

Natural Supersedure of Queens in Honey Bee Colonies

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Definition and reasons of supersedure

Supersedure, as it relates to apiculture, is the bees' way of replacing an existing queen with a new queen in the same hive, without intervention by the beekeeper. Thus supersedure is nature's way of re-queening. Generally this occurs in the spring, summer or in early autumn months. The queen supersedure process differs from that of swarming which is associated with reproduction, and in which one or more queens are raised and the old queen leaves the colony with a swarm, leaving the new queen with the hive. No new colony is formed when colonies supersede their queen. Supersedure queens are raised out of need; swarm queens result from a physiological urge in the colony.

Supersedure queens are raised when the bees are unhappy with the performance of the current queen and decide to replace her. Evidently the queen must not be doing exactly what the bees expect of her. A number of reasons might account for this, such as physical condition of the queen (missing a leg or wing), old age, disease such as nosema, depleted spermatheca, poorly bred queen (developed from old larva rather than new larva), not making enough pheromones, or even no new bees emerge for 21 days following introduction of a package in a new hive.

The honeybees know more about the condition of their queen than we could ever know by just looking at her. Apparently bees determine queen failure through a special chemical substance or pheromone produced by the queen from her mandibular glands. This pheromone is passed on to her attendants or retinue via touch, grooming and feeding and hence to the other bees in the hive as they share food. The presence of this pheromone inhibits queen cell building as well as the development of the workers' ovaries. Bees evaluate their queen based on the quality of this pheromone she produces. If they begin to receive an insufficient amount each day, they may perceive she is not up to the job. A young, healthy queen inhibits her replacement. Her pheromone is strong. As she ages her pheromone secretion declines; the bees will sense this and set about raising new queens to replace her with a daughter queen.

The stronger the queen's pheromones, the more acceptable she is to the bees. Older queens are frequently replaced or superseded more than younger queens due to age differences in pheromone secretion. The colony population size may also influence whether a colony supersedes its queen. A queen may secrete adequate pheromone to supply a small colony. A large colony is more likely to replace its queen than a weak colony, possibly because overcrowding causes poor pheromone distribution of the queen throughout the hive.

Usually a queen that is being replaced through supersedure is failing in some way, perhaps is old and is deficient in egg laying. However, on occasions, bees will supersede young, vigorous and good laying queens. We cannot tell all the subtleties, such as level of queen pheromone, just by looking at the brood pattern. Maybe she is laying fine, but not producing enough pheromones to satisfy the bees of the hive, or she is infested with nosema or viruses. One will also, at times, observe a queen with a poor brood pattern, but who is still not being superseded. Perhaps she is still producing plenty of queen pheromone and that is probably the most important factor. Perhaps there is nothing wrong with the queen. It could be that the queen is from highly hygienic stock. There may be mites, disease, or poisoning in the brood and the bees are cleaning up all the affected larvae and pupae so you don't notice, or perhaps the colony does not perceive that the conditions are just now proper for replacing the queen and having her mate successfully.

Queen raising by honeybees

Queens are naturally raised in three different circumstances: swarm queens, supersedure queens, and emergency queens.

Queens are raised in specially constructed cells that start out as queen cups for the resident queen to lay eggs in. Queen cups are larger than the worker and drone cells and are oriented with the cell opening downward.



Empty queen cups

Photo source: Little eco footprints.com

When the queen cup is occupied is called a queen cell. Queen cells that begin from a queen cup are either swarm cells or supersedure cells. After an egg is laid in a cup, the worker bees extend the cup into a queen cell in which the queen is raised. Worker bees do not extend the queen cups into queen cells unless they have had eggs laid in them. The completely constructed queen cell is somewhat shaped like a peanut pod, usually 25-29 mm (1-1½ inches) in length and hangs downwards from the comb.

The new queen spends its stages in the cell as it develops from egg to larva and then pupa. The worker bees feed the larva abundantly on royal jelly for the entire larval stage. This special feeding produces a female with fully developed reproductive organs. When the larva is ready to pupate they cap or seal the cell with beeswax. When the virgin queen is ready to emerge, she will bite her way through the bottom of the cell. When she has emerged the cap may still be attached to the cell.

The queen bee needs 15-16 days to develop and leave her cell, depending on the temperature. Bees usually raise several queens at the same time. The first queen to emerge from her cell will immediately sting the unhatched queens to death while they are still inside their cell. If there is more than one queen in a colony, the queens will fight to the death. After about 4-7 days, the virgin queen is ready to mate. The newly mated queen can commence laying eggs after two to three days.

Identification of queen cell types

When opening a hive and finding queen cells, the inexperienced beekeeper is tempted to destroy them as a swarming prevention measure. Not all queen cells are necessarily swarm cells. As mentioned previously, there are three types of queen cells. Only the presence of swarm cells indicates that the colony is preparing to swarm. The other two types are present for different purposes.

