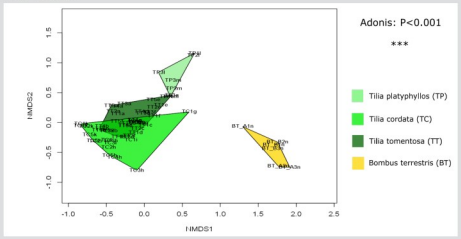
Results

Mortality

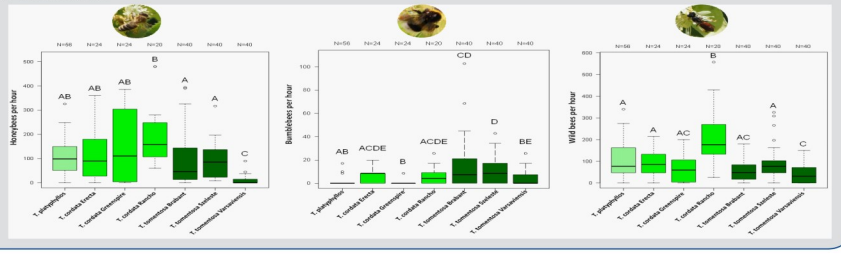




Floral scent



Bee abundance



Discussion

Regarding bumblebee mortality we assume that isolation of linden trees and lack of alternative flowering species in the surrounding area might be the important factors. Especially in late summer, when silver linden are in bloom, isolated trees without other close food sources lead to enhanced competition for the nectar available in the blossoms. Consequently, the bumblebees are unable to fully cover their energy requirements anymore as they spend more energy during foraging flights than gaining by nectar intake, hence dying on the ground. Floral scents of different linden species are unique in their composition and might be important to lure bees to the trees for pollination. The specific role of single compounds must be analysed further in detail for possible impacts on bumblebee behavior or physiology. However, all investigated linden species (including silver linden) are valuable trees for bee pollinators as they are visited by various bumblebees, other wild bees and honeybees foraging for nectar and pollen.

Thanks to everyone who participated and contributed in any way, especially both the **University of Würzburg** and the **LWG Veitshöchheim**. Further appreciation goes to the supervisors, collegues and assistants.

SESSION 2: Genetik und Zucht

V2.1: Die Geruchssensitivität von Drohnen und deren Verwendung als Selektionsmerkmal bei der Varroa-Resistenzzucht der Honigbiene

Use of *Apis mellifera* drone's olfactory sensitivity towards pathological odours as a selection trait in the breeding against Varroa destructor

Ivelina Ivanova, Kaspar Bienefeld

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Early detection and removal of sick brood is the most effective strategy against brood diseases, such as infestation by the mite *Varroa destructor*. Recent findings suggest that genes associated with the olfactory perception of worker bees play a central role in *Varroa*-sensitive hygiene (VSH).

In the following approach, the odour sensitivity of drones was investigated through a standardized PER (Proboscis extension response) test. Individuals with positive/negative conditioning outcome to two parasitized-pupae extracts (***extract-low*** and ***extract-high***) were used for breeding. Twenty-one queens of VSH selection line (***SelQ***) and nineteen queens from an unselected line (***ConQ***) were single-drone-inseminated with drones that showed either a positive (***SenD+***) or a negative (***SenD-***) PER test. Individual VSH behaviour of totally 5072 offspring of these combinations (***SelQ x SenD+, SelQ+ x SenD- ConQ x SenD+, ConQ x SenD-***) were subsequently observed in a special unit with infrared light. The results from the observation were also separately examined considering the hygienic status of the participating queens and drones.

The results of the PER test of the drones were not significantly reflected in the VSH results of the respective offspring, On the other hand, the hygienic status of the participating queens/drones was crucial for the manifestation of VSH.

Keywords: Varroa destructor, hygienic behaviour, olfaction, drones, breeding

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SESSION 2: Genetik und Zucht

V2.2: Mechanismen der Varroaresistenz - von biologischen Grundlagen zur praktischen Nutzung

Mechanisms of Varroa - resistance - from biological principles to practical usage

Martin Gabel[1,2], Ricarda Scheiner[1], Ingolf Steffan-Dewenter[1], Ralph Büchler[2]

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[2]Landesbetrieb Landwirtschaft Hessen, Bieneninstitut Kirchhain

Among several mechanisms of Varroa-resistance in *A. mellifera*, traits like a suppressed mite reproduction (SMR) and defense behaviours such as recapping (REC) or Varroa-sensitive hygiene (VSH) are of special interest for the selection of Varroa-resistant honeybees. In this light, a joint project of the bee institutes Hohen Neuendorf and Kirchhain, the German beekeeper assoc. (DIB) and Buckfast (GdeB) as well as Carnica (AGT) breeders started in March 2019. Within three years, different breeding stocks will be screened and selected regarding their SMR and REC characteristics. In 2019 and 2020, a total of 1,403 MiniPlus-colonies with single-drone-inseminated queens were tested according to standardized protocols in twelve breeding groups across Germany. On average, a SMR value of 46% was found (0-100%, n=834, 10 single infested cells resp.), with ca. 15% of those colonies showing SMR values >75%. Brood samples from full-grown performance-tested colonies showed a mean SMR value of 38 % (4-92%, n= 100, 25 single infested cells resp.) and a mean REC value of 40% (0-100 %) in infested cells. In parallel, separate study setups focused on the biological background of different traits to elaborate deeper knowledge and improve existing protocols. Therefore, SMR and REC were measured repeatedly after brood interruptions of varying durations. In 27 colonies, queens were either caged for 10, 20 or 30 days (n= 7 resp.) to induce a brood break of corresponding duration or were left uncaged as a control (n= 6). Colonies were subsequently sampled for SMR and REC investigation at three time points: (1) while queens were caged, (2) in the 1st, (3) in the 2nd and (4) in the 3rd brood cycle of mites after caging. The proportion of non-reproductive mites was significantly affected by time of sampling ($F(3,54)= 3.62$; $p= 0.002$) and experimental group ($F(3,18)= 4.22$; $p= 0.02$). Results indicate that brood breaks can affect both, SMR and REC. Implications for practice and future research are discussed.

Keywords: suppressed mite reproduction, recapping, breeding, brood interruption, *Varroa destructor*

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SESSION 2: Genetik und Zucht

V2.3: Herausforderungen bei der Heritabilitätenschätzung für die Honigbiene

Challenges in heritability estimations for honey bees

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The heritability of a trait describes which proportion of the observed variance in a population has genetic origin and thus, to what extent selection for the trait can translate into improved phenotypes. Compared to other livestock species, in honeybees this notion is complicated, because the genetic source of variance is split into queen and worker group effects. The uncertain paternity due to the honeybee's mating behavior further impedes the estimation of heritabilities. While several studies successfully estimated heritabilities for honeybee traits, the literature also provides numerous reports where standard procedures for the estimation of genetic variances, such as AIREML (average information restricted maximum likelihood), failed to return reasonable results when applied to honeybee populations, particularly when pedigree or performance data were incomplete. As a reaction, estimations were carried out with simplified models, attributing all genetic influence on a trait to either the queen or the worker group. We conducted a large-scale simulation study to investigate under which conditions the AIREML algorithm is likely to yield accurate heritabilities for honeybee populations. Furthermore, we examined how meaningful results are if the underlying genetic model is simplified. For this purpose, over 2.5 million variance estimations were carried out on simulated data, spanning over a variety of traits, apiary sizes, rates of data completeness, and levels of mating control. We could show how these parameters influence the outcomes of variance estimations and confirm findings from real data studies, e. g. that it is basically impossible to separately estimate queen and worker group variances if mating is uncontrolled. Furthermore, we gained insight into the properties of variance estimates with simplified models and can therefore provide guidelines how estimated heritabilities that were obtained with different models can be compared to each other.

Keywords: heritability, queen and worker effects, REML, parameter estimation, Monte Carlo simulation

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SESSION 2: Genetik und Zucht

V2.4: SETBie: Innovative Kombination von klassischer Zucht, genetischer Analyse und Evaluation in der Praxis

SETBie: Innovative combination of classical breeding, genetic analysis and evaluation in the practice

Birgit Gessler[1], Lina Sprau[1], Melanie Liebsch[1], Peter Rosenkranz[2], Martin Hasselmann[1]

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The honey bee ectoparasite Varroa destructor is the main threat of honey bee colonies leading to annual colony losses worldwide. With the project SETBie in Baden-Württemberg, we aim to decipher molecular markers for the varroa-sensitive hygiene trait (VSH). SETBie stands for “selection and establishment of Varroa mite sensitive honey bee colonies with VSH.” VSH is a trait, where honey bees remove Varroa infested brood. In doing so, the female mites are aborted in their reproduction cycle leading to a reduction of Varroa within the bee colony. The project SETBie combines expertise of 36 local beekeepers that work together with several research institutions, providing the power for an innovative combination of classical breeding, genetic analysis and evaluation in the practice. In 2020 424 (2019: 311) honey bee colonies of the European subspecies *A.m. carnica*, *A.m. mellifera* and Buckfast were artificially inseminated with semen of preselected colonies. 214 of these colonies (2019: 126) were infested with 180 mites and the ability to detect and remove mites was investigated. We found a promising progression in numbers of bee colonies showing a removal rate of over 75% compared to 2019. 37 of the analysed colonies were tested additionally via artificial mite infestation and 18 out of these 37 bee colonies could be confirmed for high brood removal rates. Ongoing vitality tests of descendants will demonstrate the evaluation in the praxis. Furthermore, age standardized adult worker bees were sampled and are processed for population genome, transcriptome and epigenome analyses to reveal new insights for potential marker selection. We aim to develop stable-inherited molecular markers that will be tested and evaluated for its suitability on a broader scale with the potential for the application in selection-programs. This project may further contribute to a more sustainable honey bee colony breeding. Supported by the European Agricultural Fund for Rural Development (EAFRD).

Keywords: molecular markers, varroa destructor, VSH

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ABLAUF ZURÜCK

SESSION 2: Genetik und Zucht

V2.5: Validierung der genomischen Selektion bei der Honigbiene

Validating Genomic Selection for Honey Bees

Richard Bernstein, Manuel Du, Andreas Hoppe, Zhipei G. Du, Julia C. Jones, Anja Strauß, Kaspar Bienefeld

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Project GeSeBi aimed at establishing genomic selection and applying it to improve relevant traits in honey bees with special attention on the higher resistance against diseases. In addition this approach provides extended insights into genetic diversity of the breeding population. To achieve this, a high density SNP chip was developed which comprises 103‘270 markers. Concepts that had already been proven useful in other species were rethought and adapted to the peculiarities of the honeybee biology, like polyandry and haplodiploidy and the simultaneous influence of direct (workers) and maternal (queens) effects. Via international cooperation with beekeepers and beekeeping organizations, 3‘383 samples of performance tested queens were gathered. The validation of genomic selection compares breeding values obtained from the classical method to breeding values obtained from single step. The genotyped queens born in 2017 (n = 265) were assigned to the validation set. The phenotypes of queens in the validation set were not used for the calculation of breeding values. The breeding values of the queens in the validation set were evaluated in two ways. Firstly, they were correlated to the phenotypes of the queens belonging to the validation set. Secondly, they were correlated to breeding values of the queens in the validation set, obtained from a classical breeding value estimation using all phenotypes. Considering the comparatively small data set and the problems in standardizing the environmental influence on traits for honey bees, the results are very promising. They indicate that genomic selection offers increased genetic gain by enabling successful preselection of unphenotyped queens.

Keywords: Genomische Selektion, SNP-Chip, Zuchtwertschätzung

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SESSION 2: Genetik und Zucht

V2.6: Erhebliche genetische Fortschritte in der internationalen Zucht der *Apis mellifera carnica* seit der Einführung der genetischen Evaluation

Substantial genetic progress in the international *Apis mellifera carnica* population since the implementation of genetic evaluation

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The *A. m. carnica* subspecies of the honeybee has long been praised for its gentleness and good honey yield before systematic breeding efforts began in the early 20th century. The introduction of modern techniques of genetic evaluation (best linear unbiased prediction, BLUP) and computerized data management in the mid 1990s started a process where the availability of information allowed intensified breeding for which precise account can now be given, 25 years after its introduction. We analyzed the official breeding value estimation in http://BeeBreed.eu to characterize breeding progress and inbreeding. From about 2000 onward, the genetic progression accelerated and resulted in a considerable gain in honey yield and desirable properties without increased inbreeding coefficients. The prognostic quality of breeding values is demonstrated by a retrospective analysis. The success of *A. m. carnica* breeding shows the potential of BLUP-based breeding values and serves as an example for a large-scale breeding program.

Keywords: Zuchtwertschätzung

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SESSION 2: Genetik und Zucht

V2.7: Europas erste Genbank für die Honigbiene

Europe's First Gene Bank for Honeybees

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Honeybee biodiversity in Europe and Germany is threatened by many factors, including introgressive hybridization, introduced pests/parasites, and the loss of breeding stock entailed by the loss of breeders. Biobanks are a last resort for counteracting the possible loss of biodiversity. Their purpose is not only to revive a certain bee population after a total loss, but also to prevent such events by cross-breeding. Therefore, it maximizes the possibilities of a genetic response to challenges that are difficult to foresee today, such as climate change. In February 2019 the German Federal Ministry of Food and Agriculture entrusted the Bee Research Institutes in Hohen Neuendorf and Kirchhain with the task of establishing a national gene reserve for the honeybee in Germany. To establish a functioning biobank, many questions need to be solved: what and where to store the genetic material? Which genetic resources should be prioritized? How should they be collected? What quality tests need to be performed on the samples? Who should have access to them, and under which conditions? How can there be ensured that future users are informed about the specific characteristics of the preserved resources? In this contribution, we report our experiences from carrying out this task, in order to illustrate practical problems and point out some possible solutions.

Keywords: biobank, conservation, cryopreservation

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SESSION 2: Genetik und Zucht

V2.9: Eine Vergleichsuntersuchung auf Malta zwischen der einheimischen *A. m. ruttneri* und eingeführter *A. m. ligustica* im Hinblick auf Überleben, Volksentwicklung und Krankheitsanfälligkeit

A comparative study of survival, colony performance and disease levels in the endemic honeybee *A. m. ruttneri* and the introduced *A. m. ligustica* in Malta

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Apis mellifera ruttneri, the honey bee subspecies endemic to Malta, must be regarded as seriously endangered, but currently only few scientific data are available that could support and guide conservation measures. In June 2017, a first systematic study was set up to compare survival, colony performance, and levels of disease of the endemic honey bee with introduced *A. m. ligustica*. A total of 33 colonies (*A. m. ruttneri*, n=15 and *A. m. ligustica*, n=18, sister queens) were evenly distributed across two apiaries on Malta. After an initial treatment against *Varroa destructor*, no further chemical treatment was performed. Colony survival, productivity and behaviour were assessed in regular intervals, and colonies were sampled for assessment of Varroa infestation, *Nosema* spp. and virus infections. Colonies of *A. m. ruttneri* showed better colony development, especially in the rainy season during winter, when they were consistently and significantly stronger than *A. m. ligustica* colonies (Dec17: $p < 0.05$; Jan18: $p < 0.01$; Mar18: $p < 0.05$). Over the entire duration of the experiment, except for the samplings Feb18 and Mar18, *Varroa* infestation levels in *ruttneri* colonies were significantly lower than in *ligustica* colonies. In general, they remained below 10% in *ruttneri*, while they reached up to 40% in *ligustica* colonies. Consistently, at the time of maximum differences in *Varroa* infestation levels (May18), infections of DWV between the two subspecies also differed significantly ($p < 0.05$). After one year, only four *ligustica* colonies were alive, while twelve *ruttneri* colonies had survived. These twelve were monitored for an entire additional year, and brood was sampled in regular intervals for screening for SMR and REC. Preliminary values of SMR (57%) and REC (65%) were recorded (n=10). The baseline data provided by this study will contribute to guiding beekeepers in their decision on queen purchases, and ultimately, support conservation measures for *A. m. ruttneri*.

