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Beekeeping/ Apiculture

OTHER LIVESTOCK TOPIC

Abstract: This publication discusses various aspects of beekeeping or apiculture, including state inspection programs, beginning basics, income sources and budgets, insurance, Africanized bees, organic certification, and various bee pests and diseases. Information on educational and training opportunities and further resources are also discussed.

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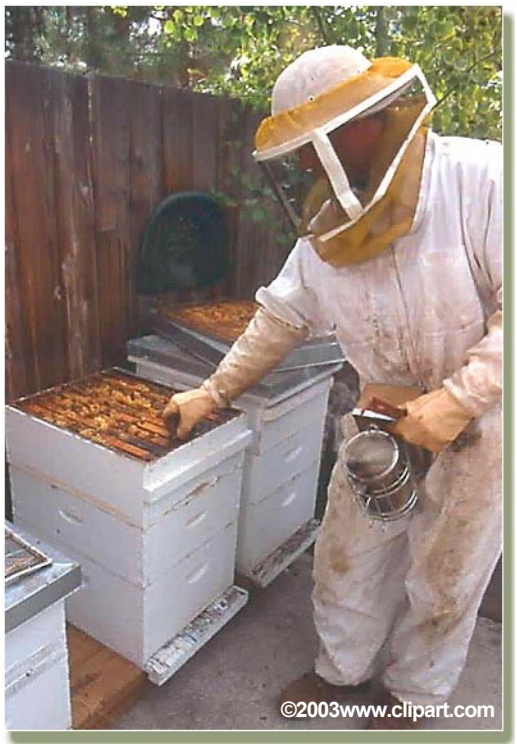
Introduction

This publication is intended as a guide for anyone interested in beginning or expanding a beekeeping enterprise. Whether the bees are kept as pollinators for crops or for the income from their products, producers need to be aware of their states' apiary laws concerning inspection, registration, and permits, as well as labeling and marketing standards. Producers also need to be aware of pesticide application laws and pesticide notification laws relative to bees. Both beginning and experienced beekeepers need to consider liability insurance; the possibility of Africanized hybrid bees taking over the hives; and all the pests and diseases that afflict bees and their colonies.

To maintain a healthy hive and guard against the new pests and diseases that have been introduced in recent years, beekeepers need to continually monitor new developments in apiculture. The **Further Resources** section of this publication lists many websites, USDA Research Facilities, periodicals, associations, and books with information on all aspects of beekeeping.



Related ATTRA Publications

- Alternative Pollinators: Native Bees
- Phenology Web Links: (1) Sequence of Bloom, Floral Calendars, What's in Bloom; (2) Birds, Bees, Insects and Weeds
- Organic Farm Certification and the National Organic Program

State Inspection Programs

It is important that beekeepers have their bees registered and inspected as required by law. The American Society of Beekeepers' free on-line class, Intermediate Beekeeping 201, suggests some excellent steps to follow when working with your state's apiary inspection programs. Lesson Five states:

All states have laws regarding apiary inspection. The regulatory body is usually the Department of Agriculture

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and some division within it. Some states have full time staff to handle an apiary section and others do not. When moving bees from one state to another, inspection of bees is regulated by the receiving state. Many require previous inspection before arrival and will do follow-up inspections once the bees are located within the new state. If you are planning to make a business of selling queens, bees, or moving bees for pollination, then it is very important to understand the laws in the states you are dealing with....

*It is important therefore to know who has the responsibility to inspect your bees and under what conditions the inspection is done. Inspecting bees is a nice job. One must deal with all kinds of problems: First, angry beekeepers (not their bees). Bee inspectors are people just like you and me. If treated with respect, they will respect you as well. Their job is to find disease. If your bees have disease and you don't know it, then they have done you a good service by pointing the disease out to you. On the other hand, they may require treatment of the bees, which you do not agree with. Make sure you understand the law before sounding off on the bee inspector — it is not his/her fault that he/she found disease in your bees. However, you have a right to ask that samples be taken and sent to the Beltsville USDA lab for confirmation of the disease. (American Society of Beekeepers, No date–a) [See instructions on how to ship bees to Beltsville in **Appendix**: Beltsville Free Bee Diagnostic Service].*

An all-state (and Canadian provincial) State Apiarist Directory, which includes state bee inspectors, other regulatory officials with apicultural responsibilities, and other professional apicultural specialists, is available on-line at <http://www.mda.state.mn.us/ams/apiary/directory.htm>.

Beginning Beekeeping Basics

It is usually wise to start small, learn efficient management techniques, and expand the beekeeping operation as time, experience, and finances permit. Initial outlay can reach $200 per hive, and other equipment, such as a smoker, veil, gloves, feeding equipment, honey extractor, etc., will add to the expense.

Anyone interested in becoming a beekeeper needs to study published information (see **Further Resources:** Books, Websites, Periodicals), but

many beekeeping skills are best learned by working with an experienced beekeeper. The Alberta Agriculture, Food, and Rural Development publication *Commercial Honey Industry* states: "Only through hands-on experience can new entrants gain the basic skills required for opening hives, removing frames, identifying queens, recognizing the difference between brood and honey cappings, and recognizing the difference between honey and pollen in a cell" (Dey, 2001).

The American Society of Beekeepers make the following suggestions in the final lesson of their Beekeeping 101 class:

> *One way to find other beekeepers who can help you with problems you encounter is to join a local bee club or state organization. Bee Culture Magazine publishes a Who's who in beekeeping each spring. You could check the listing for the state in which you live and contact the individuals listed. Ask them for information about bee clubs and who you need to contact. The person listed under the Department of Agriculture responsible for inspection should have a good idea. They are often called upon to speak at local meetings. The State Extension service should also be a good source. If you purchase either major bee magazine — each carries a calendar of events. You can get an idea of where the nearest bee meeting is to you. These are generally state or regional meetings. (American Society of Beekeepers, no date–b)*

Beekeeping can be labor-intensive during certain times of the year. Working with bees requires a gentle touch and calm disposition. It also requires a basic understanding of the honey bees' behavior during the various seasons and during handling and moving.

> *Beekeeping can be undertaken by anyone who has enough ability and determination to look after the bees properly, enough courage to work with bees, and enough money to buy bees and equipment. Please note: Before you get into beekeeping, you should check to make sure local zoning laws allow you to keep honey bees and what your reaction is to bee stings. (American Society of Beekeepers, no date–c)*

Beekeeping is not a seasonal enterprise, but requires year-round management. The beginning beekeeper needs to consider his or her available labor limitations, and keep the enterprise at an easily managed size. The enclosed Mid-Atlantic Apiculture Research and Extension Consortium (MAAREC) publication *Summary of Management Practices Around the Calendar* provides management suggestions, and is also available at <http://maarec.cas.psu.edu/bkCD/Startkeeping/Starting.html>.

