The Traveling Beekeeper

Biology of Cell Production & Cell Starting

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In spite of some beekeeper's best hopes, queen bees have finite lives, although they are the longest lived of any individual in the superorganism we call the bee colony. As a result of their evolutionary history, honey bees have developed several strategies for queen replacement. Before we discuss queen cell production methods, we will review the conditions under which queen cells are produced in nature.

When a queen fails, the bees notice. There is considerable beekeeper and bee scientist debate about the reasons for failure and the mechanisms the bees use to detect it. The most widely accepted theory is linked to a reduction in pheromone production by the queen—when a vigorous queen starts to produce fewer chemicals that are part of queen pheromone, or queen substance. The bees stimulate the queen to start new queen cells. The most common reason for failure is due to the queen's increasing age and reduced egg laying. If a queen has been producing as many as 1,300-1,500 eggs per day and suddenly produces only 600, we would agree with the bees that it is time for the old queen to be replaced by *supersedure*. If a bee colony had an infinite life (even superorganisms eventually die), they would still need to systematically replace the old queen with a new queen in order to maintain colony population.

The second queen production strategy occurs when a colony grows strong enough to reproduce itself. Bee colonies, as superorganisms, reproduce the social unit by *swarming*, when part of the colony leaves with one queen and part stays behind with another.

Queen cells four days after grafting, with excellent coverage by the nurse bees. Note the cells are near the point of being sealed.

At times it is difficult to sort out supersedure queens from swarm queens because both are triggered by a reduction in the *concentration of queen pheromone per bee*. The colonies with a vigorous queen and many bees—conditions we associate with swarming—predictably have brood areas filled with eggs, larvae and pupae. Queen cell cups are often on the edge of the brood area, and for that reason the swarm cells are located on the edge or fringe of the brood nest. We find queen cups at the bottom and sides of the brood combs, and also where there has been a break in the comb (and between hive bodies) or constructed on a piece of burr comb.

If we follow the theory that reduced queen pheromone is responsible for new cell initiation, then the supersedure process is explained in the very same way, only now the colony is often weaker and has a reduced brood area. The queen lays eggs into those queen cups located within the brood nest resulting in supersedure on the face of the comb. There may be empty queens cups outside the brood area that are not used.

The third queen cell production mechanism results when a queen is accidentally killed or removed, and the bees use the *emergency* response to build cells. Over time colonies have been subjected to extensive predation by mammals, birds, other insects and humans. During these attacks the queen may be killed. When the queen is killed or

Student queen producer at a class in Texas. The bees are only covering the cells that first were accepted.

removed, the queen pheromone drops dramatically, so the cell production response is strong and immediate. Some estimate that colonies know that their queen is missing in as little as 15 minutes. Without the queen the worker bees select a large number of worker larvae and convert their worker cells into a queen cells. They feed the larvae with royal jelly throughout development. The chemical nature of royal jelly changes as the new queen larva matures and is fed by worker bees. This diet provides the biochemical triggers for development as a queen rather than a worker.

The emergency response gives each colony a survival strategy to keep itself alive by producing cells from suitably aged larvae remaining in the comb. In this behavior, many cells may be started, but relatively few are completed.

Cell Starting

When large numbers of young nurse bees are confined in a queenless state with abundant food and water, they will start a large number of queen cells and initially feed them very well. Because they are confined, they cannot sustain this intensity of feeding, so after the second day the number of viable cells drops. In this emergency environment, starter colonies are an excellent way to start a large number of cells, but not to finish them.

There are many ways to make cells in a beekeeping operation. For small quantities, beekeepers can remove the queen from a quality colony, and let the bees raise emergency cells in her absence. A modification of this method is to move open brood and bees above a screen or board with a new, rear entrance placed on the hive to let the queenless bees produce natural queen cells. Charles Mraz of Vermont used this method throughout his lifetime and felt it maintained genetic diversity. If a queen is a good brood producer and the colony is strong and healthy, move her with a frame or two of brood and worker bees to a new hive and let her establish a new colony. The queenless hive can then produce a new queen.

A Simple Starter Colony

To start queen cells we use the emergency response by removing the bees from the queen. In our system, we rely on the colony's biological urge to produce queens from the right-aged larvae we give the hive after the queen is removed. We introduce these suitable larvae to produce a new queen.

