The Traveling Beekeeper

The State of Queen Production

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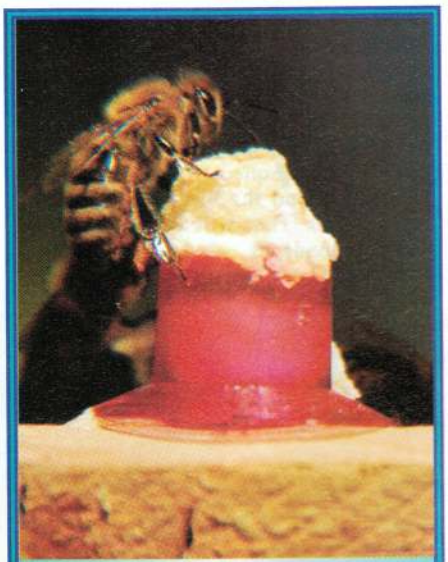
WHAT IS QUEEN REARING?

Understanding Supersisters

The honey bee colony is often described as a superorganism, one that is only able to reproduce through swarming. There are at least two important aspects of the nature of this superorganism. First, none of its individual components, the queen, the worker or the drone, are able to produce a new colony by themselves. In fact, they cannot survive very long without the support of the colony unit. Compare this to the overwintering bumble bee or yellow jacket wasp queen. In the spring they start a new colony by themselves. But if you put any solitary bee, of any type, in a container and hold it, it will eventually die when cut off from the full colony, the mother ship from which it came. A few hundred worker bees will attempt to develop some level of organization, and often will produce unfertilized eggs that result in drones, but eventually die for the lack of new worker bees. Queens and drones are the reproductives of the hive. The queen is also the chemical center and the egg-laying machine of the colony—two closely related functions. Alone they die. One queen and one drone, they die. One queen and a hundred drones, and they will die. It takes a critical mass of workers, and a queen bee in one of her forms, to create the superorganism. Only the drones are not immediately critical to the colony's survival, although they are the ultimately critical for colony reproduction and success within the ecosystem.

The second aspect of the superorganism is the natural instinct for a queen bee to mate with many drones. Researchers David Tarpy and Tom Seeley called the queen bee *curiously promiscuous* because the queen will, on average, mate with 13 drones, but a few mate with as many as 45 males. Then, amazingly, she is done with mating. Her sex life is over and she becomes the center of the colony. In evolutionary terms she is probably too valuable to the colony to risk her nonreturn after theoretical renewal matings. There are no annual vacation flings in the life of a queen—she is done mating—done with sex—when she starts to lay eggs. Her job is to lay eggs when and where the workers prepare cells, drone and worker, as colony physiology demands.



Queen cell about 48 hrs after grafting shows abundant royal jelly through the plastic cell cups. These cells may be shipped to other beekeepers and installed into nuclei or to increase colonies. If the bees complete the cells, the queen is likely to be accepted. If the cell is destroyed by the bees, the beekeeper can decide what to do weeks before the queen would not be found.

The consequence of the multiple matings is that as her daughters emerge, there is the development of sister workers who share the same father drone, and some worker bees may have the same father as the queen bee, since the queen herself started life as a worker bee egg. Once thought to be the center of power inside the hive, more recent thinking is that it is too risky for any one group of workers to so completely dominate the colony. Instead, colonies of bees have a shared management plan, by which certain groups of sister workers specialize in certain tasks, as influenced by the genetics of the father drone. At the same time each group can keep the colony alive and growing. One group may be very good at comb building, another is genetically programmed to remove diseased larvae, and the process we call hygienic cell cleaning. Others may be able to regulate the temperature of the brood nest, while others possess certain genetically influenced foraging behaviors. If you are in an area where clover is in bloom, it is good to have bees that are genetically adapted to forage on clover, instead of orange blossoms, which are not present in the area. Although all honey bees are general foragers, they all carry with them some plant preferences that have been wired into their genetic nature by the process of co-selection of bee and flower. This may be one advantage of locally adapted stocks, rather than bringing in bees foreign to the area. However, if the foreign bees carry other skills, like mite resistance, we expect them to feed at the local floral restaurants, grow and develop without protest. And, they will do that with success or die.

Queen Duplication

The duplication of the single queen in each colony is controlled by a complex set of interactive parameters determined by the strength of the colony and the physiological state of the queen. Strong colonies with vigorous queens are genetically programmed to swarm as the sole form of colony reproduction provided by nature. Average colonies generate one or two swarms each season—swarming more than twice increases the chance of excessively weakening the parent colony to the point that it will not survive the winter.

As part of the swarming process, the colony produces queen cells at the end of the brood nest. Since the colonies ready to swarm are usually large and fill the comb with brood, the swarm cells appear at the edge of the brood nest, often at the side and bottom of the comb. However, swarm cells may be produced anywhere on the comb.

