

Managing Small Hive Beetles

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The small hive beetle *Aethina tumida* (SHB) is an invasive pest of bee hives, originally from sub-Saharan Africa. These beetles inhabit almost all honey bee colonies in their native range, but they do little damage there and are rarely considered a serious hive pest.

How this pest found its way into the U.S. is unknown, but it was first discovered to be damaging honey bee colonies in Florida in 1998. It has since spread to more than 30 states, being particularly prevalent in the Southeast. The beetles have likely been transported with package bees and by migratory beekeepers, but the adult beetles are strong fliers and are capable of traveling several miles at a time on their own.

In Arkansas the beetles are usually considered to be a secondary or opportunistic pest, only causing excessive damage after bee colonies have already become stressed or weakened by other factors. Infestations of beetles can put significant stress on bee colonies, which can be compounded by the stress of varroa

mites and other conditions. If large populations of beetles are allowed to build up, even strong colonies can be overwhelmed in a short time.

Honey bee colonies appear able to contend with fairly large populations of adult beetles with little effect. However, large beetle populations are able to lay enormous numbers of eggs. These eggs develop quickly and result in rapid destruction of unprotected combs in a short time. There is no established threshold number for small hive beetles, as their ability to devastate a bee colony is related to many factors of colony strength and overall health. By maintaining strong bee colonies and keeping adult beetle populations low, beekeepers can suppress the beetles' reproductive potential.

Description

Adult SHB are 5-7 mm ($\frac{1}{4}$ ") in length, oblong or oval in shape, tan to reddish-brown, dark brown or black in color and covered in fine hairs, but their size and appearance can be highly variable within a population.



FIG. 1. Adult small hive beetles are often observed in the hive with their head and antennae tucked down beneath the thorax. They are oblong in shape, around 6 mm long, with variable coloration that ranges from tan to reddish-brown, dark brown or black.



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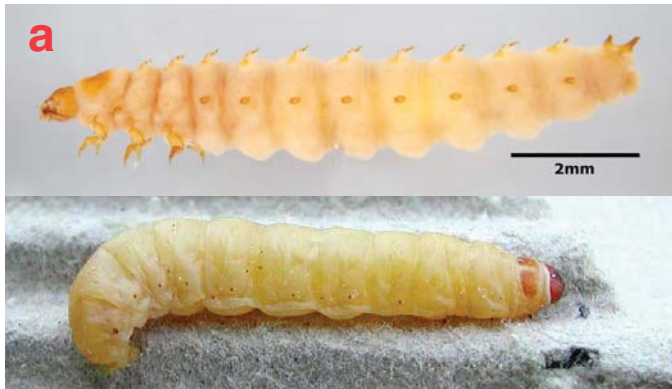


FIG. 2. The larva of the small hive beetle (a) could be confused with smaller larva of the greater wax moth (b). SHB larvae are distinguished by the numerous spines along the body as well as three distinct pairs of legs near the anterior end. Wax moth larvae lack spines and have an additional four pairs of short, less-developed prolegs. Both pests can be found in the same hive.



FIG. 3. Adult SHB can sometimes be observed running across the surface of the combs during hive inspections, often pursued by honey bees.

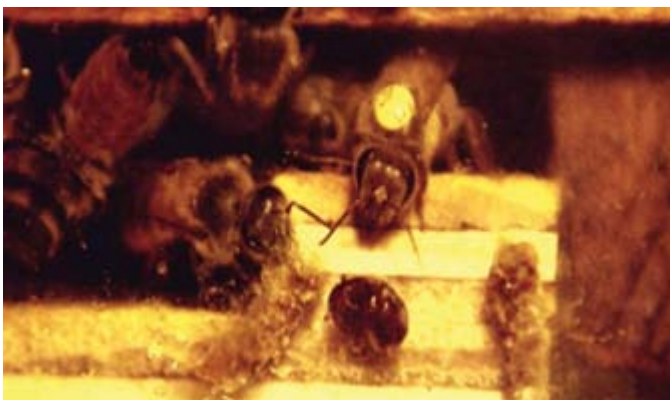


FIG. 4. Adult SHB seek shelter from bees in small crevices in the hive, inaccessible to honey bees. A confined SHB is guarded and fed by the worker bees.

