4-H ADVANCED BEEKEEPING MANUAL

NAME_____ AGE_____

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CLUB NAME_____ LEADERS NAME_____

Florida Cooperative Extension Service / Institute of Food and Agricultural Sciences / University of Florida / John T. Woeste, Dean

4-H Advanced Beekeeping Manual

By

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ADVANCED BEEKEEPING PRE-TEST

1. What is the significance of the number twenty-one (21) to beekeepers?

2. What is division of labor in a honey bee colony based on?

3. What do worker honey bees use to make food for the developing larvae?

4. What is bee botany?

5. How can the beekeeper stimulate his colony of honey bees?

6. List five requirements honey bees need to help them survive the winter:

7. What important nectar- and pollen-producing plants occur near your bee yard?

8. Why does the most important inspection of a honey bee colony occur in the spring time?

9. What is swarming? How can it be prevented?

10. Name two different types of honey a beekeeper might produce:

Remember Sergeant Joe Friday? He was the taciturn Los Angeles policeman played by Jack Webb in the television program, Dragnet. His monotonous line was, "all we want are the facts". Once he got the facts, Sergeant Friday usually solved the crime.

In the basic 4-H beekeeping manual, you were provided with a lot of facts about bees and beekeeping. You'll get some more here. Mostly though, this booklet will deal with concepts. Beekeeping concepts are harder to fully understand than bee facts. In order to use the concepts wisely, you will have to think a little more and use information you learned in basic beekeeping, as well as your experiences manipulating bee colonies. Knowing about the concepts of beekeeping, though, will make you a much better beekeeper.

When finished with this booklet, you should be able to:

1. Tell the importance of the number twenty-one (21) to the beekeeper.
2. List the pollen- and nectar-producing plants in your area and the time they bloom.
3. Add supers
4. Prevent swarming
5. Prepare a colony for winter
6. Tell how division of labor works in a honey bee colony.

CONCEPTS: BASED ON FACTS

To see how concepts are developed from a knowledge of facts, let's find out some more about entomology. You already know entomology is the study of insects which have six legs and three body parts, and that they are cold-blooded creatures. But why is the biggest insect in the world less than a foot long? There are several possible answers. One might be because of their hard outer skeleton. As body size increases, so does weight. So, if insects got too big, their outer skeleton couldn't support the weight, and they'd collapse. Insects breathe directly through the skeleton, and each tiny cell in an insect's body must be provided with a small tube called a tracheole (branches of bigger tubes called trachea) to bring in air. It's possible for an insect to get so big that a point would be reached where this kind of breathing system wouldn't function. Really, we don't know exactly why insects don't get any bigger, but knowledge about size, weight and respiration in insects help us explain why most of them are small.

Insect Body Size:

1. Limited by weight because of exoskeleton
2. Limited by tracheal breathing system

How do concepts built on facts help a beekeeper? Why is it important, for example, for beekeepers to know about the twenty-one day development cycle of the worker honey bee? It's not because the writer of this book thought, "this is important", but because it designates the time limit a bee colony can develop a generation of bees in--something every good beekeeper always takes into consideration if he wants a good honey crop.

Here are some other concepts to be discussed in this booklet:

1. The growth of bee population based on pollen and nectar production by separate plants and at different times.
2. The swarming instinct and how it is prevented.
3. The supering of the hive, when and why.
4. The how and why of wintering honey bees.
5. The significance of the beekeeper's calendar.

First, though, a few more facts. Worker honey bees are the most numerous kind in a hive. Do you remember how many there usually are? And it's this population of worker bees that's responsible for gathering the nectar which determines the size of the beekeeper's honey crop. But not all workers forage.

DIVISION OF LABOR: MORE PRODUCTION PER WORKER

Are you familiar with Henry Ford? Although most people know him for his automobiles, he is much more recognized for developing the concept (There's that word again!) of the assembly line. He believed the best way to provide everyone with an automobile was to build them with specialized labor, where each person does one job well and quickly. If you visit a modern automobile plant, you're liable to see one person on the line put in place five bolts which another person will fasten with a wrench. This is the concept of division of labor. And each day we know the value of the assembly line and its division of labor. Most people either own or have access to an automobile because of it.

BEE DIVISION OF LABOR: DEPENDENT OF AGE

Honey bees never heard of Henry Ford. It doesn't make much difference though, because bees developed the idea of the assembly line using specialized labor way before Mr. Ford's time. Each worker bee has a specialized job in a colony. Usually, this is based on the age of the bee, but not always. Young bees are born or emerge from their cell (in how many days from being laid as an egg?) to begin life in the colony by doing housework--cleaning the six-sided cells of the comb.

