Other Enterprises

Beeswax

Beeswax, used mainly for comb foundation, is an important commodity to the cosmetics industry, candlemaking, and other manufacturing. California produces approximately 600,000 pounds annually—about 10 percent of the total produced in the U.S. (The U.S. imports more beeswax than it produces, a fact that might influence a beekeeper's goals.)

Beeswax, secreted by wax glands located on the underside of the bee's abdomen, is used by worker bees to construct combs. To achieve maximum beeswax production, large quantities of honey or sugar syrup must be present in the colony because bees must consume about 8 pounds of honey to produce 1 pound of wax. In preparation for wax production, bees gorge themselves with honey and hang in chains called "festoons." In about 24 hours wax secretion begins.

For small operations a solar wax melter is the simplest and most economical way of rendering wax. (See UC publications listed in *References*.) Commercial beekeepers use steam-heated tinned copper, galvanized iron, aluminum, or stainless-steel containers to render beeswax. A few operations use a heated wax press to extract wax that otherwise would adhere to the cocoons in brood combs.

Most beekeeping supply dealers buy raw wax or will exchange it for foundation. Clean light wax from comb cappings yields the highest market price.

Royal jelly

Royal jelly, used to prime queen cell cups, raise bee brood in the laboratory, and by some individuals for medicinal or cosmetic purposes, can be produced year-round in some areas in California. Good production requires the strongest colony that can be produced, adequate nectar and pollen flow, and feeding of colonies when natural sources of food are lacking. A queenright colony is usually used in royal jelly production, because queenless colonies require more labor to keep colony populations high. Any one of the following three types of hive setups is effective.

(1) Customarily, a one-story hive with nine frames is divided so that there are five frames for normal

brood rearing and four frames for royal jelly production. To create a division, a sheet of window-screen wire and a sheet of plastic are fastened to a strip of 1/8-inch by 1-inch wood so that the wood is between them. The wooden strip, screen, and plastic each should be long enough to extend the complete length between the front and back walls of the hive body. The screen should be long enough to reach the bottom board, and the plastic should be long enough to cover the top bars of five adjacent frames. The long side of the screen and the plastic should be fastened to the wood.

After the frames are moved to the appropriate positions and the worker bees have an opportunity to reposition themselves, the screen is inserted between the fifth and sixth frames, and the plastic sheet is laid over the five frames upon which the queen is allowed to roam. This keeps her from moving to the adjacent group of four frames where royal jelly is to be produced. The four frames on the royal jelly side consist of two outer frames of honey and pollen, one inner frame of open (young, uncapped) brood, and another inner frame containing a bar upon which have been grafted 15 to 20 queen cells.

The nurse bees of the colony will be stimulated to secrete royal jelly to feed the larvae in the queen cells as well as the uncapped brood in the adjacent frame. The frame holding the grafted cells should be removed on the fourth day after the grafts have been placed in position. The cells are then trimmed down to the level of the royal jelly they contain and the larvae removed. An aspirator is used to remove the royal jelly from the cells. The jelly is packaged in 1-pound, airtight Opalite ointment jars and refrigerated at 40°F. Usually, jelly is shipped to the buyer as soon as possible after harvest and by the fastest transportation possible.

(2) Another setup consists of a two-story hive, with the previously described one-story hive used as the upper story (or super) above a queen excluder; each story has its own queen. Under these conditions additional nurse bees can move up from the bottom hive to help rear the cells.

(3) A two-story hive has a queen and a colony of bees in the lower hive body, separated from the super by a queen excluder. An open wooden rectangle (made of 1-inch stock) with outside dimensions identical to the hive body is placed above the queen excluder and a super is placed on it. This holds the bottom of the frames in the super an extra inch above the top bars of the frames in the hive body, and thus reduces the probability of crushing bees when frames are placed in the super. Nine frames are used in the super. The center frame has a bar with 15 to 20 grafted cells on it for jelly production. On each side of this frame is a frame of open brood and nurse bees. The other six frames are for honey and pollen.

Regardless of the setup used, the colony must be managed in certain ways for maximum production:

- Frames of originally open brood on either side of the frame holding the bar of grafted cells must be replaced with new frames of open brood at least every 14 days, or after every fourth graft. To produce open brood, frames with empty cells are placed in the brood nest area of the queenright portion of the hive.
- A residue of jelly is left in each cell when the jelly is harvested. A drop of royal jelly diluted by one-

half with water is placed on the residue of jelly in the cell before grafting because the larvae float off the grafting tool more easily onto this diluted drop.

