The 4th N.Z. Honey Bee Research Symposium

June 28th 2023, Energy Events Centre, Rotorua

Schedule & Abstracts

Schedule

Session 1

Moderator: Phil Lester, *Victoria University*

8:45	Welcome	Phil Lester *Victoria University*
8:55	Greetings from ApiNZ	Karin Kos, *CEO* *Apiculture NZ*
9:00	Retaining Hive Genetics	Avner Cain *Freebees Honey*
9:15	The bee plant finder tool	Angus McPherson *Trees for Bees Trust*
9:30	Are bees truly disappearing from the globe?	Ben Phiri *Ministry for Primary Industries*
9:45	Recognition of an odour pattern from *Paenibacillus larvae* spores by trained detection dogs	Neroli Thomson *Massey University*
10:00	Effects of abscisic acid dietary supplementation on pathogen tolerance in honeybees	Nicolas Szawarski *Universidad Nacional de Mar del Plata*

10:15am -10:35am Break, 20 minutes

Session 2

Moderator: Evan Brenton-Rule, Ministry for Primary Industries

10:35	The MPI Honey Bee Collection: now welcoming applications from researchers	Hayley Pragert & Richard Hall *Ministry for Primary Industries*
10:40	Application of FTIR and raman spectroscopy in differentiating NZ honey varieties	Kat Holt *Massey University*
10:55	Determination of various chemical and physical properties in Chatham Islands honey	Simon Winship *University of Waikato*
11:10	Decreased abundance of *Lasioglossum* spp. bees correlated with increased pesticide use intensity across horticultural landscape gradients	Felicia Kueh Tai *Plant and Food Research*
11:25	Life in the leaves: is the mānuka leaf surface microbiome a potential driver of mānuka honey quality?	Anya Noble *University of Waikato*
11:40	Can microbes alter honeybee foraging decisions?	Manpreet Dhami *Manaaki Whenua*
11:55	Assessing foraging activity: A non-invasive approach to monitoring behavioural responses of honey bee colonies	Epernay Carta *Plant and Food Research*

12:10pm - 1:10pm Lunch, 1 hour

Session 3

Moderator: Claire McDonald, Ministry for Primary Industries

1:10	A more coordinated approach: Research prioritisation for the apiculture sector	Martin Lass *ApiNZ Science Panel*
1:25	Using dsRNA for varroa mite control in beehives	Rose McGruddy *Victoria University*
1:40	Varroa resistance breeding in NZ	Rae Butler *Bee Smart Breeding*
1:55	Testing effects of DWV-targeting double-stranded RNA on viral loads across different body parts of individual adult bees	Zoe Smeele *Victoria University*
2:10	Using lithium chloride to control *Varroa destructor* in New Zealand honey bee colonies	Felicia Kueh Tai *Plant and Food Research*
2:25	Safeguarding Australia's bees: The quest for the best Varroa IPM solution	Fazila Yousuf *Applied BioSciences*
2:40	Early detection of Varroa through environmental DNA hive surveillance	John Roberts *CSIRO, Australia*

2:55pm - 3:15pm Break, 20 minutes

Session 4

Moderator: John Mackay, dnature

3:15	Beekeeping outside the box: Smart Ideas programme update	Ashley Mortensen *Plant and Food Research*
3:30	Protecting honey bees from varroa mites with microbial-secreted compounds	Alex Maan *Lincoln University*
3:45	Controlled environment agriculture (CEA): Indoor beekeeping	Charles Watene *Plant and Food Research*
4:00	Metal analysis: Insight into honey origin and bee health	Megan Grainger *University of Waikato*
4:15	A novel neutralising antibody therapy reduces deformed wing virus loads in the Western honey bee (*Apis mellifera*)	Neil MacMillian *Victoria University*
4:30	Effects of toxic heavy metals on European honey bee (*Apis mellifera*) neuronal cells	Brittany Jaine *University of Waikato*
4:45	Argentine ants increase deformed wing virus loads in honey bees	Antoine Felden *Victoria University*
5:00	*Industry insights, facilitated by John Mackay*	All
5:15	Student Awards & Closing	Evan Brenton-Rule *Ministry for Primary Industries*

