MP 419

BEEKEEPING

UNIVERSITY OF ARKANSAS
DIVISION OF AGRICULTURE
Cooperative Extension Service

University of Arkansas, United States Department of Agriculture, and County Governments Cooperating

Beekeeping

revised by

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and

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Introduction

Keeping honey bees is a fascinating art that appeals to persons of varied interests. People enjoy studying the behavior of bees because of their complex social behavior. Many persons keep bees as a hobby and often obtain yields of honey above their own needs which is sold or given away. Others, holding full-time employment, keep bees as a source of supplemental income. Lastly, some individuals take up beekeeping as a full-time enterprise. Aside from the production of honey, certain beekeepers engage in the production of package bees and replacement queens. Likewise, due to the interest in natural foods supplements, some beekeepers may specialize in pollen collection and marketing while others collect royal jelly for use in the human diet or for medicinal reasons.

Whether in a planned program or not, all persons keeping bees contribute to the pollination requirements of both wild and cultivated plants, many of them dependent on insect activity for fertilization.

General Situation

The topography of Arkansas influences the kinds of agricultural crops grown in the respective regions of the state. The beekeeper must learn the cropping practices and sources of nectar and pollen near proposed or potential apiary sites. The Delta region is most suitable for commercial honey production (see Fig. 1) while in the western two-thirds of the state including the Coastal Plain, Ouachita and Ozark Mountains, the honey production potential ranges from marginal to good depending on the local wild flora and/or agricultural crops. Some migratory beekeepers have established overwintering apiary sites in several counties primarily in southwestern Arkansas.

In general, the major nectar flow in the mountains and coastal plains takes place in the spring and early summer. In the Delta counties the major nectar flow occurs from mid-July to early September. The initiation of nectar flow above colony needs is illustrated in Fig. 2. Occasionally late summer and fall blooming plants provide a nectar flow that contributes to winter food requirements for the bees and irregularly, provides a small amount of surplus honey.

The long growing season together with relative mild winter temperatures make special protection against cold weather unnecessary in Arkansas. Some beekeepers overwinter colonies in the more southern counties, obtaining population increase prior to moving the bees to other states for a rich harvest of nectar. Locating the apiary yard so that it is at least partially sheltered against northerly winds and exposure to the sun is adequate protection for Arkansas conditions. Locating the bees on a slope where there is good air drainage, clean water is readily available and vegetation or trees do not interfere with the flight pattern is desirable.

Favorable Localities

The most productive localities in Arkansas include the northeastern and eastern counties. Profitable localities are also in certain river valleys, notably the Black, Saline and portions of the Arkansas, Ouachita, Red and White river valleys. In Figure 1, the distribution of bee colonies by county reflects the availability and quantity of nectar producing flora as governed by the agricultural practices of the major regions of the state.

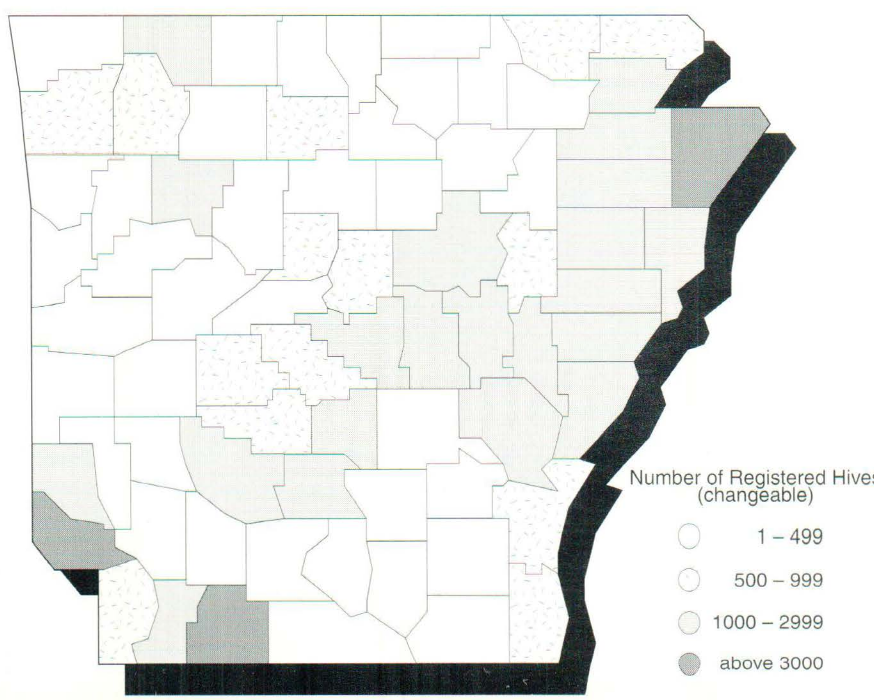

Figure 1 – Density of bee colonies. The heavier the density, the more favorable the area is for honey production.

The ideal situation is a succession of nectar-producing flora, beginning early in the season and continuing without serious interruption until late fall. There is no area in the state in which the ideal situation dependably occurs from year to year. Thus, to operate profitably, the beekeeper may have to move bees once or twice a year to harvest seasonal nectar flows in different localities.

Soil and weather conditions which affect plant life and cropping practices largely determine whether or not a locality is favorable for apiculture. In Arkansas, the major agronomic crops that provide significant sources of nectar are cotton and soybeans. Forage legumes such as crimson clover, red clover, white clover and vetch may yield good to excellent crops of nectar. However, all varieties are erratic, being affected by weather patterns as well as soil chemistry. While the acreage is not great where grown, sunflower is an excellent source of nectar.

Regions favored with an abundance of important nectariferous plants may have certain handicaps. The prevalence of bitterweed, if common and widespread, interferes seriously with production of good quality honey. Smartweed (*Polygonum* sp.) produces a strong flavored, odoriferous honey unacceptable to many people. Honeydew, a sugary secretion from aphids and scales infesting many plants but particularly oaks, pines and other trees, is attractive to bees particularly in late summer and fall. As a rule, "honeydew" honey is too dark to be attractive in appearance and the flavor is not agreeable.

Average weekly weight loss or gain of beehives from November through May for northwest, southwest and northeast Arkansas (typical). The "x" indicates initiation of a nectar flow above colony needs.

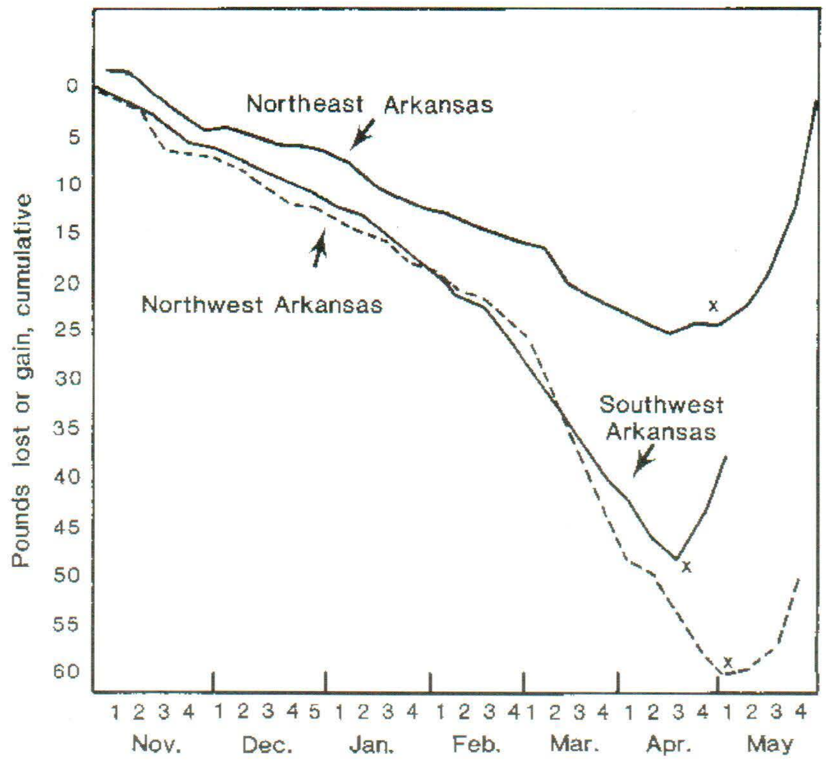

Figure 2 – The typical use pattern of over-wintering food supply by bees in three major areas of Arkansas, and the approximate initiation of a surplus nectar flow within the three areas.

Important Honey and Pollen Plants

Honeybees, to be productive, must have adequate sources of nectar and pollen. Some plant species produce both nectar and pollen while others provide only nectar or pollen. The following list identifies major or important plants that provide nectar and/or pollen.

Cotton (*Gossypium hirsutum*) is a major source of nectar. Cotton yields nectar from floral as well as extrafloral nectaries. Cotton is an excellent source of nectar, but it does not yield equally well in all parts of the state or when grown on some soil types. Cotton production is concentrated in the delta counties. Insecticide applications limit the acreage of cotton that can be pastured by bees. Integrated pest management systems are designed to reduce the hazard to bee populations, but beekeepers must develop cooperative relationships with farmers so that, when necessary, bees may be moved to avoid undue losses from pesticide treatment.

Soybean (*Glycine max*) is the dominant cultivated crop (acreage wise) grown in Arkansas and has probably become the major source of nectar. For reasons not understood, in some areas and on some soils, good yields of nectar are not obtained. Bees may also obtain pollen from soybean. While insecticide usage is not as great as on cotton, exercise similar precautionary measures to avoid undue losses from insect control treatment.

Sunflower (*Helianthus annus*) while not grown extensively in Arkansas, provides good quality nectar and pollen. Extrafloral nectaries in the bracts and on the upper leaves of the plant are sometimes visited by honey bees. Pesticide treatments are sometimes required on late maturing fields.

Legumes: Clovers of several species and varieties are collectively important sources of nectar throughout the state. Some clovers like white clover (*Trifolium repens*), red clover (*Trifolium pratense*), alsike clover (*Trifolium hybridum*), crimson clover (*Trifolium incarnatum*) that are grown as forage legumes may at times provide excellent sources of nectar. White and yellow sweet clovers (*Melilotus alba*) and (*Melilotus officinalis*) are found in local areas throughout the state. Both clovers are more productive when grown on alkaline soils. Vetches (*Vicia* sp.) are erratic in their attraction of bees and nectar production, however, when available, the honey is of high quality and excellent flavor. In some areas, particularly in northeastern Arkansas, vetches may provide an early flow of nectar adequate for a crop of surplus honey. The lespedezas (*Lespedeza* sp.) produce nectar, and may at times, be important in supplying maintenance requirements of the colony; but usually they are scant producers of surplus honey.

Woody Plants of several species provide nectar of good quality. Holly (*Ilex opaca*) is an important source in the river bottoms and forested areas of the central and southern counties. Black gum (*Nyssa sylvatica*) and tupelo gum (*Nyssa aquatica*) sometimes contribute a good nectar flow. They are most common in the southern and western counties. Black locust (*Robinia pseudoacacia*) is abundant throughout western Arkansas and locally elsewhere. Weather conditions during the blooming period of black locust may limit nectar collection by the bees. Willow (*Salix* sp.) is probably the most important of the woody plants in Arkansas due to its widespread abundance, early blooming habit and because of the production of both nectar and pollen early in the season. Redbud (*Cercis canadensis*) is common throughout Arkansas, but it is found most frequently in the Ozark and Ouachita mountains and along streams and in woodlands where the soil is moist and rich. It is also used extensively as an ornamental tree. Redbud blooms early in the spring and where abundant it provides an excellent source of nectar and pollen for early spring brood rearing.

