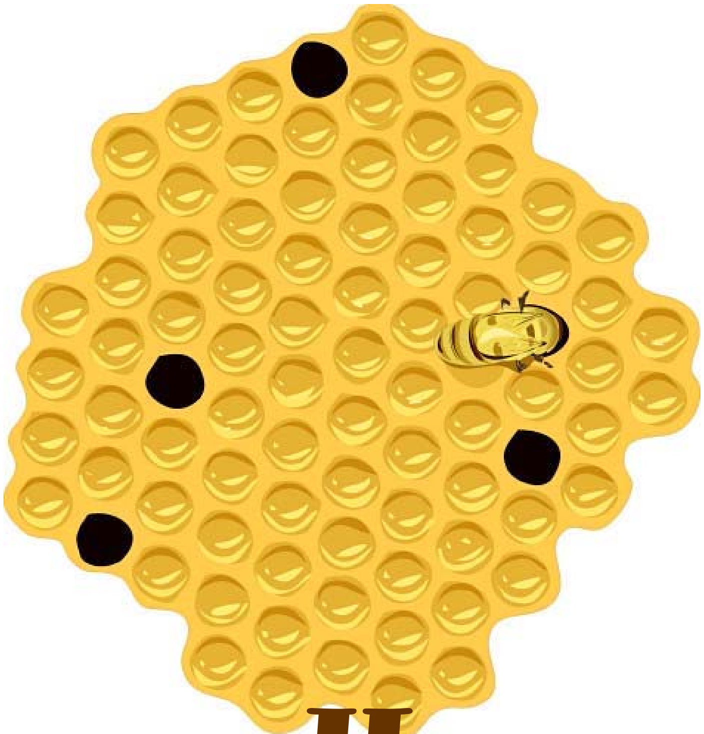


Honey Bee Pests

Contents:

Honey Bee Pests

Full name	Description	Description	Description	Where found	Symptoms	Further Symptoms	Results
Varroa destructor anderson. an external mite	Dark brown, pencil-lead size spider	Found walking around but most in brood cells	Can be found with drone scans, sugar shakes & sticky bottom boards	Mostly in drone cells, in sealed worker cells when heavily infected	dead larvae decay; surviving adults often have deformed wings	Not always scattered brood pattern; infestation greatest in drone brood	Shortens bees' life, kills entire colonies, causes secondary viral infections
Acapis woodi. An internal mite	Microscopic, semi-transparent			With disection and microscope, found in tracheal tubes of older bees	Most common in late-Winter to early-Spring. After closed-in season, bees appear to starve with feed in the combs	Bees often have “K-wing”, Some bees can’t fly and appear disorientedWhen warm, bees found walking on combs or outside hive	Shortens bees' life, kills entire colonies.
Aethina Tumida Murray.	Adults: Reddish-brown, pin-head sized, round beetle	Larvae: walking around on frames, comb, bottom boards. Fore-legs only & small horns on rear. No webbing.	Found on bottom boards and in cracks and crevices. Adults hide from light while larvae attracted to light	Walking around, slimy honey, trash on bottom board	Visual	Slimed honey, slimy honey on bottom board.Bees won't eat honey or feed touched by beetle larvae.	Kills small colonies. Can make a mess in honey house.
Achroia grisella & Galleria mellonella	Adults: Moths which lay eggs in hives	Larvae: maggot-like, makes webbing, and spins coccons, walks with fore and hind legs.	Not a true parasite	In or on combs in dead or weak colonies.	Visual	Destroys combs and scars wooden ware.	Finishes colonies weal or dying from some other cause

Varroa Destructor Mite

scientific name: *Varroa destructor* Anderson & Trueman

(Arachnida: Acari: Varroidae)

Introduction

The varroa mite, *Varroa destructor* Anderson & Trueman, an ectoparasite of honey bees, was first described as *Varroa jacobsoni* by Oudemans (l904) from Java on *Apis cerana*. However, Anderson and Trueman (2000), after studying mtDNA Co-I gene sequences and morphological characters of many populations of *V. jacobsoni* from around the world split it into two species. *Varroa jacobsoni* s.s. infests *Apis cerana* F. in the Malaysia-Indonesia region. *Varroa destructor* Anderson & Trueman, 2000 infests its natural host *A. cerana* on mainland Asia and also *A. mellifera* L. worldwide (Zhang 2000).

