UNIVERSITÄT HOHENHEIM

ARBEITSGEMEINSCHAFT DER INSTITUTE FÜR BIENENFORSCHUNG E.V.

Landesanstalt für Bienenkunde

Fachgebiet Populationsgenomik bei Nutztieren

Tagungsband

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

vom 5. bis 7. April 2022

Inhalt

Programm

Dienstag – 05.04.2022

N: Nachwuchswissenschaftler:in

11:00	**Anmeldung, Aufhängen der Posterbeiträge, Aufspielen der Vorträge, Vesper**		
13:00	Begrüßung	Marina Meixner (Vorsitzende AG Bieneninstitute), Peter Rosenkranz (Hohenheim), Klaus Schmieder (Vizepräsident DIB)	
13:15	**Hauptvortrag**		
	The honeybee, the mite and the virus: a tale of dangerous liaisons **Francesco Nazzi,** Università di Udine, Dipartimento di Scienze agroalimentari		
ab 14:15	**Session 1 (Chair: Ingrid Illies)** **Ökologie, Wildbienen, Bestäubung**		
14:15	**Attraktivität von Blühstreifen in der Landwirtschaft für Honigbienen, Wildbienen und anderer Insekten** **Martin Ziron**, FH Südwestfalen Agrarwirtschaft Soest		V1.1
14:30	**Möglichkeiten des visuellen Bestäubermonitoring** **Katharina Schmidt**, apic.ai GmbH Karlsruhe		V1.2
14:45	**Unterschiedliche Langzeiteffekte des Weinbergbrachenmanagements auf Artengemeinschaften von Bienen, Schmetterlingen und Zikaden** **André Krahner**, Julius Kühn-Institut Braunschweig		V1.3
15:00	**Populationsdemographie wildlebender Honigbienen in deutschen Wäldern** **Patrick Kohl**, Tierökologie - Julius-Maximilians-Universität Würzburg	N	V1.4
15:15	**Postersession 1 & Kaffee**		
ab 16:30	**Fortsetzung Session 1 (Chair: Ingrid Illies)** **Ökologie, Wildbienen, Bestäubung**		
16:30	**Erste Ergebnisse zur Identifizierung von insektenbestäubten Pollen** **Franziska Walther**, Helmholtz-Zentrum für Umweltforschung - UFZ Leipzig	N	V1.5
16:45	**Vertikale Begrünungssysteme: Ein effektiver Beitrag zur Förderung von Bestäubern?** **Manuel Treder**, Universität Hohenheim, Landesanstalt für Bienenkunde	N	V1.6
ab 17:00	**Session 2 (Chair: Bernd Grünewald)** **Physiologie & Verhalten**		
17:00	**Sammeldistanzen, Habitatpräferenzen und saisonale Kolonieentwicklung von Honigbienen in einem mitteleuropäischen Waldgebiet** **Benjamin Rutschmann,** Julius-Maximilians-Universität Würzburg	N	V2.1
17:15	**Standorteffekte auf die Saccharoseantwort von Honigbienen** **Julia Balogh**, Goethe-Universität Frankfurt, Institut für Bienenkunde Oberursel	N	V2.2
17:30	**Eingehende Bewertung von *Chlorella*-Sirup als Nahrungsergänzungsmittel für Honigbienen** **Silvie Dostalkova**, Palacký University Olomouc, Czech Republic	N	V2.3
17:45	**Das Paarungsverhalten der *Heriades truncorum*** **Samuel Boff**, Universität Ulm		V2.4
18:00	**Cholinergic signaling in developing honey bees** **Paul Siefert**, Goethe-Universität Frankfurt, Institut für Bienenkunde Oberursel		V2.5
18:15	**Ende der Vortragsveranstaltung**		
18:30	**Abendessen**		
19:30	**AG-Party**		

Mittwoch – 06.04.2022

N: Nachwuchswissenschaftler:in

ab 9:00	**Session 3 (Chair: Jakob Wegener)** **Genetik & Zucht**		
9:00	**EurBeST- Studie zur Bienenzucht in Europa** **Ralph Büchler**, LL Hessen, Bieneninstitut Kirchhain		V3.1
9:15	**Genom-weite Assoziationsstudie für sechs imkerlich relevante Merkmale** **Richard Bernstein**, Länderinstitut für Bienenkunde Hohen Neuendorf	N	V3.2
9:30	**Die Funktion eines genetischen Schalters, der die geschlechtsdimorphe Augendifferenzierung bei der Honigbiene steuert** **Ann Christin Langen**, Heinrich-Heine-Universität Düsseldorf	N	V3.3
9:45	**Potential der instrumentellen Besamung für eine nachhaltige Honigbienenzucht** **Manuel Du**, Länderinstitut für Bienenkunde Hohen Neuendorf		V3.4
ab 10:00	**Session 4 (Chair: Jens Pistorius)** **Bienenschutz & Pflanzenschutz**		
10:00	**Einzelne und kombinierte Wirkungen der neuartigen Insektizide Flupyradifuron und Sulfoxaflor mit dem Fungizid Azoxystrobin auf die Darmmikrobiota von Honigbienen** **Yahya Al Naggar**, Martin-Luther-Universität Halle-Wittenberg		V4.1
10:15	**Comparative study investigating the temperature impact on the infectivity of microorganisms and their effect on various bee species** **Kevin Nack**, Julius Kühn-Institut Braunschweig	N	V4.2
10:30	**Postersession 2 & Kaffee**		
12:15	**Mittagessen**		
ab 13:30	**Fortsetzung Session 4 (Chair: Jens Pistorius)** **Bienenschutz & Pflanzenschutz**		
13:30	**Monitoring von lipophilen Behandlungsmitteln im Schweizer Bienenwachs** **Christina Kast**, Agroscope, Zentrum für Bienenforschung Bern		V4.3
13:45	**Auswirkungen von Pflanzenschutzmitteln und Nahrungsressourcen auf die Entwicklung von Hummelvölkern und deren Mikrobiom** **Denise Castle**, Julius Kühn-Institut Braunschweig	N	V4.4
14:00	**Antagonistische Interaktionen zwischen Mangelernährung und einem Insektizid bei Hummeln *Bombus terrestris*** **Lars Straub**, Institut für Bienengesundheit, Universität Bern		V4.5
14:15	**Ende der Vortragsveranstaltung**		
14:25	**Gruppenbilder**		
14:45	**Exkursion (nur für gebuchte Teilnehmer:innen)** **Busfahrt nach Hohenheim** **Besichtigungen der neuen Landesanstalt für Bienenkunde mit Sektempfang** **Besuch im Landwirtschaftsmuseum Hohenheim**		
18:30	**Abendessen im „Schwanen-Bräu“, Filderstadt-Bernhausen** **(nur Exkursionsteilnehmer:innen oder nach Voranmeldung)**		

ab 9:00	**Session 5 (Chair: Marc Schäfer)** **Bienenpathologie**		
9:00	**Hohe Prävalenz von *Paenibacillus larvae* in Bienenvölkern Palästinas** **Mohammad Alqurneh**, Martin-Luther-Universität Halle-Wittenberg	N	V5.1
9:15	**Experimentelle Übertragung von DWV-A und DWV-B zwischen Honigbienen und Hummeln** **Anja Tehel**, Martin-Luther-Universität Halle-Wittenberg	N	V5.2
9:30	**Wirksamkeit und Nebenwirkungen einer Varroabehandlung mit 60%iger Ameisensäure in verschiedenen Verdunstersystemen bei Honigbienen** **Antonia Bachert**, Justus-Liebig-Universität Gießen	N	V5.3
9:45	**Zusammenhang zwischen Agrarumweltmaßnahmen und Virusprävalenz bei Honigbienen und Hummeln** **Patrycja Pluta,** Martin-Luther-Universität Halle-Wittenberg	N	V5.4
10:00	**Happy Hive – EAsy Life: Effektivität und Nebenwirkungen von Lithiumchlorid als neues Varroabehandlungsmittel** **Carolin Rein**, Universität Hohenheim, Landesanstalt für Bienenkunde	N	V5.5
10:15	**Das Verbundprojekt SMR-Selektion - Grundlagenforschung und Anwendung in der Varroaresistenzzucht** **Martin Gabel**, LL Hessen, Bieneninstitut Kirchhain	N	V5.6
10:30	**Sind VSH und/oder SMR die Lösung für das Varroa-Problem? Die Zwischenbilanz des Kooperationsprojektes SETBie nach drei Jahren selektiver Züchtung** **Lina Sprau**, Universität Hohenheim, FG Populationsgenomik	N	V5.7
10:45	**Kaffeepause**		
ab 11:15	**Fortsetzung Session 5 (Chair: Elke Genersch)** **Bienenpathologie**		
11:15	**Suppressed Mite Reproduction SMR: Ein effizientes Instrument zur Selektion *Varroa-destructor*-resistenter Honigbienen?** **Benjamin Dainat**, Agroscope, Zentrum für Bienenforschung Bern		V5.8
11:30	**Können Modelle zur Etablierung digitaler Indikatoren der Bienenvitalität beitragen?** **Volker Grimm**, Helmholtz-Zentrum für Umweltforschung - UFZ Leipzig		V5.9
11:45	**Zwei neue diagnostische Verfahren für die Detektion von Amerikanischer Faulbrut (AFB), inklusive Genotyp-Differenzierung des AFB-Erregers *Paenibacillus larvae*** **Sandra Ehrenberg**, Friedrich-Loeffler-Institut Insel Riems		V5.10
12:00	**Auftreten von Bienenviren in Österreich und ihre Korrelation mit Winterverlusten von Bienenvölkern** **Linde Morawetz**, AGES Austrian Agency for Health and Food Safety Wien		V5.11
12:15	**Molekularbiologische Detektion von *Malpighamoeba mellificae*** **Marc O. Schäfer**, Friedrich-Loeffler-Institut Insel Riems		V5.12
12:30	**Evenius-Preisverleihung, Verabschiedung**		
13:00	**Mittagessen**		
14:00	**Mitgliederversammlung** (nicht öffentlich)		

Poster

N: Nachwuchswissenschaftler:in

1 Ökologie, Wildbienen, Bestäubung		
Pollensammelverhalten von Mauerbienen *Osmia* sp. bei Ansiedlung in Steinobstanlagen **Raghdan Alkattea**, Universität Hohenheim, Landesanstalt für Bienenkunde		P1.1
Bunte Bioenergie: Wie Bienen von Sorghum im Mischanbau mit Blühpflanzen profitieren **Luca Berger**, LL Hessen, Bieneninstitut Kirchhain	N	P1.2
Umwelteinflüsse auf die Zuckerschwelle von Honigbienen im Feldversuch **Johanna Bock,** Goethe-Universität Frankfurt, Institut für Bienenkunde Oberursel		P1.3
Honigbienen in Bauernhänden – Bienenhaltung auf landwirtschaftlichen Betrieben als Keim für ein bestäuberfreundliches Biodiversitätsmanagement **Jana Bundschuh**, Forschungsring e.V. Darmstadt		P1.4
Straßen und Bahnstrecken – Quellen vibratorischer Lärmverschmutzung für Bienenvölker? **Sarah Chehaimi**, Ruhr-Universität Bochum	N	P1.5
Nichtheimische Pflanzen als Nahrungsquelle für heimische Wildbienen **Ina Heidinger**, LWG - Institut für Bienenkunde und Imkerei Veitshöchheim		P1.6
Eine Datenbank zur Orientierungshilfe für die Auswahl blühender Bäume und Sträucher zur Wiederaufforstung bienenfreundlicher Nutzwälder und Agroforstsysteme **Angelika Holstein**, Justus-Liebig Universität Gießen	N	P1.7
Employing remote sensing data to assess the impact of landscape on honeybee colony development **David Holzhacker**, Julius-Maximilians-Universität Würzburg	N	P1.8
Bestäuberfreundliche städtische Pflanzungen: Von der Datenerhebung hin zu einem praktisch anwendbaren Leitfaden **Vera Joedecke,** Staatliche Lehr- und Versuchsanstalt für Gartenbau Heidelberg		P1.9
Auswirkungen des Belohnungssystems von Wild- und Kulturpflanzen auf die Attraktivität für Bestäuber **Kira Nürk**, Universität Hohenheim, Landesanstalt für Bienenkunde	N	P1.10
Ressourcenverfügbarkeit urbaner und naturnaher Standorte als Grundlage für das Nestwachstum der Dunklen Erdhummel **Lydia Rongstock,** Goethe-Universität Frankfurt, Institut für Bienenkunde Oberursel	N	P1.11
Naturnahe Habitate begünstigen das Winterüberleben von wildlebenden Honigbienen in Agrarlandschaften **Benjamin Rutschmann**, Julius-Maximilians-Universität Würzburg	N	P1.12
Measuring the quality of pollinator habitats and the effectiveness of measures to increase feed availability? **Katharina Schmidt**, apic.ai GmbH Karlsruhe		P1.13

2 Physiologie & Verhalten		
Steigende Temperaturen führen zu einer vermehrten Brutaktivität im Winter. Kann eine induzierte Brutpause die Auswirkungen auf Winterbienen verringern? **Annely Brandt**, LL Hessen, Bieneninstitut Kirchhain		P2.1
Einfluss von Juvenilhormon auf das Verhalten und die Physiologie von Honigbienen **Lioba Hilsmann**, Julius-Maximilians-Universität Würzburg	N	P2.2
Beobachtung des Insektenflugs an Raps und Bienenweide **Felix Karger**, Fachhochschule Südwestfalen Agrarwirtschaft Soest	N	P2.3
Farbschalenerfassung von Bienen: Einfluss von Schalendurchmesser und Blütenumgebung auf Erfassungsergebnisse **André Krahner**, Julius Kühn-Institut Braunschweig		P2.4
Eine akustische Analyse des Flugs von Honigbienen-Drohnen **Eduard Musin**, Länderinstitut für Bienenkunde Hohen Neuendorf	N	P2.5
Paarungskontrolle durch Flugzeitverzögerung – Ergebnisse aus einem zweijährigen Feldversuch **Eduard Musin**, Länderinstitut für Bienenkunde Hohen Neuendorf	N	P2.6
Hinweise auf unterschiedliche Energiestoffwechsel-Wege zwischen und innerhalb der Kasten von *Apis mellifera* **Viktoria Parafianczuk**, Länderinstitut für Bienenkunde Hohen Neuendorf		P2.7
3 Genetik & Zucht		
Der schnelle Wandel der traditionellen Imkerei und Kolonievermarktung untergräbt die genetische Differenzierung von *Apis mellifera simensis* in Äthiopien **Teweldemedhn Gebretinsae Hailu**, Universität Hohenheim, FG Populationsgenomik	N	P3.1
Gene unter Selektion in zwei invertierten chromosomalen Regionen der westlichen Honigbiene (*Apis mellifera*) **Marco Mazzoni**, Universität Hohenheim, FG Populationsgenomik	N	P3.2
Analysen zur genetischen Diversität von *Apis mellifera* aus der Republik Sacha (Jakutien, Russland) **Leon Reinhold**, Universität Hohenheim, FG Populationsgenomik	N	P3.3
4 Bienenschutz & Pflanzenschutz		
Assessing the impact of microbial plant protection product mixtures on honeybee workers **Tina Feer**, Julius Kühn-Institut Braunschweig	N	P4.1
The ground-nesting bee *Anthophora plumipes* as a potential test organism for investigating risks to bees of pesticide residues in soil **Sara Hellström**, Martin-Luther-Universität Halle-Wittenberg		P4.2
Thiamethoxam in der Zuckerrübenbeize – eine Gefahr für Bienen? **Ingrid Illies**, LWG - Institut für Bienenkunde und Imkerei Veitshöchheim		P4.3
Untersuchung von Effekten kombinierter Pflanzenschutzmittel auf die Larvenentwicklung von *Apis mellifera* **Sarah Manzer**, Julius-Maximilians-Universität Würzburg	N	P4.4
Keine Hinweise auf synergistische Effekte eines Neonikotinoids und eines Nicht-SBI-Fungizids auf Honigbienen **Antonia Schuhmann**, Julius-Maximilians-Universität Würzburg	N	P4.5
Pestizidrückstände in Larvenfuttergelee der Westlichen Honigbiene *Apis mellifera* – eine Übersicht **Karoline Wüppenhorst**, Julius Kühn-Institut Braunschweig	N	P4.6

5 Bienenpathologie		
Vergleich der Wirkung von chemischen und biotechnischen Varroabehandlungs-verfahren auf die Viruslast mit dem Flügeldeformationsvirus in Honigbienenvölkern **Annely Brandt**, LL Hessen, Bieneninstitut Kirchhain		P5.1
Paenibacillus larvae* Sekundärmetabolit Paenilamicin: Aktivität gegen *Bacillus thuringiensis* und Selbstresistenzmechanismus von *P. larvae **Julia Ebeling**, Länderinstitut für Bienenkunde Hohen Neuendorf		P5.2
Disease-associated odour profiles of infected honey bee larvae **Silvio Erler**, Julius Kühn-Institut Braunschweig		P5.3
Der Kampf gegen Milbe mit künstlicher Besamung, Infizierung und Hochdurchsatz-Sequenzierung **Birgit Gessler**, Universität Hohenheim, FG Populationsgenomik	N	P5.4
***Varroa destructor* ist ein biologischer Vektor für DWV-B.** **Sebastian Gisder**, Länderinstitut für Bienenkunde Hohen Neuendorf		P5.5
Die Biofilmbildung ist wichtig für die Virulenz von *P. larvae* **Josefine Göbel**, Länderinstitut für Bienenkunde Hohen Neuendorf	N	P5.6
Einfluss von Temperatur und Gruppengröße auf die Lebensdauer von Honigbienen in Käfigversuchen **Nicole Höcherl**, LLA Triesdorf – Bienenhaltung		P5.7
Landesweites Screening auf Bienenviren in ägyptischen *Apis mellifera* Völkern **Mohamed Kaandeil**, Martin-Luther-Universität Halle-Wittenberg	N	P5.8
Infektion der Arbeiterinnen der Riesenhonigbiene *Apis dorsata* mit *Nosema ceranae*, das von verschiedenen Honigbienen-Wirtsarten isoliert wurde **Rujira Ponkit**, Burapha University, Thailand	N	P5.9
Update zur Labordiagnose von *P. larvae* **Antonia Reinecke**, Länderinstitut für Bienenkunde Hohen Neuendorf	N	P5.10
Immune Inhibitor A - eine mögliche Metalloprotease als Virulenzfaktor von *Paenibacillus larvae*? **Sarah Riebschläger**, Länderinstitut für Bienenkunde Hohen Neuendorf	N	P5.11
Kein Hinweis auf Viren Wirtswechsel von Honigbienen *Apis mellifera* auf Schmetterlinge *Vanessa cardui* **Alexandria Schauer**, Institut für Bienengesundheit, Vetsuisse Fakultät, Universität Bern	N	P5.12
Modellierung der Kontrolle des Befalls von Honigbienen mit *Varroa destructor* mit BEEHAVE **Isabel Schödl**, Helmholtz-Zentrum für Umweltforschung - UFZ Leipzig	N	P5.13
In vivo serial passages of *Paenibacillus larvae* - Evolution in a 24-well plate **Niklas Sibum**, Länderinstitut für Bienenkunde Hohen Neuendorf	N	P5.14
Sind die Winterverluste in Honigbienenvölkern in Nordostdeutschland aufgrund von *Nosema ceranae* Infektionen erhöht? **Vivian Schüler**, Länderinstitut für Bienenkunde Hohen Neuendorf	N	P5.15
Effekte von *Bacillus thuringiensis* Sporen auf Larven der Honigbiene **Niklas Sibum**, Länderinstitut für Bienenkunde Hohen Neuendorf	N	P5.16
Virulenz von DWV-A in *Bombus terrestris* ist kontextbedingt **Tabea Streicher**, Martin-Luther-Universität Halle-Wittenberg	N	P5.17
Genotypen A und B des Krüppelflügelvirus bei einheimischen und eingeführten *Apis*-Arten in Thailand **Chantaphanwattana Thunyarat**, Martin-Luther-Universität Halle-Wittenberg	N	P5.18

6 Bienenprodukte, Imkereipraxis, Technologie		
Einfluss verschiedener Winterfutter auf die Überwinterung von Bienenvölkern **Hannes Beims**, Bezirk Oberbayern - Fachberatung für Imkerei		P6.1
Auswirkungen einer innovativen Bienenhaltung auf die Vitalität von *Apis mellifera* L. – „Vitalbiene“ **Lena Frank**, LL Hessen, Bieneninstitut Kirchhain	N	P6.2
Das Vorhaben »BeeonicFlow« – Bienenwabeninspirierte bionische Flow-Fields für elektrochemische Flussreaktoren **Jan Girschik**, Fraunhofer Institut für Umwelt-Sicherheit und Energietechnik UMSICHT		P6.3
Späte Trachten – Fluch oder Segen? **Ina Heidinger**, LWG - Institut für Bienenkunde und Imkerei Veitshöchheim		P6.4
Melezitosehonig doppelt Ernten? **Ingrid Illies**, LWG - Institut für Bienenkunde und Imkerei Veitshöchheim		P6.5
Vergleich eines neuen Haltungssystems für Honigbienen (HIIVE) mit der konventionellen Segeberger Beute **Moritz Mating**, Freie Universität Berlin	N	P6.6
Ermittlung der Fehlerrate von elektronischen Bienenzählern mittels Räuber-Bienen **Richard Odemer**, Julius Kühn-Institut Braunschweig		P6.7
Projekt „Insektenschonendes Mähen“: Eine derzeit laufende Evaluierung insektenschädigender Effekte durch verschiedene Mähtechniken **Linde Morawetz**, AGES – Austrian Agency for Health and Food Safety		P6.8
Sensor-basierte Schwarmvorhersage **Diren Senger**, Uni Bremen, Kognitive Neuroinformatik	N	P6.9
www.honiguntersuchung.de - die Honiganalyse geht online **Norman Tanner**, Länderinstitut für Bienenkunde Hohen Neuendorf		P6.10
RF-Dosimetrie von Honigbienen (*Apis mellifera*) bei Exposition mit elektromagnetischen Feldern im Frequenzbereich von 1-80 GHz **Richard Überbacher**, Seibersdorf Laboratories, LE/EMC and Optics Österreich	N	P6.11

Hauptvortrag

The honeybee, the mite and the virus: a tale of dangerous liaisons

Francesco Nazzi

Dipartimento di Scienze agroalimentari, ambientali e animali, Università di Udine

The biological cycles of *Apis mellifera*, *Varroa destructor* and the deformed wing virus are closely intertwined in a complex network of interactions.

Some crucial nodes of this network will be discussed, focusing on the events occurring during the honey bee pupal stage. In particular, the chemical basis of host finding by Varroa will be described in light of the subsequent effects caused by the vectored virus on the developing bee. A special attention will be paid to the mutualistic interaction between the mite and the virus and the potential consequences for the host.

Both “how” and “why” questions will be considered, trying to report both the biological effects and their implications.

E-mail: **francesco.nazzi@uniud.it**

Vorträge

Session 1: Ökologie, Wildbienen, Bestäubung

V1.1 Attraktivität von Blühstreifen in der Landwirtschaft für Honigbienen, Wildbienen und anderer Insekten

Attractiveness of flowering strips in agriculture for honey bees, wild bees and other insects

Martin Ziron, Christina Ziron, Felix Karger

Fachhochschule Südwestfalen Agrarwirtschaft am Standort Soest, Fachgebiet Tierproduktion, Lübecker Ring 2, 59494 Soest

Blühstreifen stellen für Bestäuber eine wertvolle Pollen- und Nektarquellen da. Insbesondere dann, wenn sie über einen längeren Zeitraum blühen und so Trachtlücken füllen. Im Rahmen der Untersuchungen wurde den folgenden Fragestellungen nachgegangen:

- Wie oft und von welchen Bestäubern werden einzelne Pflanzen aufgesucht?
- Gibt es Mischungen die präferiert werden?
- Wie groß ist die Konkurrenz von Honigbienen und anderen Bestäubern?

Auf 4 Standorten in NRW wurden in vier Blühmischungen für landwirtschaftliche Flächen im Hinblick auf die Attraktivität von Bestäubern über einen Zeitraum von 3 Monaten regelmäßig ein repräsentativer Ausschnitt von je einem m² je Blühmischung digital aufgezeichnet und anschließend am Computer einzeltierbezogen nach Insektengruppen ausgewertet. Dabei wurde erfasst, wie häufig und wie lange die Insekten die Fläche besuchten.

Ergebnisse Blühmischungen
Es ließen sich signifikante Unterschiede zwischen den Mischungen feststellen. Besonderen Einfluss hatten hierbei *Phacelia tanacetifolia, Malva sylvestris* und *Helianthus annuus*, wobei der auch der % Anteil in der Mischung einen Einfluss hatte.

Attraktivität der Blühmischungen für einzelne Insektengruppen
Die höchste Gesamtsumme an Insekten findet sich bei der einjährigen Mischung 02. Honigbienen sind in der größten Gesamtzahl auf 01 zu beobachten. Eine Erklärung, dass Mischung 01 vor allem für Honigbienen interessant zu sein scheint ist, dass die hier enthaltenen Pflanzenarten *(Sinapis alba, Phacelia tanacetifolia, Helianthus annuus)*, für Massentrachten sorgen.

Gesamtsumme der Insekten mit und ohne Honigbienen
Auf drei Standorten machen Honigbienen die Hälfte und mehr der erfassten Insekten aus. Auf einem Standort umfassten Honigbienen nur etwa ¼ der Insekten. Dort waren Hummeln die dominierende Art. Überrascht hat bei den Untersuchungen, die sehr hohe Anzahl an Insekten die pro m² innerhalb von einer Stunde bei allen Blühmischungen beobachtet werden konnten.

Keywords: Honigbiene, Wildbiene, Insektenflug, Blühstreifen

E-Mail: **Ziron.Martin@fh-swf.de**

V1.2 Möglichkeiten des visuellen Bestäubermonitoring

Possibilities of visual pollinator monitoring

Katharina Schmidt

apic.ai GmbH, Haid-und-Neu-Straße 7, 76131 Karlsruhe

The development of new methods to precisely and reliably record the behavior of pollinators has become more important considering the changing regulatory requirements for the risk assessment of pesticides due to the decline in pollinator abundance. The current possibilities for observing the activity and foraging of honey bee and bumblebee colonies are time- and resource-intensive, and thus reach their limits in terms of extent. Presently, behavioral changes in flight activity can only be monitored for short periods of time. Moreover, determining the amount and diversity of pollen collected is only possible with pollen traps, which interfere with colony dynamics.

