Sniffing out American foulbrood: Volatile biomarkers for non-invasive diagnosis

Jessica M. Bikaun

The University of Western Australia

Co-authors: *Tiffane Bates, Maike Bollen, Gavin Flematti, Julia Grassl*

Funding*: CRC for Honey Bee Products, JMB is funded by a University of Western Australia Alexander Juett Fellowship PhD Top-Up Scholarship in Agriculture*

Speaker Bio

Growing up on a farm in the southwest of Australia fostered my interest in conservation biology and biosecurity. During my undergraduate degree at the University of Western Australia, by chance and great timing, I volunteered as a field assistant for the Centre for Integrative Bee Research (CIBER). I quickly became addicted to bees and completed my Honours research on honey bee reproductive biology with CIBER's Prof. Boris Baer. I am now combining my passion for honey bees and biosecurity through my PhD research on American foulbrood with the CRC for Honey Bee Products.

Presentation

American foulbrood (AFB) is the most costly honey bee disease in Australia. Caused by the bacterium, *Paenibacillus larvae*, AFB kills honey bee larvae and converts the cadaver to a foul smelling, spore-laden, glue-like mass. Early detection and intervention are critical to prevent the disease from spreading to nearby hives and apiaries. Although various diagnostic methods have been developed, AFB remains a significant problem for beekeepers: diagnosis is often slow, still requiring beekeepers to visually identify AFB symptoms on the brood frame. In this project, we investigated the volatile compounds associated with the notoriously foul smell of AFB, to determine if specific compounds could be used as a method for quick and non-invasive diagnosis. We used Gas Chromatography Mass Spectrometry (GC-MS) to identify 41 compounds that are significantly elevated in - or exclusive to - AFB-diseased brood, compared to healthy brood. We further investigated specificity of the compounds for AFB compared to brood that had died of temperature shock or other brood diseases. These biomarker compounds can be used to diagnose AFB-diseased brood with an accuracy over 97%. In a follow-up field experiment, we demonstrated that 19 of the volatile biomarkers could be detected non-invasively in beehive air. We are now developing sensor surfaces for the biomarkers to create a portable, electronic, diagnostic "beehive breathalyser" device. The goal of this work is to develop a practical and cost-effective tool that will de-risk high-density beekeeping through improved biosecurity.