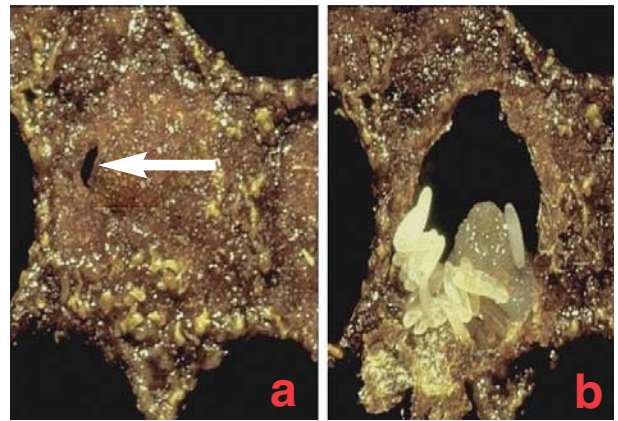


FIG. 5. Female SHB may puncture the cappings of brood comb cells for oviposition (a). SHB eggs may be deposited in masses directly on a pupating honey bee (b).



FIG. 6. Multiple SHB larvae in the cells of a honeycomb. Larvae feed on pollen and honey as well as bee brood, eggs and dead bees. Adult SHB may also prey upon honey bee eggs and larvae.



FIG. 7. Honeycombs infested with small hive beetle larvae take on a glistening or "slimy" appearance. Honey contaminated by beetle larvae is unfit for consumption by either bees or humans.

The adults are usually observed in the hive with their heads tucked down beneath the thorax so that antennae and legs are often not apparent (Fig. 1). The larvae are elongated, cream-colored to slightly golden grubs, growing to 10-12 mm ($\frac{1}{2}$ "). They may be mistaken for young larvae of the greater wax moth (*Galleria mellonella*). The two types of larvae can be differentiated by their appearance (Fig. 2). Beetle larvae have three pairs of well-developed legs near the anterior end, while wax moth larvae have three pairs of legs near the anterior and four pairs of less-developed prolegs toward the posterior. SHB larvae also have numerous dorsal spines, which wax moth larvae are lacking. Both pests can be found simultaneously in the same hive, however.

Honey bees are not able to efficiently remove adult beetles from the hive, and their hard shells resist stinging. Rather, the bees are observed to pursue adult beetles across the combs (Fig. 3). Beetles will seek cracks and crevices in which to escape from the bees, who in turn will imprison the beetles in these cracks, preventing them from escaping (Fig. 4). The beetles have developed the ability to stimulate the mouthparts of worker bees with their antennae, similar to drones begging for food, and are able to trick their guards into feeding them. This behavior allows the beetles to survive in confinement for extended periods. Opening hives for inspections may free the beetles from their confinement.

Sometimes the SHB population becomes too large for the worker bees to protect against, and the beetle population can increase rapidly. This may happen due to weakening colony health or declining bee population, or due to beekeeper action. When swarming occurs, the number of bees available to patrol the interior of the hive is reduced, which may allow the beetle population to surge. When colonies are split or nucs are created, the number of bees in the new colonies may be insufficient to protect against the beetle population. Mating nucs used in queen rearing may be particularly susceptible to SHB. Over-supernumerary hives provides the beetles with excessive space in which to move and hide and provides additional oviposition sites, while increasing the area that the worker bees must patrol.

The use of grease patties for tracheal mite control or the addition of protein supplement patties for spring build-up may increase SHB infestations. Both adult and larval beetles are attracted to these patties as a food source. If patties are found to be infested with larvae, remove and dispose of them immediately, wrapping them in several layers of plastic bags to prevent SHB from escaping.

The adult female beetles will lay egg masses in cracks and crevices around the hive or directly on pollen and brood combs. Beetles may puncture the capping or wall of a brood cell and deposit eggs inside it (Fig. 5). A single female beetle can produce over 1,000 eggs in her lifetime. Beetle eggs are similar in shape to those of honey bees but approximately $\frac{1}{3}$ the size. Eggs generally hatch in 2-4 days (Fig. 6), and

the larvae immediately begin to feed on pollen, honey and bee brood. In 10-16 days, beetles complete their larval development and will exit the hive to pupate in the soil. The majority of larvae remain within about 180 cm (6') of the hive they exit but can crawl much longer distances if needed. Larvae will burrow up to 10 cm (4") into the soil, where they remain 3-4 weeks to complete pupation. Within 1-2 days of emerging from the soil, adult beetles will seek out a host bee colony, which they locate by odors.

