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SMALL HIVE BEETLE

(*Aethina tumida*)

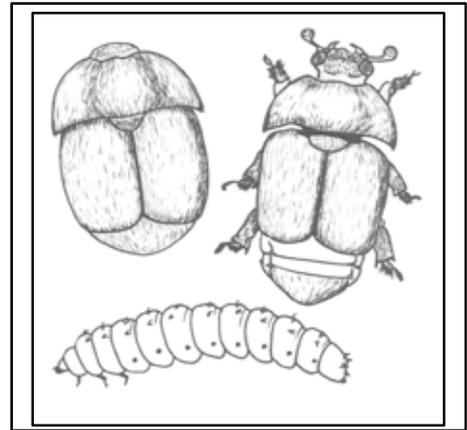
Small hive beetles (*Aethina tumida*) are one of the most economically detrimental pests of honey bees in the United States. Not only can they significantly reduce brood and honey production, in extreme cases they can cause total collapse of the colony (Ellis, 2003). A scavenger of honey bee colonies, small hive beetles were once thought to only have extreme impacts on weak colonies, but evidence suggests they also have the potential to cause significant damage to strong colonies (Eyer *et al.*, 2009; Hood, 2004; Levitt *et al.*, 2013).

The small hive beetle (*Aethina tumida*) was first identified in the southeastern United States in the mid-1990s. Before its discovery in the U.S., the beetle was known to exist only in tropical or sub-tropical areas of Africa where it is a less serious pest. How it found its way to North America is not certain. It is known that their initial discoveries in the U.S. tended to be in port cities. Since adults will feed on fruit and are especially fond of cantaloupe, the beetles may have been accidentally introduced into this country via a shipment of fruit originating from Africa.

Although primarily found in the southeastern United States, beetles have established in over 30 states in the West Coast, the Northeast and in the Midwest—even Hawaii (NAPIS, 2014; Hood, 2004). Historically it was thought that small hive beetles were able to complete their life cycle more easily in sandy soil (Pettis and Shimanuki, 2001), but studies show that small hive beetles can also thrive in silty clay soil or silty clay loam soil (Guzman *et al.*, 2009).

Heavy clay soil does not appear to be conducive to small hive beetle pupation (Delaplane cited in Wenning, 2001).

Adequate soil moisture, however, has been found to be correlated with pupation success (Schmolke, 1974; Guzman *et al.*, 2009; Lundie, 1940).



DESCRIPTION

The adult beetle is small, about 3 mm wide or 1/3 the size of a bee, reddish brown or black in color and covered with fine hair. The larvae are small, cream colored and similar in appearance to young wax moth larvae. You can differentiate the beetle larvae from wax moth larvae by examining their legs. Small hive beetle larvae have three sets of legs just behind the head. Wax moth larvae, like all moth and butterfly larvae, have three sets of legs behind the head but in addition have a series of paired prolegs which run the length of the body. Prolegs are absent in beetle larvae.

LIFE CYCLE

Once an adult beetle enters the hive, it will seek refuge in small cracks and crevices to protect itself from honey bees. Some types of bees demonstrate guarding behavior in which bees imprison adult beetles in cracks and crevices to prevent them from reaching the comb. Some bees will even try to entomb beetles in a crack or crevice using propolis (Hood, 2011). Small hive beetles are clever in that they are able to solicit food from bees that have imprisoned them; to do this, the small hive beetles rub the bee's mandibles with their clubbed antennae to induce the bee to regurgitate food, which the beetles then eat (Ellis, 2005). Females lay their eggs in large masses and prefer to lay directly on a food source, such as pollen or bee brood. They will, however, lay in cracks and crevices if necessary. Adult beetles can lay eggs in capped cells by chewing a small hole to insert their ovipositor in to lay eggs (Ellis, 2003). A single female beetle can easily lay 1,000 eggs in her lifetime (Somerville, 2003). Depending on weather conditions, eggs will hatch within 3 to 5 days. Upon hatching, beetle larvae will search for food, including honey, pollen, and brood, with a preference for bee brood (Elzen *et al.*, 2000). Typically the larvae feed for 10-14 days and then enter the wandering stage where they exit the hive at dusk to drop into the soil to pupate. If ideal conditions are not available, the wandering larvae can live and wander for a considerable amount of time until it reaches soil where it can pupate (Schmolke, 1974). Most beetles pupate in the first 10 cm of soil (Pettis and Shimanuki, 1999; Guzman *et al.*, 2009) and over 80% of small hive beetle pupation occurs within one foot of the hive entrance; nearly all pupation occurs within three feet of the hive entrance (Pettis and Shimanuki, 1999).

