WAX MOTH

Biology and
Treatment Methods
Against Wax Moth

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INTRODUCTION

- Wax moths were the leading beekeeping pests in some regions of the US until the mid-1980s. At that point Varroa parasitic mites were imported and quickly spread to all regions of the country.
- Wax moths are still a problem and damage from these pests can be significant if the pest is not controlled.
- There are two wax moth species found in all regions of the US:
  - Greater wax moth, *Galleria mellonella*
  - Lesser wax moth, *Achroia grisella*
- The lesser wax moth is much smaller problem than the greater wax moth.
- These moths are attracted by hive odors and enter a beehive during the night.

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WORLDWIDE DISTRIBUTION

The wax moth was first reported in the Asian honeybee.
It spread world wide to northern Africa, Great Britain, parts of Europe, the Americas, Australia, and New Zealand.

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WAX MOTH AND BEES

- **Italian bees** are better at controlling the larvae of greater wax moth than some other races of Apis mellifera.
  (Milum, 1940; Morse, 1978).
- **African hybrids** in South America are more adept at recognizing greater wax moths and preventing their entry into the hive than European honey bees.
  (Eischen et al. 1986)
- However, **Africanization of European honey bees** in Venezuela apparently has led to increased greater wax moth problems, a result of additional absconding leaving combs unprotected.
  (Hellmich and Rinderer, 1990).

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THE TROUBLE MAKERS

- **Greater Wax Moth**
  Galleria mellonella
  aka honeycomb moth

- **Lesser Wax Moth**
  Achroia grisella

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THE GREATER WAX MOTH

- **Scientific name:**
  Galleria mellonella
- **Other names:**
  Bee moth, bee miller, wax miller, honeycomb moth, and webworm.
- **Best environment:**
  Combs in dark, warm, poorly ventilated places.
- **Their prey:**
  Weak, diseased, starved, or otherwise abnormal colonies.
- **They feast:**
  honey, pollen, and brood.
- **Aggression and cannibalism** has been shown in wax moth.

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WHY SHOULD WE CONTROL THE WAX MOTH?

- Sadly, very few studies have been done on wax moth, due to the fact that it does not destroy food crops and that it can easily be controlled.
- Beekeepers control them to prevent damage to equipment.
- It has never been considered a major pest, and other pests like Varroa, Small Hive Beetles, and tracheal mites are of bigger concern.

Wax moths vector pathogens:

Wax moths vector viruses:	
IAPV	Israeli Acute Paralysis Virus
BQCV	Black Queen Cell Virus
Varroa also spreads these viruses.	

Their fecal matter spreads:	
Paenibacillus larvae	American Foulbrood

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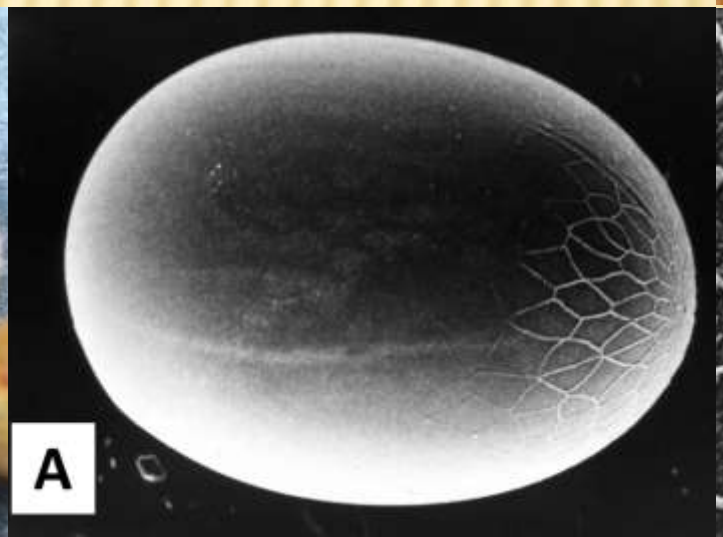
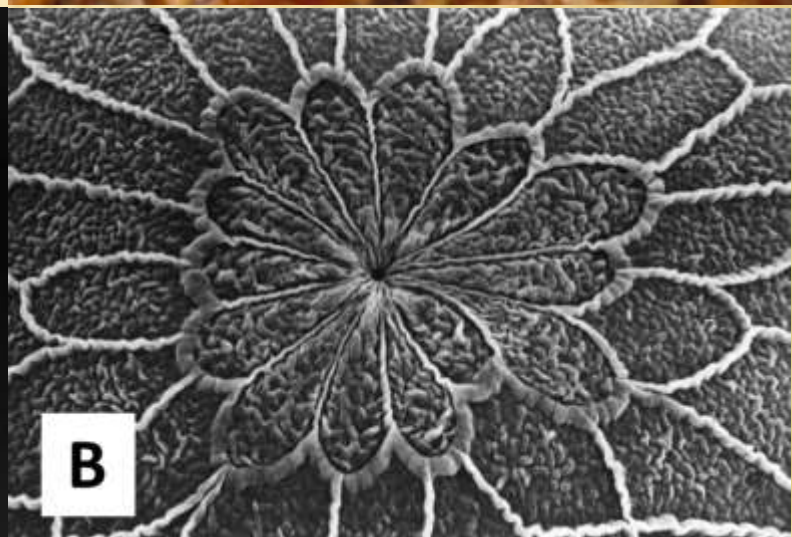
DEVELOPMENTAL STAGE: EGG (5 – 35 DAYS)

- Small, white to light pink, and slightly oblong with a size of less than 1/5th of an inch.
- Laid in cracks the farthest from the light.
- Females lay clumps of 50-150 eggs.
- After 4 days, the larvae is visible inside of the egg with a dark ring.
- 12 hours before hatching, the larvae is fully visible through the egg shell (chorion).
- Eggs hatch at 75 - 80F in 5-8 days.
  Egg hatching in lower temperatures of 50-60F may take up to 35 days.





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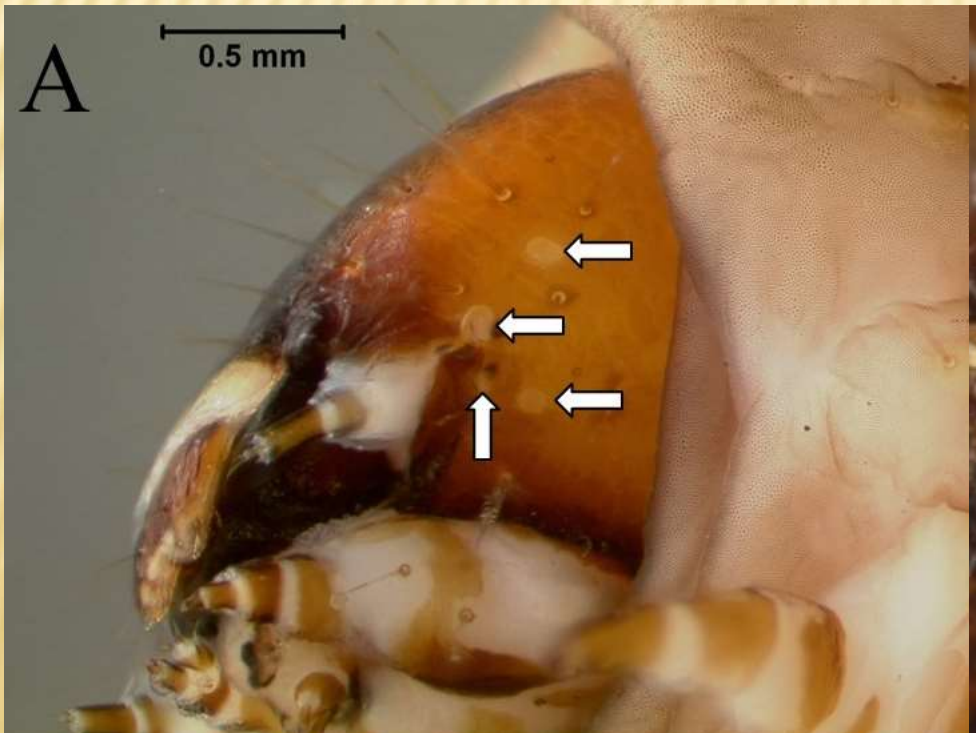
DEVELOPMENTAL STAGE: LARVAE (20 – 150 DAYS)

- Larvae is white and small in size 1-3mm (1/25”) when hatched.
- It burrows almost immediately into wax and tunnels through the comb foraging. Wax moth larvae is capable of boring into wood.
- This is the only developmental stage in which wax moth eat.
- The foraging time is usually 28 days, but can be as long as 5 months, or until it reaches it’s full size of 7/8”. The moth itself molts during this period 7 times.
- The larvae has the ability to eat and digest polyethylene plastic.
  In laboratory experiments about 100 caterpillars consumed 92 milligrams of a plastic shopping bag over the course of 12 hours.



