Beekeeping Instructor's Guide

Drone Bees

Fourth In A Series

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Introduction

In this session (or series of sessions, as you are able) examine with your class the role of the drone bee in the beehive. In your lecture/textbook section review the biology of drone production, reproduction and removal. When age-appropriate, discuss the mating behavior of drones, drone congregation areas and what happens during mating.

Then, if possible, go to the apiary to examine the stages of drone development. Find newly emerged drones and compare them with drones that are flying in and out of the hive. In the laboratory examine the large eyes and reproductive structure of the drones' body. If possible, collect semen and examine some under a high powered compound microscope.

A. Lecture-Textbook

Drone Metamorphosis

The male bees in a hive are called drones. They have few duties in the hive other than to mate with new queens that area hives produce. Drones have a 24 day development time, the longest of the bees. Drone brood is produced only when the colony is in a growth period, or if the queen has depleted her supply sperm stored in her body.

Drones past emergence feed themselves, first on pollen, and then on honey. This drone is on a honey frame and refueling on honey between mating flight attempts.

Drones are genetic envoys available to nearby virgin queens necessary to supply the diversity of sperm healthy colonies need for survival against diseases. Drones die when they mate. It is unusual for them to mate with queens from the same location – both queens and drones have behaviors that insure out-crossing and minimize inbreeding. This makes the small-scale beekeeper dependant on the drones produced in colonies within a mile or more radius. Drone saturation requires multiple nearby locations for success.

Healthy drone populations are necessary for genetically robust, disease resistant colonies. When maintaining a special line of bees it is necessary to have large colony numbers adequate to supply drones needed for the successful production of queens.

When the nectar flow is over, or when a colony is in stress, workers expel drones from the hive as a means of saving resources (pollen and nectar). Anytime there is stress in the hive, the workers will remove or 'trim' young drones and consume the protein and other foods in their body for colony survival.

Brood

The term brood (the immature stages of the colony) usually describes the worker brood, but there is usually drone brood included in the total population of brood during the Spring and Summer. These eggs, larvae and pupae are kept in a compact region of the hive called the brood nest or brood chamber. The bees keep his area at 95°F. to ensure rapid and healthy development of the young bees.

Drone Comb

Worker bees produce the beeswax honey comb during a nectar flow or when fed thin (1:1) sugar: water mixture. The bees are stimulated to secrete wax scale on the underside of their abdomens on eight wax plates. These wax scales are moved to the mouthparts and chewed with saliva and formed into beeswax comb. It takes eight to 12 pounds of honey to produce one pound of beeswax.

The bees use the comb to house brood (new bees) and for honey and pollen storage. There is a formal organization to these various components that every new beekeeper must learn and respect.

The Life of the Drone Bee

Drone bees in the hive develop from unfertilized eggs. They are essential for the mating of new queen bees, and are produced during the Spring and Summer of the year when the weather and food supplies support large bee populations. Healthy colonies of bees seldom have drones in the hive during the Winter since they consume food and cannot mate inside the hive. Large healthy hives will, sometimes, have many drones overwinter however, a sign of a strong colony.

Drones are a natural part of the hive, but they are produced by the colony only during natural mating weather. We do not find many drones in cold climates during the Winter or when there is no food coming into the hive. Drone populations peak when worker bee populations peak, about the same time as swarming. In strong colonies with abundant food reserves, drones are present for most of the Summer, but their production slowly declines as Summer begins. While Florida hives start drone production in January or early February, it is March or April for Michigan to produce drones. Usu-

ally drone rearing starts about six weeks before the first swarming activity.

Vigorous, healthy colonies produce about five percent of the colony population in drones at the peak of the queen replacement (swarming and supersedure) season that comes with the rapid growth and development of colonies in your local area. Swarming season moves North as Spring moves North, stimulated by growing day length, but primarily the abundance of food. By the Summer equinox the key stimulation of increasing day length slowly reverses, but drone rearing continues until September to November (depending on latitude). A strong incoming food supply will prolong drone production, or it may be done by early June if the pollen and nectar supply has already dried up. This happens in parts of Florida and Texas, as well as other areas of North America. There may be a second cycle of drone production in the late Summer and early Fall to coincide with local nectar flows, if they happen. When the incoming food is reduced or stops, worker bees become selective about the number (and age) of the drones they keep, even if they are their brothers. The colony rules!

Normal drone production is an indication of a healthy colony. It indicates that virgin queens in the area will be well served by your healthy and well-fed drones.

Using drones for mite control

Drones have been used extensively by beekeepers as a means of Integrated Pest Management (IPM) against *Varroa* mites. Instead of using miticides to kill *Varroa*, beekeepers remove sealed drone combs to reduce the reproductive upswing of *Varroa* populations. *Varroa* mites have a relatively low rate of increase on worker brood, perhaps a 10 to 20% increase with each brood cycle, so it takes several brood cycles to double the *Varroa* mite population without drone brood in the colony.

Bees instinctively build drone brood and if you add drone cells, *Varroa* mites will skyrocket in numbers. Drones have a three-day longer developmental time than workers. This gives more time for more mites to develop in each cell. In one cycle of *Varroa* growth, there may be two to five times more mites coming out of the cells than went into them as foundress mites. Doing the math: each 'foundress' mite will develop two to five daughter mites inside the sealed drone cell. No wonder *Varroa* mite population explodes so quickly.

