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BEEKEEPING

CURRENT TOPIC

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Anyone interested in keeping bees or in producing income from a beekeeping operation should first investigate all available sources of information. County Cooperative Extension offices are an excellent source of information on beekeeping, as are entomologists and apiculturists at your local land-grant university. State apiculturists, usually with the Department of Agriculture, are another source of information. These people can provide names of local beekeepers to contact. Hobbyists are often very willing to discuss their management techniques, problems, and solutions. These contacts will indicate successful techniques that have been used in a specific climatic or geographic area. It would also be a good idea to study several of the publications on bees listed in the enclosed resource list, as well as the many web sites now available on beginning beekeeping.

The enclosed article "The Basics of Beekeeping" will familiarize the novice with bee morphology, strains, and basic beekeeping equipment. Catalogs from the companies listed in the enclosed **Resource List** will give you an idea of how much it will cost to begin beekeeping.

Income Derived from Beekeeping

It is probably wise to start small, determine efficient management techniques, and expand the beekeeping operation as time, experience, and funds permit. Initial outlay can reach $200 per hive, and other equipment, such as a honey extractor, adds to expenses. Gerald Wallis, retired entomologist and apiculturist at the University of Arkansas, estimated that even with optimum management it would take a minimum of 100 hives to provide the primary income for an individual (1). He assumed in his estimate that the beekeeper would be selling honey as well as providing pollination services (hive rentals) to farmers and orchardists. Figures from a 1999 survey in the Pacific Northwest show that beekeepers were charging about $30 per hive rental, and that hive rentals provided roughly 65% of the beekeepers' incomes (2).

On the other hand, it is possible to augment income with a few hives, especially with creative retailing of honey and other bee products such as honeycomb, wax, and pollen. In addition, a bee colony may provide valuable pollination on the producer's own farm.

Small-scale beekeepers often ask how they should determine a price for their honey. Prices around the country vary widely. In 1998, prices for honey ranged from 58 cents a pound in Mississippi to $1.65/lb. in Nevada, with the overall average price being 65 cents per pound (3). However, these prices reflect the price of honey that is being produced by large-scale, commercial beekeepers and do not accurately reflect what small beekeepers should charge for their honey (4). The best sources of price information will probably be other local beekeepers. In the past few years, consumers have been willing to pay more for value-added products, such as flavored honeys, honey wine, honey beer, and packaged honey gifts, than for plain, unadorned honey.

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Honey Bee Pests

During the last decade, tracheal mites and varroa mites have become major bee pests and seriously threaten the industry in the United States. Mites have killed over 90% of wild honey bees and 60% of commercial bees (5). A pest new to U.S. beekeepers is the small hive beetle. The following discussion focuses on alternative methods of pest control.

Tracheal mites

Microscopic tracheal mites (*Acarapis woodi*) kill bees by infesting their breathing tubes. Alternative control methods focus on cultural and chemical manipulations and on resistant bees.

A common treatment for tracheal mites entails mixing 50 grams of menthol with 50 grams of vegetable shortening into patties and spreading it thinly on cardboard sheets (6). Place the sheets on top of the frames for a total of 25 days. Since menthol has to vaporize to be effective, it must be used at temperatures of at least 60°F. Also, an entrance reducer should be used and set to the smallest opening because the fumes are heavier than air and will tend to settle out through the hive entrance (7). Some beekeepers report that bees have an aversion to the menthol and that large numbers will initially vacate the hive but eventually return. Purified menthol (from peppermint) and instructions on its use are available from beekeeping supply companies. Spring and fall treatments are recommended.

Information on the next technique, using a vegetable oil and sugar patty, comes from Dr. Tom Webster (8) of Kentucky State University. He suggests mixing equal parts of vegetable oil and sugar into a slurry. Place the resultant patty on a piece of hardware cloth and rest the hardware cloth on the top bars of the hive. The bees will crawl over the patty and eat some of it. In the process they will acquire a small amount of oil on their bodies which will smother the mites. The patty should be replaced if it is consumed before the three-week treatment is over. Again, spring and fall treatments are recommended.