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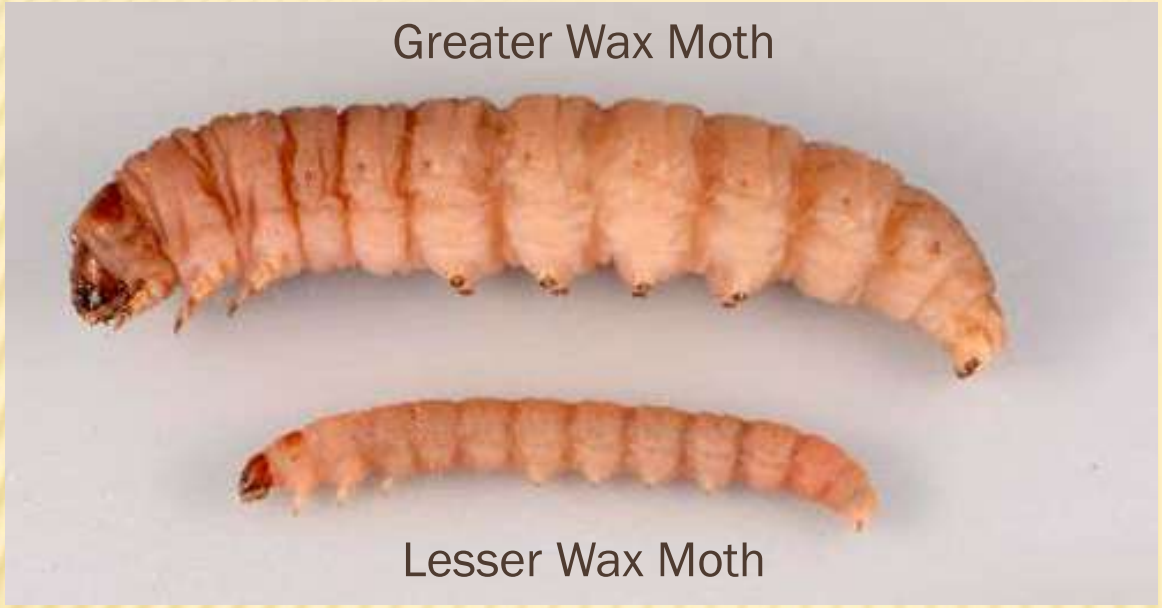
WAX MOTH - SMALL HIVE BEETLE

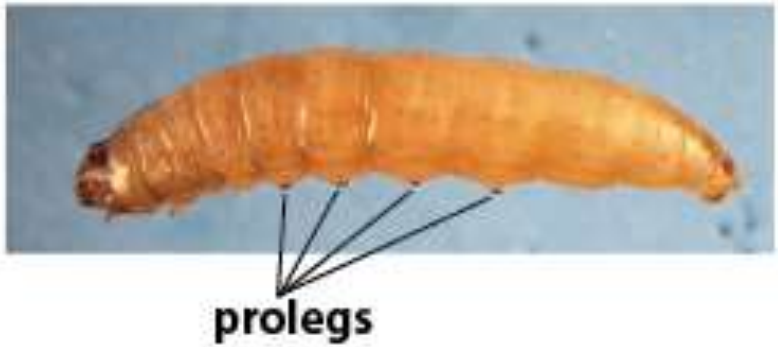


Larvae cannot be sexed.

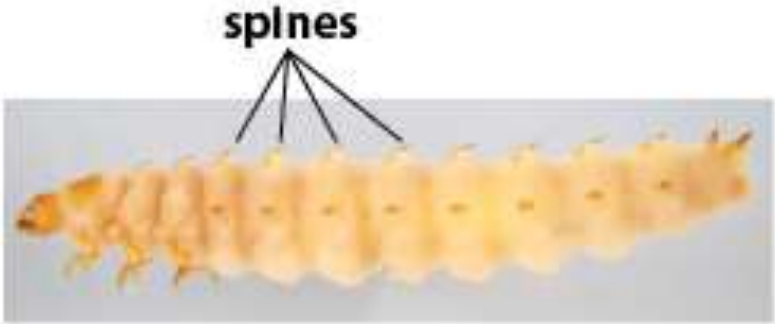
Wax Moth and Small Hive Beetle

The small hive beetle larvae may resemble greater wax moth larvae (*Galleria mellonella*).

Greater wax moth larva: no spines, has prolegs



Small hive beetle larva: spines, no prolegs



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DEVELOPMENTAL STAGE: COCOON (2 – 3 DAYS)

- The larvae will spin a cocoon to pupate. This process takes about 2 ¼ days to complete.
- The greater wax moth larvae tend to congregate in the hive whereas the lesser wax moth larvae are more likely to be found individually in tunnels within the comb.

DEVELOPMENTAL STAGE: PUPA (8 – 62 DAYS)

- Within the cocoon the larvae changes into a pupa usually in 4 - 6 days under ideal conditions.
- This stage can lasts 8 - 62 days, allowing the pupa to overwinter when temps are cold.
- After 4 days the pupa will darken into a dark brown color.

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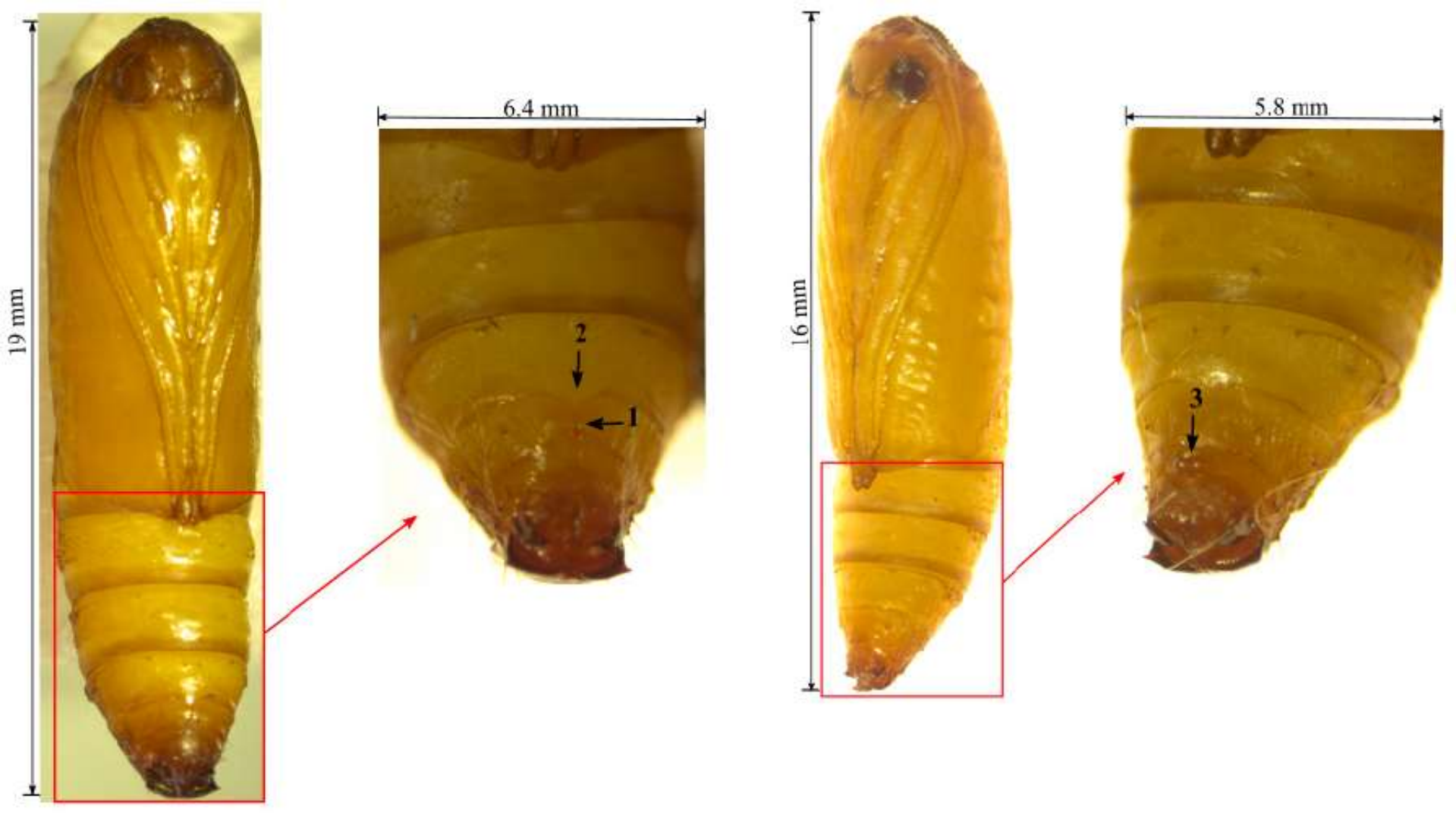
DEVELOPMENTAL STAGE: PUPA WAX MOTH CAN BE SEXED



Female pupa:

(1 and 2) cloven sterna forming copulatrix's aperture.

