

The Perfect Queen



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Larry Connor

Where we have been and where we are going

Previous articles in this series have reviewed the drone's role in the colony and how to produce large numbers of that unique colony member. This hit a positive cord with some readers of this magazine and I appreciate the comments from those who have contacted me to ask questions or just to say thank you. Several commercial beekeepers have even become interested in my line of reasoning (and hopefully not just to prove I've gone off the deep end).

Beginning this month, I will concentrate on the issue of queen quality, or as beekeepers see it, The Perfect Queen. It is hard to draw clean lines between the role of the queen, the drones she mated with, and the behavior of the resulting workers, because they are so closely tied together. I want to look at a variety of queen problems, including supercedure rates of queens, abnormal numbers of drone brood, and poor colony performance.

The Most Important Characteristic of a Queen

Years ago I was attending a meeting in a southern state where Professor Walter Rothenbuhler of The Ohio State University was speaking to a group of 35-40 queen producers. At a key point, Dr. Rothenbuhler asked the queen producers to state "The Most Important Characteristic" which should be directing bee-breeding research. Rothenbuhler was one of a handful of highly respected bee geneticists in the 1970s, and is still frequently cited for his efforts to identify genes that control hygienic bee behavior that provide resistance to American

foulbrood (and general hive cleanliness).

Back then I was pretty innocent to the ways beekeepers and queen producers thought. Seated safely at the back of the room, I just 'knew' that the group would offer up just four or five traits on which everyone would agree: items like high honey production, high vigor, excellent wintering and of course, resistance to diseases.

My education was expanded as the hands flew up with suggestions for the 'Most Important' list, which grew rapidly and included a wide range of behaviors and traits. I no longer have my notes but I recall that there were over 30 items these producers felt were "Most Important Characteristics." (I suggest you try this at your next beekeepers meeting. If you are so motivated, email it to me).

Keep in mind that all this took place years before tracheal mites, *Varroa* mites, hive beetles, African bees and high honey prices were part of the U.S. beekeeping industry. Not surprisingly, most of the 'Most Important' items were pretty self-serving to the persons making the suggestions:

One southern package bee producer wanted lots of bees so he could shake lots of packages, so his queens needed to produce huge amounts of brood.

A northern beekeeper wanted queens that would withstand the stress of being moved North to South to North and into and out of pollination and nectar flows.

Someone suggested queens that were resistant to pesticides, a widespread problem at the time. But a large honey producer wouldn't hear of such a thing if the honey

might become contaminated.

One producer sought bees that kept a clean brood nest and a neat and tidy hive with minimum use of burr comb or propolis. A migratory beekeeper wanted plenty of burr comb and propolis to keep his hives from shaking apart while being handled.

Oh, of course, everyone thought honey production and vigor were important, but rarely not "Most Important." Everyone seemed to have different characteristics they considered more important than vigorous colonies that made lots of honey. That day, I learned that queen perfection was in the eyes of the *bee-holder*.

Vigorous Queens

To understand queen perfection, we must differentiate between genetic perfection and conditions of queen production. During Walter Rotherbuhler's talk, the group discussed the conditions under which queens were produced, and the stresses they experienced before installation. Everyone agreed that queens must withstand the rigors of being mailed to customers, shipped in packages, or moved on trucks. They should not be superceded for at least *two years* and should produce solid blocks of worker brood and very few drones; just enough to mate with the daughter queen. Of course they will never swarm, sting, or consume stores unnecessarily.

I knew then we had crossed the line between genetically-controlled traits and ones dependant upon the conditions of queen rearing. It is useful to review queen biology again, to understand the concept of a Perfectly Produced Queen. For

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Size IS important

Large queens are better queens because they contain more egg-producing structures – call ovarioles – and as a result, they lay more eggs. Queens that lay more eggs produce more bees that will (probably) gather more nectar and thus pollinate more flowers. Queens have two large ovaries, collectively holding between 260 to 373 ovarioles (based on a study of 280 queens by Eckert in 1934). Since all the ovarioles produce five to seven eggs per day, well-fed, vigorous (healthy) queens routinely lay 1200 to 1500 or more eggs *per day* during buildup periods. There are 1440 minutes in a day so we are looking at an egg-laying rate of about one egg per minute! (Reports of 2000 or more eggs per day suggest, to me, a not unusual springtime situation where two queens are laying at the same time, perhaps the hive's mother queen and her newly mated supersedure daughter egg-laying on the same comb!)