In the southern half of the state, particularly in the Coastal Plains, rattan vine (*Berchemia scandans*) and buckwheat vine (*Brunnichia cirrohosa*) are highly regarded as sources of nectar. Where abundant, they provide a surplus of good quality. These plants are usually associated with wooded areas, along stream beds and river bottoms. Both are characterized by a long blooming period lasting from late spring on through the summer months.

Many other plant species contribute to the economy of the bee hive. Collectively they may occasionally provide a surplus of honey but seldom in large amounts. The spring flora, consisting of fruit bloom, clover bloom, elms, maple, brambles, purple henbit and many other early flowering plants, is usually adequate to provide for early colony build-up. Often, depending on the abundance of nectar-producing flora, surplus yields of honey may be obtained in the spring. In the hill and coastal plains counties, this is the major crop of honey.

Fall flora, consisting of Spanish needle, asters, goldenrod and smartweed is usually a dependable source for winter stores. Occasionally good quality surplus honey may be obtained from Spanish needle and goldenrod. Under the stress of drought conditions, or as a result of other unfavorable climatic conditions, nectar flow from these sources is limited and sometimes inadequate for winter needs.

Pasture management or improvement programs favor the beekeeper on the one hand and are unfavorable on the other. Where the program includes the planting of legumes, particularly white clover, good bee pasture becomes available. Clipping and/or herbicidal control of weeds in pastures and along field margins have reduced the availability of Spanish needle, goldenrod and asters as a nectar source in late summer and fall. However, clipping of clover-fescue pastures or heavy grazing is required to release the clover from shading and subsequent bloom production.

Other cultural practices may have a bearing on the availability of nectar. Get acquainted with the situation in your locality and adapt management practices accordingly.

Undesirable Honey Plants and Separation of Flows

Bitterweed (*Heleniun tenuifolium*), described as a nectar-laden plant, is a serious handicap. Unfortunately, it is widely distributed over the state. Honey from bitterweed is extremely bitter. Where it or other undesirable nectar plants, or honeydew, are abundant, try to separate the honey crop from desirable sources from undesirable plants. Remove supers filled or largely filled before bitterweed honey comes in and put empty supers in their places. In this way, the beekeeper avoids a mixture of good and bitter honey. The flavor of bitterweed honey seems largely, if not entirely, in the pollen grains; and the honey, if allowed to stand for a year or longer, loses most of its bitterness. Use off-flavored honey and off-colored honey for feeding bees in winter or at other times when needed. Do not put such honey on the market.

Pollen Sources

Early spring brood rearing may be initiated by the availability of pollen from early blooming plants. In some sections of the state, witch hazel (*Hamamelis* sp.) is frequently stimulated to bloom by mild weather in late December and January. If there is an abundance of the shrub in the vicinity of an apiary yard, brood production may start before adequate pasture is available. Other plants that may provide pollen and nectar in early spring include elms, maples, dandelion, purple henbit, redbud and many other plants. The nectar and pollen from early blooming plants stimulate colony build-up which may require supplemental feeding until the major nectar flow gets underway from more abundant sources such as willow, clovers, vetch, rattan, crossvine and others.

In recent years, pollen has been extolled as a nutritional item. Special skills and equipment are required for collecting and processing pollen for human use.

Site and Equipment

The duration of high summer temperatures and the number of cool, cloudy and rainy days in spring must be considered in locating an apiary yard. Partial shading during hot summer weather is desirable. Too much shade is as bad as too much exposure to the sun. Too much shade tends to make the bees cross and keeps them from working early in the morning. A location with early morning and late afternoon sun is most desirable. Good air and water drainage should characterize the apiary site. Easy accessiblity for loading and unloading hives is highly desirable.

Hives are best placed on low foundations, bricks or a slab of concrete. A low position facilitates handling of heavy supers and hive bodies.

Do not let tall grass, weeds or bushes grow immediately in front of the hives. They seriously interfere with the field bees, both going and coming, during foraging activity.

Lay pieces of roofing tin or roofing shingles in front of the hive to prevent grass and weeds from interfering with accessibility to the hive entrance. You may apply certain herbicides to unwanted vegetation.

Several types of hives are in use. Regulations require that they have movable frames to facilitate inspection for diseases. The one most commonly used by the beginner and small beekeeper is the Langstroth hive (Fig. 3). It contains 10 frames,

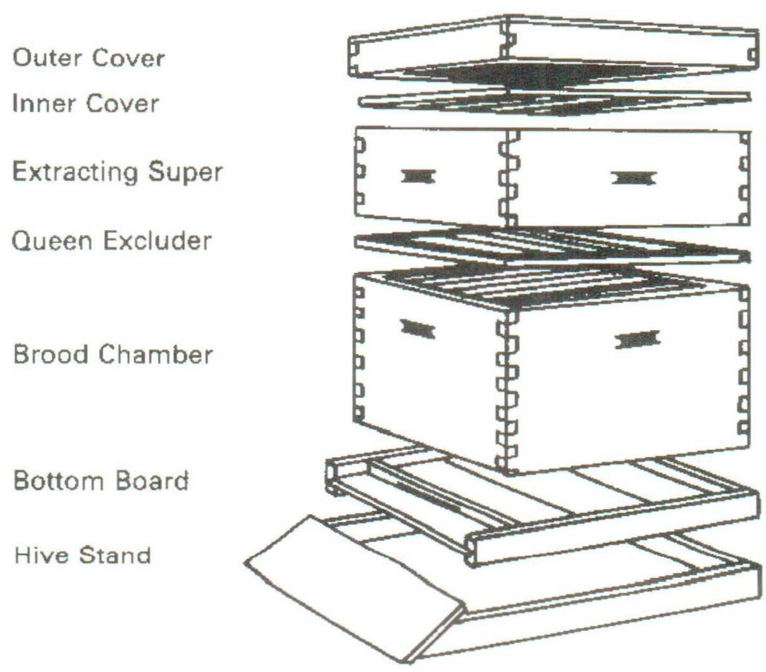

Figure 3 – The typical structure of a bee hive, commonly referred to as the Langstroth hive.

spaced $1\frac{3}{8}$ inches center to center. The beehive consists of a bottom board which may rest on a hive base or be set on blocks or bricks. The brood chamber may consist of one or two deep bodies, $9\frac{9}{16}$ inches in depth. The supers for the storage of honey are usually shallow, $5\frac{11}{16}$ inches deep. Commercial and large scale beekeepers frequently use an intermediate size known as the Illinois super, which is $6\frac{5}{8}$ inches deep. It holds more honey than a Langstroth or standard shallow super, but when full it is much easier to handle than a deep chamber.

The frames used by most beekeepers are the "Hoffman" self-spacing frames. The deep or brood chamber frame is $9\frac{1}{8}$ by $17\frac{5}{8}$ inches, the Illinois frame $6\frac{1}{4}$ by $17\frac{5}{8}$ inches and the shallow frame $5\frac{3}{8}$ by $17\frac{5}{8}$ inch size.

Place the inner cover on top of the top super. The top cover, usually covered with galvanized or aluminum sheeting, telescopes over the top of the hive an inch or more.

Plastic hive furniture, all plastic frames and foundation and plastic foundation covered by a thin layer of beeswax, is available to the beekeeper instead of the traditional woodware and foundation made of beeswax. There are some advantages to the use of the plastic ware as well as problems. Before investing heavily in such equipment, use some on a trial basis to determine if it is advantageous to your management system.

In addition to hive bodies, bottom boards, covers, several supers with a supply of frames and sheets of foundation, the beekeeper needs a smoker, hive tool, veil and gloves. The smoker is essential. When working with bees, always keep the smoker within easy reach and working properly. Pine straw is an excellent smoker fuel, but you may also use old rags, gunny sacks and dry peat moss.

A hive tool is likewise essential. It is especially made to facilitate moving of frames, as well as supers and hive bodies. A discarded file, flattened and sharpened at both ends and bent at a right angle at one end, is a good substitute. A veil is necessary, although under ideal conditions, a well-behaved colony may be handled without a veil. However, for personal comfort and safety, always wear a veil. Gloves are useful when working under unfavorable conditions or with a pugnacious colony. Leggings or some other means of protecting the ankles are desirable under the same conditions. All beekeeping equipment may be obtained from a beekeeper's supply house. Hives may be constructed, but take care to get exact dimensions because these are essential to the construction of good combs.

The movable frames for the hive body, as well as the supers, should be equipped with full sheets of wax foundation, properly wired. This prevents damage to combs when frames are handled or the bees moved.

How to Start

A beginner usually starts with packaged bees. A 3-pound package with a queen purchased from a reliable queen and package bee producer and installed properly will soon develop into a strong productive colony.

Escaped swarms (see swarming) are often found, particularly during the spring and early summer and later in the cotton and soybean areas. They are easily captured and can be put to work at once, if suitable hives with frames and wax foundation are made readily available to the bees (Fig. 4). Colony establishment is facilitated if you can provide a frame or two of honey from another hive. The quality of the bees is not a serious consideration as long as they are not diseased. If the colony is dark and/or hostile in disposition, it can be improved by requeening with a new queen of known origin. Wild swarms may sometimes be contaminated by disease. Only large vigorous swarms that occur during good nectar flows should be hived (see cover photo).

Figure 4 – A ten-frame brood chamber ready to receive a swarm of bees, either captured as a swarm or obtained as package bees. Note the front entrance feeder in place.

Races of Bees

Four races of commonly recognized bees are readily available to the beekeeper. These are the German, Italian, Caucasian and Carniolan bees. Of these, the Italian race and its variants are most popular in this area.

The first bees were introduced into America about 1621. Presumably this introduction was of the German race, frequently referred to as "black bees" because of their dark color. This bee readily adapted to the United States, where nectar producing flora was abundant and the hollow trees of the forests provided suitable sites for establishment of the colonies. For more than 200 years this race provided the major, if not the only, stock of bees in the United States. This race has been largely supplanted by other, more hardy and productive races of bees.

The Italian race of bees was introduced into the United States about 1860 and since that time has become the most important race in commercial beekeeping. Because of its productivity, adaptability and versatility in behavior, it is recommended as the preferred race to use in Arkansas.

The Caucasian and Carniolan races have certain favorable attributes which appeal to some beekeepers. However, maintaining the purity of the race without intensive management is difficult.

Hybrid lines are available which have been developed for productivity, gentleness and resistance to disease. Again, intensive management is required to maintain the integrity of the hybrid line.

In summary, before purchasing bees, review the qualities of each race or hybrid with respect to the management routine of the individual beekeeper.

When and How to Install Bees

The best time to install package bees in Arkansas is in the spring, the last half of April to the first of June. Order package bees about 4-6 weeks prior to preferred date of installation. Have the bees arrive when nectar and pollen are available from early blooming plants, preferably 6-8 weeks prior to the main honeyflow.

