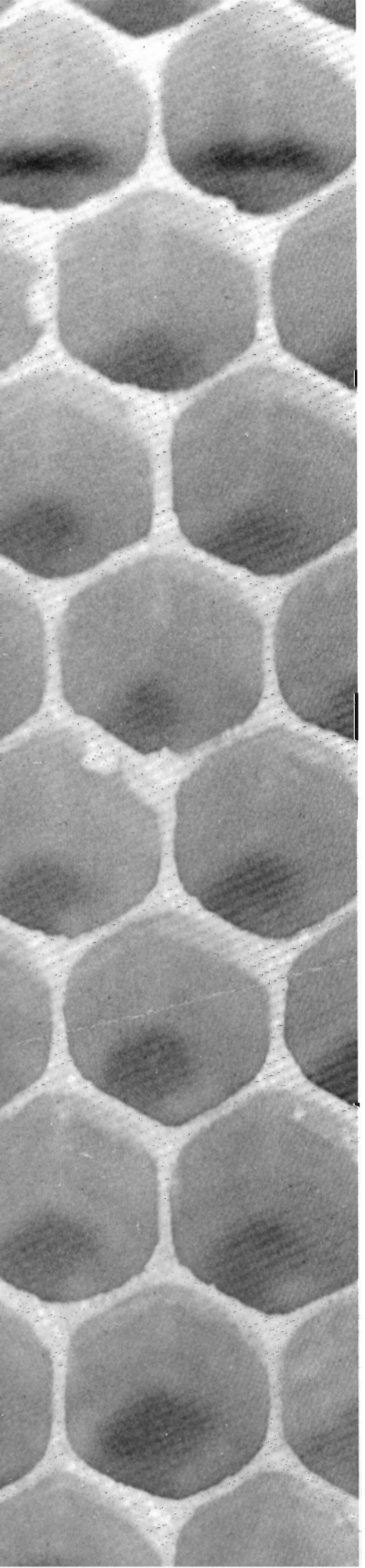

INFORMATION BULLETIN 209
A Cornell Cooperative Extension Publication

Small-Scale

Queen Rearing

by Beekeepers in the Northeast

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and
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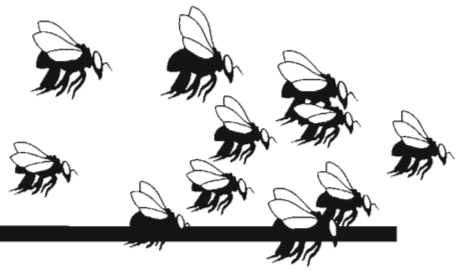
This publication is intended to help hobby or commercial beekeepers rear queens for their own use or for sale locally. Marketing and many other details of commercial queen rearing are not covered, although the procedures outlined here are similar to those used by commercial queen rearers. Experience in beekeeping is assumed, as well as familiarity with many beekeeping terms.

Rearing queens can be a useful skill. Beekeepers who rear their own queens not only save the cost of purchasing queens, but also have the option of improving their stock to suit themselves. For example, they may wish to select queens especially well adapted to local conditions.



General Points about Queen Rearing

Why rear queens?

Main reasons that beekeepers need additional queens are to requeen colonies in which the old queen appears to be failing, to head splits when increasing the number of colonies or replacing colonies that have died out, and to improve the stock of bees. For instance, colonies with aggressive bees can be requeened with gentle stock, or colonies where disease is a problem may benefit from queens of disease-resistant stock. In the Northeast, queens that will produce colonies with good wintering ability may be especially desirable.

What makes a good queen?

The three main attributes of a good queen are (1) that she comes from an egg laid in a good colony, which means a colony characterized by the qualities the beekeeper wants to encourage; (2) that she mates with drones from similarly good colonies; and (3) that she receives plenty of food as a larva, so that she will be large and, therefore, a prolific egglayer.

In practice it is difficult to control (2), because both queens and drones may fly several miles to a "drone congregation area" where mating takes place. Thus, queens normally mate with an uncontrolled mixture of drones from all the colonies within about a 5-mile radius. Large-scale commercial queen rearers try to increase the number of good drones in their area by putting extra drone comb in their colonies that surround the mating yard. Beekeepers with enough colonies or those located in areas remote from other beekeepers may also be able to control the local drone pool. Controlling (1) and (3) is fairly easy, and good queen rearing on a small scale largely consists of doing so.

When do bees rear queens?

Bees will rear a new queen in connection with swarming (colony reproduction); to replace a failing queen (supersedure); or in an emergency, to replace a queen that has died suddenly.

