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Small hive beetle management options

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Small hive beetle (SHB), *Aethina tumida* Murray, Order Coleoptera (beetles), is a member of the Family Nitidulidae which contains a number of similar beetles native to Australia. This scavenger of honey bee colonies which originated from sub-Saharan Africa, was first identified in Australia in October, 2002. When identified, the SHB was well entrenched in feral and managed honey bee colonies, preventing any eradication attempt. The large number present and spread of the SHB indicated they had been in NSW for well over a year prior to identification. In their native homeland SHB are considered a minor pest to the African species of honey bees. Where SHB incursions have occurred and European honey bees are managed in hot humid locations e.g. south-eastern USA 1998 and eastern Australia 2002, SHB have become a major pest of beekeeping industries.

Current distribution

SHB can be found throughout much of New South Wales and Queensland as far north as Ingham. SHB have also been found on a few occasions in Victoria but conditions appear not to suit its establishment. In the eastern states, distribution of the SHB is widespread, particularly along the warmer coastal strip where climatic conditions better suit the SHB life cycle. In 2007 an incursion occurred into the north of Western Australia at Kununurra. It appears SHB may have become established at Kununurra.

Spread

Since its discovery, SHB has spread rapidly through Queensland and New South Wales. Factors aiding its rapid spread have been:

- The migratory nature of commercial beekeeping in Australia. Beehives are often moved over large distances and inadvertently carry any SHB present to new locations.
- The strong flight capability of SHB. SHB quite readily take flight when temperatures are high and seek out new colonies. It is suggested that SHB are capable of flying over 10 km and they can readily detect and intrude into honey bee colonies, aiding their establishment in new areas.

Large numbers of feral honey bee colonies have allowed SHB to become established in areas of suitable climatic conditions.

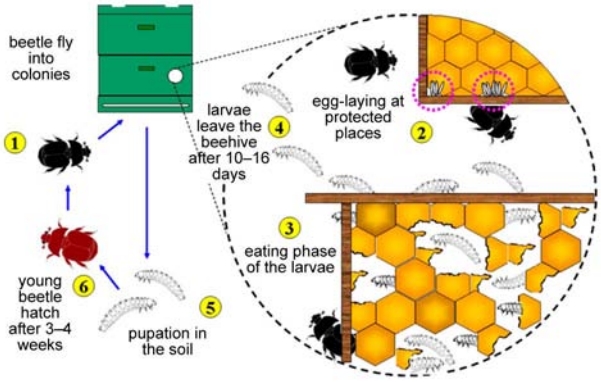
Life cycle

Temperature and available food will cause variation to the life cycle with higher temperatures (to a threshold) resulting in faster development rates. Lack of protein in the diet slows development of larvae and results in smaller adult SHB. Egg laying by female SHB also declines to zero relative to the protein in their diet.

Average development rates

SHB can reproduce on fruits in the laboratory with limited success; however, it is very unusual to see SHB on fruit in the environment. Honey bee colonies are their much preferred food source.

The lifecycle of the small hive beetle *Aethina tumida* (Murray 1867)



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Eggs	1–6 days	Usually 2–3 days
Larvae – feeding – wandering	10–28 days 6–14 days 4–3 days	Usually about 16 days
Pupae	10–60 days	Usually 21–28 days
Adults – sexual maturity – life	 7 days 6 months	

Identification

Eggs

Pearly white colour, about 1.4 mm long and 0.26 mm wide, about two-thirds the size of a honey bee egg. Eggs are laid in irregular clusters usually in cracks and crevices in honey bee colonies, close to a food source.

Larvae

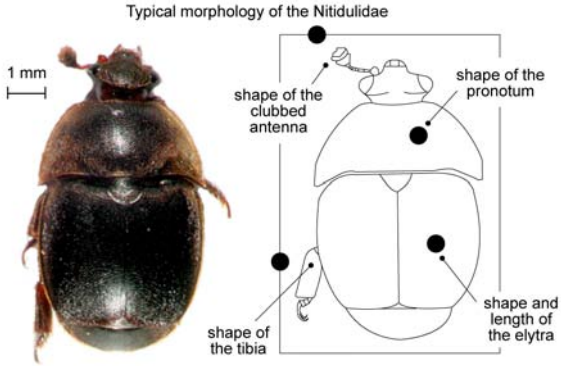
Creamy white colour, growing to 10 mm long and 1.6 mm wide. They have six prolegs at the front of the body that provide good grip and two rows of small spines along their back. Unlike wax moth larvae which produce webbing (the damage left is dry), SHB larvae chew through combs, causing the honey to ferment, resulting in 'sliming' of the combs. It is this stage of the life cycle that causes the most damage to honey bee colonies.