Male pupa:

(3) a pair of small rounded knobs representing the phallomeres.

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DEVELOPMENTAL STAGE: ADULT (7 TO 21 DAYS)

- Wax moths are not easily disturbed and would rather run than fly.
- Wax moths are attracted to strong bee colonies since there is a strong hive smell.
- Adults do not feed at all. They have mouth parts but their proboscis is underdeveloped.
- Greater wax moth females live about 12 days and males 21 days. Lesser wax moths are shorter lived with females 7 days and males 13 days.
- After mating the female will start laying eggs for the rest of her short life.
- Greater wax moth females can lay over 2,000 eggs per day, but the average is about 700.
  Lesser wax moth females will lay 250 - 300 eggs per day.

Greater Wax Moth
Top - male
Bottom - female

Lesser Wax Moth
Top - male
Bottom - female

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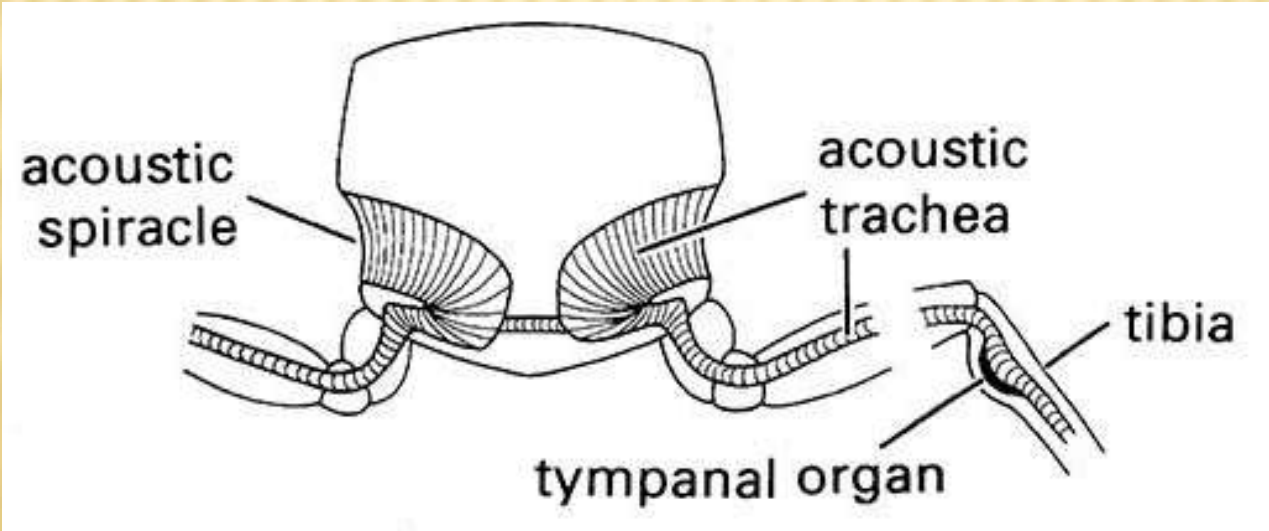
WAX MOTH MATING RITUAL

- Wax moth are nocturnal and their peak activity is between 6pm and midnight.
- Males and females fly out to nearby trees.
- Males produce a short ultrasonic sound from their tympanal organ to stimulate females. It is reported wax moths are capable of hearing ultrasonic frequencies approaching 300 kHz, possibly the highest frequency sensitivity of any animal.
- The females in return fan their wings releasing her pheromones.
- This stimulates the male and he releases a sex pheromone.
- The female gets attracted and seeks out the male to copulate.
- Only the females will return to the bee hive.



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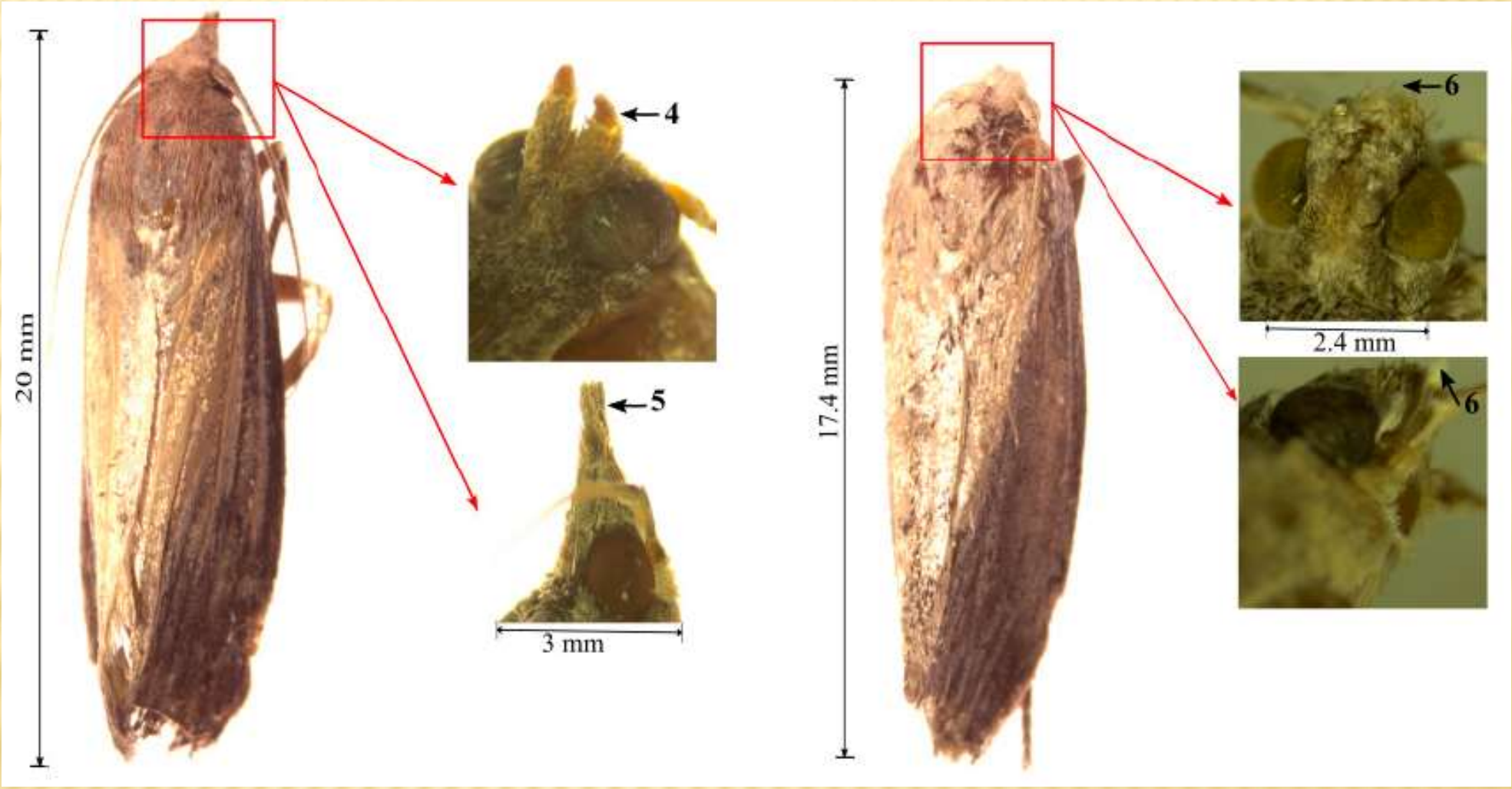
GREATER ADULT WAX MOTH SEXING



Wax moth female adult:
(4) bifurcated proboscis,
(5) labial palps projecting forward (beak like appearance).