Several researchers have shown that neem can control both tracheal and varroa mites. The neem can be added to sugar water or placed directly onto the bees. Dr. T.P. Liu, a Canadian researcher, showed that a concentration of 3 ml of neem extract per liter of sugar syrup significantly decreased numbers of tracheal mites (5). Dr. A.P. Melathopoulos found that a ten percent concentration of neem oil placed directly on bees killed over 50% of varroa mites (9). Neem has also been shown to be effective against American foulbrood (9). [Nota bene: As of June, 2000, neem is not registered as a honey bee mite control.]

There is some evidence that tracheal mites prefer new combs to older ones (10). A study conducted in North Dakota in 1994 found that colonies on new comb were three to four times more likely to be infested with tracheal mites than colonies on old comb.

Crossbreeding for strains resistant to mites has resulted in the Yugoslavian and Buckfast bees, which are resistant to tracheal mites. Breeders of Yugos advertise regularly in *American Bee Journal* (see the enclosed **Resource List** for contact information). Buckfast bees and queens are available from:

R. Weaver Apiaries
Rt. 1, Box 256
Navasota, TX 77868
409-825-7312
Email: beeweaver@tca.net
http://www.beeweaver.com

Varroa mites

For years, the only control for varroa mites (*Varroa jacobsoni*) has been the miticide fluvalinate (Apistan®), a synthetic pyrethroid. Recently, beekeepers in Europe and several U.S. states have seen strains of mites resistant to Apistan (12, 13). It is only a matter of time before resistance becomes more widespread.

There are three main reasons for finding alternatives to Apistan: some mites are proving resistant to the chemical; honey cannot be gathered from colonies while Apistan is in use; and many beekeepers are seeking a more sustainable method of raising bees.

Crossbreeding efforts continue in the hope of finding bees that are resistant to mites—whether through breeding, grooming behaviors, or cell-building tendencies. Yugos exhibit some resistance to varroa mites, and research is currently underway to investigate the behavior of "hygienic" bees. These bees spend more time cleaning themselves and their hives, which keeps varroa mites at a manageable level. Recent research has shown that hygienic behavior is heritable, and researchers Marla Spivak and Martha Gilliam have been building up populations of hygienic bees from the ten percent or so that occur naturally. Hygienic bees detect and remove diseased bees quickly, before the pest organisms can move to other bees. Hygienic bees are also more resistant to American foulbrood, European foulbrood, and chalkbrood (14).

Recent research indicates that smaller starter cells help control varroa mite infestations (15). Foundation sheets (sheets of wax imprinted with base cell sizes) with cells 22% smaller in diameter provided higher winter survival rates for bees.

There is a relatively new method of varroa control that involves changing the bottom board of a hive (16). Often, mites fall off of bees and land on the bottom board. They can then crawl back up into the hive and reattach to bees. A "sticky board" that has been sprayed with something oily (usually PAM™) can be placed over the hive's bottom board and covered with a screen. When mites fall off the bees, they fall through the screen and land on the sticky board and are unable to regain access to the hive. (The screen prevents bees from falling onto the sticky board.) A twist on this method is to create bottom floors made entirely of screen. Not only does this aid in varroa control, it also helps control fungal diseases (17). For more information on using mesh floors, see http://www.ifas.ufl.edu/~mts/apishtm/apis99/apaug99.htm.

Another cultural control method is to encourage worker bees to draw drone comb. Varroa mites prefer drone brood to worker brood. After the drone pupae have been capped, the drone comb is removed from the hive and discarded.

Russian bees are another resistant strain of honey bees. These bees evolved in Russia's Far East, where mites and honey bees have co-existed for decades. "Compared to domestic honey bees, Russian bees are more than twice as resistant to attack by varroa mites, according to tests by geneticist Thomas E. Rinderer and colleagues at ARS' Honey Bee Breeding, Genetics, and Physiology Research Unit in Baton Rouge, Louisiana" (11). These researchers have now bred enough Russian bees to supply U.S. beekeepers. Russian bees are available from:

Glenn Apiaries
PO Box 2737
Fallbrook, CA 92088
760-728-3731
Email: queenb95@aol.com
http://member.aol.com/queenb95/index.html

Bernard's Apiaries
1025 Bernard St.
Henderson, LA 70517
318-228-7535
Email: sbernhoney@aol.com

Apicure™ is a newly registered miticide that contains formic acid, a colorless liquid with a penetrating odor that is found in ants and in many plants. Formic acid controls both tracheal and varroa mites and has been used for years in Canada and Europe. Recent trials have shown that the gel kills up to 84% of varroa mites and 100% of tracheal mites. Apicure is a gel that is sealed in plastic bags that are sliced open and placed in the hives. After the acid evaporates, it leaves a harmless residue that does not contaminate honey, wax, or the beekeeper.

