Caswell County Beekeepers Association

2018 Beginning Beekeeping Course

January 10 – March 17, 2018

Housekeeping Announcements

- Changes to the schedule will be posted online on our CCBA website under Bee School (CaswellCountyBeekeepers.org/Bee-School) and e-mailed to students.

- Class hours are from 6:30PM to 8:30PM with a 10 minute break in the middle.

- Please wear your name badge.

- Refreshments are available at the back of the class.

- Restrooms are in the hall just outside the classroom entrance.

- Please turn off cell phones or set to vibrate during class hours. If you must make or take a call, please step in the hallway or go outside.

- Your class fee includes membership to CCBA. CCBA meets the 4th Thursday of the month at 7PM (except November and December). Our first meeting in 2018 is Thursday, January 25, 2018.

- CCBA encourages you to also join the North Carolina State Beekeepers Association (NCSBA). NCSBA has 2 meetings each year and offers 4 levels of certification in beekeeping.

Beginning Beekeeping Course Outline[1] – 2018

Objective: *To provide the knowledge and resources for a person to become a beekeeper.*

Session	Date	Subject	Instructor
1	Jan 10	Introduction to Beekeeping	Robert Neal
		o Review Course Outline o Brief history of honey bees and beekeeping in US o Social order of a honey bee colony o Stages of honey bee development – eggs, larvae, pupae o Makeup of a bee's home – comb, cavity, entrance, propolis, bee space o Colony activity during a year – buildup, foraging, winter bees, clustering o References, books, publications, organizations: NCSBA, CCBA, EAS, etc.	
2	Jan 17	Equipment	Robert Neal
		o Basic hive components - bottom board, hive body, frames, queen excluder, honey super, inner cover and lid o Hive variations – medium, Illinois, deep, shallow, top bar, flow hive o Woodenware – types of wood, quality, joints, construction, painting o Assembly - joining, nailing, gluing, maintaining bee space and critical dimensions, square, flush o Considerations on initial hive components purchase – commonality, manufacturer compatibility, weight, construction, type of materials, costs o Protective gear - veil, coveralls, and gloves o Tools – hive tools (straight, j-hook), frame grips, smoker, spacers, brush, hive straps or staples	
3	Jan 24	About the honey bee	Robert Neal
		o Eight species of honey bees in the genus Apis o Twenty-four races in the species mellifera o External/internal anatomy o Pheromones o Life stages o Worker o Drone o Queen	
4	Jan 31	The colony	Robert Neal
		o Division of labor o Duties of the worker bee o The drone o The queen o Superseding o Swarming o Colony activity during a year – buildup, foraging, winter bees, clustering	

Session	Date	Subject	Instructor
5	Feb 7	Starting a Honey Bee Colony	Scott Oakley
		o Choosing a location – water source, direction of entrance, amount of sunlight, windbreak, accessibility, away from sidewalks/playgrounds /neighbors/public/vandals o Setup site – hive components, install stand, level o Hive type - full size, package, nuc, split, swarm, cutout, trapping. o Feeding (different type feeders) o Inspecting – queen right, drawing comb, sufficient food stores	
6	Feb 14	Bees' enemies, pests, and diseases	[NC Inspector]

		o Mites – varroa, tracheal
		o Diseases:
		  o vectored from mites – acute bee paralysis, deformed wing virus, chronic paralysis virus (K-wing)
		  o Other diseases – nosema, European foulbrood, American foulbrood, chalkbrood, sacbrood
		o Small Hive Beetles
		o Wax Moth
		o Pesticides
		o Other – ants, spiders, mice, hornets, wasps, dragonflies	

7	Feb 21	Food and water for your bees	Phil Barfield
		o Flowering plants and trees (ID, bloom period) o Feed and pollen substitutes (sugar, HFCS, pollen patties/substitutes) o Natural and artificial water sources	
8	Feb 28	Products of the hive	Phil Barfield
		o Bees o Honey o Comb honey o Wax o Pollen o Propolis o Royal jelly o Apitherapy	
9	Mar 7	Managing your bees	Robert Neal
		o Seasonal management – spring/fall o Increasing/decreasing hive space o Inspections –when, what to look for, internal, external o Checking food stores o Feeding o Nectar (honey) flow o Ventilation/moisture control o Culling old comb o Re-queening o Pest prevention/control o Harvesting honey surplus o Robbing	

Session	Date	Subject	Instructor
10	Mar 17	Field Day (4 hours at an apiary in the local area) [1]	Robert Neal

		○ Light smoker and inspect a hive (first by an instructor and then by one or more of the students)
		○ Check for disease, check brood pattern and find the queen
		○ Identify a drone
		○ Identify eggs, young larvae, sealed worker brood, sealed drone brood, pollen and honey
		○ Show how to:
		  ○ Check for Varroa mites
		  ○ Start a nuc
		○ Show steps necessary in preparation for honey flow - add a queen excluder, add two or more supers, remove entrance reducer
		○ Demonstrate getting a hive ready for winter- include checking a hive for honey stores, feeding by several different methods, removing the queen excluder, providing upward ventilation and adding an entrance reducer	

Notes:

1 Course outline, topics, and schedule are planned but are subject to change.

2 Classes meet on Wednesdays from 6:30PM to 8:30PM.

3 For the field day, each student should bring a veil and any other protective equipment they feel comfortable with while working bees. The smoker and hive tool will be provided. The location and starting time will be given during the class. Please note the Field Day will be on a Saturday. Rain date for the Field Day will be March 24th (also a Saturday).

Directions: Classes will meet in the basement of the Agriculture Services building (126 Court Square) next to the Historic Courthouse in downtown Yanceyville, NC. Please park and enter from the back of the building on the lower level. A Google map can be found on our web site at http://caswellcountybeekeepers.org/directions/.

Course information can be found at http://caswellcountybeekeepers.org/bee-school/. The web page will be kept updated and provide class changes or cancellations in case of emergencies, weather, or instructor availability.

Questions? Please e-mail ccba@caswellcountybeekeepers.org or call Phil Barfield at (336) 459-3276.

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Session 1

Introduction to Beekeeping

Session 1 - Introduction

Not only has there been an explosion of new beekeepers, but there is also more natural beekeeping information available. A good bit, though not all, has been accumulating on the Internet. While doing some background research for this article (and other searches), I came across some seriously **BAD** information on the net. Some of it was just down right **WRONG** from beginning to end! That provoked me to do a quick survey among beekeepers (hobbyist and commercial), honey bee academics and beekeeping supply purveyors. I asked them to answer a simple question: what books or beekeeping information would you recommend to 1) a beginner and 2) a more experienced beekeeper.

Here is the list of titles (in order of most nominations to least):

Beginner information	More Advanced
The Beekeepers Handbook	*The Wisdom of the Hive*
First Lessons in Beekeeping	*Honeybee Democracy*
The ABC & XYZ of Bee Culture	*The Biology of the Honey Bee*
Honey Bee Biology and Beekeeping	*Honeybee Ecology*
The Hive and the Honey Bee	*The Buzz About Bees*
Backyard Beekeeping	*Bee Culture magazine*
Bee-sentials	*American Bee Journal*
A Book of Bees: And How to Keep Them	
Beekeeping: A Practical Guide	
Hive Management	

Of course you know this, but not everything you read or see on the Internet is correct!
Anyone can post a blog or YouTube video on his/her practices, thoughts, opinions, conclusions, personal views, belief, ideas, etc. And, because we've been somewhat trained to trust what's in print and other media, subconsciously we expect that it MUST be right! Please be careful while searching information in cyberspace. Especially, if you're a new (newer) beekeeper, start with credible information. Build your foundation of beekeeping knowledge from reliable, sound, and peer reviewed material. Don't buy into some fly-by-night, who's only credible experience is website building, and has had only one bee hive (now a dead-out) in his/her life. Yet, people of this ilk have convinced novice beekeepers to follow their nonsensical beekeeping theories, which invariably leads these new beekeepers to lose their colony, become discouraged, and likely give up beekeeping entirely. Thus, our cause loses a potentially great beekeeper.

HISTORY OF BEEKEEPING IN THE UNITED STATES

By Everett Oertel[1]

The honey bee (*Apis mellifera* L.) is not native to the Western Hemisphere. Stingless bees (Meliponids and Trigonids) are native to the West Indies, as well as Central and South America. Wax and small amounts of honey were obtained from stingless bee nests by the early Indians of these areas.

Information available indicates that colonies of honey bees were shipped from England and landed in the Colony of Virginia early in 1622. One or more shipments were made to Massachusetts between 1630 and 1633, others probably between 1633 and 1638. The author was not able to find any records of importing honey bees into other Colonies, but it is reasonable to assume that they were brought by the colonists to New York, Pennsylvania, Carolina, and Georgia.

Records indicate that honey bees were present in the following places on the dates shown: Connecticut, 1644; New York (Long Island), 1670; Pennsylvania, 1698; North Carolina, 1730; Georgia, 1743; Alabama (Mobile), 1773; Mississippi (Natchez), 1770; Kentucky, 1780; Ohio, 1788; and Illinois, 1820 (Oertel *1976*). By 1800, honey bees were widely distributed from the Atlantic Ocean to the Mississippi River.

Honey bees may have been taken to Alaska in 1809 and to California in 1830 by the Russians, according to Pellett (*1938*), but no records are available as to whether they survived. In the 1850's, bees were shipped from the Eastern States to California. A few hives were taken over land, but most of the hives were sent by ship to Panama, by land across the Isthmus, and then by ship to California. Probably, the bees reached Oregon and Washington from California in natural swarms or in hives taken there by settlers. There are no dependable records that describe how bees spread westward from the Mississippi River into the Mountain States. It seems likely, however, that bees moved into these areas the same way they did into Oregon and Washington; that is, in natural swarms or in hives carried by the early settlers.

Development of Modern Equipment

For thousands of years, colonies of honey bees were kept in wooden boxes, straw skeps, pottery vessels, and other containers. Honeycomb built in such hives could not be removed and manipulated like the movable combs of today. No doubt the first hives used in the American Colonies were straw skeps (fig. 1). Later the abundance of cheap lumber and lack of trained people to make straw hives caused a fairly rapid shift to box hives made of wood. Log gums, that is, sections of bee trees containing colonies of bees, occasionally were

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Figure 1.—The straw skep was used widely in Europe, but very little in North America.

[1] Retired, formerly apiculturist, U.S. Department of Agriculture.

sawed out and used as hives. A few gums may be in use even now, particularly in wooded, isolated areas (figs. 2 and 3). Some ingenious farmers built wood hives with easily removable tops (caps) so that chunks of honey could be removed without killing the colonies. Affleck (*1841*) showed caps (now called supers) in his illustrations, but he did not give any details such as when they were first used.

In 1852, L. L. Langstroth, a Congregational minister from Pennsylvania, patented a hive with movable frames that is still used today. The principle upon which Langstroth based his hive is the space kept open in the hive to allow bees passage between and around combs. This space is about three-eighths of an inch wide; space that is less than this is sealed with propolis and wax, while space wider is filled with comb. Before this time hives were either Greek bar hives or leaf hives that allowed the beekeeper to inspect the comb (fig. 4). Langstroth is called "the father of modern beekeeping."

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FIGURE 2.—An unusually tall bee gum.

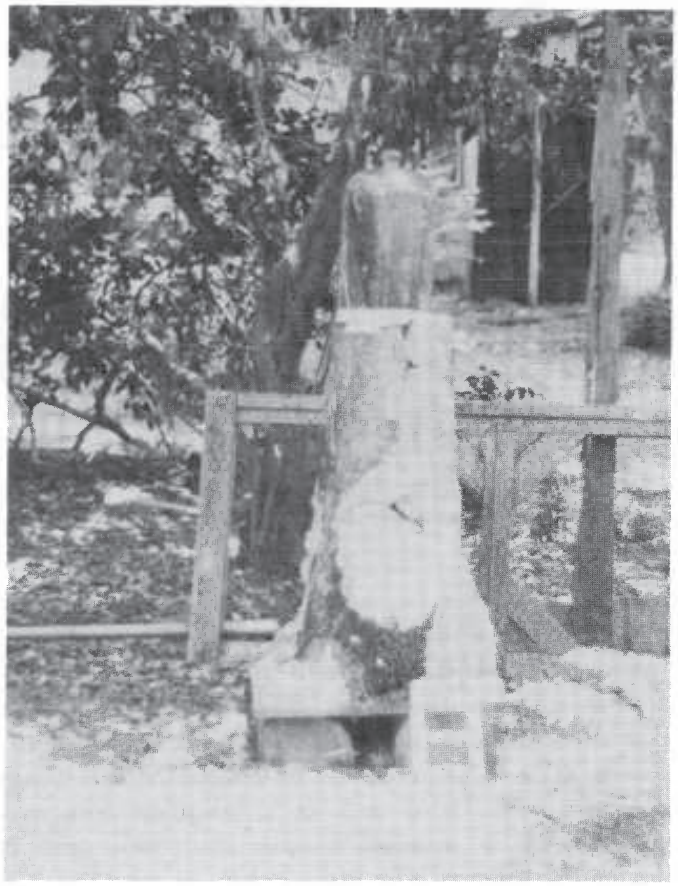

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FIGURE 3.—Bee gum with glass jar on top for honey storage.

In the period between the importation of honey bees by the early colonist and invention of the movable frame hive by Langstroth, beekeepers had little capability for managing their colonies. They increased their number of colonies each spring by capturing swarms and killed them in the fall by burning sulfur at the entrance of the hive so that the honey and beeswax could be removed. The comb, then, was crushed to squeeze out the honey.

Honey generally was obtained (1) by cutting bee trees and taking what honey was available, (2) by killing colonies and taking the honey within the hive, or (3) by taking whatever honey was stored in a crude super or cap that was placed on the hive during the summer.

Modern methods of beekeeping came very rapidly following Langstroth's patent. Other inventions soon followed that made large-scale, commercial beekeeping possible. Wax-comb foundation,

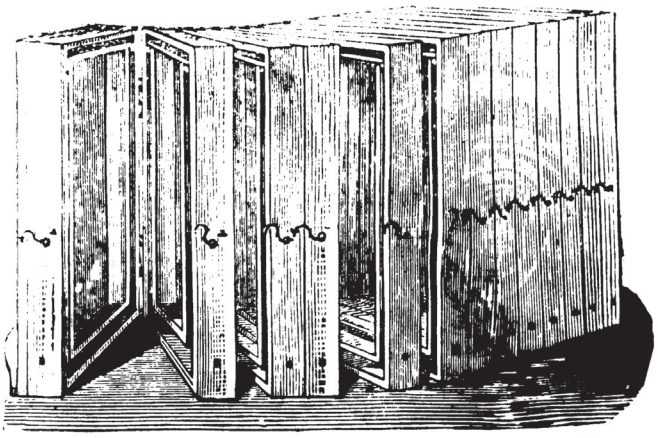

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FIGURE 4.—Book hive with hinged frames used by François Hüber in Switzerland, who published his observations in 1792.

invented in 1857, made possible the consistent production of straight, high-quality combs of predominantly worker cells. Pellett (*1938*) gives a detailed account of the development of wax-comb foundation. The invention of the centrifugal honey extractor in 1865, and its subsequent improvements, made possible large-scale production of extracted honey. The bee smoker, as now used by beekeepers, evolved from a pan used to contain some burning, freely smoking material, the smoke of which could be blown across the open hive to control the bees. The all-important bee veil gradually evolved from pieces of coarse cloth that were wrapped about the head of the beekeeper.

Introduction of Italian Stock

No one knows how many colonies or hives of honey bees were brought to the American Colonies by the first settlers. Nor do we know from what countries they came: England, Holland, France, Spain, or perhaps somewhere else? It is likely that after the early imports all increase was by natural swarming. Since we do not know how many colonies were brought to the east coast, we cannot determine the degree of inbreeding.

In the 1850's, the superior merits of the Italian race of honey bees became known to a few leaders of American beekeeping and they attempted to import queen bees from Italy. Accounts of these first efforts are confusing, but according to Pellett (*1938*), the first known successful importation of Italian queen bees was made in 1860.

During the last part of the 19th century, some queen bees of other races were brought into this country. They were imported from Egypt, Cyprus, the Holy Land, Syria, Hungary, and Tunisia, according to Pellett (*1938*). None of those races, or selections, was of lasting use in the United States, however. Carniolan and Caucasian queen bees also were imported and still are used to a limited extent. The bee journals and the trade catalogs from about 1870 until after World War I carried advertisements for imported queen bees or their progeny, largely Italian stock. Today, the American version of the Italian race is widely used throughout this country.

Imported Italian queen bees were advertised for sale by L. L. Langstroth and Sons, Oxford Ohio, in 1866, but no prices were given. Those interested were advised to write for a price list. In 1867, Adam Grimm, Jefferson, Wis., advertised imported Italian queen bees for sale at $20 each. He promised to sell medium-sized colonies of bees, with imported queens, in movable comb hives for $30 each in 1868. Others who advertised Italian queen bees for sale in 1867 were C. B. Bigelow, Vermont; A. Gray, Ohio; Ellen S. Tupper, Iowa; William W. Cary, Massachusetts; and K. P. Kidder, Vermont. This last group did not quote prices. Egyptian queen bees were offered for sale by Langstroth and Sons and A. Gray, but no prices were quoted. Charles Dadant, Illinois, offered imported Italian queen bees for sale at $12 each.

The originally introduced dark bees of northern Europe predominated throughout much of the United States and Canada during the 1800's and into the 1900's. Strains present toward the end of that era tended to be irritable and nervous, running readily over the combs and hive. These strains were also subject to European foulbrood disease. Queen bees were shipped from Europe in large numbers from the 1880's to 1922, when a law was passed prohibiting further imports. The purpose of this law was to prevent introduction of the acarine mite, which was causing serious problems in Europe, into the United States.

As queen rearing developed into a large-scale commercial enterprise in the Southern States and Italian queens from Europe were used extensively in the breeding program, a strong, Italian-type bee predominated. Before the end of the 1920's, however, after years of persistent requeening with southern queens, northern beekeepers largely replaced the black bees with a less nervous, Italian-type bee that resisted European foulbrood.

Queen Bee Rearing

As the number of colonies owned and operated by individual beekeepers increased, a market developed for young queen bees. In 1861 Henry Alley, William Carey, and E. L. Pratt, all of Massachusetts, began producing queens for sale. These early producers used narrow strips of comb containing eggs and larvae which they fastened to the top bars or partial combs. When these materials were added to swarm boxes that were queenless, queen cells formed. The queen cells were distributed individually to queenless colonies for mating.

G. M. Doolittle, Onondaga, N.Y., in 1889 developed a comprehensive system for rearing queen bees that is the basis of bee production today. His system, essentially, was making wax cups and placing worker bee larvae into them from which the queen-rearing bees formed the queen cells. This same system, or some modification of it, is used today by all commercial queen rearers.

Since 1886 queen bees have been sent in the mail, which has benefited both buyers and sellers (Pellet *1938*). Losses in transit have been reported from time to time, but on the whole, shipment by mail has been satisfactory. Post offices will accept either single queen cages or several cages stapled together. About a million queen bees are sent in the mail annually. Most of these bees are mailed to places in the United States and Canada, but some are sent to other countries.

Recent developments include the crossing of selected inbred lines to produce hybrid bees, and as of 1977, the direct sale of artificially inseminated queens. This step marks the beginning of a new era in bee breeding, in that male and female lines can now be controlled in a commercial breeding program.

Commercial Beekeeping

From the beginning of beekeeping in the 1600's until the early 1800's, we assume that honey was largely an article of local trade. Many farmers and villagers kept a few colonies of bees in box hives to supply their own needs and those of some friends, relatives, and neighbors (fig. 5). According to Pellett (*1938*), Moses Quinby of New York State was the first commercial beekeeper in the United States as his sole means of livelihood was producing and selling honey. Quinby (*1864*) described the box hives that he built so that combs of honey could be removed without first killing the colonies. Quinby writes of his financial returns as: "In particularly favorable seasons, hives will yield a profit of one or two hundred percent—in others, they hardly make a return for trouble." Quinby, after experimenting with a few movable comb hives, gradually replaced his box hives with the movable comb-type and advised others to do likewise.

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FIGURE 5.—Box hive used widely in the United States before movable frame hives became available.

Other beekeepers in Quinby's neighborhood used his methods and began to produce honey on a commercial scale. As the use of movable comb hives, comb foundation, and improved honey extractors became more widespread, commercial beekeeping spread into other States. Poor roads and the use of horse-drawn vehicles restricted the size of the area in which a beekeeper could operate and the number of colonies that could be managed profitably. After World War I, however, with better highways and increased use of motor vehicles and more efficient methods of colony management and honey handling, commercial beekeepers throughout the United States were able to expand the size of their businesses. By 1957 Anderson (*1969*) estimated that 1,200 professional beekeepers operated 1,440,000 colonies in the United States. By that time, hobbyists had a few

colonies, the part-time beekeepers kept from 25 to 300 colonies, and the commercial beekeeper had up to several thousand colonies. Some U.S. beekeepers have owned as many as 30,000 colonies.

Comb or Section

The term "section" used here describes the honey produced in small wooden frames or sections. The production of section honey is, to coin a phrase, "the fanciest product of the beekeeper's art." Probably, section honey was first produced in the 1820's. Moses Quinby produced section honey in the 1830's and 1840's and did not claim that the method originated with him. Honey was produced by cutting large holes in the top of a box hive, setting a shallow cap on the hive, and filling the cap with wooden sections that might have small comb starters fastened to them. A cover was placed over the hive. The sections, which were of various sizes, might contain up to 4 pounds of honey when filled. Some beekeepers inverted glass containers over the holes in the box hive, and if they were lucky had honey stored in them.

The crude method of section honey production was gradually abandoned as more and more beekeepers began to use movable comb hives. The large homemade section boxes were replaced with smaller, factory-made ones. Supers especially fitted to hold the sections were developed. Manufacturers sold 45 million to 55 million sections annually in the years just before World War I. Between about 1875 and 1915, approximately one-third of the honey produced in New England, New York, Pennsylvania, the Midwest, and a few Western States was in the form of section honey. Generally, the nectar flow in the Southern States was not suitable for section honey production.

Increase in Production of Extracted Honey

The amount of section honey produced declined rapidly after World War I. The product was fragile and difficult to ship; shelf life was short and combs were likely to leak or granulate. Production of section honey required a heavy nectar flow of several weeks' duration, and a great deal of hand labor for cleaning, weighing, and grading. In addition, beekeepers were unable to provide the intensive colony management needed in outyards miles from their homes. The Pure Food Law of 1906 gave buyers more confidence in the purity of extracted honey, thereby increasing demand for it. During the sugar-short period of World War I, the demand for honey increased and, as the price was high, production of extracted honey increased rapidly.

Large amounts of liquid honey were shipped in wooden barrels in the last part of the 19th century. Then 60-pound metal cans came into general use. Today, most bulk honey is sold in steel drums.

Development of Honey-Packing Plants

As commercial honey producers increased the size of their operations, they found it difficult to pack and sell the crop on the retail market and specialized honey-packing plants developed in the 1920's. Packing plants now are very sophisticated in packing liquid or smoothly crystallized honey.

Beeswax

Beeswax was an article of commerce soon after it became available in the Colonies. It was widely used in candles at home and abroad. The wax was melted, poured into molds, and then transported to market. North Carolina in 1740 and Tennessee in 1785 permitted taxes to be paid in beeswax because of the shortage of money (Oertel *1976*). Information is not available about how much beeswax was produced or used in the Colonies in the 1600's and the first part of the 1700's. Beeswax was an article of export in the 18th century, particularly from the ports of Philadelphia, Charleston, Pensacola, and Mobile. In 1767, a total of 35 barrels of beeswax were exported from Philadelphia and 14,500 pounds from Charleston in 1790. Beeswax was listed in articles exported from the British Continental Colonies in 1770:[2] Value 6,426 pounds sterling; 128,500 pounds weight; 62,800 pounds to Great Britain; 50,500 pounds to Southern Europe; 10,000 pounds to Ireland; and the rest to the West Indies and Africa. Honey was not mentioned.

Bee Supply Manufacturers

No doubt, before the invention of the movable comb hive, beekeepers made their own box hives. Movable comb hives and frames must be cut to exact measurements, so machine methods grad-

[2] Taken from *Historical Statistics of the United States*, 2 parts, 1975, Bureau of the Census, U.S. Department of Commerce.

ually took over from manufacture by hand. As metal honey extractors came into general use, companies began to offer them for sale. C. P. Dadant began to sell bee hives and frames to his neighbors in 1863 and comb foundation in 1878.[3] By 1884, Dadant and Sons had sold 60,000 pounds of comb foundation throughout the United States.[3] In 1867, C. B. Bigelow of Vermont advertised that he sold the Langstroth bee hive (fig. 6). In 1868, J. Tomlinson, Wisconsin, had honey boxes and frames for sale. In the same year, the National Bee-Hive Company, Illinois, sold bee hives, frames, honey boxes, and honey extractors.

A. I. Root and Moses Quinby started to sell bee supplies in 1869. In 1870, Henry Alley, Massachusetts, sold the Langstroth hive, and A. V. Conklin, Ohio, sold the Diamond bee hive. Later on in the 1870's, Alley offered the Bay State hive for sale, claiming that this was the "best hive in use." Edward Kretchmer, Iowa, began to manufacture and sell supplies in 1874. The W. T. Falconer Co., New York State, started its bee supply business in 1880. At about this same time, P. L. Viallon, Louisiana, began to manufacture and sell bee hives.

Today's beekeeper, who is used to large colonies of bees, would be amused or puzzled if he could see the small hives used in the American Colonies, and even in the States until about 1900 to 1920. The small hives meant small colonies of bees, small crops of surplus honey, and many swarms. Several old books the author consulted stated that a beekeeper should be well pleased if a colony contained 10,000 to 25,000 bees. Even Moses Quinby, a leading beekeeper in the mid-1880's, stated that a 12- by 12- by 14-inch hive (excluding the cap or super) was large enough for use in New York State and an even smaller hive probably would be adequate in warm climates. Quinby thought that 25 pounds of honey was sufficient to last a colony from October 1 to the following April. Charles Dadant, on the other hand, advocated large hives and strong colonies of bees. Over the years, other beekeepers became convinced that a colony must have a large population at the beginning of the nectar flow, an accepted practice today.

[3] Personal communication from Dadant & Sons, Inc., Hamilton, Ill.

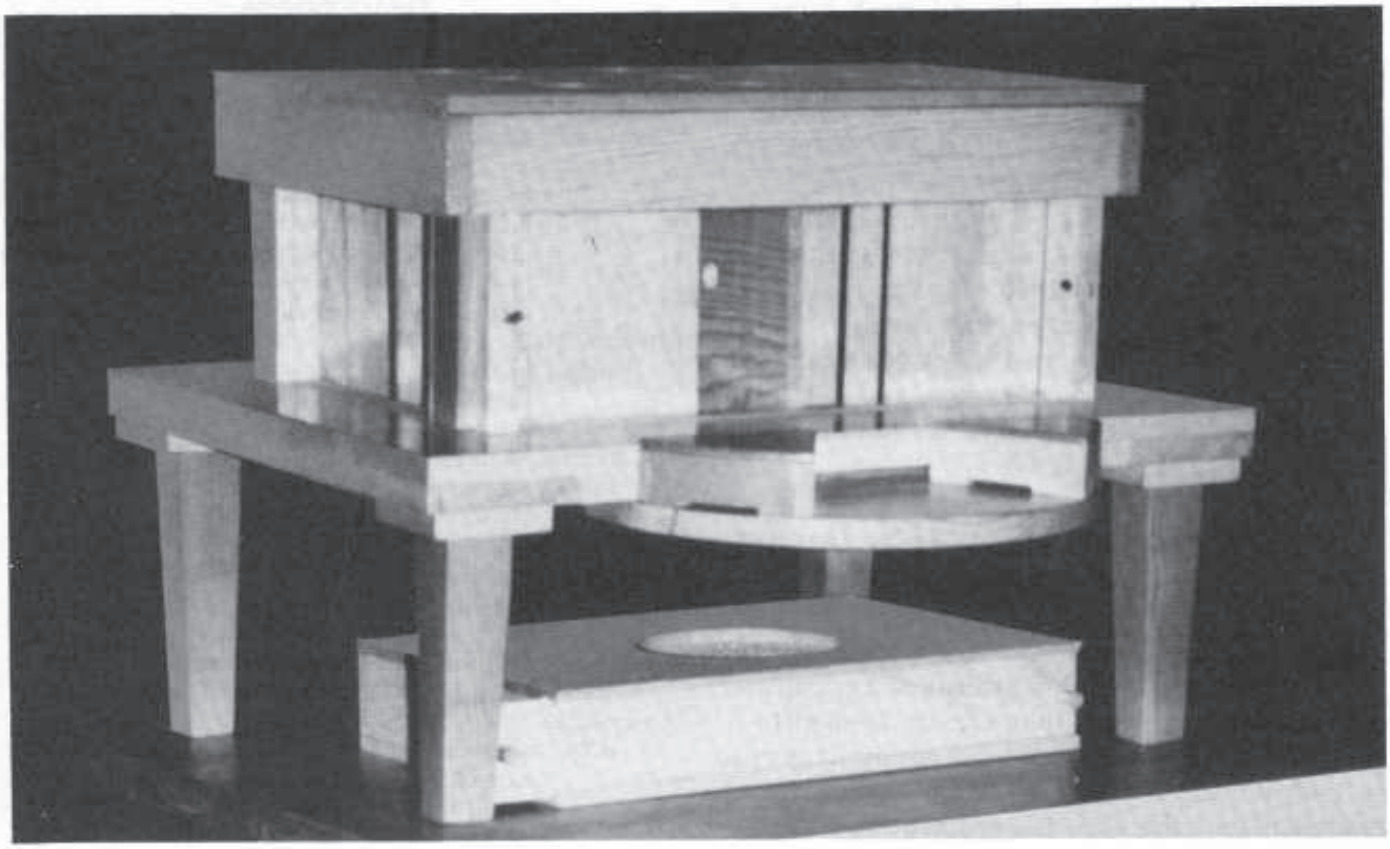

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FIGURE 6.—Model of Langstroth's original movable-frame hive, with the front removed to show the frames.

Twentieth Century

During the 20th century, the dimensions of bee hives and frames became more standardized, thus eliminating the various sizes that were so confusing 100 or more years ago. The 10-frame movable comb hive is now used throughout the world wherever beekeeping is seriously practiced. Most beekeepers use full-depth standard hive bodies for brood chambers; some also use them for honey supers, while others use shallow or half-depth bodies. Development of strong colonies for major nectar flows rests upon such fundamentals as hive room, adequate stores, and high-quality queen bees. Commercial and part-time beekeepers control swarming in their colonies, but beginners still have difficulties. Drugs (antibiotics) are now available for the control of foulbrood and nosema disease. Artificial insemination of queen bees, that is, controlled mating, is being used commercially to a limited extent.

The rental of colonies for the pollination of certain crops has increased markedly in this century, although management of colonies for such purposes needs to be improved.

The wax moth (*Galleria mellonella*) has been a serious pest of stored combs and weak hives. A limited survey by Williams (*1976*) showed that in recent years annual losses caused by the wax worm ranged from $48,000 in Louisiana to $1,016,000 in Florida. Such early writers as Affleck (*1841*), Langstroth (*1862*), and Miner (*1859*), gave much space to the damage caused by this pest and how it might be controlled. A number of patents were issued in the 1840's and 1850's for various devices that were supposed to keep wax moths from entering bee hives. None was effective. Chemicals have been used with some success, and the feasibility of using biological control methods is being studied.

Research Sponsored by U.S. Department of Agriculture

A full description of apicultural research, as conducted by the U.S. Department of Agriculture, needs much more space than can be devoted to it here. Consequently, only a brief outline is given. In 1860 William Bruckisch, a German immigrant, suggested that the U.S. Government should conduct investigations in beekeeping, and money was set aside to start such research in 1885. Those who have had responsibility for guiding this program are listed below:

N. W. McLain—1885–87, discontinued because of lack of funds.

Frank Benton—1891–1907, work suspended in 1896–1897; no funds. Spent much of his time locating and shipping stock from Europe.

E. F. Phillips—1905–06, acting; 1907–24

J. I. Hambleton—1924–58

C. L. Farrar—1958–61

F. E. Todd—1961–65

S. E. McGregor—1965–69

M. D. Levin—1969–75

E. C. Martin—1975–79

The following did some of their research while employed in the USDA's Division of Bee Culture. Their names were well known in the earlier part of this century.

James A. Nelson—author of *The Embryology of the Honey Bee*. 1915.

R. E. Snodgrass—author of *Anatomy and Physiology of the Honeybee*. 1925.

G. F. White—basic bulletins on bee disease, 1906–20.

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The Colony and Its Organization

Honey bees are social insects, which means that they live together in large, well-organized family groups. Social insects are highly evolved insects that engage in a variety of complex tasks not practiced by the multitude of solitary insects. Communication, complex nest construction, environmental control, defense, and division of the labor are just some of the behaviors that honey bees have developed to exist successfully in social colonies. These fascinating behaviors make social insects in general, and honey bees in particular, among the most fascinating creatures on earth.

A honey bee colony typically consists of three kinds of adult bees: workers, drones, and a queen (Figure 1). Several thousand worker bees cooperate in nest building, food collection, and brood rearing. Each worker has a definite task to perform, related to its adult age. But surviving and reproducing take the combined efforts of the entire colony. Individual bees (workers, drones, and queens) cannot survive without the support of the colony.

In addition to thousands of worker adults, a colony normally has a single queen and several hundred drones during late spring and summer. The social structure of the colony is maintained by the presence of the queen and workers and depends on an effective system of communication. The distribution of chemical pheromones among members and communicative "dances" are responsible for controlling the activities necessary for colony survival. Labor activities among worker bees depend primarily on the age of the bee but vary with the needs of the colony. Reproduction and colony strength depend on the queen, the quantity of food stores, and the size of the worker force. As the size of the colony increases up to a maximum of about 60,000 workers, so does the efficiency of the colony.

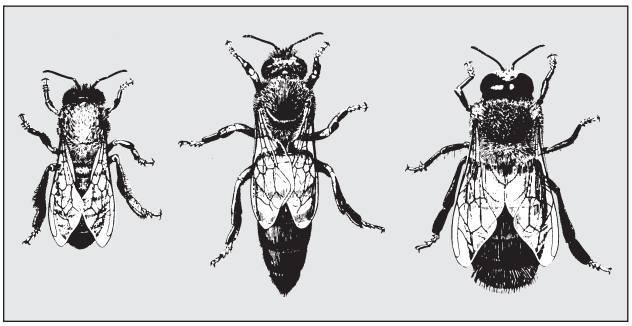


Figure 1. Three types of honey bees normally found in a honey bee colony: worker, queen, and drone. (Courtesy of the U.S. Department of Agriculture)

Queen

Each colony has only one queen, except during and a varying period following swarming preparations or supersedure. Because she is the only sexually developed female, her primary function is reproduction. She produces both fertilized and unfertilized eggs. Queens lay the greatest number of eggs in the spring and early summer. During peak production, queens may lay up to 1,500 eggs per day. They gradually cease laying eggs in early October and produce few or no eggs until early next spring (January). One queen may produce up to 250,000 eggs per year and possibly more than a million in her lifetime.

A queen is easily distinguished from other members of the colony. Her body is normally much longer than either the drone's or worker's, especially during the egg-laying period when her abdomen is greatly elongated. Her wings cover only about two-thirds of the abdomen, whereas the wings of both workers and drones nearly reach the tip of the abdomen when folded. A queen's thorax is slightly larger than that of a worker, and she has neither pollen baskets nor functional wax glands. Her stinger is curved and longer than that of the worker, but it has fewer and shorter barbs. The queen can live for several years—sometimes for as long as 5, but average productive life span is 2 to 3 years.

The second major function of a queen is producing pheromones that serve as a social "glue" unifying and helping to give individual identity to a bee colony (Figure 2, next page). One major pheromone—termed queen substance—is produced by her mandibular glands, but others are also important. The characteristics of the colony depend largely on the egg-laying and chemical production capabilities of the queen. Her genetic makeup—along with that of the drones she has mated with—contributes significantly to the quality, size, temperament, and productivity of the colony.

About one week after emerging from a queen cell, the queen leaves the hive to mate with several

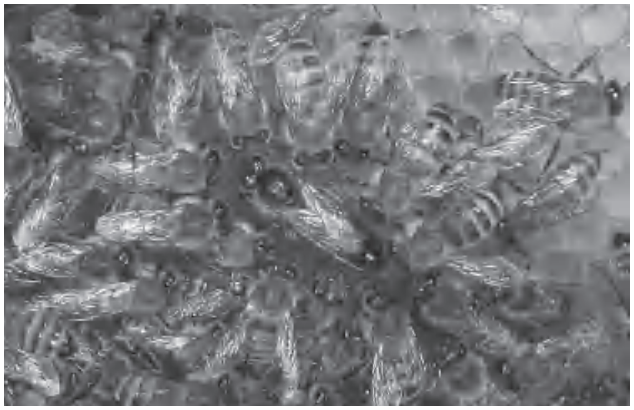


Figure 2. Queen surrounded by attendant workers. Although unique in shape and size, the queen is recognized by works and drones, not by the way she looks, but by her "chemical signature" or pheromone called queen substance.

drones in flight. Because she must fly some distance from her colony to mate (nature's way of avoiding inbreeding), she first circles the hive to orient herself to its location. She leaves the hive by herself and is gone approximately 13 minutes. The queen mates, usually in the afternoon, with seven to fifteen drones at an altitude above 20 feet. Drones are able to find and recognize the queen by her chemical odor (pheromone). If bad weather delays the queen's mating flight for more than 20 days, she loses the ability to mate and will only be able to lay unfertilized eggs, which result in drones.

After mating, the queen returns to the hive and begins laying eggs in about 48 hours. She releases several sperm from the spermatheca each time she lays an egg destined to become either a worker or queen. If her egg is laid in a larger drone-sized cell, she normally does not release sperm, and the resulting individual becomes a drone. The queen is constantly attended and fed royal jelly by the colony's worker bees. The number of eggs the queen lays depends on the amount of food she receives and the size of the worker force capable of preparing beeswax cells for her eggs and caring for the larva that will hatch from the eggs in 3 days. When the queen substance secreted by the queen is no longer adequate, the workers prepare to replace (supersede) her. The old queen and her new daughter may both be present in the hive for some time following supersedure.

New (virgin) queens develop from fertilized eggs or from young worker larvae not more than 3 days old. New queens are raised under three different circumstances: emergency, supersedure, or swarming. When an old queen is accidentally killed, lost, or removed, the worker bees select younger worker larvae to produce emergency queens. These queens are raised in worker cells modified to hang vertically on the comb surface (Figure 3). When an older queen begins to fail (decreased production of queen substance), the colony prepares to raise a new queen. Queens produced as a result of supersedure are usually better than emergency queens since they receive larger quantities of food (royal jelly) during development. Like emergency queen cells, supersedure queen cells typically are raised on the comb surface. In comparison, queen cells produced in preparation for swarming are found along the bottom margins of the frames or in gaps in the beeswax combs within the brood area.

Drones

Drones (male bees) are the largest bees in the colony. They are generally present only during late spring and summer. The drone's head is much larger than that of either the queen or worker, and its compound eyes meet at the top of its head. Drones have no stinger, pollen baskets, or wax glands. Their main function is to fertilize the virgin queen during her mating flight, but only a small number of drones perform this function. Drones become sexually mature about a week after emerging and die instantly upon mating. Although drones perform no useful work for the hive, their presence is believed to be important for normal colony functioning.

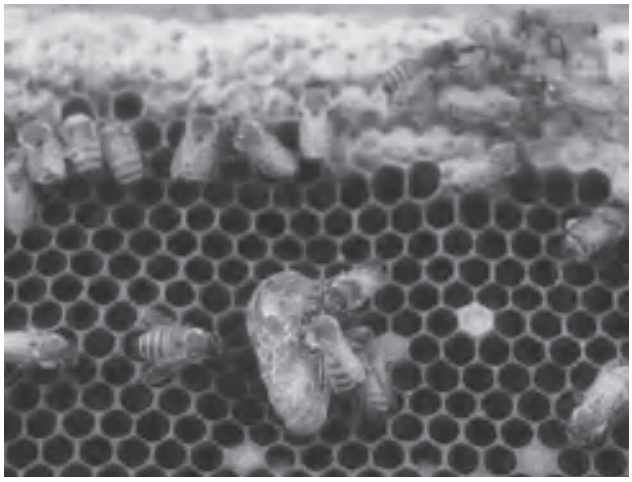


Figure 3. Emergency queen cell built by workers by modifying an existing worker cell to accommodate the larger size of the queen. (Courtesy Maryann Frazier)

While drones normally rely on workers for food, they can feed themselves within the hive after they are 4 days old. Since drones eat three times as much food as workers, an excessive number of drones may place an added stress on the colony's food supply. Drones stay in the hive until they are about 8 days old, after which they begin to take orientation flights. Flight from the hive normally occurs between noon and 4:00 P.M. Drones have never been observed taking food from flowers.

When cold weather begins in the fall and pollen/nectar resources become scarce, drones usually are forced out into the cold and left to starve. Queenless colonies, however, allow them to stay in the hive indefinitely.

Workers

Workers are the smallest bodied adults and constitute the majority of bees occupying the colony. They are sexually undeveloped females and under normal hive conditions do not lay eggs. Workers have specialized structures, such as brood food glands, scent glands, wax glands, and pollen baskets, which allow them to perform all the labors of the hive. They clean and polish the cells, feed the brood, care for the queen, remove debris, handle incoming nectar, build beeswax combs, guard the entrance, and air-condition and ventilate the hive during their initial few weeks as adults. Later as field bees they forage for nectar, pollen, water, and propolis (plant sap).

The life span of the worker during summer is about 6 weeks. Workers reared in the fall may live as long as 6 months, allowing the colony to survive the winter and assisting in the rearing of new generations in the spring before they die.

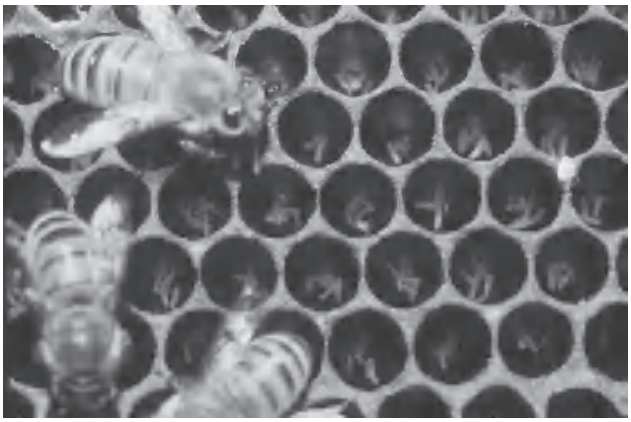


Figure 4. Eggs laid by workers (laying workers) in a queenless colony. (Courtesy Scott Camazine)

Laying Workers

When a colony becomes queenless, the ovaries of several workers develop and workers begin to lay unfertilized eggs. Normally, development of the workers' ovaries is inhibited by the presence of brood and the queen and her chemicals. The presence of laying workers in a colony usually means the colony has been queenless for several weeks. However, laying workers also may be found in normal "queenright" colonies during the swarming season and when the colony is headed by a poor queen. Colonies with laying workers are recognized easily: there may be anywhere from five to fifteen eggs per cell (Figure 4) and small-bodied drones are reared in worker-sized cells. In addition, laying workers scatter their eggs more randomly over the brood combs, and eggs can be found on the sides of the cell instead of at the base, where they are placed by a queen. Some of these eggs do not hatch, and many of the drone larvae that do hatch do not survive to maturity in the smaller cells.

Bee Development

All three types of adult honey bees pass through three developmental stages before emerging as adults: egg, larva, and pupa. The three stages are collectively labeled brood. While the developmental stages are similar, they do differ in duration (see Table 1). Unfertilized eggs become drones, while fertilized eggs become either workers or queens. Nutrition plays an important part in caste development of female bees; larvae destined to become workers receive less royal jelly and more a mixture of honey and pollen compared to the copious amounts of royal jelly that a queen larva receives.

Table 1. Developmental stages of the three castes of bees.

DEVELOPMENTAL STAGE	DURATION OF STAGES		
	QUEEN	WORKER	DRONE
	Days		
Egg	3	3	3
Larval stage	5 ½	6	6 ½
Pupal stage	7 ½	12	14 ½
Total developmental time	16	21	24

Brood

EGGS

Honey bee eggs are normally laid one per cell by the queen. Each egg is attached to the cell bottom and looks like a tiny grain of rice (Figure 5). When first laid, the egg stands straight up on end. However, during the 3-day development period the egg begins to bend over. On the third day, the egg develops into a tiny grub and the larval stage begins.

LARVAE

Healthy larvae are pearly white in color with a glistening appearance. They are curled in a "C" shape on the bottom of the cell (Figure 6). Worker, queen, and drone cells are capped after larvae are approximately 6, 5½, and 6½ days old, respectively. During the larval stage, they are fed by adult worker (nurse) bees while still inside their beeswax cells. The period just after the cell is capped is called the prepupal stage. During this stage the larva is still grub-like in appearance but stretches itself out lengthwise in the cell and spins a thin silken cocoon. Larvae remain pearly white, plump, and glistening during the prepupal stage.

PUPAE

Within the individual cells capped with a beeswax cover constructed by adult worker bees, the prepupae begin to change from their larval form to adult bees (Figure 7). Healthy pupae remain white and glistening during the initial stages of development, even though their bodies begin to take on adult forms. Compound eyes are the first feature that begin to take on color; changing from white to brownish-purple. Soon after this, the rest of the body begins to take on the color of an adult bee. New workers, queens, and drones emerge approximately 12, 7½, and 14½ days, respectively, after their cells are capped.

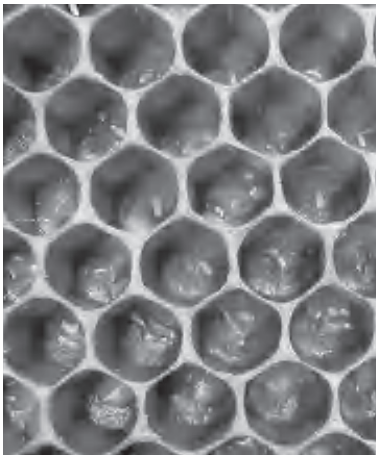


Figure 5. Cells with fertilized eggs laid by the queen. (Courtesy Maryann Frazier)

BROOD PATTERNS

Healthy brood patterns are easily recognized when looking at capped brood. Frames of healthy capped worker brood normally have a solid pattern with few cells missed by the queen in her egg laying. Cappings are medium brown in color, convex, and without punctures (Figure 8). Because of developmental time, the ratio should be four times as many pupae as eggs and twice as many as larvae; drone brood is usually in patches around the margins of brood nest.

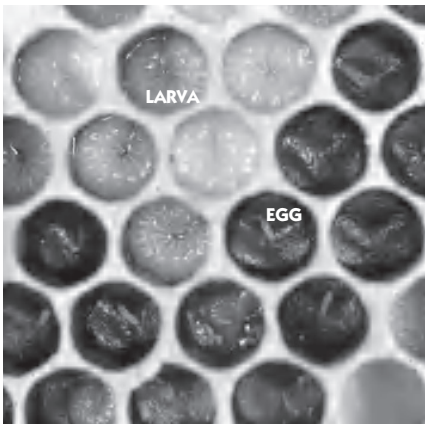


Figure 6. Cells with healthy worker larvae. (Courtesy Dewey Caron)

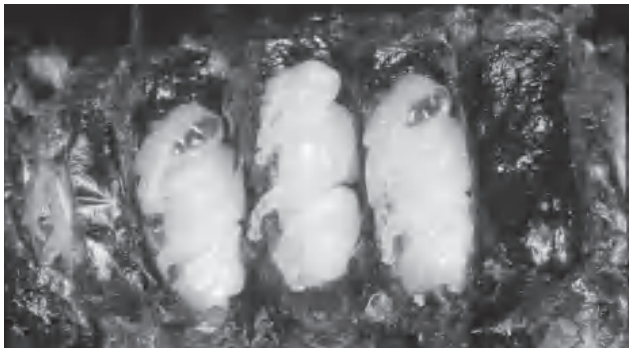


Figure 7. Honey bee pupae changing from the larval to adult form. (Courtesy Scott Camazine)

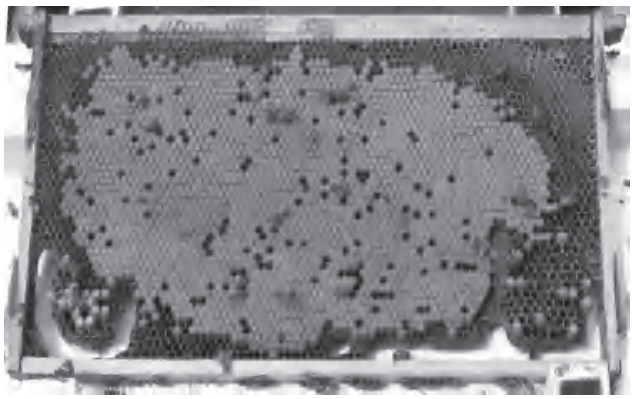


Figure 8. Comb of sealed worker brood with drone cells in the lower corners. (Courtesy Maryann Frazier)

Beehive Components

The modern bee hive is like a highly efficient multistoried factory with each "story" having a specific function. These "stories" work together to provide a home for bees and a honey factory for the beekeeper.

A. Hive Cover - Telescoping cover "telescopes" over the sides of the top super to protect the hive. Galvanized covering.

B. Inner Cover - Creates a dead air space for insulation from heat and cold.

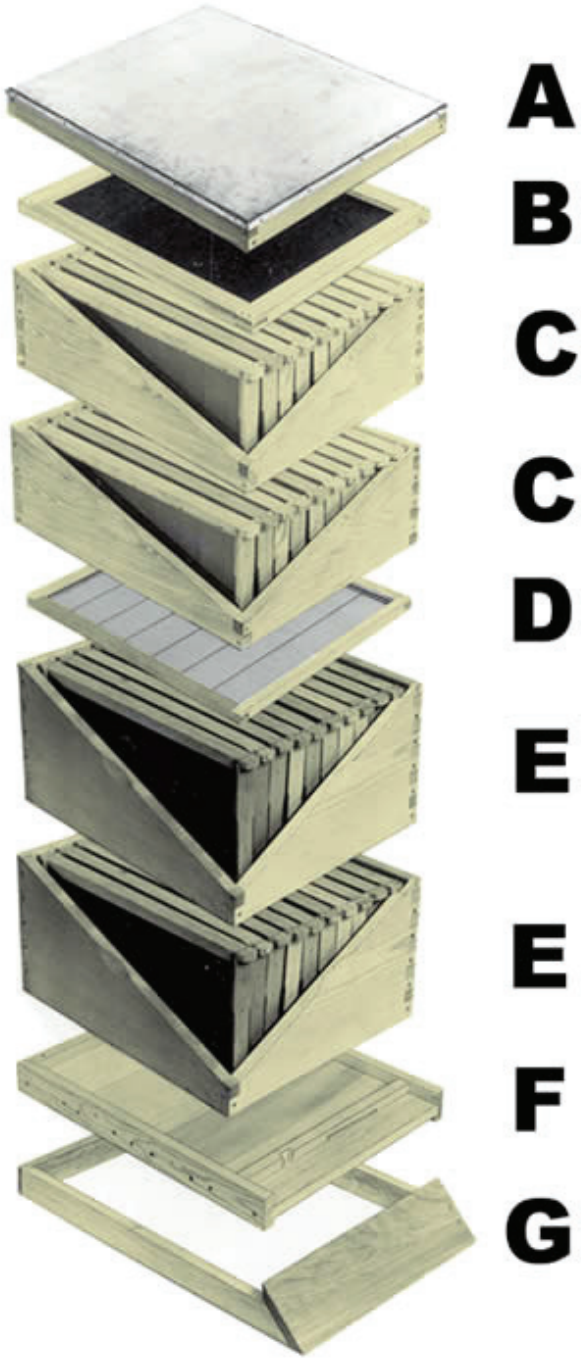
C. Shallow Supers - Consist of Super, Frames and Beeswax Foundation for "surplus" honey storage. Bees store their extra honey in the frames for the beekeeper to remove. 6-5/8' or , 5-11/16'' supers, or even hive bodies may be used.

D. Queen Excluder - Keeps the queen bee in the brood chambers as she is too large to pass through the excluder. Prevents her from laying eggs and raising brood in honey supers placed above the excluder.

E. Hive Bodies - Consists of Body, Frames and Beeswax Foundation. "Brood Chambers" are the bees' living quarters. Queen lays eggs in these chambers and brood is raised. Honey is also stored for the bees' food.

F. Bottom Board - Forms the floor of the hive. Shown with wooden entrance reducer in place to keep mice and some cold out during winter.

G. Hive Stand - Supports the hive off the ground to keep hive bottom dry and insulate hive



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Session 1 - Introduction

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Seasonal Cycles of Activities in Colonies

A colony of honey bees comprises a cluster of several to 60,000 workers (sexually immature females), a queen (a sexually developed female), and, depending on the colony population and season of year, a few to several hundred drones (sexually developed males). A colony normally has only one queen, whose sole function is egg laying. The bees cluster loosely over several wax combs, the cells of which are used to store honey (carbohydrate food) and pollen (protein food) and to rear young bees to replace old adults.

The activities of a colony vary with the seasons. The period from September to December might be considered the beginning of a new year for a colony of honey bees. The condition of the colony at this time of year greatly affects its prosperity for the next year.

*1*Research entomologist, Science and Education Administration, Carl Hayden Center for Bee Research, Tuscon, Ariz. 85719.

In the fall a reduction in the amounts of nectar and pollen coming into the hive causes reduced brood rearing and diminishing population. Depending on the age and egg-laying condition of the queen, the proportion of old bees in the colony decreases. The young bees survive the winter, while the old ones gradually die. Propolis collected from the buds of trees is used to seal all cracks in the hive and reduce the size of the entrance to keep out cold air.