Wax moth male adult:
(6) curved and inwardly hooked labial palps (snub-nose appearance).

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	Lesser Wax Moth Eggs	Greater Wax Moth Eggs
size	0.41 ± 0.02 × 0.31 ± 0.01 mm (l × w)[1]	0.44 ± 0.04 × 0.36 ± 0.02 mm (l × w)[1]
description	nearly spherical creamy-white in color[2]	spheroid to ellipsoid, ovoid or obovoid, pink-cream white in clusters of 50-150 eggs[2]
length in life stage	7-22 days, depending on environmental conditions; 7.1 ± 1.0 days[3]	3 - 30 days depending on environmental conditions[2]
diagnostic characters	"Reticulation limited to anterior end, carinae surrounding primary cells conspicuously broader around outer margins of cells"[1] (Fig. 1)	"Reticulation at least faintly visible over entire surface, carinae surrounding primary cells of uniform width"[1] (Fig. 1)
	Lesser Wax Moth Larvae	**Greater Wax Moth Larvae**
Size	1-20 mm long; fully grown = 18.8 ± 0.4 mm (length)[3]	first instar = 1-3 mm (length) fully grown = 12-20 mm (length), 5-7 mm diameter[2]
description	narrow white bodies with brown heads and pronotal shields[2]	creamy-white with gray to dark gray markings, a small slightly pointed, reddish head[2] (Figs. 6, 7, and 9)
length in life stage	6-7 weeks at 29° to 32°C; 30.10 ± 2.5 days[3]	6-7 weeks at 29° to 32°C[2]
diagnostic characters	"Stemmata absent (Fig. 4); spiracle with black peritreme thicker on caudal margin"[4] (Fig. 5)	"Head with 4 stemmata on each side (Fig. 4); spiracle with yellowish peritreme of uniform thickness"[4] (Fig. 5)
	Lesser Wax Moth Pupae	**Greater Wax Moth Pupae**
Size	11.3 ± 0.4mm in length & 2.80 ± 1.89 mm in width[3]	12-20 mm in length & 5-7 mm in width[2]
description	yellow-tan pupa in a white cocoon often covered in frass and other debris[2]	dark reddish brown pupa in an off-white, parchment-thick cocoon[2] (Fig. 9)
length in life stage	37.3 ± 1.2 days[3]	6-55 days depending on environmental conditions[2]
	Lesser Wax Moth Adults	**Greater Wax Moth Adults**
size	male = 10 mm long female = 13 mm long	15 mm (length) with a 31 mm average wingspan
description	small, silver-bodied with a conspicuously yellow head, oval shaped forewings and heavily fringed hind wings[2]	heavy-bodied, reddish brown with mottled forewings and pale cream-colored lightly fringed hind wings[2]
lifespan	female = 6.90 ± 1.135 days male = 12.90 ± 1.30 days[3]	female = ~ 12 days male = ~ 21 days[2]
diagnostic characters	"Forewing breadth less than 5 mm; termen of forewing convex (hindwing of male with concave termen); Cu of hindwing apparently 3-branched; labial palps conspicuous though short (length not exceeding diameter of eye); labial palps of male transversely incurved, pincerlike"[4] (Figs. 11 and 12)	"Forewing breadth 5 to 7 mm; termen of forewing concave; Cu of hindwing apparently 4-branched; labial palp long (about as long as longest leg spur) and protruding" (Figs. 11 and 12)[4]

Table: Standard Methods for Wax Moth Research; James D Ellis

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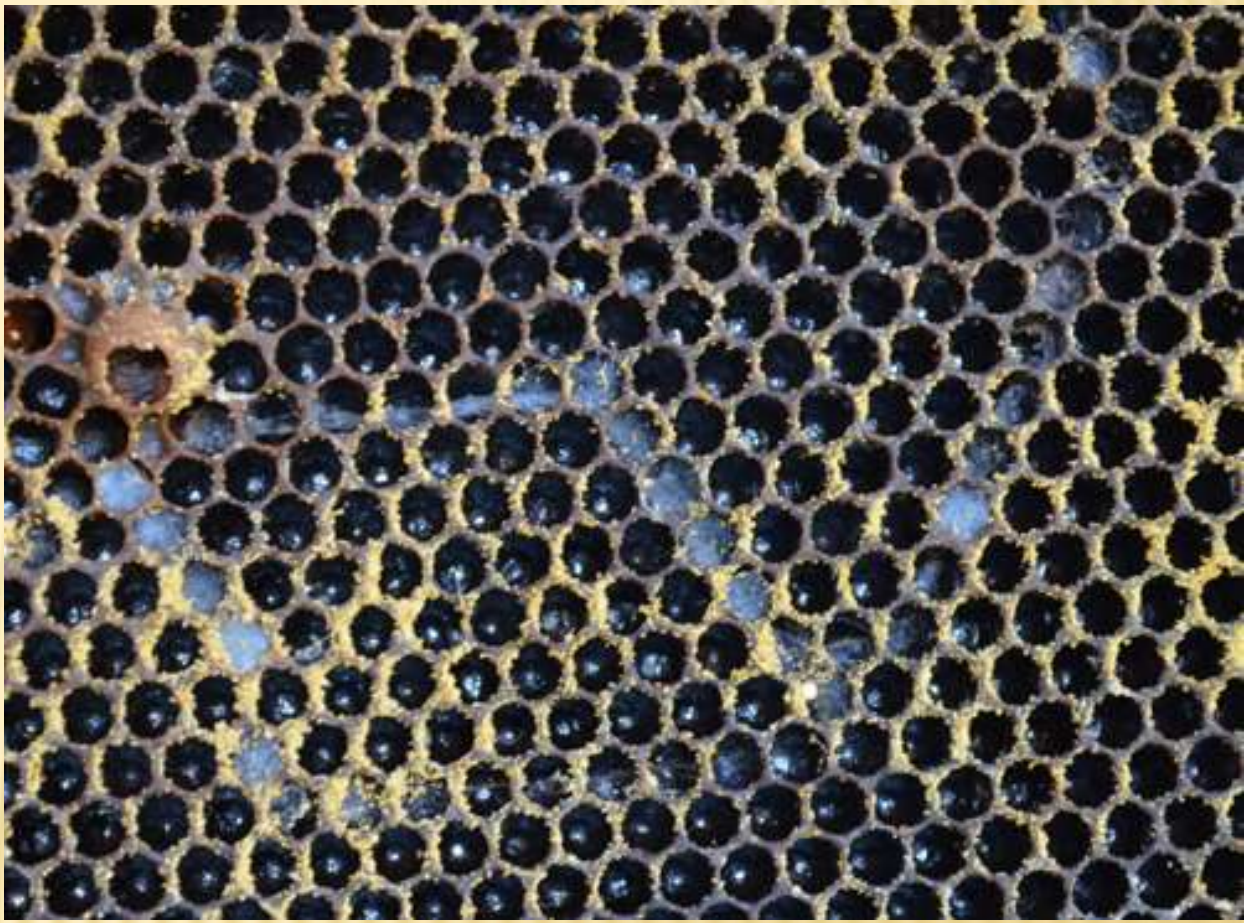
EARLY SIGNS OF WAX MOTH

- Tunneling is the first sign.
- Wax moths prefer:
  - Honey supers
  - Comb with pollen stores
  - Brood comb with cocoons
  - Or simply wax
- Stored comb is their preferred target.



Linear pattern with webbing is the give away.
See all the yellow specks?
Wax moth frass.

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WAX MOTH AND BROOD

- **Brood Balding:**
  Greater wax moth tunneling under brood will raise the brood and caps. Bees know something is not right and uncap the brood and brood balding can be observed. The lesser wax moth tunnels underneath the cap causing the same symptoms.
- **Bee Cannibalism:**
  Some form of cannibalism can be observed in bees as they will eat some of their brood's head; a protein rich resource. More advanced pupa stages may remain untouched and these bees usually hatch normally.
- **Deformed Legs and/or Wings:**
  Some honey bee pupae nearing maturity may have deformed legs or wings. One of the causes of this deformity is a result of wax moth excreta affecting the final molt of the pupa before its emergence from the cell.
- **Galleriasis:**
  Newly formed adult bees are sometimes unable to emerge from their cells. These bees are trapped by silken threads produced by greater wax moth larvae tunneling at the base of the cells. These young bees eventually die inside of the cell and are later removed by hive bees. This is a minor problem and is rarely seen.

