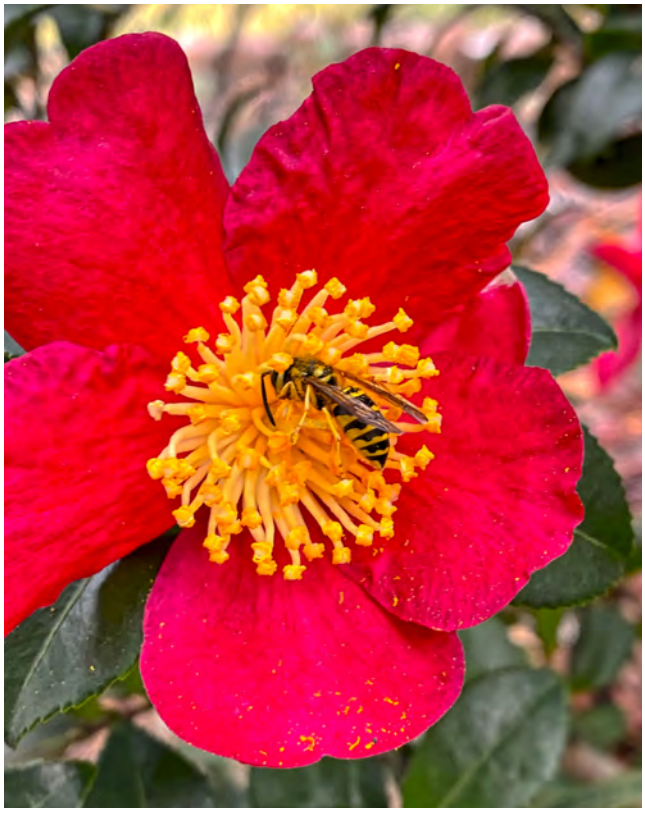
# BEGINNING BEEKEEPING COURSE

Green-Head Coneflower (*Rudbeckia laciniata*)

Honey bee foraging on Sweetleaf (*Stevia rebaudiana*)

September 2020 Hive Inspection



Yellow Jacket foraging on (*Camellia sasanqua*)

Late Fall removal of male bees on October 10, 2020

An Introductory Course on beekeeping presented by members of the Alamance County Beekeepers. This notebook is a collection of many articles and other information, selected, printed and assembled by the instructors.

2021

# Introduction to Beekeeping Section Overview

Welcome to the Alamance County Beekeeper's Beginning Beekeeing Course. We have selected nine aspects of beekeeping that will serve as the basis of the course. Although beekeeping is a topic that requires continual study, with the basic parts of this class you should be able to feel confident in getting and maintaining bees of your own and to know where to find resources to assist you should the need arise.

## Class Notes

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# History Timeline

Here's a look at some of the big moments in the history of American bees and beekeeping:

**1622** -- The first known record shows European bees being shipped to the American colonies, from England to Virginia. Wild, native American bees -- representing nearly half the world's 7,000 species -- don't live in hives or make significant quantities of honey.

**1800** -- By this time, European honey bees were widely distributed from the East Coast to the Mississippi.

**1850** -- By this time, European honey bees were found from coast to coast.

**1851** -- L. Lorenzo Langstroth observes the “bee space” making the use of removable frame hives feasible.

**1865** -- Franz Von Hruschka, an Austrian, invents the centrifugal honey extractor making large scale honey production possible. American companies such as Dadant and Sons and A.I. Root soon begin production of similar machines.

**1896** -- “Disappearing disease,” an undiagnosed ailment that causes the disappearance or death of honey bees, is noted in parts of the United States.

**1900s** -- European foulbrood disease strikes American colonies in the early part of the century, before disease-resistant stocks were introduced in the 20s.

**1922** -- Congress bans the importation of bees.

**1960s** -- “Disappearing disease” again strikes, this time in Texas and Louisiana.

**1984** -- Tracheal mites are found for the first time in Florida bee colonies.

**1987** -- Varroa mites are found in Florida bee colonies, causing death to some colonies in as little as seven months.

**1990** -- Africanized bees (aka "killer bees"), first brought to Brazil in 1952, reach the United States in Texas. As of 2007, they were found in nine Southern and Southwestern states.

**1990s** -- Widespread use of a popular antibiotic leads to resistant strains of American foulbrood disease, a particularly problematic bacterial infection. Varroa mites soon also develop resistance to a commonly used pesticide.

**2000** -- A Cornell University report estimates that the economic value of honey bees as pollinators is $15 billion.

**2003** -- Varroa mites that are resistant to approved pesticides become more and more common.

**2005** -- For the first time since 1922, honey bees are imported to replenish dwindling American populations. Some have estimated the population loss since the 1980s at 50% but the available data is not comprehensive.

**2006** -- A National Academy of Sciences report warns that continued declines in populations of North American pollinators, particularly European honey bees and native bumblebees, could threaten 75% of all flowering plants, including most food crops.