Prior to arrival of the package bees, prepare the hive with frames of pollen and honey. If these are not available, mix 10 pounds of granulated sugar to a gallon of warm water a day or two before arrival. Place a division board feeder to the outside of comb or foundation frames or prepare an inverted pail feeder. Fill with sugar syrup just prior to installing bees.

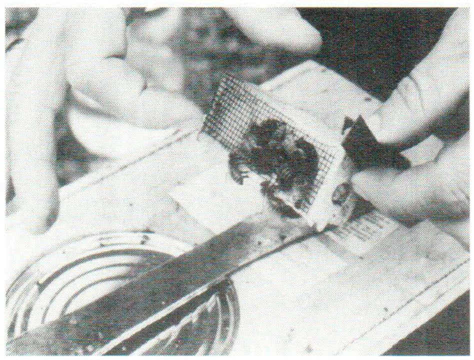

Figure 5 – Queen cage.

Figure 6 – Removing feeder can from a package of bees. Opening must be covered to avoid uncontrolled escape of bees.

When ready to hive the bees, sprinkle the screen cage with warm water so the bees cannot easily fly. Shake the bees down into the bottom of the cage, remove the queen cage (Fig. 5) and feeder can (Fig. 6) for introduction. Remove the paper over the candy plug, or punch a nail through the plug. Place the queen cage face down across the top of the frames, or hang it, candy end up, between two frames toward the back of the hive (Fig. 7). Place an empty super on top of hive and shake bees from cage into hive (Fig. 8). Invert feeder pail with sugar syrup on top of

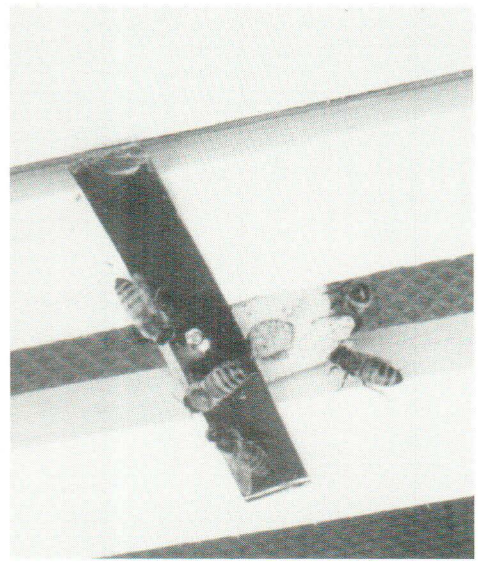

Figure 7 – Queen caged, candy end up.

Figure 8 – Pouring package bees over brood frames.

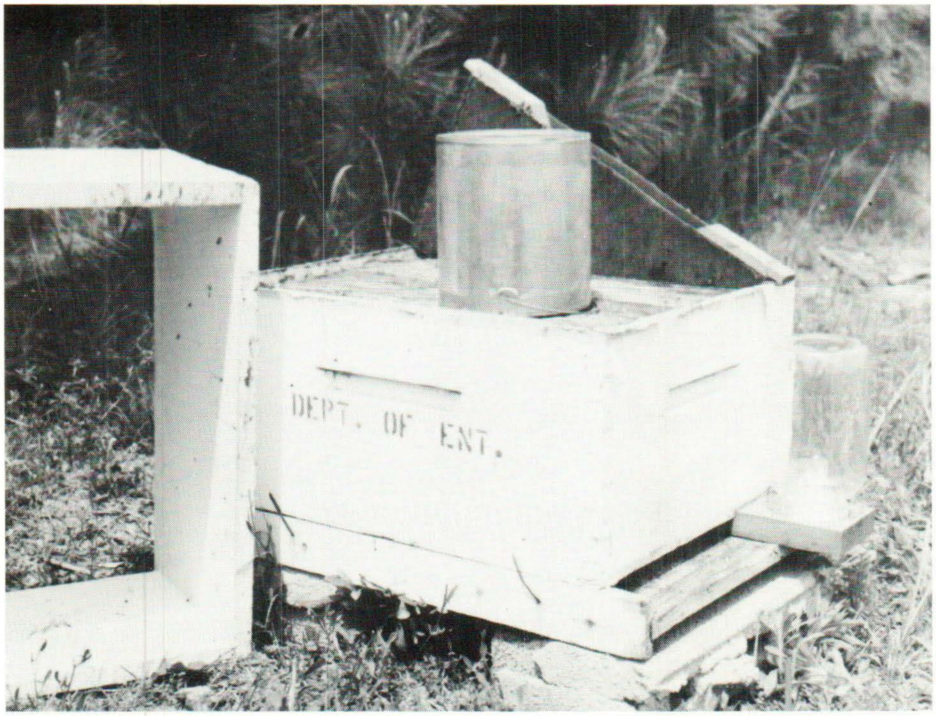

Figure 9 – Examples of feed containers, i.e., a gallon pail with small holes punched in the lid and inverted over the brood frames; a division board feeder which takes the place of a brood frame until the colony is established; a front entrance feeder mounted in the entrance. The novice will find the entrance feeder convenient to use.

frames, or replace one frame with a division board feeder along one side (Fig. 9). Cover the hive and let it remain undisturbed for 5-7 days. After a few days, remove the empty super and refeed, using a division board feeder. Normally, this feeding is sufficient unless there is a dearth of nectar and pollen in the area. In this case, feed as needed to keep the colony developing in numbers.

In areas where the spring flow is the major source of honey, obtaining a surplus the first year is usually impossible. Rather, concentrate on building colony strength for winter survival and production the following year.

One or more books devoted to bee culture are desirable for the beginner. Magazines are helpful in solving current problems. Two major journals are devoted to bee culture. In these, you'll find not only much valuable and timely information, but also reliable sources for beekeepers' supplies, package bees, queens and possibly a good market for the honey crop.

The cost of getting a start naturally depends on the number of colonies obtained at the beginning. Supply houses are glad to furnish estimates upon request.

The Colony

The colony consists of one queen, a few thousand up to 100,000 or more workers, and during the summer, a variable number of drones.

Development of a queen, from egg to adult, requires 16 days. Hatching of the egg takes 3 days; the larval state is 5½ days; and the pupal stage (capped over) is 7½ days. Workers may be reared in 21 days (stages are 3, 6 and 12 days respectively). Drones require 24 days for complete development (3, 6½ and 14½ days).

Queen

The queen is recognized by her long abdomen and more uniform leathery color. The abdomen extends well beyond the folded wings (Fig. 10). Her only function is to lay eggs. Egg laying begins in early spring, when the first pollen comes in, and continues until early fall or as long as pollen is available. At the height of brood rearing, the queen may lay 2,000 or more eggs in a day.

The queen may live five years or longer, but her period of usefulness rarely extends beyond two years, when she should be replaced by a young and vigorous queen. Old queens tend to produce an excessive number of drones.

Old queens are commonly superseded by a young queen without any assistance from the beekeeper. But this method of letting "nature take its course" may result in a deterioration of the stock and is not good beekeeping.

Good queens may be reared by an experienced beekeeper. A beginner will do better to buy good queens from a reliable dealer.

Introduce a new queen at any time a colony becomes queenless or when the queen is old or failing. Colonies should be requeened every two years, and early enough to insure that a large number of young vigorous bees may be produced to live through the winter. Spring dwindling in colonies is often due to the fact that the overwintering bees fail to live until the brood has emerged.

Under no conditions should a queen be introduced while robbing is underway (see page 15). If the colony to be requeened has an old queen, remove her 2-3 days prior to introducing the new queen. Various techniques are used, depending on the experience of the individual beekeeper. Generally, the procedure is similar to installing the queen in a hive of package bees.

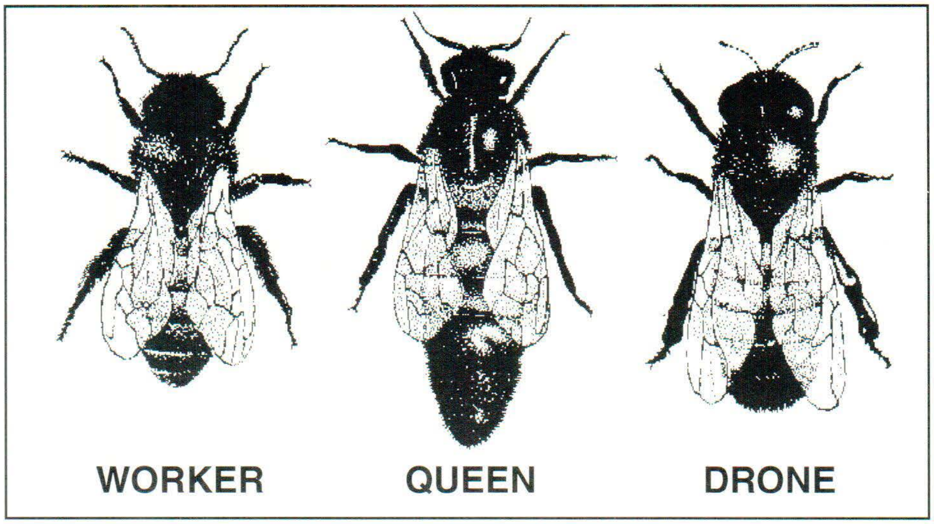

Figure 10 – Three castes of the honey bee – queen, drone and worker.

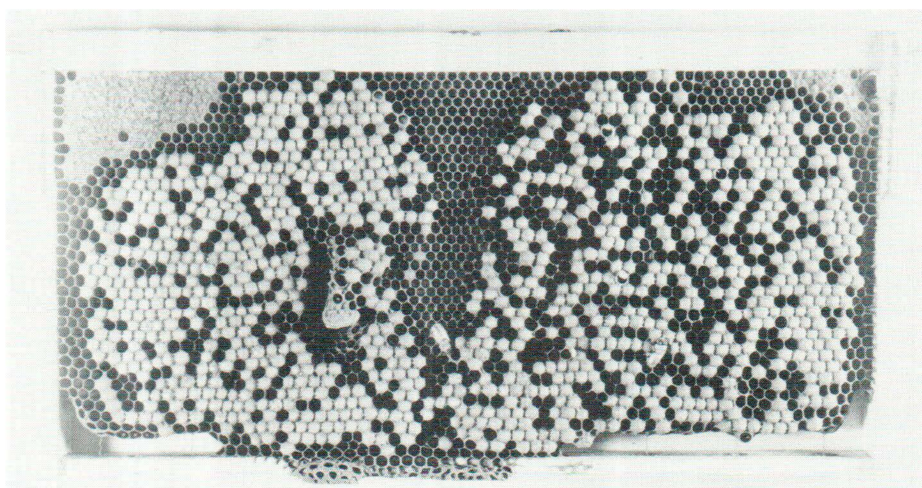

Figure 11– Supercedure cell in center with drone brood cells covering most of the remainder of the frame.

Workers

Workers, the smallest of the castes (Fig. 10), are females, but normally incapable of reproduction. They are unable to mate but may assume the function of laying eggs in a hopelessly queenless colony. Their eggs produce only drones. Workers do all the work of carrying nectar and pollen, transforming nectar to honey, building combs, feeding the larvae, capping cells containing fullgrown larvae, rearing queens, ventilating the hive, defending it and various other tasks. Workers have well-developed compound eyes on the sides of the head and three simple eyes on the vertex. The tongue is well-developed and elongated for sucking up nectar.