In order to obtain a robust database on the effects of environmental factors and agricultural practices, the need for innovative technologies has been expressed repeatedly. The monitoring technology of apic.ai was developed to meet these demands. It is able to continuously quantify the activity patterns, the amount of pollen collected and the proportion of pollen foragers in real time. Studies have been conducted and are ongoing to validate the technology and test its applications. An overview of the results will be presented, among them:

- Decline in activity and reduction in collecting behavior as a result of exposure to a neonicotonoide
- Determination of the living conditions of honey bees based on pollen availability and diversity at the location
- Upcoming long-term monitoring of different landscape structures and incorporation of the results into hive simulation models

The subsequent discussions are intended to provide ideas for the further development of the technology, especially in regard to the insights that can be drawn for the protection of pollinators in agriculture and for beekeeping practices. They will be incorporated into the BMEL-funded research project OCELI (Bienenbasiertes Biomonitoring zur Erschließung der synergetischen Wirkmechanismen von Landwirtschaft & Bestäuberinsekten).

Keywords: Neue Technologien, Monitoring, Effekte, visuell, Künstliche Intelligenz

E-Mail: **katharina.schmidt@apic.ai**

V1.3 Unterschiedliche Langzeiteffekte des Weinbergbrachenmanagements auf Artengemeinschaften von Bienen (Apiformes), Schmetterlingen (Lepidoptera) und Zikaden (Auchenorrhyncha)

Different long-term effects of vineyard-fallow management on bee (Apiformes), butterfly (Lepidoptera), as well as plant- and leafhopper (Auchenorrhyncha) communities

André Krahner[1], Lea Jäger[2], Matthias Porten[2], Michael Maixner[3], Juliane Schmidt[2], Thomas Schmitt[4, 5, 6]

[1]Julius Kühn Institute (JKI) –Federal Research Centre for Cultivated Plants, Institute for Bee Protection, Messeweg 11/12, 38104 Braunschweig, Germany

[2]Public Service Centre for Rural Development in the Region Mosel (DLR Mosel), Görresstraße 10, 54470 Bernkastel-Kues, Germany

[3]Julius Kühn Institute (JKI) – Federal Research Centre for Cultivated Plants, Institute for Plant Protection in Fruit Crops and Viticulture, Geilweilerhof, 76833 Siebeldingen, Germany

[4]Senckenberg German Entomological Institute, Eberswalder Straße 90, 15374 Müncheberg, Germany

[5]Zoology, Institute of Biology, Faculty of Natural Sciences I, Martin Luther University Halle-Wittenberg, 06099 Halle (Saale), Germany

[6]Entomology and Biogeography, Institute of Biochemistry and Biology, Faculty of Science, University of Potsdam, 14476 Potsdam, Germany

Insect conservation through habitat management is particularly important in regions of high biodiversity potential, such as steep-slope viticultural landscapes. Therefore, we compared realistic options for the conservation of open and flower-rich vineyard fallows (annual mulching and sowing of wildflower seeds) in the Moselle region (SW Germany) from 2012 to 2020.

While fallow treatments had no effect on butterfly and Auchenorrhyncha taxa richness and abundance, sowing was associated with significantly higher numbers of sampled bee individuals compared to plots without sowing, but only when plots were mulched (ratio = 2.299, SE = 0.104, df = 46, p = 0.0011, Negative Binomial GLMM). On sown plots, mulching was correlated with more sampled bee individuals compared to plots without mulching, but not significantly so (ratio = 1.546, SE = 0.372, df = 46, p = 0.0767).

For Auchenorrhyncha abundance and taxa richness, no differences between vineyards and fallows were observed. Significant differences in sampled bee individuals between fallow plots and managed vineyards were restricted to fallow plots receiving both mulching and sowing treatment, with more sampled bee individuals in these fallow plots compared to vineyards (ratio = 1.746, SE 0.321, df = 58, p = 0.0287). With regard to butterflies, significantly more individuals (ratio = 2.864-3.420, SE = 0.527-0.626, df = 135, p < 0.0001, Negative Binomial GLMM) and species (ratio = 2.118-2.524, SE = 0.292-0.337, df = 136, p < 0.0001, Poisson GLMM) were sampled in all fallow treatments compared to vineyards.

These findings indicate that the investigated insect taxa respond differently to the management of vineyard fallows in the long term. Vineyard fallow management can promote bee and butterfly communities in viticultural landscapes. Since Auchenorrhyncha were indifferent with regard to fallow management, these measures are not likely to compromise plant protection in terms of increased vector populations.

Keywords: bees (Apiformes), vineyard fallow management, plant- and leafhoppers (Auchenorrhyncha), butterflies (Lepidoptera)

E-Mail: **andre.krahner@julius-kuehn.de**

V1.4 Populationsdemographie wildlebender Honigbienen in deutschen Wäldern

Population demography of feral honeybees in German forests

Patrick L. Kohl, Benjamin Rutschmann, Ingolf Steffan-Dewenter

Lehrstuhl für Tierökologie und Tropenbiologie, Biozentrum, Julius-Maximilians-Universität Würzburg, Am Hubland, 97074 Würzburg

European honeybee populations are considered to consist mainly of managed colonies, but recent censuses have revealed that wild/feral honeybees still occur in various countries. To estimate their relevance for ecosystems, information is needed on their population demography. We monitored the populations of forest-dwelling feral honeybees in three regions in Germany (Swabian Alb, counties Coburg and Lichtenfels, county Weilheim-Schongau) by making repeated surveys of trees with cavities of the black woodpecker for up to four years. We inferred population densities based on cavity occupation rates and the known densities of cavity trees. By combining the direct observations of the fate of individual colonies (n = 112) with microsatellite genotyping we determined their annual survival rate. Each summer, about 10 % of the cavity trees were occupied, corresponding to densities of about 0.23 feral colonies per square km (an estimated 5 % of the regional honeybee populations). The populations decreased moderately until autumn but dropped massively during winter, so that their densities were only about 0.02 colonies per square km in early spring. During reproductive (swarming) season, in May and June, populations recovered, with new swarms preferring nest sites that had been occupied in the previous year. The annual survival rate and the resulting average life span of feral colonies were 10.6 % and 0.6 years respectively. For a population of colonies with these characteristics to be self-sustaining, each colony would need to produce 8–9 swarms per year. Since feral colonies only produce about 2 swarms, we conclude that their populations are not self-sustaining. We estimate that each summer, around 70 % of the feral colonies are founded by swarms from managed hives. Our study shows that feral honeybee colonies predictably complement managed ones in Germany because thousands of swarms escape from apiaries each spring.

Keywords: beech forests, life-history traits, swarming, wild honeybees, woodpecker cavities

E-Mail: **patrick.kohl@uni-wuerzburg.de, benjamin.rutschmann@uni-wuerzburg.de**

V1.5 Erste Ergebnisse zur Identifizierung von insektenbestäubten Pollen

First results on the identification of insect-pollinated pollen

Franziska Walther[1], Carolin Plos[2,3], Elsa Friedrich[4], Thomas Hornick[1], Martin Hofmann[5], Daniel Lahr[6], Annette Schroeder[4], Martina Janke[7], Annika Melching[7], Patrick Mäder[5], Susanne Dunker[1]

[1] Helmholtz-Zentrum für Umweltforschung – UFZ, Permoserstraße 15, 04318 Leipzig

[2] Martin Luther University Halle-Wittenberg, Institute of Biology/Geobotany and Botanical Garden, Am Kirchtor 1, 06108 Halle

[3] German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig, Deutscher Platz 5E, 04103 Leipzig

[4] Universität Hohenheim. Landesanstalt für Bienenkunde, Erna-Hruschka-Weg 6, 70599 Stuttgart

[5] Software Engineering for Safety-Critical Systems Group, Technische Universität Ilmenau, 98693 Ilmenau

[6] Wirtschaftswissenschaftliche Fakultät Uni Leipzig, Grimmaische Straße 12,04109 Leipzig

[7] LAVES - Institut für Bienenkunde Celle, Herzogin-Eleonore-Allee 5, 29221 Celle

Pollen is a crucial source of food for the bee colony. However, pesticides are also introduced into the bee colony via pollen and nectar. Knowledge of the composition of pollen allows to determine the plant origin of possible pesticides or other toxins that were introduced. In order to identify pollen to genus or family level, sophisticated and time consuming light microscopic pollen analyses or expensive sequencing techniques are currently required. Within the NutriBee project, an automated, reliable, high-throughput method to identify insect-pollinated food plants is being developed. The method is based on a combination of multispectral imaging flow cytometry (MIFC) and deep learning. A first set of neural network classifiers was trained, including several thousands of microscopic images of around 100 classes of pollen from different plant species and revealed accuracies above 90 %. In addition, intraspecific variability was examined to better estimate the size of the required pollen reference database.

Keywords: pollen, intraspecific variability, flow cytometry

E-Mail: **franziska.walther@ufz.de**

V1.6 Vertikale Begrünungssysteme: Ein effektiver Beitrag zur Förderung von Bestäubern?

Vertical greening systems: An effective contribution to promote pollinators?

Manuel Treder[1], Vera Joedecke[2], Karsten Schweikert[3], Ute Ruttensperger[2], Peter Rosenkranz[1]

[1] Universität Hohenheim, Landesanstalt für Bienenkunde, Erna-Hruschka-Weg 6, 70599 Stuttgart

[2] Staatliche Lehr- und Versuchsanstalt für Gartenbau Heidelberg, Diebsweg 2, 69126 Heidelberg

[3] Universität Hohenheim, Core Facility Hohenheim, Schloss Hohenheim 1C, 70599 Stuttgart

The ongoing decline of insect pollinators demonstrates the need for effective protection strategies. Urban areas can serve as refugia for pollinators, but land availability plays an important and limiting role for possible promotion measures. Thus, this challenge requires innovative concepts for pollinator conservation in addition to conventional flower beds. But can pollinator friendly green walls be such an alternative and serve as attractive food sources for wild and managed pollinators?

To answer this question, vertical systems of about 6 m² and adjacent horizontal beds with identical plantings were set up at two different testing sites in Baden-Württemberg, Germany. Each vertical system and flower bed consisted of groups of native perennials and bred ornamentals.

With a total of 92 observation trials including more than 2,800 single plant observations, 12,963 pollinators were counted over a two-year period. During the counts, performed throughout the whole seasons and under standardized conditions, important parameters such as number of flowering units, temperature or solar irradiance were recorded continuously.

Using GLMM, our preliminary results show no differences in the total attractiveness (including all pollinators) between vertical systems and horizontal plantings ($p > 0.1$). However, the group specific analysis revealed that honey bees showed a highly significant preference for the horizontal plantings ($p < 0.001$), while wild bees clearly preferred the vertical systems ($p < 0.05$). Furthermore, our results show a significant increase in pollinator visits with increasing height of the vertical systems ($p < 0.01$).

Taken together: these results suggest that vertical greening systems have a high potential as pollinator-promoting measures in urban areas, especially for wild pollinators.

This work is funded by the Ministerium für Ernährung, Ländlichen Raum und Verbraucherschutz Baden-Württemberg.

Keywords: pollinator diversity, vertical green, urban ecology, wild bees, green walls

E-Mail: **manuel.treder@uni-hohenheim.de**

Session 2: Physiologie & Verhalten

V2.1 Sammeldistanzen, Habitatpräferenzen und saisonale Kolonieentwicklung von Honigbienen in einem mitteleuropäischen Waldgebiet

Foraging distances, habitat preferences and seasonal colony performance of honey bees in a Central European forest landscape

Benjamin Rutschmann, Patrick Kohl, Ingolf Steffan-Dewenter

Lehrstuhl für Tierökologie und Tropenbiologie, Biozentrum, Julius-Maximilians-Universität Würzburg, Am Hubland, 97074 Würzburg

Forests and woodlands are considered important sources of honey bee forage in many European countries. However, resource supply might be spatially and temporally restricted and landscape-scale studies in a European forest region are currently lacking. Capitalizing on the waggle dance, we investigate honey bee foraging in a beech dominated forest landscape in Germany. We analyzed 2022 dances performed by bees of twelve colonies placed at locations with varying degree of forest cover (50-99% at a 2 km radius), thereby identifying foraging distances and habitat preferences over almost an entire foraging season (March–August 2019, 8 observation days). By connecting dance information with colony weight recordings, we estimated the contribution of the different habitat types to honey yield.

Foraging distances generally increased with the amount of forest in the surrounding landscape. Yet, this effect strongly depended on the season and was more pronounced for pollen than for nectar foraging. Even though colonies deeper in the forest had to fly further, colony weight accumulation was not affected by forest cover. Compared to the expectation based on the proportions of different habitats, colonies foraged significantly more frequently in cropland and grasslands than in deciduous and coniferous forests, with late summer being the most difficult period for pollen foraging in forests. During times of colony weight gain, the use of forests for nectar/honeydew foraging was close to the expectation, highlighting forests as an important source of carbohydrates during short periods of the year. However, considering the whole foraging season, deciduous forests in Germany do currently not offer suitable honey bee foraging habitat. To promote pollinators within managed forests, large-scale supplementation of native insect-pollinated trees, shrubs and secondary successions in forest gaps should be implemented.

Keywords: *Apis mellifera*, Central European forest landscape, habitat preferences, waggle dance decoding, weight recordings

E-Mail: **benjamin.rutschmann@uni-wuerzburg.de**

V2.2 Standorteffekte auf die Saccharoseantwort von Honigbienen

Habitat effects on the sucrose responsiveness of honeybees

Julia Balogh, Johanna Bock, Bernd Grünewald

Institut für Bienenkunde, Polytechnische Gesellschaft, Goethe-Universität Frankfurt am Main, Karl-von-Frisch-Weg 2, 61440 Oberursel

Honeybees (*Apis mellifera*) are generalist foragers using a wide range of floral resources. Factors shaping their foraging decisions include pollen and nectar availability, weather, and intrinsic individual traits. Since bees need to assess local nectar quality, a trait related to foraging decisions is sugar perception. This can be measured as sucrose responsiveness, the probability of a bee extending its proboscis in response to varying concentrations of sugar. Individual sucrose responsiveness depends on several intrinsic and extrinsic factors such as age, social role, and foraging conditions. The average sucrose responsiveness of a honeybee colony changes throughout the year. However, it is unknown whether these changes are due to seasonal, ecological, or in-hive factors. In this study, we investigate the relationship between sucrose responsiveness of honeybees and ecological parameters. The bee colonies are located along environmental gradients, including climate and types of land use. Sucrose responsiveness is assessed throughout the season. Furthermore, we monitor biotic and abiotic parameters, such as colony growth, flowering vegetation and weather. Our preliminary results suggest for the first time that sucrose responsiveness varies with habitat conditions. In June, sucrose response scores (SRS) were significantly higher at our mountain habitat, where bees responded to all sucrose concentration (SRS = 6), while colonies at three locations with different characteristics displayed SRS of 2 and 3. Our results suggest a link between environmental factors and the sugar perception of honey bees. We expect our ongoing data collection to confirm the link between specific habitat conditions and sucrose responsiveness and aim to provide insights into factors shaping the foraging-related behaviour of honeybees. Furthermore, our findings will help us to anticipate effects of climate and land use changes on their pollination efficiency and colony growth.

Keywords: foraging, perception, sucrose, ecology

E-Mail: **J.Balogh@em.uni-frankfurt.de**

V2.3 Eingehende Bewertung von *Chlorella*-Sirup als Nahrungsergänzungsmittel für Honigbienen

In-depth assessment of *Chlorella* syrup as a nutritional supplement for honey bees

Silvie Dostalkova[1], Marek Petrivalsky[1], Dalibor Kodrik[2,3], Michael Simone-Finstrom[4], Jiri Danihlik[1]

[1] Department of Biochemistry, Faculty of Science, Palacký University Olomouc, Šlechtitelů 27, Olomouc, 783 71, Czech Republic

[2] Department of Biochemistry and Physiology, Institute of Entomology, Biology Centre, Czech Academy of Sciences, Branišovská 31, 370 05 České Budějovice, Czech Republic

[3] Department of Zoology, Faculty of Science, University of South Bohemia, Branišovská 31, 370 05 České Budějovice, Czech Republic

[4] USDA-ARS, Honey Bee Breeding, Genetics and Physiology Research, Baton Rouge, LA 70810

Global agricultural expansion reduces the availability of flowers (pollen and nectar) for honey bees. One solution to this shortfall is the additional feeding to honey bee colonies of food supplements. However, the effectiveness of nutritional supplements on bee health and vitality (e.g. oxidative stress, immune function) is usually not well studied. *Chlorella* algae have a nutrient profile similar to natural pollen, thus they have a promising application in beekeeping as a food supplement. This study evaluated *Chlorella vulgaris*-enriched syrup as a bee dietary supplement in terms of its effect on honey bee oxidative stress, digestive enzyme activity, and protein vitellogenin level. After the application of *Chlorella* syrup to the colonies, we did not observe changes in digestive enzymes activity in adult worker bees but we did observe higher gene expression of the antioxidant enzymes *catalase* (Mann-Whitney U test, p=0.017, Z=-2.390) and *superoxide dismutase1* (Mann-Whitney U test, p=0.044, Z=-2.016). However, in larvae, the expression of those genes was not affected. In *Chlorella*-fed colonies, we recorded a three times higher concentration of vitellogenin in the hemolymph of worker bees (Mann-Whitney U test, p=4×10-6, Z=-4.629); vitellogenin is a phospholipoglycoprotein which has many roles in honey bees as an antioxidant, as a store of nutrients for the individual, and in immunity. The results provide a solid base and guidelines for further implementation of *Chlorella* as an effective and safe pollen substitute in apiculture practice.

Keywords: pollen supplement, microalgae, oxidative stress, vitellogenin

E-Mail: **silvie.dostalkova@upol.cz**

V2.4 Das Paarungsverhalten der *Heriades truncorum*

The mating behaviour of large-headed resin bee Heriades truncorum

Samuel Boff

Ulm University, Department of Evolutionary Ecology and Conservation Genomics, Ulm, Germany

In several Hymenoptera species females assess male quality in the process of mating choice. The female of the large-headed resin bee *Heriades truncorum* (Hymenoptera: Megachilidae: Osminii) is an example of an oligolectic solitary bee species which the mating behaviour up to now was not described. In this study I perform laboratorial based experiments to describe the mating behaviour of *H. truncorum* and to test the hypothesis that male size has an effect over female choice depending on the density of mating partners. In an environment with only one male, female copulate with males of all sizes (GLM, χ^2= 0.62, df = 1, p = 0.42), but a significant preference for bigger size males was found in environments with mating partner options (GLM; χ^2 =4.65, df = 1, p = 0.03). Female quality evaluation took place independent of the number of males. These findings suggest that mating success in this species relay on a mechanism of female choice

Keywords: density of mating partners, female choice, male size, oligolectic bee

E-Mail: **samboff@gmail.com**

V2.5 Cholinergic signaling in developing honey bees

Paul Siefert[1], Frederic Strobl[2], Danilo Lüdke[2], Christin Schrod[1], Ernst Stelzer[2], Kathi Zarnack[2], Bernd Grünewald[1]

[1] Institut für Bienenkunde, Polytechnische Gesellschaft Frankfurt am Main, Goethe-Universität, Frankfurt am Main, Germany

[2] Buchmann Institute for Molecular Life Sciences (BMLS), Goethe-Universität, Frankfurt am Main, Germany

The cholinergic system (CS) is an evolutionary highly conserved signaling mechanism and regulates multiple cell processes within bacteria, plants, fungi, and in animals. The neuronal and the non-neuronal CS use the choline acetyltransferase, Acetylcholine (ACh), Acetylcholine receptors (AChR), ACh-degrading esterases and choline transporters. Brood food produced in the hypopharyngeal glands of nurse bees contains millimolar concentrations of ACh, which is required for proper larval development. However, the non-neuronal cholinergic system within the developing honey bee is insufficiently investigated, as its receptor expression and localizations are missing. Here we show (i) our Acetylcholine brood food analysis, (ii) our progress performing long-term live imaging of the embryonic development (fluorescent protein-encoding mRNA and light sheet-based fluorescence microscopy) and (iii) single-embryo RNA-seq reanalysis to determine nAChR gene expression within the embryo. In April 2020 ACh concentration in brood food ranged from around 4 to 0.5 µmol/g from larval development day one to five respectively. In August of the same year this was reduced to 0.5 and 0.1 µmol/g, suggesting a seasonal effect. In our mRNA experiments we fluorescently labeled the nuclei, the actin cytoskeleton, and the cell membranes within the developing embryo and conducted a series of survival experiments. Furthermore, our single-embryo RNA-seq reanalysis showed possible differences between workers and drones during embryogenesis, with varying degree in regards to the nine alpha- and two beta-subunits of the nicotinic AChR. We aim to investigate the cause of the brood food seasonal effects, and to develop transgenic honey bee lines to fluorescently label cells expressing AChR alongside use cholinergic modulation. Especially with regard to man-made factors, our data can help to better identify the hazards, raise awareness and develop countermeasures.

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

E-Mail: **siefert@bio.uni-frankfurt.de**

Session 3: Genetik & Zucht

V3.1 EurBeST- Studie zur Bienenzucht in Europa

EurBeST study on Honeybee breeding in Europe

Ralph Büchler, Marina D. Meixner et al

Landesbetrieb Landwirtschaft Hessen, Bieneninstitut Kirchhain, Erlenstraße 9, 35274 Kirchhain, Germany

The EurBeST study on behalf of the European commission was carried out to evaluate the level of varroa resistance of commercially available honey bees and to explore possibilities of improvement by selective breeding. Analysis of the EU market for reproductive material, including queen production and trade, shows high diversity of organisation, but also a weak development of breeding structures in some countries. EU beekeepers are satisfied with the quality of breeding material, except for varroa resistance traits. Despite growing demand, no established market for varroa-resistant stock in Europe exists, and supply of queens is limited.

To provide reliable data regarding the performance of resistant stocks, specific lines were compared under commercial conditions in five case studies, including traditional traits and varroa resistance (VSH, SMR, REC, hygienic behaviour). Strong genotype-environment interactions affected many traits, highlighting the importance of local adaptation. Local lines produced more honey, but the test lines had fewer mites at the end of the study. Some lines from long-term selection programs combined good productivity and improved varroa resistance.

A cost-benefit analysis was carried out on the economic aspects of queen production, colony evaluation, and selection for varroa resistance. Based on the results, recommendations are presented for beekeepers involved in breeding and policy makers.

Keywords: Selective breeding, *Varroa destructor,* resistance, Europe

E-Mail: **ralph.buechler@llh.hessen.de**

V3.2 Genom-weite Assoziationsstudie für sechs imkerlich relevante Merkmale

Genome-wide association study for six economically relevant honey bee traits

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

Länderinstitut für Bienenkunde; Friedrich-Engels-Straße 32; 16540 Hohen Neuendorf

Modern bee breeding usually focusses on honey yield, gentleness, calmness during inspection, reduced swarming drive, and Varroa resistance. Varroa resistance is measured by the hygienic behaviour towards pierced brood cells and by an estimate of the development of the Varroa infestation rate. Recently, genomic breeding value estimation was validated for honey bees. A high-density SNP chip comprising 103‘270 markers was used to genotype 2970 queens heading phenotyped colonies.

Weighted single step BLUP proved to be a viable method to estimate reliable genomic breeding values. The method uses weights for each marker, so-called SNP-effects. SNPs are usually void of biological function, and the effects are likely due to neighbouring genes or other loci which have a biological effect on the trait, so-called quantitative trait loci (QTL). Thus, windows of 50 neighbouring SNPs were considered. For each SNP-window, the explained genetic variance was calculated in percent of the genetic variance explained by all SNPs. SNP-windows explaining a high proportion of the genetic variance are likely to harbour QTL.

On average a SNP-window explained between 0.01 and 0.02 % of the genetic variance, depending on the trait. The top SNP-windows for each trait explained more than 0.1%. For honey yield, a SNP-window explaining more than 0.5% of the genetic variance was found. The results suggest that the traits are highly polygenic, although regions which are likely to contain associated QTL were identified. Further studies into the biological functions of genes in these regions are ongoing. Since the traits are rather polygenic, genomic selection cannot work based on a few QTL, but a dense marker map is required.

Keywords: SNP-Chip, Assoziationsstudie, Zuchtwertschätzung

E-Mail: **richard.bernstein@hu-berlin.de**

V3.3 Die Funktion eines genetischen Schalters, der die geschlechtsdimorphe Augendifferenzierung bei der Honigbiene steuert

The function of a genetic switch controlling sexually dimorphic eye differentiation in honeybees

Oksana Netschitailo, Yidong Wang, Anna Wagner, Eveline C. Verhulst, Ann-Christin Langen, Martin Beye

Institut der Evolutionsgenetik; Heinrich-Heine-Universität Düsseldorf; Universitätsstraße 1; Gebäude 26.14 Etage U1; 40225 Düsseldorf

Sexually dimorphic structures are prominent in the animals including the honeybee. However, the regulatory mechanism leading to the sex-specific morphological structures remains mostly unresolved. We identified the gene *glu* in the honeybee, which acts as novel genetic switch to instruct the selective and sex-specific formation of a single structure, the compound eye. *glu* transcripts are sex-specifically spliced and are controlled by the *fem* gene. As a result, a ZnF domain is only present in the female Glu proteins. Here I would like to present my experiments on a gain of function experiments of the *glu* gene in males. We expect that *gluF* would feminize the male eye structure. To do so, we fused exon 7/8 using CRISPR/Cas9 via homologous recombination. This experiment will mimic the female state in males, since only the female *glu* transcripts will be produced in these $glu^{Ex7\text{-}8F}$ males. We found that the dorsal closure of eyes was less pronounced and eyes were smaller in the frontal view in the males demonstrating feminization. The dorsal lens facets had an intermediate size between those of females and males ($p < 0.001$) suggesting a loss of masculinization and a gain of feminization. These results demonstrate that the *glu* gene is a novel switch gene that provide sex-specific activity for the differentiation of the compound eye.

Keywords: Genetic switch, sexual differentiation, sex determination, trait development, trait evolution

E-Mail: **ann-christin.langen@hhu.de, oksana.netschitailo@hhu.de, martin.beye@hhu.de**

V3.4 Potential der instrumentellen Besamung für eine nachhaltige Honigbienenzucht

The potential of instrumental insemination for sustainable honeybee breeding

Manuel Du, Richard Bernstein, Andreas Hoppe, Kaspar Bienefeld

Länderinstitut für Bienenkunde Hohen Neuendorf, Friedrich-Engels-Str. 32, 16540 Hohen Neuendorf

Mating control constitutes a crucial part of honeybee breeding. Currently, it is mostly ensured by the use of isolated mating stations, where geographic remoteness allows only drones from drone producing queens (DPQ) with a selected dam to participate in the mating process. However, for many burgeoning breeding programs in Europe, this method of mating control is not feasible, because suitable locations are scarce. Instrumental insemination appears as a viable alternative that is independent of geography and comes with several theoretical advantages. Due to increased control over the mating process, breeding values can be estimated more accurately. Furthermore, a greater variety of sires can be selected, thus enhancing the genetic variance, and finally, by the direct selection of DPQ, the paternal generation interval can be reduced by one year.