Session 1

Retaining hive genetics

Avner Cain

Freebees Honey

The practice of re-queening is typically done to prevent swarming and ensure the hive’s productivity. While re-queening is widely accepted, it comes with a downside: every time a hive is re-queened, its unique genetics are lost and replaced with new genetic material. The hive's potential to pass on its unique genes to the next generation is eliminated. As a result, many good and promising hive genetics have been lost over time. While replacement and disposal of genetics in hives that show obvious signs of a non-promising future is encouraged, genetics of hives that do not show these signs could be retained. The bees have biological knowledge that we don’t have access to, and it could be that they will be able to manage their own genetics better than we do. By allowing every good hive to have a daughter hive, with a queen of their own choosing, we can explore a more natural genetic selection that over time may lead to a more resilient stock. The speaker presents an alternative method which allows the benefits of a young queen, while retaining the hive’s genetics. This method is proven to be as productive as any re-queening method that uses queen cells. Facing a worldwide bee crisis, this alternative concept is worth scientific research.

The bee plant finder tool

Angus McPherson[1], Linda Newstrom-Lloyd[1.2], David Glenny[2]

[1]Trees for Bees Research Trust, New Zealand

[2]Manaaki Whenua Landcare Research, Lincoln, PO Box 69040, New Zealand

The need for increased planting of a wide range of trees and shrubs has never been higher. Riparian protection, land stabilisation, biodiversity loss, livestock welfare, and adverse weather event damage are all compelling reasons to plant. This is reflected in current programmes supporting planting on farms, including climate change (1 Billion Trees), land stabilisation (Erosion Control Funding Programme, Hill Country Erosion Programme), and water quality (Riparian Fencing and Waterways Funding Initiative, sector and regional programmes). Planting for bees is also necessary to provide plentiful pollen and nectar resources for improved bee health. We have shown that planting bee forage can be incorporated into the above planting types in our 34 demonstration farms. To promote planting for bees we developed a user-friendly online tool, the Bee Plant Finder. It is designed to help you select great bee forage plants to meet different purposes with multi-function plants on farms. The tool contains 222 plants, their flowering times, plant features and site conditions.

Are bees truly disappearing from the globe?

Ben Phiri[1], Damien Fèvre[2,3], Arata Hidano[4]

[1]Ministry for Primary Industries, Upper Hutt; [2]University of Otago, Dunedin; [3]AbacusBio Ltd, Dunedin; [4]London School of Hygiene & Tropical Medicine, London

Headlines regarding honey bee colony losses give an impression of large-scale global decline of the bee population that endangers beekeeping worldwide. We examined long-term trends temporal and geographical beekeeping trends to fact-check the headlines. Our analysis was based on the data collected by the Food and Agriculture Organization of the United Nations from 1961 to 2017. We tracked three beekeeping variables: colonies of managed honey bees, honey production and beeswax production. All these three variables increased during the study period showed at the global level. The number of managed honey bee colonies increased 85.0%, honey production 181.0% and beeswax production 116.0%. The amount of honey produced per colony increased by 45.0%, signifying improvements in the efficiency of producing honey. However, we found that the human population grew faster than that of honey bees. In 1961 there were 13.6 colonies per 1000 human population, which dropped to 10.9 colonies per 1000 population in 2017.

