

## 1. Activities

Late in winter a number of trees begin to produce pollen. As pollen begins to trickle into the hive, the queen begins to lay eggs. The rate will increase along with expanding nectar and pollen sources as well as with the colony's ability to keep the developing brood warm.

Pollen is stored with a layer of honey covering it. With honey for a seal the pollen will remain good for a year or longer.

When foragers and in-house workers swallow nectar, an enzyme (invertase) is added to it that cause its sugars to change form (sucrose to glucose and fructose). This substance is stored in cells, water is evaporated from it and when its moisture content drops below about 18% in-house workers will cap it. It is now considered 'ripened' honey.

Side view of two-box hive

When left to their own devices honey bees will put their house in order. Developing brood in the center, a layer of pollen and then stored honey.

**1.1 Temperature Regulation:** The temperature inside a bee hive is maintained at about 95°F. This is accomplished by a variety of mechanisms. Cluster size - In cold weather bees will form a tighter cluster. In winter they cluster in the middle of the hive, each bee facing headfirst into a cell. They are able to 'disconnect' their wings from the flying muscles and then activating those muscles makes them 'shiver'; generating heat.

During warmer weather bees will stand in the entrance of the hive and fan their wings causing air to circulate. Water foragers will deposit water droplets on the comb. The evaporating water will help reduce the internal hive temperature.

**1.2 Orientation:** New foraging workers will make their first flight in the immediate vicinity of the hive. They will often be seen in large numbers hovering just beyond the entrance. This behavior is often referred to as 'play flight'. The forager will continue to expand her orientation flights further and further from home. An experienced forager will have learned the shortest route to and from home. 'Making a beeline'

**1.3 Finding food (Dances):**In 1788 Spitzner described bee dances that communicated honeyflow and location of nectar sources. A returning forager 'performs' these dances on the comb within hive before a group of potential foragers.

His observations went unnoticed until Karl von Frisch published his observations in 1967. His work earned him a Nobel Prize in 1973.

In the 'round' dance (figure 1) the performing bee runs in narrow circles on the comb. She may periodically reverse directions. The dance excites many of the spectators who then leave the hive, presumably, to locate the nectar source. The 'round' dance is performed when the source of forage is located within 100 meters of the hive. It doesn't provide any directional information. The recruited foragers search in all directions from the hive. As sources of forage are located further and further from the hive the 'round' dance goes through several transitional stages until the refined 'waggle' or 'wag-tail' dance is performed (figure 6).

The 'waggle' dance gives both distance and directional information. The speed that the performer travels the 'straight runs' determines the distance from the hive. The faster the performer travels, the closer the forage source. Direction is determined by the angle of the straight run compared to directly vertical. Vertical represents the direction that the sun is located relative to the entrance of the hive. For example a straight run that is directly vertical (figure 1) indicates that the forage is in the same direction as the sun. A straight run directly downward (figure 2) indicates that the forage is in the opposite direction of the sun. A straight run that is 30° to the right of vertical (figure 3) indicates that the forage is 30° to the right of the sun.

As a performer dances a potential forager will 'beg' for a 'sample'. In this fashion, it is believed, the quality of the food is transmitted.

**1.4 Swarming:** An amazing event in nature. February to May. If the colony is vigorous and crowded new queen swarm cells will be made, eggs laid in them and nurse bees will begin feeding the larvae with 'Royal Jelly'. When the first of the new queens emerge, the old queen will leave the hive. About half of the workers will go with her. They will collect in a mass, often clinging to a branch or fence, near the old hive. Scout bees will search for a suitable new home. When one is located, the swarm bees will take flight and travel to the new location.

All they have brought to their new home is the honey in their stomachs. They must build comb to start producing new brood and to store honey and pollen to survive the upcoming winter. The odds are against them. In early studies it

was determined that swarm colonies in the wild survived the following winter only 25% of the time. For this reason swarms will rarely form after May.

Graph 1: Normal colony buildup, 2: Swarm colony buildup, 3: Diseased colony buildup

## 2. Installing a Package of Bees

- When package is received check to see that your bees have arrived in good condition Place the package into the hive where it is going to be installed (remove some frames to allow it to fit).
- Wait until late PM
- When ready to install, mix up a sugar syrup solution (1:1) and place it in a clean spray bottle. Spray bees through the screened sides until dampened...do not soak them
- Tap the package gently on the ground, so that the bees fall to the bottom
- Using a hive tool pry up the package cover board
- Remove the queen cage and feeding can - recover the opening
- Check the queen and make sure she is active
- Remove cork (or cover) from 'candy' end of queen cage
- Suspend cage between two frames making sure that screened sides are exposed
- Tap the package gently on the ground and remove the cover board
- Gently shake bees from package into the hive
- Put hive covers on
- If using a screened bottom, install the debris tray
- Place entrance reducer at hive entrance
- Place package with remaining bees at the hive entrance

## 3. Honey Bee Diseases and Non-Infectious Disorders

3.1 Feeding: Newly installed package bees should be fed 1:1 sugar/water for at least 6 to 8 weeks.

To overwinter a typical colony of bees will require 30 - 50lbs of honey. If their reserves aren't sufficient by early Fall, you should feed them heavily 2:1 sugar/water. Check again in late winter to be certain that they still have stored honey. Feed as needed.