Anything – absolutely ANYTHING – that interferes with the development and size of the queen and the number of her ovarioles will affect queen performance. Dr. G.H. 'Bud' Cale, developer of the Midnite and Starline hybrid bees, was a strong advocate of large queens, and was frequently critical of queen producers who shipped queens that were smaller than acceptable. These small queens are often quickly superseded soon after introduction. In fact, he and I shared the opinion that 30 to 50% of all commercially reared queens were superseded by the end of their first season. A large part of that premature replacement occurs during the first

month after queen installation.

Since both the Starline and Midnite bees were hybrids, they both demonstrated hybrid vigor and some increase in queen size was a result of this breeding. But the queens initially selected for use to create these hybrids were large queens and they produced large queens, with huge egg-laying rates. (There are limits, as in all things. I must mention that the lines that produced the most brood were not always used in the hybrids due to the presence of other undesirable traits.)

In his book, *Beekeeping for Beginners* (Journal Printing Company for Dadant and Sons, 1964), Bud Cale shows a picture of three queens (page 96), and he evaluates them for size. The smallest was a very poor layer. This stubby type had an engorged abdomen just slightly longer than the forewing of the bee.

The second queen has forewings that cover all but two segments of the queen's abdomen (plus the tip). She is very typical of the queens I now see in many beekeepers' colonies.

The third queen's forewings failed to cover almost three abdominal segments, and those segments are much more swollen, so the length of the forewing was just a little less than half the length of the engorged abdomen. When I worked in Florida, beekeepers would call these "gator" queens because they had a long "tail" Such queens are the result of excellent queen rearing conditions, proper feeding by the nurse bees, and have the maximum number of ovarioles producing eggs at maximum rate.

My bias is that the queens produced under ideal swarming conditions set the size standard for queen quality. Think about it: the bees have produced the queens from larvae of their choice, fed them profusely, and never allowed them to become stressed. Conditions in the area should support good drone pro-

duction, so mating should approach the ideal.

Further, queens produced under *emergency* conditions may be the poorest standard: the bees are limited to the larvae they have in the colony at the time of the queen's accidental death (or beekeeper removal). The conditions of cell production, feeding, stress elimination and drone supplies are unknown and subject to great variation.

Queen producers mimic swarming conditions by providing too many nurse bees rather than not enough. They provide a surplus of feed, combs of honey and pollen for ideal rearing conditions. One Florida queen producer claimed he put the starter boxes for queen cells in bed with him and his wife to keep them warm on really cold nights. He may have been teasing this young Yankee beekeeper, but I still remember the point he was making!

Handle with Care!

Once we have produced a large queen, we can easily lose the benefit of that queen if we allow her to become damaged by chilling, overheating, rough handling, exposure to pesticides, or some other horror. Here is a short list of hazards to avoid . . .

Rough-handling of queen cells

Queen cells should be handled like thin-shelled eggs. Always handle them from the cell base and be very careful not to damage the tip or sides of the queen cell. If you are using a plastic or wax cell cup, use a wood or plastic base and always, always handle the cell by the base. And don't drop or shake the cells because the larva may be dislodged from its hold on the royal jelly at the base. If you have ripe cells, any sharp movement may cause damage to the queen's body, especially to the wings. She has to fly to mate, remember?

When you install a queen cell into a nucleus colony, push *only* the cell base into the wax of a comb, making sure the tip is *never* touched or crushed by comb when you push them together.

