Producing Swarm Queens for Fun, Profit, and Really Big Queens

Part 2: Establishing a swarm-queen protocol

by Shelley Stuart

In Part 1, I reviewed swarm-queen production from a theoretical position by evaluating the minutiae of what makes a colony swarm. I recommend reading that article first: It lays the foundation for the experimental processes described here.

Over the summers of 2024 and 2025 I ran several trials to work out a repeatable, reliable method to convince colonies of bees to make swarm queens on demand, without swarming themselves. The Northeast Sustainable Agriculture Research and Education (SARE) program supported this research with a two-year grant awarded in the fall of 2023.

Field experiment: summer 2024

The first process I developed nurtured a colony to the very edge of swarming, put the queen in an isolation cage with a special queen frame, and observed how many swarm queens the colony would (or would not) make.

Colonies

I selected overwintered colonies housed in 8-frame Langstroth hives with one deep and one medium. I also experimented with one 5-frame nuc. The full-sized colonies had second-year (overwintered) queens, and the nuc had a first-year swarm queen raised during the spring trials.

I deliberately pushed colony populations to overcrowding by not adding space as the spring flow approached in May in central New York. I was prepared to mimic ample environmental resources by adding pollen patties and sugar syrup, but the colonies had plenty of pollen and nectar available from the surrounding flora.

I used the following cues to decide when to start the experiments:

- The bee population filled an estimated 80% of the hive;
- Drones reached an estimated 5-10% of the hive population;
- The colony had a minimum of four frames of capped brood (three frames in the nuc); and
- The colony had ample honey and pollen (either stored or actively being collected).

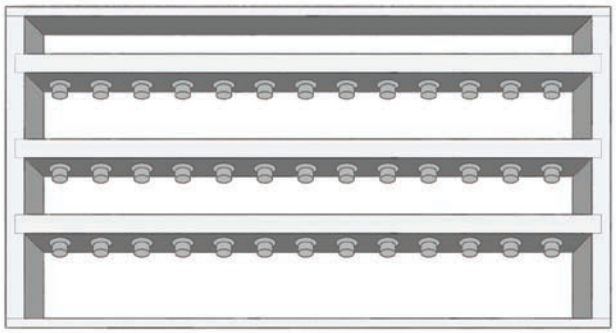
Queen frames and cups

I created three types of frames, shown in Figure 1: A) frames with only queen bars and cups; B) frames with partial brood comb and a queen bar; and C) fully drawn brood frames with queen cups randomly pressed into the face of the comb.

I offered the colonies standard JZBZ cups, 3D-printed cups with 9 mm openings, and wax-dipped cups (approximately 9.5 mm in diameter) pressed onto 3D-printed bases to make them easier to use on a queen bar (Figure 2).

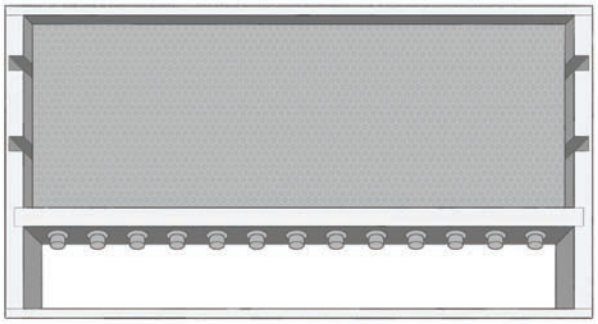
Queen control

In both full-sized hives and nucs, I placed the experimental frame into a deep-frame queen isolation cage, then added the two-year-old queen to the cage.