The Mississippi State University publication *Getting Started in Beekeeping* provides an excellent summary of what is required to begin. The publication suggests:

> *If you decided that you wanted to get started in beekeeping, you would need the basic components of the hive, a source of bees, protective gear, ancillary gear, and equipment for handling the honey crop. The hive is the man-made structure in which the honey bee colony lives. New bee equipment is generally unassembled when purchased. Assembly directions furnished by bee supply dealers are usually easy to follow. It is important for beginners to purchase their equipment early so that it will be ready to use when the bees arrive. Some beekeepers find they can save money by making their own equipment or purchasing used equipment. With both approaches, it is important that the equipment is standard size. Purchasing used equipment can present problems and is not recommended for the beginner. Initially you may have problems simply in locating a source of used equipment and determining its value or worth. In addition, secondhand equipment may be contaminated with pathogens that cause various bee diseases. Always ask for an inspection certificate indicating that the apiary inspector did not find any evidence of disease.*
>
> *There are several different ways of getting started in the bee business: buying package bees; purchasing a nucleus colony (nuc); buying established colonies; collecting swarms; and taking bees out of trees and walls. Most beginners start with either a package or a nuc. Packages are the preferred way. In purchasing nuclei and colonies you might be buying other beekeeper's problems, such as mites or disease. Collecting swarms and transferring bees is difficult and not recommended for the beginner. The best time to start with bees [is] in the spring or early summer.*
>
> *Ancillary equipment includes the bee smoker and hive tool, which are essential for working bees. Bee veils should be worn at all times to protect the face and neck from stings. Beginners who fear being stung should wear canvas or leather gloves. Many experienced beekeepers who find gloves too cumbersome*

decide to risk a few stings for the sake of easier handling. White or tan clothing is most suitable when working bees. (Collison, 1996)

Some of the many other decisions that beginning and experienced beekeepers need to consider are:

- Location of hives—Hives should not be located near homes or areas used for recreation. Hives need to be near nectar and pollen sources and fresh water; protected from predators, vandals, and adverse weather conditions; and accessible throughout the year.
- Processing honey and other bee products—Follow state and federal regulations for processing, labeling, and handling food products.
- Marketing honey and other bee products—Types of products and marketing strategies — Will you market to consumers at farmers' markets or on-farm, to retailers, to a honey cooperative, or to honey packers?

Beekeeping Income Sources

Depending on the part of the country and other environmental factors, a typical colony of bees can produce 80 to 120 pounds of surplus (harvestable) honey and 10 to 18 pounds of pollen in an average year (Deeby, 2002d). Besides selling honey and other bee products—such as beeswax, pollen, royal jelly, propolis, bee venom, or queens—beekeepers can also provide pollination services (hive rentals) to farmers and orchardists (ERS/NASS, no date).

In 1999, commercial beekeepers in the Pacific Northwest—averaging about 2,000 hives each—were charging from $20 to $40 per hive for pollination services, depending on the crop. In addition, they were transporting and renting these hives about three different times during the year to different parts of the country. Those rentals provided roughly 65% of the commercial beekeepers' incomes (Burgett, 1999).

On a more modest scale, keeping just a few hives can generate some income, especially with creative retailing of honey, honeycomb, wax, and pollen. In addition, a bee colony can 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. In June 2002, the USDA/Agricultural Marketing Service/National Honey Report listed prices for honey ranging from $0.83 per pound in Florida to $1.00 per pound in Wisconsin, Minnesota, and Montana (USDA/AMS, 2002) (See **Further Resources**: Periodicals on how to obtain these monthly reports). However, these reports reflect the price of honey that is being produced by large-scale beekeepers and do not indicate what small beekeepers should charge for their honey (Wenning, 1999). The best sources of local price information will probably be other local beekeepers. And some consumers are willing to pay more for value-added products—such as flavored honeys, honey wine, honey beer (mead), and packaged honey gifts—than for plain honey.

Budgets

The Pennsylvania State University Cooperative Extension Agriculture Alternatives publication *Beekeeping* (enclosed) contains an annual beekeeping budget that summarizes the receipts, costs, and net returns for 10 mature bee colonies. The publication notes that "successful side-line operations typically maintain 50 to 500 colonies." It also states that "There will be no receipts from an operation until the second year" (Frazier et al., 1998). The sample Excel budget is available at <http://agalternatives.aers.psu.edu/other/bees/index.htm>.

Several detailed commercial beekeeping budgets for honey and pollination operations are available in the Alberta Agriculture, Food, and Rural Development Ministry publication *Commer-*

cial Honey Industry. It should be remembered that dollar amounts are stated in Canadian dollars (about 64 cents to the U.S. dollar at the time of this writing). The publication can be viewed at <http://www.agric.gov .ab.ca/agdex/600/616_830-1.html>.

These budgets were designed as aids for evaluating a beekeeping enterprise. The sample budget presents a workable combination of inputs that will produce a given output. This combination of inputs probably doesn't represent any given beekeeping operation, and the actual costs of inputs are likely different for each operation. While there may be hundreds of combinations of variable and fixed costs, as well as income potentials, each budget gives only one combination. Different production and management practices, as well as various marketing opportunities, can make the beekeeper's actual budget quite different from these budgets.

Beekeeper's Insurance

Beekeepers need to consider insurance for personal injury, property damage, and circumstantial liability. In an article in the *American Bee Journal*, the author comments:

> *Insurance! The very word sends shivers down the reader's spine. Or if not shivers, at least annoyance at putting out so much money over so many years, and getting so little in return. But what does insurance have to do with beekeeping, you ask? Only this—as a seller of honey, you are liable for injuries sustained by your customers. Moreover, as a keeper of bees, you incur negligent and non-negligent risk from several different directions. (Scott, 2002)*

He goes on to suggest these areas of concern:

- Customer injury, such as someone getting sick (or claiming to) from eating honey or other bee products, or someone injured by a piece of glass or other foreign object in the honey.
- Property injury, such as a child playing around the hives, getting stung, and going into anaphylactic shock.
- Circumstantial injury caused by the unforeseen results of some action the beekeeper takes. (Scott, 2002)

The same author continues:

> *So you see, there may be a need for insurance, especially if you are a larger commercial beekeeper. The conventional wisdom is that if anything happens on my property, my homeowner's insurance will cover the liability. But that is incorrect. It depends on whether the beekeeping is a hobby or business and on the size of the claim. Moreover, it is an easy argument to make that any revenue generated is a business, not a hobby....*
>
> *The decision is not an easy one. Every beekeeper must decide what level of risk he/she is willing to tolerate. But every beekeeper should be aware that along with dead hives, varroa mites, poorly laying queens, and bad weather, he/she must also endure some exposure to liability. (Scott, 2002)*

Beekeepers should check with their insurance companies to discuss their specific needs. Different insurance companies have different concerns about the many aspects of beekeeping liability. Bee and honey associations may be able to help their members with this type of protection. In the past, the American Beekeepers Federation provided a liability insurance program for its members. The Federation's website states that "Through the Federation's master policy you can obtain liability insurance to protect your beekeeping operation in today's litigious society" (American Beekeeping Federation, 1999). Beekeepers should contact their associations to see whether this type of coverage is available (see **Further Resources**: Associations).

Organic Apiculture Standards

Beekeepers wanting to market organic honey or other organic bee products will need certification by a USDA-accredited organic certification agency. Please refer to ATTRA's *Organic Farm Certification and the National Organic Program* for general certification information.

The National Organic Standards Board (NOSB) Apiculture Task Force Report was released September 15, 2001. The Draft Organic Apiculture Standard recommendations, while serving as guidelines, are not regulations (standards) until formally implemented by USDA/National Organic Program. The NOSB recommendations are available at the USDA/NOP website, <http://www.ams.usda.gov/nosb/lscommRMR/reports/apiculture.html>.