Jobs of Worker Bees

Days	
1-2	cleaning cells
3,4,5	feeding older larvae
6,7	feeding younger larvae
6-10	processing nectar
14-16	secreting wax
16-20	constructing cells
20	orientation flying
20-40	foraging for nectar and pollen

Within a day or two, however, they graduate to nurse bees. They don't get a diploma, rather their body changes. Glands in the head begin to swell, allowing the bee to produce a large amount of white, milky substance called jelly or brood food. The brood food provides a lot of protein for the developing larvae. Do you remember the source of the bees' protein? The young bees eat pollen which is broken down by their bodies. The proteins from the pollen are then incorporated by the head glands into brood food.

As the brood food glands develop, the young bees begin to feed older larvae (those over three days old). We can only guess why this is true. Perhaps they don't have the experience yet to feed the younger, extremely delicate and fragile larvae? It is only later (4 to 6 days from emergence) they begin to feed younger larvae.

Also, about that time (6 to 10 days from emergence), the young bees graduate from being nurses to processing honey. They receive the watery nectar from foraging bees and begin the process of chemical change and water removal which finally turns this sweet solution from flowers into honey. The young bees may also branch out and do other duties at this time, like fanning to cool the hive or guarding the entrance from intruders.

The brood food glands then slowly begin to become reduced in size, for the bees no longer need to feed the larvae. That job is taken over by younger bees. Around 16 to 20 days from emergence, other glands develop and, if times are good, wax begins to be manufactured by the bee's body. The young wax-makers then hang together between the combs while the wax flows out of their bodies and hardens into delicate flakes or scales. These wax scales are then removed by the wax-maker and passed up the line to construction bees which put them in place, chewing and shaping them into cells of the honey comb. If remove a comb (when a lot of nectar is being brought into a colony) you may see long strands of wax-makers hanging onto each other by their legs.

By the time a worker bee reaches 20 days of age from emergence, she's usually had a varied life inside the hive. Now, though, she graduates, leaves the colony and begins orientation flights which will end in her becoming a forager bee. Orientation flights are sometimes called "play flights" by beekeepers. You're likely to see these on warm spring and summer mornings when a cloud of bees will exit the hive and hover in the air near the entrance, each bee flying in ever increasing circles farther and farther from the colony.

BEE MANAGEMENT BY THE BEEKEEPER

What does all the above mean to a beekeeper? It depends. If a beekeeper is rearing queens, he knows young bees are the only ones that can make enough food necessary to produce the well-fed larvae from which quality queens will develop, and he adjusts his beekeeping to get a large supply of young bees. A honey producer, on the other hand, is more interested in adult bees old enough to forage for nectar. Young bees will always be necessary he knows, but a majority of older workers out in the field when the blooms are producing nectar is what really counts to make a fine honey crop. So the honey producer may stimulate his bees by early feeding hoping to have a larger field force when plant nectar production begins.

BEE BOTANY

When we talk about bees, it's difficult not to talk about plants. Not all plants, but those few that are so important to honey bees. Have you heard of willow honey? Few persons have. When do willows bloom? Early spring is the time bees need a lot of pollen and nature has provided in her scheme of things plants blooming at that time that do produce much pollen. The willow is one. Can you name some other plants blooming this time of year that also produce pollen for bees? How about red maple?

Soon, though, pollen will not be in such great demand by the bees as their population begins to peak. Later, when there's a maximum population of foraging bees, other plants bloom which mostly produce nectar and the protein necessity of brood rearing is reduced. Citrus, blackberry, crimson clover, saw palmeto, tupelo and gallberry are just a few examples.

Usually a definite decline in bee population is observed during mid to late summer. Can you explain why? Fewer nectar- and pollen-producing plants bloom this time of year. Soon, however, in some areas, the population again begins to expand in response to flowers like goldenrod, smartweed, aster, melaleuca and summer farewell which produce nectar in the early fall. All this seems straightforward. Unfortunately, there's never any certainty about how and/or when nectar will be produced. Soil types, rainfall, and other local weather conditions as well as many other factors may combine to make one year poor and the next year good.

That doesn't mean to say there isn't a pattern to all this. There is--usually an orderly increase and decrease of the bee population through the year stimulated by the presence or absence of pollen and nectar-producing plants. It's up to the beekeeper to help the bees during times when this rhythm is interrupted. Rain, for example, can literally wash away nectar, or an early cold spell can cut short a valuable source of food before the bees have a chance to store it in their combs.