When nectar in the field becomes scarce, the workers drag the drones out of the hive and do not let them return, causing them to starve to death. Eliminating drones reduces the consumption of winter honey stores. When the temperature drops to 57° F, the bees begin to form a tight cluster. Within this cluster the brood (consisting of eggs, larvae, and pupae) is kept warm-about 93° F – with heat generated by the bees. The egg laying of the queen bee tapers off and may stop completely during October or November, even if pollen is stored in the combs. During cold winters, the colony is put to its severest test of endurance. Under subtropical, tropical, and mild winter conditions, egg laying and brood rearing usually never stop.

As temperatures drop, the bees draw closer together to conserve heat. The outer layer of bees is tightly compressed, insulating the bees within the cluster. As the temperature rises and falls, the cluster expands and contracts. The bees within the cluster have access to the food stores. During warm periods, the cluster shifts its position to cover new areas of comb containing honey. An extremely prolonged cold spell can prohibit cluster movement, and the bees may starve to death only inches away from honey.

The queen stays within the cluster and moves with it as it shifts position. Colonies that are well supplied with honey and pollen in the fall will begin to stimulatively feed the queen, and she begins egg laying during late December or early January-even in northern areas of the United States. This new brood aids in replacing the bees that have died during the winter. The extent of early brood rearing is determined by pollen stores gathered during the previous fall. In colonies with a lack of pollen, brood rearing is delayed until fresh pollen is collected from spring flowers, and these colonies usually emerge from winter with reduced populations. The colony population during the winter usually decreases because old bees continue to die; however, colonies with plenty of young bees produced during the fall and an ample supply of pollen and honey for winter usually have a strong population in the spring.

Spring Activity

During early spring, the lengthening days and new sources of pollen and nectar stimulate brood rearing. The bees also gather water to regulate temperature and to liquefy thick or granulated honey in the preparation of brood food. Drones will be absent or scarce at this time of the year.

Later in the spring, the population of the colony expands rapidly and the proportion of young bees increases. As the population increases, the field-worker force also increases. Field bees may collect nectar and pollen in greater amounts than are needed to maintain brood rearing, and surpluses of honey or pollen may accumulate).

As the days lengthen and the temperature continues to increase, the cluster expands further and drones are produced. With an increase in brood rearing and the accompanymg increase in adult bees, the nest area of the colony becomes crowded. More bees are evident at the entrance of the nest. A telltale sign of overcrowding is to see the bees crawl out and hang in a cluster around the en trance on a warm afternoon.

Combined with crowded conditions, the queen also increases drone egg laying in preparing for the natural division of the colony by swarming. In addition to rearing workers and drones, the bees also prepare to rear a new queen. A few larvae that would normally develop into worker bees are fed a special gland food called royal jelly, their cells are reconstructed to accommodate the larger queen, and her rate of development is speeded up. The number of queen cells produced varies with races and strains of bees as well as individual colonies.

Regardless of its crowded condition, the colony will try to expand by building new combs if food and room are available. These new combs are generally used for the storage of honey, whereas the older combs are used for pollen storage and brood rearing.

Swarming

When the first virgin queen is almost ready to emerge, and before the main nectar flow, the colony will swarm during the warmer hours of the day. The old queen and about half of the bees will rush en masse out the entrance. After flying around in the air for several minutes, they will cluster on the limb of a tree or similar object. This cluster usually remains for an hour or so, depending on the time taken to find a new home by scouting bees. When a location is found, the cluster breaks up and flies to it. On reaching the new location, combs are quickly constructed, brood rearing starts, and nectar and pollen are gathered. Swarming generally occurs in the Central, Southern, and Western States from March to June, although it can occur at almost any time from April to October.

After the swarm departs, the remaining bees in the parent colony continue their field work of collecting nectar, pollen, propolis, and water. They also care for the eggs, larvae, and food, guard the entrance, and build combs. Emerging drones are nurtured so that there will be a male population for mating the virgin queen. When she emerges from her cell, she eats honey, grooms herself for a short time, and then proceeds to look for rival queens within the colony. Mortal combat eliminates all queens except one. When the survivor is about a week old, she flies out to mate with one or more drones in the air. The drones die after mating, but the mated queen returns to the nest as the new queen mother. Nurse bees care for her, whereas prior to mating she was ignored. Within 3 or 4 days the mated queen begins egg laying.

During hot summer days, the colony temperature must be held down to about 93° F. The bees do this by gathering water and spreading it on the interior of the nest, thereby causing it to evaporate within the cluster by its exposure to air circulation.

During the early summer, the colony reaches its peak population and concentrates on the collection of nectar and pollen and the storage of honey for the coming winter. After reproduction, all colony activity is geared toward winter survival. Summer is the time for storage of surplus food supplies. The daylight period is then longest, permitting maximum foraging, although rain or drought may reduce flight and the supply of nectar and pollen available in flowers. It is during the summer that stores are accumulated for winter. If enough honey is stored, then the beekeeper can remove a portion and still leave ample for colony survival.

Caswell County Beekeepers Association

Promoting beekeeping in Caswell County, NC

Welcome

The **Caswell County Beekeepers Association** meets every ***fourth Thursday of the month*** at 7:00PM (except November and December) in the basement of the Agriculture Building next to the Historic Courthouse in downtown Yanceyville, NC. The public is invited to join us for socializing and the meeting.

We discuss a variety of aspects of beekeeping in Caswell County, North Carolina including:

- Colony management
- Beekeeping equipment
- Beekeeping and honey bee problems and their solutions
- Honey and other beekeeping products.

We are a local chapter of the North Carolina State Beekeepers Association.

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Session 1 - Introduction

Caswell County Beekeepers Association

Promoting beekeeping in Caswell County, NC

Events

December 16, 2017 – **Introduction to Beekeeping**

The Caswell County Beekeepers Association will hold a talk on Saturday afternoon, Dec 16, from **2PM to 4PM** about honey bees and what it takes to get into beekeeping. The talk is free and open to all. Please join us in the basement of the Agriculture Building next to the Historic Courthouse in downtown Yanceyville. Click on Directions for a map.

January 10 to March 17, 2018 – **9-week Beginning Beekeeping Course**

See Bee School for more information on topic, schedule, field day, cost, and registration.

March 1-3, 2018 – **NCSBA Spring Conference**

Session 1 - Introduction

NCSBA North Carolina State Beekeepers Association

Who We Are

The NCSBA is a volunteer led organization comprised of more than four thousand active members, almost all of which are hobbyist beekeepers that are also members of a network of local beekeeping associations. These local associations are chartered by the NCSBA and serve to help their members learn and enjoy the practice of keeping bees.

Throughout North Carolina, the beekeepers of the NCSBA can be seen promoting the honey bee to the public at beekeeping schools, county fairs, festivals, and special events. You may have seen some of us presenting at a public event such as Bug Fest in Raleigh, Bee Friendly Day in Tarboro, National Honey Bee Day at Waynesboro State park in Goldsboro, at our Honey Bee Exhibit at the North Carolina Zoo in Asheboro, or at the North Carolina State Fair in Raleigh where we promote the goodness of NC honey with our annual honey sales program.

Join Online Now

Master Beekeeper Program

With our master beekeeper program, we have helped thousands of people become certified beekeepers and learn the very interesting practice of beekeeping. Our local chapters participate in this program by offering bee schools on an annual basis where individuals can learn and become certified beekeepers. Learn more…

Test Your Knowledge!

There are four levels in the program. The first three levels require a passing score on the written exam. Try the sample quizzes below to get an idea of what is expected. The questions in each quiz are taken from actual exams. There is no obligation and you will receive the results once you complete the quiz. Good luck!

Updated 12/1/2016

Certified Level	Journeyman Level	Master Level

Games!!!

Certified Game – Definitions	Journeyman Game – Definitions	Master Game

Session 1 - Introduction

NCSBA North Carolina State Beekeepers Association

Statewide Conferences

The NCSBA holds state-wide conferences twice a year, in the Spring and Summer. In odd-numbered years, the Spring Conference is held jointly with the South Carolina Beekeepers Association, alternating locale between states.

2018 NCSBA Spring Conference – March 1st – 3rd, New Bern, NC

being hosted at the
New Bern Riverfront Convention Center
203 South Front Street
New Bern NC 28560

Highlights of Past Meetings

- 2017 Summer Meeting, July 13,14, and 15th – Winston-Salem , NC
- 2017 NCSBA/SCBA Spring Meeting, Mar 3-4, Rock Hill, SC
- 2016 NCSBA Summer Meeting, July 7-9, Hickory, NC
- 2016 NCSBA Spring Meeting, Feb 25-27, New Bern, NC
- 2015 NCSBA Summer Meeting, July 9-11, Lake Junaluska, NC
- 2015 NCSBA/SCBA Spring Meeting, Feb 5-7, Monroe, NC
- 2014 NCSBA Summer Meeting, July 10-12, Wilkesboro, NC
- 2014 NCSBA Spring Meeting, March 6-8, Wilmington, NC
- 2013 NCSBA Summer Meeting, July 11-13, Pinehurst/Southern Pines, NC
- 2013 NCSBA/SCBA Spring Meeting, March 1-2, Rock Hill, SC
- 2012 NCSBA Summer Meeting, July 12-14, Lumberton, NC
- 2012 NCSBA Spring Meeting, March 9-10, Morganton, NC
- 2011 NCSBA Summer Meeting, July 7-9, Elon, NC
- 2011 NCSBA/SCBA Spring Meeting, March 4-5, Dallas, NC
- 2010 NCSBA Summer Meeting, July 8-10, China Grove, NC
- 2010 NCSBA Spring Meeting, March 5-6, Lumberton, NC
- 2009 NCSBA Summer Meeting, July 9-11, Wilkesboro, NC
- 2009 NCSBA/SCBA Spring Meeting, March 6-7, Rock Hill, SC
- 2008 NCSBA Summer Meeting, July 10-12, Pinehurst, NC
- 2008 NCSBA Spring Meeting, March 7-8, Burlington, NC
- 2007 NCSBA Summer Meeting, July 12-14, Kinston, NC
- 2007 NCSBA/SCBA Spring Meeting, March 2-3, Monroe, NC
- 2006 NCSBA Summer Meeting, July 13-15, High Point, NC
- 2006 NCSBA Spring Meeting, March 17-18, Clemmons, NC

NCSBA NORTH CAROLINA STATE BEEKEEPERS ASSOCIATION

Website Links

NOTICE: Selecting any of these links will open a new window which is not part of the NCSBA site.

BEEKEEPING AND RELATED LINKS IN NORTH CAROLINA:

Center for Honeybee Research in Asheville, NC
The Wolfpack's Beeyard (NCSU Entomology Apiculture)
NC Dept of Agriculture Apiary Services Program
NC Africanized Honey Bee Resources
NC Honey Bee Research Consortium
Bee-Linked: Linking pollinators and farmers in NC

NATIONAL AND INTERNATIONAL ASSOCIATIONS:

American Beekeeping Federation (ABF)
Eastern Apicultural Society (EAS)
International Bee Research Association (IBRA)
Mid-Atlantic Apiculture Research and Extension Consortium (MAAREC)
American Honey Producers Association (AHPA)

U. S. HONEYBEE RESEARCH LABS:

Bee Research Laboratory – Beltsville, Maryland
Carl Hayden Bee Research Center – Tucson, Arizona
Honey Bee Breeding, Genetics & Physiology Lab – Baton Rouge, Louisiana
Kika de la Garza Subtropical Agricultural Research Center – Weslaco, Texas
Pollinating Insects Research Unit – Logan, Utah

BEEKEEPING COMMUNITIES & FORUMS:

Beekeeping Forums – An international beekeeping community
Bee Source – Beekeeping forums, downloadable plans
Beemaster – International beekeeping forums
VSHBreeders – Forum focused on breeding VSH queens

NATURAL & SUSTAINABLE BEEKEEPING:

The Bee Space – Smart, Simple & Sustainable beekeeping blog
Organic Beekeeping – Yahoo! group with 5,000+ members focused on natural

beekeeping
Bush Farm Bees – Michael Bush's blog on natural beekeeping

MAGAZINES & PUBLICATIONS:

American Bee Journal
Bee Culture
Beekeepers Quarterly – magazine from Great Britain

HONEY

National Honey Board – One ingredient. The way nature intended.
Eating Well Honey Recipes
Southern Living Honey Recipes
Martha Stewart Honey Recipes
Bon Appétit Honey Recipes
USDA Annual Honey Report – Includes number of colonies producing honey, yield per colony, honey production, average price, price by color class and value; honey stocks by state and U.S from 1996 to present

HIVE MANAGEMENT

Hive Tracks – Web-based hive management software (Located in Western NC)
BeeTight – Web-based & Mobile App hive management software
MyBeeHives – Web-based hive management software

Session 1 - Introduction

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Brushy Mountain Bee Farm

The lush rolling hills of North Carolina are home to the Brushy Mountain Bee Farm. Lying in an isothermal belt, the Bee Farm is surrounded by orchards of apples and peaches, with small vineyards close by. This rich land with varied wild and cultivated plants is a perfect spot for honeybees.

Brushy Mountain Bee Farm was established by Steve and Sandy Forrest and opened for business in 1977. It began as a part time business with the office and wood shop in the home of Steve and Sandy. In 1980 it grew into a full time business that spread into an old barn that was on the property and a small two-room house. A year later a 200 year old log cabin was moved from an adjacent property and attached to the two room house to form the retail and storage facility for the business. The first warehouse was built in 1983 for storage and shipping and the offices were moved into the log cabin. As the business grew more buildings were added and today it occupies over 30,000 square feet under roof with a woodshop, metal shop, sewing room, and warehouse space.

Brushy Mountain continues to expand and provide products from coast to coast and beyond. Since 1998 we have had our catalog on-line and an e-commerce site for the convenience of our customers.

Each year we seek ways to make the products we make better, and to increase our knowledge to provide the best information to our beekeeping customers. Beekeeping has become more challenging in today's world but we are constantly seeking new remedies, innovative products and ideas to keep you successful with your bees. Our knowledgeable and courteous staff is available to provide you with the latest information. The future of the Bee Farm is invested in supplying the best quality, best service, and best support in the beekeeping industry.

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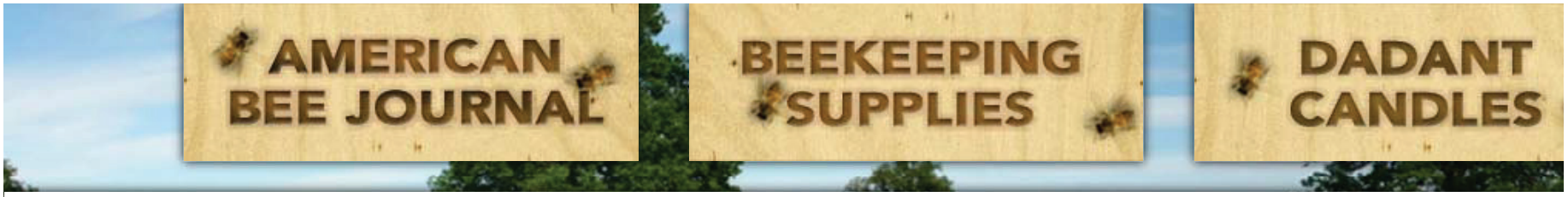
Session 1 - Introduction



Dadant & Sons has produced quality beekeeping supplies since 1863.

Welcome to the world of beekeeping where Dadant & Sons, Inc. is America's oldest & largest manufacturer of **beekeeping supplies**! Beekeeping is a fascinating hobby and proves to be a challenging business as well. There are many aspects to beekeeping, ranging from raising the bees and producing honey to using the products from the hive for crafts, cooking and for your health. We have helped the beekeeper for many generations and it is our goal to continue providing helpful information to all beekeepers, from small to large. We have included a brief company **History**, a **Learning Center** for the beginners, a **News** section to keep everyone up-to-date on industry developments and helpful **Links** to connect you to associations and websites of interest. You can also visit the **Shop** where you can check out our secure online catalog.

We also offer the **American Bee Journal**, "The Beekeeper's Companion Since 1861". Our monthly magazine dedicated to beekeeper's that is distributed worldwide. Dadant & Sons, Inc. produces a wide range of beautifully handcrafted, **100% beeswax candles** and paraffin candles handcrafted in the U.S.A.

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Types of hives

Warre

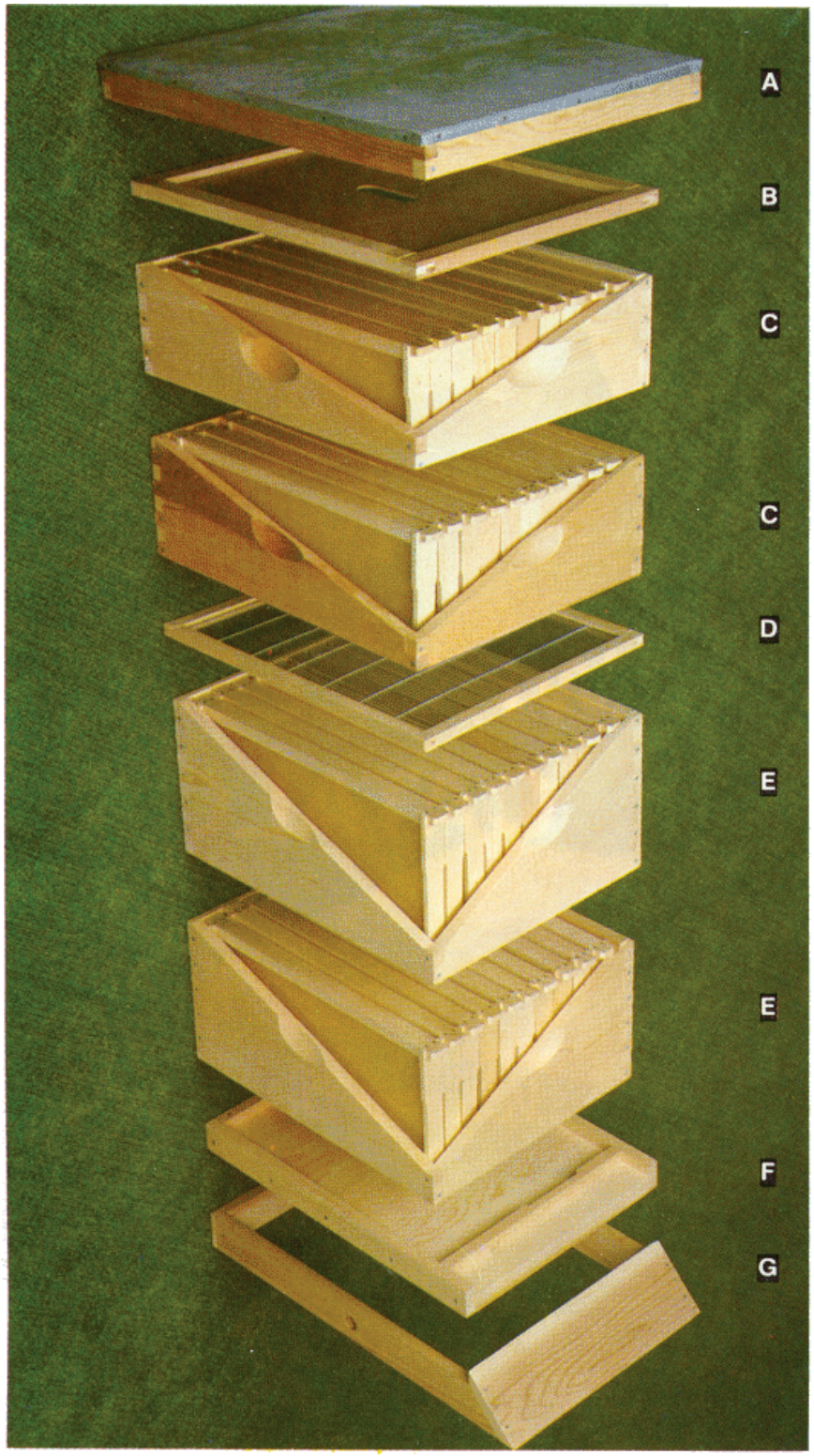
8 frame Langstroth

10 frame Langstroth

Top bar

5 frame nuc

Flow™ Hive



The modern bee hive is like a highly efficient multistoried factory with each "story" having a specific function. These "stories" work together to provide a home for bees and a honey factory for the beekeeper.

A) Hive Cover — telescoping cover "telescopes" over the sides of the top super to protect the hive. Galvanized covering.

B) Inner Cover — Creates a dead air space for insulation from heat and cold.

C) Shallow Supers — For "surplus" honey storage. Bees store their extra honey in these for the beekeeper to take. 6⅝", 5 11/16" supers, or even hive bodies may be used.

D) Queen Excluder — Keeps the queen bee in the brood chambers as she is too large to pass through the excluder.

E) Hive Bodies — "Brood Chambers" are the bee's living quarters. Queen lays eggs in these chambers and brood is raised. Honey is also stored for the bees' food.

F) Bottom Board — Forms the floor of the hive. Shown with wooden entrance reducer in place to keep mice and some cold out during winter.

G) Hive Stand — Supports the hive off the ground to keep hive bottom dry and insulate hive.

Successful beekeeping means easy manipulation of the frames of brood and honey to provide a "surplus" of honey beyond that needed by the bees to live on and rear their replacements. It is this "surplus" that the beekeeper removes and markets.

Components of the Hive

Session 2 - Equipment

Bee Culture

The Magazine of American Beekeeping

(http://www.beeculture.com/)

NOVEMBER 1, 2014

DEEPS, MEDIUMS, SHALLOWS, OR? . . . DECISIONS, DECISIONS, DECISIONS

All boxes are not created equal. Pick the one best for you.

by Ross Conrad

In the old days choosing a home for your bees was relatively easy. Bees were kept in a portion of the original tree that the swarm had moved into (log gum), or other handy containers made of wood, mud or straw (skeps). Beekeepers being the way beekeepers are, started to experiment

over time with various designs and styles in an effort to "make 'em better." Some developed frames (or top bars), designed to be placed inside the skep. Others developed additions that could be placed on top of the log gum, or under the skep in order to provide the colony with additional room for expansion when needed. One thing led to another, and today we have so many options and choices for bee hives that it can create a bewildering experience for the beginning beekeeper.

Now if you are just getting started and preparing to choose the style of hive your bees will call home, the easy thing to do is to just ask your mentor, the instructor of your beekeeping class, or your neighborhood beekeeper what hive is best. This approach will help you cut through all the options to the best choice for you and your area…or will it? The person you ask is likely to simply recommend what they use which is usually what they were taught to use by their mentor or teacher. Their decision may work well for them, but is it really the best choice for you? In order for you to make a more fully informed choice, here is a summary of the primary options currently available.

Double deeps, all mediums, a mix of deeps and shallows – the number of permutations available for today's beekeepers when it comes to choosing a hive can be overwhelming.

The Conventional Deep Langstroth Hive

The hive patented in 1852 by L. L. Langstroth that opens from the top and features movable frames has become the most commonly used style of hive in the world.
The deep Langstroth-style hive body that is 9-5/8 inches high, holds 10 frames and designed with bee space in mind has long been the standard brood box for managed colonies. While a single deep box is often sufficient for bees in Southern climes, in Northern regions, two deeps are usually utilized for the hive proper in order to provide additional room for brood rearing and food storage. The deep super can weigh upwards of 80 pounds when filled with honey, so having an additional empty deep box into which

frames can be transferred during manipulations/inspections rather than moving the whole hive body at once, might just save your back. Of all the options, the deep Langstroth hive body tends to provide the greatest expanse of uninterrupted comb into which the queen can lay her eggs (something that queens seem to prefer). Nowadays however, the conventional Langstroth hive made up of deep brood boxes is starting to become not so common and conventional.

Mediums

With the advent of so many backyard beekeepers taking up the craft of apiculture during the past decade there is a growing trend in the use of medium sized boxes for hive bodies which, at 6-5/8 inches tall, only weigh about two-thirds as much as a comparable deep when full. This size box is often called a Western, or Illinois Super. The big advantage of using all medium boxes for both the hive body and the honey supers is that you only have to inventory a single frame size for all your equipment and never have to worry about the incompatibility of your frames of comb and boxes. When three medium boxes are used for the brood chamber it creates just about the same size hive cavity as two deep hive bodies. Beekeepers down south may use two medium supers in place of a single deep. The drawback to using all mediums is that you will need to use more pieces of equipment and will end up with significantly more frames to handle when conducting frame manipulations and inspections compared to deep brood boxes. Also due to their shorter height, more medium boxes will be required for honey storage than when deep supers are used. The additional frames will significantly increase the amount of work needed to extract honey during the harvest.

Shallows

At 5-11/16 inches high, the shallow box is the lightest option for regular use as a hive body or honey super. Shallow boxes can be used as hive bodies if need be, but they have the same drawbacks as the medium sized boxes only accentuated! As a result, shallows are most commonly used as honey supers. You may see boxes that are 4¾ inches deep being offered for sale by beekeeping supply companies. These are not extra short shallow supers, but specialty boxes made especially for comb honey production.

Eight-Frame Equipment

Another fairly recent development is the popularity of eight-frame Langstroth-style equipment. Available in either the deep or medium sizes, an eight-frame box is lighter by about 20 percent than its 10-frame counter part and being narrower, the center of gravity when grasped with both hands is closer to the body making it easier to lift. The downside is that an eight-frame hive will need to be taller than a comparable 10-frame hive due to the smaller cavity space created by the eight-frame box. This can provide an additional challenge in years when there is a strong honey flow and the supers are stacked up like a skyscraper requiring use of a ladder to reach the top. The narrow base can also make the eight-frame hive more likely to topple over in heavy winds, especially when top heavy during those good honey years. Since the majority of beekeepers still use 10-frame equipment, it may also be harder to resell used eight-frame equipment to another beekeeper should you ever decide to give up your beekeeping career.

Mixing It Up

Today the hive that is made up of a single sized box is relatively rare. Most hives utilize one size box for the hive body and a smaller box, either a medium or shallow for the honey supers above. Down South for example a medium is often placed above a single deep, while the double deep more common in Northern regions, is often topped with medium or shallow supers that are placed above for the collection of honey that is intended for harvest. Eight- and ten-frame equipment however, cannot be used on the same hive very effectively due to the varying widths. This lack of interchangeability suggests that one should get either eight-frame equipment, or 10-frame equipment and stick to that size throughout their beekeeping days. Otherwise the day will inevitably come when a ten-frame super is needed and all that is available are supers designed to hold eight frames, or vice-versa.

Top Bar Hives

Alternatives to the Langstroth hive have become popular. The most common alternative to the Langstroth hive is the Top Bar Hive (TBH). The Top Bar Hive comes in two styles, the Kenyan TBH that features sloping walls, and the Tanzanian TBH that has straight walls. Top bar hives typically consist of a single box, but since their use and production has not been standardized in the way that the Langstroth hive has, the TBH comes in a wide variety of sizes. Beekeepers who build or purchase top bar hives that feature a top bar that is the same size as the Langstroth top bar find that their compatibility with the Langstroth hive is very convenient when performing certain hive manipulations or if they decide to move their bees from one style of hive into the other. Top bar hive inspections can only be conducted one frame at a time. Unlike with Langstroth-style supers, there is no ability to move large numbers of frames quickly and honey production tends to be limited requiring a lot of additional labor. This is why it is unlikely that the majority of commercial beekeepers will ever switch over to top bar hives.

Warré Hives

The Warré hive offers another alternative to the Langstroth hive. Unlike the top bar hive however, the Warré has established interior dimensions that are standardized and the hive has the ability to be "supered" from the bottom as the colony expands. As with the TBH, combs are typically attached to a top bar and allowed to be built naturally without the aid of sheets of foundation. Warré hives tend to be better for honey production than TBH, though raising the entire hive in order to add a super to the bottom of the colony may be challenging.

Unique/Original Designs

In the continuing effort to improve upon bee hive design, some beekeepers will experiment with their own unique hive designs. Here again, designs that feature frames or top bars that are compatible with the standard Langstroth hive make life easier, especially when transferring bees, brood and comb into or out of a Langstroth hive. As long as the hive design incorporates the bee space and a removable frame into its design, it should not run afoul of the bees' preferences, or state laws that require a movable frame to enable inspections for diseases and pests.

So what type of hive is best for you? If lifting heavy objects is a concern the top bar hive, or a Langstroth hive – especially those made up of eight-frame medium boxes – may be the best options. Much also depends on your purpose for keeping bees. If honey production is important then a Langstroth or Warré hive is likely to be more satisfying. If you will be keeping bees such as Italians that tend to build up early in late winter/early spring, Langstroth and Warré hives rather than a TBH will allow for easier expansion of the honey storage area in order to help ensure enough room for the extra honey that the Italian bees will need to survive the winter without supplemental feeding. Just remember that if you experiment with more than one style of hive, try to ensure that the top bars from each hive are the same length so that combs may be moved from one hive to another to simplify any hive manipulations that you may want to make in an attempt to correct hive issues or relocate colonies.

Bees are incredibly resourceful and adaptable and are able to thrive in almost any type of cavity that we provide. From my point of view, it is not the box that you keep your bees in that is critical as far as the bees are concerned, but how you care for them that matters most.

Ross Conrad is author of Natural Beekeeping, revised and expanded 2nd edition. Join Ross and the Colorado Beekeeping Association in Broomfield, CO from 8:30-5:00 for an advanced beekeeping workshop on Saturday January 24, 2015. http://coloradobeekeepers.org/ross-conrad/

Comparision of the 8 and 10 frame beginner beekeeping kits.

	8-Frame Kit	10-Frame Kit
Standardization	8-frame hives have been in use for over 100 years and are again increasing in popularity. Some components like the frames are interchangeable between 8- or 10-frame hives, but other parts like supers will fit one size hive or the other.	10 Frame is the more common sized hive used in the US over the last several decades. This hive would be compatible with the majority of hives/hive components in use today.
Management flexibility	The English Garden Hive consists of all medium (6-5/8") height brood chambers and supers. Having all uniform size chambers means that any chamber can be used for any purpose (either as a brood chamber, as a feed "super", or as a true super for surplus honey). It also means that frames can be moved between brood boxes and supers, which opens up several helpful management options.	10-frame hives use one or more deep (9-1/8") brood chamber(s) to which shallow- or medium-height honey supers are normally added. Having different sized chambers is a slightly more specialized way of doing things.
Decorative style	The appearance of the English garden hive stands out chiefly because of the decorative A-frame top covered in solid copper. (The decorative copper top is also available for 10-frames hives, but is only standard on the English garden hive.)	Our standard 10-frame hive comes with a flat, aluminum-covered telescoping top and looks very standard.
Heavy lifting	A completely full English garden super can hold close to 30 lbs of honey or over 40 lbs total including the weight of the wood and all. The center of gravity is also closer to the body making it easier to lift and carry. In the case of the English garden hive, a brood chamber is the same size as a super.	A completely full 10-frame medium super can hold over 35 lbs of honey or close to 50 lbs total including the weight of the wood and all. A deep 10-frame brood chamber can weigh close to 80 lbs total when full.
Smaller hive?	Although the individual levels of 8-frame hives are smaller (by 2 frames) than 10-frame hives, that doesn't make any real difference in the size of the colony. 8-frame hives simply expand upwards sooner than 10-frame hives which expand outwards further. Some beekeepers feel that the relative upward orientation of an 8-frame hive more closely meets instincts of bees that naturally build their nests in tree hollows.	
Cypress vs. Pine	We make our English garden supers from all cypress wood. Although paint or clear varnish is normally used to protect cypress woodenware, cypress also has some natural resistance to decay.	We use pine lumber to manufacture our standard 10-frame hive as well as most of our hive bodies and supers. Paint is normally used to protect pine woodenware.

How to Become a Beekeeper in North Carolina

Introduction

Beekeeping is a very enjoyable and rewarding pastime that is relatively inexpensive to get started. Moreover, it's a hobby that can eventually make you money! The following is a primer on how to start your first hive and begin keeping bees.

Beehive Equipment

The minimum amount of equipment you will need to become a beekeepers is one complete 'starter' hive, which consists of a *bottom board* (the hive "floor"), a *hive body* (the main box) with 10 *frames* (on which the bees build wax comb), an *inner cover* (the hive "ceiling"), and a *lid* (the hive "roof") (Figure 1). A colony of bees can live very successfully in such a hive and can store enough honey for its own needs. They may quickly out grow this space, however, and produce a swarm (where approximately half of the bees will fly away to start a new colony). To keep the bees from swarming, and to harvest their surplus honey, you will likely need additional hive equipment. But if you don't want to collect honey, then a starter hive is all the equipment you will ever need.

Most beekeepers are not content with watching half of their bees fly away, and so they will try to prevent this from happening by furnishing more hive space in the form of additional boxes, called '*supers*', on top of the original box. This gives the colony more space to grow and the bees more room to store honey. If you wish to remove honey from the hive, adding supers is a necessity.

We recommend that a first-time beekeeper start with two full beehives. That way, you will have a minimal frame of reference to compare your new colonies and to develop your management techniques.

In addition to furnishing a beehive, you will also need some other equipment. There are three items that are required to safely work a beehive: a *smoker* (to pacify the bees and reduce their defense response), a *hive tool* (to pry apart hive equipment and frames), and a *veil* (to protect the head and face). Beginners often feel more comfortable with the extra protection of a full-body beekeeping *suit* and *gloves*, but eventually they are not necessary if the bees are handled properly.

Session 2 - Equipment

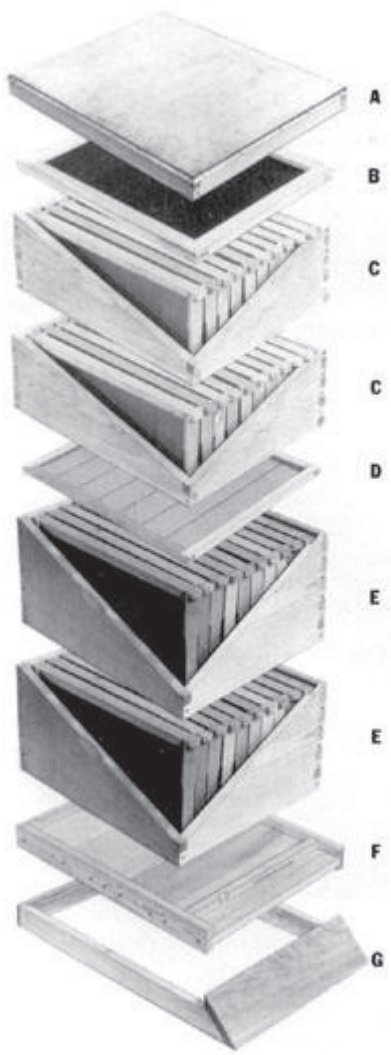


Figure 1. Basic hive equipment.

Getting Started

Equipment is available from any one of several beekeeping supply companies (listed below) and may be purchased in a variety of ways. Most companies have 'starter kits', which usually include a complete starter hive (without bees), smoker, hive tool, and veil (Figure 2 and Figure 3). There are also 'deluxe kits', which include the previously mentioned items, as well as additional equipment to add to the hive as the colony population grows. The prices of these kits range from about $125.00 for the starter hive to about $325.00 for a deluxe kit. You can also buy the individual (pre-cut) parts of the hive and assemble it yourself (listed in Table 1).

Once a hive is assembled, it is ready to house bees. There are three main ways to acquire a living honey bee colony. First, you may purchase a five-frame 'nucleus' colony (or "nuc box") from a local beekeeper who is registered to sell bees (contact the NC Department of Agriculture & Consumer Services for a current listing; see below). A nuc box usually contains five frames of 10,000 adult bees, wax comb (with honey and pollen), brood (developing young), and an egg-laying queen. Starting a colony this way can cost between $70-100, but it will become a mature hive very rapidly and be less likely to fail. Second, you may purchase a three-pound 'package' of bees with a queen. Any number of beekeeping operations nationwide will send through the mail a screened wooden box with live bees, costing $45-65. The bees can then be shaken out of the package, and they will establish themselves in the hive. Third, you can capture a swarm that has escaped from another hive. Although not as common as they once were, wild swarms can be obtained in the early to mid-spring (late March, April, and early May). Local beekeeping clubs often have "swarm-call" lists to assist beekeepers in capturing swarms reported in their area, and beginners usually need help with capturing their first swarm. These latter two approaches are more cost effective (virtually free in the latter case), but the bees will need more time for the colony to develop and become productive.

Of course, honey bees have the potential to sting in defense of their hive. The frequency of being stung, however, is much lower than what is commonly believed. If managed properly—using smoke, a hive tool, protective clothing, and gentle manipulation—stings are quite unlikely. If a beekeeper is stung, localized pain and swelling is a normal reaction and one that should not cause undue concern. Nonetheless, bee venom can be a serious allergen for certain people, with 1 in 200 persons having a true allergic reaction requiring immediate medical attention. Consult with a physician if you have any concerns about being stung.

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Individual Hive Item	**Approximate Price (or range of prices)**	**Description/Purpose**
Bottom board	$10.00	Hive body sits on this and acts as the floor of the hive.
Hive body	$8.00-10.00	Standard size is 9 5/8 deep. Holds 10 full-size frames. Also called a deep super.
10 deep frames	$8.50	Full-size frames used by the bees to construct their wax comb.
10 wax sheets	$7.00	Foundation used by the bees for building their honey comb.
Inner cover	$8.00	Thin board between top box and outer cover. Helps with ventilation.
Outer cover	$17.00	Covers the top of the hive. Provides shelter from the elements.
Smoker	$24.00-30.00	Used before opening a hive to help calm the bees and make them less likely to sting.
Hive tool	$4.50	Used to pry apart pieces of the hive that have been stuck together with 'bee glue' or propolis.
Veil	$11.00-25.00	Covers the head and face of beekeeper to prevent stings to these sensitive areas.
TOTAL	**$98.00-120.00**	
Additional Items		
Bee suit	$50-150	Complete suits cover whole body to help protect from stings.

Session 2 - Equipment

Gloves	$10.00-20.00	May be used to prevent stings to the hands, but they can make it more difficult to manipulate the hive.
Entrance reducers	$1.00	Minimizes amount of entrance space the bees need to guard and minimizes the flow of cold air in winter.
Queen excluder	$6.00	Placed below the honey supers to prevent queen from laying eggs in the honey comb.
Feeder	$4.00-17.00	During times of food scarcity, bees may need to be fed sugar water. There are several types of feeders available.
Supers (assembled with frames)	$35.00	Any box placed on top of the hive body to give the colony more room. Honey supers are used for producing honey.

Figure 2. An assembled 'starter' hive.

Figure 3. Beekeeping gear: hive, tool, smoker, and veil.

Resources

Books

The Beekeeper's Handbook, by Diana Sammataro and Alphonse Avitabile. Designed for beginners, this book has very nice drawings and diagrams that describe the parts of the hive, what is necessary to get started, how to obtain bees, and general seasonal management. Also discusses bee pests and diseases, an important aspect of modern beekeeping.

Session 2 - Equipment

First Lessons in Beekeeping, by Keith Delaplane. Introduction to beekeeping with descriptions of necessary equipment, basic biology of the colony, honey plants, and pollination. Good overview of management of a colony in different seasons.

Beekeeping for Dummies, by Howland Blackiston. Designed for beginners with good step by step directions on practical aspects of beekeeping, but limited information on background biology.

Honey Bees and Beekeeping: A year in the life of an apiary, by Keith Delaplane. Instructions for the beginner on setting up an apiary and how to maintain it throughout an entire year. In addition to the book, there are two videos with topics in beekeeping for beginners.

The Hive and the Honey Bee, edited by Joe M. Graham, Dadant & Sons. The ultimate reference book! Very detailed information that is designed for the more advanced beekeeper. In-depth information on honey bee biology, seasonal management, diseases and hive pests, even starting a beekeeping business. Ideal for looking up information on any topic, but not designed to read from cover to cover.

Periodicals

Bee Culture (http://www.beeculture.com): Monthly Issues, 1 year subscription- $25.00; TEL: 800-289-7668 or 330-725-6677; FAX: 330-725-5624

American Bee Journal: Monthly Issues, 1 year subscription- $24.95; TEL: 217-847-3324; FAX: 217-847-3660; EMAIL: abj@dadant.com (mailto:e-mail:%20%20abj@dadant.com)

Speedy Bee: Monthly Issues, 1 year subscription $17.25 , TEL: 912-427-8447; FAX: 912-427-8447; EMAIL: speedybee@bellsouth.net (mailto:speedybee@bellsouth.net)

Beekeeping supply companies

North Carolina

Brushy Mountain Bee Farm (http://www.brushymountainbeefarm.com), 610 Bethany Church Rd Moravian Falls, NC 28654; TEL: 800-BEESWAX (800-233-7929); FAX: 336-921-2681; EMAIL: sales@brushymountainbeefarm.com (mailto:sales@brushymountainbeefarm.com)

Miller Bee Supply (http://www.millerbeesupply.com), 11562 North Highway16, Millers Creek, NC 28651; TEL: 888-848-5184; Customer Service: 336-667-7513; EMAIL: woodnwax@earthlink.net (mailto:woodnwax@earthlink.net)

Other states

Mann Lake Ltd. (http://www.mannlakeltd.com), 501 S. 1st St Hackensack, MN 56452; TEL: 800-880-7694; Customer Service: 218-675-6688; FAX: 218-675-6156; EMAIL: beekeeper@mannlakeltd.com (mailto:beekeeper@mannlakeltd.com)

Dadant & Sons Inc. (http://www.dadant.com), 51 South 2nd, Hamilton, IL 62341; TEL: 888-922-1293

The Walter T. Kelly Company (http://www.kelleybees.com/), PO Box 240 Clarkson, KY 42726-0240; TEL: 800-233-2899; EMAIL: kelleybees@kynet.net (mailto:kelleybees@kynet.net)

Contact information

Session 2 - Equipment

North Carolina State Beekeepers Association (http://www.ncbeekeepers.org)

North Carolina has approximately 60 county beekeeping associations across the state, which are part of the larger North Carolina State Beekeepers Association (NCSBA). Most of these chapters meet monthly with instructional programs, and many clubs offer new beekeeper classes each year. These local associations serve as valuable resources where experienced beekeepers offer advice and can act as mentors to beginning beekeepers. If you would like some hands-on experience before you start your own hives, offer to help a beekeeper in your area when they are working with their bees.

North Carolina Department of Agriculture and Consumer Services, Apiary Inspection (http://www.ncagr.gov/plantindustry/Plant/apiary/index.htm)

North Carolina is fortunate to have an active Apiary Inspection program, which is part of the NC Department of Agriculture & Consumer Services (NCDA&CS). There are six regional inspectors across the state who serve as important resources for beekeepers to keep their hives free of diseases and pests. All new beekeepers should contact their regional inspector so that they may register their hives and have them periodically inspected.

North Carolina State University Apiculture Program (http://entomology.ncsu.edu/apiculture)

The Apiculture Program at NC State University has been a leader in honey bee research, outreach, and instruction. Part of the program's mission is to assist beekeepers by helping to develop and disseminate information about new management techniques to improve colony health and productivity. For further information about the program, contact your local Cooperative Extension Agent (http://www.ces.ncsu.edu/index.php?page=countycenters).

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Session 2 - Equipment

Bee gear

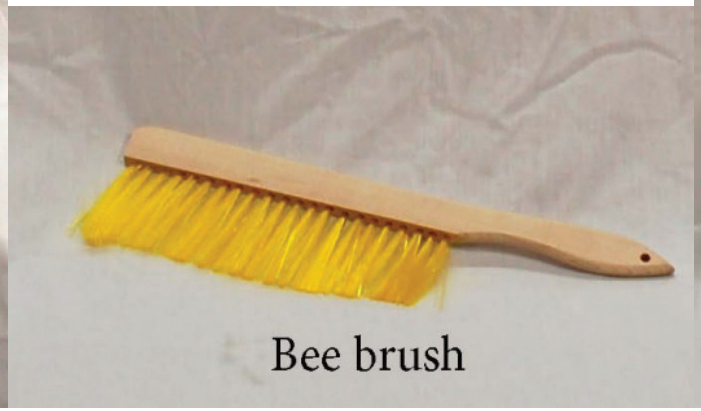

Protective
gloves


Hive tool


Frame grip

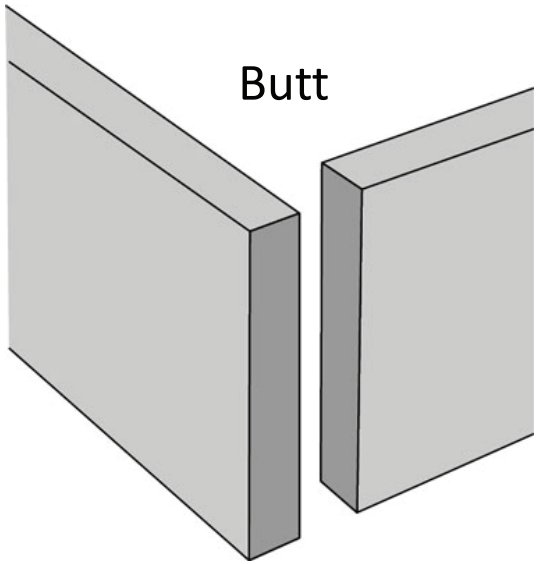

J-hook hive tool

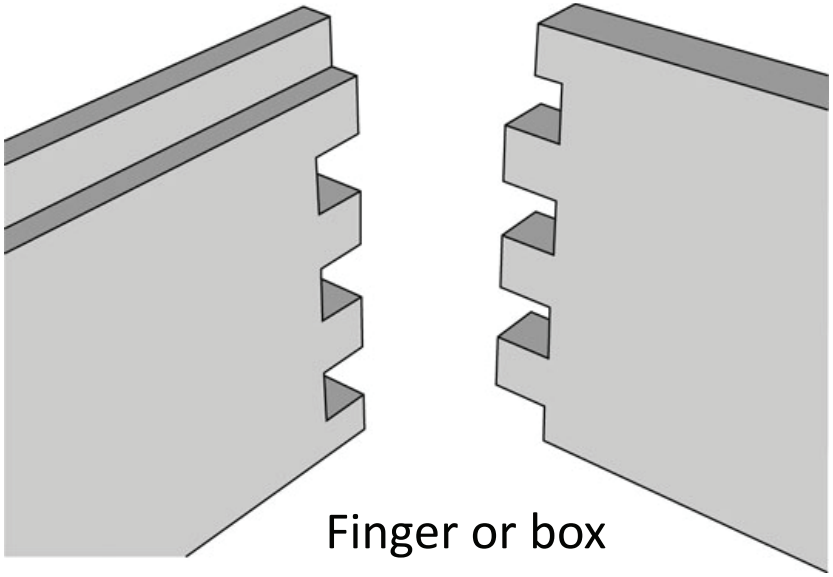

Beekeepers Veil

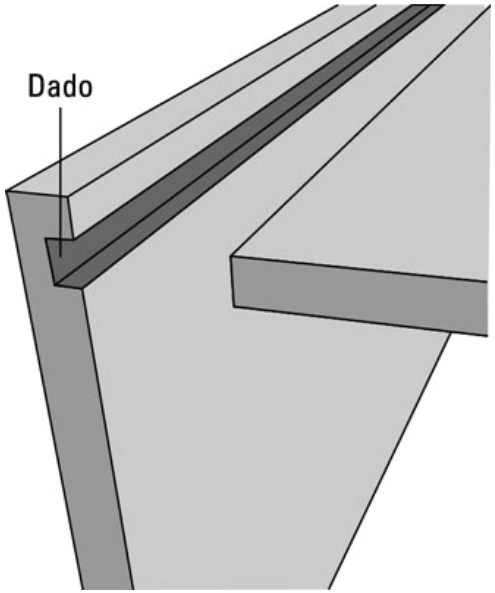

Bee brush

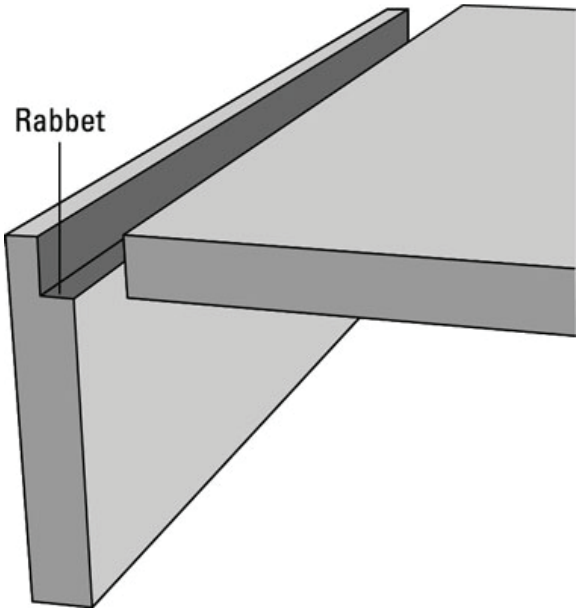

Smoker

Beehive Joints









Beekeeping Equipment

Equipment needs vary with the size of your operation, number of colonies, and the type of honey you plan to produce. The basic equipment you need are the components of the hive, protective gear, smoker and hive tool, and the equipment you need for handling the honey crop.

The hive is the man-made structure in which the honey bee colony lives. Over the years a wide variety of hives have been developed. Today most beekeepers in the United States use the Langstroth or modern ten-frame hive. A typical hive consists of a hive stand, a bottom board with entrance cleat or reducer, a series of boxes or hive bodies with suspended frames containing foundation or comb, and inner and outer covers (Figure 9, next page, includes dimensions for those wishing to construct their own hives). The hive bodies that contain the brood nest may be separated from the honey supers (where the surplus honey is stored) with a queen excluder.

The Hive

HIVE STAND

The hive stand, actually an optional piece of equipment, elevates the bottom board (floor) of the hive off the ground. In principle, this support reduces dampness in the hive, extends the life of the bottom board, and helps keep the front entrance free of grass and weeds. Hive stands may be concrete blocks, bricks, railroad ties, pallets, logs, or a commercially produced hive stand. A hive stand may support a single colony, two colonies, or a row of several colonies.

BOTTOM BOARD

The bottom board serves as the floor of the colony and as a takeoff and landing platform for foraging bees. Since the bottom board is open in the front, the colony should be tilted forward slightly to prevent rainwater from running into the hive. Bottom boards available from many bee supply dealers are reversible, providing either a $\frac{7}{8}$- or $\frac{3}{8}$-inch opening in front.

HIVE BODIES

The standard ten-frame hive body is available in four common depths or heights. The full-depth hive body, $9\frac{5}{8}$ inches high, is most often used for brood rearing. These large units provide adequate space with minimum interruption for large solid brood areas. They also are suitable for honey supers. However, when filled with honey, they weigh over 60 pounds and are heavy to handle.

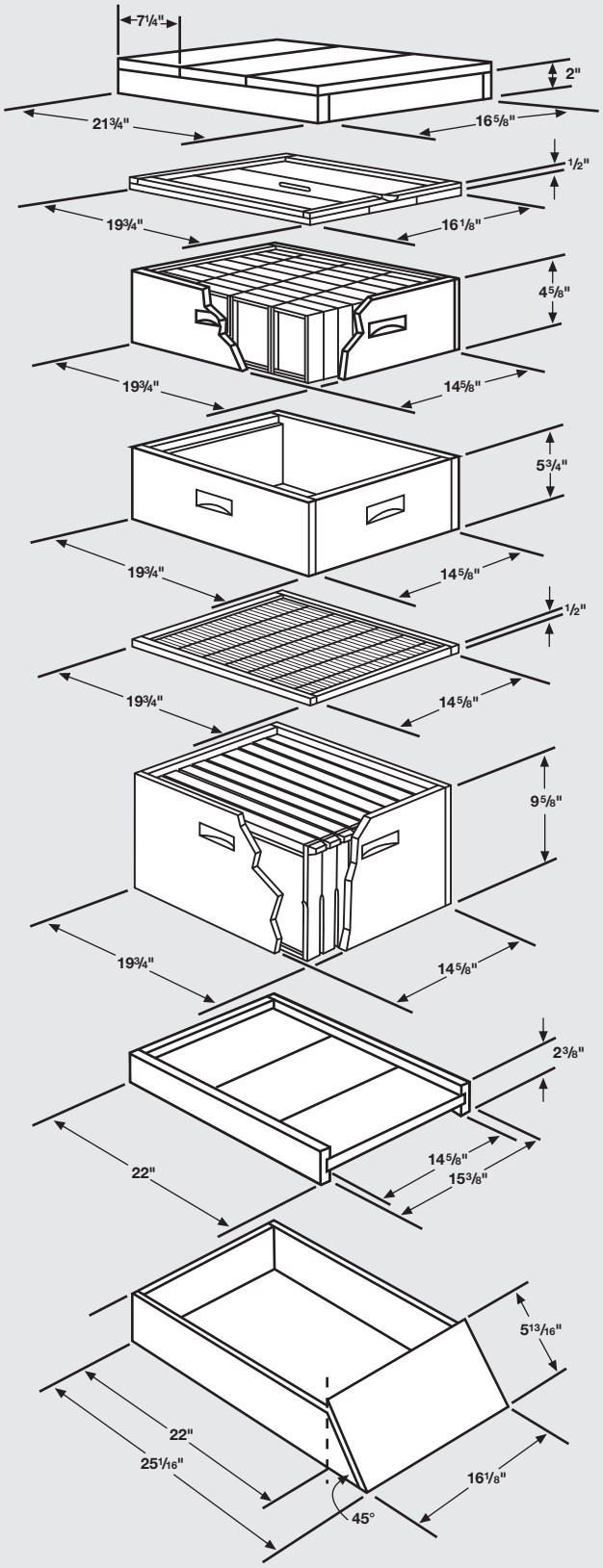
The medium-depth super, sometimes called the Dadant or Illinois super, is $6\frac{5}{8}$ inches high. While this is the most convenient size for honey supers, it cannot be cut efficiently from standard-sized lumber. An intermediate size ($7\frac{5}{8}$ inches) between the full- and medium-depth super is preferred by some beekeepers, especially those who make their own boxes.

The shallow-depth super, $5\frac{1}{16}$ inches high, is the lightest unit to manipulate (about 35 pounds when filled with honey). This size has the greatest cost of assembly per square inch of usable comb space.

Section comb honey supers, $4\frac{5}{8}$ inches high, hold either basswood section boxes or plastic rings and section holders. Section comb honey production is a specialized art requiring intense management and generally is not recommended for beginners.

Some beekeepers prefer eight-frame hive bodies. These were mostly homemade, but one U.S. bee supplier is now selling eight-frame boxes as English garden hive boxes. Beekeepers rearing queens and/or selling small starter colonies (nucs) prefer to use a three- or five-frame nuc box usually with standard deep frames. These can be purchased from bee supply dealers and are constructed from wood or cardboard, the latter for temporary use only.