- **Spring/Summer March - September**  
Pollen or pollen substitute in early Spring to 'jump start' brood buildup  
Sugar syrup at 1:1 - stimulates foraging  
1gal of hot water + 8lbs (16 cups) of sugar ≈ 1.5gal of 1:1 syrup  
High Fructose corn syrup
- **Fall/Winter October - February**  
Sugar syrup at 2:1 (sugar:water)  
1gal of boiling water + 16lbs (32 cups) of sugar ≈ 2 gal of 2:1 syrup

3.2 **Queen Problems:** Probably the most common problem of all  
Infertility - Excessive drone brood - often age related  
Inbreeding - Spotty brood  
Queen loss - Emergency supercedure cells  
Laying workers - multiple eggs per cell, drone brood only  
**Preventative - Replace queens annually**  
**Treatment - Replace queen**

#### 4. **Breeding a Better Bee**

- Hygienic Behavior - Bees can detect an abnormal cell of brood and remove it
- This is a heritable trait.
- Suppressed Mite Reproduction (SMR) - Variety of heritable traits specific to Varroa mite - Foundress fails to mate or dies, or her brood die or they fail to mate, or the foundress mates too late for her brood to develop. For example, it may be some form of aggressive grooming.
- Russian - From Eastern Russia -believed to have developed natural resistance, possibly hygienic or SMR traits, after intermingling with *A. cerna* early in the 20<sup>th</sup> century. First importation of honey bees into the US since the 1920s.
- Survivor - has no definition. Frequently a marketing phrase

#### 5. **The Label is the Law!**

##### 5.1 **Natural Ingredients: Safe and Effective**

- Thymol - extract from the herb Thyme. One of the active ingredients in Listerine mouthwash.
  - From the package label:  
*Harmful if swallowed, absorbed through skin, inhaled. Causes irreversible eye damage. Corrosive: Causes skin burns. Do not get into eyes, on skin or on clothing. Do not breathe dust or vapor. For*

*handling activities use a dust/mist filtering respirator. Wear protective eyewear (goggles or face shield) and chemical resistant gloves.*

- **Applicators and handlers must wear:**  
*Coveralls worn over long sleeve shirt*  
*Chemical resistant footwear and socks*  
*Waterproof gloves*  
*Protective eyewear*
- **Directions:**  
*To prevent the bees from gnawing the tablet, either enclose each piece in an envelope of screen wire or place the uncovered pieces above a sheet of metal screen that prevents the bees from contacting it.*

0.06% Thymol in Listerine mouthwash  
74% Thymol in ApiLife Var  
1200X

Note the hands of the person holding the ApiLife Var tablets

## 5.2 Varroa Mites: 1987 *Varroa destructor*

- Has resulted in the near extinction of feral colonies
- Small tick like animal that attaches itself to the body of the bee, pierces the body and sucks the bees' blood.

Natural parasite of *Apis cerana* (small Asian honey bee). Probably infested migratory colonies of *A. mellifera* that were being transported across Russia in the early 19<sup>th</sup> century.

Mated female hides in open brood cell, beneath bee larva. Once capped, she lays eggs (5-7) on bee larva. Hatched eggs feed on developing bee. First egg laid is male. Remainder are female. Male mates with sisters and then dies. When bee emerges, so do mature, mated female *Varroa*.

Currently found everywhere except Hawaii and Pitcairn Is.

Damaged wings, shortened life span, loss of colony vigor, eventual collapse - robust colony, untreated will collapse within 2 years!

### Treatment

- Apistan (fluvalinate, a pyrethroid - contact) for 45 days - Resistance occurred
- Checkmite (Coumophos - organophosphate - contact) for 42 days - Resistance occurred
- ApiLife Var (Thymol - essential oil - fumigant) 3 treatments @ 7 - 10 days intervals
- Apiguard (Thymol - essential oil - fumigant) 2 treatments @ 14 day interval
- MiteAway (Formic Acid - fumigant) 1 treatment
- Powdered sugar dusting - lodges in the mite's foot pad and they lose their grip. Use with a screened bottom board.
- Screened bottom boards
- Hygienic, SMR, VSH, Russian - resistant stock
- Small Cell?????

