Beekeeping Basics

Working with Queen Cells

by MEGHAN MILBRATH

Queen cells are the unsung heroes of sustainable beekeeping. Most beekeepers still seek out mated queens for splits and replacements when queen cells work just as well or even better. There are many advantages to using queen cells over mated queens. A huge advantage is seen in the spring, as queen cells are available earlier in the season. By definition, they are ready weeks before mated queens. For those of us in the north, a week can make all of the difference in making splits for swarm control. Where I live in Michigan, winter tends to hang on as long as it can, and then instantly and dramatically flip a switch to summer. During the cold spring, it is difficult to maintain nucs and have good weather for mating, so it is almost impossible for me to have mated queens ready by the time I want to make splits for swarm control. I can however, make a big cell starter and have enough queen cells ready for all my splits before the weather turns.

The second benefit is that queen cells are significantly cheaper. This economic advantage is really important when we are looking to replace large numbers of older queens, or if we don't have good success in introducing queens (many beekeepers throw money away on mated queens that aren't accepted). Canadian researchers looked at the economics of queen rearing, and found that queen cells cost the producers between $2 and $5 per cell, while mated queens cost from about $10 to over $25 to produce (Bixby 2020). From the producer side, the difference in labor is enormous. I can raise 90 cells from just two or three hives — I just need a strong starter and a hive with a good queen and graftable larvae. I will have 90 cells in just over a week. If I want 90 mated queens, I need to manage well over 100 mating nucs, which require multiple hives to start, and I have to feed and maintain them for a month.

Many times when I suggest using a queen cell rather than a mated queen, I am met with an objection — "Won't that cause too much of a brood break?" While using a queen cell will indeed cause a brood break, this is considered an advantage in my book, and not a concern. In the era of varroa, we have to have a season-long management strategy. A brood break is a lovely and effective part of this strategy, because it creates a period where varroa cannot reproduce and when the mites are vulnerable to grooming or at risk of leaving the hive on a forager. We can even increase the effect on varroa control by adding in an oxalic acid treatment while the colony is broodless. Even better, a well-timed brood break can actually increase honey production. A broodless period means that there are fewer young mouths to feed, and more bees are available to gather and process nectar for honey. Nectar flow brood breaks have long been a technique used by comb honey producers to maximize honey production during a strong flow.

They're easier and cheaper, and have a high rate of acceptance.

Another advantage to using queen cells is that they are often more available locally. As mentioned above, they are easier and cheaper to produce, and can be made earlier in the season. This means that many smaller-scale beekeepers that would not be able to maintain a large apiary of mating nucs for queens will be able to produce cells for beekeepers in their club. Not only will you have bees from a colony that thrived in your area, with similar nectar flows and weather, but you will also not have to worry about the stress of transport. Shipping can be incredibly damaging to queens; heat loss during transport has been linked to low sperm viability, which can affect overall colony performance (Pettis et al. 2016, McAfee et al. 2020). If you are going to spend the money and time on replacing a queen and you are going to count on her production over the next year, you want to make sure that she is in excellent health.

The final advantage to queen cell use is the high rate of acceptance. Many beekeepers struggle to introduce mated queens in hives, especially when colonies are larger, or conditions are not ideal. When a virgin emerges in a queenless colony, there is no concern about introduction. The bees will accept her as she comes out of a cell as a young virgin, and you do not have to mess around with push-in cages and candy plugs.

There are some downsides to using queen cells. First and foremost, when using a queen cell, you'll only get half of the genetics of the original colony. The drone part of the equation will come from wherever you are located. This may be a positive thing, if you have lots of good, overwintered colonies thriving in your area, or it may be less than ideal if you don't know the

A frame of 72-hour cells. These cells traveled safely from Ohio to Michigan in a queenless nuc with lots of nurse bees and food. I put the frame right into a strong queenright hive (above a queen excluder) to finish, and I had lots of great queen cells to distribute to beekeepers in MI. This system is an easy and economical way to share genetics. The queen producer has to graft and then wait only a few days, so it is easy to organize logistics. Thanks to Dwight Wells for both the cells and the photo.

genetics of the bees that are around. The other downside to using queen cells is that you have to account for some of the virgins not returning from their mating flights. This isn't the end of the world, but you'll have to prepare for it by making an extra split or two, and planning on combining those that fail.

There are multiple advantages to using queen cells instead of mated queens. In my operation, I use them for spring splits, for making up nucs to overwinter, and to requeen old and failing colonies. It is an excellent practice to make up a few nucs with some queen cells to learn the process, and to have them on hand to support or replace your other colonies.

How to use queen cells

Queen cells are just as easy to use as mated queens, if not easier. They are easy to transport and install. However, there are considerations to their timing, transport, and introduction that will allow you to have the best success.

