STORING AND PROTECTING BROOD COMB FROM WAX MOTH

WAX MOTH SPECIES & BIOLOGY

In Manitoba, we have both species of wax moth; greater wax moth, *Galleria mellonella* L and lesser wax moth, *Achroia grisella* F. (Fig 1). Both species can cause significant damage to hive equipment but greater wax moth larvae are considered the more impactful and a more serious pest than lesser wax moth (Fig 2). The dried fruit moth, *Vitula edmansae* L. is another stored product pest found in Manitoba, which can also cause damage to hive equipment. Similar in size to lesser wax moth, this pest is also considered less destructive than greater wax moth. This infosheet focuses on greater wax moth as the principal pest of concern and will simply be referred to as wax moth.

Figure1: Adults of the Greater wax moth (left) and Lesser wax moth (right)

Figure2: Mature larva (left) and Adult moth (right) of the Greater wax moth.

Wax moths are able to detect the smell of beeswax from great distances away using their antennae. The moths are most attracted to dark comb because it contains pollen and pupal skins that are an ideal protein source for the developing larvae. Although wax moth is capable of damaging supers, it much prefers brood comb and unless the infestation is extremely large, super comb is rarely damaged by wax moth.

Climatic factors such as temperature and wind direction have a strong influence on whether or not wax moth is likely going to be a significant pest in a given year. For example, a hot summer/fall is typically more prone to wax moth outbreaks than a cool summer/fall. In terms of wind direction, years where there have been several days of strong southerly winds during the spring, combined with warm spring temperatures has often resulted in increased populations of migratory pest like diamondback moth and wax moth. Temperature and relative humidity (RH) play a crucial role in determining the amount of time wax moth requires to complete its lifecycle. The optimum temperature for development is 29˚C - 35˚C with moderate 30% – 50% RH. It takes between 3-5 days for the eggs to hatch when the temperature is 30˚C, and up to 35 days at 18˚C. Under ideal conditions it can take only 20 days for the larvae to complete its larval cycle, but in suboptimal conditions it can take several months.

Feeding damage can occur at all larval stages but the final instar (i.e. 4th instar) is generally considered the most damaging stage (Fig 3). Prior to pupation, the mature larva will chew a cavity into the frame forming a gallery where it will spin a cocoon. In cases when there are large numbers of wax moth pupating between the frames, the combs can become fused together. Under ideal conditions, the pupal cycle can be completed in approximately a week, but under suboptimal condition it could take months. For a detailed description of the biology and lifecycle of greater wax moth, please visit the following link: [Greater wax moth Galleria mellonella: biology and use in immune studies Oxford Academic (oup.com)]

Figure 3: Greater wax moth silk webbing and larvae feeding on brood comb wax and pollen.

IMPACT OF WAX MOTH ON STORED COMB

When winter losses are high and dead hives are not being repopulated with bees the succeeding summer, concerns about how to properly store the brood chambers and protect them from pests like wax moth are widespread amongst beekeepers. It is important to put this risk into perspective in terms of *potential* impact vs *probable* impact. For example, if you currently have an ongoing problem with wax moth in your operation, having to store a lot of brood chambers without bees to protect them would certainly increase the potential impact of this pest. The risk that an outbreak of wax moth could occur increases dramatically because of the increased habitat and food (i.e. brood chambers). The fact that there is an existing population of wax moth in the operation further increases the risk that the wax moth population would not have to migrate very far to find ideal feeding and breeding habitat. Now, if the environmental conditions in the storage area where the brood chambers are stored is ideal for wax moth development, the likelihood (i.e. probability) that the wax moth could develop into an outbreak situation and cause significant damage to the stored comb increases dramatically.

Although increasing the amount of stored brood chambers could greatly increase the amount of habitat and feed for the pest, without an existing wax moth population and favourable environmental conditions for the wax moth to thrive, the likelihood of an outbreak of wax moth in a single summer in Manitoba is fairly low. It is therefore important to know whether you have an existing population of wax moth in your operation and/or be able to monitor for the pest to determine if or when control strategies are needed. In most cases, if there is not an existing wax moth population in the operation, simply monitoring for the pest and minimizing pest access to the stored equipment may be sufficient to

prevent an outbreak. Separating the brood chambers from the honey supers can be an effective way of focusing your monitoring and cold storage needs on the dark comb.