Recognition of an odour pattern from *Paenibacillus larvae* spores by trained detection dogs

Neroli Thomson[1], Michelle Taylor[2], Pete Gifford[3], Sarah Cross[2], James P Sainsbury[2]

[1]School of Veterinary Science, Massey University, Palmerston North, New Zealand
[2]Bee Biology & Productivity Team, The New Zealand Institute for Plant and Food Research Limited, New Zealand
[3]K9 Search Medical Detection, Beaconsfield, New Zealand

Spores of the bacteria *Paenibacillus larvae* play a central role in the transmission of American Foulbrood (AFB), a major disease of honey bee (*Apis mellifera*) colonies. This study investigated whether trained detection dogs could recognise an odour pattern from *P. larvae* spore samples. Given that spores are metabolically inactive, it was unknown whether they would produce enough volatile organic compounds to form an odour pattern that could be detected by dogs. Three dogs were trained to identify laboratory-produced *P. larvae* spore samples and were systematically desensitized to non-target odours with a series of control samples. Two of the dogs successfully completed training and were then tested by having each dog perform six searches in an odour-detection carousel with the trainer blinded to the location of the spore samples. In this high-stakes forced-choice test, each dog was asked to identify one new spore sample, containing approximately 93–265 million *P. larvae* spores, from seven control samples. Both dogs correctly identified the spore sample every time (100% success rate); the probability of this result occurring by chance was $p = 0.0000038$. Therefore, this study demonstrates proof-of-concept that dogs can recognise an odour pattern from bacterial spore samples, in this case, *P. larvae*.

Effects of abscisic acid dietary supplementation on pathogen tolerance in honeybees

Nicolas Szawarski[1,2]; Enzo Domínguez[2]; María Paz Moline[2]; Martín Eguaras[2]; Matías Maggi[2]

[1]Bee Biology & Productivity Team, The New Zealand Institute for Plant and Food Research Limited
[2]Centro de Investigación en Abejas Sociales (CIAS) (IIPROSAM-CONICET), Universidad Nacional de Mar del Plata (UNMdP), Argentina

Among the major drivers of bee decline is agriculture expansion and intensification, which is often associated with increased pesticide input and loss of natural and semi-natural habitats. We monitored solitary ground-nesting bees (*Lasioglossum* spp. and *Leioproctus paahaumaa*) from eight avocado orchards across a gradient of horticultural intensities. We then tested the association(s) between bee abundance and pesticide use intensity, surrounding land cover, soil hardness, and slope. Factors that were negatively associated with the abundance of one or both native bee species were percent surrounding grassland, soil hardness, and pesticide use intensity. The slope of the surrounding lands was positively associated with the abundance of one or both native bee species.

The MPI Honey Bee Collection: now welcoming applications from researchers

Hayley Pragert and Richard Hall
Ministry for Primary Industries

Honey bee samples collected as part of a longitudinal study of honey bee health are now available for researchers to access. The MPI Honey Bee Collection was amassed during the MPI Bee Pathogen Programme and the MPI ApiWellbeing Project, which ran from 2016 to 2021. Many beekeepers from around New Zealand gave access to their apiaries for the collection of samples and data. The collection contains over 132,000 bees from 2,595 hive inspections throughout the country, as well as additional *Paenibacillus larvae* cultures. Metadata is also available, but the collection is anonymised, and any identifying information is withheld. The collection provides an important biosecurity resource, and could provide for other types of meaningful scientific research that benefit apiculture in New Zealand. There is now an application process for interested researchers. We also recognise the significant contribution that participant beekeepers made in establishing this collection.

Application of FTIR and raman spectroscopy in differentiating NZ honey varieties

Katherine A Holt[1], M Waterland[2], J Gulasekharam[2], Michel Nieuwoudt[3], C Tollemache[3], L Mowbray[2]
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Currently, the only standard for classifying NZ (non-mānuka) honeys is informal and uses pollen profiles and physical and organoleptic properties. Spectroscopic techniques have shown promise for classifying monofloral honeys in overseas studies but have limited application in Aotearoa. We have analysed >80 samples of monofloral NZ honeys from eight different varieties (mānuka, rewarewa, kāmahi, pōhutukawa, rātā, honeydew, clover and tāwari) with both Fourier Transform Infrared (FTIR) and Raman spectroscopy, to determine if either method offers an alternative avenue for classification of New Zealand varieties. Mānuka, rewarewa, honeydew are clearly differentiated by both FTIR and Raman, however Raman spectroscopy performs better in differentiating the other varieties, potentially offering a better avenue as a classification method.