Timing. Queen cells vary in their hardiness depending on where the virgin is in her development. A larva sitting on a pool of royal jelly in an open cell is pretty hardy to temperature changes, but is vulnerable to drying out or being shaken off the food. A queen that is mid-pupation, just forming her wings, is very delicate, and even a few shakes or short period at the wrong temperature can have lifelong consequences. A completely ripe cell that is just about to emerge will be just as hardy as a virgin, and can handle a few more knocks and swings in temperature. I will sell queens at a few times in their development, at days I feel are safe for transport: as young as 72 hours old, the day they are capped, and right before emergence. I try not

Two homemade queen cell transport devices that use foam packing to keep the queen cells stable and upright. A hot water pack can be added under the foam in the cooler on the left, and the box on the right used modified cell protectors to allow for extra protection — even if the queens emerged during transport.

to sell or transport queen cells when they are in their sensitive development phase, to reduce the chance of harm to the developing queen.

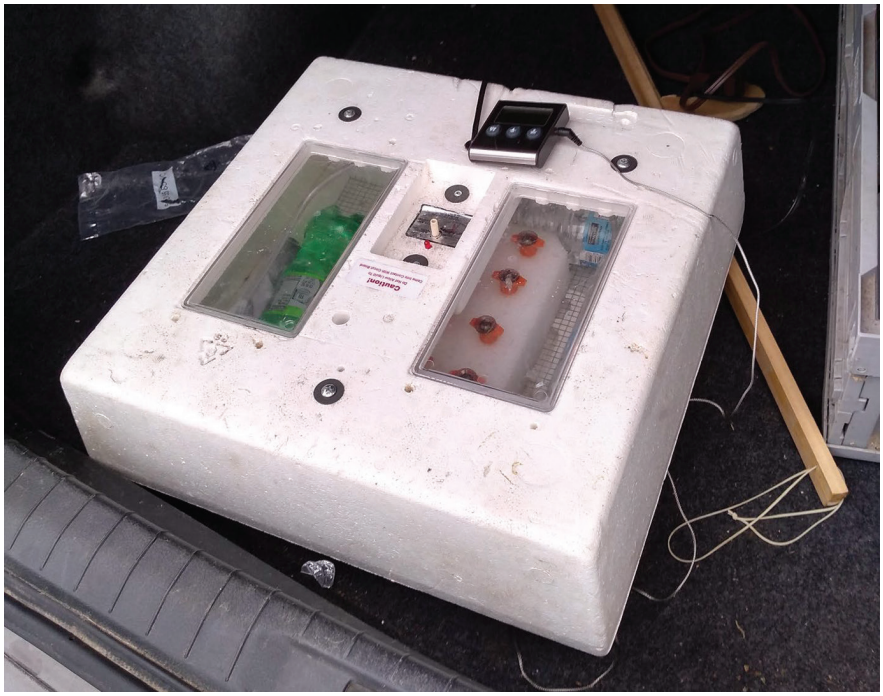
It is important to know how old the cells are (the day they are grafted) so that you can know the best way to transport them. Younger, uncapped cells transport best in a queenless nuc with bees to tend to them, but can travel short distances in a container as long as they aren't jostled heavily and don't dry out. Usually if I have to transport open queen cells, I'll create a nuc with nurse bees — it doesn't have to be full, but you want enough bees to cover and care for the cells. For short distances, I've had success putting the cell into a Styrofoam cup, and covering the cup with a wet paper towel.

There are many ways to safely transport capped queen cells. You can purchase a commercial incubator, but they are quite expensive, and in most cases not worth the cost. If you are traveling a long distance, you can make an incubator out of materials that you have at home. Basically, you want the cells to be warm, upright, and cushioned from bumps on the road. A really nice method is to use a small cooler with a bottle of hot water at the bottom, that is covered by a thick layer of sawdust or pine shavings. The cells can be nestled into the sawdust and will remain stable and warm for hours. Shorter distances are even less concerning, especially on warm days. A transport container can be as simple as some toilet paper in an egg carton. I have one beekeeper who buys queen cells from me every year, and every year he will take them home by wrapping a piece of paper around the cell like a tube, and sticking it into the chest pocket of his shirt. Often, if customers don't bring anything for transport I'll grab a container from the recycling bin, add some pine needles or paper towels, and nestle the cell so that it is gently upright and protected. You'll want to keep the cells as close to 95°F as possible, but if queen cells are kept at a cooler temperature, it doesn't seem to affect the quality of the emerging queen (Chuda-Mickiewicz et al 2015).

Here is another perfectly good way to transport multiple cells. The milk jug was filled with hot water from the tap, and we were able to transport dozens of cells safely in the pine needles.

Installation

For the best chance of success (emergence and survival), install a queen cell into a nuc that has been queenless for some time (some studies say 5 days is best, others say a few hours). You want the bees to have time to realize that they are queenless and to be very accepting of the new cell. If you want to ensure that your new queen will have no competition when she emerges, make up the nuc a week in advance and then tear down any emergency cells before you install the queen cell. This way you will know that the bees will not have young larvae to create any competitive emergency cells, and you will know that the queen that you find in the nuc is the one with the genetics that you want (and not a rogue emergency queen). If you have to install a cell right after removal of the old queen, it is best to use a cell protector — either a commercially available model, or tinfoil. If you use tinfoil, you want to cover the sides of the cell, but leave the bottom open for the queen to emerge — you can either



A chicken egg incubator that has been modified to transport queen cells. Incubators work well for long-distance travel. Some are designed to plug right into your vehicle, others can be used with an inverter.