Queen rearing by the grafting method outlined here gets bees to begin the process of queen rearing by making them queenless. It simulates the emergency queen-rearing situation. Once the queen cells are started, however, they will be cared for even in a queenright colony, provided the colony has adequate food.

When can queens be reared?

Queens can be reared any time that colonies have drones. The easiest time to rear them is during the swarming season and during periods of nectar and pollen abundance. In New York, queens can be reared from late April until the end of September.

Where can queens be reared?

Queens can be reared anywhere that honey bees are kept. Some locations, however, require less effort on the part of the queen rearer.

The Process of Queen Rearing

Preparing equipment for grafting

The following equipment is used:

• Artificial queen cups. These are small cups of beeswax that duplicate the queen cups found in honey bee colonies, although the mouth is somewhat wider and deeper (fig. 1). They can be purchased quite cheaply or made to the correct dimensions with a small dipping stick. Some purchased queen cups come with wax bases so that they can be fixed to a cell bar. Those without wax bases are first attached to a wooden cell base, which is then attached to the cell bar. Plastic cups are also available commercially.

• Wooden cell bases. These are small cylinders of wood with one end drilled out to receive the closed end of a baseless queen cup. The flat side of the wooden cell base is attached to the cell bar with molten beeswax.

• Frame and cell bars. The frame is a normal wooden frame with no comb in it. Usually three horizontal, detachable cell bars are fitted into slots in the sides of the frame.

• Grafting tool. Metal tools for this purpose are sold, but better results can be achieved by whittling a toothpick (use toothpicks of rectangular, not circular, cross section) with a sharp razor. Cut the final ¼ inch (½ cm) or so of the toothpick into a gently tapering wedge, so that the pick becomes extemely thin, but is still broad, at the end (fig. 2). The aim is for the tip to bend easily if touched onto a surface. Before use, the tip of the pick can be moistened to make it more pliable. Make up a dozen or so picks at one time and store them, ready for use, in a small vial or jar with a lid.

• Royal jelly. Royal jelly should be collected beforehand from uncapped queen cells. Cells with 3-day-old larvae will contain the maximum amount. Use a special small spoon to scoop it out or squeeze the cell from the base so that the royal jelly comes out like toothpaste (fig. 3). The queen larva should first be removed using forceps or a toothpick. If stored in a well-sealed small bottle in a freezer (fig. 4), royal jelly will keep for over a year.

Frames are usually made up with three cell bars, each with 15–20 cups. Beeswax is used to make sure everything sticks together. The insides of the queen cups should be blown free of dust. Alternatively, a completed frame with cups can be put into a strong colony for about 2–24 hours to allow the bees to clean and polish them.

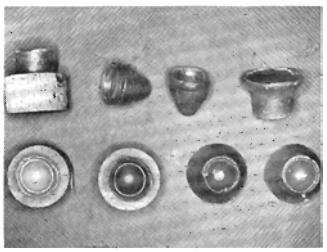


Figure 1. Commercially available queen cups of various types.

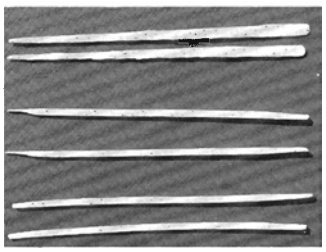


Figure 2. Wooden toothpicks as they come from the box (lowest pair) and as modified for grafting (top pair, top view; middle pair, side view).

Selecting colonies to graft from

Carefully select the breeder colonies from which to graft. To some extent, the characteristics of these colonies will appear in the colonies headed by the queens reared. The most desirable characteristics of honey bee colonies

NOTE: see page 7 for figures 3, 6-11, and 16-17.

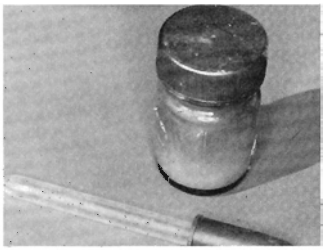


Figure 4. An eye dropper for priming cells with royal jelly and a glass jar with a lid for storing it.

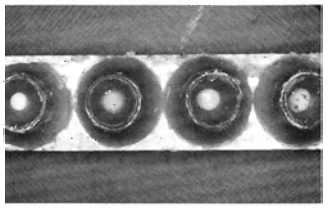


Figure 5. A view looking into queen cups primed with royal jelly diluted with water.

are usually considered to be high production of honey, absence of disease, ease of working (gentleness), good brood pattern, disinclination to swarm, good wintering ability, and, according to beekeeper preference, color of the bees. During normal beekeeping operations, note which colonies are most suitable and keep track of desirable colonies by using written records. If more than about 10 queens are to be reared, graft from several colonies rather than from only one. This helps to maintain genetic diversity and minimizes the chance of inbreeding in the bees in your operation. Inbreeding can produce queens with poor brood patterns.