In 1951, varroa mite was found in Singapore. In 1962-63, the mite was found on *Apis m. mellifera* in Hong Kong and the Philippines (Delfinado 1963) and spread rapidly from there. Adaption to a new host (*Apis m. mellifera*), the importation of queen bees from infested areas, and the movement of infested colonies of bees for pollination led to the rapid spread of this mite. Following the find of a single varroa mite in Maryland in 1979, the Division of Plant Industry and H.L. Cromroy, University of Florida, made an inspection of Florida bees in 1984. The varroa mite was not found at that time, but in 1987 it was detected in Wisconsin and Florida. It remains unknown how or when the varroa mite was introduced into the continental U.S.A. In Florida, the varroa mite has been found on flower feeding-insects *Bombus pennsylvanicus* (Hymenoptera: Apidae), *Palpada vinetorum* (Diptera: Syrphidae), and *Phanaeus vindex* (Coleoptera: Scarabaeidae) (Kevan et al. 1990). Although the varroa mite cannot reproduce on other insects, its presence on them may be a means by which it spreads short distances.


bee with varroa mite

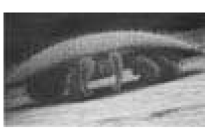
Distribution

The varroa mite is now cosmopolitan, being found in Indonesia (Oudemans 1904), Singapore (Gunther 1951), and USSR (Breguetova 1953); it was found on *Apis m. mellifera* in Hong Kong (Delfinado 1963) and Philippines (Delfinado 1963). It quickly spread to the Peoples Republic of China (Ian Tzien-He 1965), India (Phadke et al. 1966), North Korea (Tian Zai Zai Soun 1967), Cambodia (Ehara 1968), Japan (Ehara 1968), Vietnam (Stephen 1968), Thialand (Laigo and Morse 1969), Czechoslovakia (Samsinak and Haragsim 1972), Bulgaria (Velitchkov and Natchev 1973), South Korea (Delfinado and Baker 1974), Paraguay (Orosi-Pal 1975), Taiwan (Akratanakul and Burgett 1975), Argentina (Montiel and Piola 1976), Poland (Koivulehto 1976) Romania (Orosi-Pal 1975), Urguay (Grobov 1976), Germany (Ruttner 1977), Bangladesh (Marin 1978), Brazil (Alves et al. 1975) Myanmar (Marin 1978), Hungary (Buza 1978), Tunisia (Hicheri 1978), Greece (Santas 1979), Iran (Crane 979), Libya (Crane 1979), Turkey (Crane 1979), Yugoslavia (Santas 1979), Lebanon (Popa 1980), and likely other countries. Again, the mite was first detected in the USA in 1987 and has spread to most of North America. A full description of varroa's introduction, spread and economic impact has recently been published (Sanford 2001).

Description

Adult female mites are brown to dark brown, shaped like a crab, measuring 1.00 to 1.77 mm long and 1.50 to 1.99 mm wide. Their curved bodies fit into abdominal folds of the adult bee and are held there by the shape and arrangement of ventral setae. This protects them from the bee's normal cleaning habits. Adult males are yellowish with lightly tanned legs and spherical body shape measuring 0.75 to 0.98 mm long and 0.70 to 0.88 wide. The male chelicerae are modified for transferring sperm. The protonymph and deutonymph stages were described by Delfinado-Baker (1984).