Some feel that queen cells are produced at the edge of the comb because the queen spends less time at the edges of the broodnest, and deposits less queen pheromone there. I have observed the opposite: queens spend a lot of time searching for empty cells in the far reaches of the brood combs. I would suggest that queen cells are produced at the edges of frames because this is where the youngest larvae are found in a rapidly expanding spring colony, and thus is where the bees MUST build cells.

Not all queen rearing is related to the swarming process. When a queen is failing, exposed to miticides, diseased, or otherwise impaired, the colony often selects larvae 12 to 36 hrs old for the production of replacement queen cells, the location determined by position of the young larvae of the correct age. At times swarm cells are used to produce queens for swarming, and swarm cells are used by colonies for queen replacement. The use of cells appears to be very fluid. Not all queen cells are used. Some colonies produce queen cells and do not use them for either swarming or supersedure of the old queen. Accurately predicting what a colony will eventually do with some queen cells is at times next to impossible.

What is the history of queen rearing?

The early beekeepers employing Langstroth's movable frames explored many options of queen rearing. The most successful system was developed by G.M. Doolittle featuring the method of transferal of a young larva to a wax (now often plastic) queen cup and provided the beekeeper with control of the genetic nature of the queen. Doolittle imported breeder queens from Italy and other countries. He and A.I. Root were leaders in the replacement of the black race of honey bees with primarily Italian stocks, known for their gentleness, productivity, and larger food consumption.

What are the traditional problems with queen rearing?

Even Doolittle recognized there were problems with production of queens from the transferal method. As early as 1870 (long before many of our current issues like pesticide residues) he noticed queen failure during the middle of the buildup period in the middle of June. These queens were all found to be queens produced by queen rearing methods. At the same time the colonies headed by queens from natural swarms did not fail. These conditions mimic reports we hear today, that queens produced under the conditions of mass production are not as successful (in terms of acceptance, duration within the hive and egg-laying productivity) as supersedure and swarm queens.

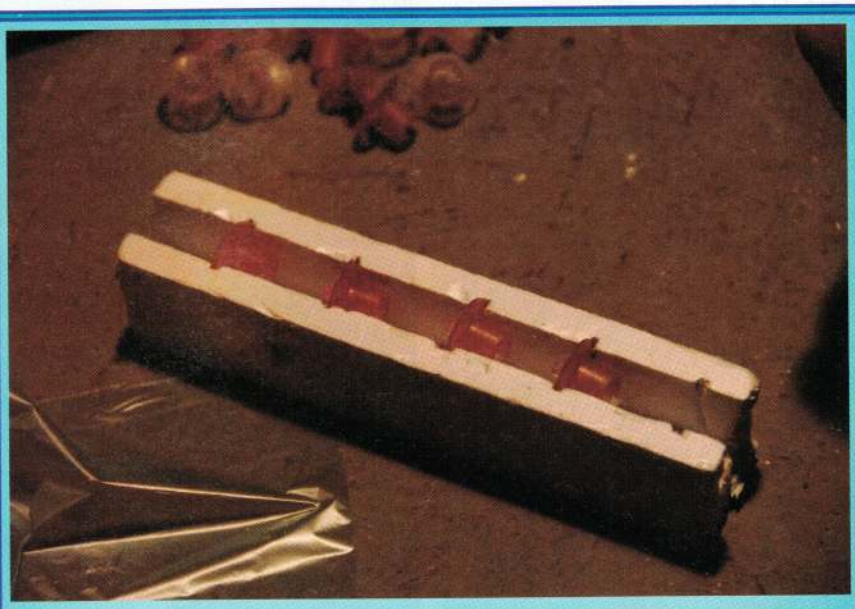
The production of new queens for package bees is not new, nor are the challenges present in this method of increasing colony numbers. Old USDA research reports from the 1930s report that a full third of all queens in package bees were replaced by the end of the first season. This problem of queen failure continues. General dissatisfaction with queen quality, as expressed by introduction success, short-term survival and longevity of the queen is the most common complaint I find in the industry. I have posed this question with beekeepers across North America and in Europe. In questioning these groups I find the satisfaction from purchased mated queens to be the lowest, and the use of personally reared queens from locally adapted stock to be the highest. This has helped me focus on the collection, selection and use of queens adapted for local conditions, and the local production of these queens. Time will tell if this system will pay dividends.

Return of Queen Production in Northern States and Canada

At a meeting I hosted in October in Comstock, Michigan, Vermont beekeeper and queen producer Mike Palmer reflected on his observations about the geography of queen production in the United States. Old bee journal advertisements reflected the northern source for all queens about 100 years ago. After World War II the majority of queen production had moved to southern states, in large part to fill the need for very early queen production. Now there are more northern queen producers in 2009 than there were ten years ago, but they are all small is size and are not producing so many queens as to advertise for their sale. The wonderful network of beekeeping is such that there are phone calls for queens, queen cells and even virgin queens if there is even a hint of their production!