- The cells producing royal jelly should be grafted again as soon as possible after the previous jelly has been harvested.
- Larvae are grafted from frames of brood borrowed from the queenright section of the royal jelly producing colonies.
- The queen sometimes cannot produce enough nurse bees, but this can be corrected by requeening with a more prolific queen. More bees can be added by placing combs of emerging bees from other colonies into weak colonies.
- Each colony should be harvested every fourth day. One pound of royal jelly per 200 colonies is usually produced under the best conditions, which are the same as those for honey production.

For best quality, royal jelly should be shipped as quickly as possible after production.

Harvesting pollen

Bee-collected pollen has a number of uses besides providing nutrients to bees. Pollen has become a permanent supplement in many peoples' diets. Extracts of pollens are important in desensitization to hay fever.

Pollen-collecting activities of bees can be monitored to determine efficiencies of colonies used for pollination services. It should be noted, however, that any pollens that contain toxicants should be avoided. California buckeye pollen is toxic to bees as are pollens that are contaminated with pesticide residues.

Pollen is carried to the hive in ball-like pellets on the hind legs of foraging bees. A portion of the pollen pellets may be harvested by placing a pollen trap on a hive. Generally, the hive is rearranged so that the pollen trap serves as the entrance; it may be located at the bottom, middle, or top of the hive. After the bees become accustomed to the new entrance, a sieve of two layers of 5-mesh hardware cloth, separated by 1/4 inch and with holes offset, or a perforated (3/16-inch holes on staggered centers) metal plate, is positioned in the trap. The sieve knocks off some of the pellets that fall into a collection tray. The tray should be equipped in some manner to reduce the moisture content of incoming pellets (often a screen or cloth bottom) and should have an 8-mesh, thin wire, hardware cloth cover to prevent bees from entering and recovering the pollen. Pollen traps may be purchased from suppliers of beekeeping equipment, but many individuals prefer to design their own.

Pollen traps should be used only during heavy pollen flows. At the hive, bees will increase emphasis on pollen collecting to make up for what is lost, but this is possible only when there is spare pollen within flight range.

Pollen pellets should be removed from the traps every 2 or 3 days. The pellets should be spread out and allowed to air dry for 24 hours to reduce the potential for mold growth. Then the pollen can be placed in containers and stored at 0°F. Freezing increases the storage life of the product well over a year and eliminates all stages of stored product insects, which can become a

serious problem. Frozen pollen becomes moist and crumbly when thawed and should be used immediately upon removal from the freezer.

An alternative method for storing pollen, developed at the University of Guelph, Ontario, Canada, is to mix the pollen with half its weight of fine granulated sugar. Pack the mixture to within a 1/2-inch layer of the top of the storage container, cover the mixture with a 1/2-inch layer of sugar, and seal airtight. Pollen stored mixed with sugar remains soft and moist and can be formed into cakes and fed directly to bees or mixed into a pollen supplement.

Sources of Nectar and Pollen

Hundreds of species of California plants yield pollen or nectar, but the most important plants for honey production are alfalfa, oranges, cotton, lima beans, sages (black, sonoma, white, and white leaf), yellow starthistle (fig. 12), wild buckwheats, manzanita, eucalyptus, and bluecurls. Extensive use of herbicides to control weeds has decidedly reduced bee pasturage in California. Beekeepers should actively encourage the use of plants beneficial to bees for plantings along roadsides and other rights of way, revegetation of disturbed lands, and ornamental plantings.

Alfalfa, oranges, cotton, corn, and beans present a hazard for bees because of the pesticides used on them.

California buckeye, *Aesculus californica* (Spach) Nutt., deserves a special note of caution because of its toxic nature to bees and its wide distribution and abundance. The tree is found throughout the foothills of cismontane (see *Glossary*) California from Siskiyou and Shasta counties to Kern County and northern Los Angeles County below 4,000 feet. It blooms in May and June and is very attractive to honey bees, but when buckeye pollen becomes predominant in the diet of larval bees, malformed nonfunctional adults result. (See complete discussion in *Other Disorders*.)

Fig. 12 Yellow starthistle, a highly prized honey plant of northern California.

