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Small Hive Beetle, *Aethina tumida* Murray

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Introduction and History

Small hive beetles (SHB) (*Aethina tumida* Murray, Coleoptera: Nitidulidae) are native to sub–Saharan Africa. The beetles were introduced into the southern United States in the 1990s through unknown origins (Hood 2000). They were first identified in Florida in 1998, and a quarantine restricting the movement of hives was established by the Florida Department of Agriculture and Consumer Services. However, the beetle was discovered across state lines and in an insect collection in South Carolina that had been compiled a few years prior, so the quarantine order was lifted (Hood 2004, Ambrose 2016).

SHB is not considered a pest of honey bees in its native African range. It is beneficial since it primarily invades sick colonies of the African honey bee, *Apis mellifera scutellata* Lepeletier. African honey bees abscond from the hive more frequently than the western honey bees, *Apis mellifera mellifera*, leaving the cleaning of the empty and possibly diseased hive to scavenging SHBs. Since western honey bees tend to remain in their hives, SHB can become a pest of managed colonies (Neumann and Elzen 2004).

Fig.1. Small hive beetle larva, dorsal view. Pest and Diseases Image Library, Bugwood.org

Distribution: SHB is now widespread throughout beekeeping regions of the United States. The beetles can be transported in bee packages or with migratory beekeepers. It is also established in Canada, Australia (Neumann et al. 2010, Beverley 2021), and Mexico (Hernández Torres et al. 2021). Some of the newer global introductions include Korea (Lee et al. 2017), Portugal, Italy (Jamal et al. 2021), Chile (Araneda et al. 2021) and Brazil (Pereira et al. 2021).

Life Cycle and Description

As a beetle, SHB has four life stages: eggs, larva, pupa, and adult. SHB can have five generations a year. Infestations peak in the late summer through the fall.

Eggs: Eggs are white, 1.4 mm long, and laid in clusters. Eggs can be laid in honey bee brood cells, but they are also deposited on food sources like pollen or in crevices away from bees (Hood 2004). Eggs hatch in three to six days depending on environmental conditions (Somerville 2003).

Larvae: The larvae are creamy-white with a tan head, measuring up to 12 mm long (Lundie 1940). They have three pairs of prolegs and two rows of small spines running the length of their back and a pair of stout spines on their last abdominal segment (Figs. 1 & 2). Larvae feed on bee brood, pollen, and honey. They remain larvae for 8 to 29 days depending on temperature. Larvae enter a wandering phase 6 to 14 days after hatching and leave the hive to find a pupation site in moist soil nearby.

SHB larvae are often confused with the greater wax moth (*Galleria mellonella* L.) larvae. Both are pests of honey bees and can be found in active and stored hives. Common characteristics include the similar creamy white color of the larval body with three pairs

of legs near the head. SHB larvae can be distinguished by the dorsal spines. Wax moth larvae lack dorsal spines and have 4 pairs of prolegs, fleshy leg-like appendages on the ventral side (Fig. 3). Infestation by greater wax moth is detectable by the presence of webbing on the comb (Fig. 4). The body of an SHB larva is smaller and firmer than the soft, plump body of a wax moth larva.

Fig. 2. Small hive beetle larva showing spines on dorsal side. Pest and Diseases Image Library, Bugwood.org

Pupae: SHB larvae leave the hive through the front entrance during their wandering stage and burrow in nearby soil to pupate in earthen cells. They prefer moist soils and burrow up to 20 cm (3 to 4 in) deep

Fig 3. Greater wax moth larvae without spines on the dorsal side. Susan Ellis, USDA APHIS PPQ, Bugwood.org

(Hood 2014). The pupae begin as a creamy white color and change to a dark brown as they get closer to emergence (Ellis 2004). They remain in a pupation chamber (excavated area in the soil) for approximately two to 15 weeks depending on weather conditions (Somerville 2003). Recent research has shown that they can also successfully pupate in greenhouse substrates (Cornelissen et al. 2020)

Adults: Adult SHB are dark brown to black, and measure 5 to 7 mm long and 3.2 mm wide. The antennae are clubbed (Fig. 5). The wing covers are short and do not completely cover the abdomen. The adults live up to 6 months and overwinter in the hive (Lundie 1940). Females prefer to oviposit in the hive on stored pollen or brood comb. It is estimated that females can lay up to 2,000 eggs during their lifetime (Somerville 2003). After emergence, the adults fly several kilometers searching for honey bee colonies to infest which they locate through volatiles.

