The **Research** Buzz

by Hannah Whitehead, Honey Bee Extension Educator, UMass Amherst, **September 2020**

Welcome back to the Research Buzz, a recurring column that summarizes the newest and coolest in bee research. This week, you will learn about crop pollination (which bees are visiting our crops? and are there enough?), and how flowers can become sites of disease transmission for bumble bees. You will also hear about research from the University of Georgia on propolis-friendly hive design and *Varroa* mite evolution. Finally, we will describe an exciting new bumble bee behavior that may have implications for climate change. You can also read this column on the UMass Extension website.

1 Are US Crops Pollination-Limited?

Wild squash bee on a pumpkin flower.
Photo by Elsa Youngsteadt (NC State Extension)

Many important food crops depend on pollinators. At the same time, pollinators may be less abundant: yearly honey bee losses remain high, and many wild bee species are in decline. Past research has studied the effect of insufficient pollination on wild plants; surprisingly little has focused on crops. Are crop yields limited by insufficient pollination? And how important are wild bees (as opposed to honey bees) for crop pollination?

Recently a multi-university group carried out a national study looking at seven key crops across the US – almond, apple, blueberry, tart cherry, sweet cherry, pumpkin, and watermelon. They monitored pollinator visits to target farms in key growing regions, as well as available blossoms and final yield. They then estimated the proportion of pollination that was performed by wild bees and assessed yield loss due to insufficient pollination. **They found that the apples, blueberries, sweet cherries and tart cherries were pollination limited.** They also discovered that wild bee visitation varied by crop: pumpkins were overwhelmingly pollinated by wild bees (74.6% of visits), while almonds were pollinated exclusively by honey bees (100% of visits). **Overall, wild bees performed about 26% of pollinator visits.** The authors estimate the value of wild bees to the economy at 1.5 billion across all target crops except almonds. The economic value of honey bees across these crops totaled 2.2 billion.

Why is this research important?

This study found that wild bees provide substantial agricultural pollination services, and that several large-scale crops in the US may be limited by a lack of pollinators. **It provides clear support for the need to preserve and attract native bees in agricultural areas.**

Read the full study here.

2

Designing a Propolis-Friendly Hive

Many studies have shown that propolis improves honey bees' immune response. **But what is the most practical way to encourage bees to coat the hive interior with propolis?** To answer that question, researchers at the University of Georgia compared the efficacy of three propolis-inducing hive modifications: 1) propolis traps stapled to the hive interior, 2) parallel grooves cut into the interior hive walls, and 3) roughened interior hive walls (using a mechanical wire brush). They measured propolis production in 20 colonies over the course of a year and found that all three designs increased propolis deposition compared to standard hives. However, the bees stored propolis in the grooved hives less consistently over time. **The researchers concluded that roughed walls are the most effective and practical way to create a propolis envelope, since they induce maximum propolis hoarding and don't detract from bee space (like the propolis trap design).**


Images of hive interiors, from left to right: stapled propolis traps, parallel grooves, and roughened walls (Hodges et al. 2020)

Why is this research important?

This study has practical implications: **hive manufacturers could simply use naturally rough, un-planed lumber for hive interiors in order to create propolis-friendly hives**. Future research could directly test the effect of rough hive interiors on colony health.

Read the full study here.

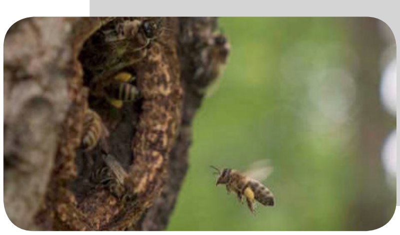
3

Are Mites from Feral Colonies Less Virulent?