Determination of various chemical and physical properties in Chatham Islands honey

Simon Winship
School of Science, University of Waikato

Honey is predominantly sugar and water. Enzymes, minerals, and bioactive compounds such as phenolics are also present in small quantities. These components give each variety a unique composition, often representative of its floral origin and geographic location. Chatham Island (Rēkohu/Wharekauri) and neighbouring Pitt Island (Rangiauria/Rangiaotea), collectively known as the Chatham Islands, are home to native plants which are not found anywhere else in the world. This provides an untapped resource for unique honey types, which may have important chemical and bioactive properties yet to be discovered. This investigation will determine the various properties of honey produced from the Chatham Islands, including sugars, phenolic compounds, bioactivity, residues detection (tutin and glyphosate), trace elements, quality parameters, pollen, and physicochemical properties such as colour, moisture, pH and conductivity. This research aims to profile Chatham Islands honey to support the growing apiculture industry on the islands.

Decreased abundance of *Lasioglossum* spp. bees correlated with increased pesticide use intensity across horticultural landscape gradients

Felicia Kueh Tai[1,2], Jacqueline Beggs[2], Ashley N Mortensen[1], David E Pattemore[1,2]

[1]Productive Biodiversity & Pollination, The New Zealand Institute for Plant and Food Research Ltd, Hamilton, NZ
[2]School of Biological Sciences, University of Auckland, Auckland, New Zealand

Among the major drivers of bee decline is agriculture expansion and intensification, which is often associated with increased pesticide input and loss of natural and semi-natural habitats. We monitored solitary ground-nesting bees (*Lasioglossum* spp. and *Leioproctus paahaumaa*) from eight avocado orchards across a gradient of horticultural intensities. We then tested the association(s) between bee abundance and pesticide use intensity, surrounding land cover, soil hardness, and slope. Factors that were negatively associated with the abundance of one or both native bee species were percent surrounding grassland, soil hardness, and pesticide use intensity. The slope of the surrounding lands was positively associated with the abundance of one or both native bee species.

Life in the leaves: is the mānuka leaf surface microbiome a potential driver of mānuka honey quality?

Anya S Noble, Michael J Clearwater, Megan Grainger, Charles K Lee

School of Science, University of Waikato, Hamilton, New Zealand

A growing body of research demonstrates the importance of leaf-dwelling microorganisms on plant physiology. However, we know little about the microorganisms that associate with our New Zealand honey sources, such as mānuka. The first study of the mānuka leaf surface identified a group of bacteria that may be functionally important for the host. We now investigate whether these microorganisms are shared among other plant species and why they colonise mānuka leaves. Our findings reveal many of the microorganisms on the mānuka leaf surface are mānuka-specific and recruited by the host. These mānuka-specific microorganisms provide a foundation for future studies to investigate the relationship between the leaf surface microbiome and desirable traits of our honey sources, such as nectar DHA.

Can microbes alter honeybee foraging decisions?

Manpreet K Dhami[1], Robert Brown[1], Mateus Detoni[1], Marion Donald[1], Patrick Garvey[1], Amelia Gibbs[1], David E Pattemore[2], Connor Watson[1]

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Honeybee foraging decisions depend on a range of important floral cues, such as flower color, smell, and nutritional value of nectar and pollen. Certain floral cues can be altered by microbes residing in these flowers, including smell and nectar chemistry. We evaluate the role of microbes in modifying floral cues in field collected mānuka flowers, and via a series of controlled experiments assess whether honeybees exhibit differential preference for 6 combinations of microbe-inoculated synthetic nectars. We find that compounds of microbial origin can be detected in field-collected mānuka nectar. Coupled with multi-choice behaviour assays, we show that honeybee exhibit both preference and deterrent foraging behaviours against microbe-inoculated nectars. Microbes are commonly associated with floral resources, especially nectar, where they consume sugars and amino acids. We reveal an important role of these microbes in mediating honeybee foraging decisions.

