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TITLE: **Africanized Honey Bee Research**

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Objectives

Objective 1: develop methods to maintain and produce commercial honey bee stocks that are free from the influence of Africanization

Objective 2: develop programs that will allow selective breeding and stock improvement of resident honey bee populations following Africanization

Objective 3: determine the efficacy of and develop methods for improving the genetic composition of feral honey bee populations following Africanization

Objective 4: develop improved methods for analyzing mitochondrial and nuclear DNA in order to determine the range and degree of Africanization throughout California

Objective 5: develop better breeding techniques including instrumental insemination

Objective 6: develop new apicultural practices for commercial beekeeping

Project Overview

No one knows how widely distributed Africanized honey bees (AHB) will be in California. Their rate of spread is slower than we anticipated, but it is clear that they are still expanding in the very hot and dry regions of the south-eastern corner. We cannot yet predict what will happen if or when they "break out" of the desert into the more hospitable climates of Southern California. However, we are continuing to monitor them. This year we again conducted a survey in the Imperial and Riverside counties to estimate the density of Africanized bees in those areas that have already had more than 30 AHB colonies identified by the California Department of Food and Agriculture.

Research conducted this year was primarily directed toward developing apicultural practices to help beekeepers produce, manage, and maintain good, commercially acceptable stocks in areas that have established populations of Africanized honey bees. Our prior research has demonstrated that colonies with queens produced and mated in uncontrolled Africanized areas are extremely defensive and not suitable for commercial beekeeping. So,

in order to maintain good commercial colonies beekeepers must requeen their colonies on a regular basis with the desired stocks. Requeening has 3 component parts: 1) finding the old queen, 2) introducing the new queen to colony, and 3) the survival of the queen until the next requeening event. We investigated each of these components in a highly Africanized area of Mexico.

Many beekeepers select and produce their own honey bee stocks. Honey bee queens mate with an average of about 15 males while they fly through the air within a few miles of their hives. This will be problematic for beekeepers who wish to produce their own stocks within areas that have an established population of Africanized bees. For the past 6 years we have conducted a breeding program in Mexico designed to determine the efficacy of breeding bees in highly Africanized regions. Here I report the final results of this study

Africanized Honey Bees in California

Africanized honey bees were first detected in Blythe, California in October 1994. Since then, more than 30 colonies have been detected, primarily throughout the Imperial Valley. This past spring we conducted a survey that extended from Winterhaven, California on the extreme south-eastern corner of California, north to Blythe, east to Palm Springs then south through the Coachella Valley, and along the west shore of the Salton Sea, into the Imperial Valley. Honey bees were sampled randomly while they foraged at flowers. We then examined their mitochondrial DNA using a technique developed in our lab and now used by the California Department of Food and Agriculture, to determine if they were derived from the invading Africanized population. Of 196 bees collected at 42 locations, only 3, from 2 locations, were determined to be Africanized. Our survey demonstrated that although AHB are present in California, and are apparently continuing to spread, they are still at very low densities relative to the European (commercial type) bees in those areas.

Finding Africanized and European Honey Bee Queens

In order to maintain manageable colonies of honey bees in areas of California that have feral Africanized honey bee populations, beekeepers must requeen their colonies regularly. The first problem with requeening is finding the queen that you want to replace. Finding AHB queens is more difficult because AHB become extremely active and run around on the combs when they are disturbed. We tested three different queen introduction methods: 1) the "traditional" method where each frame of the hive is individually scanned by the beekeeper while he looks for the queen, 2) the "shaking" method where all the bees are shaken off of the combs and forced through a queen excluder that acts as a filter for the queen (the queen is larger than the workers and, therefore, remains behind and can be easily seen), and 3) the "smoke" method where 30 puffs of smoke were introduced into the hive entrance, then the lid of the hive was removed and scanned for the presence of the queen (this method was tried because the queens run from the smoke to the top of the hive). The amount of time to find the queen was recorded for each colony using each method. Average search times were 225, 145, and 75 seconds respectively for methods 1-3. Queens in Africanized colonies were found significantly faster when the smoking and shaking methods were used while European queens were found more quickly than Africanized queens when using the traditional method. Queens from AHB colonies were found 75% of the time compared with 60% for European queens when the smoke method was used. These results suggest that finding queens in Africanized colonies will not be an additional problem for California beekeepers.

Introduction, Acceptance, and Length of Life of Queen Honey Bees in an Africanized Area

New queens cannot be placed directly into colonies. Instead, they must be separated from the worker bees until the workers "get used" to them. This period of time, usually 1-3 days, is known as queen introduction. We tested three different methods of queen introduction in Ixtapan de la Sal, Mexico, and area that has had a feral AHB population since 1990: 1) the "traditional" method of confining the queen in a 3-hole cage with a candy release, 2) the traditional method plus rubbing the body of the replaced queen on the cage to provide the scent of the old queen (some California beekeepers believe this improves acceptance of new queens), 3) the traditional method plus applying vanilla extract to the cage (some Mexican beekeepers believe that this improves acceptance), and 4) the traditional method plus applying hexadecane to the cage (hexadecane has been shown to be an important chemical for helping bees recognize their own family members).

The traditional method gave the highest rate of acceptance (80%) followed by the vanilla (75%), hexadecane (67%), and rubbed queen (67%) treatments. Of the 260 successfully introduced queens, 61%, 40%, and 28% were still in the hive after 6, 9, and 12 months, respectively. These results are very similar to those we previously found for queen introduction and survival in commercial colonies in California. We reported an average introduction success rate of 61% with 37% of the successfully introduced queens still present after 10 months. These results suggest that traditional methods of queen introduction should be continued, but that colonies in Africanized regions should be more than once a year.

Introduction and Acceptance of European Queens in Africanized and European Colonies

California beekeepers may have problems requeening AHB colonies with European queens. We tested this by introducing 38 and 37 European queens into Africanized and European colonies, respectively. Queen acceptance did not differ between the AHB (84%) and European (89%) colonies. Therefore, queen acceptance should not be an additional problem for beekeepers in Africanized regions of California.

Selection of Productive and Manageable Honey Bees in an Africanized Area

We have now completed the final year of our breeding program designed to determine the efficacy of breeding commercially acceptable honey bees in highly Africanized areas using common methods of breeding. After four generations of selection we have successfully maintained honey production at about 30 kg per colony, compared with a dramatic drop to less than 20 kg in unselected commercial bees. This decline in the unselected population is presumably due to increased competition with the local feral AHB. Defensive behavior has declined in our breeding population from an average of 97 stings per minute (these are collected in a black leather target), to 39. Selection for wing length (an indicator of Africanization and the success of the breeding program) has increased the length of the fore wing from 9.06 to 9.14 mm. At the beginning of the selection program, 29% of the commercial colonies in our program contained African mitochondrial types, an indicator of the degree of Africanization. Today less than 10% of the colonies have the African mitotype. By comparison, the feral population went from being completely European in late 1989 to having nearly 100% African mitotypes today. Our results demonstrate that it is possible to selectively improve commercial bees in highly Africanized areas, even when queens are allowed to mate naturally.