Project Report 1994

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

Where are the Bees?

In late October, the first Africanized honey bees were detected in California. These bees were from an established colony located near Blythe. Africanized bees were expected in California in early Spring, but their spread has apparently slowed down. Why? There are at least three hypotheses:

1. **The bees have reached their natural, climatic range.** It is expected that eventually these tropically-adapted Africanized bees will reach a climate for which they are not suited. This has apparently happened in Argentina where their southern expansion halted just south of Buenos Aires. This hypothesis is unlikely to explain the slow spread of Africanized bees into California, however, because their spread throughout the deserts of northern Mexico and south-eastern Arizona has been very rapid. The deserts themselves do not seem to impede their expansion.

2. **The bees have interbred with Europeans and the Africanized traits have become diluted.** This is not a likely explanation because the first Africanized colony identified in California was "highly" Africanized, based on current identification procedures. In addition, it had African-type mitochondria, demonstrating that it is part of a continual maternal lineage of feral colonies stretching back to its original importation into southern Brazil in 1956. There is little evidence for a genetic "dilution" of the Africanized bees by feral or commercial European colonies.

3. **The feral, Africanize population is being reduced by the parasitic mite, *Varroa jacobsoni*.** This is the most likely explanation. We studied the spread of this recently-introduced parasitic mite by examining samples of worker honey bees taken from 208 feral colonies in 1990. These colonies were distributed throughout California. We resampled 124 of the nest sites for Varroa in 1993 and 1994. There were no Varroa mites detected in any of the samples from 1990, suggesting that the feral population was not severely infested at that time. However, by 1993, 75% of all of the sampled nest sites located in the Sacramento Valley were empty, and all of the occupied nest sites with surviving colonies had severe infestations. We found a similar result when we sampled feral colonies from southern California, near Riverside. From these and other data, we estimated that in areas of California with intensive use of honey bees for pollination, the feral population had been reduced by Varroa to about 13% of its original size.

Africanized bees show some resistance to Varroa, relative to European bees. In our studies conducted in Mexico, we have found that brood and adults from European colonies are about twice as likely to get parasitized by Varroa than brood and adults from Africanized colonies. However, Africanized bees are not immune to Varroa. Beekeepers in the state of Vera Cruz, Mexico are suffering severe Varroa damage to their Africanized commercial colonies. It seems likely that Africanized feral colonies are also suffering. If this is true, then we can hope that the feral population of Africanized bees in California ultimately will be reduced due to Varroa parasitism and cause fewer problems for commercial beekeeping. But, only time will tell.

What has been the impact of Varroa on commercial beekeeping? We studied the rates of infestation of commercial hives and the rate of Varroa population growth throughout a year. Our results were staggering. In temperate climates, where similar studies have been conducted, Varroa populations grow in colonies about 10 fold per year. In the Central Valley of California, Varroa populations grow about 286 fold per year, or about 30 times faster than in more temperate climates. We also found that during two times of the year, May-June and October-November, colonies are being infested by large numbers of adult mites. These episodes of infestation correspond to periods of the year when honey bee colonies are very active in robbing each other. This means that beekeepers must treat their hives **at least** twice each year with the miticide, fluvalinate. These two treatments increase their operating costs by at least $10.00 per hive, per year.

Pollen Hoarding Selection

We are continuing our selection program for increased pollen stores and pollen collecting. After 5 generations of selection, our high strain colonies stored more than 6 time as much pollen as colonies from our low strains (Fig. 1). We are now in our 7th generation.

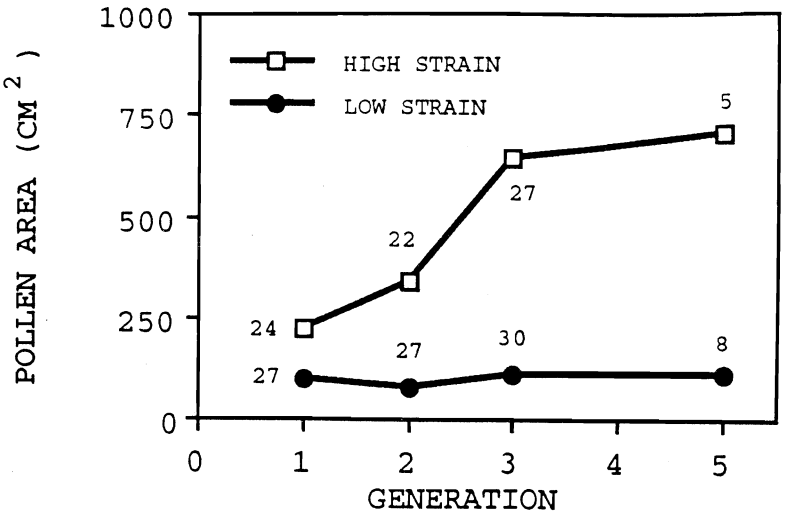

Figure 1. Results of five generations of two-way selection for high and low pollen hoarding strains of honey bees. Open boxes represent average areas of stored pollen for colonies of high strain bees; closed circles, averages of colonies of the low strain. Strain averages differed significantly in all generations. The number of colonies evaluated for each strain, each generation is shown by each symbol. Generation 4 results are not shown because colonies were tested under different conditions and the results are not equivalent. Evaluations were made by directly measuring the amount of pollen stored in each comb within the nest.

In previous reports, we demonstrated that high strain colonies have significantly more pollen foraging activity than low strain and commercial colonies. Now, we are locating genes on honey bee chromosomes that are responsible for the observed differences. So far, we have found two major genes that collectively are responsible for 59% of the total observed variance between our high and low strains. Our study used only 38 colonies and, as a consequence, our markers are not close enough to the genes to be effective in marker-assisted selection. However, this summer we repeated the study using 159 colonies. We are now constructing a new genetic map and are hopeful that we will find markers that are very close to the these two major genes.

Prospects for Honey Bee Certification

Currently, the only official method of identification and certification of Africanized honey bees is USDA-ID morphometrics. This method measures 21 different body parts of 10 workers from a colony and subjects these measurement data to a computerized statistical analysis. The analysis then classifies the colony from which the workers were sampled as either European or Africanized. We tested the efficacy of this system for detecting colonies of varying degrees of Africanization ranging from highly Africanized to pure European. We found that the USDA-ID morphometrics were only able to detect highly Africanized colonies, hybrid colonies were classified as European. We performed defensive behavior tests on these same colonies and found that hybrid colonies were extremely defensive, like the highly Afrricanized bees. We conclude from these studies certification of commercial honey bee colonies as free from Africanization will not be feasible. Extremely defensive hybrid colonies will be classified European and will not be subject to any restrictions. Colonies should not be evaluated on the basis of their pedigrees. What matters is behavior, a trait that beekeepers should be alert to and ready to requeen objectionable colonies.