Workers reared in spring or early summer live about six weeks. Two weeks of this is spent mostly in the hive, the remainder in the field. Workers reaching adult stage in the fall will, under favorable conditions, live well into the following spring.

Drones

Drones, the male caste, are appreciably larger and stouter than workers (Fig. 10). Their buzzing is of a different pitch from that of workers and it is readily recognized by an experienced beekeeper. The only function of the drone is to fertilize the young queen. Drone larvae develop in cells visibly larger than worker cells (Fig. 11). They are reared chiefly in spring and early summer. The compound eyes meet on top of the head. The antennae are longer than those of either the worker or queen and are composed of 13 segments instead of 12 in the worker or queen. The mouthparts are greatly reduced. Later in the season, especially in the event of a drought or a shortage of nectar for some other reason, the drones are summarily killed or driven out. As mentioned earlier, an excessively large number of drones appear in an apiary when one or more of the queens are kept beyond their period of usefulness. A colony that is queenless may develop laying workers which produce only drones. When this occurs, the colony loses its effectiveness and will eventually die out completely.

Laying Workers

When laying workers become active in a queenless colony, it is practically impossible to successfully introduce a new queen or to encourage the colony to rear one by introducing unsealed brood and eggs from another hive. The bees and brood of the queenless colony may be scattered among several other hives with frames of brood and bees from queen-right colonies placed in the queenless hive. The original bees will return to their old hive, but the laying workers will remain in the new hive and will probably be destroyed. The restructured colony in the queenless hive will rear out a new queen. Another option is to destroy the queenless colony completely.

Temperature Relationships

The activities of honey bees are influenced greatly by temperature. Rarely is any useful work performed below 55°F or above 100°F. At a temperature of 100°F or more, the bees remain idle at the hive or cluster outside (Fig. 12). At 55°F or slightly below, an individual bee soon loses the ability to fly. When temperature falls to 47°F, bees form a cluster and through activity within the clusters are able to survive very cold temperatures.

When brood production begins, the temperature in the brood area is kept at approximately 94°F. During this period the hive consumes large amounts of honey and pollen. If enough food is not available and weather conditions hinder foraging for nectar and pollen, the colony becomes weakened and perhaps succumbs to wax moth and be lost altogether.

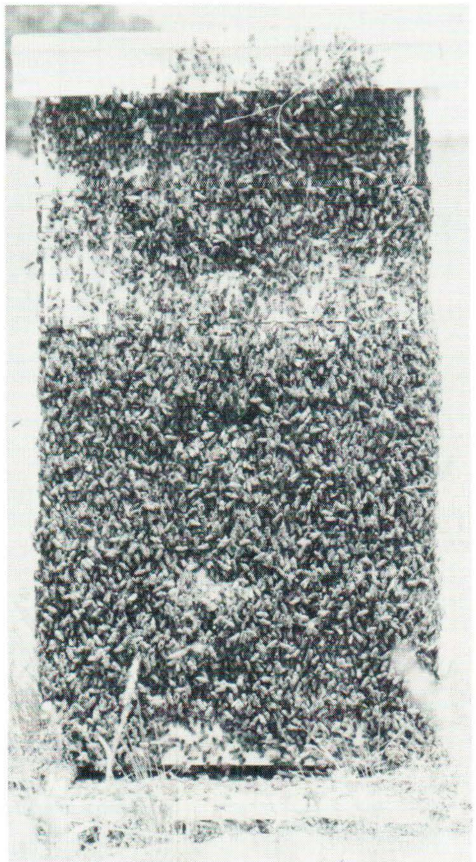

Figure 12 – Bees clustering on exterior of hive due to high temperature and crowded conditions within the hive. Lack of adequate room encourages the development of swarming.

Handling Bees

Bees, even the most gentle, cannot properly be considered domesticated. A swarm captured in some bee tree may be as easy to handle as a hybrid colony that has long been in an apiary. On the other hand, a swarm settling in the woods does not apparently suffer for want of attention from the beekeeper.

A good beekeeper can work bees without getting severely stung because of an understanding of bee behavior. Beekeepers know what bees do under certain conditions, and how to make them respond in the desired manner.

Some races of bees have a better disposition than others. Italians, Caucasians and Carniolans are considered gentle; German or "black bees" are regarded as pugnacious. These races differ in various respects, such as building bur combs, responding and resistance to some diseases. For the average beekeeper, especially the beginner, Italians are considered best. Hybrid strains, resistant to disease and bred for gentleness, are available.

Do not disturb bees on a rainy day, on a cold and cloudy day, early in the morning or late in the afternoon. They are much more apt to sting under these conditions than when the weather is warm.

The ideal time to work with bees is during the middle of the day, when the field bees are carrying nectar and the entire colony is busy. In lifting the top or removing frames, be steady and somewhat slow. Never strike at bees buzzing about the head.

When working at a hive, never stand in front of the entrance. Before opening the hive, blow a few puffs of smoke into the entrance. Smoke generally quiets the bees. It causes them to fill up on honey, with the result that they will not sting so readily. Give ill-tempered bees ample time to fill up. After lifting the cover, pry the inner lid loose at one corner and blow a few puffs. After this, remove the lid and lift the frames. When you take out several frames, note their positions so you can put them back in the same place. When examining combs hold them on edge, never flat, because when filled with honey or brood they may drop out of the frame.

Transferring Bees

The use of old-fashioned box hives or hives with non-removable frames is **illegal** in Arkansas. All hives should be equipped with movable frames. This facilitates manipulation and inspection.

When bees are removed from gums or box hives to modern movable frame hives, the combs with brood honey can be largely saved. After removing the cover from the box hive, put an empty box of about the same size, bottom up, on top of the open hive with sticks, drive the bees into the empty box. From the box, they are shaken into the new hive (in the place formerly occupied by the box hive). The combs in the box hive are cut out, trimmed, fitted into frames and tied crosswise with two strings. Strings should be lightweight and need not be strong. The bees will soon fasten the combs more securely and also remove the strings.

Uniting Bees

Weak colonies die as a result of a severe winter, following a prolonged drought, or from other causes. Beekeepers who keep strong colonies prevent such losses.

A weak colony can usually be built up by the addition of sealed brood taken from strong colonies. When there are several weak colonies, it is probably better to unite two or more together.

Two colonies may be brought together by placing the hive containing the weaker on top of the other. Before doing this, remove the cover and inner lid from the lower hive and lay two thicknesses of newspaper to form a temporary partition between the two hive bodies. Separate colonies of bees have their own identifying odors and fighting occurs if the bees are immediately combined. You may raise the cover of the top hive a bit to permit ventilation. The two colonies thus gradually get together, and few bees are stung to death. The beekeeper may remove the less desirable of the two queens, or he may leave this to the queens themselves.

Conversely, strong colonies may be divided in the spring. This is an important item in good management when a larger apiary is desired.

Moving Bees

If the bees are to be moved only a short distance, close the entrance of the hive with a block of wood or wire screen. Fasten the top and bottom covers securely with wire or staples available for this purpose. Hives should be moved in cool weather or in summer by night. If the bees are moved a long distance in warm weather, replace the top cover by a screen wire tacked over the frames.

After the hive is in the new location, you may release the bees by removing the block from the entrance. The bees should be smoked a little to quiet them down and reduce "running." Place a slanting board or some twigs to obstruct the flight. This prevents bees from leaving without taking notice of the change in location. Bees leaving from the new location without being properly oriented are likely to be lost. If the hive is moved one to two miles or less, many field bees return to the former location resulting in a weakened colony.

Feeding Bees

Feeding is sometimes necessary in spring, when cool weather prevents or delays the spring nectar flow. In fall, especially after a prolonged drought, some colonies may have inadequately provided for winter, and the shortage must be supplied, if the bees are to survive until spring.

For proper wintering, not less than 55 pounds of honey stored in the comb or eight frames fully filled should be left in the hive. To be on the safe side, good beekeepers leave 50 to 60 pounds of honey in the hive.

Honey unfit for marketing may be fed to the bees. However, when feeding honey, there is some danger that robbing may be started. In addition, if there is some diseased brood in the colony from which honey is taken, the disease may be spread by feeding honey. The simplest method of feeding homey is to take well-filled frames from colonies that have a surplus above their needs and inset them in hives that are short of stores.

Another method is to provide the bees with a sugar-and-water mixture, half and half. This may be given in an entrance feeder (Fig. 4) or friction top pail (Fig. 9). In using the pail, punch numerous small holes through the top and place the can, filled with the mixture, top down, on top of the frames. An extra hive body, or shallow super, is necessary to accommodate the feeder. Usually the best feeder is the division board feeder used in place of one of the regular frames. Front entrance feeders also may be used when opening a hive is undesirable. Observe some precautions to avoid robbing. The use of sugar syrup limits the chance of spreading disease.

For emergency feeding in the spring or summer, use granulated sugar, five pounds to the colony. Pour it onto the bottom board at the entrance, and tilt the hive to carry it well inside. The sugar can also be poured over the tops of the frames or on top of the inner cover.

Robbing

Robbing is a serious matter and may assume disastrous proportions. A common cause is leaving honey or combs exposed in or near the apiary. Transferring bees from boxes into frame hives may result in robbing. Termination of nectar flow following prolonged drought is commonly a cause. Robbers are recognized by the fact that they enter the hive (that is being robbed) with a contracted abdomen, and leave with the abdomen distended to fly straight to their own hive. They enter the hive that is being robbed by jerky movements, flying back and forth in front of the entrance. They do not alight on the bottom board and go straight into the hive, but try to sneak in. They retreat hastily when attacked by guard bees.

Robbing should be avoided at all times because of the danger of spreading American foulbrood and parasitic bee mites, should they be present in the area.

During a dearth of honey flow, examine colonies subject to robbing either early in the morning or late in the evening. Do not leave full frames or supers of honey exposed and keep the period of hive opening at a minimum.

When robbing starts, stop all handling of bees in the apiary. A bunch of wet grass or weeds thrown over the hive that is attacked may stop the robbers. If not, close down the entrance to about one-half inch, and wipe the front of the hive with a rag dipped in kerosene or diluted carbolic acid. Since weak colonies are likely to be robbed, management practices that equalize the strength of all colonies in an apiary yard are recommended as a preventive measure.

Swarming

Swarming is a natural reproductive instinct of all social insects living in perennial colonies. It is their means of spreading and forming new colonies. Swarm control is one of the greatest problems facing the beekeeper. The swarming instinct is not equally strong in all races of bees. Carniolans are said to swarm more often than the Italian race. Even among the Italians, however, some colonies may have a tendency to swarm excessively. Aside from the natural tendency to swarm, the principal causes for swarming are lack of room and adequate ventilation. Under these conditions the worker bees will construct queen cells and prepare to swarm.

The beekeeper will attempt to control or limit the swarming behavior. To obtain a harvest of surplus honey requires strong, well-populated colonies of bees. One strong colony, prevented from swarming, produces more honey than the combined yield from a parent colony and its swarm colony.