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BAD CASES

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WOOD DAMAGE

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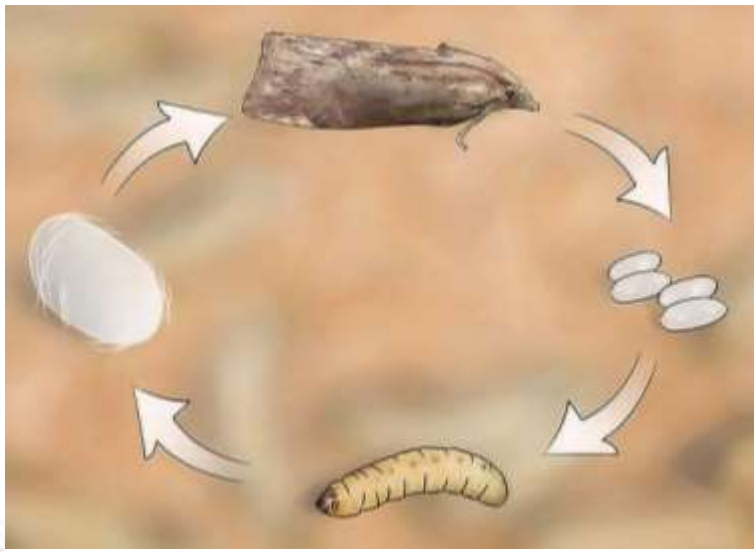
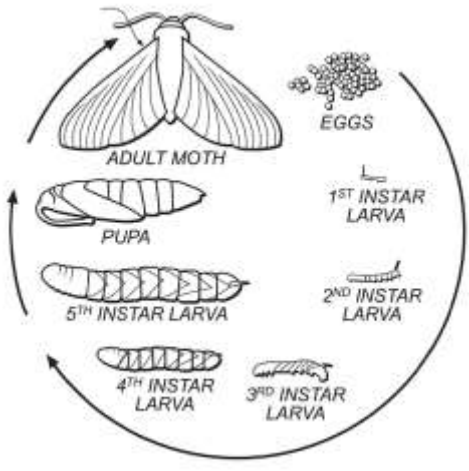
IPM OPTIONS

IPM
Integrated Pest Management





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MECHANICAL METHOD: HAND COLLECTION

- Collecting by hand…perhaps not…

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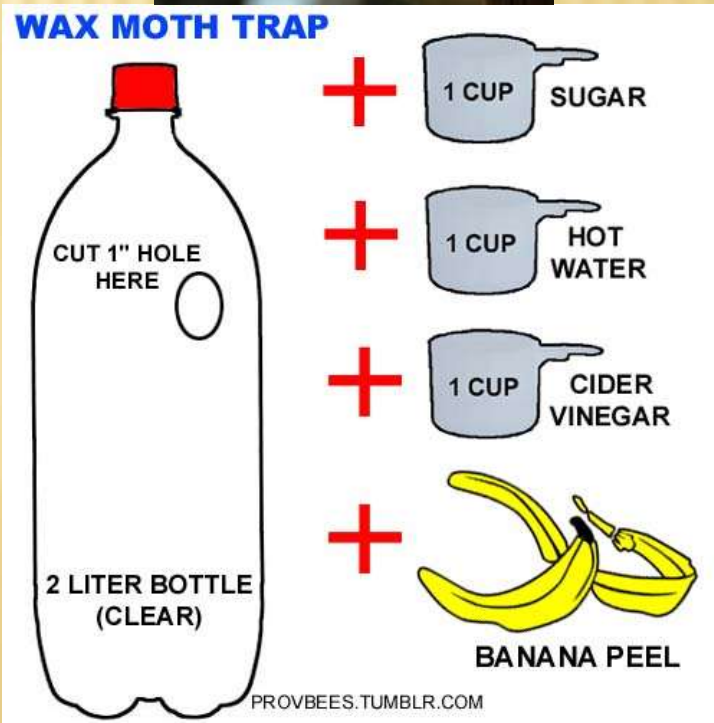
MECHANICAL METHOD: THE BANANA TRAP

- A homemade trap can be easily constructed and used outside in the apiary as well as in the honey house or comb storage room to attract and kill wax moth adults.
- These traps can be constructed from readily available, low cost materials.
- 2 liter clear soda bottle with lid secured and a 1.25 inch diameter hole should be cut in the side of the bottle just below the shoulder of the neck.
- The ingredients for the bottle trap include 1 cup white vinegar, 1 cup granulated sugar, 1 cup hot water, and a banana peel.
- The bottle should be set aside a few days until the contents begin to ferment after which the bottle will be suspended a few feet off the ground.
- Wax moths adults will be attracted by the trap contents and will enter the bottle entrance and die because they are unable to escape.



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MECHANICAL METHOD: BUG ZAPPERS

- Insect zapper devices will kill the wax moth, but also kill any other insect that comes into contact with the zapper power grids. The purple/blue light attracts adult insects, and they are electrocuted between two high voltage grids (3000 volts).
- Zappers vary in their ability to attract and kill insects; a 15 watt lamp should be sufficient to cover the average comb storage area. Higher voltage grids of 5000–6000 volts are more effective if the number of insects that are coming into contact with the grid is considerable. These units are cheap to run, but require regular cleaning of the tray under the zapper.
- The downside is that these devices only kill adult wax moth, and not the larvae; thus, any adult moth that lays eggs in stored combs must go through its full developmental stages before emerging as an adult, which may or may not be attracted to the insect zapper before it mates and lays eggs. The devices could be very useful in monitoring the presence and numbers of adult moths, if and when adults are detected in any number.

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MECHANICAL METHOD: FREEZING

- Freezing the comb achieves three purposes. It kills the adult, larvae and eggs.
- 24 hours at 5F is sufficient to kill all stages of the greater wax moth.
- Take out and let defrost in a moth free room.
- Store airtight until the next season.

Steppler Farms uses a reefer.
This trailer is cooled to 20F for a week to freeze out the wax moth.

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MECHANICAL METHOD: COLD TREATMENT

- Minimum cold temperature storage time required to kill all life stages of wax moths in honey-extracted comb are:
  - 20ºF (-7ºC) for 4.5 hours
  - 10ºF (-12ºC) for three hours
  - 5ºF (-15ºC) for two hours
- Additional time should be given for equipment to reach required minimum temperatures, especially in hot weather or large capacity freezers.
- Wax moth development is accelerated at higher temperatures, so comb honey should be protected from this pest beginning immediately after harvest.
- Freezing individual frames containing wax moth larvae from live bee colonies is recommended to control this pest, but this will rarely result in successfully salvaging a colony that also shows signs of weakness.

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MECHANICAL METHOD: HEAT TREATMENT

- Heat can be used to kill all life stages of wax moths by using the following exposure periods:
  - 115°F (46°C) for 80 minutes
  - 120°F (49°C) for 40 minutes
- Combs should not be heated above 120°F (49°C) because combs will sag above this temperature and beeswax melts at about 148°F (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. (Shimanuki and Knox 1997)
- Hot water baths (air exclusion) of 3 - 5 hours are also being used in South America.

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MECHANICAL METHOD: STORING OUTDOORS

- Wax moths do not like light; that is why they fly at night. They also don't like the cold.
- In Russia and other cold nations it is common practice to hang the frames up outdoors. They use wire mesh to keep birds out.
- Suspending in car ports or other open structures is also common.
- This method is not recommended for frames that have already become wax moth infested.

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CHEMICAL METHODS

Always follow product labels and
wear proper protective clothing.
Do not hold your breath and think it is ok.
Think: Eyes, skin, lungs, and stomach.

POISON Help®
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CHEMICAL METHOD: FUMIGATION WITH CARBON DIOXIDE

- Carbon dioxide can be used as a fumigant to control wax moths in stored comb or comb honey.
- Air-tight treatment rooms or fumigation chambers are required to hold 80-98% carbon dioxide levels which have to be maintained continuously for up to 5 days to kill all life stages of wax moths.
- Only 4 hours are required at 98% carbon dioxide with a temperature of 100°F and relative humidity of 50% to kill all life stages of the wax moth.
- Not cost effective.

Old fumigation methods include sulfur dioxide, acetic acid, carbon disulphide, calcium cyanide, methyl bromide, phosphine, and ethylene dibromide.
All fumigants are known to cause severe bodily harm to human and animals or are known to cause cancer.