Research is currently underway that involves using essential oils to kill both kinds of mites. One of the problems with using essential oils is that many of the compounds are toxic to honey bees as well as mites. Several herbal extracts or essential oils have been tested. For the most current information on using essential oils to control varroa mite, visit West Virginia University's web site at http://www.wvu.edu/~agexten/varroa.htm.

One study that investigated herbal extracts explored using thymol-based products in Texas, Virginia, and Minnesota (18). There were good results in Texas and Virginia, but less mite mortality in Minnesota. One reason given for this difference is that higher temperatures in the southern states helped the thymol to diffuse into the colony better. Another variable that may have affected the study was the number of hive bodies—in Minnesota, three brood chambers were used, while in Texas only one brood chamber was used. The most active blend in the study was thymol and citronella.

Another study showed that origanum, a thymol mixture, clove, bay, and tea tree were most effective against varroa mites (19). However, these products did not provide the level of control that Apistan provides.

Dr. Raymond Nabors, an Extension entomologist with the University of Missouri, warns that one should not expect more than 60% control from herbal extracts (20). Herbal extracts or essential oils may, however, become part of an integrated pest management system for mites.

In the late 1990s, research was conducted in Switzerland to determine if organic acids and essential oils affected the taste of honey (21). The researchers found that formic acid was easiest to detect, followed by oxalic and lactic acids. Also, the weaker the natural taste of the honey,

the easier it was to detect one of these acids. For essential oils, thymol was easiest to detect, followed by camphor and menthol.

Dr. Frank Eischen, an entomologist with the USDA's Agricultural Research Service in Weslaco, Texas (22) has done other work that has focused on using natural products to control mites. Dr. Eischen has focused on using the smoke of different plants to knock down mites. So far, he has had good results with creosote bush and dried grapefruit leaves. Creosote bush smoke achieves a 90 to 100 percent mite knockdown after one minute, but excessive exposure can harm the bees. Grapefruit leaves, however, seem less toxic; after 30 seconds, smoke from grapefruit leaves knocked 90–95% of the mites off the bees but killed neither mites nor bees (23). Dr. Eischen doesn't recommend using this technique, however; he calls it "crude." The long-term goal of his research is to isolate chemicals in the smoke that adversely affect mites and use those chemicals as the active ingredients of miticides (24). For more information, contact Dr. Eischen.

Some unpublished information has come from the bee listserver regarding mineral oil control of mites. Apparently, Dr. Pedro Rodriguez has had good success using food grade mineral oil, applied on the top bars of the hive frames, at a rate of 2.5 cc per hive. Dr. Rodriguez applied the oil every two weeks for one year. He concluded that, "contrasted to the characteristics of other oils, lard, Apistan, or menthol (used as acaricides), mineral oil seems to offer a preferable medium based on per unit cost, physical characteristics (odorless, flavorless, does not deteriorate, does not contaminate honey or bee products, can be utilized all year long) for utilization as an acaricide" (25).

More research needs to be conducted in this field of study. As Dr. Tom Sanford stated in a recent APIS newsletter: "The take-home message to the would-be experimenter...is that applying oils of essence and related chemicals carries considerable risk and should be approached with extreme caution" (18).

There are several ways to check for infestation levels of both mites. See the enclosure titled "Surveying for and Controlling Varroa Mite Infestations" for more information. The American Association of Professional Apiculturists (AAPA) has an eight-page pamphlet available titled "Protecting Honey Bees from *Varroa jacobsoni*" that describes methods for detecting varroa mite. To obtain a copy, send 50 cents to:

Extension Beekeeping
Varroa Pamphlet
PO Box 110620
Gainesville, FL 32611-0620

Bees can be diagnosed free of charge for both species of mite by sending bees in a small, tightly-closed, plastic bottle of rubbing alcohol to the USDA Bee Disease Diagnosis Laboratory (26).

