PennState Extension

Queen Cell Production: Grafting and Graft-Free Methods

Queen production allows beekeepers greater autonomy and independence, enabling individuals to better meet the goals of honey production, pollination, colony production, and genetic selection.

Figure 1. A capped queen cell and nurse bee. Photo: Kate Anton, Penn State

There are numerous methods of producing queen honey bees. Beekeepers who wish to produce more than a handful of queens in a season typically do so by grafting. Grafting is the action of transferring a larva from a brood cell into a manufactured cell cup. This technique allows beekeepers to create any number of queen cells that are easy to handle and transport. This article describes common grafting and graft-free techniques and equipment for producing queen cells in moveable cell cups (Figure 1).

Grafting Basics

Before grafting, a cell builder or starter must be available to receive the grafted larvae. Information about cell builders can be found in the article Cell Builder Basics.

The next step in grafting is selecting the brood frame. Frames from vigorous colonies are ideal; look for day-old larvae on frames where eggs and older larvae are also present. Larvae suitable for grafting will be very small with a slight comma-shaped curvature, while older larvae are larger with a more defined C-shape (Figure 2).

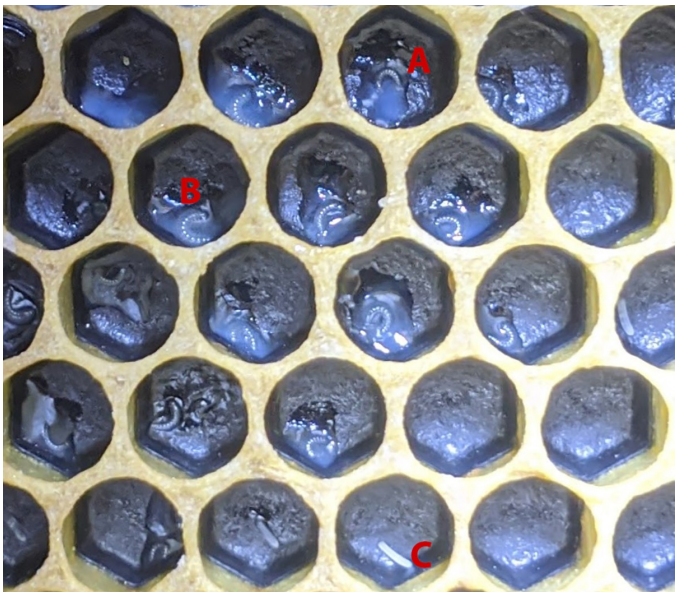

Figure 2. Eggs and lare in brood cells (A) Graftable larva. (B) Older, larger larva. (C) Egg. Photo: Kate Anton, Penn State

Gently brush nurse bees from the selected frame to prevent damaging the delicate larvae. The larvae must be grafted quickly upon their removal from the colony, as they are vulnerable to chilling, desiccation, or starvation without nurse bees to regulate the temperature and humidity, or to provide feeding visits. A damp towel draped over the frame will keep the humidity high and should be used to cover the part of the frame that is not in use. Optimal environmental conditions for grafting include a warm, draft-free room. For grafting, the donor frame is often placed on an incline (Figure 3) and a flashlight or headlamp is used to identify the best larval candidates.

Figure 3. Grafting frame on a stand with a damp towel to maintain humidity. Photos: Kate Anton, Penn State.

Many beekeepers graft into colorful plastic cell cups, while others make their own from wax. There are several commercially available brands, the most common style is the plastic base mount cell cup (Figure 4.A). These cell cups are inserted into a grooved bar (Figure 4.B) that fits in a specially made frame. Alternatively, a grooved top bar in a standard frame may be used.

Figure 4. (A) Plastic base mount cell cup. (B) Grafting bar with cell cups. Photos: Kate Anton, Penn State.

Before grafting, many beekeepers prime their cell cups with a small amount of royal jelly mixed with water, although water alone can be used. Priming prevents larvae from drying and may provide a small amount of nutrition. Too much liquid, however, can drown the larvae. Nurse bees will remove the priming liquid and replace it with royal jelly in the cell builder.

Grafting Tools

A variety of commercial tools are available for this delicate work. Tool choice is subject to individual preference, and beekeepers often create their own from materials such as wire, a paper clip, or other common household items.

The German grafting tool (Figure 5A) is made of stainless steel and looks similar to a dental instrument. About the length of a pencil, this model is easy to grasp and offers the beekeeper a great deal of control and visibility inside the cells.

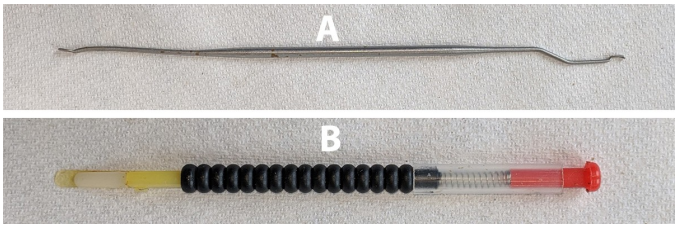

Figure 5. (A) German grafting tool. (B) Chinese grafting tool. Photos: Kate Anton, Penn State.

The Chinese grafting tool (Figure 5B) has a pliable plastic tip for sliding under the larva and royal jelly and scooping out the contents of the cell. A spring-loaded retractable mechanism allows the larva and royal jelly to be moved from the tip into the cell cup. This tool does not require cell cups to be primed, which can speed the grafting process. This tool is a common choice in commercial operations.