The NOSB report recommends that if products from an apiculture operation are to be sold as organic, the bees and hives have to be managed in compliance with the organic livestock standards for at least 270 days prior to removal of products from the hive. This includes developing an organic apiculture plan for your organic certification agency and observing all the national organic provisions. For example:

- Origin of the livestock—Hives have to be under continuous organic management for no less than 270 days prior to removal of honey or other products, or hives need to be purchased from organic sources.
- Supplemental feed—Organic honey and organic sugar syrup are allowed up to 30 days prior to honey harvest.
- Forage area—Hives have to be located at least 4 miles from any area using prohibited materials listed in the standards or from any contaminated sites.
- Living conditions—Hives must be made of natural materials, such as wood or metal, but not with treated lumber.
- Health care practices—Make sure all therapeutic products are listed on the National List of Allowed and Prohibited Substances as NOSB approved, or are approved by your organic certification agency.
- Record keeping—Necessary for documenting movement of hive, health care, and sale of products, as well as for auditing.

Africanized Hybrid Bees

Since 1990, Africanized honey bees—the so-called "killer bees"—have been a threat to beekeepers in the United States. These hybrids have invaded Texas, New Mexico, Arizona, Nevada, and California, as well as Puerto Rico and the Virgin Islands (Information Staff, 2002). It is not known how far north the Africanized honey bees can live in the U.S., but they can live in the Andes of South America. The limiting factor to their spread seems to be that they don't store as much food as most other honey bees. This means they may starve to death in winter when there are no flowers blooming (Anon., c. 2002).

Texas A&M University has a website that lists the Africanized Honey Bee Quarantined Counties in Texas, as well as a USDA map showing the locations of Africanized honey bees in the United States. As of July 10, 2002, Texas had 143 counties quarantined for Africanized honey bees. The quarantine allows beekeepers to move bee hives within but not out of the zone, in an effort to prevent the assisted spread of Africanized honey bees. For additional information on Africanized honey bees, visit <http://agnews.tamu.edu/bees/quaran.htm>.

Africanized honey bees are impossible to physically distinguish from regular honey bees. The bees have to be analyzed in a lab to determine whether they are Africanized (Anon., c. 2002). Behaviorally, Africanized bees are typically aggressive when reacting to threats that non-Africanized bees would ignore. The USDA Beltsville Bee Research Laboratory provides free authoritative identification of Africanized honey bees, as well as diagnosis of bee diseases and pests, for Federal and State regulatory agencies and for beekeepers worldwide [See instructions on how to ship bees to Beltsville in the **Appendix**]. Texas's Honey Bee Identification Lab at Texas A&M University allows Texas residents to have samples of honey bees identified free of charge. Texas residents should contact their Extension agent about this service (Anon., c. 2002).

Honey Bee Pests

During the past 15 years, tracheal mites and varroa mites have become major bee pests that seriously threaten the industry in the United States. Mites have killed more than 90% of wild honey bees and 60% of commercial bees in the U.S. (Quarles, 1997). A new pest to U.S. beekeepers—first identified in Florida in 1998—is the small hive beetle (Frazier and Steinhauer, 1999). The following discussion focuses on least-toxic methods of controlling these pests.

Tracheal Mites

Microscopic tracheal mites (*Acarapis woodi*) lay eggs in the abdominal breathing tubes of the bee, and their larvae feed on the bee after the eggs hatch. The mites came to the United States from Mexico in 1984 (Higgins, 2002). Alternative control methods focus on cultural and chemical manipulations and on mite-resistant bees.

Dr. Eric Erickson at the Carl Hayden Bee Research Center in Tucson, Arizona, commented in an electronic question-and-answer forum concerning tracheal mites that "Most colonies in the United States are resistant to tracheal mites. This is largely due to the fact that we have never had a highly effective chemical treatment. Hence, susceptible colonies died and resistant colonies survived" (Erickson, 2002a).

A common treatment for tracheal mites entails mixing 50 grams of menthol with 50 grams of vegetable shortening and spreading it thinly on cardboard sheets that are placed on top of the frames for a total of 25 days (Bosisio, 1990). 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 (Tabor, 1990). With the smaller entrance, hive ventilation may become a problem during hot days when bees gather at the entrance and vibrate their wings to ventilate the hive. 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 vegetable oil and sugar, comes from Dr. Tom Webster at Kentucky State University. He suggests mixing equal parts of vegetable oil and sugar into a patty, placing it on a piece of hardware cloth, and resting 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 gather a small amount of oil on their bodies. The oil 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 applied directly on 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 (Quarles, 1997). Dr. A. P. Melathopoulos found that a ten-percent concentration of neem oil placed directly on bees killed more than 50% of varroa mites (Grossman, 1998). Neem has also been shown to be effective against American foulbrood (Grossman, 1998). [*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. A study conducted in North Dakota in 1994 found that colonies on new combs were three to four times more likely to be infested with tracheal mites than colonies on old combs (Erickson et al., 1998).

Varroa Mites

Varroa mites came to the United States in 1986 and have spread through all 48 contiguous states. The mites live in the hive, attach themselves to the bees' abdomens, and suck the bees' vital flu-

ids. The bees become sick, and the hive slowly dies (Higgins, 2002).

How to Detect

The NebGuide publication *Using the Sugar Roll Technique to Detect Varroa Mites in Honey Bee Colonies* states:

> *Globally, [the varroa mite] is the most important pest of honey bees and it has caused extensive losses in feral and managed colonies. Once introduced, varroa mites have never been eradicated from any country or region, [and] beekeepers must adopt an integrated pest management strategy to protect their colonies. Early detection and assessment of infestation levels are important components of a varroa management plan. Since varroa mites feed by piercing the intersegmental membranes on the underside of the bee's abdomen, they are not easily observed on bees until the colonies are severely injured. Beekeepers need to use a detection technique to check their colonies for mites. In addition to detecting mites, beekeepers need to accurately assess the infection levels to determine when control measures are warranted....*
>
> *The five most commonly used detection and assessment methods for varroa are: 1) ether roll, 2) alcohol wash, 3) brood examination, 4) sticky boards placed on the bottom board, and 5) acaricides with sticky boards. (Macedo, 2001)*

These five methods are discussed in the enclosed section "Varroa Jacobsoni", from *Diagnosis of Honey Bee Diseases* (USDA), available at <http://maarec.cas.psu.edu/bkCD/Bee_Diseases/varroa.html>.

The enclosed NebGuide publication discusses the alternative technique of using powdered sugar to detect varroa mites, also available at <http://www.ianr.unl.edu/pubs/INSECTS/g1430.htm>. Another detection method is described in the publication *Mite excreta: A new diagnostic tool for detecting Varroa mites!* at the USDA/Carl Hayden Bee Research Center website, <http://gears.tucson.ars.ag.gov/rf/detect/detect.html>.

Chemical Treatment

For years, the only control for varroa mites (*Varroa jacobsoni*) has been the miticide fluvalinate (Apistan®), a synthetic pyrethroid. However, beekeepers in Europe and several U.S. states have seen strains of mites resistant to Apistan®. It is only a matter of time before resistance becomes more widespread. It is also important to remember that honey cannot be gathered while Apistan® is in use.