We used computer simulations to quantify the benefits of instrumental insemination for different population sizes and traits with different heritabilities. In instrumental inseminations, queens were paired with 12 drones that all came from the same DPQ. When we did not reduce the generation interval, we found that instrumental insemination could indeed generate higher genetic gain at lower inbreeding rates. Only five insemination stations à 8 DPQ were needed to conserve as much genetic variance as could be maintained with 20 isolated mating stations of the same size.

In contrast, when reducing the paternal generation interval, we observed substantially higher inbreeding rates. By selecting dams and sires from the same generation, the probability of pairing closely related queens and drones was greatly increased.

In conclusion, we think that instrumental insemination can serve as a great alternative and that its theoretical aspects should be further investigated.

Keywords: instrumental insemination, inbreeding, genetic progress, honeybee breeding, stochastic simulation

E-Mail: **manuel.du@hu-berlin.de**

Session 4: Bienenschutz & Pflanzenschutz

V4.1 Einzelne und kombinierte Wirkungen der neuartigen Insektizide Flupyradifuron und Sulfoxaflor mit dem Fungizid Azoxystrobin auf die Darmmikrobiota von Honigbienen

Individual vs. combined effects of novel insecticides flupyradifurone and sulfoxaflor with the fungicide azoxystrobin on gut microbiota of honey bees

Yahya Al Naggar[1,2], Bala Singavarapu[3], Robert J. Paxton[1,4], Tesfaye Wubet[3,4]

[1] General Zoology, Institute for Biology, Martin Luther University Halle-Wittenberg, Hoher Weg 8, Halle (Saale), 06120 Germany.

[2] Zoology Department, Faculty of Science, Tanta University, Tanta, 31527 Egypt.

[3] Department of Community Ecology, UFZ-Helmholtz Centre for Environmental Research, Theodor-Lieser-Str. 4, Halle (Saale), D-06120 Germany.

[4] German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig, Puschstrasse 4, Leipzig, 04103 Germany.

Apis mellifera has a relatively consistent gut microbial community that is thought to enhance host health and protect against parasites and pathogens. But the gut microbiome can be disrupted by agro- and inhive chemicals, putting honey bee health at danger. We used a controlled and fully crossed laboratory experimental design to test the effects of chronic exposure to field-realistic sublethal concentrations of two nicotinic acetylcholine receptor agonist insecticides (nACHRs), flupyradifurone (FPF) and sulfoxaflor (SULF) and azoxystrobin (Azoxy) fungicide, individually and in combination, on the survival of individual honey bee workers and on their gut microbiota (fungal and bacterial diversity and composition). The gut microbiota was assessed in a total of 135 samples by metabarcoding with the fungal ITS2 fragment and the V4 region of bacterial 16S rRNA. We found more than additive interaction effects between the insecticides FPF or SULF and the fungicide Azoxy on honey bee survival. The fungicide Azoxy substantially reduced the Shannon diversity of fungi after chronic exposure for 10 days. The relative abundance of the top 10 genera of the bee gut microbiota was also affected differently by the fungicide, insecticides, and the fungicide-insecticide combinations. The treatments significantly impacted the microbial community composition and differentially abundant microbial genera. We thereby present the first evidence that the insecticides FPF and Sulf, the fungicide Azoxy, and the fungicide-insecticide combinations reduce bee health and the relative abundance of beneficial and pathogenic gut microbiota.

Keywords: gut microbiota, community, pesticide, dysbiosis

E-Mail: **yehia.elnagar@science.tanta.edu.eg**

V4.2 Comparative study investigating the temperature impact on the infectivity of microorganisms and their effect on various bee species

Kevin Nack

Institute for Bee Protection, Julius Kühn Institute (JKI) - Federal Research Centre for Cultivated Plants, Messeweg 11-12, 38104 Braunschweig, Germany

Several microbial plant protection products (PPPs) have been developed as alternative to chemical PPPs, since growing concerns regarding the adverse effects of chemical PPPs on environment and non-target organism have been reported. In contrast to chemical PPPs, usually a higher application frequency of microbial based products is required which may result in a potential increase in their environmental dispersion. Although the mode of action of some microbial-based products has been extensively studied, several knowledge gaps related the interactions between non-target insects, including bees, and the applied microorganisms still exist. Based on the differences in colony and nest temperatures of various bee species and the preferred growth temperatures of the applied bacteria and fungi, we investigated the response of bee species (*Apis mellifera*, *Bombus terrestris*, and *Osmia bicornis*) to the exposure to different microbial PPPs under laboratory conditions. The bees were exposed acutely or chronically to products containing either *Bacillus thuringiensis subsp. aizawai* or *Beauveria bassiana* at temperatures of 18°C, 26°C, and 33°C. Behaviour, food uptake and mortality were recorded daily over 15 days. Our results show that the temperature may play an important role in the response of bees after exposure to the microbial PPPs. In general, tested bees were more sensitive to the tested *B. thuringiensis*-based product than to the *B. bassiana* based product. *B. terrestris* showed higher sensitivity to the tested *B. thuringiensis*-based product than other bee species, whereas *O. bicornis* were more sensitive to the tested *B. bassiana* based product than other bee species. In conclusion, additional studies under field conditions are needed to assess the infectivity and possible pathogenicity of such microbial PPPs for different bee species.

Keywords: temperature, microbial pesticide, *Apis mellifera*, *Bombus terrestris*, *Osmia bicornis*

E-Mail: **k.nack@tu-braunschweig.de**

V4.3 Monitoring von lipophilen Behandlungsmitteln im Schweizer Bienenwachs

A long-term survey on lipophilic acaricide residues in commercial Swiss beeswax

Christina Kast, Verena Kilchenmann, Jean-Daniel Charrière

Agroscope, Swiss Bee Research Centre, Schwarzenburgstrasse 161, 3003 Bern, Switzerland

The use of lipophilic drugs for treatment against *Varroa destructor* has been monitored in recycled beeswax since 1991. Samples were taken by Swiss wax producers from all batches produced every other year. The samples were pooled according to the different production sizes and represented the average annual residue levels of the entire Swiss production. In addition, individual samples were included in 2019 to obtain the residue ranges. Maximum average annual residue levels of bromopropylate (5.3 mg/kg) and *tau*-fluvalinate (2.9 mg/kg) were determined in 1992 and 1996, respectively. These residues were still detectable in individual samples from 2019 up to maximum levels of 0.2 and 0.6 mg/kg, respectively, although the respective veterinary drugs have not been authorized for many years. Coumaphos residues increased significantly in 2015, up to an average annual level of 3.3 mg/kg, indicating that beekeepers had been using products containing coumaphos. Intensive information campaigns were launched and the annual residue levels decreased in the following years. In 2019, coumaphos levels in individual samples ranged from 0.01 to 4.3 mg/kg. In 2021, the authorisation for products containing coumaphos for beekeeping expired in Switzerland, so residue levels are likely to decrease over time. In 2009, maximum values of thymol up to an average annual level of 87.5 mg/kg were measured. The steady decline in thymol residues in recent years indicates that beekeepers are using thymol-containing products less frequently. In summary, this survey provides an overview of the lipophilic acaricides used in Switzerland over the last thirty years. Recent analyses show that residues of bromopropylate, tau-fluvalinate and thymol in Swiss beeswax have decreased compared to previous years, while coumaphos remains one of the most important contaminants in Swiss beeswax. The monitoring programme has proved useful in preventing high contaminant levels in Swiss beeswax.

Keywords: beeswax, acaricide, residue, *Varroa destructor*, *Apis mellifera*

E-Mail: **christina.kast@agroscope.admin.ch**

V4.4 Auswirkungen von Pflanzenschutzmitteln und Nahrungsressourcen auf die Entwicklung von Hummelvölkern und deren Mikrobiom

Impact of plant protection products and nutritional resources on bumble bee colony development

Denise Castle[1,2], Abdulrahim T. Alkassab[1], Falk Gerdes[1,3], Silvio Erler[1], Hannes Beims[4], Michael Steinert[3], Ingolf Steffan-Dewenter[2], Jens Pistorius[1]

[1] Julius-Kühn-Institut, Institut für Bienenschutz, Messeweg 11/12, 38104 Braunschweig

[2] Lehrstuhl für Tierökologie und Tropenbiologie, Biozentrum, Julius-Maximilians-Universität Würzburg, Würzburg

[3] Institut für Mikrobiologie, Technische Universität Braunschweig, Braunschweig

[4] Institut für Bienenkunde, Niedersächsisches Landesamt für Verbraucherschutz und Lebensmittelsicherheit (LAVES), Celle

In conventional agriculture, plant protection products (PPPs) play an important role to ensure production quality and quantity. During their foraging flights, bumble bees and other pollinators might be exposed to PPPs, either to single products or mixtures of PPPs. The objective of this study is to investigate the interaction between multiple stressors (different nutritional status and exposure to a mixture of PPPs) and their potential impact on bumble bee colonies and microbiome under semi-field conditions.

In the study four different treatments were realized in a total of twenty tunnels: ten tunnels planted with the bee attractive sweet lupine (*Lupinus albus*) and ten tunnels planted with sweet lupine and a flower strip. Half of the tunnels were used for a spray-application with a tank mixture of the fungicide prochloraz and the insecticide chlorantraniliprole. Every tunnel included two queen-right bumble bee colonies (*Bombus terrestris*). Various parameters were investigated, such as mortality of adults, colony development and the composition of the microbiome in adult guts.

Overall, mortality of adult bumble bees in the treated variant (lupines and flower strips) was significantly higher than in the control, and in treated flower strips higher than in treated lupine. This variance in mortality in treated flower strips and lupine might be explained by a higher flight activity in flower strips. The number of young brood (eggs and larvae) did not differ between variants. However, the number of pupae in lupine was significant lower than variants with flower strips. In combination with PPPs, significant negative interaction effects were detected for the number of pupae.

Our results show that the mixture of chlorantranilipole and prochloraz had a negative effect on worker mortality, but not on brood development, except for the combination with a diet containing monofloral lupine.

Keywords: plant protection products, bumble bees, nutrition, combined stressors, microbiome

E-Mail: **denise.castle@julius-kuehn.de**

V4.5 Antagonistische Interaktionen zwischen Mangelernährung und einem Insektizid bei Hummeln *Bombus terrestris*

Antagonistic interactions between malnutrition and an insecticide in bumble bees, *Bombus terrestris*.

Lars Straub[1,2], Verena Strobl[1], Selina Bruckner[3], Domenic W. Camenzind[1], Annette Van Oystaeyen[4], Felix Wäckers[4], Geoffrey R. Williams[3], Peter Neumann[1,2]

[1] Institute of Bee Health, Vetsuisse Faculty, University of Bern, Bern, Switzerland

[2] Agroscope, Swiss Bee Research Centre, Bern, Switzerland

[3] Department of Entomology and Plant Pathology, Auburn University, Auburn, AL, USA

[4] Biobest Group NV, Westerlo, Belgium

Global insect biodiversity declines due to reduced fitness are linked to interactions between environmental stressors. In social insects, inclusive fitness depends on successful mating of reproductives, i.e. males and queens, and efficient collaborative brood care by workers. Therefore, interactive effects between malnutrition and environmental pollution on sperm and feeding glands (hypopharyngeal glands (HPGs)) would provide mechanisms for population declines, unless buffered against due to their fitness relevance. However, while negative effects for bumble bee colony fitness are known, the effects of malnutrition and insecticide exposure singly and in combination on individuals are poorly understood. Here, we show that malnutrition and insecticide exposure result in neutral or antagonistic interactions for sperm and HPGs of bumble bees, *Bombus terrestris*, suggesting strong selection to buffer colony key fitness components. In a fully-crossed laboratory experiment, male drones and female workers were exposed to the neonicotinoid thiamethoxam or/and deprived of proteins (pollen) or not. No significant effects were observed for mortality and consumption (both p's > 0.33), but significant negative effects for sperm traits and HPGs were (all p's < 0.05). The combined effects on these parameters were not higher than the individual stressor effects, indicating neutral or antagonistic interactions (all p's > 0.14). Despite the clear potential for additive/synergistic effects, simultaneous malnutrition and insecticide exposure surprisingly did not reveal an increased impact compared to individual stressors, possibly due to key fitness traits being resilient. Our data support that stressor interactions require empirical tests on a case-by-case basis and need to be regarded in context to understand underlying mechanisms and adequately mitigate the ongoing decline of the entomofauna.

Keywords: glands, interaction, nutrition, sperm, thiamethoxam

E-Mail: **lars.straub@vetsuisse.unibe.ch**

Session 5: Bienenpathologie

V5.1 Hohe Prävalenz von *Paenibacillus larvae* in Bienenvölkern Palästinas

High prevalence of *Paenibacillus larvae*, the pathogenic agent of American foulbrood disease, in Palestinian honey bee colonies

Mohammad Alqurneh[1, 2], Nino Bergmann[1], Islam Nairoukh[2, 3], Abdul-Jalil Hamdan[2], Hans-Hinrich Kaatz[1]

[1] Martin-Luther-University Halle-Wittenberg, Inst. Biology, Zoology (Germany)

[2] Hebron University, Dept. Plant Protection, and Production (Palestine)

[3] Union of Agricultural Work Committees (UAWC), (Palestine)

Palestine faced honeybee colony losses of about 30% throughout the last years. Therefore, we attempted to elucidate the reasons for these losses. A field survey was conducted in two consecutive years to screen Palestinian beekeeping locations for infection by the spore-forming bacterium *Paenibacillus larvae*, the causative agent of American foulbrood disease (AFB). Honey samples were collected from 10 colonies each of eight apiaries throughout West bank in spring, summer, and fall. Presence, number of spores, and strains were identified microscopically, via bacterial cultivation and PCR with specific primers, respectively. Unexpectedly we detected foulbrood spores in 87% of the inspected apiaries, 28% of all colonies contained spores, and 59% of the infected colonies were lost during the study period. Highest spore loads were found in fall compared to summer and spring and reflect the seasonal pattern of AFB-infected colonies. Genotyping revealed ERIC I (LT_{100} 12 days) in four apiaries. Additionally, the more virulent ERIC II strain (LT_{100} 7 days) was found in two apiaries and is considered the first report of ERIC II in the Middle East. This detection of *P. larvae* is the first recorded occurrence of this fatally ignored pathogen in Palestine. The study emphasizes the need for immediate steps towards efficient treatment limiting the spread of this deleterious brood disease within the country and in neighbouring countries.

Keywords: American foulbrood; *Paenibacillus larvae*; PCR; Prevalence

E-Mail: **mohammad.alqurneh@student.uni-halle.de**

V5.2 Experimentelle Übertragung von DWV-A und DWV-B zwischen Honigbienen und Hummeln

Experimental transmission of DWV-A and DWV-B between honey bees and bumble bees

Anja Tehel, Tabea Streicher, Simon Tragust, Henriette Kühnert, Robert J. Paxton

Allgemeine Zoologie, Martin-Luther-Universität Halle-Wittenberg, Hoher Weg 8, 06120 Halle

Several correlative studies indicate viral spillover from managed honey bees to wild bee species such as bumble bees that could play a role in decline of the latter. Yet there are few experimental data on viral spillover and the directionality of transmission. Here we investigated the transmission of the honey bee viruses deformed wing virus genotype A and genotype B within and between species in a controlled lab experiment. Experimentally infected bees acted as virus donors while uninfected bees as recipients.

In a first experiment, donor and recipient bees were mixed in the same cage, mimicking intracolony transmission. This setup permitted multiple plausible routes of transmission and maximised bee-to-bee transmission. A second experiment mimicked food-borne transmission via a common food source. Donor and recipient bees were maintained in separate cages throughout and transmission (faecal-oral and oral-oral) was permitted by transferring a donor cage's feeding tube every 24 hours to its paired recipient cage. We tested for viral transmission in both experiments 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 (-80°C) and checked for viral titres.

Transmission from honey bees to bumble bees was readily recorded for DWV-A, yet we did not detect viral spill-back from bumble bees to honey bees. For DWV-B, transmission happened in all combinations. Our results highlight the potential risk of viral spillover from honey bees to wild bee species but also reveal the unknown risk of bumble bees acting as a virus reservoir and spreading the virus to other species.

Keywords: DWV, spillover, spillback, cross-species transmission, RNA virus

E-Mail: **anja.tehel@zoologie.uni-halle.de**

V5.3 Wirksamkeit und Nebenwirkungen einer Varroabehandlung mit 60%iger Ameisensäure in verschiedenen Verdunstersystemen bei Honigbienen

Effectiveness and side effects of a varroa treatment with 60% formic acid in various evaporation systems in honey bees

Antonia Bachert[1,3], Ricarda Scheiner[3], Annely Brandt[2], Ralph Büchler[2]

[1] Institut für Pharmakologie und Toxikologie, Justus-Liebig-Universität Gießen, Deutschland

[2] Landesbetrieb Landwirtschaft Hessen (LLH), Bieneninstitut Kirchhain, Deutschland

[3] Universität Würzburg, Biozentrum, Verhaltensphysiologie und Soziobiologie, Würzburg, Deutschland

Formic acid is one of the most effective organic acids in combating *Varroa destructor*, but its future use depends on a new legal evaluation after cessation of the standard approval under the veterinary medicines ordinance.

In this study, we examine the effectiveness and side effects of a 60% formic acid in various available evaporator systems under controlled conditions. Colonies were treated once with the standard dosage (230 g) or experimentally with a double dosage (460 g) using a Liebig Dispenser® or Nassenheider Professional® long-term evaporator. Another group was treated with Formic Pro® stripes as a positive-control, while the negative-control group was not exposed to any treatment. Subsequently, mite fall was examined continuously over a period of two months. Our results demonstrate a high and reliable effectiveness of more than 95% of double dosage evaporators, while the treatment with standard dosage achieved an effectiveness of over 75% for both dispensers. The Formic Pro® gel stripes achieved an effectiveness of over 90%. This proves the high effectiveness of 60% formic acid in the evaporator application against the varroa mite. Number of dead bees checked in the individual test groups. Deaths was counted regularly during the treatment period and up to 14 days afterwards, and losses of queens were noted. The standard dosage produced no more dead bees than the untreated control group, while the double dosage and the gel stripes resulted in significantly more losses. Queen losses were particularly evident in the group of Formic Pro® stripes. In conclusion, all treatments were very effective against Varroa compared to the untreated control. Due to the low number of bee deaths, which did not differ from the untreated control, the conventional standard dosage is considered as more bee-friendly, but the double standard dosage is more effective and meets the effectiveness criteria of the European Medicines Agency.

Keywords: *Varroa destructor*, parasite control, organic acid

E-Mail: **bachert.antonia@web.de**

V5.4 Zusammenhang zwischen Agrarumweltmaßnahmen und Virusprävalenz bei Honigbienen und Hummeln

Relationship between agri-environmental measures and pathogen prevalence in honey bees and bumble bees.

Patrycja Pluta[1], Kathrin Czechofsky[2], Annika Hass[2], Catrin Westphal[2], Robert J. Paxton[1]

[1] Allgemeine Zoologie, Institut für Biologie, Martin-Luther-Universität Halle-Wittenberg, Hoher Weg 8, 06120 Halle (Saale)

[2] Funktionelle Agrobiodiversität, Department für Nutzpflanzenwissenschaften, Georg-August-Universität Göttingen, Grisebachstraße 6, 37077 Göttingen

Bees suffer declines due to agricultural intensification, which leads to loss of habitats, food resources and increased exposure to harmful pesticides. Agri-environmental measures that have been applied to mitigate these negative effects include establishment of semi-natural habitats, flower strips and a shift to organic farming. To examine the relationship between agri-environmental measures and pathogen prevalence, we placed *Apis mellifera* hives and *Bombus terrestris* nests at 16 independent agricultural sites varying in the amount of organic agriculture, flower strips and semi-natural vegetation. Then we collected samples of both species from the experimental colonies at two timepoints (early/late season) and screened them for the most common viral and eukaryotic bee pathogens with the use of PCR and qPCR techniques. The overall prevalence of common bee viruses (BQCV, DWV, SBV, ABPV) increased from 23% to 32% in *A. mellifera* and decreased from 27% to 11% in *B. terrestris.* The prevalence of eukaryotic parasites: trypanosomatids (*Crithidia* spp.) and neogregarines (*Apicistis* spp.), increased from 33% to 42% in *A. mellifera* and from 14% to 45% in *B. terrestris*. The relationship between landscape variables and pathogen prevalence varied across agri-environment measures, with organic farming and high flower abundance lowering pathogen prevalence, and semi-natural habitats raising pathogen prevalence in honey bees; bumble bee pathogen prevalence showed no clear trend. These data point to agricultural measures that might benefit bee health and mitigate their decline.

Keywords: wild bees, honey bees, landscape, agriculture, pathogens

E-Mail: **patrycjaa.pluta@gmail.com**

V5.5 Happy Hive – EAsy Life: Effektivität und Nebenwirkungen von Lithiumchlorid als neues Varroabehandlungsmittel

Happy Hive – EAsy Life: Efficacy and side effects of Lithium chloride as a new Varroa treatment

Carolin Rein, Julia Renz, Peter Rosenkranz

Universität Hohenheim, Landesanstalt für Bienenkunde, Erna-Hruschka-Weg 6, 70599 Stuttgart

For beekeepers worldwide the options for the treatment of the parasitic mite *Varroa destructor* are still unsatisfactory. The discovery of Lithium chloride (LiCl) as a new acaricidal compound with systemic mode of action opens a new door for an “easy to apply” treatment. LiCl is a naturally occurring and widely distributed salt which is used in human medicine and is even a natural component of honey.

LiCl is well tolerated by adult bees. However, a treatment with 25 mM LiCl over the complete larval development resulted in only 7% surviving brood cells, whereas a short application over less than 48 h did not lead to significant brood damages. First analyses of the LiCl concentration in larvae with ICP-OES confirmed an accumulation of lithium during the larval development. Interestingly, hardly any lithium was found in the first larval instars indicating that LiCl is not incorporated into worker jelly.

To prevent such brood damages, we tested two applications in brood free colonies: (1) A summer treatment with a 50 mM LiCl dough after caging the queen for 3 weeks. This application revealed an efficacy of about 98% and clearly outperformed the simultaneously implemented treatment with formic acid in control colonies with brood. After the LiCl application and releasing of the queen, the colonies established new brood nests without visible damages. (2) In winter colonies we investigated the efficacy and possible side effects of the trickling of a LiCl sugar solution on the winter cluster and compared it with usually performed oxalic acid treatment. We did not find differences in mite and bee mortality between the two applications. At least in brood-free colonies, LiCl could be an effective, safe and easy to apply option for the varroa treatment. The aim of our current project is to develop applications which can be used in breeding colonies without damaging the brood. The “EAsyLife” project is supported by funds of the Federal Ministry of Food and Agriculture (BMEL).

Keywords: Varroa destructor, Lithium chloride, efficacy, brood damages

E-Mail: **carolin.rein@uni-hohenheim.de**

V5.6 Das Verbundprojekt SMR-Selektion - Grundlagenforschung und Anwendung in der Varroaresistenzzucht

The joint project on SMR-selection - basic research and application in breeding towards Varroa-resistance

Martin Gabel[1,2], Ricarda Scheiner[2], Ingolf Steffan-Dewenter[3], Ralph Büchler[1]

[1] Landesbetrieb Landwirtschaft Hessen, Bieneninstitut Kirchhain, Erlenstraße 9, 35274 Kirchhain, Germany

[2] Universität Würzburg, Lehrstuhl für Verhaltensphysiologie und Soziobiologie, Biozentrum, Am Hubland, 97074 Würzburg

[3] Universität Würzburg, Lehrstuhl für Tierökologie und Tropenbiologie, Biozentrum, Am Hubland, 97074 Würzburg

Based on the traits suppressed mite reproduction (SMR) and recapping (REC), the nationwide project on SMR-selection aims to improve *Varroa*-resistance by bridging science and breeding practice. Since 2019, this collaboration enabled the standardized evaluation of more than 2000 MiniPlus-colonies with single-drone-inseminated queens and more than 900 full-grown performance-tested colonies throughout Germany. On average, SMR values of 46% (MiniPlus: 0-100%, n=1302, ≥10 cells) and 34% (performance-tested: 4-100%, n= 710, ≥25 cells) were found. Additionally, separate studies focused on the biological background of *Varroa*-resistance, such as seasonal dynamics of related traits. Therefore, SMR, REC, infestation parameters and brood termination rates were measured five times from April to October in 2019, 2020 and 2021 respectively (n=20; 20 & 15 colonies resp.). On colony level, there was a positive correlation between REC of all cells and brood infestation (Spearman: r(133)=0,47), bee infestation (Spearman: r(133)=0,43) and brood termination rates (Spearman: r(131)=0,44, p<0.001 resp.). In contrast, there was no correlation between infestation parameters and targeted recapping of infested cells (RECinf), pointing to a more specific origin of this behavior. The probability of failed reproduction in single infested cells was significantly affected by sampling time (GLMM: $\chi2$ = 152.23, p < 0.001, n = 4106) and recapping status (i.e. recapped or not; GLMM: $\chi2$ = 10.33, p = 0.001, n = 4106). The same applied for the underlying causes of failure in fertile mites in case of recapping (GLMM: delayed: $\chi2$ = 9.15, p = 0.003; no male: $\chi2$ = 8.1, p = 0.004; n = 4106 resp.) and sampling time (GLMM: delayed: $\chi2$ = 120.91, p < 0.001; no male: $\chi2$ = 32.22, p = 0.004; n = 4106 resp.). Infertility of mites was also affected by sampling time (GLMM: $\chi2$ = 94.7, p < 0.001) but not by recapping status. Results underline both, seasonal variation in SMR and REC, as well as the effect of REC on mite reproduction.

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

E-Mail: **MartinSebastian.Gabel@llh.hessen.de**

V5.7 Sind VSH und/oder SMR die Lösung für das Varroa-Problem? Die Zwischenbilanz des Kooperationsprojektes SETBie nach drei Jahren selektiver Züchtung

Are VSH and/ or SMR a solution for the Varroa problem? The interim results of the SETBie cooperation project after three years of selective breeding.

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

[1] Universität Hohenheim, Institut für Nutztierwissenschaften, Fachgebiet Populationsgenomik bei Nutztieren, Garbenstraße 17, 70599 Stuttgart

[2] Universität Hohenheim, Landesanstalt für Bienenkunde, Erna-Hruschka-Weg 6, 70599 Stuttgart

There is a broad agreement among beekeepers and bee scientists that the worldwide varroa problem can only be solved by selective breeding of varroa resistant honey bees. Behavioural traits like VSH (Varroa sensitive hygiene) and SMR (suppressed mite reproduction) can reduce the parasitic pressure in a colony. Here, we summarize the main results of three years of a breeding and selection program (SETBie) in cooperation with serval institutions and 37 beekeepers in Southern Germany. The SETBie project is part of the European Innovative Program (EIP).

