

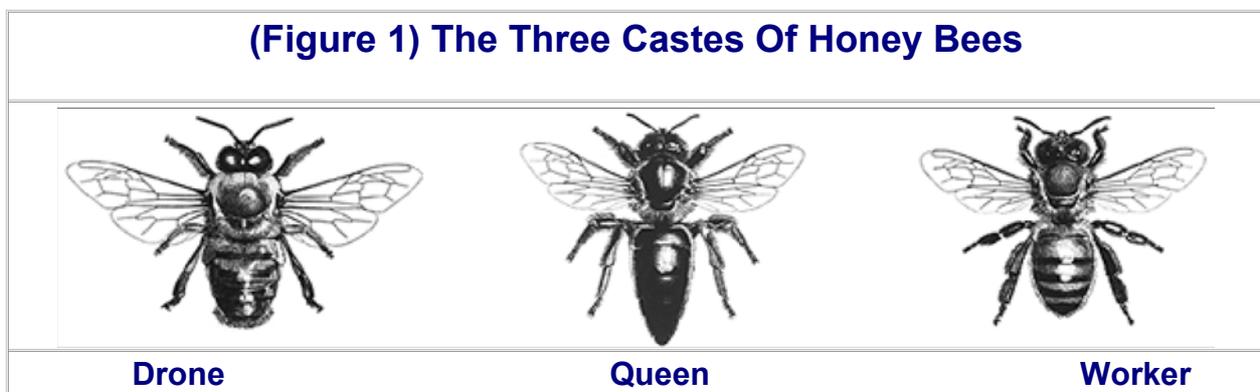
Honey Bees and Beekeeping

Honey bees are one of the most well-known, popular and economically beneficial insects. For thousands of years, man has plundered honey bee colonies to get honey, bee larvae and beeswax. Now, honey bees are commonly kept in artificial hives throughout the United States. Although many people make a living from bees, most beekeepers are hobbyists who have only a few hives and who simply enjoy working with these fascinating insects.

Honey Bee Biology



Honey bees, like ants, termites and some wasps, are social insects. Unlike ants and wasps, bees are vegetarians; their protein comes from pollen and their carbohydrate comes from honey which they make from nectar. Social insects live together in groups, cooperate in foraging tasks and the care of young, and have different types, or "castes," of individuals. There are three castes of honey bees (Figure 1):



Workers- Reproductively underdeveloped females that do all the work of the colony. A colony may have 2,000 to 60,000 workers.

Queen - A fully fertile female specialized for producing eggs. When a queen dies or is lost, workers select a few young worker larvae and feed them a special food called "royal jelly." These special larvae develop into queens. Therefore, the only difference between workers and queens is the quality of the larval diet. There is usually only one queen per colony. The queen also affects the colony by producing chemicals called "pheromones" that regulate the behavior of other bees.

Drones - Male bees. A colony may have 0 to 500 drones during spring and summer. Drones fly from the hive and mate in the air with queens from other colonies.

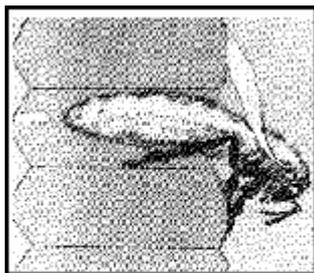


Figure 2. Queen lays an egg.

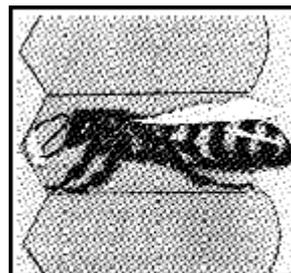


Figure 3. Young larva.

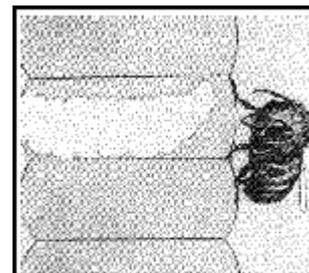


Figure 4. Mature larva.