Different management schemes are used according to the depth of hive bodies utilized for the brood area of the hive. One scheme is to use a single full-depth hive body, which theoretically would give the queen all the room she needs for egg laying. However, additional space is needed for food storage and maximum brood nest expansion. Normally a single full-depth brood chamber is used when beekeepers want to crowd bees for comb honey production, when a package is installed, or when a nucleus colony or division is first established. Most beekeepers elect to use either two full-depth hive bodies or a



Outer Telescoping Cover

3 pieces 7¼" X ¾" X 18⅛" (top)
2 pieces 21¾" X ¾" X 2" (sides)
2 pieces 16⅜" X ¾" X 2" (ends)

Inner Cover

2 pieces ½" X ¾" X 16⅛"
2 pieces ½" X ¾" X 18¼"
2 pieces 6" X ⅜" X 19¾"
1 piece 4⅛" X ⅜" X 19¾"

Section Comb Super

2 pieces 19¾" X ¾" X 4⅝" (sides)
2 pieces 14⅝" X ¾" X 4⅝" (ends)

Shallow Extracting Super

2 pieces 19¾" X ¾" X 5¾" (sides)
2 pieces 14⅝" X ¾" X 5¾" (ends)

Queen Excluder

2 pieces 19¾" X ¾" X 5¾" (sides)
2 pieces 14⅝" X ¾" X 5¾" (ends)

Full Depth Hive Body

2 pieces 19¾" X ¾" X 9⅝" (sides)
2 pieces 14⅝" X ¾" X 9⅝" (ends)

Bottom Board

3 pieces 7⅛" X ¾" X 15⅜" (floor)
2 pieces 2⅜" X ¾" X 22" (sides)
1 piece 2⅜" X ¾" X 14⅝" (end)

Hive Stand

1 piece 3" X ¾" X 14⅝" (back end)
2 pieces 3" X ¾" X 25 1/16" (sides)
1 piece 5 3/16" X ¾" X 16⅛" (front end)

ILLUSTRATION BY PETER KAUFFMAN

Figure 9. Equipment and dimensions for a standard Langstroth hive.

Figure 10. Typical honey bee colonies with two hive bodies and one super (front two colonies). The colony on the left is on a hive scale. (Courtesy Dewey Caron)

full-depth and a medium or shallow for the brood area (Figure 10). However, using hive bodies similar in size permits the interchange of combs between the two hive bodies. Beekeepers who wish to avoid heavy full-depth hive bodies may elect to use three shallow hive bodies for the brood nest. This approach is certainly satisfactory, but it is also the most expensive and time consuming in assembly since it requires three boxes and thirty frames instead of two boxes and twenty frames.

FRAMES AND COMBS

The suspended beeswax comb held within a frame is the basic structural component inside the hive. In a man-made hive, the wooden or plastic beeswax comb is started from a sheet of beeswax or plastic foundation. After the workers have added wax to draw out the foundation, the drawn cells are used for storage of honey and pollen or used for brood rearing.

Frames are $17\frac{5}{8}$ inches long and either $9\frac{1}{8}$, $7\frac{1}{4}$, $6\frac{1}{4}$, or $5\frac{3}{8}$ inches high to fit the various hive-body depths. Each frame consists of a top bar, two end bars, and a bottom bar. Top bars may be either grooved or wedged; bottom bars are split, solid, or grooved. Some types may have advantages over others, but the choice is generally a personal preference that includes consideration of cost. Top bars are suspended on ledges or rabbets in the ends of the hive body. V-shaped metal strips or metal frame spacers are often nailed on the recess for reinforcement. A popular commercial end bar has shoulders to help ensure correct bee space between adjacent frames and side of the box.

The comb foundation consists of thin sheets of beeswax imprinted on each side with patterns of worker-sized cells (Figure 11). Two basic types of comb foundations are distinguished by their relative thickness: thin surplus foundation is used to produce section comb honey, chunk honey, or cut-comb honey; a thicker, heavier foundation should be used in the brood chamber and in frames for producing extracted honey. Thicker foundations often are reinforced with vertically embedded wires, thin sheets of plastic, metal edges, or nylon threads. When deciding whether to invest in plastic beeswax foundation in plastic frames versus pure beeswax foundation in wooden or plastic frames, initial cost, assembly time, durability, and length of expected use are all factors you should consider. Plastic foundation and frames are becoming increasingly popular.

When using beeswax foundation in wooden frames, securing the foundation within the frame with either metal support pins or horizontal wires is necessary. The thin wedge of the top bar secures wire hooks extending from one side of the vertically wired foundation to help secure the foundation, ensuring that it remains in the center of the frame for proper drawing by the bees. Combs may be strengthened further by embedding horizontal wires (28 or 30 gauge) into the foundation with an electric current from a small transformer or by using a spur wire embedder. This activity is time consuming and difficult to master, but only a well-supported foundation results in well-drawn combs.

Figure 11. A sheet of comb foundation suspended in a wooden frame. (Courtesy Dewey Caron)

Frames with new foundation should only be given to rapidly growing colonies such as a package, swarm, or colony split (division) or to established colonies during a major nectar flow. Workers build beeswax combs of six-sided cells by adding wax to the cell base imprints on the sheet of foundation. When foundation is given to colonies during a nectar dearth, the bees will often chew holes in the foundation, thus resulting in poorly drawn finished combs.

Beeswax is produced by four pairs of glands on the underside of the worker's abdomen. As wax is secreted and exposed to the air, it hardens into flat wax scales. To produce comb, the bees remove the wax scales from the underside of the abdomen with spines located on their middle legs. The wax scale is then passed to the mouthparts where it is manipulated until pliable and ready to be formed into six-sided cells.

QUEEN EXCLUDER

The primary functions of the queen excluder are to confine the queen and her brood and to store pollen in the brood nest. It is an optional piece of equipment and is used by less than 50 percent of beekeepers. Many beekeepers refer to queen excluders as "honey excluders" because at times workers are reluctant to pass through the narrow openings of the excluder to store nectar in the supers above until all available space in the brood chambers is used up. To minimize this problem, allow the bees to begin storing nectar in the supers before installing the excluder. Nectar stored in drawn comb will entice the bees to pass through the excluder. Never put supers of foundation above a queen excluder.

An excluder is constructed of a thin sheet of perforated metal or plastic with openings large enough for workers to pass through. Other designs consist of welded round-wire grills supported by wooden or metal frames.

Frames of honey in the super directly above the brood chamber or comb sections act as a natural barrier to keep the queen confined to the brood nest. Properly timing the reversal of brood chambers in the spring with supering during a surplus nectar flow will serve the same purpose as a queen excluder. For this reason, queen excluders are sometimes used with the addition of the first supers (but again, installed only after some nectar has been stored in the supers) and then removed. Since beeswax combs used for brood darken with use, a queen excluder can help ensure separation of brood combs from honey combs to avoid unnecessarily darkening honey.

Queen excluders also are used to separate queens in a two-queen system, to raise queens in queenright colonies, and for emergency swarm prevention. An excluder also may help in finding the queen. If you place an excluder between two hive bodies, after 3 days you will be able to determine which hive body contains the queen by locating where eggs are present.

INNER COVER

The inner cover rests on top of the uppermost super and beneath the outer telescoping cover. It prevents the bees from gluing down the outer cover to the super with propolis and wax. It also provides an air space just under the outer cover for insulation. During summer, the inner cover protects the interior of the hive from the direct rays of the sun. During winter, it prevents moisture-laden air from directly contacting cold surfaces. The center hole in the inner cover may be fitted with a Porter bee escape to aid in removing bees from full supers of honey.

OUTER COVER

An outer telescoping cover protects hive parts from the weather. It fits over the inner cover and the top edge of the uppermost hive body. The top is normally covered with a sheet of metal to prevent weathering and leaking. Removal of the outer cover, with the inner cover in place, disturbs few bees within the hive and allows the beekeeper to more easily smoke the bees prior to colony manipulation.

Beekeepers that routinely move hives use a simple cover, often referred to as a migratory lid. Covers of this type fit flush with the sides of the hive body and may or may not extend over the ends. In addition to being lightweight and easy to remove, these covers allow colonies to be stacked. Tight stacking is important in securing a load of hives on a truck.

OTHER PIECES OF HIVE EQUIPMENT

In addition to the basic hive components, adding other pieces of equipment is possible. A few beekeepers like to use the slatted bottom board, others a different English-style cover. Beekeeping offers much room for creativity and individualization.

PLASTIC HIVE EQUIPMENT

The basic parts of the hive traditionally have been made out of pine, cypress, or redwood. Today all hive components are available in plastic. Plastic hive components and plastic frames that snap together are durable, strong, lightweight, easy to assemble, and require little maintenance. While plastic frames and foundation are becoming increasingly popular, plastic hive covers, bottom boards, and hive bodies have not proved to be as useful because plastic does not breathe and does not allow easy moisture ventilation. Plastic also warps easily, and some types let in too much light, which makes drawing foundation difficult.

PAINTING THE HIVE PARTS

All parts of the hive exposed to the weather should be protected with paint. Do not paint the inside of the hive; the bees will varnish it with propolis (a mix of plant sap and wax). The only purpose in painting is to preserve the wood. Most beekeepers use a good latex or oil-based, exterior, white paint. A light color is desirable because it prevents heat buildup in the hive during summer. Although white is a traditional color, various combinations of colors will help reduce drift between colonies.

SUPPLIERS

New bee equipment is generally "knocked down" or unassembled when purchased, but you can also purchase assembled equipment for a higher price and shipping fee. Assembly directions are furnished by bee supply dealers and are usually easy to follow. Novice beekeepers are strongly encouraged to seek the help of a more experienced beekeeper in assembling the hive components for the first time. Beginners should purchase their equipment early so that they can put together and paint hives before the bees arrive. Sheets of foundations should not be installed in the frames until needed because storage temperatures and handling may cause the wax to stretch and warp, resulting in poorly drawn combs.

Some beekeepers find they can save money by making their own equipment or by purchasing used equipment. With both approaches, the equipment must be a standard size. When constructing beekeeping equipment, a thorough understanding of bee space is a necessity. You can consult readily available construction plans, such as those supplied on page 8, or use commercial pieces as a pattern. Many beekeepers find they can economically make covers, hive bodies, and bottom boards, but frames are more difficult and time consuming. Success depends on availability and cost of materials, proper woodworking equipment, and the beekeeper's woodworking skills.

Purchasing used equipment can present problems and is not recommended for the beginner. Initially you may have problems simply locating a source of used equipment and determining its value or worth. In addition, secondhand equipment may be of non-standard dimensions or contaminated with pathogens that cause various bee diseases, despite considerable time in storage. Always ask for an inspection certificate indicating that the state apiary inspector examined the hives and did not find any evidence of disease.

For additional information and sources on beekeeping equipment and supplies, see the list of dealers in the appendix or consult local and regional beekeeping newsletters, your local county extension office, national and regional beekeeping publications, or the MAAREC Web site (maarec.cas.psu.edu).

Ancillary Equipment

SMOKER

A bee smoker and hive tool are essential for working bees. The smoker consists of a metal fire pot and grate with bellows attached. The size of the smoker is a matter of individual preference. The 4 x 7 inch size is probably the most widely used. Plan to purchase/use a smoker with a heat shield around the firebox to avoid burning clothing or yourself if you intend to support the smoker between your legs as you work a colony. Some beekeepers like the model with a hook to hang the smoker over the open hive body as they inspect it, thus keeping the smoker handy at all times.

To produce large quantities of cool, thick smoke, coals must be above the grate and unburned materials must be above the coals. Suitable smoker fuels

include burlap, corn cobs, wood shavings, pine needles, cardboard, punk wood, bark, sumac bobs, cotton rags, dry leaves, and bailer twine. An alternative liquid smoke is available that you mix with water and spray onto the bees with a mister-type applicator.

HIVE TOOL

The hive tool is a metal bar essential for prying apart frames in a brood chamber or honey super, separating hive bodies, and scraping away wax and propolis (Figure 12). Holsters to hold hive tools are available, but many beekeepers prefer to hold the hive tool in the palm of their hand to keep it accessible and to keep their fingers free for lifting boxes and frames. The hive tool should be cleaned from time to time to remove propolis, wax, and honey. This may be done simply by stabbing the tool into the ground or by burning it in the hot fire pot of a smoker. Both cleaning methods help prevent the spread of bee diseases. A screwdriver or a putty knife are poor substitutes for a sturdy hive tool and may cause frame/hive body damage.

Figure 12. A hive tool being used to remove burr comb from the top bars on the comb. (Courtesy Dewey Caron)

Protective Clothing

You should wear a bee veil at all times to protect your face and neck from stings. Three basic types of veils are available: those that are open at the top to fit over a hat, completely hatless veils, and veils that form part of a bee suit. A wire or fabric veil that stands out away from the face worn over a wide-brim, lightweight hat that fits securely offers the best protection. Veils without hats, although lightweight and fold easily for transport, do not always fit as securely on the head as they should. The elastic band that fits around your head often works upward, allowing the veil to fall against your face and scalp as you bend over to work with bees.

A wide variety of coveralls (bee suits) is available to beekeepers in a wide price range. The most expensive bee suits are not always the best or easiest to use. Coveralls are useful to avoid getting propolis on your clothing and greatly reduce stings if maintained properly and laundered regularly. Coveralls or shirtveils (long-sleeved shirts) made especially for beekeepers with attached, removable veils are popular.

White or tan clothing is most suitable when working bees. Other colors are acceptable, but bees react unfavorably to dark colors, fuzzy materials, and clothing made from animal fiber. Windbreakers and coveralls made from ripstop nylon fabric are excellent for working bees, although they may be too hot to use in the summer.

Beginners who fear being stung should wear canvas or leather gloves. Many experienced beekeepers find gloves cumbersome and decide to risk a few stings for the sake of easier handling. Form-fitting gloves (such as those suitable for lab work or household chores) reduce stings and sticky fingers from honey and propolis. Ankles with dark socks and open wrists are areas vulnerable to stings. Angry bees often attack ankles first because they are at the level of the hive entrance. You should secure your pant legs with string or rubber bands or tuck them inside your shoes or socks. Secure open shirtsleeves with Velcro, rubber bands, or wristlets to reduce stings to these sensitive areas.

You should avoid using after-shave lotions, perfumes, and colognes when working with bees because such odors may attract curious bees. Regularly launder clothing and gloves used in inspection to eliminate sting/hive odors that might attract/irritate bees.

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About Honey Bees

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The Three Bees

There are different types of bees in a honey bee hive: Worker, Drone and Queen. Each has its own important roles and performs specific duties in a bee colony.

The queen bee can be recognized by her abdomen, which is usually smooth and elongated, extending well beyond her folded wings. Her function in the hive is one of production. She is normally the only reproductive female in the colony. Egg-laying begins in early spring, initiated when the first fresh pollen is brought home by the workers. Egg production will continue until fall, or as long as pollen is available. At the height of her productivity, the queen could lay as many as 2000 eggs each day. A queen bee can live for up to five years, but her period of usefulness rarely exceeds two or three years. Younger queens produce many more eggs, and older ones may produce excessive drones. Many beekeepers re-queen their colonies every year or two. Older queens are often superseded (replaced) by the workers without any assistance, or even knowledge, of the beekeeper. Good quality queens can be reared by an experienced beekeeper, but a beginner will usually do better to buy good queens from a reputable producer.

Queen bees also produce a pheromone known as **queen substance** . This mixture of chemicals is passed individually from bee to bee throughout the entire hive as they share food. If a queen bee is removed from a colony, the workers will notice her absence within several hours because of the drop in the level of this pheromone. This queenless state quickly initiates the urge to rear a new "emergency" queen from the youngest available larvae (1-3 days old). The presence of this pheromone also inhibits the development of the workers' ovaries. After a period of queenlessness, some may become laying workers. Workers also evaluate their queen based on the quantity of the pheromones she produces. If workers begin to receive an insufficient dose each day, they may perceive her as poor quality, and begin making preparations to supersede her. Beekeepers often mark the queen's thorax with a dot of paint to make her easy to find, and to determine if she has been replaced.

Workers are the smallest of the bee castes, but are by far the most numerous. All workers are female, and normally incapable of reproduction. They are unable to mate, but in a hopelessly queenless colony, workers may begin to lay unfertilized eggs, which develop into drones. Workers do all of the necessary tasks within a colony. They secrete the wax used in the hive, and form it into honeycombs. They forage for all of the nectar and pollen brought into the hive, and transform the nectar into honey. They produce royal jelly to feed to the queen and young larvae. They also tend to the needs of the larvae and queens. They cap the cells of mature larvae for pupation and remove debris and dead bees from the hive. Worker bees defend the hive against intruders and maintain optimal conditions by heating, cooling and ventilating the hive. Workers have well-developed compound eyes on the sides of their heads, and three simple eyes (ocelli) at the vertex. Their tongue is well developed and elongated for taking up nectar from flowers.

Workers reared in the spring and early summer tend to live for five to six weeks. The first two weeks of their lives is spent as house bees, doing tasks in the hive. The remainder of their time is spent as field bees, foraging for food outside the hive. Workers that reach maturity in the late fall may live well into the following spring. They must maintain a cluster of bodies around the queen bee, keeping her warm through the winter months. Later, when egg-laying resumes, they must raise the first generation of young bees the next year.

Drones are the male honey bees. They are visibly larger and stouter than workers. They possess large distinctive eyes that meet on the top of their heads, and have antennae slightly longer than the workers or queen. Their mouth parts are generally reduced. Drones develop from unfertilized eggs, and drone cells are visibly larger than those of workers. Drones do not tend the brood, produce wax, or collect pollen or nectar. They will feed themselves directly from honey cells in the hive, or beg food from worker bees.

The only function of a drone is to fertilize a young queen bee. They are reared chiefly in the spring and summer, beginning about four weeks before new queens are produced, thus ensuring that ample drones will be available to mate with emerging queens. Their day is typically divided between periods of eating and resting, and patrolling mating sites known as **drone congregation areas** . Drone production will cease in the late summer, as the quantity of available food declines. Before winter, the drones are usually driven out of the hive by workers, who guard against their return. A colony that has lost its queen may develop laying workers, who can produce only drones. When this occurs, the colony is effectively doomed. The production of many drones, therefore, will be their final effort to pass on the colony's genetic line by mating with a virgin queen from another colony.

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Races of Honey Bees

Around 20,000 species of bees have been described in the superfamily Apoidea. These all share a number of common traits that are unique to bees, and separate them from the rest of the Hymenoptera. While ants and wasps are carnivorous in at least some stage of their life cycle, bees are completely herbivorous, deriving all of their nutrition from the pollen and nectar of flowers (an exception to this is when, under nutritional stress, worker bees may kill and consume bee larvae, thus conserving the protein). The anatomy of the bee is superbly adapted for the collection of their food from flowers.

Multiple species of bees are kept around the world. In some tropical regions of Africa, Australia, and the Americas, native stingless bees are kept for honey production. In Asia several species of *Apis* are utilized by people. But the western honey Bee, *Apis mellifera*, is the most common bee kept for honey and pollination around the world. Originating in Africa, the western honey bee spread across the entire continent and into Europe and the Middle East, occupying environmental niches. Over centuries in isolation, distinct races, or sub-species, of *Apis mellifera* adapted to specific regions and climates, and acquired recognizable differences in behavior, appearance, and disposition.

Numerous races of the honey bee are recognized, and have been kept by people in many cultures throughout history. Each of the races of has genetic traits that are potentially desirable for beekeeping, such as honey production or disease resistance, and they may possess other traits that are less desirable, such as susceptibility to disease, or a highly defensive temperament. All of these races of honey bee are sub-types of a single species, and are capable of successfully interbreeding, resulting in hybrid bees types.

While honey hunting for wild bees' nests was probably common throughout the ancient world, the Egyptians were among the first to attempt keeping bees in artificial hives. Barges loaded with colonies of *Apis mellifera* lamarkii would travel up and down the Nile River, following the seasonal abundance of flora. As beekeeping methods spread, most ancient cultures are known to have kept the bees that were endemic to their regions. As Europeans explored and colonized other parts of the globe, they have transported and established the western honey bee on every continent except Antarctica. These bees adapted and thrived in many places while in others, they succumbed to parasites and diseases originally adapted to other bee host species. In the early 1600s, English colonists brought hives of *Apis mellifera* mellifera to the Jamestown settlement. These bees thrived in the old growth forests of the New World, and spread west in advance of the pioneers. These bees were said to be easily excitable, "runny" on the combs, and susceptible to some diseases, however they overwintered well in cold climates. In the mid-19th century, the Italian race of bees, *Apis mellifera* lingustica, was imported to the U.S. and became the most popular race of domestic honey bee due to a gentle disposition and high honey production.

Bees adapted to conditions in Europe faced fewer predators than those in Africa. The cold winters of northern Europe encouraged bees to gather excess honey for winter food, and forced the bees to develop their overwintering strategy of clustering for warmth. These traits helped the honey bees to thrive in North America, but when they were imported to South America, they did not fare as well in the tropical environment. In an attempt to breed a productive honey bee that was adapted to a tropical climate, Brazilian scientists in 1956 imported colonies of *Apis mellifera scutellata* from Tanzania. In 1957, some of the bees escaped and bred with populations of European honey bees in Brazil. These hybrids became known as **Africanized honey bees** (AHB) and thrived in the tropical environment. They quickly spread and have since moved through Central America and Mexico, effectively replacing most of the European bee stock in these regions. In 1990 the first AHBs were detected in Texas. In 2005 they had entered Arkansas. Re-queening colonies with bees of known gentle European stock will be essential in maintaining beekeeping in Arkansas with the arrival of the AHB.

Many races and hybrids of European honey bees are available for purchase in the U.S. There is no "perfect" honey bee for all locations, but the mixtures of traits that each type possesses can help the beekeeper choose a variety that may do well in a particular climate. Because honey bee stocks are constantly transported around the U.S. for sale and for pollination of crops, and because the mating behavior of honey bees takes place far outside of the hive, maintaining pure strains of any line of bees is practically impossible without instrumental insemination techniques or extremely isolated bee yards. The table at right compares some of the general characteristics associated with some of the common races of honey bees.

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Anatomy of a Worker Honey Bee

The honey bee is an elegant creature, and a blend of aesthetics and functionality. Nearly every aspect of a honey bee's body and many of its behaviors are perfectly adapted for its role as a pollinator. (Photo by Jon Sullivan, pdphoto.org)

Wings

The ability to fly far and fast has greatly contributed to the success of bees. They can forage up to three miles from their hives, and reach speeds of 15 miles per hour. Bees have four wings, but a row of small hooks, called hamuli, on the leading edge of the hindwing fits securely into a groove on the trailing edge of the forewing, allowing the bee to couple the wings together into a single flight surface. When at rest, the bee can unhook its wings and fold them back. (Photo by Jon Sullivan, pdphoto.org)

Compound eyes

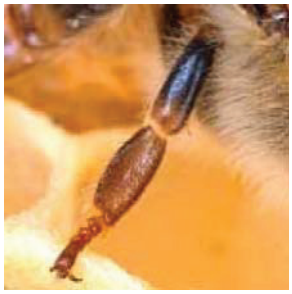
Each of a honey bee's compound eyes contain over 6500 separate facets, allowing it to see in front, to the side, above and below itself. In addition, bees can perceive all the colors visible to humans except for red, which appears black to them. Honey bees, like many other insects, can see UV light as a separate color, which we cannot. Bees can also detect the polarization of UV light, which aids their navigation on cloudy days, when the sun is not visible in the sky. Bees also have three simple eyes, called ocelli, that are grouped together near the top of the head. These are sensitive to light, but cannot focus an image, and are likely used to orient to light. (Photo by Scott Bauer, USDA)

Antennae

A bee's antennae are covered with thousands of sensory cells for touch and smell. A bee's sense of smell is much more acute than any mammal's and is very important locating food and in communication between hive members. These sensitive organs also relay information about air speed and orientation during flight.

Branched setae

The bee's body is covered with branched setae, or feathery hairs. Pollen grains stick to these hairs as the bees forage on flowers. Some of the pollen is transferred to new plants, resulting in fertilization of the flowers. The rest is later combed into the pollen basket, and carried back to the hive. Most insects have some setae on their bodies, which aid in their sense of touch, but these finely branched hairs are unique to the bees. (Photo by Petr Kratochvil, www.publicdomainpictures.net)



Legs

The bee's six strong legs provide a very stable base for walking or standing, ensuring that at least three feet can contact the surface at all times when moving. Each foot is equipped with claws for grabbing uneven surfaces, as well as a sticky pad for gripping smooth surfaces. Each pair of legs is also equipped with special structures and arrangements of setae for grooming the body or pollen and debris.
(Photo by Scott Bauer, USDA).

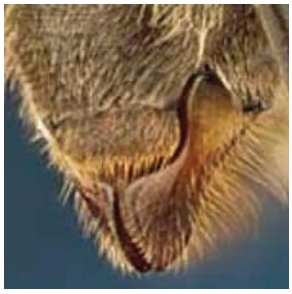
Pollen basket
The pollen basket, or corbicula, is made of long stiff hairs that curve around a wide flattened section of the honey bee's back leg. Stiff hairs on the other legs are used to comb pollen grains from the bee's body, which is compacted and stored in the pollen basket for transport back to the hive. (Photo by Scott Bauer, bugwood.org)

Proboscis

The honey bee has a long tongue, or proboscis, which it uses to lap up nectar from deep inside of flowers. (Photo by Rose-Lynn Fisher)

Wax glands

Wax glands on the underside of the bee's abdomen secrete flakes of beeswax, which is used to build the honeycombs. Many bees work together to produce and form the wax that becomes their home. Bees must consume at least eight pounds of honey in order to metabolize one pound of wax. (Photo by Zack Huang, cyberbees.net)

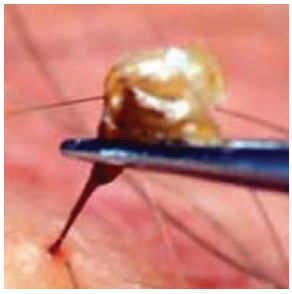


Mandibles

These mouthparts, or mandibles, are strong and very useful. The jaws are attached to powerful muscles, and can be used to pick up and remove debris from the hive, to attack intruders, and to delicately manipulate the wax into perfectly formed honeycombs. (photo by Charles Krebs)

Warning colors

Yellow and black stripes are nature's warning colors. Like many wasps and bees, these highly visible markings warn other animals that the insect can be dangerous. Many harmless flies have adopted these colors as well, to fool predators into thinking they may be able to sting. (Photo by Jon Sullivan, pdphoto.org).



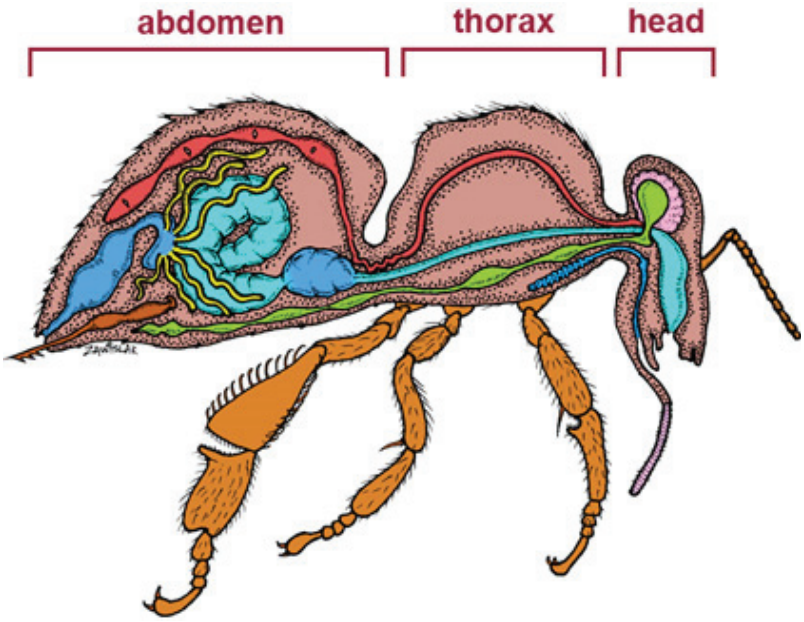
Stinger

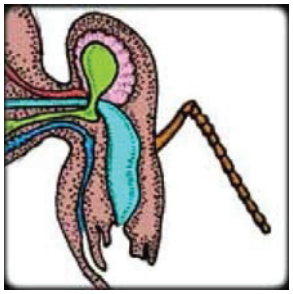
The stinger is used by the bee only for defense. The end is barbed, like a fish hook, so it can penetrate skin, but not easily come out. When a bee stings, its stinger and attached venom sac is torn from her abdomen, and she will die shortly afterward. Honey bees are not naturally aggressive, and are reluctant to sting unless they feel that they, or their nest, are threatened. The shaft of the stinger is a modified ovipositor (egg-laying structure), and is therefore only found in worker bees. The queen bee's ovipositor is not barbed, and is used for egg-laying, but she can sting rival queens and occasionally will sting a careless beekeeper if she is mishandled. (Photo by Scott Bauer, USDA)

Session 3 - Bees

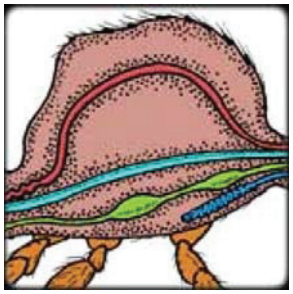
Internal Anatomy of a Honey Bee

Like all insects, a honey bee's body is divided into 3 segments: the head, thorax, and abdomen (illustration by Jon Zawislak).

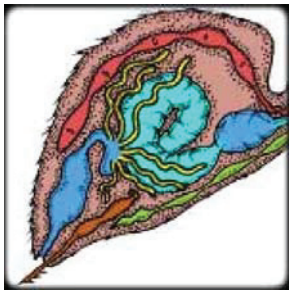




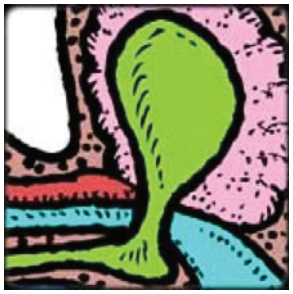
The **head** is dominated by large compound eyes, sensitive antennae and a complex arrangement of mouthparts. The bee's head also houses the brain and contains several important glands.



The **thorax** is primarily used in locomotion, as the attachment site for six legs and four wings. The ventral nerve cord, heart and esophagus pass through, but most of the space inside the thorax is taken up by sets of powerful flight muscles. Salivary glands are located ventrally, near the front of the thorax, connecting by a duct to the oral cavity in the head.



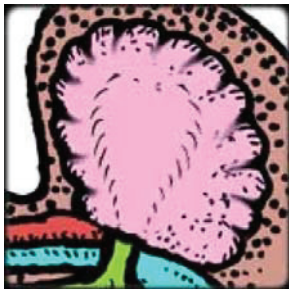
The **abdomen** protects the organs for the digestive system. Also present are the heart, venom sac, and several glands. The reproductive organs are also located in the abdomen. In a laying queen bee, the ovaries take up much of the space here, and account for the larger size of the abdomen. Among the sterile worker caste, however, these remain undeveloped.



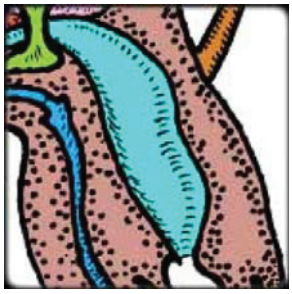
The **brain** appears dominated by the optic lobes, which process the visual input from the large compound eyes. Honey bees also have excellent memory processing and learning abilities, necessary for long foraging flights away from their hives. The brain coordinates and regulates the functions of all the bodily systems. While only about 1 cubic millimeter in size, the honey bee's brain contains some of the most densely-packed neuropil tissue known in any animal brain.

Session 3 - Bees

The **ventral nerve cord** runs the length of the bee's body, connecting the brain with all the other organs and systems. Numerous ganglia along the way assist in coordinating local neural processing.

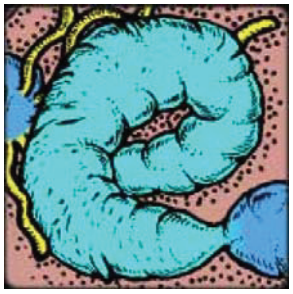


Worker bees possess a **hypopharyngeal gland** that produces royal jelly, or bee milk. This rich blend of proteins and vitamins is fed to all bee larvae for the first three days of their lives, after which workers and drones are fed a mixture of pollen and honey. When a female larva is fed continuously on royal jelly, she will rapidly develop into a queen bee. This nutritious diet will remain the only food that a queen will ever consume, allowing her to maintain a high level of continuous egg production.



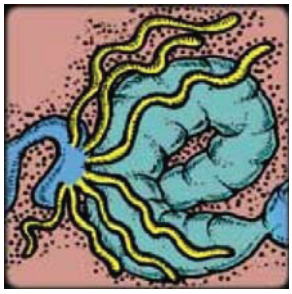
The **pharynx** is the first section of the alimentary canal. Strong muscles here provide suction to draw in nectar from flowers. This is also the site for taste reception in insects.

The **honey crop** (also called the honey stomach) is where the worker bee stores collected nectar for the trip back to the hive without digesting it. A muscular valve called the proventriculus can be closed, keeping the nectar from passing into the stomach. The crop is expandable, allowing the bee to carry a larger load. Back in the hive, the contents of the crop can be ejected back through the mouth for storage in a honey cell or to feed other bees by trophallaxis.

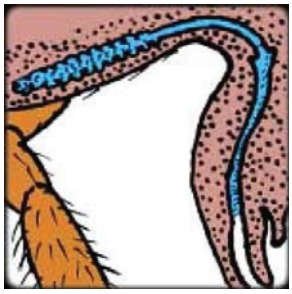


The true **stomach** (or ventriculus) is the site of primary digestion for pollen and nectar. Coiled around in the abdomen, it is actually about twice the length of the bee's body. The epithelial cells that line the stomach wall are the site of attack by the microsporidia Nosema.

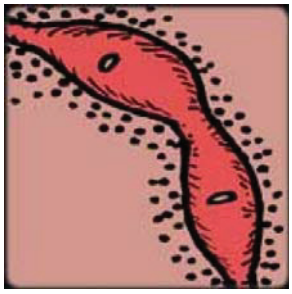
The **hind gut** is composed of the intestine and rectum, where reusable metabolic products are reclaimed and excess water is reabsorbed into the body. The rectum is also distensible, and can hold a large volume of waste matter. Bees keep meticulously clean nests, and will hold their wastes until they can make a "cleansing flight" outside of the hive. In climates with long, cold winters, bees can actually wait for weeks or months to perform this task.



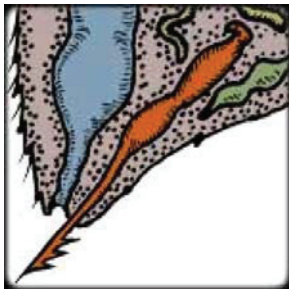
Numerous **Malpighian tubules** connect to the basal end of the hid gut and float freely in the abdominal cavity. They function much like the kidneys of vertebrates, removing excess salts and metabolic wastes from the blood and concentrating it into the intestine, where it can be removed.



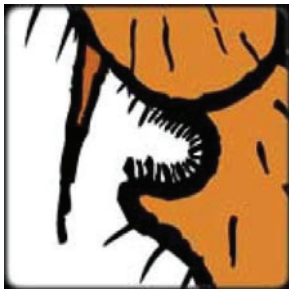
Salivary glands are located in the front of the thorax, and connected to the mouth by a duct. This gland produces enzymes which aid in the breakdown of food. In particular, an enzyme called invertase is released, which functions to break down the sugars in nectar, and is essential to the process of converting it into honey.



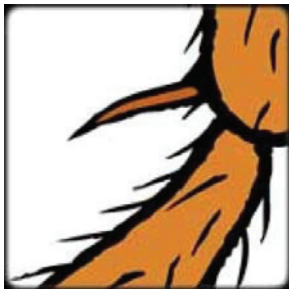
An insect's **heart** is simply a series of musculated chambers connected the aorta, a tube that runs forward to the head. When relaxed, blood from the abdominal cavity enters the heart chambers through openings called ostioles. When it contracts, the ostioles close, and blood is forced forward through the aorta to the brain, and then circulates back through the thorax, bathing all the organs and muscle tissues along the way. This type of open circulatory system is well well-suited for a small insect.



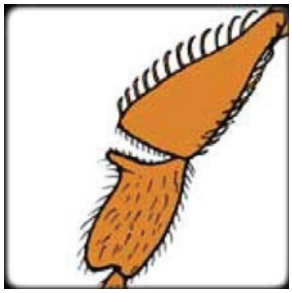
Connected to the stinger is a **venom sac**, which holds a mixture of protein chemicals (the venom) and alarm chemicals. These proteins can quickly cause a painful localized reaction in vertebrates, which can be severe to life-threatening in highly sensitive individuals. When a bee stings, the barbed shaft of the stinger is left behind, along with the venom sac. An attached muscle continues to pump venom through the stinger, even after it has been disconnected from the bee. For this reason, a bee stinger should be removed immediately by scraping it with a credit card or pocket knife blade, and not by pinching it, which can forcibly inject the venom into the skin.



The antennae are important sensory organs for the bee, which must remain clean in order to function effectively. Each of bee's front legs is equipped with an **antenna cleaner**. This specialized notch is lined with numerous fine, stiff setae. As the shaft of the antenna is drawn through, debris is removed. The tibial spur on the front legs helps to hold the antenna against the notch.



The **tibial spur** of the middle legs can be used to stab the fresh wax flakes secreted by glands on the lower abdomen. The wax can then be transferred to the mandibles where it is be shaped and positioned on the comb.



The **pollen press** is located just below the pollen basket on the hind legs. As pollen is combed from the rest of its body, the bee uses this leg joint to compress the grains into a dense mass, which can be more efficiently stored in the corbicula.

For further reading, **The Anatomy Of The Honey Bee** by **R.E. Snodgrass** is now available online in the Google Book archive.

For detailed video lessons on honey bee structure visit the **Understanding Bee Anatomy website** .

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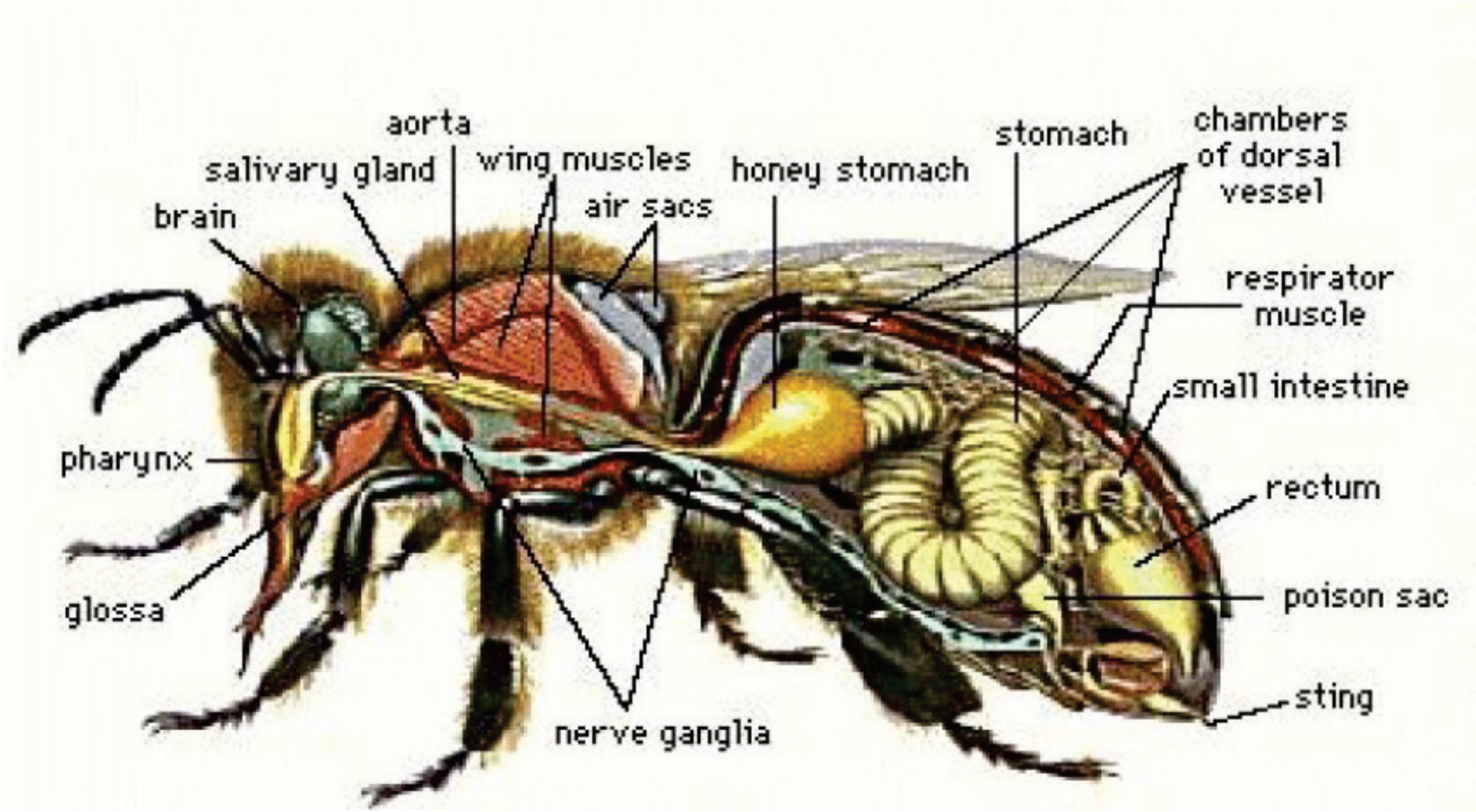

INFORMATION SHEET 1

Bee Basics

Bees may not have a good reputation because of their ability to sting, but many are important and beneficial. Honey bees are the bees with the best public image. We see them as industrious ("busy as a bee") and we appreciate their main product, honey, as setting the standard for all that is wonderful and sweet. Here we will discuss some basic facts and history about bees.

Over 25,000 species of bees have been identified in the world, with perhaps as many as 40,000 species yet to be identified. In the continental United States scientists have found approximately 3,500 species of bees. The desert regions of northern Mexico and southern Arizona have the richest diversity of bees found anywhere in the world. Although there is no exact count, a bee scientist at the USDA Carl Hayden Bee Research Center says there are between 1,000 and 1,200 species of bees within 100 miles of Tucson!

You may wonder how this can be true. It turns out that not all bees are social bees that live in large families like bumble bees and honey bees. Most are less well-known bees called solitary bees, for example carpenter bees, leafcutter bees, alkali bees, digger bees or sweat bees. Female solitary bees build their own nests and provide food for only their own offspring. All bees collect pollen and nectar, and many of the solitary species are essential because they pollinate plants ignored by honey bees.

What we call honey bees are represented by eight to 10 species in the genus *Apis*, a name from which comes the word for beekeeping (apiculture) and the word for a bee yard (apiary). The species of honey bee commonly found today in Europe, Africa, the Middle East and the Americas is *Apis mellifera*, which means honey carrier. This name is not technically correct as the bees carry nectar from flowers which they then use to produce honey back in the hive. Only when the bees are moving to a new nest (swarming) do they carry honey.

There are 24 races of *Apis mellifera*. The races have different physical and behavioral characteristics such as body color, wing length, and susceptibility to disease. But, since they are all of the same species, bees from one race can mate with bees from another race, creating even more variation within the honey bee universe. Caucasian bees (*A. mellifera caucasica*) are known to be extremely docile, whereas the black or German bees (*A. mellifera mellifera*) are known to overwinter well in severe climates. The African group of bees includes not only the largest number of geographic races (12), but also some of the best known, such as the notorious *A. mellifera scutellata.* It was a few queens of this highly defensive race that were brought into Brazil in 1957 and started the bees we now know as "Africanized honey bees."

The true honey bee was not native to the Americas. Prior to Columbus, people in Central and South America collected honey from bees known as "stingless bees." Although stingless bees do actually lack a stinger, they are not completely defenseless. They can inflict painful bites with their mandibles. They also do not produce honey in the same quantity as *A. mellifera*.

In the early part of the 16th century, the Spanish brought over the first honey bee colonies. English colonists did the same and soon honey bees had escaped into the wild and were buzzing all over North America. In some cases, the honey bees travelled in advance of the European settlers and came in

contact with Native American tribes, who dubbed them "white man's flies." By the time the frontier had been settled, late in the 19th century, honey bees were regarded as a natural part of the insect world in North America.

In Brazil and other tropical areas, the introduced honey bees did not survive as well as they did in temperate climates. In an effort to improve honey production in the tropics, a scientist began some breeding experiments using some of the common European honey bees and crossing them with the *A. mellifera scutellata* bees. This Africanized mixture proved to have the highly defensive behavior of the African race. In 1957 some of the bees escaped, and they have been slowly spreading northwards ever since. Africanized honey bees reached Arizona in 1993.

More than 211,000 beekeepers maintain about 3.2 million honey bee colonies in the United States. Beekeepers often use their bees for pollination of crops rather than for honey production. In fact, one third of our food production is the direct result of pollination by insects. So, although we will have to be more cautious of honey bees in the future, they will remain an important part of our environment.

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INFORMATION SHEET 2

The Honey Bee Body

Honey bees have many characteristics common to all insects. Insects have a hard outer covering called an exoskeleton, rather than an internal skeleton like vertebrates. The exoskeleton, which is made of a material called chitin, helps to protect the internal organs of the insect and helps prevent desiccation (drying out). In order to grow, the insect must shed the exoskeleton.

Insects have three body regions: the head, thorax and abdomen. The head contains the sensory organs, and appendages for ingestion. The thorax contains the appendages for locomotion, the legs and wings. The abdomen contains the organs for digestion and reproduction.

Honey Bee Anatomical Characteristics

Abdomen. The honey bee abdomen is composed of nine segments. The wax and some scent glands are located here in the adult. The sting is contained in a pocket at the end of the tapering abdomen in adult females.

Antenna(e). The form of the antenna in insects varies according to its precise function. The antennae are feathery in male moths, elongated in the cockroach, short and bristle-like in the dragonfly, and bead-like in the termite. In honey bees, the segmented antennae are important sensory organs. The antennae can move freely since their bases are set in small socket-like areas on the head. Each of the antennae are connected to the brain by a large double nerve that is necessary to accommodate all of the crucial sensory input. The tiny sensory hairs on each antenna are responsive to stimuli of touch and odor.

Eye(s). Honey bees and people do not see eye to eye. Although honey bees perceive a fairly broad color range, they can only differentiate between six major categories of color, including yellow, blue-green, blue, violet, ultraviolet, and also a color known as "bee's purple," a mixture of yellow and ultraviolet. Bees can not see red. Differentiation is not equally good throughout the range and is best in the blue-green, violet, and bee's purple colors.

Like most insects, honey bees have compound eyes that are made up of thousands of tiny lenses called facets. Scientists think that each facet in a compound eye takes in one small part of the insect's vision. The brain then takes the image from each tiny lens and creates one large mosaic-like picture. This image is somewhat analogous to the image produced on a television screen, in which the "picture" is essentially a grid composed of dots of light. The advantage of the compound eye is its ability to detect movement. Honey bees can easily differentiate between solid and broken patterns, but show a preference for broken figures. Related to this, bees respond more readily to moving flowers than to stationary ones. Therefore, their eye is better adapted for movement perception than for form percep tion.

Honey bees also have three smaller eyes in addition to the compound eyes. These simple eyes or "ocelli" are located above the compound eyes and are sensitive to light, but can't resolve images.

Head. The honey bee head is triangular when seen from the front. The two antennae arise close together near the center of the face. The bee has two compound eyes and three simple eyes, also located on the head. The honey bee uses its proboscis, or long hairy tongue, to feed on liquids and its mandibles to eat pollen and work wax in comb building.

Leg(s). The honey bee has three pairs of segmented legs. The legs of the bee are prima rily used for walking. However, honey bee legs have specialized areas such as the anten nae cleaners on the forelegs, and the pollen baskets on the hind legs.

Mandible(s). T he honey bees have a pair of mandibles located on either the side of the head that act like a pair of pliers. The mandibles are used for any chores about the hive that require grasping or cutting, such as working wax to construct the comb, biting into flower parts (anthers) to release pollen, carrying detritus out of the hive, or gripping enemies during nest defense.

Proboscis. The proboscis of the honey bee is simply a long, slender, hairy tongue that acts as a straw to bring the liquid food (nectar, honey and water) to the mouth. When in use, the tongue moves rapidly back and forth while the flexible tip performs a lapping mo tion. After feeding, the proboscis is drawn up and folded behind the head. Bees can eat fine particles like pollen, which is used as a source of protein, but cannot handle big particles.

Pollen Basket(s). A smooth, somewhat concave surface of the outer hind leg that is fringed with long, curved hairs that hold the pollen in place. This enclosed space is used to transport pollen and propolis to the hive. Also called a corbicula.

Pollen Press. Once the bees have gathered the pollen, they move it to the pollen press located between the two largest segments of the hind leg. It is used to press the pollen into pellets.

Rakes and Combs. Structures on the legs used to collect and remove pollen that sticks to the hairy bodies of honey bees.

Stinger. The stinger is similar in structure and mechanism to an egg-laying organ, known as the ovipositor, possessed by other insects. In other words, the sting is a modified ovipositor that ejects venom instead of eggs. Thus, only female bees can have a stinger.

The sting is found in a chamber at the end of the abdomen, from which only the sharp -pointed shaft protrudes. It is about 1/8-inch long. When the stinger is not in use, it is re tracted within the sting chamber of the abdomen. The shaft is turned up so that is base is concealed. The shaft is a hollow tube, like a hypodermic needle. The tip is barbed so that it sticks in the skin of the victim. The hollow needle actually has three sections. The top section is called the stylet and has ridges. The bottom two pieces are called lancets. When the stinger penetrates the skin, the two lancets move back and forth on the ridges of the

stylet so that the whole apparatus is driven deeper into the skin. The poison canal is en closed within the lancets.

In front of the shaft is the bulb. The ends of the lancets within the bulb are enlarged and as they move they force the venom into the poison canal, like miniature plungers. The venom comes from two acid glands that secrete into the poison sac. During stinging, the contents of the alkaline gland are dumped directly into the poison canal where they mix with the acidic portion.

When a honey bee stings a mammal, the stinger becomes embedded. In its struggle to free itself, a portion of the stinger is left behind. This damages the honey bee enough to kill her. The stinger continues to contract by reflex action, continuously pumping venom into the wound for several seconds.

Thorax. The thorax is the middle part of the bee and is the anchor point for six legs (three pair), as well as two sets of membranous wings in the adult. Pollen baskets for carrying pollen back to the hive are located on the hind legs.

Wax Gland(s). Four pairs of glands that are specialized parts of the body wall, which during the wax forming period in the life of a worker, become greatly thickened and take on a glandular structure. The wax is discharged as a liquid and hardens to small flakes or scales and sits in wax pockets. The worker bee draws the wax scales out with the comb on the inside hind leg. The wax scale is then transferred to the mandibles where it is chewed into a compact, pliant mass. The beeswax is then added to the comb. After the worker bee outgrows the wax forming period, the glands degenerate and become a flat layer of cells.

Wing(s). The honey bee has two sets of flat, thin, membranous wings, strengthened by various veins. The fore wings are much larger than the hind wings, but the two wings of each side work together in flight. Just flapping the wings does not result in flight. The driv ing force results from a propeller-like twist given to each wing during the upstroke and the downstroke.

INFORMATION SHEET 3

Honey Bee Biology

The following is a discussion of the members of a honey bee colony, their development and their duties within the colony.

The vast majority of adult honey bees in any colony are female **worker** bees. The jobs of the worker bees are: tending and feeding young bees (larvae), making honey, making royal jelly and beebread to feed larvae, producing wax, cooling the hive by fanning wings, gathering and storing pollen, nectar and water, guarding the hive, building, cleaning and repairing the comb, and feeding and taking care of the queen and drones. In part, the job the worker honey bee performs on any given day depends on its age.

As insects, honey bees pass through four distinct life stages: the **egg**, **larva**, **pupa** and **adult**. The process is called complete metamorphosis, which means that the form of the bee changes drastically from the larva to the adult. Passing through the immature stages takes 21 days for worker bees. On the first day, the queen bee lays a single egg in each cell of the comb. The egg generally hatches into a larva on the fourth day. The larva is a legless grub that resembles a tiny white sausage. The larva is fed a mixture of pollen and nectar called **beebread**. On the ninth day the cell is capped with wax and the larva transfor ms into the pupa. The pupa is a physical transition stage between the amorphous larva and the hairy, winged adult. The pupa doesn't eat. On day 21, the new adult worker bee emerges.

The male members of the colony, the **drones**, are somewhat larger and make up only about five percent of the hive population. Drones are fed **royal jelly**, and develop in a slightly larger cell than worker bees from unfertilized eggs. Drones remain in the pupal stage for 15 days, so they don't emerge until day 24. Drones have huge compound eyes that meet at the top of their head and an extra segment in their antennae. In comparison to worker bees, drones have wider bodies and their abdomens are rounded rather than pointed. Drones, like all other male bees and wasps, do not have stingers.

There is only one **queen** in a honey bee colony. She is slightly larger than a worker bee, with a longer abdomen. She does not have pollen baskets on her legs. Eggs destined to become queens are laid in a larger cell, and the larvae are fed only royal jelly. The adult queen's sole duty is to lay eggs, up to 2,000 a day! She is fed by the workers and never leaves the hive except to mate.

Queen bees also have stingers and use them in battles with each other for dominance of the colony. If a new queen emerges from her incubation cell and is detected by the current queen, the "old lady" often goes over and kills her rival. In this way, the stability of the colony is maintained. When a queen gets old or weak and slows her production of queen substance, she is generally replaced by a new queen. New queens are also produced in colonies about to swarm.

Virgin queen bees take what is known as a "**nuptial flight**" sometime within the first week or two after emerging from the pupal chamber. The new queen flies out of the hive and begins to produce a perfume-like substance called a "**pheromone**." The drones in the area are attracted to the pheromone and the queen will mate with as many as 20 of them. After mating, the drones die.