***Precaution*: although no harmful carbon dioxide residues are left behind on treated comb or inside the fumigation chamber following use, a fully charged carbon dioxide room is hazardous to humans and can result in death.**

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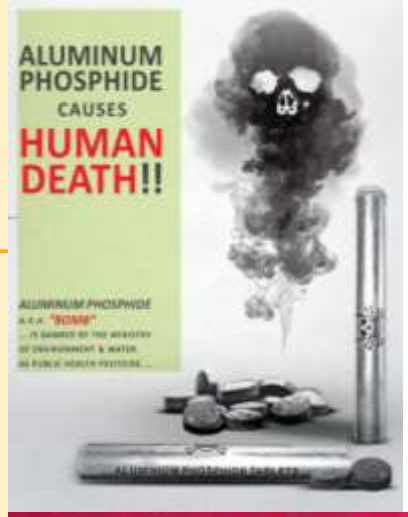
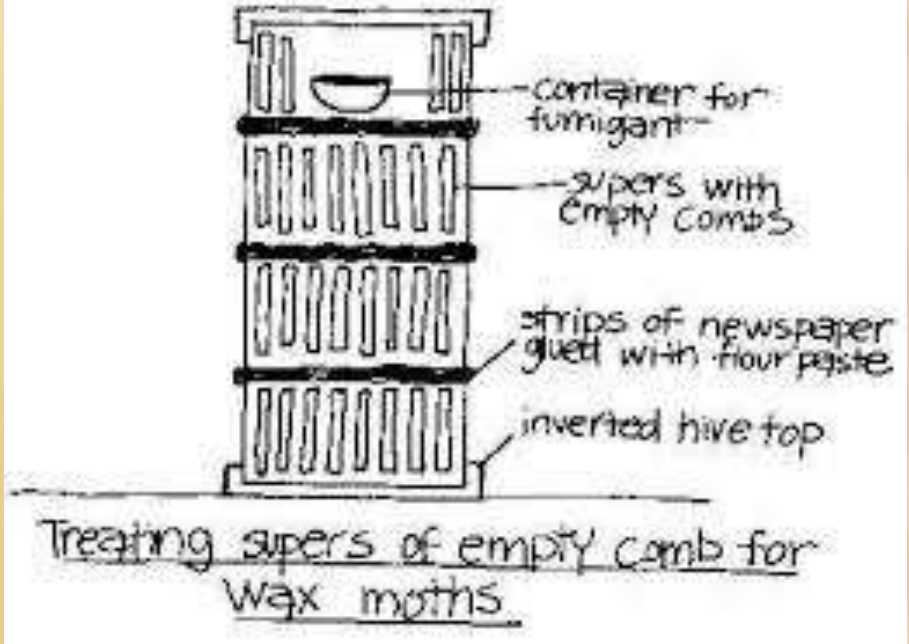
CHEMICAL METHOD: PHOSTOXIN

- Aluminum phosphide is sold under various trade names and comes in tablet or pellet form and turns to a gas as a fumigant for control of wax moth in stored drawn comb.
- The material is highly effective for killing wax moths but it is flammable and is extremely hazardous to humans.
- It is classified as a “restricted use chemical” that only licensed pesticide applicators can legally purchase and use.





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CHEMICAL METHOD: PARADICHLOROBENZENE - PDB

- PDB is registered for wax moth control for use in protecting stored comb.
- PDB cannot be used for wax moth control in live bee colonies, nor is it approved for protection of comb honey. **Honey readily absorbs BPD fumes resulting in honey being unfit for human consumption.**
- PDB is available in crystalline form which vaporizes when temperatures are higher than 70°F (21°C).
- The product label calls for 3 ounces (85 g) or 4 tablespoons to be placed on top bars of the top super with lid to cover the stacked supers. Some beekeeping equipment suppliers sell a hive shim that contains a sliding drawer which crystals can be conveniently placed and inspected. As the crystals vaporize, the vapors are heavier than air causing the vapors to move downward through the stacked supers killing wax moth adults, larvae, and pupae. **The vapors will not kill wax moth eggs**.
- PDB vapors also repel wax moths from entering exposed equipment. However, crystals vaporize quickly at warm temperatures and have to be replenished periodically.
- Beekeepers are strongly advised to air out stored chemically exposed supers for a day or two away from PDB prior to placement on colonies because **it is toxic to bees at high concentrations**.

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CHEMICAL METHODS: NOT ALL MOTH BALLS ARE THE SAME

- P = Permissible
- Paradichlobenze or Para Moth
- Can be used to treat comb. Keep away from honey and bees.

- N = NO
- Naphtalene or Old Fashioned Moth Balls
- Leaves toxic residue in bees wax. Cannot be used!

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CHEMICAL METHODS:
PLANT VOLATILE OILS AND CHEMICALS

Lemongrass oil, menthol, thymol, thyme, camphor, naphthalene, blue gum, and spearmint were eliminated early on.

Latent effects of tested volatile oils and chemicals on some biological aspects of *G. mellonella*.

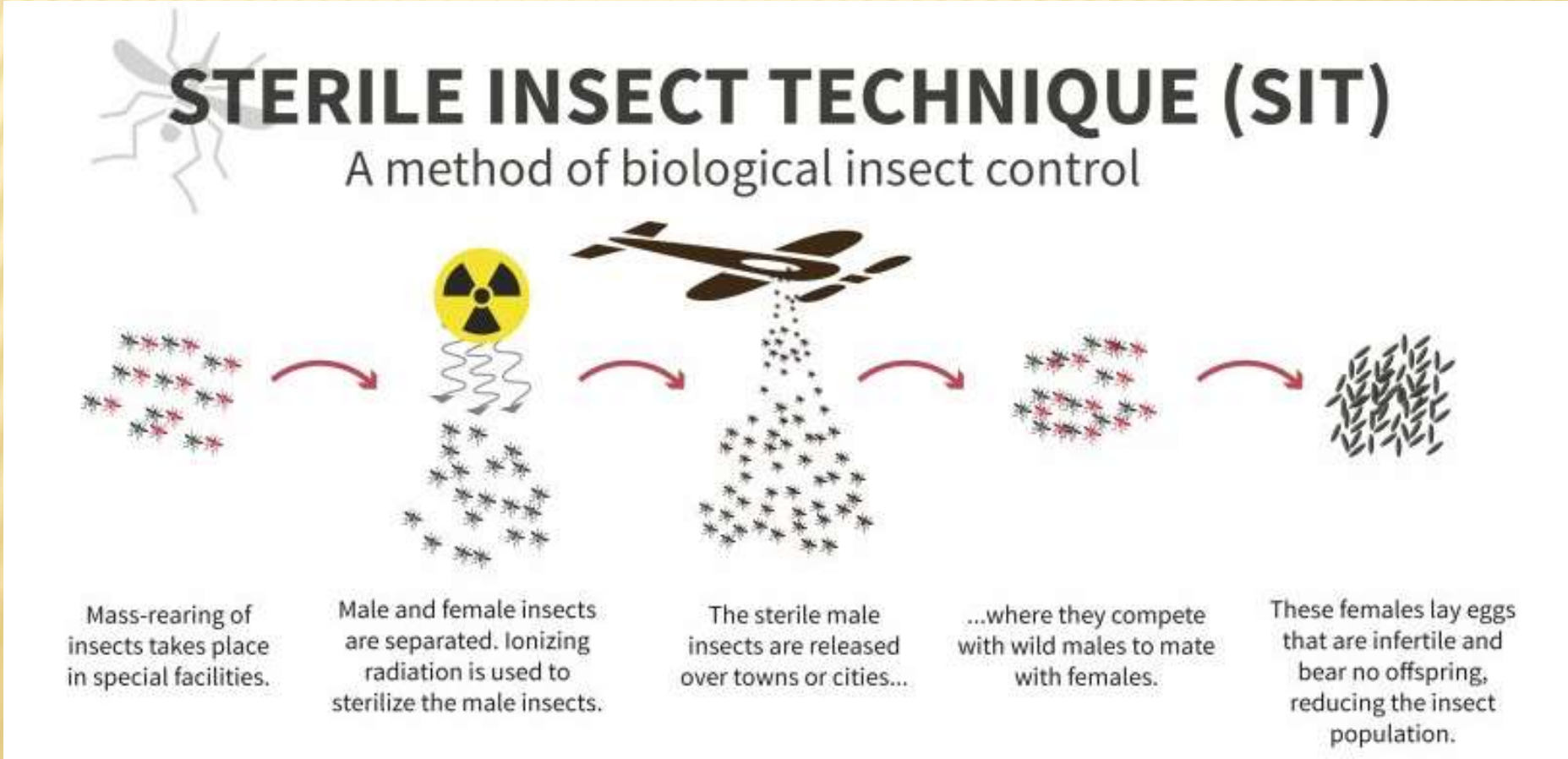
Parameters	% Mortality *		Pupal period (day)	Longivity (day)		Oviposition	
Treatments	Larvae	Pupae		Male	Female	Egg/female	% Hatchability
Methyl salicylate	10.0 ±2.73	65.0 ±4.46	13.6 ±0.68	24.6 ±2.24	40.8 ±2.57	226.6 ±22.69	46.0 ±5.09
Formic acid	17.6 ±1.12	7.2 ±1.16	12.8 ±0.37	4.0 ±0.99	7.2 ±1.49	46.2 ±2.48	93.0 ±3.74
Clove oil	14.0 ±1.87	50.0 ±2.73	9.2 ±0.58	5.6 ±0.87	8.6 ±0.51	238.2 ±40.45	46.0 ±3.99
Eugenol	29.0 ±1.89	57.0 ±1.38	13.6 ±0.51	26.6 ±3.17	40.0 ±1.97	61.4 ±8.19	91.8 ±3.88
Acetic acid	0.0 ±0.00	17.0 ±2.54	16.2 ±0.58	22.0 ±3.74	34.6 ±0.51	96.0 ±1.70	85.6 ±2.97
Basil oil	7.0 ±1.22	13.0 ±1.22	17.2 ±0.97	30.6 ±0.60	37.4 ±2.18	123.0 ±13.40	94.8 ±1.71
Control	0.0 ±0.00	1.0 ±0.99	16.0 ±0.55	26.4 ±2.22	35.0 ±2.53	528.0 ±54.99	98.6 ±0.98
L.S.D. 5%	**3.86**	**14.39**	**1.29**	**6.96**	**5.78**	**81.76**	**10.82**