The May 2000 issue of *Bee Tidings*, a newsletter published by University of Nebraska Extension and the Nebraska Beekeepers Association, discussed the use of Apistan® strips:

> *Apistan® strips are a highly effective control for susceptible mite populations, but no longer provide adequate control in some beekeeping operations. Beekeepers who choose to use Apistan® should check to determine if their colonies will respond to the treatment prior to spending a lot of time and money on treatment. Dr. Jeff Pettis, a USDA Scientist at the Beltsville Bee Laboratory, described a resistance monitoring procedure in an American Bee Journal article. To conduct the Pettis test, prepare a pint wide-mouth jar by inserting a sugar cube and a note card that has been trimmed to fit the jar. Staple a 3/8" by 1" piece of an Apistan® strip to the card near the top of the card. Prepare a two-piece canning lid for the jar by replacing the center portion with screen wire that will allow mites to pass but not the bees (8 mesh per cm works well). Collect 250-300 mite infested bees in the jar and hold them for 24 hours in a cool and dark place. Invert the jar and shake it several times to recover any dead mites on a sheet of paper. After recovering the mites, place the jars in an oven at low heat (about 140° F.) until the bees are dead. Then, shake the jar again to recover any mites that were not killed by the Apistan® strip. This test will give you a good indication of how effectively Apistan will perform in your colony. Apistan® strips can be purchased in any state and are available from most bee supply dealers. They have a Section 3, or general use, label. (University of Nebraska Extension/Beekeepers, 2000)*

Apicure™ is a registered miticide that contains about 65% formic acid, a colorless liquid with a penetrating odor that is found in ants and in many plants. Formic acid controls tracheal mites and is used for the suppression of varroa mites. It has been used for years in Canada and Europe. Apicure™ is a slow-release gel that is sealed in plastic bags that are sliced open and placed in the hives. It should be removed after 21 days and 28 days before honey flow. It should also be used only when daytime temperatures are between 45° and 95°F, with the hive entrance fully open (Apicure, Inc., no date).

A possible option for varroa control was mentioned in the July 2002 *American Bee Journal*. In the article "Varroa Control with Fungal Pathogens May Be an Option Soon," the authors discuss their research in isolating and screening several fungi that were highly pathogenic to varroa at temperatures similar to average hive temperatures. They state that they hope to offer beekeepers this option in the near future (Kanga and James, 2002).

Several alternative solutions to Varroa control have been studied in Europe. They include lactic acid, oxalic acid, thymol, essential oils, neem oil, and several bio-technical measures. These control measures are discussed in the Swiss Bee Research Center website publication at <http://www.apis.admin.ch/english/Themes/Varroa.htm>. However, according to Blane White, Aviary Inspector in Minnesota, lactic acid and oxalic acid have not been tested in the United States and are not approved treatments. He also comments that thymol has had limited testing in the United States, and that it does work under some conditions. However, there are no approved thymol treatments in the U.S. at present (White, no date).

Using essential oils to kill both kinds of mites has been researched. 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 and 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 tested thymol-based products in Texas, Virginia, and Minnesota (Sanford, 1997). 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. 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 effective blend in the study was thymol and citronella.

In the late 1990s, Swiss researchers tried to determine whether organic acids and essential oils affect the taste of honey (Bogdanov, 1999). They 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. Of the essential oils, thymol was easiest to detect, followed by camphor and menthol.

More research needs to be conducted. In an APIS newsletter, Dr. Tom Sanford stated, "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" (Sanford, 1997).

Bio-technical Methods of Control

One method of varroa control involves changing the bottom board of a hive (Sanford, 1998). Often, mites fall off of bees and land on the bottom board. They can then crawl back up into the hive and reattach themselves 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 get back onto the bees. (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 (Sanford, 1999). For more information on using mesh floors, go to <http://apis.ifas.ufl.edu/apis99/apjun99.htm#4>. Blane White, Apiary Inspector in Minnesota, says that screen bottoms can reduce varroa populations by 15% to 30%, and that once the screens are installed, no further labor is needed (White, no date).

Thomas Deeby at the Carl Hayden Bee Research Center, in an electronic question-and-answer forum, made the following comments about smoker fuel to knock varroa mites off of bees and screened bottom boards to reduce mites in the hive:

> *Products that have been tried range from menthol, to tobacco, grapefruit and other citrus leaves, and creosote leaves. High heat itself stuns them. Sticky boards and slotted bottom boards also seem to have some measure of success....*
>
> *Natural Products Smoke - Beekeepers routinely use smoke to calm their bees before opening the hive. Tobacco smoke increases mite fall and has been used for both detection and control of varroa. More recently, Dr. Frank Eischen, USDA bee research scientist, demonstrated that creosote bush and grapefruit leaves produce a smoke that can*

knock down 90% of the mites in test cages. However, excessive exposure to natural product smoke can harm bees. Also, mites are not usually killed by the smoke and may recover if not removed from the colony by a sticky board or other mite trapping device. Mites in brood cells are not affected by natural product smoke. While natural product smoke is not an approved treatment for varroa, there is no legislation prohibiting their use as smoker fuel. With careful attention to bee safety, the smoke of some natural products may be helpful in retarding varroa population growth in colonies.

Anti-varroa bottom boards - A French beekeeper, Jean-Pierre Le Pabic, has devised a bottom board that may help reduce varroa injury. He suggests that in a standard bottom-board-equipped colony, mites that fall from bees are able to easily reattach themselves to another host bee. He designed a bottom board consisting of 12 tubes that run lengthwise with a space between them that permits mites to fall to the bottom, but through which bees cannot pass. He reports that mite populations remain low in hives fitted with this bottom board due to the inability of varroa mites to climb back up to where they can reattach to a new host. Anyone who has worked with sticky boards knows that numerous mites drop to the sticky traps whenever colonies are examined or smoked. This novel approach to varroa control may help reduce beekeeper's dependence on chemical treatments. (Deeby, 2002c)

For more information on the Le Pabic anti-varroa bottom board, see the enclosed article or visit <http://www.apiservices.com/happykeeper/index_us.htm>.

Dr. Pedro Rodriguez has had success using food-grade mineral oil (FGMO). Test results show that FGMO is highly efficient for control of varroa infections. It is economical, non-contaminating, and gentle to the environment. It can be applied every two weeks or so for the entire year. It is used in conjunction with screened bottom boards to prevent mites from re-attaching themselves to bees after falling off. Food-grade mineral oil does not alter the quality of the honey (Arias Martinez et al., 2001). While the use the FGMO is still unregulated and in a testing phase, the potential use of FGMO for control of varroa mites deserves to be considered. Much of the latest information on the use of FGMO and methods of application is located at the website <http://www.beesource.com/pov/rodriguez/>.

Research indicates that smaller starter cells help control varroa mite infestations (Senft, 1997). Foundation sheets (sheets of wax imprinted with base cell sizes) with cells 22% smaller in diameter provided higher winter survival rates for bees.

Another cultural control method is to encourage worker bees to make drone brooder combs. 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. Blane White, Apiary Inspector in Minnesota, states that removing two to three combs of drone brood can reduce varroa population by about 50%. For more information on this method, White recommends the website <http://www.xs4all.nl/~jtemp/dronemethod.html> (White, No date).