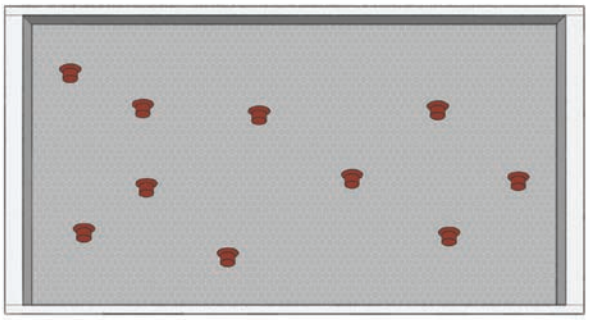


Celia Stuart

A: Queen bars and cups

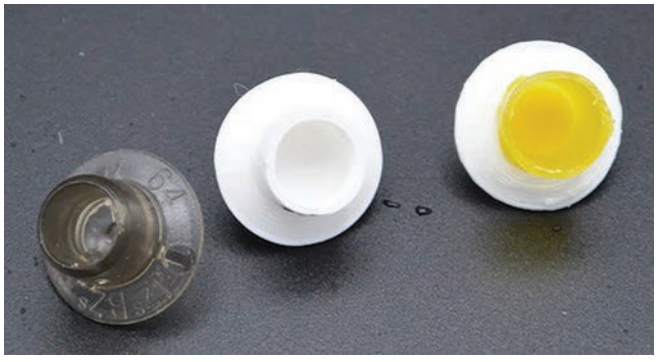


B: Brood comb above a queen bar



C: Face-oriented queen cups

Fig. 1



Shelley Stuart

Fig. 2 *From left to right: JZBZ, 3D printed with PLA filament, wax-dipped cups*

Key observations

Regarding the methodologies

Having pushed a full-sized colony to the swarming level, it was obviously packed with thousands of bees. Finding the queen in this mass was challenging and time-consuming — clearly not an efficient use of a queen breeder's time, unless the results merit this investment.

I added extra holding equipment to help find the queen if I couldn't locate her on my first pass through the colony. After I evaluated a frame for the queen, I stashed the frame in a waiting nuc or deep box. This prevented her from scurrying to a frame I'd already searched.

Once I found the frame with the queen, I put her in an empty nuc box for holding. This gave me the time to set up the experimental frame and isolation cage in the original hive before inserting the queen. Now, though, I had added new requirements to the method: a separate holding box, and a nuc box.

Evaluating the laying progress of my queens in the isolation cages presented a similar problem. Nurse bees blanketed the frame of open brood and swarm cells. Pulling the frame out to check the status of the queen cells — or to remove them — risked the queen escaping. Once again, the handy empty nuc box became an essential piece of equipment so that I always knew where the queen was.

Handling the queen presented another challenge. Many ABJ readers certainly have the skill and confidence to pluck a queen from a frame and put her where desired and only ruffle her setae slightly. For the record, this is not me — I made a queen "faint" last summer during my trials. I had not considered this barrier to entry: Grabbing the queen can be daunting, and it's tricky to do without injuring her.

Regarding bee behavior

As I expected, simply placing a frame with only queen cups in an isolation frame with a queen did not quickly create charged queen cells. The one successful run of this configuration occurred after the queen remained in the isolation cage for three weeks, when she laid eggs in 15 queen cups (Figure 3).

A queen bar with only empty queen cups on it meant that worker bees had no strong reason to enter the isolation cage. The only attractant was the queen and her pheromones, not the alluring draw of brood pheromones. Therefore only a few attendants needed to enter the cage to tend to the queen.

Any worker influence on queen-cell production was therefore very limited, even when the colony was actively preparing to swarm. The queen may have responded to the lack of workers around her. A low population of nurse bees (and/or attendants) apparently triggered "not time to swarm" signals, and therefore the queen did not lay in the offered queen cups. Or perhaps the lack of nurse bees signalled low pollen and nectar availability, so she instinctively stopped laying eggs as some strains do during dearth periods.

Shelley Stuart



Fig. 3 *Not very pretty, but somewhat successful: The top bar had four queen cells, the middle bar four, the bottom bar seven.*

Shelley Stuart



Fig. 4 *Nearly all queen cups directly below the brood had queen larvae.*

However, when left in an isolation cage long enough, the queen did lay eggs — I suspect her reproductive biology forced her to start laying. The resulting brood odor drew in workers to provision the queen cells, but they also started to draw out worker comb on the top part of the frame. By now most of the capped brood in the colony had emerged, which opened up the brood nest, and thus stepped the colony back from a swarm impulse.

The workers also seem to prefer nurturing queen cells in proximity to brood comb. As I noted above, I tried three different queen-frame configurations. I had the most reliable success when I placed cell bars directly beneath open and/or capped brood comb. You can see this most dramatically in Figure 4. This frame had a total of 10 charged queen cells; nine came from the bar directly beneath the brood comb.

Going nuclear

My most intriguing discovery came later in the summer when I manipulated a nuc colony for the trials. In the nuc I found that the queen isolation cage was prohibitively large and reduced the colony's internal space too much.[1] I removed the isolation cage, allowed the queen free range of the nuc, and inserted two experimental frames. Each frame had ¾ drawn comb and one queen bar with empty cups.

