Typically, female adult SHB are larger than their male counterparts. We placed a worker in the photo for context. Note the metric scale. Male SHB are on the left, with the females closest to the honey bee. All photos courtesy of Dr. Lee Bushong

The Small Hive Beetle in North Florida

by Lee Bushong and Worrel Diedrick

The small hive beetle, *Aethina tumida*, or SHB for short, is an important pest to us in the southeast United States. Every year we wrestle with pests that impact the Western honey bee in some fashion. Unfortunately, the SHB and varroa mite, *Varroa destructor*, seem to dominate the conversation among beekeepers. Earlier this year, we sold some nucs to an older gentleman and he had a lot of questions about the SHB. He told us that his father was a bee farmer in pre-1980s Florida and no one ever heard about SHB or varroa at that time. So, we told him about the importance and economic impact of these pests, as well as methods of control. We also explained how the SHB arrived here from Africa into ports of Charleston, South Carolina and Savannah, Georgia in the mid-1990s, and its migration since then.

Usually, when we sell colonies to new beekeepers, we provide meaningful information on integrated pest management (IPM) techniques. We always underscore that managing the SHB is a fluid exercise that changes as new management information is made available about this pest. A simple search of the internet will reveal a litany of advertisements for several products that purport to control the SHB. Some beekeepers balk at the idea of introducing an insecticide into a colony of insects and others swear by it. As scientists, we don't really have a position either way, as long as the product labels are followed and the product is used properly. What we have found to be useful in the field is a combination of the following approaches that reduces the SHB's ability to overrun a colony.

2020 Summer observations

This year, the north Florida region witnessed an explosion of SHB. A colleague of ours noted recently in his research that SHB developed resistance to conventional pesticides by 200% (Kanga et al., 2018). In layman's terms, the amount of product used to kill SHB was no longer effective. In fact, the fatal amount to kill the beetle was 200 times more powerful than the conventional dose. This makes sense if apiaries are using pesticide products to control the beetle. And, this may contribute to the population explosion in the region.

We have noticed summer attrition of bee colonies in the 70% range, with nearly half of that number unexplained but resembling Colony Collapse Disorder. CCD is an event where the majority of the colony's population disappears with no logical explanation as to why. The hives that were suspected of CCD were abandoned with the exception of a very small cluster of workers left behind. Stores of food and brood were present, as well as an occasional queen. Analysis of these hive structures revealed an incredibly high population of SHB present.

We attribute pest pressure as a leading factor in absconding or other abandonment of hive structures. Within our hives, we have noticed unprecedented numbers of SHB. Literally, dozens of hive beetles scurry

This is beetle activity upon opening the top cover of the hive. The beetles are scurrying on the inner cover. Note the bees addressing the beetles.

There are a lot of beetles coated in diatomaceous earth.

when the inner cover is removed. The normal questions begin to circle: How many are actually here? Where are they coming from? And what can we do? That is the focus of this article.

The small hive beetle

Aethina tumida, or the small hive beetle, is native to Africa. It hails here from the sub-Saharan desert, so it is a heat-tolerant organism. The beetle has spread through Africa, the United States, Australia, and other countries. It is considered a significant pest in terms of both biological importance and economic impact. SHB have very hard exoskeletons and generally are impervious to honey bee stings. They are very fast movers, preferring to locate themselves in the smallest of cracks in the hive. They seem to prefer comb that is less patrolled and we tend to find the majority on frames 1, 2, 9 & 10. Honey bees tend to herd the beetles into "prisons" where the bees surround them and keep them contained (Ellis, 2005). If you see a cluster of bees in the corner of your bottom board, brush them aside and you may notice 10-15 beetles in a cluster.

The beetle can fly and cover quite a bit of distance. They will lay eggs in the hive, and if there isn't a sufficient workforce of honey bees to counter the SHB population threat, you may find a ball of maggots on the comb or bottom board. The larvae are small, measuring about 9-10 mm in length. (People always confuse them with wax moth larvae — the hive beetle larva doesn't spin webbing as the wax moths do. Wax moth larvae tend to be gray whereas SHB larvae are creamy white.) When the larva is ready to pupate, it will crawl out of the hive and drop to the ground where it will burrow to pupate. The time it spends in the ground varies regionally and seasonally, but 3-4 weeks is the average. In time, the newly emerged adult will repeat the cycle (Ellis, 2010).

Fresh traps and sweeping sheets. In a few days, the sheets will be all torn up by the bees, but that makes them even more effective traps!

Population

We randomly selected a single deep colony and removed as many SHB as possible. During this inspection, we verified the presence of a laying queen, sufficient workers, and uncapped and capped brood. It might be prudent to point out that if a laying queen was not present, or there wasn't a sufficient workforce within this hive, the colony would naturally weaken and succumb to environmental and pest pressures as the honey bee population would not be replenished or sustained. We replaced the hive components and added fresh, never-before-used traps, and waited a week to reinspect.

Upon reinspection, the presence of the queen was still evident. There were plenty of freshly laid eggs, honey bee larvae at various stages of development, capped brood, a sufficient workforce, and stores of bee bread and nectar/honey. All identifiable SHB were collected and later counted. There was no evidence of SHB larvae within the hive. Overall,

SHB larvae are out of control in this hive.

The aspirator is the piece of equipment with the yellow hose. The hose goes to the mouth and the exposed metal tube collects the beetles. The beetles are trapped in a clear container.

there were 536 SHB collected from a single deep hive.