To prevent swarming, examine each colony once every 10-14 days. If more space is needed, provide an additional super. If the bees cluster on the front of the hive, they probably need better ventilation. This can be arranged by blocking up the top cover one-half inch. Examine the brood frames for queen cells (Fig. 13), and remove all of these. The swarm (queen) cells are usually near or at the bottom of the comb. An exception to this rule is the supersedure cell (Fig. 11). It is a large queen cell located near the top of the frame, between the top bar and the comb. It

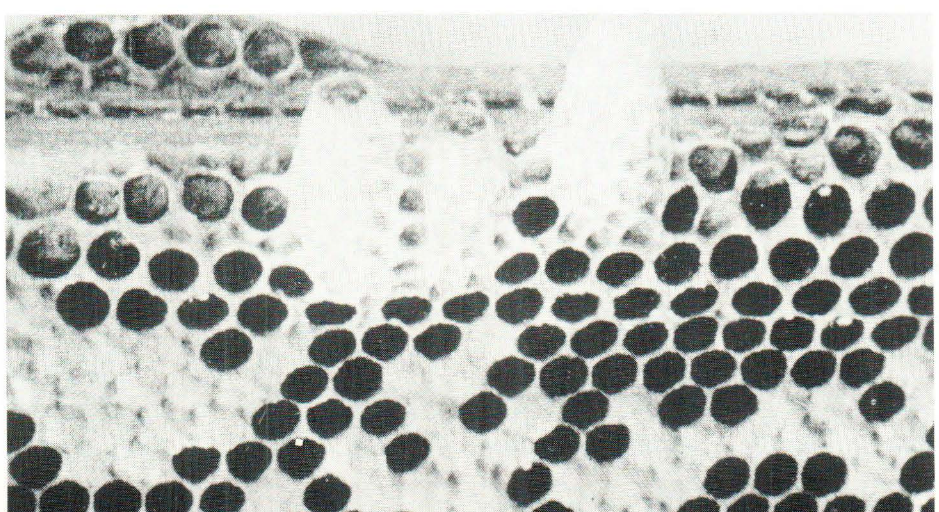

Figure 13 – Swarm cells on lower edge of frame.

may be left intact so that the workers can replace an old failing queen with a young one.

Reversing the first and second stories of the hive in the spring when the second story becomes well-filled with brood is one of the simplest measures to suppress the swarming instinct. Brood rearing usually begins in the second story. By placing the second story beneath the first, the bees will have more room and will carry much of the honey up from below.

If the colonies are given as many supers of comb as they can cover during the build-up period before the main honey flow, the swarming behavior will be less likely to develop than if the colony is confined to only one or two brood chambers. When crowded and overheated conditions exist, providing larger entrances and shading of the hives and/or staggering the supers vertically tends to alleviate the effects of these unfavorable conditions.

Requeening annually or semi-annually with queens from stock that has a low tendency to swarm inhibits the development of supersedure cells. Clipping the wings of the queen has long been practiced as a part of swarm control. Clipping the wings of the queen does not inhibit the development of the swarming instinct but usually results in the return of the swarm to its hive until a new queen may be reared. Where possible, intensive management at this time may prevent further swarm development.

Spring Management

As soon as warm weather sets in, examine the colonies. If stores are nearly exhausted, feeding may be necessary, especially if cold spells are likely to occur and interrupt the early flow. Unite weak colonies, those with not enough bees to cover two frames. If a colony does not have a generous amount of worker brood under way, or has a large proportion of drone brood (Fig. 11), or if the colony is queenless, unite it with some other colony. Weak colonies should not be expected to rear a good, vigorous queen. Requeening is difficult very early in the season. Queens are not readily available and are expensive. In general, the best time for this is late summer or early fall, but in time to ensure progeny before the end of the season.

Colonies should also be checked for both species of parasitic bee mites at this time. Treatment should be initiated before honey flow begins, if mites are present in the colony.

Fall Management

The primary functions of fall management activities are to bring to a close the active productive period and to begin preparation for the next season. With the decline in the availability of pollen and nectar, brood rearing will be reduced or terminated. The old bees die off and colony strength weakens. As this occurs, reduce the amount of hive space to the needs of the colony during the winter. Adequate stores of honey and pollen, from 30-50 pounds, should be provided the colony for winter food. Place the frames of winter stores so that the cluster of bees does not have to break to obtain needed food. Reduce the hive entrance to prevent the entrance of mice and winter wind. It is also desirable to examine all brood combs for evidence of disease and parasites. If there is evidence of a disease or parasite condition, take appropriate measures to eliminate or treat the problem. Extreme care should be taken to avoid the transfer of diseases or parasites to other colonies in the apiary.

Winter Protection

Some form of winter protection is desirable in all parts of the state. Just how much is needed is best determined by experience. Beginners can best learn from some successful beekeeper in the neighborhood. Essentials are: shelter against cold winds and an entrance reduced to winter size. This should be 3/8 inch deep by one to four inches wide. The entrance should not face the direction of prevailing winds.

Honey Production

Whether extracted honey or cut-comb sections are to be produced is for the beekeeper to decide. Generally speaking, nectar flows in Arkansas do not favor section comb honey production. Much depends on the abundance and yield of nectar-bearing flowers.

Extracted honey is easily produced by a beginner. It does require an extractor and some other equipment. Unless the beekeeper can extract from about 10 colonies, the cost may not be worthwhile. If the honey crop is sufficient for extracting, this is by all means the most practical and economical method of production. Some beekeeping supply houses provide extracting services or have extractors for rent.

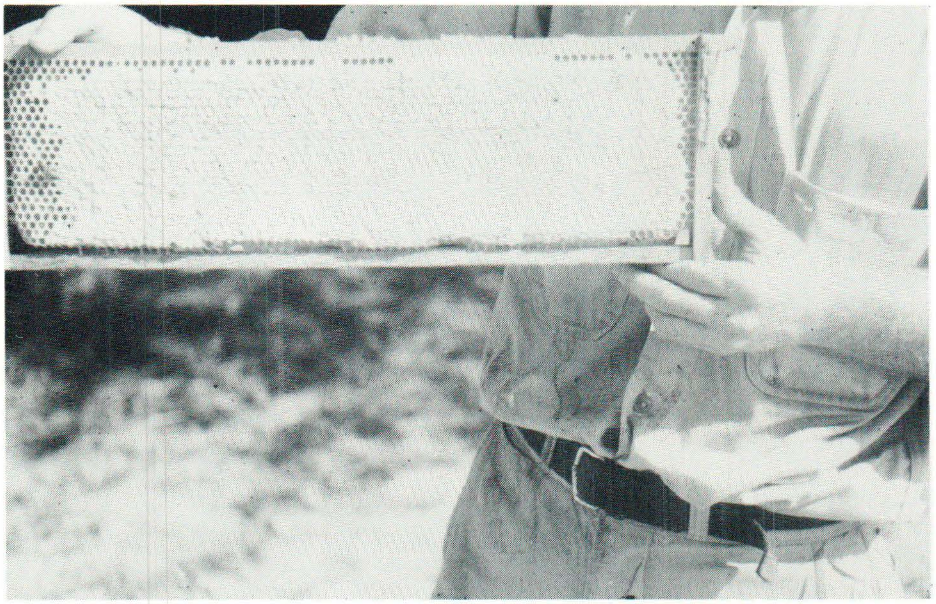

Figure 14 – A filled and capped comb.

The beginner with a few colonies may produce bulk comb honey using shallow frames. The frames should be supplied with thin sheets of foundation without wires. The combs, when filled and capped (Fig. 14), may be cut from the frames, wrapped in cellophane or stored in jars.

The beginner in beekeeping should not attempt to produce section comb honey. It requires considerable experience, large colonies and a strong, reliable flow of nectar. Comb sections are not as attractive to bees as are combs in frames. Bees have to be forced into comb sections and this may result in a tendency to swarm excessively.

Selling Honey

Good beekeepers usually find a ready market for honey. It may be packaged and sold locally on the retail market or extracted and sold in bulk to a processor. In retailing honey, put it in containers that customers will readily accept.

Attractiveness is very important in selling honey. It may be sold in roadside stands, grocery stores or other handy locations where people gather. An attractive pack with "eye appeal" results in "repeat customers." Honey is usually sold wholesale in large containers according to the amount on hand and the needs of the wholesale buyers.

When packing for retail sales, choose standard glass containers of sizes most acceptable to the buyer. Generally, for extracted honey, one pound and either four or five pound jars will move readily from the shelf. An attractive eye-catching label, relatively small in size is not only required by law but will also contribute to eye appeal and "impulse" buying. Good sanitation practices as required by the State Health Department must be followed and the quality held as high as possible regardless of the manner in which the honey will be marketed.

Diseases and Parasites

Honeybees are subject to a whole spectrum of diseases and pests. Until recently, the foulbroods were the most troublesome; however, today beekeepers must be aware of many diseases and pests. In general, good beekeeping practices help to maintain good, healthy bee colonies. An understanding of the detection, prevention and control of the colony's diseases and parasites is a must for the successful beekeeper.

Bacterial

American Foulbrood. This disease attacks the larvae and pupae (brood) of the colony. Its effect is usually not visible before the larvae is about six days old or right after the cell has been capped. Combs with diseased brood are characterized by sunken cappings, usually off-colored, a number of which may have pin holes (Figs. 15-20). The diseased larvae become brown or copper-colored and if broken by a toothpick the larval contents string out like glue. As the dead larvae dries, it forms into a scale at the bottom of the cell and is not easily removed by the bees. Because of its ropiness and the difficulty in removing the scales, this bacteria is impossible for the bees to completely clean up. A strong "glue pot" odor is characteristic of this disease, but the smell is not always prevalent in the earlier stages. If unchecked, American foulbrood will completely destroy an entire apiary.

Treatment: The only totally effective remedy is to burn the infected colonies-hive bodies, frames, combs and bees. The recommended procedure is to dig a hole at least two feet deep, large enough to hold all diseased bees and equipment. Place a supply of dry wood in the bottom of the hole. Kill the bees in the hive by raising the lid and pouring gasoline or kerosene over the frames. The entrance should be closed and the hive carried to the pit. Start the fire and as soon as it is burning well, throw the diseased hive into the fire making sure that all dead bees and hive parts are burned completely. When the burn is complete, cover the residue at once with a foot of soil. This is to prevent uninfected bees from coming into contact with the infected material. If you wish to salvage the hive body, dump only the bees and frames into the fire. All parts of the infected hive should be scraped to remove wax and propolis which should also be thrown into the fire. The salvaged hive parts should be disinfected by "torching" with a blow torch until entire surfaces have been scorched to kill the disease organism. The equipment may then be repainted and used again. If this procedure is followed, it must be done thoroughly or there is the risk of reinfection.

European Foulbrood. This disease does not normally attack sealed brood. When the larvae die, they become grayish to brownish yellow in color. Infected larvae usually die in a curled position in the bottom of the cell. Dead larvae flatten against the bottom or side wall of the cell. When dry, the scale does not stick to the wall of the cell and is easily removed. If broken by a toothpick, the dead larva will not "rope out" as with American foulbrood.

Control - Systematic application of Terramycin mixed with sugar effectively prevents both American and European foulbrood. The mixture is sifted over the top of the brood frames where the workers will pick it up and distribute it throughout the brood chambers. The drug is to be used only as a preventive treatment.