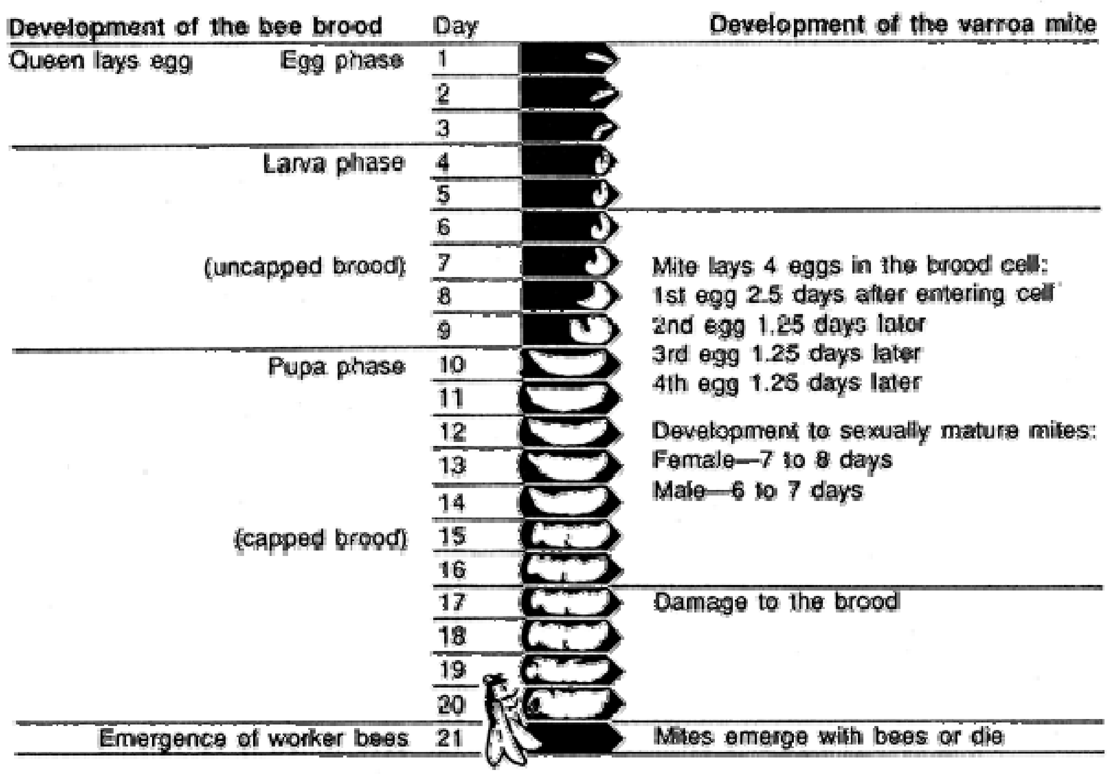

adult female, ventral and dorsal views


adult female, anterior view

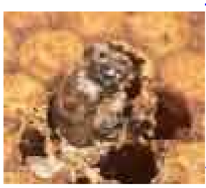

adult female, dorsal view

Life Cycle

The life cycle of the varroa mite is synchronized with that of its honey bee host; it may be that hormones or pheromones of honey bees are necessary for the mite to complete its development (see graphic). The female lays eggs in bee brood cells. Developing mites feed on developing honey bee larvae. Males and females copulate in the cell. The male dies, but pregnant females emerge from the cell along with their bee host and seek another cell to repeat the cycle. It is thought the length of the postcapping period in honey bees is an important indicator of eventual infestation. The longer the postcapping time, the more time there is for more female mites to develop.




varroa mites


young bee with varroa mite

Hosts

Among the bees that serve as hosts of the varroa mite are *Apis cerana*, *A. koschevnikovi*, *A. mellifera mellifera*, *A. m. capenis*, *A. m. carnica*, *A. m. iberica*, *A. m. intermissa*, *A. m. ligustica*, *A. m. macedonica*, *A. m. meda*, *A. m. scutellata*, and *A. m. syriaca*.