Fig. 4. Greater wax moth webbing and damage (*Galleria mellonella*), Juan Campá, MGAP, Bugwood.org

Damage

Adults and larvae of SHB feed on the eggs, larvae, and food of the honey bee (Lundie 1940) (Fig 6). The larval stage of the beetle is the most damaging because larvae burrow through the honeycomb consuming bee brood and food (Fig. 7). The adult beetles also migrate among colonies within the same apiary. Severe infestations can cause honey bee colonies to abscond or trigger the collapse of the colony. SHB also carries yeast in their feces that can cause honey to ferment, resulting in "sliming out" of the honey (Fig. 8). Feces from the beetle in the honey will result in a total loss of the honey crop (Hood 2004, Neumann et al. 2016).

Detection

Upon opening a hive for inspection, the beekeeper may see beetles flee to hide in the crevices of the hive. The beetles run away from light and might be seen only on the inner cover or scurrying across the combs. Larva can be visible on the comb and the honey may

appear slimy and fermented. They can also be detected by searching the surrounding soil for pupae.

Management

The best way to defend against SHB is to have strong, clean colonies. There is currently no defined economic injury level for SHB. The beekeeper should monitor beetle activity and estimate the level of infestation to make control decisions.

Honey bees will attack adult SHB, causing the beetles to hide in cracks to avoid the attack. The adult beetles may congregate in crevices that are usually in the darker and cooler parts of the hive. When bees try to attack the beetles, the beetles tuck their legs and antennae close to their bodies to protect them from chewing. The bees can also use propolis to encapsulate the beetles in a small area in the hive. Interestingly, beetles can trick bees into feeding them by rubbing the mouthparts of the bee with their antenna while encapsulated (Ellis et al. 2002).

Fig. 5. Small hive beetle adult. Mandy Frake, Bugwood.org

Cultural control: Along with strong colonies, breeding bees for hygienic behavior can reduce beetle populations. In addition, beekeepers can remove excess burr comb and condense the bee population to the fewest possible hive bodies. The addition of too many hive bodies increases the area that bees must patrol so that the beetle may hide unnoticed (Hood 2000). Hive beetles prefer areas that are high in humidity with shade, so placing hives in sunny locations will help reduce populations (Hood 2004). Hive

beetles can survive and reproduce in rotting fruit (Eischen et al. 1999). Keeping the apiary clear of additional beetle breeding areas is important for control and management.


Fig. 6. Adult small hive beetles and honey bees on comb. Jessica Louque, Smithers Viscient, Bugwood.org

Trapping: There are several different types of traps available for purchase to control SHB. The three most widely used traps include the Better Beetle Blaster (Dadant & Sons, Hamilton, Illinois, United States), screened bottom boards, and insecticide-baited beetle traps. The beetle blaster is a plastic trap that is positioned between the frames and filled with apple cider vinegar and vegetable or mineral oil. The vinegar acts as an attractant, while the oil will smother the beetles that fall into the trap (Hood 2004). The screened bottom board trap is placed at the bottom of the hive with a screen that is large enough for beetles, but not bees, to fall through. This trap can be made by a beekeeper by using an aluminum pan filled with oil or a sticky substance below the screen that prohibits the beetles from crawling back up into the hive after they fall. This trap also helps reduce varroa mite numbers and other pests that fall from the hive. Bait traps contain an attractive bait with an insecticide, such as borax laced with honey or sugar, for the beetles to eat. These traps are usually 10 mm in width with a small opening so only the beetles can enter.

Some beekeepers have reported success in controlling SHB populations by placing strips of Swiffer floor cleaning pads (Proctor and Gamble, Cincinnati, OH) or dryer sheets in their hives. The beetles get stuck on the floor pads while most bees escape. However, a search of the scientific literature shows that this has not been scientifically proven through experimental research.