**2007** -- "Colony collapse disorder" is coined to describe an apparently new affliction striking bee colonies. Affected hives empty as bees fail to return after leaving to forage. Beekeepers in at least 35 states have reported significant losses of up to 90 percent, prompting government investigations, Congressional deliberations and widespread public concern.


**Note 3.01**
(Previously Note #1)

## BEES AND BEEKEEPING IN NORTH CAROLINA

**Who Keeps Bees?** Anybody can keep honey bees. In North Carolina, farmers, businessmen, homemakers, carpenters, children, doctors, university professors, and just about anyone else you can imagine keeps bees.

**Where Can Bees Be Kept?** Bees can be kept almost anywhere. There are beekeepers in deserts, small towns, in rural areas, in suburban areas, in large cities, and on beach front property. There is even at least one beekeeper in New York City who keeps several hives of bees on the roof of his penthouse apartment.

**What is a Bee Colony?** A bee colony is merely a large family of bees. It consists of one queen who is the mother of all of the other bees in the hive, between 15,000 - 50,000 worker bees and several hundred drones (male bees).

**How Popular is Beekeeping in North Carolina?** Beekeeping is a very popular hobby and interest seems to be on the increase. There are over 10,000 beekeepers in the state and about 1,200 of them belong to the N. C. State Beekeepers Association. In addition, the NCSBA has beekeeping chapters in most of the N. C. counties.

**Are There Beekeeping Education Programs in N.C.?** Yes, there are many programs such as regular courses on honey bees at N.C. State University, short courses offered at the annual NCBA conventions (twice a year) and at local NCSBA chapter (county) meetings, and of course the N.C. Master Beekeeper Program. The N.C. Master Beekeeper Program is the largest and most long-lived state master beekeeping educational program in the United States. The program is completely free of charge to N.C. residents and is sponsored by the N.C. State Beekeepers Association, N.C. State University (Extension Service), and the N.C. Dept. of Agriculture.

**What is the North Carolina State Insect?** The honey bee!

**Is North Carolina an Important Beekeeping State?** Definitely! North Carolina ranks in the top ten states based on its number of beehives. In addition, there are more beekeepers in North Carolina than any other state. The great majority of the state's beekeepers are hobby beekeepers with less than 10 hives of bees per beekeeper.

**Why Is Beekeeping Important in North Carolina?** In a typical year, North Carolina's beekeepers (with a little help from their bees) produce between 5 and 6 million pounds of honey with a value of approximately $10 million dollars. In addition, they also produce over 120,000 pounds of beeswax. But that is only part of the story. Honey bees also contribute another $70 million plus to the state's agricultural economy through the pollination of such crops as apples, blueberries, cucumbers and other vine crops.

**Does a Bee Sting Hurt?** Yes, but few things in life are free, not even honey. It is also important to note that a good beekeeper learns how to reduce the chances of being stung.

**What North Carolina Crops Really Benefit from Honey Bee Pollination?** Many of our fruit and vegetable crops such as apples, blueberries, cucumber, melons, pumpkins, squash, strawberries, and watermelons show increases in yield and quality from honey bee pollination. In addition, a sizeable portion of the diet of North Carolina's wildlife (birds, squirrels, bears, etc.) feed on bee pollinated plants.

**How Much Does it Cost to Get Started in Beekeeping?** The first hive of bees and the equipment to work the bees should cost about $175.00. Additional hives cost less because some of the equipment is interchangeable and reusable.

**What Are Some of the Ways to Earn Money from Honey Bees?**

- sale of honey
- sale of beeswax and beeswax products such as candles
- renting bee colonies for pollination
- sale of queen and package bees
- sale of specialty bee products such as pollen, bee venom and royal jelly

**How Much Money Can a Hobby Beekeeper Earn Per Colony of Bees?** In N. C. the average hobby beekeeper can expect to earn approximately $60-$80/colony from honey sales. This amount may fluctuate from year to year and the beekeeper may also earn income from other sources such as the sale of beeswax, pollination, etc.

**Where Can I Obtain Additional Information on Beekeeping?**

**Visit the NCSBA web site:** http://www.ncbeekeepers.org

**Visit the NCSU web site:** https://www.ncsuapiculture.net

Extension Apiculturist at N. C. State University (general information on beekeeping and beekeeping education programs)

Dr. David R. Tarpy, Extension Apiculturist
Campus Box 7613
N. C. State University
Raleigh, NC 27695-7613
Phone: (919) 515-1660

**Visit the NCDA web site: http://www.ncagr.gov/plantindustry/plant/apiary/index.htm**

NC Dept. of Agriculture (information on bee disease inspection services and state regulations on beekeeping):
Mr. Don Hopkins, Apiary Inspector Supervisor
N. C. Dept. of Agriculture
PO Box 27647
Raleigh, NC 27611