In this project, the SMR value was documented via the RNSBB SMR protocol and the VSH value was conducted by artificially infesting single cells with varroa mites.

In total, 559 preselected colonies were analysed for their SMR value; 89 of these colonies were in addition tested for VSH in order to evaluate a possible correlation of both traits. 55 of the tested colonies showed high levels of SMR (< 40%) and in 31 colonies extraordinary high VSH values (< 50%) could be identified. We discuss in particular the problems occurring during the accurate quantification of these traits under field conditions. One obstacle is the often low number of mites which can be found during the screening of test colonies, even though the colonies have been artificially infested with a sufficient number of mites prior to the evaluation. This significantly reduce the number of colonies to be considered in subsequent statistical analysis. Here, the direct evaluation of VSH after artificial infestation of mites into brood cells might provide more reliable results, despite the labour-intensive procedure. A crucial aspect of such selection work is the genetical basis of the SMR and VSH traits. We present first results on how these traits are expressed in a cohort of daughter colonies established from colonies with high VSH values. For first analyses for the genetical basis of these traits see poster of Birgit Gessler at this meeting. This shows how breeding programs can be part of a solution against the varroa mite.

Co-financed by the European Agricultural Fund for Rural Development (EAFRD).

Keywords: Varroa, VSH, SMR, selection

E-Mail: **lina.sprau@uni-hohenheim.de**

V5.8 Suppressed Mite Reproduction SMR: Ein effizientes Instrument zur Selektion *Varroa-destructor*-resistenter Honigbienen?

Suppressed Mite Reproduction SMR: An efficient tool to select *Varroa destructor* resistant honey bee?

Adrien von Virag, Matthieu Guichard, Markus Neuditschko, Vincent Dietemann, Benjamin Dainat

Zentrum für Bienenforschung, Agroscope, Schwarzenburgstr. 161, 3003 Bern, Schweiz

V. destructor remains the major threat to the European honey bees, *Apis mellifera*. The selection of lineages resistant to this parasite is considered the most sustainable and durable solution to improve the survival of infested colonies without resorting to varroacidal treatments. Suppressed Mite Reproduction (SMR) is currently one of the most frequently used resistance trait in selection programs. Our study aimed at evaluating the utility of this trait for selection and to test methodological improvements.

We evaluated whether the mite fertility- and mite fecundity-based methods to measure SMR in worker brood provide comparable results and assessed their repeatability by acquiring a second measure in the same colony within a week. We also evaluated the reproducibility of SMR by measuring the trait in the highly attractive drone brood. Finally, we verified the correlation between SMR values and *V. destructor* infestation rates of colonies.

Our results shows that the fertility and fecundity methods are equivalent, but have a low repeatability as well as a low reproducibility. Phenotyping reliability could not be improved by screening drone brood. Thus, it does not appear possible to improve SMR selection using drone brood, which, being available early in the season, could allow a reduction of generation time and an acceleration of genetic progress towards resistance. SMR values were weakly correlated with *V. destructor* infestation rates. A better ability to phenotype SMR ahead of initiating long-lasting selection programs as well as a better knowledge of resistance mechanisms leading to colony survival to *V. destructor* infestation are mandatory to improve selection strategies in breeding programs for resistance against this deleterious parasite.

Keywords: Drone brood, selection, resistance, SMR, Worker brood

E-Mail: **benjamin.dainat@agroscope.admin.ch, matthieu.guichard@agroscope.admin.ch**

V5.9 Können Modelle zur Etablierung digitaler Indikatoren der Bienenvitalität beitragen?

Can models contribute to the establishment of digital indicators of bee vitality?

Jürgen Groeneveld[1], Richard Odemer[2], Volker Grimm[1]

[1] Helmholtz-Zentrum für Umweltforschung – UFZ, Permoserstr. 15, 04318 Leipzig

[2] Institut für Bienenschutz, Julius Kühn-Institut (JKI), Bundesforschungsinstitut für Kulturpflanzen; Messeweg 11/12, 38104 Braunschweig

It is a long-standing goal to develop indicators of bee vitality and health to support both beekeeping and regulatory risk assessment of pesticides, ideally based on automated measurements (e.g., scales and bee counters). However, it is not clear which characteristics of a hive provide the most meaningful signals. To systematically investigate how a potential stressor (reduction of food resources in spring) can be detected based on hive characteristics, we conducted simulation experiments using the established honey bee simulation model BEEHAVE. As indicators of colony vitality, a) the number of adult bees, b) the number of capped brood cells, c) the cumulative number of foraging trips, and d) the cumulative differences in daily hive weight (as used in TrachtNet) were used. The simulations are based on a typical agricultural landscape in northern Germany with oilseed rape as the main food source. To quantify the difference between reference and stressed colonies, we calculated the difference between the reference values and the stressed value, normalized by the range of reference values. We always compared the mean values of 100 replicate simulations. We found that the negative consequences of reduced forage availability in spring were well detected by all four indicators. However, the timing at which the stress effects were detected varied significantly. While the number of capped brood cells decreased by 10% on day 86 (March 27) early in the year, the effects on flight activity and hive weight that exceeded 10% occurred much later (162 and 167 days). The decrease due to food shortage in spring increased with time if no action was taken, reaching up to 45% in the number of capped brood cells on day 166. We conclude that indices focusing on brood development are most promising since we could show that they are informative early warning signals and are also reliably and relatively easy to measure.

Keywords: honey bees, indicators, bee vitality, simulation model, BEEHAVE

E-Mail: **volker.grimm@ufz.de**

V5.10 Zwei neue diagnostische Verfahren für die Detektion von Amerikanischer Faulbrut (AFB), inklusive Genotyp-Differenzierung des AFB-Erregers *Paenibacillus larvae*

Two novel diagnostic tools for the detection of American foulbrood (AFB) including a genotype differentiation of the AFB causing agent *Paenibacillus larvae*

Sandra Ehrenberg, Lukas Rüttinger, Friedrich Scholz, Marc O. Schäfer, Robert Kammerer

Friedrich-Loeffler Institut, Südufer 10, 17493 Greifswald

American foulbrood (AFB) is the most devastating bacterial brood disease of honey bees (*Apis mellifera*). AFB causes colony and economic losses worldwide and is a notifiable disease in many countries. Disease diagnosis is usually conducted via visual inspection. If a colony is suspicious, the disease has to be confirmed in the laboratory, which often is very time-consuming. The aim of the project is to develop sensitive and fast diagnostic tools (lateral flow device = LFD & sandwich ELISA) to diagnose AFB and distinguish between the two main genotypes (ERIC I and ERIC II) of *Paenibacillus larvae*, the causative agent of AFB.

Since ELISAs and LFDs are based on antibody detection of antigens, specific monoclonal antibodies (mAbs) for detection of *P. larvae* in general and for the genotype ERIC II were produced in mice. All produced mAbs were characterized using indirect ELISA and Western Blot. Suitable mAb candidates were used for the establishment of a sandwich ELISA and the LFD. The developed assays are detecting *P. larvae* in general and the genotype ERIC II specifically. The sandwich ELISA against *P. larvae* is detecting all of the tested field strains (n = 60), whereas the ERIC II sandwich ELISA is detecting all of the tested ERIC II field strains (n = 30) but none of the tested ERIC I field strains (n = 30). The sandwich ELISAs and the LFD were evaluated with certain bee-associated bacteria showing no cross reactivity against them.

After successful establishment of the assays they will be validated using field samples in the laboratory and directly with colonies in the field.

Keywords: American foulbrood, diagnosis, antibodies, Paenibacillus larvae

E-Mail: **sandra.ehrenberg@fli.de**

V5.11 Auftreten von Bienenviren in Österreich und ihre Korrelation mit Winterverlusten von Bienenvölkern

Prevalence of bee viruses in Austria and their correlation with winter colony losses

Linde Morawetz[1], Antonia Griesbacher[2], Hemma Köglberger[1], Adi Steinrigl[3], Robert Brodschneider[4]

[1] AGES – Austrian Agency for Health and Food Safety, Department for Apiculture and Bee Protection, Vienna, Austria

[2] AGES, Department for Statistics and Analytical Epidemiology, Graz, Austria

[3] AGES, Department Molecular Biology, Mödling, Austria

[4] University of Graz, Institute of Biology, Graz, Austria

Several bee viruses are known to cause diseases in honey bee colonies which lead to weakened or dead colonies. During three consecutive years, each September beekeepers collected samples from five colonies per apiary and sent them alive in queen cages to the AGES laboratory (number of apiaries: 2018 *n*=198; 2019 *n*=195, 2020 *n*=190). Per apiary and year, one pooled sample (10 bees per colony) was analysed with quantitative real time RT-PCR. In the following spring, beekeepers reported the overall winter losses of their sample colonies. To model the correlation between virus titer and the winter losses two models were used: a General Linear Model (GLM) with binomial distribution and a Random Forest Model (RFM). Both models showed that a high titer of Deformed Wing Virus Type B (DWV-B) was correlated with high colony losses. Additionally, in both models an effect of Acute Bee Paralysis Virus on winter losses was present, but less pronounced than the effect of DWV-B. The prediction of the RFM allowed additionally the definition of a threshold for DWV-B: above a titer of 10^8 copies RNA/ml homogenate the probability of winter loss increased steeply. With other viruses, the two models differed in their prediction: the GLM described a negative effect of Chronic Bee Paralysis Virus, while the RFM identified a negative effect of Black Queen Cell Virus on colony survival. The data confirm that two viruses, which are distributed by *Varroa destructor*, are still main problems for colony survival. Other viruses could act as additional stressors, a larger dataset may be necessary to verify the observed trends. This research was conducted within the project “Zukunft Biene 2” (DaFNE grant number: 101295) funded by the Austrian Federal Ministry of Agriculture, Regions and Tourism, the federal provinces of Austria, the beekeeping umbrella organisation ‘Biene Österreich’ and in-kind contributions of AGES, the Veterinary University Vienna and the University of Graz.

Keywords: bee virus, winter loss, modelling, Citizen Science

E-Mail: **linde.morawetz@ages.at**

V5.12 Molekularbiologische Detektion von *Malpighamoeba mellificae*

Molecular detection of *Malpighamoeba mellificae*

Marc O. Schäfer, Juliane Horenk, Claudia Wylezich

Friedrich-Loeffler-Institut, Südufer 10, 17493 Greifswald – Insel Riems

Analogous to vertebrate kidneys, the principal organs of excretion and osmoregulation in insects are the Malpighian tubules. Besides their role in osmoregulation, they are specialized for organic solute transport, and for metabolism and detoxification.

The protozoan *Malpighamoeba mellificae* infects the Malpighian tubules of adult honey bees. *M. mellificae* is ingested as cysts that develop into trophozoites which are feeding 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 was often shown to co-occur with *Nosema apis* infections. However, knowledge of the disease and its spreading is poor, as most reports of this amoeba come from the 1960s and earlier. Detection of the disease is almost exclusively based on microscopic observation of the cysts, due to their constant morphology and light-refraction abilities. Genetic markers for *M. mellificae* would allow its sensitive identification using molecular tools to gain more on its epidemiology. Here, we present a diagnostic PCR assay, consisting of two primers and one probe that were developed based on 18S rRNA gene sequences of the amoeba, generated with metagenomic sequencing of Malpighian tubules with and without *M. mellificae* cysts.

The PCR assay was initially tested and adjusted with samples microscopically tested for the presence of *M. mellificae* cysts. Later, it was validated by examining material with unknown infection status.

The role of protozoan parasites in honey bee health and their distribution in the world is not well understood. The herein described diagnostic PCR tool for detection of *M. mellificae* will allow the study of amoebiasis disease in large scale surveillance studies as well as in routine diagnostics, thus better understanding the role of this protozoan on the health of honey bee colonies worldwide.

Keywords: Malpighian tubules; amoebiasis disease; Malpighamoeba mellificae; molecular diagnostics; adult honey bee

E-Mail: **marc.schaefer@fli.de**

Poster

1 Ökologie, Wildbienen, Bestäubung

P1.1 Pollensammelverhalten von Mauerbienen *Osmia* sp. bei Ansiedlung in Steinobstanlagen

Pollen collecting behavior of the mason bee *Osmia* sp. settling in stone-fruit orchards

Raghdan Alkattea[1], Jessica Fischle[1], Christian Sattler[2], Annette Schroeder[1]

[1] Universität Hohenheim, Landesanstalt für Bienenkunde, Erna-Hruschka-Weg 6, 70599 Stuttgart

[2] Obstbau Sattler, am Mühlbach 17, 56072 Koblenz

Unlike honey bees and bumblebees, mason bees have a solitary way of life. Each female builds her own nest and takes care of her brood without the help of other conspecifics. However, under favorable conditions, many females can nest close together. While honeybees start foraging by temperature above 12° C, mason bees have the advantage of flying at lower temperatures and can be settled in fruit orchards for the purpose of getting better pollination results.

To investigate the attractivity of stone-fruit pollen to the mason bee, 20 nesting equipment, containing 10 nests (Tubes) each, occupied by two *Osmia* species: *Osmia cornuta* (horned mason bee) and *Osmia rufa* (red mason bee) were located in a stone-fruit orchard near Koblenz in Rheinland-Pfalz, and transferred to the Apicultural State Institute, University of Hohenheim, Stuttgart after the pollination season.

All brood cells were numbered and in total 209 pollen samples were separately extracted. 209 pollen slides were prepared and 300 pollen per slide were counted under a light microscope (x 400 magnification).

We found pollen grains of 35 different plants. The most dominant pollen type was oak pollen (about 70%), then maple pollen (14%), and rape seed pollen (10%). However, stone-fruit pollen was only 1% of the total counted pollen grains. Further pollen analyses in next seasons and different locations are needed to find out whether the mason bee would better contribute in pollinating stone-fruit's flowers, when other attractive pollen sources, such as pollen of oak and maple are not available.

Keywords: Osmia, stone-fruit, pollen

E-Mail: **alkattea.raghdan@uni-hohenheim.de**

P1.2 Bunte Bioenergie: Wie Bienen von Sorghum im Mischanbau mit Blühpflanzen profitieren

Colorful Bioenergy: How bees benefit from Sorghum in mixed cropping with flowering plants.

Luca M. Berger[2], Reinhold Siede[1], Steffen Windpassinger[3], Ralph Büchler[1]

[1] Landesbetrieb Landwirtschaft Hessen, Bieneninstitut Kirchhain, Erlenstraße 9, 35274 Kirchhain, Germany

[2] Philipps-Universität Marburg

[3] Justus-Liebig Universität Gießen, Institut für Pflanzenzüchtung

Mixed cultivation of Sorghum (*S. bicolor*) with nectar plants to combat insect decline - that's the idea behind the SoBinEn project. The mixed crops are intended to loosen corn-heavy bioenergy crop rotations and provide flower-visiting insects with a rich source of pollen and nectar without losing yield.

To examine the benefits of the mixtures for bees (*Apis mellifera*), in 2021 three combinations of the main crop Sorghum and the undersown crops (*Trifolium hybridum, T. alexandrinum, Phacelia tanacetifolia*) were studied in a flight tent experiment. Free-standing colonies in the middle of sorghum-clover fields and empty tents were used as control groups. It was found that the colonies at the sorghum-phacelia tents raised significantly more brood ($p<0.001$, linear mixed model (LMM)) than the colonies in the control tents without undersowing. The free-standing colonies raised significantly more brood than any other colonies ($p<0.001$, LLM). Therefore, it can be concluded that the concept of mixed cropping can support nutritional requirement of bees, especially under field conditions.

To further test this assumption, fields of sorghum-clover mixture (*T. hybridum*) were cultivated at two Sites in Hesse, each about 1.5ha in size. On a transect of 3km length, three bee colonies each were placed at eight locations to test the influence of the fields on colony development. The brood raising capacity was evaluated. It was found that the factors location ($p=0.625$, LLM) and distance ($p=0.127$, LLM) had no significant influence on brood quantity, whereas time was a significant factor ($p<0.001$, LLM).

Due to wet and cold weather conditions, plant flowering was slightly delayed, which limited the validity of the experiment. Therefore, a further run of the experiment in 2022 is required to retest the hypothesis.

Keywords: *Sorghum bicolor*, mixed cropping, undersown, honey bee nutrition

E-Mail: **Bergerl@students.uni-marburg.de**

P1.3 Umwelteinflüsse auf die Zuckerschwelle von Honigbienen im Feldversuch

Environmental influences on sucrose responsiveness of honeybees in a field experiment

Johanna Bock, Julia Balogh, Prof. Dr. Bernd Grünewald

Institut für Bienenkunde Polytechnische Gesellschaft, Goethe-Universität Frankfurt am Main
Karl-von-Frisch-Weg 2, 61440 Oberursel

Foraging honeybees evaluate nectar depending on the sucrose content. But the responsiveness to sucrose is a dynamic trait showing intra- and interindividual variation. Individual sucrose responsiveness was found to be varying with forager's tasks, seasonal variations, and nectar availability. It has been shown that sucrose responsiveness can be altered by the sucrose content of available solutions in flight cages, indicating a connection between food resources and the sucrose perception of foragers. Since environmental influences on sucrose responsiveness have not yet been addressed in field experiments so far, we determined sucrose response thresholds from hives located at different landscapes. We observed honeybee colonies from a mountain site to be significantly more responsive than those from urban, agricultural, and mixed forest type sites, indicating that habitat conditions can have an effect on sucrose responsiveness in honeybees. In June 2021, foragers from a site with difficult foraging conditions and scarce nectar sources exhibited a mean sucrose response score (SRS) of 6, which indicates a low response threshold, since bees responded to all presented concentrations. By contrast, hives from an agricultural site showed a mean SRS of 3 (response to only 3 highest trials). The mean SRS was 2 at both an urban and a mixed forest type site. Hives from all sites developed a mean SRS of 6 towards late summer (August 2021), when nectar sources faded at all sites. These results, although preliminary, indicate that sucrose perception could function as an adaptive parameter to environmental conditions.

We suggest further studies on this subject to uncover mechanisms of honeybee colony adaptation strategies to changing environments. The connection of environmental data with the individual perception of sucrose could be useful to further examine the question whether sucrose responsiveness could be a key trait of honeybee colonies adjusting to their environment.

Keywords: sucrose responsiveness, nectar availability, environmental influences

E-Mail: **bockjohanna@aol.com**

P1.4 Honigbienen in Bauernhänden – Bienenhaltung auf landwirtschaftlichen Betrieben als Keim für ein bestäuberfreundliches Biodiversitätsmanagement

Honeybees in farmer's hands – Beekeeping as a driver for pollinator-friendly biodiversity management

Jana Bundschuh, Ulrich Hampl, Mirko Lunau, Tabea Meischner, Christopher Brock

Forschungsring e.V., Brandschneise 5, D-64295 Darmstadt

In landwirtschaftlichen Systemen in Westeuropa ist seit vielen Jahren durch vielschichtige Problemlagen eine wachsende Trennung der imkerlichen und landwirtschaftlichen Tätigkeiten zu beobachten, obwohl beides immanent eng verbunden ist. Das dreijährige partizipative Forschungs- und Beratungsprojekt BienenHaltenHof (Forschungsring e.V. / Demeter Beratung e.V.) begleitet 12 landwirtschaftliche Betriebe fachlich bei der Etablierung einer eigenen Bienenhaltung auf dem Hof und erfasst Bedingungen, Hemmnisse und Erfolgsfaktoren dafür, diese im landwirtschaftlichen Arbeitsalltag zu integrieren. Die Hypothese, dass eine Bienenhaltung durch das landwirtschaftliche Personal selbst auf den Bauernhöfen ein intensiveres Biodiversitätsmanagement motiviert als vor der Auseinandersetzung mit den Honigbienen, wird mittels qualitativer sozialwissenschaftlicher Methoden getestet.

Ob sich die Gesundheitsparameter und die Energiebilanz der Bienenvölker in verschiedenen Haltungssystemen mit unterschiedlicher Eingriffsintensität (Dadant-Magazin, Bienenbox, Bienenkiste, Schiffer Tree) unterscheiden, wird als zweiter Projektteil ein Systemvergleich mit jeweils acht Völkern in den vier Beutentypen zeigen. Das Freiland-Experiment findet an zwei Standorten (je 4 Replikate jeder Gruppe) in Norddeutschland (großräumige Agrarstrukturen, Ackerbau) und in Süddeutschland (stärker strukturierte Landschaft, v.a. Grünland und wenig Ackerbau) über drei Jahre statt. Die Ergebnisse dieses Projekts werden einerseits die Möglichkeiten einer extensiven Bienenhaltung durch Landwirt:innen beschreiben und andererseits zur Diskussion um extensive Tierhaltungsformen in der Landwirtschaft durch eine verbesserte Datenlage beitragen.

Keywords: farmer beekeeping, agriculture, biodiversity, honeybees

E-Mail: **bundschuh@forschungsring.de**

P1.5 Straßen und Bahnstrecken – Quellen vibratorischer Lärmverschmutzung für Bienenvölker?

Roads and railroads – source of vibrational noise pollution for honey bee colonies?

Sarah Chehaimi, Wolfgang H. Kirchner

Ruhr-Universität Bochum, Fakultät für Biologie und Biotechnologie, 44780 Bochum

In recent years numerous studies have revealed adverse effects of anthropogenic noise on physiology and behaviour of animals. However, they have mainly been focusing on mammals and birds. Very few studies have addressed effects on invertebrates and nearly all of them have concerned air-borne sounds entirely ignoring substrate-borne vibrations. Anthropogenic sources of air-borne sounds and substrate-borne vibrations, like traffic on highways and railroads, airports and industrial sites, might affect physiology and behaviour of arthropods, which are known to be often extremely sensitive to substrate-borne vibrations.

Honey bees (*Apis mellifera*) communicate through substrate-borne vibrations in various behavioural contexts. Therefore, we investigated whether railroads and/or highways can effectively be a source of vibrational noise pollution for honey bee colonies, since it is not unusual to find honey bee hives in the nearby areas.

Comb vibrations generated by trains and vehicles were recorded at different distances. The attenuation of these vibrations turned out to be highly variable depending on the ground. Moreover, the amplitudes of comb vibrations induced by heavy and/or fast trains and vehicles were well above the threshold of sensitivity and often above the level of bees' communication signals.

We therefore conclude that vibrational noise pollution generated by railroads and highways can potentially be a source of disturbance and stress for exposed honey bee colonies.

Keywords: stress, substrate-borne vibrations, anthropogenic noise, *Apis mellifera*

E-Mail: **sarah.chehaimi@ruhr-uni-bochum.de**

P1.6 Nichtheimische Pflanzen als Nahrungsquelle für heimische Wildbienen

Non-native plants as a food source for native wild bees

Ina Heidinger, Hanno Korten, Ingrid Illies, Eva-Maria Geiger

Bayerische Landesanstalt für Weinbau und Gartenbau, An der Steige 15, 97209 Veitshöchheim

Most bedding and balcony plants are cultivated, non-native wild plant species of different families. They are used for planting in urban green space such as gardens and can provide pollen and nectar for different flower visiting insects, especially later in the season when native plants are scarce. Non-native plants, such as herbaceous perennials from the North American Prairie, are also used as substrate for agricultural biogas production. However, their impact on native insects is quite unclear and their value as a food source is discussed controversially. The benefit of these plants for native wild bees, especially oligolectic species, is often doubted in general.

Therefore, we observed the interaction of native wild bees and non-native plants for 18 days during the blooming period in 2021. Flower visitations by wild bees collecting pollen were recorded for (i) an assortment of bedding and balcony plants and (ii) in the field at two different sites with mixtures of late flowering, herbaceous perennials.

In this study, we found 283 individuals (177 females and 106 males) of 24 different wild bee species (10 genera) foraging on 12 different non-native plant species. More than 70 % of them (128 individuals) were classified as pollen gatherers. Besides polylectic bees (e.g. *Bombus terrestris*) we also found oligolectic species (e.g. *Osmia spinulosa*). Ten bee species we identified are listed on the German and the Bavarian red list of endangered species.

Our results clearly show that non-native plants are used by native, polylectic and oligolectic wild bees as a pollen source. Thus, non-native plant species can make an important contribution to the pollen supply of bees, especially in urban areas and agricultural landscape. As many of them show a late summer flowering phenology, they can fill a forage gap and thus can contribute to the diet of insects later in the season when native plants are scarce.

Keywords: non-native plants, wild bees, pollen, foraging

E-Mail: **ina.heidinger@lwg.bayern.de**

P1.7 Eine Datenbank zur Orientierungshilfe für die Auswahl blühender Bäume und Sträucher zur Wiederaufforstung bienenfreundlicher Nutzwälder und Agroforstsysteme

A decision support tool for the selection of flowering trees and shrubs for the reforestation of bee-friendly commercial forests and agroforestry systems

Angelika Holstein[1,2], Philipp Weckenbrock[2], Martin Gabel[1], Annely Brandt[1]

[1]LLH-Bieneninstitut Kirchhain, Erlenstraße 9, 35274 Kirchhain

[2]Institut für Pflanzenbau und Pflanzenzüchtung II, Justus-Liebig-Universität Gießen, Karl-Glöckner-Str. 21 C, 35394 Gießen

Climate change is already leaving its mark on forests: drought, heat, storms, and subsequent bark beetle infestations have caused enormous damage, especially to spruce forests. Many areas need to be reforested with more sustainable, well-adapted woody plants. This opens a window of opportunity to combine economic goals, e.g. high quality timber production, with ecological goals, such as the protection of pollinators. Our database with 94 tree and shrub species relevant for a German context is based on a comprehensive literature research and is intended as a support tool for the selection of suitable species for a bee-friendly afforestation. The main evaluation criteria for the selection of species were (i) benefits for beekeeping, (ii) protection of pollinators, (iii) forest suitability, and (iv) climate resilience. The aim was to provide a continuous food supply for honey bees and other flower-visiting insects in forests and agroforests. To determine the most valuable species for bees, a "bee nutritional value index" is established by multiplying flowering duration by nectar and pollen values. Based on these parameters, rankings for different requirements as well as a flowering calendar are presented. The filters and sorting functions in the database allow the selection of species, based on individual target priorities, e.g. ecologically and economically adjusted deciduous forest in Germany (*Cornus mas, Salix spec., Prunus avium, Acer platanoides, Sorbus torminalis, Tilia cordata, Castanea sativa, Rubus idaeus*). The results confirm that conflicts of interest between beekeeping, forestry and nature conservation exist, but approaches are enabled by an appropriate species selection. In conclusion, our "Bee-Forest Database" provides a user-friendly guide for bee-friendly afforestation.