Once the queen has mated, she heads back to the hive to start laying eggs in beeswax chambers that the workers have created especially for this purpose. A queen can lay her own weight in eggs every day and, since she can maintain the sperm she has collected for her lifetime in a special pouch in her body, she can continue laying eggs indefinitely. The fertilized eggs laid by a queen become female worker bees and new queens. The queen also lays some unfertilized eggs, which produce the drones. Since they come from unfertilized eggs, the drones carry only the chromosomes of the queen.

The drones could be called the couch potatoes of the insect world. While they wait for an opportunity to mate with a virgin queen, they are fed and cared for by workers, and only occasionally fly out of the hive to test their wings. If no opportunity to mate arises by fall, the drones are ejected from the nest by the workers and left to fend for themselves.

On average, queen bees live for about a year-and-a-half, although some have been known to survive for up to six years. While she is alive and active, the queens are constantly cared for by workers acting as attendants. In cases where a queen dies prematurely and the colony had no new queen to replace her, some worker bees develop the ability to lay eggs but, because they cannot mate, they produce only drones and the colony eventually perishes.

When the colony starts to become too crowded, some of the bees split off to form a new colony. This is called **swarming**. First the eggs for new queens are laid in their special larger cells. "Swarming" occurs when part of the colony breaks off with the old queen and flies off looking for another place to call home. The bees engorge themselves on their honey reserves before leaving so as to have sufficient energy to make it to a new location. There can be multiple swarms from one hive, since new queens can also emerge and fly off with part of the worker force.

A honey bee swarm in a tree.

Return to homepage

The Different Types of Honey Bees

Introduction

Honey bees, like all other living things, vary among themselves in traits such as temperament, disease resistance, and productivity. The environment has a large effect on differences among bee colonies (for example, plants in different areas yield different honey crops), but the genetic makeup of a colony can also impact the characteristics that define a particular group. Beekeepers have long known that different genetic stocks have distinctive characteristics, so they have utilized different strains to suit their particular purpose, whether it be pollination, a honey crop, or bee production.

What Is a Bee Stock?

The term “stock” is defined as a loose combination of traits that characterize a particular group of bees. Such groups can be divided by species, race, region, population, or breeding line in a commercial operation. Many of the current “stocks” in the United States can be grouped at one or more of these levels, so the term will be used interchangeably, depending on the particular strain of bees in question.

Wide variation exists within stocks as well as among them. Any generalities about a particular stock should be treated with caution, since there are always exceptions to the rule. Nonetheless, the long and vast experience of beekeepers allows some oversimpli- fications to be made in order to better understand the different types of bees available. The following is a brief overview of some of the more common commercially available honey bee stocks in the United States.

Session 3 - Bees

	Italian	***German***	***Carniolan***	***Buckfast***	***Caucasian***	***Russian***
Color	Light	Dark	Black	Medium	Dark	Gray
Disease resistance						
Varroa	-	-	-	-	-	+
Tracheal	-	-	-	+	0	+
*AFB**	0	-	+	0	0	0
*EFB***	0	0	0	0	0	0
Other	0	0	+	+	-	0
Gentleness	Moderate	Low	High	Low-Mod	High	Low-Mod
Spring buildup	Good	Low	Very good	Low	Very low	OK
Over-wintering ability	Good	Very good	Good	Good	OK	Very good
Excess swarming	OK	OK	High	Low	Low	OK
Honey processing	Very good	OK	Good	Good	Low	OK
Propolis	Low	OK	Low	Low	High	OK
Other traits	Heavy robbing	Short tongue, nice white cappings	Low robbing, good comb builders	Supersedure queens produce defensive colonies	Long tongue	Brood rearing affected by flow, queen cells always present

Session 3 - Bees

	Italian	*German*	*Carniolan*	*Buckfast*	*Caucasian*	*Russian*
* AFB = America foulbrood ** EFB = European foulbrood						

The Italian Bee

Italian honey bees, of the subspecies Apis mellifera ligustica, were brought to the United States in 1859. They quickly became the favored bee stock in this country and remain so to this day. Known for their extended periods of brood rearing, Italian bees can build colony populations in the spring and maintain them for the entire summer. They are less defensive and less prone to disease than their German counterparts, and they are excellent honey producers. They also are very lightly colored, ranging from a light leather hue to an almost lemon yellow, a trait that is highly coveted by many beekeepers for its aesthetic appeal.

Despite their popularity, Italian bees have some drawbacks. First, because of their prolonged brood rearing, they may consume surplus honey in the hive if supers (removable upper sections where honey is stored) are not removed immediately after the honey flow stops. Second, they are notorious kleptoparasites and frequently rob the honey stores of weaker or dead neighboring colonies. This behavior may pose problems for Italian beekeepers who work their colonies during times of nectar dearth, and it may cause the rapid spread of transmittable diseases among hives.

The German Bee

Honey bees are not native to the New World, although North America has about 4,000 native species of bees. Honey bees were brought to America in the 17th century by the early European settlers. These bees were most likely of the subspecies *A. m. mellifera*, otherwise known as the German or “black” bee. This stock is very dark in color and tends to be very defensive, making bee management more difficult. One of the German bees’ more favorable characteristics is that they are a hardy strain, able to survive long, cold winters in northern climates. However, because of their defensive nature and their susceptibility to many brood diseases (such as American and European foulbrood), this stock lost favor with beekeepers well over a century ago. Although the feral bee population in the United States was once dominated by this strain, newly introduced diseases have nearly wiped out most wild honey bee colonies, making the German bee a rare stock at this time

The Carniolan Bee

The subspecies *A. m. carnica*, from middle Europe, also has been a favored bee stock in the United States for several reasons. First, their explosive spring buildup enables this race to grow rapidly in population and take advantage of blooms that occur much earlier in the spring, compared to other stocks. Second, they are extremely docile and can be worked with little smoke and protective clothing. Third, they are much less prone to robbing other colonies of honey, lowering disease transmission among colonies. Finally, they are very good builders of wax combs, which can be used for products ranging from candles, to soaps, to cosmetics.

Because of their rapid buildup, however, carniolan bees tend to have a high propensity to swarm (their effort to relieve overcrowding) and, therefore, may leave the beekeeper with a very poor honey crop. This stock requires continued vigilance to prevent the loss of swarms.

The Caucasian Bee

A. m. caucasica is a race of honey bees native to the foothills of the Ural mountains near the Caspian Sea in eastern Europe. This stock was once popular in the United States, but it has declined in regard over the last few decades. Its most notable characteristic is its very long tongue, which enables the bees to forage for nectar from flowers that other bee stocks may not have access to. They tend to be a moderately colored bee and, like the Carniolans, are extremely docile. However, their slow spring buildup keeps them from generating very large honey crops, and they tend to use an excessive amount of propolis—the sticky resin substance sometimes called “bee glue” that is used to seal cracks and joints of bee structures—making their hives diffi- cult to manipulate.

The Buckfast Bee

In the 1920s, honey bee colonies in the British Isles were devastated by acarine disease, which now is suspected to have been the endoparasitic tracheal mite Acarapis woodi. Brother Adams, a monk at Buckfast Abby in Devon, England, was charged with creating a bee stock that could withstand this deadly disease. He traveled the world interviewing beekeepers and learning about different bee strains, and he created a stock of bees, largely from the Italian race, that could thrive in the cold wet conditions of the British Isles, yet produce good honey crops and exhibit good housecleaning and grooming behavior to reduce the prevalence of disease. Bees of this stock are moderately defensive. However, if left unmanaged for one or two generations, they can be among the most fiercely defensive bees of any stock. They also are moderate in spring population buildup, preventing them from taking full advantage of early nectar flows.

The Russian Bee

One of the newer bee stocks in the United States was imported from far-eastern Russia by the US Department of Agriculture's Honey Bee Breeding, Genetics, and Physiology Laboratory in Baton Rouge, Louisiana. The researchers' logic was that these bees from the Primorski region on the Sea of Japan, have coexisted for the last 150 years with the devastating ectoparasite Varroa destructor, a mite that is responsible for severe colony losses around the globe, and they might thrive in the United States. The USDA tested whether this stock had evolved resistance to varroa and found that it had. Numerous studies have shown that bees of this strain have fewer than half the number of mites that are found in standard commercial stocks. The quarantine phase of this project has been complete since 2000, and bees of this strain are available commercially.

Russian bees tend to rear brood only during times of nectar and pollen flows, so brood rearing and colony populations tend to fluctuate with the environment. They also exhibit good housecleaning behavior, resulting in resistance not only to varroa but also to the tracheal mite.

Bees of this stock exhibit some unusual behaviors compared to other strains. For example, they tend to have queen cells present in their colonies almost all the time, whereas most other stocks rear queens only during times of swarming or queen replacement. Russian bees also perform better when not in the presence of other bee strains; research has shown that cross-contamination from susceptible stocks can lessen the varroa resistance of these bees.

Other Notable Stocks

Many other honey bee stocks are worth noting:

- The Minnesota Hygienic stock has been selected for its exceptional housecleaning ability, significantly reducing the negative effects of most brood diseases.
- The VSH, or the "Varroa Sensitive Hygiene" stock (used to be named the SMR stock, referring to "Suppression of Mite Reproduction"), also was developed by the USDA honey bee lab in Louisiana by artificially selecting commercial stocks for mite resistance. While not an independently viable stock on its own (because of inbreeding), the VSH trait has been incorporated into other genetic stocks so that these stocks may also express this highly desired characteristic.
- The Cordovan bee is a type of Italian bee that has a very light yellow color, which is more attractive to many beekeepers.

Numerous hybrid stocks are also available commercially:

- The Midnite bee was developed by crossing the Caucasian and Carniolan stocks, hoping to maintain the extreme gentleness of both strains while removing the excessive propolis of the Caucasians and minimizing the swarming propensity of the Carniolans.

- The Starline was developed from numerous strains of the Italian stock by Gladstone Cale of the Dadant Bee Company. It was once favored by commercial beekeepers because of its tremendous honey yields, particularly in clover, but the popularity of this stock has declined in recent decades.
- The Double Hybrid is a cross of the Midnite and the Starline.

Conclusion

While a tremendous amount of variation remains within and among the different bee stocks, some generalities still can be made. Bee differences can be used to advantage by beekeepers, depending on what traits interest them, so using different stocks can be a powerful tool at the beekeeper's disposal. There is no "best" strain of bee, as the traits favored by one beekeeper may differ significantly from another's choice. Thus, it is best for each beekeeper to experience the characteristics of the different bee strains first hand and then form an opinion about which stock best fits his or her situation.

For more information on beekeeping, visit the Beekeeping Notes website (http://entomology.ces.ncsu.edu/apiculture/beekeeping-notes/).

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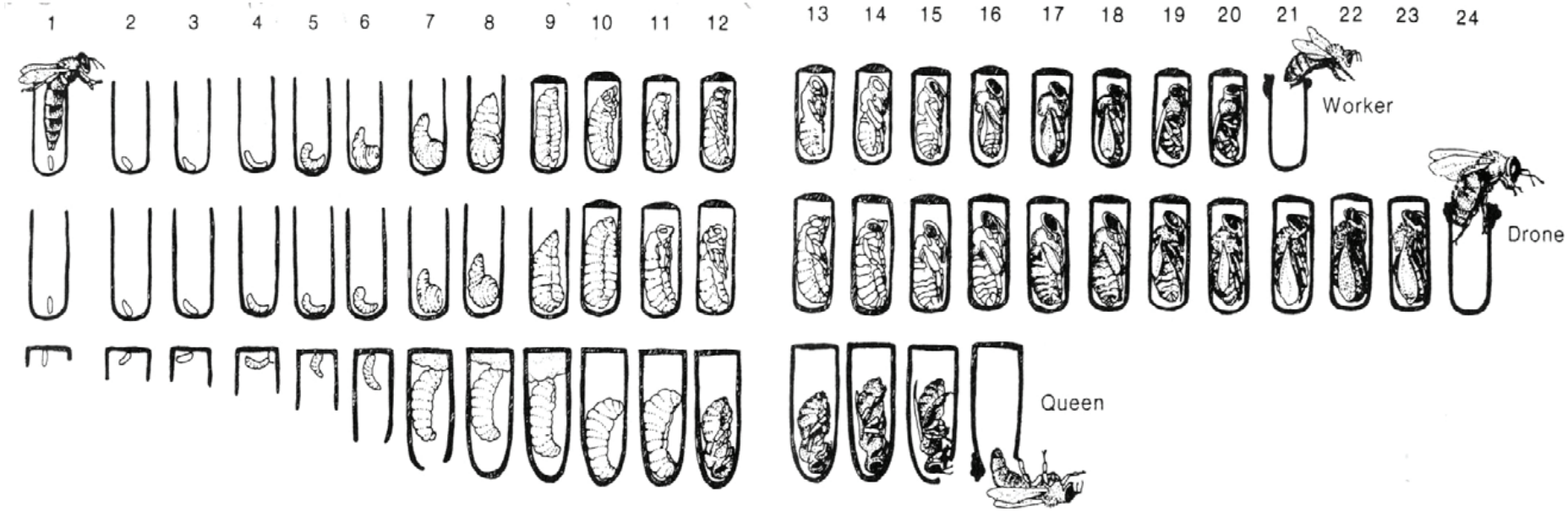
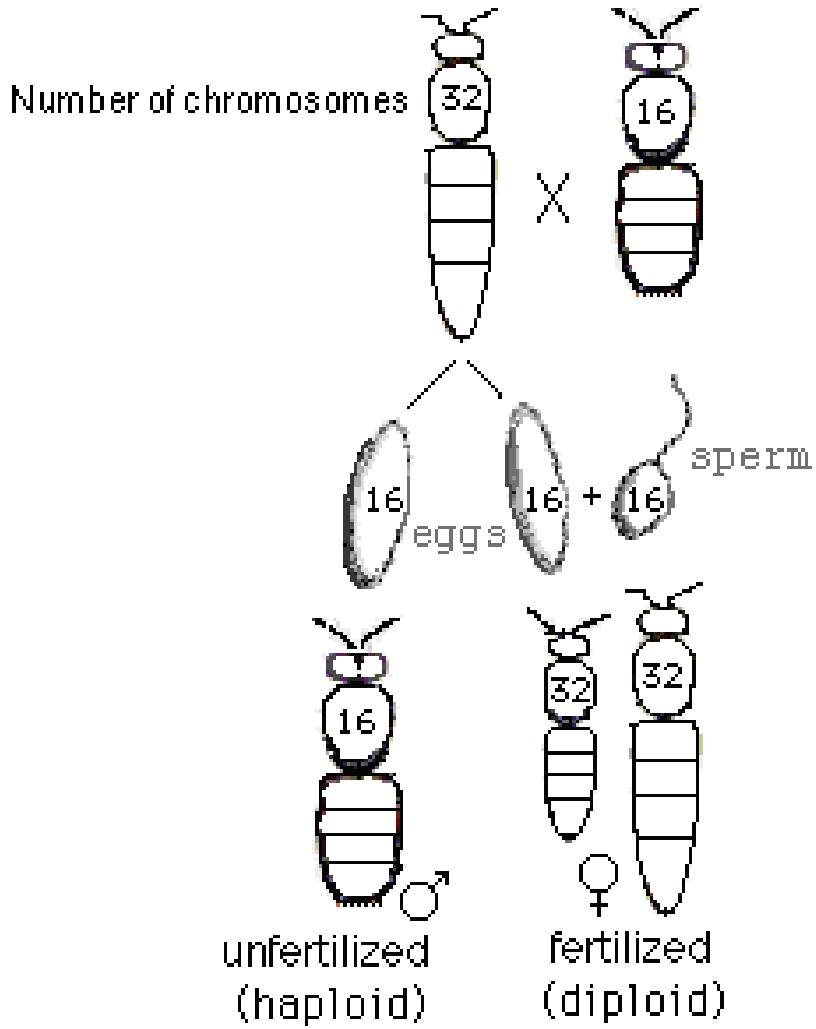
Session 3 - Bees



Complete metamorphosis, development times differ

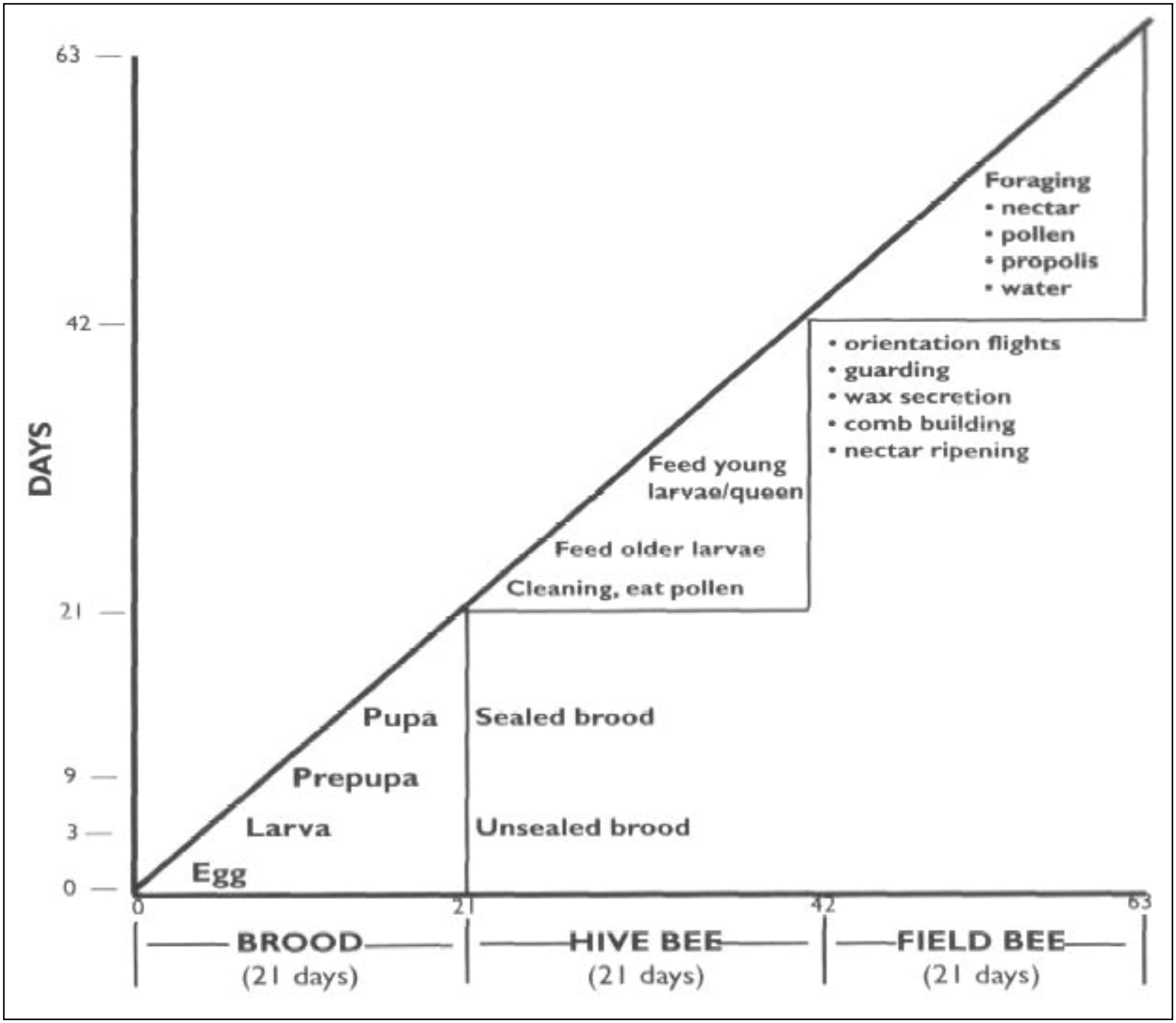
Honeybee Chromosomes



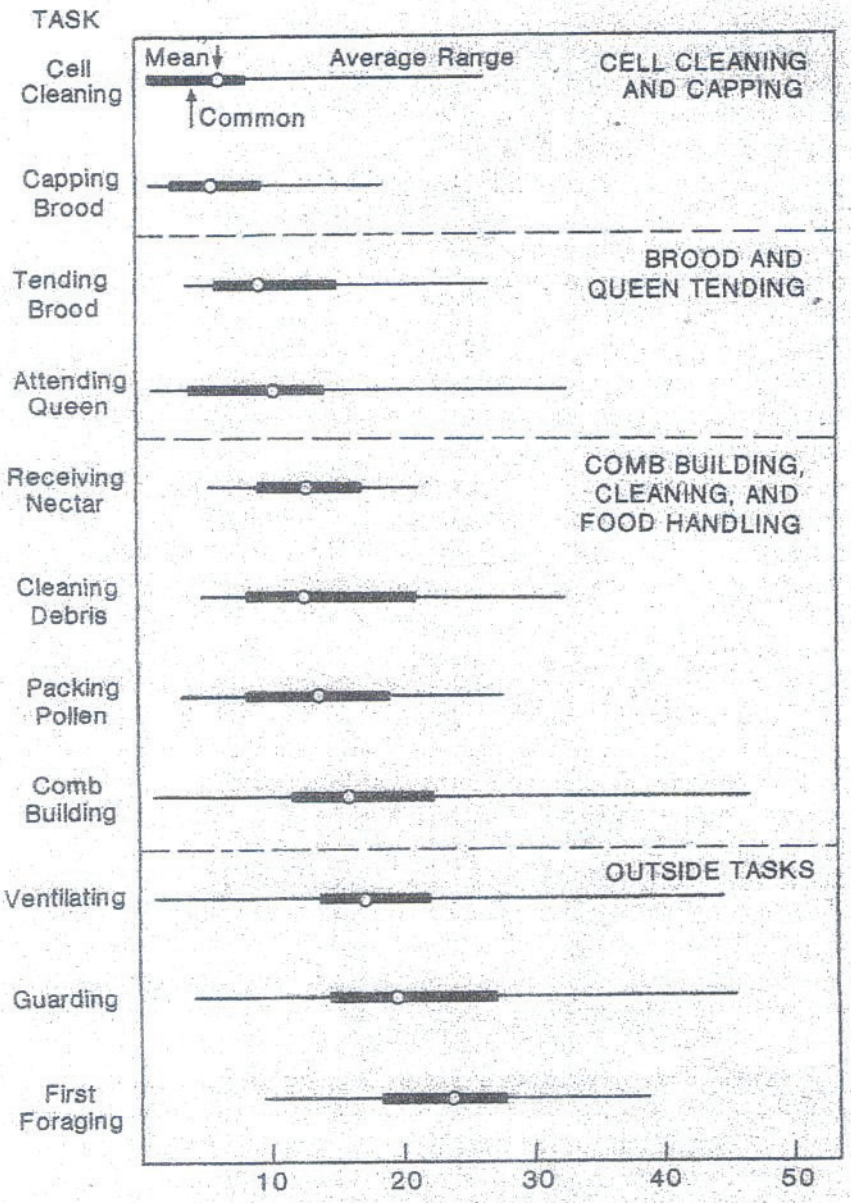
Genetics

- Females have 32 Chromosomes, 16 from mother, 16 from father
- Males (Drones) have 16 Chromosome, 16 from mother – haploid - parthenogenesis
  - ***NOTE: The Queen has control over whether an egg is fertilized when she lays it.***
- Controlled Breeding
  - Islands, Downs, Artificial Insemination

Age Related Duties of Worker Bee - **temporal polyethism**



AGE-RELATED ACTIVITIES OF WORKER BEES



Fig

Temporal polyethism

1. This also is called age-related division of labor.
2. Queens always lay eggs and drones attempt to mate their whole lives, but workers change jobs depending on their age.
3. Workers jobs change as different glands develop.
4. They gradually move towards the entrance of the hive as their jobs progress.
5. There is some flexibility if there are not enough workers doing a job.

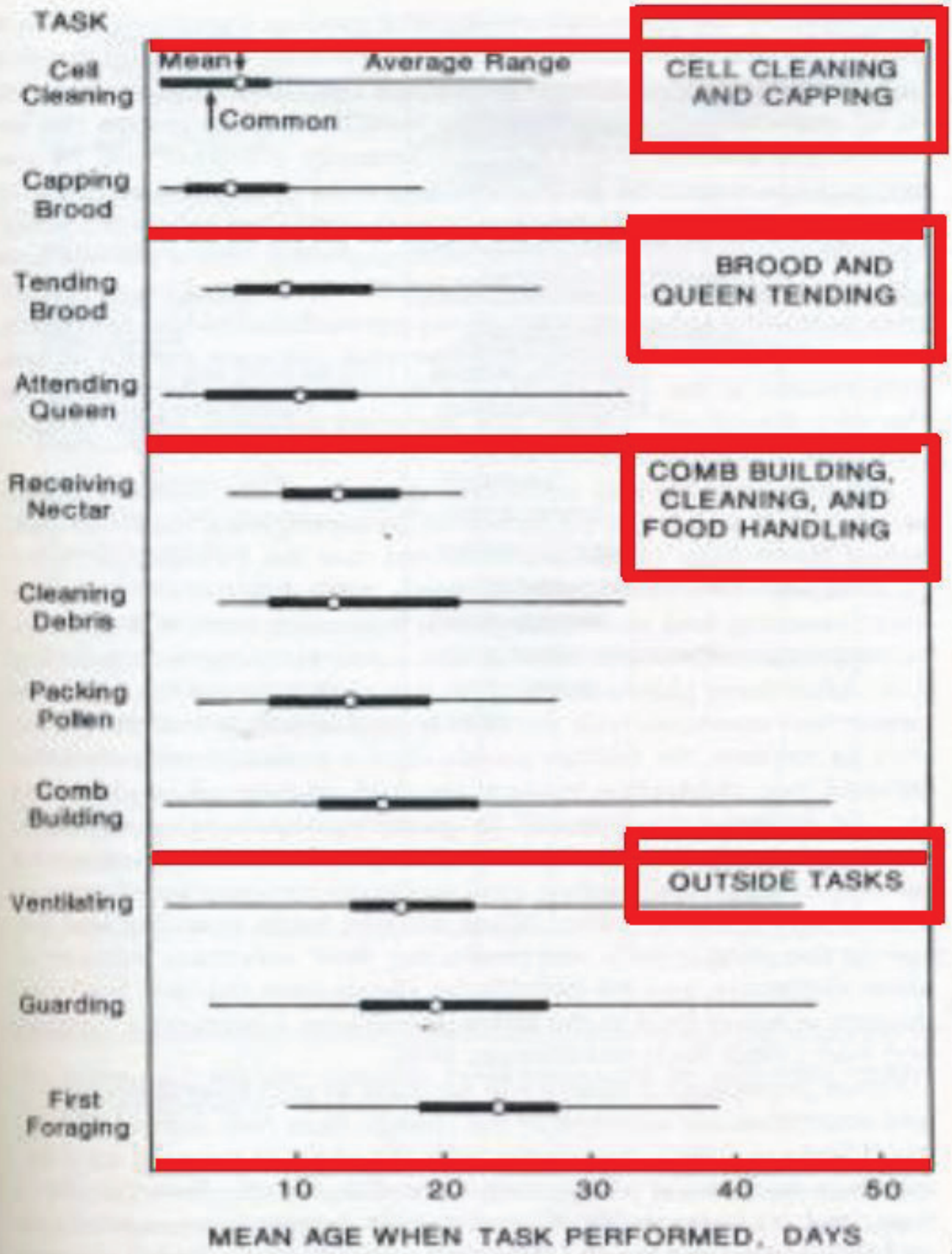
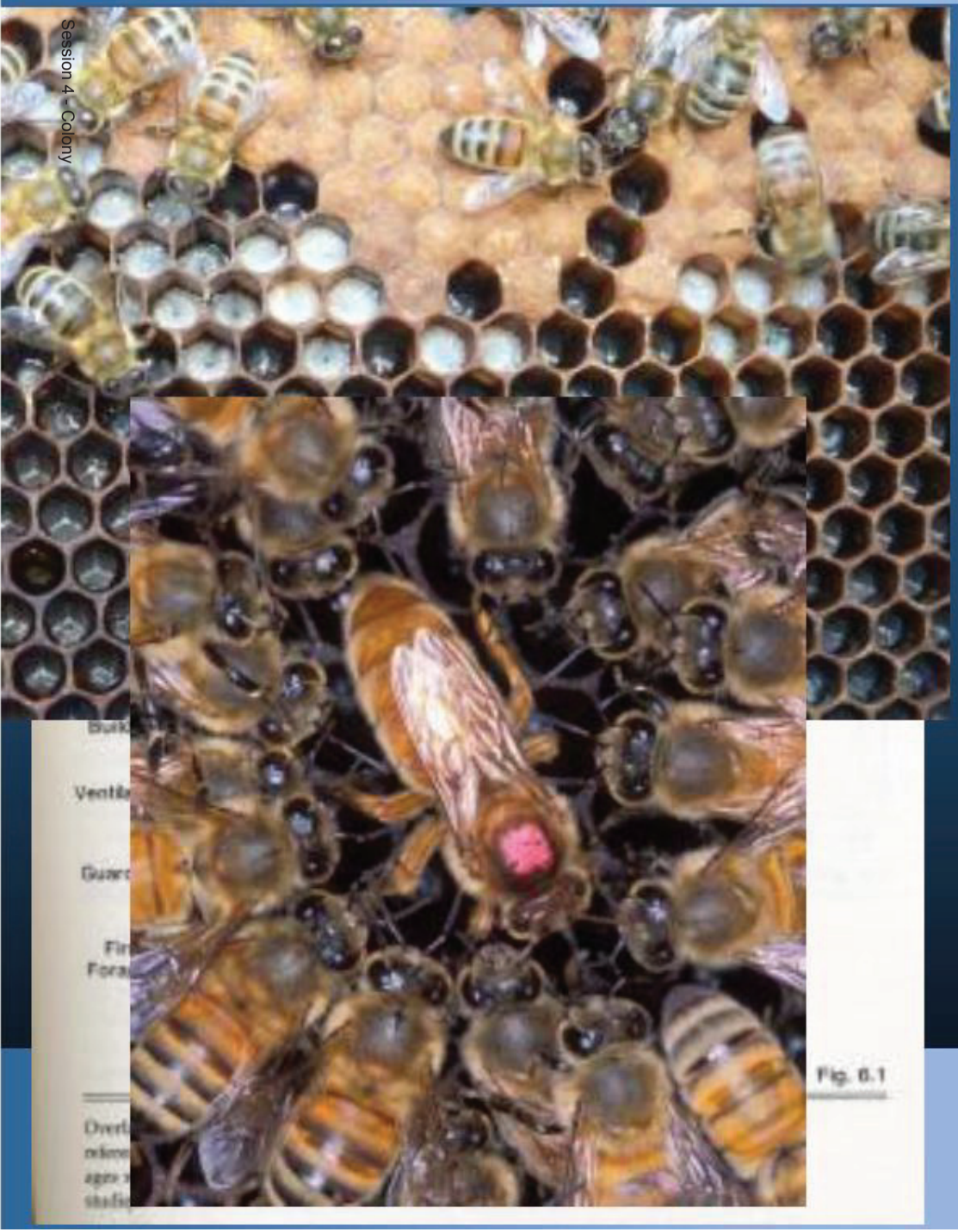


Fig. 6.1

Overlap of age-related task performance by worker bees. Data are from the references cited in Table 6.1 and represent the mean ages and most common ages when tasks were performed, and average range of ages from these studies.

Cleaner Bees

Nurse Bees



Workers become nurse bees after their hypopharyngeal glands develop.

Nurse bees feed and care for the brood.

After their glands are fully developed at about 6 days after emergence, nurse bees can feed the youngest larvae royal jelly.

Pollen Storage and Cleaning Colonies

Wax Producers

Worker bees have wax producing glands on the ventral side of the abdomen.

A worker's wax glands begin working ~12 days after emergence.

The wax glands secrete small sheets of wax which are removed by the bee, mixed with saliva, and manipulated with the mandibles.

At this point they can help building new wax comb or capping cells.

Orientation Flights

A worker will begin taking orientation flights at 18 days of age.

Honey bees and other Hymenoptera use landmarks to find locations again.

Circling flights around a hive are necessary to fix the hive location.

During this stage bees are prone to drifting, where a bee returns to the wrong hive.

Ventilating Bees

Guards

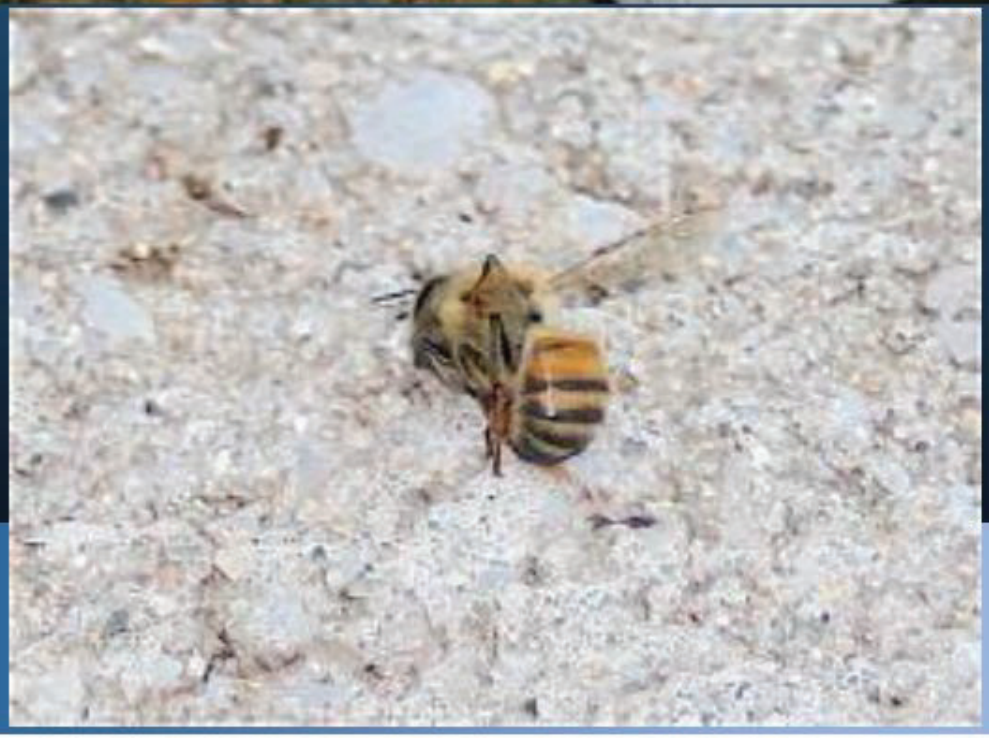
Workers begin guarding the hive at 18-24 days.

Guards assess everything that tries to enter the hive.

Each hive has a distinct odor which identifies foragers as part of the hive. Intruders will not have this smell.

Guards are the first line of defense against pests and robbers.

Undertaker Bees



Most bees die outside of the hive.

Worker bees usually only live 5-6 weeks, less if there is a very strong nectar flow and much more if they are overwintering.

When bees die inside the hive, it is the undertaker bee's job to remove them.

This is an important part of a hive's sanitation and overall health.

Foragers

Foragers are the oldest workers, 21 days and older.

They collect four different things:

1. Pollen
   Bees' protein source
2. Nectar
   Bees' carbohydrate source
3. Water
   Used for hydration, to dilute honey, and for cooling the hive by evaporation.
4. Propolis
   Tree resins, used to seal the hive against invaders

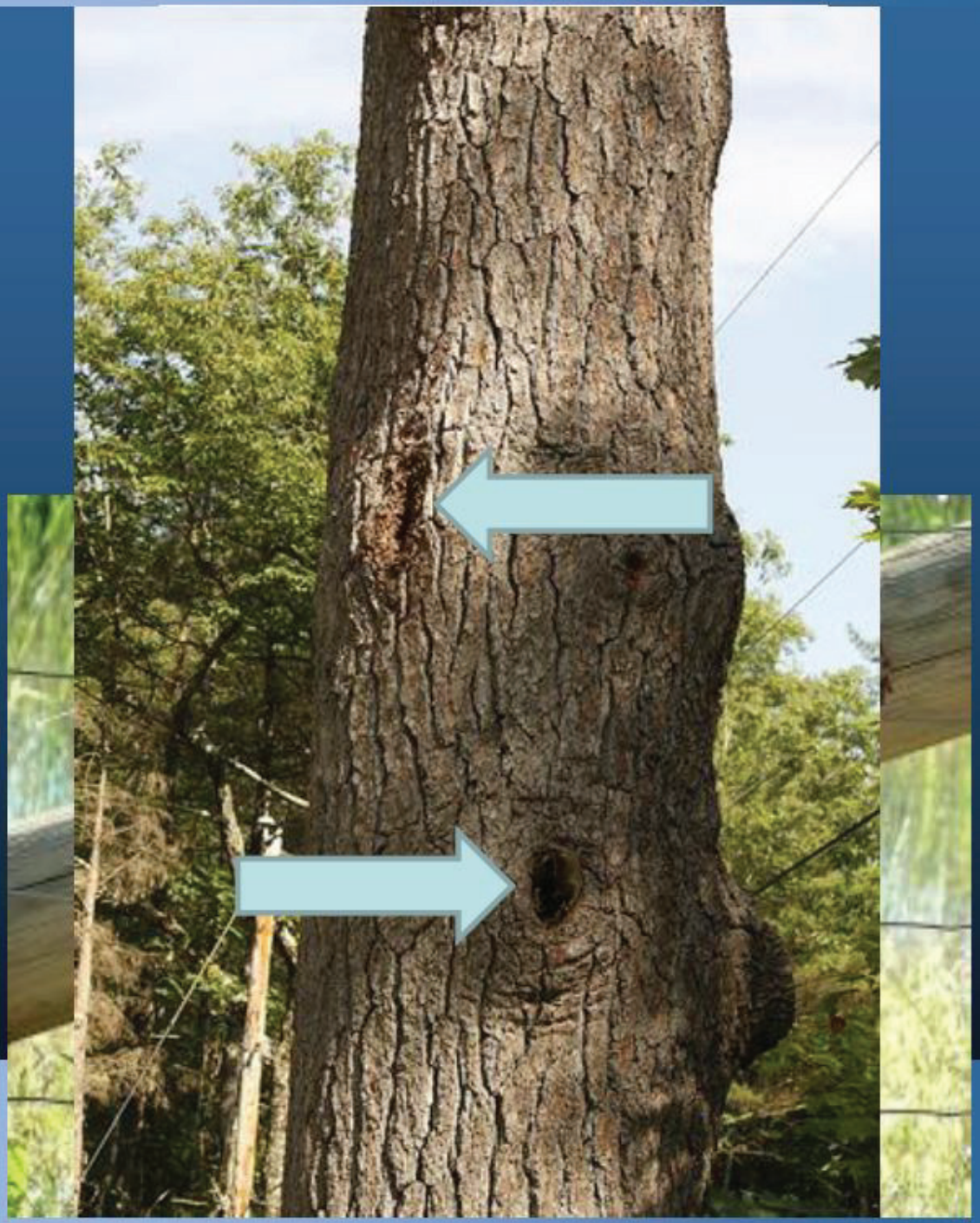
Swarms!

Swarming is how honey bees reproduce on a colony level, usually when their hive begins to feel crowded.

First, several new queens are reared.

While they are developing as larva, the old queen leaves with ~30-70% of the workers in the colony.

The cluster of bees looks for a home into which to move.



What do bees do as they prepare to swarm?

Construct queen cups.

Queen lays eggs in queen cups.

Queen begins to lose weight (as much as 1/3 of her weight).

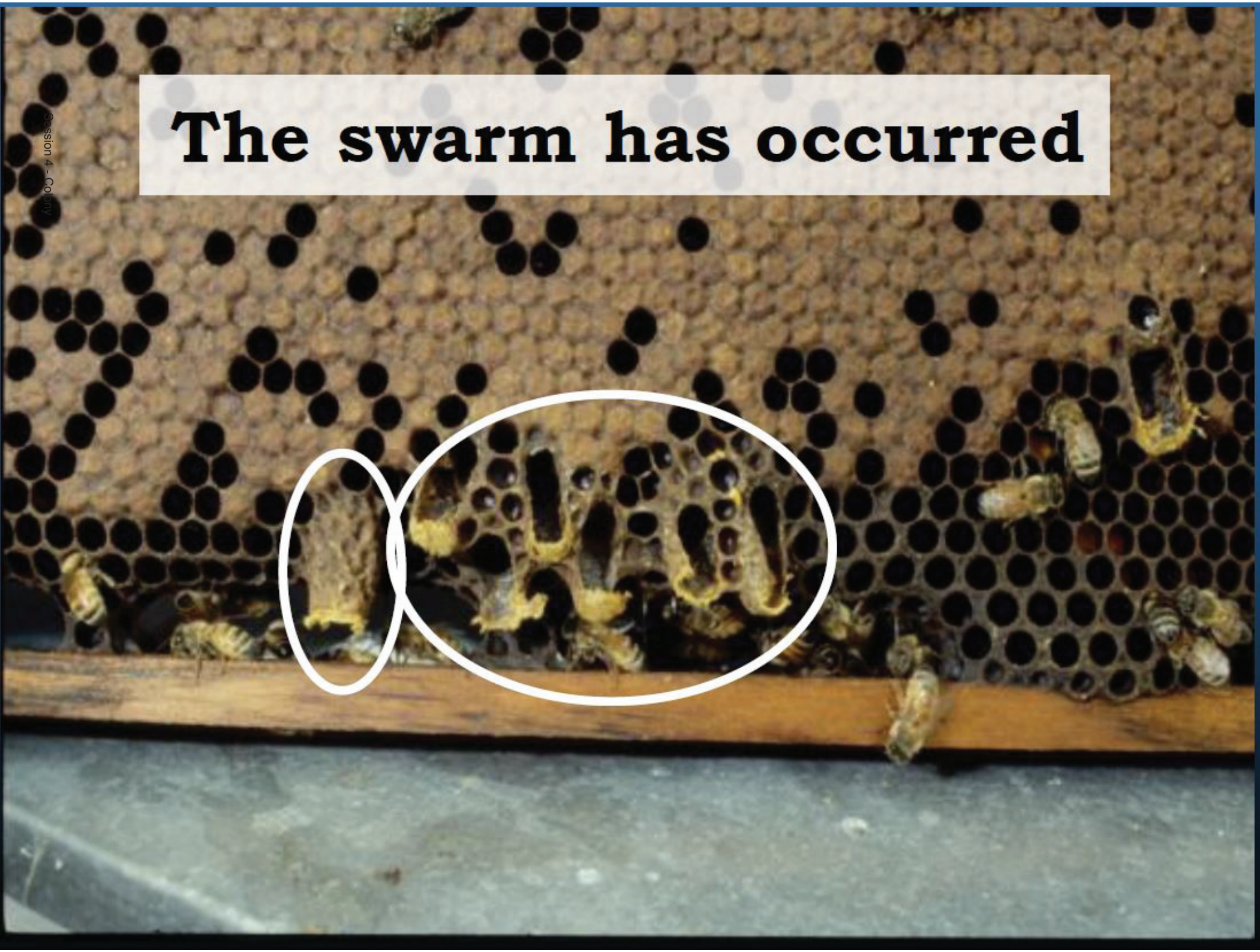
Queen bees reduce egg production.

Some workers engorge and stop working.

30-70% of the worker bees swarm, typically with the old queen (who does not make the decision to swarm).

Swarms

The presence of queen cells


The swarm has occurred

Queen Supercedure

Queens are replaced when they stop laying well or produce less queen substance.

Workers begin provisioning new queen cells.

In inefficient supersedure, the old queen dies before the new queen emerges, causing a break in brood production.

In efficient supersedure, the old queen survives until after the new queen emerges, which can briefly result in mother-daughter queen colonies.

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NC STATE UNIVERSITY

THE HONEY BEE DANCE LANGUAGE

Session 4 - Colony

Background

Honey bee dancing, perhaps the most intriguing aspect of their biology, is also one of the most fascinating behaviors in animal life. Performed by a worker bee that has returned to the honey comb with pollen or nectar, the dances, in essence, constitute a language that "tells" other workers where the food is. By signaling both distance and direction with particular movements, the worker bee uses the dance language to recruit and direct other workers in gathering pollen and nectar.

The late Karl von Frisch, a professor of zoology at the University of Munich in Germany, is credited with interpreting the meaning of honey bee dance movements. He and his students carried out decades of research in which they carefully described the different components of each dance. Their experiments typically used glass-walled observation hives and paint-marked bee foragers. First, they trained the foragers to find food at sources placed at known distances from the colony. When the bees returned from gathering food from those sources, von Frisch and his students carefully measured both the duration and angle of the dances the foragers performed to recruit other bees to help gather food. Their findings led them to the concept of a dance language. Von Frisch's work eventually earned him the Nobel Prize for Medicine in 1973.

The concept of a honey bee dance language, however, has had its skeptics.

Several scientists, among them Adrian M. Wenner, professor emeritus of natural history at the University of California at Santa Barbara, have a different idea. They believe the dance exists, but they are not certain it communicates the location of a food source. These critics have argued that floral odors on a forager's body are the primary cues that enable the recruit-bees to locate new food sources. Many experiments have directly tested this alternate hypothesis and demonstrated the importance of floral odors in food location. In fact, von Frisch held this same opinion before he changed his mind and developed the theory of the dance language.

The biological reality probably lies somewhere between these two extremes. The most commonly accepted view is that recruits go to the area depicted in the dance, but then home in on the flower patch using odor cues. Indeed, researchers have built a robotic honey bee that is able to perform the dance language and recruit foragers to specific locations. But the robot is unable to properly recruit foragers to a food source unless it carries an odor cue on its surface. Nevertheless, it is clear that honey bees use the distance and directional information communicated by the dance language.

Components of the Dance Language

When an experienced forager returns to the colony with a load of nectar or pollen that is sufficiently nutritious to warrant a return to the source, she performs a dance on the surface of the honey comb to tell other foragers where the food is. The dancer "spells out" two items of information—distance and direction—to the target food patch. Recruits then leave the hive to find the nectar or pollen.

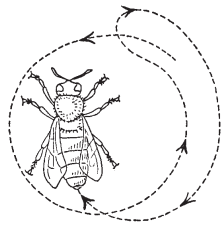
Distance and direction are presented in separate components of the dance.

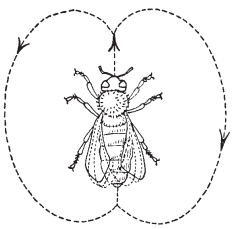
Distance

When a food source is very close to the hive (less than 50 meters), a forager performs a round dance (Figure 1). She does so by running around in narrow circles, suddenly reversing direction to her original course. She may repeat the dance several times at the same location or move to another location on the comb to repeat it. After the round dance has ended, she often distributes food to the bees following her. A round dance, therefore, communicates distance ("close to the hive," in this example), but not direction.

Food sources that are at intermediate distances, between 50 and 150 meters from the hive, are described by the sickle dance. This dance is crescent-shaped and represents a transitional dance between the round dance and a waggle dance.

The waggle dance (Figure 2), or wag-tail dance, is performed by bees foraging at food sources that are more than 150 meters from the hive. This dance, unlike the round dance, communicates both distance and direction. A bee that performs a waggle dance runs straight ahead for a short distance, returns in a semicircle to the starting point, runs again through the straight course, then makes a semicircle in the opposite direction to complete a full figure-eight circuit. While running the straight-line course of the dance, the bee's body, especially the abdomen, wags vigorously from side to side. This vibration of the body produces a tail-wagging motion. At the same time, the bee emits a buzzing sound, produced by wingbeats at a low audio frequency of 250 to 300 hertz or cycles per second. The





von Frisch, 1976

Figure 1. Round dance

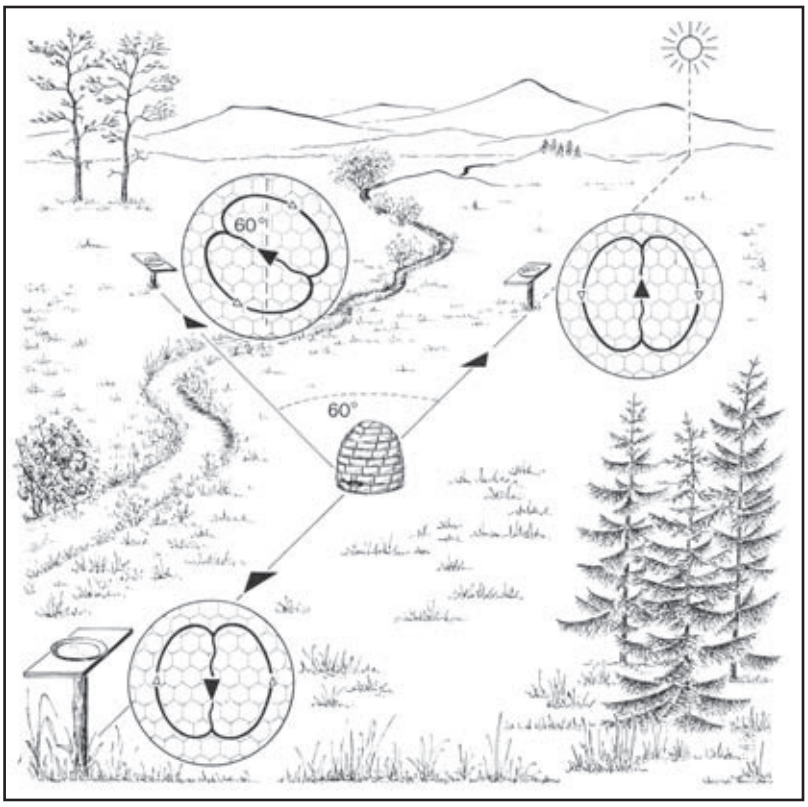
Figure 2. Waggle dance

buzzing occurs in pulsebeats of about 20 milliseconds, delivered at a rate of about 30 per second.

While several variables of the waggle dance relate to distance (such as dance "tempo" or the duration of buzzing sounds), the duration of the straight-run portion of the dance, measured in seconds, is the simplest and most reliable indicator of distance. As the distance to the food source increases, the duration of the waggling portion of the dance (the "waggle run") also increases. The relationship is roughly linear (Figure 3). For example, a forager that performs a waggle run that lasts 2.5 seconds is recruiting for a food source located about 2,625 meters away.

DIRECTION

Although the representation of distance in the waggle dance is relatively straightforward, the method of communicating direction is more complicated. The orientation of the dancing bee during the straight portion of her waggle dance indicates the location of the food source relative to the sun. The angle that the bee adopts, relative to vertical, represents the angle to the flowers relative to the direction of the sun outside the hive. In other words, the dancing bee transposes the solar angle into the gravitational angle. Figure 4 gives three examples: A forager recruiting to a food source in the same direction as the sun will perform a dance with the waggle-run portion traveling directly upward on the honey comb. Conversely, if the food source is located directly away from the sun, the straight run will be performed vertically downward. If the food source is 60 degrees to the left of the sun, the waggle run will be 60 degrees to the left of vertical.



Barth, 1982

Figure 4. Waggle-run direction

Because directional information is given relative to the sun's position and not to a compass direction, a forager's dance for a particular resource will change during a day. This is because the sun's position moves during the day. For example, a food source located due east will cause foragers to dance approximately straight up in the morning (because the sun rises in the east), but in the late afternoon, the foragers will dance approximately straight down (because the sun sets in the west). Thus, the location of the sun is a key variable in interpreting the directional information in the dance.

The sun's position also is governed by geographic location and time of year. The sun will always move from east to west over the course of the day. However, above the Tropic of Cancer, the sun will move from southeast to southwest, whereas below the Tropic of Capricorn, the sun will move from northeast to northwest. Within the tropics, the sun may be located to the south or to the north, depending on the time of year.

Thus, to translate the directional information contained in the honey bee dance, one must know the angle of the waggle run (with respect to gravity) and the compass direction of the sun, which depends on location, date, and time of day.

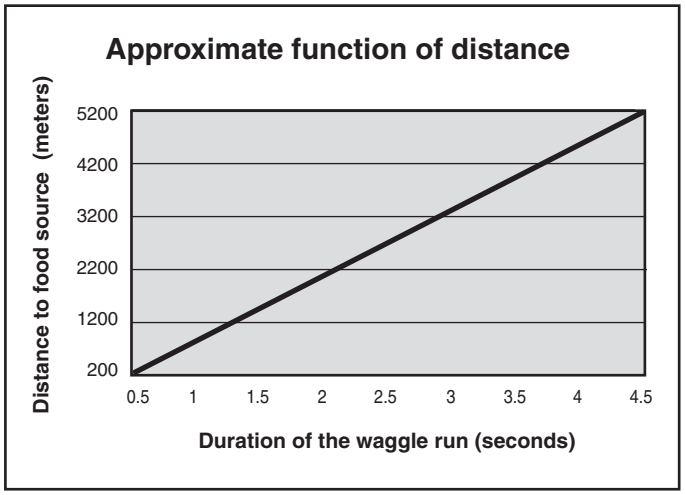


Figure 3.
The relationship of distance to waggle-run duration.

MORE INFORMATION

Visit the Web site for the Apiculture program at North Carolina State University to try out an interactive movie that enables the user to change, in real time, a forager's dance, depending on the numerous variables that are important for the bee's communication of distance and direction to recruits. The Web site is: http://entomology.ncsu.edu/apiculture/Dance_tutorial.html

CONCLUSION

The honey bee dance language serves as a model of animal communication in classroom situations at all levels. It is one of the more intriguing behaviors in the animal kingdom and solidifies honey bees as one of the most interesting systems in biology.

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NCSBA NORTH CAROLINA STATE BEEKEEPERS ASSOCIATION

How to Buy or Sell Bees in NC

For Buyers:

For a list dealers have been approved to sell bees in North Carolina and are permitted to sell or ship bees:

http://www.ncagr.gov/plantindustry/Plant/apiary/index.htm

There are links at the bottom of the page.

For Sellers:

Parties interested in selling honey bees in the State of North Carolina must submit the following forms to N.C. Department of Agriculture and Consumer Services:

1. A current health Certificate from state of origin.
2. Application form for Permit to Sell Bees in North Carolina.
3. A non-refundable $25.00 Permit Fee must accompany the above application.
4. Compliance agreement for producers who wish to sell queens or packaged bees in North Carolina. Be sure to provide the requested information. The forms must be signed and dated.

All forms must be typed or printed legibly. Unsigned forms cannot be processed.

Upon receipt of the appropriate forms, your application will be considered.

It is unlawful to market queens, packages, nucs, or hives before the Permit to Sell Bees in North Carolina has been issued.

