MAAREC
Mid-Atlantic Apicultural Research & Extension Consortium

Delaware, Maryland, New Jersey, Pennsylvania, West Virginia and the USDA cooperating

WAX MOTH

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The wax moth is a mixed blessing for beekeepers. The moths recycle combs of colonies that die in the wild as well as the beeswax combs of the beekeeper. They are also raised for use as fish bait, animal feed, scientific research and they are a good representative insect to use in Biology and Entomology classes. Beekeepers see the wax moth as a pest.

The beekeeper is more likely to see the adult moth but it is the larval or caterpillar (worm) stage that causes damage to wax comb. The larva is most destructive to beeswax combs in storage, especially in areas that are dark, warm and poorly ventilated. Annually it is estimated that the wax moth causes more than 5 million dollars in losses to beekeepers in the U.S.

The wax moth is regionally called the bee moth, the wax (or bee) miller or a webworm. There are both a greater wax moth, the most destructive comb pest, and a lesser wax moth, which, due to its smaller size, is less serious. There are three related moth pests of stored products that may also be found on combs or in bee hives. These are the Mediterranean flour moth, the Indian meal moth and the dried fruit moth. These last 3 feed mainly on pollen and are less destructive as they do not make extensive webs in the wax combs.

Most beekeepers know the damage wax moths cause. The moth life cycle consists of 4 stages. The first life stage, the egg, is tiny. Eggs are not noticeable unless we specifically look for them. Usually the female adult lays her eggs in batches. The eggs are laid in cracks between hive parts in dark out of the way places. Females produce up to 300 eggs each.

Wax moth eggs hatch to the larval stage in 5 to 8 days. New larvae burrow into beeswax comb attempting to reach the comb midrib. They are specialists to eat and grow and feed for 1 to 5 months, depending on the temperature. When fully grown, they are 3/4ths of an inch long and look like your typical caterpillar. They have a dark, hard head capsule, 3 pairs of small segmented legs and several body segments, some of which have caterpillar prolegs. They are white initially, turning dark grey as they age.

In contrast to its name, the wax moth does not digest beeswax. It lives on impurities in comb and for this reason prefers to infest beeswax comb that has been used for brood rearing. Foundation is seldom bothered and only by small larvae that often die before reaching the adult stage. In capped honey, young larvae tunnel just below the cappings. This causes harvested honey to leak from packages and makes comb honey less attractive and salable.

The third life stage, or cocoon, is a transformation life stage from caterpillar to adult. Fully grown larvae spin a silk cocoon that is dense and tough. It does this in comb or in debris at the bottom of the hive but more frequently it is firmly attached to the frame or hive body. The cocoon is cemented into a boat shaped cavity the larvae chews in the wood. This damage persists in equipment long after the wax moth emerges. Once the cocoon is spun, larvae change to the pupal stage.

Wax moth pupae may hatch rapidly or take 2 months to change to the adult stage depending upon temperature. Adults are 3/4ths of an inch with longer wing span (1 1/4 to 1 1/2 inches). Males are slightly smaller and can be distinguished by a scalloped front wing margin compared to a smooth one in females. The wings fold roof-like over the body; wing scales and body are a non-descript grayish-brown. Adults often run before they take flight when disturbed.

Wax moths fly mainly at night. During daylight they rest in dark spaces. They have acute sensory capability to find and exploit beeswax. They readily enter bee hives to lay eggs but the bees keep their numbers under control. It is in stored equipment or in weakened or die out colonies that their numbers explode. We then find all 4 life stages, tunnels of silk throughout the combs, especially near midribs, deposits of dark fecal matter, cocoons stuck to frames everywhere and a disintegrating comb structure. If left to continue or not quickly detected all the beekeeper is likely to see is the gritty debris of comb remains on the bottom board and boat shaped cocoon attachments with no or little comb left intact.

CONTROL OF WAX MOTH IN COLONIES

The bees themselves are the best control of wax moth in active bee colonies. It is not unusual to find an occasional wax moth adult or larva in a colony. They will be in out-of-the way places and in areas bees can't get to such as areas between top bars and inner covers. The bees may even have sealed the caterpillar off with a propolis fence. If you have many combs, especially darker combs that have had brood in them, or a weak colony, more wax moths and their damage may be evident.

Beekeepers frequently state that wax moths are responsible for killing their colony. They are not capable of doing this. What has happened is that the colony became weak, or more likely lost its queen, and the population dwindled to where there were too few adults to protect the combs. The adult female lays her eggs and the caterpillars hatch and grow. The caterpillar protected in its silken tunnel is hard for the bees to remove. Before the beekeeper discovers the weakened or queenless colony, the damage can accelerate. Under favorable conditions in the southern U.S. or tropical climates, wax moths can completely destroy brood combs in a month.

In addition to insuring active, populous colonies, keeping the hive clean and free of debris can help reduce wax moth damage. The bees need access to all parts of the hive. Don't neglect to remove the debris that accumulates on the bottom board or in cracks and crevices. Reasonable removal of burr comb and propolis will also help remove places where wax moths can become established.

