NebGuide

University of Nebraska–Lincoln Extension, Institute of Agriculture and Natural Resources

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G2225

How to Set Up and Conduct a Honey Bee Swarm Biology Demonstration

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A resource for beekeepers, teachers, and scientists who want to use an artificial swarm to teach others about honey bees and the biology of the swarming process.

Background

A honey bee swarm is one of the most amazing phenomena in the natural world. When a colony swarms, thousands of bees leave their home and set up a temporary bivouac (*Figure 1*) from which they send out scouts to evaluate potential nest sites. The scouts return to the bivouac and perform a dance that communicates to their nest mates the location of any potential nest site found. The scouts then investigate potential nest sites indicated by other scouts, and upon returning to the bivouac, dance to indicate the better nest site. When all the scouts are dancing the same dance, the swarm becomes airborne and moves to the new nest site. When swarming, bees have neither young nor food to protect, and their defensive instincts are minimal.

The purpose of this demonstration is to teach participants about pheromones and how the orientation and queen pheromones function in coordinating swarming.

Preparation

Prepare the swarm by shaking 3-4 pounds of nurse bees into a package bee cage provided with a caged mated queen. This can be accomplished by shaking the adult bees from brood frames from one or more hives. Each frame covered with bees will yield about one-half pound of adult bees, so you will need to shake 6-8 frames. A funnel helps get the bees into the cage. After shaking the bees, add a caged mated queen and a feed can of 1:1 (wt:wt) sucrose syrup. Store the bees in a cool, dark place for 72 hours. The 72 hours is essential for the bees to transition from perceiving themselves as a colony that needs to defend its home to swarm mode in which they direct their energies to staying with their queen and finding a new nest site. Bees caged for less than 72 hours may exhibit defensive behavior when the package cage is opened. It is also prudent to have an extra queen on hand. If the queen in the package cage dies, you cannot do the demonstration unless you have a spare queen to give them. If you attempt to do the demonstration with queenless bees, the bees will exhibit defensive behavior.

Figure 1. Bivouac on cross

The Day of the Demonstration

Temperatures should be 75-95°F, and winds should not exceed 10 mph. Place a wooden cross (6-foot tall) in the ground. Three hours before the demonstration, bring the package of bees to the site and spray them liberally with 1:1 sugar syrup. Thirty minutes after feeding the bees, bounce the package bee cage to cause the bees to fall to the bottom. Spray the bees with water to minimize flight, and then remove the feed can and the caged queen. Tether the queen cage to the cross and shake the bees out of the cage. Within a half hour the bees will have found their queen and formed a bivouac around her. Thirty minutes before the demonstration, spray the bees on the cross liberally with sugar syrup. Note: If temperatures are below 65°F, or if

winds exceed 15 mph, this demonstration will not work as bees will crawl in the grass rather than fly when you make the swarm airborne (ideal conditions are a temperature 75-95°F and wind not more than 10 mph).

The Demonstration

Allow the participants to come near the swarm and observe dancing on the bivouac surface. You can spread your fingers and gently pull your hand through the edge of the cluster to get a handful of bees (*Figure 2*). After letting the participants observe the bees on your hand, toss them into the air and let them rejoin the bivouac. Have the participants stand back approximately 40 feet. Gently remove the cross from the ground and dislodge the bees from it by making an upward thrust. Most of the bees will become airborne and begin searching for their queen (*Figure 3*). A small number of bees will, however, come down in the grass. At this time the participants can form a line to walk through the flying swarm and back to their original position (*Figure 4*).

Next, take the caged queen in your hand and move to a new position that is 20-30 feet away from where the cross was originally located. Use a 5-foot long wooden 2 x 4 to support your arm. Expose the queen cage. The first bees to find her will begin scent fanning and as the flying bees detect the odor plume, they will move to where the queen is located (*Figure 5*). This process typically takes 15-20 minutes. After the swarm reforms on your arm, bring a 5-frame nuc box with empty combs and place it near the swarm. Place a 3 x 3 foot sheet of plywood on the ground in front of the nuc box and dislodge the swarm from your arm onto the plywood. When the bees begin marching in, remove the caged queen from your hand and spray her with water (to prevent flight). Open the queen cage and place the empty queen cage on the plywood and near the hive entrance. Release the queen among the bees that are marching in (*Figure 6*). Tell participants to observe scent fanners and how large numbers of bees cluster on the empty queen cage long after the queen is gone.