Economic Importance

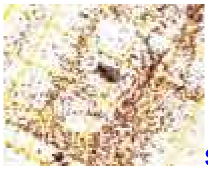
The varroa mite is one of the most serious pests known for *Apis mellifera*, principally because it is an introduced and therefore exotic organism on *Apis mellifera*. It feeds on the haemolymph of the developing honey bee larva, pupa, and the adult bee. Heavily infested colonies usually have large numbers of unsealed brood cells. Dead or dying newly emerged bees with malformed wings, legs, abdomens, and thoraxes may be present at the entrance of affected colonies. If left unchecked, mites can cause loss of most affected colonies. It is reported in Europe that weak colonies are subject to being robbed by stronger colonies of may die within three to four years from the lack of worker bees to manage the brood and gather nectar. In Florida, infested colonies have died within seven months, probably due to the ideal weather conditions for mite development. Because varroa mites usually cause the death of a colony of *Apis mellifera*, it has been suggested that the development of this particular host/parasite relationship is still incomplete. The original host, *Apis cerana*, supports populations of mites without collapsing and *Apis m. scutellata* (the African or Africanized honey bee) seems to have some resistance or tolerance to varroa mite (Ritter 1981).

Survey and Detection

Ether Roll: The most widely used technique involves shaking 300 to 500 bees (1/4 to 1/3 pint) from the center frame of the brood nest into a pint jar. Spray automotive ether starting fluid for about two seconds onto bees. Close jar and shake vigorously for 10 to 15 seconds, then roll slowly. Mites can be seen stuck to the jar's interior.

Sugar Shake: Rather than starting fluid, which kills the bees, one can use powdered sugar as a substitute. Place a few table spoons of powdered sugar in a mason jar. Next, scoop up about ½ cup of bees (about 300) and dump them in the jar. Replace the lid with #8 hardware cloth and screw it onto the jar using the band. Now gently “slosh” the bees around in the sugar to ensure they are fully coated. The sugar dislodges the mites which can then be shaken through the screen to be counted.

Sticky Paper: Place a sheet of white paper coated with cooking oil (i.e., Pam®) on the hive bottom and cover with #8 hardware cloth. Check the "sticky board" after 3 days for mites and do not replace. Sticky boards are commercially available for this purpose. Do not use during honey flow.

 sticky paper trap

Shake and Wash: Shake 1/4 of bees from the brood nest into a jar. Cover with 70% isopropyl alcohol and place on shaker for 15 to 30 minutes. Pour contents through a 8 mesh screen to count the mites. Replace bees in pint jar and preserve with alcohol, if planning to send a sample to a lab. Count bees in white enamel pan and reshake sample a second time to recover any additional mites.

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VARROA JACOBSONI
OR
VARROA MITE

BIOLOGY - The adult mite is between the size of a yearling tick and a seed tick and is reddish brown in color. They cling to the adult bee they are feeding on. They ingest small quantities of blood which weakens the bee and leave wounds for infections. The adult bee is only an intermediate host and and a means of transport. The female mite enters a brood cell shortly before it is capped. She lays 2 to 6 eggs on the larvae and they hatch after 24 hours. Complete development of the mite takes 8 to 10 days (6 to 7 for the smaller, yellowish male). The young mites mate in the capped cells and emerge on the adult bee. The females seek a brood cell again after 4 to 13 days. They live about 2 months in the summer and 5 to 8 months in the winter.

SPREAD - Can spread through queen and bee sales. Spreads rapidly from bees in close proximity. (Bees meeting at water & nectar sources). Also, keep in mind that drones and even workers can drift from hive to hive. Very rapid from yards within 1.6 miles has been verified.

DETECTION - The dwindling of the colony is reason to suspect mites. Also, watch for a low incedence of flying. There are several methods for detecting Varroa mites. The easiest are the ether roll test, sugar shake or the drone scrapping methods.

TREATMENT - See medications section.

HONEY BEE TRACHEAL MITE - *Acarapis woodi*

The honey bee tracheal mite, *Acarapis woodi*, or acariosis as the disease is known in Europe, afflicts only adult honey bees. The parasite was first described in 1921 in bees in Great Britain. This discovery and concern over the potential impact that this mite would have on beekeeping in the United States led to the enactment of the Honeybee Act of 1922, which restricted the importation of honey bees from countries where this mite was known to exist.