CONTROL IN STORED COMBS

When we remove and store drawn comb, we increase the opportunity for a wax moth infestation. The warmer the temperatures, the more vigilant we must be. Simply trying to put frames in plastic bags won't be enough because eggs could already be present. Storing drawn comb outside in the open air won't suffice either unless you are in an area of freezing winter temperatures of the northern states. If you store comb, plan to protect it from wax moth.

FUMIGATION

Several materials have been used to fumigate beeswax combs before placement in storage. For beekeepers in more northerly states, one fumigation may suffice as normal winter temperatures will keep wax moths under check over winter. Currently paradichlorobenzene (PDB) is the fumigant of choice. It can be purchased from bee supply dealers or at hardware and drug stores everywhere. Be sure you purchase 100% PDB and not the other common moth fumigant naphathlene.

PDB is heavier than air so you don't need to put it at the bottom of a stack of supers/hive bodies. Since it does not kill the egg stage, you need to be sure you have a continuous fumigation in areas of high temperatures. PDB cannot be used to fumigate honey filled combs.

Beekeepers build or purchase various types of structures to store drawn comb when not in use on colonies. Some beekeepers fumigate and then store combs in more wax moth proof enclosures. You can also store combs outside, stacked so you can fumigate as well as keep rodents and weather damage to a minimum. The queen excluder is helpful to keep stacked equipment rodent proof.

PDB works best above 70°F as it volatilizes to the gas state. It is non-explosive and nonflammable. Since beeswax comb can absorb the gas odor, you should air combs that you remove from storage before using them on bee colonies. To get the best fumigation, stack your hive bodies as tightly as possible, even taping cracks and broken covers. Use 3 ounces of crystals for each stack of 5 full depth boxes or 8 half depths. Placing the crystals on a piece of cardboard or newspaper is preferred over putting the crystals directly on the top bars. Remember the gas is heavier than air so you should put the crystals at the top of the stack. Keep the bottom closed to help retain the fumigant in your equipment stack. If the ambient temperature remains high, check the crystals every month or so and replenish as necessary.

PROTECTING HONEY IN THE COMB

You should not fumigate honey with PDB that you intend to eat or sell. Simply removing and packaging honey may not be enough however, since wax moth eggs may already be present when you remove the honey from the hive. The tiny larvae are going to chew through cappings and make unattractive silken tunnels on or just below the surface of the cappings. The honey will ooze from the holes and this plus the webbing and debris will quickly make your honey unattractive and unappealing.

You can use carbon dioxide to fumigate honey for sale as well as to fumigate drawn comb you will store in moth proof enclosures. Some fruit and vegetables are treated with carbon dioxide so you might be able to use the existing facility of a farmer in your area rather than build a unit of your own. You need a 98% CO_2 concentration for 4 hours under slight heat (100°F) and moderate (50%) humidity to adequately protect against wax moth. Longer fumigation under less ideal conditions may not necessarily suffice.

Alternatives are to use heat or freezing temperatures to protect honey in the comb. Both methods are temperature and time dependent. The colder or hotter the temperature the less time required. For example at 20°F you should leave comb honey in for 4 1/2 hours but at 5°F you need keep it only 2 hours. If you use heat you need at least 115°F for 80 minutes of exposure or 40 minutes at 120°F. Above 120°F you may melt wax. Be sure you get even distribution to avoid hot pockets. Cold is generally easier and safer to use than heat, since a freezer works quite well.

Heat or cold treatment is preferred over PDB fumigation by queen and package bee producers. There is no odor or chemical residue that may interfere with queen rearing.

NATURAL CONTROL

A natural microbial bacteria Bacillus thuringenisis (Certan®) has been discovered that is specific for wax moth. It was once

available for sale by bee supply companies but is no longer manufactured. Other Bt's (Dipel, Thuricide) widely used to control caterpillars are not fully effective against wax moth. A virus also kills wax moth under natural conditions but no commercial preparation is available. Using the sterile male release technique has been shown to be a possible control strategy under test conditions but no program currently uses this methodology.

There are traps available for stored product pests such as Indian meal and Mediterranean flour moths. They use synthetic sex attractants and live captured females to trap and eliminate the males. So far a trap effective against the wax moth has not been developed as males apparently do not rely solely on chemical pheromones to find females; they also use ultrasound. A component of the female sex pheromone Nonanal is also found in beeswax and may help explain how wax moths find beeswax for oviposition.

Wherever wax moth's exist we also find a wasp predator - a braconid wasp. It helps keep numbers down in an outbreak situation but is not effective enough for beekeepers to use in on-going moth control.

Beekeepers will never completely win the battle against wax moth. It is an insect well adapted for surviving around bee colonies. We need to be vigilant to not allow wax moth to take more than their share of drawn comb that the bees work so hard to produce.

MAAREC, the Mid-Atlantic Apiculture Research and Extension Consortium, is an official activity of five land grant universities and the U. S. Department of Agriculture. The following are cooperating members:

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Participants in MAAREC also include state beekeeper associations, and State Departments of Agriculture from Delaware, Maryland, New Jersey, Pennsylvania and West Virginia.

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