'Bout a 100 – Sideline Beekeeping

SIZE MATTERS

How Important Is The Size Of The Queen?

Larry Connor

He was a soft-spoken gentleman serious in his intention of setting me straight. I had been discussing the importance of size of the queen to a group of beekeepers, and after he quietly challenged my thesis that big queens are good for the colony.

This happened a long time ago, and I don't recall where or the circumstances of the conversation, just the intensity of this man, himself of diminutive stature, who nonetheless appeared to be able to out-work and out-argue even the best.

The easiest thing to do with beekeepers like this is to immediately agree with their arguments, regardless of the content, and then try to swing them around to your point of view. His statement was simple and direct: Small queens are very good.

So I agreed with him, hoping that somewhere there really are small queens that produce quality hives and a good honey crop. That there are undoubtedly racial or genetic lines that produce variability in size, so if one wanted to use that stock, the queen may be smaller than what we ordinarily used.

I stood my ground that it was important to produce and use the largest queen that that genetic line could provide; that larger queens are superior to smaller queens, and last longer in the colony before being superseded.

Then he explained that he lets bees in nucs raise their own queens. The bees in the nucs came from strong colonies, he argued, and thus the queen they would produce would also be good.

Indiana beekeeper Ross Hunter shows off queen cells he grafted that were in the starter colony overnight. All the cells he grafted had royal jelly in the cells, along with the larvae.

I thought I had him. While the stock might be very good, the fact that a small group of bees, with perhaps just 10 or 20 percent of the population of the full colony, was responsible for raising the queen. How can that queen be equal to a queen produced in a full sized colony, I argued?

They were raised by bees from a good colony, he countered. We were at a stalemate when someone interrupted our conversation and it was over. We had both started repeating our major points.

This gentleman did not change my opinion about queen size, but he did make me think about the role of smaller queens in bee colonies and in beekeeping operations. If everything has a time and a place, there must be a role for small queens as well.

Years later, I am still looking for that role.

That size thing . . .

Queen size is determined by nature and nurture. The genetics of the queen's parent lines (mother queen and father drone) are critical to the final size of a queen. Add to this the conditions prior to and under which the queen is produced: number of bees in the colony, overall food supply, status of the nectar flow, ratio of nurse bees to house bees, stores of food, amount of food coming into the hive, and its exposure to pesticide, disease and mites. The list goes on an on; topics that will make most beekeepers pull out their hair.

Research has shown that the largest queens are produced by colonies with excellent food reserves that select the right-aged larvae for the initial queen cells. Most of the queen stock available in North America features large queens. It is their nature to be large. There are a number of advantages to having large queens:

1. More eggs. Larger queens are able to produce a larger number of eggs per day than small queens. This is because the larger queens possess more ovarioles in their two ovaries. These structures nearly completely fill the abdomen. A laying queen is an egg-laying machine. Let's consider a queen with a hypothetical genetic potential to produce 1400 eggs per day. This queen may have about 350 ovarioles, each producing four eggs per day. Over the course of one 21-day brood cycle, the queen will lay 29,400 eggs. If these were all to develop into adult bees (they will not because of diploid drones), then there will be 8.4 pounds of new bees produced by the colony.

Consider if the same queen is poorly fed during her larval development, and she does not have as many ovarioles. If there are one quarter less or 262 ovarioles producing four eggs per day, there would be about 1050 eggs laid per day. In a 21-day brood cycle, this would result in 22,050 bees or only 6.3 pounds of bees.

Conditions present during queen development include the number of nurse bees present to feed and care for the developing queen cell during that critical period from egg hatching to cell sealing. This is 5.5 to six days. If the colony is large, has an abundance of nurse bees, stored food, incoming food, and excellent health (no disease or significant mite load), the queen will reach her potential.

When these conditions are less than perfect – there are fewer nurse bees, food supplies are small, or the colony is suffering from a disease like chalk brood or has a mite load that interferes with queen feeding, then the queen will develop with fewer ovarioles.