# THE VALUE OF HONEY BEES AS POLLINATORS IN N.C.

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%) (*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** (*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 Office, the North Carolina Department of Agriculture and Consumer Services, or visit the "**BeeLinked**" web site at:

http://www.ncagr.gov/plantindustry/beeboard/index.htm



NC STATE UNIVERSITY A&T STATE UNIVERSITY COOPERATIVE EXTENSION
*Helping People Put Knowledge to Work*

*Table 1*. The value of NC agriculture directly attributable to honey bee pollination.

| FRUITS AND VEGETABLES | Total Value of Production ($1000s of dollars) 2002 | 2003 | 2004 | 2005 | 2006 | D | P | Value attributable to honey bees ($1000s of dollars) 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 | 32,235.000 | 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 | 3,969.000 | 4,573.170 | 8,164.800 | 5,398.722 |
| ***Subtotal*** | ***148,209.440*** | ***147,634.250*** | ***140,058.920*** | ***146,313.920*** | ***168,747.280*** | | | ***93,074.957*** | ***98,360.200*** | ***90,724.622*** | ***92,088.442*** | ***108,178.832*** | ***96,485.411*** |
| ***(% of total value)*** | | | | | | | | ***62.8%*** | ***66.6%*** | ***64.8%*** | ***62.9%*** | ***64.1%*** | ***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 |
| ***Subtotal*** | ***414,262.000*** | ***745,143.000*** | ***632,863.000*** | ***739,315.000*** | ***724,876.000*** | | | ***42,869.770*** | ***77,897.480*** | ***63,504.700*** | ***132,606.690*** | ***129,880.220*** | ***89,351.772*** |
| ***(% of total value)*** | | | | | | | | ***10.3%*** | ***10.5%*** | ***10.0%*** | ***17.9%*** | ***17.9%*** | ***13.7%*** |
| ***TOTAL*** | ***562,471.440*** | ***892,777.250*** | ***772,921.920*** | ***885,628.920*** | ***893,623.280*** | | | ***135,944.727*** | ***176,257.680*** | ***154,229.322*** | ***224,695.132*** | ***238,059.052*** | ***185,837.183*** |
| ***(% of total value)*** | | | | | | | | ***24.2%*** | ***19.7%*** | ***20.0%*** | ***25.4%*** | ***26.6%*** | ***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 NC pollination in 2007.

| CROP | Recommended Hives/acre | Estimated Values for 2007 Acreage | No. 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*** |

**Note 3.02**
(Previously Note #1A)

# THE IMPORTANCE OF HONEY BEES IN NORTH CAROLINA

Honey bees are not native to the New World. They are immigrants, but they are an essential part of both our agricultural economy and the overall ecosystem including homeowners, wildlife, and anyone with an interest in nature.

Honey bees are important throughout the Americas and, in fact, throughout the world, but a brief description of their importance here in North Carolina may be more meaningful to the residents of this state.

## The Various Ways That Honey Bees Are Important in North Carolina

1. Honey -- Each year honey bees kept by beekeepers in North Carolina produce over $6 million worth of that delicious food. Some of the most popular honeys in the eastern United States are produced here, such as sourwood, black locust, tulip poplar and many others. Even though honey is a very popular food product, it is not the real reason for the importance of the honey bee.

2. Beeswax, Royal Jelly, Bee Pollen and Other Products of the Hive -- North Carolina beekeepers also produce a wide variety of bee products from the beehive with the aid of their honey bees. These products have a variety of uses such as beeswax for candles and cosmetics, royal jelly for cosmetics, bee pollen as a protein source, and more. These products are very popular as health foods and cosmetics, but they are not the main importance of honey bees in the state.

3. Pollination -- Pollination is defined as the transfer of pollen (the male portion of a flower) to the female portion which is then followed by fertilization and the production of fruit and/or seeds. Honey bees are undoubtedly the most important pollinators of food crops for humans and probably of food for wildlife in North Carolina and the entire nation. This is the main importance of honey bees.

   Without adequate insect pollination, many of the crops grown in North Carolina could not be produced on a commercial basis, and honey bees are the most important insect in the process of pollination.

In North Carolina there are many crops that require some insect pollination and the following crops could not be produced if we did not have honey bees available for this task: apples, cucumbers, squash, watermelons, many of the berry crops, and more.

Why Are Honey Bees So Important For Pollination? It is reasonable to ask, "Why can't other insects do the pollination work?" It is true that many other bees (non-honey bees), flies, and other insects also do some pollination when they visit flowers; but those insects cannot take the place of honey bees. Those other insects do not have the special features that honey bees possess:

Reasons Honey Bees Are So Effective in Pollination of Commercial Crops:

* A honey bee colony may consist of up to 60,000 individuals while most other insects are solitary or only have colonies of a few hundred individuals.
* Honey bee colonies have adult insects throughout the entire year while other insects exist for only a portion of the year as adults. Adults do most of the pollination.
* Honey bee colonies can be moved by beekeepers to any location in the state where bees are needed for pollination and this is not usually an option with other insects. (Bumble bees are an exception, but those colonies number only a few hundred individuals.)
* Honey bees are managed by beekeepers who have developed successful management practices based on thousands of years of mankind's experience with honey bees.