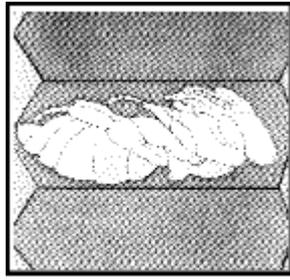


Figure 5. Pupal stage.

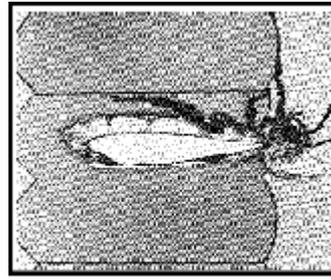


Figure 6. Adult emerges.

The queen lays all her eggs in hexagonal beeswax cells built by workers. Developing young honey bees (called "brood") go through four stages: the **egg**, the **larva**, the inactive **pupa** and the young **adult**. The castes have different development times (Table 1).

Newly emerged workers begin working almost immediately. As they age, workers do the following tasks in this sequence: clean cells, circulate air with their wings, feed larvae, practice flying, receive pollen and nectar from foragers, guard hive entrance and forage.

Unlike colonies of social wasps and bumble bees, honey bee colonies live year after year. Therefore, most activity in a bee colony is aimed at surviving the next winter.

During winter, bees cluster in a tight ball. In January, the queen starts laying eggs in the center of the nest. Because stored honey and pollen are used to feed these larvae, colony stores may fall dangerously low in late winter when brood production has started but plants are not yet producing nectar or pollen. When spring "nectar flows" begin, bee populations grow rapidly. By April and May, many colonies are crowded with bees, and these congested colonies may split and form new colonies by a process called "swarming." A crowded colony rears several daughter queens, then the original mother queen flies away from the colony, accompanied by up to 60 percent of the workers. These bees cluster on some object such as a tree branch while scout bees search for a more permanent nest site - usually a hollow tree or wall void. Within 24 hours the swarm relocates to the new nest. One of the daughter queens that was left behind inherits the original colony.

(Table 1) Development Time Of Honey Bee Castes			
Stage	Days After Laying Egg		
	Worker	Queen	Drone
Hatching	3	3	3
Cell Capped	8	8	10
Becomes A Pupa	11	10	14
Becomes An Adult	20	15	22.5
Emerges From Cell	21	16	24

After the swarming season, bees concentrate on storing honey and pollen for winter. By late summer, a colony has a core of brood below insulating layers of honey, pollen and a honey-pollen mix. In autumn, bees concentrate in the lower half of their nest, and during winter they move upward slowly to eat the honey and pollen.

Preparing To Keep Bees

Honey bees can be kept almost anywhere there are flowering plants that produce nectar and pollen. Choose a site for bee hives that is discrete, sheltered from winds and partially shaded. Avoid low spots in a yard where cold, damp air accumulates in winter.

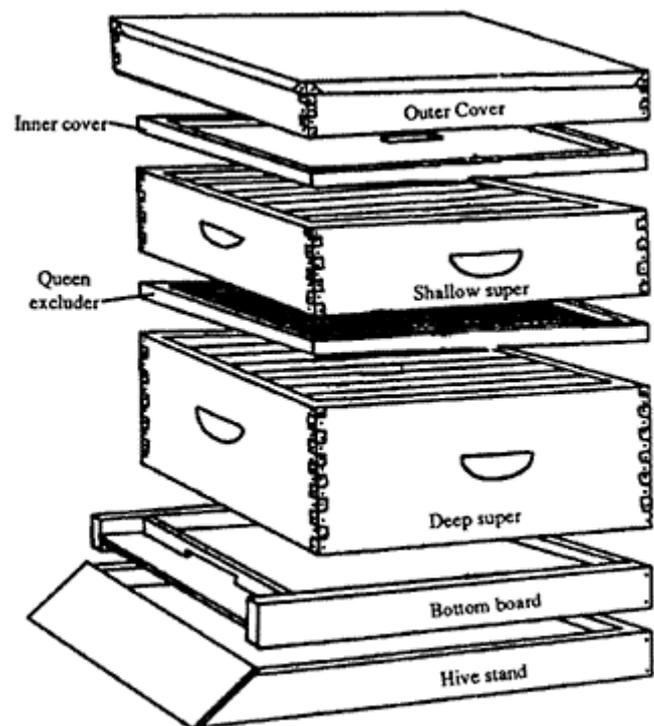
Be considerate of non-beekeeping neighbors. Place hives so that bee flight paths do not cross sidewalks, playgrounds or other public areas. In dry weather, bees may collect water at neighbors' swimming pools or water spigots. Avoid this by giving your bees a water source in your yard such as a container with floating wood or styrofoam chips. The floating objects prevent bees from drowning.