Wild Plant Sources of Both Nectar and Pollen*

Plant	Where found	Time of bloom	Color of honey
Bluecurls (*Trichostema lanceolatum* Benth.)	Dry open fields below 3,500 feet; most of cismontane California.	August to October	White
Buckwheats, wild (*Eriogonum* spp.)	Throughout California.	April to November	Light amber
Buttonbush (*Cephalanthus occidentalis* L.)	Along streams and lakeshores, below 3,000 feet; throughout Central Valley and adjacent foothills.	June to September	White to light
Clover, Brewer (*Trifolium breweri* Wats.)	Wooded slopes below 6,500 feet; in Sierra Nevada from Madera County north; in Trinity, Siskiyou, and Del Norte counties.	May to August	White
Deervetch: broom; wild alfalfa (*Lotus scoparius* [Nutt.] Ottley)	Dry slopes, often following burns below 5,000 feet; most of cismontane California.	March to August	White
Eucalyptus (*Eucalyptus* spp.)	Central Valley and Coast Ranges south to San Diego County.	December to July	Light amber
Filaree (*Erodium* spp.)	Stock forage plant of open grassy areas, below 3,500 feet; throughout cismontane California.	February to August	Light amber
Goldenweed fleece (*Haplopappus arborescens* [Gray] Hall)	Dry foothills below 4,000 feet (to 9,000 feet in Sierra Nevada); cismontane Sierra from Nevada County to Tulare County; Coast Ranges from Del Norte County to Ventura County.	August to November	Amber
Jackass clover (*Wislizenia refracta* Engelm.)	Alkali plains in San Joaquin Valley. Very limited distribution due to land reclamation.	April to November	Water white

—continued

Wild Plant Sources of Both Nectar and Pollen* *(continued)*

Plant	Where found	Time of bloom	Color of honey
Mesquite (*Prosopis glandulosa* Torr. var. *torreyana* [L. Benson] M. C. Jtn.)	Washes below 3,000 feet; Colorado and Mojave deserts, San Joaquin Valley, and interior valleys from Santa Barbara County to San Diego County.	April to June	Light amber
Mountain misery (*Chamaebatia foliolosa* Benth.)	Open forest, 2,000 to 7,000 feet; Shasta County to Kern County.	May to July	Amber
Mustard (*Brassica* spp.)	Weeds of orchards, open grassy slopes, and waste places; throughout cismontane California. Limited by weed control.	January to May	Light amber
Poison oak (*Rhus diversiloba* T. & G.)	Low places, thickets, and wooded slopes, below 5,000 feet; throughout cismontane California.	April to May	White
Rabbit brush (*Chrysothamnus nauseosus* [Pall.] Britt.)	Dry, open plains, and mountainsides, 2,500 to 9,500 feet. Mostly in transmontane California.	September to October	Light amber
Sage, black (*Salvia mellifera* Greene)	Dry slopes, below 2,000 feet; Coast Ranges from Monterey Bay to San Diego County.	April to July	Water white
Sage, Sonoma [creeping] (*Salvia sonomensis* Greene)	Dry slopes, below 6,500 feet; foothills of Sierra Nevada from Shasta County to Calaveras County, and Coast Ranges from Siskiyou County to Napa County, plus Monterey, San Luis Obispo, and San Diego counties.	May to June	White
Sage, white (*Salvia apiana* Jeps.)	Dry slopes, below 5,000 feet; Santa Barbara County south to San Diego County.	April to July	Water white
Sage, white leaf [purple] (*Salvia leucophylla* Greene)	Dry slopes, below 2,000 feet; Orange County north to Monterey and Kern counties.	May to July	Water white
Sages other than black, Sonoma and white leaf (*Salvia* spp.)	Mountain ranges and foothills throughout California, mostly below 5,000 feet.	Spring and summer	Water white
Spikeweed and tarweed (*Hemizonia* spp.)	Dry, open slopes and grassy fields below 3,000 feet; throughout cismontane California.	April to November	Light amber to amber
Starthistle, yellow (*Centaurea solstitialis* L.)	Widely distributed weed. Limited by extensive weed control program. Was widely spread in Sacramento Valley.	May to October	White to extra light amber
Sumac, laurel (*Rhus laurina* Nutt.)	Dry slopes, below 3,000 feet; cismontane southern California from Santa Barbara County to San Diego County.	June to July	Amber
Toyon (*Heteromeles arbutifolia* M. Roem.)	Brushy slopes and canyons below 4,000 feet; foothills and mountains of cismontane California.	June to July	Amber
Wild lilac (*Ceanothus* spp.)	Dry slopes, often rocky or wooded, mostly below 6,000 feet; foothills and mountains of cismontane California.	March to July	White
Willow (*Salix* spp.)	Streambanks, meadows, and wet places; throughout California.	January to July	Amber

*See *California Flora*, Munzand Keck, 1959. Berkeley: University of California Press.