An Example of the Importance of Honey Bees -- Cucumbers:

North Carolina is one of the leading producers of cucumbers. Cucumbers require insect pollination to produce marketable fruit and the honey bee is the only insect that is a realistic pollinator for this commercial crop. Note the following:

Based on studies at North Carolina State University:

* Cucumber flowers that do not receive insect visitation do not set any fruit. They do not even set fruit that is culled or thrown away. NO BEES = NO FRUIT (Cucumbers)
* Cucumber flowers not only require insect visitation but each flower requires a large number of insect visits -- the average requirement is 12 insect visits to each flower (blossom) during a one day period. Only honey bees are available in adequate numbers to ensure good cucumber fruit set. A reduced number of bee visits will result in fruit that aborts or in fruit that is small and misshapen.

The importance of honey bees is not limited to just the commercial production of crops such as cucumbers. Honey bees are also important in the pollination of many fruits, vegetables and seeds in the home garden. If your vine crops have flowers but are not producing any fruit (vegetables), then the reason is probably that they are not being pollinated by insects such as honey bees.

Food for Wildlife -- In addition to being important in the pollination of commercial and backyard crops, honey bees are also important in the pollination and production of foodstuffs for wildlife. For example, up to 20 or 25% of a black bear's diet may come from berries, seeds, etc. that are insect pollinated. In addition, many birds feed on insect (honey bee) pollinated seeds, nuts, and berries. Of course, other insects also pollinate many of the foodstuffs for wildlife, but honey bees definitely play a major role.

A Recent Problem -- Honey bees have been important in the pollination of many plants grown in N.C., but recently there has been a serious problem. The accidental introduction of two mite pests into the Americas in recent years has drastically reduced the number of honey bee colonies throughout the Americas, in the U.S. and in North Carolina. We have lost over 1/3 of our managed bee colonies (bees kept by beekeepers) in the state within the last five years and the problem is ongoing. In addition, over 90% of the feral honey bee colonies (honey bees living in the wild) have also been destroyed by the mite pests. This reduction in honey bee numbers means fewer bees for pollination. Beekeepers, researchers and state regulators are all working to reduce the impact of the mite pests on honey bees, but in the meantime it is in everyone's interest to protect all of the remaining honey bee colonies that we have in both managed beehives and in the wild.

Prepared by: J.T. Ambrose, Extension Apiculturist - May 1997

APICULTURE PROGRAM
DEPARTMENT OF ENTOMOLOGY
NORTH CAROLINA STATE UNIVERSITY
Dedicated to the dissemination of information and understanding of honey bees and bee management
EXTENSION RESEARCH INSTRUCTION

# THE ROLE OF HONEY BEES IN APPLE POLLINATION

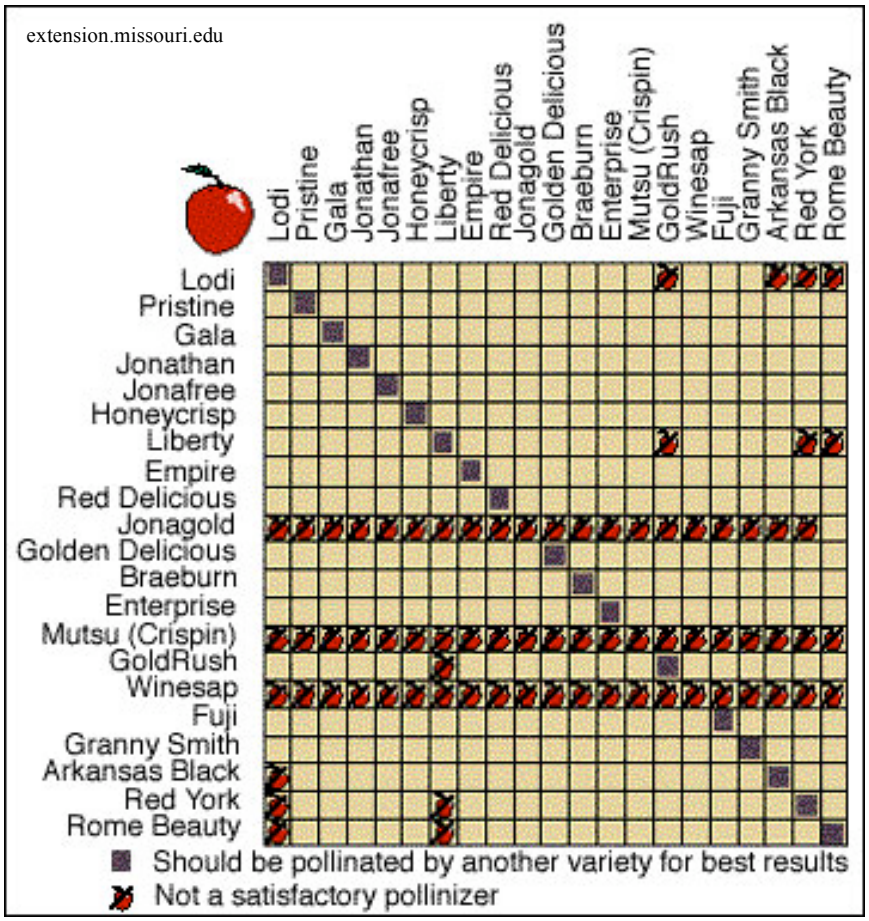
Honey bees, like other common agricultural plants and animals in the United States, are not native to North America but were imported from Europe in the early 17th century. Because of the ease by which honey bees are transported, they have become the primary insect pollinator used in agriculture. Honey bees are responsible for one-third of food people eat. In these days of agribusiness and corporate farms, our diet and the U.S. economic livelihood are dependent upon the pollination services provided by honey bees.