Tolerant Strains of Honey Bees

Since varroa mites became a major problem, various strains of honey bee have been tested and crossbred in the hope of finding bees that are tolerant to mites—whether through selective breeding for grooming behaviors or for cell-building tendencies. Currently there are at least four options for beekeepers to consider. They are the hygienic bees, Russian bees, SMR (Suppressed Mite Reproduction) Smart bees, or local varroa-tolerant bees.

Hygienic bees spend more time cleaning themselves and their hives, which promotes some resistance to varroa mites. 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. These are now commercially available. 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 (Sanford, 1998b). The publication *The Hygiene Queen* provides information on some of the traits that are selected for and also provides the standard quantitative test used. The publication is available at <http://www.beekeeping.com/articles/us/hygiene_queen.htm>.

Russian bees are a resistant strain of honey bees being developed and tested by the USDA Baton Rouge Bee Lab. These bees evolved in Russia's Far East, where mites and honey bees have co-existed for decades. Commercial evalu-

ations of Russian bees have shown good mite resistance and exceptional winter hardiness. In tests comparing domestic honey bees with the Russian bees, the varroa mite reproduction was two to three times lower with the Russian bees (Suszkiw, 2001). Contact Dr. Thomas E. Rinderer at the USDA Baton Rouge Bee Lab for information on where to get Russian queen bees (see **Further Resources**: USDA Research Facilities, for contact information). For additional information on Russian honey bee research, see the *Agricultural Research* article "Russian Honey Bee Earning Its Stripes" at <http://www.ars.usda.gov/is/AR/archive/oct01/bee1001.htm>.

The USDA Baton Rouge Bee Lab found a trait of the honey bee that prevents the varroa mite from reproducing and thereby provides genetic resistance to it. This trait is called "suppression of mite reproduction" or SMR (commonly pronounced SMART). The USDA lab has bred a line of honey bees that carry this trait and have released them for commercial sale with several queen bee producers. The SMRD Project at Baton Rouge is described in the publication *Breeding Honey Bees that Suppress Mite Reproduction* at <http://msa.ars.usda.gov/la/btn/hbb/jwh/SMRD/SMRD.htm>. In this publication the authors state:

> *We now have varroa-resistant stocks of bees inbred for the SMR trait, and these colonies greatly limit mite growth. The U.S. queen rearing industry is geared toward the production of naturally mated queens, which makes the production of commercial inbred resistant queens very unlikely (unless queens are mated in an isolated area such as an island). However, queen producers can readily produce hybrid queens. We found mite growth to be intermediate between resistant bees and susceptible bees when resistant queens are free-mated with susceptible drones (Figure 6). Although colonies with hybrid queens (resistant x control) had intermediate populations of mites, they had half the mites found in the susceptible controls. Hence, even hybrid queens should provide beekeepers a tangible level of resistance. (USDA/Honey Bee Breeding, c. 2001)*

The Carl Hayden Bee Research Center has demonstrated that it is relatively easy for beekeepers to produce varroa-tolerant bees with their own locally adapted bees, though it does require an elevated level of hive management. The enclosed publication *Producing Varroa-tolerant Honey Bees from Locally Adapted Stock: A Recipe* provides information on what to do and how to do it. This publication is also available at <http://gears.tucson.ars.ag.gov/publ/tolerant2.html>.

Small Hive Beetles

In 1998, the small hive beetle, a native of South Africa, was found in Florida. As of October 2001, the small hive beetle had been found in 24 states, most of them east of the Mississippi River. 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 United States. (USDA/BARC, c. 2001)

In an on-line question-and-answer session about small hive beetles, Thomas Deeby stated:

> *These are extremely tough beetles and very difficult to stop or control. They will either burrow through soft mulch or crawl to a location that is easier for them to access. There are soil conditioners, soil fungus and insect predators that are being currently tested. By the time the beetles pupate, the larvae have caused much damage in the hive, which will not be cleaned up by the bees, and it just escalates from there. This is going to be a very difficult pest to deal with. Pesticides in the hive, in the soil, corrugated cardboard on the bottom board, and other traps seem to be the methods of treatment to date. Keeping strong colonies will help, but not guarantee SHB will not pay you a visit. Moving your hives to break the reproductive cycle of the beetle may work, assuming you have alternate locations for your colonies.*
>
> *These are some of the things we know about SHB. Two weeks after decimating the comb in a hive, the mature larvae of the small hive*

beetle seek the soil under the hive to continue their life cycle. They seem to prefer sandy soil and burrow in 6–8 inches where they pupate and later emerge as beetles. Hard ground only slows the larvae down as they radiate out searching for softer ground. Strong colonies of honey bees can remove some of the larvae in the hive but according to Garth Cambray, in South Africa, the bees do not kill the larva and they drop them up to 50 m from the hive, which allows them to continue their cycle and pupate in the ground.

The small hive beetle is a tough customer. Not only is its exoskeleton hard, providing a solid armor of protection but also it has well-developed wings and can fly at least 5 miles. David Westevelt, state inspector in Florida reports a beetle infestation in a colony 14 miles from the nearest apiary and he has found beetles in feral swarms living in trees. Cold weather has no ill effect as Bill Wilson, Agricultural Research Service, Weslaco Bee Laboratory, Texas, reports that the beetles were found in the center of clusters of honey bees in North Carolina where the night temperature was consistently below freezing. Dr. Lundie who first studied the beetle in 1940 found that adult beetles live up to 6 months. It is known that the beetle can survive days without food so the chance of live beetles being transported in colonies or on equipment is very high.

There is one insecticide currently registered for use on soil in an apiary. It is Gardstar® 40% EC, a permethrin. Beekeepers have used soil drenches of insecticides they might use on ants, such as chemicals approved for fire ants. This is not a legal use. Results are variable and use of permethrin or other insecticides may do more harm via accidental contamination of bee equipment and/or killing of the bees themselves.

Please contact the USDA scientists working in Beltsville and Weslaco for follow-up information. (Deeby, 2002a)

The USDA/BARC Bee Research Laboratory provides the following information concerning the small hive beetle on their website <http://www.barc.usda.gov/psi/brl/bd-shb.htm>.

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. (USDA/BARC, c. 2001)

The only known chemical treatment is a product called Bayer Bee Strips ™ or CheckMite+™, which contains the organophosphate coumaphos.

Under the Section 18 authority of the EPA, many states have been granted use of these strips for control of varroa mites and small hive beetles. Maryanne Frazier and James Steinhauer in the *News–Small Hive Beetle Pest Sheet* state:

> *The section 18 registration for Bayer Bee Strips is for non-food use. There is no allowance for any coumaphos residue in honey or wax. All surplus honey supers must be removed before treatment and not be replaced until after the treatment has been removed. Coumaphos is in a group of highly toxic materials called organophosphates. The dermal (absorption through the skin) toxicity of coumaphos to mammals is approximately 20 times greater than that of Apistan. It is therefore imperative that beekeepers follow all label instructions, including wearing gloves, when using Bayer Bee Strips....*
>
> *...Under the section 18 registration, the sole distributor of Bayer Bee Strips is Mann Lake Ltd., 501 S First Street, Hackensack, MN 56452-2001, orders 1-800-233-6663, office 218-675-6688. They will be required to keep records of the number of strips sold in each state. (Frazier and Steinhauer, 2000)*

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 a comb of all stages of wax moths is to freeze it. Freezing the comb at 20°F for a minimum of 4.5 hours or 5°F for 2 hours is recommended. After freezing, the comb needs to be stored where no adult wax worm moths can get to it, but the beekeeper will still need to check the comb at least monthly for any signs of reinfestation (Tew, 1997).