For North Carolina residents, a permit is not required for (1) the sale of less than 10 bee hives in a calendar year, (2) at one time going -out-of-business sale of less than 50 beehives, or (3) the renting of bees for pollination purposes or the movement of bees to gather honey.

If you would like to request forms or if you have questions regarding this procedure, please visit the website at:

http://www.ncagr.gov/plantindustry/Plant/apiary/index.htm or contact Don Hopkins at (336) 376-8250 or Don.Hopkins@ncagr.gov.

Session 5 - Starting

NCDA&CS
BENEFICIAL INSECT LAB
1060 MAIL SERVICE CENTER
RALEIGH, NC 27699

2017 Permits to Sell Bees

The following dealers have been approved to sell bees in North Carolina and are permitted to sell or ship bees of the said apiary.

In State Companies Permitted to Sell Bees

The inspectors' report forms for these apiaries are public records and are on file at the Beneficial Insect Lab, 950 East Chatham Street, Cary, NC 27511, (919) 233-8214.

Company Name	Address	City	State	Zip Code	Status	Spring Inspection	Phone Number
1 SweetWings Honey Bee Farm	2014 Coddle Creek Hwy	Mooresville	NC	28115	Active	+	(704) 904-6725
7 Stands Bee Farm	1885 Middle Fork Rd	Hays	NC	28635			(336) 957-4744 / (336) 984-7768
Alan Cannady	411 Main Street	Newton Grove	NC	28366	Active	+	(910) 594-0193
Albemarle Bee Co.	32586 B Austin Rd.	New London	NC	28127	Active		(704) 463-1233
B & Z Bee Farm	12 Indian Ln	Weaverville	NC	28787			(828) 231-6211
Bailey Bee Supply	147 Boone Square St.	Hillsborough	NC	27278	Active		(919) 241-4236
Bee Sweet Bee Farm, LLC	503 Peach Street	Shelby	NC	28150	Active	+	(704) 487-7731
Beech Mountain	2775 Beech Mountain Road	Elk Park	NC	28622	Active		(828) 733-4525
Beez Needz	3662 Edgar Rd.	Sophia	NC	27350	Active		(336) 431-2339
Betseys Bees	1226 Mt. Olivet Church Rd.	Franklinton	NC	27525	Active		(919) 495-1450
Bill Boyd	5803 Old Monroe Rd.	Indian Trail	NC	28079	Active		(704) 821-7310
Billy Searcy	310 Rubin Wilson Rd.	Mill Spring	NC	28756	Active	+	(828) 817-0266
Blanton Apiaries	1844 Back Creek Ct	Asheboro	NC	27205	Active	+	(336) 465-1719
Bob Doty	6325 Stirewalt Rd.	Kannapolis	NC	28081	Active		(704) 934-2640
Brother Allen Apiary	1399 Lake Logan Rd	Canton	NC	28716			(828) 400-1735
Brushy Mountain Bee Farm	610 Bethany Church Rd	Moravian Falls	NC	28654	Active	+	(336) 258-4110
Bryan Fisher	712 Deaton St	Kannapolis	NC	28081	Active		(980) 521-8642
Chad Williamson	839 Tot Dellinger Rd	Cherryville	NC	28021			(704) 530-7489
Charles B Fleming	1214 Clark Rd	Lillington	NC	27546	Active	+	(910) 814-0486
Charles Dean Trull Jr	1428 Trull Place	Monroe	NC	28110	Active	+	(704) 201-3520
Charles Revis	921 East Court St	Marion	NC	28752			(828) 925-1430
Chris Mendenhall	5703 Midway School Rd	Thomasville	NC	27360			(336) 442-9835
Clint Brooks	25607 Rowland Rd	Locust	NC	28097	Active	+	(980) 333-5841
Curtis M. Wooten	7429 Old Maple Hill Rd	Burgaw	NC	28425	Active		(910) 540-4611
Dandelion Bee Supply Inc.	737 Irish Potato Rd.	Concord	NC	28025	Active	+	(704) 784-0101
Danny H. Lashus	556 Stephens Road	Providence	NC	27315	Active		(434) 710-4344 / (434) 770-8102
David Bridgers	118 Wellington Dr	Wilmington	NC	28411	Active		(910) 686-1947
David Fruchtenicht	2927 Chapel Hill Rd	Durham	NC	27707	Active		(919) 489-0428

David Link	157 Crepe Myrtle Circle	Winston Salem	NC	27106	Active		(336) 251-3427
David Stallings	1121 Erkwood Hts.	Hendersonville	NC	28739	Active	+	(828) 606-9592
Donnie Smith	599 John Russell Rd.	Raeford	NC	28376			(910) 875-5640
Dyson Apiaries	468 Dyson Rd.	Mocksville	NC	27028	Active		(336) 492-6408
Earpsboro Bees	1725 Earpsboro Rd.	Zebulon	NC	27597			(919) 453-8440 / (919) 404-1441
Eddie G Hicks	2571 Howard Austin Rd	Granite Falls	NC	28630	Active	+	(828) 896-7764
Eric Nelon	1959 NC 108 Hwy E	Columbus	NC	28722	Active	+	(828) 779-0685
Eurofins Agroscience Services, Inc.	8909 Atkins Rd.	Mebane	NC	27302	Active	+	(336) 269-6517
Faith Apiary	792 Hamlin Ford Rd	Dobson	NC	27017	Active	+	(336) 320-8363
Frank Wyatt	P.O. Box 4563	Eden	NC	27289	Active	+	(336) 616-7044
Garry Whitley	36824 Melton Rd.	Albemarle	NC	28001	Active	+	(704) 982-0698
George Page	2686 Piney Grove Rd.	Kernersville	NC	27284			(336) 497-4310
Gerry and Libby Mack	121 Hermitage Rd	Charlotte	NC	28207	Active		(704) 953-0565
Gommin Inc	1945 Davis Mtn Rd.	Hendersonville	NC	28739	Active	+	(828) 693-1966
Green Acres Apiary	9152 Bay Trace Drive	Linden	NC	28356	Active	+	(910) 364-5286
Half Moon Honey	4179 Gum Branch Road	Jacksonville	NC	28540	Active	+	(910) 346-8281
Harris Apiaries	10055 Hwy 53 West	White Oak	NC	28399	Active	+	(910) 988-6227
Hendley's Farm	1476 Roby Conley Rd	Marion	NC	28752			(828) 460-0292
Hidden Happiness Bee Farm	1106 Chestnut Mtn Rd	Deep Gap	NC	28618	Active	+	(336) 957-0275
Holbert Bee Supply	P.O. Box 217	Saluda	NC	28773	Active	+	(828) 749-2337
Holt's Apiaries LLC	132 Holt's Ln	Siloam	NC	27047	Active	+	(336) 710-4904
Jeff Ritchie	3901 Piney RD	Morganton	NC	28655			(828) 438-1720
Jeffrey C. Hinson	16331 Philadelphia Church Rd.	Oakboro	NC	28129	Active	+	(704) 438-8760
Jeffry V. Cox	3117 Tyrus Rd.	Eastover	NC	28312	Active	+	(910) 578-4949
Jeremy Tyson	742 Eagle Falls Rd.	Madison	NC	27025	Active		(336) 453-1281
Joey Lee Bullin	2633 Woodruff Rd.	Boonville	NC	27011	Active	+	(336) 244-1415
John Caudle Apiaries / Herbs Bees LLC	1029 Sewickley Drive	Charlotte	NC	28209			(704) 763-1646
John Christie	224 Firefly Hill Rd.	Marshall	NC	28753	Active		(828) 231-6973
Johnathan Lutz	2112 Ashwood St.	Maiden	NC	28650	Active	+	(828)428-3744
Johnny's Honey Bee Farm & Supplies	6500 Little Satterwhite Rd	Oxford	NC	27565			(919) 482-5071
Just Bee Cool Apiary	1011 Napa Place	Apex	NC	27502			(919) 740-5134
Kathy Webb	308 Webb Farm Rd	Salisbury	NC	28147	Active		(704) 213-3179
Kenneth Edgar	4725 Carya Drive	Wilmington	NC	28412			(910) 367-1896
KTs Orchard & Apiary	195 Pigeon Ford Rd.	Canton	NC	28716			(828) 279-5614
Kyle Sanborn	7500 Pine Ridge Road	Faison	NC	28341	Active	+	(252) 917-3828
Larry R. Cox	1506 Old Quarry Rd.	Sparta	NC	28675	Active		(336) 467-4340
Lee's Bees	1818 Saddle Club Rd	Mebane	NC	27302	Active	+	(919) 949-6140
Lick Log Branch Apiaries	111 Log Gap Rd	Fairview	NC	28730			(828) 275-2225
Lott Farm and Apiary	56 Sparrow Dr	Waynesville	NC	28786	Active		(828) 646-3399
Mark S. Houser	771 Whiteside Rd	Rutherfordton	NC	28139			(828) 447-5944
Mark Smith	103 Sprucewood Circle	Locust	NC	28097	Active	+	(704) 787-2501
Mary Skelton	166 Azalea Dr.	Waynesville	NC	28786	Active	+	(828) 550-5763
McCoy Feed & Farm Supply Inc	4420 Hwy 24-27 East	Midland	NC	28107	Active		(704) 888-2298
Mike Bourn	1104 Arbor Drive	China Grove	NC	28023	Active		(704) 506-5390
Mike Josey	7090 Wishing Well Rd	Pfafftown	NC	27040	Active	+	(336) 407-1553

Miller Bee Supply, Inc.	496 Yellow Banks Rd.	North Wilkesboro	NC	28659	Active	+	(336) 670-2249
Mountain Valley Apiaries	212 Mt Top Rd.	Thurmond	NC	28683	Active		(336) 874-2260
Nadeau Farms Inc	538 Gum Bridge Rd	Elizabeth City	NC	27909	Active	+	(252) 619-7308
Old Dutch Farm Apiary	3336 Startown Rd	Newton	NC	28658	Active		(828) 855-6942
Orr Bee Supply	323 Morris Hollow Rd.	Old Fort	NC	28762	Active	+	(828) 581-4494
Penny Apiaries	501 Penny Rd.	Beulaville	NC	28518	Active	+	(910) 290-2663 / (910) 290-4186
Phillip Haines	12560 Appin Rd	Laurinburg	NC	28352	Active	+	(910) 217-5832
Plank Road Apiary	3350 S. Plank Rd	Sanford	NC	27330			(919) 776-9517
Queen Bee Honey Farm LLC	119 Terry Springs Ln	Statesville	NC	28677	Active		(704) 682-4018
Rabbit Creek Bee Company, LLC	260 Corbin Cove Dr.	Franklin	NC	28734			(828) 634-1233
Ralph Harlan	1295 Brevard Place Road	Iron Station	NC	28080	Active		(704) 807-6207
Rayon Locklear	2883 S. Duffie Rd	Red Spring	NC	28377	Active	+	(910) 843-5561
Rev. Earl Jones Bee Farm	175 Folks Drive	Red Springs	NC	28377	Active	+	(910) 734-9337
Revis Russian Apiaries	P.O. Box 2520	Marion	NC	28752	Active		(828) 652-3524
Rick Williams	1207 Maple Ridge Road	Wilmington	NC	28411	Active		(910) 231-1755
Robert E. Baucom	2518 Hamilton X Rd	Marshville	NC	28103	Active		(704) 624-5116
Robert M. Dennis	1040 High Meadows Drive	Concord	NC	28025			(704) 721-5630
Robert Smith	5204 NC Hwy 127 South	Hickory	NC	28602	Active	+	(828) 261-5210
Rocking Bee Farms LLC.	368 New Hope Ch. Rd	Star	NC	27356			(704) 453-1131
Roger Walker	13965 US 64 ALT. Hwy West	Rocky Mount	NC	27801	Active	+	(252) 442-4065
Sapony Creek Apiaries	6154 West Mount Drive	Rocky Mount	NC	27803	Active		(252) 904-1446
Silk Hope Apiaries	1642 Henderson Tanyard Rd.	Pittsboro	NC	27312	Active		(919) 542-3157
Silver Spoon Apiaries	P.O. Box 4486	Wilmington	NC	28406			(910) 352-7868
Smaranda Cristea	P.O. Box 1618	Jacksonville	NC	28546	Active	+	(910) 358-2672
Spring Bank Bee Farm, Inc.	298 Spring Bank Road	Goldsboro	NC	27534			(919) 738-7638
Squeaky Tree Honey Farm	1417 Alexander St.	Statesville	NC	28677	Active	+	(704) 450-7335
Sweet Betsy Farm	3947 Mudcut Road	Marion	NC	28752	Active		(828) 724-4444
Tates Apiaries	2241 Union Cross Rd.	Winston-Salem	NC	27107			(336) 788-4554 / (336) 970-3952
Taylor-Rodgers LLC	213 Martin Farm Lane	Knotts Island	NC	27950	Active	+	(203) 803-5262
Terry Weaver	237 N. Trent Rd.	Merritt	NC	28556	Active		(252) 249-6170
Thomas "Kenneth" Medlin	91 Daisy Lane	Hurdle Mills	NC	27541			(336) 364-1915
Timothy A. Frye	PO Box 761	Liberty	NC	27298	Active	+	(336) 549-7358
TJ's Bees	630 Waddell Rd	Roaring River	NC	28669			(336) 957-4285 / (336) 262 2406
Tony Parker	15913 Sam Potts Hwy.	Bolton	NC	28423			(910) 655-0741 / (910) 386-7725
Triad Bee Supply LLC	4062 Evergreen Dr.	Trinity	NC	27370	Active		(336) 475-5137
Triple J Farms	595 Duke Whittaker Rd	Mocksville	NC	27028	Active		(336) 492-7564
Vince Applebee	24300 N.C. Hwy 8	Denton	NC	27239	Active	+	(336) 859-3895 / (336) 250-9582
Wagner Brother's Apiaries	624 Erwin Rd	Sanford	NC	27330	Active	+	(919) 478-6222
Wagram Apiary	24560 McGill St.	Wagram	NC	28396	Active	+	(910) 318-1202
Wayne D Medlin	3122 Lanesboro Rd	Marshville	NC	28103	Active	+	(704) 774-5355
Wayne Hansen	8004 Southway Rd	Charlotte	NC	28215	Active		(704) 536-4805 / (704) 287-4805
Wild Mountain Bees LLC	23 Merrimon Ave	Weaverville	NC	28787	Active		(828) 242-3906
William Fricks	2020 Jo Mac Rd	Chapel Hill	NC	27516	Active		
William Trivette	10500 McFarland Rd	Laurel Hill	NC	28351			(910) 610-3369
Zachary Lamas	8743 Allison Road	Cedar Grove	NC	27278			(603) 748-8334

Out of State Companies Permitted to Sell Bees

Company Name	Address	City	State	Zip Code	Status	Health Certification	Phone Number
Back Forty Bees	304 Back Forty Loop	Williamsburg	VA	23188	Active	+	(757) 745-9081
Blue Ridge Honey Co.	P.O. Box 15	Lakemont	GA	30552	Active	+	(706) 782-6722
Bordelon Apiaries, LLC	283 Palmer Ridge Rd	Plaucheville	LA	71362	Active	+	(337) 988-6644
Carolina Bee Supply LLC	10 S. Main St	Travelers Rest	SC	29690	Active	+	(864) 610-2337
Gardner's Apiaries / Spell Bee LLC	510 Patterson Rd	Baxley	GA	31513	Active	+	(912) 367-9352
Hardeman Apiaries	P.O. Box 214	Mt. Vernon	GA	30445	Active	+	(912) 583-2710
Jarrett Apiaries	1903 Hwy. 198	Baldwin	GA	30511	Active	+	(706) 677-2854
JJ's Honey	5748 Chancey Rd	Patterson	GA	31557			(912) 647-3726
Kelley Beekeeping Co	807 W. Main St	Clarkson	KY	42726	Active	+	(270) 242-6019
Kona Queen Hawaii	P.O. Box 768	Captain Cook	HI	96704	Active	+	(808) 328-9016
Kutik's Honey Farm LLC	1204 Holladay Rd	Manning	SC	29102	Active	+	(607) 336-4105
M&N Apiary, LLC	264 Tillman Anderson Rd	Jesup	GA	31545	Active	+	(912) 294-6123
Norray's Honey Inc	741 Pleasant Valley RD	Berne	NY	12023	Active	+	(518) 872-2257
Roberts Bee Company	2700 S. Macon St. Ext.	Jesup	GA	31545	Active	+	(912) 427-7311
Rossman Apiaries Inc	3364-A GA Hwy 33 N	Moultrie	GA	31768	Active	+	(229) 985-7200
Rufer's Deep East Texas Queens LLC	PO Box 394	Milam	TX	75959	Active	+	(612) 325-1203
Strachan Apiaries Inc.	2522 Tierra Buena Rd.	Yuba City	CA	95993	Active		(530) 674-3881
Virginia Eastern Shore Apiaries	23340 Roseland Drive	Accomac	VA	23301	Active	+	(757) 710-5684
VP Queen Bees	P.O. Box 99	Iva	SC	29655	Active	+	(864) 348-3026

It is unlawful to sell queens, packages, nucs or hives before the Permit to Sell Bees in North Carolina has been issued. For North Carolina residents, a permit is not required for: (1) the sales of less than 10 bee hives in a calendar year; (2) a one time going out-of-business sales for less than 50 bee hives, or (3) the renting of bees for pollination purposes or the movement of bees to gather honey.

Information or application forms for the Permit to Sell Bees in North Carolina are available by writing: Attn: Tammy Morgan, NCDA&CS, 1060 Mail Service Center, Raleigh, NC 27699, calling (919) 233-8214, or contacting your local county extension office.

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Selection of Location

The first decision the new beekeeper must make is where to put the hive. There are different factors that make a beehive location successful. There are also other questions about location to consider. For one thing, try to choose a location that is as close to your home as possible. There are several reasons for this. The closer the hive is to your house, the more convenient your storage area will be and the less time you'll spend traveling to and from your hive. If they are nearby, you will be able to inspect them more often.

Occasionally, beehives are vandalized by thoughtless people who find a beehive in an isolated area an irresistible target for rock throwing or shotgun blasts. Therefore, having the beehive closer to your home or the home of some other responsible person provides greater security for the colony.

Nectar
You need to make a careful study of available honey plants around a potential hive location. Honey bees get most of their nectar and pollen within a half-mile radius of their hive location. However, they can travel from one to two miles on their collection trips, depending upon the ruggedness of the terrain and the prevailing winds.

Water
Bees, like all animals, need a constant supply of water. It is best if there is a stream or pond in the vicinity of the beehive. A good source of water is especially necessary if your beehive is to be located close to neighbors' homes. Otherwise, the bees may choose your neighbor's water faucet, the children's wading pool, or the bird bath for a source of water. To avoid having your bees become a nuisance, place a tub or pan of water near the hive, and your bees will learn to go only to that safe "watering hole." Make certain that the water source has something in it the bees can land on without danger of drowning, such as cork floats, bark, or layers of crushed rock.

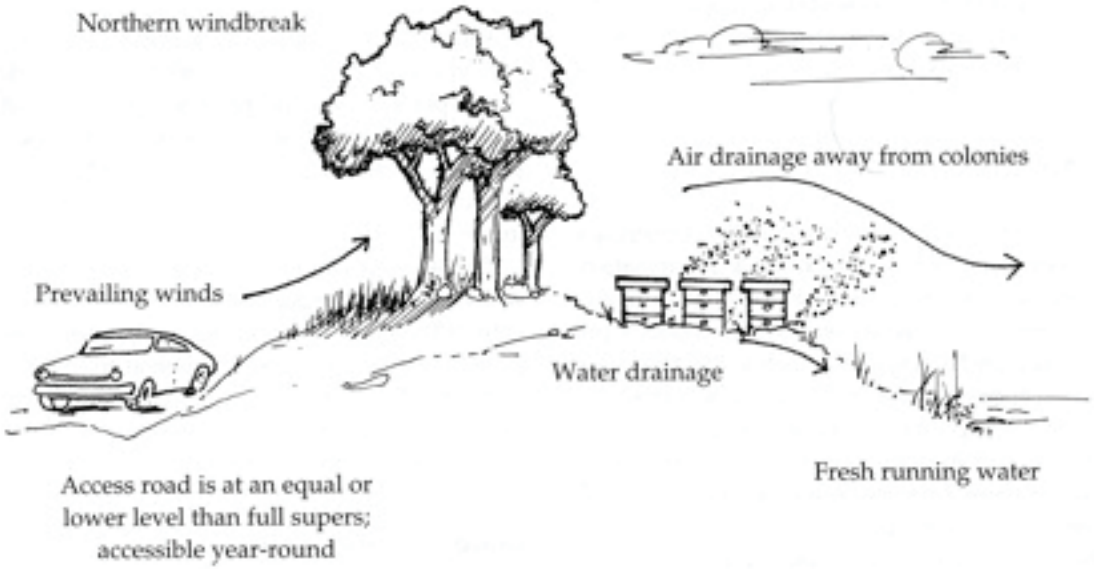
Drainage
There must be some water near the hive, but not too much. There should never be any possibility of the hive having to sit in water. Therefore, look for a spot with good drainage. Keep the hive off the ground using a hive stand or bricks and tilt it slightly forward. This will permit any moisture that may accumulate to run out the front entrance. Leaning the hive slightly forward also makes it easier for the bees to remove dead bees and other waste materials.

Sunlight
When locating your bees, also consider available sunlight. Your hives should have as much sunlight as possible, especially during the winter months. Face your hive toward the south, where the entrance will have the greatest exposure to sunlight and will be protected from the cold north winds of winter. If your location makes it inconvenient to place the hives facing south, try facing them east to catch the morning sun.

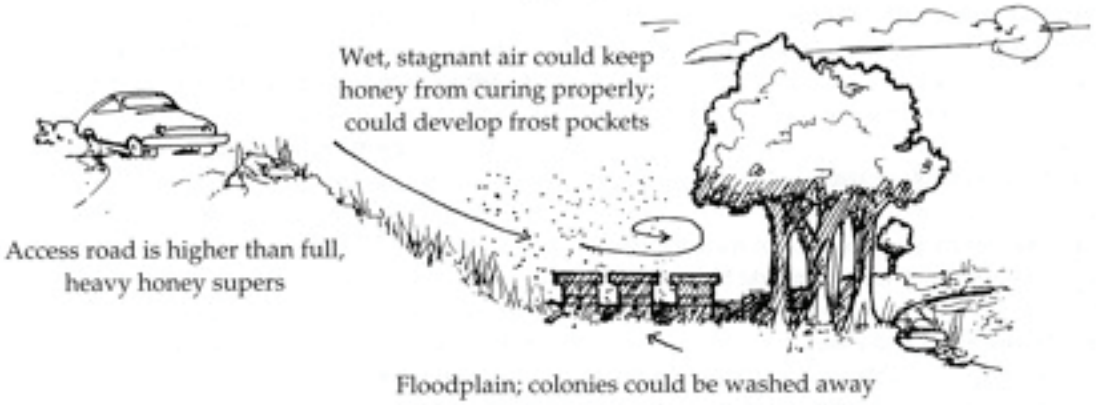
Vegetation
Finally, think about the vegetation immediately around your hive location. Trees to the west or north provide valuable protection from winter winds. You will want to keep the grass and weeds cut around your hive. This will reduce any danger of fire damage and provide good ventilation, which is necessary for the bees to maintain the proper hive temperature.

source: Purdue Extension publication 4-H-586-W

Ideal Apiary Site



Poor Apiary Site



Drawing by J. Propst; labeling ©1997 D.Sammataro

You like potato and I like potahto
You like tomato and I like tomahto
Potato, potahto, tomato, tomahto
Let's call the whole thing off

-- George & Ira Gershwin, "Let's Call the Whole Thing Off"

Beekeepers love to fight about things. Should we use screened or solid bottom boards? Reverse hive bodies or not? 8-frame or 10-frame equipment? Shallows, mediums or deeps? If we "win" the argument or find others who agree with us, it validates our primal need for self-worth. (A fascinating book on this topic is How We Know What Isn't So by Thomas Gilovich.)

But let me share a secret: In beekeeping, very few things are critically important. Almost every piece of equipment we use or method we employ is for the purpose of making things easier for the beekeeper, not the bees. Honey bees are very robust creatures, able to live on every habitable continent under widely diverse conditions. For the most part, they don't care one way or the other about what we do or how we do it. I've heard it said that "it all works," and that is, in general, true.

The corollary to this theorem is that beekeepers often agonize over the wrong things. "Woe is me… my sugar syrup is too thick for this time of year so my bees are going to suffer!" "Oh no! My hives are pointed northwest instead of southeast! How can I ever forgive myself?" "I've been using 'pine needles' instead of 'pine straw' in my smoker… I'm so embarrassed!"

One of the many decisions that new beekeepers have to make, and one that they'll get tons of spirited opinions on, is whether to start with packages, nucs or complete hives. Of course the dream way to start is with captured swarms, but that is extremely hit or miss and cannot be relied upon (see Free Bees? [December 2014]). The saying, "A bird in the hand is worth two in the bush" is appropriate here in a very literal sense. So although Hilda Ransome tells us in The Sacred Bee that,


FOR SALE

YOUNG ITALIAN BEES

½ lb., $1.25; 1 lb., $2.00; 2 lbs., $3.75; 3 lbs., $4.50. Untested Queen, $1.00; Tested, $2.00. Nuclei, $1.25 per frame. No disease. Also Apiaries of from 50 to 500 colonies.

Would like to correspond with anyone desiring location in fine, sweet clover belt, where the queen-rearing business or shipping bees by the pound can be carried on under ideal conditions. Always have big swarms issue by April 1.

Stover Apiaries,
Mayhew, Miss.

A classified ad from the April 1913 issue of American Bee Journal offered packages, nucs and even entire apiaries! For price comparison, in 1913 sirloin steak was 25 cents per pound, a dozen eggs were 35 cents and a gallon of milk cost 36 cents.

according to Eastern European folklore, it is bad luck to buy bees, beginning beekeepers are wise to do it anyway. Once a hobby beekeeper is up and running with a successful year or two under her/his belt, under normal circumstances it shouldn't be necessary to ever buy bees again (except perhaps queens).

The reason that packages, nucs and complete hives are all legitimate and popular options for starting up is that they each have their own advantages and disadvantages. Ultimately the choice should depend on the buyer's goals, experience set, risk assessment and finances.

Complete hives

Starting with complete hives is the same as moving an existing hive. How complete "complete" is will depend on the seller, but it should include a full-sized colony of bees with a laying queen, lots of brood and fully drawn comb. It may include a full complement of basic equipment (bottom board, brood box, frames

with drawn comb, inner cover, outer cover).

Advantages

1. No build-up time required.
2. Should be robust with respect to surviving the first summer dearth and preparing for winter.
3. If purchased early enough, could easily produce a surplus honey crop.

Disadvantages

1. This is the most expensive option on a total-dollar basis, although it may be a bargain on a per-bee basis.
2. Complete hives for sale are not easy to find locally -- they are a rather uncommon commodity, not available in large numbers. (Check the NC Agricultural Review classified ads for offers.)
3. They cannot be shipped – on-site pick-up only, wherever that may be.
4. "Complete" means that the hive comes complete with any well-established diseases and pests.
5. Buyer beware: Buying a used car involves careful inspection and questioning before the purchase; buying used bees should be no different. Just like used cars, they can be sold by very ethical professionals, ignorant amateurs, lying cheaters and every combination thereof.
6. The purchaser is starting out full-bore with a large colony, not easing into beekeeping toe-first. Large, established colonies sting a lot more, eat a lot more and require more skill to inspect than small "starter" colonies.

Nucleus colonies

A nucleus colony, or "nuc" for short, is like a "nuclear family": it has a home (albeit small), a laying queen, a proportionate number of worker bees, a nice amount of brood (e.g. a couple of frames' worth) and enough food stores to suffice as the colony becomes established.

If full colonies are like "adults", nucs are like "teenagers". They are well on their way to "adulthood" but still have a lot of maturing to do.

Most nucs consist of five deep frames of drawn comb which contain a mix of honey, pollen, brood and empty cells. The ratio of brood to stores and empty comb is not standardized and should be discussed with the seller before purchase. Apiculture author Larry Connor says, "I like to prepare a five-frame nucleus colony with two or three frames of brood, plus two food frames, and an empty drawn comb so the bees will emerge and swell the number of bees in the nucleus."[1]

Sometimes nucs are sold "with frame exchange", which means the buyer gives the seller five new frames, fully assembled with foundation, to replace the five that are included in the nuc. The buyer should expect a discounted price that reflects the cost of the frames with foundation ($2 to $3 each). It seems more common for experienced beekeepers to sell nucs "without exchange" because the quality of frames they may receive in trade is highly variable. For the buyer, "without exchange" is a lot easier and no more expensive overall.

Nucs will either be sold in cardboard nuc boxes or the seller will transfer five frames directly into the buyer's equipment. Note that wooden nuc-sized equipment can be purchased to hold five-frame colonies, but these have absolutely nothing to do with a brand new beekeeper buying a nuc. A first-time beekeeper should put the nuc frames into full-sized equipment since the goal is to have the colony expand as rapidly as possible. I have spoken to novices who mistakenly think that they are supposed to start with nuc-sized equipment and then step up as the colony grows; that approach is completely misguided. Nuc-sized hives are a great tool for many tasks (for example, see May 2016, Making Splits Without Bananas) but they don't directly complement our goal of growing full-sized colonies.

[1] Lawrence John Connor, "Making and Maintaining Connections" in American Bee Journal, vol. 156 no. 11 (November 2016), p. 1256.

This cardboard nuc box has been opened to aid ventilation and allow the bees to make cleansing flights.

Another critical point about nucs is that they must be given adequate ventilation during transport. A good nuc will have a lot of bees confined in a small space, probably with only a small air vent or two. If the nuc is transported in the back of a hot station wagon and left for an hour or so while the owner runs into WalMart, the bees will all be dead from heat exhaustion and suffocation when the owner returns. Beekeeper Steve Andrijiw advises that we should treat nucs and packages as we would a baby. If we leave our baby in a hot car for an hour, we'll end up on the 6 o'clock news. And we would look pretty silly if we then went back to the daycare and tried to exchange it for a live one. "Knowing better" is the responsibility of the buyer. Once we leave the bee store, they are our bees and are under our care. (See January 2016 Get Thee to a Bee School for ways to get educated in beekeeping basics.)

Nucs are most commonly sold on deep frames but sometimes can be purchased on mediums. Don't assume one or the other; ask the seller! Medium nucs won't have as many bees, brood or stores because, hey, mediums aren't as big as deeps. However they will cost the same because they are the same amount of trouble and effort for the seller either way.

Advantages

1. The colony has a several-week head start on comb building and brood rearing compared to a package or captured swarm.
2. If the queen was the queen-mother for the nuc's brood (not simply installed shortly before the sale), we can assess her brood pattern.
3. Colonies on comb with open brood are far less likely to abscond than newly-installed packages or swarms.
4. Local producers often, but not always, are selling nucs made from stock that has proven successful in our area. Despite heated rhetoric on this topic, this isn't really a big deal – honey bees are robust and do well in a variety of climates – but it doesn't hurt. Also note that the definition of "successful" may vary significantly from a bee-seller versus a beginning hobby beekeeper. Ask what selection criteria a local producer uses for raising her/his bees.
5. Since nucs are typically sold directly from the source, the buyer has the opportunity to assess the credentials, experience and reputation of the seller.

Disadvantages

1. Nucs cost about a third more than packages. In other words, for slightly more than the price of two nucs, a new beekeeper could buy three packages (a pair and a spare!).
2. As with complete hives, it is easy to buy someone else's existing problems: disease, high varroa mite loads, etc. Ask what mite treatments have been used and when, when the apiary was last inspected for mites and what the percentage infestation was, whether the colonies have been inspected by the State (which is required by law for someone selling more than 10 colonies in a year), the seller's beekeeping experience and credentials, and any other questions you can think of. If you don't like the answers, buy elsewhere.

3. Nucs aren't uncommon but aren't nearly as abundant or universally available as packages. They are not shipped, so the buyer must travel to the seller to make a purchase.
4. Typically, nucs aren't available until at least a month or so later than the earliest packages. This can negate the "head start" advantage of nucs. Conversely, they are often available late in the season. This is great if someone needs to repopulate a failed colony that has a full complement of already-drawn comb but a late start is very unwise when starting a brand new colony.

Packages

A.I. Root introduced the idea of selling bees by the pound in 1879 and the industry as we know it was up and running by 1913. Packages of bees and queens can be safely and reliably shipped across the country, from a distant supplier to your local post office. Or a local reseller may travel to the supplier, most often in south Georgia, and bring back hundreds or even thousands of packages for sale at their local shop.

Package production is done in parts of the country that have long bee-growing seasons with very early springs, notably California, Texas, Florida and south Georgia. Almost all of the packages sold in our area are produced by one of a couple of large, professional outfits in south Georgia. These are well-respected, well-run family businesses that date back many generations. They supply bees to the entire Eastern US and are very good at what they do.

African honey bees (aka "killer bees") are well established in Texas, southern California and the lower half of Florida. Even though you can find suppliers from there on-line, please do not make the mistake of buying bees from those areas. It is fine for a beekeeper in Texas to buy vicious bees from Texas, but only an inexperienced chucklehead or arrogant fool would knowingly bring them to North Carolina. South Georgia is still considered a safe (non-Africanized) source of packages and queens.

Since the vast majority of packages sold around here come from exactly the same place, price, convenience and availability should be the primary factors in deciding where to purchase. It makes no sense to drive a hundred miles to buy a package that came from the same apiary as the ones being sold by the guy next door, unless you can get it substantially cheaper and earlier. In general, we want the earliest delivery date we can possibly get. Don't ignore the old adage: "A swarm in May is worth a load of hay; a swarm in June is worth a silver spoon; a swarm in July isn't worth a fly." For us, we should shift this up a month, starting in April, but that messes up the rhyme. The point is that a package (or swarm) installed at the end of March or first of April has a terrific chance of success. The later spring progresses, the less time there is for a colony to draw out a full complement of comb, build up a healthy population and store up sufficient food for winter. Remember that our main honey flow only runs from April to May, sometimes into June if we are lucky. Those are the "fat times" for honey bees. If a package isn't installed until June, the beekeeper faces an extremely challenging uphill battle with no guarantee of success.

This photo documents the beginning of my beekeeping adventure, encouraged and assisted by my daughter Martha. These two packages were the first and last bees I've ever purchased.

Packages, also known as "artificial swarms", are my sentimental favorite means of starting as a beekeeper. The only bees I have ever purchased, apart from queens I've brought in for their genetics, were the two packages I bought through the mail when I first started out. Since then I have helped others install their packages, including 250 that a group of us installed in a single afternoon for a research project. Package installation is a fun experience that every beekeeper should try even if it isn't with her/his bees.

I do not prefer the installation method promoted in a popular textbook whereby the open package is left inside the hive and removed a day or so later. This is completely unnecessary and requires an additional invasive hive visit. Furthermore, it invites the bees to begin building comb inside the package rather than on the foundation we have provided. Instead, once the queen cage has been attached inside the hive between the frames, the inverted package should be shaken out in a back-and-forth rocking motion directly over the frames. The entire operation takes a few seconds. There will be a few stragglers remaining in the package. The mostly-empty package should be placed on the ground near the hive entrance. The stragglers will soon join their sisters in the hive and the empty package can be retrieved the next day without disturbing the colony.

Neophyte beekeepers fear shaking out packages but bees in a package (or a reproductive swarm) are in the gentlest state they are ever going to be in. They may whirl around in a cloud but they have no home to defend so aren't aggressive. While it is remotely possible to get stung while installing a package or collecting a swarm, it isn't likely unless we accidentally pinch a bee. I always recommend wearing a veil (I value my eyesight!) but that's the only protective equipment that should really be necessary when installing packages.

Similarly, smokers shouldn't be used when installing packages because the smoke interferes with the bees' Nasonov pheromone reception. This is the "here is home" smell that bees release in order to assemble their sisters. We want the bees to congregate inside their new home with their new queen, so don't want to do anything to discourage that. A beekeeper can light a smoker and keep it within reach just in case something goes horribly wrong, but don't plan to use it. Please don't misunderstand: this advice about smokers only applies to installing packages. For regular inspections, smoke saves bees' lives by deterring stinging. There is no good reason not to use an appropriate amount of smoke when disturbing established colonies.

Advantages

1. Packages are the cheapest way to start out with purchased bees.
2. They are universally available, either at local resellers or through the mail.
3. Packages can be purchased earlier than nucs.
4. If full colonies are like "adults" and nucs are like "teenagers", packages are like "babies" or "puppies". They'll grow as your own experience and comfort level grows.
5. Packages should, on average, have the cleanest and healthiest bees of the three options if they are produced by the major Georgia apiaries.

Disadvantages

1. Packages, or any swarm, may abscond (totally abandon the hive) shortly after being installed. This usually doesn't happen but is a risk. Once the colony begins building comb and raising brood, the risk of absconding practically disappears.
2. Bees can be stressed in transit if ventilation and temperature aren't properly controlled.
3. The colony must start from nothing. In addition to the resource requirements this entails (e.g. converting carbohydrates to wax), this means that it will be at least 3 weeks before there are any more new bees in the colony, since it takes 21 days from egg to emergence of an adult worker. The colony population will decline until new bees begin to arrive. This is no different

than what occurs during natural swarming so isn't a "problem" as such; it is just means that a package cannot grow as rapidly as a nuc. If a beekeeper has existing hives, comb and brood can be borrowed from them to boost a package; this would, in effect, be a hybrid between a package and a nuc.

4. A package started in the late spring/early summer cannot be expected to thrive or survive long-term without a lot of effort and luck.
5. A package's appearance gives very little indication of how well it will do in the future.
6. It is not uncommon for a package to contain an unmarked queen hidden among the mass of worker bees in addition to the marked queen in the cage. This isn't a problem for a highly experienced beekeeper who recognizes what is going on but it can create chaos for everyone else. The workers will kill the caged queen, either while she is in the cage or after she is released. If the beekeeper tries to introduce another caged queen, the bees will kill her also and will continue to do so with any introduced queen as long as they have the queen that they came with. If you install a package and the bees kill the queen from the cage, ask an experienced beekeeper to carefully inspect the colony for the presence of an additional queen. Or wait two weeks before doing anything, giving the colony time to raise worker brood (quite obvious from the way it is capped), which clearly indicates the presence of a mated, laying queen.

Your choice

I hope it is clear that the form of bees that someone starts out with (full hive, nuc, package, natural swarm) is not a critical factor for success. It all works, which is why each of those variations remains popular. None is perfect – all have plusses and minuses. Your choice should be guided by your relative priorities related to expense, fun, ease and availability, as well as outside factors such as time of year. But you don't have to make a single choice… you could start with one of each and compare!

Regardless of how your bees will arrive, order early! Suppliers are already taking orders for next spring. They'll be filled on a first-come, first-served basis and supplies often run out.

The earliest delivery dates I've seen so far are during the last week of March. That timing would be excellent and would give the best assurance of success – don't settle for anything later if those early spots are available when you order. But realize that those dates are "if all goes well". Many years, delivery is delayed due to poor spring weather in south Georgia, which prevents packages and queens from being produced on schedule. So an early reservation date doesn't guarantee an early delivery date. That's another reason to get a spot on the list as close to the top as possible.

A list of producers and dealers who are legally authorized to sell honey bees in North Carolina can be found on the NCDA&CS website. As the posting indicates, "It is unlawful to sell queens, packages, nucs or hives before the Permit to Sell Bees in North Carolina has been issued. For North Carolina residents, a permit is not required for: (1) the sales of less than 10 bee hives in a calendar year; (2) a one time going out-of-business sale for less than 50 bee hives, or (3) the renting of bees for pollination purposes or the movement of bees to gather honey. " The list isn't an endorsement of the sellers; it simply shows those who are legally allowed to operate in our state. ***IMPORTANT NOTE:*** *Due to a paperwork mix-up, Bailey Bee Supply wasn't included in the 2016 list that was posted on-line, but rest assured that the store is authorized to sell bees in 2017.*

So stop reading now, go pick up the phone and order those bees! And remember, whichever option you choose, there's no need to fight about it!

Randall Austin is a NC Master Beekeeper keeps a few honey bee hives in northern Orange County. He can be reached at s.randall.austin@gmail.com.

HOW TO INSTALL A PACKAGE OF HONEY BEES

One of the more common means of starting a new beehive is by ordering live honey bees from a commercial vendor. Such 'packaged' bees typically contain about 12,000 live adult workers (approximately 3 pounds), one newly mated queen bee, and an inverted can of sugar water, all contained in a wooden box with screened sides (Figure 1).

When installing a package of bees, you should wear a veil and take appropriate precautions to prevent bees from crawling up you pant legs. You also will need a hive tool, a smoker, a small nail, a spray bottle filled with sugar syrup, and one or more gallons of sugar syrup to feed the new colony. To make the syrup, mix warm water with granulated or powdered sugar in a 1:1 ratio and mix thoroughly until all of the sugar is dissolved.

Step 1. Pick up your bees from the post office or other place of delivery. Carefully look over the package for any cracks or tears in the screen, and inspect the bees to make sure they are alive and in good health (it is normal to have about one inch of dead bees in the bottom of the box). If there is an excessive amount of dead bees, it may be an indication that they have been overheated during shipping, in which case you should contact your package provider. Spray the bees with sugar syrup; be generous, but be sure not to drown the bees!

Figure 1. A pallet of 3-lb packaged honey bees.

Step 2. Place the package in a cool, dark place to allow the bees to 'rest' for several hours before installing them into a hive. Make sure the bees are not exposed to excessive heat or cold, loud noise, or

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unusual vibrations. Periodically spray the bees with sugar syrup (1 part sugar, 1 part water) until you are ready to install the bees into a hive. This is a good time to make sure all of your hive equipment is ready.

Figure 2. Prepare a space in the hive in which to shake the bees.

Step 3. When your equipment is set up and you are ready to install the bees into the hive, feed the bees again with sugar syrup and carry the package (by holding the wooden sides) into the apiary. Be sure to keep your hands away from the screened sides of the package to avoid getting stung through the screen. Place the package on the ground in a shaded area.

Step 4. Remove three or four frames from the center of the brood chamber to create a space in the hive for the bees (Figure 2).

Step 5. Spray the bees again with sugar syrup.

Step 6. With the hive tool, remove the wooden panel from the first package of bees (Figure 3a). Gently remove the tin feeder and queen cage from the hole in the top of the box (Figure 3b). Shake bees from the outside of the queen cage and inspect the queen to ensure that she is still alive and healthy. Place the queen cage in the shade (Figure 3c). Replace the wooden panel over the hole to prevent bees from escaping (Figure 3d).

Step 7. Immediately before installing the bees into the hive, firmly knock the package on the ground once to make the bees drop to the bottom of the box. Be sure to hold the wooden lid in place while doing this.

Figure 3. (a) Remove the package lid. (b) Remove the feeder and queen cage. (c) Check that the queen is alive in her cage. (d) Quickly replace the package lid.

Figure 4. Shake the bees into the hive.

Figure 5. Let the remaining bees enter the hive.

Figure 6. Replace the frames.

Figure 7. Gently remove the cork on the *candy* end of the queen cage.

Step 8. Next, remove the wood panel and quickly invert the package over the hive body. Firmly and vigorously shake the bees into the space in the hive (Figure 4). It might be necessary to shake the package several times. Don't worry if there are a large number of bees flying around; they are largely "confused" and therefore not defensive, and they will eventually settle down and enter the hive.

Step 9. Prop the package in front of the entrance of the hive so that any remaining bees in the package can crawl into the hive (Figure 5).

Step 10. Gently return the frames to the hive after the workers have dispersed on the bottom board (Figure 6), being sure not to crush any bees.

Installing the queen

1. Remove the plastic cap from the long side of the queen cage with the white sugar candy (Figure 7). The bees will eat the candy and eventually release the queen within one or two days. This time-release method allows the bees to become accustomed to the queen, minimizing the chance that the bees will reject the queen. *Do not remove the cork on the end without the candy!*

2. Place the queen cage *candy side up* between two center frames of the hive (Figure 8). Make sure the cage is secure between the frames so that it does not fall to the bottom of the hive.

Figure 8. Secure the queen cage, candy-end up, in between the center frames.

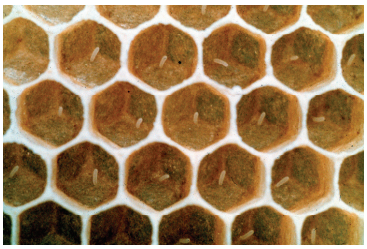


Figure 9. Newly laid eggs in the brood comb.

3. Feed the new colony with sugar syrup. *It is critical that the bees have an ample supply of food at all times, particularly before there is a sufficient supply of honey stored in the colony.* Replace the inner cover and lid.

4. Inspect the colony 5 days after installing the package to ensure that the queen is alive and has been released. Inspect the colony again after another 5 days to verify that the queen has begun laying eggs. Eggs appear as small grains of rice standing up in the center of cells (Figure 9). If necessary, add sugar syrup again at this time.

Troubleshooting

Sometimes, problems may arise while starting a new hive from packaged bees. Here are some common issues, and some potential solutions.

1. **"My queen was not accepted by the workers!"**

- Occasionally, the workers will not accept the queen either before or after she is released from her cage. You will know this has occurred if the queen is dead in the cage or missing from the hive. If this is the case, you may either:
    1. Insert a replacement queen from a commercial vendor, or
    2. Unite the hive to an existing colony by:
        - Placing a single sheet of newspaper on the top of the established hive, making sure that it is completely covered;
        - Poking numerous small holes into the newspaper with your hive tool;
        - Placing the hive body of the queenless colony on top of the hive body with the newspaper;
        - The bees will chew through the paper and unite with the queenlesss colony.

2. **"The bees are not building enough wax comb!"**

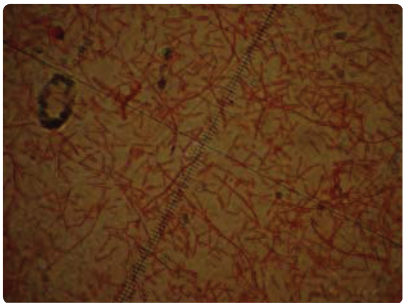
- Feed!!! Feed!!! Feed!!! Bees will build the wax comb in response to a need for it. Thus they require ample sugar syrup to secrete enough wax. Even when they are well fed, they may still take several weeks to furnish ten frames with wax comb.

3. **"The queen is present, but she is only producing drone brood!"**

- On occasion, a queen is not properly mated or has depleted her sperm stores. Thus she is only able to lay unfertilized eggs, which will develop into drones. As drones do no work in a hive, a colony consisting of only drones will quickly die out. You can identify a drone-laying, or 'failing', queen by the presence of a majority of drone brood throughout the colony. Drone brood is larger than normal worker brood and protrudes from the surface of the comb. If you find the queen to be a drone layer, the only solution is to replace the queen by one of the two methods described above.

Plant Industry - Plant Protection Section
Apiary Services

The mission of the North Carolina Department of Agriculture and Consumer Services Apiary Program is to promote and protect the state's beekeeping industry. The Apiary Program provides disease and disorder inspections (apiarymp.html) and fumigation services in an effort to control diseases and pests of the beekeeping industry. Additionally, the Apiary Program provides educational workshops to educate the state's beekeepers on the biology and treatment of mite and disease pests of honey bees and africanized bees. Promotional effects are achieved through lectures to county and state beekeeping organizations or any other groups that are interested in apiculture or related topics.



Paenibacillus larvae, the causative organism in American foulbrood

(images/Slide02_000.jpg) (images/DSC00485_000.JPG) Above Image Magnified (images/Slide02_000.jpg)

Session 6 - Diseases

Honey Display at the State Fair

The Apiary Program is also responsible for the bee and honey display at the North Carolina State Fair (http://www.ncstatefair.org/) in Raleigh and the Western Carolina State Fair (http://www.ncagr.com/markets/fairs/mtnfair/index.htm) in Asheville. Apiary Program personnel participate in most of the states county and regional fairs.

The Apiary Program in cooperation with the Food and Drug Protection Division (http://www.ncagr.com/fooddrug/)of the North Carolina Department of Agriculture and Consumer Services provides honey house sanitation inspections.

Additional Apiary Program Sites and Related Links:

- Apiary Inspection Services by Counties (apiarymp.html)
- Report 2008-09 (documents/ApiaryReport2008-09.pdf)
- Bee Linked (../../beeboard/index.htm)
- 2017 Apiary Registration Form (documents/BS2ApiaryRegistrationForm01-2017.pdf)
- Small Hive Beetle (hivebee.html)
- List of Dealers Authorized to Sell Bees in NC (updated - May 8, 2017) (documents/PermitToSell20175-8.pdf)
- How to Sell Bees in North Carolina (../../plant/apiary/sellbees.htm)
- N.C. Bee and Honey Act of 1977 (http://www.ncga.state.nc.us/EnactedLegislation/Statutes/HTML/ByArticle/Chapter_106/Article_55.html)
- N.C. Bee and Honey Act of 1977 (RTF printable) (http://www.ncga.state.nc.us/EnactedLegislation/Statutes/RTF/ByArticle/Chapter_106/Article_55.rtf)
- (/pollinators/index.htm)Honey and Bee Industry Regulations (../../Regs/48a0200.htm)
- N.C. Africanized Honey Bee Advisory Task Force - 291 (documents/2011NCAHBActionPlan.pdf)
- Beekeeping, Tracheal Mite Disease, and Varroa Mite Disease (http://entomology.ces.ncsu.edu/apiculture/beekeeping-notes/)
- N.C. Pollinator Information (../../../spcap/bee/)

- Beecheck (/pollinators/Driftwatch.htm)

For Additional Information Contact:
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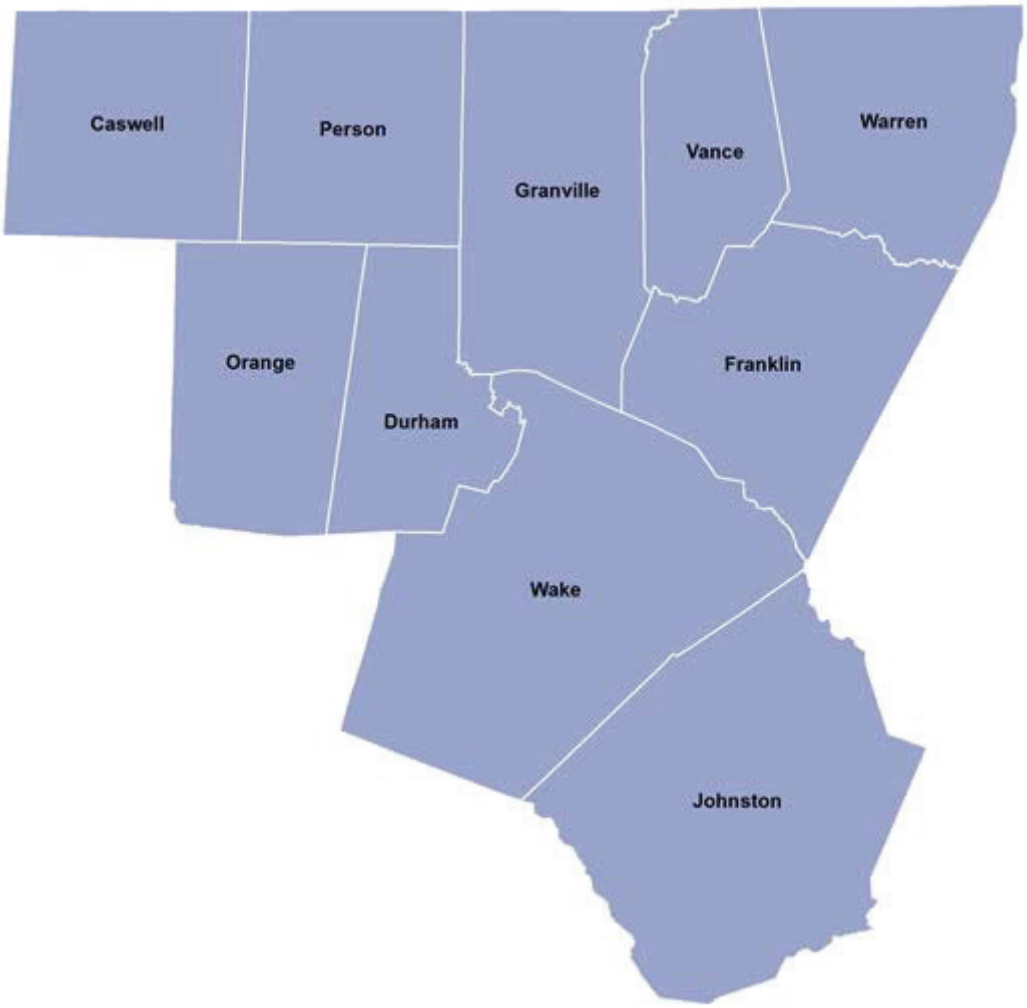
Session 6 - Diseases

Plant Industry - Plant Protection Section
Apiary Inspection Services



Contact: William M. Hicks - ***Apiary Inspector***

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E-Mail Address: Will.Hicks@ncagr.gov (mailto:Will.Hicks@ncagr.gov)

Return To Apiary Inspection Map Page (apiarymp.html)

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Disease Management and Guidelines for the Honey Bee

Introduction

It is the goal of every beekeeper to maintain healthy, productive colonies. This can only be accomplished by reducing the frequency and prevalence of disease within beehives. The following is an outline of recommendations for detecting and treating colonies for economically important parasites and pathogens of honey bees so that beekeepers may achieve this goal, and do so in a sustainable way for the long-term health of their colonies.

Overview

Disease/Pest	Causative Agent	Symptoms
Adult Parasites		
Varroa mites	The parasitic mite *Varroa destructor*	Presence of adult mites, deformed wings
Tracheal mites	The parasitic mite *Acarapis woodi*	K-wings, morbidity
Nosema	The protozoan *Nosema apis*	Diarrhea, distended abdomens
Brood Pathogens		
American foulbrood (AFB)	The bacterium *Paenibacillus larvae*	Discolored larvae, foul smelling brood, ropy remains, scale
European foulbrood (EFB)	The bacterium *Melissococcus pluton* and associated flora	Discolored larvae, foul smelling brood, non-ropy remains, no scale
Chalkbrood	The fungus *Ascophaera apis*	White or black mummies in cells or on bottom board
Sacbrood	A viral infection	Brown larvae in the curled "canoe" shape
Hive Pests		
Wax moths	Larvae of *Galaria mellonella*	Silk cocoons and/or tunnels
Small hive beetle (SHB)	Larvae of *Aethinda tumida*	Wet combs, maggot-like larvae

Varroa Mites

Session 6 - Diseases

Cause

The parasitic mite, *Varroa destructor.*

Symptoms

- Presence of adult mites on adult bees, brood, or hive debris.
- Adults with shortened abdomens, misshapen wings, and deformed legs.
- Dramatic decline in adult population and brood area, with spotty brood pattern.