The adults are strong fliers and can disperse to other beehives easily. Beetles are also thought to travel with honey bee swarms. Individual beetles can live up to 6 months or more, and several overlapping generations of beetles can mature within a colony in a single season. Beetle reproduction ceases during the winter when adult beetles are able to overwinter within the bee cluster.

Damage

Economic damage from SHB occurs when the bee population is insufficient to protect the honeycombs from the scavenging beetle larvae. When adult beetles first invade a colony, they may go unnoticed until their populations increase through reproduction or immigration. Both adult and larval beetles will prey upon honey bee eggs and brood.

When large numbers of beetle eggs hatch in weak colonies, the combs of honey can become "wormy" and take on a glistening, slimy appearance (Fig. 7). Unlike wax moths, these beetle larvae do not necessarily damage the combs themselves and do not produce extensive webbing. Ruined honey can be washed from the combs, which may then be frozen for 24 hours to kill any beetles or eggs on them and placed back onto a strong hive to be cleaned and repaired by the bees.

When large numbers of adult beetles defecate in the honey, they introduce yeasts, causing the honey to ferment and run out of the cells. In this case, the queen bee may cease laying, and the entire colony may abscond. Weak colonies are particularly vulnerable to attack, but even strong colonies can be overwhelmed by large populations of beetles. Nucleus colonies used for queen production or colony splits can be especially vulnerable to beetle attacks.

Beetles can create sudden problems if bee escapes are used prior to harvesting and supers of honey are left virtually undefended by bees. If honey is removed from the hive but not immediately extracted, beetles can invade the honey house and quickly ruin a large portion of a honey harvest. Wet cappings from recently extracted honey are also extremely attractive and vulnerable to beetle infestation. Honey contaminated by small hive beetles will be rejected by bees, is entirely unfit for human consumption and should never be bottled or mixed with other honey for packing.

Detection

Beetles are easily detected by visual inspection of colonies. When a hive is opened, adult beetles may be observed running across the underside of the outer cover, on either side of the inner cover and on the top bars of frames. Also, beetles may be seen running across the surfaces of combs (Fig. 3). To detect beetles in the top hive body, open the hive, place the outer cover on the ground in a sunny spot and place the top hive body into the cover (Fig. 8). Conduct normal colony inspection activities on the rest of the hive. If present in the top super, adult beetles will retreat from the sunlight, and after about 10 minutes, you may lift the hive body and look for beetles in the cover. Beetles in the lower hive body will similarly retreat to the bottom board.

Strips of corrugated cardboard, with the paper removed from one side, or pieces of corrugated plastic (obtained as scraps from a sign shop) can be placed on the bottom board at the rear of the hive. Adult beetles, fleeing from bees, may seek shelter in the small spaces of the corrugations and can be easily seen. Bees may chew up and remove cardboard strips left in a hive for extended periods.

Varroa sticky boards are usually ineffective in detecting small hive beetles. Adult beetles prefer dark conditions, will migrate toward the tops of hives that have screen bottoms and may be more easily detected by placing corrugated strips on the top bars of the upper super or above the inner cover.

Small hive beetle larvae are often found clustered together in corners of a hive or on frames. This behavior also differentiates them from wax moth larvae, which are found scattered throughout a hive. Older beetle larvae orient toward light sources, and in the honey house, a single fluorescent light near the floor may attract beetle larvae which exit the hives when seeking a place to pupate. These larvae can be swept up and drowned in soapy water.

Surfaces of combs that appear slimy or fermented honey bubbling from the combs are positive signs of beetle activity. Fermented honey has an odor described as decaying oranges.

If you suspect the presence of hive beetles, you may contact your state apiary inspector to arrange a visit, or you may bring a specimen in alcohol to your local Cooperative Extension office for positive identification.

Control

Prevention is the most effective tactic of small hive beetle control. Chemical controls are available but are of limited use. Good beekeeping management practices in the bee yard and in the honey house are sufficient to contain hive beetle problems in most cases. A combination of cultural and mechanical controls will usually help to maintain beetle infestations within a manageable range.