Good placement of a queen cell. Photo by Melissa Holohan

roll a small piece of tinfoil like a tube vertically around the cup and cell, or you can cut a hole in the middle of a small square of tinfoil for the tip of the cell, wrapping the sides.

For the greatest chance of emergence and acceptance, place the queen cell onto a brood frame, being careful to handle the cell by the cup. If you can find a small depression in the frame, place it there, otherwise just focus on putting it near the top of the brood nest, in a place sure to be covered by bees.

Put one cell per hive. Unless something happens, most cells that are capped will emerge. It isn't worth the extra cost or stress on the queen to have two emerge in a single nuc (Boch and Avitable 1979). If you are concerned about the number of queens you'll end up with, it is better to make up extra mating nucs, as the biggest risk is not the queens not emerging, but in not coming back from a mating flight. Any colonies that are queenless can just be combined with queenright colonies later.

Finally, you'll want to write out your calendar. Check the colonies when you can comfortably expect to see brood. You'll want to wait about a month after grafting, so make sure you know the age of the cell. Many beekeepers check too early, and that can wreck everything because they disrupt the colony too much while the virgin is not fully accepted or when she is out on a mating flight.

If you have a chance to get queen cells, but you don't have your nucs or splits made up, you can always bank them in a queenright hive above a queen excluder, or you can use an incubator if they are capped. Just make sure that you know exactly the day they will emerge, so that you don't have one virgin emerge and tear down the remainder of the cells, and you are careful on which days you handle them.

Using queen cells without removing the old queen

I would be wonderful if we didn't have to remove the queen first, and could just drop a queen cell into a queenright hive. Finding the old queen is intimidating to beginners, and is a lot of labor for beekeepers at all levels. We have been looking at this process of "stimulated supersedure" since at least the 1890s (Miller), and it was studied heavily in the 1960s to 1980s. These studies showed that while most of the cells emerge in a queenright hive, there is very low survival and replacement by the young queen. Using nucs, one study found only three of the 14 queenright nucs successfully requeened, compared to 18 of the 20 nucs where the queen was removed a few hours ahead of time (Boch and Avitable 1979). Another small study showed 17-31% success in introducing queen cells with no isolation from the original queen (Jay 1981). The largest study of requeening with queen cells without removing the queen used over 900 colonies, adding ripe queen cells into honey supers. While 70% of the cells showed that queens had emerged, very few colonies were actually successfully requeened (Szabo 1982). It didn't seem to help if the queens were young or old, or if multiple queen cells were added, or if the cells were added to the brood nest instead of the honey supers, or if the cell was left in the honey supers above a queen excluder (Boch and Avitable, 1979). There may be some benefit if the brood nest is split, the queen cell is accepted, and then the colony is recombined. In a study of 23 colonies with the nest split with only a queen excluder and recombined a week later, almost 40% of the young queens survived, and this increased to 50% if a division board was used (Boch and Avitable 1979).

It may make a difference how old the original queen is. There is some thought that the queens that didn't get replaced were fairly young and productive, and the older queens were more likely to get replaced. If your main goal is to replace older queens with better genetics, it may make sense to periodically drop in queen cells, under the assumption that you'll only replace the ones that need it.

Peer (1977) showed that over 80% of about 4000 colonies successfully replaced queens over a 3-year period when ripe queen cells were introduced into the top of multi-story hives 2-3 weeks before the end of the honey flow. Studies in Lithuania also were able to get a higher success rate (71-81% over time) when they persistently checked and re-added queen cells (Skirkevicius 1963). Beekeepers will have to evaluate their labor and queen costs to see if this method is economical for their operations.

Another method of requeening using queen cells that is fairly successful is to split the brood nest into sections (either by physically splitting the colony or using a division board), adding a queen cell to the queenless part, and then recombining them with newspaper once the new queen is accepted. Beekeepers can successfully requeen large colonies without removing the queen by the following method, outlined in Forster 1972: First, raise the original queen and the brood nest above a division board (a sheet of wood or metal fitted with risers top and bottom and an entrance). Add a queen cell to the bottom box, and then later reunite both boxes by removing the division board. This method found an average survival rate of over 90% for the young queens

(of the ones that mated successfully), and was done without a break in the brood cycle or loss in honey production (this was done in New Zealand in the early 1970s, so varroa was not a concern at that time). For larger operations that have more queen cells and less time, you could simply add a queen cell to both boxes (the one with the queen and the one without the queen), assuming that the queen-right colony would tear down the cell, as there was only slightly less success when the new queen was in the upper box.

Consider using queen cells for making your splits and for requeening. They are cheaper, easy to transport and handle, and you can really improve the sustainability of your operation with well-timed brood breaks and young queens.

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