Destroying queen cells may lead to queenlessness. It is vital for the beekeeper to be able to identify and understand the different types of queen cells to perceive what is happening.

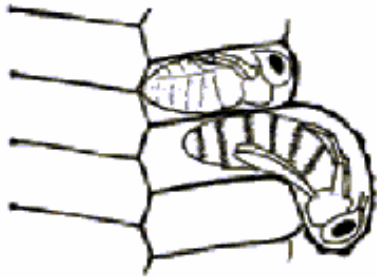
Emergency cells are built when a colony becomes queenless. The queen may have been killed accidentally, or dropped onto the ground during hive manipulation. Emergency cells are also started if the queen is removed from a colony by the beekeeper when making an artificial swarm.

The bees in such a colony begin to raise a new queen in a hurry by converting worker cells containing young larvae into emergency queen cells. The number of queen cells produced under emergency impulse is variable and depends upon the size of the colony. In a strong colony many are sometimes raised; a small or weak one makes a few. Often the bees will build two, three or more at the same time.

The nurse bees start to feed the larva that is destined to be a queen lavishly on royal jelly exactly as when they raise a queen for swarming or supersedure.

The mouth of the selected worker cell is enlarged outward and downward like regular queen cell to accommodate for the increased size of a queen. The emergency cell is typically part horizontal and part vertical with a right angle

bend in the middle (see drawing below). When an emergency cell is opened, it can be seen that it has a worker cell base.



Emergency cells are built anywhere that there are larvae or eggs, although a central position on the comb is common. They look smaller than queen cells for swarming or supersedure.



Emergency queen cells raised by queenless hive from enlarged worker cells

Supersedure cells occur when the colony has decided to replace the current queen. The supersedure cell is started as a natural queen cup. The colony raises only a few cells, commonly 1 to 3, and they tend to be nearly uniform in age. They are typically raised on the face of a brood comb and in the same comb, not along the comb edge and near the bottom bars like swarm cells. These cells are usually long and heavily covered with beeswax. Supersedure cells can occur any time in the active season when a queen is failing.

In the process of natural supersedure a new queen develops, while the old one continues to lay eggs. The old queen is not killed until the new queen has successfully mated and begun egg laying. This toleration of the old queen may be a safeguard, ensuring the presence of a laying queen, in the event of the virgin queen fails to return from her mating flight.

In some cases, the young, new queen and the old one may both live in the hive in harmony for some time, but generally the old queen is killed at the end

of the supersedure. It is not known whether she dies a natural death or is killed by the young queen or by the bees.

Supersedure queen cells do not require any intervention from the beekeepers, except to leave them alone and let the supersedure run its course. The bees know something is wrong with the queen and want to correct it.



Two supersedure queen cells on the comb face
Photo by Richard Underhill



Well formed supersedure queen cell in the center of brood comb
Photo by Mark Gretchen. Queen cell/beeranch.wordpress.com



The original queen circled in green and her replacement circled in red, both are laying eggs on the same frame following supersedure
Photo by Micheál Mac Giolla Coda

Swarm cells are the most common type, built from queen cups for raising new queens when the bees preparing to swarm. Swarm cells are the most numerous; about six to twelve are generally produced. Some colonies build up to 50 of them. These cells are typically located on the bottom portion of the comb or in gaps in the comb within the brood area. In general, several cells are started at intervals during a period of several days and are seen at various stages of development.



Swarm cells on the bottom of a comb
Photo by George Smichinski

Natural Supersedure – Is it Good or Bad?

- Queens raised as a result of supersedure are often of good quality since they receive larger quantities of royal jelly during development. Capped supersedure cells can be cut out and used in making new nucleus colonies or requeening.
- The hive will have a new queen. A very young queen is a better laying queen than an older queen and has the ability to produce enough of her pheromone to spread over all the bees in a large colony.
- Colonies that have just superseded rarely swarm unless the colony is overcrowded and does not have enough space. This is a very important matter from the beekeeper's standpoint.
- Good stock can come from superseded queens but you may also get an aggressive mix. If you have a pure queen and she is superseded, her daughter will have 1/2 of her genetics passed on to her offspring. The drones she mates with will provide the other 1/2. Thus, if she mates with drones of other races, the bees she produces will be hybrid because they will have genetic material from both parents.
- Natural supersedure is done by the bees when there is something wrong with the queen. This means the colony is not at peak potential and will not be until they get a new queen (about 30 days).

How to prevent supersedure

A well mated and healthy queen bee should have a life expectancy of three to five years. Then she has to be replaced or the queen will run out of sperm, the colony will become queenless, and it will perish.

The best practice to prevent the colony from initiating supersedure is by requeening the colony every year, or at least every other year.

When you replace the old queen yourself with one that is purchased from a reputable queen breeder, the queens and drones come from "gentle stock". When your supersedure queen (probably of good queen stock) flies off to mate, you have no control over the drones with which she is mating. They may or may not be from stocks that you want in your hives.