Bee Diseases

Bee diseases are specific to either the brood or adult bees. Brood diseases generally are considered more detrimental to the colony than are adult diseases. No disease of bees affects humans.

Before attempting to diagnose brood diseases, the beekeeper should become familiar with the appearance of healthy brood in all stages (Plate II). In healthy colonies there is regularity in the arrangement of eggs, open larvae, capped brood, and emerging bees. Healthy larvae in open cells are plump, glistening, and pearly white. Brood cappings normally are uniform and raised slightly above the comb surface. Once in place over the larvae, the cappings remain free of visible holes until emerging bees cut their way out of the cells.

Brood diseases

Symptoms of brood disease generally first become noticeable in combs containing mature brood where young bees are emerging or in combs containing more than one cycle of brood. Symptoms also may be found in brood combs of a hive in which the colony has died of a brood disease. Symptoms can be observed readily only after the adult bees have been shaken off the comb.

A comb being examined should be tilted so that direct sunlight illuminates the lower side walls and bottoms of the cells. This makes it possible to see any disease scale that might be present. If no dead brood is found in open or uncapped cells, it is advisable to remove any sunken, discolored, or punctured cappings and examine the cell contents. When dead brood is found, the following should be noted: position of dead brood, age and type of brood affected, color, consistency, odor of dead brood in various stages of decay, and position and tightness of scales.

The consistency of decaying larvae is important in disease diagnosis. Consistency can be determined by stirring the decaying larva with the larger end of a toothpick and slowly withdrawing the adhering mass, observing the texture and noting whether the material can be stretched out into a thick thread. This threadlike property is termed ropiness. Used toothpicks should be burned in the smoker or wrapped in wax paper and sent to the California Department of Food and Agriculture for analysis, if American foulbrood is suspected.

American foulbrood (AFB). This, the most serious larval bee disease in North America, is found in California and at times has made commercial beekeeping unprofitable in some areas. Colonies should be inspected periodically for this disease.

Larvae dead of AFB lie fully outstretched on the lower cell walls (Plate II). Pupae also may be killed and usually die with their "tongues" stretched vertically across the cells. Diseased larvae or pupae gradually change color from white, through butterscotch, to dark coffee brown, and finally dry to become thin scales that adhere tightly to lower cell walls. Decaying brood is slimy and ropy, and a burned odor is often noticeable.

American foulbrood is caused by a bacterium, *Bacillus larvae* White. Spores enter the bee larva in contaminated food, and bacteria resulting from these spores multiply and kill the larva in its cell, usually just after the cell has been capped. The bacteria continue to multiply in the dead tissues and cause decay. As the decaying mass dries, the bacteria transform into highly infectious spores, billions of which may be contained in a single dried scale. Spores of *B. larvae* are extremely resistant to high and low temperatures, to chemical disinfectants, and to the dehydrating action of honey that normally kills bacteria. The spores can remain alive and infectious for decades in honey, in combs, and on used equipment.

The disease is spread within the colony by adult bees whose mouthparts are contaminated from working with nectar or honey containing spores, or by attempts to remove diseased brood. Spores from contaminated mouthparts of nurse bees are incorporated into larval brood food and the larvae become infected. Nectar, honey, and pollen collected from hives in which the bees are infected with AFB are contaminated with spores and may cause disease if given to a healthy colony.

American foulbrood is persistent, and infected colonies soon become unable to rear enough healthy brood to maintain colony populations. As infection progresses, the colony is weakened, honey and combs in a diseased colony become heavily contaminated with spores, and the disease is spread when robbing bees bring contaminated honey back to neighboring colonies. Thus, diseased colonies constitute a serious menace in any area where bees are kept.

To control AFB and prevent its spread, colonies must be inspected regularly and diseased colonies must be destroyed. After the disease has been discovered and abated in an apiary, the remaining colonies should be thoroughly examined again in 30 to 60 days. A beekeeper not experienced in AFB abatement who finds signs of this disease should contact the county agricultural commissioner immediately to obtain assistance.

