

## CHAPTER 2.2.5.

# SMALL HIVE BEETLE INFESTATION (*AETHINA TUMIDA*) (INFESTATION WITH *A. TUMIDA* [SMALL HIVE BEETLE])

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## SUMMARY

*The small hive beetle, Aethina tumida Murray 1867 (Coleoptera: Nitidulidae), is a parasite and scavenger of honey bee colonies. Adult and larvae small hive beetles feed on honey bee brood, honey and pollen, thus causing brood death, fermentation of honey and comb destruction. The beetles can promote structural collapse of the nest and cause the adult honey bees to abscond. The extent of beetle-associated damage likely depends on climate conditions, among other factors. Small hive beetles tend to be more problematic in areas with warm temperatures and high humidity than in areas with lower temperatures and humidity. The small hive beetle can be a serious problem in honey-extracting facilities where stored comb, honey and wax cappings are potential feeding and breeding areas. Beetle development from egg to adult requires 3–12 weeks, depending on humidity, temperature and food availability. The flying adult beetles actively infest honey bee colonies of all strengths and sizes.*

**Identification of the agent:** *An infestation by the small hive beetle can be recognised either indirectly via colony-wide damage associated with the beetle or directly via eggs, larvae and adults. An early diagnosis can be made after opening the colony and finding adult beetles under the colony lid, on the bottom board, or hiding in the combs (especially peripheral combs).*

**Serological tests:** *No serological tests are applicable.*

**Requirements for vaccines:** *No vaccines are available.*

## A. INTRODUCTION

The small hive beetle (hereafter referred to as “beetle” or “small hive beetle”), *Aethina tumida* Murray, Coleoptera: Nitidulidae (Murray, 1867), is native to sub-Saharan Africa (Hepburn & Radloff, 1998) but has been found in the United States of America (1996), Egypt (2000) and Australia (2002) (Neumann & Ellis, 2008). Introductions were found in different regions of Canada in 2002, 2006, and annually from 2008 to 2012. However only the population in southern Ontario appears to be established (Kozak, 2010). Larvae and eggs of the small hive beetle have been identified in cages of imported queens in Portugal (2004), but all bee hives were destroyed immediately (Neumann & Ellis, 2008). The small hive beetle can be spread by active flying, movement of infested honey bee colonies, or transportation of infested hive products (Lundie, 1940; Hood, 2004). Within its native range in Africa, the beetle is usually considered a minor pest, and reproduction appears more successful in weak and stressed colonies or in recently abandoned nests (Lundie, 1940). However, it can cause considerable damage in colonies of European honey bee subspecies within its new ranges (Hood, 2004; Neumann & Elzen, 2004).

### 1. Life cycle

The infesting small hive beetle adults mate in the colony and the female beetles oviposit several eggs in typical clutches in small cracks or within capped brood cells (Ellis, 2005; Lundie, 1940). More than 1000 adult beetles may occur within a colony in some situations (Elzen *et al.*, 1999). Adult beetles can survive up to 6 months and females can oviposit about 1000 eggs in their lifetime (Lundie, 1940), though Hood (2004) suggested the upper limit may be 2000 eggs. Successful egg emergence is negatively correlated with relative humidity, with fewer eggs hatching at a relative humidity <50%. The larvae emerge from the eggs after 1–6 days (most within 3 days) and feed on pollen, honey and bee brood like the adults (Lundie, 1940; Schmolke, 1974). Adult beetles also can

be fed by worker bees via trophallaxis, especially while confined in bee-guarded “prisons” (Ellis, 2005). Larval development takes about 8–29 days depending on food availability and temperature (Ellis *et al.*, 2002b; Lundie, 1940; Schmolke, 1974). Following this, the larvae reach the wandering phase and leave the colony to pupate surrounding the colony (Lundie, 1940). Pupation takes about 2–12 weeks depending on temperature and soil moisture (Ellis *et al.*, 2004). Emerging adults leave the soil and can fly to search for new host colonies, thereby completing the life cycle of the small hive beetle.

## 2. Impact of the disease

The reason for the apparent difference in the impact of the small hive beetle on colonies within its native range and those in its new ranges are not well understood (Ellis & Hepburn, 2006). They may include quantitative behavioural differences between African and European honey bee subspecies, different beekeeping techniques used, climatic differences, and/or escape from natural enemies, among other plausible hypotheses (Hood, 2004; Neumann & Elzen, 2004).