N.B. * 1- Cumulative mortality. 2- Mean ± SE.

POTENTIAL EFFICACY OF CERTAIN PLANT VOLATILE OILS AND CHEMICALS AGAINST GREATER WAX MOTH, Galleria mellonella L.; Owayss, Ayman. (2007).

STERILE INSECT TECHNIQUE (SIT)

- SIT was used to eradicate the screw-worm fly.
- This method is presently used to control the pink bollworm moth.
- Using 350 Gy Gamma-radiation was most effective when done in wax moth pupae. Sadly the pupae was very fragile and required high input cost.
- Gamma radiation of wax moth eggs showed that the emerging larvae were more destructive and could exacerbate economic losses.



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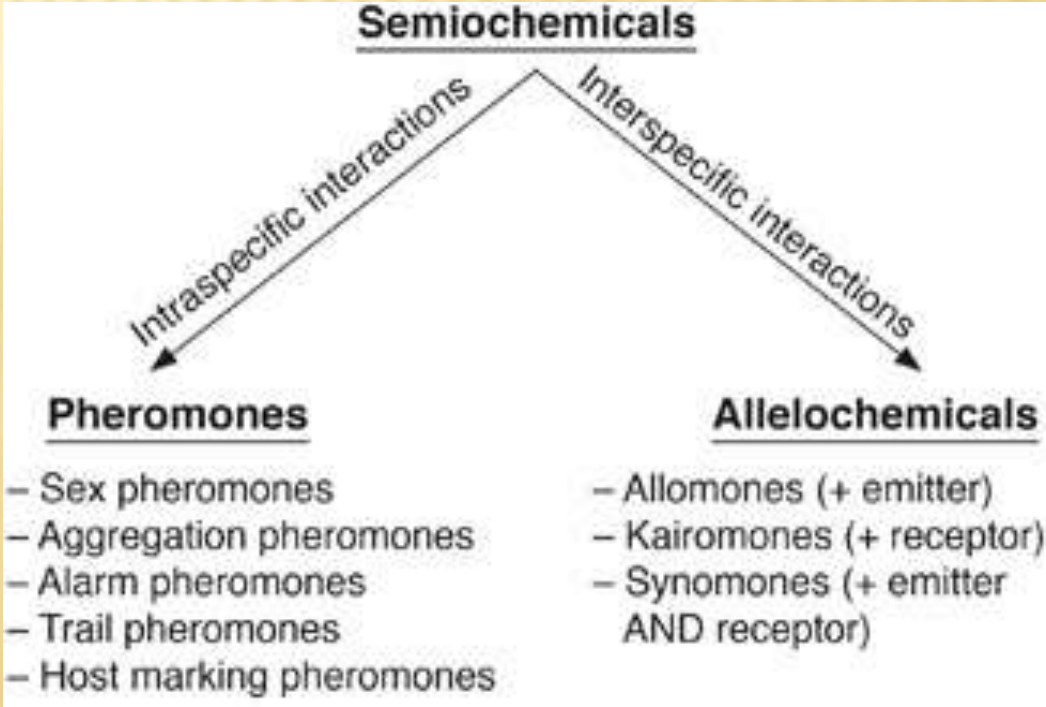
SEMIOCHEMICAL METHODS

- Semiochemicals are chemical compounds that are released by living organisms into their environment. They elicit either a behavioral or physiological response in a subsequent insect organism that perceives the signal.
- Pheromones are the most known ones, but there are also allelochemicals.
- Honeybees are among the most well studied living organisms when it comes to semiochemicals.

Traps with wax moth sex pheromone components were not attractive to wax moth. This suggests that the acoustic signal was missing.



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BIOLOGICAL CONTROLS

- **Biological** control is the beneficial action of parasites, pathogens, and predators in managing pests and their damage.
- Biocontrol provided by these living organisms, collectively called “natural enemies,” is especially important for reducing the numbers of pest insects.

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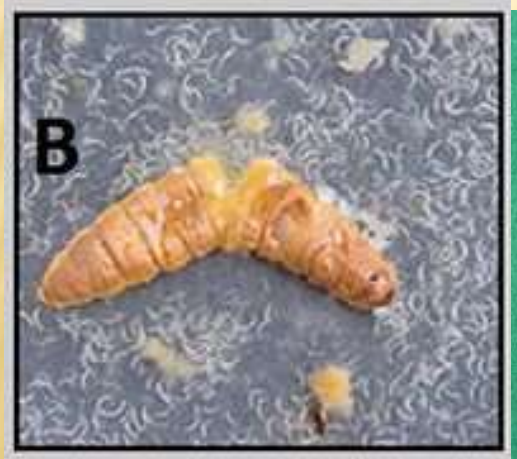
BIOLOGICAL CONTROL: NEMATODES

- Various nematodes (ring worms) are deadly to wax moth.
- Soil dwelling nematodes like Heterorbabditis bacteriophora, Steinernema carpocapsae, and Steinernema riobrave are deadly to wax moth to name a few.
- Wax moth are reared to feed nematodes for commercial crops pest control.
- Sadly, these soil dwelling nematodes are also bad for honey bee larvae. More research is needed.