There are three Acarapis species associated with adult honey bees: *A. woodi*, *A. externus*, and *A. dorsalis*. These mites are difficult to detect and differentiate due to their small size and similarity; therefore, they are frequently identified by location on the bee instead of morphological characteristics. However, only *A. woodi* can be positively diagnosed solely on habitat; the position of other species on the host is useful, but not infallible. *Acarapis woodi* lives exclusively in the prothoracic tracheae; *A. externus*, being external, inhabits the membranous area between the posterior region of the head and thorax or the ventral neck region and the posterior tentorial pits; and *A. dorsalis* is usually found in the dorsal groove between the mesoscutum and mesocutellum and the wing bases.

The *A. woodi* female is 143-174 um in length and the male 125- 136 um. The body is oval, widest between the second and third pair of legs, and is whitish or pearly white with shining, smooth cuticle; a few long hairs are present on the body and legs. It has an elongate, beak-like gnathosoma with long, blade-like styles (mouthparts) for feeding.

When over 30 percent of the bees in a colony become parasitized by *A.woodi*, honey production may be reduced and the likelihood of winter survival decreases with a corresponding increase in infestation. Individual bees are believed to die because of the disruption to respiration due to the mites clogging the tracheae, the damage caused by the mites to the integrity of the tracheae, microorganisms entering the hemolymph (blood) through the damaged tracheae, and from the loss of hemolymph.

The tracheal mite has now been reported on every continent except Australia. Initial detections of *A. woodi* were reported in Brazil in 1974, in Mexico in 1980, and in Texas in 1984. The mites are transmitted bee to bee within a colony by queens, drones and workers. In addition, the movement of package bees and queens, as well as established colonies, has resulted in the dissemination of this mite throughout much of the United States.

One of the first problems that became apparent when the tracheal mite was detected in the United States was the lack of agreement on their economic impact. The literature from Europe did not always agree and beekeepers, research scientists and regulatory officials had differing opinions on the interpretation of the data. However, it soon became evident that the mites were having a serious impact on beekeeping and spreading faster than predicted. The level of infestation within colonies was higher than expected. It is apparent that the tracheal mite found an extremely susceptible honey bee host in the United States.

The population of *A. woodi* in a colony may vary seasonally. During the period of maximum bee population, the percentage of bees with mites is reduced. The likelihood of detecting tracheal mites is highest in the fall and winter. No one symptom characterizes this disease; an affected bee could have disjointed wings and be unable to fly, or have a distended abdomen, or both. Absence of these symptoms does not necessarily imply freedom from mites. Positive diagnosis can only be made by microscopic examination of the tracheae; since only *A. woodi* is found in the bee tracheae, this is an important diagnostic feature.

In sampling for *A. woodi*, collect moribund bees that may be crawling near the hive entrance or bees at the entrance as they are leaving or returning to the hive. These bees should be placed in 70% ethyl or methyl alcohol as they are collected. Bees that have been dead for an indeterminate period are less than ideal for tracheal mite diagnosis.

Menthol is the only material that is currently approved by the Environmental Protection Agency (EPA) for the control of these mites in the United States. Beekeepers can minimize the impact of tracheal mites by intensive management practices to maintain populous colonies and by using menthol.

Colonies can be treated with menthol when there is no heavy nectar flow and daytime temperatures are expected to reach at least 60 F. The best time being in the spring when the weather is warm, and in the late summer or fall of the year immediately after removing the surplus honey.

Directions for Using Menthol: Fifty grams (1.8 ounce) of crystalline menthol should be enclosed in a 7" x 7" plastic screen bag or equally porous material and placed inside a colony for 20-25 days. Menthol placed on the top bars is the preferred method of treatment provided the daytime temperature does not exceed 80 degrees F. During hot weather, the menthol should be placed on the bottom board of the colony. There should be no honey supers on the hive during the treatment, and the menthol should be taken out of a colony at least one month before any anticipated flow. Before using menthol, read and follow the approved label carefully.