Pupae

Mature larvae leave the hive to pupate within close proximity to the hive. They usually burrow into moist soil to a depth of 5–20 cm but can utilise a range of moist mediums. SHB can crawl large distances (>100 m) to find suitable conditions for pupation. Pupae start creamy white and change to a chestnut brown to black as they develop into an adult beetle form prior to emergence.

The small hive beetle *Aethina tumida* (Murray 1867)

Typical morphology of the Nitidulidae



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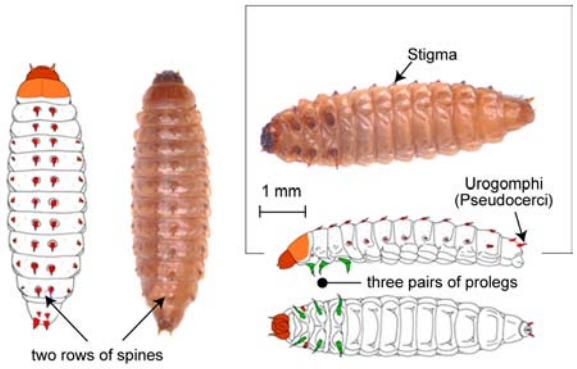
The small hive beetle larva *Aethina tumida* (Murray 1867)



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Adults

Adult SHB are dark brown to black oval-shaped beetles, usually around 4–7 mm long and 2.5–3.5 mm wide. Size varies as a result of diet during the larval stage. A partial covering of fine chestnut coloured hairs makes them difficult to pick up. The main recognisable features are rounded clubbed antennae, the abdomen protruding from the elytra (wing cases) and the shield shape of the pronotum (covering over the thorax).

Finding SHB in a hive

Locating SHB in a bee hive can be difficult when SHB numbers are low. When there are large numbers present in the hive, SHB are readily seen scurrying to darker locations, avoiding the light. To locate SHB when in low numbers, there are two options.

1. Open the hive. Place the lid on the ground and place the super squarely on it. Leave a few minutes and SHB will move down into the lid to avoid the light. Remove the super and inspect the lid for SHB. A similar approach can be used for the brood box using a loose bottom board.
2. Unobtrusive checking. In the hive, SHB seek refuge from the harassment of bees. Placing a piece of coreflute or corrugated cardboard in the hive, sealed at one end, provides an ideal hiding location for the SHB (holes need to allow SHB entry but prevent bees). A wire can be attached to allow placement and removal via the hive entrance. Preferably position it at the rear of the bottom board. Leave for a few days and then remove and inspect for SHB.

Potential damage

- SHB are capable of prolific multiplication. Under laboratory conditions 80 SHB can become more than 36,000 adult SHB by day 63. SHB can cause severe damage to honey bee colonies and stored equipment, resulting in the colony

collapsing. Feeding SHB larvae cause most of the destruction by:

- Consuming bee eggs, bee brood, pollen and honey.
- Burrowing through combs and cappings, leaving them damaged. Thin-walled new combs are more susceptible than older combs.
- Defecating in and thereby contaminating honey with a yeast that causes the honey to ferment, froth and weep out of the cells. Affected frames are said to be 'slimed'. This honey is not usable for bee or human consumption.
- Large numbers of SHB in a hive can result in the queen bee stopping laying and the colony absconding from the hive.
- Stored honey supers (full or extracted), stored hive equipment, slum gum, broken frames, unclean extracting sheds etc. are all very susceptible to SHB larval damage because no bees are present to protect them from adult beetles laying eggs. Spoilage of honey, damaged combs and increased SHB populations can result.

It is estimated that 6000 SHB larvae can be reared from a single frame of brood.

Weak or queenless hives are considered to be more susceptible to SHB damage than strong healthy colonies. However, all colonies are susceptible to damage when large numbers of SHB are present.