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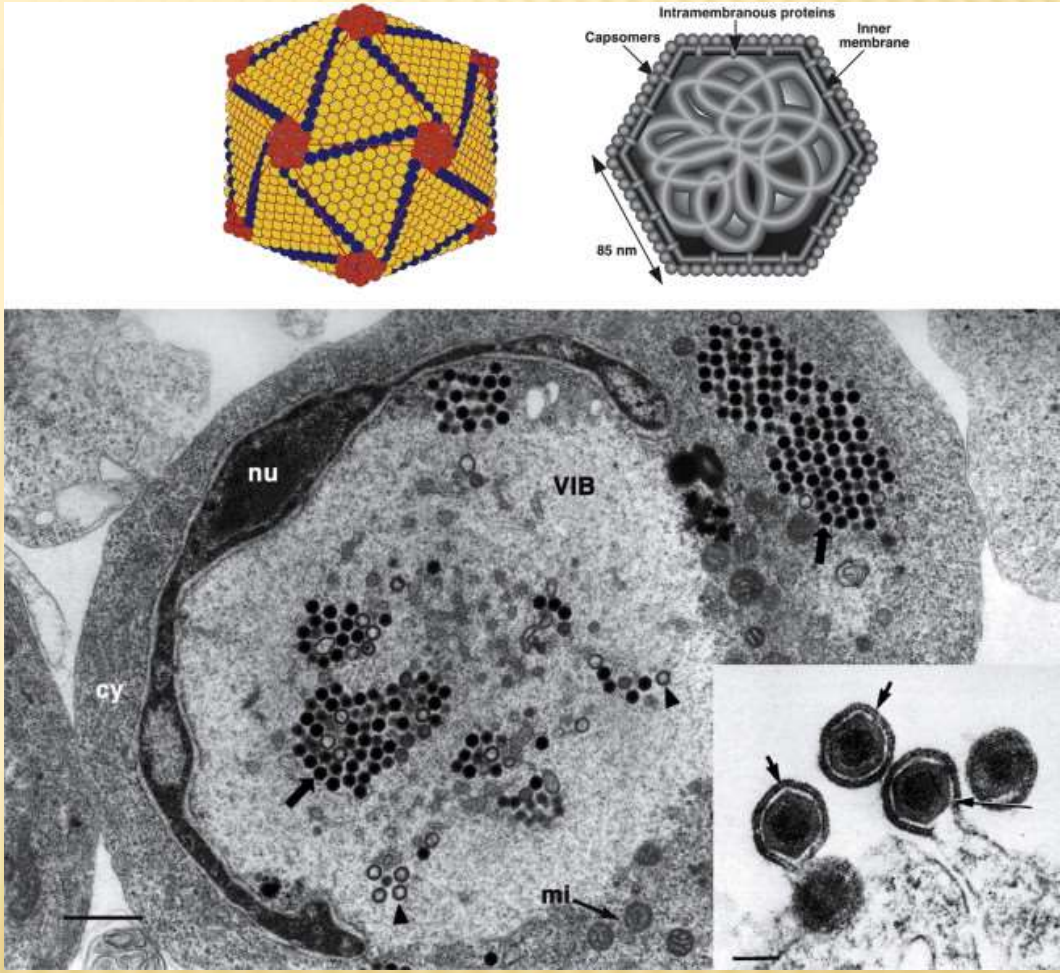
BIOLOGICAL CONTROL: VIRUS

- Sericesthis Iridescent Virus (SIV)
- A SIV infection of the hemocytes of the wax moth Galleria mellonella.
- See Study: Effects on total and differential counts and hemocyte ontogeny; Malcolm S. Lea; December 2004. https://doi.org/10.1016/0022-2011(86)90141-2



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BIOLOGICAL CONTROL: PREDATORY WASPS

Problem:
Bees will keep them out of their hives. These wasps are only successful after a colony has collapsed.

Apechthis ontario

Apanteles galleriae

Bracon hebetor

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BIOLOGICAL CONTROL: RED IMPORTED FIRE ANTS

- Some beekeepers in the southwest US place supers of infested combs on colonies of the red imported fire ant (Solenopsis invicta) for a day or so. On a larger scale, beekeepers in South America place pallets full of super boxes next to fire ant colonies. Light and airflow must be present for ants to work them.
- The red imported fire ant is of serious concern since it is also a predator to ground nesting bees.
- **Warning: Beekeepers who are allergic to fire ant venom are not advised to practice this form of wax moth biocontrol.**

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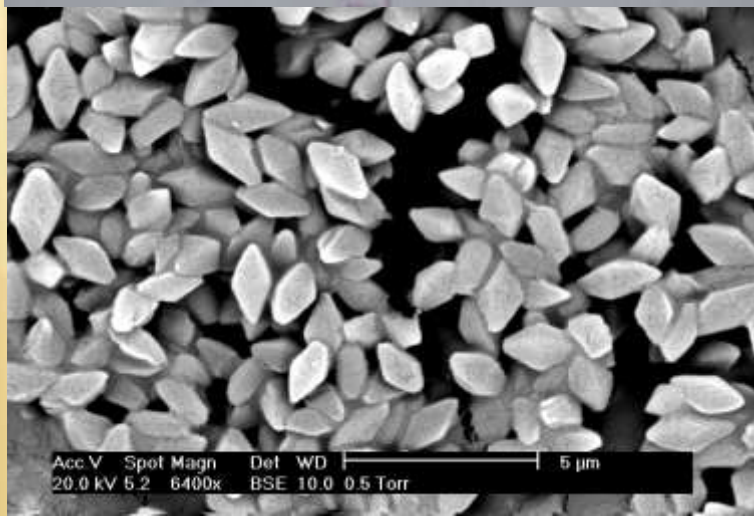
BIOLOGICAL CONTROL: BACILLUS THURINGIENSIS

- *Bacillus thuringiensis* was first discovered in 1901 by Japanese biologist Ishiwata Shigetane in silkworms. He named it *Bacillus sotto*, using the Japanese word *sottō* (卒倒, 'collapse'), here referring to bacillary paralysis.
- In 1911, German microbiologist Ernst Berliner independently rediscovered it when he isolated it as the cause of a disease called Schlaffsucht in flour moth caterpillars in Thuringia (hence the specific name *thuringiensis*).
- *B. sotto* would later be reassigned as *B. thuringiensis* var. *sotto*.
- *B. thuringiensis* is closely related to Bacillus cereus, a soil bacterium, and Bacillus anthracis, the cause of anthrax; the three organisms differ mainly in their plasmids.

German microbiologist Ernst Berliner



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BIOLOGICAL CONTROL: BACILLUS THURINGIENSIS AIZAWAI

- B401, a microorganism, is a product manufactured by Vita-Europe Ltd. for the biological control of wax moths.
- It is not currently registered for use in the US. B401 was marketed in the US several years ago under the trade name Certan®. There have been some indications that this product may be re-registered in the US.
- The product is a bacterium, Bacillus thuringiensis, subspecies aizawai. It kills young wax moth larvae as they attempt to feed on comb and must be used as a preventive before combs are infested.
- Leaves no residue on comb and it is harmless to bees and humans. Some other strains of Bacillus thuringiensis are toxic to bees and humans, so beekeepers must resist the temptation of using other BT products.
- One application of the product gives wax moth protection in stored comb until the next season.
- B401 is currently available in Canada and some European countries.
- https://www.vita-europe.com/beehealth/products/b401/

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BIOLOGICAL CONTROL: BACILLUS THURINGIENSIS RECIPE

- **BT aizawai mixing ratio:**
- Mix 4 teaspoons into one gallon of water. Use immediately.
- The powder has an indefinite shelf life prior to mixing.
- Remember, it is currently not registered in the US to control wax moth.

XenTari is available in the US, and the product label lists crops and insects it is used for. It can be applied during the day when bees are flying. http://gcrec.ifas.ufl.edu/static/docs/pdf/strawberry-pathology/MSDS-pesticides/xentari.pdf

Avoid eye and skin contact.
Do not inhale.
A N-95 mask must be worn.

Other BT's (Dipel, Thuricide) widely used to control caterpillars are not fully effective against wax moth.

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RECOMMENDATIONS TO CONTROL WAX MOTH

- Maintain healthy, strong colonies to promote high bee-to-comb ratio.
- Clean varroa mite detector boards and beetle traps on a regular basis.
- Trap adult wax moths in the apiary as well as in the honey house.
- Do not leave supers of drawn comb in unoccupied beehives.
- Extract honey from supers within 2 days of hive removal.
- Freeze lightly damaged wax moth infested equipment.
- Burn badly damaged wax moth infested equipment.
- Replace old comb, especially brood comb, with new foundation.
- Remove some burr comb and proprolis.
- Maintain good sanitary conditions inside and outside the honey house.
- Use chemicals as a last resort.

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MY RECOMMENDATIONS TO CONTROL WAX MOTH IN STORED EQUIPMENT

- After harvest, let bees rob frames clean.
- Store in an airtight container, plastic bag, or store in a stack sealed with tape.
- Inspect weekly for signs of wax moth for a full month.
- No sign - you are good to store without any further inspections, assuming it is stored cold.
- Freeze the entire container for 3 days if you see signs of wax moth. 3 days assure that the entire container gets frozen solid. Store normally for the rest of the winter. No more inspections are needed.
- This does not apply to cocoons. These must be scraped off and freezing has to follow. Consider other methods of control.

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REARING BEES OR MOTHS?

- When wax moths take over, maybe it is time to go fishing.
- Wax moth larvae make great fish bait.
- Instruction of how to rear them are simple…
  - www.wikihow.com/Grow-a-Wax-Worm-Farm
  - The Beekeeper's Handbook, Diana Sammataro, pages 261-262.

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DON'T CARE FOR FISHING…

Wax worm salad and macadamia nut wax moth cookies. Yummy?

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