Grafting

Grafting is initially the most difficult step in queen rearing, but it can easily be learned with a little patience. Most beginners have good results the first time by following the scheme described here. Good eyesight and a good source of light are needed.

The essence of grafting is the transfer of 1-day-old worker (that is, female) bee larvae into artificial queen cups. In practice the difficulty lies in doing this quickly and efficiently with very small larvae, without damaging them with the grafting tool or allowing them to dry out.

Follow these steps:

1. Prime each queen cup with a small drop of diluted royal jelly, using an eye dropper (fig. 4), just before grafting. Each drop should be about 1/8 inch (3 mm) across and, if possible, should form a rounded droplet in the middle of the queen cup, not a smear of liquid. Dilute the royal jelly beforehand with tap water (about half and half) to achieve about the consistency of the food in a cell containing a typical 1-day-old worker larva (fig. 5). On hot days, when evaporation is especially a problem, use slightly more water. It is possible to graft without royal jelly, either into a droplet of water or without any liquid (dry grafting), but the success rate will probably be lower. Once the queen cups have been primed, the bars containing the cups should be covered with a damp cloth or placed inside a nucleus box with dampened inner surfaces, to prevent the drops from drying out. Drying out can also be reduced by using a fine mist sprayer.

2. Obtain one or more frames of brood containing a sufficient supply of 1-day-old larvae from the chosen parent colony or colonies. (A suitable frame should be chosen ahead of time and marked. Confining a queen on a comb enclosed in screen within a hive is the best way to get a uniform supply of larvae of the right age.) The larvae should each be floating in a pool of food. Brush all the adult bees off the frame and put it into the dampened nucleus box or wrap it in a damp cloth. The frame should be removed from its colony only when you are ready to graft; otherwise, the larvae in the cells will gradually dry out, making grafting impossible, and will eventually die.

3. Seated comfortably, with a bright source of illumination behind you (fig. 6), place one end bar of the frame with the young larvae on your knee and hold the other end bar up so that the frame is in front of you at an angle of about 45 degrees. Place a bar of queen cups on the side of the top bar, holding it there with your hand.

4. Arrange the light so that you can clearly see the bottoms of the cells and look for an area containing the youngest larvae. Larvae to graft are almost transparent, skinny, C-shaped, and about one-and-a-half times the length of an egg (fig. 7). Resist the temptation to use larger larvae, because they may result in undersized queens. Take the grafting toothpick between first finger and thumb and insert it into the cell so that the tip touches the cell bottom. Then, gently push the pick in such a way that the tip goes underneath the larva, which is floating in its food (fig. 8). The pick is then lifted out with the larva on it. Ideally the larva should be half on and half off the tip of the pick (fig. 9). The larva is then transferred to a queen cup by touching it onto a drop

of royal jelly in a queen cup, then pushing down on the pick so that the larva floats off (fig. 10). Try to arrange things so that the larva is floating in the middle of the drop of royal jelly (fig. 11). Do not submerge larvae and never scrape them off, because such treatment may kill them. Larvae that get rough treatment should be discarded on the assumption that they have been damaged.

The process outlined is very quick and easy when done correctly. When all the cups on a bar contain newly grafted larvae, the bar is put into the moistened nucleus or put under a damp cloth. When all the grafting is done, insert the bars into the frames and put them into the starter colony. Aim at getting grafted larvae into the starter colony as soon as possible to minimize any drying out.

Grafting requires good illumination. The sun is a good source of light, but grafting outdoors encourages robbing by bees; the larvae themselves attract robbers, and bees will pluck them from an exposed comb. To minimize this possibility, don't graft right in the bee yard. The sun also dries out larvae very quickly. If you work indoors, you potentially have more control over the environment and can also make yourself more comfortable.

Preparing a starter colony for newly grafted larvae

After grafting, the frames of queen cups with young larvae are immediately transferred to a specially prepared starter colony (fig. 12). A starter colony is a strong colony with many workers but no brood or queen. In this condition the bees will very readily "start" a large number of queen cells when given grafted young larvae. The starter colony must be prepared beforehand. Begin preparations several days before you graft by feeding a strong colony extra sugar syrup (unless there is a honey flow) to get the bees into top shape.