The beekeeper also has the ability to stimulate the bee colony. He can, and many do, feed the bees sugar syrup in anticipation of the nectar to come. That way a bigger population of foraging bees will be available at the time most of the nectar is being produced. Should he do this, however, the beekeeper then must be prepared to continue to feed the insects to keep them alive if the nectar for some reason isn't produced.

Let's now look at a visual summary of all these events. Attached is a beekeeper's calendar for a full year. Notice how the population of adult honey bees goes up and down. Compare this population rise and fall with the number of plants blooming at the usual time. Bloom time is shown in the middle of the page by solid black lines. Dotted black lines show possible blooming time. Are there any kinds of comparisons you can make? Generally, the population and bloom time operate as shown, but not always. The timing may be off anywhere from one to three weeks based on weather conditions and other factors. Maple, for example, usually blooms from mid January to mid February. But it can begin earlier or later.

Finally, the third portion of the calendar shows the possible manipulations by the beekeeper. Again these manipulations must be done depending on prevailing conditions.

Now, let's go through a beekeeping year while looking at the calendar. We will start with September. Why not January? Because the beekeeping year usually begins in autumn when the bees are put away for winter.

WINTERING

You already know insects are cold-blooded. So how do these creatures pass the winter? Most overwintering insects do so alone, sort of hibernating like bears. The honey bee is different, however, and because of its complex society, can overwinter as a colony. Basically, the bees ball up when the temperature drops. They create heat in this ball or cluster by flexing their flight muscles--much like our muscles create heat when we shiver. A layer of bees on the outside of the ball confines the heat produced within the ball.

Requirements for Winter

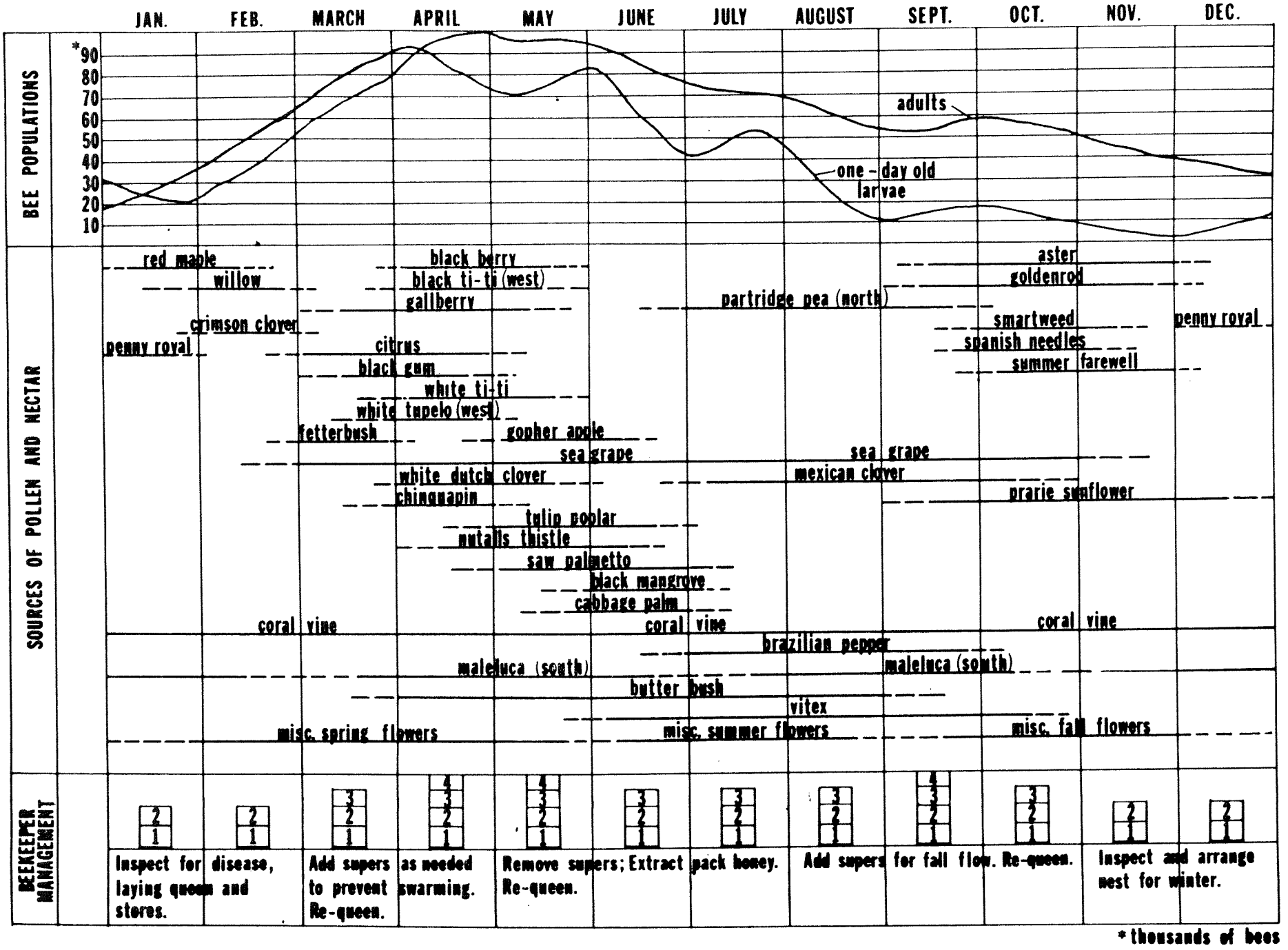
1. Necessary supplies
2. Adequate population
3. Good Queens
4. Hive protection
5. Ventilation