The apple tree is one of the most cultivated plants in the entire world with more than 7,500 known cultivars. The wild ancestral apple, *Malus sieversii*, is indigenous to the Tien Shan Mountains that border China and Kazakhstan, which is also part of the native range of the western honey bee, *Apis mellifera*. Around the same time colonists imported bees to the "new world", they also brought apple trees. The value of apples in the U.S. has been estimated at over $2.10 billion every year (Table 1.).

Pollination is the transfer of a plant's male reproductive cells (pollen) to the female reproductive structures of a flower (stigma). Because honey bees collect nectar and pollen from many flowering plants they are very effective pollinators. Apple flowers cannot self pollinate and therefore require cross pollination. This means they not only require a pollinator like the honey bee, but they also require a pollenizer (which could be either an apple or crabapple variety that produces viable and compatible pollen). Honey bees are the most important pollinators of apples in North America. In 2006, over 500,000 honey bee hives were needed to pollinate apple orchards.

## Pollination obstacles


There are many different factors that can result in poor pollination of apple trees. If the pollinator (bee) population is too small, the 'pollination threshold' will not be reached and there will be a lack of viable pollen transferred to receptive flowers. Good weather during flower bloom is also critical for optimal pollination. Honey bees tend to visit flowers in the morning. Any disturbance of early visitation times due to weather, spray schedules, mowing, or other management practices may significantly affect the pollination efforts of honey bees and other pollinators. The presence of pollen sources or compatible pollenizer varieties is crucial for the successful pollination of apple flowers. Below is a chart that lists apple varieties from earliest to latest bloom times, and the compatibility of varieties as pollinizers.



## Fertilization threshold


In order for complete fertilization to occur after pollination, 6-7 ovules must be fertilized by a sufficient number of pollen grains. If this threshold is not met, the results can be morphological and physical deformities in the fruit, a decrease in yield, smaller fruit size, and a reduction in the calcium content of the fruit (which can subsequently lead to storage problems).Moreover, if adequate fertilization is not achieved, the fruit may not remain on the tree until harvest.

## Colony strength

There are steps a grower can take when renting hives for pollination in order to ensure adequate pollination by honey bees. Colony strength is very important to ensure sufficient pollination. When the lid is removed from a beehive housing a strong colony, the bees should spill out—due to the large number of adult bees within the hive. Bees should cover 6 to 8 frames in a 10-frame hive, known as a 'cluster count'. Moreover, each frame should have sufficient amounts of brood and young larvae to guarantee an adequate future foraging population. As part of their duties, NCDA&CS Apiary Inspectors will perform this service upon request.

## Moving hives into the crop

To maximize their effectiveness as pollinators, it is important to consider when bees should be moved into the orchard. Moving hives into a crop during the night is less stressful on the bees, because they are not flying and the temperatures are generally cooler. To maximize the likelihood that the bees will forage on the apple flowers, and thus transfer pollen, it is a good idea to move hives into the apple orchard after roughly 5-10% of the apple flowers have blossomed. Removing all weeds and non-target plants is also imperative; avoid the competition for your target crop.

## Hive placement

Hive placement within the orchard is a very important factor to consider. It has been shown that bees prefer to forage within 300 ft of hive. Many different placement scenarios have been proposed depending upon the layout of the orchard, but it has been generally recommended that groups of 4-8 hives be placed at intervals of 500 ft. In order to allow the bees to take advantage

of the early morning bloom time, it is also important to place hives in sunlight—preferably with the front of the hive receiving morning sun to promote early foraging. Avoid cool, damp, and heavily littered or trafficked sites and places where a vehicle may become stuck.

**Number of hives per acre**

The optimal number of hives per acre for apples has been researched since the mid-1970's, and recommendations have ranged from 0.25 to 5 hives per acre. The scientific literature average is ***1.5 hives per acre***, and this is the recommended number for apple growers. However, different factors can affect the number of hives needed to ensure optimal pollination. The attractiveness of the crop has a large effect on the foraging activity of the pollinators. If the crop is not appealing to the pollinator, or if there is a more rewarding crop in bloom nearby, it may be necessary to increase the number hives per acre. Therefore, it is important to remove (if possible and legal) any non-target forage that may entice the bees from the apple blossoms, including flowering weed on the orchard floor. If it is not possible to remove these plants, then more hives may be needed to ensure that the apple blossoms are visited. The local population density of wild bees can also affect the number of hives necessary for pollination services. If there are few wild bees in the area, it may be important to increase the recommended number of hives per acre. On the other hand, if there is a thriving wild bee population, sufficient pollination may be achieved with fewer hives per acre, which can save the grower money.