Heat can also kill all stages of wax moths. The combs need to be heated to 115°F for 80 minutes or 120°F for 40 minutes, but never hotter than 120°F. Make sure all combs reach the required temperature before starting to time them. Adequate air circulation is important to evenly heat the combs. Remember that combs are softened by high temperatures and may sag and become distorted. Heat treat only combs with no honey in them (Tew, 1997).

A chemical method for control of wax moths is paradichlorobenzene (PDB or mothballs). The treatment procedure is to place 6 tablespoons or 3 ounces of PDG crystals on stacks of 5 supers. The stack should be as air tight as possible, so close all openings and seal the cracks between supers with masking tape. The crystals are placed on a paper positioned on the frame's top bars. More crystals should be added every 2 to 3 weeks. DO NOT use PDB on honeycombs containing honey intended for human use (Tew, 1997).

A Swiss study conducted in 1997 showed that *Trichogramma* wasps could be used to control wax moths. In the study, five hatches of *Trichogramma* eggs were released at 3-week intervals during the summer and were effective even under heavy wax moth infestation (*Trichogramma* wasps are solely egg parasites, meaning that they are ineffective on any stage of wax moths except eggs) (Bollhalder, 1999).

Honey Bee 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.

In an on-line forum, Thomas Deeby stated:

> *Terramycin® (oxytetracycline HCL) is the only drug approved for use as a preventive treatment against American foulbrood. This antibiotic does not kill Bacillus...spores, but prevents or delays their growth when present in low concentrations in the food fed by workers to susceptible larvae. While this treatment allows individual larvae to survive, it does absolutely nothing about the virulent spores in the contaminated equipment. Thus the disease usually reappears once drug feeding stops. There has been recent evidence in this country for bacterial resistance to Terramycin. One of the suspected causes for this development is the sharp increase in use by beekeepers of the medicated vegetable oil extender patty. Bees do not always consume the patties rapidly which leads to a situation in which antibiotic lingers in the hive for weeks or even months. Resistance was not a problem in this country prior to the widespread use of extender patties in the 1990s. For these reasons it is recommended that beekeepers remove all uneaten portions of medicated extender patties after patties have been in the hive for one month.*
>
> *There are alternative treatments to AFB without using TM [Terramycin ®]. Queens are being bred that create more resistan[ce] to*

brood diseases in the introduced hives. Check the Journals for these Hygienic Queens. Lincomycin Hydrochloride is a possible alternative antibiotic to TM, but is still awaiting FDA approval. Essential oils like rosemary and tea tree oils have been tried with some limited success. Sulfa and Ethylene Oxide Gas (ETO) have been used successfully in the past, although I am not sure if you can find them or in which states they are allowed. Keeping your equipment clean, sanitizing your extracting equipment looking for scale and destroying those frames, not allowing bees to rob a dead colony and not feeding honey to colonies other than those producing it are some of the ways you can prevent the spread of AFB to your other colonies. Please contact our Beltsville Bee Lab for follow-up information. (Deeby, 2002b)

In most states, if a colony is stricken with AFB or EFB, it must be killed and burned. This is done to prevent further infections in nearby colonies. In an on-line forum, Dr. Eric H. Erickson, commenting on whether soaking frames and boxes infected with AFB with a bleach solution would sterilize them, stated:

Unfortunately, bleach will not kill the spores of afb. They have outer 'shells' that are impervious to almost all chemicals unless they are applied using heat and pressure. You should consider rendering the wax and selling it, and burning the equipment. Alternatively, you could reinstall bees in the equipment and treat with antibiotics if your state regulations allow this procedure. (Erickson, 2002b)

According to an article in the *American Bee Journal*, cleaning bee boxes and frames in boiling lye water is an effective method of removing the wax and propolis, as well as stripping the old paint. The article states that boiling lye water "remains an inexpensive treatment for destroying American Foulbrood spores by subjecting them to the scarification necessary to breakdown the spore's seed coat as the heat of 212°F alone is inadequate to do this." The article calls this a dangerous enterprise that requires safety equipment because "lye is a caustic chemical, which will eat through clothing, chemically burning the skin underneath." An addition warning is also included: "IMPORTANT SAFETY TIP: DO NOT ADD LYE TO HOT WATER!" (Sollenberger, 2002).

Educational and Training Opportunities

Educational and training opportunities are available from some state universities. Some of these universities sponsor beekeeping workshops or specialized training for both beginning and master beekeepers. Check with your local Extension office or your state Apiarist.

Pennsylvania State University's Department of Distance Education offers a correspondence course entitled "AG 5126—Introductory Beekeeping." It provides basic information needed to manage a small number of honey bee colonies. It has 10 lessons, with no examination, and costs $74.00, including materials and tuition. For information and registration procedures, contact:

The Pennsylvania State University
Department of Distance Education
Independent Learning Center
207 Mitchell Building
University Park, PA 16802
(800) 252–3592

The American Society of Beekeepers provides free on-line classes including Beginning Beekeeping 101, Intermediate Beekeeping 201, and Advanced Beekeeping 301. Each class has lessons in different aspects of beekeeping. The classes are all free, but anyone interested in getting a certificate of achievement will need to pay $25.00 to take a test. For additional information on any of these classes, visit <http://www.gobeekeeping.com/>.

Three specialized beekeeping short courses devoted to stock improvement are offered every summer at The Ohio State University Rothenbuhler Honey Bee Laboratory, in Columbus, Ohio. The classes are the Art of Queen Rearing, Instrumental Insemination & Breeding, and Advanced Insemination Instruction. These courses are designed to advance the beekeeping industry as well as provide training for research

personnel. For additional information about these annual classes, contact:

Susan W. Cobey
Rothenbuhler Honey Bee Lab
1735 Neil Avenue
Columbus, OH 43210
(614) 292–7928, Fax: (614) 292–5237
Email: Cobey.1@osu.edu
http://www174.pair.com/birdland/Breeding/classmain.html

Summary

Fortunately, bee diseases are not as widespread as the tracheal and varroa mites are, but beekeepers should be aware of the symptoms of the various diseases and pests and be prepared to act accordingly. The pests and diseases mentioned above, and other diseases such as nosema, chalkbrood, and stonebrood, are covered in most good bee books (see **Further Resources**: Books). Beekeepers need to remember that the USDA Beltsville Bee Research Laboratory provides free authoritative diagnosis of bee diseases and pests, as well as identification of Africanized honey bees [See instructions on how to ship bees to Beltsville in the **Appendix**].

Anyone interested in keeping bees for pollinating plants or for producing additional income from bee products should first investigate all available sources of information. County Cooperative Extension offices are a good source of information on beekeeping, as are entomologists and apiculturists at your local land-grant university. State apicultural inspectors, usually with the Department of Agriculture, are another good source of information. These sources should be able to provide contact information to local beekeepers.