Hive manipulation is also considered to increase risk to colony breakdown, especially under conditions of high SHB numbers, temperature and humidity.

Management strategies

Many of the strategies to minimise SHB damage may only need to be utilised during the summer period when temperatures are reaching 30°C plus and humidity is 70% or higher. Under these conditions SHB activity increases and climatic conditions suit reproduction.

SHB management for the apiary

Maintain strong, healthy colonies with young productive queens. Unite weak colonies together or combine them to strong colonies. Boost weaker colonies with a frame of capped brood from strong colonies (make sure you are not transmitting AFB).

Minimise hive manipulations. To reduce the chance of SHB reproduction after manipulation, leave the hive lid slightly ajar or place a stick under one side of the lid to increase air flow through the colony, thereby reducing humidity. Return to normal after 4–6 hours. If robbing starts, close immediately.

Keep a high bee to comb ratio. Make sure that bees do not have too much comb relative to colony size by removing excess supers.

Avoid leaving clearer boards on hives beyond 2 days. As the bee to comb ratio declines so does the protection provided by the bees against the SHB. This can lead to a suitably warm location for rapid SHB development which can result in honey spoilage.

Avoid areas of known high SHB populations during high risk times. If SHB are a major problem where you have your bees, if possible move them to an area with less SHB or to an area less favourable for SHB reproduction (e.g. west of the Great Dividing Range).

Minimise cracks and crevices in the hive. Use good quality equipment and remove burr comb and items that prevent bee access to areas such as cover mats.

Keep the bottom board free of debris. SHB can breed in this debris in low numbers unbeknown to the beekeeper, thereby increasing the SHB population in the area.

Take care when re-queening. The combination of hive stress, hive manipulation and an obstacle (queen cage) that prevents bee access to an area provides a set of circumstances suitable for SHB reproduction.

Avoid using combs/equipment that are infested with any stage of the SHB life cycle. Infested or 'slimed' combs/equipment should first be decontaminated (see 'Equipment recovery') prior to re-use.

Maintain good hygiene around the apiary. Do not leave dead colonies, combs, burr comb, beeswax scraps, etc. around the apiary that can attract and encourage SHB to breed.

SHB management for honey bee colonies

Commercially available

A few commercial products are available to trap and reduce adult beetle populations. Most rely on the principle of SHB seeking protection away from the harassment from bees and are effective in controlling adult beetles only in honey bee colonies. The size differential between SHB and bees is utilised, with most devices permitting SHB entry while preventing access to the larger bee. The main devices available in Australia are:

Beetltra®

– Semi-permanent attachment onto the bottom board base either screwed or pop riveted on.

– Can be accessed without hive disturbance.

Beetltra trap un-attached (upper) and attached (lower) to a bottom board. Slits or holes allow SHB entry into a removable reservoir containing lime.

– Manufacturer recommends the use of garden lime in the reservoir.

AJ Beetle Eater®

– Sits between the top bars of the frames.

– Must open hive to install and remove.

– Relies on oil reservoir to kill SHB.

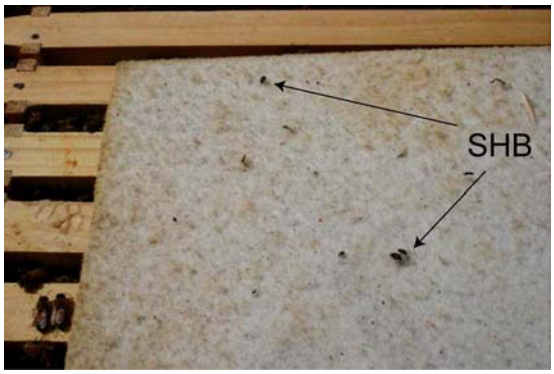
– Hive movement can result in oil spillage.