Grafting Technique

Grafting is delicate work that requires patience, a steady hand and excellent vision. To graft, lower the grafting tool behind the curve of the larva, maneuver the tool under the larva and the small pool of royal jelly, and gently lift and transfer the larva to the center of the cell cup (Figure 6). If using the Chinese grafting tool, simply deposit the larva and royal jelly in the center of the cell cup. When using the German grafting tool, surface tension from the priming liquid helps to transfer the larva from the grafting tool to the cell cup. Mastering this technique takes practice and repetition. Damaged, submerged, or poorly positioned larvae will not survive.

Figure 6. (A) Young larva in brood cell. (B) Larva and royal jelly on a chinese grafting tool. (C) Larva and royal jelly in detail. (D) Grafted larva in cell cup. Photos: Kate Anton, Penn State

When grafting multiple cell bars, be sure to cover the bars with a damp cloth to prevent dessication. After the desired number of grafts have been made, place the cell bars (with cell cups facing up) in the frame and transport it to the cell builder (Figure 7B). Invert the cell bar frame and lower it into the center of the colony (Figure 7A). Once this process is started, the queen cells should be handled gently, and care should be taken to avoid inverting queen cells again for the duration of development.

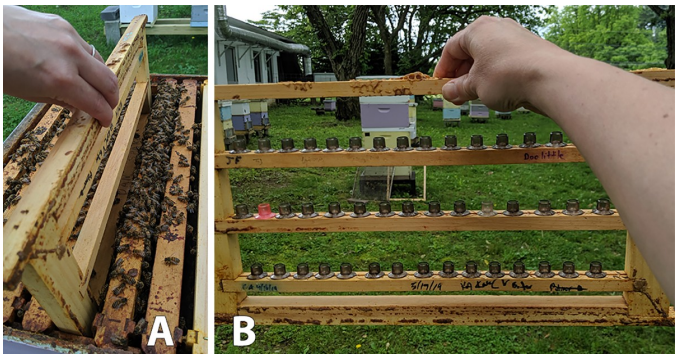

Figure 7. (A) Grafting frame placement in cell builder. (B) Grafting frame, with cell cups facing up, transported to the cell builder. Photos: Kate Anton, Penn State

Graft-free cell production

Grafting requires practice, excellent vision and a steady hand and is not practical for every beekeeper. There are many techniques to rear queens without grafting which work well for small scale production. Alternative graft-free methodsinclude the Jenter and Nicot systems, which allow for the production of numerous, moveable queen cells.

The Jenter and Nicot systems are graft-free systems that work by enclosing the queen in a special box that is positioned on a brood frame. The queen lays eggs directly into a 10 x 11 grid of

removable brown cell cups (Figure 8). Workers freely enter and exit the box to care for the queen and young larvae. When the eggs hatch into larvae, the brown cell cups are transferred into customized equipment that attaches to a cell bar (Figures 9A and 9B). The cell bars fit into a specialized frame that can be introduced to a cell builder or starter, as detailed above.

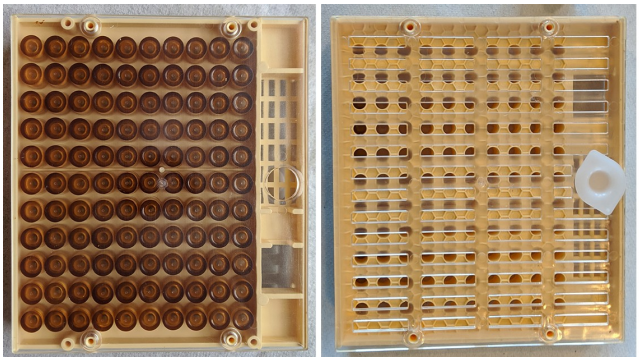

Figure 8. Nicot system viewed from the top and bottom.

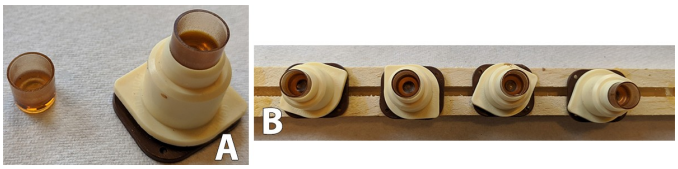

Figure 9. (A) Brown cell cup and Nicot cup holder and socket. (B) Cell bar with Nicot components. Photos: Kate Anton, Penn State

Large scale queen cell production has allowed the commercial honey bee industry to meet both agricultural and hobbyist beekeeping demands.Convenient and inexpensive, these methods make it relatively easy to produce any number of queen cells. This scale of queen production, along with the flexible behaviors inherent to honey bee colonies, are ultimately responsible for making honey bees the dominant pollinator in many landscapes.

More Information

- Information on honey bee biology: The Hive and the Honey Bee by Lorenzo Langstroth
- Information on queen rearing: Queen Rearing Essentials by Lawrence John Connor
- Learn more about The Grozinger Lab research
- Center for Pollinator Research
- This modification makes it much easier, and faster. An article about grafting modification.

This article is part of a series on biology and techniques for queen rearing from the Center for Pollinator Research at The Pennsylvania State University.

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