Keywords: A. m. ruttneri, colony performance, local adaptation

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SESSION 2: Genetik und Zucht

V2.10: Insights into Ethiopian honey bees based on morphometric and genetic analyses

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Ethiopia is a major beekeeping country located in northeast Africa where several evolutionary lineages of *Apis mellifera* overlap. However, classification of subspecies and lineage of honey bees in that region has been partly inconsistent: debating between a unique *A. m. simensis* or multiple subspecies and lineages. The aim of this study was to elucidate Ethiopian honey bees in reference to African subspecies and global lineages using forewing geometric morphometry and mitochondrial (COI-COII) analyses. In addition, we conducted analyses based on classical morphometry and a nuclear marker (r7-frag) to further characterize the bees. For these purposes, 660 worker bees representing 66 colonies were collected from different agro-ecological zones (AEZ) that include different elevational levels. Geometric morphometric and mitochondrial analyses showed that the honey bees belong to lineage Y, supporting the hypothesis of five lineages. Forewing venation discriminated the samples from all reference subspecies other than *A. m. simensis*. Within Ethiopian bees, we found five mitochondrial haplotypes including Y2, Y1, A1, O5 and Y3 (new). Moreover, elevation strongly associated with forewing size ($r=0.67$; $P<0.01$) and shape ($F=4.03$; $P<0.01$). Similarly, multivariate morphometric analyses based on nine characters of forewing and hind leg separated Ethiopian bees from all reference subspecies except *A. m. simensis*. Both morphometric and genetic analyses indicated low overall differentiation within Ethiopia due to high gene flow. However, morphological and genetic differentiation slightly increased with increasing elevational level as found for highland bees when compared to lowland and midland bees. Within r7-frag, an allelic length polymorphism was detected to be strongly associated with AEZ ($X2=11.84$, $P<0.01$). In conclusion, Ethiopian honey bees belong to one subspecies that is characterized by high gene flow likely influenced by anthropogenic activities.

Keywords: honey bee, subspecies, lineage, Ethiopia, Tigray

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ABLAUF ZURÜCK

SESSION 3: Bienenpathologie

V3.1: Abundanz verschiedener Viren in der Königinnenzucht

Abundance of different viruses during the queen breeding process

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Seit Jahrzehnten werden im LAVES – Institut für Bienenkunde Celle jährlich Königinnen der Celler-Linie in Pflegevölkern über mehrere Serien gezogen. Auf Grundlage der aktuellen Diskussion zur Verbreitung von Viren haben wir unsere Zuchtpraktik in den letzten vier Jahren systematisch beprobt. Hierzu wurden potentielle Zuchtvölker, Pflegevölker und Drohnenvölker der drei Belegstellen Rehwinkel, Torfhaus und Neuwerk, sowie abgängige Königinnen auf sechs verschiedene bienenpathogene Viren untersucht. Die Ergebnisse zeigen eine deutliche Zunahme der Virusabundanz über die Serien hinweg. Dieses spiegelt sich in den Ergebnissen aus den Pflegevölkern und der abgängigen Königinnen wieder. Weiterhin zeigen die Virusnachweise und -abundanzen, dass die Aufzucht in Pflegevölkern der kritische Punkt hinsichtlich Virustransmission in der Königinnenzucht zu sein scheint. Zudem hat die Beprobung unserer Belegstellen gezeigt, dass eine Verbreitung der untersuchten Viren über unseren Zuchtstoff oder die Anpaarung auf unseren Belegstellen als sehr unwahrscheinlich eingestuft werden kann. Diese Arbeiten werden ab 2021 mit konkreten Untersuchungen zur horizontalen und vertikalen Virustransmission fortgesetzt.

Keywords: Königinnenzucht, Virusanalytik, BQCV, CBPV, Virustransmission

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SESSION 3: Bienenpathologie

V3.2: Prävalenz von Viren in schwarzen Honigbienenvölkern auf den Kanarischen Inseln mit oder ohne Naturschutzprogramm

Prevalence of viruses in black honey bee colonies on the Canary Islands with or without a conservation programme

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The black honey bee (*Apis mellifera*) from the Atlantic Canary Islands belongs to the African evolutionary sub-lineage with Atlantic distribution and exhibits adaptation to the local environment, including use of the local flora for honey production. In 2001 it became protected on one Canary island, La Palma, by the Canarian Government, which strictly forbids the introduction of foreign honey bees to that island. We hypothesized that the lack of imports might be associated with a reduced prevalence and diversity of pathogens such as Deformed wing virus (DWV) on La Palma. In order to test this hypothesis, colonies were sampled across La Palma in 2017, after 16 years of conservation, and examined for their viruses. For comparison, colonies from the island of Gran Canaria, which has not been protected from the importation of honey bees, were similarly examined. Out of a total of 54 colonies examined, 29 from La Palma (LP) and 25 from Gran Canaria (GC), 38 colonies (19 LP, 19 GC) were infected with at least one virus. Above all, there were major differences in the prevalence of the two DWV genotypes A and B across islands. The widespread DWV-A could not be detected on La Palma but was common on Gran Canaria (68 %). Exactly the opposite is the case with DWV-B, which was quite prevalent on La Palma (41 %), but only rarely detected on Gran Canaria (12 %). Similar prevalence on both islands was found for BQCV (LP: 17 %; GC: 12 %), CBPV (LP: 17 %; GC: 4 %) and ABPV (LP: 7 %; GC: 16 %), though La Palma had slightly more infected colonies compared to Gran Canaria for BQCV and CBPV. The viruses KBV, SBV and SBPV could not be detected on either island. Though the protection program for the preservation of honey bees on La Palma may contribute to supporting its local honey bee population, it has not resulted in a reduction in viral prevalence.

Keywords: virus, Canary Islands, conservation programme, deformed wing virus

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SESSION 3: Bienenpathologie

V3.3: Infektionsexperiment zeigt Virenübertragung von Honigbienen auf Hummeln jedoch keine Übertragung ausgehend von Hummeln

Experimental infection reveal viral spill-over from honey bees to bumble bees but no spill-back

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Pathogen spill-over can be an important cause of biodiversity decline. Several correlative studies indicate viral spill-over from managed honey bees to wild bee species such as bumble bees that could play a role in their decline. Yet experimental data on viral spill-over and the directionality of transmission are lacking. Here we investigated the transmission of the honey bee virus Deformed wing virus genotype A within and between species in a controlled lab experiment. Experimentally infected bees acted as virus donors while uninfected bees as recipients. They were kept together at different pre-determined levels of contact. The study is separated into two parts. Part I demonstrats a scenario where bees of both groups had full contact. Under this scenario, virus transmission could potentially happen through diverse routes such as e.g. via faeces, salvia, trophallaxis or self-grooming. In part II, recipient bees merely had contact with the donor bees via a transferred feeding tube. Here, direct contact between the bees was excluded and only contaminated food could act as transmission route. We tested viral transmission in 4 donor-recipient combinations: from *Apis* to *Apis*, from *Apis* to *Bombus*, from *Bombus* to *Apis* and from *Bombus* to *Bombus*. After several days, bees from both groups where frozen and checked for viral titres. We were able to show that transmission from honey bees to bumble bees is possible, yet we did not detect viral spill-back from bumble bees to honey bees. Our results highlight the potential risk of viral spill-over from honey bees to wild bee species but also reveal the low risk of bumble bees acting as a virus reservoir and spreading the virus to other species. Our results underscores the importance of additional studies on the virulence of DWV in wild bee species as well as studies investigating the potential adaption of DWV to a new host so as to evaluate its impact on host individual and population fitness.

Keywords: B. terrestris, DWV, multi-host pathogen, cross-species transmission

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SESSION 3: Bienenpathologie

V3.4: Happy hive – happy life: Aktueller Kenntnisstand über Lithiumchlorid als neues Varroabehandlungsmittel

Happy hive – happy life: state of knowledge about Lithium Chloride as a new Varroa treatment

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Varroa destructor in combination with virus infections is still the crucial factor for winter losses of honeybee colonies and economic damages in the beekeeping business. Until now, there is no veterinary product available that fulfils all requirements of the beekeeper regarding efficacy, tolerability, "easy to apply", contamination of bee products and risk of resistant mites. Since 2018 Lithium Chloride, a newly discovered acaricidal compound with systemic mode of action is part of the discussion. LiCl is a naturally occurring and widely distributed salt which is used in human medicine and even is a natural component of honey. We could confirm that LiCl at a concentration of 25 mM – solved in sugar sirup and fed to cages bees – led to mite mortalities of nearly 100 %. Also, in brood-less colonies LiCl kills around 95 % of the mites. As the honeybees are naturally brood-less during wintertime, it is also conceivable to use LiCl as a winter-treatment. However, the relatively low brood tolerability still represents an unsolved problem for the treatment in colonies with brood. We here present new data on the efficacy and tolerability of different LiCl applications. We used standardized Mini-Plus hives to track the distribution of LiCl within a colony and full-sized colonies for the evaluation of efficacy and life span of adult bees. The results so far confirm that LiCl is an effective and "easy to apply" acaricide with a very good tolerability with adult bees. We also see options to overcome the problem of brood damages. The development of such smart applications of LiCl in cooperation with our partner siTools in Munich will be supported by an innovation grant of the BMEL.

Keywords: Varroa destructor, Lithium Chloride, treatment, acaricide

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SESSION 3: Bienenpathologie

V3.5: Die Reproduktion der Varroamilbe (Varroa destructor) ist kein Auslöser für Varroa Sensitive Hygiene (VSH) oder Recapping Verhalten

Varroa sensitive hygiene (VSH) and recapping behaviour are not triggered by the reproduction status of the Varroa mite (*Varroa destructor*)

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Selective breeding programs for varroa resistance contribute to a solution to the worldwide problem of the parasitic varroa mite (*Varroa destructor*) in honey bee colonies. These programs aim to establish varroa-resistant honey bees to minimize the use of chemicals and prevent colony damages. Behavioural traits such as “Varroa Sensitive Hygiene” (VSH) and “Recapping” are common selection criteria in such programs. VSH is a behavioural trait expressed through adult bees by removing varroa-infested brood. Some breeding groups use protocols based on the assumption that mite reproduction is a trigger for brood removal. Therefore, the ratio of reproducing to non-reproducing mites is used as a calculation for the VSH value. In this study, the effect of mite reproduction as a potential trigger for brood removal behaviour was investigated. The experiment was conducted by artificially infesting cells with mature Varroa mites. The results show that there was no significant difference in the removal rate of reproductive and non-reproductive mites. The decision of bees to remove varroa infested brood seems to be not based on the reproduction status of the mite, excluding mite reproduction as a possible trigger for VSH. Furthermore, the use of the SMR protocol (i.e., mite reproduction rate) likely does not accurately reflect the VSH value. Analysis of recapping behaviour in retrospect of the mite's reproductive status also did not differ. This study also shows that artificial infestation should be the preferred method to evaluate VSH behaviour. This research was conducted as part of the project "SETBie - Baden-Württemberg", supported by the European Agricultural Fund for Rural Development (EAFRD).

Keywords: Varroa resistance, Varroa sensitve hygiene, VSH, recapping, artificial infestation

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SESSION 3: Bienenpathologie

BV3.1: Presence of RNA viruses in Africanized honey bees and a native stingless bee species of the Yucatan Peninsula, Mexico

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There is a perceived worldwide decline in pollinators. One potential cause is the high prevalence of RNA viruses and their negative effects on managed bees in temperate climates; the same viruses are found in temperate wild bee species, too. In tropical regions such as the Yucatan Peninsula of Mexico, considered an important zone for the production of honey from Africanized honey bees and with 17 different native species of eusocial stingless bee, the presence of these viruses remains poorly studied. We evaluated the presence of six widespread honey bee viruses in Africanized honey bees and the native stingless bee species *Melipona beecheii* in the Yucatan Peninsula. From January to April 2019, we collected 10 individuals per species from 12 locations across the Yucatan Peninsula in "Meliponarios" (stingless bee apiaries) and surrounding areas. Samples were stored in RNA-Later to conserve the RNA so as to conserve RNA viruses within them. We tested whole-body RNA extracts by RT-PCR for the presence of six RNA virus targets: DWV (genotypes A and B), BQCV, ABPV, SBV and SBPV, all of which have been associated with honey bees from temperate regions. The presence of three of these viruses in Africanized honey bees and *M. beecheii* could be confirmed. This is the first report of honey bee RNA viruses detected in Africanized honey bees as well as the native stingless bee species *M. beecheii* from the Yucatan Peninsula.

Keywords: RNA virus, *Apis mellifera*, *Melipona beecheii*, native bee, +ssRNA

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SESSION 3: Bienenpathologie

BV3.2: Vergleich verschiedener Varroabehandlungen in Sommer und Winter

Comparison of different varroa treatments in summer and winter

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The effective treatment of the parasitic honey bee mite Varroa destructor is one of the challenges beekeepers have to face today. Although there is a variety of registered products, many beekeepers are unsure which product operates best in regard to their specific beekeeping management and mite load and some even fail to effectively treat against varroa. Here we present a survey of the varroa experiments at the Apicultural State Institute in 2019/20 and discuss the efficacy of three widely used varroacides and the new, yet not registered agent lithium chloride, concerning their usage in summer and winter.

In total, there were 28 hives of *Apis mellifera* at three locations near the University of Hohenheim for three different summer treatments against Varroa destructor: an formic acid treatment (FA 60 % ad us vet., Nassenheider® professional; N=9), an approved long term acaricide (Apivar®, N=11) and a combined treatment of a biotechnical brood free period with a short-term feeding of lithium chloride sugar paste (50 mM LiCl, N=9). The registered agents were used according to the recommendation. The efficacy of LiCl was controlled with follow-up treatment with Apivar® over several weeks . For winter treatment we compared the mite fall and bee mortality by trickling sugar solutions with oxalic acid (Oxuvar® 5,7%; N=15) and lithium chloride (50 mM LiCl; N=16).

We confirmed again the slow onset of effect of Apivar® in comparison to the formic acid treatments, especially when applied in highly infested colonies. The systemic treatment with LiCl in brood-free colonies showed an efficacy of more than 90% for highly infested colonies. Both, the oxalic acid and LiCl trickling in winter had a comparable good effect on mite fall and bee mortality.

The study shows the importance of regularly controlling the registered varroacides on their efficacy to adjust their practical use, also in comparison with new varroacides like LiCl.

Keywords: Varroa destructor, formic acid, Apivar®, oxalic acid, lithium chloride

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SESSION 3: Bienenpathologie

BV3.3: Ergebnisse einer Proteomanalyse des Ektoparasiten Varroa destructor nach einer Ameisensäurebehandlung

Results of proteome analysis of the ectoparasite Varroa destructor after formic acid treatment

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Varroa destructor ist einer der bedeutendsten Parasiten von *Apis mellifera*. Die Behandlung mit Ameisensäure (AS) ist derzeit weltweit am weitesten verbreitet. Um das Verständnis zum Wirkmechanismus der AS zu erweitern, wurde die molekulare Reaktion in Varroamilben (VM) auf Protein-Niveau untersucht. Honigbienenvölker wurden über einen Nassenheider Verdampfer mit 60%iger AS ad us. vet. Behandelt, adulte weibliche VM vor Beginn der AS-Behandlung als Kontroll- und 24 Stunden später als Behandlungsgruppe entnommen. Aus je vier Replikaten eines Pools aus 40 Individuen wurde das Gesamtprotein isoliert und durch eine Proteomanalyse mittels Liquid-Chromatographie-Massenspektometrie/ Massenspektometrie (LC-MS/MS) untersucht. Insgesamt wurden 2637 Proteine identifiziert. Für die quantitative Analyse wurden nach der MS-Datenverarbeitung nur differenziell exprimierte Kandidatenproteine (Fold Change ≥ 2; $p \leq 0{,}05$) verwendet, die in mindestens drei von vier Proben über alle Behandlungen gefunden werden konnten. Diese wurden funktionell annotiert und auf Akkumulation in spezifischen intrazellulären Signalwegen untersucht. Die Analyse ergab 205 differentiell exprimierte Proteine: 91 waren in der AS-behandelten Gruppe im Vergleich zur unbehandelten Kontrollgruppe induziert und 114 reprimiert. Eine eingeschränkte Proteinsynthese bei gleichzeitig gesteigertem Proteinabbau deuten eine Imbalance in der Proteostase an. Anzeichen für oxidativen Stress gaben eine signifikante Dysregulation von Kandidatenproteinen der mitochondrialen Zellatmung und eine Induktion von Hitzeschockproteinen. Weiterhin war eine gesteigerte Konzentration mehrerer mit der Detoxifikation assoziierter Kandidatenproteine zu beobachten. Diese Ergebnisse deuten auf eine durch die AS-Behandlung ausgelöste dysregulierte Zellatmung sowie auf eine Erhöhung zellulärer Abwehrmechnismen (erhöhte Hitzeschockproteine und Detoxifikationsenzyme) hin.