Assessing foraging activity: A non-invasive approach to monitoring behavioural responses of honey bee colonies

Epernay Carta, James P Sainsbury, Ashley N Mortensen

Bee Biology & Productivity Team, The New Zealand Institute for Plant and Food Research Limited, Hamilton, NZ

Foraging behaviour of honey bees, *Apis mellifera*, is known to be influenced by various factors including weather, health status and colony strength. Standardised assessments of foraging activity offer a non-invasive approach to monitoring colony health and strength, providing an efficient alternative to traditional methods that can disrupt colony function. By recording the number of worker bees (those carrying pollen and those without are both counted simultaneously) returning to the hive through four one-minute observations, the foraging profile of each colony can be tracked through almost any circumstance. These assessments have served as one of our default response variables for numerous treatments because of their simple yet informative nature. Foraging activity coarsely correlates with colony strength and health. It provides additional insights into physiological colony changes in response to the environmental conditions and management practices, also highlighting persistent patterns of response between colonies.

A more coordinated approach: Research prioritisation for the apiculture sector

Martin Lass
ApiNZ Science Panel

To ensure the long-term success of the apiculture sector, a unified research and development strategy is crucial. The development of this strategy should facilitate collaboration between the sector and research providers, enabling them to jointly work on projects aimed at achieving the necessary outcomes for success. This presentation will address the current progress and future plans for developing the proposed strategy. It will discuss the creation of a varroa-focused strategy currently under development, as well as a future comprehensive research strategy that encompasses bee health, pollination, bee products, and other related areas. In addition, the presentation will explore the most effective means by which the industry can communicate these priorities to interested research providers, thereby ensuring that the sector's present and future requirements are taken into consideration.

Using dsRNA for varroa mite control in beehives

Rose McGruddy, James Baty[1], Mariana Bulgarella[1], Antoine Felden[1], John Haywood[1], Brian Manley[2], Jim Masucci[2], Zoe Smeele & Phil Lester[1],
Victoria University of Wellington, School of Biological Sciences, PO Box 600, Wellington, New Zealand

Varroa has become an increasingly problematic issue and is now estimated to be the leading cause of colony loss in New Zealand. Varroa control methods currently rely on synthetic or organic miticides. These miticides vary in efficacy and can have negative impacts. We have been investigating gene silencing or RNA interference (RNAi) as a potential next-generation control method for pests like Varroa. In laboratory settings, our research has demonstrated RNAi's effectiveness in preventing Varroa reproduction. We have since progressed to field trials to compare RNAi's effectiveness in mite control. The field trials demonstrated that RNAi has the capacity to reduce mite levels to subeconomic thresholds, although additional work is needed to determine how application rates will need to vary with hive size and mite abundance. This study underscores the potential of RNAi as a species-specific mite management alternative.

Varroa resistance breeding in NZ

Rae Butler[1] and Linda Newstrom-Lloyd[2,3]
[1]Bee Smart Breeding, New Zealand
[2]Trees for Bees Research Trust, New Zealand
[3]Manaaki Whenua Landcare Research, Lincoln, PO Box 69040, New Zealand

This project focuses on Varroa Sensitive Hygiene (VSH) testing and breeding, based on six years of practice and a thorough literature review. Informed by the experiences of successful overseas projects in VSH breeding, we are adapting methods for our NZ conditions. We propose a framework to expedite the adoption of VSH trait selection and breeding across New Zealand, benefiting beekeepers, queen producers, and breeders. Our Varroa Resistance Breeding Project aims to achieve the following immediate goals: 1) Field testing VSH expression in commercial colonies in Canterbury; 2) Developing a protocol for testing VSH in New Zealand conditions; 3) Organizing a workshop on VSH and establishing a NZ Queen Bee Breeding Association. Discovering or integrating highly rated VSH bee stock into commercial operations offers an accessible approach for beekeepers to enhance their stock and reduce reliance on miticide treatments.