Means of prevention

- Screened bottom boards.
- Mite-tolerant stocks, such as Russian, SMR, or Minnesota hygienic.
- Drone-brood trapping.
- Treatment of inert dusts.

Methods of detection

- Sugar shake or ether roll.
- Sticky board.
- Alcohol wash.
- Drone-brood inspection or visual inspection.

Treatment recommendations (see flow chart)

Spring (prior to honey flow)

- If varroa levels are equal to or more than **2-3 mites per 100 adult bees** (sugar shake, ether roll, or alcohol wash) or **40-80 mites per 24 hours** per sticky board, treatment is warranted.
- The use of volatile treatments, such as thymol or formic acid, are not recommended since they can result in decreased brood area. Use the appropriate dosage of **Apistan®** or **Checkmite+®** as long the mites have not previously developed a resistance.

Late spring/summer (during/immediately following honey flow)

- Never use any chemical treatments while honey supers are on hives.
- Employ one or more means of prevention, such as screened bottom boards or mite-tolerant stock.

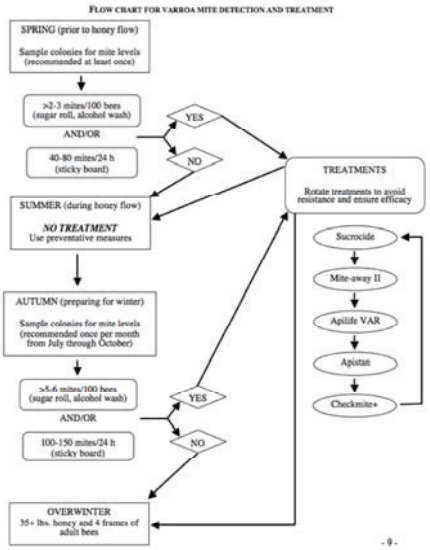
Autumn (preparing for winter)

- Sample frequently for mites, preferably once a month.
- If varroa levels are equal to or more than **5-6 mites per 100 adult bees** (sugar shake, ether roll, or alcohol wash) or **100-150 mites per 24 hours** per sticky board, treatment is warranted.
- Rotate treatments as often as possible to minimize the prolonged exposure of any one chemical for the mites. This will help ensure that the mites do not develop a resistance to the available treatments.

For more information, see NCSU Beekeeping Note 2.03, *Varroa Mites* (http://content.ces.ncsu.edu/managing-varroa-mites-in-honey-bee-colonies), on the biology, detection, prevention, and treatment of varroa mite infestations.

Varroa mite

Varroa mite



Flow chart for Varroa mite detection and treatment.

Tracheal Mites

Cause

The parasitic mite, *Acarapis woodi.*

Symptoms

- There is no one tell-tale sign of this disease.
- Disjointed wings or 'K-wing,' distended abdomen.
- Bees often crawling on the bottom board appearing "morbid."

Means of prevention

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- Resistant stock, such as Buckfast or Russian.

Methods of detection

- Positive identification of tracheal mites can only be made upon microscopic observation of trachea (the breathing tubes of adult bees).
- If you suspect a tracheal-mite infestation, contact your regional NCDA&CS Apiary inspector.

Treatment recommendation

- Verify infestation level whenever tracheal mites are suspected (see above).
- If the percentage of infested adult workers is 10% or greater, treatment is warranted. Treat colonies in the late summer or autumn.
- Recommended treatments:
  - **Mite-a-thol®** (menthol crystals)
  - **Mite-Away II®** (formic acid pads)
  - **Apilife VAR®** (thymol pads) or **Apigaurd®** (thymol gel)

Tracheal mites

Nosema

Cause

The protozoan, *Nosema apis* or *Nosema ceranae*. The latter has largely displaced the former over the last few decades so that *Nosema ceranae* is the most prevalent.

Symptoms

- There is no single symptom of the disease.
- Adults may have distended abdomens and defecate within the hive rather than take cleansing flights.

Means of prevention

- There is no exact means of prevention for nosema.
- Since the disease can be caused by stress, maintaining strong, healthy colonies is the best means of prevention.

Methods of detection

- Infections can only be confirmed by dissecting the digestive tract from individual bees. Diseased individuals have white, soft, and swollen ventriculae rather than brown and tubular.
- Hind gut contents can be examined under a microscope, and nosema spores can be counted using a hemocytometer.

Treatment recommendation

Spring (prior to honey flow)

- The only registered treatment for nosema is **Fumadil-B®**. Treat if there are more than **1 million spores per bee**.
- Mix **Fumadil-B®** with sugar syrup according to the label and feed to bees.

Late spring/summer (during/immediately following honey flow)

- No treatment warranted. Maintain strong colonies.

Autumn (preparing for winter)

- Treat if there are more than **1 million spores per bee**.
- Mix **Fumadil-B®** with sugar syrup according to the label and feed to bees.

Honey bees defecating in the hive due to Nosema.

American Foulbrood

Cause

- The spore-forming bacterium, *Paenibacillus larvae larvae*.

Symptoms (see Table 1 below (http://content.ces.ncsu.edu/disease-management-and-guidelines-for-the-honey-bee#table1))

- Brood is dull white, becoming light brown to almost black.
- Age of dead brood is usually older sealed larvae or young pupae.
- Sealed brood is discolored and sunken, often with punctured cappings.

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- Heavy infections have brittle, black scales that lie flat on the bottom of brood cells, formed from the dried remains of diseased brood. These scales contain billions of AFB spores and are highly contagious and persistent.

Means of prevention

- Hygienic stocks.
- Avoid robbing by keeping colonies strong.
- Minimize comb swapping between hives.
- Replace three combs in the brood chamber every year with foundation or drawn combs from honey supers.
- Disinfect bee hives or suspect frames and brood boxes at the NCDA&CS fumigation chamber using ethylene oxide.
- It is **not** recommended to preventatively treat colonies with antibiotics, as it masks AFB symptoms (increasing the spread of the disease among hives) and resistant strains of AFB may develop.

Methods of detection

- 'Ropy test.' Since larval remains of AFB-infected brood are elastic, a common field diagnostic is to pull the remains out of the cell with a toothpick or small twig. If the remains are elastic and "rope" out of the cell an inch or two, it is likely AFB rather than another brood disease.
- Holst milk test. This is a simple procedure that can be accomplished in most beekeeping operations. Place a suspect scale or smear of a diseased larva in a glass vial containing 4 ml of 1% powdered skim milk. Place the tube in a warm place (preferably at 37ºC). If AFB is present, the suspension should be clear in 10-20 minutes, since *P. larvae* spores produce proteolytic enzymes.
- Other, more sophisticated tests can be performed in the laboratory. Contact your regional NCDA&CS Apiary inspector for details.

Treatment recommendations

- Verify infestation and distinguish from other brood diseases (see Table 1 (http://content.ces.ncsu.edu/disease-management-and-guidelines-for-the-honey-bee#table1)).
- Contact your regional NCDA&CS Apiary inspector to inform them of an AFB outbreak.
- Burn all frames and euthanize bees.
- Scorch or fumigate empty brood boxes, bottom boards, inner covers, and lids.

American foulbrood disease

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European Foulbrood

Cause

- The bacterium *Melissococcus pluton* and associated flora.

Symptoms (see Table 1 below (http://content.ces.ncsu.edu/disease-management-and-guidelines-for-the-honey-bee#table1))

- Brood is dull white, becoming light brown to almost black.
- Age of dead brood is usually younger, unsealed larvae.
- Consistency of remains are rubbery and granular, not elastic.

Means of prevention

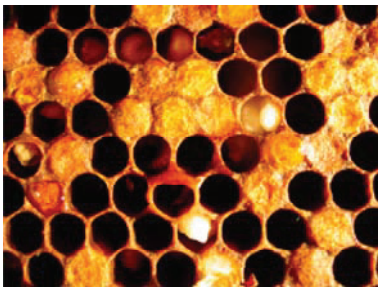
- EFB is largely a disease caused by stress. Thus maintaining a strong, healthy colony is the best prevention of the disease.

Methods of detection

- Visual inspection.

Treatment recommendations

- Verify infestation and distinguish from other brood diseases (see Table 1 (http://content.ces.ncsu.edu/disease-management-and-guidelines-for-the-honey-bee#table1)).
- For colonies with light infections, reduce the area of the brood nest, replace infected combs with foundation, and keep colony population strong.
- For colonies with heavy infections, treat with **Terramycin**® or other approved antibiotic. Feed to colonies in powdered sugar by dusting the appropriate amount on the top bars on the outside of the brood nest. Note that prophylactic use of any antibiotic is never recommended to avoid the evolution of resistance, and should only be applied as a last resort.
- For all cases, maintain a hive quarantine (i.e., do not exchange frames from or into the hive) and be vigilant for re-emergent signs of EFB.



European foulbrood

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Chalkbrood

Cause

- The fungus, *Ascophera apis.*

Symptoms (see Table 1 below (http://content.ces.ncsu.edu/disease-management-and-guidelines-for-the-honey-bee#table1))

- Hardened, white or black “mummies” that resemble the consistency of chalk.
- Mummies can be located in capped or uncapped brood cells, or they may litter the bottom board or on the ground directly outside the front entrance of a hive.

Means of prevention

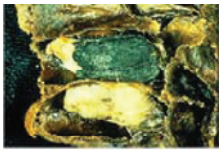
- Chalkbrood is largely a disease caused by stress. Thus maintaining a strong, healthy colony is the best prevention of the disease.
- Chilling may also increase chalkbrood, so ensure that there is an adequate adult population to keep the brood nest warm during cold weather.

Methods of detection

- Visual inspection is fairly obvious, thus the presence of mummies is usually sufficient to confirm infection.

Treatment recommendations

- There are no chemotherapies for chalkbrood. Requeening may be beneficial.



Chalkbrood

Sacbrood

Cause

- A viral pathogen of bee larvae.

Symptoms (see Table 1 below (http://content.ces.ncsu.edu/disease-management-and-guidelines-for-the-honey-bee#table1))

- Dead larvae appear watery and granular with a thick skin that forms a sac.
- The head of an infected larva is lifted toward the top of the cell, resembling the shape of a canoe.

Means of prevention

- Sacbrood is largely a disease caused by stress. Thus maintaining a strong, healthy colony is the best prevention of the disease.

Methods of detection

- Visual inspection.

Treatment recommendations

- There are no chemotherapies for sacbrood. Requeening may be beneficial, and maintaining a strong colony often the best cure for the disease.

Sacbrood

Wax Moths

Cause

- Larvae of the *Galeria mellonella* moth.

Symptoms

- Large, 1.5 inch larvae tunneling through the wax combs of weak hives or stored bee equipment.
- Silk cocoons, typically found on the side bars or top bars of frames in infested hives or equipment.

Means of prevention

- Maintain strong colonies and inspect weak colonies often.
- Cycle combs through the freezer for 1-2 days before storing.
- Place **Paramoth® crystals** on stacks of stored combs according to the label.

Methods of detection

- Visual inspection.

Treatment recommendations

- Store unused combs with PDB crystals. ***Never*** place crystals on a living colony, as the fumes are highly toxic to adult bees and brood.
- If heavy infestations are found, freeze combs for 1-2 days before reusing.

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Wax moths

Small Hive Beetle (SHB)

Cause

- Larvae of the beetle *Aethinda tumida.*

Symptoms

- Presence of adult beetles ***and*** eggs or larvae (presence of adults only does not necessarily indicate a problem).
- Watery, fermenting comb with small white grubs eating the wax.
- Larvae crawling out of the front entrance of the hive and burrowing into the soil.

Means of prevention

- There are no chemical products that deter SHB infestation. Researchers are currently working on a SHB lure, but the technology is not yet available for use by beekeepers.
- Beekeeping supply stores sell SHB traps that are inserted between the bottom board and brood chamber.

Methods of detection

- Visual inspection and verification of SHB larvae.
- Young wax moth larvae can sometimes be mistaken for SHB larvae. The two can be distinguished since SHB larvae have dorsal spines, whereas wax moth larvae do not.

Treatment recommendations

- If adults are present, tape ½ a strip of **Checkmite+®** beneath a square of corrugated cardboard placed on the bottom board of the hive. The beetles often seek a refuge below the cardboard and come into contact with the pesticide. NOTE: the presence of **Checkmite+®** strips for the control of varroa mites does not simultaneously confer control for SHB.
- If larvae are present and crawling out of the hive:
    - Replace infected combs with foundation, then burn them or freeze them if salvageable.
    - Apply **GuardStar®** soil drench around the perimeter of the hive to kill developing pupae in the ground around the hive.

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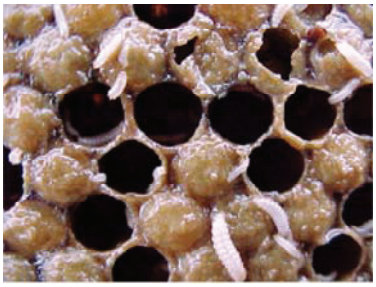
- There are currently no in-hive chemical treatments for SHB larvae.

For additional information about SHB biology, identification, prevention, and treatment, see NCSU *Beekeeping Note* 2.05, *The Small Hive Beetle (http://content.ces.ncsu.edu/the-small-hive-beetle-a-pest-of-honey-bee-colonies)*.



Small hive beetle larvae

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Symptom of dead brood	**American foulbrood**	**European foulbrood**	**Chalkbrood**	**Sacbrood**
Appearance of comb	Sealed brood is discolored and sunken, often with punctured cappings	Sealed brood is discolored and sunken, often with punctured cappings	Mummies found in sealed and unsealed brood	Scattered sealed brood with punctured cappings
Age	***Usually older sealed larvae or young pupae***	***Usually young, unsealed larvae***, but occasionally older coiled larvae	Older larvae in upright cells	Usually older sealed larvae upright in cells
Color	Dull white, becoming light brown, coffee brown, dark brown, then almost black	Dull white, becoming light brown, coffee brown, dark brown, then almost black	***Chalk white or black***	Grayish or straw-colored, becoming brown or darker
Consistency	***Soft, becoming sticky to ropy***	Watery and ***granular***; rarely sticky or ropy	Hard and rocklike	***Watery and granular; tough skin forms a sac***
Odor	Slight to pronounced odor of gym socks	Slightly sour to penetratingly sour	Slight, non-objectionable	None to slightly sour
Scale characteristics	Hard, brittle, and black. Uniformly lies flat on lower side of cell. Adheres tightly. ***Fine, threadlike tongue of dead pupae*** may be present.	Usually twisted in cell. Does not adhere to cell wall. ***Rubbery*** and black.	Does not adhere to cell wall. ***Brittle and chalky***, white to black in color.	Head prominently ***curled toward center of cell like a canoe***. Does not adhere to cell wall.

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Table 2. A list of products that are currently registered for the treatment of honey bee parasites, pathogens, and pests.

Brand name	Type(s) of chemical	Varroa mites	Tracheal mites	Nosema	AFB/EFB	Wax moths	SHB
Apigaurd	Thymol, an essential oils	X	X	-	-	-	-
*Apilife VAR	Blend of essential oils, particularly thymol	X	X	-	-	-	-
Apistan	Fluvalinate, a synthetic pyrethroid	X	-	-	-	-	-
Apivar	Amitraz, a synthetic miticide	X	-	-	-	-	-
*Checkmite+	Coumaphos, an organophosphate	X	-	-	-	-	X
Fumadil-B	Fumigilin, an antibiotic	-	-	X	-	-	-
GardStar	Pemethrin, a synthetic pyrethroid	-	-	-	-	-	X
Mite-a-thol	Menthol, an essential oil	-	X	-	-	-	-
Mite-Away II	Formic acid, an organic biopesticide	X	X	-	-	-	-
Paramoth	PDB crystals, a fumigant	-	-	-	-	X	-
Sucrocide	Sucrose octanoate, a synthetic biopesticide	X	-	-	-	-	-
Terramycin	Oxy-tetracycline, an antibiotic	-	-	-	X	-	-

* - These products are registered as a Section 18 Emergency-use pesticide, and therefore require a

private applicators pesticide license to purchase and apply.

As always, use of non-approved chemical treatments is strictly prohibited, as are any applications of chemicals that do not follow the registered label.

Contact Information

North Carolina Department of Agriculture & Consumer Services, Apiary Inspection (http://www.ncagr.gov/plantindustry/plant/apiary/apiarymp.html)

North Carolina State University Apiculture Program (http://entomology.ncsu.edu/apiculture)

For more information on beekeeping, visit the Beekeeping Notes website (http://entomology.ces.ncsu.edu/apiculture/beekeeping-notes/).

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Managing Varroa Mites in Honey Bee Colonies

Introduction

The varroa mite (Varroa destructor) is the most serious pest of honey bee colonies worldwide. This parasite was first detected in North Carolina in 1990, having been introduced to the United States just three years earlier. Virtually all feral (or “wild”) honey bee colonies have all but been wiped out by these mites, and beekeepers continue to struggle with varroa infestations in their hives. In North Carolina alone, the number of managed beehives has dropped by an estimated 44 percent since the invasion of the mites. It is vital, therefore, to understand the varroa mite and the options available for its control.

Mite Biology

The mite is an external parasite which attacks both adult bees and the developing honey bee larvae. The adult mites have a flattened oval shape, are reddish-brown in color, and are about 0.06 inches wide (about the size of the head of a pin). The mated female mite enters the cell of a developing bee larva and lays up to six eggs. The developing mites feed on the pupae and, depending on the number of mites, may kill it, cause it to be deformed, or have no visible effect. While the males die in the cell, the adult daughter mites climb onto an adult worker bee and feed on its hemolymph (bee “blood”). The female mite can then repeat the cycle by entering cells of other developing larvae. Mites prefer drone larvae over worker larvae, but they will infest worker larvae and eventually kill the colony if preventative measures are not taken.

The mites can harm the bees indirectly as well. In addition to the obvious effects of mites feeding on developing and adult bees, the mites can also serve as vectors of several viruses that can kill bees. These secondary infections, facilitated by the mites compromising the bees’ immune systems, can cause a condition known as Parasitic Mite Syndrome (PMS), which can kill colonies within months of infestation.

Detection methods

Many colonies that succumb to varroa infestations will do so in the late summer or fall. It is difficult to simply inspect a colony and determine if it has a high level of mites. It is important, therefore, to sample bee hives to estimate the degree of infestation.

Sugar Shake Method. This method estimates the mite prevalence within the colony (the percentage of adult bees with mites).

1. Obtain a clear 1-pint jar or other container with a lid made from ⅛-inch hardware cloth or similar mesh material. If you can't find a jar with a mesh lid, make a mesh lid for your container.
2. Brush or shake approximately 200 adult bees from a frame with emerging brood into the jar.
3. Close the mesh lid on the jar and add 2 to 3 tablespoons of 6x powdered sugar through the lid.
4. Set the jar aside for several minutes to allow the bees (and mites) to be covered in sugar.

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5. Shake the sugar (and dislodged mites) out of the jar onto clean, flat surface (preferably white). The bees, although covered in sugar, are not killed and can be returned to the colony. If 10 or more mites are found per 200 bees, then appropriate measures should be taken to control the mite population. A magnifying glass may be necessary to see the mites.

Sticky Board Method. This method estimates the total mite load of the colony (total number of mites in the hive).

1. Purchase a commercial sticky board from a beekeeping supply company, which has a pre-applied adhesive and sampling grid drawn on the surface. Alternatively, sticky boards may be constructed by placing a stiff sheet of white paper.
2. Spray the upper surface of the paper (facing the bees) with an aerosol cooking spray, or apply a thin layer of petroleum jelly to the upper surface of the paper to create a homemade sticky board.
3. Please the board or paper between two 8-mesh wire covers (with one cover on the top and one on the bottom) so that the bees do not adhere to the sticky surface.
4. Place the sticky board on the bottom floor of the hive. A portion of the mites will fall off the bees, fall through the the mesh screen and stick to the white board.
5. Remove the board 24 hours later and count the total number of mites on it. If the number of mitets is between 60 and 190 (depending on the size of the colony), then appropriate control measures shoud be taken.

Alcohol Wash Method. Similar to the sugar roll, this method requires that the beekeeper brush or shake adult bees into a clear container to measure the prevalence of varroa mites.

1. Pour 1 to 2 inches of rubbing alcohol (isopropyl alcohol) into a clear 1-pint jar or container with a solid lid.
2. Brush or shake approximately 200 adult bees from a frame with emerging brood into the container.
3. Vigorously shake the container for at least 30 seconds, and then examine the container for dead mites sinking to the bottom. If you see 10 or more mites per 200 bees, then you should treat the colony.

Drone Brood Inspection. Because of the variation in sampling, this method is not always a reliable indicator of mite levels in a colony. However, it can be used to verify the relative degree of varroa infestation.

1. Find any capped drone brood within the hive, which is typically located on the periphery of the brood nest.
2. Uncap the cells and gently remove the pupae.
3. Closely inspect the drone pupae for adult varroa mites. If 10 percent or more of the drones are infested, then you should take appropriate measures to reduce the mite population.

Current recommendations are to monitor all honey bee colonies for varroa mite infestation, preferably numerous times over the course of a season, to determine if and when treatment is necessary. It is also recommended that multiple sampling techniques are employed to make sure that an accurate measure is obtained for each hive.

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Size comparison of a varroa mite.

Controlling Varroa Mites

Traditional methods for varroa mite control have been to hang plastic strips impregnated with chemical pesticides between the wax combs of bee hives (see below). Unfortunately, and perhaps inevitably, the mites are rapidly developing resistances to many of the common treatments, which has prompted researchers to develop numerous alternative methods to prevent and treat varroa mite infestations. These methods range from structural or mechanical changes to bee hives, to new stocks that are more tolerant of mites, to new bio-pesticides that are valuable alternatives to the standard synthetic treatments.

Mechanical control

Certain control methods involve changes in the management practices of beekeeping. The benefit of such mechanical control measures is that they do not use chemicals to reduce mite levels, thus they may be employed even during times when the bees are collecting and producing honey. They may, however, be more laborious or require new equipment, and they may not be as effective as other control measures.

Screened bottom boards. Research has shown some benefit of replacing the wooden bottom of a standard bee hive with a wire-mesh screen or other non-solid surface. Several studies have shown numerical decreases in mite levels of colonies using screened bottoms compared to solid bottoms. While the reasons for this decrease is unknown, it may be due to better hive ventilation or to the loss of mites inadvertently dropping through the floor of the hive. The benefits of bottom screens are minimal, however, and usually require additional methods of treatment.

Drone-brood trapping. Varroa mites prefer to infest drone brood, which are the developing pupae of male honey bees. This is because drones are larger and take longer to develop, so that female mites can produce more offspring per generation. Beekeepers may take advantage of this preference by placing special combs with drone-sized cells in their hives to attract mites to the brood. These combs can then be removed before the drones—and the mites—emerge from their cells. Depending on the time of year, this practice can dramatically reduce the mite populations within colonies.

Inert dusts. Adult mites move through the hive by clinging to the backs of adult bees. Some research has shown that covering all the adults in a colony with fine dust particles, such as powdered sugar or talc, can cause the mites to lose their grips and fall off their hosts. This technique can be laborious and quite disruptive to a colony, but it requires no chemical pesticides.

Mite-tolerant stocks

Some of the more exciting advances in varroa mite control has been in honey bee genetics. In recent years, much work has been done with the development of particular strains of honey bees that have shown tolerance to the varroa mite. Though the mechanisms are not completely understood, some behavioral and physiological traits likely play a role in varroa resistance. Today, several strains of bees are available that have been shown to reduce the number of varroa mites within their colonies.

Russian strain. Researchers at the USDA Honey Bee Research Lab in Baton Rouge, Louisiana have imported bees from the Primorsky region in far-eastern Russia because they co-exist with the original host species of varroa (the sister honey-bee species, *Apis cerana*). Because these Russian bees have been exposed to the mite for a longer period compared to other strains, it follows that they may have developed a resistance to the mite. Indeed, research has shown that they are over twice as resistant to varroa as other commercial stocks. Moreover, for reasons that are yet unclear, this stock appears to be highly resistant to the tracheal mites, a second parasitic mite that infests honey bee colonies. The Russian strain has been made available for commercial purchase in the U.S. after a protracted period in quarantine.

VSH stock. Standing for Varroa Sensitive Hygiene, this trait was selected for by USDA researchers using classical bee breeding and instrumental insemination techniques. The bees have been selected to detect varroa mites in the cells of developing pupae and remove them before the mites can reproduce. This stock has been crossed with other, more common commercial stocks in an attempt to integrate this useful trait into other bee strains.

Hygienic behavior. Many queen breeders have actively bred for colony brood-nest “cleanliness” or hygienic behavior. Much research has demonstrated lower levels of numerous diseases in colonies selectively bred to uncap and removed diseased or parasitized brood (e.g., the Minnesota Hygienic stock). While these stocks are not immune to varroa parasitism, they may significantly reduce the need for other control methods.

Bio-pesticides

Biopesticides are defined as naturally occurring organisms or their by-products, and several have been registered for controlling varroa mites in honey bee colonies. The efficacy of many biopesticides can equal to that of conventional chemical pesticides. However, the delivery of these chemicals can be quite different, and understanding these differences is important to insure successful control of varroa.

Apilife VAR®. This product—containing a combination of the essential oils thymol, eucalyptol, and menthol—has been approved by the US Environmental Protection Agency (EPA) for its use in North Carolina to treat both varroa and tracheal mites. Several studies have shown between 65% and 97% effectiveness at killing varroa mites. The delivery medium of this product is a vermiculite tablet, which must be broken into four pieces and placed in the four corners of the hive between the brood chambers. Each section must be wrapped in wire mesh to prevent the bees from chewing it and removing it from the hive prematurely. New tablets must be used every week for three weeks for complete effectiveness. The effectiveness of Apilife VAR® is temperature dependent and can only be used effectively in temperatures above 60°F and below 90°F. The product may cause significant mortality of bee brood, thus it may be most useful as a fall treatment when brood rearing naturally declines. Though Apilife VAR® is considered an organic pesticide, it is a restricted-use chemical and can only be purchased and applied by those individuals who have a valid NC Pesticide Applicators License.

Formic acid. The EPA has recently permitted the use of formic acid for the control of varroa mites in the United States. This method has been used by beekeepers in Canada and Europe for many years, and it is the only chemical pesticide that can be used for organic honey production. There are several delivery methods for formic acid, such as placing pads soaked with liquid formic acid on top of the hive (by the

trade name Mite-Away II®). The product cannot be used during a honey flow, and the daily high temperatures must be between 50°F and 79°F. If temperatures exceed 82°F during the first week of treatment, it must be removed from the hive as it may result in a significant loss of brood and adult bees. Small colonies (fewer than 6-20 frames of bees) can themselves be overwhelmed by the fumes. Care must also be taken by the beekeeper while applying formic acid, as it is highly corrosive and poisonous to humans, thus proper precautions must be taken to avoid exposure.

Chemical (Synthetic Pesticide) Treatments

Conventional means of varroa control involve synthetic pesticides being administered to a colony by placing plastic strips impregnated with the active chemical within the hive. While these treatments have traditionally provided very high levels of control, there is an increasing prevalence of resistance to these chemicals which makes them less reliable in some areas.

Apistan®. One of the first pesticides to be registered by the EPA for the control of varroa mites was Apistan®, the trade name for fluvalinate (a synthetic pyrethroid). It is sold as a plastic strip impregnated with the active pesticide, and the strips are hung between the frames of a hive just outside of the brood nest. Fluvalinate is a contact pesticide and provides up to 100% control of varroa mites when properly used. In recent years, however, there has been increasing reports of varroa mites developing resistance to this pesticide. It is highly recommended, therefore, that Apistan® be rotated with other treatments to reduce the development of resistance to chemical control by the mites and to ensure its efficacy.

Apivar®. Using the chemical amitraz, this is a relatively new product available to beekeepers for mite control. It works in much the same way as Apistan®, but the mites have not yet developed a resistance.

Checkmite+®. Largely in response to fluvalinate resistance, the EPA registered another synthetic chemical as a Section 18 emergency-use pesticide for varroa control. Checkmite+®, the trade name for coumaphos, is also sold as a plastic strip impregnated with the active pesticide that, when the bees and mites into contact with it, can provide up to 100% control when used properly. Coumaphos is a member of the organophosphate group of pesticides, and residues can accumulate in wax and be harmful to bees at high levels. Just as with Apistan®, there have been documented cases of varroa mites developing resistance to this pesticide, so it is important to use it according to label directions and to alternate its use with other approved treatments. Checkmite+® is also registered for the control of the small hive beetle (*Athena tumida*), and its sale in North Carolina is restricted to those individuals who have a valid NC Pesticide Applicators License.

Apilife VAR

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Summary

1. Varroa mites are currently the greatest threat to beekeepers and their colonies, and infested colonies will probably perish if action is not taken to control mite levels. Thus, they are a significant threat to a beekeeper's income and satisfaction.
2. Monitoring hives for mite levels enable beekeepers to determine whether treatment is necessary and to make informed decisions about when to take action.
3. The exclusive and continual use of one chemical product is more likely to result in the development of resistance by the pest. Several different products should be used on a rotating basis.
4. Do NOT, under any circumstances, experiment with non-approved chemical treatments. Such practices are illegal and may result in bee death, the contamination of honey and wax, and severe harm to the beekeeper.
5. Because of the inherent risks with the use of chemical pesticides, and the fact that some of the available treatments can only be obtained by individuals with a current pesticide certification, it is recommended that all beekeepers receive training and certification through the NCDA&CS Pesticide Licensing Program.
6. For additional information or assistance, contact your local NCDA&CS bee inspector (http://www.ncagr.gov/plantindustry/plant/apiary/index.htm), your local county Cooperative Extension center (http://www.ces.ncsu.edu/local-county-center/), or the Apicultural Program at NCSU (http://entomology.ncsu.edu/apiculture).

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Table 1. Management practices for varroa mites in honey beehives.

Management Method	Chemical (if applicable)	Relative Effectiveness	Degree of Manipulation	Other Pests Controlled	License Required
Screened bottom board	-	Low	Low	-	-
Drone brood trapping	-	Moderate	Moderate	-	-
Inert dusts	-	Moderate	High	-	-
Mite-tolerant stocks	-	Moderate	Low	TM‡	-
Apilife VAR®	Thymol	Moderate-High	Moderate	TM	Yes
Sucrocide®	Sucrose octanoate	Moderate-High	High	-	-
Mite-Away II®	Formic acid	High	Moderate	TM	-
Apistan®	Fluvalinate	High*	Low	-	-
CheckMite+®	Coumaphos	High*	Low	SHB	Yes

* In areas where resistance has not developed; TM = tracheal mite; SHB = small hive beetle
‡ For Russian strain only

Ths project received support from the Golden LEAF Foundation (http://www.goldenleaf.org/).

Contact Information

North Carolina Department of Agriculture & Consumer Services, Apiary Inspection (http://www.ncagr.gov/plantindustry/plant/apiary/apiarymp.html)

North Carolina State University Apiculture Program (http://entomology.ncsu.edu/apiculture)

For more information on beekeeping, visit the Beekeeping Notes website (http://entomology.ces.ncsu.edu/apiculture/beekeeping-notes/).

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Oxalic Acid FAQs

WHAT IS OXALIC ACID?

Oxalic Acid is a *naturally occurring acid* found in plants. It became popular in Europe & Canada for treating Varroa Mites in a honey bee hive.

IS IT A LEGAL VARROA TREATMENT IN THE UNITES STATES?

Oxalic Acid has been approved by the EPA to treat honey bee colonies in the United States. It must pass state approval before it may legally be sold in each state. This is a continuing process and a list of states that have been approved can be found on our website.

Versions of Oxalic Acid can be found in hardware stores but those have various additives mixed with them that can cause issue with the bees. Also it is illegal to use them for hives.

WHEN IS THE BEST TIME TO USE OXALIC ACID TO TREAT?

The most effective time to treat a hive with Oxalic Acid is when a hive has little to no sealed brood. It cannot penetrate capped brood so it will have no effect on the next generation of mites that were left in capped brood. You can treat in the spring and summer but research shows that Oxalic works best in the fall/winter.

WHEN WILL MY HIVE BE BROODLESS?

The best time for a broodless hive is during late fall through the winter. You can also manipulate the hive by caging the queen for 14 days. That keeps her from laying and capping any more brood. 14 days provides enough time to treat your hive and allow the treatment residue to subside before returning the queen to lay brood.

CAN YOU TREAT IN THE SUMMER?

While some studies say you can treat honey bees in the summer, there are too many variables that can cause issues during summer treatments. Summertime is usually when the hive is full of capped brood so it could take multiple treatments to reduce all the mites concealed with the brood. *Continuous multiple treatments can affect the bees severely.*

CAN YOU TREAT DURING A HONEY FLOW?

It has not been approved for use during a honey flow. If you have honey supers on the hive you must remove them before treating and leave them off for at least 14 days to give the Oxalic Acid treatment time to be fully cleansed from the hive to avoid contamination of the honey.

HOW CAN IT BE USED TO TREAT?

There are three approved methods to treat with Oxalic Acid:

Solution Method:
Note: To completely dissolve Oxalic Acid Dihydrate, use warm syrup.
Dissolve 35g of Oxalic Acid Dihydrate in 1 liter of 1:1 sugar water (weight : volume). Smoke bees down from the top bars. With a syringe or an applicator, trickle 5 ml of this solution directly onto the bees in each occupied bee space in each brood box. The maximum does is 50ml per colony whether bees are in NUCs, single, or multiple brood chambers.

Under certain unfavorable conditions (e.g. weak colonies, unfavorable overwintering conditions), this application method may cause some bee mortality or overwintering bee loss.

A complete kit is available with all the parts you will need for Solution Method (35 grams Oxalic Acid, nitrile gloves, protective goggles, 60mm syringe, and instructions)

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Vaporizer Method:
Apply only to outdoor colonies with a restricted lower hive entrance. Seal all upper hive entrances and cracks with tape to avoid escape of Oxalic Acid vapor. Smoke bees up from the bottom board. Place 1g Oxalic Acid Dihydrate powder into vaporizer. Follow the vaporizer manufacturer's directions for use. Insert the vaporizer apparatus through the bottom entrance. Apply heat until all Oxalic Acid has sublimated.

Spraying Package Method:
Ensure bees are clustered before applying.
Spray broodless package with 1:1 sugar water solution (without Oxalic Acid mixed) at least 2 hours before spraying with Oxalic. This fills their stomachs to reduce ingestion of Oxalic Solution.
Mix 1:1 ratio sugar water with 35 grams of Oxalic Acid (same ratio as Solution Method). For a 2 lb package, use 21mL of solution. For a 3 lb package use 31mL solution.
Store bees in a cool darkened room for 72 hours before hiving.

HOW MANY HIVES CAN OXALIC ACID TREAT?

**All totals calculated from dosage amounts listed in treatment methods above.*
Solution Method: 20 hives
Vaporizer Method: 35 hives
Spraying Package Method: 47 2lb packages & 30 3lb packages

WHAT SAFETY MEASURES SHOULD I TAKE WHEN USING OXALIC ACID?

***DO NOT* let Oxalic Acid make contact with skin, eyes, or be ingested.** Wear proper personal protective equipment (rubber gloves, safety goggles, long sleeve shirt) when mixing or distributing Oxalic Acid. If exposure to skin or eyes does occur consult directions and safety sheet for instructions. If severe reaction occurs, call 911. Wash hands, exposed skin, and PPE directly after treatment to avoid contamination.

HOW EFFECTIVE IS OXALIC ACID?

The effectiveness of Oxalic Acid treatment can be in excess of 95%, but solution method have a higher efficacy.

HOW MANY TIMES SHOULD I TREAT MY HIVE?

You will only want to treat your hive ONCE during the fall/winter. Honey bees have a low tolerance to Oxalic Acid. Overexposure can cause issues and death in the hive.

As with any other treatment, some bee mortality may occur, especially if hive is already weak. **Check your mite count and strength of hive before applying any treatment.** If you are uncertain of hive's strength, you can get a second opinion by asking a local beekeeper or your local bee inspector.

CAN I USE OXALIC ACID WITH OTHER MEDICATIONS?

Since it is a naturally occurring chemical, it can be used in conjunction with other non-varroa treatments. DO NOT mix directly with other chemicals while treating.

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HOW DO YOU STORE OXALIC ACID?

Dried, unmixed Oxalic Acid should be kept in a cool dry place will not expire.
Mixed solution can last up to a week at room temperature and a few months if kept in the fridge.

IF THE SOLUTION STARTS TO TURN TAN/BROWN OR SMELL FUNNY DISCARD IMMEDIATELY. DISCOLORATION MEANS AN ALTERNATE CHEMICAL [HYDROXYMETHYLFURFURAL] IS FORMING AND IS TOXIC TO BEES. DISCOLORATION CAN BE CAUSED BY LONG EXPOSURE TO THE SUN.

*Some information gathered from Randy Oliver's "Oxalic Acid: Questions, Answers, and More Questions: Part 1 of 2 Parts"; http://scientificbeekeeping.com/oxalic-acid-questions-answers-and-more-questions-part-1-of-2-parts/

Posted by Brushy Mountain Bee Farm at 11:34 AM

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The Small Hive Beetle: A Pest of Honey Bee Colonies

Introduction

The small hive beetle, *Aethina tumida*, was first detected in the United States in 1996 near Charleston, South Carolina. In the spring of 1998 in Fort Pierce, Florida, a scientist with the Florida Department of Agriculture and Consumer Services positively identified this beetle as the small hive beetle (SHB), a destructive pest of honey bee colonies. Prior to its detection in the United States, the only recorded sightings of this insect occurred in the southern regions of Africa.

During the summer of 1998, the beetle was blamed for the loss of more than 20,000 honey bee colonies in Florida. The beetles spread quickly. That same year, beekeepers and inspectors also reported occurrences in Georgia, South Carolina, and North Carolina. Since 1998, the small hive beetle has become established in most counties in North Carolina as well as across most of the United States. This demonstrates its remarkable ability to disperse by flight and human transport.

Description

Adults

An adult small hive beetle is 5 to 7 millimeters long and brown to black in color (Figure 1A). The SHB is a member of the beetle family Nitidulidae and, therefore, has the club-shaped antennae that are common within this family. For instance, the picnic beetle, which is often mistaken for the SHB, has similar antennae. Other distinguishing characteristics include a shield-shaped thorax and broad, flattened legs. Adult beetles tend to hide on the bottom of the hive or just under the inner cover, and they scatter quickly once the hive is opened. This behavior can make them difficult to locate. Therefore, they may go unnoticed at low levels of infestation.

Larvae

SHB larvae are small, white, worm-like, and approximately 10 to 12 millimeters long (Figure 1B). The larvae appear similar to wax moth larvae, but SHB larvae are distinguished by their dorsal spines.

Life Cycle

As long as a colony of bees remains strong, adult SHBs are not generally destructive and may live in the hive as adults in large numbers for long periods of time without causing problems. If a colony becomes stressed or weakened, however, the beetles will take advantage of this opportunity and begin to lay

eggs. Within 24 hours, these eggs hatch into very small larvae that begin to feed immediately. The larvae feed on the honey and pollen stores, as well as on the developing brood. In doing so, they tunnel through the comb and cause stored honey to run out, creating a sticky mess that, in extreme cases, causes the adult honey bees to abandon the hive.

Under ideal conditions, SHB larvae feed for 7 to 10 days. Then they leave the hive, crawl on the ground to a suitable location, dig into the soil, and pupate. Pupation takes three to five weeks (or longer during cooler temperatures), after which the new adults emerge from the soil and seek out a beehive to start the cycle all over again. The new adult beetles can survive a winter within the cluster of bees inside the hive.

Figure 1A. Adult beetle.

Figure 1B. SHB larvae in hive debris.

Impact and Future Outlook

When the SHB was first detected in North Carolina, the NC Department of Agriculture & Consumer Services (NCDA&CS) set up a quarantine with the goal of minimizing its spread and possibly eradicating it. The quarantine was lifted in July 2003 because the beetle had successfully established itself across the state and thus eradication was no longer an option. Although entomologists originally believed that SHBs could survive only in sandy soil and warm climates, the beetles have demonstrated that they can survive in just about any kind of soil. They can also survive extreme winter conditions.

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The arrival of SHBs means that beekeepers must make some changes in the methods they use. When they first encountered the destructive potential of this honey bee pest, many beekeepers thought that the outlook for the whole industry was grim. But when beekeepers make a few adaptations to their beekeeping practices, the outlook for the industry does not appear as alarming.

Figure 2. Adult small hive beetles (circled) crawling on the surface of a comb inside a beehive.

Prevention

In the past, some of the more severe problems caused by SHB infestations occurred in the honey house where supers had been stacked and were waiting to be extracted. Beekeepers must take preventive measures to ensure healthy colonies and thus minimize hive infestations by SHBs. The following precautions should be taken to keep these beetles from infesting bee colonies:

- When colonies die for any reason, remove the equipment from the yard immediately and store it properly before beetles infest it.
- Extract honey from supers immediately after removing the supers from the colony.
- Keep the honey house clean.

These are some other recommendations that should be followed to help prevent invasions and infestations of the small hive beetle into your bee yard:

- Do not throw burr comb on the ground around the hives. It is better to collect all excess wax in a bucket and remove it from the yard.
- Minimize the amount of time inspecting colonies, as the beetles easily detect the bees' alarm pheromone. This makes the beetles scatter and hide.

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- Remove excess supers from the colony, as frames with few or no adult bees make good hiding places for beetles.
- If larvae are found on the bottom board, do not brush them off onto the ground. Doing so will only lead to more adult beetles in a few weeks. Any larvae found should be removed from the colony and killed by either freezing them for 24 hours or placing them in a closed container with soapy water.

Treatment

Inside the hive

For controlling the SHB inside the beehive, coumophos is the only registered chemical pesticide available. This product (sold under the trade name of CheckMite+) is formulated as plastic strips impregnated with the pesticide. The strips are cut in half and attached to a small piece of cardboard placed on the bottom board of the hive. The beetles will hide beneath the cardboard and contact the pesticide, which kills them. In North Carolina, CheckMite+ is a restricted-use pesticide. Thus, you must have a pesticide applicator's license to purchase and use it. Coumophos is an organophosphate that can be very dangerous to humans and honey bees if misused. It is important to read the label and follow the directions carefully. These precautions are especially important:

- Honey supers must be removed prior to treatment.
- If honey is produced while a hive is being treated, the honey cannot be sold or used for human consumption.

A nonchemical means of inside-the-hive control is the West small hive beetle trap. This is a two-piece plastic trap that sits on the existing bottom board. The top piece has small holes, and the bottom is filled with vegetable oil. As the beetles enter and move throughout the hive, the bees tend to chase them, causing the beetles to look for a hiding spot. The beetles try to escape the harassment of the bees by exiting through the holes of the trap. Then they fall into the oil and drown.

Outside the hive

Another product, GuardStar, is available for control outside the hive if larvae are observed crawling out of a hive entrance. GuardStar is a liquid treatment that is mixed with water and applied to the ground around the hive to kill the beetles pupating in the soil. The active ingredient is permethrin, a synthetic pesticide that is highly toxic to honey bees. Therefore, this product should be applied with great caution.

At this writing in early 2006, there are still many unknowns about this beetle, such as their mating cues and the signals they use to locate a hive. Researchers are working to decipher these cues to SHB behavior, which may lead to better control measures in the future, such as lures and bait traps.

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If you think you have small hive beetles in your hives, you should contact your regional NCDA&CS apiary inspector before you begin treatment. Once the presence of the beetles has been verified, treatments may be used as needed. But neither CheckMite+ nor GuardStar should be used as a preventive measure.

Figure 3. A comparison of an adult SHB and a SHB larva.

For More Information

For more information, contact the following:

Honey Bee Inspection Program Office (http://www.ncagr.gov/plantindustry/plant/apiary/index.htm)
NC Department of Agriculture & Consumer Services
Telephone: 919-233-8214

Honey Bee Program Research Facility (http://www.cals.ncsu.edu/entomology/apiculture/)
NC State University
Telephone: 919-513-7702

For more information on beekeeping, visit the Beekeeping Notes website (http://entomology.ces.ncsu.edu/apiculture/beekeeping-notes/).

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This project received support from the Golden LEAF Foundation (http://www.goldenleaf.org/).

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Beekeeping

Department of Entomology Insect Note

Note 1.04
(Previously Note #2)

HONEY PLANTS OF NORTH CAROLINA

Knowledge of the plants honey bees use is important to every beekeeper. Plants provide the nectar for honey production and pollen for brood production. Coincidently, the bees pollinate the plants allowing seed and fruit to develop.

The type and availability of nectar sources in an area determines, not only the potential honey production for that locality, but also the flavor, color and quality of the honey crop. Pollen is collected by bees and provides the essential protein for brood development. For these reasons, a beekeeper who knows his local flora will be better able to develop a management system which fully utilizes those potential honey and pollen plants.

North Carolina is a large state and exhibits considerable variety in honey plants as one travels from the sea to the mountains. This note lists the average blooming dates of some of the important nectar sources in the state's three main geographical areas. The figure in parenthesis following each blooming date indicates the average number of days flowering may be expected. There are others which you should learn.

Some good references are:

Honey Plants Manual by H.B. Lovell. 1966. A. I. Root Company, Medina, OH 44256.

American Honey Plants by F.C. Pellett. 1947. Orange Judd. N.Y.

Manual of the Vascular Flora of the Carolinas by Radford, Ahles and Bell. 1968. UNC Press, Chapel Hill, NC

Calendar of Beekeeping. N.C. State Beekeepers Assn. 1403 Varsity Drive, Raleigh, NC 27606.

Plant	Average bloom date (duration)		
	Mountains	Piedmont	Coastal Plain
Alsike Clover (*Trifolium hybridum*)	–	Apr 4 (102)	--
Aster (*Aster* spp.)	Aug 30 (40)	Sep 25 (35)	Sep 30 (40)
Basswood, Linden (*Tilia* spp.)	Jun 20 (23)	--	--
Black Gum (*Nyssa sylvatica*)	May 5 (10)	Apr 26 (14)	Apr 27 (24)
Black Locust (*Robinia pseudoacacia*)	May 15 (14)	Apr 27 (10)	--
Blackberry (*Rubus* spp.)	--	Apr 10 (20)	Mar 1 (46)
Crimson Clover (*Trifolium incarnatum*)	--	Apr 10 (25)	--
Dandelion (*Taraxacum officinale*)	May 1 (50)	Mar 15 (60)	Mar 5 (55)
Gallberry (*Ilex glabra & coriacea*)	--	--	May 12 (28)
Goldenrod (*Solidago* spp.)	--	Aug 8 (67)	Aug 1 (85)
Heartsease, Smartweed (*Polygonum* spp.)	--	Jul 4 (126)	--
Holly (*Ilex* spp.)	May 8 (15)	Apr 30 (15)	Apr 24 (16)
Huckleberry (*Gaylussacia* spp.)	--	--	Apr 5 (32)
Ladino Clover, White Clover (*Trifolium repens*)	May 29 (51)	Apr 14 (102)	--
Pepperbush (*Clethra alnifolia*)	--	--	Aug 1 (20)
Persimmon (*Diospyros virginiana*)	May 22 (15)	May 20 (13)	--
Privet (*Ligustrum* spp.)	--	May 8 (23)	--
Raspberry (*Rubus* spp.)	May 17 (17)	Apr 30 (20)	Apr 20 (40)
Red Maple (*Acer rubrum*)	Mar 5 (35)	Feb 1 (40)	Jan 20 (45)
Sourwood (*Oxydendrum arboreum*)	Jun 25 (25)	Jun 10 (20)	Jun 1 (20)
Sugar Maple (*Acer saccharum*)	--	Mar 5 (25)	Feb 25 (25)
Sumac (*Rhus* spp.)	Apr 8 (146)	Apr 3 (151)	Apr 1 (153)
Sweet Clover (*Melilotus* spp.)	Jun 8 (53)	May 28 (37)	--
Tulip Poplar (*Liriodendron tulipifera*)	May 25 (23)	Apr 25 (29)	Apr 17 (30)
Tupelo Gum (*Nyssa aquatica*)	--	--	Apr 20 (30)
Vetch (*Vicia* spp.)	--	Apr 28 (46)	--

Prepared by J. Ambrose; revised by S. Bambara 6/21/95

"Pollinator Paradise" Garden at Chatham Marketplace

Created by Debbie Roos, North Carolina Cooperative Extension

More info at www.protectpollinators.org

Common Name	Scientific Name	Origin
Perennial Flowers		
Yarrow	*Achillea* x 'Moonshine'	naturalized
Yarrow	*Achillea* x 'Paprika'	naturalized
Anise hyssop	*Agastache* x 'Blue Fortune'	hybrid of U.S. native
Licorice hyssop	*Agastache rupestris*	southwest U.S.
Giant bugle weed	*Ajuga reptans* 'Caitlin's Giant'	exotic
Nodding onion	*Allium cerneum*	NC
Arkansas bluestar	*Amsonia hubrechtii*	NC
Eastern wild columbine	*Aquilegia canadensis*	NC
Golden columbine	*Aquilegia chrysantha*	southwest U.S.
Butterfly weed	*Asclepias tuberosa*	NC
Wild indigo	*Baptisia* x 'Carolina Moonlight'	NC
Wild indigo	*Baptisia* x 'Purple Smoke'	NC
White wild indigo	*Baptisia alba*	NC
Dwarf wild indigo	*Baptisia minor*	NC
Yellow wild indigo	*Baptisia tinctoria*	NC
Gray-leaved conradina	*Conradina canescens*	NC
Lobed tickseed	*Coreopsis auriculata*	NC
Tickseed	*Coreopsis pubescens* 'Sunshine Superman'	NC
Tall tickseed	*Coreopsis tripteris*	NC

Common Name	Scientific Name	Origin
Moonbeam coreopsis	*Coreopsis verticillata*	NC
Purple coneflower	*Echinacea purpurea*	NC
Purple coneflower	*Echinacea purpurea* 'Fragrant Angel'	NC
Purple coneflower	*Echinacea purpurea* 'Harvest Moon'	NC
Purple coneflower	*Echinacea purpurea* 'Kim's Knee High'	NC
Purple coneflower	*Echinacea purpurea* 'Tiki Torch'	NC
Purple coneflower	*Echinacea purpurea* 'Twilight'	NC
White coneflower	*Echinacea purpurea* 'White Swan'	NC
Joe-pye weed	*Eupatorium dubium*	NC
Wild ageratum	*Eupatorium coelestinum*	NC
Boneset	*Eupatorium perfoliatum*	NC
White wood aster	*Eurybia divaricatus*	NC
Lanceleaf blanketflower	*Gaillardia* 'Oranges and Lemons'	NC
Lanceleaf blanketflower	*Gaillardia* 'Burgundy'	NC
Lanceleaf blanketflower	*Gaillardia* 'Torchlight'	NC
Hardy geranium	*Geranium* 'Dilys'	exotic
Hardy geranium	*Geranium* 'Rozanne'	exotic
Swamp sunflower	*Helianthus angustifolius* 'Gold Lace'	NC
Swamp sunflower	*Helianthus angustifolius* 'Mellow Yellow'	NC
Purple-head sneezeweed	*Helenium autumnale* 'Red Shades'	NC
Purple-head sneezeweed	*Helenium flexuosum*	NC
Oxeye daisy	*Heliopsis helianthoides* 'Summer Nights'	NC
Velvet mallow	*Hibiscus grandiflora*	NC
Seashore mallow	*Kosteletzkya virginica*	NC
Blazing star	*Liatris ligulistylis*	mid-west U.S.
Small head blazing star	*Liatris microcephala*	NC
Gayfeather	*Liatris spicata*	NC
Bee balm	*Monarda fistulosa* 'Claire Grace'	NC
Spotted beebalm	*Monarda fruticulosa*	Texas
Eastern horsemint	*Monarda punctata*	NC
Wild quinine	*Parthenium integrifolium*	NC

Common Name	Scientific Name	Origin
Beard tongue	*Penstemon* 'Husker Red'	NC
Small's beard tongue	*Penstemon smallii*	NC
White moss phlox	*Phlox nivalis* 'Snowdrift'	NC
Obedient plant	*Physostegia virginiana*	NC
Prairie coneflower	*Ratibida columnifera*	NC
Orange coneflower	*Rudbeckia fulgida*	NC
Brown-eyed susan	*Rudbeckia triloba*	NC
Lyreleaf salvia	*Salvia lyrata*	NC
Hoary skullcap	*Scutellaria incana*	NC
Sedum	*Sedum spurium* 'Dragon's Blood'	exotic
Tall sedum	*Sedum* x 'Matrona'	exotic
Bluestem goldenrod	*Solidago caesia*	NC
Sweet goldenrod	*Solidago odora*	NC
Rough-leaf goldenrod	*Solidago rugosa* 'Fireworks'	NC
Showy goldenrod	*Solidago speciosa*	NC
Stokes' aster	*Stokesia laevis* 'Mary Gregory'	NC
Stokes' aster	*Stokesia laevis* 'Peachie's Pick'	NC
Eastern silvery aster	*Symphyotrichum concolor*	NC
Smooth aster	*S. laeve* 'Bluebird'	NC
Aromatic aster	*S. oblongifolium* 'Fanny's Aster'	NC
Aromatic aster	*S. oblongifolium* 'October Skies'	NC
Aromatic aster	*S. oblongifolium* 'Raydon's Favorite'	NC
Foamflower	*Tiarella cordifolia* 'Running Tapestry'	NC
Verbena	*Verbena canadensis* 'Homestead Purple'	NC
Threadleaf ironweed	*Vernonia lettermanii*	southern U.S.
Ironweed	*Vernonia noveboracensis*	NC
Adam's needle	*Yucca filamentosa* ' Golden Sword'	NC

Common Name	Scientific Name	Origin
Perennial Herbs		
Bronze fennel	*Foeniculum rubrum*	exotic
Lavender	*Lavendula* spp.	exotic
Catmint	*Nepeta* 'Walker's Low'	exotic
Oregano	*Origanum* 'Herrenhausen'	exotic
Oregano	*Origanum* 'Rosenkuppel'	exotic
Mountain mint	*Pycnanthemum incanum*	NC
Virginia mountain mint	*Pycnanthemum virginianum*	NC
Rosemary	*Rosmarinus officinalis*	exotic
Thyme	*Thymus* spp.	exotic
Vines		
Climbing aster	*Ampelaster carolinianus*	NC
Honeysuckle	*Lonicera sempervirens* 'Cedar Lane'	NC
Honeysuckle	*Lonicera sempervirens* 'John Clayton'	NC
Honeysuckle	*Lonicera sempervirens* 'Major Wheeler'	NC
Passionflower	*Passiflora incarnata*	NC
Trees and Shrubs		
Abelia	*Abelia* x *grandiflora* 'Rose Creek'	exotic
Pepperbush	*Clethra alnifolia*	NC
Dwarf Fothergilla	*Fothergilla* 'Mount Airy'	NC
Witchhazel	*Hamamelis virginiana*	NC
Oak-leaf hydrangea	*Hydrangea quercifolia*	NC
Shrubby St. John's Wort	*Hypericum frondosum* 'Sunburst'	NC
Possumhaw	*Ilex decidua*	NC
Inkberry/Winterberry	*Ilex glabra*	NC

Common Name	Scientific Name	Origin
Virginia sweetspire	*Itea virginica*	NC
Sourwood	*Oxydendrum arboreum*	NC
Eastern ninebark	*Physocarpus opulifolius* 'Diablo'	NC
Fragrant sumac	*Rhus aromatica*	NC
Staghorn sumac	*Rhus typhina*	NC
Sassafras	*Sassafras officinale*	NC
Blueberry	*Vaccinium corymbosum*	NC
Viburnum	*Viburnum nudum*	NC
Blackhaw viburnum	*Viburnum prunifolium*	NC
Grasses		
Splitbeard bluestem	*Andropogon ternarius*	NC
Switchgrass	*Panicum virgatum* 'Heavy Metal'	NC
Switchgrass	*Panicum virgatum* 'Northwind'	NC
Switchgrass	*Panicum virgatum* 'Shenandoah'	NC
Little bluestem	*Schizachyrium scoparium* 'The Blues'	NC

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Beekeeping
Insect Pest Management
Department of Entomology Insect Note

Beekeeping Insect Note 2B

Landscape Planting for Bees

Prepared by:
S. Bambara, Extension Specialist

Dated 1/93
Placed on the Web 3/95 by the Center for Integrated Pest Management

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Increased urbanization of our rural areas has destroyed native forage vegetation in many places. In addition, many of our hobby beekeepers living in the suburbs enjoy watching bees work the flowers. With this in mind and because honey bees are so important for pollinating agricultural, horticultural, and wild plants, there is at least one small thing we can do to support our state insect.