Keywords: Varroa destructor, Ameisensäure, Proteomanalyse, LC-MS/MS

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SESSION 3: Bienenpathologie

BV3.4: Eine neue Methode zur Extraktion von Hämolymphe erwachsener Honigbienen zur Analyse von Lithiumkontaminationen nach Varroa-Behandlung

A new method for the extraction of hemolymph from adult honeybees to analyze lithium contaminations after Varroa treatment

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Lithium chloride (LiCl) was shown to be a highly effective systemic agent against the mite Varroa destructor. If LiCl solved in sugar syrup is fed at a concentration of 25 mM to caged bees, almost 100% of the mites are killed (Ziegelmann et al., 2018). However, it is still unknown how the honeybees metabolize the ingested lithium and how LiCl is distributed in different compartments of the bee´s body. Of particular interest is the respective concentration of LiCl in the hemolymph (and fat body) as the nutritional source for the mites. For this approach it is necessary to collect large amounts of pure hemolymph in a relatively short periods of time. The methods used so far proved to be too slow, unproductive or not reliable enough. Here I describe a new, reliable and for a high-yield extraction method of hemolymph in order to measure lithium in this specific compartment of the honeybees. This method allows to collect sufficient amounts of pure hemolymph for a quantitative analysis of lithium by an ICP-OES or ICP-MS analysis which was established by our University Core facility. In first cage experiments, honeybees where fed with two different concentrations of LiCl (25 mM and 50 mM) and it could be proven that the method is suitable to quantify lithium in the hemolymph. Furthermore, the preliminary results indicate that lithium is only present in the hemolymph in the first three days after feeding. Afterwards it seems to get filtered out of the hemolymph. This finding is an important step to better understand the mode of action of lithium chloride and to determine exactly the concentration of LiCl required for an effective application.

Keywords: Lithiumchlorid, Varroa destructor, hämolymphe

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SESSION 3: Bienenpathologie

BV3.5: Die Suche nach der Nadel im Heuhaufen − Produktion, Selektion und Charakterisierung spezifischer und monoklonaler Antikörper zur Detektion und Unterscheidung zwischen Amerikanischer und Europäischer Faulbrut

Looking for a needle in a haystack – production, selection and characterization of specific monoclonal antibodies for detection and distinction of American and European foulbrood

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American and European foulbrood (AFB & EFB) are devastating bacterial brood diseases of honeybees (*Apis mellifera*), which cause colony and economic losses worldwide. Disease diagnosis is conducted via visual inspection and suspicions have to be confirmed in the laboratory, which often is very time-consuming. The aim of the whole project is to develop a fast and sensitive field test kit (lateral flow device; LFD) to diagnose and distinguish between EFB, AFB and two genotypes (ERIC I and ERIC II) of *Paenibacillus larvae*, the causative agent of AFB, in one device employable in the field. Since LFDs are based on antibody detection of antigens, we first confirmed that pathogen-, and genotype-specific antigens exist. Mice and rabbits were immunized with the disease-causing bacteria *Melissococcus plutonius* and *P. larvae* (ERIC I and ERIC II). Using ELISA and Western blot analysis, we identified specific antibodies for each pathogen. Until now, we have established monoclonal antibodies (mAb) specific for *P. larvae* and *M. plutonius* in general, recognizing a ~60 kDa antigen, and a specific mAB for *P. larvae* ERIC II, recognizing a ~130 kDa antigen. The mAbs were tested in an indirect ELISA against different field strains in order to test for strain detection coverage. Furthermore, the mAbs were tested against common bee associated bacteria to exclude cross reactivity with other bacteria. Applying produced mAbs, a highly sensitive LFD based on multicolored silver-nano-particles for multiplexed diagnostic can be established.

Keywords: AFB, EFB, lateral flow device, monoclonal antibody

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SESSION 3: Bienenpathologie

BV3.6: Molekulardiagnostischer Test zum Nachweis von *Malpighamoeba mellificae* PRELL

Molecular diagnostic test for detection of *Malpighamoeba mellificae* PRELL

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The protozoan *Malpighamoeba mellificae* Prell (1926) is an amoeba that infects the Malpighian tubules of honey bees. The amoebae, ingested as cysts, develop into trophozoites that feed upon tubule epithelia. The resulting damage of the Malpighian tubules can induce an imbalance of waste excretion and hemolymph exchange. This causes the so-called amoeba or amoebiasis disease in adult bees, which sometimes is co-occurring with Nosema infections. Most reports of this amoeba come from the 1960s and earlier, and knowledge of the disease and its spreading is very poor. The lack of any genetic markers for the species hampers its sensitive identification using molecular tools and knowledge on its epidemiology. After metagenomic sequencing of Malpighian tubules containing *Malpighamoeba mellificae* cysts and Malpighian tubules not containing any *M. mellificae* cysts, gene sequences of the amoeba were revealed for the first time. PCR primers and a probe were developed based on the 18S rRNA gene. These were initially tested and adjusted with samples microscopically tested for the presence of *M. mellificae* cysts. Next steps are to perform detailed microscopic investigations of the amoeba and the validation of a sensitive diagnostic PCR tool to investigate the disease and the prevalence of *M. mellificae* in more detail.

Keywords: Malpighamoeba mellificae, molecular diagnostics

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SESSION 4: Bienenschutz, Pflanzenschutz & Bienenprodukte

V4.1: Der aktuelle Status der *Apis mellifera* Unterarten in ihrem ursprünglichen Verbreitungsgebiet

The current status of the *Apis mellifera* subspecies in their native range

Alina Komm, Kaspar Bienefeld

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The diversity of local adaptations enables the western honeybee (*Apis mellifera*) to live under a great variety of environmental conditions. In the future, this wide range of variances in morphology and behavior could be the prerequisite for the bees to cope with upcoming challenges such as climate change. Threats such as increasing hybridization and the loss of natural habitats endanger this diversity in large parts of the natural distribution range. Both, the causes and the effects of this process, can´t be limited to the borders of countries or continents. A quantitative survey of beekeepers, politicians and scientists gave us an insight into the situation of the various subspecies. The survey took place in Africa, the Middle East, Central Asia and Europe. We received 180 responses from 79 countries. A clear majority (86%) of the respondents noted, that the conservation of *Apis mellifera* should be encouraged in his or her country. 6 out of 7 of those who answered „no“ to this question stated, that there are no more autochthonous subspecies in in the region they report on. Almost 80% of the study participants from Europe stated, that at least one of these subspecies: imported *A. m. carnica* or *A. m. ligustica*; Buckfast bees or indefinable *A. m.* hybrids can be found in their country. In Asia, 79% of the respondents knew one of these subspecies from their region. In the African countries it was only 14%. Agricultural change was cited as the greatest threat to the subspecies native to Africa. Their biggest advantage is their high Varroa destructor resistance, while the main disadvantage of the European subspecies was their vulnerability to the Varroa mite. The good suitability to the local conditions was chosen as the greatest advantage of the subspecies native to the Asian region. The interest of all three groups (beekeepers, politicians and scientists) in the conservation of the local subspecies is a central result of this study. It is important to recognize, promote and protect the diverse advantages of the locally adapted subspecies in the entire natural distribution range.

Keywords: Apis mellifera, subspecies, natural distribution range, genetic diversity

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SESSION 4: Bienenschutz, Pflanzenschutz & Bienenprodukte

V4.2: Honigbienenvitalitätsmonitoring in Raum und Zeit

Honey bee vitality monitoring in space and time

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Honigbienen sind essentielle Bestäuber und daher ist ihr Schutz von zentraler Bedeutung für die landwirtschaftliche Produktion und die Sicherung der biologischen Vielfalt. Wir präsentieren Langzeit-Fallstudien auf Bienenvolks- und Bundesebene und wie sich Klima und andere Faktoren auf die Leistungsfähigkeit von Honigbienenvölker auswirken können. Die vorgestellte Studie ist Teil des vom Bundesministerium für Ernährung und Landwirtschaft geförderten Verbundprojekts 'Monitoring der biologischen Vielfalt in Agrarlandschaften' (MonViA). Erste Analysen der letzten 60 Jahre in Mitteleuropa zeigten, dass eine Änderung von Temperatur und Niederschlag den Honigertrag gesteigert hat [doi 10.5073/JfK.2020.05.02]. Eine +1 °C Temperaturänderung erhöht den jährlichen Honigertrag um +0,9 kg pro Volk, während +100 mm Niederschlag den Ertrag um -0,4 kg verringert. Basierend auf Klimawandelprognosen für den Zeitraum 2020-2050, schätzen wir eine potenzielle Ertragssteigerung von +0,4 bis +0,8 kg Honig pro Volk. Weitere klimatische Faktoren verdeutlichen wie die Bienenleistung mit diversen Wetterbedingungen zusammenhängt (Wind, Luftfeuchtigkeit, Sonne, Schnee, etc.).

Keywords: Apis mellifera, honey bees, wild bees, pollinator populations, temperature, precipitation, climate, impact assessment

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SESSION 4: Bienenschutz, Pflanzenschutz & Bienenprodukte

V4.3: Verbesserte Methode für die routinemäßige Untersuchung von Honig mittels FTIR-Spektroskopie

Improved method for routine honey analysis by FTIR-spectroscopy

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Infrared spectroscopy is a reliable and sustainable method to analyze materials of any consistency, and allows to determine several parameters simultaneously. In contrast, classical methods are costs and time consuming, and because of the use of chemicals not environment friendly. The Fourier transform infrared spectroscopy (FTIR) is a useful tool to simplify and expedite honey analysis and has been established for routine in the LIB. Characteristic vibrations of all molecules in a sample were recorded by excitation with infrared light (400-4000 cm-1). The corresponding spectral regions were taken to calibrate the different honey quality parameters. By using FTIR with attenuated total reflection (ATR), the method was improved and extended for new quality parameters. Honey samples were analyzed by FTIR-ATR and additionally by standard methods (n> 3000; reference data). The spectral and reference data form the basis for the development of calibrations using Partial least squares regression (PLS) and Discriminant analysis. An extensive validation process and a successful participation in a proficiency testing confirms the reliability of the FTIR-ATR method. Nine different sugars, moisture, pH value, acidity, electrical conductivity and color can be analyzed after simple sample preparation in only one measurement. Additionally, a prediction for certain unifloral honeys is available. The FTIR-ATR method enables a more detailed analysis with less effort and costs. These advantages of a modern technological process in honey quality analysis can be directly passed through into practice. By continuously elaborating the quality and number of the analysis parameters (e.g. hydroxymethylfurfural content), the determination of honey quality by FTIR-ATR will be more valuable in future.

Keywords: honey, quality parameters, infrared spectroscopy, FTIR-ATR

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ABLAUF ZURÜCK

SESSION 4: Bienenschutz, Pflanzenschutz & Bienenprodukte

V4.4: Wirkungssteigerndes Potential von Zusatzstoffen und ihre Auswirkungen auf Honigbienen im Laborkontakttest

The potential of adjuvants to increase insecticidial effects on honey bees in laboratory contact toxicity tests

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Currently more than 350 adjuvants are authorized for use in Germany (January 2021) to ensure full efficacy of plant protection products (PPPs) even under unfavourable conditions. They may be added to the spray solution as wetting agents, adhesives or water conditioners and are also used in bee-attractive crops like apple or oilseed rape during flowering. However, in contrast to PPPs, adjuvants are not subject to extensive approval testing including risk assessment for pollinators. Little is known about the effects of tank mixtures, especially those with adjuvants. The aim of this study was to clarify whether and to what extent adjuvants mixed with insecticides cause an increase in bee toxicity and lead to lethal and sub-lethal effects. Therefore, six commonly used adjuvants with different functions were selected for a laboratory screening and investigated in tank mixtures with B4-insecticides belonging to the groups of neonicotinoids, pyrethroids, diamides, carbamates and butenolides. The tests were conducted according to the OECD test guideline 214 with certain adaptations. Following contact exposure of honey bees in a spray chamber (insecticide and adjuvants alone and in combination) mortality and behavior were monitored for at least 48 hours. Our results confirm findings from literature on possible increases in toxicity of insecticides which are classified as not dangerous to bees when mixed with adjuvants. The screening resulted in increased mortality rates compared to the solo application of the insecticide. Adjuvants applicated alone did not show any lethal effects. The tests indicate that the potential of adjuvants to increase the toxicity depends on the used adjuvant and insecticide. Finally, for a realistic and knowledge-based risk assessment on bees further studies in field realistic conditions are necessary.

Keywords: adjuvants, insecticides, tank mixtures, honey bees, toxicity increase

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SESSION 4: Bienenschutz, Pflanzenschutz & Bienenprodukte

V4.5: Bewertung der Auswirkung mikrobieller Pflanzenschutzmittel auf die Zusammensetzung des Darmmikrobioms und die Gesundheit von Honigbienen

Assessment of the impacts of microbial plant protection products containing *Bacillus thuringiensis* on the gut microbiome and the survival of honeybees

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This study aimed to evaluate the effect of a microbial plant protection product (PPP) with the active substance *Bacillus thuringiensis* subspec. *aizawai* (strain: ABTS-1857) on adults and larvae of honey bees. To determine the contamination levels of Bt in different hive-matrices, a feeding study under semi-field conditions was performed. Bt was found in all matrices over the entire test duration in different concentrations, but the concentration appeared to decrease with the time. Furthermore, two chronic adult and a chronic larval study were conducted under laboratory conditions to test the effect of different concentrations of the PPP. Possible modifications of the chronic oral toxicity test were assessed by additional pollen feeding. The survival of adult bees and larvae was affected after chronic exposure to PPP depending on the tested concentrations. Also, pollen feeding to adults significantly increased the survival of the treated bees. Subsequently, an in-hive feeding experiment under field conditions was performed to examine the effects of Bt on the brood development and the composition of the gut microbiome in worker bees. The abundance of the intestinal core bacteria *Snodgrasella alvi*, *Gilliamella apicola* and *Bifidobacterium asteroides* was tested. The brood termination rate of treated colonies was higher than in control colonies. Regarding the gut microbiome, only *B. asteroides* showed a significant higher relative abundance in bees of the treated hives than of the control hives, so a species-specific reaction may be assumed. In general, the PPP with the Bt-strain ABTS-1857 showed a strong effect on the mortality of adults and larvae under laboratory conditions. In the field similar effects regarding the brood development occurred and it has been proven that Bt can be discovered in different matrices in the hive with different concentrations and a time-dependent degradation rate. No consistent treatment effects on the three tested bacteria species of the gut microbiome were found.

Keywords: microbial pest controlling products, *Bacillus thuringiensis*, oral toxicity, brood development, honeybees

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SESSION 4: Bienenschutz, Pflanzenschutz & Bienenprodukte

V4.6: Nährstoffe beeinflussen die Reaktionen verschiedener Bienenarten auf die Exposition von Pflanzenschutzmitteln

Nutritional conditions modulate responses of different bee species to exposure of plant protection products

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Dietary nutrition (e.g. amino acids, fat, carbohydrates, protein and phytochemicals) is important for bee development and health. Especially, amino acids are necessary for growth, development, gene regulation and immunity. Therefore they might be also relevant for the detoxification of PPPs. How far different diets can affect health and resilience of different bee species in combination with plant protection products has been little investigated.