Keywords: pollinator protection, biodiversity, nutrition, ecological land-use, forestry

E-Mail: **angelika.holstein@umwelt.uni-giessen.de**

P1.8 Employing remote sensing data to assess the impact of landscape on honeybee colony development

David Holzhacker[1], Christoph Otten[2], Stefan Berg[3], Ricarda Scheiner[4]

[1] Lehrstuhl für Geographie und Geologie – Universität Würzburg

[2] Dienstleistungszentrum Ländlicher Raum Westerwald-Osteifel, Fachzentrum für Bienen und Imkerei, Mayen

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

[4] Lehrstuhl für Verhaltensphysiologie und Soziobiologie – Universität Würzburg

The TrachtNet is an observation network of several hundred honeybee hives across Germany fitted with scales which we have employed to assess the effects of immediate landscape on colony development and yield, thereby combining honeybee ecology with latest geographical approaches. The landscape around the hives can be categorized using a satellite-based classification. We here rely on the dataset of the ‘Sentinel 2’ satellite. The classification was based on the Land Use / Cover Area Frame Survey. This allows large areas to be mapped globally in detail. The scales record any weight changes in the hive in bins of 5 minutes. Our aim is to relate the initiation of foraging in spring, the end of the main foraging period in summer and the weight gain of colonies to different landscape types across Germany over several years. In the long run, we further aim to study effects of climate change on honeybee colony phenology in different areas and landscapes across Germany. Ultimately, our approach can identify the best local conditions for optimal yield in different regions of Germany. To test our approach, we examined 40 beehives in Bavaria and Rhineland-Palatinate for seasonal weight changes in 2016 and 2017. Our preliminary data suggest that a high proportion of sealed area, as well as agricultural land, are important factors for colony development and yield.

Keywords: honeybee, landscape, foraging, TrachtNet, colony development

E-Mail: **david.holzhacker@uni-wuerzburg.de**

P1.9 Bestäuberfreundliche städtische Pflanzungen: Von der Datenerhebung hin zu einem praktisch anwendbaren Leitfaden

Pollinator friendly urban plantings: From data gathering into an applicable guideline

Vera Joedecke[1], Manuel Treder[2], Peter Rosenkranz[2], Ute Ruttensperger[1]

[1] Staatliche Lehr- und Versuchsanstalt für Gartenbau Heidelberg, Diebsweg 2, 69126 Heidelberg

[2] Universität Hohenheim, Landesanstalt für Bienenkunde, Erna-Hruschka-Weg 6, 70599 Stuttgart

Urbanization is one of the main drivers of insect biomass loss. However, cities can support a diverse fauna of certain insect groups, given appropriate structures are present. In order to turn cities into more suitable habitats it is necessary to use the potential that lies within urban green spaces. Focusing on pollinator insects, we evaluated 14 urban flower beds including around 200 herbaceous perennials with regard to their attractiveness for different pollinator groups. By performing pollinator counts on standardized sections of these plantings over two years, we identified attractive plant species and varieties. These results, in turn, were given to landscape designers to plan pollinator adapted planting concepts, based on the following criteria: location adapted plant selection (semi-shade on fresh ground, semi shade on dry ground, sunny on fresh ground and sunny on dry ground), evaluated plants attractive to pollinators, a certain amount of native plant species (between 20 % and 80 %) with regard to specialized insects, flowering phase from early spring to autumn and an appealing design. Furthermore, nesting aspects, such as ground nesting sites or deadwood structures, as well as a considerate maintenance were included. In this way, four pollinator friendly planting concepts were created and turned into a guideline including crucial background information on pollinators. The practical orientation of this approach allowed evaluating established practices in landscaping and returning our results back into practical application. These planting concepts shall serve as a guidance for planners and performers in charge of realizing urban plantings and sensitize for actions that can help to improve the ecological situation in our cities.

This work is funded by the Ministerium für Ernährung, Ländlichen Raum und Verbraucherschutz Baden-Württemberg.

Keywords: pollinator diversity, pollinator friendly plants, urban ecology, wild bees, urban landscape

E-Mail: **Vera.Joedecke@lvg.bwl.de**

P1.10 Auswirkungen des Belohnungssystems von Wild- und Kulturpflanzen auf die Attraktivität für Bestäuber

Effects of floral rewards in wild and cultivated plants on pollinator attractiveness

Kira Nürk[1], Vera Joedecke[2], Raghdan Alkattea[1], Ute Ruttensperger[2], Peter Rosenkranz[1], Manuel Treder[1]

[1] Universität Hohenheim, Landesanstalt für Bienenkunde, Erna-Hruschka-Weg 6, 70599 Stuttgart

[2] Staatliche Lehr- und Versuchsanstalt für Gartenbau Heidelberg, Diebsweg 2, 69126 Heidelberg

Without any doubt we are faced with a dramatic and continuing decline of pollinators in the recent years. Among others, the main reasons for the decline are the lack of nesting sites and pollen and nectar sources, in particular for oligolectic pollinators. Urban areas represent a possible refuge for pollinators due to diverse pollen and nectar sources through private gardens and green spaces. Here, the benefits of cultivated compared to wild plants for pollinators are currently much under debate. Against this background the aim of our study was to identify whether there are measurable differences between cultivated and wild plants in terms of pollen quantity and pollen volume. For this purpose, 9 cultivated and 9 wild plant species were examined. Quantitative pollen counts and microscope photographic pollen measurements were performed to determine the pollen grain number and pollen volume of the plants. Furthermore, we performed regular pollinator counts on these plants over a two years period and correlated these results with the pollen data. The pollinator counts were recorded at two testing sites in Baden-Württemberg over the flowering season in 2020 and 2021 resulting in a total of 92 observation trials. Preliminary results indicate that cultivated plants were preferred by honeybees, while wild bees foraged to a similar extent on both plant groups. The different plant groups showed extreme variations in the numbers of pollen grains (range: 433 – 808,659 pollen grains per flower) and pollen volumes (range: 2016 µm³ - 750,109 µm³ per pollen grain). Overall, there was only a weak correlation between pollen grain number and pollinator visits when considering all plants. However, the correlation was higher in wild plants compared to cultivated plants. In addition, the correlation of pollen grain number with bee visits was higher in the wild bees than in honey bees. The data indicate that "pollen grain number" is more important for wild bees than for honey bees.

Keywords: pollinator diversity, pollen reward, urban ecology, wild and ornamental plants

E-Mail: **kira.nuerk@uni-hohenheim.de**

P1.11 Ressourcenverfügbarkeit urbaner und naturnaher Standorte als Grundlage für das Nestwachstum der Dunklen Erdhummel

Bumblebees in anthropogenic environments: influences of habitat quality on the growth rate of bumblebee colonies in semi-natural and urban environments

Lydia Rongstock, Hannah Nohr

Institut für Bienenkunde, Goethe-Universität Frankfurt, Karl-von-Frisch Weg 2, 60144 Oberursel

Land-use changes and habitat-degradation are important drivers of the wild insect pollinators decline. This study focuses on the support of habitat quality and food resources of anthropogenic environments on the bumblebee colony-growth of *Bombus terrestris*. For six weeks, bumblebee colonies were placed in three urban and three semi-natural environments in the city Frankfurt am Main and the surrounding area. Besides weekly monitoring of the hives' weight and a final specimen count, the habitat quality was assessed with a biotope-type mapping and a detailed flowering plant-species identification in a radius of 650 m. Colonies thrived better at near-natural sites, yet the overall queen mortality rate was high. Unusually high precipitation levels in 2021 may have inhibited the colony-growth rates.

Keywords: Bumblebees, resource availability, colony growth

E-Mail: **rongstock@bio.uni-frankfurt.de**

P1.12 Naturnahe Habitate begünstigen das Winterüberleben von wildlebenden Honigbienen in Agrarlandschaften

Semi-natural habitats promote winter survival of wild-living honeybees in an agricultural landscape

Benjamin Rutschmann, Patrick Kohl, Alejandro Machado, Ingolf Steffan-Dewenter

Lehrstuhl für Tierökologie und Tropenbiologie, Biozentrum, Julius-Maximilians-Universität Würzburg, Am Hubland, 97074 Würzburg

The diversity of endemic honeybee subspecies and ecotypes is at risk in Europe because modern apiculture

promotes only a small number of honeybee strains. A crucial step for the conservation of honeybee diversity is the assessment of the status of remaining wild populations and their limiting factors. Here we present a two-year census of native, wild-living honeybees inhabiting power poles in an intensive agricultural landscape in Galicia, NW Spain. The autumn colony densities were at least 0.22 and 0.17 colonies/km² and winter survival rates were 59% and 26% for the years 2019 (N = 29) and 2020 (N = 23), respectively. Both the initial occurrence and the subsequent winter survival of the colonies were positively correlated with increasing proportions of wood- and shrubland in the surroundings in both study years. These observations highlight the importance of semi-natural habitats for the conservation of wild-living honeybees.

Keywords: Feral honeybees, Power poles as nest sites, Semi-natural habitats, Landscape effect, *Apis mellifera iberiensis*

E-Mail: **benjamin.rutschmann@uni-wuerzburg.de, patrick.kohl@uni-wuerzburg.de**

P1.13 Measuring the quality of pollinator habitats and the effectiveness of measures to increase feed availability?

Katharina Schmidt, Aline Mack

apic.ai GmbH, Haid-und-Neu-Straße 7, 76131 Karlsruhe

The qualitative and quantitative decline in habitats have been identified as two main drivers of the decline in insect abundance. As a reaction to the decline, a variety of biodiversity measures such as flower strips, nesting aids or insect hotels have been established in urban and rural areas in recent years. As part of the BMEL-funded research project, OCELI site-specific criteria for attractive pollinator habitats and indicators to comprehensively test the effectiveness of improvement measures are in development. Two problems have been identified in this context:

1. Difficulties in measuring the attractiveness of the habitats
2. Lack of data regarding the effectivity of agricultural and environmental measures to improve living conditions

We have made progress in creating a solution for these challenges. A sufficient, continuous feed supply as well as pollen diversity have been identified as critical indicators for a suitable habitat for pollinators. With the development of apic.ai's visual monitoring technology, precise data can be collected automatically and long-term monitoring of these indicators as well as measures impacting them becomes possible. With the help of the technology, it is possible to determine the activity, the foraging behaviour, the quantity of pollen collected on honey bees and commercial bumblebees. Furthermore, as they are flower steady, the colour of the pollen collected by honey bees, can be used as an indicator for feed diversity. First tests in using the technology to determine whether a site is bee-friendly and offers an attractive habitat for bees and other pollinators have been promising.

Keywords: flower Strips, Feed availability, habitat quality, pollinator monitoring, pollen colour

E-Mail: **katharina.schmidt@apic.ai**

2 Physiologie & Verhalten

P2.1 Steigende Temperaturen führen zu einer vermehrten Brutaktivität im Winter. Kann eine induzierte Brutpause die Auswirkungen auf Winterbienen verringern?

Climate change: raising temperatures increase brood activity in winter colonies. Can induced brood interruptions mitigate the impact on winter bees?

Annely Brandt, Denis Schuller, Ralph Büchler

LLH-Bieneninstitut Kirchhain, Erlenstr. 9, 35274 Kirchhain

In temperate climate zones like Germany, honey bee colonies used to cease brood production in late autumn and queens started to lay eggs again in early spring. Lately, beekeepers observe brood activity throughout the winter month in some colonies. Since 2016, we systematically monitored the brood activity status for 60 colonies per year in late November or beginning of December. Here, we describe a positive correlation of brood activity and temperature. Moreover, we show that surface temperature of colonies measured by infrared technology is inapt to reliably predict the brood status of the colony.

To experimentally analyse the impact of continuous brood activity during winter month, we caged the queens for 0, 1, 2 or 3 month, starting in early October (7 - 11 colonies per treatment group). In two consecutive years, all queens survived the caging phase and resumed to lay eggs. In strong colonies, occupying two brood boxes, we found no effect of queen caging with regard to colony size: the number of workers in late February was comparable to early October. Only in small colonies, with an average size of 8114 (± 1074) bees in October, the number of bees decreased significantly in caged colonies (6858 ± 1536; p = 0,038, ANOVA, Bonferroni corrected) until the end of February. Interestingly, in caged colonies, we observed a tendency of *Varroa destructor* reduction and decreased food consumption. We observed no effect on the survival of winter bees, as measured by the retrieval rate of marked bees. Currently, the detailed analysis of winter bee physiology, e.g. fat body quantities and gene expression levels of vitellogenin and juvenile hormone is ongoing.

In conclusion, we observed no negative effects of prolonged queen caging on queen survival and colony development in strong colonies. Whether there are positive effects, e.g. on mite infestation levels, food consumption or physiological traits of winter bees needs to be verified in further experiments.

Keywords: climate change, winter bees, food consumption, *Varroa destructor*

E-Mail: **annely.brandt@llh.hessen.de**

P2.2 Einfluss von Juvenilhormon auf das Verhalten und die Physiologie von Honigbienen

Influence of juvenile hormone on honeybee behavior and physiology

Lioba Hilsmann, Felix Schilcher, Markus Thamm, Markus Krischke, Ricarda Scheiner

Lehrstuhl für Zoologie II, Am Hubland, 97074 Würzburg

Division of labor in the Western honeybee (*Apis mellifera*) can be influenced by internal factors such as age. Young honeybees (nurse bees) perform their tasks inside the hive, older honeybees (foragers) forage outside the hive. Transition from nursing to foraging seems to be regulated by juvenile hormone, because its level generally increases with age. Nurse bees thus have lower juvenile hormone levels than older foragers. Other characteristics, such as sucrose responsiveness and the amount of triglycerides in the fat body, also change with adult maturation. Foragers are more responsive to sucrose than nurse bees and the fat bodies of foragers are significantly reduced compared to fat bodies of nurse bees.

To find out whether there is a causal relationship between these factors, newly emerged honeybees were treated topical with juvenile hormone III. In a timespan of eight days after treatment the honeybees were tested for their sucrose responsiveness and titers of triglycerides and juvenile hormone were quantified.

Treatment with JH-III resulted in higher JH-III levels on all five test days compared to the controls (GLMM: $x = 28.949$; $P < 0{,}001$). Topical treatment also increased responsiveness to sucrose (GLMM: $x = 8.0781$; $P < 0{,}01$). Juvenile hormone treatment further decreased triglyceride levels (GLMM: $x = 18.4936$; $P < 0{,}05$). The results of this study prove a causal link between JH-III, sucrose responsiveness and triglycerides.

Keywords: juvenile hormone, transition, honeybee, division of labor

E-Mail: **lioba.hilsmann@uni-wuerzburg.de**

P2.3 Beobachtung des Insektenflugs an Raps und Bienenweide

Felix Karger, Martin Ziron, Christina Ziron, Ingo Glock, Dennis Köpp

Fachhochschule Südwestfalen Agrarwirtschaft am Standort Soest, Fachgebiet Tierproduktion, Lübecker Ring 2, 59494 Soest

Sowohl Blühstreifen, als auch Flächen mit Winterrapsanbau zählen besonders in Agrarlandschaften zu den wichtigen Nahrungsquellen für Bestäuber. Mit dem folgenden Versuch wurden drei verschiedene Fragen untersucht:

1. Welche Bestäuberarten besuchen mit welcher Häufigkeit und Dauer den Winterraps und die Blühweidemischung?
2. Welchen Einfluss haben die Witterung und die Tageszeit auf die Aktivität der Bestäuber?
3. Gibt es Unterschiede in der Attraktivität zwischen Blühweidenmischung und Winterraps?

Mittels einer Action-Kamera wurde der Insektenflug auf einer Winterraps (*Brassic napus L.*)- und Blühweidenmischungsparzelle an 5 Tagen in der Hauptblühphase jeweils 1 Stunde aufgezeichnet. Die untersuchte Fläche war jeweils 1m^2 groß. Die Beobachtung erfolgte zu unterschiedlichen Tageszeiten und Witterungen. Mit Hilfe einer Computersoftware wurden die Besuchshäufigkeit und –dauer der einzelnen Bestäuberarten, bezogen auf Insektengruppen, ausgewertet.

Besuchshäufigkeit und –dauer der Bestäuberarten
Bei beiden Versuchsparzellen gibt es sowohl in der Häufigkeit, als auch in der Dauer der Blütenbesuche von Honigbienen und anderen Bestäubergruppen (Hummeln, Falter und Sonstige) relativ große Unterschiede. An vier Beobachtungstagen ist die Häufigkeit und Dauer der Besuche durch Honigbienen um den Faktor 2-10 höher als die der übrigen Insekten.

Einfluss der Witterung und der Tageszeit auf die Aktivität der Bestäuber
Der Niederschlag hat einen relativ großen Einfluss auf die Aktivität der Bestäuber, da die meisten Insekten bei Regen deutlich weniger fliegen und somit auch die Nahrungssuche einstellen. Die Tageszeit hat, bezogen auf die gemessene Zeitspanne von 10-16 Uhr, eine geringere Auswirkung auf die Aktivität.

Unterschiede in der Attraktivität zwischen Blühweidenmischung und Winterraps
Die Bienenweidemischung ist wahrscheinlich auf Grund der höheren Blütenvielfalt und evtl. höherer Nektarverfügbarkeit attraktiver als der Raps.

Keywords: Videobeobachtung, Honigbiene, Hummeln, Winterraps, Blühstreifen

E-Mail: **Ziron.Martin@fh-swf.de**

P2.4 Farbschalenerfassung von Bienen: Einfluss von Schalendurchmesser und Blütenumgebung auf Erfassungsergebnisse

Pan trapping for bees: the impact of bowl diameter and floral context on sampling results

André Krahner, Anke C. Dietzsch, Felix Klaus

Julius Kühn Institute (JKI) –Federal Research Centre for Cultivated Plants, Institute for Bee Protection, Messeweg 11/12, 38104 Braunschweig, Germany

Although pan traps have been used for sampling bees for decades, across a wide range of habitats and geographical regions, uncertainty persists as to how pan-trap as well as sampling-site characteristics influence sampling results. Investigating the effect of pan-trap size and floral context on sampled bee communities, we set up two experiments in 2021. In the first experiment, we installed 108 pan traps at 6 sites, with equal proportions of color-size combinations per site (yellow, blue, white; 22 cm or 12 cm). In the second experiment, we installed 72 pan traps at 13 sites, with equal proportions of color-context combinations per site (yellow, blue, white; center of flower strip or adjacent, i.e. at 1 m distance from the edge of the flower strip), and we assessed the percent flower cover in 2.5 m radii around each trap. For each experiment, we sampled bees in three rounds of 24 hours.

In total, we collected 1168 and 1915 bee individuals in the pan-trap size and in the floral-context experiment, respectively. Large pan traps sampled significantly more bee individuals than small pan traps, with regard to white (ratio = 2.87, SE = 0.740, df = 322, p = 0.0001; Negative Binomial GLMM) and yellow traps (ratio = 3.04, SE = 0.708, df = 322, p < 0.0001), while no effect was observed in blue pan traps (ratio = 1.31, SE = 0.310, df = 322, p = 0.2592). Although traps at the flower strip center were surrounded by a higher proportion of flowers, no differences in the number of bee individuals were observed in pan traps adjacent to the flower strip compared to traps at the flower strip center (ratio = 0.98, SE = 0.097, df = 231, p = 0.8419; Negative Binomial GLMM). However, we found a positive but non-significant correlation between percent flower cover and number of collected bee individuals (estimate = 0.00914, SE = 0.005, z = 1.735, p = 0.0828; Negative Binomial GLMM).

Based on these findings, we advocate for the use of large pan traps and, when sampling in contrasting habitats, floral assessments around traps.

Keywords: bees, Apiformes, sampling, method, pan trap

E-Mail: **andre.krahner@julius-kuehn.de**

P2.5 Eine akustische Analyse des Flugs von Honigbienen-Drohnen

An acoustical analysis of honeybee drone flight

Eduard Musin[1]; Thomas Geier[2]; Kaspar Bienefeld[1], Jakob Wegener[1]

[1] Länderinstitut für Bienenkunde Hohen Neuendorf e.V., F.-Engels-Straße 32, 16540 Hohen Neuendorf

[2] Brandenburgische Technische Universität Cottbus-Senftenberg, Siemens-Halske-Ring 14, 03046 Cottbus

The complex mating stimulus of honeybee drones and queens has until now not been elucidated. As mating occurs in free flight, an obvious candidate component is the humming sound produced by drones, noticeable also for human observers in congregation areas. In order to prepare experiments aimed at testing a possible involvement of drone-emitted sounds in honeybee mating, we here analysed acoustic frequencies that honeybee drones emit during flight. Using an anechoic chamber, we also studied the directivity of the sounds emitted. Furthermore, we compared the drone sounds to those produced by a quadrocopter. A frequent effect of a quadrocopter hovering in the vicinity of the drone pathways is to trigger congregation and flights against the gusts created by the propellers. The origin of sounds produced by drones was verified by comparing acoustic recordings with high speed camera-observations of wing beats. The quadrocopter used in our study emits a 360±10 Hz frequency. Honeybee drones emit 250±10 Hz during free flight and 210±10 Hz in tethered flight. These frequencies match those of winbeating. Sounds produced by drones are mostly spreading laterally and posteriorily. Our data provide a basis for testing an involvement of drone-emitted sounds in honeybee mating.

Keywords: drone, quadrocopter, sound, directivity, wingbeating frequency

E-Mail: **eduard.musin@hu-berlin.de**

P2.6 Paarungskontrolle durch Flugzeitverzögerung – Ergebnisse aus einem zweijährigen Feldversuch

The ‚Delayed Flight-Time'-method of mating control – Results of a two-year field study

Eduard Musin[1]; Lothar Lucke[2]; Klaus Bartsch[2]; Christian Grune[3], Kaspar Bienefeld[1], Jakob Wegener[1]

[1] Länderinstitut für Bienenkunde Hohen Neuendorf e.V., F.-Engels-Straße 32, 16540 Hohen Neuendorf

[2] Landesverband Brandenburgischer Imker e.V., Dorfstrasse 1, 14513 Teltow

[3] Zuchtverband Dunkle Biene Deutschland e.V., webmaster@ig-dunklebiene.de

The efficiency of mating control defines the speed of genetic progress in honeybee breeding. Conventional techniques, use of isolated mating stations and artificial insemination, are not universally available. The delayed flight-time-method of mating control (DFM) could be an alternative, but has not yet been validated for use under central European climates. It consists in restraining the queens and drones that are intended to mate until after the end of the natural flight times of drones. In a previous report at this conference, we showed promising results of this method from a small-scale test in a private apiary. Here we report on the performance of the method in a bigger setup, implemented in a geographically isolated location that allowed us to control the number and origin of drones present. Over two mating seasons, we compared two variants of DFM, one involving cooling of mating nuclei during times of non-flight, and one without cooling. We also tested different time regimes for the opening and closing of flight entrances for queens and drones. We used two different subspecies of A. mellifera for distinguishing “wanted” and “unwanted” matings from the offspring. Eight to eleven drone-producing colonies of each subspecies were installed in the apiary, and a total of approximately 170 mating nuclei were used. The results show that DFM greatly increases the frequency of “wanted” matings, A varying but substantial fraction of mated queens exclusively produced offspring whose morphology was in line with that expected under the hypothesis of matings with “wanted” drones. The optimum time for queen and drone release is discussed. We conclude that DFM can allow control of honeybee matings in the presence of great numbers of “unwanted” drones, even though the obtainable mating purity is variable. DFM could be a valuable addition to the catalogue of mating control measures used in bee breeding.

Keywords: moonshine method; mating control; Apis mellifera; flight time

E-Mail: **eduard.musin@hu-berlin.de**

P2.7 Hinweise auf unterschiedliche Energiestoffwechsel-Wege zwischen und innerhalb der Kasten von *Apis mellifera*

Evidence for alternative pathways of energy metabolism between and within honeybee (*Apis mellifera*) castes

Viktoria Parafianczuk[1]; Kathrin Engel[1]; Jürgen Schiller[1]; Jakob Wegener[2]

[1] University of Leipzig, Institute for Medical Physics and Biophysics, Haertelstrasse 16 – 18, 04107 Leipzig, Germany

[2] Länderinstitut für Bienenkunde Hohen Neuendorf e.V., F.-Engels-Straße 32, 16540 Hohen Neuendorf

The species Apis mellifera is characterized by a pronounced sexual dimorphism as well as the existence of two distinct castes in the female gender. Additionally, there are various task specializations within the worker caste. In an earlier publication at this conference, we have reported that worker bees specializing in within-cell heat generation can be distinguished from other workers by biomembranes composed of highly-saturated (phospho)lipid species. Another striking peculiarity of these “heater bees” is the predominance of short-chained fatty acyl residues in cardiolipin, a lipid class known to stabilize elements of the respiratory chain in the inner mitochondrial membrane.

Here we extend this work by comparing the saturation and acyl-composition of phosphatidylcholines (PC) and cardiolipins (CL) in queens, drones, and workers of different task specialization (newly emerged and older hive bees, foragers). Lipid analysis was performed by coupling separation by thin-layer chromatography (TLC) and detection by mass spectrometry (MS). Because of the known involvement of CL in energy metabolism, we compared these castes/etotypes also with regard to the expression of two uncoupling proteins (UCP). UCPs create a shortcut in the proton gradient across the mitochondrial membrane, permitting heat generation without the involvement of ATP.

We found that honeybee castes and ethotypes show profoundly different saturation levels of both PC and CL, which seem correlated with differences in their risk of exposure to high/low temperatures. We also found differences in the level of UCP-expression, pointing towards considerable caste/task adaptations of energy metabolism.

Keywords: cardiolipin, heat generation, uncoupling protein, forager bee, hive bee

E-Mail: **wegenerj@hu-berlin.de**

3 Genetik & Zucht

P3.1 Der schnelle Wandel der traditionellen Imkerei und Kolonievermarktung untergräbt die genetische Differenzierung von *Apis mellifera simensis* in Äthiopien

Rapid transformation of traditional beekeeping and colony marketing erode genetic differentiation in *Apis mellifera simensis* within Ethiopia

Teweldemedhn Gebretinsae Hailu[1], Peter Rosenkranz[2], Martin Hasselmann[1]

[1] University of Hohenheim, Institute of Animal Science, Department of Livestock Population Genomics, Garbenstraße17, 70599 Stuttgart, Germany

[2] University of Hohenheim, Apicultural State Institute, Erna-Hruschka-Weg 6, 70599 Stuttgart

Traditional beekeeping is an important part of rural livelihood in Ethiopia. In northern Ethiopia, development initiatives recently tried to transform it into improved apiculture, which led to colony marketing development. We assessed the progress in beekeeping, colony marketing and gene flow with a hypothesis that the extension might have supported both production and genetic conservation. Progress in regional total annual honey production, yield (kg/hive/year), colony population and type of beehives were analyzed based on annual reports from 2004 to 2020. In addition, colony market survey was conducted in one of the central markets (Enticho) in Tigray to analyze spatial and agro-ecological zone (AEZ) distributions of the honey bees, and elucidate driving factors and genetic implications related to this developing trend by interviewing 120 sellers and buyers.