Once emerging from the soil as an adult, the beetles will seek out a host hive where they can reproduce and lay eggs. Small hive beetles are excellent flyers and can fly many miles in search of a host hive. They also have incredibly sensitive olfactory senses that allow them to efficiently seek a food source. Once a host hive is located, a female beetle can lay eggs as soon as one week after emerging from the soil. In colder climates, adult beetles will overwinter with the cluster of bees but do not lay eggs or pupate during the winter months. This is not necessarily the case in milder climates where beetle pupation can occur (Pettis and Shimanuki, 1999).

Small hive beetles can live three months in ideal temperatures, with maximum adult longevity occurring when temperatures are between 28-32°C (82-90°F). Temperature can also drastically impact hatch success, time to hatching, larval growth, and adult fecundity (Meikle and Patt, 2011).

DAMAGE

While this beetle is not considered a major pest in Africa, it can be a serious pest in the United States and can result in significant economic losses for beekeepers. In addition to consuming the resources of the colony, the adult beetles defecate in the honey causing it to ferment and run out of the combs (Lundie, 1940). Full honey supers stored in the honey house, supers above bee escapes, and weak hives with honey but few bees seem most vulnerable to attack. When small hive beetle infestations are heavy, even in strong colonies, the queen will stop laying eggs and the bees may abscond.

DETECTION AND MONITORING PRACTICES

All hive inspections should be done with an eye open for this pest. When opening a hive containing beetles, adults can be seen running across the inner cover, combs, and bottom boards to find hiding places as they do not like to be exposed to light. In a heavy infestation, soiled, fermented honey may also be found at the hive entrance—this stage is referred to as “leaking”. A ‘decaying orange’ odor may be given off by the fermented honey. Large masses of larvae may be seen on the combs and bottom board in heavy infestations. An easy way to differentiate small hive beetle larvae from wax moth larvae in the hive is to check for silken tunnels, webbing or cocoons in the hive—if you see any of these signs on the comb, you are dealing with wax moth larvae.

The only device that has been developed to provide a quantitative assessment of small hive beetle population sizes in a hive is a diagnostic strip developed by Schäfer *et al.*, 2008. These diagnostic strips work by allowing beetles to hide in the flutes of the corrugated plastic while preventing bees from accessing the beetles. They have a mean capture rate of 30% of the colony SHB population and are easy to place since they easily slip in through the hive entrance. These diagnostic strips are intended to be used with a solid

bottom board; if you are using a screened bottom board, it is important to place the diagnostic strip on a platform to give the beetles the ability to reach the trap. The platform must be sturdy and straight enough to prevent beetles from hiding between it and the diagnostic strip or the side wall of the hive. To make a diagnostic strip, take 4 mm corrugated plastic and cut it to approximately 20 inches by 3 inches. Leave it in place for 48 hours. When removing the strip, pull it out gently and quickly; do not inspect the hive or smoke the bees until after you have pulled the strip out of the hive. The beetles can be removed from the strip by dumping them in a light colored bin filled with soapy water where they can then be counted. Since no action threshold for treatment has been established for small hive beetles, it is important that you document your capture rates to help you in determining if you think pest control is necessary.

Take care when buying packages or nucs, especially from southern states as they are at a higher risk of being infested with beetles. If you suspect small hive beetle infestation or would simply like to have colonies inspected for the presence of these beetles, contact your state apiary inspection service or local bee club.

CONTROL

In general, it is recommended that an Integrated Pest Management (IPM) plan be used in managing any type of honey bee pest (for more information on IPM, visit extension.psu.edu/pests/ipm). However, as mentioned, no action threshold has been set to date for small hive beetles, which is integral to a successful IPM program.

Until such thresholds are established, it is recommended that you try the following types of control methods in the following order to minimize the risk to your bees, humans, and the environment: cultural and mechanical controls, biological controls, or chemical controls. Action against the pests may be needed and should be taken without delay if you encounter small hive beetles in the hive—especially if you have had a recurring problem.

1) Cultural Controls

Cultural controls are a change in practice that helps to reduce pest problems. For small hive beetles, one of the easiest cultural practices that can be implemented is to relocate your hives to a sunny area. Small hive beetles

prefer the shade, and it is harder for them to pupate in dry, sunny areas. Another simple cultural control is to try and keep your hives strong so that they are able to defend against small hive beetles. Oversupering or inspecting hives too frequently can also make it difficult for bees to kill or imprison beetles. Bees that exhibit hygienic behavior typically are better at controlling small hive beetles as well. Keeping a clean apiary and removing any equipment that is not in use can also make your yard less attractive to small hive beetles. If you have a severe problem, it is advised to relocate the hive(s) before treating them. Small hive beetle adults are very mobile and the problem can quickly spread to other hives within a yard.