Testing effects of DWV-targeting double-stranded RNA on viral loads across different body parts of individual adult bees

Zoe E Smeele, James W Baty, Phil J Lester
School of Biological Sciences, Victoria University of Wellington, PO Box 600, Wellington, New Zealand

Deformed wing virus (DWV) represents a severe threat to honey bee health, especially in the presence of *Varroa destructor,* and has been associated with high over-winter colony loss. The application of pathogen-specific double-stranded RNA (dsRNA) molecules has shown promising results for controlling honey bee pathogens and parasites. I assessed the effects of DWV-specific dsRNA on DWV loads in gut, abdomen, and head samples of individual adult bees to test if treatment with DWV-dsRNA has different effects on viral loads across the bee body. Overall, DWV loads appeared higher in gut samples compared to heads and results may suggest variability in DWV knockdown between individuals. Results from this experiment offer important considerations for evaluation and development of effective next-generation pathogen-specific control strategies for honey bee viruses.

Using lithium chloride to control *Varroa destructor* in New Zealand honey bee colonies

Felicia Kueh Tai, Mateusz Jochym, Jon Choi, John Mitchell, Michelle A Taylor
The New Zealand Institute for Plant and Food Research Limited, Hamilton, New Zealand

Our ability to control *Varroa destructor* in European honey bees (*Apis mellifera*) is hampered by the majority of the mite's lifecycle occurring within the capped brood cells. This limits the window of exposure to chemical controls to ~4 days when the mites emerge and before they enter another cell. To combat this effectively, a chemical must be administered using a slow-release delivery matrix. Lithium salts are the first varroacide to be identified in the last three decades that are lethal to *V. destructor* in the lab and show promise in the field. However, its current application period in sucrose solution has limitations because sucrose solution ferments, bees consume it, and it can be stored as honey. We will discuss the path to transfer this efficacy from lab to field, whereby a slow-release delivery matrix is being developed to counter these inefficiencies.

Safeguarding Australia's bees: The quest for the best Varroa IPM solution

Fazila Yousuf and Mary Whitehouse
Applied BioSciences, 205B Culloden Road, Macquarie University NSW 2109

Despite detection of the Varroa mite in New South Wales, Australia maintains its Varroa-free status due to successful eradication efforts. In anticipation of potential Varroa establishment, our project systematically identifies and develops non-chemical control methods suited for Australian conditions. Drawing on global experiences, we prepare for a swift response with emerging Varroa control techniques if required. To assist the efficacy of these methods, we advocate Integrated Pest Management (IPM) as the cornerstone strategy against Varroa. IPM is a well-established sustainable pest control approach enabling techniques to be combined and tailored for different parts of the Australian beekeeping industry. Our objective is a comprehensive list of emerging Varroa detection and control methods, suitable for integration into an IPM system within the Australian beekeeping industry's structural framework. This preparedness underlines an industry supported, IPM response, ready for deployment if Varroa becomes endemic, fortifying the resilience and future of Australian apiculture

Early detection of Varroa through environmental DNA hive surveillance

John Roberts[1], Florence Bravo[1], Francisco Encinas-Viso[1], Richard Hall[2], Frank Lindsay[3], Francesco Martoni[4], Natale Snape[5], Alejandro Trujillo-Gonzalez[6]

[1] Commonwealth Scientific and Industrial Research Organisation (CSIRO), Canberra, Australia; [2] Ministry for Primary Industries, Wellington, New Zealand; [3] Wellington Beekeepers Association; [4] Agriculture Victoria, Australia; [5] Tropwater, James Cook University, Townsville, Australia; [6] EcoDNA, University of Canberra, Australia

Surveillance for Varroa using conventional methods (e.g., alcohol washing, sticky boards) is great for monitoring mite levels but lacks the sensitivity for detecting early mite infestations in hives. Detecting Varroa DNA from the hive environment (e.g., honey, pollen, debris) is a potentially more sensitive approach and could be a valuable biosecurity tool in Australia's effort to eradicate Varroa. We investigated this approach in New Zealand by introducing Varroa-free bee colonies from the Chatham Islands to a Wellington apiary and monitored the course of mite invasion through forensic swabs of hive entrances and brood comb. We also examined Varroa DNA detection in honey and hive swabs from additional hives with a range of mite infestation levels. Our results indicate that Varroa DNA detection from hive environmental samples can identify low mite infestations and with further optimisation could assist with area-wide surveillance in Australia.