The two main ways of making up the starter colony are as follows:

Pritchard method. In this method the colony is left in position, but the queen, all the brood, and most of the frames are removed. As frames are removed, most of the adult bees clinging to them are shaken off so that they remain in the starter colony. Leave behind just one single hive body containing six to eight frames, including at least two frames of honey and two with pollen. The frames of grafted larvae are put into the middle of the colony 4–24 hours after removing the queen and brood. The queen can be kept alive in a queen cage for a day or two, and the frames of brood can be put into a super on top of a strong colony to be looked after. The starter colony should be fed sugar syrup unless there is a good honey flow. It is absolutely essential that the queen is not in the starter colony.

Swarm box method. In this method about 6 pounds (3 kg) of bees from one strong colony, without the queen or brood, are put into a nucleus box or hive body that is screened on the bottom and has a lid on the top, so that the bees are trapped in the box. You will probably need a funnel and a package cage to do this. (The brood and queen can be left in the original colony, if there are still enough bees left to care for them. If not, some of the brood should be given to other colonies.) Inside the box are two frames containing pollen and at least two containing honey. Frames of grafted larvae are inserted a few hours after making up the swarm box. The swarm box is then taken indoors, to a place where the temperature will not vary much, and fed with a jar of sugar syrup. The box can be left outside provided it is shaded and the bees are given a feeder jar of dilute syrup with which to feed and cool themselves.

With either method, up to 100 larvae in queen cups can be given to a starter colony, although the success rate may be greater if only 40–50 are given. The grafts are left in the starter colonies for 20–30 hours and then transferred to cell-building colonies. (The bees in the

Figure 12. A populous starter colony, showing a frame of started queen cells being removed 24 hours after insertion.

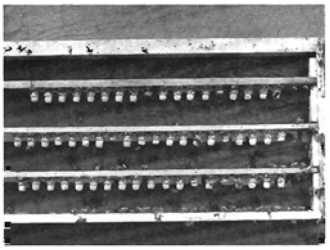


Figure 13. A frame of about 60 queen cups after 24 hours in a starter colony. About 85 percent of the cups have been accepted.

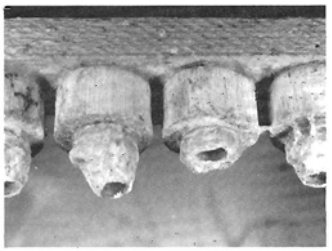


Figure 14. Queen cups 24 hours after grafting. One of the grafts (second from right) was not accepted by the bees.

Figure 15. Feeding a colony with a gallon jar of sugar syrup. The jar is inverted over the inner cover hole and then covered with an empty super; the jar's lid is perforated with small (about 1/16 in., or 1.5 mm) nail holes.

starter colony do not have the resources to successfully look after them for longer.) The starter can be used again on a fresh batch of grafted larvae on the second day, although fewer larvae can be started because the resources of the starter are somewhat depleted. The original workers, queen, and brood from the starter are then reunited. If possible, cage the queen for a day or two in case the bees try to reject her. It is not necessary to destroy a colony to make a starter; bees are merely borrowed and are returned after a day or so.

Preparing a cell-builder colony

After 20–30 hours in the starter colony, larvae in the queen cups are swimming in royal jelly, and the edges of the artificial queen cups are slightly drawn out and rounded over (figs. 13 and 14). In this state they will be accepted and fed by a strong queenright colony, known as the cell-builder colony.

A cell-builder colony should be strong and should be fed with sugar syrup (except during a honey flow) for a few days before, and during, the cell-building process, which takes about 4 or 5 days. Use a feeder that is inside the hive—for example, an inverted gallon glass jar inside an empty super (fig. 15)—to prevent any robbing. When the bees have plenty of resources to feed the developing queen larvae, then heavy-bodied, highly fertile queens are produced. More than anything else, the quality of the queens produced will depend on the care they receive in the cell-builder colony. Studies have shown that heavier queens result in larger honey crops. To check that your queen larvae are getting plenty of food, sacrifice a few capped queen cells by cutting them open to observe whether there is unused royal jelly in the base of the cell (fig. 16). If so, it is a good sign, for more food was provided by the workers than the queen larva could use.

Each cell builder should be given 20 or fewer cells to build, depending on the food stores and the population of nurse bees in the colony. (Exceptionally strong colonies may be able to rear more than 20.) The frame (or frames) containing the started queen cups is put above a queen excluder, directly over the brood chamber. Frames containing young brood and pollen are put on either side to attract some nurse workers to the area of the hive containing the queen cups. The colony stays strong, with lots of nurse bees, as its adult queen is active and laying below the excluder.