The Northern Nucleus

In November I co-hosted the third Southern New England Beekeeper's Assembly in Hamden, Connecticut. When I asked for a show of hands, about half of the audience said that they are overwintering nucleus-sized hives this winter. This is a dramatic change; lead in part by Mike Palmer (who spoke at the first SNEBA meeting three years ago) and by Kirk Webster, who was a speaker in November. Webster has written about this idea extensively in the *American Bee Journal*. The use of summer-produced nucleus hives requires summer-reared queens, and many (certainly not all) of these beekeepers are using queens they produce themselves, or allow the bees to produce through the emergency instinct found in queenless colonies, resulting in cell production behavior.



Transport holder for 48 hr queen cells. These are placed into plastic bags to maintain humidity, and care is used to prevent over heating or chilling.

A Global View

Also in November, I spoke to ANERCEA, the French queen producer and bee breeder's organization, meeting in Viviers. It was an exciting meeting to attend, and I have just started to mentally process all of the information I took in at the meeting in conversations, and from the tours of beekeeping operations in southern France during the visit. From this visit I want to share two initial findings:

1. Beekeepers use two-day-old queen cells to requeen colonies, and especially to increase hives. Two days after grafting using the Doolittle transferal method of a 12-24 hr old larvae into a queen cell, if the larvae is accepted by the bees, the larvae will be floating on a bed of royal jelly, but will not be so large that it can wiggle out of the cell. French beekeepers like John Kefuss and Maria Bolt, based outside of Toulouse, France, are using and selling queen cells 48hrs after grafting. They discovered this method from Eastern Europe, and it has one huge advantage for the beekeeper. IF the queen cell is accepted by the new colony, the cell production is finished by the colony, removing considerable doubt about queen cell fate. This allows the beekeeper to carefully inspect the mating colony to see if the cell is sealed. If so, the bees have accepted the queen-to-be. If not, the cell will be torn down and will be empty. The beekeeper can then add another cell, after carefully checking the combs for queen cells.

Using the JZ-BZ plastic cells cups with a wide base, Kefuss cuts strips of stiff insulation material to securely hold these 48-hr old cells, transport them and ship them to other beekeepers. While older queen larvae will wiggle out of their cell, this age of larvae do not. Selling for three or four Euros each, these cells are lower cost for the beekeeper, and they are less expensive to produce for the queen breeder. The beekeeper is essentially selling genetic material in a highly usable state. The cells in the insulation strips (cut on a table saw from solid sheets of insulation material purchased at the home stores), are placed into plastic bags to keep them from drying out. Also, the cells are carefully carried so they are not too warm or too cold, but no effort is made to keep them at 90-95 degrees F. I suspect the risk to the larvae is not cold but excess drying.

2. John Kefuss and I have been friends since the 1970s, and in 1979 he spent several months with me in Labelle, Florida when I operated Genetic Systems, Inc. His nagging and cheerleading were factors in my writing *Bee Sex Essentials*. I have always liked John because he constantly challenged my thinking. Or lack of thinking. For this entire time John has been dealing with beekeeping changes in Southern France, including two parasitic mites. He refers to his breeding program as the James Bond system, 007; *Live or let die*. He has not treated his colonies for 10 years and has now developed a set of genetic families that are able to produce successfully without miticides. Like many survivor stock breeders, he took a huge hit in the early years, dropping from about 1,000 colonies to a few hundred on good years. But, the stock is now productive and vigorous. He checks the bees every year by doing mite counts by pulling out larvae and checking for mites. He has found that he not only has low mite levels in these samples, but also low reproductive rates as expressed in terms of new female mites in the cells. While he may be selecting for hygienic behavior, Kefuss feels he is also selecting for other resistance and tolerance mechanisms that have not yet been described.

What I describe next is a reflection of our global economy. For me to import stock from France would require serious quarantine procedures as used to bring in the Russian stock and more recently for Sue Cobey's introduction of Carniolian stock from Europe. They have similar procedures in Australia, and breeder queens from John Kefuss' stock in France have been imported into Australia and are being used as breeder queens to produce the queens that will be shipped to California in packages. If I were to purchase packages from Australia, I would want to have some of the Kefuss stock from France to see how they do under my conditions. Remember, these bees will be 50% pure Kefuss stock at first. This is the first step in what I see as a truly international bee breeding plan.

Larry Connor will conduct the Serious Sideliner Symposium at the Reno meeting of the American Beekeeping Federation in January. After his visit to France he is thinking of renaming the group the Semi-Professional Beekeepers Symposium.