AJ Beetle Eater being placed in a hive. Oil is then put into the reservoir. Photo courtesy of Department of Agriculture and Food, Western Australia

Home made

Home made trapping devices are limited by the imagination with new ideas continually evolving. Most are reservoir type devices that provide SHB refuge from bee attack by preventing bee entry. A range of different container types can be used including jars, takeaway food containers, Petri dishes, fishing tackle boxes, etc. The reservoirs (trapping devices) can be attached or put anywhere within the hive but more success has been obtained by attaching or placing them on the bottom board. It is easier to use a container that fits into or onto the hive so that major hive modifications are not necessary. To date the most effective products used in the reservoirs have been vegetable oils, agricultural lime or diatomaceous earth. Be aware that anything put into the hive can result in contamination within the hive. Using or making the container opaque encourages SHB entry. SHB entry holes, drilled or melted, should be 4.5 mm in diameter.

Felt type materials can capture adult SHB which become tangled in the fibres, providing bees a better opportunity to attack them. Floor vinyl backed with felt, grey geotextile (used in road construction) or some carpet types can be used as cover mats for this purpose.



Floor vinyl cover mat with dead SHB adults captured in the felt backing.

Corflute can be used under the lid or placed in the hive entrance onto the bottom board. A string or wire attached allows easy placement and removal. SHB seek refuge in the material. Regularly checking and killing SHB present in the harbourage can help to reduce SHB numbers in the hive.

The control devices described above are better suited for beekeepers with stationary hives rather than commercial migratory operations.

A range of SHB traps including fishing tackle boxes, corflute and packaging used for screws etc. The reservoirs contain either garden lime or edible cooking oil.

Chemical

In-hive chemical control of SHB: no in-hive chemical treatments are currently registered in NSW for SHB control. The use of home made chemical baits etc. in beehives is illegal and poses a major risk to the beekeeping industry through chemical contamination of apiary products. This could be extremely damaging to export markets and the industry's reputation.

Permethrin (500 g/L)

Permethrin can be used as a soil drench around beehives or ground intended for hive placement to break the SHB life cycle by killing pupating larvae. See the Australian Pesticides & Veterinary Medicines Authority (APVMA) Permit – PER9469 (expires 31 March 2009). You must obtain a copy of the Permit. The solution is prepared by adding 1 ml of permethrin (500 g/L) per 1 litre of water and is applied to the soil at 4 L prepared solution per square metre. Applications are only to be done when SHB adults or larvae have been observed in or around the hives. Caution needs to be taken when using around hives as it is an insecticide that will kill bees. The prepared solution should be applied late in the evening after bees become inactive or 1–2 days prior to hives being placed on a new site. Thoroughly wet the ground in an area 45–60 cm wide in front of each hive or a 1 m radius where hives will be placed. Application can be repeated at 30 day intervals. The product must be used in the manner specified in Permit PER9469. It is recommended that the grass be cut prior to application and apply using large droplet sizes to prevent spray drift, e.g. from a watering can. Prevent livestock from grazing treated areas.

SHB management for stored equipment

Techniques used for wax moth control are also effective for SHB control.

Aluminium phosphide (phosphine)

Can be used to fumigate stored equipment in the same way that it is used for wax moth control. The product must be used in the manner specified in Permit PER8486 (expires 30 June 2010). You must obtain a copy of the Permit.

Not only does it kill all stages of the SHB, it is also **toxic to all other insects and mammals, including humans.** Only one registered product is available to use for this purpose: Fumitoxin® fumigant coated insecticide tablets from Nufarm.

Boxes of combs to be fumigated should be placed in a sealed container, or wrapped in thick, gastight plastic. Place the pellets on a tray so they are not touching; do not heap them. Complete release of

An example of the warning sign to use when fumigating

the gas will take 3–5 days. Post warning signs on all four sides of the stack or container (**danger – .poison gas – keep away**). Lock and seal the exit door after application. Always refer to the label directions for use, and read the instructions for full details of how to use the product.

Whatever the method used to fumigate combs, the process should not be carried out in the vicinity of people, pets or other livestock. The fumigation area should never be part of, or attached to, a house.

Do not use when temperatures are below 15°C and relative humidity within the area to be fumigated is less than 25%.

The gas will penetrate wood and combs and will kill all stages of the SHB. It will not, however, prevent the reinfestation of combs. Therefore it is necessary to recheck for any SHB activity on a regular basis, depending on the degree of risk, or the ambient air temperature.

Before the combs are placed back on a colony, any residue gas should be allowed to dissipate, by thoroughly airing for not less than 48 hours. Phosphine should not be used on combs containing honey meant for human consumption.