Methods of control

Traps: We use several methods to trap or control the SHB. The most popular of these among beekeepers seems to be the beetle trap. There are usually two kinds offered — single-use, and a type designed for reuse. In this instance, we used disposable traps. Both are sold by the major online beekeeping supply companies and are affordable. Most instructions suggest to put some oil and/or vinegar into the trap so when the beetles enter it, they fall into the liquid and drown. We use diatomaceous earth in ours. The earth dehydrates and kills the SHB efficiently and it doesn't ferment and stink like a trap filled with beetles rotting in oil. Overall, there are usually 5 or 6 traps per box.

Aspirator: When inspecting colonies, we carry manual aspirators with us. It's a neat little tool that is essentially a handheld vacuum. As the beetles scurry around, often chased by bees, it is difficult for us to carry out physical control by crushing them (but when we can, it is so satisfying!), so we use the aspirator to suck them out of hives and into vials. The aspirator is designed in such a way that a screen at one end of the straw prevents one from inhaling insects. As the vial fills, we'll tap all the beetles to the bottom before dismantling and dumping them into a mason jar for later analysis or destruction. When honey bees imprison the beetles, one just has to insert the aspirator into their cluster to remove the beetles. One might have to gently brush the bees apart to get all of them. The aspirator is a good tool to remove beetles from cracks and crevices and it is also quite handy when inspecting frames. The SHB will often hide in empty honeycomb cells and tend to cell hop when feeling threatened. In this manner, they look like little waves on the comb. The aspirator allows one to remove them easily without damaging the comb at all.

Entanglement: There are many cloths available on the market that serve to entangle SHB effectively. While not endorsing any one product, for the ease of this discussion, we will draw your attention to Swiffer dry sweeping sheets as an example. These cloths are available at nearly any grocery or sundry store and are available online as well. It doesn't matter what brand is used, as long as they are the dry sheets and are not treated with any chemicals. The fibers are woven in such a way that when the beetles are fleeing the honey bees, they become entangled in the material and either die from dehydration/starvation or are killed by the bees. We cut or rip cloths in strips and line the corners of hive bodies, edges of top bars and around the beetle traps. If any readers have experience with the beetle traps, you'll know that when you lift them, beetles are often found congregating on the frames under the lips of the trap. A little of the cloth under the traps, between the trap lip and the top bar of the frame, catches the beetles nicely.

Screened bottom boards: These handy bottom boards have hardware mesh screens in lieu of traditional solid wood. Screened bottom boards are a double-edged sword, though. If used correctly, they are a great resource. If used improperly, they are a harbinger of doom.

The screened bottom board is designed to have a mesh with holes of sufficient size to allow SHB to fall through and prevent honey bees from doing so. Under the mesh is a framed area that holds a pan, tray, or sticky board. We've used both, but our preference is a tray with a layer of diatomaceous earth on it. Diatomaceous earth is significantly cheaper than sticky boards. As the beetles are chased about within the hive, they will fall to the to bottom board and either fall through the screen or voluntarily seek that area as a refuge. The earth or

(L) *These cloths are placed in known beetle congregation/prison points. Notice how the cloth is torn up. This is a result of the bees trying to remove it. The beetles burrow into the roughed-up cloth and expire.* **(R)** *Diatomaceous earth is placed in the tray, in this case, an old lunch tray, and inserted into the bottom board.*

sticky board is what ushers the beetle's demise. Both are effective but need to be maintained and cleaned or replaced regularly. The trays, if left unattended, will fill with detritus and debris and become a personalized pest hotbed. Screened bottom boards are not used through the winter or cooler months, and are usually only used during the hot, humid months of summer and dearth. Humidity will dampen the diatomaceous earth, reducing its effectiveness. One must change it every week or whenever it loses the powdery texture. The same logic should apply to sticky boards. As pollen, insects, dirt, and debris fall through the screen to the bottom, the sticky board will lose its tack over time.

Environment: Hive beetles are not fans of the sun. They usually move at dusk or dawn, and if one should observe their hive entrance during these times, you'll probably see them flying into it. Some researchers suggest that the larvae will exit the hive at night to make their journey for pupation. The location of your hives is important. There is a common belief in the northern Florida/southern Georgia region that one should not locate an apiary in an area with direct sunlight because it gets too hot. We can tell you that the hives that are shaded have more SHB than those located directly in the sun (personal observation). If you find a ball of SHB larva on one of your frames, set it in the sun and watch them quickly die. In this regard, they're like vampires. The sun equals death.

Another environmental consideration is the substrate under the hives. Remember, SHB has to have soil to pupate and complete the lifecycle. We've observed several apiaries around north Florida where the substrate is solid (concrete) and sometimes Astroturf, and the SHB population is markedly less than other apiaries where there is soil immediately under the hives We've also heard of people using rock salt covered with dirt, and others who've used nematodes as a method of control. These last two methods have not been evaluated by us.

This year's population explosion of SHB and the higher attrition rates of colonies in the north Florida area are troublesome. The amount of pest pressure on managed colonies can be extrapolated to include feral colonies as well. It may be the resistance of the SHB to conventional pesticides that has allowed such a boom in population. Also, as colonies die, the pest pressure increases on those remaining. With the dearth upon us, beekeepers should be extra vigilant in managing their colonies by inspecting hives regularly. One single control method is not sufficient by itself to control SHB. Physical control is still the king. Crushing or aspirating SHB immediately removes the pest-pressure within the colony, allowing the colony to focus on reproduction and storage. Traps and entanglement are secondary lines of defense, but these have to be used properly to be effective. Environmental factors as they relate to the reproduction of the SHB can place pressure on the beetles and drive their numbers down. The lessons from the field this summer are that one must use a multipronged approach to effectively reduce the SHB pressure on the colony.

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