Most houses and yards are landscaped, so by merely making certain choices, nectar or pollen producing plants can be used with little or no additional cost. Though they have only a tiny effect on a single hive, every little bit contributes and the more people use these plants, the more significant will be the total benefit. Below are listed some plant material which can be used around homes, parks or city streets. All are highly attractive to bees except where noted. Attractiveness may vary in different regions. Most of the berry and seed bearing plants also produce good forage for birds.

This list is not complete and all plants may not thrive in all parts of the state. Consult any reference on landscape plants or your Cooperative Extension agent for further information about how to use some of these. You may also want to visit local gardens or plantings for ideas.

Ground Covers

- Ladino clover - blooms late spring-summer
- Crimson clover - blooms late spring
- Ajuga - blooms spring
- Graph Hyacinth - blooms spring
- Strawberry - blooms spring
- *Ampelopsis brevipedunculosa* - blooms late spring

Shrubs

- Barberry (*Berberis* sp.) - blooms spring: evergreen*
- Vitex - blooms most of summer: deciduous
- Privet (*Ligustrum*) - blooms late spring: may produce bitter nectar

- Abelia - blooms summer/fall; evergreen; mildly attractive
- Quince (*Chaenomeles*) - blooms spring
- Blueberry (*Vaccinium*) - blooms spring
- Silverberry (*Eleagnus*) - blooms late spring; deciduous; fragrant*
- Nandina - blooms summer; mildly attractive
- Pieris (*Pieris japonica* - blooms spring; evergreen
- Holly (*Ilex*) especially *I. burfordi, I. cornuta, I. rotunda*; blooms spring; almost all species excellent nectar source; may require pruning*
- Euonymous - blooms summer; variable attractiveness among species
- Silverling (*Baccharis halimifolia*) - blooms fall; native aster shrub in coastal plain and piedmont
- Pepperbush (*Clethra alnifolia*) - blooms late spring; native coastal plain shrub, survives piedmont; evergreen*

Small Trees

- Red Bud (*Cercis*) - blooms early spring; native or cultivated varieties
- Apple, Crabapple (*Malus*) - blooms early spring; usually requires pruning*
- Pussy Willow (*Salix*) - blooms early spring; most *Salix* spp. good
- Golden Rain Tree (*Koelreuteria paniculata*)_ - blooms summer
- Sourwood (*Oxydendron arboreum*) - blooms midsummer; irregular nectar production
- Sumac (*Rhus*) - blooms summer/fall; shrub or small tree; deciduous*
- Holly (*Ilex*) - blooms spring; many species achieve tree status if unpruned*
- Beebee Tree (*Evodia danielli*) - blooms late summer
- Hercules Club (*Aralia spinossa*) - blooms late summer

Large Trees

Maple (*Acer* spp.), especially *A. rubrum, A. ginnala* - blooms early spring; good nectar production

- Linden, Basswood (*Tilia* - blooms in spring; excellent nectar production
- Black Locust (*Robinia pseudoacacia*) - blooms spring; inconsistent nectar production
- Tulip, Yellow Poplar (*Liriodendron tulipifera*) - blooms spring; fast growing; excellent nectar production
- Black Gum, Tupelo (*Nyssa*) - blooms spring; Tupelo requires moist soil
- Persimmon (*Diospyros*) - blooms late spring

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*Also provides food/cover for birds.

Suggested References

Honey Plants Manual. H.B. Lovell. 1966. A.I. Root Co., Medina, OH 44256.

American Honey Plants. F.C. Pellett. 1947. Orange Judd, NY.

"Bee Forage of North America." Ayers & Harman, in *Hive and Honey Bee*. 1922. Dadant & Sons, Hamilton, IL.

Beekeeping
Insect Pest Management
Department of Entomology Insect Note

Note 1.05
(Previously Note #2A)

AN HERB GARDEN FOR THE BEES

In addition to "merely" keeping bees, the successful beekeeper must often branch out into many other areas of expertise, such as botany, carpentry, wholesale/retail marketing mechanics, accounting, etc. All of these related areas are important but a working knowledge of botany is probably one of the most important. As beekeepers, we are intrinsically botanists, for bees and plants are interdependent and the nature and productivity of the plant population plays a major role in the success or failure of any beekeeping operation.

One frequently stated need of many beekeepers is how to increase nectar availability in an area. Herbs provide a direct means for the beekeeper to improve and expand the honey flow in this area. An herb is defined as any nonwoody plant that dies down to the ground after flowering. More commonly, herbs are defined as plants that are used for such purposes as medicinal treatment, nutritional value, food seasoning, coloring or dying. Herbs are extremely versatile plants and, unlike trees and shrubs, most will bloom the same year that they are planted. With sufficient variety, an herb garden can have plants in bloom for 10 months of the year.

With a little planning, herbs can provide both excellent nectar and pollen sources for honey bees. These plants can supply valuable bee pasture during periods of dearth, but careful planning must precede planting. Most herbs will grow anywhere, and most will bloom profusely, but not all will attract honey bees. Strict attention must be paid to varieties, ecotypes, soils, climate, fertilization, and watering.

Varietal selection is most important. Some plants, such as feverfew, simply will not attract honey bees. Ecotypes are an even more subtle difference that play an equally important role. Ecotypes are species of plants that are adapted to a particular environment. This is to say that a

catnip plant native to Iowa may not grow, or bloom, or produce nectar the same if it were transplanted to a location in North Carolina. Thus, the herb gardener with an eye towards nectar production should be very careful in ordering plants from areas with different climates, for the plants will
look the same, but their systems may well be altered due to the change in environment,and they may perform differently. To add a tempering note, plants touted as honey plants in other parts of the country may fail miserably in North Carolina, but other "unknowns" can fill the niche and perform very well under North Carolina conditions. Fertilization, water, and soils are things the herb gardener can control, and normal gardening practices would be followed in these areas.

Designing an Herb Garden

An herb garden can be as simple or complex as the gardener desires. Herbs can be grown in established borders, among low growing shrubbery, or in a vegetable garden. The simplest way, in terms of organization and care, is to designate a certain space for herbs and herbs only. The design one chooses can range from formal gardens to simple displays. Care should be taken to segregate tall growing herbs such as the bee balms from low spreading herbs like the mints and thymes to minimize unwanted shading. Planting herbs of the same family (i.e. the mints) in groups also eases care and identification.

The authors recommend planting herbs in a raised bed bordered with railroad cross ties, or similar materials, to keep the herbs in and the weeds out. After filling the bed with soil (preferably a light soil to promote early growth and provide good drainage), have a soil test run to insure a pH of 6.5-7, and add organic matter in whatever form is convenient. Soil fertility should be kept at a low to moderate level, as heavy fertilization will extend the vegetative portion of a plant's life cycle, causing a later reproductive, or flowering phase.

The next step is to apply a mulch. Black plastic provides an excellent mulch for herbs. It serves to warm the soil in the spring, prevent evaporative moisture loss from the soil, completely control weeds, and if the herbs are planted in pot sized holes in the plastic, control the spread of those herbs which would other wise take over the herb garden. Water can be applied to the base of the plants when needed, and holes can be punched in the plastic with a nail to facilitate drainage of rain water. An additional "cosmetic" mulch of pine bark, or sawdust can be spread on the plastic if desired.

The beekeeping herb gardener usually has more than enough things to do, so the herb garden should be designed for minimal maintenance. Congruent with the concepts of a raised bed, moisture saving mulch, and "container-sized" planting holes, is the use of perennial herbs wherever possible. Perennials die back each fall but return the following spring and will last for many years, if properly cared for. Herbs can be propagated from seeds, cuttings, or layering. Layering is generally easiest, the procedure being to cover a portion of the plant stem with a mound of soil, and roots will shortly

form on the portion covered by the soil. This new plant can be cut off from the mother plant and planted in a new location. Any plants started from seed should be planted indoors or in a cold frame early in the spring and transplanted to a permanent site with the onset of warm weather.

The following list of herbs is based upon the results of a two year research project conducted by the authors at N. C. State University. The listed herbs were selected primarily on their attractiveness to honey bees, but ease of growing and long term maintenance were also contributory factors.

Herb	Growth Habit	Propagation	Use	Attractiveness to Bees
Basil	annual, 12"	seed	culinary herb	moderate
Bee Balm	perennial, 24"	seed, division	mint teas	high
Borage	annual, 10"	seed	garnish foods	high
Catnip *Musini*	perennial, 20"	seed	sedative teas	high
Catnip *Catara*	perennial, 20"	seed	sedative teas	high
Chives	perennial, 12"	seed, bulbs	culinary herb	slight
Comfrey	perennial, 36"	division	medicinal herb	slight
Hyssop (Anise)	perennial, 36"	seed	teas	high
Lavender	perennial, 24"	seed	sachets	slight
Marjoram	perennial, 12"	seed	culinary herb	moderate
Mints	perennial, 10"	cuttings, division	mint teas	high
Sage	perennial, 12"	seed, division	culinary herb	moderate
Salvia, blue	annual, 24"	seed	ornamental	high
Salvia, white	annual, 24"	seed	ornamental	high
Spider Plant	annual, 24"	seed	ornamental	high
Teasel	perennial, 36"	seed, division	ornamental	moderate
Thistle, Globe	perennial, 48"	seed	ornamental	moderate
Thymes	perennial, 6"	seed, cuttings	culinary herb	high
Yarrow	perennial, 24"	seed	tea	slight

Notes: 1. Some of the herbs such as the mints may impart a very distinctive flavor to the honey that the bees produce.

2. The above "uses" of the herbs are listed for informational purposes only and is not meant to be an endorsement of any particular use.

References:

Clarkson, Rosetta E. 1970. Herbs, Their Culture and Uses. MacMillian Publishing Company, New York, N.Y.

Foley, Daniel F. 1971. Herbs for Use and Delight. Dover Publications, Inc. New York. N.Y.

Lust, John. 1974. The Herb Book. Bantam Books, New York, N.Y.

Meyer, Joseph E. 1960. The Herbalist. Meyerbooks, Glenwood, Ill.

Stary, Franfised and Valclav Jirasek. 1973. Herbs, A Concise Guide in Color. Hamlyn Publish Group Ltd., New York, N.Y.

Seed Sources: The following list is for informational purposes only and the inclusion of a firm does not constitute endorsement nor does the exclusion of a firm suggest non-endorsement.

Pellet Gardens Catalog of Honey Plants, Atlantic, Iowa 50022.
Nichols Herb and Rare Seeds, 1190 N. Pacific Hwy., Albany, Oregon 97321.
Parks Seeds, Greenwood, South Carolina 29647.
A World Seed Service, J. L. Hudson, P.O. Box 1058, Redwood, California 94064.

Prepared by: W. G. Lord, Research Technician

Honey Plants of the Triangle Checklist

trees:

- ☐ Red Maple
- ☐ Prunus family:
  apples, pears, cherry etc..
- ☐ Crabapple
- ☐ Redbud
- ☐ Holly
- ☐ Tulip Poplar
- ☐ Locust
- ☐ Sourwood
- ☐ Chaste Tree

shrubs:

- ☐ Oregon Grape
- ☐ Flowering Quince
- ☐ Trifoliate Orange
- ☐ Blueberry
- ☐ Winter Honeysuckle
- ☐ Abelia
- ☐ Hydrangea
- ☐ Butterfly Bush
- ☐ Caryopteris
- ☐ Sumac

perennials:

- ☐ Winter Aconite
- ☐ Lamium family: Henbit, Red Dead Nettle
- ☐ Blackberry, Raspberry
- ☐ Jo Pye Weed
- ☐ Verbena
- ☐ Echinacea
- ☐ Salvias
- ☐ Asters
- ☐ Goldenrod

herbs:

- ☐ Lavender
- ☐ Rosemary
- ☐ Chives, Allium
- ☐ Borage
- ☐ Horehound
- ☐ Oregano
- ☐ Mint
- ☐ Heal-All
- ☐ Mountain Mint
- ☐ Catmint

annuals:

- ☐ Soybean
- ☐ Cotton
- ☐ Smartweed
- ☐ Poppies
- ☐ Cosmos
- ☐ Cleome
- ☐ Clovers
- ☐ Buckwheat
- ☐ Sunflowers

Bees forage on different flowers at different locations and different times of year. The flavor of the nectar of a particular flower can determine the flavor of the honey if the bees are working one type of flower or mostly one type at a single time. This honey is often stored all together in a frame so it can be extracted separately from other types. These are called Artisan Honeys.

Some of the common types of honey found in North Carolina are:

Early blooming Fruit Trees: Apple, Cherry, Prunus family: Light early spring honey with a slight fruit taste, not as distinctive as Blueberry.

Blueberry: Light golden honey with a fruity finish like blueberries, very distinctive.

Clover: Light honey with very sweet finish.

Tulip Poplar: Mid colored honey with good rich even flavor.

Sourwood: Very pale honey with great almost citrus flavor.

Wildflower: Usually darker honey with rich flavor but varies with mix of blooms.

Buckwheat: Very dark honey tastes almost like molasses, acquired taste.

Goldenrod: Very yellow honey tends to crystallize so usually used to overwinter bees.

Plants for Bees Resource Listing

Books

The Hive and the Honey Bee - Dadant & Sons, available at www.dadant.com
The latest edition of the classic book on beekeeping. Completely rewritten, revised and enlarged. The best reference book on honey bees and beekeeping. 22 chapters, 33 world-famous authors, hundreds of photos and drawings, clothbound with attractive gold stamped cover and spine, and many special features: new 52-page U.S. and Canadian honey plants table, updated Africanized honey bee information, parasitic bee mites management, business practices, marketing, hive products, bee behavior, pesticides, and more.

Honey Plants of North America - John H. Lovell, ISBN: 0936028203
Root Publishing has issued this reprint of a beekeeping standard. Written in 1926, the comprehensive and detailed information about nectar and pollen sources as well as the intricacies and intimacies of the honey bee/plant relationship is still wonderfully pertinent and timely. The only book of its kind still in print.

Online Resources

http://www.thedailygreen.com/going-green/tips/bee-friendly-plants

http://nature.berkeley.edu/urbanbeegardens/

Apiculture Program at NCSU • http://www.cals.ncsu.edu/entomology/apiculture/

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ENY152

UF UNIVERSITY of FLORIDA IFAS Extension

The Benefits of Pollen to Honey Bees[1]

Amanda Ellis, Jamie Ellis, Michael O'Malley and Catherine Zettel Nalen[2]

The honey bee's basic nutritional requirements are similar to those of humans; namely, they need proteins (amino acids), carbohydrates (sugars), minerals, fats/lipids (fatty acids), vitamins, and water. In order to meet their nutritional requirements, honey bees collect nectar, pollen, and water.

Bees forage for water at almost any source close to their colonies. These sources include ponds, streams, leaky taps, the neighbor's pool, dog dishes, or bird baths. During hot weather, honey bees use water to cool the colony by fanning and evaporating water droplets inside the hive. Water may also provide essential minerals in addition to hydration.

Honey bees consume processed nectar (honey) and pollen (bee bread), both of which are provided by flowers (Figure 1). Nectar, which bees convert to honey, serves as the primary source of carbohydrates for the bees. It provides energy for flight, colony maintenance, and general daily activities. Without a source or surplus of carbohydrates, bees will perish within a few days. This is why it is important to make sure that colonies have sufficient honey stores during the winter months. Colonies can starve quickly! Nectar also is a source of various minerals, such as calcium, copper, potassium, magnesium, and sodium, but the presence and concentration of minerals in nectar varies by floral source.

Figure 1. Honey bee on an orange blossom. Photo Credit: Honey Bee Research and Extension Laboratory, University of Florida.

Pollen Content

Pollen, in the form of bee bread, is the honey bee's main source of protein and it also provides fats/lipids, minerals, and vitamins. The protein that pollen provides is vital to brood production and the

1. This document is ENY152 (IN868), one of a series of the Entomology and Nematology Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Original publication date September 2010. Visit the EDIS Web Site at http://edis.ifas.ufl.edu.
2. Amanda Ellis, Florida Department of Agriculture and Consumer Services, Division of Plant Industry; James D. Ellis, assistant professor, M. K. O'Malley, former Extension assistant, C. M. Zettel Nalen, Extension assistant, Department of Entomology and Nematology, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL 32611.

development of young bees. Pollen is the most nutritionally variable food source that honey bees use and typically is composed of the following: water (7-16 %); crude protein (6-30 %); ether extract (1-14 %); carbohydrates including reducing sugars (19-41 %), non-reducing sugars (0-9 %), starch (0-11 %); lipids (5 %); ash (1-6 %); and unknown (22-36 %). Pollen from different floral sources has different quantities of each component: all pollens are NOT equally nutritious to the bees.

The protein pollen provides is essential for hive growth, but the amount of crude protein available in pollen is highly variable among different pollens, ranging from 6-30% of the total dry weight of the pollen. Protein is composed of amino acids, 10 of which have been identified as essential to honey bees. These include threonine, valine, methionine, isoleucine, leucine, phenylalanine, histidine, lysine, arginine, and tryptophan. The quantity and type of amino acids present in pollen varies by the floral source from which the pollen was collected.

Where is Pollen Produced?

Pollen is produced by the stamen, which is the male reproductive portion of a flower (Figure 2). Honey bees play an important role as pollinators as they transfer pollen from the stamen of a flower to the stigma (female part) of the same or different flowers. Sometimes the pollen only needs to be transferred to a stigma on the same flower or another flower on the same plant, but often the pollen must reach a different plant altogether. Consequently, a very intricate relationship has developed between plants and their pollinators, as both parties rely on one another for survival.

In terms of pollen production, plant species differ in the quantity and quality of pollen produced. Some plants may produce an abundance of pollen, but the pollen may be of poor quality, whereas others may produce very little but high quality pollen. Plants that are closely related (within the same genus) tend to have similar amounts of crude protein available in their pollens. Plants with relatively high crude protein values include canola (*Brassica napus* – 23%) and almond (*Prunus dulcis* – 26%), while plants with lower crude protein levels include raspberry/blackberry (*Rubus* spp. – 19%), willow (*Salix* spp. – 17%), sunflower (*Helianthus annuus* – 16%), and pine (*Pinus* spp. – 7%). It is important to note that there are several different methods used to analyze protein content in pollen which, in turn, can yield different results. Consequently, one must use published protein levels in various pollens as a general guideline and not a definitive value.

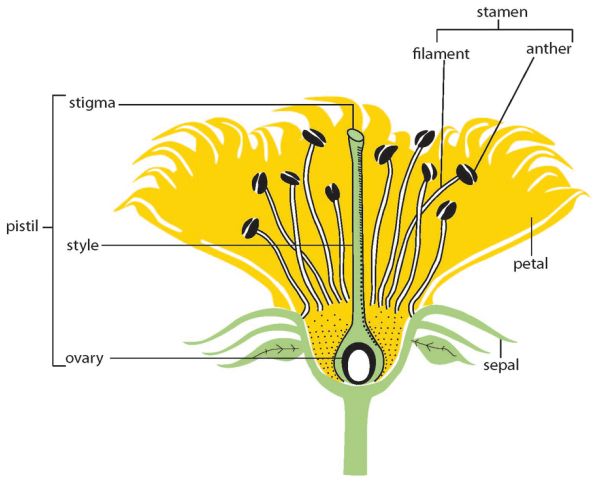

Figure 2. Anatomical diagram of a flower. Photo Credit: Entomology and Nematology Department, University of Florida.

Pollen Collection by Honey Bees

It has been observed that honey bee workers choose pollen based on the odor and physical configuration of the pollen grains rather than based on nutritive value. A typical size honey bee colony (approximately 20,000 bees) collects about 57 kg of pollen per year. On average, 15-30% of a colony's foragers are collecting pollen. A single bee can bring back a pollen load that weighs about 35% of the bee's body weight. Bees carry this pollen on their hind legs, on specialized structures commonly called "pollen baskets" or corbicula (Figure 3).

Once pollen is brought back to the colony, the workers condition it by adding glandular secretions containing enzymes and acids that prevent harmful bacterial activity and prepare the pollen for long-term storage (Figure 4). Stored pollen often is called "bee bread". Bees also add beneficial microbes to the pollen and they produce enzymes that help the pollen release nutrients and amino acids. Bee bread is consumed by a colony relatively quickly and only stored for a couple of months if there is a surplus. A

colony's annual requirement for pollen has been estimated to range from 15 to 55 kg.

Figure 3. Worker bee carrying pollen in her pollen baskets. Photo Credit: Honey Bee Research and Extension Lab, Trevor Schleuter, University of Florida.

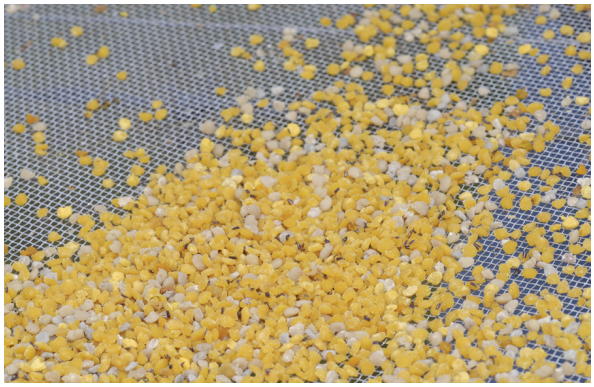

Figure 4. Pollen that has been collected from a pollen trap placed on the bottom board of a bee hive. Photo Credit: Honey Bee Research and Extension Lab, C.M. Zettel Nalen, University of Florida.

Bees require pollen for growth and development. Immature (larval) bees are fed a mixture of brood food and bee bread. Newly emerged bees consume bee bread so that their bodies can complete development. The amount of pollen required to rear a single worker larva has been estimated at 124-145 mg, this containing about 30 mg of protein. The minimum level of protein required for honey bees has been estimated to be between 20-25% crude protein. Pollens with protein levels in this range are more useful to colonies and allow them to meet their protein requirements readily. A diet of high protein pollen increases worker bee longevity, while brood rearing is reduced when supported by pollens low in protein.

Protein content is very important and is the most studied component of pollen, but little is known about the importance of other trace nutrients available in pollen to bees. The chemical analysis of the composition of pollen is complex and only a relatively few pollens have been investigated well. A good publication to review for pollen contents of many common plants is "*Fat Bees Skinny Bees* – a manual on honey bee nutrition for beekeepers" (http://www.rirdc.gov.au/reports/HBE/05-054.pdf). The authors of this manual include a list of pollen compositions from some common Australian plants. When reviewing the list, remember that plants within the same genus often have similar protein contents. This list can serve as a guideline for predicting protein content of pollen from similar plants in the U.S.

Ensuring Colony Nutrition

What can a beekeeper do to ensure that the nutritional requirements of the colony are met? A beekeeper should make certain that plants in the area actually provide pollen. For example, bees do not forage on many ornamental plants, so all blooming flowers are not attractive to bees. Also, the volume of pollen produced by a plant is not correlated necessarily to a bee's use of that plant's pollen. Pine trees, for example, produce copious amounts of protein-poor pollen but typically are not visited by honey bees. Additionally, plants that produce large amounts of nectar do not always also provide pollen for bees. When considering the nutritional requirements of honey bees, it is important to remember "variety, variety, variety". No single pollen meets all the nutritional needs of a colony so a variety of pollens from different plant sources will help ensure that these needs are met. Just like humans, bees need well-rounded diets. When inspecting a honey bee colony, one should see frames with a rainbow of pollen colors (orange, yellow, red, white, green, etc.) present in the cells. Additionally, pollen quality is more important than quantity.

A beekeeper should be familiar with both nectar and pollen producing plants in their area. Also, a colony's requirements change depending on season, brood production, and the beekeeper's goals. If there is a lack of pollen, or a suspicion that the pollen available is of poor quality, a pollen substitute or supplement may be provided to the colony.

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The Value of Honey Bees as Pollinators in North Carolina

Honey Bees as Pollinators

Many crops require insects to move pollen from one flower to another. Pollination ensures fruit set, proper development, more fruit, and viable seed. **Honey bees** are the **most important insect pollinator** for crops grown in North Carolina.

- Vegetable and fruit crops that require honey bees include cucumbers, blueberries, watermelons, apples, squash, strawberries, melons, and peaches.
- Forage crops that benefit from honey bee pollination include alfalfa, cotton, peanuts, and soybeans.
- Averaged over the last five years, honey bees have directly accounted for approximately **$96 million** in annual fruit and vegetable production (67.9%) and approximately **$186 million** in total annual crop productivity (24.5%) (see Table 1).

Since the mid-1980s, honey bees have been plagued by two exotic parasitic mites that can kill entire colonies if left untreated. The result has been a **dramatic drop** in the state's **honey bee population.**

- The estimated number of **managed** hives in the state has declined from a high of 180,000 hives before the mite introduction to **only 100,000 hives** currently.
- Most **wild honey bee colonies**, which also served as pollinators, **have been wiped out** by these mites.

It is now necessary that growers of bee-dependent crops **rent hives** to ensure proper and successful pollination.

- Pollination rentals often require **pollination contracts** between growers and beekeepers to ensure an adequate number of honey bees in the crop during the bloom period.
- An estimated **240,000 hives will be required for pollination in 2007** (see Table 2), which exceeds the number of managed hives in the state. Thus it is vital to **contract pollinators well ahead of the date they are needed**.

To **locate beekeepers in your area**, contact your local Cooperative Extension center (http://www.ces.ncsu.edu/local-county-center/) or the NC Department of Agriculture & Consumer Services (http://www.ncagr.gov/plantindustry/Plant/apiary/index.htm).

Session 8 - Products

	Total Value of Production ($1000s of dollars)							Value Attributable to Honey Bees ($1000s of dollars)					
Fruits and Vegetables	**2002**	**2003**	**2004**	**2005**	**2006**	**D**	**P**	**2002**	**2003**	**2004**	**2005**	**2006**	**5 Year Avg.**
Apples	22,205.000	17,103.000	16,630.000	13,859.000	19,799.000	100%	90%	19,984.500	15,392.700	14,967.000	12,473.100	17,819.100	16,127.280
Blueberries	22,534.000	34,777.000	2,235.000	36,702.000	48,745.000	100%	90%	20,280.600	31,299.300	29,011.500	33,031.800	43,870.500	31,498.740
Brambles	583.440	938.250	1,003.920	1,003.920	1,025.280	80%	90%	420.077	675.540	722.822	722.822	738.202	655.893
Cucumbers (fresh)	12,075.000	13,260.000	11,340.000	8,400.000	13,299.000	90%	90%	9,780.750	10,740.600	9,185.400	6,804.000	10,772.190	9,456.588
Cucumbers (pickled)	23,490.000	23,612.000	19,404.000	19,952.000	10,260.000	90%	90%	19,026.900	19,125.720	15,717.240	16,161.120	8,310.600	15,668.316
Grapes	2,934.000	2,989.000	3,366.000	3,653.000	4,624.000	10%	10%	29.340	29.890	33.660	36.530	46.240	35.132
Melons	20,000.000	20,000.000	20,000.000	20,000.000	20,000.000	80%	90%	14,400.000	14,400.000	14,400.000	14,400.000	14,400.000	14,400.000
Peaches	3,500.000	2,400.000	2,940.000	5,100.000	5,115.000	60%	80%	1,680.000	1,152.000	1,411.200	2,448.000	2,455.200	1,829.280
Pumpkins	2,000.000	2,000.000	2,000.000	2,000.000	2,000.000	90%	10%	180.000	180.000	180.000	180.000	180.000	180.000
Squash	10,260.000	8,430.000	9,000.000	9,860.000	11,480.000	90%	10%	923.400	758.700	810.000	887.400	1,033.200	882.540
Strawberries	19,125.000	15,300.000	15,840.000	18,525.000	19,440.000	20%	10%	382.500	306.000	316.800	370.500	388.800	352.920
Watermelons	9,503.000	6,825.000	6,300.000	7,259.000	12,960.000	70%	90%	5,986.890	4,299.750	43,969.000	4,573.170	8,164.800	5,398.722
Subtotal (% of total value)	***148,209.440***	***147,634.250***	***140,058.920***	***146,313.920***	***168,747.280***			***93,074.957 62.8%***	***98,360.200 66.6%***	***90,724.622 64.8%***	***92,088.442 62.9%***	***108,178.832 64.1%***	***96,485.411 64.2%***
Forage Crops													
Alfalfa (hay)	5,000.000	5,940.000	3,120.000	106,080.000	115,872.000	100%	60%	3,000.000	3,564.000	1,872.000	63,648.000	69,523.200	28,321.440
Cotton (lint)	163,263.000	322,051.000	253,286.000	315,910.000	281,424.000	20%	80%	26,122.080	51,528.160	40,525.760	50,545.600	45,027.840	42,749.888
Cotton (seed)	25,704.000	37,692.000	41,795.000	38,548.000	3,945.000	20%	80%	4,112.640	6,030.720	6,687.200	6,167.680	631.200	4,725.888
Peanuts	45,990.000	73,280.000	77,112.000	56,448.000	49,459.000	10%	20%	919.800	1,465.600	1,542.240	1,128.960	989.180	1,209.156
Soybeans	174,305.000	306,180.000	257,550.000	222,329.000	274,176.000	10%	50%	8,715.250	15,309.000	12,877.500	11,116.450	13,708.800	12,345.400

	Total Value of Production ($1000s of dollars)							Value Attributable to Honey Bees ($1000s of dollars)					
Subtotal (% of total value)	***414,262.000***	***745,143.000***	***632,863.000***	***739,315.000***	***724,876.000***			***42,869.770 10.3%***	***77,897.480 10.5%***	***63,504.700 10.0%***	***132,606.690 17.9%***	***129,880.220 17.9%***	***89,351.772 13.7%***
TOTAL (% of total value)	***562,471.440***	***892,777.250***	***772,921.920***	***885,628.920***	***893,623.280***			***135,944.727 24.2%***	***176,257.680 19.7%***	***154,229.322 20.0%***	***224,695.132 25.4%***	***238,059.052 26.6%***	***185,837.183 23.2%***

D = Dependency of crop on insect pollination for fruit set
P = Proportion of insect pollinators that are honey bees

Resources: Delaplane, K. S. and D. F. Mayer. (2000). *Crop Pollination by Bees*. CABI Publishing, Cambridge.
McGregor, S. E. (1976). *Insect Pollination Of Cultivated Crop Plants*. Agriculture Handbook No. 496, USDA-ARS, U.S. Gov. Print. Office, Washington, DC.
Morse, R. A. & N. W. Calderone. (2000). *The value of honey bees as pollinators of U.S. crops in 2000*. Bee Culture 128: 1-15. National Agricultural Statistics Service

Table 2. Estimated number of hives required for North Carolina pollination in 2007.

		Estimated Values for 2007	
Crop	**Recommended Hives/Acre**	**Acreage**	**Number of Hives Needed**
Apples	1.5	6,740	10,110
Blueberries	3.0	5,240	15,720
Brambles	0.8	245	196
Cucumbers (fresh)	2.2	5,510	12,122
Cucumbers (pickled)	2.2	78,360	172,392
Melons	1.5	4,000	6,000
Peaches	0.2	1,200	240
Pumpkins	1.5	1,500	2,250
Squash	1.5	3,730	5,595
Strawberries	3.5	1,460	5,110
Watermelons	1.8	6,090	10,962
TOTAL		***114,075***	***240,697***

THE
AMERICAN APITHERAPY SOCIETY INC.

Raw honey has been used for its medicinal value for thousands of years by many cultures. Hippocrates, the father of medicine, wrote of the medical uses of honey. All the major religious texts mention the health benefits of honey. Raw honey—honey which has not been filtered, heat-treated, or processed—is not just a healthy food. It is a powerful medicine when taken internally or used topically. The favorable effects of raw honey as a natural medicine for a wide variety of ailments are well known in folk medicine and are beginning to be documented in the modern scientific literature.

Its chemical composition makes it easier to digest than regular sugar, and its metabolism does not stimulate insulin secretion to the same degree as does sugar. Thus honey can be used in small amounts as a healthy substitute for regular sugar and artificial sweeteners. It also contains small amounts of protein, vitamins, minerals, and enzymes.

Common indications for oral ingestion of honey include: insomnia, anorexia, stomach and intestinal ulcers, constipation, osteoporosis, and laryngitis. A clinical trial in Saudi Arabia found honey to relieve dyspepsia (chronic indigestion). It was also found to help heal bleeding ulcers and GI inflammation. Manuka honey from New Zealand was found to inhibit the growth of H. pylori, the bacteria that is sometimes responsible for the development of ulcers. Research has confirmed honey's ability to act as a broad-spectrum antibiotic, as well as its antifungal and antiviral properties.

Indications for the external application of honey include treatment of athlete's foot, eczema, lip sores, and both sterile and infected wounds resulting from accidents, surgery, bed sores, or burns. In many countries, including France and Germany, physicians recommend using honey as a first line of defense against burns, superficial wounds, and in some cases, even deep

lesions such as abscesses. Wounds treated with raw honey generally heal faster and with less scarring than with conventional treatments. Raw honey is a natural and painless antiseptic. It kills germs because it is hydrophilic, meaning it absorbs or attaches to water in its environment thus dehydrating any bacteria it comes in contact with. In addition, honey contains an enzyme called glucose oxidase. This enzyme is converted to hydrogen peroxide, which is another powerful anti-microbial agent. In a 1991 study, honey was compared with silver sulfadiazine, the standard treatment for burn patients, and the results were astounding. Only 8% of patients treated with honey developed infections, compared to 92% of those treated with the silver sulfadiazine.

In addition to the previously mentioned medicinal uses for honey, it has also been shown to reduce the average size of postoperative scars significantly, treat cataracts and conjunctivitis, normalize the digestive microflora, calm the nerves, and facilitate sleep. These are just a few of the many uses for honey.

(from material provided by Andrew Kochan, MD, 6-08)

Beeswax

Not Just Honey!

When you think of bees you think of honey, right? Did you know bees produce a variety of beneficial products other than honey? Read on for more information on these products.

Beeswax

The word wax describes a large variety of substances of plant and animal origin, as well as man-made products, which are mostly petroleum derivatives. Natural waxes are not single substances, but a mixture of various long-chain fatty acids and a variety of other constituents, depending on their origin. Wax from the honeybee has an extremely wide spectrum of useful applications and occupies a very special position among waxes.

For centuries, beeswax was appreciated as the best material for making candles. The wrappings of Egyptian mummies contained beeswax and beeswax has long found use in medicinal practices and in creams and lotions. Of all the primary bee products it has been, and remains, the most versatile and most widely used material.

Production of wax

Young bees in the hive, after feeding the young brood with royal jelly, take part in the construction of the hive. Engorged with honey and resting suspended for 24 hours together with many other bees in the same position, 8 wax glands on the underside of the abdomens of the young bees secrete small wax platelets. These are scraped off by the bee, chewed and masticated into pliable pieces with the addition of saliva and a variety of enzymes. Once chewed, attached to the comb and re-chewed several times, they finally form part of this architectural masterpiece, a comb of hexagonal cells, and a 20 g structure, which can support
1000 g of honey. Wax is used to cap the ripened honey and when mixed with some propolis, also protects the brood from infections and desiccation. Together with propolis, wax is also employed for sealing cracks and covering foreign objects in the hive. The wax collected by the beekeeper is that which is used in comb construction. Frame hive beekeeping produces wax almost exclusively from the cap and top part of the honey cells.

Wax collection and processing

There are several ways of collecting beeswax. More commonly in frame hive beekeeping, wax is rendered from the capping removed during honey extraction. This produces a very high quality, light colored wax. Light colored broken combs provide the next quality of wax, whereas old black brood combs yield the smallest proportion and lowest quality of wax. Scrapings from sidewalls and the bottom board contain very high proportions of propolis and should not be mixed with better quality waxes. They can be used in swarm traps, for hive wood treatments, or in other preservatives for wood.

Different qualities of wax can be produced by separating new white honeycombs from darker ones or from those with portions of brood. Since whole combs are harvested and crushed or pressed, the proportion of wax per kilogram me of honey (10-15%) is much higher than with frame hive beekeeping, where the yield is only 1-2%. Before processing, all comb or wax pieces should be washed thoroughly to remove honey and other debris. Wax can be separated in solar

wax melters, by boiling in water then filtering, or by using steam or boiling water and special presses.

Wax should never be heated above 85 C. If wax is heated directly (without water) or above 85 C discolorations occurs. Direct exposure of wax to hot steam results in partial saponification.

Physical characteristics of beeswax

Virgin beeswax, immediately after being secreted, elaborated and formed into comb, is white. It becomes darker with use inside the hive as pollen, silk and larval debris are inadvertently incorporated.

The melting point of beeswax is not constant since the composition varies slightly with its origin. Various pharmacopoeias give a range of 61-66C or more commonly, 62-65 C. Its relative density at 15 C is 0.958 – 0.970 g/cm3 and its electrical resistance ranges from 5×1012 to 20×1012 Ohm m. Its thermal conductivity coefficient is 2.5 x d10-3 Jcm/s°Ccm2. The saponification value of beeswax is 85-100.

Beeswax is an inert material with high plasticity at a relatively low temperature (around 32 C). Beeswax is also insoluble in water and resistant to many acids, but is soluble in most organic solvents such as ether, benzine, benzol, chloroform, and turpentine oil and after warming, in alcohol and fatty oils. Ghedda waxes from the Asian honeybee species are described as softer and more plastic. The melting point of wax from three Meliponid (stingless bee) species ranged between 64.6 and 66.5 C.

The composition of beeswax

Pure beeswax from Apis mellifera consists of at least 284 different compounds. Not all have been completely identified but over 111 are volatile. At least 48 compounds were found to contribute to the aroma of beeswax. Quantitatively, the major compounds are saturated and unsaturated monoesters, diesters, saturated and unsaturated hydrocarbons, free acids and hydroxy polyesters. There are 21 major compounds, each making up more than 1 % of the pure unfractionated wax. Together they account for 56% of the wax. The other 44% of diverse minor compounds probably account for beeswax's characteristic plasticity and low melting point (Tulloch, 1980).

Various plant growth-promoting substances, such as myricil alcohol, triacontanol, gibberellin GA3 and a rape oil steroid have been detected in and isolated from beeswax. They described at least 11 proteins in the freshly secreted wax scales of A. mellifera capensis worker bees and 13 proteins in the wax combs of A. m. scutellata and A. m. capensis.

Beeswax is considered safe for human consumption and has been approved as an ingredient in human food in the USA. It is inert, i.e. it does not interact with the human digestive system at all and passes through the body unaltered. However, substances dissolved or encapsulated in wax are slowly released. This property is exploited in many medicinal preparations.

The physiological effects of wax

Because it is inert, beeswax has no direct effect on humans or larger animals. However, its indirect effects can be very strong. If mixed with medicinal drugs or poisonous baits, wax preserves the active materials longer and releases them slowly. It can be used to create thin non-corrosive, non-allergenic protective films on many surfaces from metals to fruits and human skin. Thus it protects against external damage such as corrosion and abrasion as well as against

moisture loss. It is a good electric insulator and, when saponified with borax, allows the mixture of very stable and smooth emulsions for cosmetics. Even in small concentrations it improves other formulations in the same way.

A very small anti-inflammatory and antioxidant activity can be observed in beeswax due possibly to some inclusions of propolis or other minor ingredients.

The uses of wax today

In the past, beeswax had a wide range of uses. Though in many cases beeswax can be replaced with cheaper, synthetic waxes, its very special characteristics, medicinal benefits, plasticity and aroma ensure its continuing use. The trend for more natural products in cosmetics may also increase its use. Presently, there is a scarcity of beeswax in industrialized countries, at least seasonally.

In beekeeping

In countries with frame hive beekeeping, the majority of locally produced beeswax is consumed by beekeepers for the making of wax foundations. Bees will not accept foundation made of synthetic waxes such as paraffin wax. In order to reduce damage during hive management and honey extraction in centrifugal extractors, foundation sheets are reinforced with wire either by the beekeeper (frame per frame) or by the manufacturer who embeds the wire into the foundation sheet.

For candle making

Beeswax was the major raw material for candles until the development of cheaper petroleum products such as paraffin wax. Since beeswax has a higher melting point than most paraffin waxes (most of which melt between 480 and 68C) beeswax candles remain straight at higher ambient temperatures. If wick size is correctly proportioned with respect to the diameter of the candle, they are less likely to drip than candles made from other materials. Waxes with a melting point above 88C do not perform well during burning.

For metal castings and modeling

Because of its plasticity, beeswax is easily formed and carved. It maintains its shape well even over very long periods of time as proven by wax sculptures found in ancient Egyptian graves. Its relatively low melting point permits easy and complete removal from casting moulds. The hollow space left in these moulds can then be filled with molten metal. Modeling in wax, or ceroplasty is a well developed art used also for scientific models in important collections around the world.

In cosmetics

The unique characteristics of beeswax give a certain solidity to emulsified solutions, facilitate the formation of stable emulsions and increase the water holding capacity of ointments and creams.

Beeswax not only improves the appearance and consistency of creams and lotions but is also a preferred ingredient for lipsticks, because it contributes to sheen, consistency and colour stabilization. Other cosmetic applications are found in cold creams (8-12% beeswax content by weight), deodorants (up to 35 %), depilatories (hair removers, up to 50%), hair creams (5-10%), hair conditioners (1-3%), mascara (6-12%), rouge (10-15%), eye shadows (6-20%) and others. Borax is the classic emulsifier, available in most pharmacies. Today's "high-chemistry" cosmetics use a large array of other synthetic emulsifiers. The chemical process on which the emulsification is based is the saponification of the acids in beeswax, i.e. the result is technically soap. The associated cleansing effect is exploited in so-called cleansing creams, which are very much like simple skin creams.

Food processing

Beeswax has been used in a variety of products and processes from packaging to processing and preservation. It has also been used as a separation agent in the confectionary industry and in cigarette filters. A common application for beeswax is the protection of containers against the effects of acids from fruit juices or honey. Steel drums for storage and shipment of honey have to be treated to prevent corrosion and dissolution of iron. The treatment involves expensive food grade paint, a plastic liner made from a food grade plastic film or a thin coat of beeswax.

Industrial technology

A patent describes a material for encapsulating electrical and electronic apparatus for use in high moisture or chemically active environinents.
Another patent describes the preparation of a material for embedding or electrically insulating circuits of high and ultra-high frequency. The mixture of 10-30% ceresin wax, 55-65 % beeswax and 15-25 % ethyl cellulose has a high melting point, is very hard at high temperatures, very strong when cold and can be remelted. A patent for an anti-corrosion rust inhibitor describes the incorporation of one or more different waxes, including beeswax. Other effective coatings contain beeswax; one such is composed of 90% mineral jelly and 10% beeswax. In other formulations, beeswax may be used as a binder, particularly if lubricant characteristics are required or if mixtures have to be ingested. Beeswax has also been used to decrease viscosity and improve slip-casting properties when casting glass under pressure. For agricultural pest control, beeswax has been an ingredient of slow release pellets of pyrethrum pesticides.

Textiles

Textiles and papers can be waterproofed with various products containing beeswax. Emulsions containing beeswax for leather treatment.

Varnishes and polishes

A varnish made from dammar resin and beeswax to be used for paintings and for art restoration. If propolis is included, the suitability of the locally available material should be tested.

Printing

In the old art of etching or engraving, beeswax was used as a protective surface coating. Wax was applied to a heated metal plate. The excess drained off while the remaining wax solidified into a thin film through which the design was drawn. The application of concentrated nitric acid or a mixture (1:8 by volume) of concentrated hydrochloric and nitric acids for a few minutes etched away the exposed metal and left the engraved part ready for negative printing. Today, liquid asphalt is normally used instead. Beeswax was part of a liquid protective coating for plastic lithography plates and also for automobiles. Glass can be etched with hydrofluoric acid after protecting those areas with beeswax, which are to remain clear.

Various inks, pens, markers and even carbon paper often contain small amounts of beeswax for typewriter ink includes a recipe of 1 part Japan wax or beeswax, 1 part Hitaide resin 503, S parts fluorescent granules (pigment) and 0.02 part Emulgen PP 150 (an emulsifier).

Medicine

As a coating for drugs or pills, beeswax facilitates ingestion but retards dissolution of the enclosed compounds until they reach the digestive tract. Beeswax can also be prepared as a mixture with the drug and then functions as a time-release mechanism, releasing the drug over a longer period of time.

One such suppository base (a substance which allows slow release of another substance) has been developed on the basis of 5% beeswax, 5% palmitic acid and 90% of Nubon, a semi-synthetic hydrogenated vegetable oil. This was used initially with chloramphenicol. In another preparation, beeswax alone served as the carrier for the drug. On an experimental basis nalidixic acid suspended in beeswax remained longer in the blood of tested animals after oral application than when the acid was administered directly. With another drug, the antihistamine chlorpheniramine maleate, various mixtures of glyceryl monostearate, stearic acid, lactose and higher proportions of beeswax had been successfully tested as a base. Many more examples can be found in pharmaceutical and medical literature. Each drug application requires its own specific modifications of the rudimentary base formulation.

Chewing dark comb (but not the old, black brood comb) without honey, brood or beebread is known to be effective against colds. It was shown that even the wax fractions of propolis have antiviral activities. Older combs contain among many other things a good portion of propolis.

Beeswax can be used to fill capsules with equal amounts of drugs or other ingredients of various granule sizes. The granules of drugs are made adhesive by coating them with molten wax (about 90g molten wax for 3kg of granules), fat or glycerol, by spraying with liquid paraffin or by mixing them with powdered wax or fat and heating. After thorough mixing the hard capsules are pressed with their open end into an evenly spread layer of the mixture. This process can also be adapted to making pills with pollen. A mixture of equal parts melted beeswax and honey is recommended for treating cracked hooves of animals. It should be applied after the cracks have been thoroughly cleaned.

Others

Other products in which beeswax provides some improvement and in which it is a traditional ingredient, include grafting wax, crayons, floor and furniture polish, general purpose varnish, sealing wax, corrosion prevention, protective car polishes and sewing thread- especially for sail and shoe making.

The fact that plant growth stimulators have been isolated from beeswax favours it over synthetic substitutes for use as a grafting wax. An Indian study on A. cerana wax suggests that its triacontanol content may be an economical alternative source for this plant growth stimulator.

Many other applications for beeswax, in cosmetics and pharmaceuticals may benefit also from the presence of minor components, which have not yet been thoroughly investigated.

Storage

Beeswax should only be stored in its rendered, clean form. Before rendering, it will quickly be attacked by wax moths, which are able to destroy large quantities of wax in short periods of time. Clean wax in large blocks is not attacked by wax moths.

Storage should be in cool dry places and never in the same room with any kind of pesticide. Wax will slowly crystallize over time and as a consequence become harder, but this process is reversible without any damage, just as with crystallized honey. Wax can be stored for very long periods of time without losing its major characteristics as items from Egyptian graves more than 2000 years old have shown.

The added ingredients affect the storage requirements of products made with beeswax. Polishes containing only mineral or non-vegetable oils can last for years

Quality control

Beeswax, when sold in solid blocks should always both be clean and have the color and odor characteristics. Though adulteration is easy (usually with cheap paraffin waxes), its detection is only possible with chemical tests.

Quality standards for wax are set in most countries according to their pharmacopoeias. A few industries like the Japanese cosmetic industry but also the American Wax Importers and Refiners Association specify their own limits. These have to be obtained from the respective industry representations or trade publications. Such standards may vary considerably from country to country and manufacturer to manufacturer.

To detect adulteration, a number of tests may have to be conducted. The simplest is to determine the melting point, by measuring the temperature at which the first liquid wax appears during very slow heating. It should be between 61 and 66C or preferably between 62 and 65 C. However, values within this range are not a guarantee of purity.

Determining the saponification cloud point is an officially accepted, sensitive method for determining adulteration. The method is limited to detecting quantities greater than 1 % of high melting (80-85 C) paraffin waxes, or more than 6% of low melting (50-55 C) paraffins. The test measures the amount of hydrocarbons, which saponify (turn into soap) in a specific amount of ethanol and give a clear solution. If the solution becomes clear at or below 65 C, the wax is probably unadulterated with paraffin. If it is adulterated, the solution will turn clear only at a higher temperature. The saponification cloud point is not suited to detect adulteration with carnauba wax, but gas liquid chromatography (GLC) can detect the 6% of free C32 alcohol (an alcohol molecule with 32 carbon atoms) contained in Carnauba wax. Beeswax only contains very little.

It was also suggests that GLC can be used to detect adulteration of beeswax with as little as 1 % of petroleum hydrocarbons from low melting paraffins, but not for detecting low levels of high melting paraffin waxes.

Pharmacopoeia list ester values from 66 to 82 but most beeswaxes range between 72 and 80. It was suggested that values of 70 to 80 are most typical. Acid values range from 16.8 to 24 and ratios between ester and acid values are fairly stable and narrow, mostly between 3 3 and 4.2. The ratios can change after excessive heating and can exceed 4.2 with heating to 100 C for only

24 hours, while the ester and acid values might remain within set limits. Ester and acid values in waxes from other Apis species may be significantly different.

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Pollen

Not Just Honey!

When you think of bees you think of honey, right? Did you know bees produce a variety of beneficial products other than honey? Read on for more information on these products.

Pollen

Bee Pollen

Bee pollen contains about 30% protein, 55% carbohydrates, 1 % to 2% fat, 3% minerals, and trace vitamins. Components vary depending on plant source, geographic region, harvest methods, and season of the year. It may contain up to 100 vitamins, minerals, enzymes, amino acids, and other substances, but the physiologic benefit of many of these components is unclear. Some bee pollen supplements also contain 3.6% to 5.9% vitamin C.

Bee pollen is available as capsules, chewable tablets, topical creams (in combination with other moisturizers), jelly, liquid (manufactured bee pollen extract, vegetable glycerin, and grain neutral spirits), powder, raw granules, soft gel caps, and tablets. It's available in products such as Health Honey and Super Bee Pollen Complex.

Benefits And Uses of Bee Pollen

Bee pollen is used to enhance athletic performance, minimize fatigue, and improve energy.

It may relieve or cure cerebral hemorrhage', brain damage, body weakness, anemia, enteritis, colitis, constipation, and indigestion. Bee pollen may be beneficial in treating chronic prostatism and relieving symptoms of radiation sickness in those being treated for cervical cancer. It may also be an effective prenatal vitamin, and may aid in weight loss.

Although bee pollen is used to treat allergic disorders, such use isn't recommended because bee pollen commonly causes allergic reactions.

Administration

* Granules: One manufacturer recommends taking 1 teaspoon or more by mouth every day; another recommends starting with 1 granule at lunchtime and increasing by 1 granule with each meal until 1 teaspoon is taken at every meal (may be sprinkled on food or mixed in a drink)
* Liquid: 10 to 12 gtt of extract may be added to 8 oz of water and taken by mouth two to three times a day .
* Oral use: 1 to 3 g may be taken by mouth every day .
* Powder: 1 to 2 teaspoons (5 to 10 g) by mouth every day; may be consumed as sold or may be blended or mixed with other foods .
* Soft gel cap: 1 cap or more may be taken by mouth every day .

* Tablets: Dosage varies depending on the formulation and manufacturer. Tablets may be swallowed whole or taken dissolved in a mixture with warm water and honey.

Side Effects of Bee Pollen

Those with sensitivity or allergies to pollen should avoid use. Those with allergies to apples, carrots, or celery should use with caution because of the potential for adverse reaction.