We have known for years that the presence of *Nosema apis* in a colony will reduce queen productivity. Now, with *Nosema ceraena* in many hives, it is abundantly clear that a queen may be produced by *Nosema*-infected bees and the resulting queen is smaller and has fewer ovarioles, Moreover, when an adult queen is infected with a pathogen, her ability to lay eggs is reduced by the infection in her mid-gut. In fact, *Nosema* is often associated with queen replacement through supercedure.

2. More stored sperm. A larger queen will have a larger spermatheca than a small queen, and even a 10% difference in the size of this structure will make a volume difference of about 25% of the sperm stored in the fluid-filled sac. Since queens only mate (average of 13.2 drones) for a brief period of their early life and spend the rest of their life in the hive (except for swarming), then the number of stored sperm is directly related to the number of eggs the queen can fertilize until she runs out and starts to produce unfertilized eggs in worker cells. As a drone-laying queen, she may or may not be superseded by the worker bees, and the colony may or may not survive.

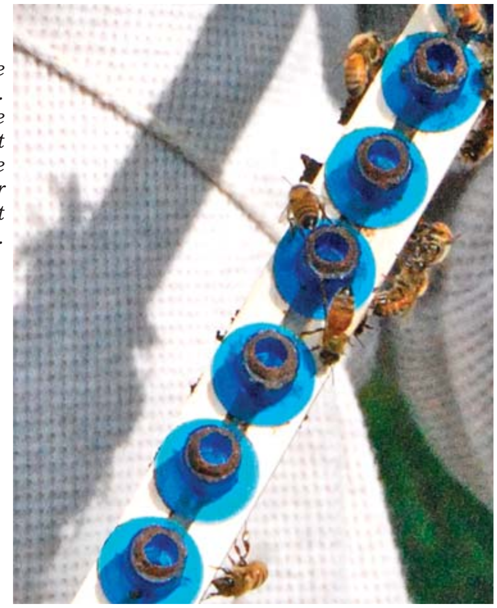
Evaluating queen cells

This Spring I've been teaching a number of queen rearing classes to hobby and sideline beekeepers. In the multi-session classes, we are better able to evaluate how we have done in our efforts. The challenge of teaching these classes is the limitations posed by using someone else's bees. Every beekeeper has his or her individual objectives in their craft, and for an outsider (me) to walk in and expect conditions to be ideal for queen rearing is not a reality. We can come close, but that is the best we can do.

I teach a traditional starter and finisher system of raising queens because it is the basic system. There are many variations for making queen cells, but I like to look at the essentials of starting the cells in a queenless, broodless, flightless mass of nurse bees, where the emergency instinct is strong and they will start many cells.

After the cells are started they are moved to strong, two-story finisher colonies where the queen is confined below an excluder and open brood, pollen, and nectar are placed in a second brood chamber above the excluder. A feeder is provided as well.

The advantage of the starter system is we look at the cells 12 to 18 hours after the grafted larvae were placed into the starter box. At that point the larvae that have



Closeup of the cells in Photo 1. The dark blue cells make it difficult to see the thin layer of royal jelly at this stage.