Beekeeping Equipment

One new hive with bees and basic equipment costs about \$150. Hive parts are cut to standard dimensions that mimic the space bees naturally leave between their combs. Always reproduce these dimensions exactly if you make your own bee hives. You will need the following equipment.



1. **Bee hive** - is made up of:
2. **Bottom board** - wooden stand on which the hive rests. Set bottom board on bricks or concrete blocks to keep it off the ground.
3. **Frames and foundation** - wooden frames that hold sheets of beeswax foundation that is imprinted with the shapes of hexagonal cells. Bees use the foundation to build straight combs.
4. **Hive body or brood chamber** - large wooden box (called a "super") that holds 10 frames of comb. This space (the brood nest) is reserved for the bees to rear brood and store honey for their own use. Either one or two hive bodies can be used for a brood nest. Two hive bodies are common in cold winter regions. Beekeepers in areas with mild winters successfully use only one hive body.



Elements of a beehive

5. **Queen excluder** - placed between the brood nest and the honey supers. This device keeps the queen in the brood nest, so brood will not occur in honey supers. An excluder is usually not necessary if two hive bodies are used.
6. **Honey supers** - shallow supers with frames of comb in which bees store surplus honey. This surplus is the honey that is harvested.
7. **Inner cover** - prevents bees from attaching comb to outer cover and provides insulating dead air space.
8. **Outer cover** - provides weather protection.
9. **Smoker** - the most valuable tool for working bees. A smoker calms bees and reduces stinging. Pine straw, grass and burlap make good smoker fuel.

10. **Hive tool** - ideally shaped for prying apart supers and frames.
11. **Veil and gloves** - protect head and arms from stings. After they gain experience, most beekeepers prefer to work without gloves.
12. **Feeders** - hold sugar syrup that is fed to bees in early spring and in fall.



Consult the list of addresses of bee equipment suppliers. Exterior wooden parts should at least be coated with good oil base paint. To maximize the life of exterior parts, first dip them in copper naphthenate wood preservative, then paint them. Assemble interior frames with wood glue and nails.

Buying And Moving Colonies



The easiest, and sometimes the best, way to start keeping bees is to buy two established colonies from a reputable local beekeeper. Buying two colonies instead of one lets you interchange frames of brood and honey if one colony becomes weaker than the other and needs a boost. Buy bees in standard equipment only. Competent beekeepers usually have one or two hive bodies on the bottom board with shallower honey supers above. Question the seller if supers are arranged differently. The condition of the equipment may reflect the care the bees have received, so be suspicious of colonies in rotten, unpainted wood. Once the colony is opened, the bees should be calm and numerous enough that they fill most of the spaces between combs.