Ecologists have long wondered whether beekeeping practices themselves have caused *Varroa* to become more destructive. According to host-parasite theory, parasites will become more virulent (increased reproduction, leading to quicker host death and quicker spread to new hosts) when hosts are clustered, because there is no downside to killing the host (there is always a new one to infect!). A parasite should evolve avirulence (lower reproduction, slower host-death and slower spread), when hosts are dispersed, since the parasite must keep the host alive until it encounters (or gives birth to) another host. **It follows that mites infesting crowded apiaries would become more virulent; while mites infesting dispersed feral colonies would become less virulent.**

Researchers from UGA recently tested this theory. They stocked 8 apiaries with miticide-treated packages and queens from the same source, and then infested them with mites from one of three donor colony groups: commercial hives, hobbyist hives or feral colonies. Two apiaries received no mites. They then tracked mite growth, colony health and mortality over three seasons. **They found that mites from feral colonies had lower population growth compared to mites from either managed background.** They were surprised to find that un-inoculated hives also developed high mites. **However, they saw no differences between apiaries in colony strength or survival. They concluded that feral mites do seem to display lower virulence; however, something more complicated is affecting hive outcomes.** They suggest that it may have to do with host-parasite interactions, and that future studies could pair bees and mites from different backgrounds.

Read the full study here.


Wild bee nest (from The Lives of Bees, by Tom Seeley)

4 Plant Composition Affects Bumble Bee Pathogens

In order to support bee health, advocacy groups have encouraged planting flowering strips along agricultural fields, roads, and residential areas. **In addition to providing food, however, these flowers can be hubs of disease transmission for pollinators.** Recently, researchers from Lynn Adler's UMass lab tested the impact of different flowers on bumble bee health. They had previously shown that certain flowers increase or decrease transmission of bumble bee gut infections in the lab (read it here). In this study, they assembled three groups of outdoor tents and filled them with: (1) a pollinator-dependent crop (canola) + a flowering strip of mostly high-transmission plants , (2) canola + a low-transmission flowering strip, and (3) canola only. They placed bumble bee microcolonies in the tents for 2-week intervals and monitored bee disease and colony reproduction. **They found that bees in tents with high-transmission flowering strips had double the infection intensity of those in low-transmission tents. However, bumble bee reproduction was improved in tents with any flowering strip, compared to those with only canola.**

Lynn Adler leading a tour of the research tents. Photo by Ben Barnhart.

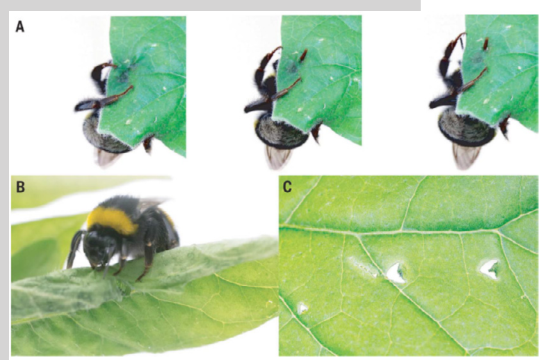
Why is this research important?

This study found that flowering strips improved bee reproduction, regardless of flower composition. However, certain floral mixes also increased infection intensity. The researchers don't know why some plants led to lower infection; future research will explore factors like floral architecture, plant volatiles, and nectar chemistry. Understanding how plants affect bee disease is important because it could help us to design optimal planting mixtures for flowering strips.

Read the full study here.

Bumble Bees Damage Leaves to Induce Early Flowering 5

A research group from France and Switzerland recently published a startling discovery in Science: **when workers from a common European bumble bee species (*Bombus terrestris*) are pollen-deprived, they will damage plant leaves in order to induce early flowering.** The study was inspired when the researchers casually observed bumble bees chewing holes in plants. They subsequently conducted a series of experiments and found that bumble bee colonies that were deprived of pollen were more likely to damage plant leaves, and that **plants with bee-chewed leaves flowered significantly earlier (30 days on average!) than plants that were mechanically damaged or left undisturbed.** This behavior was observed in two other bumble bee species, but not in honey bees. this is the first evidence that some bee species directly manipulate plants in order to accelerate flowering when forage is scarce. As climate change alters the phenology of both plants and their insect pollinators, this behavior could become increasingly important to help *Bombus terrestris* align flowering times with resource needs.



Bumble bee (Bombus terrestris) chewing a leaf. Pashalidou et al. 2020.

Read the full study here.

Contact: Hannah Whitehead, UMass Extension, hwhitehead@umass.edu