We investigated single and mixture effects of oral exposure to the insecticide Chlorantraniliprol and the EBI-fungicide Prochloraz for diets with different nutritional value. Adult *Apis mellifera*, *Bombus terrestris* and *Osmia bicornis* bees were fed either sugar solution, sugar solution with amino acids or a diverse pollen mixture. Various parameters such as longevity, food consumption, protein content and enzyme activity were studied in the laboratory in cages with either 10 individuals (for *A. mellifera*) or 5 individuals (*B. terrestris* and *O. bicornis*).

The results showed interspecific differences among bee species in response to various factors. Chlorantraniliprol in single and mixture exposure had negative effects on all bee species, particularly when only fed with sugar solution. In general, providing additional pollen to *O. bicornis* and *B. terrestris* had a positive effect on longevity of the bees, whereas amino acids had no positive effect on *O. bicornis*. Interestingly, *A. mellifera* benefitted more from additional amino acids than from pollen, especially in combination with Prochloraz they showed reduced adverse effects. This may indicate that *A. mellifera* benefits especially from high protein content and amino acid composition, whereas *B. terrestris* and *O. bicornis* may benefit from other pollen compounds, such as phytochemicals. Furthermore it is possible, that *B. terrestris* and *O. bicornis* have different essential amino acids requirements than *A. mellifera*. An appropriate nutritional composition seems to reduce stress from orally consumed PPPs.

Keywords: pesticides, nutrition, diet, physiology

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SESSION 4: Bienenschutz, Pflanzenschutz & Bienenprodukte

V4.7: Vergleichende Untersuchung des Expositionslevels von Honigbienen, Hummeln und Solitärbienen nach Applikation einer Tankmischung von Thiacloprid und Prochloraz im Freiland

Large scale study comparing the exposure level of honeybees, bumblebees and solitary bees after application of a tank mixture of thiacloprid-prochloraz

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According to differences in their biology and foraging behaviour, these bee species may be exposed to different quantities of residues. Field trials were conducted in four German regions in spring 2018 to evaluate the risks of a tank mixture containing thiacloprid and prochloraz to honeybees as well as other pollinators (bumblebees, solitary bees) under realistic conditions. The recommended application rate of 72 g thiacloprid/ha and 675 g prochloraz/ha was applied as a tank mixture on flowering oilseed rape during bee flight. Seven honey bee colonies, five bumble bee colonies, and five solitary trap nests with cocoons were placed next to each field. The eight fields were located pairwise (control, treatment) in four regions (Celle, Braunschweig, Bochum, Hohenheim). For each species, several matrices such as flowers, dead bees, honey sacs and pollen sacs from foragers, honey and pollen from colonies, as well as mud walls from solitary bee nests were continuously collected and analysed for residues of thiacloprid and prochloraz. The results indicated differences in the exposure levels among bee species, which suggests differences in the risk profiles of those three bee species.

Keywords: residues, tank mixture, bees, pollen, honey sac

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SESSION 4: Bienenschutz, Pflanzenschutz & Bienenprodukte

V4.8: Das "Digital Beehive" Projekt - wie Sensordaten dabei helfen Nebenwirkungen von Pflanzenschutzmitteln auf Honigbienen zu verstehen

The Digital Beehive project – using sensor data to understand side effects of plant protection products on honey bees

Silke Andree-Labsch, Catherine Borrek, Klaus-Reinhard Thois, Ulrich Krieg, Philipp Senger

Bayer Crop Science

Within the framework of bee (honey bee, *Apis mellifera*) pollinator risk assessment of plant protection products, semi-field studies (in net houses) are conducted under worst-case exposure conditions to evaluate potential side-effects on the colony level. During these trials, side effects on the bee colonies are being assessed by trained experts in agreement with the existing standards. These assessments are time consuming, only represent snapshots in time, and are subject to time-lags for assessments from different hives and treatment groups. Hence, the accuracy of the trials based on the standard methodology is limited. During the 2019 und 2020 seasons we performed four semi-field studies at the trial station Gut Höfchen during which some of the colonies were exposed to chemical treatments (Dimethoate or Lambda-Cyhalothrin). In addition to performing the standard assessments, we installed sensor systems at the hives which enabled continuous recording of data and, for further analysis, combined the sensor data with weather data recorded at the trial site. This talk focuses on the discussion of the “bee activity” data (count of bees entering and leaving the hive). We compare the activity from the sensor systems to numbers of bees counted by experts and find that the sensors enable a higher precision, especially for high bee activities. Furthermore, we present the signatures of the different treatments in the data and introduce a modelling approach to differentiate between weather and treatment effects. Digital monitoring systems enable a continuous data acquisition, high precision assessments especially at high bee activities, and can help us to foster a better understanding of the different factors influencing the health and behavior of bees. Based on our findings we want to discuss added value and limitations of the current set-up and outline our way forward.

Keywords: Bienenschutz, Pflanzenschutz, IoT, Sensoren

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SESSION 4: Bienenschutz, Pflanzenschutz & Bienenprodukte

BV4.1: Bee Warned – das Frühwarnsystem für exotische Bienenschädlinge in Bayern – wie geht es weiter?

Bee Warned – the monitoring system for exotic bee pests in Bavaria – what´s next?

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The distribution of *Aethina tumida* in Europe seems to be still limited to the south of Italy, but the verification of the small hive beetle in Sicily in summer 2019 expands the distribution area from Calabria to the province of Syracuse. On the other hand, in 2019 nests of *Vespa velutina* were discovered in and around Karlsruhe (Baden-Württemberg, German-French border) as in previous years. However, the evidence of a nest in Mannheim (northern Baden-Württemberg) and sightings of hornet-workers and –queens in southern Hesse and Rhineland-Palatinate in the years 2019 and 2020 demonstrate the expanded distribution range of the *V. velutina* in Germany. In addition, several nests have also been found and removed in Hamburg. Both parasites are harmful to honey bees and an early detection of these species seems to be essential to counter their further distribution. For early detection we set up a monitoring system with trained beekeepers distributed all over Bavaria. Each monitoring beekeeper was provided with beetle traps, to be placed in five bee colonies (April/May, June/July and August/September) for four weeks. Additionally they observed the hive entrances and the surroundings for preying hornets, to detect an occurrence of *V. velutina*. Since 2017, we were able to establish 241 monitoring apiaries all over Bavaria. Fortunately, we have detected neither *A. tumida* nor *V. velutina*, so far. However, what´s next? Last year we programmed a Web-App for a sustainable establishment of Bee Warned. This platform enables a simplified input of observations and an automated evaluation. Furthermore, it will open the monitoring for all interested beekeepers, which will result in a much more detailed and intensive observation of the occurrence and distribution of the two pests.

Keywords: small hive beetle; *Aethina tumida*; Asian Hornet; *Vespa velutina*; monitoring system

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BEE WARNED

Das Frühwarnsystem für exotische Bienenschädlinge in Bayern: Wie geht es weiter?

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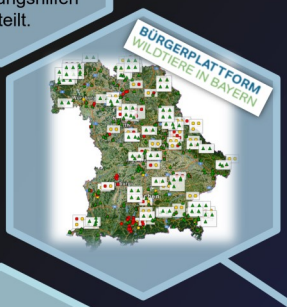
241 Monitoring-Imkereien. 30.000 Bestimmungshilfen verteilt. Die Asiatische Hornisse in Hessen und Hamburg nachgewiesen.

Pilotphase: Monitoring mit 195 Imkereien. Die Rückmeldequote 75,5%! 18.000 Bestimmungshilfen verteilt.



Bee Warned startet. Schulungsmaterialien für Imker/innen und BSV. Startpaket für Monitoring-Imker.

Erstnachweis der **Asiatischen Hornisse** in Deutschland und des **Kleinen Beutenkäfers** in Italien!

Eine **Webbasierte Anwendung zur Dateneingabe** wurde programmiert. Eine teilautomatisierte Auswertung erleichtert das Datenmanagement. Bundesweite Ausweitung möglich. Neu auftretende Schädlinge können schnell eingepflegt werden.

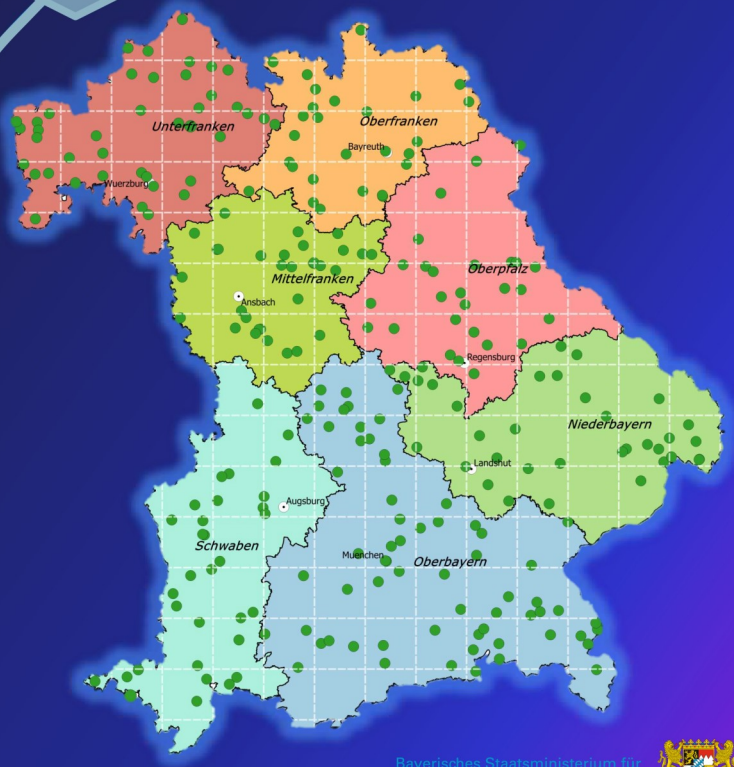
2020

2019

2018

2017

2014



Bayerisches Staatsministerium für Ernährung, Landwirtschaft und Forsten

SESSION 4: Bienenschutz, Pflanzenschutz & Bienenprodukte

BV4.2: Rückstände in Blütenpollen – ist das noch gesund?

Contaminants in bee pollen – is that still healthy?

Andreas Schierling

Tiergesundheitsdienst Bayern e. V.

Bee pollen is offered to the consumer as a healthy nutritional supplement, sometimes even as a remedy with multiple benefits. Although pollen collected by bees can possibly supplement the diet in a meaningful way, there is hardly any evidence of a health-promoting effect. However, any positive effect is irrelevant to bee pollen, contaminated with active agents in potentially harmful quantities. In order to determine possible risks by contaminants in Bavarian bee pollen, we analyzed pollen samples (GC-MS/MS, LC-MS/MS) with regard to pesticides, varroacides and further active ingredients from the beekeeping environment as well as pyrrolizidine alkaloids (PA). In the analyses of pesticides, varroacides and further agents a large part of the pollen samples (66,7 %) were found to be highly contaminated by a large number of active substances. The detectable compounds were primarily fungicides and insecticides, which among others are used in cultures of rapeseed. PA contaminations proved to be widespread, especially in pollen collected in summer (45,5 % of summer samples contaminated), and were sometimes found in alarmingly high concentrations of up to 11,5 mg/kg. The detectable PA can mainly be assigned to plant species from the Senecionidae and Boraginacea families. There are currently no legally established maximum residue levels for plant protection agents. Since no toxicologically relevant amounts were detectable, no sample had to be criticized. However, the PA contents of some summer samples significantly exceeded the orientation values suggested by the EFSA resulting in a potential health hazard. Every beekeeper who collects pollen can therefore only be strongly recommended to have the safety of his product checked before it is marketed.

Keywords: pollen, contaminants, pesticides, pyrrolizidine alkaloids

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In Kooperation mit

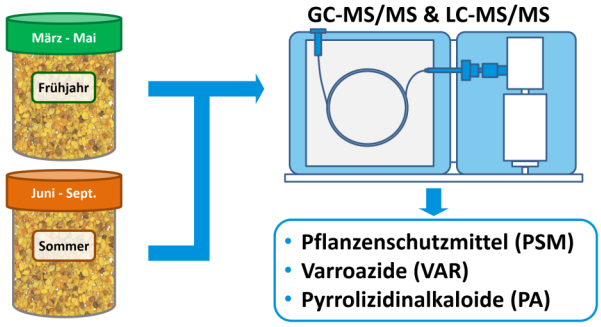
Rückstände in Blütenpollen – ist das noch gesund?

Dr. Andreas Schierling, Tiergesundheitsdienst Bayern e.V.

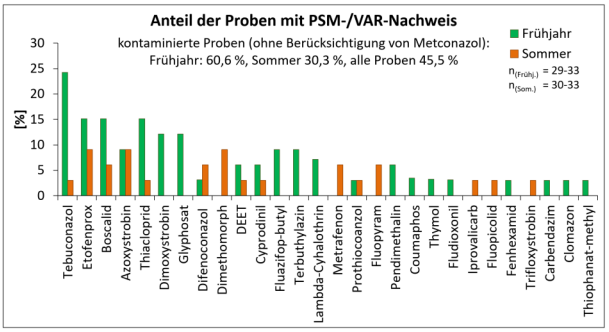
www.tgd-bayern.de

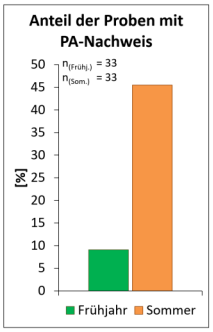
Einleitung

Trotz bislang fehlender eindeutiger Nachweise einer gesundheitsfördernden Wirkung wird Blütenpollen dem Verbraucher meist als gesundes Nahrungsergänzungs-, z.T. sogar als Heilmittel angeboten. Ob nun vorhanden oder nicht, müssen Blütenpollen jedoch jegliche positiven Effekte abgesprochen werden, wenn dieser Wirkstoff-Rückstände in potentiell gesundheitsschädlichen Größenordnungen enthält. Um mögliche Risiken durch Kontaminanten in Blütenpollen ermitteln zu können, wurden über die staatliche Fachberatung für Bienenzucht Bayern Pollenproben von bayerischen Imkern gesammelt und vom Tiergesundheitsdienst Bayern e.V. rückstandsanalytisch untersucht.

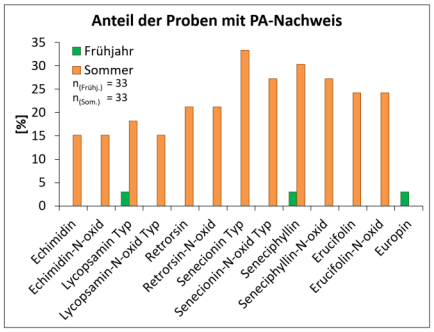


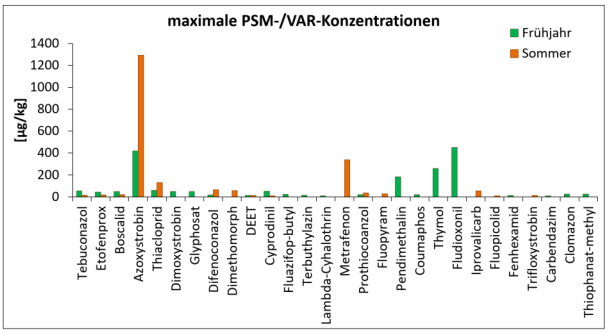
Ergebnisse Analytik Pflanzenschutzmittel (PSM)/Varroazide (VAR)

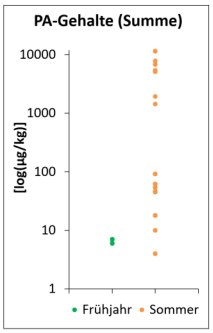




Ergebnisse Analytik Pyrrolizidinalkaloide (PA)

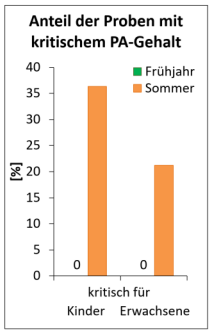






Toxikologische Bewertung von PA in Pollen

	Kind	Erwachsener
Pollenkonsum	2 Teelöffel = 10 g pro Tag	
Maximalmenge PA (EFSA[1])	0,0237 µg PA pro kg Körpergewicht und Tag	
Angen. Körpergew.[2]	16,15 kg	70 kg
Max. PA-Menge im Pollen	39 µg/kg	166 µg/kg



Diskussion

In Bayern gesammelter Blütenpollen zeigte sich in vielen Fällen als mit PSM, VAR und/oder PA kontaminiert. Für PSM in Pollen existieren derzeit keine gesetzlich festgelegten Rückstandshöchstgehalte (RHG) und die für VAR geltenden RHG wurden nie überschritten. Da die PSM-Gehalte in den untersuchten Proben nie toxikologisch relevante Größenordnungen erreichten, waren diesbezüglich keine Beanstandungen notwendig. Dennoch muss von Pollenernten in Regionen mit behandlungsintensiven landwirtschaftlichen Kulturen abgeraten werden.