Safety

Store unused or partly used containers in a locked room, away from children, animals, food, feedstuffs, seed and fertilisers. Store pellets in the closed original container, in a dry, cool, well-ventilated area out of direct sunlight. A risk assessment should be conducted of the location in which the fumigation is to take place. The premises should not be attached to a building or be a part of a building in which people will be present during the fumigation process. Aluminium phosphide tablets should be transported in an open environment, not in an enclosed space (such as a motor vehicle interior).

Very dangerous

This product can kill if swallowed. It releases dangerous phosphine gas slowly in moist air and immediately if wet. Do not inhale the vapour, as it

can kill if inhaled. Avoid contact with eyes and skin. Do not inhale dust. Open the container in the open air. Keep it away from water and liquids. Keep it away from naked flames, as it forms toxic gas. Wear elbow-length PVC gloves when opening the container and using the product. If dispensing by hand, wear a full-face respirator with combined dust and gas cartridge (canister) or supplied air respirator. Wash your hands after use.

First aid

If the person applying phosphine experiences headaches, or in any way feels unwell, they should immediately remove themselves from the area in which the phosphine is being used. If poisoning occurs, contact a doctor or the Poisons Information Centre (phone 13 11 26). Do not give mouth-to-mouth resuscitation if it is swallowed. For protection, the rescuer should use an air-viva, oxy-viva or one-way mask, and resuscitate in a well-ventilated area.

Cool rooms

The temperature thresholds for SHB survival and/or reproduction have not yet been accurately determined.

Freezer rooms: it is known that temperatures below freezing will kill all stages of SHB.

Cold rooms: for prevention of SHB damage to equipment it is necessary to prevent SHB reproduction. This can be achieved with constant temperatures of 10°C or below.

Low humidity

SHB eggs are susceptible to desiccation. SHB damage can be prevented by maintaining a low relative humidity of around or below 40%. This can be achieved using dehumidifiers in closed rooms, the use of fans to provide air movement through the equipment or by storing equipment to allow good air flow through it.

Equipment recovery after SHB damage

Individual frames with small localised damage caused by SHB larvae can be placed into a strong colony to be cleaned. Care must be taken not to introduce SHB into the receiving hive. For more severe infestations and colony damage, infected equipment should be removed and all SHB killed (freeze, drown). The use of washing up detergent or bleach in water kills larvae faster. Once all SHB are killed the frames and equipment are soaked and washed thoroughly to get rid of the spoilt honey. Rinse thoroughly, dry and return washed equipment back into a strong colony to clean up any remaining damage. It may take some time for bees to accept the SHB damaged equipment.

Future control methods

NSW DPI in conjunction with Rural Industries Research and Development Corporation (RIRDC) have developed an SHB refuge impregnated with insecticide that relies on direct SHB contact for control. Trials have shown promising results, with 90% plus corrected mean percentage reductions in SHB numbers in the hives trialled. The device is specifically designed to prevent bee access as the insecticide is very lethal to both SHB and bees. The insecticide has a low vapour pressure, reducing the risk of residue contamination. The device can be inserted into the hive via most hive entrances making it easy to install and remove from a colony. The product requires commercialisation and registration but to date has not attracted commercial interest.

Recent research has found that adult SHB carry a yeast that grows on pollen and omits volatile chemicals that attract adult SHB. This knowledge may lead to the design of an effective lure/trap for use inside and/or outside of a beehive.

Chemical users

All pesticide users in NSW must hold a training qualification, as required under clause 7A of the NSW Pesticides Regulation 1995. Training at AQF Level 3 is required to use fumigants.

Notification

SHB is a notifiable pest under the *Stock Diseases Act 1923*, and as such beekeepers are required to inform a NSW DPI inspector gazetted under the Stock Diseases Act of SHB within 48 hours of becoming aware of its presence.

References

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Somerville, D. (2007). *Wax Moth*. NSW DPI Primefact 658.

Boecking, O. (2005) The small hive beetle *Aethina tumida.* Typical morphological aspects and the life cycle. http://beebase.csl.gov.uk/pdfs/shb.ppt#1

Additional Reading

APVMA permit 9469
http://permits.apvma.gov.au/PER9469.PDF

APVMA permit 8486
http://permits.apvma.gov.au/PER8486.PDF

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