THE SMALL HIVE BEETLE

The small hive beetle (SHB), *Aethina tumida* Murray (Coleoptera: Nitidulidae), was identified from honey bee colonies (*Apis mellifera*) in Florida by M.C. Thomas of the Florida Department of Agriculture, June 1998. This was the first report of this insect in the Western Hemisphere; it was previously known only in sub-Saharan Africa. Adult beetles are 5mm long, dark brown to black and can be found within honey bee colonies. Eggs are laid in concealed areas and empty cells and larvae seek out pollen bee brood and honey to feed upon. The feeding of larvae causes honey to drip from the cells and often ferment, leaving a repellent on combs that can cause adult bees to abandon the comb and leave the hive. Beetle larvae complete their feeding on bee combs and then migrate outside to pupate in the soil. Development from egg to adult beetle takes 30-80 days. Reports from South Africa suggest that the beetle is rarely a significant pest with African bees. However, since beekeepers in the United States manage a different race of honey bee than in South Africa, the effects of this pest on U.S. beekeeping are largely unknown.

Distribution in the United States: The small hive beetle has been found in over 35 states, as of February 2010. Migratory beekeepers transport bee colonies from areas known to be infested with the small hive beetle and the probability that this pest is more widespread is very real due to the migratory pollination demands within the U. S.

Nature of the problem: The small hive beetle is considered a secondary pest in South Africa, attacking small or weak hives but rarely affecting strong hives. The honey bees in South Africa are primarily *Apis mellifera scutelata*, an aggressive bee that has excellent housecleaning and defensive traits. In contrast, the bees kept in North America are predominately *A. m. ligustica* or *A. m. carnica* and differ in behavior from African bees. The difference between races of bees coupled with different climatic and colony management styles between South Africa and the United States make it difficult to predict the impact of this new pest on the U. S. beekeeping industry. Reports from states with SHB have indicated occasional problems with beetles infesting and destroying hives in the apiary. However, more problems have been reported from damage by SHB to stored honey.

Damage to colonies and stored honey: Small hive beetle larvae affect combs of stored honey and pollen and will also infest brood combs. During the feeding action by larvae an associated repellent sticky substance is laid down on the combs and this can result in bees abandoning the hive. When honeycombs are removed from colonies, bees then no longer protect the combs allowing larvae to feed uninhibited. The management practice of removing honey and then storing it in warehouses prior to extraction will need to be changed with the introduction of this beetle. Additionally, the handling of wax cappings and honey in areas known to have the small hive beetle will require increased sanitation. Our research has shown that reducing relative humidity below 50% where honey is stored will inhibit SHB eggs from hatching and thus reduce or eliminate larval damage in honey.

Small Hive
Beetle Larvae

Figure 1. *Aethina tumida* Murray, adult, dorsal view. Beetle is somewhat distended.

Wax Moth

Wax moths can be a terrible problem to bee hives if allowed to get out of hand and will destroy brood comb in a very short time if unchecked. There are some simple steps to prevent the damage, but first it might be simpler to discuss the life cycle to understand where the problem comes from.

A normal healthy hive will keep wax moth under control by ejecting the larvae, but weakened hives with small populations can be overcome by wax moth infestations destroying the brood comb, ultimately destroying the hive.

There are two varieties of moth which take delight in dining on wax the 'Greater' and also the 'Lesser' Wax Moth the greater wax moth is a mottled grey in colour approx 1 -1B= inches in length while the lesser is smaller and slimmer approx B= inch in length and white/silver. As all moths, they prefer night time to mate and lay eggs. (Photos are available in our picture gallery.)

Most wax moths are seen in early summer in our area, and we see them under the overhang of hive roofs, out of the daylight, when the hive is disturbed they take off quickly and disappear into the trees.