Drugs may be fed to colonies not showing AFB disease symptoms as an aid in preventing the disease. Terramycin is registered for such use and has appropriate directions on the container label. It is illegal in California to medicate or otherwise maintain an AFB-diseased colony of bees.

European foulbrood (EFB). This disease, which occurs in some parts of California, can seriously cripple a colony. Strong colonies can usually recover.

Larvae dead of EFB are coiled in the cell bottoms or are twisted across

the lower cell wall; occasionally, they die in an outstretched position. Diseased larvae first turn yellow, then brown, and finally dry to form dark, irregularly shaped scales that are easily removed from the cells. Decaying larvae have a wet, paste-like consistency; sometimes exhibit a degree of ropiness; dry to form scales closely resembling those of AFB disease, and give off a sour odor. Pupae rarely are affected. It is rare that a larva, dead of EFB, is found with the head upstretched to resemble the tongue mentioned in the previous discussion of American foulbrood.

Sometimes EFB appears suddenly and spreads rapidly through colonies. This is most likely to occur in spring after the first or second brood cycle and during a pollen dearth. At other times, it may spread slowly and do little damage. A good nectar flow seems to hasten recovery. The disease usually subsides by midsummer, but occasionally remains active during summer and fall; or it may seem to disappear and then reappear in fall. Terramycin is registered for use in treating EFB-diseased colonies. Label directions must be followed closely to avoid injury to brood or contamination of honey.

European foulbrood often can be controlled by dequeening the diseased colony for 10 days, which breaks the brood-rearing cycle and gives the bees an opportunity to clean diseased brood from the cells. The colony then can be requeened and more bees added, or it can be united with a stronger colony after the 10-day period. This treatment frequently is also effective against parafoulbrood.

Parafoulbrood. Occasionally found in California, parafoulbrood is comparable to EFB in its effect. Larvae dead with parafoulbrood typically lie twisted across the lower cell walls, although sometimes those lying in a normal coiled position may also be dead. Occasionally, older larvae in sealed cells are killed and lie outstretched. The decaying mass has a reddish brown color, and the texture usually is moist and pasty or gummy; occasionally, there is ropiness. This disease is easily confused with either AFB or EFB and sometimes appears to be a mixture of the two.

Sacbrood. Sacbrood seldom results in more than slight damage to colonies. Larvae killed by the disease lie fully outstretched on the lower cell walls and are usually yellow or brown and darker at the head end. The larval skin remains intact, and the body contents become watery, making it possible to remove diseased larvae intact as a fluid-filled sac. The odor is sour. Scales are brown and wrinkled with turned-up ends, and they are easily removed. Sacbrood is more prevalent in spring but usually clears up with a good nectar flow. Colonies in which the disease persists can be requeened with resistant stock or united with stronger colonies after killing the susceptible queen.

Adult bee diseases

There are two major diseases of adult bees, nosema disease and paralysis. Nosema disease is endemic in many colonies, but its detrimental effects are very subtle. Paralysis occurs sporadically with symptoms very similar to insecticide poisoning.

Nosema. Caused by a microscopic protozoan, *Nosema apis* Zander, this disease seldom causes mortality. The

only reliable way to determine whether *Nosema* is present in a colony is to submit a sample of bees for laboratory examination. *Nosema* infections become much more severe during bad weather, when bees are confined to hives. An infected colony may become seriously weakened during the critical population buildup period in spring. Infected bees have their lives shortened as much as 40 percent, even though they appear to forage normally until shortly before death. More importantly, however, infected nurse bees rapidly lose the ability to produce the royal jelly required to feed the queen, the brood, and the drones. Lack of royal jelly leads to population stagnation or decline during periods of anticipated population explosion, even when there is an abundance of spring pollen and nectar sources. These negative effects often are referred to as "spring dwindling." Severe infections can lead to off-season (winter) supersedures that produce drone layers (permanently virgin queens) or queenlessness by the next spring.

Losses from *Nosema* are not always immediately apparent, as it is common for infected bees to die away from the hive. It usually is too late to apply effective control when signs of the disease are seen, so prevention is the only alternative. Fumagillin, sold under various trade names, is registered for preventive treatments. The disease may be held to a minimum by keeping colonies strong and by overwintering them in locations sheltered from wind and open to maximum sunshine. Confinement of bees, pollen shortage, unripened winter feed, chilling, and frequent handling can accelerate buildup of *Nosema*.