A modified hive entrance with a 0.75-inch PVC pipe to reduce colony invasion by adult beetles produced mixed results. There were reported problems with brood production and temperature regulation with the reduced entrance opening (Ellis et al. 2002). Therefore, this is not recommended to manage SHB.

Fig. 7. Small hive beetle larvae with slime in honey bee comb. James D. Ellis, University of Florida, Bugwood.org

Mechanical control: Many beekeepers propose mechanical control of SHB by exterminating each beetle manually on sight with a hive tool (Hood 2004).

Chemical control: Beekeepers who use chemical treatments for SHB control are required by law to follow the insecticide labels. Incorrect application may negatively impact the colony and contaminate the honey harvest.

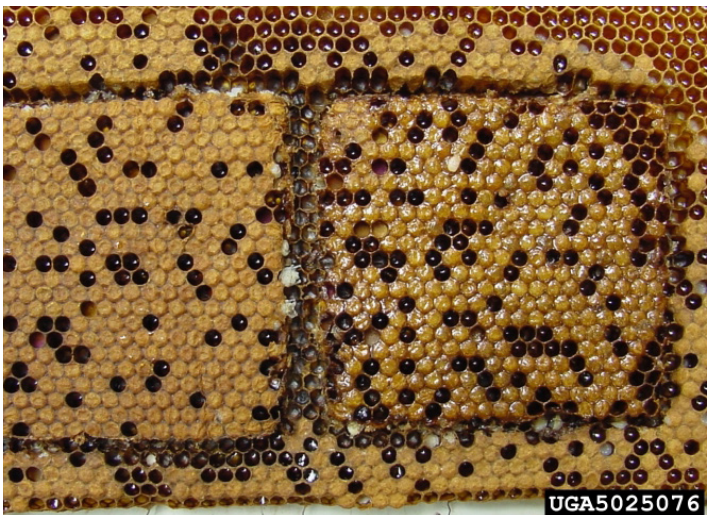

Fig. 8. Damage by the small hive beetle. 'Slime' is visible on right side of comb. Keith Delaplane, University of Georgia, Bugwood.org

Once established, SHB can be chemically treated inside or outside the hive. Currently, the only registered product for SHB control in the hive is the Checkmite Bee Mite Strip (Bayer HealthCare AG, Germany) containing the organophosphate coumaphos, which is applied in strips within the colony. Resistance to coumaphos and fluvalinate has been reported in some SHB populations in Florida (Kanga et al. 2021). Outside the hive, GardStar® (Y-Tex; Cody, WI) is approved as a soil drench to control the larvae and pupae in the soil. The main ingredient in GardStar® is the pyrethroid permethrin.

Fig. 9. Wax moth larva mortality caused by entomopathic nematodes. Entomopathic nematodes will also infect small hive beetle. Peggy Greb, USDA Agricultural Research Service, Bugwood.org

Diatomaceous earth (DE) is a relatively benign substance used to help control SHB. DE causes mortality through disruption of the waxy epicuticle layer of the beetle, resulting in dehydration. The addition of DE to traps placed under or throughout the hive will result in mortality to the adult beetles (Buchholz et al. 2009, Cribb et al. 2012).

Some chemicals applied for a particular pest of honey bee hives may also help control other pests. For example, treatments for SHB may also help control wax months in stored equipment. Additionally, some treatments for Varroa mite will also work against hive beetles (Roth et al. 2019)

Biological control: Entomopathic nematodes, primarily the nematode *Steinernema carpocapsae* (Weiser), have successfully infected and controlled the larva and pupa in the soil outside the hives (Sanches et al. 2021) (Fig. 9). Entomopathic nematodes can be purchased online and applied to damp soil around the hive.

Conclusion

The SHB is a pest that requires careful monitoring within honey bee colonies. Keeping hives crowded with bees is the most effective way to control SHB, along with other honey bee pests. If SHB does become established, the cultural, chemical, mechanical, and biological control methods described above will help control the infestation.

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