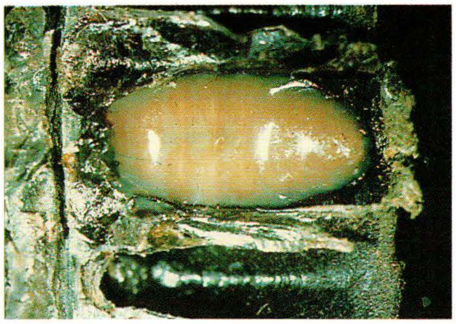

Figure 15 – Bee larva in early stages of infection by American foulbrood disease organism.

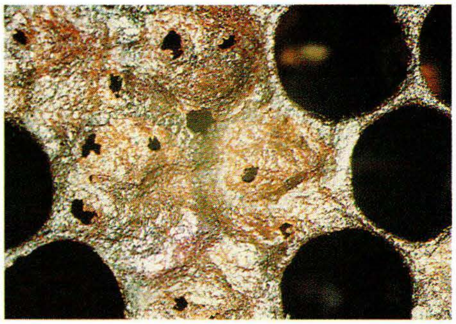

Figure 16 – Characteristic sunken and pitted cappings over bee larvae infected with American foulbrood.

Figure 17– Ropiness test for American foulbrood. Larval contents will "rope" out if larva is punctured with a toothpick.

Figure 18 – Front view of bee pupa in early stage of American foulbrood infection. Note extrusion of mouthparts.

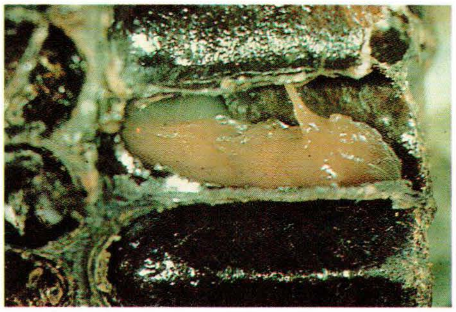

Figure 19 –Lateral or side view of pupa in early stage of infection by American foulbrood.

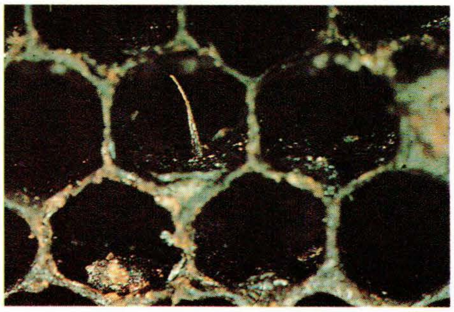

Figure 20 – Advanced stage of American foulbrood infection. Body of bee pupa dries down into a "scale" in bottom of cell with the characteristic tongue line.

Procedure:

1. Combine ¼ cup of Terramycin (TM-25, animal grade) with 1 pound of powdered sugar.
2. Mix thoroughly by sifting several times through a kitchen sifter.
3. Dust or sprinkle 3 level tablespoonfuls of the mixture to top of brood frames. Do not overdose.
4. Treat three to four times at weekly intervals.
5. Do not apply drugs during a nectar flow.

You can get the Terramycin from your local farm supply store or order it directly from bee supply outlets.

Beekeepers experiencing or suspecting disease problems should contact the Apiarist, Arkansas State Plant Board, Little Rock, for advice and assistance.

Nosema is actually caused by a single-celled animal, a protozoa, which inhabits the "gut" of the adult bee. Spores are ingested by the adult bee and pass through the honey stomach to the ventribulus, or true stomach. They germinate, invade the gut and keep releasing new spores which continue the cycle. It spreads especially well during confinement, when bees can't take their cleansing flights. The defecated spores are then available for the entire colony. Nosema impairs the digestive process which causes premature aging and ultimately causes adult bees to starve. The disease also causes the degeneration of both royal jelly and the queen's ovaries which, in turn, hamper brood rearing.

Nosema is probably more prevalent and does more damage than commonly thought. Studies have shown that 80 percent of all samples sent to the major USDA apiary labs for any reason show this disease. The results of the disease can cut back on colony productivity and actually kill colonies. Furthermore, the stress from Nosema is thought to put the colony at more risk for other complications.

A certain diagnosis of Nosema can only be done with a microscope, but yard observations can give clues. The classic clue is a heavily spotted hive front after confined times. Also, bees with distended abdomens and unhooked wings could indicate such a problem.

The use of fumagillin, a strong healthy colony, a prolific queen and clean hive conditions will keep Nosema at bay or at least to a minimum level. Hives whose colonies have perished from Nosema should not be repopulated before killing remaining spores by heat treating the equipment for 24 hours at temperatures near 120 degrees. Fumagillin for bees is available at supply houses by the names of Fumidil-B and Nosema-X. Fall treatment in a sugar syrup is most effective. Follow label instructions. A heavy syrup will be stored by the bees and the antibiotic will be effectively used when brood rearing begins in the Spring.

Fungal

Chalk Brood disease is actually a fungus which adversely affects the larvae. It rarely affects the colony to the extent that serious damage is done but clearly cuts into brood productivity which puts a limiting factor on bee populations. It is thought that the disease is caused by factors which include cool, moist conditions, poor genetics, contaminated pollen and spore levels of previously infected comb or food sources (e.g., water, nectar and honey). It should be noted that while not terribly destructive, Chalk brood is another stress on a colony which makes it more susceptible to other problems.

Chalk brood is very easy to identify and its name almost describes it. The larvae become "mummified" in the cells and the nurse bees will uncap them and leave them exposed in that state. They are often white and chalk-like but sometimes will have a gray to black hue. A hygienic colony will pull them out of the cells and push them out the from entrance where the beekeeper can observe them on the landing or the ground in front of the hive.

Young productive queens and strong colonies are the best defenses against Chalk brood. Care should be taken not to put infected combs into "clean" colonies as the spores can remain infectious for at least 15 years.

Viruses

Several viruses infect honey bees. Until recently, severe problems were not caused by viruses in the United States. Today some of the viruses are causing paralysis or death to bees and severe damage to entire colonies. Viral diseases generally cannot be controlled with medications. General good beekeeping practices are needed to combat these diseases, and the culling or weeding out of susceptible stocks is also a good practice.

Sacbrood is the virus most commonly known in American beekeeping. Larvae infected with Sacbrood virus usually die during the prepupal state, about the time the cell has been capped. A bad case of Sacbrood can result in uncapped or partially uncapped cells being scattered throughout the brood pattern. The larva will typically lie along the length of the cell with its head slightly raised. Color will change from white to creamy brown and eventually to dark brown. The skin of the larva becomes tough and can be punctured to find a more liquid substance inside; hence, its name.

Bee Paralysis is thought to be caused by two distinct viruses: Chronic Bee Paralysis Virus and Acute Bee Paralysis Virus. Not a lot is known about these diseases, but the symptoms include partially paralyzed bees near the hive entrance, bees removing partially paralyzed bees and the "hairless black syndrome" when almost greasy-looking, black bees start becoming prevalent. Kashmir Bee Virus is thought to possibly be a strain of Acute Bee Paralysis Virus.

Honeybee Parasitic Mite Syndrome (BPMS) was first detected in Arkansas in 1995 after debuting in several other states. It appears that it is a combination of viruses which had given bees minimal problems prior to the increase in infestation levels of mites. It is thought that the mites have either vectored these viruses or, at least, the havoc they've created has given the virus the foothold it needs to become established.

While a sure diagnosis cannot be made outside a laboratory, symptoms of Parasitic Mite Syndrome can be broken down between what can be observed in the adult bee population and what can be observed in the brood. The adult bee symptoms include the presence of Varroa mites, reduction in adult bee populations, evacuation of the hive by crawling adult bees and queen supersedure. Brood symptoms are less clear and include the presence of Varroa mites, a spotty brood pattern, possible symptoms resembling European Foulbrood, American Foulbrood (without ropiness, the typical odor or brittle scales) and Sacbrood.

Prevention and remedies for BPMS requires the elimination of as many stress factors as possible. This includes adequate food supplies, a young productive queen, good preventative practices for the bacterial diseases and keeping mite populations to minimal levels.

Parasites

Acarapis Woodi or the **Honeybee Tracheal Mite** (HBTM) was discovered in the U.S. in 1984. Although it spread to 17 states in the first 13 months, it was not confirmed in Arkansas until 1987. It's spread primarily by migratory beekeepers, queen and bee sales and from bee yard to bee yard by natural means. It can be generally assumed that if there is one infested colony in a yard, the other colonies in the yard are also infested. Today, Tracheal mites are considered to be present in all of the continental states and in all counties of Arkansas.

The Tracheal mite is of microscopic proportions but has done a great amount of damage to countless colonies of honeybees. The mites propagate year round in the trachea, or breathing tubes of the bee, where they spend most of their life. The only time they are outside of bees is when they are questing for a new host. Not only do they clog the bee's breathing passages but they also puncture the tubes in the process and shorten the lives of individual bees and, eventually, kill the entire colony.

Because of their size and the fact that they spend the bulk of their life inside bees, symptoms, detection and treatment are not easy. Clinical symptoms include the observation of several bees crawling around in a disoriented fashion with wings at abnormal angles. Sometimes they are found in small clusters on the ground apparently unable to fly. Colonies with sizable infestations often die during the late winter months, looking as though they've starved even though there may be plenty of honey in the hive. Often, in these conditions, there might be only a small cluster or no bees left in the hive at all. Detection can only be confirmed through dissection and microscopic examinations of individual adult bees.

Menthol crystals and vegetable shortening patties are the only proven, legal methods of controlling Tracheal mite levels in colonies. Without treatment, not only will the colony die in short order, but also nearby colonies will become infested. Menthol for use in bee hives is specially formulated and can be purchased through bee supply houses. It is important to note that menthol vaporizes in the hive at temperatures above 60 degrees, and the vapors are what combat the mites. At temperatures above 80°F, the menthol vaporizes so fast that the bees are chased out of the hive and treatment becomes ineffective. The bees should be exposed to menthol vapors for at least 21 days during which time the beekeeper should not have honey supers on the hive. This is because the menthol could contaminate the honey and comb. The vapors would also become too thin in the larger volume to be effective. For the same reason, the hive should be relatively airtight for menthol vapors to be effective. The lid should be tight, and cracks and holes should be sealed. Vegetable shortening patties made available in the hive have proven effective in limiting the success of the tracheal mites. Tracheal mites need young bees for hosts. With a shortening and sugar 2:1 mixture available to the bees at all times, their bodies become greasy and the mites are much less successful in finding appropriate hosts.

Varroa jacobsoni or the **Varroa mite** was first found in Arkansas in 1991. Like the Tracheal mite, the Varroa mite spread by migratory beekeepers, queen and bee sales and from bee yard to bee yard by natural means. It can be generally assumed that if their is one infested colony in a yard, the other colonies in the yard are also infested. Today, Varroa mites are considered to be present in all of the continental states and in all counties of Arkansas.

The Varroa mite is nearly the size of the head of a pin and is reddish-brown in color. It propagates on larvae in the brood cells of the honeybee. When the adult bee emerges, the mites wander briefly, attach to adults for feeding and then find another appropriately aged larvae on which to repeat the process. Because of their longer developmental period, the mites prefer drone brood over worker brood to use for their nurseries. These mites damage and deform brood and their feeding habits also shorten the lives of individual adult bees. Left uncontrolled, their populations continually increase during the brood season and overcome entire colonies.