Rough treatment of queens

Always, always, always pick up a queen by her wings. If you are clipping and/or marking a queen, make



sure you hold her gently by the thorax, *not* the abdomen. With hundreds of egg-producing ovarioles in the abdomen, you can see how a careless pinch could cause serious damage. When clipping a queen (I support his practice to mark queens for identification purposes), make sure you clip *only* the wing, and not a stray leg that frequently pops up when you go to make the snip. The general rule for clipping is to clip the right forewing on even years (2004) and the left forewing on odd years (2003, 2005). A clipped wing will never grow back, so you will know that the queen in the hive is the one you installed there, and how old she is as well.

No extreme temperatures

Queens (in mailing cages) should not be subjected to cold or heat. Unfortunately, a recent study at Penn State University confirmed what I had always suspected; that the U.S. Postal Service routinely allows queen bees to become exposed to very high and very low temperatures. I use the short-sleeved shirt test. If you are comfortable in a short-sleeved shirt, the temperature is okay for the queen. If you reach for a jacket or to switch on the air conditioner, then it is too cold or too hot for the queens as well, although a queen may take a bit more heat than some humans. Remember, the brood nest is usually about 92°F.

Hydration

Queens are shipped with worker bees and a bit of queen candy, which contains some water. This is the sole water source of the queen and her attendants. A drop of water on the screen will provide additional water. The attendants will lap it up quickly if they need water. Queen candy can be made too hard and too soft. One will dry out the queen, and the other sugar coat her. Neither are desirable.

Holding queens

Overnight In a cooler room without direct sunlight (to cause overheating). This keeps the queen and the attendants quieter. If they seem restless, offer water slowly, providing only what they need.

And provide *clean* water. Use a dropper if possible. Your finger has

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all manner of ‘stuff’ on it – everything from transmission fluid to hamburger grease.

Longer than overnight Queens should be removed from the shipping cage and installed into a queen bank. This is not always convenient or even possible. I had good luck holding queens (in their cages without attendants) by shaking a few nurse bees onto the cages inside a small box holding a piece of queen candy. If the bees were getting old (several days) dump them out and add new nurse bees. The box of queens was carried to the apiary and queens installed as needed. Remember to keep the box of queens in the cool shade and not to leave them in the truck or car on a hot day!

Controlled Introduction

The largest loss of queens is at the time of introduction. Why? Because most beekeepers are either in a hurry or they are careless. It is a point in the queen’s life when she is still fragile: newly emerged, newly mated, and newly laying. The queen has arrived into your hands after several days of travel, exposure to heat and/or cold and who knows what. She has lost significant weight since she was removed from the mating nucleus. If present, the nurse bees in the shipping cage are likely to fight with the worker bees in the new colony. *For this reason,*

attendant bees should be removed before the queen is introduced.

I advise that queens be introduced into colonies but not allowed to escape from the cage too quickly. I like to restrict a queen in her cage for at least three to five days prior to her release. Why? This holding does several things. First, I believe that the queen scent (pheromones) of the new queen is dispersed throughout the colony by communal feeding. Second, the queen is re-fed and re-hydrated resulting in increased weight, increased pheromone production and restarting egg laying. She may actually start laying eggs in the cage, which is an indication of her status.

Unless you are sure you are experiencing a strong nectar flow, feed, feed, feed the colony where you are introducing the new queen. This enhances the food exchange process, engorges the workers *and* the queen, and helps duplicate conditions present during a nectar flow.

General Colony Manipulations

Rough handling and a careless disregard for the queen during colony inspection often leads to pinching and crushing of queens. Work carefully and slowly. Keep handy an empty hive body shell or nuc box to place the frame holding the queen if you want to know where she is during your inspections. You don’t want to put your foot through the comb holding the queen and accidentally kill her.

Always think about the queen. Once, while searching for a queen, I felt a bee crawling up the inside my pants leg. I instinctively went to pinch the bee when I felt its size. I shook the bee out of my work pants and it was the queen. This clipped queen was on a mission: purpose unknown. She returned to her hive without comment. **BC**

Dr Lawrence (Larry) Connor is owner of Wicwas Press, New Haven, CT where he edits and publishes books on bees and beekeeping – LJConnor@aol.com or website www.wicwas.com.

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Charles Harper
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421 Louveteau Rd., Carencro, LA 70520

337.896.5247

labceman@cox-internet.com