ScienceWatch – A Destructive Mimicking Mite

"They are essentially getting through the door and reaching the inner sanctum by using the bees' own complex communication codes against them." – Z. Huang

Social insects recognize one another by "body odor," a mixture of hydrocarbon chemicals they produce, which allows them to distinguish nest mates from intruders and even recognize the various castes in the colony. Different ant castes also make characteristic sounds to identify each other and some parasites have broken these highly sophisticated communication codes to achieve unfetterred nest access (http://hras.org/sw/swseptoct2015.htm and http://hras.org/sw/swnovdec2015.htm).

Bees have their parasites too. The mite *Varroa jacobensi* evolved as an ectoparasite on Asian honeybees (*Apis cerana*). A female mite lays several eggs on a bee larva. The developing mites feed on the larva—and later on pupae and adults—by sucking their blood (hemolymph). About 70 years ago the mite jumped hosts to the European honeybee (*Apis mellifera*) and in 1987 it was discovered in *A. mellifera* living here. Recently it became clear that it was a new mite species, aptly named *Varroa destructor*.

Asian honeybees survive infestations because they have evolved defenses against mites. First, mites can only reproduce on drone larvae. Second, Asian bees comb mites from adult bees and remove infested larvae or pupae from the nest (grooming and cleaning behaviors). The European honeybee, however, shows very weak grooming and cleaning behaviors against the newer *V. destructor* threat and female mites infest both drone and worker larvae. Beekeepers are trying to develop "mite resistant" European bees with enhanced grooming and cleaning behaviors because uncontrolled infestations destroy hives in 2-3 years. Even worse, Varroa mites, along with neonicitinoid pesticides, are implicated in a devastating phenomenon called colony collapse disorder (CCD), whereby workers leave the hive and disappear, abandoning their queen and brood. CCD annually destroys 40% of bee colonies in the US.

Now a study in the June 2015 issue of *Biology Letters* shows that the successful spread of *V. destructor* stems from its ability to quickly decipher and mimic the chemical codes of a new host. The research team headed by Zachary Huang, an entomologist at Michigan State University, E. Lansing, MI, already knew the mite was a master of chemical mimicry. Bees change their chemical profile as they develop from larvae to pupae to adults, and the mite adapts its chemical profile accordingly.

In the new study the team challenged the mite's ability to change its profile to match that of a different host by transferring mites between the two bee species. They took mites grown on either

European or Asian bees and transferred them to larvae of both bee species. After eight days of development they collected each bee pupa with its associated mite(s). Mites and bees were then separated, yielding four groups of mites depending on their former and present hosts, and four groups of bees depending on their species and where their mites originated.

They next determined the chemical profile for each bee group and each mite group by gas chromatography and statistically analyzed the profiles for similarities between mites and bees. As expected, they found that mites grown on the same bee species they came from had chemical profiles closely resembling that host. However, the profiles of the switched mites were much closer to the new bee species than the one they originated from. In just a few days the mites had switched their chemical profiles.

"This remarkable adaptability may explain their relatively recent host shift from Asian to European honeybees," said Huang. He also noted that since the original Asian bee host had developed a strategy to detect and remove the parasite, the newer European bee host might also acquire it over time. "…bees are adapting to detect these invaders. Our results give a clear illustration of an arms race between the parasites and the host bees based on chemical mimicry and its detection," he said.

Honeybees are extremely important because they pollinate about 100 food crops. Right now the mites are winning. Let's hope the bees gain the advantage.

Saul Scheinbach