Because of their size and habits, detection of Varroa mite infestations is not difficult and can be done in the bee yard. It is important for beekeepers to periodically monitor mite levels to maintain adequate control over their populations. There are several methods of detection of varroa mites. Three easy ones follow:

Drone scan - This method uses a capping scratcher to remove several drone larvae or pupae with a leverage movement. Because of the whiteness of the hosts, the mites show up very easily in this test. While easy and quick, this method only tells if serious infestations are present; a light infestation may or may not be detected (Fig. 21-22)

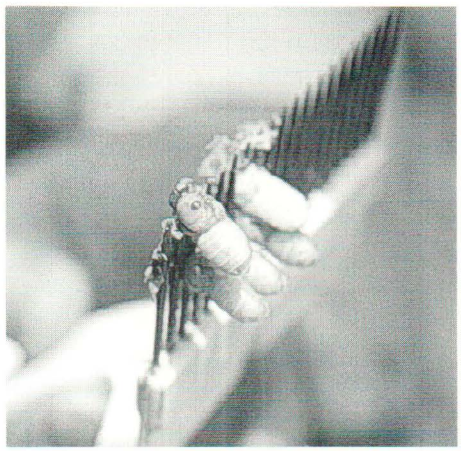

Figure 21 – Drone brood pulled with capping scratcher.

Figure 22 – Drone pupae with varroa mites.

Ether roll - This method uses a wide mouth, pint jar and can of ether or starter fluid. First, lightly coat the inside of the jar with a short spray of ether. Next, push a sample of approximately 300 adult bees from the brood areas of one or several colonies of bees of the same yard. (It is critical that the bees come from the brood areas because that's where the mites will most often be found.) Spray a quick blast of ether on the bees in the jar to sedate them and knock the mites off their bodies. Then, shake the jar rather hard for several seconds before rolling the jar slowly to cause the mites to adhere to the sides (Fig. 23). Done effectively, this method allows the beekeeper or inspector to get a count of the number of mites which were on the 300 bee sample.

Figure 23 – Ether roll with mites adhering to sides of jar.

Sticky board - This is the most difficult but also the most accurate for detecting low and assessing actual infestation levels. For this method, remove all surplus honey supers and place fresh Apistan® strips in the brood area of the colony. Also, place a protected sticky board below the brood frames on the bottom board area of the colony. This sticky board can be something purchased for this purpose or simply a piece of white, Pam® coated poster board covered with an 8 mesh screen or hardware cloth. Mites afflicted by the fluvalinate in the strips will fall and stick to the white surface where they can easily be counted after a couple of days of exposure.

These tests are tools for detecting and/or assessing infestation levels. To understand the levels of infestation, beekeepers should understand that during the brood season, 80 percent of the mites are protected in cells at any given time. This leaves one out of five mites exposed to the ether roll or sticky board tests. Therefore, with the sticky board test, multiply the number of fallen mites by five to come up with an actual mite count for a given colony.

With the ether roll test, assess the colony's population and judge what percentage of the colony was used in the test. In a colony of 60,000 bees where 300 bees were used in the ether roll, it means that one of every 200 bees were used. Therefore, the number of mites found should be multiplied by 200 and then that product multiplied by five (for the exposed mites). Thus, in this example, if one mite was found in the jar, it would mean that 1,000 mites were in the colony.

These numbers are guides for the beekeeper to understand the seriousness of the infestation and how critical treatment is at the time of the test. Any detection would mean that treatment will be necessary but the urgency depends on the level of infestation. Here are some guidelines to judge treatment urgency:

1. **Less than 100 mites per colony**; the mites are not currently a critical problem but will require treatment in the fall and should be monitored bimonthly to check for large increases.

2. **Between 100 and 1000 mites per colony**; this is getting pretty detrimental to the colony and treatment should begin as soon as possible after removing the honey, even if that means giving up some of the incoming crop. It's not worth sacrificing the bees for a little more honey.

3. **More than 1000 mites**; the colony is about to collapse. Remove supers and treat immediately. Treatment will be needed again in the Fall, and close monitoring is critical.

Apistan® strips can be used at any time if supers are removed and label instructions are followed (Fig. 24). However, best results take place when the mites are mostly on the bees and most likely to contact the strips. Late fall is probably the time of year with the least or no brood. However, if the beekeeper waits too long, the winter clusters get tight and mites can escape treatment. In our climate, two treatments per year are indicated, one in spring and another in fall, but the above methods can tell you more than the "general rule." Follow label directions, and do not leave strips in longer than the label allows. This could cause mites to become resistant.

Bee Pests

Wax Moths

The two species of wax moths, greater wax moth (*Galleria mellonella)* and lesser wax moth (Achroia grisella), have similar habits and life cycles. Wax moths occur nearly all over the world where man keeps bees.

They have been troublesome pests for as long as man has kept bees. Fortunately, they are not so very serious if the bees are well kept. In neglected apiaries, they are commonly believed to cause the death of numerous colonies. As a rule, wax moths take over a hive only when most of the bees have died from starvation or disease. In such colonies adult bees may be observed in cells where they are held by the silken web left by wax worms that have

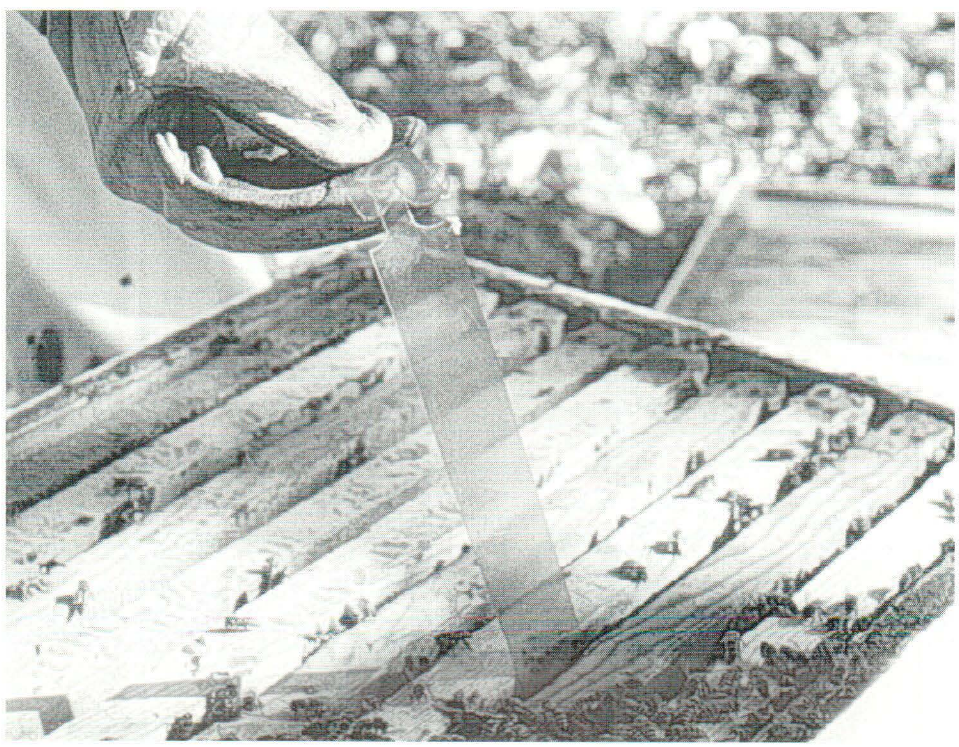

Figure 24 – Apistan® strip being placed between frames for Varroa mite control.

traversed the comb (Fig. 25). Such small colonies should be eliminated by uniting. Strong colonies of bees, well supplied with stores, are not likely to be invaded by wax moths.

Wax moths are a more serious pest in the South than in the North because the long warm season permits a greater number of generations to appear. The females lay up to 2,240 eggs. A generation follows another every six weeks under favorable conditions. Thus, unused combs stored in a shed may give rise during the summer months to quite an enormous population of wax moths.

Natural Control. Bees, at least such races as the Italian, are the wax moth's most important enemy. A strong colony, headed by a vigorous queen, keeps the hive free from moths. Weak colonies or other colonies troubled with wax moths, if given the proper attention, can be rid of the pest.

Artificial Control. Combs or comb honey in storage may be fumigated for wax moths. The materials recommended for this purpose are (1) carbon disulfide, (2) paradichlorobenzene and (3) 80 percent - 20 percent mixture of carbon Tetrachloride and Ethylene dichloride. All three are very effective against larvae, pupae and adult moths. They are not effective against the eggs; therefore, a second fumigation is necessary. It should be done about two weeks after the first.

Carbon disulfide is inflammable, and the fumes are poisonous. It should preferably be used outdoors. One ounce of the liquid is sufficient for five supers. Stack the supers or hive bodies to be fumigated and seal around the edges with gummed paper. The vapor is heavier than air, hence the material is poured on the frames of the top super.

Paradichlorobenzene is a white crystalline substance that evaporates on exposure to air. It is not inflammable and is the safest of the three materials recommended. Its fumes are not dangerously poisonous to man. It is used at a rate of one pound to 10 cubic feet of space. The fumes are heavier than air, hence the crystals are scattered over the frames of the top super or hive body.

Carbon tetrachloride – Ethylene dichloride mixture is used at the rate of two ounces to five supers and is used in the same manner as carbon disulfide. Keep stored combs in hive bodies or other tight containers where they can be fumigated at frequent intervals.

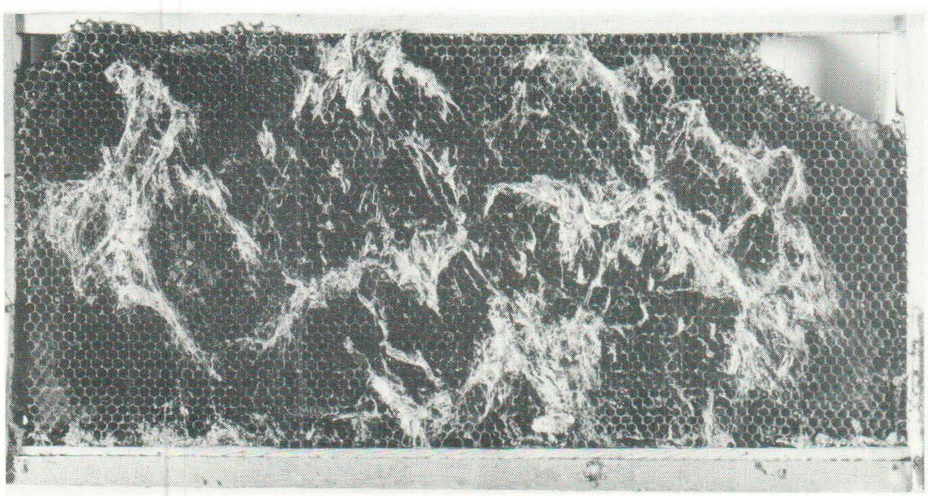

Figure 25 – Wax moth infested comb.

Ants and Mice

Less serious than wax moths are various other troublesome invaders. Most important among these are ants. If ants invade a hive in considerable numbers, they are a real menace and one that the bees cannot handle themselves.

