Mid-Atlantic Apicultural Research & Extension Consortium

MAAREC

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

INTEGRATED PEST MANAGEMENT (IPM) FOR BEEKEEPERS

MAAREC Publication 4.8
February 2000

Beekeepers prior to the 90's knew pesticides were detrimental to bees. Many beekeepers were indemnified for losses to pesticides in an 11 year federal program during the 1970's. Beekeepers were paid (indemnified) for dead bees killed or injured by pesticides - often repeatedly usually by the same pesticide in the very same location each year.

Beekeepers today have a different relationship with pesticides. Bee mites and the threat of unacceptably heavy overwinter losses now necessitate placement of a pyrethroid pesticide (fluvaluate - Apistan®) directly into the bee colony. Developing resistance by Varroa mites to this chemical and a new threat, small hive beetles recently introduced and now inhabiting 4 southeastern states (Florida to North Carolina), will lead to use of another pesticide, the organophosphate coumaphos (CheckMite+®) directly inside bee colonies in 1999.

In ten years, beekeepers have come 180° today to rely on a pesticide to keep Varroa mites from attacking and killing honey bees. Pesticides are the easiest and surest means of insuring a healthy, productive bee colony just as we rely on them in the home, with our ornamental and greenhouse plants and in the agricultural sector. Pesticide usage, which slowed during the 80's has increased during the present decade; it is a $10 billion annual
expenditure.

Registration and probable use of the organophosphate coumaphos runs contrary to the rest of the industry in the U.S. To meet the mandates of the Food Quality Protection Act (FQPA) of 1996, the most recent revision of the laws governing pesticides, 75% of food crop acreage needs to be managed using IPM principles; this will increase to 90% in 5 years. In 1988 1/2 of all new pesticides registered were biopesticides. OP's (such as coumaphos) will be the first group of currently registered pesticides targeted by EPA to be phased out over the next 10 years. The bee industry is not in sync with the times.

Are their alternatives to maintaining a relatively pest free and healthy bee colony without the use of pesticides? For hobbyist and professional beekeepers the answer is an emerging yes - it is adoption of IPM.

IPM

IPM stands for INTEGRATED PEST MANAGEMENT. IPM is an effective and environmentally sensitive approach to pest management that utilizes a combination of common-sense practices. Pest management, as opposed to pest eradication, implies that some pests will always be around. A goal of IPM is to manage these pest populations, keeping their populations below a level where damage can be tolerated. This level is called an economic injury level. IPM means not relying on a single pest control scheme - i.e. not relying exclusively on a chemical pesticide as the solution. IPM techniques can be employed to keep mite populations below a point where they do not cause unacceptable monetary losses to beekeepers.

A good IPM program involves selection, integration and implementation of a mixture of pest control strategies (biological, cultural and chemical) based on predictable economic, ecological or sociobiological consequences. In other words, IPM attempt(s) to solve insect/mite pest problems while keeping the cost to both ecosystem and human society in mind.

In actual practice, IPM is a decision making process. Monitoring or sampling is important because it is necessary to know not just that a pest is present but also if the population is increasing or decreasing. It is important to know where it exists in the environment, and if a control might be warranted. The IPM decision process is:

IF pest suppression treatments are needed,
WHEN they are needed,
WHERE they are needed, and
WHAT mix of control tactics could be used.

CONTROL OF BEE MITES WITH PESTICIDES

Pesticides are chemicals expressly used to kill another living organism. They may originate from natural plant or animal compounds or they may be made in a laboratory in a synthetic process. Most of the 5000+ chemicals on the market have been exposed to honey bees during the testing phase. This testing is needed to register each pesticide chemical as manufacturers seek to determine if there are detrimental effects to honey bees – a representative beneficial organism. Until recently, pesticides were lab and field tested for their toxicity to honey bees and listed by relative toxicity in categories from highly toxic to relatively non-toxic.

Today virtually all beekeepers rely on use of the insecticide fluvaluate for Varroa mite control. This material is put inside the bee colony using specially manufactured plastic strips (Apistan®) or homemade using Mavrik® soaked into card-

board strips. (This latter is a misuse as it is not permitted by the label for Mavrik®). Misuse occurs when the label does not specifically permit use in bee colonies, label directions are not followed (such as more Apistan® strips are used than permitted) or the pesticides are used or left in colonies during the incorrect time of the year.

