Apivectoring: A novel tool for Hawaii's IPM toolbox

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Honey bees are recognized worldwide for their critical role in crop pollination. Here in Hawaii, their pollination role extends beyond just high-value crops like coffee and Macadamia nuts[1] – in the absence of native pollinators, such as the Hawaiian yellow-faced bees or native honey creeper birds, honey bees aid in the propagation of native plants[2,3]. But in agricultural systems especially, honey bees may come in to contact with pesticides used to control economically harmful insect, pathogen, and weed pests. Producers may be faced with a situation where they are paying to control a multitude of damaging pests while balancing safety for the bees they need for pollination services. Wouldn't it be nice if an integrated pest management (IPM) approach existed that could address pest control while promoting pollination services simultaneously?

Well, there could be! Apivectoring, also called entomovectoring, is the use of pollinating insects for the precision delivery of microbial control agents (MCA) that kill target pests. As a honey bee leaves her hive, she exits through a specialized dispenser containing the MCA, coating her with a fine powder. When she alights on a flower, some of this biocontrol agent is left behind. As she flies through the field, the powder is also deposited on the leaves, such that she returns to the colony "clean" and can unload her gathered pollen and nectar. The MCA left on the flowers and leaves may go to work immediately against insects and pathogens, or it may colonize the flower and act as a prophylactic for the developing fruit and later dissemination[4].

It may seem like science fiction, but this technology has been successfully used to control various crop insect pests and plant pathogens in Canada and Europe, in both greenhouse and open field settings[5,6]. Bumble bees as entomovectors have already been commercialized in Europe (biobestgroup.com). The success of this technology is due to the ecostacking approach, where multiple ecosystem services (e.g. pollination and IPM) are provided by the bee vectors. Organic strawberry and raspberry production saw 47-66% reductions in grey mold (*Botrytis cinerea*) from apivectoring of the MCA *Gliocladium catenulatum* under multiple weather conditions and across a wide geographic range (Finland to Italy)[6].

The ultimate success of an apivectoring system will depend upon a number of interacting factors, including dispenser design for proper MCA distribution, selection of the most efficient bee species in a production system, transport and delivery of the MCA, and the safety of this control agent for the environment and humans[7]. However, once optimized for a subtropical environment, this could be beneficial to organic producers across Hawaii by encouraging pollination services to boost yields, reducing pesticide input costs, and increasing overall profits.

Potential systems that merit further exploration include Macadamia nut and the Macadamia felted coccid and coffee and the coffee berry borer – both of these insect pests are highly susceptible to the fungal MCA *Beauveria bassiana*[8]. But plant protection could extend beyond cropping systems – think Rapid ʻŌʻhia Death devastating ʻōʻhia forests across the state. Could apivectoring be used to help control the disease agent or the boring ambrosia beetles whose feces spreads the spores? The avenues for future research into apivectoring in Hawaii are numerous.

I want to hear from you! Please fill out this brief survey so I can better adapt future research to meet the needs of Hawaii's farmers: http://go.hawaii.edu/h8J

Want to learn more about bees in Hawaii? Check out the Mālama Pua pollinators extension webpage: https://cms.ctahr.hawaii.edu/pollinators

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