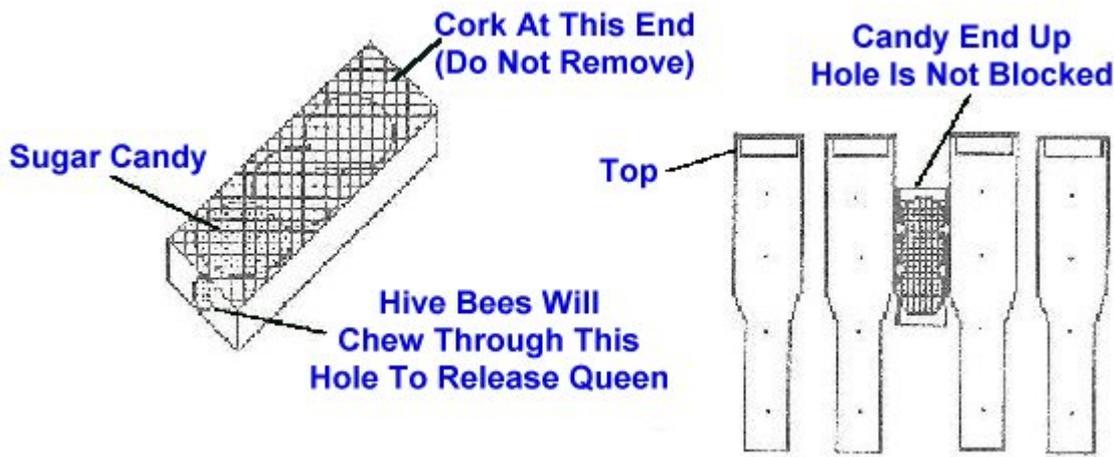
Be sure each super has at least nine frames of comb. Inspect combs in the deep supers for brood quality. Capped brood is tan - brown in color. A good queen will have at least five or six combs of brood, and she will lay eggs in a solid pattern so that there are few skipped cells. Look for symptoms of brood disease and wax moth larvae (see the section on "Honey Bee Diseases and Pests").

Bee hives are easiest to move during winter when they are lighter and populations are low. Moving hives is a two-man job. Close the hive entrance with a piece of folded window screen, seal other cracks with duct tape, fasten supers to each other and to the bottom board with hive staples then lift the hive into a truck bed or a trailer. Tie the hives down tightly. Remember to open hive entrances after the hives are relocated.

Installing Packaged Bees

Another way to start keeping bees is to buy packaged bees and queens and transfer the bees into new equipment. Bees are routinely shipped in two to five- pound packages of about 9,000 to 22,000 bees. Once your packages arrive, keep the packages cool and shaded.

Set up a bottom board with one hive body and remove half its frames. Make some sugar syrup (one part sugar:one part water) and spray the bees heavily through the screen; bees gorge themselves with syrup and become sticky, making them easy to pour. Pry off the package lid, remove the can of syrup provided for transit, find and remove the queen suspended in her cage and re-close the package. The queen cage has holes at both ends plugged with cork, and one end is visibly filled with white "queen candy." Remove the cork from this end and suspend the queen cage between two center frames in your hive. Workers will eat through the candy and gradually release the queen.



Next, bounce the package lightly to shake all bees into a clump on the bottom, quickly take off the lid and shake the bees into the hive on top of the queen. As the bees slowly spread throughout the hive, gently return the frames you removed earlier. Carefully place the inner and outer covers on your new colony and feed your bees sugar syrup continuously until natural nectar flows begin.

After two days, check to see if the bees have released the queen from her cage. If she was released, you will probably find her slowly walking on one of the center combs. If bees have not yet released her, return the queen cage to the hive until she is released. A week after the queen's release, check the colony again. By this time, you should find white wax combs under construction with cells containing syrup, eggs or young larvae. If you do not find eggs, the queen may be dead and she must be replaced immediately. Order another queen and introduce her as before.

Catching Swarms

Another way to get started is by finding and installing swarms. Sometimes swarms cluster on accessible places such as low tree branches, and property owners are usually eager for a beekeeper to remove them. If you find a safely accessible swarm, get a five-gallon plastic bucket with some kind of perforated cover such as window screening. Spray the swarm heavily with sugar syrup, place the bucket underneath it then give the branch a sharp shake to dislodge bees into the bucket. Cover the bucket and install the swarm in a hive as you would packaged bees (except for the steps on installing a caged queen).