Die nachweisbaren Gehalte an PA hingegen erwiesen sich v.a. in den im Sommer gesammelten Pollen-Proben häufig als toxikologisch relevant. Unter Berücksichtigung von der EFSA veröffentlichter toxikologischer Daten zu PA kann eine potentielle Gesundheitsgefährdung bei diesen kritisch mit PA belasteten Proben nicht mehr sicher ausgeschlossen werden. Zur Vermeidung hoher PA-Gehalte wird empfohlen den Zeitraum für die Pollenernten auf das Frühjahr zu beschränken.

Die Ergebnisse zeigen die hohe Relevanz einer rückstandsanalytischen Untersuchung von gesammelten Blütenpollen zur Beurteilung möglicher gesundheitlicher Risiken bei dessen Konsum.

zitierte Literatur und Datenquellen

[1] Risks for human health related to the presence of pyrrolizidine alkaloids in honey, tea, herbal infusions and food supplements; EFSA Journal 2017; 15(7): 4908

[2] Basisdaten zur toxikologischen Bewertung von Pyrrolizidinalkaloiden in Lebensmittel des Bayer. Landesamtes für Gesundheit und Lebensmittelsicherheit (mündl. Mitteilung)

Für dieses Poster wurden Erkenntnisse und Ergebnisse verwendet, die auf Untersuchungen des TGD Bayern e.V. basieren, die aus Mitteln des Freistaates Bayern durch das Bayerische Staatsministerium für Landwirtschaft und Forsten gefördert wurden.

SESSION 4: Bienenschutz, Pflanzenschutz & Bienenprodukte

BV4.3: Pestizidrückstände in Blütenpollen aus Baden-Württemberg

Pesticide Residues in Bee Pollen from Baden-Wuerttemberg

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Currently, healthy diet is becoming ever more important and correspondingly the interest in bee products has grown steadily. Besides honey, bee pollen collected by honey bees (*Apis mellifera*) can be used as a valuable nutritional supplement by humans. Due to their wide range of essential amino acids, bee pollen has nutritional values and is also an important source of vitamins and other elements. However, the contamination by pesticides might significantly influence the quality of the pollen collected in agricultural areas. To investigate the risk of pesticide contamination, pollen samples were collected at 81 locations in Baden-Wuerttemberg at different time of the season, including natural habitats as well as locations in intensive agriculture. Pooled pollen samples were collected with pollen traps in March, April and June. In total, 222 pollen samples were collected. The samples were analyzed in cooperation with the LUFA Speyer using QuEChERS and LC-MS/MS. The samples were analyzed for a total of 287 pesticides and their metabolites, of which 77 were identified in our samples. The pesticide exposure in individual locations, classified regions and different periods will be presented. First evaluations show that more than 70% of the samples collected in April (during rapeseed and fruit bloom) showed positive findings, while samples taken in March and June showed lower percentages of contamination. The project “Pollen sammeln in Baden-Württemberg” was initiated to support domestic bee pollen production and to establish a network of beekeeper for further research (supported by the Ministry of Rural Areas and Consumer Protection Baden-Wuerttemberg).

Keywords: bee pollen, pesticide residues, Baden-Wuerttemberg

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SESSION 4: Bienenschutz, Pflanzenschutz & Bienenprodukte

BV4.4: Bienenschutz: Risikobewertung von Pflanzenschutzmitteln

Bee protection: risk assessment of plant protection products

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Pflanzenschutzmittel (PSM) dürfen nur in den Verkehr gebracht werden, wenn in einer geeigneten Risikobewertung festgestellt wird, dass unter Praxisbedingungen keine unannehmbaren Auswirkungen auf die Brut, auf das Verhalten und auf das Überleben sowie die Entwicklung von Bienenvölkern auftreten. Das Pflanzenschutzgesetz macht dabei keine Unterscheidung zwischen synthetischen PSM, Naturstoffen und Mikroorganismen, denn auch Naturstoffe und Mikroorganismen können Risiken bergen. Die Zulassungsprüfung von PSM gliedert sich in zwei Teile: Wirkstoff- und Produktprüfung. Die Überprüfung der Wirkstoffe erfolgt unter Einbeziehung aller europäischen Mitgliedstaaten und unter Leitung der Europäischen Kommission. Sobald Wirkstoffe genehmigt sind, kann die Zulassung von Produkten auf nationaler Ebene Länderebene beantragt werden. Zulassungsstelle für PSM in Deutschland ist das Bundesamt für Verbraucherschutz und Lebensmittelsicherheit. Es arbeitet dabei mit drei Bewertungsbehörden zusammen: Dem Bundesinstitut für Risikobewertung, dem Julius Kühn-Institut und dem Umweltbundesamt. Jedes PSM wird auf seine akute und chronische Toxizität für Stock- und Flugbienen sowie auf mögliche brutschädigende Eigenschaften geprüft. Auch Störungen des Orientierungsvermögens und andere subletale Effekte werden erfasst, da sie sich direkt oder indirekt auf die gemessenen Versuchsparameter wie z.B. Mortalität, Flugintensität, Populationsentwicklung, Brutentwicklung, Überwinterung auswirken. Auch das gleichzeitige Ausbringen mehrerer PSM als sog. Tankmischungen wird berücksichtigt, und bestimmte Mischungen aus Insektiziden und Fungiziden werden aufgrund möglicher synergistischer Wirkungen in Praxisversuchen geprüft. Das Risiko für Bienen wird national auch für Zusatzstoffe geprüft, die die Wirksamkeit von PSM sicherstellen sollen oder das Ausbringen der PSM verbessern können.

Keywords: Honigbiene, Risikobewertung, Pflanzenschutzmittel

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Bienenschutz: Risikobewertung von Pflanzenschutzmitteln

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Julius Kühn-Institut
Bundesforschungsinstitut für Kulturpflanzen
Federal Research Centre for Cultivated Plants

Nur geprüfte und zugelassene Pflanzenschutzmittel (PSM) dürfen angewendet werden. Die Prüfung erfolgt nach der EU-Verordnung Nr. 1107/2009. Die Bewertung der *Bienengefährlichkeit* von PSM und des eigentlichen *Risikos* für Bienen bei den PSM-Anwendungen wird in Deutschland vom Julius Kühn-Institut (JKI) durchgeführt. Die anschließende Zulassung der PSM in Deutschland erfolgt durch das Bundesamt für Verbraucherschutz und Lebensmittelsicherheit (BVL).

Risikobewertung - JKI

PSM-Anwendungen dürfen kein unakzeptables oder nicht beherrschbares *Risiko* für Bienen darstellen.

1. Exposition

Zuerst wird die Möglichkeit einer *Exposition* der Bienen mit dem PSM beurteilt. Grundlage hierfür ist die beantragte Ausbringungsmethode z.B. als Sprüh- oder Beizmittel. Der Kontakt mit dem PSM kann direkt (z.B. übersprühen) oder indirekt (z.B. über Nahrung) erfolgen.
Besteht die Möglichkeit einer Exposition, muss das *Gefährdungspotential* des PSM untersucht und das *Risiko* für die Bienen bewertet werden.

Gefahr
Beschreibt eine Situation oder Eigenschaft, die das Potenzial hat, Schaden zu erzeugen.

Risiko
Ist die Wahrscheinlichkeit mit der eine Gefahr eine negative Schädigung zur Folge hat.

2. Gefährdungspotential

Zur Beurteilung des *Gefährdungspotentials* eines PSM für Bienen wird ein gestuftes Prüfsystem angewendet. Hier werden die Hauptexpositionswege „Oral" und „Kontakt" standardisiert nachgestellt.

Alle Versuche werden nach validierten und EU-weit akzeptierten Richtlinien durchgeführt.
Bei jeder nächsthöheren Prüfstufe wird das Ergebnis ökologisch relevanter, lässt sich aber weniger gut standardisieren.

Prüfsystem

Prüfstufe 1 – Einzelbiene
Richtlinie:
OECD 213, 214, 239, 245, 246, 247

Prüfstufe 2/3 - Volksebene
Richtlinie:
OECD 75, EPPO 170

Prüfsystem

Ermittlung des *Gefährdungspotenzials* eines PSM. Geprüft werden adulte Bienen und Bienenlarven und adulte Hummeln. Die Richtlinien für Solitärbienen sind aktuell in der Entstehung.

1.Stufe: Labor (hohe Standardisierbarkeit)

Ziel ist es, Konzentrationen oder Dosen zu ermitteln, die:
- *negative Effekte* verursachen z.B. Letalität/Toxizität (LC (letale Konzentration), LD (letale Dosis))
- *keine negativen Effekte* verursachen (NOEC (no observed effect concentration), NOED (no observed effect dose)

Die Verabreichung des PSM erfolgt einmalig (akut) oder über einen längeren Zeitraum (chronisch). Dieses kann als Futterzugabe (Oral) oder einmalige Applikation direkt auf die Biene (Kontakt) erfolgen.

2./3.Stufe: Halbfreiland, Freiland (hohe ökologische Relevanz)

In dieser höheren Prüfstufe werden PSM geprüft, wenn:
- die Gefährdungsschwelle des HQ überschritten wurde
- es relevante Verhaltensauffälligkeiten auf Laborebene gab
- überprüft werden soll ob *Risikominimierungsmaßnahmen* das Risiko beherrschbar machen (z. B. eine Anwendung nach dem täglichen Bienenflug)

Die getestete Konzentration entspricht mindestens der beantragten maximalen Aufwandmenge des PSM.

3. Risikobewertung

In Prüfstufe 1 erfolgt die Risikobewertung von PSM unter anderem über den Schädigungsquotient (HQ). Hierbei handelt es sich um einen berechneten Wert, der sich aus der maximalen Exposition und der Toxizität des PSM ergibt. Der HQ sollte eine festgelegte Gefahrenschwelle (GS) nicht überschreiten. Wird die GS dennoch überschritten, kann ein Risiko für Bienen nicht ausgeschlossen werden. Das Mittel ist somit potenziell bienengefährlich. Diese potentielle Gefahr kann über die Prüfstufen 2/3 unter ökologisch relevanteren Bedingungen nochmals geprüft werden.
Bleibt sie bestehen oder werden die Prüfstufen 2/3 nicht durchgeführt, gilt das PSM als bienengefährlich.
Da Gefahren, die von einem PSM ausgehen, nicht geändert werden können, müssen die Risiken geändert werden. Diese kann durch das Verringern oder Verhindern einer Exposition der Bienen mit dem PSM erfolgen. Hierzu empfiehlt das JKI dem BVL Risikominimierungsmaßnahmen, deren Wirksamkeit in Versuchen aus den Prüfstufen 2/3 belegt seinen müssen.
Die *Maßnahmen* oder *Auflagen*, mit denen Risiken schlussendlich vermindert werden, werden als *Risikomanagement* zusammengefasst

Risikomanagement - BVL

Mit der Zulassung von PSM werden Auflagen und Anwendungsbestimmungen festgesetzt, deren Einhaltung die *Vermeidung unakzeptabler Risiken* für Bienen gewährleisten soll. Festgelegt werden z.B. die maximale Aufwandmenge sowie die maximale Häufigkeit, der Zeitraum, die Zielkultur der Anwendungen und technische Mindeststandards für das Ausbringen von PSM. Beschränkungen von Kombinationen mehrerer Produkte können festgesetzt werden, wenn synergistische Effekte bekannt sind.

Wichtigste Auflagen – Prüfbereich Bienen

NB6611 – Bienengefährlich (B1) Keine Anwendung in blühende oder von Bienen beflogene Kulturen [….]
NB6621 – Bienengefährlich (B2) Anwendung nur nach dem Ende des täglichen Bienenfluges [….]
NB663 – Nicht bienengefährlich (B3) Bienen werden aufgrund der durch die Zulassung festgelegten Anwendungen des Mittels nicht gefährdet.
NB6641 – Nicht bienengefährlich (Bienenungefährlich; B4) Bis zur höchsten durch die Zulassung festgelegten Aufwandmenge (oder Anwendungskonzentration, falls eine Aufwandmenge nicht vorgesehen ist).

Gekürzte Darstellung

Sonderauflagen - Vorsicht bei Tankmischungen

Tankmischungen bienenungefährlicher Pyrethroide mit bestimmten Fungiziden können bienengefährlicher sein als die Anwendungen der einzelnen Mittel.

NB6612 – Bienengefährlich (B1) Das Mittel darf an blühenden Pflanzen und an Pflanzen, die von Bienen beflogen werden, nicht in Mischung mit Fungiziden aus der Gruppe der Ergosterol-Biosynthese-Hemmer angewendet werden.
NB6623 – Bienengefährlich (B2). Das Mittel darf in Mischung mit Fungiziden aus der Gruppe der Ergosterol-Biosynthese-Hemmer an blühenden Pflanzen und an Pflanzen, die von Bienen beflogen werden, nur abends nach dem täglichen Bienenflug bis 23:00 Uhr angewendet werden, […]

Gekürzte Darstellung

www.julius-kuehn.de

SESSION 4: Bienenschutz, Pflanzenschutz & Bienenprodukte

BV4.5: Comparative exposure of honey bee brood (*Apis mellifera* L.) to pesticides under semi-field and field conditions

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Plant protection products can have lethal and sub-lethal effects on honey bee populations. Based on EU Regulation 1107/2009/EC, the current regulatory risk assessment on honey bees has to address the risk on honey bee larvae. According to the EFSA Bee Guidance Document, 2013, possible higher tier methods for a refinement under more realistic exposure conditions are semi-field and field studies following the OECD Guidance Document 75 or the method by Oomen et al, 1992. In a semi-field OECD GD 75 study the exposure of honey bee brood is driven by pollen and nectar, which is collected by foraging bees from a treated crop inside a tent. An Oomen field study considers an exposure via a treated sugar solution, which is fed directly inside the bee hive. Based on these feeding sources, nurse bees produce larval food (worker jelly), which is offered to the brood and contains residues of the plant protection products. However, it remained unclear if the exposure of larvae in both study types is comparable. Therefore, a study was conducted to evaluate the comparability of an exposure of young honey bee brood to plant protection products through larval food under semi-field and field conditions. In a semi-field study following the OECD GD 75 study design, a tank mixture of an insecticide containing thiacloprid and of a fungicide containing boscalid and dimoxystrobin was applied at their maximum application rates in a bee attractive crop. Simultaneously, in a field study following the Oomen method the same plant protection products were used to spike a sugar solution at field realistic residue levels derived from the same maximum application rates. Our results show higher residues in the worker jelly in the Oomen method compared to the OECD GD 75 study and indicate a higher exposure of honey bee brood exposed via treated sugar solution compared to honey bee brood exposed by nectar and pollen.