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 visit several different websites and study the on-line publications (see **Further Resources**: Websites) on beginning beekeeping to learn about bee morphology, strains, pests, and beekeeping equipment. Periodicals are an excellent method for keeping current with all the new research and products available to assist beekeepers (see **Further Resources**: Periodicals).

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Further Resources

Websites

BeeCulture Magazine
http://bee.airoot.com/beeculture/index.htm
On-line listing of Who's Who in the Beeyard for each state. On-line publication Insect Pollination of Cultivated Crop Plants. On-line monthly column Beekeeping in the Digital Age describing how communications in the digital age affect production and dissemination of beekeeping information, by Dr. Malcolm T. Sanford, Former Extension Beekeeping Specialist at the University of Florida. Weekly updated Catch the Buzz with the very latest information from the world of beekeeping. Also provides many excellent links to other sources of information, as well as some articles from BeeCulture Magazine.

The American Society of Beekeepers
http://www.gobeekeeping.com/
Three free on-line beekeeping classes, a listing of National and regional bee organizations, a monthly newsletter, and additional beekeeping information.

Beekeeping: The Beekeeper's Home Pages
http://ourworld.compuserve.com/homepages/beekeeping/
Beekeeping website links with hundreds of other beekeeping resources. It also has an extensive listing of companies that sell bee equipment.

Mid-Atlantic Apiculture Research and Extension Consortium (MAAREC)
http://maarec.cas.psu.edu/index.html
A regional effort to address the pest management crisis facing the beekeeping industry in the Mid-Atlantic Region. On-line newsletter and many excellent publications on all aspects of beekeeping, including pests and diseases.

The Bee Works
http://www.beeworks.com/index.htm
Canadian website with a good information center on various aspects of beekeeping.

George Imirie Certified Master Beekeeper
http://www.beekeeper.org/george_imirie/index.html
On-line monthly "pink pages" on many aspects of beekeeping.

The Pollinator Home Page
http://www.pollinator.com/index.htm
List of beekeepers who provide pollination service, and good information on pollination.

World's Beekeeping Directory
http://www.beehoo.com/
Worldwide listings of sources of information, training, and many other items of interest to beekeepers.

Top Bar Hive Beekeeping
http://www.gsu.edu/~biojdsx/main.htm
Website devoted exclusively to collecting and distributing information about beekeeping with top-bar hives.

Pennsylvania State University
http://agalternatives.aers.psu.edu/other/bees/bees.pdf
Publication Beekeeping and sample bee budget.

Texas A&M University
http://agnews.tamu.edu/bees/quaran.htm
Map of areas of known African honeybee quarantine.

Food and Agriculture Organization of the United Nations Rome
http://www.fao.org/docrep/w0076e/w0076e00.htm
On-line publication Value-Added Products from Beekeeping.

University of California Small Farm Center
http://www.sfc.ucdavis.edu/pubs/SFNews/archive/94032.htm
On-line publication Starting a Small Beekeeping Operation.

University of Nebraska—Lincoln
http://www.ianr.unl.edu/pubs/insects/g1104.htm
On-line publication Getting Started in Beekeeping.

University of Tennessee—Knoxville
http://web.utk.edu/~extepp/redbook/bee2000.pdf
On-line publication Apiculture

University of Missouri—Columbia
http://muextension.missouri.edu/xplor/agguides/pests/g07600.htm
On-line publication Beekeeping Tips for Beginners.

University of Georgia
http://www.ces.uga.edu/pubcd/b1045-w.html
On-line publication Honey Bees and Beekeeping.

Educational Concerns for Hunger Organization (ECHO)
http://www.echonet.org/tropicalag/technotes/BeehiveD.pdf
On-line Tech Note Beehive Designs for the Tropics.

USDA Research Facilities

Five USDA laboratories are studying breeding, behavior, and benefits of wild and domesticated bees. Check these sites regularly to monitor current research into controlling many of the honeybee's parasites and diseases.

USDA/BARC Bee Research Laboratory
Building 476, BARC-EAST
Beltsville, MD 20705
(301) 504–8205, Fax: (301) 504–8736
http://www.barc.usda.gov/psi/brl/brl-page.html
Studies bee diseases, pests, and nutritional needs. Provides bee diagnostic services.

Carl Hayden Bee Research Center
2000 E. Allen Road
Tucson, AZ 85719
(520) 670–6380, Fax: (520) 670–6493
http://gears.tucson.ars.ag.gov/
Research explores pollination, mites, and control of Africanized honeybees. They also have Expert Forum on Honey Bees, a state-of-the-art, user-friendly, Internet question-and-answer information resource available at no cost. Anyone can use this service to ask any and all questions about bees and get answers directly from the experts at the Carl Hayden Bee Research Center.

Honey Bee Breeding, Genetics, and Physiology Research
1157 Ben Hur Road
Baton Rouge, LA 70820–5502
(225) 767–9280, Fax: (225) 766–9212
http://msa.ars.usda.gov/la/btn/hbb/
Research on breeding honeybees that tolerate harsh climate, disease, insects, and other hazards.

Bee Biology and Systematic Laboratory
Utah State University
5310 Old Main Hill
Logan, UT 84322–5310
(435) 797–2524, Fax: (435) 797–0461
http://www.loganbeelab.usu.edu/
Research involves alternatives to honey bees as pollinators, and wild bees.

USDA/ARS Beneficial Insects Research Unit
2413 E. Highway 83
Weslaco, TX 78596
(956) 969–4852
http://weslaco.ars.usda.gov
Studies mites that infest breathing tubes (trachea) of honeybees. Designs mite control measures and tracks spread of mites.

Computer Software

Carl Hayden Bee Research Center
http://gears.tucson.ars.ag.gov/soft/bke/index.html
The new release: BK-Economics 1.34 is available for Windows and Macintosh. BK-Economics is a software package that was developed by a team of scientists at the Carl Hayden Bee Research Center in Tucson, Arizona, to assist commercial beekeepers in streamlining their business practices. This software allows beekeepers to simulate years of business, taking into account factors like equipment purchases, labor force, transportation, marketing strategies, loans, honey flow, and other hive products. This software, when used in combination with the marketing strategy information in the publication, can help beekeepers formulate a successful business plan.

This software is downloadable on-line in "net installer" versions. If downloading BK-Economics off the web is not a viable option, you may choose to receive a copy by mail. This software is a product of USDA research and is offered AT NO COST to anyone. Address and phone numbers for Carl Hayden Bee Research Center are listed above in the USDA Research Facilities.

Periodicals

American Bee Journal
Dadant & Sons, Inc.
51 South Second Street
Hamilton, IL 62341
(217) 847–3324, Fax: (217) 847–3660
http://www.dadant.com/journal/index.html
Monthly magazine for hobbyists and professional beekeepers. Subscription: $20.95 per year.

Bee Culture
A. I. Root Company
Subscription Dept., Dept. W
623 W. Liberty Street
Medina, OH 44256
(800) 289–7668, ext. 3255
http://bee.airoot.com/beeculture/
Monthly apiculture magazine. Subscription: $21.50 per year.

The Speedy Bee
P.O. Box 1317
Jesup, GA 31545–1317
(912) 427–4018, Fax: (912) 427–8447
Monthly newspaper for the beekeeping and honey industry. Subscription: $17.25 per year.