Honey Bee Management

Management is scheduled around natural nectar flows. Beekeepers want their colonies to reach maximum strength **before** the nectar flows begin. This way, bees store the honey as surplus that the beekeeper can harvest instead of using the honey to complete their spring build-up.

Feeding and medicating should be done January through February. Queens resume laying eggs in January after which brood production accelerates rapidly to provide the spring work force. Some colonies will need supplemental feeding. If colonies are light when you hoist them from the rear, they need sugar syrup. Mix syrup (one part sugar, one part water) and feed the bees heavily. Commercially available pollen supplements provide extra protein for population growth. Feed all medications (see the section on "Honey Bee Diseases and Pests") early enough to allow for labeled withdrawal periods before nectar flows begin.

By mid-February, the hives are ready for detailed inspection. On warm days (at least 45 degrees F) check the colonies for population growth, the arrangement of the brood nest and disease symptoms. Colonies with less brood than average can be strengthened by giving them frames of

sealed brood from stronger neighbors. If you use two hive bodies, most of the bees and brood may be in the upper body with little activity in the bottom one. If so, reverse the hive bodies, putting the top one on the bottom. This relieves congestion and discourages swarming. If you use one hive body, relieve congestion by providing honey supers above a queen excluder. Swarming should be avoided because it severely reduces colony strength.

Mail-order queens are usually available by the last week in March. Annual requeening, whether in early spring or in fall, is one of the best investments a beekeeper can make. Compared to older queens, young queens lay eggs more prolifically and secrete higher levels of pheromones which, in turn, stimulate workers to forage, suppress swarming and suppress disease outbreak. To requeen a colony, find, kill and discard the old queen. Let the colony remain queenless for 24 hours then introduce the new queen in her cage as described in the section "Installing Packaged Bees." With a new queen, you can also make a new colony by taking frames of brood, honey and bees from a strong colony (leaving behind the old queen), placing them in a new hive body with a new queen then moving the new hive to a new location. This controlled "splitting" of a colony lets a beekeeper manage the swarming process; congestion and the swarming urge are relieved in the strong colony, and the removed bees are housed in a managed hive instead of lost.

If you feed your colonies, medicate them, requeen them and control swarming, they should be strong enough to collect surplus nectar by mid-April. This is the time to add honey supers above the hive bodies. Add plenty of supers to accommodate incoming nectar and the large bee populations; this stimulates foraging and limits late-season swarming. As nectar comes in, bees place it in cells and evaporate it to about 18 per-cent water content. When bees cap the honey, it is considered ripe.



Not all honeys are alike. Usually, lighter honeys command higher prices, and most beekeepers try to keep darker honeys from mixing with lighter ones. For example, some beekeepers remove supers with dark tulip poplar honey before it can mix with incoming sourwood honey which is lighter.

During late summer and early autumn, brood production and honey production drop. Unlike in spring, you should now crowd the bees by giving them only one or two honey supers. This forces bees to store honey in the brood nest. Colonies are usually overwintered in two hive bodies or in one hive body and at least one honey super. If you overwinter in one hive body and a honey super, remove the queen excluder so the queen can move up into the honey during winter. Colonies should weigh at least 100 pounds in late fall. If they are light on stores, feed them a heavy syrup (two parts sugar one part water).

Processing Honey

Honey is sold as "extracted" honey - bottled, liquid honey that has been extracted from the combs; "comb" honey -honey still in its natural comb; and "chunk" honey - a bottled combination of extracted and comb.

Honey extracting equipment for the hobbyist is specialized and represents a one-time investment of about \$500 for new equipment. Used equipment is often available at significant savings. These are the basic tools and procedures for extracting honey:

1. **Uncapping knife** - A heated knife for slicing off the cappings from combs of honey.
2. **Uncapping tank** - A container for receiving the cappings. Wet cappings fall onto a screen, and honey drips through to the bottom of the tank and out a spigot.
3. **Extractor** - A drum containing a rotating wire basket. Uncapped combs are placed in the basket and the basket is turned by hand or by motor. Honey is flung out of the combs onto the sides of the tank and drains through a spigot.
4. **Strainer** - A mesh of coarse screen or cloth directly under the extractor spigot. This filters out large debris such as wax and dead bees.