Once the frames filled with brood and food, the bees built three charged queen cells in the cups I had supplied them. I suspect that the small volume of the nuc meant that the queen cups were regularly exposed to the workers and the queen. The colony could experience a natural, bee-driven swarm cycle while at the same time provisioning beekeeper-supplied queen cups, which I could then harvest.

Adding multiple experimental frames did not increase the number of charged queen cells: When I offered three experimental frames and two standard deep frames, the number of charged cells at swarming time did not meet the capacity of the queen cups offered. In fact, the bees started to draw worker comb over two of the experimental-frame queen bars, rejecting the queen cups offered there.

Christel Trutmann



Fig. 5 *Queen cells at the base of freely drawn comb*

Field experiment: summer 2025

Based on these observations, I focused on using nucs for swarm-queen breeding for the second summer of the trial. The nucs had one swarm-queen frame as illustrated in Figure 1B, and the queen had free access to the entire colony. Three beekeepers local to my area also joined the study, starting swarm-queen nucs from their own colonies. (One did not complete the study or provide data.) Of the five nucs in my apiary, two produced queen cells directly in the offered JZBZ cups one time each, and they also went freestyle on the same frames. Measured from the base of the cup, the queen cells ranged from 28.0 mm to 39.1 mm in length (median: 31.8 mm). Another participant eventually had queen cells on the frame, with more cells on free-hanging comb than in JZBZ cups (Figure 5).

More bee behavior

Bees can (and will) "uncharge" queen cups: They will remove eggs and larvae for undetermined reasons. This happened multiple times in different colonies over both years; I found eggs and/or larvae in JZBZ cups, and three days later the same cups had been cleaned and polished.

To avoid workers uncharging queen cells, I established a cell starter/finisher (also a nuc) and moved a queen frame with four charged cells to it (three with eggs, one with a newly hatched larva). Three days later, despite their queenless status, the workers had cleaned out the swarm cells.

Consistent with the behavior seen in Figure 4, of the frames that successfully produced queen cells, the ones above the bars largely contained open and capped brood. This seemed consistent in my apiary, as well as others' (Figure 5). The frames that were built over almost always became honey or pollen frames.

When given a choice, the workers turn up their antennae at JZBZ cups and start queen cups where they want to *thankyouverymuch* (Figure 6). They will even put swarm cups on the sides of frames, and it appears that they will readily make swarm cells along the bottom edge of the comb, if given open space there (Figures 5, 6).

Next steps

Based on my findings, I'm planning two alterations for 2026. First, move the experiment to a single deep in order to allow the bee population to increase. The smaller cavity of the nuc restricted the colony growth and may have been a factor in the uncharging events. With larger numbers I may find that once the queen cells are charged, they stay charged.

Second, provide frames without a bottom cross-piece. Allow the bees to build comb freestyle along the bottom of the frame, where they have more reason to also build swarm cells similar to Figure 5. Once the swarm cells are established, move that frame to a new colony, or cut out the queen cell from the surrounding comb to move elsewhere.

Shelley Stuart



Fig. 6 *Well, at least I can safely move this queen cell.*

Summary

Over the two summers, I took 26 queen cells to the fully capped stage, with another dozen or more charged queen cells never progressing beyond egg or larva.

I was able to get queens to lay eggs in swarm cups directly by isolating the queen, but not quickly, nor efficiently. By offering queen cups in a nucleus-sized colony, the bees were willing to make swarm cells out of beekeeper-supplied queen cups but not reliably. They would also start swarm cells and then undo that — as though changing their minds about swarming at all. More frequently the colony would draw comb over the cups in the empty space on the queen frames. My field notes mirror the experiences that my volunteer participants had, particularly with the bees filling the queen-cup space with comb.

Commercial queen rearers need hundreds of queens available on a predictable timetable. None of my trials suggest that it's possible to meet this demand using natural swarm biology. I still feel that it could benefit hobbyists, who generally need only a few queens over a summer. If a hobbyist can turn the problem of swarming into an opportunity to breed larger queens, or queens they feel have better varroa control, they could cultivate bigger, healthier colonies. Hobbyists paying attention to swarming signals will also be better positioned to prevent swarming in their apiaries.