National Honey Market News
USDA/AMS/Fruit and Vegetable Division
21 N. First Avenue, Suite 224
Yakima, WA 98902–2663
(800) 487–8796
http://www.ams.usda.gov/search/index.htm
Search for "National Honey Report" for the latest reports. Catalogs monthly honey prices for the country. Subscription: $36 for 12 issues.

Associations

American Beekeepers Federation
P.O. Box 1038
Jesup, GA 31598–1038
(912) 427–8447
http://www.abfnet.org
Members include commercial beekeepers, researchers, and hobbyists. Encourages development of better bees through better queens. Seeks to maintain uniform trade practices and principles in production/sale of packaged bees and queens. Annual meeting.

Apiary Inspectors of America
Blane White
(651) 296–0591
http://www.mda.state.mn.us/ams/apiary/aiahome.htm
Members include state/provincial apiarists, inspectors, researchers, and individuals. Active in research meetings and publishes a newsletter. Has an on-line directory of all state and provincial apiarists.

National Honey Board
390 Lashley Street
Longmont, CO 80501–6045
(303) 776–2337, Fax: (303) 776–1177
http://www.nhb.org
The National Honey Board administers an industry-funded national research, promotion, and consumer information program to increase honey consumption in the United States and abroad. Excellent website with many marketing ideas and suggestions.

American Honey Producers Association
536 Ashmont Road
Madison, SD 57042
(605) 485–2221
http://www.americanhoneyproducers.org
Membership is mostly for commercial honey producers, but membership ranges in scale from 1 to 40,000 hives owned. They hold an annual convention and publish a quarterly newsletter. They have a varying dues structure according to size of honey operation.

Eastern Apicultural Society of North America, Inc.
John Tulloch
EAS Treasurer
P.O. Box 473
Odessa, DE 19730
(302) 378–1917
http://www.easternapiculture.org
The largest non-commercial beekeeping organization in the U.S. Has an annual conference every summer with lectures, workshops, vendor displays, and short courses for beginning and advanced beekeepers in one of its 26 member states or provinces in the eastern U.S. and

Canada. EAS also publishes a quarterly newsletter, The EAS Journal.

Books

Educational Concerns for Hunger Organization (ECHO) on-line Book Store:

Beekeeping: A Practical Guide. 1993. By Richard E. Bonney. 192 p. $18.95.

Keeping Bees. 1986. By John Vivan. 238 p. $10.95.

Golden Insect. 1989. By Stephen Adjare. 103 p. $14.50.

Hive Management: A Seasonal Guide for Beekeepers. 1990. By Richard Bonney. 145 p. $14.95.

Order from:
Educational Concerns for Hunger Organization (ECHO)
17391 Durrance Road
North Fort Myers, FL 33917
(239) 543–3246, Fax: (239) 543–5317
http://echonet.org/shopsite_sc/store/html/foodprocessing.html

Volunteers in Technical Assistance (VITA) publications (see their complete catalog at http://www.vita.org/publications/pubcat.htm).

A Beekeeping Guide. 1989. By Harlan Attfield. VITA Technical Bulletin #9. 45 p. $7.25.

Centrifugal Honey Extractor. No date. VITA Technical Bulletin. VIT009-1. 9 p. $5.25.

Order from:
PACT Publications
1200 18th Street, NW
Washington, DC 20036
(202) 466–5666, Fax: (202) 466–5669
Email: pubs@vita.org
http://www.pactpublications.com

Other Books:

The following books are available from bookstores and on-line booksellers. If a book is listed as out-of-print, you may be able to obtain it through Interlibrary Loan; check with your local librarian. You may also be able to buy a copy through an on-line used-book search site, such as <http://www.bookfinder.com/>.

The ABC and XYZ of Bee Culture. 1990. By Roger Morse. 516 p. $32.00.

The Beekeepers Handbook. 1998. By Diana Sammataro, Alphonse Avitabile, and Roger Morse. 224 p. $24.95.

Beekeeping for Dummies. 2002. By Howard Blackiston and Kim Flottum. 336 p. $19.99.

Beeswax: Production, Harvesting, Processing, and Products. 1982. By William L. Coggeshall and Roger A. Morse. 192 p. Out of Print.

The Hive and the Honey Bee. 1992. Joe M. Graham, editor. 1324 p. $36.00.

Honey Bee Pests, Predators and Diseases. 1997. Roger Morse and Kim Flottum (editors). 575 p. $40.00.

How to Keep Bees and Sell Honey. 1993. By Walter T. Kelley. 144 p. $9.00.

The New Complete Guide to Beekeeping. 1994. By Roger A Morse. 207 p. $17.00.

The New Starting Right with Bees. 1990. By Kim Flottum and Diana Sammataro. 136 p. $7.99.

Rearing Queen Honey Bees. 1997. By Roger A. Morse. 128 p. $14.95.

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The electronic version of **Beekeeping/Apiculture** is located at:

HTML
http://www.attra.ncat.org/attra-pub/beekeeping.html

PDF
http://www.attra.ncat.org/attra-pub/PDF/beekeeping.pdf

Appendix

Beltsville Free Bee Diagnostic Services

The USDA/BARC Bee Research Laboratory staff at Beltsville, Maryland provides free authoritative identification of Africanized honey bees and diagnosis of bee diseases and pests for Federal and State regulatory agencies and for beekeepers worldwide.

HOW TO SUBMIT SAMPLES FOR DIAGNOSIS

Samples of Adult Honey Bees

Send at least 100 bees. If possible, select bees that are dying or have died recently. Decayed bees are not satisfactory for examination. Bees should be placed in 70% ethyl or methyl alcohol as soon as possible after collection and carefully packed in leak-proof containers. Alternatively, bees can be placed in a paper bag or loosely wrapped in a paper towel, newspaper, etc. and sent in a mailing tube or heavy cardboard box. **AVOID using plastic bags, aluminum foil, waxed paper, tin, glass, etc**. because they promote decomposition.

Samples of Brood

The sample of comb should be at least 2 X 2 inches and contain as much of the dead or discolored brood as possible. **NO HONEY SHOULD BE PRESENT IN THE SAMPLE**. The comb can be in a paper bag or loosely wrapped in a paper towel, newspaper, etc. and sent in a heavy cardboard box. **AVOID wrappings such as plastic, aluminum foil, waxed paper, tin, glass, etc**. because they promote decomposition. If a comb cannot be sent, the probe used to examine a diseased larva in the cell may contain enough material for tests. The probe can be wrapped in paper and sent to the laboratory in an envelope.

How to Address Samples

Send all samples to:

Bee Disease Diagnosis
Bee Research Laboratory
Bldg. 476, BARC-East
Beltsville, MD 20705
(301) 504-8173

Include a short description of the problem along with your name and address. There is no charge for this service.

Email: KnoxD@ba.ars.usda.gov

Please Note: All incoming mail is now being opened by a private contractor and examined before being forwarded to the BRL. Also, there is a possibility that some of this mail will be irradiated. **Therefore, time-sensitive samples or samples requiring culturing (AFB Resistance Test) should be sent by UPS or FedX.**

Source: USDA/BARC Bee Research Laboratory, No date.