5. **Storage tank** - A large tank with a spigot, or "honey gate," at the bottom. As honey settles in the tank, air bubbles and small debris rise to the top and can be skimmed off, allowing honey that is bottled from the honey gate to be clear and attractive.

Sometimes extracted honey granulates. This is a natural process, and the honey is still perfectly edible. If bottled honey granulates, loosen the lid and place the jar in a pan of water on a stove. Heat and stir the honey until it re-liquifies.

Comb honey requires little specialized equipment, so it is a good way for a new beekeeper to get started. Supply companies offer special comb honey supers for producing comb honey in round or square one-pound sections. "Cut-comb" honey is the easiest and least expensive honey to produce. With cut-comb, the entire comb is cut away from the frame then further cut into smaller sections and packaged in special plastic boxes. Regardless of these variations, all comb honey requires special extra-thin foundation. Freeze comb honey overnight before it is sold to kill any wax moth eggs and larvae.

Chunk honey is made by placing a piece of cut comb honey in a jar and filling up the rest of the jar with extracted honey. Remember to freeze the comb honey first.

Wax cappings are a valuable by-product of extracting. After cappings have dripped dry, wash them in water to remove all honey. Melt the cappings, strain the wax through cheesecloth and pour it into bread pans or a similar mold. Supply companies can render your beeswax bricks into new foundation at considerable savings.

Pollination

Many valuable crops benefit from insect pollination (the transfer of pollen from one flower to another flower). This process increases fruit yield and, often, the size of the fruit. Honey bees are important pollinators because they can be managed and easily moved to crop sites, for this one colony per acre is commonly used.

Stings

Anyone who keeps bees will inevitably get stung. Consider this before you invest in a beekeeping hobby. You can greatly reduce stinging if you use gentle, commercially reared queens, wear a veil, use a smoker and handle bees gently. Experienced beekeepers can handle thousands or even millions of bees daily and receive very few stings.

A bee sting will cause intense local pain, reddening and swelling. This is a normal reaction and does not, in itself, indicate a serious allergic response. With time, many beekeepers no longer redden or swell when they are stung (however, it still hurts!). An extremely small fraction of the human population is genuinely allergic to bee stings. These individuals experience breathing difficulty, unconsciousness or even death if they are stung and should carry with them an emergency kit of injectable epinephrine, available by prescription from a physician.



Figure 9 . Removing a stinger: always scrape, never pull a stinger from your skin.

When a bee stings, the stinger and poison sack remain in the skin of the victim. Always **scrape** the stinger and poison sack out of the skin with your fingernail or a hive tool (Figure 9); never **pull** it out because this squeezes the remaining venom into the skin.

Honey Bee Diseases And Pests

Honey bee brood and adults are attacked by bacteria, viruses, protozoa's, fungi and exotic parasitic mites. Additionally, bee equipment is attacked by other insects. Disease and pest control requires constant vigilance by the beekeeper.

American Foulbrood - (AFB) is a bacterial disease of larvae and pupae. The bacteria form highly persistent spores that can be spread by adult bees and contaminated equipment. Infected larvae change color from a healthy pearly white to dark brown and die after they are capped. Cappings of dead brood sink inward and often are perforated. Check for AFB by thrusting a small stick or toothpick into the dead brood, mixing it then withdrawing the mass. Brood killed by AFB will be stringy and rope out about inch. Colonies with AFB must be burned by a state bee inspector. To prevent AFB, feed colonies the antibiotic TerramycinÆ according to label instructions in early spring and fall. Allow at least four weeks from the last TerramycinÆ treatment until the first nectar flow.

