Drone Saturation

For Small Scale Operations

Larry Connor

Drone Holding Colonies (DHCs) are special colonies that are made up much like a cell finisher used in queen production, but instead of finishing queens, you will use it to finish and hold drones. Here's How.

What is drone saturation?

The idea behind drone saturation is based on several bits of knowledge of bee mating biology.

First, we've known for a long time that a virgin queen mates with more than one drone. Recently, Dr. David Tarpy of North Carolina State University wrote that the average queen mates with 13 drones (13.2 is the mean), with the range from one drone to 45. Think about it – 45 drones, that is a lot of drones for one virgin queen. She must have been quite the drone killer. But even at 13, the numbers add up if you are mating dozens or hundreds of virgins at the same time.

Second, we know that drones and virgin queens from the same colony have different behaviors in selecting the mating area they fly to (the Drone Congregation Area or DCA). Virgins seem to fly out further than the drones, probably in response to some evolutionary instinct to prevent inbreeding. This creates a real headache for the beekeeper wanting to control mating in his or her queen rearing operation. Unless the beekeeper has access to an isolated area, creates artificial isolation, or uses instrumental insemination, there is a very high probability queens will mate with some undesirable drones (what I call *non-target drones* in the rest of this discussion).

Third, if a virgin queen mates with 13 drones, that means that there must be many more unsuccessful drones produced to provide the best of the successful sexual partners. If only a small percentage of all the drones are successful in mating (as suggested in the literature), it means that the beekeeper must provide a *huge* number of drones for every queen so that she is fully mated. It serves no purpose or benefit for virgin queens to mate with weak drones, poor fliers, drones with development problems (poor pollen nutrition, exposure to coumophos, diseased conditions in the hive, etc.), and old drones (known to carry diseases to queens).

Flooding an area with drones of diverse genetics

There are two aspects of the drone flooding activity. First, you must produce a large number of target (desirable and compatible) drones to mate with the virgins you will produce. Second, you must somehow get rid of or restrict non-target drones (those of unknown characteristics, incompatible genes, or ***African origin***).

To increase disease resistance, the beekeeper should take steps to increase the genetic diversity of the drones being produced for mating. The use of a single drone source works *against* the natural instinct of the virgin to mate with a mixture of drones that are not genetic brothers. This is a huge change in thinking for a lot of people, like myself, coming from the background of producing a drone line for the Starline and Midnite hybrids. In the past our goal was to saturate the mating area (not mating yard) with drones of *one* desirable type. These were closely related drones, coming from the same drone mother breeder. Now, David Tarpy and Tom Seeley's observations are clear – that in nature, mating to closely related drones **is not desirable**.

Diversity is to be celebrated in the beehive when it comes to the variation of the queen's mating partners. To achieve this level of variation will require the use of multiple, unrelated drone sources, but all of target lines.

With *Varroa destructor* well established in North America, and with the African bee working it's way through the southern parts of the country, many beekeepers are looking for ways to provide a local, acclimatized stock of honey bees that will provide healthy, vigorous colonies that have mite tolerance/resistance, and mated in such a manner as to eliminate ***any*** intrusion by African bees. Colony vigor is a key aspect of these programs, and essential for successful queen production.

This article has evolved from talks I gave at the Southern Adirondack Beekeepers Association annual seminar in March (Albany), and at the Maine State Beekeepers Association (Augusta) in April.

Flooding with target drones

If you are a sideline beekeeper with 40 colonies, you are in luck, because I am going to pick that colony number as a model for our discussion about queen production in a mating area that you have managed for drone saturation. Traditionally, beekeepers have attempted to obtain saturation by moving in an adequate number of colonies to guarantee target drones. In our model, this would mean that you will need to move in all your colonies, all 40 of them, into the queen mating area you have worked to develop. If you have selected a somewhat isolated area where there are few surrounding colonies, or if you found a secure, large location owned by a single landowner, or if you have just been lucky and fallen into a good mating area, there is an excellent chance that this area *is not* ideal for nectar production. So you are trading good mating success for all the queens you plan to produce for a large chunk of the honey crop.

Well, that just doesn't make much sense. Moving bees is hard work (with 40 colonies I doubt you have mechanized the colony moving process). It will cost you labor, fuel costs and lost queens to move those bees, plus you have written off part, maybe all of your honey crop. Fortunately, there is a way to avoid most of these problems.