Figure 2. Handful of bees

Figure 3. Walking thru swarm

Figure 4. Standing in swarm

Figure 5. Bee bivouac forms on presenter's arm

Figure 6. Hiving swarm

Precautions

Presenters should tape their pant legs, as bees will crawl up vertical objects, and they should put cotton in their ears and nose, as bees will crawl into dark cavities. Presenters should have an assistant to explain what is happening while the swarm is settling on the presenter's arm, as bees will fly into open mouths. Presenters can attach the queen cage to their chin and let the swarm form a bee beard; however, doing so may make the presenter appear to be a circus act, and participants may pay too much attention to the act and miss all the good biology there is to learn. It is prudent to do the demonstration several times without an audience to fine-tune your techniques. It is important to have several knowledgeable assistants to explain the biology and answer questions while the presenter manipulates the bees. Note that bees void their waste on the wing, so be sure to set up the swarm three hours before participants arrive to give them time to take a cleansing flight.

Handout for Participants

Pheromone

Pheromones are chemical messages secreted to the outside of the body that cause a specific response by members of the same species. They are context specific, and they may be either short-lived or persistent. They are the predominate means of communication in the insect world. They are extensively used by solitary insects to find a mate. Social insects, such as the honey bee, have a multitude of pheromones that enable them to interact cooperatively.

Today we will learn about two honey bee pheromones that coordinate thousands of insects in leaving their hive to establish a new colony. Swarming typically occurs in the spring when colony populations grow rapidly and congestion occurs in the nest. When a swarm issues, 40-50 percent of the bees will fly out of the parent colony with the old queen, leaving behind queen cells containing virgin queens and enough bees to rebuild the colony population.

The swarm will typically settle on a tree limb, but they may settle on a car antenna or other inconvenient site. Scout bees will leave the swarm to look for a new nest site. When they return, they dance to indicate the location of potential sites and will visit the nest sites indicated by other scouts. When all bees in the cluster agree on the best site (by all doing the same dance), the swarm becomes airborne and moves to the new nest site.

The two pheromones that regulate the swarming process are the orientation pheromone (Nasanov pheromone) and the queen pheromone (queen substance). The Nasanov pheromone (*Figure* 7) is volatile and attracts bees from a distance. The queen pheromone (*Figure 8*) is less volatile and attracts bees from close range. When the swarm queen settles on a branch, the first bees to find her expose their Nasanov gland near the tip of their abdomen and begin fanning their wings to distribute the orientation pheromone. Bees in the swarm follow the Nasanov gland odor plume (smells a lot like Lemon Pledge®) to the limb with the scent fanners. However, they will only stay there if they detect queen pheromone.

Today we will visit an artificial swarm containing approximately 11,000 bees. We will make the swarm airborne and observe them seeking odor plumes to lead them to their queen. Bees in a swarm have no food reserves or young to protect and will only sting if they are stepped on or become tangled in long hair or a fuzzy sweater. The swarm is one of the most spectacular events in the natural world, and you can walk among the thousands of queen-seeking bees without fear of being attacked. When we provide a beehive for the swarm to move into, you can observe hundreds of scent fanners near the entrance releasing the orientation pheromone to call other bees to the new nest entrance.

Figure 7. Scent fanners releasing orientation pheromone

Figure 8. Queen pheromone attracts circle of attendants

Honey Bee Swarm Biology Review Questions

1. Why do honey bees swarm?

2. Honey bee colonies exhibit defensive behavior when disturbed. Why do bees in a swarm not exhibit defensive behavior?

3. What is a pheromone?

4. What are two pheromones that are used by swarming honey bees, and explain the role that each of them plays.

5. When we made the swarm airborne, which of the following explains how the bees found their queen?

   A. They followed visual cues
   B. They followed auditory cues
   C. They followed odor plumes
   D. They were lucky to find her

6. How does a beekeeper go about hiving a swarm?

7. Why is swarming a critical process for honey bee survival?

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Index: Insects & Pests
Other Pests
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