The beekeeping progressed substantially; usage of frame hives grew from 1% to 23%, annual honey production tripled and managed colonies increased by 90%. Frame hives result in higher honey yield ($F=88.8$, $P<0.001$) than local hives. Colonies were exchanged between sellers and buyers with significant differences in spatial ($X^2=104.56$, $P<0.01$) and AEZ ($X^2=6.27$, $P=0.044$) distributions. The honey bees originate mainly from highland areas of two districts of colony reproduction, and re-distributed to wider areas for honey production. Most buyers showed preferences for colony color (73.3%) and AEZ of origin (88.3%) – resulted in uni-directional flow. Consequently, no genetic differentiation was detected between two contrasting elevations in the source area due to a high level of gene flow ($Nm=17.87$) compared to other areas in the region ($F_{ST}=0.22$, $Nm=2.23$) based on a nuclear marker known to be associated with elevational adaptation. Overall, the regional apiculture progressed significantly, but there is no evidence that beekeeping extension contributed to genetic conservation.

Keywords: apiculture; Ethiopia; colony; diversity; *Apis mellifera*

E-Mail: **teweldemedhng.hailu@uni-hohenheim.de**

P3.2 Gene unter Selektion in zwei invertierten chromosomalen Regionen der westlichen Honigbiene (*Apis mellifera*)

Genes under selection in two inverted chromosomal regions of the Western Honey bee (*Apis mellifera*)

Marco Mazzoni, Martin Hasselmann

University of Hohenheim, Institute of Animal Science, Department of Livestock Population Genomics, Garbenstraße17. 70599 Stuttgart, Germany

The western honey bee (*Apis mellifera*) is characterized by its large native range, covering a wide variety of habitats. *A. mellifera* can live from high mountain ranges to low and dense tropics, thus being well adapted to various climatic conditions. East Africa mountain regions are of particular interest as high mountains are populated by *A. m. monticola*, denoted as mountain bee that differs in phenotype when compared to bees of surrounding savannahs (*A. m. scutellata*). Morphologically and behaviorally, these bees can be distinguished, with *monticola* being less aggressive, darker and larger than *scutellata*. However, the distinction between the two subspecies is still debated since from a genetic point of view, only little differentiation exists, with the exception of two regions on chromosome 7 (r7) and chromosome 9 (r9). Both regions were identified as inversion polymorphisms, chromosomal aberration being frequently associated with adaptation. Inversions suppress recombination, leading to selection of favorable variants. r7 and r9 cover genes involved in e.g. learning, memory formation and metabolism which can be good candidates to adaptation to high altitude. This initial study focuses on the detection of sites under positive selection in the genes located in r7 and r9 to narrow down potential signs of adaptation. The dataset was made of 53 East African honey bee samples retrieved from 4 different whole genome projects (PRJNA357367, PRJNA294105, PRJNA237819, PRJNA481428).

By using iqTree and PAML we first clustered samples according to each individual gene and then studied patterns of selection across all the genes inside r7 and r9. Preliminary results show that some of the genes involved in metabolism and learning exhibit sites under positive selection. These analyses will be enriched by genome and transcriptome data from additional samples in the future to elucidate the regulatory network underlying the adaptation of *A. mellifera* to high elevation habitats.

Keywords: positive selection, inversion polymorphism, local adaptation

E-Mail: **marco.mazzoni@uni-hohenheim.de**

P3.3 Analysen zur genetischen Diversität von *Apis mellifera* aus der Republik Sacha (Jakutien, Russland)

Analyses on the genetic diversity of *Apis mellifera* from the Republic of Sakha (Yakutia, Russia)

Leon Reinhold, Felix Handke, Melanie Liebsch, Teweldemedhn G. Hailu, Birgit Gessler, Martin Hasselmann

Universität Hohenheim, Institut für Nutztierwissenschaften, Fachgebiet Populationsgenomik bei Nutztieren, Garbenstraße 17, 70599 Stuttgart

The climatic conditions in the Republic of Sakha (Yakutia, Russia) are characterized by long and very cold winters and short flowering season, resulting in several challenges for beekeeping and breeding activities. Although there exists a growing interest in beekeeping, insights into the genetic diversity of honeybees in Yakutia have not been obtained so far.

In this study, worker and drone samples from up to 28 colonies representing five locations near the river Lena were analyzed using mitochondrial cytochrome oxidase (COI-COII) and nuclear *complementary sex determiner* (*csd*) gene fragments.

Sequence analyses of COI/COII revealed different haplotypes for the C and M lineages. Predominantly, C1 and C2 haplotypes were found in 17 colonies, whereas in seven colonies M4 haplotypes were found. Interestingly, four haplotypes showed highest similarity to the recently described *A.m. sinisxinyuan* that belongs the M -lineage, too.

Furthermore, 53 *csd* sequences were identified in 24 colonies. The subsequent population genetic analysis revealed 37 different haplotypes. The comparison of the Yakutia *csd* sequences with 91 previously published *csd* sequences resulted in a match of 21 already known allele variations. Thus, 16 new *csd* allele variants could be found in the Yakutia samples.

Consequently, our first genetic study of honey bees in Yakutia indicates a relatively high *csd* allele diversity accompanied with lineages that are particularly adapted to colder climates. Thus, one may conclude that the special beekeeping methods in Yakutia do not represent an obstacle for the development of strong bee colonies.

Keywords: Diversity, Yakutia, *csd*, CO1, haplotypes

E-Mail: **leon.reinhold@uni-hohenheim.de**

4 Bienenschutz & Pflanzenschutz

P4.1 Assessing the impact of microbial plant protection product mixtures on honeybee workers

Assessing the impact of microbial plant protection product mixtures on honeybee workers

Tina Feer[1,2], Abdulrahim T. Alkassab[2], Michael Steinert[1], Jens Pistorius[2]

[1] Institute for Bee Protection, Julius Kühn Institute (JKI) - Federal Research Centre for Cultivated Plants, Messeweg 11-12, 38104 Braunschweig, Germany

[2] Institute of Microbiology, Technische Universität Braunschweig, Spielmannstraße 7, 38106 Braunschweig, Germany

The importance of microbial plant protection products (PPPs) in agriculture is steadily increasing, especially since they are considered to substitute chemical PPPs. Tank mixes are often common practice by farmers to reduce costs and increase the effectivity by controlling a broader spectrum of pests. However, there is no available information on the possible interactions between microbial PPPs and bee´s responses after exposure to such combinations.

We studied several tank mixes of microbial PPPs depending on application of the products on the same crops. Five products with different microorganisms as active ingredients and their combination were tested, including *Bacillus thuringiensis* ssp. aizawai (strain: ABTS-1857), *B. thuringiensis* ssp. kurstaki (strain: EG 2348), *B. amyloliquefacien* (strain: QST 713), *Beauveria bassiana* (strain: ATCC 74040) and *Cydia pomonella* granulosis virus (GV0005).

Caged winter honey bees were placed in an incubator at 26°C and 65% humidity and exposed orally either acute or chronic (over 10 d) to the maximum recommended application rate of solo-product or mixture of two products. Mortality and food uptake amount was recorded daily over 15 d.

Our results show that mixture of products containing *B. thuringiensis* ssp. aizawai and *B. amyloliquefacien* caused higher mortality rate compared to the solo products, whereas the effects in other mixtures are mostly related to the solo products which have the strongest effects. On the other hand, mixtures containing *C. pomonella* granulosis virus and/ or *B. thuringiensis* ssp. kurstaki did not affect the bee's survival compared to the other microbial PPPs.

In conclusion, further studies are necessary to assess the effects of such mixtures as the effects of tank mixtures of two or more PPPs on honey bees, as these are not routinely assessed in the risk assessment of plant protection products.

Keywords: *Bacillus thuringiensis*, *Apis mellifera*, tank mixture, microbial plant protection product

E-Mail: **abdulrahim.alkassab@julius-kuehn.de**

P4.2 The ground-nesting bee *Anthophora plumipes* as a potential test organism for investigating risks to bees of pesticide residues in soil

Sara Hellström, Karsten Seidelmann, Robert J. Paxton

Martin Luther Universität, Allgemeine Zoologie, Hoher Weg 8, 06120 Halle (Saale)

- Abstract entfällt -

Für Details wenden Sie sich bitte an die Autoren.

For details please contact the authors.

Keywords: solitary bee, ground-nesting bee, soil contaminants, pesticide

E-Mail: **sara.hellstroem@zoologie.uni-halle.de**

P4.3 Thiamethoxam in der Zuckerrübenbeize – eine Gefahr für Bienen?

Thiamethoxam in sugar beet seed dressing - a risk for bees?

Ingrid Illies[1], Stefan Berg[1] Andreas Schierling[2], Jens Pistorius[3], Gabriela Bischoff[4],

[1] Bayerische Landesanstalt für Weinbau und Gartenbau, An der Steige 15, 97209 Veitshöchheim

[2] Tiergesundheitsdienst Bayern e.V., Senator-Gerauer-Str. 23, 85586 Poing

[3] Julius Kühn-Institut, Institut für Bienenschutz, Messeweg 11-12, 38104 Braunschweig

[4] Julius Kühn-Institut, Institut für Bienenschutz, Königin-Luise-Straße 19, 14195 Berlin

For the control of yellowing viruses in sugar beet, the sowing of seeds treated with dressing Cruiser 600 FS (active ingredient Thiamethoxam) was approved on a limited area in Bavaria in 2021. In an accompanying monitoring six bee colonies were placed at each of three sites near Würzburg before sowing. Treated seeds were sown at two sites, and one site served as a control with untreated seed. The objective of the study was to evaluate whether bee colonies are exposed to the active ingredient, particularly during sowing and plant growth.

Mortality at the hive entrance was recorded daily from mid-March to the end of May. Bees returning to the hive were caught at the hive entrance before and after seeding and before and after emergence of young plants. At these times, honey and pollen was sampled from all colonies.

To ensure a temporal differentiation of the origin of possible residues in hive matrices, at the beginning of June, the colonies were exchanged at the sites and the mortality was recorded once a week also pollen samples were collected until the end of September.

No significant differences in mortality and colony development between the colonies of the three locations were detectable. Residues of Thiamethoxam or the metabolite Clothianidin could neither be detected in returning foragers (n=5; pool samples), nor in the dead bees (n=21). The active ingredient was also not detectable in honey (n=55) or pollen (n=53).

However, flowering weeds and inflorescences of sugar beet could be observed in the fields. Thiamethoxam (0.52-17.79 µg/kg; LOD 0.1 µg/kg) and Clothianidin (1.03-6.90 µg/kg; LOD 0.2 µg/kg) were detectable in this plant material. The flowering weeds and the inflorescences were visited by several insects (hoverflies, wild bees, a.o.), so that an exposition and uptake of the active substance might be possible.

For the cages used in this study, a group size of 25 individuals has proven successful. Dead animals can be easily removed and the living bees observed properly.

Keywords: residues, sugar beet, seed dressing, Thiamethoxam

E-Mail: **ingrid.illies@lwg.bayern.de**

P4.4 Untersuchung von Effekten kombinierter Pflanzenschutzmittel auf die Larvenentwicklung von *Apis mellifera*

Investigation of effects of combined plant protection products on the larval development of *Apis mellifera*

Sarah Manzer, Kristine Lohmann, Laura Değirmenci, Ricarda Scheiner

University of Würzburg, Biocenter, Behavioral Physiology & Sociobiology (Zoology II), Lehrstuhl für Zoologie II, Am Hubland, 97074 Würzburg

Plant protection products (PPPs) are widely used in agriculture and known as prominent stressors for honeybees. PPPs have also been found in larval food.

We investigated the effect of active ingredients of PPPs during honeybee larval development on mortality, slip weight and wing distance of honeybees (*Apis mellifera*) by performing *in vitro* rearing of worker larvae. Freshly hatched larvae were fed diets mixed with active ingredients of PPPs in two field realistic concentrations (medium and high) to reveal potential synergistic effects. The diets contained either an insecticide (Acetamiprid) or fungicide (Boscalid + Dimoxystrobin) applied alone or both in an insecticide-fungicide-mixture. The effects in the developmental stages of larvae, pupa and adult animal were quantified.

The feeding of active ingredients of PPPs had an impact on mortality of the hatched adult bees. In medium concentration animals receiving a combination of insecticide and fungicide during their larval development survived longer than controls ($p < 0.01$, Kruskal-Wallis-H test) or fungicide bees ($p < 0.001$). However, animals receiving a high concentration showed an increased mortality compared to all other groups (mix vs. control: $p < 0.001$, mix vs. fungicide: $p < 0.01$, mix vs. insecticide: $p < 0.001$). In both concentrations a synergistic effect due to the mix treatment could be detected, as the single treatments did not differ from the control group.

Furthermore, animals with a high concentrated mix treatment showed a reduced body weight in contrast to control ($p < 0.05$, Sidak-post hoc test) or insecticide-treated animals ($p < 0.01$) Again, insecticide and fungicide interacted synergistically.

There was no effect of treatment on wing distance, neither in medium nor in high concentrations.

In general, the intake of active ingredients from PPPs during larval development has the potential to affect adult honeybees, especially in combination.

Keywords: in vitro larval rearing, insecticide, fungicide, synergistic effect

E-Mail: **sarah.manzer@uni-wuerzburg.de**

P4.5 Keine Hinweise auf synergistische Effekte eines Neonikotinoids und eines Nicht-SBI-Fungizids auf Honigbienen

No evidence of synergistic effects of a neonicotinoid and a non-SBI fungicide on honeybees

Antonia Schuhmann, Ricarda Scheiner, Johannes Oppelt

University of Würzburg, Biocenter, Behavioral Physiology & Sociobiology (Zoology II), Am Hubland, 97074 Würzburg

Honeybees are important pollinators. However, they are severely threatened by plant protection products (PPPs). Most frequently, different PPPs are applied in combination or sequentially. Mixtures of different PPPs like neonicotinoids and sterol biosynthesis inhibitor (SBI) fungicides can lead to synergistic effects on pollinators. How other mixtures could affect honeybees is not known. Sublethal effects, in particular, are often underestimated. The responsiveness to sucrose and the learning performance of honeybees were tested after chronic PPP treatments (insecticide: Mospilan®, fungicide: Cantus® Gold) using proboscis extension response tests followed by differential conditioning. Furthermore, the orientation ability was studied with homing experiments. Responsiveness to sucrose did not differ between groups (Logistic Regression, $p>0.05$) and the learning performance did not differ between treatments (Logistic Regression, $p>0.05$). The percentage of arriving bees (Chi square, $p>0.05$) and the homing duration (Kruskal-Wallis test, $p>0.05$) in the orientation experiment did not differ between treatments. This suggests that the bees can degrade the tested substances efficiently and that the mixture of Mospilan® and Cantus® Gold does not grossly affect the detoxification process. However, due to the large number of possible combinations, PPP mixtures should be examined in detail in the future.

Keywords: synergistic effects, insecticides, fungicides, interaction, sublethal effects

E-Mail: **antonia.schuhmann@uni-wuerzburg.de**

P4.6 Pestizidrückstände in Larvenfuttergelee der Westlichen Honigbiene *Apis mellifera* – eine Übersicht

Pesticide residues in larval food jelly of the Western honey bee *Apis mellifera* – a review

Karoline Wüppenhorst, Jakob H. Eckert, Michael Steinert, Silvio Erler

Julius Kühn-Institut, Institut für Bienenschutz, Messeweg 11/12, 38104 Braunschweig

Honey bees are of public interest because of their pollination service, and production of honey, wax, and propolis. Further, they are considered as model organisms in pesticide risk assessment on pollinators. Previous studies have investigated residue analysis in different bee matrices like honey, bee bread or wax, and some in larval food jelly. We summarize the findings dealing with pesticide residues in all larval food jellies and elaborate factors influencing the pesticide occurrences as well as possible harmful risks for the larvae. It was demonstrated that residue analysis were mainly done in royal jelly, while only one study focused on residue detection in worker jelly. Overall 30 out of 176 pesticidal substances could be detected in a range of 0.15 to 3860ppb. The experimental setup, respectively the exposure scenario, was the major factor influencing the pesticide occurrence. A comparison of the detected doses with available reference values from risk assessment on larvae, showed no lethal effects for larvae. The literature screening revealed that there are still missing information on pesticide degradation within different bee matrices, possible effects on larval physiology, contamination pathways and associated accumulation or dilution factors of contaminants.

Keywords: pesticides, food jelly, risk assessment, sub-lethal effects

E-Mail: **karoline.wueppenhorst@julius-kuehn.de**

5 Bienenpathologie

P5.1 Vergleich der Wirkung von chemischen und biotechnischen Varroabehandlungs-verfahren auf die Viruslast mit dem Flügeldeformationsvirus in Honigbienenvölkern

Effects of chemical and biotechnical Varroa destructor treatments on Deformed Wing Virus load in honey bee colonies

Barbara Bank-Wolf[1], Reinhold Siede[2], Matthias König[1], Marina D. Meixner[2], Annely Brandt[2]

[1] Institut für Virologie, Fachbereich Veterinärmedizin, Schubertstraße 81, 35392 Gießen

[2] Landesbetrieb Landwirtschaft Hessen, Bieneninstitut Kirchhain, Erlenstraße 9, 35274 Kirchhain

Varroa destructor is an ectoparasite of honey bees. The damage this parasite causes by sucking on adult bees and brood is amplified by the transmission of numerous viruses to its host. In particular, the association between *V. destructor* and Deformed wing virus (DWV) is a major cause of colony losses. Despite the relevance of *V. destructor* and DWV for colony survival, little is known about the effects of different *V. destructor* treatments on the dynamics of DWV infections. Here, we investigate the effects of three commonly used sanitation approaches on *V. destructor* and DWV infection levels: (1) formic acid evaporation (FA), (2) total brood removal (TBR), (3) induced brood disruption by caging the queen for 25 days (QC).

Each group comprised 8 heavily infected colonies with infestation rates between 4 and - 19%, occupying approx. 20 combs. Colony size, mite infestation levels and DWV load were recorded between June and September. A linear mixed model was fitted to the data (SPSS software). DWV burden was dependent on the factors time and pre-treatment DWV burden ($p < 0.05$). All treatments reduced DWV loads effectively to the detection limit until end of September. Differences between treatments were not significant ($p > 0.05$) as well as interactions between treatment and time ($p = 0.105$), which indicates a similar rapid effect of all three treatments. With respect to colony size, the best-fitting model showed a significant effect of treatment ($p = 0.004$), of time and of the interaction between both ($p < 0.001$), but not of initial colony size ($p = 0.067$). TBR resulted in small colonies and led to four out of eight fatalities at the end of the experiment ($p = 0.002$; chi-square test), probably due to the relative late start of treatment in July. In conclusion, TBR, FA and QC are equally suitable for successful sanitation of heavily infested colonies in late summer, with TBR being associated with a higher risk of colony collapse.

Keywords: *Varroa destructor*, Deformed wing virus, formic acid, total brood removal, queen caging

E-Mail: **annely.brandt@llh.hessen.de**

P5.2 *Paenibacillus larvae* Sekundärmetabolit Paenilamicin: Aktivität gegen *Bacillus thuringiensis* und Selbstresistenzmechanismus von *P. larvae*

Paenibacillus larvae secondary metabolite Paenilamicin: Activity against *Bacillus thuringiensis* and self-resistance mechanisms of *P. larvae*

Julia Ebeling[1], Josefine Göbel[1], Niklas Sibum[1], Tam Dang[2], Timur Bulatov[2], Roderich D. Süssmuth[2], Elke Genersch[1,3]

[1] Länderinstitut für Bienenkunde Hohen Neuendorf e.V., Friedrich-Engels-Str. 32, 16540 Hohen Neuendorf

[2] Institut für Chemie, Technische Universität Berlin, 10623 Berlin

[3] Institut für Mikrobiologie und Tiersuchen, Fachbereich Veterinärmedizin, Robert-von-Ostertag-Str. 7-13, Freie Universität Berlin, 14163 Berlin

The causative agent of the honey bee disease American Foulbrood (AFB), *Paenibacillus larvae*, produces the secondary metabolite Paenilamicin (Pam) which has antibacterial and antifungal activity. Paenilamicins are a group of linear cationic polyketide-peptide hybrids bearing unnatural hydroxylated and N-methylated building blocks as well as D-amino acids and a spermidine moiety. In co-exposure bioassays, Pam was recently shown to be active against the saprophyte *Paenibacillus alvei*, a microbial competitor of *P. larvae* in the larval gut. Here we show our results on the activity of Pam against the insect-pathogen *Bacillus thuringiensis* in a honey bee larvae assay with synthesized as well as purified Pam. These data further confirmed that Pam is a potent antimicrobially active secondary metabolite of *P. larvae*. This potency suggested the hypothesis that *P. larvae* needs a self-resistance mechanism to prevent self-destruction by Pam. Within the Pam gene cluster, we identified the acetyl-CoA-dependent N-acetyltransferase PamZ as putative self-resistance factor. In this study, we generated a *pamZ* knockout mutant of *P. larvae* and successfully confirmed the role of PamZ in the self-resistance mechanism in an agar diffusion assay.

Keywords: American Foulbrood, *Paenibacillus larvae*, Paenilamicin, secondary metabolite, self-resistance

E-Mail: **elke.genersch@hu-berlin.de**

P5.3 Disease-associated odour profiles of infected honey bee larvae

Elisa Kathe, Karsten Seidelmann, Oleg Lewkowski, Yves Le Conte, Silvio Erler

Julius Kühn-Institut, Institut für Bienenschutz, Messeweg 11/12, 38104 Braunschweig

Disease-associated hygienic behaviour is a well-known defence mechanism of honey bees. Detection and removal of diseased individuals are central tasks, which are well described for *Varroa*-sensitive hygiene. Candidate substances or odorant signature mixtures have been studied intensively, however mainly for *Varroa* mite and fungi (*Ascosphaera* sp., causing chalkbrood) infected brood. For all diseases, olfactory cues (brood pheromones, signature mixtures, and diagnostic substances) emitted by diseased individuals are key factors for larvae-worker communication to discriminate healthy from infected brood.

Here, we used coupled gas chromatography-mass spectrometry (GC-MS) to measure changes in cuticular hydrocarbon (CHC) and brood pheromone (BEP) profiles of larvae artificially infected with *Melissococcus plutonius*, the causative agent of European foulbrood. Although chemical profiles did not differ extensively, and no diagnostic substances were found in significant quantities, infection-specific differences were detectable for CHC and BEP profiles. Furthermore, β-ocimene was present in all larvae with highest quantities in healthy young larvae, whereas oleic acid was present only in old infected larvae. The variable amounts of each substance may shape the characteristic mixture, which is supposed to trigger EFB-associated hygienic behaviour in specialized worker bees. The degree of hygienic behaviour, expressed by hygienic bees towards *M. plutonius*-infected brood and healthy brood covered with EFB-specific odour, has to be evaluated in future studies to draw conclusions from artificial laboratory infections to in-field relevance.

Keywords: chemical ecology, brood disease, hygienic behaviour, brood pheromones, European foulbrood

E-Mail: **silvio.erler@julius-kuehn.de**

P5.4 Der Kampf gegen Milbe mit künstlicher Besamung, Infizierung und Hochdurchsatz-Sequenzierung

The fight against the mite using artificial insemination, infestation and high-throughput sequencing

Birgit Gessler[1], Laurence Kuhlburger[2], Lina Sprau[1,3], Melanie Liebsch[1], Peter Rosenkranz[3], Martin Hasselmann[1]

[1] Universität Hohenheim, Institut für Nutztierwissenschaften, Fachgebiet Populationsgenomik bei Nutztieren, Garbenstraße 17, 70599 Stuttgart

[2] Zentrum für Quantitative Biologie (QBiC), Auf der Morgenstelle 10, 72076 Tübingen

[3] Universität Hohenheim, Landesanstalt für Bienenkunde, Erna-Hruschka-Weg 6, 70599 Stuttgart

The honey bee ectoparasite *Varroa destructor* is the main threat of honey bee colonies leading to annual colony losses worldwide. With the joint project SETBie in Baden-Württemberg, we aim to decipher molecular markers for the varroa-sensitive hygiene trait (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 underlying molecular mechanisms of VSH are still unclear. In this project we combine a sophisticated combination of colony phenotyping and high-throughput sequence analysis.

By artificial infestation with varroa mites in individual brood cells, colonies of the subspecies *Apis mellifera mellifera*, *A.m. carnica* and Buckfast were established and tested for VSH. As a result, the colonies were categorized in VSH high or VSH low. 46 colonies with 8 age defined worker bees from each colony were chosen for the initial molecular analyses, combining transcriptome, genome and methylation sequencing of the same individuals.

Preliminary analyses of candidate genes of the genomic approach reveal interesting single nucleotide polymorphisms (SNPs) associated with gene ontology terms such as e.g. regulation of olfactory learning and the nervous system. Combining additional datasets will broaden our understanding of the underlying molecular aspects for VSH.

Furthermore, it will lead to the identification of stable-inherited molecular markers for VSH that will be tested and evaluated for its suitability on broader scale with the potential application in selection-programs.

Co-financed by the European Agricultural Fund for Rural Development (EAFRD).

Keywords: SETBie, Varroa destructor, VSH, molecular marker

E-Mail: **Birgit.Gessler@uni-hohenheim.de**

P5.5 *Varroa destructor* ist ein biologischer Vektor für DWV-B.

Varroa destructor acts as biological vector for DWV-B.

Sebastian Gisder[1], **Elke Genersch**[1,2]

[1] Institute for Bee Research, Department of Molecular Microbiology and Bee Diseases, Hohen Neuendorf, Germany

[2] Freie Universität Berlin, Fachbereich Veterinärmedizin, Institut für Mikrobiologie und Tierseuchen, Berlin, Germany

Deformed wing virus (DWV) is a single stranded, positive sense-RNA virus which belongs to the family of Iflaviridae. Horizontal and vertical transmission of DWV from bee to bee is mainly characterized by covert infections without visible symptoms on the individual or colony level. In contrast, vectorial transmission of DWV, by the globally distributed *Varroa* mite (*Varroa destructor*), is linked with symptoms of overt infections which are characterized by pupal death, emerging bees with crippled wings or cognitive impairments of adult bees due to brain infections. So far, four different DWV-variants, DWV-A, -B, -C, and -D are described in the literature of which DWV-A and -B verifiably differ in virulence. In the recent past, it has been repeatedly reported that *V. destructor* acts as a vector for DWV, but there has been controversy and heated debate as to whether DWV acts as a mechanical or biological vector. For the latter to be true, DWV would need to be able to infect *V. destructor*. In order to resolve this question, we analyzed tissue sections of *Varroa* mites which were collected from heavily mite-infested colonies, by fluorescence *in situ*-hybridization (FISH). We detected clear signals for DWV in the intestinal cells and also salivary glands when DWV-B-specific probes were used but no signals were detected when DWV-A-specific probes were applied. Our results provide compelling evidence that DWV-B replicates in *V. destructor* tissues and therefore, *V. destructor* can act as a biological vector for DWV-B but not DWV-A transmission.