Preferring to work in the dark the moths enter the hive through top entrances left unscreened and unguarded by the bees, perhaps a sudden cold snap making the bees cluster, and lay eggs in cracks unavailable to the bees. These hatch in due course and the grey larvae begin feeding on wax and hive debris, tunneling just under the cell caps and feeding on the discarded cocoons left by the bees, leaving behind an extremely sticky white web, similar to spiders web but almost impossible to pull apart. So perhaps they are misnamed and should be called Cocoon moths?

With a little care wax moth can be outwitted and the damage they do can be prevented.

First, the practice of top entrances should be examined, provided they have screening then there will be no problem. Leaving a big hole in the inner cover, then a badly fitting roof, is just asking for trouble. Or even worse those holes drilled in the top of boxes allowing the bees a second entrance are a real problem. Apart from pollen in the honey, a cold evening and the bees pull down and form a cluster leaving that entrance unguarded, easy pickings for the wax moth, as they will fly in cooler conditions than bees.

They do say that prevention is better than cure. I have already given one way, using screening to prevent wax moth entering the hive top. The second point could be to use a trap to draw the moths away from the hive area. There are, to my knowledge, no commercial wax moth traps, but we use a country cure which works extremely well and I would recommend to all.

Take a 2 litre plastic pop bottle and drill a 1 inch hole just below the slope on the neck, then add 1 cup water, 1 cup sugar, 1 half cup vinegar and finally 1 banana peel. Wait a few days till it starts to ferment, then tie it into a tree close to the hives. This trap will draw the wax moth, they enter the hole can't get out and drown in the liquid, this will even draw in and kill the bald faced hornet.

Assuming you have followed the above instructions, then you should be able to prevent damage, but what to do if you have already a problem of wax moth?

Extensive damage, evidenced by the white webs, might be simpler to burn and start again. In cases of minor infestations pull out any larvae you can see and clean out all webs. Freezing is a very good way of killing larvae and eggs, so storage in an outside unheated shed during the winter can be useful. Boxes should have a screen top and bottom to prevent mouse damage and allow light to filter down as wax moth prefer the dark.

A treatment is placed onto the stacked pile of boxes during storage and consists of ParadiChlorBenzene crystals. These are used over newspaper in the stack, needs airing out before use.

Contrary to public opinion wax moth can be controlled, but I stress that prevention is better than cure, and the simplest way is to prevent wax moth getting into the hive through gaps and spaces.

Integrated Pest Management in Beekeeping,
A general concept & specifics for Varroa control

Ed Levi, Arkansas State Plant Board

As more and more problems seem to besiege the honeybees, it becomes incumbent on the bee's guardians to become better beekeepers. While chemical controls of these problems have their place, and in many ways have served us well, they are not the only solutions. In fact, as we see more and more problems with the chemicals we've employed, we learn they are only stop-gap solutions that need to be employed very prodigiously and, at best, only on an emergency basis.

Continued use of chemicals has caused uncounted problems in the hive. Queen and drone fertility has been documented from chemical residues and bee viability is suspect. We have watched as the diseases and pests have gained tolerance and/or resistance to the chemicals we've employed for their control. We have chosen to tolerate levels of contamination in a food product that sells largely because of the concept that it is "pure and natural." If used carelessly, use of chemicals can put at risk the very product that is the end product of our endeavors; honey.

The concept of Integrated Pest Management (IPM) in beekeeping serves purposes on a few levels. It strives for the long solution, it minimizes the use of chemicals that can damage the "pure and natural" image of honey, it minimizes the negative effects of chemicals in the hive, and it safeguards the usefulness of the chemicals for when they are most needed. These advantages have a price; they can be more labor intensive. At the same time, they can save.

IPM is not the changing from chemical controls to some other method. It is the educated integrated use of methods as needed. This requires knowledge of the pest or disease and the level of infestation. This requires a knowledge of all the tools available in combating the pest or disease and what they do both in the combating the problem as well as the unintended "damage" they can cause. It's long term goal should be to aid the honey bee colony in acquiring self defenses so that it can handle its own problems. Basically it is helping where needed while doing as little damage as possible. Like raising kids, the goal is the bees' self-reliance. Unfortunately, honey bee colonies in today's modern world seem to be constantly attacked from the environment to which they are exposed.