**Chemical attractants and pesticides**

There are several chemical attractants available, most of which are composed of synthetic honey bee pheromones. These chemicals can stimulate increased bee visitation and recruitment, and in some cases they can promote the earlier onset of daily foraging activities. These compounds are particularly helpful to use when there are suboptimal pollination conditions. However, while these attractants may increase bee visitation, they may not necessarily increase pollination.

In agriculture, it is often necessary to use chemical insecticides and herbicides to remove unwanted pests and plants. Unfortunately, these chemicals can have adverse effects on the pollinator community, especially if they are applied while the target crop is in bloom. If chemical control is needed during the pollination period, there are a few things to consider so that the pollinator community is minimally impacted. First, do not spray during the flowering period if at all possible. This will help minimize the exposure of the pollinator to the potentially

harmful chemicals. Second, use chemicals with low bee toxicity, particularly those with short residual times and moderate to low $LD_{50}$ ratings as outlined on the chemical label. In general, granule and liquid formulations are safer than powder and dust applications. The granule and liquid formulations minimize drift onto non-target flowering plants. Finally, late-afternoon or evening application of chemicals is recommended to minimize the exposure of foraging bees to potentially harmful chemicals. The best approach is to anticipate and manage pest problems before bees are placed in the orchard. More information about pesticides and their effects on honey bees can be found in the North Carolina Agricultural Chemicals Manual <https://content.ces.ncsu.edu/north-carolina-agricultural-chemicals-manual>

**Renting a pollinator hive and setting up a pollination contract**

A 'pollination fee' is the cost to rent a hive of bees during the bloom of a particular crop. Pollination contracts are made between the grower and the beekeeper to help ensure that a sufficient number of bees are present in the crop during bloom. The national average pollination fee per hive for apples has been increasing in recent years. In 2004, the price per hive was $31, on average; in 2005, the average price jumped 7% to $37; and in 2006, the price was $40, up 17% in just two years. More recent data are not available at this time, but this upward trend is expected to continue. These increases were most likely caused by the shortage of beehives available, increased demand for almond pollination in California (where pollination fees can reach $150 per hive or more), and a declining population of managed honey bees. A link to a sample contract is located below photo.

**Conclusions**

The efficient use of honey bees for apple pollination can result in an increase in both fruit quantity and quality. In fact, one major complaint of some growers is that honey bees can set too much fruit and the crop must be thinned. While a heavy crop can be thinned, a light crop cannot be increased after the pollination period has ended. In the end, proper bee pollination will ensure adequate seed formation and reduce the incidence of deformed apples, which in turn results in better success for the grower.

https://agdev.anr.udel.edu/maarec/wp-content/uploads/2010/03/Pollination_Contract.pdf

## References

Bramlage, W.J. (2001). On the Origin of the Edible Apple. Fruit Notes Volume 66, Dept. Plant and Soil Sciences, University of Massachusetts. 2 pgs.

Delaplane, K.S. and D.F. Mayer (2000). Crop pollination by Bees. CABI Publishing, Cambridge. 344 pgs.

McGregor, S.E. (1976). Insect Pollination of Cultivated Crop Plants. Agricultural Handbook No. 495, USDA-ARS, U.S. Gov. Print, Office, Washington, DC. 411 pgs.

Morse, R.A. and 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 (http://www.nass.usda.gov/)

**Table 1.** Acres, yield, production, value and value attributable to honey bees for Apples, 2005-2006 in the entire U.S. (**A**) and North Carolina only (**B**). Data consolidated from the NASS and Morse & Calderone (2000).

**A**

| Apples (nation) | Acres harvested | Yield/acre | Production | Price/unit | Value | Value attributable to honey bees |
|---|---|---|---|---|---|---|
| **2005** | 379,560 thousand | 25,600 lbs. | 9,719,900 thousand lbs. | 0.18 / lb. | $ 1,680,747 | $ 1,512,672 |
| **2006** | 377,490 thousand | 26,700 lbs. | 10,072,100 thousand lbs. | 0.21 / lb. | $ 2,099,129 | $ 1,889,216 |

**B**

| Apples (NC) | Acres harvested | Yield/acre | Production | Price/unit | Value | Value attributable to honey bees |
|---|---|---|---|---|---|---|
| **2005** | 6,800 thousand | 19,100 lbs. | 130,000 thousand lbs. | 0.12 / lb. | $ 13,859 | $ 12, 473 |
| **2006** | 6,800 thousand | 25,900 lbs. | 176,000 thousand lbs. | 0.12 / lb. | $ 19,799 | $ 17,819 |

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NC State Apiculture Program


# THE NORTH CAROLINA MASTER BEEKEEPER PROGRAM

## *Background*

The N. C. Master Beekeeper Program (MBP) is the oldest, continuously active program of its kind in the country. Established in the fall of 1982, its purpose is to provide an infrastructure whereby beekeepers can improve their beekeeping skills and knowledge on a continuous basis within a system that objectively and formally acknowledges those accomplishments. It also serves as a means of providing valuable information to beekeepers and the public through various outreach services.