Keywords: pesticides, worker jelly, brood study, risk assessment

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SESSION 4: Bienenschutz, Pflanzenschutz & Bienenprodukte

BV4.6: Gefährdung von Bienenvölkern bei Bekämpfung des Schwammspinners (*Lymantria dispar*) mit Mimic®?

Risk to honeybee colonies during control of the gypsy moth (*Lymantria dispar*) with Mimic®?

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The gypsy moth (*Lymantria dispar*) is a butterfly that lives on oaks and other deciduous tree species. Since the beginning of the 1990s, there have been repeated outbreaks in Franconian oak stands. Defoliation can result in high failure rates of oaks, which is why the gypsy moth is treated. Mimic® contains the active ingredient tebufenozide, acts selectively as a moult accelerator in butterflies and is classified as non-hazardous to bees (B4). In 2020, prior to application of the insecticide by helicopter, 12 bee colonies were placed in the treatment area, with an additional 6 colonies outside as control. On the evening before treatment, 6 colonies in the treatment area were closed and reopened the following day after treatment. Colony development, mortality at the hive entrance and residues in honey, pollen loads and returning foraging bees were determined. No differences in colony development and mortality were observed between the three groups. In colonies with flight possibility on the treatment day, residues of the active substance were detected in returning bees (183.7 µg/kg) and in pollen loads (816 -23600 µg/kg). On the following day, these residues decreased in the returning bees (36.7 µg/kg) and in the pollen loads (407 -1232 µg/kg). Residues were also detected in returning bees (13.7 µg/kg) and pollen (407-951 µg/kg) on the following day in colonies that were closed on the day of treatment. Bee colonies are exposed to the active ingredient tebufenozide when Mimic® is applied, effects on mortality and colony development could not be detected. Closing the colonies during application reduces peak residue levels of the active ingredient but does not completely prevent exposure.

Keywords: Lymantria dispar, honeybee, residues, tebufenozide

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Gefährdung von Bienenvölkern bei Bekämpfung des Schwammspinners (*Lymantria dispar*) mit Mimic®?

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Einleitung

Der Schwammspinner (*Lymantria dispar*) gehört mit den Frostspannern, Eichenwicklern und Frühlingseulen zur „Eichenfraßgesellschaft“. Seit Anfang der 90er Jahre kam es in fränkischen Eichenbeständen immer wieder zu Massenvermehrungen, die durch warme und trockene Witterung begünstigt wird. Folge ist ein Kahlfressen von Eichen- und Eichenmischwäldern im Frühjahr.
An Standorten mit Massenvermehrungen wurde 2020 das Präparat Mimic® mit dem Wirkstoff Tebufenozid ausgebracht. Tebufenozid wirkt bei Schmetterlingslarven als Häutungsbeschleuniger und ist als bienenungefährlich (B4) eingestuft.
Im Jahr 2020 wurde geprüft, ob Bienenvölker im Behandlungsgebiet mit dem Wirkstoff in Kontakt kommen und das zeitweise Verschließen der Fluglöcher den Wirkstoffeintrag reduzieren kann.

Abb. 1: Die Gelege des Schwammspinners werden von den Weibchen mit Afterwolle abgedeckt (a). Die adulten Weibchen sind deutlich heller gefärbt als die Männchen (b). Die Larven werden bis zu 7 cm lang (c) und können durch Kahlfraß erhebliche Schäden verursachen (d).
Bilder: LWF, Lemme

Material und Methoden

In Bayern wurden im Untersuchungsjahr 2020 ca. 2.800 ha mit Mimic® behandelt (750 ml/ha). In Retzstadt (Unterfranken) wurden im Behandlungsgebiet und an einem Kontrollstandort Versuchsgruppen mit jeweils 6 Bienenvölkern aufgestellt:

Gruppe I: Kontrolle, Standort außerhalb des Behandlungsgebiete

Gruppe II: Versuchsstandort im Behandlungsgebiet mit **offenem Flugloch** am Tag der Behandlung

Gruppe III: Versuchsstandort im Behandlungsgebiet mit **geschlossenem Flugloch** am Tag der Behandlung

Die Volksentwicklung der Völker wurde mittels Populationsschätzungen und die Mortalität am Flugloch über Totenfallen erfasst. Heimkehrende Sammlerinnen und Höselpollen am Tag vor der Behandlung (Tag -1, 06.05.2020), am Behandlungstag (Tag 0, 07.05.2020) und am Tag nach der Behandlung (Tag +1, 08.05.2020) wurden auf Rückstände untersucht.

Abb. 2: Applikation mittels Helikopter.

Abb. 3: Bienenvölker mit Totenfallen

Danke

Wir danken Dr. Nicole Höcherl, Hildegard Zipper und Egbert Roth für die technische Unterstützung. Das Projekt wurde mit Mitteln des Bayerischen Staatsministeriums für Ernährung, Landwirtschaft und Forsten unterstützt.

Ergebnisse

Es konnten keine Unterschiede in der Volksentwicklung und in der Mortalität zwischen den drei Gruppen beobachtet werden. Bei Völkern mit Flugmöglichkeit am Behandlungstag konnten Rückstände des Wirkstoffs in heimkehrenden Sammlerinnen und im Pollen nachgewiesen werden (siehe Abb. 5 und 6). Am Folgetag nahmen diese Rückstände in den Sammlerinnen und im Pollen ab. Auch bei Bienenvölkern, die am Behandlungstag verschlossen waren, konnten am Folgetag Rückstände in Sammlerinnen und im Pollen nachgewiesen werden.

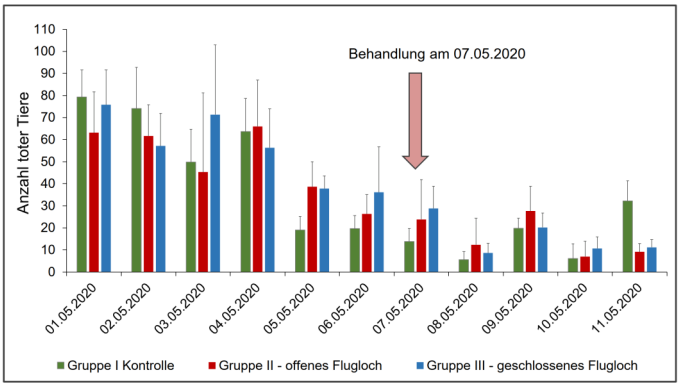

Abb. 4: Mortalität am Flugloch. Dargestellt sind die mittlere Anzahl toter Bienen (n=6) und die Standardabweichung.

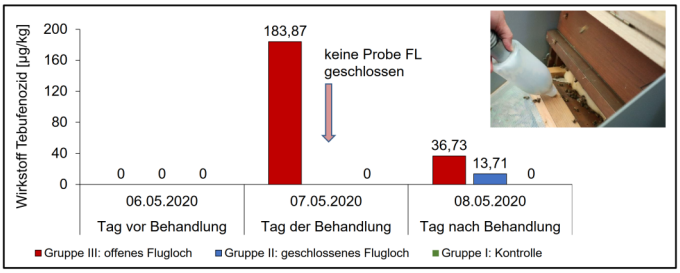

Abb. 5: Rückstände in heimkehrenden Sammlerinnen am Tag vor der Behandlung, am Behandlungstag und am Tag nach der Behandlung.

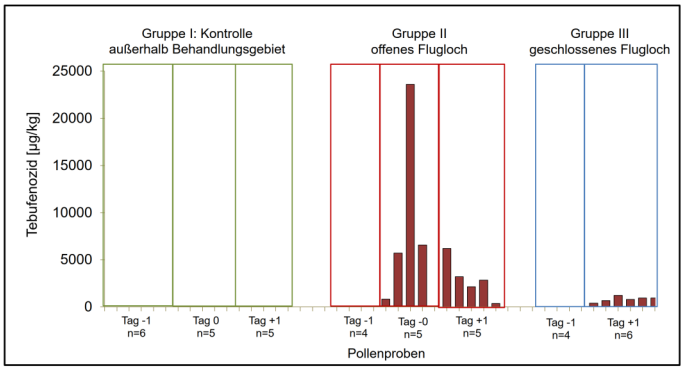

Abb. 5: Nachweise des Wirkstoffs Tebufenozid in Höselpollen. Der Pollen wurde am Tag vor der Behandlung (Tag-1), am Tag der Behandlung (Tag 0) und am Folgetag (Tag +1) mittels Pollenfallen gesammelt. Dargestellt sind die Wirkstoffmengen in den einzelnen Proben. Wenn die Pollenmenge für eine Analyse zu gering war, wurden Proben gepoolt, daher sind die n-Zahlen z. T. kleiner 6.

Diskussion

Bienenvölker kommen bei der Anwendung von Mimic® mit dem Wirkstoff Tebufenozid in Kontakt. Die Mortalität und Volksentwicklung werden nicht beeinflusst. Das Verschließen der Völker während der Applikation reduziert den Wirkstoffeintrag, schließt ihn aber nicht völlig aus.

SESSION 4: Bienenschutz, Pflanzenschutz & Bienenprodukte

BV4.7: Chronisch hohe Glyphosat-Exposition verzögert die Entwicklung bei Arbeiterinnen unter Freilandbedingungen

Chronic high glyphosate exposure delays individual worker bee development under field conditions

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The ongoing debate about glyphosate-based herbicides (GBH) and their effects on bee pollinators is a controversial issue. This experiment, therefore, aims to investigate possible sublethal GBH effects on brood and colony development, field residues in bee products, adult survival and the wintering of honeybees (*Apis mellifera* L.) under field conditions. To answer these questions, we chose four independent research approaches. In our key experiment, we exposed mini-hives (n = 5 / treatment) over a breeding cycle (21 days) to sublethal glyphosate concentrations of 2 mg / kg (T1, low) and 200 mg / kg (T2, high). The brood development and the colony conditions were assessed. We then weighed and labeled freshly emerged workers from exposed colonies and introduced them to uncontaminated mini-hives to monitor lifespan for 25 consecutive days. The results of the key experiment showed an insignificant effect of glyphosate on colony conditions ($P > 0.05$, ANOVA: number of bees, beehive weight) and the survival of individual workers ($P > 0.05$, Log-rank test, pairwise). In T2, however, "brood termination" was increased ($P < 0.05$, T-test, pairwise) and hatching fresh weight was significantly reduced ($P < 0.05$, T-test, pairwise). In light of these results, we suggest that chronic high glyphosate exposure can significantly delay worker brood development, while no further adverse effects appear at the colony level. In this context, we discuss complementary results and consequences of GBH exposure for honeybee health.

Keywords: honey bee health, glyphosate-based herbicides, brood development, field exposure, survival, overwintering, colony conditions, sublethal effects, residues

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ABLAUF ZURÜCK

SESSION 4: Bienenschutz, Pflanzenschutz & Bienenprodukte

BV4.9: Untersuchung der Effekte von hochfrequenter elektromagnetischer Strahlung auf Honigbienen

Effects of chronic radiofrequency electromagnetic radiation (RF-EMF) on honey bees

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The increasing use of wireless technologies and the urbanization are leading to higher emission rates of electromagnetic fields (EMF) in populated areas. This anthropogenic electromagnetic radiation is a form of environmental pollution and might represent a stressor with negative impact on bees or other flying insects. Especially in cities, a high exposure of electromagnetic frequencies e.g. in the range of 2,4 and 5,8 GHz by using wireless technologies can be found. However, to date the effects of non-ionizing electromagnetic radiation on vitality, behavior and gene expression of insects are poorly understood. In our experiment we used honey bees as test organisms and analyzed the effects of a chronical and simultaneous exposure to 2,4 and 5,8 GHz on brood development, longevity and homing ability. For that purpose, we used a high-quality radiation source which generates a consistent, definable and realistic electromagnetic radiation, made for this experiment by the Communications Engineering Lab (CEL) at the Karlsruhe Institute of Technology. Two groups (EMF, control) with 8 colonies each were analyzed under field conditions from July until October 2020. Our preliminary results show no significant effects of chronic radiofrequency electromagnetic radiation on the brood development and adult worker longevity, but indicate weak effects on the home finding success of foraging honey bees. This work, as part of the project BioVa, is funded by the State of Baden-Württemberg: “Sonderprogramm zur Stärkung der biologischen Vielfalt”.

Keywords: RF-EMF exposure, honey bee, anthropogenic stressor, electromagnetic radiation

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SESSION 5: Physiologie & Verhalten

V5.1: Verhaltensuntersuchungen zur Häufigkeit und Dauer des Ausfliegens der Bienenkönigin zum Begattungsflug

Behavioral studies on the frequency and duration of queen bee flight to mate

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Problemstellung: Der Begattungsflug stellt die letzte Hürde einer erfolgreichen Königinnenaufzucht dar. Um die Verluste zu minimieren muss der Imker das Ausflugsverhalten der Königin und die Witterungseinflüsse kennen. Im Rahmen der Untersuchung wurden die folgenden Fragestellungen betrachtet: • Zu welcher Tageszeit fliegt eine unbegattete Bienenkönigin zur Begattung aus? • Wie häufig und wie lange fliegt eine unbegattete Bienenkönigin aus? • Welchen Einfluss hat die Witterung auf das Ausflugverhalten? Methodik: Die Untersuchungen fanden bei einem Königinnenvermehrer im Kreis Soest statt. Dieser arbeitet mit „Mini Plus Beuten“. Vier Kameras erfassten parallel die Fluglöcher von 8 „Mini Plus Beuten“. Es konnten drei Zuchtserien ausgewertet werden! Parallel erfolgte die Erfassung der Klimaparameter. Anhand der Videoaufzeichnungen war es möglich zu ermitteln, wann die Königin die Beute verließ und wieder zurückkehrte. Ergebnisse: Bei insgesamt 12 Königinnen konnte der Begattungsflug beobachtet werden. Die Königinnen flogen zwischen 13.46 und 16:33 Uhr bis zu vier Mal aus. Die ersten Flüge waren kurze Orientierungsflüge von weniger als 5 Minuten. Anschließend flog die Königin zum dritten oder vierten Mal zum eigentlichen Begattungsflug aus. Diese Ausflugszeiten sind deutlich länger (zwischen 11 und 23 Minuten). Flüge erfolgten ausschließlich an Tagen an denen die Temperatur während der Ausflugszeit deutlich über 20 Grad Celsius lagen. Bei starker Bewölkung konnten keine Flüge der Königinnen beobachtet werden. Bei einer zurückkehrenden Königin war bei der Rückkehr in die Beute noch das Begattungsmal zu erkennen als Sie in die Beute zurückkehrte. Kurz darauf wurde dies von einer Arbeiterin wieder herausgetragen. Diskussion Die in der Literatur angegebenen Werte zum Ausflugverhalten (Ausflugszeitpunkt 12 und 17 Uhr, Orientierungsflüge weniger als 5 Minuten, Begattungsflüge - 12-30 Minuten) stimmen sehr gut mit den eigenen Untersuchungen überein. Für den Imker bedeutet dies folglich, gerade im Nachmittagszeitraum keine Kontrollmaßnahmen in Völkern mit Jungköniginnen durchzuführen.

Keywords: Bienenkönigin, Begattungsflug, Orientierungsflug

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SESSION 5: Physiologie & Verhalten

V5.2: Lebendbeobachtung der Embryogenese von *Apis mellifera* - Ermittlung der Funktion von Acetylcholin in der Honigbienenentwicklung

Live imaging of *Apis mellifera* embryogenesis - Investigating the role of acetylcholine in honey bee development

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Proper honey bee development is vital for healthy populations and high agricultural yields. Within the colonies, unfertilized eggs develop into male drones and fertilized ones become female workers and queens. Embryonic development has not yet been comprehensively investigated in the honey bee due to the lack of adequate imaging methodology, which until today mainly encompasses two-dimensional transmission or static electron microscopy. Both methods fail in detecting proliferation, migration and differentiation on the cellular level within the subject. For fluorescence microscopy, fluorophores have to be present within the bee embryo, and – contrary to Drosophila – suitable transgenic bee lines are not available. Here, we show a new method to perform long-term live imaging of the embryonic development by injecting fluorescent protein-encoding mRNA during early stages and using light sheet-based fluorescence microscopy for detection. Instead of imaging only specific regions or isolated processes, we herewith acquire morphogenetic data in a systematic fashion and capture the embryo in its entirety. The high spatiotemporal resolution of our data allows us to show exclusive developmental processes within the embryogenesis of females. Via cholinergic modulation we aim to determine the role of acetylcholine in male and female honey bee development. Especially with regard to endangered honey bee persistence due to such man-made factors, our morphogenetic data can help to better identify the hazards, characterize the detriments, raise awareness and develop countermeasures.