There are four steps to IPM in Beekeeping:

- Genetics
- Mechanics
- Measuring
- Chemicals

For proper employment of IPM in Beekeeping, these should be used in the order they are listed above:

1. <u>Genetics</u>, while it is not a quick fix, it is the real, long-term solution. We are blessed with those who have scientifically worked to come up with bees that demonstrate resistance to various problems. We should take advantage of these traits. We can also be doing our own selection of traits in the areas of hygienic behavior and disease resistance. At any rate, we should be working toward the goal of having bees that take care of the problems themselves without the aid of systematic drug therapies.

2. While working on the genetics, <u>mechanical</u> controls of bee diseases and pests should be employed. Some of these are clearly labor intensive but will not only save money, they will add to the general well being of the bees and purity of the honey. In fact, some of these methods are not so labor intensive, but all of these methods should be considered as a method of using fewer chemicals while working on the long-term solutions of genetic controls.

   The concept of using mechanical controls and genetic traits to minimize the detrimental effects of diseases and pests has given us tools for long term solutions and, in the meantime, given us the ability to stretch out the time between chemical treatments.

3. In order for you know when you can skip a chemical or, for that matter, any treatment or when it is necessary to employ such controls, the beekeeper needs to <u>monitor</u> levels of infestation. Inspecting the brood for diseases is considered normal in most operations. It should also be normal practice to measure mite load levels and keep an eye on beetle infestations. Once the mite levels are determined, they can then be compared with levels that are considered to be "economic threshold" levels to determine if chemical treatments can be skipped or are necessary at the time, or if other means might be called for. Measuring also tells when we can use alternative or mechanical methods and should be used to measure the efficacy of the various treatments employed.

   Measuring levels of Varroa mite infestations is critical for knowing if a chemical treatment can be skipped or if it is, in fact, necessary to treat as soon as possible. For all of these methods, timing is critical and factors, which must be taken into consideration include: climate of the area of concern, time of year, colony strength and amount of brood. Methods used to check levels of infestations include, in order of accuracy:

   a. Drone scans
      - A quick method for detection of infestation but of little value in measuring levels.

   b. Sugar shakes (or ether-roll or mite wash methods)
      - Best if a consistent level of approximately 300 bees are used in sample
      - Bees must come from brood area
      - Depending on time of year, 12 – 25 mites found in 300 bees is a conservative threshold

   c. Sticky bottom board with 3 day, natural fall,
      - Assuming brood is available, 150 mites would be considered a conservative threshold. (50 mites per day)

4. <u>Chemicals</u> or drugs that are labeled for specific use in beehives for the control of specific infections or infestations should be employed by closely following label instructions when threshold levels are reached and when it's felt that other methods will not be effective enough. It has been demonstrated that the frequency of use is being minimized through genetic advances and mechanical techniques. Using the chemicals as little as possible and correctly, when necessary, will maximize their benefits and make for advances in both the beekeepers operation and in beekeeping in general. When chemicals are needed, beekeepers should consider not using the same one over and over. Alternating each time or every third time will extend the efficacy of the chemicals. That said, it should be understood that the alternating of the harder chemicals, while limiting mite resistance, actually leaves the individual bee more susceptible to other problems and shortens its life.

   There are new chemicals being developed all the time. For many years we only had one chemical to control Varroa mites. As efficacy diminishes due to resistance, others are developed. Today there are several. Some of these can be called "hard" chemicals while others could be considered as "soft" chemicals. No matter which chemicals you choose to use to control the specific problem you're targeting, it is required by law to follow the label directions. Likewise, it is not legal to use products or formulations that are not labeled to control the specific pest being targeted.

For a chart of "**Chemical and Non-Chemical Controls for Bee Ailments**", see "**Medications**" section.