In 1999, the Environmental Protection Agency (EPA) approved a Section 18 exemption to permit use of a second pesticide chemical (coumaphos - CheckMite+®) to control Varroa. The label (which is "the law") for this pesticide is 6 pages long. Coumaphos, an organic phosphate, is several degrees greater in toxicity than fluvaluate, a synthetic pyrethroid. It will be limited in distribution and must be applied under numerous restrictive circumstances.

RESISTANCE OF VARROA MITES TO FLUVALINATE

Recently Varroa mites have developed resistance to the pesticide fluvaluate. Resistance may result from misuse but it is also a recognized biological property. Over 61% of agricultural mite and insect pests have demonstrated resistance to 1 or more pesticides once used to control such pests. It is a basic biological response to intensive use of a chemical compound. With only the single pesticide legally available to control Varroa mites, the intensity of use and repeated continued use (misuses according to the label) it was only a matter of time until resistance developed.

Misuse can be expected to continue - both accidental and intentional. It should be realized that although resistance has been documented, the majority of Varroa mites can still be controlled with fluvaluate as it takes awhile for resistance to become widespread. USDA researchers at Beltsville have developed a simple field test to help beekeepers confirm resistance (See Pettis, Shimanuki & Feldlaufer article in July 1998 Amer. Bee Journal).

IPM

When pest control is needed, Integrated Pest Management (IPM) uses a combination of strategies to manage pest populations. It is not biological control, although biological control is a useful tactic. IPM is not an organic program although we may integrate organic materials into our control tactic. Nor is IPM anti-pesticide but generally it attempts to reduce chemical dependency with a mix of control tactics. Control of mites in bee colonies needs to move from dependence on one or a few pesticide chemicals to a balanced IPM approach.

The success of an IPM program hinges on good monitoring. Early pest detection often allows for use of nonchemical controls. By monitoring, the exact location and size of the pest population can be determined. By analyzing data collected by monitoring, it should be possible to predict when a recurring pest might occur and then more efficiently manage that problem.

Scouting is a key element in IPM. A scout samples on a regular basis:

a. to monitor pest population levels
b. to determine when a pest is present
c. the life stage(s) present
d. how many are present (the population level).

Scouting takes time and requires knowledge of the biology of the pest species. As with many things, a little training and some experience help make scouting easier and more accurate.

SCOUTING FOR BEE MITES

One limitation of using IPM techniques to control bee mites is our base knowledge of the interaction of mites and honey bees. Thus we are often applying a pesticide because we "feel" or "believe" it will help. A recent study by Keith Tignor and R. Fell of VPI demonstrated that routine application of the antibiotics terramycin and fumagillin to package bees did not improve the development of the packages or lead to greater honey storage, yet such advice is routinely given. If we are to reduce our chemical dependency for bee mite control, better and more reliable survey techniques are needed.

Our current survey methods have not been rigorously tested to determine the proper threshold levels on which to base control decisions. Ether roll is not reliable as all the mites in our sample of adult bees, which can vary from as few as 100 to more than 500 bees, do not show up on the glass container. Washing the sample with alcohol or soapy water and then filtering through two meshes to trap mites is time consuming but a bit more reliable. We should still count the number of bees in our sample. Generally if 15 or more mites/100 bees are recovered, mite control should be employed but this has not been experimentally verified.

Opening and examining drone brood (pupae) cells, like the ether roll technique, tells us if mites are present or not present in a hive but what numbers should indicate use of mite control with an insecticide? We find highly variable numbers.

Research programs are focusing on sticky boards as the most reliable method of monitoring populations of Varroa mites. Such sticky boards may be commercially purchased or stiff cardboard covered with petroleum jelly (diluted with mineral oil for easier spreading) or cooking oil (such as PAM" spray). The board should be placed below a screen held 1/4 - 1/8 inch above the sticky surface so adult bees do not walk on the surface itself. To improve mite fall, bee colonies can be heavily smoked with pipe tobacco added to the smoker or the pesticide Apistan® may be used when the board is inserted.

Obviously there are many variables with use of sticky boards. One published threshold is 117 mites overnight (Georgia). The Delaware studies reveal 50 mites/day might be a better threshold basis.

IPM CONTROL OF VARROA

One strategy of IPM is to utilize pesticides with more specificity and lower toxicity. Fluvaluate (Apistan®) is such a chemical relative to Coumaphos. Although resistance is present, it is not yet widespread and Apistan®" , used as directed on the label, should still be considered the best treatment to ensure colony survival if threshold numbers are exceeded.