After 5 days the queen cells are all capped. The newly capped cells contain queen larvae, which soon turn into pupae (fig. 17). The young queen in a capped cell is extremely delicate, and the capped cell should not be handled at all until 9 or 10 days after grafting (fig. 18). Cells 10 or more days after grafting are referred to as "ripe." At this stage, until 24 hours before adult emergence, the pupae inside the cells are still quite delicate, but the cells can be handled if care is used.

Making up mating nuclei; queen development

The development of a queen from the time the egg is laid to the time she emerges as an adult from her cell takes about 16 days. If we imagine, to be on the safe side, that the oldest larva that was grafted was 48 hours old (= 5 days old including the egg stage, which lasts 3 days), then the first queen will start to emerge 11 days after grafting. On emergence the first queen will attempt to kill any queens that are still in their cells. For this reason the queen cells must be split up into individual colonies a day or two before the first queen is expected to emerge. Generally the queen cells are put into queenless nucleus colonies on the 10th day after grafting.

Nucleus colonies (known as nucs) are simply small colonies. Often they are in specially made two- to six-frame

Figure 3. Royal jelly squeezed from a queen cell for harvest by the queen rearer.

Figure 6. Position for grafting outdoors. Note that sunlight comes over the shoulder and the frame is tilted so that light shines into the cells.

Figure 7. A piece of comb cut back to show larvae of grafting age. Note that these larvae are not much larger than the eggs in the adjacent cells.

Figure 8. A cell cut lengthwise to show how a young larva is lifted off with a grafting pick.

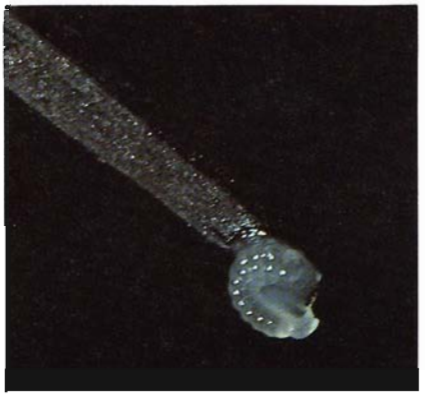


Figure 9. Grafting pick with a young larva on the tip.

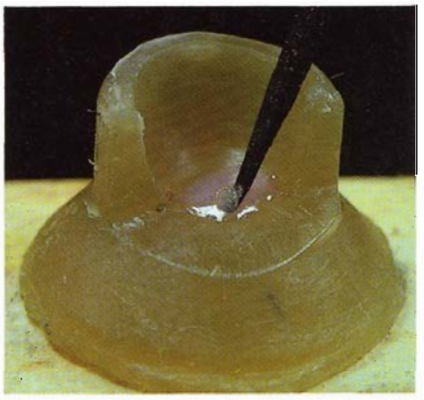


Figure 10. Depositing a young larva into a primed queen cup. (For this photograph, the royal jelly has been stained pink, and a side of the cup has been cut away.)

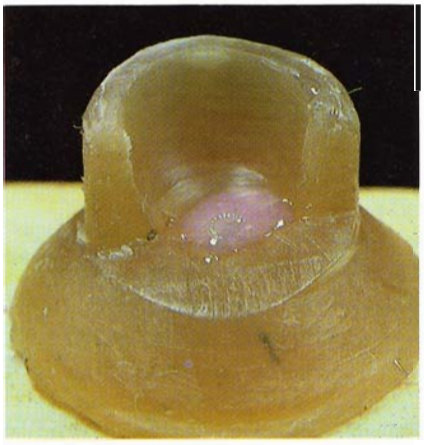


Figure 11. Young larva after grafting. Note that it is floating on the surface of the royal jelly, which has been stained pink for photographic purposes.

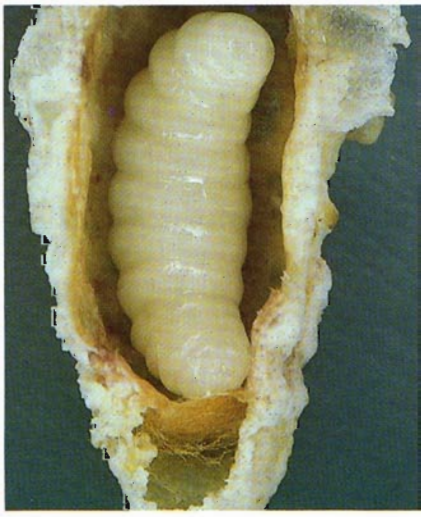


Figure 16. A queen cell cut open to show the developing larva, 5 days after grafting. The wax cell capping and the tip of the cocoon can be seen. Royal jelly fills the base of the cell.