My most successful method of starting queen cells has been with a *closed cell starter* containing the following:

1. The young nurse bees shaken from one colony,
2. A frame of pollen and one of honey,
3. One or two drawn frames for cluster space, and
4. A sponge or towel soaked with water.

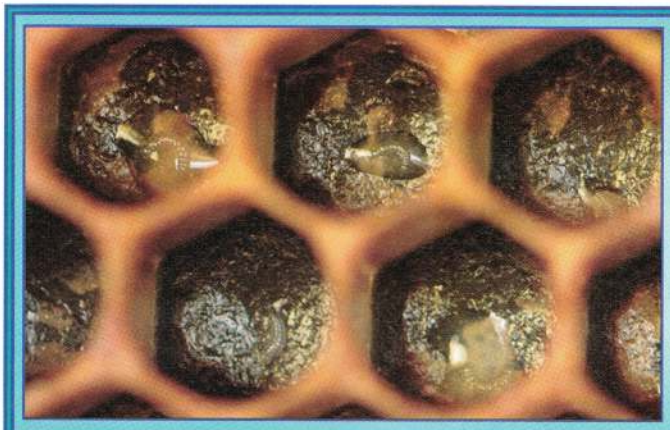
The easiest container for this starter box is a five-frame nucleus box with a screen on the bottom, and perhaps on the sides. It should be bee-tight and filled with nurse bees.

The Setup Process

This system was developed by Steve Taber and promoted by Marla Spivak and Gary Reuter in Minnesota. I have used it for over 25 years as a simple method to teach beekeepers how to raise queens. Are there other methods that work? Yes there are, and I have used many of them. However, this method is the most reliable I have found to

Worker bee feeding the larva in the queen cell cup. Note the abundant royal jelly filling the cup, a key to good queen rearing.

Good coverage from cells grafted by students at a Michigan queen rearing class. Note the smile!



What age larvae should you graft? The youngest possible. But newly hatched larvae have little royal jelly. A well-fed colony will have abundant royal jelly around the larva at 12 hrs or so.

Good cell coverage. These bees are doing a variety of duties: measuring and regulating temperature, secreting wax, forming the cell, secreting royal jelly and feeding the larva inside. Once sealed, they will keep the cell the proper temperature for good cell development, and monitor pheromone production by the maturing queen pupa.

teach others to produce cells.

The starter box is a four- or five-frame nucleus hive with window screen or hardware cloth fastened to the bottom and/or sides. This is placed on the rim of a bottom board, or two small boards, to provide ventilation. If the weather is below 45 degrees F. place it in a barn, garage or outside room to keep the bees from going into cluster. If the weather is hot, find a cool place to store the starter so the bees are not stressed.

Starter boxes can be made from a hive body you already own. I have used half of a double nuc box to establish a starter. One starter uses a cardboard nucleus box with window screen cut and taped to the sides. An eight- or ten-frame hive body (deep or medium) will work if a follower board (dummy frame), is used to confine the bees into a small area to maintain crowding and the temperature needed for cell production.

After the Graft

We will discuss the transfer (grafting) process later, but the starter colony is most often set up in the afternoon or evening, and the cell cups are placed into the starter colony following an hour or more of queenless confinement. One worker larva is moved—transferred or grafted—into each cell cup. The larvae were removed from a frame of worker brood produced by a breeder queen. The number of cells given to each starter colony will vary, according to the time of the year and the number of nurse bees. As you use this method, you will learn to estimate the ideal number of cells each starter can receive.

Because starters do a terrible job of finishing queen cells, move the started cells into a *cell finisher* the day *after* you graft. The starter is only used for 18 to 24 hours. If it has done its job, a large percentage of the cells you placed inside will have an expanded pool of royal jelly with the larvae floating on that jelly. In addition, the bees will have added beeswax to the edge of the grafting cell (either plastic or beeswax), creating a small cone of delicate beeswax.

If you use plastic cell cups, you will be able to look through them and see that there is a layer of royal jelly at the bottom of the accepted cells. Cells may be combined before being placed into the cell finisher.

Adapted from Dr. Connor's newest book *Queen Rearing Essentials*, which may be ordered at www.wicwas.com or at your bee supply dealer. He will be teaching three-day queen rearing programs in several locations this summer, including Connecticut and Michigan. Email him for details at LJConnor@aol.com or check the website.