Keep bee colonies healthy and strong. Reduce stresses from diseases, mite parasitism and other factors. Maintain and propagate bee stocks with hygienic traits that are better able to detect and remove pests and diseased brood. Eliminate, requeen or strengthen weak colonies.

Use caution when combining colonies or exchanging combs and hive bodies because beetles and their eggs can be introduced into other colonies, which can be overwhelmed. Making splits from heavily infested hives can cause a serious outbreak if insufficient numbers of bees remain to protect the hive. Avoid over-supering hives, which increases the area that the bees must patrol.

Maintain a clean apiary and honey house to reduce attraction to beetles. Avoid tossing burr comb onto the ground around hives, which may attract pests. Adult beetles appear to prefer shady locations. If possible, place hives where they receive direct sunlight at least part of the day. Keep hives and frames in good condition. Warped, cracked and rotten hive bodies provide beetles with many places to hide and make them more difficult to detect by bees or beekeepers. When debris is left to accumulate on a bottom board, beetle larvae can complete pupation inside the hive. Regular cleaning or use of screen bottom boards can prevent this build-up of debris.



FIG. 8. To detect SHB in the top super of a hive, place it on the lid of the hive in a sunny spot for about 10 minutes (a). The bright light will drive the adult beetles down to the bottom. When the super is lifted, adult beetles, if present, will be apparent on the inside of the lid (b).

Mechanical Traps for SHB

Numerous mechanical trap designs are available for use in the hive to control the adult SHB population. By maintaining a manageable adult beetle population in the hive, beekeepers can usually prevent a major infestation of beetle larvae, which cause the most destruction.

The **Hood Trap** attaches to a standard bee hive frame. It has a compartment filled with apple cider vinegar as an attractant and compartments filled with mineral oil, which drown the beetles as they enter. A drawback of this design is the empty space around the trap, which bees will often fill with drone comb, potentially increasing a problem with varroa if left unattended. This area of drone comb, however, can be regularly removed and disposed of when approximately 50 percent of the drone cells are capped, to effectively trap and remove a portion of reproducing varroa mites before they can emerge.

The **West Trap** is placed on the bottom board and requires a wooden shim to maintain proper space beneath the frames. It contains a shallow pool of mineral or cooking oil and is covered by a slatted screen that excludes bees. Adult beetles enter the trap from above to escape from bees and will fall into the oil and drown. Hives must be kept extremely level for these traps to be effective. These traps are not for use with screen bottom boards.

The **Freeman Beetle Trap** is similar to the West Trap in function. It replaces the bottom board with a 3 mm ($\frac{1}{8}$ ") screen mesh, as used for varroa control. An oil-filled tray is inserted into a compartment below the screen. Adult beetles enter the trap to escape from bees and fall into the oil and drown. Wandering beetle larvae may also fall into the trap as they attempt to exit the hive to pupate. These traps can passively eliminate some varroa mites as well. Hives must be kept level for these traps to work.

AJ's Beetle Eater traps consist of shallow oil-filled troughs with grooved lids. Traps are suspended between frames of brood or honey. Adult beetles enter the traps to hide from bees and are drowned in the oil. These traps are inexpensive and easy to use but must be emptied and refilled regularly. Also, the bees tend to propolize over some of the grooves. The manufacturer suggests placing a small sheet of vinyl across the top of the trap to prevent propolizing, but this may provide the beetles with sufficient cover without entering the trap. Similar in design and function, **Cutt's Beetle Blasters** are disposable and can be discarded when full of beetles.

Sonny-Mel traps are homemade, consisting of a small plastic sandwich box with 3 mm ($\frac{1}{8}$ ") holes. The bottom of the trap is filled with a layer of mineral oil and contains a smaller container (usually a small plastic lid) of liquid bait. To make a bait, combine 1 cup water, $\frac{1}{2}$ cup apple cider vinegar, $\frac{1}{4}$ cup sugar and the peel of 1 ripe banana, chopped in small pieces; allow to ferment for 1-2 days. These traps are placed on the top bars of the upper super and require the addition of a wooden frame to provide space for the trap.

The **USDA** beetle trap design utilizes a bait of fermented pollen and a one-way exit in the bottom board, similar to a triangular bee escape, through which the beetles may pass and become trapped in an oil-filled chamber on the other side. These traps cannot be used with screen bottom boards for varroa control or ventilation.