Keywords: embryogenesis, light sheet fluorescence microscopy, worker ontogenesis, acetylcholine

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SESSION 5: Physiologie & Verhalten

V5.3: Wirkung von Estern der Tergittaschendrüsen auf die Fruchtbarkeit von Honigbienenarbeiterinnen

Effect of tergal gland esters on honey bee worker fertility

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In social insect societies, reproduction is usually limited to only one or few individuals. In the honeybee, *Apis mellifera*, this is ensured mainly by queen pheromones that prevent ovarian development in workers. These pheromones oftentimes consist of a blend of several substances that are all needed to elicit a full response. In 2019, a blend of four esters found in the tergal glands of queens has been found to inhibit ovary development to a similar degree as Queen Mandibular Pheromone (QMP). Yet, which of these esters are actively inhibiting components and whether there are synergistic or redundant effects between them is not known. Here, we tested the individual components and the ester blend for their effects on ovary development in caged workers in the laboratory. Groups of 50 to 60 newly hatched worker bees were exposed to each of the four esters, the full blend, or a negative control (acetone) for three weeks. Afterwards, we dissected the bees and scored their ovary development. In the negative control we found a lower percentage of developed ovaries than expected. A binomial GLM was used to test the effect of the treatments against the negative control, but significant differences between the treatments and the negative control could not be detected. Yet, two treatments (ester blend and capryl caprate) suggest an partial inhibition of ovary development in workers. The inconclusiveness was possibly the result of a too small sample size and does not allow definite conclusions on the effect of the tested esters. Still, the ester capryl caprate could be a candidate for ovary inhibition and should be examined further.

Keywords: queen pheromones, ovary development, fertility signaling

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SESSION 5: Physiologie & Verhalten

V5.4: Die Dosis macht das Gift: Supplementierung mit Probiotika/ Vitaminen und Langlebigkeit/Körpergewicht von Winterbienen, *Apis mellifera*

The dose makes the poison: supplementary feeding with probiotics/vitamins and longevity/body weight of winter honey bees, *Apis mellifera*

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Healthy workers are key for survival of honey bee colonies, *Apis mellifera*, over winter. Since beekeepers replace honey with sugar water, supplementary feeding appears necessary. However, effects of probiotic and vitamin food supplements on the winter bee health parameters longevity and body weight are poorly understood. Here, we show that supplementary feeding with probiotics can enhance longevity and body weight of winter bees, but attention should be given to the doses. In the laboratory, freshly emerged winter bees (N=1865) were exposed to the antibiotic tetracycline for 72-hours (to reduce microbiota synthesizing b-vitamins) and were then assigned to eight feeding regimes: sucrose only, probiotics (low and high dosage), probiotics and sucrose & pollen (low and high dosage), b-vitamins (low and high dosage), or sucrose & pollen ad libitum. Two control groups (N=232, sucrose only or sucrose & pollen) remained on their frame for 72 hours to establish natural gut microbiota and were then moved to cages. Highest survival and body weights were observed in groups provided with pollen as well as in both controls. Moreover, workers from both controls and the probiotic low & pollen-fed workers survived longer than all other groups, thereby showing the importance of proteins and gut microbiota (Kaplan Meier, Log Rank test, all Ps<0.05). However, high doses of vitamins and probiotics led to reduced longevity, likely due to dose-dependent toxicity. Possibly, benefits of vitamins only become visible over the full life span of winter bees. The data show the considerable potential of probiotic supplementary feeding, but caution is required with respect to the applied doses.

Keywords: nutrition, probiotics, vitamins, body weight, *Apis mellifera*, winter bees

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SESSION 5: Physiologie & Verhalten

V5.5: AmOctα2R: Charakterisierung eines Honigbienen-Octopamin-Rezeptors, der die Adenylatzyklase-Aktivität hemmt

AmOctα2R: functional characterization of a honeybee octopamine receptor inhibiting adenylyl cyclase activity

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Die Katecholamine Noradrenalin und Adrenalin sind wichtige Botenstoffe bei Wirbeltieren. Insekten wie die Honigbiene synthetisieren diese Substanzen jedoch nicht. Stattdessen verwenden sie die Phenolamine Tyramin und Octopamin für ähnliche physiologische Funktionen. Diese biogenen Amine aktivieren spezifische Rezeptoren, die zur großen Proteinfamilie der G-Protein-gekoppelten Rezeptoren (GPCR) gehören. Aufgrund ihrer molekularen und pharmakologischen Eigenschaften werden Octopamin-Rezeptoren der Insekten entweder als α- oder β-adrenerg-ähnliche Octopamin-Rezeptoren klassifiziert. Bislang wurden ein α- und vier β-Rezeptoren in der Honigbiene molekular und pharmakologisch charakterisiert. Kürzlich wurde in Drosophila melanogaster ein α2-adrenerger Octopaminrezeptor (DmOctα2R) identifiziert. Dieser Rezeptor wird durch Octopamin und andere biogene Amine aktiviert und bewirkt eine Abnahme der intrazellulären cAMP-Konzentration ([cAMP]i). Hier zeigen wir, dass der orthologe Rezeptor der Honigbiene (AmOctα2R) phylogenetisch zu einer Gruppe von Rezeptoren gehört, die eng mit menschlichen α2-adrenergen Rezeptoren verwandt ist. AmOctα2R bewirkt bei heterologer Expression in einer eukaryotischen Zelllinie die Abnahme der [cAMP]i. Der Rezeptor zeigt eine ausgeprägte Präferenz für Octopamin gegenüber Tyramin. Im Gegensatz zu DmOctα2R wird der Honigbienen-Rezeptor nicht durch Serotonin aktiviert. Seine Aktivität kann durch 5-Carboxamidotryptamin und Phentolamin effizient blockiert werden. Die funktionelle Charakterisierung von AmOctα2R erweitert diese Unterfamilie der monoaminergen Rezeptoren in der Honigbiene um ein sechstes Mitglied und ist ein wichtiger Schritt zum Verständnis der Wirkungen von Octopamin auf das Verhalten und die Physiologie von Honigbienen.

Keywords: biogene Amine, zelluläre Signaltransduktion, GPCR, second messenger

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SESSION 5: Physiologie & Verhalten

V5.6: Sammelverhalten von Honigbienen während und nach Massentrachten in Agrarlandschaften

Honey bee foraging behavior during and after mass-flowering in agricultural landscapes

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In order to ensure future crop pollination, we need to understand the foraging behavior and resource use of pollinators in dynamic agricultural landscapes that provide changing amounts of floral resources. Studying honey bees (*Apis mellifera*), as important pollinators and model organism, we gained insights into their foraging preferences.

We placed honey bee colonies next to strawberry fields with different amounts of mass-flowering oilseed rape availability (OSR availability) and urban areas in the surrounding landscapes. Using waggle dance analyses, we investigated foraging patterns during and after mass-flowering of OSR. In addition, we identified the pollen resource use during OSR and strawberry flowering in more detail using pollen DNA metabarcoding and microscopic pollen identification. Finally, we linked the foraging pattern to potential strawberry pollination services.

Although agricultural landscapes were visited quite frequently during and after mass-flowering, our results indicate that the preference switches from agricultural landscapes during mass-flowering to urban areas afterwards. A detailed look on the pollen foraging showed that honey bees used both crop species, OSR and strawberry, as main pollen resources. Linking the foraging patterns to potential strawberry pollination showed that strawberry flowers are less preferred by honey bees when OSR availability was high.

Our results suggest that diverse flowering crops and other mass-flowering resources should be promoted to fulfill not only the demand for reward quantity but also to cover a longer time-period with flower resources in agricultural landscapes. However, since honey bees, as major managed pollinators, might favor other resources than target crops, landscape and bee protection measurements should take foraging preferences of alternative pollinators into account as well.

Keywords: pollination, honey bees, waggle dance, pollen analyses, foraging behaviour

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SESSION 5: Physiologie & Verhalten

V5.7: Do intruders modify the foraging behaviour of the socially polymorphic orchid bee *Euglossa viridissima*?

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Ecological factors such as parasite density or resource availability can be important selective pressures for the evolution and maintenance of social behaviour. In the socially polymorphic orchid bee *Euglossa viridissima*, a foundress mother mass provisions brood cells and lays eggs within a small nesting cavity, then seals the cavity from within to await 58-63 days for offspring emergence, whereupon brood production can re-commence. The nest may become social when one or more daughters remain in the natal nest, usually assuming a subordinate position and foraging for nesting material and brood provisions, while the dominant mother acts as a guard. Social groups might be more successful at defending the nest against intruders than solitary individuals that leave their nest unguarded when foraging. Based on video observations during the period of brood production, we observed the frequency of nest intruders, such as ants, brood parasites and other bees that steal nesting material, in relation to the foraging behaviour of *E. viridissima* females in solitary versus social nests. We found that the frequency of intrusion by parasites was significantly higher in solitary nests and that subordinate females in social nests tended to undertake longer provisioning trips than solitary females, while dominant females rarely left their nests. Thus, the presence of a female inside the nest seems to protect it against intruders, enabling the subordinate to undertake longer provisioning trips, with an associated lower risk of destruction of her nest, including her investment in kin. These results lead to the intriguing question of why polymorphism in social behaviour is maintained in the population, despite the obvious advantage of being social in the presence of parasites. Possible explanations might be a bet-hedging strategy in response to fluctuating environments in time or space as well as frequency dependent selection.

Keywords: social behaviour, nest defence, parasites, solitary vs social

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SESSION 5: Physiologie & Verhalten

V5.8: Zum Verständnis wie Umweltfaktoren die Entstehung von Melezitose beeinflussen

Understanding the Influence of the Environment on the Formation of Melezitose

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Melezitose is a trisaccharide excreted in honeydew by hemipteran species that absorb the phloem sap of different plant species. Honey bees take up the honeydew and process it into honeydew honey. Honey with high amount of melezitose, also known as cement honey, crystallizes and obstructs the combs, leading to an economical loss and malnutrition for overwintering honey bees. Nevertheless, precise analyses of the conditions under which melezitose is produced have not been realised. In order to determine the influence of environmental factors for the emergence of melezitose, 601 honeydew droplets from 12 defined hemipteran species living on 5 different host tree species were collected considering botanical, zoological, geographical and weather terms. The sugar spectra of the honeydew samples were analysed by HPLC. We found remarkable increases in the proportion of melezitose in honeydew excreted not only of the hemiptera living on spruces, but also on firs and deciduous tree species by higher air temperature, lower relative humidity and natural habitats with highly permeable soil ($F(19,580)=35.12$, $p<0.001$). We hypothesise that melezitose production is influenced by environmental conditions and indirectly by the tree and hemipteran species. Drought stress affects especially spruces with their shallow-roots living on highly permeable soil, leading to an increase of osmotically active substances in the phloem sap. Subsequently, it is to assume that the hemipteran species increase the production of the higher molecule melezitose to avoid osmotic pressure. Understanding the background of melezitose production, honey with high amounts of the trisaccharide can be avoided in the future by timely removing the hives when specific environmental conditions are given. The comprehension of the phenomena therefore provides a promising tool to develop an early warning system for beekeepers to avoid cement honey.

Keywords: melezitose, honeydew, hemiptera, drought stress, cement honey

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SESSION 5: Physiologie & Verhalten

V5.9: Unterschiede in der Futterpräferenz von Sommer- und Winterbienen gegenüber Nektar und Honigtau

Differences in the feeding preference of summer and winter bees toward nectar and honeydew

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Under natural foraging conditions, honey bees (*Apis mellifera*) use both nectar and honeydew as food sources. Honeydew differs from nectar in that it may contain not only mono- and disaccharides, but also trisaccharides as melezitose and erlose. The present study aims to analyze the preference of honey bees collected in July (presumably summer bees) and September (presumably winter bees) regarding artificial nectar and artificial honeydew conducted under laboratory conditions. In each experiment, 40-50 honey bees were kept in cages (n=6). In each cage, the bees could choose between the following two food sources which were offered at the same time in equal quantities: a solution with 39% fructose, 31% glucose and 30% sucrose (artificial nectar) and 60% of the same solution with 40% of a solution with the trisaccharide melezitose (artificial honeydew) added. The summer and winter bees consumed significantly more artificial nectar than artificial honeydew ($p<0,01$, Mann-Whitney). The consumption of the artificial honeydew of summer bees decreased over the course of the test days ($p<0,01$, Spearman-rho). There was also an increase in the consumption of the artificial nectar among winter bees over the course of the test days ($p<0,01$, Spearman-rho). The findings show that (i) worker bees prefer artificial nectar to artificial honeydew when they have a choice between the two, (ii) there was a tendency to decrease artificial honeydew consumption and increase artificial nectar in summer and winter bees over the course of the experimental days.

Keywords: feeding, cage test, honeydew, nectar, summer/ winter bee

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SESSION 5: Physiologie & Verhalten

V5.10: Olfaktometer für Versuche an Honigbienen-Drohnen in einem Flug-ähnlichen Szenario

Olfactometer for honeybee drones in a flight-like scenario

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Honeybees are strongly olfactorily-guided organisms, both inside the colony and outside of it. Honeybee drones on mating flights appear to be primarily visually-guided, but chemical cues emitted by virgin queens and, possibly, consexuals play an important role as well. Direct observation of a drone cluster pursuing honeybee queens is complicated due to its occurrence in the high air and ratio of their size and speed. Furthermore, the elucidation of the role of olfactory cues in this scenario is difficult due to the unavoidable overlap of chemical, optical, and possibly other cues. We here suggest a bioassay in which optical and olfactory stimuli can be simultaneously tested on honeybee drones in a flight-like situation under controlled conditions. The designed apparatus provides honey bees with a sufficient degree of freedom to adjust the orientation of their body while hovering and being dynamically exposed to combinations of stimuli. We tested this bioassay by observing the orientation behavior of attached drones in response to three known attractants, light, 9-ODA, and the complex blend of odors emitted by honeybee hives.

Keywords: olfactory, chemotaxis, phototaxis, controlled flight, mating, 9-ODA, orientation

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SESSION 5: Physiologie & Verhalten

BV5.1: Variation of cuticular hydrocarbon profiles among honeybee workers with different social roles and between different *Apis mellifera* subspecies

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Apis mellifera expresses a remarkable genetic and phenotypic variation that involves several subspecies, which represent an important reservoir of local adaptations and genetic diversity. However, they face a homogenization of their native geographical distribution via the hybridization and replacement of native populations of the different subspecies. This situation may affect valuable local adaptive traits, like the cuticular hydrocarbons (CHCs), which prevent desiccation and mediate intra- and interspecific communication.

Our study is the first to compare the CHC profiles of workers with different tasks inside and outside the hive of five different honeybee (*Apis mellifera*) subspecies. These subspecies has been raised under the same environmental conditions to focus on the genetic basis of the phenotypic differences. Therefore, we analyzed the CHC profiles of nurses, nectar and pollen foragers. We show that the CHC profile is strongly influenced by both subspecies and social role. There is a clear differentiation between nurses and foragers. In addition, CHC profiles of workers with different tasks differ among the five subspecies. Intriguingly the worker of different honeybee subspecies vary widely in the CHC profiles, independent of their task, even though they were maintained under the same environmental conditions.