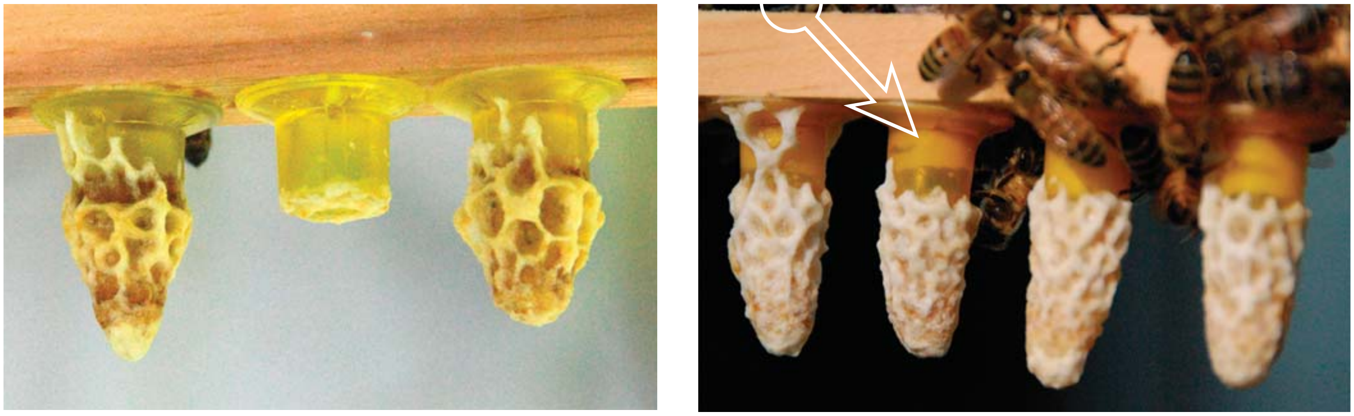
been accepted will have royal jelly added (if we primed the cells, the old royal jelly has been removed and replaced with new), and the two-day old larva is floating on a bed of right-aged royal jelly. When using plastic cell cups, you can see the royal jelly from the side. If the bees have added wax to the cell (like the tops of little volcanoes) and there is abundant food in the cell, then we know that the larva has been accepted and the starter colony has done its job. This is shown in the photos.

When the starter is not strong enough, there is a reduced amount of royal jelly in the cup. This is excellent justification to remove such cells from further production. In the transferal system we have taken a worker larva (that was never going to be a queen) and moved it to the starter colony where the bees feed it with the same food they feed to queens during natural queen replacement and swarming. The earlier this happens the more success we have with the final cells. When students move an older larva as they learn the process, it does not have as many hours of optimal feeding with royal jelly as a younger larva. That larva will come back to haunt everyone when the resulting queen emerges a day or more earlier than the rest and destroys the appropriately aged queens we want!

So, a simple inspection of cells from the starter colony will confirm if the starter did its job or not. The started larvae should be floating on a bed of royal jelly.

Those cells with adequate royal jelly are then moved to the cell finisher colony. That colony must also feed the developing larvae. The colonies are set up with lots of bees, stored food and incoming food. Under those conditions the bees will feed the started larvae well. In a few days the cells will be sealed by the worker bees and the queen larvae will complete the metamorphosis into an adult bee.

In one of the classes I taught the colonies used as cell finishers had been pulled down in strength by the removal of brood to make up increase colonies. While I am the first person to applaud the use of strong colonies for increase colonies, the removal of bees and brood from a colony makes it less than ideal for cell production. This was the case this Spring. The colonies that were



Two groups of cells. The first, left, is from a cell finisher that had bees and brood removed prior to the cell introduction. The second group of cells shows the benefit of a much stronger cell finisher. Viewed from the side, the stronger colony produced larger amounts of royal jelly and larger cells, see arrow.

the strongest in the apiary were not strong enough to be ideal cell finishers.

One of the students in the class with a little prior experience with queen rearing took the techniques home an raised queen cells of his own using a very strong over-wintered colony. The differences were striking. The weaker colony, even though it is in the middle of a nectar flow, did not produce enough royal jelly to create well-filled queen cells. The cells were shorter and there was only a thin layer of royal jell on the bottom of the cells. With the stronger colonies, the difference is striking. The cell cups appear to be nearly full with the queen food. The cells appear to be much larger and longer.

Bottom line

Monitoring the amount of residual royal jelly is one of the best methods I can give beekeepers as a method of evaluating queen cells they produce. If the cells are well started and finished, they will have surplus royal jelly in the base of the cells. The use of plastic cells makes easy to inspect the cells – it is not necessary to cut open a few cells to check them for food stores. This is perhaps the best way to control queen size.

*Dr. Connor's books, including Bee Sex Essentials, are offered for sale through many bee supply dealers, and at his website, **www.wicwas.com**. A PayPal store is available on that site for those who want to have the convenience of purchase via this option.*