Small hive beetles

In 1998, the small hive beetle, a native of South Africa, was found in Florida. The beetle has already spread to at least three other states and is seen as a serious threat to bees. The only known chemical treatment is a product called Bayer Bee Strips ™, which contain the

organophosphate coumaphos. One way to fight the beetle is to delay putting on extra combs until the bees are ready for them.

Wax moths

Greater wax moths (*Galleria mellonella*) are a common pest of honey bees and usually occur on stored honey comb. One simple and effective way to rid comb of wax moths is to freeze it while in storage. Of course, this takes a lot of freezer space so it is most often done only on a very small scale. A strain of *Bacillus thuringiensis* (commonly called Bt) has been shown to be effective against wax moths, but it is not available in the U.S. (27). A Swiss study conducted in 1997 showed that *Trichogramma* wasps can be used to control wax moths (28). In the study, five batches of *Trichogramma* eggs were released at 3-week intervals during the summer and were effective even under heavy wax moth infestation levels. (*Trichogramma* wasps are solely egg parasites, meaning that they are ineffective on any stage of wax moths except eggs.)

Diseases

The two most common bee diseases are American foulbrood (AFB) and European foulbrood (EFB).

American and European foulbroods kill bees during the pupal stage. The dead pupa rots and begins to smell, hence the name of the disease. Foulbrood is worse in high humidity. The conventional treatment for foulbrood is to use shortening patties mixed with Terramycin® three times in spring and once or twice in fall. (See the enclosed recipe from Kerry Clark for specific quantities and ingredients.) Stan Hildebrand, an organic farmer and beekeeper in Missouri, has found that one treatment per year is enough, but that one treatment is crucial (29).

If a colony is stricken with AFB or EFB, it must be killed and burned in most states. This is done to prevent further infections in nearby colonies. An alternative to burning may be to boil infected equipment for 20 minutes in water and lye soap (29). Check with your state's beekeeping specialist for treatment options where you live.

These diseases are not as ubiquitous as are mites, but the beginning beekeeper should be aware of their respective symptoms and be prepared to act accordingly. These and other diseases, as well as additional pests (e.g., wax moths, robber bees, etc.), are covered in any good bee text. In contrast, the mite problems are relatively new, so older texts will not mention them at all.

Africanized bees

Since 1990, Africanized honey bees (AHBs), the so-called killer bees, have been a threat to beekeepers in the U.S. These bees are currently invading Texas, New Mexico, Arizona, and California. It is thought that AHBs can only survive year-round in areas where the winters are very warm. See the enclosed article "Living with Africanized Bees" for more information.
I hope this material is helpful. For information on using bees other than honey bees for pollination, request the ATTRA publication *Alternative Pollinators: Native Bees*. Please feel free to call ATTRA again if you have other questions related to sustainable agriculture.

References:

1) Gerald Wallis, personal communication, 1995.

2) Sanford, M.T. 1999. 1999 Pacific Northwest honey bee pollination survey. APIS. October. p. 4.

3) Sanford, M.T. 1999. Yearly honey production and prices: Historical analysis. APIS. April. p. 1–2.

4) Wenning, Carl J. 1999. What price honey? American Bee Journal. August. p. 597–601.

5) Quarles, Bill. 1997. Neem controls bee mites. Common Sense Pest Control. Winter. p. 4.

6) Bosisio, Matt. 1990. Faster-acting menthol for bees. Agricultural Research. January. p. 22.

7) Tabor, J. 1990. Combating tracheal mites. Maine Organic Farmer and Gardener. July–August. p. 22.

8) Dr. Tom C. Webster
Community Research Service/Cooperative Extension
Kentucky State University
Frankfort, KY 40601

9) Grossman, Joel. 1998. Neem for honeybee pests. The IPM Practitioner. September. p. 10–11.

10) Erickson, Eric, Anita Atmowidjojo, Alan King, and Joanne King. 1998. Effect of "new" vs. "old" wax brood combs on honey bee tracheal mite populations in North Dakota. American Bee Journal. September. p. 672–673.