The bees are fine in this cluster all winter and will not freeze. In most of Florida, of course, it never gets that cold. But that's only if they have enough honey to eat to produce heat. This leads to one of the most important beekeeping rules: leave the bees plenty of honey for winter--most bees that die over winter don't freeze to death, they starve to death. Basically each colony should have: (1) necessary supplies of pollen and nectar; (2) adequate population size; (3) good queens; (4) hive protection; and (5) ventilation.

The usual rule is to provide a colony with 50 to 80 pounds of honey, three to four frames of pollen, a basketball-sized cluster of worker bees covering about seven frames, brood on five to six frames, a prolific queen, a north and/or northwest protective barrier such as a fence, hill or line of trees, and good upward ventilation provided by lifting the hive covers onequarter inch or so, or boring three quarter-inch holes in the brood chambers above the hand holds.

Even with all the necessary precautions taken in fall, a colony can die during winter. The winter may be warmer or colder than normal causing food consumption to increase and/or the bees to suffer more than suual, respectively. So it is important to take time to inspect the colony once-in-awhile during winter to see how the bees are progressing. On a warm day, you can open the colony to estimate its strength in bees and food. Some beekeepers simply gauge the weight of each hive by lifting it off the ground. Because bees are cold-blooded, the ball or cluster should never be disturbed at temperatures below fifty degrees!

BEEKEEPERS CALENDAR



*thousands of bees

Your most important inspection will be in spring (January-March). That's when the bees begin to produce brood. With brood production, the food supply is rapidly eaten. Remember the extreme food needs of a single larva which grows over 1,000 times its original size in just a few short days. If the weather is colder than normal and the first few flowers of spring don't appear on time, the bees could starve to death very easily. That's when you, the beekeeper, can come to their rescue by feeding sugar water, candy or even dry sugar in an emergency.

Notice on the calendar the first inspections are called for in January and February. Maples and willows are blooming at this time. Remember, they produce the pollen so necessary for young bees to develop. Adult bee population is also growing rapidly in March. That way many workers will be available to take advantage of citrus, blackberry, palmetto, gallberry and tupelo (west).

Supers are also added to provide more storage space for nectar which the bees will make honey from. Supers also give more room for the espanded bee population. This is important. If you have five brothers and sisters and live in a two bedroom house along with them and your parents, most likely the whole family will feed crowded. As a consequence, your parents may be looking for another larger house to put the family in. For the bees, it's the same. If they feel crowded--perhaps the beekeeper hasn't added any supers--they will make preparations to move.

SWARMING

Unlike your family, the whole bee colony will not move. Instead, the bees produce a new queen and then the old queen plus about half the workers and drones will leave all at once. This is called swarming, and the bees leaving the hive are called collectively, a swarm.

Many people in spring see a large clump of bees appear as if by magic on a nearby limb or on the house next door. This swarm frightens them because they've never seen so many bees at one time. Swarming bees, tough, are the least likely to sting. Have you ever been run off by a dog or seen one dog chase another? You may have noticed that as a dog leaves its yard to chase another, it becomes less committed the farther it gets away from home. The same is true for bees. With no home to defend, they usually are not in a stinging mood.