If you have an issue with small hive beetles in your honey house, cleaning up cappings and honey may help make it less attractive to beetles. Extract honey as soon as possible. Inspect stored supers for signs of beetles or fermentation frequently and remove any infested supers from your honey house.

2) Physical and Mechanical Controls

Mechanical controls physically eliminate small hive beetles once they've entered the hive. For example, when you find beetles in the hive, you can squish them with the end of your hive tool. More effective, however, are traps that have been designed for trapping small hive beetles. Although the Schäfer Diagnostic Strip described in the previous section can be used for trapping beetles, it is best used as a diagnostic strip as it does not have a way to kill or lure the beetles to the trap. There are multiple types of traps that do just that. Most traps use some combination of a lure (e.g. apple cider vinegar) and a killing mechanism (e.g., mineral oil). It is not recommended to use traps that have been treated with coumaphos (e.g., CheckMite+) unless your problem is so severe that cultural, physical, mechanical, and biological controls do not control your beetle populations (for more information see section on chemical controls).

Vacuums and aspirators have also been developed for removing small hive beetles, but are time-consuming and not a viable option for beekeepers with more than a few hives.

3) Biological Controls

Beneficial nematodes are becoming a popular method for controlling small hive beetle populations. Nematodes used for controlling small hive beetles are different species than those that cause damage to root systems or harm to people. These beneficial nematodes are referred to as entomopathogenic nematodes and only feed on specific types of insect larvae and pupae. Currently, three species are being used for controlling small hive beetles. The most popular is *Heterorhabditis indica*, followed by *Steinernema carprocapsae* and *Steinernema riobrave*. Other species may also be efficacious but have not been researched to date. These nematodes are applied to soil surrounding the hive and feed on small hive beetle larvae and pupae in the ground. It is important to apply nematodes in good environmental conditions, which typically match up well with the environmental needs of small hive beetles—e.g., moist soil, uncompacted loam or sand soil, and full or partial shade. It also helps to apply nematodes just after nightfall to improve efficacy. In ideal environmental conditions, *H. indica* can reduce the number of small hive beetle larvae and pupae in the soil by 88-100% (Ellis et al., 2010).

4) Chemical Controls

If you still have significant infestation issues after trying cultural, mechanical, and biological controls, you may want to consider chemical controls. Two chemicals are typically used for controlling small hive beetles—coumaphos and permethrin. Both of these active ingredients are highly toxic and should only be used as a last resort. For all pesticides, read and follow directions and safety precautions on labels, which may have been updated since the time of this publication. Handle pesticides carefully and store in original labeled containers out of the reach of children, pets, and livestock. Dispose of empty pesticide containers in a safe manner and place and take the necessary precautions needed to avoid contaminating forage, streams, or ponds. If you have any questions when using these chemicals or need assistance in determining if treatment is necessary, contact your state apiarist.

Coumaphos, or CheckMite+ Strips, is conditionally registered for all states in the U.S. This product can be applied at any time, including the nectar flow, but is considered a non-food use. That is, there is no allowance for any coumaphos residue in honey or wax and all surplus honey supers must be removed before treatment and not be replaced until after the treatment has been removed. Coumaphos is in a group of highly toxic materials called organophosphates. Because of the dermal (absorption through the skin) toxicity of coumaphos to mammals, it is imperative that beekeepers follow all label instructions, including wearing chemical resistant gloves and long-sleeved clothing when using CheckMite+ Strips. This product is also highly toxic to birds, fish, and aquatic invertebrates; great care must be used if applied near a body of water to avoid contamination and should never be applied directly to waterbodies.

Permethrin, or Y-Tex Gardstar® 40% EC Livestock and Premise Insecticide, is approved for the control of small hive beetle around the soil of honey bee colonies. Since hive beetles must pupate in the soil to complete their life cycle, this pesticide is used as a soil drench and provides treatment for the beetles while minimizing contact with bees and honey.

For treatment of existing infestations, apply as soon as beetles or larvae are observed in or around the hive. Thoroughly wet the ground in an area 18-24 inches wide in front of each hive (1 gallon per 6 hives). Apply in late evening after bees become inactive. For pre-placement treatment of an apiary, apply 24-48 hours prior to hive placement.

Permethrin is highly toxic to bees and extreme caution must be taken to avoid contact by spray or spray drift with the bees, hive equipment, or any other surfaces that bees may contact. When hives are present, application of the pesticide should only be made with a sprinkler can. Hand-pump sprayers should only be used when hives are not present and only for pre-placement treatment of an apiary. Do not contaminate any water or food source that may be in the area or apply during windy conditions. For better soil penetration and improved efficacy, cut grass around hive prior to application.

Visit the MAAREC Website at: <https://agdev.anr.udel.edu/maarec/>

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