Drone Holding Colonies (DHC's) are special colonies that are made up much like a cell *finisher* used in queen production, but instead of finishing queens, you will use it to finish and hold drones. You can remove frames of drone brood (at the sealing stage or later) and put the frame into a special hive body. Between these you will insert frames of worker brood. All the adhering bees go along for this, checking for the queen as you go through each colony. You will build a nine or 10 frame colony in this manner, and use it to mature drones in the brood stage, sexually finish the drones so they are optimally ready to mate, and hold them during mating attempts. And, instead of moving all your 40 colonies into the mating area, you will move just the DHC's, cutting your labor and fuel costs while keeping the rest of your colonies in their honey production locations. What could be better?

Isolated mating area in Louisiana used by the USDA-ARS laboratory in Baton Rouge to mate Russian lines of queens. Under these conditions, there are no other drones available, and the mating takes place if not interrupted by dragonflies, hurricanes and other problems. The tower used to take this photo was destroyed by last year's hurricanes. (Photo provided by USDA/ARS Baton Rouge Bee Laboratory)

A typical DHC or drone holder colony is made up of four frames of drone brood from target drone producing colonies, three or four frames of worker brood, adhering bees (no laying queen), and frames of pollen and honey. I suggest you attempt to harvest one frame of drone brood from each target drone-producing colony, which will be all 40 colonies if we do this right. To this we will add one *caged* virgin queen – healthy and vigorous but caged so she cannot fly. This queen is the essential part of the DHC or drone holder colony. Her presence tells the bees, biologically anyway, that they are undergoing queen replacement, since there is no queen laying in the combs. Further, she is producing pheromones and will suppress the development of laying workers and queen cell production. The latter is not absolute, so you will need to check the DHC in seven to 10 days to make sure that no queen cells are produced. If a queen is produced and starts to lay brood, the drones will be neglected and rejected by the worker bees; the numbers of drones will drop from thousands found in a healthy DHC colony to a few hundred found in a colony with a laying queen.

The DHC should be fed sugar syrup (I use a top feeder so drones are not lost in a division board feeder) as well as pollen supplement *at all times*. I also recommend the sugar syrup be medicated to protect the colony against *Nosema apis*. If you are concerned about *Varroa* levels, you may want to treat with Apistan, but do so with caution.

Between the time you make up the DHC and the time the drones are ready to fly in your mating area, move the colonies to within one quarter to one half mile of the mating yard where the queens are being produced. This is a recommendation Dr. G.H. Cale, Jr., made to all the Starline and Midnite hybrid producers; he knew from experience that this gave better queen mating than obtained if all the drone producing colonies were located within sight of the mating nucs. He actually tested this idea in the 1950s using the Cordovan genetic marker, a recessive trait. It works.

If you know there are other colonies in your mating area of two to five miles, make every attempt to either requeen the colonies with desirable target drone stock, or screen the entrances so that drones are unable to fly. Note, that if you put a piece of queen excluder on the entrance of a strong colony filled with drones, you can kill the colony during the afternoon mating flight as the drones struggle to get through the excluder and stop off the normal air flow and suffocate the colony. Queen and drone traps fun-

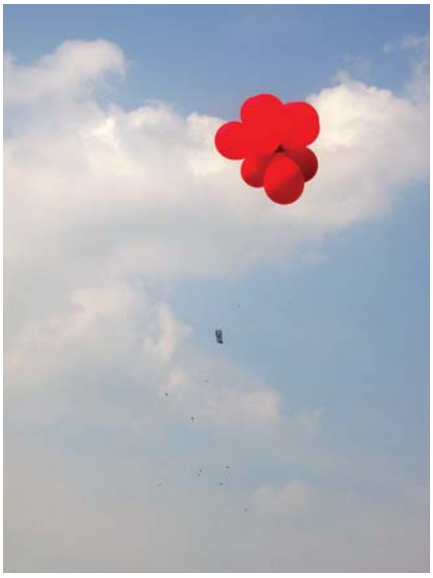
There are several advantages to this system. None of the queen introduction or queen rearing needs to be done in the early to mid Spring. Don't even think about starting until after the fruit bloom is over – for either year!

nel drones away from the entrance. Or, use a full queen excluder over the entire bottom of the hive, so both ventilation and worker bee movement are minimally disturbed.