MINIMIZING WAX MOTH DAMAGE THOUGH MONITORING AND PROPER STORAGE

The simplest way to monitor for wax moth is to set up a light trap in the shed where the brood chambers are being stored. It can be as simple as a light bulb over a pail of soapy water or using a "black light" to increase the attractiveness. Using a bug zapper can also be an effective way of ensuring that the attracted moths meet a quick demise. Using this light trap technique is a form of early detection on whether wax moth adults are able to access or are already in your storage shed. Periodically (e.g. once or twice a month) checking for wax moth feeding in your stored brood chambers is still the best and safest way to stay on top of minimizing the impact of wax moth.

Storing the brood chambers under environmental conditions that either kill the pest or at least minimize the feeding and development of the pest can be an effective control strategy on its own and when combined with monitoring can determine if additional control activities are required to break the development of the pest and reset the population as low as possible. Unused equipment should be stored in a cool (i.e. <12˚C), well-ventilated building. Wax moth are discouraged from colonizing equipment in dry, well-lit areas as opposed to a dark, damp buildings. In fact, you are better off criss-crossing your boxes rather than trying to create a so-called "moth- proof" stack of boxes.

Storing brood chambers in refrigerated trailers or over wintering buildings with air conditioning can be an effective way to protect the equipment for wax moth and if held at a cold enough temperature can not only effectively halt feeding and development of the larvae but it can kill them. Below are the shortest times found for killing wax moth larvae via cold storage:

-15˚C	for 2 hours
-12˚C	for 3 hours
-7˚C	for 4.5 hours
0˚C	for 4 hours
+2˚C	for 6 days
+5˚C	for 10 days
+10˚C	for 15 days

Heating the brood chambers has also been used to kill wax moth. Exposing the equipment to 46˚C for 80 minutes or 49˚C for 40 minutes will be sufficient to kill all life stages of the pest. Treatment exposure periods should not begin till specified temperatures are reached. Combs should not be heated above 49˚C because combs will sag above this temperature and beeswax melts at about 64˚C. Frames of comb should be heat-treated only in the upright position and should not be handled until allowed to cool. Heat treatment should be used only for comb containing little or no honey.

Beekeepers have reported perceptions that wax moth mortality in the above listed ambient temperatures may sometimes be reduced due to larvae being tucked into equipment matrices that limit

full temperature exposures; thus the extension of some temperature treatments may be considered in regards to expectations on the above listed temperatures and their 'treatment durations'.

Currently, only one chemical control product is registered for managing wax moth in beekeeping equipment in Manitoba: Certan. Certan is a biological control agent that uses the bacterium *Bacillus thuringiensis* Berliner var. *aizawai* (Bt) to target and control wax moth larvae in equipment. It is registered under an Emergency Use authorization specific to Manitoba. While not approved for use Canada-wide, Certan does not require special permission for purchase and is available at local beekeeping supply stores.

Prevention is generally regarded as the best form of control.

Below is a list of key prevention tactics for managing wax moth infestations:

- Maintain strong colonies: a well populated hive will be better able to protect itself against wax moth invasion; also better at removing wax moth larvae and repairing moth damage
- Do not leave "deadout" hives in the beeyards
- Avoid long-term storage of equipment (i.e. try to use all the supers/brood chambers at least once per season)
- Separate dark and light comb in your storage shed. Wax moth prefers and thrives on dark comb
- Store unused equipment in a cool, well-ventilated building
- Wax moth are deterred from colonizing equipment in dry, well-lit areas as oppose to a dark, damp environments
- Criss-crossing boxes rather than trying to create a so-called "moth- proof" stack of boxes may be beneficial
- Using bug zappers or bait traps can sometimes help to control adult moths
- Monitor stored equipment for the presence of wax moth larvae on a regular basis through the summer
- If at all possible, store all comb equipment in an unheated, non-insulated building over winter.

If you have any questions regarding wax moth monitoring and control, please feel free to contact Manitoba Provincial Apiarist Derek Micholson (Derek.Micholson@gov.mb.ca) or KRTP Program Lead Matthew Polinsky (krtpmb@gmail.com)

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