While bee colony damage due to adult beetles is relatively minor, the adults can cause colonies to abscond (i.e. the adult bees completely abandon the nest, Ellis *et al.*, 2003). If not prevented by the, larval feeding behaviour often is associated with fermentation of stored honey, causes severe damage to combs and often results in the full structural collapse of the nest (Lundie, 1940). Economic losses also can be associated with beetle infestations in the honey-extracting facility. Environmental conditions generally associated with extracting facilities, such as high temperature and humidity, provide optimal conditions for beetle development. Cryptic low-level reproduction may also occur either in the debris or underneath hive inserts without any signs of colony damage (Spiewok & Neumann, 2006).

## B. DIAGNOSTIC TECHNIQUES

### 1. Identification of the agent

#### 1.1. Adult beetles

The first sign of an infestation by the small hive beetle is the occurrence of adult beetles (Figure 1). Adult beetles are ~5 mm long and ~3 mm wide, with females being slightly longer than males (Ellis *et al.*, 2001). The adults are a dark brown to black colour (lighter shortly after eclosion). During inspections, adults avoid sunlight, hide, and can be observed while running for cover into corners or similarly over the combs. Adults can be confused with other nitidulid beetles, which can also be associated with colonies (see Neumann & Ritter, 2004 and Ellis *et al.*, 2008 for examples).



**Fig. 1.** Dorsal (left) and ventral (right) view of an adult small hive beetle. Photographs by Lyle Buss (left) and Josephine Ratikan (right), University of Florida.

## 1.2. Beetle eggs, larvae and pupae



**Fig. 2.** Small hive beetle eggs. Photograph by Josephine Ratikan, University of Florida.

Small hive beetle eggs (Figure 2) are white,  $\sim 1.4 \times 0.26$  mm (length  $\times$  width);  $\sim 2/3$  of the size of a honey bee egg, and are oviposited in clutches in cracks, on the bottom board, on the combs and underneath the cappings of sealed brood cells. Larvae (Figure 3) are whitish, up to  $\sim 1$  cm long (wandering phase), have three pairs of legs, and have dorsal spikes. Larvae can be found mining in the wax combs (Lundie, 1940) or in colony debris (Spiwok & Neumann, 2006). Larval infestations are typically associated with a rotten smell due to death of honey bee brood and/or fermentation of the stored honey. Wandering larvae often leave smear trails (or “slime”) inside and outside the colony (Figure 4). Once in the ground, the larvae excavate small pupation chambers (Figure 5) 1–20 cm deep in the soil (Pettis & Shimanuki, 2000), develop into pupae (Figure 6, whitish to dark brown depending on age,  $\sim 5$  mm long and 3 mm wide) and then into adults. Most larvae tunnel into soil that is  $<180$  cm from the colony (Pettis & Shimanuki, 2000).



**Fig. 3.** Dorsal (left) and ventral (right) view of a small hive beetle larva. Photographs by Josephine Ratikan, University of Florida.



**Fig. 4.** Comb damage attributed to the feeding/crawling habits of small hive beetle larvae. Notice the “slime” on the frame (i.e. the wax comb looks “wet” and it “glistens”). This is caused by the fermentation of honey, which is moved around the comb by crawling larvae. Beetle larvae can be seen in cells in the centre of the comb, where brood was present originally. Photograph credit, University of Georgia.



**Fig. 5.** Small hive beetle larvae that has tunnelled into the soil and hollowed out a chamber in which to pupate. Photograph credit, University of Georgia.



**Fig. 6.** Small hive beetle pupa (ventral view). Photograph by Lyle Buss, University of Florida.

It is difficult to find beetle eggs in a colony, especially at low levels of infestation. However, one can look in cracks/crevices around the nest or in capped brood cells that have small holes in the cappings, possibly indicating that a female beetle has punctured the capping and oviposited within the cell. Small hive beetle pupae can be found by sifting the soil around the colony and looking for the pupal chambers or the pupae themselves.

### 1.3. Manual colony examination

When monitoring honey bee colonies for the presence of small hive beetles, an examination of the hive may provide an early indication of infestation. Adult beetles can be observed hiding inside the comb cells and in the debris at the bottom of the colony. Detailed instructions for colony examination follow and are modified from Ellis *et al.* (2002a) and Ellis & Delaplane (2006). This method can be used to search for beetle adults and larvae, if larval infestations are moderate to high.



**Fig. 7.** Inspecting a colony for adult small hive beetles. The individual on the right has shaken the bees onto a piece of plywood. He followed this by bouncing both faces of the framed comb onto the wood (dislodging beetles in the cells). The individual on the left is shifting through the adult bees and using a mouth aspirator to collect the beetles. Photograph by Keith Delaplane, University of Georgia.