A Two year plan

Year one: In this 40-colony operation we will install queens from five lines of bees. These may be daughters of survivor stock from your own apiary or some other apiary in the area. Or they may be daughters of queens you have purchased from breeders and carry desirable traits you want in your operation. These may include Russian, SMR/VSH, Minnesota hygienic, New World Carniolian, or other stocks you have studied and want to introduce into your apiary. I selected the number of lines arbitrarily, but it offers an affordable method of getting drone mothers from diverse genetic lines working for your drone diversity plan. I suggest you install eight queens from all five stocks, giving you young, vigorous queens from the different stocks. During this first season, I strongly recommend you eliminate any undesirable traits you observe: chalk brood, foulbrood, defensive behavior, and poor hygienic behavior. In the latter, use the liquid nitrogen test to evaluate dead brood removal by colonies at 24 and/or 48 hours after the treatment. This will give you a valid index of the level of hygienic activity in each colony. Eliminate and replace non-hygienic bees, and keep an eye on the best for possible breeding use.

Year Two: In the Spring of the second year you will evaluate your colonies again, eliminating those that do not give you traits you want. Some level of winter loss (5-10%) is desirable, since you want Winter hearty stock to survive. From the surviving colonies, select the three best and keep them aside as grafting mothers for queen cell production. You may pick the ones you feel you like the best based on your beekeeping experience, or you may develop a complex selection index on your laptop to record and weigh all the observations you have made. Pick three and a few backups.



Drone flight in a bee flyway at the University of Nebraska at the June, 2005 Master Beekeeper Workshop organized by Dr. Marion Ellis. The cage contained queen lure (pheromone) on a cotton tab in the cage. Virgin queens fly further than drones for mating, requiring drone colonies to be placed 1/4 to 1/2 mile away from the mating yard to create a successful mating area.

You will now prepare to set up drone holding colonies. If all 40 colonies are in production (you have filled in any poor performers from a few nuclei you keep at all times). For as long as you want to mate queens (something you decide), every two weeks you will make up and move 40 frames of drone brood from

target drones source colonies and put them into DHC's. Locate these colonies into the mating area.

If the average colony gives you a drone brood frame with a patch of brood yielding about 2000 drones (1,000 on each side), (there's about 4,000 on each side of a drone-comb frame) this will provide you with 80,000 drones at the time of mating. These are not ordinary drones, but ones from colonies you have worked to select and tested for an entire season. While I still cannot tell you how many drones you need for each queen you produce (if only it were that easy!), these 80,000 drones will provide 500 drones for *each one* of 160 queens you attempt to mate, or *80 drones* for each of a 1,000 queens. (Remember you need a minimum of 13 drones/queen.) Using the first example, if you mate 160 queens every two weeks in your mating area, you will have generated well-mated queens. Repeating this labor over two to six cycles (depending on your season and personal schedule) a 40 colony operator could be producing and marketing hundreds of locally acclimatized queens for local beekeepers, and at $15 per queen, this could add up to a tidy sum.

There are several advantages to this system. None of the queen introduction or queen rearing needs to be done in the early to mid spring. Don't even think about starting until after the fruit bloom is over – for either year! This will give you time to build colonies, equalize and boost them, even use them for fruit tree pollination, and get prepared for the drone and queen producing effort. If you sell 50 queens a week for 10 weeks, that is, well, you have already done the math by now.

Drone comb (green) in a target colony for drone production. This frame could be left in this colony or moved to a DHC for mating.

Once the drones in a DHC colony are depleted, the colony is not lost. Install a newly mated queen (remove the caged virgin – she is too old to mate now, poor thing), and treat the colony as an increase colony. Or split the bees into groups for winter nuclei. Add frames of brood to balance the colony's age demographics. If you make up drone holding colonies all Summer, you may have doubled your total colony count. You can do some math here too.

DHC's may be made up in one region of the country or state and moved to another, creating early season mating conditions; or mating during a dearth by heavily feeding all participating colonies. The DHC's may be trucked to mating areas in remote locations with much less trouble than large numbers of full-sized production colonies. **BC**

Larry Connor says his new book, Increase Essentials, is nearly done, and will be available soon after you read this. He doesn't mind if you contact him at ebeebooks@aol.com to reserve a copy.