As part of IPM, beekeepers remove and kill sealed drone brood by freezing it. After several days in the deep freezer the comb is thawed out and returned to the hive and the workers suck out the juices from the dead brood. Or you might scrape the sealed drone brood into a bucket and feed the slurry to the chickens or bury it as fertilizer on the garden.

For a large percentage of small-scale beekeepers, the integration of the drone comb with screened bottom boards offers two chemical-free opportunities to reduce mite populations, and all you had to do is kill a few thousand drones to do it!

Removing and killing drones goes against the colony's instinct. They NEED drones to mate with virgin queens. As a result colonies go out of their way to REPLACE removed drones. Each new queen requires 12 to 20 drones to mate with, and for every drone that successfully mates, there are probably five to 10 that never mate. There must be a very large number of drones in the air to mate with a queen during any mating flight. If you use drone comb removal or destruction and seriously reduce the number of suitors for area queens this suddenly takes on a sinister tone: A successfully mated queen must carry the sperm from the 12 to 20 drones for the remainder of her years and will NOT go back to mate again once she starts egg laying.

Due to the three-day longer developmental time than worker brood, drone brood is the favorite food of varroa mites that sneak into the cell just before sealing. One mite might produce two to five daughter mites!

Sex Determination

Honey bees share a sex determination mechanism with ants, wasps, hornets and other bees. Female individuals are created from a fertilized egg or ova, where the female releases stored sperm so the ova are fertilized. When the female does not release sperm, or for some reason fertilization does not take place, the unfertilized individual becomes a male, or drone.

The Genetics: The fertilized females have two sets of chromosomes, one from each parent, and are thus diploid. The unfertilized males only have one set of chromosomes and are haploid. Humans are diploid and have two sets of chromosomes.

Diploid - two set of chromosomes = female (worker or queen)

Haploid - one set of chromosomes = male (drone)

1. The queen controls the sex of each bee. She may not 'know' this, as evidence suggests that she acts only in response to stimuli. It has been shown that the queen measures the size of cells before she lays into them and this regulates her release of sperm. If she inspects a smaller worker cell she will release sperm, but when she inspects a drone-sized cell, she does not release sperm. The queen stores four to eight million sperm in her body after mating with 12 to 20 drones early in her adult life, before she starts egg laying.
2. When a queen does not have sperm in her body (or if she is sterile), she will only produce drone bees.
3. Drones do not have fathers, and carry only the genetic information of their mothers. This has important consequences in bee breeding programs. See *Bee Sex Essentials* for a thorough discussion of this subject.

One method beekeepers remove varroa mites is to place a medium frame into a deep hive body, and let the bees build drone comb at the bottom. The beekeeper then cuts off the sealed drone brood, and all the mites inside. This delays the need for chemical treatment in many colonies.

B. Apiary

Apiary Activities

Drones are suitable to give to small children and adults who want to handle a bee. They are often warm from the heat of the hive, and fuzzy to touch. They do not sting, but often defecate when picked up. We can have several activities with drones:

1. a. Marking drones and measuring drone drifting. Use a permanent art paint marker to put a dot of paint on the top (dorsal) surface of the drone's thorax, the section where the four wings and side legs are attached. To do this, remove drones from the honey supers of a hive, being careful not to pickup a worker! Drones have large eyes that touch at the middle of the head. Since the sting structure is a modified egg-laying device, no drones have a stinger, and are safe to handle.

b. Return the marked drones to the hive. On the following visit, put a queen excluder in front of this hive and the other hives in the apiary. During afternoon flight (calm, warm days from noon to 4 p.m.), watch for marked drones at the entrances of all the hives in the apiary. This shows how drones fly to different hives after they return from a mating attempt.

2. **How old is this drone?** Find a frame of drone brood where young drones are emerging from the cells. Look for drones that are still soft and downy. These are newly emerged drones. Be careful if you pick them up, as they defecate some really nasty stuff.

Next, go to a frame on the outside of the brood nest (usually the frame next to the outside frame of brood). There should be pollen-filled cells, where drones feed upon the pollen. Yes, drones can feed themselves! Carefully pick up some of these drones, they should be firm to the touch, and if they defecate, the material will not be quite so nasty.

Finally, go to frames of honey and look for drones there. If they are sexually mature they will fly away from you when you try to pick them up. Their bodies will be hard and any fecal material will be clear from all the honey they are eating for energy for mating flights.

C. Microscope Lab

In the lab take some of the sexually mature drones and learn how to ejaculate them to harvest semen. Put the tan or brown material on a microscope slide and examine it under a high powered compound microscope. The spermatazoa will be clumped but will be actively moving for several minutes until they die under the light and heat of the scope. Use you cell phone camera and take some photographs! BC

D. Discussion

What would happen to a colony that did not produce drones, and all the area colonies failed to produce drones? What would happen to area colonies. Can your students think of anything that would kill all the drones in all the hives?

New book is on its way: Bee-sentials: A Field Guide. *Check* ***www.wicwas.com*** *for details.*