European Foulbrood - (EFB) is a bacterial disease of larvae. Unlike with AFB, larvae infected with EFB die before they are capped. Infected larvae are twisted in the bottoms of their cells, change to a creamy color and have a smooth "melted" appearance. Because EFB bacteria do not form persistent spores, this disease is not as dangerous as AFB. Colonies with EFB will sometimes recover on their own after a good nectar flow begins. To prevent EFB, treat colonies with TerramycinÆ as described above.

Chalkbrood - Is a fungal disease of larvae. Infected larvae turn a chalky white color, become hard then turn black. Chalkbrood is most frequent during damp conditions in early spring. Colonies usually recover on their own.

Nosema - Is a widespread protozoan disease of adult bees. In spring, infected colonies build up very slowly or not at all. Bees appear weak and may crawl around the front of the hive. Discourage nosema by selecting hive sites with good air flow. Damp, cold conditions seem to encourage this disease. Treat nosema by feeding the drug FumidilÆ B in sugar syrup in spring and fall. Do not feed the medication immediately before or during a nectar flow.

Wax Moths - Are a notorious pest of beekeeping equipment. Adult moths lay eggs near wax combs, then their larvae hatch and begin burrowing through the combs to eat debris in the cells. Moth larvae ruin combs and plaster them with webbing and feces. Honey bees are usually very good at protecting their colonies from moth larvae. If moth damage is found in a colony, there was some other problem (usually queen loss) that weakened the colony first. Moth damage is most common in stored supers of comb. Protect stored supers by stacking them no higher than five hive bodies. Tape shut all cracks, put paradichlorobenzene crystals at the top of the stack and cover the stack with a lid. Replenish the crystals as they evaporate.

Tracheal Mites - These microscopic mites enter the tracheae (breathing tubes) of young bees. Inside the tracheae, mites block air exchange and pierce the walls of the tubes to suck blood. Symptoms resemble those of nosema. Bees become weak, crawl at the hive entrance and sometimes uncouple their wings so that all four wings are visible. Colony death rates are highest during winter and early spring. If you suspect tracheal mites, see your county Extension agent for help in diagnosing the disease. Infested colonies are treated with Miticur^{AE} or special formulations of menthol.

Varroa Mites - These mites are about the size of a pin head and are copper in color. Female mites cling to adult bees and suck their blood. Females then enter a bee brood cell and produce several offspring which, in turn, suck the blood of the developing bee. Infested colonies almost always die within three to four years unless they are treated. Colonies are treated with Apistan^{AE}, a formulation of fluvalinate. Because tracheal mites and Varroa mites are newcomers to the United States, control technology is rapidly changing and has not been well worked out.

Unwanted Honey Bee Colonies

When honey bees swarm and establish new colonies, they often move into hollow trees or voids inside walls of houses. Non-beekeepers are not accustomed to the sight of natural bee colonies, and they may react toward them with fear and hostility. Beekeepers are frequently asked to rid someone of unwanted bee colonies.



Someone with a natural bee colony should first decide if a problem truly exists. Honey bees, even those in walls of houses, do not cause any structural damage. Bees high in a tree or in the walls of an upper story are usually so far removed from people that there is virtually no chance of stinging. Unless people directly encounter the bees, the property owner should consider them an interesting opportunity to study nature!

If you decide to eradicate honey bees from a wall void, be prepared to pay for the services of an experienced beekeeper and a carpenter. To permanently solve the problem, the entire nest and the bees must be removed and the entrance resealed. It is not enough to simply spray inside the nest entrance with an insecticide because after the insecticide degrades, the cavity and combs are attractive to future swarms of bees. Moreover, if bees in a wall are killed but the nest is not removed, the combs are no longer ventilated and wax and honey may melt and stain interior walls. An experienced beekeeper can expose the nest and remove the bees and comb. The property owner is responsible for hiring a carpenter to reseat the void.

Information Gathered From Various Sites On The Internet