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Honey that is removed from a colony should be extracted within 1-2 days. Wax cappings are an attractive food for beetles and should be processed quickly or stored in sealed containers. Honey supers can be removed from weak colonies to lessen the territory of combs that the bees must patrol. If not ready for extraction, these supers can be placed on strong colonies, in a manner similar to protecting them from wax moth infestations. However, if small hive beetles or their eggs are present on the combs, the addition of these beetles can be sufficient to cause the strong colony to collapse. Honey supers can be frozen at -12°C (10°F) for 24 hours to kill all stages of beetles before transferring supers to a strong colony. Store empty supers under conditions of good air circulation and less than 50 percent humidity.

Pollen traps should not be left on heavily infested hives for extended periods. The unprotected pollen can serve as a substantial protein source for beetles as well as a protected breeding site.

Utilize mechanical traps in the hive to reduce the number of adult beetles that can produce eggs, while also reducing the need for pesticides.

Soil Treatment

The pupal stage is a vulnerable time in the beetle life cycle. Slightly moist, loose, sandy soil is optimal for their development. Locating colonies on hard clay or rocky soil, rather than light sandy soil, can reduce the number of beetle larvae that successfully pupate. If larvae are present in the colony, soil around the hive can be treated with a permethrin drench to prevent the larvae from pupating, killing them in the soil. ***Use with caution, as permethrin is highly toxic to bees!***

Prepare the site by removing fresh water sources and mowing vegetation around the hives to be treated to allow the solution to directly contact the soil. Mix 5 ml (1 teaspoon) GardStar® 40% EC into 1 gallon of water (enough to treat six hives). To avoid contaminating the bee hive surface with pesticide drift, do not use a sprayer. Apply the solution using a sprinkler can or watering can. Thoroughly drench the area in front of the hive (and beneath it if screen bottom boards are used), wetting an area 18-24 inches around the hive, ensuring that wandering beetle larvae will contact treated soil.

Application should be made late in the evening when few bees are flying. Do not contact any surface of the bee hive or landing board with insecticide. USDA testing indicates that permethrin binds to the soil and remains active for 30-90 days, depending on soil type, pH and moisture content. Reapply as needed.

Permethrin is corrosive and can cause irreversible eye damage. Avoid contact with eyes, and wear proper eye protection during application. **Read and follow all label instructions for the legal and appropriate use of any pesticide.**

Studies have indicated that soil-dwelling entomopathogenic nematodes have potential to provide some control of pupating SHB. Some species of these nematodes are commercially available from biological suppliers for use in the soil under and around bee hives. It is not yet evident whether these nematodes are effective in all soil types or if they can persist through drought or overwintering conditions in Arkansas. However, they may be useful as part of an overall integrated pest management plan.

Because of insufficient scientific evidence on the efficacy of this control method, the University of Arkansas cannot make specific recommendations for the use of nematodes at this time.

Chemical Treatment in the Hive

The chemical coumaphos (sold as Checkmite+ for varroa control) is the only pesticide registered for in-hive treatment of adult small hive beetles in Arkansas.

- Use one strip of Checkmite+ per hive.
- Treatments should not be applied while surplus honey is being collected.
- Do not place honey supers on a hive until 14 days after Checkmite+ strip has been removed, or treat hives after honey has been harvested.
- Prepare a 4x4" piece of corrugated cardboard by removing the paper surface from one side and covering the smooth side with duct tape or shipping tape to prevent the bees from tearing up or removing it.
- Cut a single strip of Checkmite+ in half and staple both pieces to the corrugated side of the cardboard.
- Chemical-resistant gloves must be worn while handling strips – **do not use leather bee gloves when handling this product!**
- Insert the cardboard square, strip side down, onto the center of the bottom board, or above the inner cover if screen bottom board is used.

- Beetles will seek shelter in the corrugations and contact the strip. Bees should not be able to contact the pesticide.
- Leave treatment strips in place for a minimum of 42 days, but no more than 45 days.
- Dispose of strips according to label directions.
- Do not treat the same colony with coumaphos more than two times in one year.

These instructions are presented as general guidelines. Users are responsible for reading and following all label instructions for the legal and appropriate use of any pesticide.

Selected References

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