Beekeeping outside the box: Smart Ideas programme update

Ashley N Mortensen[1], Juliana Posada-Rangel[2], James P Sainsbury[1]
[1]Bee Biology & Productivity Team, The New Zealand Institute for Plant and Food Research Limited, Hamilton, NZ
[2]Entomology department, Texas A&M University, College Station Texas, USA

Traditional beekeeping practices rely on mature colonies with a large workforce to maximise honey production, and it has been assumed that mature colonies are also ideal pollinators. However, large colonies require many house bees to tend to brood, thermoregulate, and remove debris. Newly established swarm colonies have unique demands for nectar and pollen to support rapid construction of wax combs and the initiation of brood production. Moreover, swarm colonies have reduced brood rearing and thermoregulatory requirements compart to mature colonies. We are investigating the foraging patterns and physiological drivers of swarm colonies as potential application as optimised, '*bee-spoke'*, pollination units. Progress thus far includes systematic testing of hive architecture to support newly established swarm colonies, evaluation of swarm-colony health, and assessments of foraging activity post establishment. We will share our learnings to date, discuss trials presently underway, and outline plans for the final year of the programme.

Protecting honey bees from varroa mites with microbial-secreted compounds.

Alex Maan[1], Rae Butler[2], Rudi Marquez-Mazlin[3], Bevan Weir[4], Bob Brown[4], Travis Glare[1], Artemio Mendoza-Mendoza[1]
[1]Wine, Food and Molecular Biosciences Department. Lincoln University, New Zealand
[2]Bee Smart Breeding, New Zealand
[3]School of Physical & Chemical Sciences, University of Canterbury, New Zealand
[4]Manaaki Whenua – Landcare Research, New Zealand

Biological control has of varroa mites has been trialled using varroa-virulent microbes but demonstrated limited success under the microbe-hostile conditions of the hive. We sought to isolate and characterise microbial secretions with potential acaricidal properties from New Zealand sourced fungi with the aim they can be used to develop biologically derived varroa mite treatments. Using bioassays, we have identified a promising candidate with comparable efficacy to currently used miticides, and are now investigating controlled delivery systems for use in-hive

Controlled environment agriculture (CEA): Indoor beekeeping

Charles Watene, James P Sainsbury, Anya Noble, Epernay Carter, Nicolas Szawarski, Mateusz Jochym, Melissa A Broussard, Ashley N Mortensen
Productive Biodiversity & Pollination, The New Zealand Institute for Plant and Food Research Ltd, Hamilton, NZ

With changing weather patterns, controlled environment agriculture (CEA) is being researched for sustainable production of crops. Future goals for CEA production of various crops, including those requiring pollination, are ambitious, as are their pollination needs in this hyper-modified environment. We assessed productivity and health of honey bees (*Apis mellifera*) in a CEA system compared with the outdoors to understand how honey bees respond to CEA conditions. We also explored strategies to support effective use of honey bees in CEA. We found that foraging activity was greatly reduced in the CEA system compared with outside. Moreover, colonies reduced in total weight and population in CEA in contrast to typically increasing in both measures while outside. However, the degree of change in weight was much more pronounced than that of the population size. Notably, a concurrent pollination assessment indicated sufficient pollination potential of honey bees in CEA despite the reduced foraging activity.