### 5.3 IPM

- When to treat
  - Economic Thresholds (ET)
  - Sticky board 'mite drop'
  - 60 to 190 mites during 24hr = 3300mites. 6600 is Economic Loss
- Rotate treatment - avoid pest's resistance
- Genetic resistance
  - Hygienic behavior
  - SMR - Suppressed Mite Reproduction
- 1990's First importation of queens since 1920's. USDA in Louisiana. From Eastern Russia - high degree of Varroa resistance - probably from early intermingling with *A. cerna*

### 5.4 Small Hive Beetle: 1998 *Athena tumida*

- Adult flies into the hive and lays eggs. Larvae are scavengers - omnivorous - they'll eat anything; honey, pollen and brood. SHB larvae leave the hive and pupate in the soil.
- Spoiled honey - larvae defecate - cause fermentation
- Locate hives in full sun
- Preventative - Hygienic behavior
- Treatment - Gardstar (Permethrin) soil treatment at front of hive
- Checkmite (Coumophos)
- Traps

## 6. Other Non-Infectious Disorders

### 6.1 Skunks, Bears and Mice:

- Skunk preventative - elevate hive entrance
- Mice preventative - elevate and/or reduce hive entrance
- Bear preventative - Electric fence

### 6.2 Pesticide Kills: Sudden loss of foragers or many dead bees in and around the hive

- Preventative - If pesticides are being used in the area, block the hive entrance to keep foragers from leaving the hive.
- Treatment - Feed remaining bees until colony strength is restored

### 6.3 Wax Moth: *Galleria mellonella*

- The larvae of this moth eat wax comb, leaving behind a silken tunnel full of droppings
- Causes damage to honey and brood comb
- Rarely a problem in strong colonies
- Preventative - maintain strong colonies
- Treatment for stored comb - Paradichlorobenzene (PDB or moth ball crystals)

### 6.4 Tracheal Mites: *Acarapis woodi*

- Brought about the 1922 US Honey Bee Act. Entered the US by 1984 from Mexico
- Small mites and their microscopic larvae live in the thoracic tracheae (breathing apparatus) of adult bees.
- Feed on hemolymph by piercing the walls of the tracheal tubes
- After mating must find newly emerged bee to complete life cycle
- Weakened or destroyed colonies (especially in North)
- At high infestation many workers cannot fly - damaged nerves - may walk away from hive
- Spread by drifting bees
- Need to send of samples via Extension Service to confirm infestation
- Preventative - Resistant stock
- Treatment - Menthol packets
- \*Oil/sugar 'extender patties' - mating disruptant
- Terramycin improves survival

## 7. Infectious Diseases of the Honey Bee

### 7.1 American Foulbrood: Bacterium - *Paenabacillus larvae*

- Spores ingested by larva- grow inside larva
- Larva die after cell is capped, then decomposes
- Brown, 'snotty', ropey brood cells
- Odor of decay, 'rotten egg' smell
- Preventative - Terramycin in Spring and Fall
- Treatment - Hygienic behavior, 'Tylosin'
- Burn the hive - the spores are nearly indestructible

### 7.2 European Foulbrood: Bacterium - *Melissococcus pluton*

- Usually mid to late Spring
- Larva ingests spores, germinate, multiplies internally in larvae, competes for nutrients
- Larva will consume more...sometimes nurse bees will evict heavy eaters
- Larva will die from starvation before the cell is capped
- Larvae appear to be yellow or brown, often in a twisted mass in cell
- Healthy capped brood cells are convex, diseased cell caps are concave
- Slight sour odor
- Often by the time the symptoms show, colony is already healing itself
- Preventative - Terramycin in Spring and Fall
- Treatment - Terramycin, Tylosin
- Let the colony heal itself
- Hygienic behavior

### 7.2 Chalkbrood: 1968 Fungi - *Ascosphaera apis*

- Larva ingest fungal spores, multiplies internally, robs nutrients, kills larva
- Dead larva covered in gray fungal spores, appears chalklike - called 'mummies'
- Not usually considered serious
- Preventative - Improve ventilation (screened bottom board), prop open cover
- Avoid placing hives in damp, low-lying areas
- Hygienic behavior
- Remove old frames
- Treatment - Place infected hives in sunny location

7.3 Nosema: Protozoan - *Nosema apis*

- Rarely a problem in the South
- Adult ingests spores, often from stagnant water, reproduce internally, damage epithelial cells of digestive system.
- Slow Spring buildup, bee fecal spots at front of hive (dysentery)
- Reduces the bees' lifespan
- Rarely kills a colony
- Preventative - Make fresh water available
- Treatment - Fumidil B w/sugar syrup