A third chemical, formic acid gel, has been registered for bee mite control. Betterbee in New York is completing packaging and label requirements. Tests show that it works in cooler temperatures better than Menthol, a material used for tracheal

mites, but too-warm conditions cause it to evaporate too fast and not offer the necessary control. Two applications, about two weeks apart, control 100% of tracheal mites and 90% or better for Varroa mites.

A large number of essential oils (biopesticides) have been tested by Penn State and the MAAREC project and by other researchers at other locations. Several have been found that may be effective but delivery and dosage levels have yet to be determined. A plastic strip impregnated with several oils is being developed by the Tucson USDA lab that has a slow-delivery system of 24 days. It is important to realize that just because a chemical may be a common, readily available material, when concentrated or used directly inside a bee colony it will not necessarily be safer or less toxic to bees or humans.

Mite Trapping/Brood Cycle Interruption

The sticky board technique, useful to monitor mite numbers, may also be a means of reducing bee mite numbers if sticky boards are used continuously. The sticky feature will need to be refreshed to insure mites do not reestablish themselves on a passing bee. Modification of the bottom board may also be a means of reducing mite numbers to reduce dependency on pesticide chemical control. What is not known is the number of mites that might fall or how this might help reduce overall mite population levels.

A promising area of studies points to management of bee colonies so there is removal of drone brood or an interruption in the brood cycle via caging of the queen. One variation is to place all colony brood in a select few colonies for treatment with Apistan® and then distribution to colonies that do not need to be exposed to the pesticide. The disadvantage, besides the great amount of effort needed to do this, is that the brood cycle needs exposure to the pesticide a minimum of the entire 21 day cycle to effectively reduce mite populations.

Drone brood trapping is an IPM technique that shows some promise though it is too labor-intensive for larger beekeepers. This technique requires that brood in bee colonies be removed and only combs with drone brood cells used for a period of two weeks. Mites have only drone brood cells to invade during this broodless period. The drone brood combs are removed at the end of the period and put in a freezer to kill all mites. Any remaining mites need to be killed with Apistan®" . When used, the number of mites in a colony drops drastically.

Resistant Stock

Another useful IPM technique is to use bee stock resistant to or tolerant of Varroa and/or tracheal mites. The USDA has tested a bee from Russia which shows some real promise. After preliminary examination in Russia and a year's quarantine here, studies show these bees have fewer Varroa on the worker larvae (30% U.S. vs. 7% Russia), and drone larvae (80% U.S. vs. 40% Russia). Moreover, when tests were run by introducing mites into clean colonies, nearly three times as many mites were found on non-resistant bees as on the Russian bees after an appropriate observation period.

Field tests were conducted with Russian bee stock during 1999 in Louisiana, Iowa, and Mississippi under commercial conditions. The stock will be maintained at the USDA Baton Rouge Lab and made available to commercial producers as breeding stock. This is different than in the past when stock (for example Yugo bee stock) was released and maintenance was left in the hands of commercial producers.

Scientists at the USDA Tucson Lab and some larger beekeepers have been selecting for colonies with fewer mites using only natural selection. Working with a commercial beekeeper, colony populations of Varroa mites initially at 120 mites/100 bees have decreased to 6 mites/100 bees in the Tucson project. One problem is the bee stock is at least partially Africanized, so exporting these to other parts of the country seems unlikely. Hygienic bee populations that are more diligent house cleaners, may also be useful. More needs to be done, but the preliminary results are very promising.

* * * * *

Beekeepers need not "reinvent the wheel" - it is still possible to foresake the "pesticide treadmill" of more and more, stronger and stronger chemicals leading to mites resistance to legally available pesticides. Spot treatments only when and where mite populations exceed threshold numbers and vigorous use of the entire arsenal of an integrated population management will best serve beekeepers, our bees, and our clientele in the long run.

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:

University of Delaware
Newark, Delaware

University of Maryland
College Park, Maryland

Rutgers University
New Brunswick, New Jersey

The Pennsylvania State University
University Park, Pennsylvania

West Virginia University
Morgantown, West Virginia

USDA/ARS
Bee Research Lab
Beltsville, Maryland

Requests for information or publications should be sent to: MAAREC, 501 ASI Building, University Park, PA 16802 Phone: (814) 865-1896 Fax: (814) 865-3048 Web site: http://MAAREC.cas.psu.edu

This publication is available in alternative media on request.

* * * * *

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

MAAREC Publication 4.8. Original from American Bee Journal Vol. 139(5): 363-365. (1999).