If you can find the ants' nest, the best remedy is to pour an insecticide spray or sprinkle a granular material over the area where the nest is. If the nest cannot be found, the ants can be driven out of the hives and kept out by one of several means. Fragments of tar paper placed between the outside and inside covers are sometimes effective.

Mice sometimes get into hives during the winter and may destroy the combs (Figs. 26 & 27). This damage may be prevented by reducing the size of the entrance so that mice cannot enter the hive.

Bee Poisoning

Commercial beekeepers sometimes suffer heavy losses from insecticides applied to crops to control destructive insects. Cotton insecticides cause the greatest loss. However, some insect problems have increased, bringing about a need for greater insecticide usage.

Excessive losses of honey bees can be avoided if sound practices both in crop and bee management are followed.

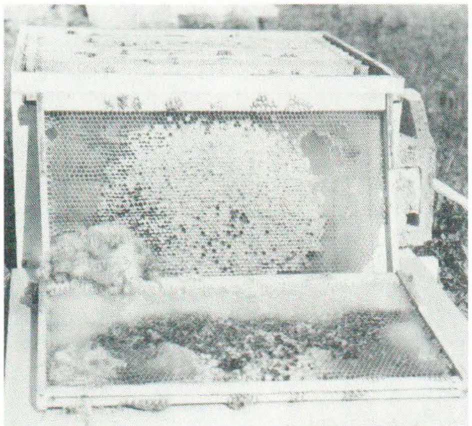

Figure 26 – Mouse nest in corner of frames resulting in loss of comb, honey and bees.

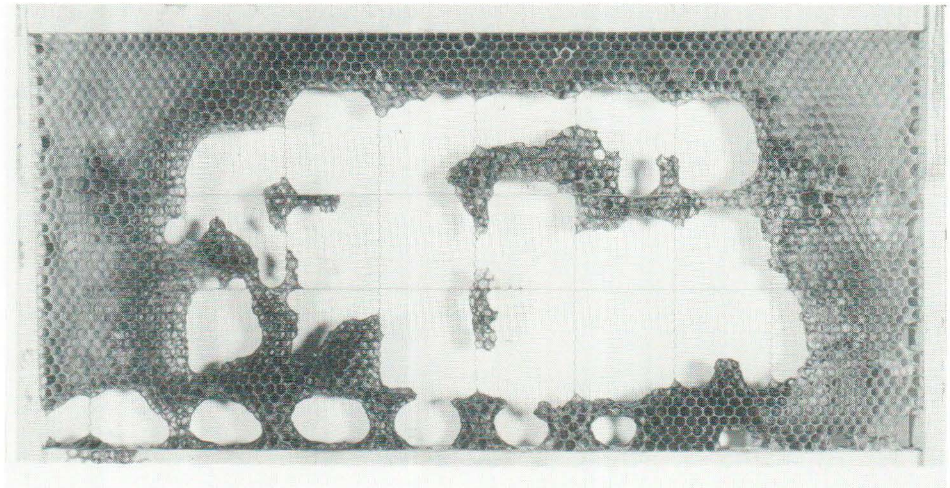

Figure 27 – Frame completely destroyed by mice.

The following general precautions should be observed by farmers:

- Choose the material least toxic to bees that will control the harmful pests on crops.
- If highly toxic materials must be used, apply them in the evening when bees are not visiting the field.
- Use sprays instead of dust. Application with ground equipment is less hazardous to bees than airplane application.
- Avoid drift of pesticide into the apiary or onto adjacent crops in bloom.
- Reduce the number of applications to an absolute minimum by careful scouting and timing.
- Give the beekeeper advance notice if a highly toxic material must be used, so he may move or otherwise protect the bees.

The following precautions should be observed by beekeepers.

- Locate the apiary out of the usual drift pattern of the pesticides being applied to fields.
- Confine the bees during and after application to prevent or reduce damage. Colonies can be confined under wet burlap or tarpaulins for a few hours to a day or possibly more.
- Keep informed on the insect situation in the area through the insect reports. These are available from your county Extension agent.
- Provide fresh water close to the apiary to prevent bees from watering in contaminated areas.

The Pollination of Plants by Bees

Many of the plant species of economic importance that are grown in Arkansas require the assistance of a pollinating agent to accomplish fertilization of the flower. While many insects may carry pollen from the stamens to the pistils, the honey bee is the chief and most effective pollinator of crop plants.

The use of honey bees to pollinate crop plants promotes increased yields, improved quality, earlier and more uniform harvest and plant vigor. The productivity of some plant varieties, normally self-fertile, may be substantially improved when bees assist in the pollinating process. Other plants normally self-sterile must receive pollen from other plants of the same species to set fruit.

Recent agricultural practices have restricted the nesting sites of "wild" honey bees as well as other insect pollinators. The varroa and tracheal mites have also practically eliminated "wild" honey bee populations. The producer, for best productivity, must enhance the wild pollinators with honey bees, either his own or by contract with a beekeeper. In Arkansas, an excellent opportunity exists to expand commercial pollinating services to ensure higher yields and better quality of harvest for many crop varieties. The small beekeeper may find this an excellent way to increase income from bees. In many cases, the crop to be pollinated may promote colony maintenance and in some cases possibly contribute to a surplus of honey above colony requirements. The following describes some of the major crops of Arkansas that are dependent on, or in which yields may be improved, by using bees as pollinators.

Alfalfa. In Arkansas, alfalfa is grown primarily for forage, seldom if ever for seed. Due to limited acreage, the weather pattern and soil types common to Arkansas, alfalfa is not considered to be reliable as a source of nectar. It is not a crop of major importance to beekeepers in Arkansas.

Apple. In general the yield and quality of most apple varieties is improved when an adequate population of bees is provided. Commercial apple growers depend on the honey bee as their major pollinating agents. Most growers contract for this service or provide their own bees.

The apple flower produces both nectar and pollen which are eagerly collected by honey bees and contributes to spring buildup in honey bee colonies. The period of apple bloom is short, the colony strength is usually low and weather conditions are often unfavorable for bee activity, thus it is rare that a surplus of honey is stored from apple bloom. Most of the commercial acreage of apples is concentrated in northwest Arkansas.

Blackberries (includes boysenberry, dewberry, youngberry, loganberry). Cultivated and wild blackberries constitute an important source of nectar and pollen to honey bees. With the expansion of commercial and U-pick plantings of blackberries, pollination requirements must be considered by the producer. If insufficient pollination occurs, a reduced number of flowers may be set or malformed fruit may result, reducing yield as well as quality. Honey obtained from blackberries is considered of good quality.

Blueberries. The production of highbush blueberries is becoming a major enterprise, particularly in northwest Arkansas. Commercial acreages as well as U-pick plantings have been established. Insect pollination, particularly by honey bees, is essential for maximum production. The plants set more fruit, larger fruit and mature earlier when there is adequate pollination. Both nectar and pollen of blueberries are attractive to bees although some varieties are more attractive than others.

Clovers. Alsike clover, crimson clover, red clover, white clover and others are grown in Arkansas primarily as forage crops and in conservation programs, rarely if ever for seed. Consequently the greatest interest in the pollination of these plants is for reseeding purposes in permanent pastures, ground cover, etc. Under suitable conditions such as favorable weather and optimum soil conditions, all of the major clover varieties produce both nectar and pollen. White clover is probably the most important variety and is widely grown in pastures. Since seed is not produced commercially, there is little interest in a planned pollination program for clovers, including the sweet clovers. Where seed production is the objective, good yields require honey bees for pollination of the flower.

Cotton. In Arkansas, cotton is a major source of nectar and pollen for honey bees. Since cotton is self-fertile, there continues to be some question as to the value of bees in cotton production. There is good evidence that upland cotton yields 5-20 percent more the first picking when bees have been provided although total production is not significantly greater than from cotton grown with bees absent.

Cucurbits (cantaloupes, cucumbers, watermelons, squash, pumpkin). These crops are grown throughout the state of Arkansas in home gardens with commercial acreages planted in scattered locations. The flowers of all cultivars of these crops are attractive to bees for pollen and nectar. Bees, primarily honey bees, are the major pollinating agents for cucurbits. Without pollinating agents such as honey bees, very few if any flowers will set fruit. Further, if inadequate pollination occurs, fruits will be small, misshapen and unsuitable for market (Fig. 28). A large percentage of commercial plantings represent hybrid lines which have relatively fewer male flowers. Consequently such fields must be saturated with bees for maximum yields. In all cultivars, a high population of bees is needed to ensure maximum yield and quality.

Grapes. Because of inadequate information, there are no recommendations for the use of honey bees on grapes grown in Arkansas. Research done elsewhere indicates the possibility that bee visitation increases production. With new varieties being introduced, further research is needed to determine if bees in grape production are feasible.

Lespedezas. Honey bees are not strongly attracted to lespedezas which are self-fertile. There are no recommendations for a pollinating program for the varieties grown for seed in Arkansas.

Peach. The flowers of peach are highly attractive to honey bees which obtain both pollen and nectar from the bloom. Most if not all cultivars grown in Arkansas are self-fertile. There is general consensus that the presence of bees may favor a heavier set of fruit, but there are no recommendations for the use of bees in a pollination program for peaches.

Figure 28 – Mal-formed cucumbers due to inadequate pollination.

Pear. The varieties of pear grown in Arkansas are considered self-sterile and require pollination to ensure good yields of fruit. Because the sugar content of the nectar is lower than that of other plant species, it is not as attractive to bees which work pear blooms primarily for pollen.

Soybean. There are no recommendations for using bees in the pollination of soybean. The bloom of soybean is self-fertile and while bees may obtain nectar and pollen from soybeans, they are not critical to the process of pollination. If hybrid soybean cultivars are developed for commercial plantings, bees could become of great importance in the production of hybrid soybean seed.

Strawberry. While the acreage of strawberries is not great in Arkansas, it makes a significant contribution to the productivity of home gardens and U-pick operations. There is some commercial acreage in the central counties. Strawberries are self-fertile and do not require insect visitation to affect pollination. Yet observations show that a good population of bees working the bloom will favor a higher yield of good quality fruit from the primary blooms than can be expected if inadequate pollination occurs (Fig. 29). Strawberries flower in a period of uncertain weather which inhibits self-pollination as well as insect activity. Thus bee activity in periods of favorable weather favors a higher yield of fruit than would normally be obtained.

Sunflower. Production of sunflower in Arkansas varies from year to year. It is an alternative crop that can be grown in a rotation program for control of nematodes attacking soybeans. The flowers of most sunflower varieties are not fully self-fertile; thus, honey bees are important as the primary pollinating agent. If there is a shortage of bees in the sunflower fields, a small seed crop is harvested. Both the nectar and pollen of sunflower are quite attractive to honey bees. There are usually extra-floral nectaries that bees may work also. Sunflower is a good source of nectar; thus, a surplus may be harvested by bees while satisfying the pollination requirements of sunflower.

Vetch. The production of vetch seed is now of minor importance in Arkansas as a result of vetch weevil infestations. Vetch is now grown primarily as a forage, or in soil conservation programs as a green manure and cover crop. Where seed production is the objective, studies show that hairy vetch is greatly benefited by the use of bees as a pollinating agent.

Figure 29 – Inadequate pollination results in poorly formed strawberries and reduced yields of marketable fruit.

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