The Role of Volatile Chemicals in the Usurpation of European Honey Bee Colonies by African Honey Bee Swarms

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Interpretive Summary:

Nest usurpation might be a major component in the Africanization of European colonies and the loss of European mitotypes in areas invaded by African bees. We have found that E-β-ocimene and four other compounds whose amounts decreased significantly in the colony following queen removal might be cues to invading swarms that communicate the presence of a queen. Workers in invasion swarms do not appear to force their way into colonies, but instead bypass the colony's guard bees by either offering food or acquiring the odors of workers in the colony. Invading workers protect their queen during the invasion process by forming a cluster around her. The workers release the queen about 48hrs after the invasion, probably after she has begun to lay or at least acquired the colony's odors. In this way, the invasion queen is 'introduced' to a colony in a way that is similar to how beekeepers introduce new queens in colonies. The cluster of workers surrounding and protecting the invasion swarm queen also is similar to how workers protect particular virgin queens in colonies when multiple queens exist during the natural requeening process. Thus, usurpation swarms may have adapted already existing worker behaviors towards queens to successfully protect and introduce them into colonies following an invasion.

Objectives:

1) Successfully stimulate usurpation on chosen hives
2) Using bioassays, determine which factors increase the chances of successful usurpation

Materials and Methods:

European honey bee queens were either caged in wire mesh so that they could not lay eggs or were removed from colonies in an apiary adjacent to the Carl Hayden Bee Research Center. Volatile compounds emanating from colonies were sampled one hour and 10 days after removing their queens by inserting a solid phase microextraction (SPME) fiber into the colony for 30 minutes. The fiber was held in place approximately 5cm from the bottom board by a wire support that hung from the middle of the top bars between two frames. A wire cage surrounded the fiber to prevent contact with the bees. After sampling, the fiber was immediately injected into a gas chromatograph coupled to a mass spectrometer to separate and characterize the compounds that were collected. The procedure was repeated three times, each time using five different colonies.

Results and Discussion:

The number of usurpation swarms seen in the winter of 2006 was very low. However, data collected in previous years indicated that queenless colonies and those with caged queens had significantly higher rates of usurpation compared with queenright colonies. Due to the low rate of usurpation swarms, we concentrated our efforts of identifying changes in nest odors following queen removal and identification of compounds that usurpation swarms might use as cues to identify queenless colonies.

From samples of colonies where queens were removed, we detected 23 compounds that were present in at least 75% of the samples on either the day the queen was removed or 10 days later. Five compounds including E-β-ocimene (a queen-specific compound detected in laying queens but not virgin queens) decreased significantly in relative amounts 10 days after queen removal indicating that they are volatile compounds produced by queens and distributed to workers or nest materials. One compound increased significantly suggesting that it might be a volatile compound associated with the queen rearing and replacement process. The differences in nest odors following queen removal might serve as cues to usurpation swarms and identify queenless colonies to invade.

Recent Publications:

Gilley, D.C. 2006. Nest odour changes following queen loss in Apis mellifera. J. Apic. Res. 45: 159-161

DeGrandi-Hoffman, G., Gilley, D. and Hooper, J. 2007. The influence of season and volatile compounds on the acceptance of introduced European honey bee (*Apis mellifera* L.) queens into European and African colonies. Apidologie 38: 230-237.