Metal analysis: Insight into honey origin and bee health

Megan Grainger[1], Amber Bell[1], Nyssa Hewitt[1], Hannah Klaus[1], Amanda French[1], Han Gan[2], Michael Goblirsch[3]

[1]School of Science, University of Waikato, Hamilton, New Zealand; [2]Department of Mathematics, University of Waikato; [3]United States Department of Agriculture

Increased urbanisation and anthropogenic activity have increased the availability of elements (e.g., copper, zinc, lead) in the environment which can be transferred to food sources (e.g., honey, pollen) and ultimately the consumer (i.e., bees and humans). Elements present and their concentrations in food sources are influenced by the geographical origin. Our recently published work analysed 20 elements in honey from 34 countries (n = 323) to demonstrate the potential of utilising the elemental fingerprint of honey to differentiate New Zealand honey from that of international origin. This work shows promise and could be explored as one tool to help protect NZ honey from international fraud. Furthermore, chronic consumption of heavy metals in food may be detrimental to a bee's performance and health. This research is investigating the movement of metals from bee food to larvae, pupae, and adults as part of a larger project to explore the effect of metals on bees.

A novel neutralising antibody therapy reduces deformed wing virus loads in the Western honey bee (*Apis mellifera*)

Neil MacMillian, James Baty, Antoine Felden & Phil Lester

School of Biological Sciences, Victoria University of Wellington, Wellington, New Zealand

The Deformed wing virus (DWV) is a major driver of high rates of colony loss of the western honey bee (*Apis mellifera*). There is currently no method to directly control the virus. Here, we demonstrate that a novel antibody therapy can reduce DWV loads in *A. mellifera*. Anti-DWV immunoglobulin Y (IgY) was raised in and collected from the eggs of chickens immunised with three recombinant DWV proteins, which was subsequently fed to adult bees. An ELISA demonstrated the anti-DWV IgY treatments oral bioavailability in *A. mellifera*. We then assessed viral loads in bees using qPCR. The antibody therapy caused up to seven-fold and statistically significant viral load reductions in DWV-infected bees. Our findings demonstrate the potential for antibody therapies to help mitigate the damaging effects of DWV. This treatment modality could be used to target other crippling pathogens and parasites of *A. mellifera*.

Effects of toxic heavy metals on European honey bee (*Apis mellifera*) neuronal cells

Brittany Jaine

School of Science, University of Waikato, Hamilton, New Zealand

Honeybee health and populations are under threat from multiple anthropogenic factors. While the effects of exposure to agricultural chemicals, such as pesticides, has been well documented, there is a gap in the literature on the risk of heavy metals to bee health. Honeybee neuronal primary bee cell cultures were created to carry out controlled laboratory experiments. This research aimed to investigate the chronic toxicity and uptake of heavy metals using cytotoxicity assays and uptake assays on these cell cultures. Cytotoxicity assays yielded relative toxicities (IC50) of Cd>Hg>Pb>Mn>Cu>Ni>Co>Fe. Lower concentrations of Cd and Pb were taken up into cells compared to Cu (an essential metal) after 96 hours (uptakes rates of y=0.83x, y=0.84x, and y=5.75x, respectively). However, Cd and Pb were more toxic than Cu (IC50 4.70, 6.50, and 44.2 μg/L, respectively), indicating the risk to the colony from chronic exposure of these metals.

Argentine ants increase deformed wing virus loads in honey bees

Jana Dobelmann[1,2], Antoine Felden[1], Phil Lester[1]

[1]School of Biological Sciences, Te Herenga Waka - Victoria University of Wellington, New Zealand

[2]Institute of Evolutionary Ecology and Conservation Genomics, Ulm University, Germany

Honey bees are under a wide range of threats, including pathogens such as viruses. The majority of invasive species are best known for their effects as predators, but may also be substantial reservoirs for pathogens. We examined how the globally invasive Argentine ant (Linepithema humile), which can reach high densities and infest beehives, is associated with pathogen dynamics in honey bees. Honey bee-associated viruses are found in various arthropod species including invasive ants. Viral loads of deformed wing virus (DWV), which has been linked to millions of beehive deaths around the globe, significantly increased in bees when Argentine ants were present. Microsporidian and trypanosomatid infections, which are more bee-specific, were not affected by ant invasion. Viral spillback from ants could increase infections in bees. In addition, ant attacks could pose a significant stressor to bee colonies that may affect virus susceptibility. These viral dynamics are a hidden effect of ant pests, which could have a significant impact on disease emergence in honey bees.