Figure 17. A queen cell cut open to show the developing pupa, 7 days after grafting. At this stage, the developing queen is quite fragile, and great care should be used if the cell must be handled.

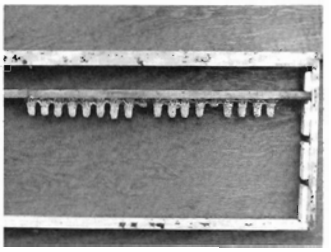


Figure 18. A bar of queen cells removed from a cell-builder colony 9 days after grafting.

Figure 19. Three types of mating nucs (left to right): three-frame nuc; two-way nuc (note separate entrances; inside there is a thin board dividing the hive into two equal halves); six-frame nuc.

Figure 20. A ripe queen cell gently pushed into an area of brood in a mating nuc or a colony to be requeened.

boxes with built-in bottomboards, but a single Langstroth hive body can also be used (fig. 19). Always use frames of standard dimensions so that they can be interchanged with other beekeeping equipment.

Nucs should be made up a few days before the ripe queen cells are ready to be transferred, and they should be queenless. The following are a few methods for making up nucs:

- Put a few frames of bees, brood, and honey into a nuc box, block the entrance with a piece of screen, tape, or even grass, and move it to a new location at least 1 mile away. Open the entrance in a day or two. Make sure that the bees do not overheat or suffocate; provide shade or water in a feeder, if necessary.
- Do the same, but leave the nuc in the same yard. Many of the field bees will drift back to the parent hive, so use more bees and include a frame of emerging brood.
- Take a strong colony standing on its own. Surround it with empty nucs and split the entire colony equally into three to six nucs, the exact number depending on the strength of the original colony. The queen should be taken away; if she is left in one of the nucs, most of the bees will join that nuc. Remove the empty hive bodies from the original colony. The returning forager bees will distribute themselves fairly evenly among all the nucs.
- Split a two-storey hive into two colonies side by side. The split that does not contain the queen from the original colony is now available to receive a queen cell.

It is also possible to requeen a strong colony with a queen cell. Find the queen in the colony and remove or kill her. Insert a ripe queen cell. The emerging queen will become the colony's new queen. This is an easy and labor-efficient requeening method.

Making up nucs is perhaps the hardest task in queen rearing, and much of the skill in queen rearing involves managing nucs effectively. Following emergence it is usually 9–14 days before the new queen begins to lay eggs. Skilled queen rearers arrange for a new batch of queen cells to be ready about 15–20 days after the previous batch. In this way the recently mated queen has about a week to lay eggs in the nuc, thus replenishing the supply of workers in the nuc, before she is removed and replaced with a ripe queen cell. As a result the nuc only has to be made up once for repeated sequential mating of queens.

Transferring ripe queen cells to nucleus colonies

Break or cut off the cell base from the cell bar and carefully lay the ripe queen cells plus cell bases on a piece of soft cloth inside a suitable box with a lid. Protect the ripe cells from the sun and do not chill them. The queen cells are then quickly transferred into queenless nucs. The queen cell is wedged between the top bars of two frames in the part of the nuc having the most brood and bees or wedged lower down in the actual brood area (fig. 20), so that the cell will be kept warm by the bees. Each nuc should have at least two frames of bees and one frame of honey. Starving nucs are unable to keep a queen cell warm.

The mating yard

A mating yard is a beeyard in which mating nucs are kept. The mating nucs are frequently arranged in such a way as to make it easy to inspect them. Some queen rearers put them off the ground on a tall stand to minimize bending over by the beekeeper. Any apiary can be used as a mating yard. Space out mating nucs, face them in different directions, and paint them different colors to make it as easy as possible for the queen to return to the correct nuc after her mating flight.

What to do with queens

When a queen is removed from a mating nuc she is generally put into a queen cage and is used to requeen a colony right away, sold, or "banked" (stored in a cage within a colony) for up to a few weeks. Many queens can be banked together in a single queenless colony that is fed sugar syrup containing fumigillin (available commercially as Fumadil-B). This procedure ensures that they are cared for and protected against nosema disease. If you bank your queens, do not put attendant bees into the queen cages and replenish the supply of bees in the colony every 5 days by adding frames of capped brood. A queen bank will fail unless there is an abundance of young adult bees. Queens can also be banked in a queenright colony directly above a queen excluder, with the colony's queen below.

Alternatively, a mating nuc can be developed into a normal colony, either by allowing it to increase naturally or by adding brood and bees to speed up the process.