Lessons learned about swarming impulses

In Part 1 of this article, I raised questions related to swarming impulses, which these summers of experimentation justified. The bees will voluntarily use plastic cups if they have to. Apparently they prefer building their own at the base of the free comb, which is also located below a full frame of brood. When they do use the plastic cups, they immediately constrict the size of the opening (Figure 7) making it clear that they have a size preference for the mouth of the queen cell.

How do eggs appear in the cups? I think that the uncharging events I documented best support the theory that the queen lays eggs in any empty cell she wanders across, and the workers decide what to do with them. (This may

Shelley Stuart



Fig. 7 *The workers consistently constrict the openings of plastic cups.*

happen in our own hives all the time, but our inspection timetables don't allow us to witness it firsthand.) If the queen laid in the queen cups when swarming was inevitable, the workers should have nurtured any charged cups to maturity rather than eliminating them. Similarly, if workers were preparing for a swarm and corralled the queen to lay in the cups, those eggs would reach maturity. This may mean that the "practice" queen cups we see on our frames are not practice at all, but preparation instead. The queen can lay in them so that if the colony needs to swarm it's ready. If not, the workers clean out the queen cups and put their efforts into the worker brood.

New questions arose when I moved my queen frame to the cell starter/finisher. A queenless cell starter should be primed to accept a queen cell in the making, yet the bees cleaned out the primed cups. Did this queen frame bring with it chemical cues that conveyed "get ready to swarm" to the queenless colony? Did the queenless bees interpret those cues to mean "the queen is about to take off" and destroy the swarm cells to stop this process so they didn't lose a queen that they didn't have? This is another side experiment to run in 2026; was this a fluke (or beekeeper error)? Will a queenless cell starter consistently destroy swarm cells? If the swarm cells are close to capping will the workers accept them?

Closing thoughts

The premise behind a swarm-queen method is that eggs laid in queen cups are larger, and therefore result in larger queens, which are generally regarded as superior for a number of reasons. Research by Saad Naser Al-Khatani demonstrated that nurse bees have a preference for making queens from larger eggs.[2] Xiaobo Wu found that queens restricted from laying will produce larger eggs once they can lay again.[3] Therefore another approach to the ultimate goal of larger queens might be to first restrict the queen from laying for a week, then put her into a Nicot or Jenter system, allow her to lay in the cells, and raise large numbers of queens using a standard starter/finisher protocol.

I remain hopeful that the results obtained over the last two summers, and the modified approach for 2026, will illuminate a reliable way to generate a modest number of swarm queens. Should the changes pan out, I will document a method for a hobby beekeeper to produce robust queens without the need for the skills, equipment, and colony resources required for the traditional grafting method. Hobbyists may also gain more confidence in their bee husbandry potential if they purposefully and successfully learn how to identify swarming conditions, and then cultivate the types of bees they want in their apiaries.

Acknowledgements

I would like to thank Christel Trutmann and Kara Bielik for their participation in the 2025 trials, and their regular observations, questions, and pictures. I also want to acknowledge the support and academic resources that Peter Borst shared with me as I researched swarming and planned the study setups.

This material is based upon work supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, through the Northeast Sustainable Agriculture Research and Education program under subaward number FNE24-102. ***https://projects.sare.org/sare_project/fne24-102/***

References

1. While increasing the size of a nucleus box is possible, it requires custom, not commercially available, equipment. I would like to take advantage of mass-marketed equipment, as it's readily available to any beekeeper.
2. **AL-Kahtani SN, Bienefeld K (2021)** Strength surpasses relatedness–queen larva selection in honeybees. PLoS ONE 16(8):e0255151. **https://doi.org/10.1371/journal.pone.0255151**
3. **Wu, Xiaobo, et al.** "Effects of Queen Cell Size and Caging Days of Mother Queen on Rearing Young Honey Bee Queens L." Journal of Apicultural Science 62.2 (2018): 215-222.



Shelley Stuart has kept bees in the Finger Lakes, NY, region since 2009. Under the HoneyApple Hill label, she markets honey into DIY kits for budding mead makers and beer brewers. Her experiences range from screenwriting to medieval reenacting, with an occasional volleyball league thrown in for good measure. She earned her Master Beekeeper certificate from Cornell University in 2015, and now facilitates the Master Beekeeping program and Beekeeping Essentials course offered by eCornell. You can contact her via **HoneyAppleHill.com**.