To see a swarm emerge from a hive on a warm morning is marvelously exciting, but beekeepers try everything possible to keep swarming from happening. That's because the bees leaving the hive are full of honey. When people move, large trucks filled with their belongings accompany them. The bees don't have any trucks, but they take as much with them in their honey stomachs as they can. To make matters worse for the beekeeper, the population left begind is fewer in number and less able to gather nectar to make a honey crop. This means that in many instances of swarming, a beekeeper's honey crop is seriously depleted or perhaps eliminated altogether.

Swarming cannot be eliminated in all bee colonies, just as giving birth cannot be totally controlled in human society. The urge to reproduce the species is extremely strong in all forms of life. The good

beekeeper, though, is the one who can prevent swarming as much as possible. The best way to do this is to add supers before the bees become crowded. Preventing swarming can usually be accomplished by adding supers gradually during March, April and May.

So one of the greatest challenges to the beekeeper is to plan ahead and add supers at the correct time to prevent swarming. When should you add supers? Usually, they are added one at a time when bees are covering all frames of the brood chamber and supers that may have been added before.

TAKING HONEY OFF

By June and July, most of the nectar-producing plants have stopped blooming. Now is the moment most beekeepers have been waiting for, to take off the honey supers. Nothing is quite so rewarding as the first bite of honey produced by your own bees.

Honey can be removed from a colony when about two-thirds of the combs are capped with wax. There are a number of ways to remove the honey. Generally, the method used is based on the size of the beekeeping operation. Very small beekeepers use a bee brush, brushing the bees from the combs one by one. They may also use a bee escape which can be found in many supply catalogs. As the operation increases in size, the beekeeper can resort to chemicals and/or bee blowers, specialized equipment found in most beekeeping supply catalogs.

Two kinds of honey can be produced by the beekeeper, extracted and comb. Extracted or liquid honey can only be economically removed from the comb by an extractor. Because of the expense of extractors, many beginners use thin comb honey foundation and simply cut the comb and honey from the frames, rather than attempting to save the wax. Foundation is put back into the frames for the bees to build on next season.

REQUEENING

Each year, another important decision must always be made by the beekeeper. Whether or not to replace the queen. Most beginners don't actively requeen colonies until they acquire experience in beekeeping. The bees also do a pretty good job of replacing queens on their own, this is called supersedure. Perhaps you decide to replace your bicycle. The new one you obtain supersedes older one.

There are many ideas about requeening and not all beekeepers agree on when or how to requeen. Many simply let the bees do it and leave it at that. Have your club ask an experienced beekeeper to come and explain why he requeens and how. There is only one basic requeening rule: the old queen must be removed before attempting to introduce a new one. Not doing this conflicts with the bees' own rule of only one queen to a colony, the present one the bees always seem to prefer, rather than any replacement the beekeeper wants to put in her place.

In August, according to the calendar, the bee population rises somewhat in response to Spanish needle, and other plants. The population, therefore, is prepared for the final blooming of the season, that of flat-topped goldenrod which in some areas is responsible for substantial nectar production.

BEE DISEASE

All colonies should also be inspected for disease at this time. Every beekeeper should be aware that diseases can infect his bees. Most states have a bee law. Check with your county extension agent or nearest representative of the state department of Agriculture to see what laws govern you and your bee club. Extensive discussions about diseases are presented in most beekeeping books.

Finally, the beekeeping year comes to a close in September and October. The surplus honey is removed and the colony is left with enough food to take it through winter. Entrance cleats are put in place to keep out wind draughts and the queen excluder has been removed. The beekeeper now takes stock of last year's success and failures and forms a new beekeeping plan which will begin with spring management next year.

The beekeeper always starts out each year with a new look at his operation. He knows that every year is not a good year and that he will make some mistakes. But he always learns from these and thereby becomes a better beekeeper. He also learns more about himself and life in general in the bargain.

A full discussion of all the concepts in beekeeping is impossible in this booklet. The following are some specialized information resources in beekeeping.

Honey: A Comprehensive Survey by Dr. Eva Crane, International Bee Research Association, London, England, 1979.

Some Important Questions in Bee Management by T.S.K. and M.P. Johansson, International Bee Research Association, London, England, 1978.

Bees: Their Vision and Chemical Senses and Language by Karl von Frisch, Janathan Cape Publications, 1968. First publishes in 1950 by Cornell University Press.

The Behavior and Social Life of Honeybees by C.R. Ribbands, Dover Publications London, 1964.