The MBP is a joint venture of the North Carolina State Beekeepers Association (NCSBA), the N. C. Department of Agriculture (NCDA), and the Apiculture and Cooperative Extension programs at the North Carolina State University (NCSU). Any resident of North Carolina with an interest in bees is invited to participate in the program, which is currently free of charge. Non-residents are also encouraged to take part, although no special arrangements will be made for testing or other programming outside of the state.

The MBP consists of four ascending levels of beekeeping expertise. The *Certified* level is the entry level of the program for participants with basic knowledge of honey bees and bee management. The *Journeyman* level are beekeepers with demonstrated competence in the craft. The *Master* level beekeeper should be able to function as a sideline or commercial beekeeper, if he or she desires, and have some expertise in several sub-specialties of apiculture. The *Master Craftsman* level is the highest attainable in the program, and is reserved only for those participants who have demonstrated excellence in teaching, public service, and honey bee management skills.

Each successive level requires that certain minimum criteria be met, which are summarized below.

| Level | Tests | | | Service and Experience | | |
|---|---|---|---|---|---|---|
| | Written | Practical | Oral | Beekeeping Experience | Public Service | Other |
| Certified | ✓ | ✓ | - | - | - | - |
| Journeyman | ✓ | ✓ | - | 2 years | 5 units | - |
| Master | ✓ | ✓ | - | 3 years | 10 units | 1 |
| Master Craftsman | ✓ | ✓ | ✓ | 2 years @ Master level | 15 units | 1, 2, 3 |

1 = Demonstrate expertise in sub-specialty; 2 = Present a program at an NCSBA annual meeting; 3 = Participate in an NCSU-sponsored research project

Becoming a participating member of the MBP requires knowledge of honey bees and beekeeping in three basic, interdependent subject areas.

1. Honey bee biology. Honey bees are living, breathing animals. Therefore it is critical that beekeepers obtain a fundamental understanding of honey bees as a biological system. This includes understanding their nest architecture, development, anatomy, genetics, behavior, ecology, and evolution. Understanding what bees do naturally facilitates their husbandry by working *with* them, rather than *against* them. Moreover, understanding their biology develops a deeper appreciation and admiration of the bees.

2. Honey bee management. Based on a thorough understanding of honey bee biology, a beekeeper may then effectively manipulate honey bees in a managed setting. Subjects include how to properly keep bees and what *not* to do. Hive construction, beekeeping equipment, and apiary establishment are also important areas of understanding. Treatment and prevention of the many diseases that afflict honey bees is also a significant management issue.

3. Honey bee industry. Managed honey bees in the US account for over $14 billion each year in pollination services and increased crop yields, and thus is a vital part of the agriculture industry in the country. Knowing the history of beekeeping, what crops require bees for cross pollination and fruit set, the honey market, and the uses of other hive products are important aspects of the apiculture industry.

The purpose of the program is to increase simultaneously the breadth and depth of knowledge within each of these areas, and to reflect that understanding back to other beekeepers and the public. Participants are objectively assessed and recognized for these valuable endeavors.

To enroll in this *free* program, or to gain more information on the N. C. MBP, call your local county extension agent, NCDA inspector, or visit one of the following web sites:

NCSBA: https://www.ncbeekeepers.org/programs/mbp

Apiculture Program at NCSU: https://www.ncsuapiculture.net

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# Resource Listing - Introduction to Beekeeping Section

## Books

*First Lessons in Beekeeping* - Keith S. Delaplane, ISBN: 0915698129
Introduces the prospective beekeeper to the basics of beekeeping through easy-to-understand text and numerous color photos on honey bee biology, beekeeping equipment, management, honey production and processing, as well as disease diagnosis and treatment.

*Backyard Beekeeping* - James E. Tew - https://www.aces.edu/pubs/docs/A/ANR-0135/ANR-0135.pdf
Backyard Beekeeping is a colorful, fact-filled introduction to all aspects of beekeeping. In a field where the abundance of information and instructions can be intimidating to the novice, this book puts information in an orderly form and aids the new beekeeper in developing hive management skills. It is also an appropriate review for the experienced beekeeper. **Free PDF Version**

*Robbing the Bees: A Biography of Honey* - Holley Bishop, ISBN: 0743250222
When former New York literary agent Bishop bought a Connecticut farmstead, she began keeping bees as a way of savoring her newfound reverence for nature in the edible form of fresh honey, a passion that now yields this engaging study of the history, science and art of beekeeping. She details the biology of the "always gracious, economical and neat" insects; explores the complex, pheromone-besotted hive society that yokes the proverbially busy insects to the tasks of comb building, nectar gathering and larvae nourishing; and eulogizes their stubborn, self-immolating defense of their honey against human pillagers. Tying it all together is a profile of salt-of-the-earth commercial beekeeper Donald Smiley, harvester of specialty honey gathered from tupelo tree blossoms in the drowsy hum of the Florida panhandle, and emblem of the fruitful alliance of two legs with six.