No known interactions are reported with bee pollen.
Clinical considerations

* Overall, bee pollen hasn't been found to have significant nutritional or therapeutic benefit over more easily and safely administered nutritional products.
* Some bee pollen products also contain bee propolis extract, vitamins, and numerous other ingredients.
* Doses as low as 1 tablespoon can cause acute anaphylactic reactions. Ask patient how much herb he uses daily.
* Patients taking bee pollen for longer than 3 weeks may experience chronic allergic symptoms such as hypereosinophilia and neurologic and GI complaints; however, such symptoms are likely to resolve after the patient stops taking the bee pollen.
* Inform patient that bee pollen should be taken between meals, with a full glass of water.
* Tell patient to remind prescriber and pharmacist of any herbal or dietary supplement that he's taking when obtaining a new prescription.
* Advise patient to consult his health care provider before using an herbal preparation because a treatment with proven efficacy may be available.

Research summary

The effects of pure bee pollen on memory have not been investigated, but clinical trials of a Chinese herbal medicine containing bee pollen have been conducted in China and Denmark . The improvements in memory seen in the Chinese study were not significant, and in the more recent double blind placebo-controlled crossover study in Denmark , no improvements were found.[1]

[1]www.OnlinePhysicians.org

Session 8 - Products

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Honeybee venom is produced by two glands associated with the sting apparatus of worker bees. Its production increases during the first two weeks of the adult worker's life and reaches a maximum when the worker bee becomes involved in hive defense and foraging. It diminishes as the bee gets older. The queen bee's production of venom is highest on emergence, which allows her to be prepared for immediate battles with other queens.

When a bee stings, it does not normally inject all of the 0.15 to 0.3 mg of venom held in a full venom sac (Schumacher et al., 1989 and Crane 1990, respectively). Only when it stings an animal with skin as tough as ours will it lose its sting – and with it the whole sting apparatus, including the venom sac, muscles and the nerve center. These nerves and muscles however keep injecting venom for a while, or until the venom sac is empty. The loss of such a considerable portion of its body is almost always fatal to the bee.
Used in small doses however, bee venom can be of benefit in treating a large number of ailments. This therapeutic value was already known to many ancient civilizations.

Honeybee venom is a clear, odorless, watery liquid. When coming into contact with mucous membranes or eyes, it causes considerable burning and irritation. Dried venom takes on a light yellow color and some commercial preparations are brown, thought to be due to oxidation of some of the venom proteins. Venom contains a number of very volatile compounds which are easily lost during collection.

88% of venom is water. The glucose, fructose and phospholipid contents of venom are similar to those in bee's blood (Crane, 1990). At least 18 pharmacologically active components have been described, including various enzymes, peptides and amines. Detailed information on the components is available in the Krell document noted below.

(taken from Krell, R.,"Value-Added Products from Bee-Keeping,"
FAO Agricultural Services Bulletin #124, 1996)

Products of Beekeeping

Not Just Honey!

When you think of Bees, you think of honey, right? Did you know bees produce a variety of beneficial products other than honey. Read on for more information on these products.

Propolis

Propolis, sometimes known as bee glue is a thick, sticky resin that bees collect from tree buds and use to cement holes in the hive and defend it against invading parasites and diseases. Traditional healers from South America, China, Japan, and Eastern Europe have valued propolis as a remedy for such ailments as gum problems and dental health, skin issues and oral sores, as well as viruses and the common cold. [1]

What is Propolis used for?

Propolis displays strong antimicrobial activity and has been used as a chemotherapeutic agent since ancient times. It was used in folk medicine as early as 300 BC for medical and cosmetic purposes, and as an anti-inflammatory drug and wound-healing agent. More recently, it has been reported to possess antibacterial, antiviral, and antifungal properties. Propolis has shown local anesthetic, anti-ulcer, anti-inflammatory, immunostimulant, and hypotensive properties. It also shows tumor-inhibiting properties in laboratory tests. Proponents of the use of propolis suggest that it stimulates the immune system, thereby raising the body's natural resistance to infection. It has been advocated for both internal and external use.

Antimicrobial

In laboratory tests, studies have shown broad spectrum antimicrobial activity of various propolis extracts, although activity was highest in gram-positive bacteria and yeasts. Synergism with certain antibiotics has been demonstrated.

In human clinical studies, propolis has been investigated for its activity against Helicobacter pylori, chronic vaginitis, genital herpes, and periodontal and respiratory tract infections. A clear therapeutic role for propolis is difficult to validate because of variations in antimicrobial action, which are dependent on geographical origin and extraction methods employed.

Anti-inflammatory

Animal studies show propolis to have anti-inflammatory effects. A clinical study of the effect of propolis in patients with asthma demonstrated a reduction in the frequency of asthma attacks, and an increase in breathing function.

Other uses

Propolis extracts have been investigated for their antioxidant properties. Study results have been inconsistent. The antioxidant activity of propolis is one of the rationales for its proposed antitumor and liver protective activity. Clinical studies on the antitumor and liver-protective activities of propolis are lacking. Animal studies show some immunostimulatory and modulatory effects.

Miscellaneous uses

Propolis is used as a mouthwash, toothpaste, and throat lozenge because of its purported antibacterial and anti-inflammatory activities. In a small clinical study, propolis mixed with mulberry leaf decreased blood sugar levels in patients with type 2 diabetes.

What is the dosage of Propolis?

There is no clinical evidence to support specific dosage recommendations for propolis.

Is Propolis safe?

Contraindications have not yet been identified.

Pregnancy/nursing

Information regarding safety and efficacy in pregnancy and lactation is lacking.

Interactions

None well documented.

Side Effects

Allergic reactions with skin and mucous membrane irritations have been reported. Sensitization to propolis also has been reported.

Toxicities

Information regarding toxicology is lacking.[2]

References

1. Edited from Solutions, a publication by the College of Agricultural, Food and Natural Resource Sciences. ©2004-2007 Regents of the University of Minnesota. All rights reserved.

2. Propolis. Review of Natural Products. factsandcomparisons4.0 [online]. 2006. Available from Wolters Kluwer Health, Inc. Accessed April 19, 2007.

Session 8 - Products

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Royal jelly is a milky substance produced by the hypopharyngeal and mandibular glands of nurse bees between their 5th and 15th days of age. All bee larvae are fed royal jelly for the first three days after being laid. After that only the larvae designated to be the queen are fed royal jelly. The components of royal jelly help the queen mature into a large, fertile and longer-living bee. Worker bees live from 4-6 weeks, whereas the queen lives up to 6 years and lays 2.5 times her weight in eggs a day. This is due to royal jelly's powerful effects on the bee's endocrine, hormonal, and metabolic systems.

The Chinese are the world's largest producers and consumers of royal jelly. Royal jelly has played a key role in traditional Chinese medicine, and is still used today to prevent and ameliorate a wide variety of medical conditions. These include, but are not limited to: anxiety, arteriosclerosis, arthritis, bone fractures, asthma, depression, fatigue, lack of sexual desire, hair loss, impotence, insomnia, liver and kidney disease, stomach ulcers, menopausal symptoms, varicose veins, a weak immune system, high and low blood pressure, and a variety of skin conditions. Royal jelly, which is high in B vitamins, has a metabolic stimulating action, which aids in the processing of proteins, carbohydrates, and lipids. It also increases oxygen consumption, improving endurance and decreasing fatigue. As a powerful antioxidant, royal jelly decreases levels of free radicals which are thought to cause aging. Royal jelly has a direct effect on the adrenal glands leading to an increased secretion of adrenaline which can be cardioprotective. With its protective effects on the cardiovascular, pulmonary, and immune systems, it is no wonder royal jelly is a prized commodity in many cultures.

The effects of royal jelly on specific conditions may be amplified when taken in combination with other bee products. One recently discovered property of royal jelly is its ability to provide protection against the negative side effects of chemo and

radiation therapies, especially when given with propolis. This combination can also be used with positive effects for viral infections including shingles and hepatitis.

While there is still much to be learned about royal jelly, there are many recent studies from Europe and Asia which show how useful it can be. A Japanese study found that royal jelly has an anti-fatigue effect in exercising mice. In China and Russia, royal jelly was effective in treating chronic viral and bacterial infections, anorexia, varicose veins, and stomach ulcers. During a flu epidemic in Yugoslavia, it was noted that those who consumed royal jelly daily were less likely to get the flu. A study done in Egypt in 1995 revealed that royal jelly was capable of killing several kinds of bacteria, including E. coli. In another study it was found that people taking 50-100 milligrams of royal jelly per day decreased total serum cholesterol by 14% and lipids by 10%.

Royal jelly helps promote collagen synthesis and is beginning to be found in many topical dermatologic products. Royal jelly is also used in healing from prolotherapy treatments and other injuries.

(from material provided by Andrew Kochan, MD, 6-08)

An interesting article about Freezing Royal Jelly: http://apitherapy.blogspot.com/2009/02/royal-jelly-should-be-frozen.html

Normally, the term **beebread** refers to the pollen stored by the **bee**s in their combs. The **beebread** has already **bee**n processed by the **bee**s for storage with the addition of various enzymes and honey, which subsequently ferments. This type of lactic acid fermentation is similar to that in yoghurts (and other fermented milk products) and renders the end product more digestible and enriched with new nutrients. One advantage is almost unlimited storability of **beebread** in comparison with dried or frozen pollen in which nutritional values are rapidly lost. The natural process carried out by the **bee**s can more or less be repeated artificially with dry or fresh **bee**-collected pollen. It is important however, to provide the correct conditions during the fermentation process.

"Of note: While allergy to **Bee** Pollen is frequently encountered, allergy to **Beebread** is very rare."

(taken from Krell, R.,"Value-Added Products from **Bee**-Keeping," FAO Agricultural Services Bulletin #124, 1996)

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CALENDAR FOR BEEKEEPING IN CENTRAL NORTH CAROLINA

Nancy Ruppert, Apiary Inspector, NCDA & CS

This calendar was designed for general beekeeping use in most of central North Carolina. Recommendations are based on average climate/weather conditions, and may vary with significant temperature changes. Those who manage hives for commercial operations may have different needs than those listed below. Details regarding bloom types/dates and pest/disease management are not included here due to space limitations; consult *reliable and current resources* for this information. This calendar is subject to being updated as new information becomes available. **Remember: bees often follow a different calendar than humans do!**

January

Add pollen supplements, if needed; check amount *and location* of honey stores, and feed (2:1 syrup or fondant) if <3/4 super of stored honey left.

Check/repair/replace stored equipment; order wax/woodenware.

Order nucs/packages.

Keep learning---bee school, read books/journals, etc.

Combine or insulate smaller (less than 4 frames of bees) hives.

Combine hives where queen has failed, if they're still alive and haven't absconded.

Move hives if they'll need to be relocated this year.

Bees may need help removing dead bodies from entrance area.

February

Noticeable pollen flow under way, especially red maple-→ brood build-up intensifying.

Minimal if any nectar available---most hives need feeding (1:1 syrup in most cases, unless honey stores very low [i.e., <1/2 super left]).

Combine hives if needed (see January entries above).

Repair/replace equipment if needed; move hives if needed; <u>keep learning.</u>

During last half of February, consider adding super/hive body of wax *foundation* to allow bees to draw out more comb for spring. (**Feeding or nectar is required for this.**)

Replace a few (<4) frames where comb is old or has excessive drone cells.

Some hives may need treatment for *Nosema* disease, especially if too cold for cleansing flights.

Call your local cooperative extension office if you want your name on a "swarm-catcher" list.

Make plans to attend the annual NCSBA Spring Meeting in March.

March

NCSBA annual Spring Meeting (usually first weekend in March)---great learning opportunity!

Swarming under way-→ implement prevention measures (make splits, remove queen cells, "checker-board", temporarily or permanently remove current mother queen); set up "bait" hives.

Reverse bottom two or three boxes on hive to give queen more room to lay: most hives have moved up above the bottom hive body, leaving it virtually empty. This measure also helps reduce swarming. Caution: **be careful not to split up clusters of brood when you do this**. Two to three weeks after this reversal, it's likely that you'll need to reverse them again. (An alternative to reversal: simply add another hive body.)

Assess for pest and/or disease problems (especially varroa mites, American foulbrood, and European foulbrood) and treat if needed. **Treatments should be completed by early April to limit risk of contaminating honey**.

Check honey stores; feed (1:1 or thinner syrup) if needed.

Look closely at the brood pattern; order new queen if current one failing.

Continue to replace few frames of old/undesirable comb, if needed.

Near end of the month, add at least one honey super; remove entrance reducers; equalize hives.

April

Nectar flow is often heaviest this month: make sure that all medications are out of hive unless required for bees' survival, be prepared to add new supers every 7-10 days, and remove feeders from all except new or weak hives.

Bees should be very busy; closely examine hives that are not, and trim weeds that may be hindering flight.

Swarming usually heavy---continue prevention/capture measures.

Look closely at brood pattern; replace queen if needed.

Have everything ready to install nucs/packages that you've ordered; **feed upon installation.**

Consider adding queen excluder to prevent brood in honey supers.

May

Nectar flow continues---keep adding supers; get extraction/bottling equipment ready. Consider adding an additional hive entrance (via 5/8" hole or shim) above brood area, for foragers.

Swarming continues---keep up prevention/capture measures.

Replace failing queens.

Start planting annuals for future nectar/pollen supplementation.

Install traps for small hive beetles if needed (i.e., if more than 20 adult beetles seen in hive).

Place two or more bee "watering holes" in apiary, if not already present.

June

Main nectar flow starts to dwindle---fewer supers needed, unless sourwood nearby: if in area of sourwood, consider harvesting available honey before mid-June sourwood flow to ensure more "pure" sourwood crop.

If honey being harvested, put "wet" supers back on hives late in day to limit robbing.

Can start late-season splits during last half of June; **feed splits initially, even if there is nectar available**

Continue measures to control small hive beetle population.

Keep water for bees constantly available.

Make plans for attending NCSBA Summer Meeting in mid-July.

July

May harvest some (or all) of honey; may continue late-season splits; continue beetle controls; keep water available for bees (see June activities).

Attend NCSBA annual Summer Meeting, if possible (usually mid-July)---great learning opportunity!

Get supers on for cotton honey, if hives near cotton fields.

Replace failing queens; consider replacing any queen that is two years old or older.

Can begin annual varroa mite assessment, and treat if needed/practical.

August

If not in area of significant cotton bloom, harvest remaining desired honey by mid-month to keep bees from eating it.

Pest control is critical this month: hive beetle populations are peaking, varroa mites are nearing their peak populations, some factors increase risk of damage from wax moth larvae, and yellow jackets/ hornets tend to be plentiful.

Careful assessment of queen performance---this month is usually last chance to replace queens until the following spring.

Can still make late-season splits early in August if using mated queens.

Keep water available for bees constantly.

Be prepared for "badly behaving bees": because nectar flow is so scarce, bees may become more defensive and more likely to rob other hives→ install robbing screens or entrance reducers (but be aware of need for ventilation), and keep hive inspections as brief as possible.

Completing honey harvest + decrease in queen's egg-laying = extra empty supers of drawn comb; store them using method that prevents damage from wax moth larvae (freezing, keeping open to light/ventilation, using paradichlorobenzene [PDB] crystals).

September

Continue measures for pest control; if hives *exposed to but not sickened by* American foulbrood, apply treatment to prevent full-blown disease. **Varroa control should be completed by end of month!!**

May feed thin (1:1 or more diluted) sugar syrup for 2-3 weeks to stimulate queen laying---builds up winter population---but by last week of September, begin feeding thicker (2:1) syrup for winter stores, although thicker syrup may not be necessary if >3 supers of honey left on hive and/or heavy fall nectar flow.

Consider *Nosema* assessment/treatment.

Combine colonies later in the month if weak and/or have failing queens.

Should have brood in bottom box→ if not, may need to rearrange things.

October

Post-treatment assessment for varroa mites (i.e., did your treatment work?).

Remove all queen excluders, if present.

Combine hives that are weak/have failing queens.

Feed thick syrup, if needed, for winter food stores.

Limit frequency of inspections after mid-October: bees are sealing cracks with propolis, and waste lots of time/energy if they have to keep replacing it.

Add entrance reducers near end of month to keep mice out.

Drones being expelled in most hives.

Plant (in October and November) herbaceous perennials for future nectar/pollen sources.

November

Combine hives that are weak/have failing queens.

Ensure adequate ventilation near top of hive.

Feed thick syrup, if needed, for winter stores.

Provide weights (brick, rock, concrete block, etc.) for tops of hives to limit wind-induced toplessness.

Plant trees for future nectar/pollen sources (tulip poplar, maple, sourwood, etc.).

Consider closing off screened bottom board to improve heat insulation.

Bee caught up before Thanksgiving, so you can enjoy food, family, football, Black Friday, etc.!

December

Combine hives that are weak/have failing queens.

Feed thick syrup if needed (i.e., if not more than one super of honey stored up).

Consider insulating smaller hives (those with 4 or fewer frames of bees).

Sell honey to Christmas gift shoppers.

Year-end review/assessment of apiary success/challenges.

Leave bees alone, if possible. (Take a break---you probably need it by now!)

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Basic Beekeeping Operations

Hive Location

While bees can fly up to two miles to find nectar and pollen, they do best with less "travel time." Bees can be kept almost anywhere; they do not have to be in a "perfect" spot. Choosing the best possible location, however, increases the chances for a strong, productive colony. Consider both the bees and your neighbors when making your decision. Some points to keep in mind are:

1. Bees need water to dilute honey and cool the hive during hot weather. If water is nearby, they can spend more time gathering nectar and less time collecting water. If necessary, a dripping garden hose or water trough filled with coarse gravel may be placed near the hive. Bees will drown in deep open water containers.
2. Bee behavior is affected by temperature. They rarely work when the temperature is below 57°F or above 100°F. They cannot fly when the temperature is below 55°F. On very hot days, bees cluster outside unshaded hives and do not work. However, too much shade in the summer makes bees irritable
3. Windbreaks provide some protection from cold winter winds. Bees eat more stores and are more susceptible to dysentery when located where cold winds hit the hive.
4. Field bees orient themselves with the sun and usually fly from mid-morning to mid-afternoon. Avoid placing hives on the west or north sides of buildings. Orient the hive entrance to the south or southeast but not into prevailing winds.
5. If you are in hilly country, locate your hive in a valley. Bees fly uphill for nectar and downhill when loaded with pollen or nectar. Locate the hive so you can carry filled supers down the slope to your storage area.
6. Locate your bees close enough to your home to observe them regularly.
7. Hives near highways, sidewalks, or watering troughs might be a nuisance. If your hive is in this situation, build a high fence so bees leaving and returning to the hive must fly over the area.
8. Avoid locating the hive near large rivers bees must cross to forage. Bees within a half mile of wide rivers often drop into the water and drown when returning home tired and loaded with nectar.
9. Bees will fly two miles in any direction over level ground for nectar, but honey production increases if nectar is closer. Try to locate the hive near fall and spring nectar sources.

Examining the Colony

"Going through the bees" is a phrase beekeepers use for opening the hive to examine the condition of the brood and food stores and look for signs of disease, swarming, or anything else that needs attention. During off-seasons, especially winter, monthly inspections are generally sufficient. During the six-week period from the beginning of rapid colony buildup to the beginning of the spring nectar flow, examine the colony weekly.

When opening a hive, take precautions to avoid harm to the bees and yourself. Most danger is avoided by working slowly and carefully and wearing the appropriate protective gear. The most important item is the bee veil because stings around the eyes or temples are more dangerous than stings elsewhere. Also, reacting suddenly to stings around the head entices more bees to sting.

Bees dislike dark, woolly, or sweaty materials, so wear clean, light-colored, cotton coveralls or a long-sleeved shirt and full-length pants. Tuck your pants cuffs into your socks and your shirt cuffs into your bee gloves, or tie your pants and shirt cuffs so bees can't get in. Bees have a harder time stinging through loose clothing, but do not wear clothing that flops about. Many beekeepers are toughened enough to tolerate a few stings on the hands so they often do not wear gloves, which are slightly cumbersome. However, it is best to wear gloves until you know how you will react to stings on the hands. Dropping a frame of bees or swatting at a stinging bee only makes things worse.

Weather and other conditions influence the temper of bees, so examine the hives under the most favorable conditions. During a nectar flow, bees work from mid-morning to mid-afternoon on calm sunny days when the temperature is above 70°F. Bees are more even-tempered when they are busy. Also, when most of the field bees are out foraging, fewer are in the hive to interfere with your inspection. Bees tend to be irritable between nectar flows or on poor flying days. When bees are actively brood rearing, avoid opening the hive on cold, overcast, or windy days lest the brood be killed by chilling.

Your smoker should be lit and smoldering properly before approaching the hive. Move to the hive from the side or rear; stay out of the line of flight. Move slowly and avoid making quick or sudden motions. Reach around to the front of the hive and give the entrance two or three puffs of smoke. This disorganizes the guard bees and distracts the others from what you do next. Quietly remove the top cover and place it upside down on the ground to the rear of the hive. Puff some smoke through the hole in the inner cover, wait a few moments, then pry up the inner cover with your hive tool. Puff a little more smoke under the cover as you lift it off. Lean the cover against the hive. Use additional smoke if necessary, but do not overdo it. A little smoke stimulates the bees to fill up on honey and be peaceful; too much smoke drives them from the hive and disrupts their workday.

Bees glue contact points together with propolis, so frames must be pried loose with the hive tool. Insert the tool between the hive wall and the ends of the frames to pry them loose. Then pry between the outside frame and the one next to it to separate them from each other. Remove the outside frame, which usually contains no brood, and stand it on end against the shady side of the hive. There is now space in the hive to shift the remaining frames. They can be removed, examined individually, and replaced. Do not set any of these frames down outside the hive. Examine as few frames as possible to assess the condition of the colony. Keep the hive open only as long as necessary to judge its condition.

Avoid crushing bees when shifting or replacing frames, especially the queen. Crushed bees emit an odor which excites other bees to sting. After a nectar flow, do not keep a hive open for more than a few minutes at a time. Otherwise, bees from other colonies might begin robbing. Robbing results in heavy bee loss. If it starts, put the hive back together immediately and place some grass in the entrance to help the bees repel robbers.

When looking at the frames, hold them vertically by the ends of the top bar. Stand so that the light comes over your shoulder. To see the opposite side of the frame, raise your right hand until it is above your left hand and rotate the frame like a hinged door until the opposite side is in full view. Then bring your right hand down level with your left. The frame will be upside down in your hands. Depending on the season, things to look for are:

1. Is there sufficient honey and pollen?
2. Is the queen healthy? If eggs and brood are present, the queen is probably all right.

3. Are swarm cells present? If so, destroy them and check further for conditions that might cause swarm reparation.
4. Is there enough room for the queen to lay and for the workers to put away stores?
5. Are the combs broken or sagging or with many drone cells?
6. Is the brood diseased? Are there sufficient worker bees? Too many drones might be a sign of a failing queen or poor combs.

Record your observations in a notebook immediately after hive examination. Look back at this information to review the season's activities and plan for next year.

Bee Stings

All honeybee workers are potential stinging insects but usually sting only to defend their colony or themselves. To avoid stings, do not pass directly in front of a colony of bees. Instead, work from the side or back. If a flying honeybee comes near you, remain still or walk to a brushy area, building, or vehicle. Swatting at bees aggravates them

If you are stung, remove the stinger immediately by scraping it with your fingernail or a knife. Do not squeeze the stinger. This injects the full dose of venom into your skin. The scent of the poison often alarms and irritates additional bees, so either wash the wound site with a natural odor or apply a few puffs of smoke to mask the scent. Rubbing the wound only produces more itching and swelling.

Persons made ill by one or several stings ordinarily should not attempt to work with honeybees. Evidence of oversensitivity to bee stings includes a sharp change in the pulse rate, difficulty in respiration, loss of consciousness, and hives on various parts of the body.

Requeening

Many queens live five years and some up to nine years, but vitality decreases with age. The aging process is hastened by a high demand to lay eggs. Most beekeepers prefer to replace the queen before she begins to fail. This can be a yearly process, but in our area most requeen every other year. Requeening is relatively inexpensive, especially when you consider the production loss and generally weakened colony due to a failing queen.

A queen may begin to fail at any time so always check her condition. Several symptoms can alert you to the problem. An old queen usually has a dark dull appearance because her body hairs have been broken or rubbed off. The edges of her wings might be worn and ragged and her abdomen might droop away from her thorax. She moves more slowly and might avoid the workers. Also, very old queens lay mostly drone eggs. The brood area of a failing queen is smaller than normal or "scattered" on the comb. Honey production is down even when production conditions are favorable. The workers build supersedure cells near the center of the comb in preparation for replacing a failing or missing queen. At this point, it might be just as well to let the queen be superseded rather than purchase a new queen. However, it is best not to let the situation deteriorate to this point. If the queen is missing for an extended period of time, workers might begin to lay unfertilized eggs. These eggs only produce drones. Unlike the queen, laying workers deposit several eggs in each cell. It is often difficult to requeen a colony that has been queenless for some time.

Requeening can be done at several times. Select a period when nectar is coming into the hive. This improves the chance of the new queen being accepted. The earliest time in the year is in spring when bees are bringing in nectar about six to eight weeks before the main nectar flow. The advantages then are few supers to handle and a relatively small colony. Also, the old queen is easier to locate, and it's easier to check for acceptance of the new queen. A disadvantage is the higher cost of queens during this time.

Some beekeepers requeen after the main nectar flow begins. If the old queen has been laying fairly well, she will have laid most of the eggs needed for a good work force. The disruption of brood rearing by introducing a new queen is only slight. A disadvantage is difficulty working through the large number of bees to locate the old queen.

Requeening can be done in the fall if there is a dependable nectar flow. The colony is not overly large at this time, and a good queen will be established for the spring buildup.

The simplest requeening method is to introduce a purchased queen from the mailing cage. About midday, as soon as possible after the queen arrives, open the hive using as little smoke as possible. Remove the brood chamber combs one by one, checking each one carefully for the old queen. When you locate her, kill her and destroy any queen cells present. Uncover the candy hole in the end of the mailing cage and punch a small nail hole through the candy. Suspend the cage in a horizontal position between the top bars of two center frames of the brood chamber. Close the hive, and do not disturb it for seven days. At the end of this time check to see if the new queen has been accepted. Look first at the mailing cage to see if she is free. If she is not, enlarge the candy hole or release her directly into the hive. If the queen is free and eggs are present in brood cells, it is not necessary to locate her.

Swarming and Its Control

A beekeeper can use one of several artificial methods to increase the number of colonies, but the natural method by which bees increase colonies is swarming. Swarming reduces honey production for the season because the parent colony and the swarm each have fewer bees than the original colony. They do not build to full strength as quickly as the original colony would have if swarming had not occurred.

When preparing to swarm, bees build large numbers of queen cells along the bottom of the comb. Shortly before a new queen emerges, the bees stop their field work. The swarm bees, usually at least half the bees in the colony, engorge with honey. They leave with the queen, fly a short distance, and cluster on a bush or tree limb. They wait there while scout bees locate a satisfactory hiving place. During the wait, the bees are very gentle and can be handled with much less danger of stinging. If scout bees come back with news of several satisfactory hive sites, the swarm somehow selects one. The dense ball of bees breaks up into a boiling cloud and flies directly to the new hive.

After the first swarm leaves the old hive, new queens may lead other swarms from the hive within a few days of each other. After all the swarming is over, normally enough bees are left in the old hive to keep it going although the colony strength might be greatly weakened.

The impulse to swarm is governed partly by the innate character of a bee colony and partly by conditions in the hive. Some races of bees tend to swarm more than others. However, swarming is most often associated with overcrowding in the hive. Overcrowding can result from a variety

of unsatisfactory hive conditions (Table 1) including lack of supers, improper super sequence, poor comb spacing, poor ventilation, too many young bees or drones, and combs filled with honey.

A common time for overcrowding is when pollen becomes abundant in spring and prompts a rapid increase in brood rearing. Brood cells are filled with brood faster than they are emptied by the emergence of new bees, so the area containing brood expands. The area being filled with nectar and pollen also increases. If space is not provided to accommodate this expansion, swarming is apt to occur.

During the spring buildup, inspect the colony weekly to see that ample space is provided for brood rearing and honey storage. Brood chambers need to be added if the colony overwintered with one hive body. If the colony has more than one brood chamber, chambers should be rearranged to best accommodate the expanding brood. Normal colony behavior is to expand the brood nest upward, so put brood chambers that are empty or contain the oldest brood on top and the chamber with the youngest brood on the bottom. Brood chambers might need to be rearranged every two to three weeks until the nectar flow starts. After the nectar flow starts honey supers should be added. See the section on supering.

Check for signs of swarming during hive inspections and at other times. If a strong colony has few bees out working on calm sunny days, the colony might be preparing to swarm. If swarm cells are along the bottoms of frames, swarming will occur soon unless changes are made. Remove the swarm cells and correct the conditions stimulating swarming. If only a few queen cells are found on the face of the comb, do not remove them; these are supersedure cells and indicate a missing or failing queen. The usual time for supersedure is also just before a nectar flow so swarming and supersedure can occur together. Supersedure swarms contain one or more virgin queens. The former queen is left behind to be replaced by a queen still developing.

You can prevent supersedure swarming by maintaining a vigorous queen in the colony. This is usually assured by requeening the colony every other year. An old, frail queen is not able to uphold her egg-laying task during the demand for rapid buildup of brood just before the main nectar flow. Workers become eager to replace her with a more efficient queen and begin building a few supersedure cells on the face of the comb. If you discover supersedure cells during hive inspection, allow them to develop. It is better to allow the bees to replace the queen than to force them to stay with a queen that is not productive. Most likely they will keep building supersedure cells until they succeed in replacing the failing queen.

Supering and Removing Supers

The procedure for supering to obtain the best honey crop depends on the style of honey desired. Styles, listed by ease of production management, are chunk comb honey, extracted honey, and section comb honey. Chunk comb honey production is advisable for beginning beekeepers. Supering instructions for the other styles of honey and special techniques can be found in such books as *How to Keep Bees and Sell Honey, The Hive and the Honeybee,* or *ABC and XYZ of Bee Culture*.

Add a super when the nectar flow starts in your area and the bees begin to whiten the tops of the frames with new wax. Super frames should be complete with foundation so the bees can start drawing out the combs immediately. Add a second super to the top when the first is two-thirds full. Add new supers on top of supers already on the hive. Add the third super when the first is

nearly full and the second is half full. Reverse the order of the first and second supers and add the third on top. If the third super is being drawn rapidly, put it next to the brood. Reversing supers keeps the bees working throughout the stack. If more supers are needed, follow the rotation suggested. Do not add supers too fast or add too many at one time. Remove each super as soon as it is completely capped. Add supers sparingly toward the close of nectar flow so there are fewer partially filled supers when the bees quit working.

When a super is completely capped over, move it to the top of the stack and place it on top of an inner cover that has a bee escape in the center hole. It takes about a day to clear the super of bees with this method. The next day the super can be removed from the hive. During the day in hot weather, do not leave on a super containing no bees. Without bees, the combs might melt.

When opening hives and removing supers, be aware of the potential of bees to initiate robbing. To avoid robbing, do not keep hives open for extended periods of time. Always keep supers of honey covered, and do not expose combs, especially those not covered with bees.

Feeding Bees

Early spring and late fall are the most important times to watch for the need to feed. Bees are nearing starvation when no capped honey is in the hives. Bees should have 50 to 60 pounds of stores going into winter. If properly wintered, enough should be left to build the colony to full strength in time for the main nectar flow.

The honey crop will be small if bees are still building colony strength during the main nectar flow. This is due to the small workforce and the fact that they must spend most of their time gathering food just to maintain the brood. It takes one cell of honey and one of pollen to rear one bee, and the adults must eat too. Food should be provided if there is an imbalance between brood needs and available food.

There might be a tendency to overfeed bees too early in the spring or too late in the winter in an attempt to prepare them for nectar flow. Bees store syrup as if it were honey and may be stimulated to swarm even if there is not a natural source of nectar. To avoid this, feed bees only the amount they need when they need it. You will learn by experience to judge the condition of stores by hefting the hive. Assume a full deep frame weighs six pounds and full shallow frame weighs three pounds. Never allow stores to drop below 12 to 18 pounds.

The best bee food is ripe honey. Beekeepers often set aside dark, strong flavored, or other low-value honey to feed bees during emergencies. The honey is left in the frames and used to replace empty frames as needed. If you do not have honey reserves, make a syrup from equal volumes of pure cane sugar and water. Bring the water to a boil and remove from the heat. Stir in the sugar until it dissolves.

You can spread dry sugar on the inner cover during warm weather when the bees are flying freely. Make sure water is available when feeding dry sugar. Sugar candy can be used for emergency winter feeding and is made as follows. Add 12 pounds of sugar to a quart of boiling water. Stir well and let simmer for 15 minutes. Add a little salt and a teaspoon of cream of tartar. Let it partially cool, then stir vigorously and pour into dishes. After the candy is set, a dish may be put upside down over the frames holding the cluster.

Honey gathered in late fall might not be ripe and can cause problems for the bees. Wintering bees become loaded with indigestible material from this honey when they cannot get out of the hive to void themselves in flight. They become restless and die in the hive. Feeding 10 pounds of syrup to the colony before brood rearing stops in the fall can help.

No special equipment is needed to feed dry sugar, but put syrup in containers large enough to hold a good amount but not enough for the bees to drown. There are many types of syrup feeders. Some are designed to be placed in the hive; others are for use outside. Outside feeders might be inaccessible to bees during bad weather and can encourage robbing by attracting bees from other hives.

One of the best feeders is a five- or 10-pound friction top pail with about a dozen small nail holes punched near the center of the lid. A large screw top jar may be used as well. Place the feeder lid-down over the hole in the inner cover on the hive body. Place a super around the feeder and cover with the top lid.

Some beekeepers prefer to use a division board feeder. The size and shape of a deep frame, it is supported in the hive by top projections like a regular frame. The feeder sides are made of metal, plywood, or a similar material. It can be made watertight by coating the inside with melted paraffin. The top floats on the surface of the syrup allowing the bees to enter and feed without drowning. The feeder is hung at one side in the hive and may be left there permanently. If no feeder is available, fill an empty comb with syrup and hang it in the hive.

An adequate supply of pollen is essential for early spring brood rearing. At this time, natural pollen is scarce and poor weather can prevent pollen collection. This is the critical period for colony buildup so you might need to feed a pollen substitute. Make this by mixing one part brewer's yeast, two parts expeller-processed soybean flour, and three parts sugar syrup. Mix these to a paste-like consistency and shape into cakes to be placed over the brood area of the colony. Start with a small cake in late winter, and use larger portions as the brood area increases. Continue to feed freshly prepared pollen substitute until natural pollen becomes available. A pollen substitute may be purchased from supply dealers and is usually better than a homemade mixture.

Types of Honey Production and Packaging

Honey is classified according to its nectar source or the style in which it is sold. You might not have much control over the nectar source, which determines the honey's color and flavor. The three main styles, however, are determined by bee management practices and simply require some advanced planning. These styles are cut comb honey, extracted honey, and section honeycomb.

Cut comb honey is the easiest to produce and the cheapest to package and market. Simply cut chunks of honey-filled comb from the frames. Wrap individual pieces in plastic wrap and they are ready for gifts or sale. The price is not as good as for other styles, but there is usually a ready market. This style is recommended for the beginning beekeeper.

Extracted honey is the liquid after it has been removed from the comb. Professional extracting equipment is available but expensive. Small-scale beekeepers can do the job cheaply by crushing the combs and letting the honey run slowly through strainers. One method is to lay the comb on top of two or four thicknesses of cheesecloth on hardware cloth or hail screen. This is

placed over a dish pan or collecting dish. The hail screen supports the mass, and the cheesecloth does the straining. Do this when temperatures are near 90°F so the honey will flow. Specialty products such as honey butter and whipped honey are made from extracted honey.

Section comb honey is the most difficult. It is produced in special square basswood containers. There are four comb sections in a shallow frame. The bees draw out the comb and fill in the cells in these sections. In effect, they package the honey for you. The management technique for this style of honey encourages the bees to swarm and they usually do. A round section adapted for use in standard frames of foundation is now available and has some advantages over the conventional section comb equipment.

Moving Bees

Moving colonies is primarily the concern of migratory beekeepers, but you might need to move yours at some time. Relocating the hive can really upset the colony. Field bees from colonies moved distances less than a mile tend to return to the original location. Move hives far enough to put them into unfamiliar territory. While there is no exact minimum distance, two miles is usually sufficient.

The best time to move bees is about dusk, when most of the bees have returned to the hive. Any time on a cool rainy day is also a good time to move bees provided they are not flying.

Fasten together hive parts using hive staples, lath, steel, or plastic strapping a day or more in advance. In hot weather, use moving screens in place of regular hive covers. Moving screens are similar to inner covers that have had the thin-plywood center replaced with eight-mesh hardware cloth. Screen the entrance closed with a folded piece of window screen or eight-mesh hardware cloth.

When you are ready to load the hives, put on a veil and light a smoker. Smoke the hive entrance well and wait a minute or two before slipping in the entrance screen. Place the hives on the truck or trailer. Arrange them as close together as possible and/or tie them in place to reduce shifting en route. At the new location, put all the hives in place, smoke the entrances well, and remove the entrance screens immediately.

Uniting Colonies

Weak colonies produce little honey and are poor risks for winter. It is better to take your losses in fall rather than spring. Combine weak colonies with moderately strong colonies with good queens. Uniting two weak colonies does not produce one strong colony. Always examine the colonies for signs of disease before combining them. Kill any queen present in the weak colony. Then place the hive, with the bottom board removed, above a single sheet of newspaper over the top of the stronger colony. Punch a few small slits in the paper to make it easier for the bees to remove the paper. The bees should remove the paper with little fighting as the colonies are united.

Beekeeping Insect Note 15

Reducing the Likelihood of Stings During Outdoor Activities

Prepared by:
S. Bambara, Extension Specialist

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The advent of warm weather is the time for outdoor fun and yard work. Picnicking, swimming, golfing, tennis, gardening and lawn mowing are just a few of the activities people engage in when the weather is pleasant.

But no one likes to be stung by an insect and for the 3-5 percent of the population who are allergic to an insect sting, such an event could be life-threatening. There are only a few types of insects which cause most of the problems. With the proper knowledge and precautions, the likelihood of being stung can be greatly reduced.

Social wasps such as yellow jackets, hornets, and paper wasps can be very sensitive to vibrations and very defensive of their nests. These nests, made of "paper" can be located underground, hanging from trees, or under protected areas. Though the nests are started anew each spring, the populations of insects build to substantial numbers by mid-summer. These nests should be avoided or eradicated with an aerosol hornet and wasp pesticide if located in a troublesome area. These insects are generally not aggressive unless they or their nests are threatened.

Most types of bees are not highly defensive and mean no more harm than does a fly. Notably, however, are the social bees such as honey bees and bumble bees which can be quite defensive around a nest, but under other circumstances have no desire to sting.

During picnicking, hiking, or other activities, you may be at greater risk to be stung as you place yourself in greater proximity with insects. Avoiding nests, being aware, and remaining calm are your best strategies. To help avoid being stung, the following suggestions should be useful:

- When hiking, wear boots or proper footwear.

- Avoid perfume, cologne, hair spray, suntan lotion or other fragrances that might attract curious insects.
- Wear dull tan or white clothing which is not baggy and which could trap an insect inside.
- Standard repellants are not effective against stinging insects.
- When picnicking, keep all food covered except during mealtime (this applies to sweets and meats). Pay special attention to open soft drink containers and glasses to be sure there are no "visitors" on or in the vessel before you take a drink.
- Do not eat or rest too near trash bins. Food debris will be a major attraction to some of these insects, especially in autumn.
- If an insect lands on you or your food, do not become alarmed. They are only investigating or foraging. Blow or gently brush the insect away. DO NOT swat or wave at the insect. Slow movement is best.
- Scout out the area for nests or potential problems before you choose that "perfect" spot to picnic or rest.

NOTE: These insects are beneficial either as pollinators (bees) or in consuming other insects. Do not destroy them unnecessarily. They will not sting without cause. If you are stung, the best treatment is to remove the stinger (if present) and apply an ice pack. If you are allergic to a particular stinging insect, carry an epinephrine kit with you or have immediate access to one. See your doctor!

NCSBA Master Beekeeper Program, Certified Beekeeper Study Guide

The first thing an interested person should do when considering becoming a beekeeper is to buy a recommended book and READ IT.

The second thing and the third things are nearly simultaneous:

2. Take a beekeeping class from a local club or cooperative extension

3. Buy *{or you arrange to borrow}* your own protective clothing (suit, jacket, veil, gloves) so that you can go into an apiary with mentors, teachers, and experienced beekeepers to learn. You cannot expect these things to be provided for you; Nor should you expect the mentor to be liable for your discomfort or injury if you are not prepared. Often these things are provided on a one-time introduction basis; but following that it would be the responsibility of the perspective beekeeper to arrange to have.

Whether you choose to use this protective gear going forward on your own is up to you. In the meantime, the distraction of your not being properly protected from stings is an extreme disadvantage to the learning process.

The fourth thing a perspective beekeeper should do is to join and participate, as much as they can, in their local and state beekeeping associations. The ability to converse and observe more experienced beekeepers in a multitude of venues is invaluable experience. (club & members bee yards; public presentations; club meetings, mentors, etc.)

The Master Beekeeper Program offered by the NCSBA is also a valuable tool towards achieving both knowledge and pleasure from beekeeping.

The progression through the MBP levels provides a structure which encourages continuing education. Beekeeping is both an art and a science. To understand the science behind any endeavor will provide the tools necessary to be more successful. The more we understand why things 'work', the better we are able to help 'make them work'.

There are four levels of the NCSBA Master Beekeeper Program. Those are CERTIFIED BEEKEEPER, JOURNEYMAN BEEKEEPER, MASTER BEEKEEPER, and MASTER CRAFTSMAN. Each has their own requirements necessary for completion. (These can be found on the NCSBA website)

The first level is CERTIFIED BEEKEEPER.

There are TWO parts to achieving the CERTIFIED BEEKEEPER certificate from the North Carolina State Beekeepers' Association. The state association is certifying that you ARE a BEEKEEPER. To do this, the Certified Beekeeper Candidate must demonstrate both academic (book) knowledge AND apiary ability.

To complete this level, one must pass a WRITTEN EXAM of true/false and multiple choice

questions with a passing grade of 70%; AND must pass a PRACTICAL EXAM that is administered by a previously documented MBP participant (Certified, Journeyman, Master or Craftsman), and who is a current NCSBA member. There is a FOUR MONTH minimum beekeeping experience before the Practical Exam can be administered

.

To facilitate studying for the Written Exam, please review the following Certified Level Study Guide:

To facilitate preparing for the bee yard Practical Exam, please review the form (see link) that is used to administer/proctor this portion.

When you feel you are ready to take the exam, contact someone at your local club, OR contact a member of the MBP Committee.

CERTIFIED LEVEL WRITTEN EXAM STUDY GUIDE

NCSBA: (North Carolina State Beekeepers Association:

Since you are here in North Carolina, you should know about the state beekeeper's association. You should know:

- How long it has been in existence
- That it is the largest state beekeepers association in the USA
- That it is a resource for information and comradery that will benefit both your beekeeping experience and expertise - by offering many programs that encourage your involvement, enjoyment, and continued education.
- What the various programs and opportunities are within the organization and within N.C. (zoo, state fair, Master Beekeeper Program, Golden Achievement Program, Certified Honey Producer Program, annual judged contests for hive products and more)

HISTORY of BEEKEEPING and HIVE PRODUCTS:

- How long has man been harvesting honey (and other products) from honeybees?
- What are some of the various ways that they kept bees?
- What list of products is obtained from a bee hive?
- What are those products used for?
- What are some of the ways that man used bees and bee products in the past?
- What is the primary importance of the honey bee?
- What is Bee Space?
- Who is Rev. L.L. Langstroth, and what is he most known for?
- Who are Charles Dadant and A. I. Root?
- What inventions have modernized beekeeping?
- When did honeybees arrive in the Americas?
- What major events occurred in the US that regulated or changed methods of beekeeping?
- What major events occurred in N.C. that regulated or changed methods of beekeeping?

RACES Of BEES

- What are the various types of bees throughout the world?
- What are the races of bees that are kept and what are their characteristics?
- What makes an Africanized Bee different from the European (or "western") honey bee?
- What threats or difficulties do Africanized bees pose to the USA and NC?
- What can be done about Africanized honey bees? (NC response)

FORAGING and POLLINATION

- What is pollination?
- Be generally familiar with parts of a flower.
- How do bees differ from other insects in relation to pollination capabilities?
- What are the benefits of apiculture to agriculture?
- What crops are dependent on honey bees for pollination?
- What crops benefit from bee pollination, but do not require bees to set fruit?
- What crops do not require bees at all to pollinate?
- What are the differences between a hobbyist beekeeper; a sideliner; and a commercial operation?
- What do the commercial operations do throughout the year?

ANATOMY:

- What are the two sexes of honey bees in a colony?
- What are the two castes of honey bees in a colony?
- What is haploid?
- What is diploid? *(taught, but not tested)*
- What are the 4 stages of honey bee development?
    - How are they different from one another?
    - What is the purpose of each stage?
    - What is the length of development time for each individual type – by stage?
    - What are the different segments of the bee?
    - What primary structures (organs and glands) are located in each segment?
    - What are their functions?
- What are the different sensory structures of an adult bee?
- Know the primary functionality of the body parts and organs, and general location of: Circulatory system
- Respiratory system
- Digestive and excretory systems
- Reproductive system
- Sensory (how do bees see/hear/smell/taste/feel?)

DRONES:

- What is the sex of a drone bee?
- Are they haploid or diploid?
- What is the primary function of drone bees?
- How do they differ in appearance and function from the queen and the workers?
- What is a drone's development time?
- How long does a drone live?
- What happens to drones in the winter?
- Do drones feed themselves?
- Do drones make wax, bee bread, or honey?

WORKERS:

- What is the sex of the "worker bees" in a colony?
- Are workers haploid or diploid?
- How is the worker different from a queen?
- Do workers have ovaries?
- Can they lay eggs?
- What are the various tasks of the worker bee; and at what age do they generally perform these tasks?
- How long does a worker bee live? (in the summer?/ in the winter?)
- What do bees forage for outside of the hive?
- How do they transport what they forage upon?
- Where are foraged items stored within the hive?
- What changes, if any, do the bees make to the items they forage for?

QUEEN:

- What is the sex of the queen?
- Is a queen haploid or diploid?
- How does she differ in appearance from a drone or a worker bee?
- How is a queen produced?
- When does a colony produce a new queen, and why?
- What is a swarm cell?
- What is a Supercedure cell?
- Where, when, and why are they in the hive?
- How, where and when do bees mate?
- What is the approximate life length of a queen?
- Approximately how many eggs does a queen lay a day (during brood build-up)?

BROOD:

- What is meant by "brood"?
- Where is brood generally found in the hive?
- What does healthy larvae look like?
- What are the three stages of development prior to emerging as a young adult bee?
- How does a brood cell become capped?
- How does the covering of brood cells differ from the covering on honey or pollen appear?
    - Why?
    - Composition?
- What does brood eat?
- How?

GLANDS:

- Hypo pharyngeal, Nasanov, Wax and Sting Glands

The remainder of the glands likely should be taught, but the Certified Candidate is not tested on those

PHEROMONES

COMMUNICATION:

- Dancing / Piping /Pheromones *(taught but not tested)*

Bee Activity / colony as an organism

- What is meant by "superorganism"?
- How far do bees fly when foraging?
- Mating?
- How much forage area is necessary to support a colony of bees?
- Bee Nutrition: what does pollen provide?
- What does nectar provide?
- Does it take more effort of the workers to make honey or wax?
- What are the following bee activities?
- How do they impact hive management?
- What can a beekeeper do to minimize negative impacts?
- What is swarming?

- What is Supercedure?
- What is absconding?
- What is a laying worker?
- What is a drone-laying queen?
- What is robbing?
- What is drifting?
- Temperatures/Weather:
    - At what temperature do honey bees decline to leave the hive?
    - Fly?
    - What are the effects of sunny vs. cloudy days?
    - Wind or no wind?
    - Humidity?
    - Rain?
    - What are safe weather conditions to do a hive inspection?

HONEY BEE MANAGEMENT:

- Where do honey bees live in nature?
- What materials do they use to construct their hives?
- Why is honey comb built the way it is?
- Bee space / shape / location / composition
- Does one strong colony make more or less honey than two colonies each half the size? Why?
- You should have a general knowledge of making "splits", combining colonies, discouraging swarming, robbing, drifting, and absconding.

HIVE EQUIPMENT:

- What components are there in a modern hive?
- What is the purpose of each piece being considered for use?
- What standard protective clothing and tools might a beekeeper use?

SITE SELECTION: (including Good Neighbor practices, rules & regulations)

- What are some considerations when deciding where to place a bee yard?
- Which direction should the hive opening(s) face? Why?
- What are some unfavorable conditions to consider when placing a bee yard?
- How might a beekeeper overcome unfavorable conditions?
- What laws exist regarding keeping bees where you intend to place your apiary?

OBTAINING BEES:

- Where might you obtain bees from?
- Know NCDA&CS apiary inspection service agency – department of Plant Industry.
- Know NC "licensed to sell bees".
- Know the procedures to install a package of bees, with a new queen. Know how to introduce a new queen to an established colony.

HIVE MANIPULATION:

- Know how to light a smoker, and keep it lit for the duration of a normal hive inspection.
- What is the proper technique for opening a hive?

- What are some beekeeper procedures that minimize colony damage, defensiveness, and encourage colony well-being?
- What beekeeper behaviors should be avoided?
- How should frames be manipulated?
- Where should they be placed if removed from the hive?
- How should a hive be put back together?
- What can be done to minimize burr comb?

STINGING:

- Why do bees sting?
- What happens to the bee once it has stung?
- What should one do if stung in the bee yard?
    - If a bee gets inside a veil?
- Know how to remove a stinger.
- What reactions to bee sting are normal?
- What reactions to bee sting are life threatening?
- What should be done in response to a normal reaction?
    - a serious life-threatening reaction?

SEASONAL MANAGEMENT:

- What colony activities can be expected of the bees at the various times of year in your area?

SPRING:

- Inspection / Feeding / Equipment Manipulation, and why?
- Safe Weather Conditions for hive manipulation.
- Describe honey flow / 70 % "rule" / ratio of sugar to water in feeding/ pollen patties

SUMMER:

- Honey Harvesting, storage, and distribution
- How does one go about harvesting honey?
- How much honey, and when should it be extracted from the colony?
- Moisture content of honey. What happens if it is higher or lower than the recommended or legal requirements?
- What types of honey are there?
- How does the choice of type of honey effect the decision on what type of
- equipment to use on a hive?
- What cleanliness and food safety procedures should be incorporated in the extraction and 'bottling' of honey?
- Are there rules and regulations that govern this activity?
- What equipment might be used for extracting and 'bottling' honey?
- How does a mechanical extractor work?
- What is a honey gate?
- Concerning Labels:
    - Are there laws and regulations governing what is required on a label?
    - What are recommendations for labels?
        - Why do some honey labels state that it is unsafe to feed honey to infants?

- What should be done with any equipment or frames from which honey was extracted?

FALL:

- What is winter-prep?
- When should winter-prep activity be initiated?
- Treating bees for pests in the fall – how and why?
- Fall re-queening vs spring re-queening
- Fall brood build-up
- Equipment considerations
- Feeding bees (ratio of sugar to water)

WINTER:

- Clustering characteristics
- Ventilation requirement
- Protection from inclement weather
- Inspecting hives during winter

IPM: Integrated Pest Management

- Define it. How and why is it useful to beekeepers?
- Pesticide legalities of labels, and usage.

PESTS of the HONEY BEE

- (Varroa Mites, Tracheal Mites, Greater Wax Moth, Small Hive Beetle…and… Ants, Yellow Jackets, Mice, Bear, possibly others?)
- Know the various pests
- Know how to check for tolerable thresholds of pest infestation. Know the cause of the introduction to the colony of these pests Know the life cycle of the pests
- Know the symptoms of infestation by pests & the effect on the colony of bees. Know what can be done to eliminate, or reduce the presence and effect of pests.

DISEASES of the HONEY BEE

- (AFB, EFB, Nosema, Sacbrood, Chalkbrood, Deformed Wing Virus, Paralysis Virus) Know the various diseases.
- Be aware of what causes the various diseases
- Know the symptoms of the various diseases; when and where to look for them
- Know the effect the diseases have on the colony
- Know the treatment or beekeeping activity to eliminate, relieve, or prevent the diseases.

At the Certified Level of the MBP, it is expected that you will know of the possible treatments; but are not expected to know the chemical names and specific requirement or limitations of each treatment. Those aspects are applied to the expectations for Journeyman, and even more so for the Master Beekeeper levels. It is anticipated that you would seek advice from a mentor or other resource, in addition to knowing that it is a legal requirement to follow all label directions.

NON-DISEASE colony disorders

- Chilled Brood / Starvation / Pesticide Exposure

- Know how to recognize them, and what can be done to prevent, relieve, or remedy them.
- CCD – know the symptoms, what to do – who to contact, what the difference is from other bee activity (such as absconding)

RECOMMENDED REFERENCES:

Internet:

- The NCSBA website: www.ncbeekeepers.org
- The NCDA&CS website: (for apiary inspection, food handling information, pollinator programs; and pesticides)
- http://www.ncagr.gov/plantindustry/Plant/apiary/apiarymp.html
  http://www.ncagr.gov/fooddrug/ http://www.ncagr.gov/pollinators/index.htm
  http://www.ncagr.gov/SPCAP/pesticides/
- Scientific Beekeeping: www.scientificbeekeeping.org
- Or other Agriculture Departments of major Eastern U.S. Universities (ie: Cornell, Florida, Maryland)

BOOKS:

- Beekeeping for Dummies : Howland Blackiston: ISBN: 978-1-118-94546-9 (also as an –E – Book) First Lessons in Beekeeping: Keith Delaplane: ISBN: 978-0-915698-12-7
- Honey Bee Biology and Beekeeping: Dewey M. Caron (and Lawrence Connor) ISBN:978-1-878075-29-1
- The Hive and The Honey Bee: Dadant Publication (2010 printing) : ISBN: 0-91-915698-09-9
- The Hive and The Honey Bee: Dadant Publication (2015 revision): ISBN: 978-0-91-915698-16-5

PERIODICALS:

- American Bee Journal : Dadant Publishing
- Bee Culture: A. I. Root Publishing

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