Insect Pollination of Cultivated Crop Plants by S.E. MacGregor, Agriculture Handbook No. 496, Agricultural Research Service, United States Department of Agriculture, 1976.

Beekeeping in the United States, Agriculture Handbook No. 335, Agricultural Research Service, United States Department of Agriculture, 1971.

Honey Bees Diseases, Pests and Predators, edited by Roger A. Morse, Cornell University Press, 1978

For those interested in basic bee research, several publications can be found in major university libraries which specialize in that area:

The Journal of Apicultural Research and Apicultural Abstracts are both published by the International Bee Research Association, Hill House, Gerrards Cross, BICKS., England SL 9 ONR.

Apiacta, Journal of the World Apiculture Association, Apimondia, Bucharest, Romania.

A BEEKEEPING DIARY

As an advanced beekeeper, you should now be keeping the records explained in the beginning 4-H manual: inventory, expenses and income.

In addition, for one year you have gained knowledge of bee botany in your area be recording what plants bloomed when and whether they provided honey and/or pollen to the bees.

Each year will be different, however, from the conditions you observed. Therefore keeping track of how conditions change each year will provide you with a much better overall picture of how your bee management is progressing.

Although much of this information will be recorded in your head, you can't possibly remember all for a number of colonies. That's why every beekeeper should keep a diary of events.

Basically a beekeeping diary consists of two parts: general observations and specifics regarding each colony. The following is suggested format for every colony eacy year.

Form 7420—Rev. 2/66

COLONY RECORD CARD—APICULTURE

Col. No. _____ _____ _____ _____ Combs from _____ 19____

Date to: _____ _____ _____ _____ Qn rank _____

	M. No.	Queen	From	Introd	Accept	Mark	Clipped	Remarks	Disposal
1									
2									
3									
4									

Date	Qn	Qn Cells		Brood					Str	Tmpr	Total Frms	Pos/Dbt	Remarks	By
		Sld	Open	e	l	p	Qlt	Qnt						

1. Col. No. is followed by four separate lines, each can be used should the colony change location during the year. Usually a letter is used to designate the beeyard, a number the colony. Date to: refers to the date the colony's location is changed.

2. Combs from indicates what colony the combs were in the previous year or whether they came from storage.

3. M. No. refers to the pedigree number of the queen. This is used in operations where controlled breeding and known parentage is important.

4. Qn -- indicates the queen is seen or not: e, l, p, refers to whether eggs, larvae or pupae are present--usually designated by a check mark; Qlt is the quality of brood--an estimate designated by excellent (E), fair (F), or poor (P); Qnt is the quality of brood in numbers of frames; Str is an estimate of the strength in frames of bees; and Tmpr is the temper--unusually aggressive bees are noted here.

Coupled with the above individual observations, you should also keep a general log. Examples of what might be indicated are: weather conditions, colony buildup data, blooming times of plants, and general colony conditions for each bee yard. Keeping this information for reference will make your beekeeping far more enjoyable and profitable.

Date	What Happened

I have supervised the work of this member and certify its completion and authenticity.

_____

Project Leader or Junior Leader

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4-H Pilot Project Evaluation Form

Because this is a pilot project, I would like to know how it can be changed to better help you and other 4-H'ers.

Please fill out this sheet at the end of your project year and mail it direct to:

Tom Sanford
Associate Professor of Entomology
202 Newell Hall
University of Florida
Gainesville, FL 32611

1. What I liked about this project: _____

2. What I did not like about this project: _____

3. Improvements I would like to see in the project: (Be specific: Include working, examples, and mark a book if possible and send with the suggestions.)

4. What do you plan to do next in 4-H? _____

5. Other comments: (Use back of page if needed) _____

_____
(If you desire, you may sign)

4-H PILOT PROJECT LEADER EVALUATION

Comments on this pilot project are solicited from club leaders. Please return to:

Dr. Tom Sanford
Associate Professor of Entomology
202 Newell Hall
University of Florida
Gainesville, FL 32611

1. Do you feel the text is clear and the directions understandable for the youngsters in your club?

2. Would you please note any additional ideas you might have for additional activities young beekeepers could do that are not mentioned in this publication.

3. What general improvements would be helpful in this publication?

4. Other comments:

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1. This document is 4HENM71 of the Florida 4-H Youth Development Program, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Reviewed June 2002. Please visit the EDIS website at http://edis.ifas.ufl.edu.

2. Malcom T. Sanford Publication contact: Nancy Johnson, 4-H Publication Coordinator, Department of Family, Youth and Community Sciences, Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville 32611.