Our results might point towards important and undiscovered functions of cuticular hydrocarbons in honeybees. On one hand CHCs are considered to respond to the climatic conditions, which selects for high amounts of alkanes to prevent desiccation. On the other hand, higher amounts of alkanes limits the communication function of CHCs. A potential trade-off between these functions, communication and desiccation prevention, could explain these results.

Keywords: cuticular hydrocarbons, social role, subspecies, differentiation

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Variation of cuticular hydrocarbon profiles among honeybee workers with different social roles and between different *Apis mellifera* subspecies

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Introduction

Apis mellifera expresses a remarkable genetic and phenotypic variation that involves several subspecies, which represent an important reservoir of local adaptations and genetic diversity [1]. However, they face a homogenization of their native geographical distribution via the hybridization and replacement of native populations of the different subspecies [1]. A situation that may affect valuable local adaptive traits like the cuticular hydrocarbons (CHCs), which prevent desiccation and mediate intra- and interspecific communication, even allowing interindividual caste recognition among workers [2-4].

The present study compares the CHC profiles of workers with different tasks inside and outside of the hive from five different subspecies of *A. mellifera* that were raised under the same environmental conditions. Therefore, the analysis is focused on the phenotypical variation of these subspecies.

Materials and Methods

Queen-right colonies of *A. m. iberiensis*, *A. m. ligustica*, *A. m. macedonica* and *A. m. ruttneri* were maintained in the departmental apiary of Zoology II in Würzburg University from April to September 2018. 10 nurse bees, 10 pollen foragers and 10 non-pollen foragers of each susbspecies were collected in July 2018. The CHCs of the honeybees were extracted with haxane for 10 minutes. The extracted CHCs were analyzed via gas chromatography-mass spectrometry. Non-metric Multidimensional Scaling was used to assess the dissimilarity of the CHC profiles. Only peaks present in at least 50% of each sample were included. The Bray-Curtis distance was used for the analysis. Statistics were done using R.

A. m. mellifera

A. m. iberiensis

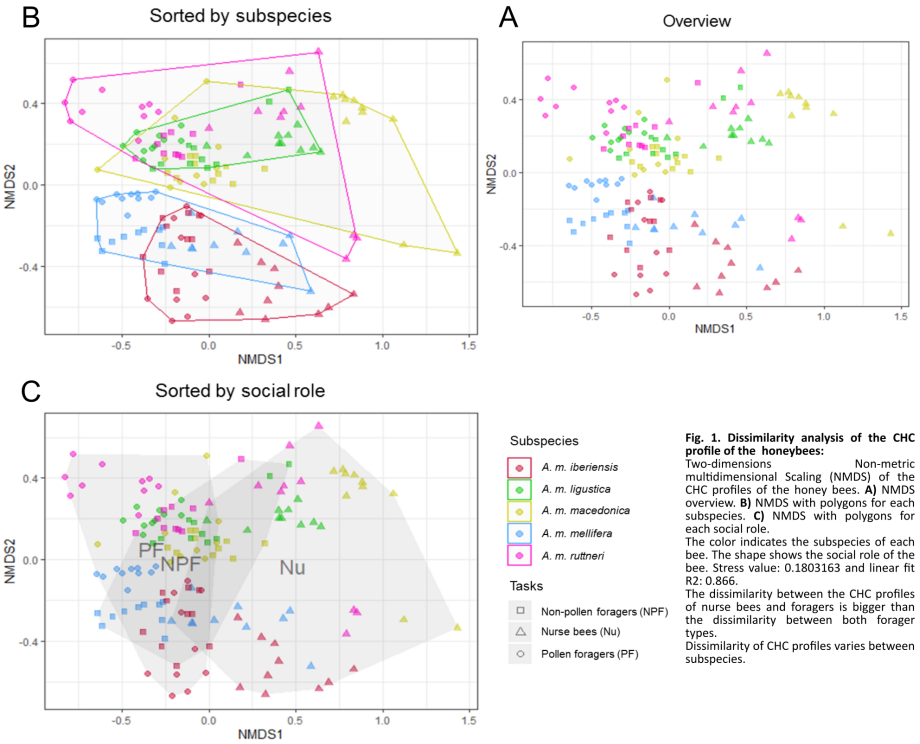


Fig. 1. Dissimilarity analysis of the CHC profile of the honeybees:
Two-dimensions Non-metric multidimensional Scaling (NMDS) of the CHC profiles of the honey bees. **A)** NMDS overview. **B)** NMDS with polygons for each subspecies. **C)** NMDS with polygons for each social role.
The color indicates the subspecies of each bee. The shape shows the social role of the bee. Stress value: 0.1803163 and linear fit R2: 0.866.
The dissimilarity between the CHC profiles of nurse bees and foragers is bigger than the dissimilarity between both forager types.
Dissimilarity of CHC profiles varies between subspecies.

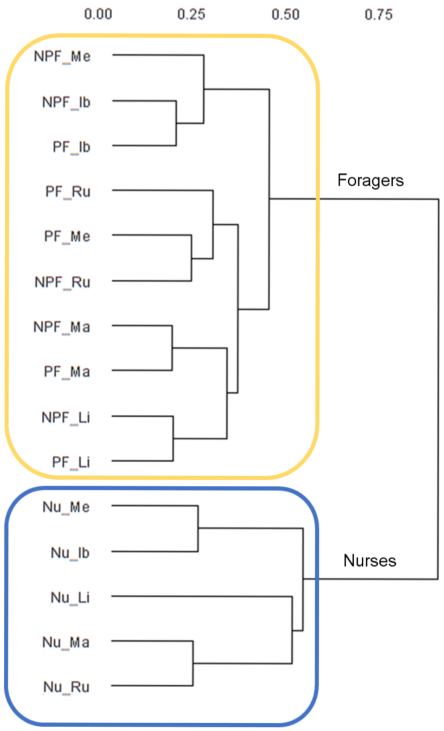
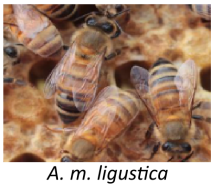


Fig. 2. Relatedness of the CHC profiles of all honeybee groups:
Each label indicates the social role (nurse bees (Nu), non-pollen foragers (NPF), and pollen foragers (PF)), followed by the subspecies (*A. m. mellifera* (Me), *A. m. macedonica* (Ma), *A. m. ligustica* (Li), *A. m. iberiensis* (Ib), and *A. m. ruttneri* (Ru)).



A. m. ligustica

A. m. macedonica

A. m. ruttneri

Results and Discussion

The composition of the CHC profiles differed among social roles, particularly between nurse bees and foragers (Fig. 1 and 2). Nurses had a higher number of methylated and unsaturated hydrocarbons than both types of foragers. The foragers displayed less interindividual variation (smaller polygon size in Fig. 1) than nurse bees. Methylations and unsaturations have been suggested to play a role in insect communication and may allow interindividual differentiation of task performance among worker honeybees [2,4]. However, they diminish the effectiveness of the CHC to prevent water loss [3]. Consequently, nurses would have a CHC profile that is less efficient for desiccation prevention than that of foragers. This suggests an environmental effect on the CHC profile of foragers. It would explain the similarity between the types of foragers whose chemical relatedness is more determined by the subspecies than by their variation in social role (Fig. 2).

Among subspecies, most of the compounds were shared but vary in their relative abundance. The CHC profiles varied among subspecies, with a clear separation of *A. m. mellifera* and *A. m. iberiensis* from *A. m. macedonica*, *A. m. ligustica* and *A. m. ruttneri* (Fig. 1 and 2). The compounds that varied the most among subspecies were alkenes and methyl-branched alkanes, which could allow honeybee workers of different subspecies to distinguish between them [2,4]. The absence of a clear variation in the number of CHCs from the different classes (e.g. alkanes), could suggest that the environmental stress had no effect on the differences of the CHC composition among subspecies [3]. Therefore, it can be considered that the variation among subspecies in the CHCs composition responds to their genetic relatedness and has a meaning in communication.

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SESSION 5: Physiologie & Verhalten

BV5.2: Anomalieerkennung auf Grundlage von Sensordaten

Sensor-based anomaly detection

Diren Senger

Universität Bremen

In dem bürgerwissenschaftlichen Projekt “BeeObserver” werden deutschlandweit an etwa 100 Bienenstöcken Temperatur-, Luftfeuchtigkeits- und Gewichtswerte gemessen. Die Werte werden alle 5-10 Sekunden an einen zentralen Server gesendet. Aufgrund der Sensordaten sollen Anomalien detektiert werden. Anomalien können lokale Ausreißer in den Daten sein, oder unübliche Trends. Lokale Ausreißer sind charakterisiert durch außergewöhnliche Veränderungen der Sensorwerte im Vergleich zu vorherigen Werten oder unübliche Kombinationen der Messwerte und können z.B. durch plötzliche, starke Wettereinflüsse oder durch andere Lebewesen, wie etwa Mäusen im Winter, verursacht werden. Außerdem führen auch imkerliche Kontrollen zu Ausreißern in den Sensorwerten. Unübliche Trends, also sich langsam entwickelnde, unübliche Verläufe der Messungen im Vergleich zu anderen Bienenstöcken könnten mit den Lebensbedingungen der Bienen und Bienenkrankheiten in Zusammenhang stehen. Bisherige Ergebnisse basieren auf Autoregressive integrated moving average (ARIMA) Modellen. Mit diesen Modellen können etwa 75% aller imkerlichen Kontrollen detektiert werden, und es werden weitere Ausreißer erkannt, deren mögliche Ursachen durch Cluster-Analysen und Beratungen mit den Imkernden ausgewertet werden sollen. Durch zukünftige Arbeiten sollen z.B. auch Merkmale von sterbenden Bienenvölkern analysiert werden um auf mögliche Faktoren für deren Tod zu schließen.

Keywords: Sensordaten, Luftfeuchtigkeit, Gewicht, Temperatur, Anomalien

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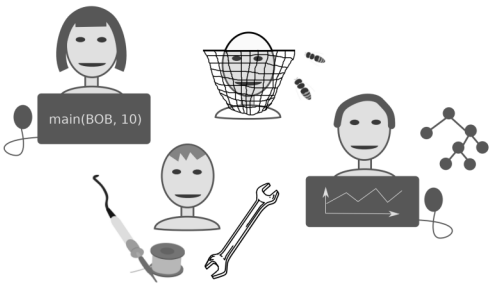
cognitive neuroinformatics

GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

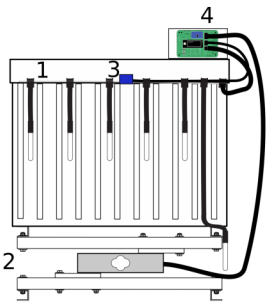
BÜRGER FORSCHUNG
Wissenschaft für alle!

Anomalieerkennung auf Grundlage von Sensordaten

In dem bürgerwissenschaftlichen Projekt “BeeObserver” werden deutschlandweit an etwa 100 Bienenstöcken Temperatur-, Luftfeuchtigkeits- und Gewichtswerte gemessen. Die Werte werden alle 5-10 Sekunden an einen zentralen Server gesendet. Aufgrund der Sensordaten sollen Anomalien detektiertwerden.

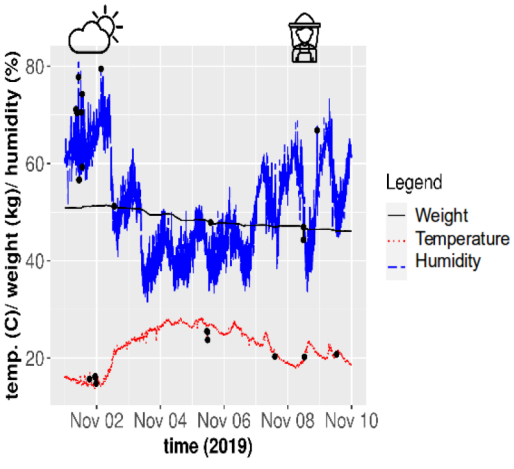


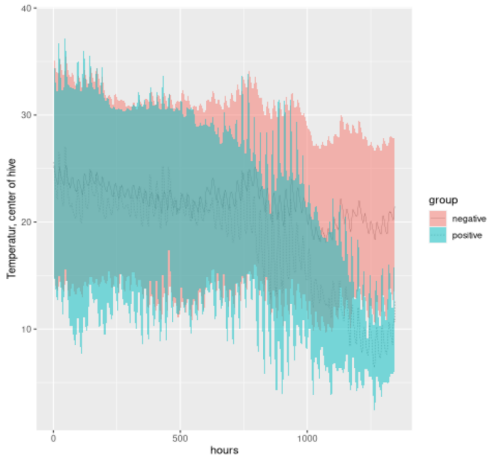
Planung, Durchführung und Datenauswertung - der gesamte Prozess wird von Bürger*innen geleistet:
Programmie-rer*innen erstellten den Code zum Aufzeichnen der Messwerte.
Bastler*innen und Maker*innen haben die Hardware entwickelt: Auswahl der Mini-Computer, Design der Platinen, Konstruktuion der Waage und der Platinen.
Imker*innen besuchen Workshops um das Sensorkit selbst zusammen zu bauen und an ihre Bienenstöcke anzupassen. Beim Imkern dokumentieren sie ihre Beobachtungen in der Bob-App.
Data Scientists starten eine umfassende statistische Auswertung der Daten, u.A. mit Mitteln des Machinellen Lernens.



Das **Sensorkit** für die Bienenstöcke ist so konzipiert, dass es **kostengünstig** ist und mit normalem Werkzeug **selbst zusammen gebaut** werden kann. Es werden folgende Werte aufgezeichnet:
1) Temperatur
2) Gewicht
3) Luftfeuchtigkeit
Alle Sensoren sind mit einem Microcontroller verbunden (4). Die Messwerte werden alle 5-10 Sekunden per W-Lan an einen Server gesendet.
Imkernde führen eine digitale Stockkarte in der Bee Observer App und können dort auch die Messwerte sehen. Die Sensordaten, und die Daten aus den Stockkarten werden im Prozess der Datenauswertung außerdem mit Wetterdaten kombiniert.

Anomalien können lokale Ausreißer in den Daten sein, oder unübliche Trends. Lokale Ausreißer sind charakterisiert durch außergewöhnliche Veränderungen der Sensorwerte im Vergleich zu vorherigen Werten oder unübliche Kombinationen der Messwerte und können z.B. durch plötzliche, starke Wettereinflüsse oder durch andere Lebewesen, wie etwa Mäusen im Winter, verursacht werden. Außerdem führen auch imkerliche Kontrollen zu Ausreißern in den Sensorwerten. Unübliche Trends, also sich langsam entwickelnde, unübliche Verläufe der Messungen im Vergleich zu anderen Bienenstöcken könnten mit den Lebensbedingungen der Bienen und Bienenkrankheiten in Zusammenhang stehen. Bisherige Ergebnisse basieren auf Autoregressive integrated moving average (ARIMA) Modellen. Mit diesen Modellen können etwa 75% aller imkerlichen Kontrollen detektiert werden, und es werden weitere Ausreißer erkannt, deren mögliche Ursachen durch Cluster-Analysen und Beratungen mit den Imkern den ausgewertet werden sollen. Durch zukünftige Arbeiten sollen z.B. auch Merkmale von sterbenden Bienenvölkern analysiert werden um auf mögliche Faktoren für deren Tod zu schließen.





Links: Anomalien (schwarze Punkte) nach saisonalem Arima-Modell. Rechts: Temperaturwerte bei gesunden Völkern (rot/ negative) und sterbenden Völkern (blau/ positive). Gezeigt werden Durchschnitt und Standartabweichung.

Das Projekt wurde vom Bundesministerium für Bildung und Forschung gefördert. Es wurde von Carolin Johannsen und Thorsten Kluß (Universität Bremen) beantragt, organisiert und verwaltet.
Ein Großteil der Arbeit wurde von Bürger*innen übernommen.
Bei Fragen und Interesse zu Details des Sensoraufbaus und Methoden der Auswertung: Diren Senger, **diren@uni-bremen.de**

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