Summary

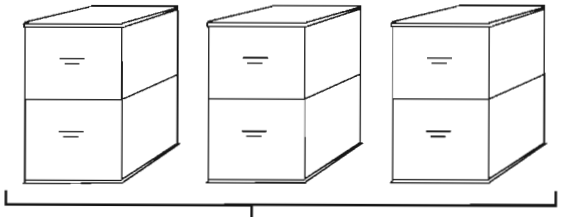
The table on this page and the summary on page 10 describe the development of a queen from egg to laying queen and the sequence of queen-rearing tasks that should be carried out. Tasks marked * are obligatory on the day mentioned. Transfer of ripe queen

Process of Queen Rearing

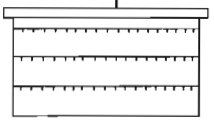
Day	*Queen-rearing day*	*Stage of queen development*	*Queen-rearing tasks*
0–1		Egg	
1–2		Egg	Feed colonies that will become starter and cell builder.
2–3		Egg	Make up frame bars, select colony to graft from.
3–4	1	Larva in uncapped worker cell	Make up starter colony or box,* graft larvae.*
4–5	2		Prepare cell builder(s) and put started queen cups in.*
5–6	3		
6–7	4		
7–8	5		
8–9	6	Larva in capped cell	
9–10	7		
10–11	8	Pupa in capped cell	
11–12	9		Make up queenless mating nucs, one per ripe cell.
12–13	10		Transfer ripe queen cells from cell builder to nucs.
13–14	11		
14–15	12		
15–16	13	Adult queen emerges	
20–25	18–23	Queen goes on mating flights	
25–30	23–28	Queen begins egg laying	
30+	28+		Remove queen from nuc and replace with ripe queen cell (grafted 10 days previously). Look at remains of queen cups to analyze what went wrong, if anything.

Steps to Follow in Rearing Queens

Breeder colonies
(queenright)



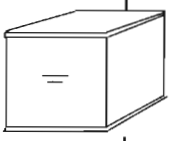
Choose breeder colonies with the properties you wish to encourage in your bees.



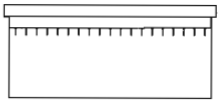
Grafted one-day-old larvae

Grafting: Transfer up to 100 one-day-old larvae from worker cells in the breeder colony to artificial queen cups held on bars in modified frames. Then, immediately transfer the frames of queen cups to a starter colony. The starter colony should be strong and well fed; also, make sure that the queen and brood have been removed in the previous 2–24 hours, so that the colony is newly queenless and broodless.

Starter
(queenless)



Put in up to 100 one-day-old larvae per colony

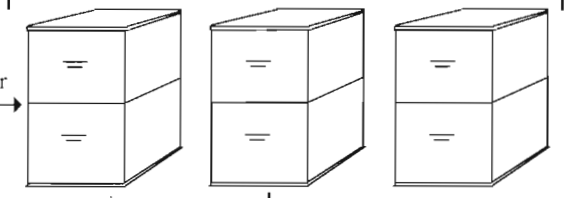


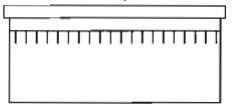
Transfer started cells to cell builders

After 20–30 hours, the queen cups will have been "started," with queen larvae swimming in royal jelly. Transfer them to strong, well-fed cell-builder colonies, placing the frame of queen cups between frames of young brood above a queen excluder. Up to 20 cells are given to each cell-builder colony.

Cell builders
(queenright)

Queen excluder

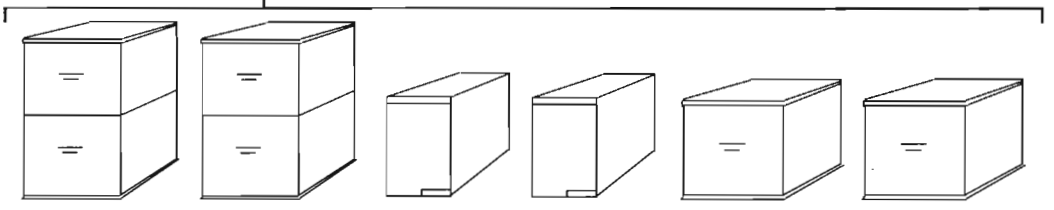




Frame of ripe queen cells

Transfer individual ripe queen cells to colonies that have been made queenless within the previous few days. Small colonies, known as nucs, are commonly used.

Put queen cells into queenless colonies—one cell to a colony—before queens start emerging.