Keywords: Varroa, DWV infection, biological vector

E-Mail: **elke.genersch@hu-berlin.de**

P5.6 Die Biofilmbildung ist wichtig für die Virulenz von *P. larvae*

Biofilm formation is important for *P. larvae* virulence

Josefine Göbel[1], **Anne Fünfhaus**[1], **Julia Ebeling**[1], **Elke Genersch**[1,2]

[1] Länderinstitut für Bienenkunde Hohen Neuendorf e.V., Abteilung Molekulare Mikrobiologie und Bienenkrankheiten, Hohen Neuendorf, Germany

[2] Freie Universität Berlin, Fachbereich Veterinärmedizin, Institut für Mikrobiologie und Tierseuchen, Berlin, Germany

American Foulbrood (AFB) is a worldwide occurring notifiable disease of the honey bee. Although it affects only the bee brood, it eventually kills the entire colony thus leading to considerable colony losses every year. The causative agent of AFB is the Gram-positive, spore-forming bacterium *Paenibacillus larvae*. A *P. larvae* infection is initiated when young larvae take up food contaminated with *P. larvae* spores. Spores germinate in the larval midgut lumen, followed by a massive proliferation of the vegetative bacteria. After this commensal phase *P. larvae* attacks the midgut epithelium with the help of various virulence factors and thereby manages to invade the larval hemocoel, resulting in death of the diseased larvae. *P. larvae* subsequently degrades the larval cadaver to a ropy mass that eventually dries out into a tightly adhering scale, consisting of billions of spores. During the pathogenesis of *P. larvae* infection, not only molecular mechanisms of the single bacterial cells play an important part, but also cooperative multicellular behaviours. In their natural habitats many bacteria do not exist as single cells but rather occur as communities called biofilms. Bacteria in a biofilm are embedded in a self-produced extracellular matrix holding the cells together and protecting them from adverse external influences. For *P. larvae* we recently demonstrated the ability to form an extracellular matrix and hence a biofilm. The aim of this study was to further investigate the role of biofilm formation for the virulence of *P. larvae*. Since polysaccharides generally conduce to biofilm formation, we constructed a gene knockout mutant lacking the production of a priming glycosyltransferase putatively involved in glycan biosynthesis of *P. larvae.* The gene disruption resulted in significantly decreased biofilm formation. Further an *in vivo* infection assay with honey bee larvae demonstrated a substantial role of biofilm formation for the virulence potential of *P. larvae*.

Keywords: *Paenibacillus larvae*, American Foulbrood, biofilm

E-Mail: **elke.genersch@hu-berlin.de**

P5.7 Einfluss von Temperatur und Gruppengröße auf die Lebensdauer von Honigbienen in Käfigversuchen

Influence of temperature and group size on the longevity of honeybees in cage experiments.

Nicole Höcherl[1], Birgit Zange[2], Ingrid Illies[3]

[1] Landwirtschaftliche Lehranstalten Triesdorf, Tierhaltungsschule, Markgrafenstr. 1, 91746 Weidenbach

[2] Hochschule Weihenstephan-Triesdorf, Am Staudengarten 12, 85354 Freising

[3] Bayerische Landesanstalt für Weinbau und Gartenbau, Institut für Bienenkunde und Imkerei, An der Steige 15, 97209 Veitshöchheim

Cage experiments are used for many purposes: Effects of pesticides, compatibility of different food or experiments on infections of bees with different pathogens are questions in which honeybees are observed in cages. A wide range of temperature conditions and group sizes used for this type of experiment can be found in the literature. For example, temperatures between 25 and 34°C are used and a minimum of three cages and 30 individuals per cage are recommended for strong statistics. However, the effects of group sizes and temperatures on mortality of bees in such experiments have not been systematically studied, so far.

In the present experiment, stainless steel cages (85 length / 67 width / 45 mm height) were equipped with a beeswax comb foundation on the back wall. Newly emerged bees were placed inside and fed *ad libitum* with a sucrose solution and a pollen paste. Thirty cages each were filled with either 10, 25 or 50 newly emerged bees. Ten cages of each group size were then kept at either 26, 30 or 34°C (∑=90 cages).

The mortality of the bees was significantly higher in cages maintained at 34°C in contrast to the cooler temperatures (26°C and 30°C). The density of bees in one cage (individuals per cage) has no significant impact on the average lifespan of the bees in this study.

During the experiment, it was observed that the bees kept at 30°C were very restless. Even if there was no measurable effect on the longevity of bees, cage experiments at 26°C (± 1°C) and a minimum of 10 bees per cage are recommended. In order not to undercool the bees at the beginning, it is advisable to keep the newly hatched bees for two days at 30°C (±1°C).

For the cages used in this study, a group size of 25 individuals has proven successful. Dead animals can be easily removed and the living bees observed properly.

Keywords: hoarding cages, cage experiments, group sizes, temperature conditions

E-Mail: **ingrid.illies@lwg.bayern.de**

P5.8 Landesweites Screening auf Bienenviren in ägyptischen *Apis mellifera* Völkern

Nationwide screening for bee viruses in *Apis mellifera* colonies in Egypt

Mohamed Kaandeil, Robert J. Paxton, Yahya Al Naggar

Allgemeine Zoologie, Institute für Biologie, Martin-Luther-Universität Halle-Wittenberg, Hoher Weg 8, 06120 Halle (Saale)

Apis mellifera are important for the pollination of many food crops but many countries have reported high annual colony losses caused by multiple possible so-called stressors. According to the FAO database, between 2005 and 2016 Egypt experienced a 50% decrease in the numbers of honey bee colonies. One of the main reasons for colony losses are diseases, particularly those caused by viruses. However, little is known about the incidence of honey bee diseases, particularly the prevalence of viruses, in Egyptian *A. mellifera* colonies. To address this shortfall, this study was aimed at determining the prevalence of widespread bee viruses in *A. mellifera* colonies in Egypt and their relation to the geographical distribution of colonies in the country and the season. Worker samples were collected from 18 geographical regions across Egypt during winter and summer 2021. Three apiaries were chosen in each region, and a pooled sample of 150 bees was collected from five different colonies in each apiary. A total of 108 samples are being screened by qPCR for common viral targets: ABPV, BQCV, CBPV, DWV- A and DWV- B, SBV, SBPV, IAPV, and EBV (Egyptian bee virus). The obtained results will aid in the systematic assessment of the global honey bee virome by filling a knowledge gap about the prevalence of honeybee viruses in Egypt and might help to prevent the spread of additional emerging infectious diseases

Keywords: Honey bee, virus, Egypt, deformed wing virus, prevalence.

E-Mail: **mohamed.kaandeil89@gmail.com**

P5.9 Infektion der Arbeiterinnen der Riesenhonigbiene *Apis dorsata* mit *Nosema ceranae*, das von verschiedenen Honigbienen-Wirtsarten isoliert wurde

Infection of workers of the giant honey bee, *Apis dorsata*, with *Nosema ceranae* isolated from different honey bee host species

Rujira Ponkit[1,2], Robert J. Paxton[1], Guntima Suwannapong[2]

[1] Allgemeine Zoologie, Institute für Biologie, Martin-Luther-Universität Halle-Wittenberg, Hoher Weg 8, 06120 Halle (Saale), Germany

[2] Department of Biology, Faculty of Science, Burapha University, Chon Buri, Thailand

Nosema ceranae is a microsporidian pathogen that was first discovered in *Apis cerana*. This parasite has recently been found to infect all honey bee species. Interestingly, *N. ceranae* isolated from different honey bee species was found to vary in its ability to infect *A. mellifera*. We asked whether *N. ceranae* isolated from different honey bee species also varies in its ability to infect *A. dorsata* workers. To do so, we investigated the ability of four *N. ceranae* isolated from the European honey bee, *A. mellifera*, and the native honey bees, *A. florea*, *A. cerana*, and *A. dorsata*, to infect *A. dorsata* at two different time points, 6 and 10 days post infection (d.p.i.). Our results showed that *N. ceranae* isolated from *A. florea* had significantly higher infectivity than *N. ceranae* isolated from *A. dorsata* on 6 d.p.i., suggesting that *N. ceranae* isolated from *A. florea* has a greater ability to proliferate in the ventriculus of *A. dorsata*. However, there was no significant difference in infectivity among *N. ceranae* isolates on 10 d.p.i. We also quantified the protein content of the hypopharyngeal glands of infected *A. dorsata* at the same time points post infection. The protein content of all infected *A. dorsata* treatment groups was lower than uninfected bees at 6 and 10 d.p.i.; all *N. ceranae* isolates affected the bee's hypopharyngeal gland protein content equally. This study suggests that the same *N. ceranae* circulates among all *Apis* species, native and introduced, that are currently in Thailand.

Keywords: *Apis dorsata*, infectivity, *Nosema ceranae*, protein content

E-Mail: **guntima@buu.ac.th**

P5.10 Update zur Labordiagnose von *P. larvae*

Update on laboratory diagnosis of *P. larvae*

Antonia Reinecke[1], Niklas Sibum[1], Julia Ebeling[1], Anne Fünfhaus[1], Elke Genersch[1,2]

[1] Länderinstitut für Bienenkunde Hohen Neuendorf e.V., Abteilung Molekulare Mikrobiologie und Bienenkrankheiten, Hohen Neuendorf, Germany

[2] Freie Universität Berlin, Fachbereich Veterinärmedizin, Institut für Mikrobiologie und Tierseuchen, Berlin, Germany

American foulbrood of bees (AFB) is a notifiable bee disease that kills not only individual larvae of the Western honey bee (*Apis mellifera*), but also entire colonies. The causative agent of AFB is the Gram-positive, spore-forming bacterium *Paenibacillus larvae*. A disease outbreak is defined by the presence of clinical symptoms in a colony and the detection of the etiological agent, *P. larvae*, in samples taken from that colony. Thus, if visual inspection of the brood combs in a colony reveals suspicious clinical symptoms, this tentative diagnosis must be confirmed by laboratory detection of the pathogen, *P. larvae*. Similarly, detection of the pathogen in the laboratory in sample material sent in, for example, by a beekeeper as part of self-inspections, means a suspicion of an outbreak of AFB. This suspicion must always be clarified with a clinical examination of the infected colony and possibly re-sampling to confirm or refute the suspicion of an outbreak of the disease.

Self-monitoring by beekeepers is essential for early diagnosis of infected, yet clinically asymptomatic colonies. As matrices for *P. larvae* spore detection, samples of brood comb honey, adult bees or hive debris are widely established, although not yet comparatively tested. Here we present our results on the recovery rate of *P. larvae* spores in brood comb honey, bee samples, and hive debris spiked with a defined number of spores in order to assess the sensitivity of the method and the detection limit of *P. larvae* spores. We also present our results from comparing field samples of brood comb honey and adult bees as matrices in diagnosing AFB. Problems with the detection of *P. larvae* due to the dominance of accompanying microorganisms occur repeatedly in both matrices. We identified the culturable bacteria via 16S rRNA gene sequencing and assessed their susceptibility towards nalidixic acid, an antibiotic often used to suppress the growth of accompanying bacteria interfering with *P. larvae* detection.

Keywords: *Paenibacillus larvae*, laboratory diagnostics

E-Mail: **elke.genersch@hu-berlin.de**

P5.11 Immune Inhibitor A - eine mögliche Metalloprotease als Virulenzfaktor von *Paenibacillus larvae*?

The putative metalloprotease Immune Inhibitor A- a potential virulence factor in *Paenibacillus larvae*?

Sarah Riebschläger[1], Juliane Schreiber[1,2], Julia Ebeling[1], Anne Fünfhaus[1], Elke Genersch[1,2]

[1] Institute for Bee Research, Department of Molecular Microbiology and Bee Diseases, Hohen Neuendorf, Germany

[2] Freie Universität Berlin, Fachbereich Veterinärmedizin, Institut für Mikrobiologie und Tierseuchen, Berlin, Germany

Worldwide, considerable losses of honey bee colonies are caused by the gram-positive spore forming bacterium *Paenibacillus larvae,* the causative agent of American Foulbrood. Five different Genotypes (ERIC I-V) have been identified by repetitive element PCR with ERIC primers, with ERIC I and ERIC II being the genotypes currently causing outbreaks worldwide. These two genotypes differ in their virulence at the individual larval and colony level, which can be explained by their different virulence factors. By genome- and proteome- analysis a putative ERIC II-specific virulence factor was found: Immune Inhibitor A (InhA), a protein of the M6-metalloprotease family. Proteases have been suspected to be relevant virulence factors of *P. larvae* since decades and InhA-homologues have been shown to play a role in virulence in other bacterial species. Therefore, we hypothesized that InhA is a virulence factor in *P. larvae* ERIC II.

To characterize this putative virulence factor, InhA was first analysed in silico, using 3D- model analysis, multiple alignment and phylogenetic trees. Comparison of a 3D- model of *P. larvae* InhA with the 3D-structure of an InhA-homologue in *Bacillus anthracis* revealed an intact active center, suggesting a functional protease, but differences in the structure of the pro-peptide responsible in *B. anthracis* for regulating InhA proteolytic activity. To find potential substrates, InhA was recombinantly expressed as a GST-fusion protein in *E. coli* and HIS-fusion protein in *B. subtilis.* Recombinant proteins were successfully purified using GST – and IMAC-Nickel-columns. The activity of recInhA was tested on typical protease substrates, such as casein or gelatine. No proteolytic activity could be detected suggesting that *P. larvae* InhA is non-functional or has a very specific activity that remains to be identified.

Keywords: *Paenibacillus larvae*, American Foulbrood, Virulence factors, Protein expression

E-Mail: **elke.genersch@hu-berlin.de**

P5.12 Kein Hinweis auf Viren Wirtswechsel von Honigbienen *Apis mellifera* auf Schmetterlinge *Vanessa cardui*

Negative Evidence for Virus Spillover from Honey Bees *Apis mellifera* to Butterflies *Vanessa cardui*

Alexandria Schauer, Orlando Yañez, Lars Straub, Peter Neumann

Institut für Bienengesundheit, Universität Bern, Schwarzenburgstrasse 161, CH-3003 Bern, Schweiz

Host shifts of RNA viruses can have drastic impact on novel host species, thereby calling for efforts to understand the possible host range of individual viruses. Although host shifts from managed Western honey bees, *Apis mellifera*, to a range of other pollinator species have been reported, host shifts to Lepidoptera are scarcely reported. Here, we use laboratory reared specimen to show that host shifts of Deformed wing virus (DWV)-A, DWV-B, and Acute bee paralysis virus (ABPV) from *A. mellifera* to the Lepidopteran *Vanessa cardui,* the painted lady butterfly, are unlikely to occur. Under optimal rearing conditions, third instar larvae of *V. cardui* were experimentally infected with Deformed wing virus (DWV)-A, DWV-B, or Acute bee paralysis virus (ABPV) propagated in honey bees through either intraperitoneal microinjections or oral feedings of 10^4 or 10^{10} viral genome copies, respectively. No clinical symptoms were observed and viral titers measured by quantitative PCR (qPCR) up to 15 days post-infection suggested no viral replication in *V. cardui.* Because injections are the most efficacious method of infection, our negative data suggest a natural limit to the host range of DWV and ABPV. More studies on a range of other potential Lepidopteran hosts are required to further validate our findings.

Keywords: pathogen, spillover, host shifts, *Vanessa cardui,* viruses

E-Mail: **alexandria.schauer@vetsuisse.unibe.ch**

P5.13 Modellierung der Kontrolle des Befalls von Honigbienen mit *Varroa destructor* mit BEEHAVE

Modelling the control of *Varroa destructor* infestation in honey bees with BEEHAVE

Isabel Schödl[1], Richard Odemer[2], Matthias Becher[3], Stefan Berg[4], Christoph Otten[5], Volker Grimm[1,6], Jürgen Groeneveld[1*]

[1] Helmholtz-Zentrum für Umweltforschung – UFZ, Department Ökologische Systemanalyse, Permoserstr. 15, 04318, Leipzig

[2] Institut für Bienenschutz, Julius Kühn-Institut (JKI), Bundesforschungsinstitut für Kulturpflanzen; Messeweg 11/12, 38104 Braunschweig

[3] Universität Graz, Institut für Biologie, Universitätspatz 2, 8010 Graz

[4] Institut für Bienenkunde und Imkerei, An der Steige 15, 97209 Veitshöchheim

[5] Fachzentrum Bienen und Imkerei, Im Bannen 38, 56727 Mayen

[6] University of Potsdam, Plant Ecology and Nature Conservation, Am Mühlenberg 3, 14476 Potsdam, Germany

The BEEHAVE model simulates the dynamics in the hive and the foraging activity of an individual bee colony in great detail. Although it still makes numerous simplifying assumptions, it appears to capture a wide range of empirical observations. It could therefore, in principle, also be used as a tool in beekeeper education, as it allows the implementation and comparison of different management options. Here we focus on treatments aimed at controlling the mite *Varroa destructor*. However, because BEEHAVE was developed in the UK, its *Varroa destructor* treatments do not reflect Good Beekeeping Practice in Germany, which includes drone brood removal from April to June, formic acid treatment in August/September, and oxalic acid treatment in November/December. We implemented these measures, focusing on the timing, frequency, and spacing between drone brood removals. The acid treatment is measured by its efficiency in killing mites. The effect of drone brood removal and medical treatment, individually or in combination, on a mite-infested colony of the Deformed Wing Virus variety was examined. The measure of effectiveness was the reduction of mites in the colony and the development of the mite population within the simulated year. We found that drone brood removal was very effective, reducing mites by 90% at the end of the first simulated year compared to simulations without drone brood removal. This value was significantly higher than the 50 to 67% reduction expected by bee experts. However, a wide range of percent reductions in the number of mites due to drone brood removal is reported in the literature, with the highest value being 85%. The discrepancy between model results and expert estimates indicates that both BEEHAVE and expert estimates should be reviewed and refined, as both are based on simplifying assumptions. These results and the adaptation of BEEHAVE to the Good Beekeeping Practice in Germany are decisive steps forward for the future use of BEEHAVE in beekeeper education.

Keywords: honey bees, simulation, Varroa mite, control, drone brood removal

E-Mail: **isabel.schoedl@ufz.de**

P5.14 In vivo serial passages of *Paenibacillus larvae* - Evolution in a 24-well plate

In vivo serial passages of *Paenibacillus larvae* - Evolution in a 24-well plate

Niklas Sibum[1], Juliane Schreiber*[1,2], Julia Ebeling[1], Anne Fünfhaus[1], Elke Genersch[1,2]

* = equal contribution

[1] Institute for Bee Research, Department of Molecular Microbiology and Bee Diseases, Hohen Neuendorf, Germany

[2] Freie Universität Berlin, Fachbereich Veterinärmedizin, Institut für Mikrobiologie und Tierseuchen, Berlin, Germany

Paenibacillus larvae is a gram-positive, spore-forming bacterium and the causative agent of American Foulbrood (AFB), considered the most dangerous disease of honey bee brood. *P. larvae* is highly specialized to its host, the honey bee larva, and also adapted to the eusocial behavior of honey bees being transmitted within the brood nest by nurse bees feeding the larvae. Once a larva has ingested the spores, *P. larvae* germinates in the midgut, proliferates and infiltrates the haemocoel. Soon after reaching deeper tissues, the larvae die. The bacterium decomposes the larval body to a brownish viscous mass, which dries down to a scale (foulbrood scale) containing millions of newly generated spores. Adult bees trying to clean the brood cells get contaminated with spores and again distribute these spores by feeding the brood. To understand the evolutionary processes between the host and the pathogen, we established an *in vivo* assay in order to serially passage *P. larvae* through honey bee larvae, mimicking the natural infection cycle in a colony. We will present first results of these assays and discuss their relevance with regard to the evolution of *P. larvae* virulence.

Keywords: *Paenibacillus larvae*, *in vivo* assay, serial passages

E-Mail: **elke.genersch@hu-berlin.de**

P5.15 Sind die Winterverluste in Honigbienenvölkern in Nordostdeutschland aufgrund von *Nosema ceranae* Infektionen erhöht?

Causes *Nosema ceranae* infection elevated winter losses in honey bee colonies in Northeast Germany?

Vivian Schüler[1], Sebastian Gisder[1], Yuk-Chien Liu[2], Detlef Groth[2]*, Elke Genersch[1,3]

[1] Institute for Bee Research, Department of Molecular Microbiology and Bee Diseases, Hohen Neuendorf, Germany

[2] University of Potsdam, Institute of Biochemistry and Biology, Potsdam-Golm, Germany

[3] Freie Universität Berlin, Fachbereich Veterinärmedizin, Institut für Mikrobiologie und Tierseuchen, Berlin, Germany

The microsporidium *N. ceranae* is considered an emerging pathogen of the Western honey bee *Apis mellifera*. Reports on the spread of *N. ceranae* suggested that this presumably highly virulent species is replacing its benign congener *N. apis* and that it is also responsible for colony losses presumably in warmer climatic regions. On the basis of a cohort study in Northeast Germany started in 2005, we studied the mortality of a total of 3502 colonies infected with either *N. apis* or *N. ceranae* or with both (co-infection) or with none (no nosema). Furthermore, we analyzed the biological effect of *Nosema* spp. in comparison to the *Varroa destructor* infestation via multivariate statistics. For the first time we saw a positive correlation between mortality and nosema infection in the study area. We observed higher mortality of colonies due to *N. ceranae*, but no replacement of *N. apis*. Nevertheless, classification decision tree analysis showed that *V. destructor* infestation played the decisive role in colony losses. Our results suggest that in a temperate climate zone only in a weakened honey bee colony, *N. ceranae* leads to a higher mortality.

Keywords: *Nosema ceranae*, *Varroa destructor*, winter colony losses

E-Mail: **elke.genersch@hu-berlin.de**

P5.16 Effekte von *Bacillus thuringiensis* Sporen auf Larven der Honigbiene

Effects of *Bacillus thuringiensis* spores on honey bee larvae

Niklas Sibum[1], Julia Ebeling[1], Anne Fünfhaus[1], Elke Genersch[1,2]

[1] Institute for Bee Research, Department of Molecular Microbiology and Bee Diseases, Hohen Neuendorf, Germany

[2] Freie Universität Berlin, Fachbereich Veterinärmedizin, Institut für Mikrobiologie und Tierseuchen, Berlin, Germany

Bacillus thuringiensis spores are used in products like „B401“ as a biological insecticide against the larval stages of the wax moth (*Galleria mellonella*). The product is used on the frames right after the honey harvest. The distributor insures that B401 is safe to use in the bee hive and does not harm the honey bee larvae of *Apis mellifera*. *B. thuringiensis* is an endospore forming bacterium and produces crystal toxins which can bind to midgut epithelia of specific insects and destroy those membranes. The aim of this study was to investigate the effect of B401 on and the pathogenicity of *B. thuringiensis* for honey bee larvae in laboratory exposure assays. To this end, laboratory-reared honey bee larvae were exposed to different concentrations of colony forming units (cfu) of *B. thuringiensis* at different times by adding an appropriate volume of B401 to the larval diet. Before and after exposure, a sterile diet was fed. Increased mortality was observed with 2 x 10^4 cfu/ml fed to one-day-old larvae; at a concentration of 2 x 10^5 cfu/ ml of food jelly, over 95 % of one day old larvae died within 24 hours after the infection. However, the older the larvae were when they ingested *B.thuringiensis* spores, the higher the survival rate was. Infection of four-day-old larvae resulted in only 20 % mortality. Analyzing the dead larvae via fluorescence *in situ*-hybridization for the presence of vegetative *B.thuringiensis* revealed that the gut of the larvae was indeed filled with vegetative *B. thuringiensis* cells, while the peritrophic matrix was unaffected and intact. This explains the age-dependent effect of B401: Since the peritrophic matrix gets stronger with larval age and *B. thuringiensis* is obviously not able to degrade the peritrophic matrix, larval susceptibility to *B. thuringiensis* decreases with larval age. Field experiments are necessary to analyze the relevance of these findings for honey bee colonies treated with B401.

Keywords: *Bacillus thuringiensis,* fluorescence *in situ*-hybridization, honey bee larvae

E-Mail: **elke.genersch@hu-berlin.de**

P5.17 Virulenz von DWV-A in *Bombus terrestris* ist kontextbedingt

Context-dependent virulence of DWV-A in *Bombus terrestris*

Tabea Streicher, Anja Tehel, Simon Tragust, Robert J. Paxton

Allgemeine Zoologie; Hoher Weg 8; 06120 Halle (Saale)

Deformed wing virus (DWV), notorious for its high virulence in the Western honey bee (*Apis mellifera)* in co-occurrence with its vector *Varroa destructor*, is known to be widespread among wild bumble bee communities. Studies on the virulence of DWV in *Bombus* spp. have provided equivocal results and were till now confined to laboratory settings. The outcome of host-parasite interactions is however known to be context-dependent; the laboratory does not replicate real-world, stressful field-conditions. To gain a better insight into the impact of DWV on bumble bees under field-realistic conditions, we studied DWV-inoculated *Bombus terrestris* workers in a natural environment. We inoculated commercially reared *B. terrestris* workers with DWV-A through feeding or injection and introduced them into commercial colonies placed in the field, thus exposing them to their natural environment. To estimate virulence of DWV-A we monitored the survival of inoculated worker bees and quantified the viral load they carried 10 days post inoculation. *Bombus terrestris* workers injected with DWV-A harboured high viral loads and exhibited a significantly reduced median survival time. Bees inoculated by feeding carried low or zero detectable viral loads and their mortality did not differ from the respective control group. Our results highlight the necessity for studies that address potential context-dependent virulence when evaluating the virulence of a pathogen in a new host species.