11) Anon. 1999. Russian honey bees. Small Farm Today. December. p. 11.

12) Anon. 1995. Fluvalinate--Use it right or lose it! APIS. February. p. 1–3.

13) Wood, Marcia, Ben Hardin, and Jill Lee. 1999. Varroa-tolerant bees keep hives buzzing. Agricultural Research. August. p. 12–14.

14) Sanford, M.T. 1998. The case for hygienic bees: A little-used technology. APIS. September. p. 1–2.

15) Senft, Dennis. 1997. Helping honey bees fight mites. Agricultural Research. May. p. 22.

16) Sanford, M.T. 1998. The "sticky board": A new apicultural tool. APIS. May. p. 3.

17) Sanford, M.T. 1999. More on open mesh floors for varroa control. APIS. August. p. 1–3.

References: continued

18) Sanford, Malcolm T. 1997. More on oils of essence in mite control. APIS. November. p. 4.

19) Sammataro, Diana, Gloria Degrandi-Hoffman, Glen Needham, and Gordon Wardell. 1998. Some volatile plant oils as potential control agents for varroa mites (Acari: Varroidae) in honey bee colonies (Hymenoptera: Apidae). American Bee Journal. September. p. 681–685.

20) Dr. Raymond Nabors, personal communication, November, 1997.

21) Bogdanov, Stefan et al. 1999. Influence of organic acids and components of essential oils on honey taste. American Bee Journal. January. p. 61–63.

22) Dr. Frank A. Eischen
USDA–ARS Beneficial Insects Research Unit
2413 E. Hwy. 83
Weslaco, TX 78596
956-969-4852
Email: feischen@weslaco.ars.usda.gov

23) Adams, Sean. 1997. Smoking out bee mites. Agricultural Research. August. p. 19.

24) Williams, Greg and Pat. 1997. Smoke from dried leaves vs. varroa mite of honey bees. HortIdeas. October. p. 114.

25) Excerpted from BEE-L (bees@systronix.net).

26) Bee Disease Diagnosis
USDA–ARS Bee Research Lab.
Bldg. 476, BARC–East
10300 Baltimore Ave.
Beltsville, MD 20705-2350
301-504-8205
http://www.barc.usda.gov/psi/brl/brl-page.html

27) Charrière, Jean-Daniel and Anton Imdorf. 1999. Protection of honey combs from wax moth damage. American Bee Journal. August. p. 627–630.

28) Bollhalder, Franz. 1999. *Trichogramma* for wax moth control. American Bee Journal. September. p. 711–712.

29) Marmel, Lila. 1999. Organic beekeeping: Is it possible? Organic Broadcaster. July-August. p. 11–12.

Enclosures:

ATTRA Resource List: Apiculture/Beekeeping

Clark, Kerry. No date. Recipe for antibiotic extender patties. Received over the Internet from kclark@galaxy.gov.bc.ca.

Harrar, Sari. 1994. The basics of beekeeping. Organic Gardening. December. p. 30–38.

Mussen, Eric. 1995. Surveying for and controlling Varroa mite infestations. Arkansas Apiary newsletter. Spring. p. 2.

Quarles, William. 1994. Living with Africanized bees. Common Sense Pest Control. Fall. p. 5–14.

Silva, Beth. 1999. Keeping bees—A buzz on the business. AgVentures. June–July. p. 50–55.

Further Reading on Mite Control:

Caron, Dewey M. 1999. IPM for beekeepers. American Bee Journal. May. p. 363–365.

Erickson, E.H., A.H. Atmowidjojo, and L. Hines. 1998. Can we produce varroa-tolerant honey bees in the United States? American Bee Journal. November. p. 828–832.

Horr, Bob. 1998. Biological control of varroa mites without chemicals. American Bee Journal. November. p. 801–804.

Jackson, Don. 1999. All about pests and diseases. American Bee Journal. August. p. 623–625.

Sammataro, Diana, Gloria Degrandi-Hoffman, Glen Needham, and Gordon Wardell. 1998. Some volatile plant oils as potential control agents for varroa mites (Acari: Varroidae) in honey bee colonies (Hymenoptera: Apidae). American Bee Journal. September. p. 681–685.

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