*Plan Bee: Everything You Ever Wanted to Know About the Hardest-Working Creatures on the Planet* - Susan Brackney, ISBN: 0399534962
Whether you're thinking of becoming a beekeeper yourself or you'd rather just admire honeybees from a distance, this whimsical guide to all things bee is filled with fascinating facts, inspiring insights, expert recipes, and all sorts of offbeat projects.

## Magazines/Newspapers

**American Bee Journal** • www.americanbeejournal.com • 217-847-3324
The American Bee Journal was established in 1861 by Samuel Wagner and has been published continuously since that time, except for a brief period during the Civil War. The Journal has the honor of being the oldest English language beekeeping publication in the world. Today, Dadant and Sons has the privilege of publishing the American Bee Journal for subscribers throughout the world. Readership is concentrated among hobby and commercial beekeepers, bee supply dealers, queen breeders, package-bee shippers, honey packers, and entomologists.

**Bee Culture** • www.beeculture.com • 800.289.7668
Bee Culture magazine has a long history, having been published continuously since the late 1800s by the A.I. Root Co. Originally it was entitled Gleanings in Bee Culture.

## Publishers/Distributors

**Wicwas Press**, Kalamazoo, MI • www.wicwas.com • 203-435-0238
Owned by Dr. Larry Connor, a beekeeper, author and speaker. Wicwas has a comprehensive collection of titles including some hard to find books.

## Beekeeping Supply Houses

**Betterbee**, Greenwich, NY • www.betterbee.com • 800-632-3379

**Brushy Mountain Bee Farm**, Moravian Falls, NC • www.brushymountainbeefarm.com • 800-233-7929

**Dadant and Sons, Inc**, Hamilton, IL (local Branch: Chatham, VA) • www.dadant.com • 800-220-8325 **Mann**

**Lake Supply**, Hackensack, MN • www.mannlakeltd.com • 800-880-7694

**Miller Bee Supply**, - North Wilkesboro, NC • www.millerbeesupply.com • 888-848-5184

**Rossman Apiaries**, Moultrie, GA • www.gabees.com • 800-333-7677

**Walter T. Kelley Co**., Clarkson, KY • www.kelleybees.com • 800-233-2899

Links to Local NC Beekeeping Supply

https://alamancebeekeepers.org/beekeeping-supply-companies/

## State Agencies

**Apiculture Program at NCSU** •https://www.ncsuapiculture.net

**NC Apiary Services** • http://www.ncagr.gov/plantindustry/plant/apiary/• 336-376-8250

## Beekeeping Associations

**North Carolina State Beekeepers Association** • www.ncbeekeepers.org
President 2011: Jeanne Price • 828-247-1640 • jeanne.price@gmail.com
With 2000+ members statewide and beyond our borders, NCSBA the largest and one of the most active state beekeeping organizations in the country.

**Eastern Apicultural Society of North America** • www.easternapiculture.org
President 2011: Everett Zurlinden • 401-885-5172 • president2011@easternapiculture.org
The Eastern Apicultural Society of North America, Inc. (EAS) is an international non-profit educational organization founded in 1955 for the promotion of bee culture, education of beekeepers, and excellence in bee research. EAS is the largest non-commercial beekeeping organization in the United States and one of the largest in the world.

## Online Resources

**Bee Source** • www.beesource.com
Information, articles, equipment plans and an active forum.

**Bush Farms** • www.bushfarms.com/bees.htm
Nebraska Beekeeper, Michael Bush, shares his experience and provides a lot of great information.

**Long Lane Honey Bee Farms** • www.honeybeesonline.com
Based in Fairmont, Illinois, professional beekeepers David and Sheri Burns sell bees, and equipment as well has maintain an educational blog.

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## Introduction to Beekeeping Class Review

Please rate the level with which you agree with the following statements:

| | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| This class was interesting and stimulated my interest in the subject matter | ○ | ○ | ○ | ○ | ○ |
| The instructor answers questions carefully and completely | ○ | ○ | ○ | ○ | ○ |
| The class materials reflected the subject matter | ○ | ○ | ○ | ○ | ○ |
| The quality of the visual aids were good and appropriate to the subject matter | ○ | ○ | ○ | ○ | ○ |
| I was able to follow along and keep up with the subject matter | ○ | ○ | ○ | ○ | ○ |
| This class met my expectations | ○ | ○ | ○ | ○ | ○ |

What did you like about this class?

What didn't you like about this class?

What topics should have been covered and were not?

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