Normal honey production colonies being requeened with queen cells

Nucs being requeened

Splits being requeened

cells can possibly be brought forward or delayed 1 day. Other tasks are more flexible. Queens can be removed any time after 2 weeks following emergence. Future starter and cell-builder colonies can be fed anytime before grafting, provided they are strong and populous at grafting time.

Troubleshooting and success in queen rearing

Queen rearing is difficult largely because of the many steps: grafting, starting, cell finishing, introducing cells into nuclei, mating. Being a successful queen rearer necessitates reducing losses at each step. Also, the timing of several steps is critical. Improving your queen-rearing technique is possible by noting exactly what has gone wrong and making appropriate corrections.

A problem in grafting or starting is fairly obvious. The quality of your cell builder can be gauged by inspecting the capped queen cells; they should contain extra royal jelly. It is not so easy to tell whether failure in the mating nuc is due to the queen not emerging or to the queen failing to return from her mating flight. Examine the nuc a week or two following the scheduled emergence of the queen. If there is a laying queen, all is well. If not, examine the remains of the queen cell. If there is a circular hole at the tip (fig. 21), then the queen emerged normally and probably died on the mating flight. If the cell has a hole in the side but no hole at the tip (fig. 21, left), then it was torn down by the workers, probably because the queen was dead when introduced into the mating nuc or became chilled in the nuc. If the cell has no holes, then it will contain a dead queen that the bees have not yet removed. In the latter two cases you should suspect that you are damaging the queens somewhere between cell capping and emergence. Eventually the bees will tear down the remains of the queen cell, making this diagnosis impossible.

If the queen cell is dead, the bees will often start to convert young larvae, if there are any in the nuc, into emergency queen cells. It is unlikely that these will provide good queens, and in any case, the queens reared will not be from your chosen breeder colony. Therefore, they should not be allowed to develop.

A nuc that fails to rear a queen can be given a second cell later; it can be maintained, if necessary, by giving it a frame of young brood to keep up the population.

Books on Queen Rearing

There are many references on queen rearing, including numerous books, chapters in several general beekeeping texts, and articles in beekeeping magazines. Some of the most complete and useful books are listed here.

Laidlaw, H. H., Jr. 1979. *Contemporary queen rearing*. Dadant and Sons, Hamilton, IL 62341.

Kelley, W. T. 1940. *How to grow queens*. Walter T. Kelley Co., Paducah, KY 42001.

Morse, R. A. 1979. *Rearing queen honey bees*. Wicwas Press, P.O. Box 817J, Cheshire, CT 06410

Smith, J. 1923. *Queen rearing simplified*. A. I. Root Co., OH 44256.

Of these, only the book by Laidlaw is still in print. The others may be available in libraries, secondhand book stores, or private collections; or they may be reprinted by the publishers.

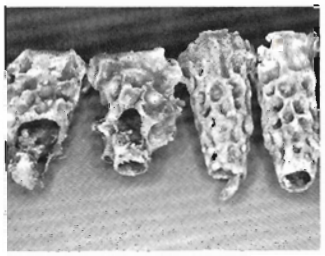
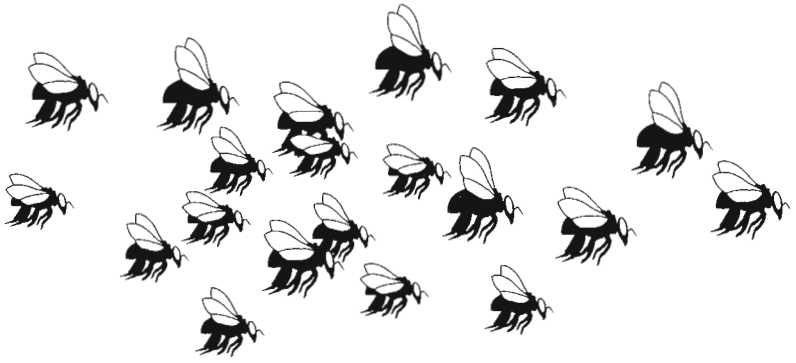


Figure 21. Queen cells provide evidence of success or failure in queen rearing. No queen successfully emerged from the cell on the left; note that the tip of the cell is unopened and the side is torn down. A queen successfully emerged from each of the other cells; note that each has a circular hole at the tip.



The following information bulletins on other aspects of beekeeping are also available:
Bait Hives for Honey Bees 139 IB-187
Beekeeping: General Information 139 IB-90
Identification and Prevention of American Foulbrood 139 LFS-925.00
Package Bees: Their Installation and Immediate Care 139 IB-7
Wintering Honey Bees in the Northeast 139 IB-109

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