Keywords: *Bombus terrestris*, DWV, virulence, context-dependent

E-Mail: **tabea.streicher@zoologie.uni-halle.de**

P5.18 Genotypen A und B des Krüppelflügelvirus bei einheimischen und eingeführten *Apis*-Arten in Thailand

Deformed wing virus genotypes A and B in native and imported *Apis* species of Thailand

Thunyarat Chantaphanwattana, Panuwan Chantawannakul, Robert J. Paxton

Allgemeine Zoologie, Institute für Biologie, Martin-Luther-Universität Halle-Wittenberg, Hoher Weg 8, 06120 Halle (Saale), Germany

Nowadays, Thailand's colonies of imported (*Apis mellifera*) and native honey bee species (*A. cerana*, *A. florea* and *A. dorsata*) face many threats, especially bee viruses, which result in economic losses for its apiculturalists. Deformed wing virus (DWV), including its two principal genotypes A and B, is a dominant virus affecting overall colony health. Yet there is a lack of knowledge of whether DWV-A or DWV-B, or both, are present in native *Apis* species in Thailand and other southeast Asian countries. This study aims to fill this gap by (i) determining the DWV genotype in different *Apis* host species using qPCR and (ii) by inferring viral transmission between different *Apis* species using DNA sequences of DWV. To do so, *Apis* host species were collected at three independent localities in northern Thailand, each minimally 3 km distant from each other. We found DWV-B in *A. florea* and *A. dorsata*, the first report of this DWV genotype in these bee species. Co-infections with DWV-A and DWV-B were detected in *A. mellifera* and *A. florea*. DWV-A titres were significantly lower in the presence of DWV-B in *A. mellifera*, suggesting that DWV-B may suppress DWV-A. The similarity of DWV sequences across *Apis* species at the same locality suggest the potential of DWV-A and DWV-B to spill over across co-occurring *Apis* species. Both genotypes of DWV represent a threat to all of Thailand's honey bee species and its apiculture industry.

Keywords: *Apis* species, virus, interference, transmission

E-Mail: **thunyarat.chan@gmail.com**

6 Bienenprodukte, Imkereipraxis, Technologie

P6.1 Einfluss verschiedener Winterfutter auf die Überwinterung von Bienenvölkern

Effects of different winterfoods on the overwintering of honeybee colonies

Hannes Beims[1,2], **Martina Janke**[1]

[1] LAVES – Inst. f. Bienenkunde Celle, Herzogin-Eleonore-Allee 5, 29221

[2] Bezirk Oberbayern – Fachberatung für Imkerei, Prinzregentstraße 14, 80538 München

The success of the honeybee season is founded bevor overwintering. Beside colony strength and vitality, the winterfood has a main impact on the quality of overwintering. In an EU founded project, we analyzed the effect of different food sources on the overwintering of honeybee colonies.

We analyzed dark-colored honey (DH), light-colored honey (LH), sugar sirup (SSi), zea-starch hydrolysate (ZSH) and 3:2 (*w/v*) sugar solution (SSo). The strength of each colony group (n=5) was estimated before feeding. Colony strength was estimated a second time after overwintering. The food was sampled before feeding (t_0), after storage in the combs (t_1) and after overwintering (t_2). We analyzed the samples for HMF, sugar composition and electrical resistivity. Moreover, we analyzed feces and bee samples for different pathogenes, as well as bees for core microbiome after overwintering.

Significant differences in the colony strength (brood + bees) could be detected after overwintering between DH and LH, SSi and ZSH. Moreover, we could detect differences in the composition of the sugar's glucose, fructose and maltose. The differences were pointed out in the electrical resistivity of the food on t_2). LH differed significantly from all other foods, whereas DH differed from SSi and ZSH. In general, both honeys showed a higher electrical resistivity than the substitute foods SSi, ZSH and SSo.

Focusing on the colony strength, the total number over overwintered bees indicated a negative influence of DH on the overwintering of bees.

Taken together, our results underline the beekeepers' point of view, that dark-colored honeys are less suitable as winterfood.

Keywords: Futter, Überwinterung, Zuckerspektrum, HMF, Auswinterung

E-Mail: **Martina.Janke@LAVES.Niedersachsen.de**

P6.2 Auswirkungen einer innovativen Bienenhaltung auf die Vitalität von *Apis mellifera* L. – „Vitalbiene“

Effects of innovative beekeeping on the vitality of *Apis mellifera* L. – ‘Vitalbiene’

Lena Frank, Ralph Büchler, Marina D. Meixner

Landesbetrieb Landwirtschaft Hessen, Bieneninstitut Kirchhain, Erlenstraße 9, 35274 Kirchhain

The ‘Vitalbiene’ project compares *Apis mellifera* L. colonies under different treatment concepts over three years in terms of health, performance, population development and mating success. In an innovative treatment group, a brood interruption in summer is induced, followed by an oxalic acid (OA) treatment; however, routine winter treatment is not performed. Instead, *Varroa destructor* infestation carefully monitored, and a winter treatment applied only when necessary. The comparison group receives formic acid treatments in late summer and OA treatment in winter. In addition, in the comparison group, drone brood is removed in spring, which is not carried out in the innovative approach.

The effects of the innovative approach on the population dynamics are investigated; furthermore, the fitness of drones of the two groups will be compared with regard to sperm quality, mating success and immune defense.

In parallel, a beekeeper network is established to transfer knowledge and to develop a training concept with the aim of spreading insights into this control concept to the public. The implementation of innovative beekeeping should, in the long term, contribute to an improved selection for increased defense against *Varroa destructor*, without increasing colony losses or reducing yield.

Starting in July 2021, colonies were evenly distributed to two apiaries with 8+8 colonies each, based on colony strength and infestation. Summer treatment was carried out according to the experimental groups, population dynamics and parasitization recorded over the course of the year. In preparation for mating trials, sister queens of two origins were established in fall 2021. To date, no winter losses are recorded among the colonies, although the innovative group did not receive any winter treatment.

Keywords: *Varroa destructor*; summer brood interruption; Innovative Beekeeping; Honey bee health

E-Mail: **lena.frank@llh.hessen.de**

P6.3 Das Vorhaben »BeeonicFlow« – Bienenwabeninspirierte bionische Flow-Fields für elektrochemische Flussreaktoren

The project »BeeonicFlow« - Honeycomb inspired bionic flow fields for electrochemical flow reactors

Jan Girschik

Fraunhofer-Institut für Umwelt-, Sicherheits- und Energietechnik UMSICHT Osterfelder Straße 3; 46047 Oberhausen

The aim of the project "BeeonicFlow" is the development of honeycomb-inspired bionic flow fields for electrochemical flow reactors, such as fuel cells, water treatment cells, electrolyzers or flow batteries. In those reactors, liquid and/or gaseous reaction fluids have to be distributed homogeneously and with low pressure losses over the electrode surfaces. For this purpose, the fluids are passed through or over the electrodes via so-called flow fields.

The natural nesting of honeybees is an impressive phenomenon of nature, but has not been considered for fluid distribution yet. Unlike the human made parallel honeycomb frames, bees in wild hives build their honeycombs in structures, which are possibly as efficiently designed as their hexagonal honeycomb cells and have correspondingly excellent accessibility and flowability.

In the project "BeeonicFlow", the natural building instinct of bees shall be used to design particularly efficient bionic flow fields. In a first step, research beehives will be prepared in such a way, that the bees are given the greatest possible freedom of design, while at the same time the inlets and outlets of the hives correspond to the fluid inlets and outlets in electrochemical flow reactors.

In a second step, already known flow field designs shall be optimized. For this purpose, the flow fields will be mapped on mid-wall wax plates, which will be placed in the research hives, to see which structural deviations occur during honeycomb construction.

The honeycomb structures created in the research hives will then be reconstructed and adapted for the use in flow reactors. The fluid dynamics will be investigated and optimized by means of dynamic fluid simulation. The most promising flow fields will be transferred into experimental reactors.

Keywords: bionic, bee comb, flow fields, reactor

E-Mail: **jan.girschik@umsicht.fraunhofer.de**

P6.4 Späte Trachten – Fluch oder Segen?

Late flowering bee plants – Curse or blessing?

Ina Heidinger, Ingrid Illies, Stefan Berg

Bayerische Landesanstalt für Weinbau und Gartenbau, Institut für Bienenkunde und Imkerei, An der Steige 15, 97209 Veitshöchheim

Various intercrops such as *Sinapis alba*, *Raphanus sativus* var. *oleiformis* or *Phacelia* spp. are cultivated in agriculture for different purpose. Depending on the extent, intercrops and also late flowering plants (e.g. *Impatiens glandulifera*) can prolong the food supply for honey bees until late autumn. However, late pollen and nectar availability on a larger scale is viewed differently by beekeepers. On the one hand they can save winter food for their colonies and the pollen can be used to breed long-living winter bees. On the other hand, an extensive foraging and breeding activity of the worker bees can lead to a shortened lifespan and thus to a poorer overwintering of the colony. In addition, a prolonged brood activity due to a long-lasting pollen supply also favours the reproduction of *Varroa destructor*.

Here, we investigated the impact of a late pollen and nectar supply on the overwintering ability of honey bee colonies. Therefore, we placed colonies (treated against *V. destructor* and completely fed for overwintering) at different sites with intercrops or *I. glandulifera* and regularly checked them for colony strength, food storage and infestation level of *V. destructor*.

As the pollen analyses showed, our colonies collected pollen of the intercrops, *I. glandulifera* and other plant species. We could not detect conspicuous weight variations indicating a large increase or decrease of the colony weight. Regardless of the testing site, some of the colonies continued to breed until late November. However, this did not lead to critical infestation levels of *V. destructor*. The colonies that were located at a site with *S. alba* in 2019 had a lower overwintering quotient than the other colonies. This difference was not statistically significant and was not confirmed in 2020.

Our results so far show that a late pollen and nectar availability do not necessarily lead to the problems mentioned above. However, it must be considered that 2019 and 2020 were very dry years, which likely had a negative effect on the plants' nectar secretion. In years with appropriate soil moisture and warm late autumns, effects on the overwintering ability of honey bee colonies could be more distinct.

Keywords: honey bees, intercrops, overwintering ability

E-Mail: **ina.heidinger@lwg.bayern.de**

P6.5 Melezitosehonig doppelt Ernten?

Double harvesting of melezitose honey?

Ingrid Illies

Bayerische Landesanstalt für Weinbau und Gartenbau, Institut für Bienenkunde und Imkerei, An der Steige 15, 97209 Veitshöchheim

The trisaccharide melezitose is increasingly found in the honeydew in recent years. Honey containing melezitose crystallizes very quickly and it is difficult to extract the honey out of the combs. Harvested combs that can no longer be centrifuged are often processed by beekeepers with a decapping wax melter. During this process, the honeycomb is exposed to temperatures of up to 90 °C. This honey is often not marketable due to the damage of heat-sensitive enzymes and colonies cannot overwinter on this honey. Therefore, in beekeeping practice this honey is often fed to the colonies and harvested again. The repeated processing of the honey by the bees results in an increase in enzymes.

In 2020, 18 colonies were placed at one apiary. After the honey harvest in July, all food combs were removed from the colonies and the colonies were placed on one brood chamber. All colonies were given a food chamber above a queen excluder and fed with 10 kg of a honey with 17.8 % melezitose and an invertase activity of 47 U/kg. Six colonies each received the honey diluted 1:1 (group 1) and 1:3 (group 2). The control group received a feeding syrup diluted 1:1 (group 3). Feeding was carried out in three portions at intervals of three days starting in the middle of July.

Keywords: honey bees, melezitose, honey harvesting

E-Mail: **ingrid.illies@lwg.bayern.de**

P6.6 Vergleich eines neuen Haltungssystems für Honigbienen (HIIVE) mit der konventionellen Segeberger Beute

Comparison of a new beekeeping system (HIIVE) with the conventional Segeberger hive

Hannah Desczyk, Moritz Mating, Stefanie Ludewig, Ralf Einspanier

Institut für Veterinär-Biochemie, Freie Universität Berlin, Oertzenweg 19b, 14163 Berlin

Das Interesse an der Haltung von Honigbienen hat in den letzten Jahren besonders in städtischen Gebieten stark zugenommen. Themen wie "Bienen-Sterben" und "tiergerechte Bienenhaltung" führten zur Entwicklung alternativer Haltungssysteme. Eines dieser neuen Beutensysteme ist das *HIIVE*-System (www.hiive.eu), welches wir in unserer Studie in Bezug auf die praktische Handhabung, das Wachstum des Volkes und die Bienengesundheit im Vergleich zur etablierten Segeberger Beute überprüft haben. Dazu wurden jeweils drei *HIIVE*- sowie Segeberger Beuten in der Saison 2021 mit *Apis mellifera carnica*-Völkern besetzt und über vier Monate beobachtet und beprobt. Dabei wurden nicht nur der Gewichtszuwachs, das Beutenklima und die Virenlast, sondern auch die Bienenvitalität mittels eines etablierten molekulargenetischen Biomarker-Arrays analysiert und zwischen den beiden Haltungsformen verglichen. Die Gewichtsentwicklung konnte nicht direkt beurteilt werden, da die Veränderungen stark durch die imkerlichen Maßnahmen beeinflusst wurden (Wabenbruch). Innerhalb des Untersuchungszeitraums konnten Unterschiede im Mikroklima gezeigt werden. Neun Gene zeigten signifikante Expressionsänderungen im Verlauf der Zeit. Einige Gene der Immunantwort und des Autophagie-Pathways (ATG10, ATG13, TOLL, PGRP-LC, Apisimin) unterschieden sich zwischen den Systemen. Die Virenbelastung (DWV, SBV) zeigte keinen Unterschied zwischen den Systemen. Das neue *HIIVE*-System war prinzipiell zur Honigbienenhaltung nutzbar, doch ergibt sich aufgrund unserer Erfahrung in der praktischen Handhabung ein Optimierungspotential dieser Beutenkonstruktion. Unsere Studie zeigt auf, dass alternative Haltungssysteme stets mit etablierten Systemen anhand wissenschaftlicher Parameter z. B. unter Einsatz molekularbiologischer Testsysteme auch auf ihre Auswirkung auf die Bienenvitalität verglichen werden und darauf aufbauend baulich angepasst werden können.

Keywords: Alternatives Beutensystem, Vergleich, Biomarker, HIIVE

E-Mail: **moritz.mating@fu-berlin.de**

P6.7 Ermittlung der Fehlerrate von elektronischen Bienenzählern mittels Räuber-Bienen

Evaluation of electronic bee counter precision using robber bees.

Richard Odemer, Anna Wernecke

Julius Kühn-Institut (JKI), Institut für Bienenschutz, Messeweg 11/12, 38104 Braunschweig

Automatic bee counters have been developed and used for various scientific purposes for exactly 100 years. But the majority of publications provide only marginal or no information about the validation of these devices. This means that the published data is of limited value, as the counting precision of the devices used is insufficiently reported.

As part of the research project "Establishing digital indicators of bee vitality in agricultural landscapes", or "VIBee" (www.vibee-project.net), launched in 2020, two prototype counters of the "BeeCheck" are being used in both field and semi-field trials. To validate a device, robber bees were utilized. An empty beehive with a food source attracted the robbers to count them afterwards. The balance of incoming and outgoing bees of this " Robbers Test" must result constantly in zero by the end of the day. Deviations represent the percentage error of the device.

When applied to our flight data, the percentage error for prototype P1 was -7.2% and for prototype P2 -5.7%. Thus, the second generation BeeCheck showed an improvement in precision compared to the old model. However, the variation of the error was larger.

The method is intended to allow validation of different devices, improve precision, and establish scientific comparability. This is especially helpful to evaluate flight data and substantially facilitate progress for new prototypes that are currently being developed.

Keywords: electronic bee counter, honey bees, flight activity, robbers test, Bee Check

E-Mail: **richard.odemer@julius-kuehn.de**

P6.8 Projekt „Insektenschonendes Mähen“: Eine derzeit laufende Evaluierung insektenschädigender Effekte durch verschiedene Mähtechniken

Project „Insect-Friendly Meadow Mowing”: An ongoing evaluation of insect-damaging effects by different mowing techniques

Dirk-Louis P. Schorkopf[1], Linde Morawetz[1], Michael Fritscher [2], Peter Frühwirth[2], Franz Handler[3], Roman Braun[4], Johannes Hintringer[4], Johann Neumayer[5], Bärbel Pachinger[6], Martin Schwarz[7], Josef Mayr[1]

[1] AGES - Austrian Agency for Health and Food Safety, Department for Apiculture and Bee Protection, Spargelfeldstraße 191, 1220 Vienna, Austria

[2] LK OÖ – The Upper Austrian Chamber of Agriculture, Auf der Gugl 3, 4021 Linz, Austria

[3] HBLFA Francisco Josephinum, Rottenhauser Straße 1, 3250 Wieselburg, Austria

[4] Maschinenring Oberösterreich, Auf der Gugl 3, 4021 Linz, Austria

[5] Obergrubstrasse 18, 5161 Elixhausen, Austria

[6] University of Natural Resources and Life Sciences, Vienna, Department of Integrative Biology and Biodiversity Research, Gregor-Mendel-Straße 33, 1180 Vienna, Austria

[7] Eben 21, 4202 Kirchschlag bei Linz, Austria

A general decrease in insect species and numbers has been increasingly observed worldwide. Here, we mainly present the methods of an ongoing study that focuses on damages caused by different mowing techniques on insects, including bees and other insect pollinators. Importantly, we chose “real-world” settings, collecting data from an agriculturally representative meadow in Austria that has been used for silage production for many years and compare it with data from extensively managed areas. Mowing is executed at exactly the same time and frequency as it would otherwise have been done without our experimental interventions. Indeed, one of the strengths of the ongoing study is the inclusion of multiple stakeholders with people from different backgrounds. We intend to contribute towards the development of standardized procedures, which allow evaluating differences between mowing techniques. The latter e.g. allows us to determine whether technical adaptations intending to reduce insect damage, indeed result in statistically significant mitigation effects. All three mowing techniques and two insect deterrent adaptations are studied in alternate and changing order during both mornings and afternoons of each experimental day. Observations include repetitions in the spring, summer and autumn during consecutive years. Hitherto, we checked more than 7524 insects and spiders (body size ≥ 3mm) from sessions either right prior or after mowing. The latter included observations for insects that were found on the ground, on the cut grass or inside the nets immediately installed over the observation areas. The hitherto collected data indicates that our approach, despite showing significant differences between different seasons and localities, will allow studies to reliably determine the damaging probability of, and significant differences between different mowing techniques. The project is funded through DaFNE (grant nr. 101562).

Keywords: mowing, arthropods, mortality, agriculture, meadow silage

E-Mail: **dirk-louis.schorkopf@ages.at**

P6.9 Sensor-basierte Schwarmvorhersage

Sensor-based Prediction of Swarming Events

Diren Senger

Uni Bremen, FB3, Kognitive Neuroinformatik, Cartesium, 4. OG, Enrique-Schmidt-Straße 5, 28359 Bremen

Die Schwarmzeit ist für viele Imkernde sehr arbeitsintensiv, da Bienenstände regelmäßig kontrolliert werden müssen. Ein unentdeckter Schwarm bedeutet einen Verlust von Bienen und Honigernte. Wir nutzen ein DIY-Sensorkit mit Temperatursensoren, einem Luftfeuchtigkeits- und Drucksensor und einer Waage um das Mikroklima im Bienenstock und das Gewicht des Bienenvolkes zu überwachen. Basierend auf den Sensordaten entwickeln wir Algorithmen zur Vorhersage von Schwärmen.
In unserem aktuellen Datensatz sind 11 Zeitreihen mit Sensordaten aus Bienenvölkern einige Tage vor einem Schwarmevent und 56 Zeitreihen aus Bienenvölkern, die in einem vergleichbarem Zeitraum nicht geschwärmt sind. Wir nutzen Dynamische Zeitnormierung und einen k-means Algorithmus, um den Unterschied einer Zeitreihe zu den beiden Gruppen, schwärmende Völker und nicht schwärmende Völker, zu berechnen. Dazu haben wir den Datensatz in einen Trainingsdatensatz, einen Validierungsdatensatz und einen Testdatensatz geteilt und probieren unterschiedliche Parametereinstellungen und Zeiträume aus.

Für den Zeitraum 1-2 Tage vor dem Schwarmabgang erreichen wir eine Vorhersagegenauigkeit von ca. 81%. Die Parameterwerte sind stark von den Zeitreihen, bzw. den gewählten Zeiträumen abhängig. In unseren univariaten Durchläufen ist aufgefallen, dass der Luftdruck ein gutes Vorhersagekriterium ist.
Deswegen planen wir einen stärkeren Einbezug von Daten des Deutschen Wetterdienstes. Außerdem möchten wir den Algorithmus in eine digitale Stockkarten-App einbinden. (1531 Zeichen)

Keywords: Schwarm, Vorhersage, Sensoren, Zeitreihen / swarming, prediction, sensors, time series

E-Mail: **diren@uni-bremen.de**

P6.10 www.honiguntersuchung.de - die Honiganalyse geht online

www.honiguntersuchung.de - honey analysis goes online

Christian Wenzel[1], Norman Tanner[2], Lisa Hirsch[3], Eduardo G. Hernandez[3], Desh Bandhu[3], Saskia Wöhl[4], Birgit Lichtenberg-Kraag[2]

[1] Digital Bee Services UG, Luisenhof 5, D-15306 Falkenhagen (Mark)

[2] Länderinstitut für Bienenkunde Hohen Neuendorf e.V., Friedrich-Engels-Str. 32, D-16540 Hohen Neuendorf

[3] Venture Labs GmbH, Leopoldstr. 44, D-40211 Düsseldorf

[4] DLR Westerwald-Osteifel, Fachzentrum für Bienen und Imkerei, Mayen

Honey that is sold has to comply legal regulations for quality and labelling. Therefore, many beekeepers take the opportunity to get their honey analyzed in a laboratory. Before the honey is sent to the honey lab, many questions arise as costs, type of analysis, size of the honey sample, safe delivery, processing time.

Therefore, we started a project to make the entire area of honey analysis digital, simpler, and therefore more efficient and transparent for beekeepers, but also less time and money consuming for the analyzing institute. The website “www.honiguntersuchung.de” was created by Digital Bee Services (DBS) supported by Venture Labs GmbH in cooperation with the LIB. The DBS is a non-profit organization sponsoring the field of beekeeping with digital products. The LIB is a qualified partner for honey analysis, gaining more than 20 years’ experience with honey analysis databases.

The website comprises two applications: the honey analysis order, enabling a user-friendly and digitized online order, and the laboratory part, were all analysis data are documented. The beekeeper is guided step by step throughout the ordering complex. The arrival of the honey in the institute and the final report are automatically confirmed by email. Registration allows the beekeeper to check individual parameters before the analysis is completed (e.g. water content, invertase activity) and to download the final report from his account.

Since September 2021, “www.honiguntersuchung.de” is available to LIB customers and is well accepted by the beekeepers. From the beginning, about 50 % of the honey samples have reached the LIB using the new web tool. In January, the DLR Fachzentrum für Bienen und Imkerei (Mayen) joined the project and their service is also available on the website. The integration of further institutes is under discussion/planning. Furthermore, the website can be adapted and expanded in cooperation with the testing institute to meet their requirements.

Keywords: website, digitalization, honey analysis, online

E-Mail: **lichtenberg.kraag@hu-berlin.de**

P6.11 RF-Dosimetrie von Honigbienen (*Apis mellifera*) bei Exposition mit elektromagnetischen Feldern im Frequenzbereich von 1-80 GHz

RF-dosimetry of honey bees (*Apis mellifera*) exposed to electromagnetic fields in the frequency range of 1-80 GHz

Richard Überbacher, Stefan Cecil, Gernot Schmid

Seibersdorf Laboratories, LE/EMC and Optics, Forschungszentrum, A-2444 Seibersdorf, Österreich

In the year 2006/07, an alarming decrease of domesticated honey bees (*Apis mellifera*) was observed by beekeepers all over the globe. This phenomenon, summarized as colony collapse disorder (CCD), is still up today not fully resolved by scientists. It seems that it is a (possible) complex mix of various factors, where pesticides based on Neonicotinoids play a central role. But also the impact of various other factors like electromagnetic fields (EMF) are up today under discussion. Recently, also the German Federal Office for Radiation Protection (BfS) has put focus on possible impact of EMF on fauna and flora. The present work investigates the absorption of microwaves inside the body of bees in the frequency range from 1 to 80 GHz. A 3D-CAD model of a bee with a high detailed brain (Virtual Honeybee-Brain Project, FU Berlin, Department of Biology) was used. Due to the lack of dielectric material parameters, the thorax and the abdomen tissue were measured (85070E Diel. Probe Kit, Agilent). The FDTD-method (Semcad-X 14.8, SPEAG) was used for the numerical simulation. The investigations examined plane wave exposure from 3 directions (front, side and top) and two polarizations (TE, TM). Maxima of the absorbed SAR_{wb} (according to ICNIRP 2020 gen.pub.) were found at8.4 GHz with 7.01 W/kg for side exposure position and at 17.6 GHz with 4.93 W/kg for the frontal one. The head of the bee absorbs at 8.4 GHz 4.5 % of the incoming energy, while at 17.6 GHz, the value increases to 23.4 % due to the shorter wavelength. The implemented brain from the Virtual Bee-Brain-Project has not shown any particularities over the frequency range. However, the (in a technical sense) tiny part between head/thorax/abdomen with its small diameter as electrical connection leads to 4x and 6x higher values compared to the mean, respectively. Under the anatomical aspect that main blood vessels and nerve cords have to pass, these parts may be a possible bottleneck through local heating effects that can severely harm the bee.

Keywords: Electromagnetic fields, EMF, RF exposure, SAR absorption, dosimetry

E-Mail: **richard.ueberbacher@seibersdorf-laboratories.at**

Autorenverzeichnis

H

I

J

K

L

M

Danksagung

Wir bedanken uns herzlich für die finanzielle Unterstützung bei

Bayer AG
Research & Development, Crop Science
Regulatory Scientific Affairs
Alfred-Nobel-Str. 50
40789 Monheim, Germany

Carl Fritz Imkertechnik GmbH & Co. KG
Immenweg 1
DE-97638 Mellrichstadt

Deutscher Berufs- und Erwerbsimker Bund e.V. (DBIB)
Asternweg 11
97724 Burglauer

Deutscher Imkerbund e.V. (DIB)
Villiper Hauptstraße 3
53343 Wachtberg

RIFCON GmbH
Goldbeckstraße 13
69493 Hirschberg an der Bergstraße

Landesverband Badischer Imker e.V.
Untertal 13
77736 Zell a.H. – Oberentersbach

Wilfried Müller Kommanditgesellschaft
Lindener Weg 12
29581 Gerdau

Impressum

Landesanstalt für Bienenkunde (730)

Erna-Hruschka-Weg 6

70599 Stuttgart

Tel. +49 (0)711 459 - 22659

https://bienenkunde.uni-hohenheim.de/

Fachgebiet für Populationsgenomik bei Nutztieren (460h)

Garbenstr. 17

70599 Stuttgart

Tel. +49 (0)711 459 23581

https://popgenomik.uni-hohenheim.de/