#### 1.3.1. Notes:

- i) This procedure is best accomplished with two people, one to work the colony and the second to collect the beetles if quantification is desired. Only one person is needed if beetle qualification is the sole desired outcome.
- ii) Some beetles inevitably fly away or hide from view during this procedure. The number of beetles that escapes is presumed to be low (<5%).
- iii) This procedure is best used for qualification of adult beetles. However, larval beetles can be found this way as well.
  - a) Place a sheet of opaque plastic (~2 × 2 m, preferably white or light in colour) or plywood in front of the colony which you want to inspect for beetles.
  - b) Lightly smoke the colony.
  - c) Remove the lid from the colony and bounce the lid on the plywood. This should be done to dislodge all adult bees and beetles adhering to the lid.
  - d) A second individual (the beetle collector) should comb through the bees (this can be done with the hand or using a small stick) and collect all adult beetles seen using an aspirator. All bees on the plywood should be inspected since beetles easily can be concealed by clusters of bees (Figure 7).
  - e) Remove the outermost frame in the uppermost super (i.e. the uppermost “box” containing bees) and shake the bees from the frame onto the plywood.
  - f) The beetle collector should repeat step d.
  - g) Once the bees have been shaken from the frame, the frame should be turned onto its face and bounced against the plywood to dislodge adult beetles from the comb. This step should be repeated two-to-three times for both sides of the frame.
  - h) The beetle collector should repeat step d.

- i) The individual working the colony should repeat step vii to all frames in the uppermost super and then bounce the empty super on the plywood. This step should be repeated for all supers, all frames, and the bottom board of the colony.

#### 1.4. Colony examination using inserts and traps

Less labour intensive diagnosis is feasible using hive inserts. Such inserts have holes that allow for the beetles to hide in the corrugations but prevent bees from entering. They can be placed on the bottom board of the colony. To detect the beetles, place a piece of corrugated cardboard or similar material (15 cm × 15 cm), with one surface peeled away to expose the ridges, on the bottom board of the bee hive with the ridged side down. Cover it with wood to fit underneath the frames on the bottom board. Leave the insert in the colony for ≤ 3 days, remove it and examine for adult and larval beetles. A similar plastic insert (Figure 8) has been shown to detect adult beetles at the apiary level and can be predictive of adult beetle infestation rates (Schaefer *et al.*, 2008). Various insecticides can be used to kill adults in these inserts.



**Fig. 8.** Plastic insert used to detect adult small hive beetles. The plastic insert contains small holes (left) in which adult beetles hide when inserted onto the bottom board of a colony, through the colony entrance (right). The insert must be used in conjunction with a traditional solid bottom board rather than a screened bottom board. Photographs by James Ellis (left) and Stephanie Kimball (right), University of Florida.

Similarly, any number of commercially available small hive beetle traps can be inserted into colonies in accordance with the manufacturers' instructions. No specific trap recommendations are made here as there are many designs and most have similar efficacies. The majority of small hive beetle traps are placed on the bottom of the colony, within a frame of a colony, or between the upper part (or top bar) of two frames in a colony. Apple cider vinegar typically is added to the traps as it acts as an adult beetle attractant. Additionally, mineral or vegetable oil should be added to the traps as a killing agent. The adult beetles will wander into the trap, thus facilitating their qualification. The traps can be used in colonies to monitor for the presence of adult beetles regularly.

## 2. Serological tests

No serological tests are available for routine laboratory diagnosis.

## C. REQUIREMENTS FOR VACCINES

There are no biological products available.

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### FURTHER READING

An FAO publication, Honey bee diseases and pests: a practical guide, W. Ritter & P. Akatanakul (eds). Agricultural and Food Engineering Technical Report No. 4. FAO, Rome, Italy, 42 pp. ISSN 1814-1137 TC/D/A0849/E, is available free of charge at:  
[http://www.fao.org/WAICENT/faoINFO/AGRICULT/ags/subjects/en/industFoodAg/pdf/AGST\\_techrep\\_4.pdf](http://www.fao.org/WAICENT/faoINFO/AGRICULT/ags/subjects/en/industFoodAg/pdf/AGST_techrep_4.pdf)

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**NB:** There are OIE Reference Laboratories for bee diseases

(see Table in Part 4 of this *Terrestrial Manual* or consult the OIE web site for the most up-to-date list:  
<http://www.oie.int/en/our-scientific-expertise/reference-laboratories/list-of-laboratories/> <http://www.oie.int>).

Please contact the OIE Reference Laboratories for any further information on  
diagnostic tests and reagents for bee diseases