Paralysis. Paralysis disease is widely distributed in California. It seldom causes serious damage, except occasionally in southern California, and affected colonies usually recover.

Diseased bees may be seen on top bars or at the colony entrance. Typically, they are weak, they shiver or tremble, and they are unable to fly or walk in a coordinated manner. Frequently their legs are widely sprawled, their wings disconnected, and their bodies hairless, with a dark, greasy appearance. They have a distinct and repulsive odor.

Paralysis is a mildly infectious virus disease transmitted directly from sick to healthy bees. Colonies in which the disease seems to persist should be requeened with a less susceptible stock.

Honey bee parasitic mites

The federal Bee Importation Act of 1922 prohibited further importation of live honey bees into the U.S. The Act was passed in response to concern about a devastating loss of bees in Europe that was associated with the presence of microscopic mites in the thoracic tracheae of the bees. The impact of infestation by the tracheal mite, *Acarapis woodi*, which was detected in the U.S. in 1984, appears to vary, depending upon the stocks of bees and environmental conditions. In California, quarantine regulations are in effect to keep the tracheal mite out of northern California. Check with your county agricultural commissioner about regulations, because they change periodically.

Varroa jacobsoni, a larger external parasitic mite of larval, pupal, and

adult honey bees, has eventually made its way from the Far East (originally hosted by *Apis cerana*) to South America. This reddish brown little mite, shaped like a crab with no big pincers, appears to be more destructive to European bees than is *Acarapis woodi*, particularly since it damages brood in addition to feeding on adult bees. Every effort is being made to keep this parasite out of the U.S.

MATERIALS REGISTERED FOR BEE DISEASE CONTROL

Oxytetracycline hydrochloride (American foulbrood control)

Commonly purchased as Pfizer's product, Terramycin, and referred to as TM. A formulation strength of 25 grams of oxytetracycline in 1 pound of mixture is referred to as TM 25. Other concentrations are available.

It is recommended that the purchased formulation be diluted down to TM 5 (1 part TM 25: 4 parts sugar) with powdered (confectionary or drivert) sugar and that 2 level tablespoons be applied carefully along the top bars of combs containing eggs and young larvae in a well established colony. Each treatment provides about 10 days of protection. The antibiotic should be used only when brood is being reared and when there is a chance that foraging bees may be robbing sick, weakened colonies during a nectar dearth (spring, early summer, fall). Medication should be terminated 4 weeks before an anticipated nectar flow to prevent contamination of honey.

Fumagillin (nosema disease control)

Currently available under a variety of trade names. Sold as a powder, it gives reliable results only when administered to the colony in sugar syrup at the concentration recommended on the label. Colonies overwintered in cold areas should be fed 2 gallons of medicated sugar syrup in fall. Colonies overwintered in warmer regions can be fed 1 gallon of medicated heavy sugar syrup in fall and the second gallon of medicated light sugar syrup in January when bees are being stimulated into early brood rearing.

Fumagillin persists for a long time in sugar syrup, so it should not be fed when early nectar flows tend to be included in the harvested honey crop.

If you see mites in your beehives, send samples, in alcohol, to the Supervisor of Apiary Projects, California Department of Food and Agriculture, 1220 N Street, Sacramento, CA 95814. It is critical to find and eliminate mite pests before they cause irreparable damage to the state's beekeeping industry.

Diagnosing diseases

If there appears to be a mixture of symptoms or if symptoms do not seem typical, it is advisable to submit samples to the Supervisor of Apiary Projects. Diagnosis is free.

To take samples of diseased brood, a smear should be made by stirring the cell contents with a clean toothpick. Transfer the smear to a small piece of waxed paper along with the toothpick, fold the paper to prevent contamination, and place in an envelope, along with a letter requesting diagnosis. Samples of scale pried loose from cell walls may be submitted in the same manner.

Samples of adult dead bees should be fresh; dried specimens are of little value. Samples should be selected carefully and made up only of bees that appear to be affected. They should be mailed in a sturdy container that will protect them from being crushed. Live bees also may be sent, provided they are properly caged. Satisfactory diagnosis can be made from a sample of 10 to 20 bees.

Comb samples are difficult to handle and are unnecessary in laboratory diagnosis for AFB determination.