# Progress Report
# Africanized Bee Project

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We now have four major research programs underway : (1) development of genetic markers to help detect Africanized bees; (2) genetic characterization of California honey bees; (3) selection of high quality bee stock for breeding; (4) assessing the impact of Africanized bees on a queen rearing business in Mexico.

## 1. Development of Genetic Markers to Help Detect Africanized Bees.

So far we have established of a "library" of honey bee DNA that might provide some useful markers. It contains over 500 separate sections of honey bee DNA that have been inserted into bacterial plasmids for cloning. We are currently testing these markers to see if they show suitable polymorphisms for use in identification. We have subscribed to a consortium on campus that is purchasing random primers to use for polymerase chain reaction analyses of DNA. We are testing some of these primers and if successful we hope to find polymorphisms between Africanized and North American bee populations that can be useful in identification procedures. This method has the advantage that single individuals can be analyzed very easily for a large number of candidate markers.

## 2. Genetically Characterizing Calfornia Honey Bees.

We have now sent out over 1000 letters throughout California requesting locations of wild bee colonies. So far this year we have collected samples from over 100 wild honey bee colonies that await genetic and morphological characterization. We will certainly collect more this year and next. Our current samples range from San Diego to Eureka.

**3. Selecting High Quality Bee Stock for Breeding.**

Honey bees can easily be selected to store greater or lesser quantities of pollen. However, just because they store more pollen does not mean that the colonies are more productive, have more pollen collecting workers, or are better pollinators. We are currently selecting high and low pollen hoarding strains of honey bees to test their efficacy in pollination services and honey production.

This spring (1990) we sampled the number of bees and the amount of pollen stored in about 400 commercial bee hives located in almond orchards around Davis and Winters. We identified those colonies that contained the greatest and least amounts of pollen to be the foundation stock for our breeding program. To begin high and low pollen hoarding strains, queens and drones from the 10 colonies with the greatest quantities of stored pollen were mated to each other as were queens and drones from the colonies with the least quantities of stored pollen. Fifty-one first generation queens of the high and low strains were then tested to determine if they differed significantly from each other with respect to the amount of pollen stored in combs, numbers of foragers, and the ratio of pollen and nectar collectors.

After the first generation we observed a significant increase in the amount of pollen stored and in the proportion of the foragers in the hive that collected pollen (Figure 1). Our results suggest that low pollen hoarding has been selected in commercial populations either deliberately,

to increase honey production, or inadvertantly. This is indicated by the difference in the shapes of the distributions of the colonies in the high and low strains. The low strain colonies are "bunched up" at the left of the distribution and showed very little selection response while the high strain colonies are spread out widely (see Figure 2). This same phenomenon was found by Richard Hellmich and Walter Rothenbuhler when they selected high and low pollen hoarding strains at the Ohio State University in the early 1980's.

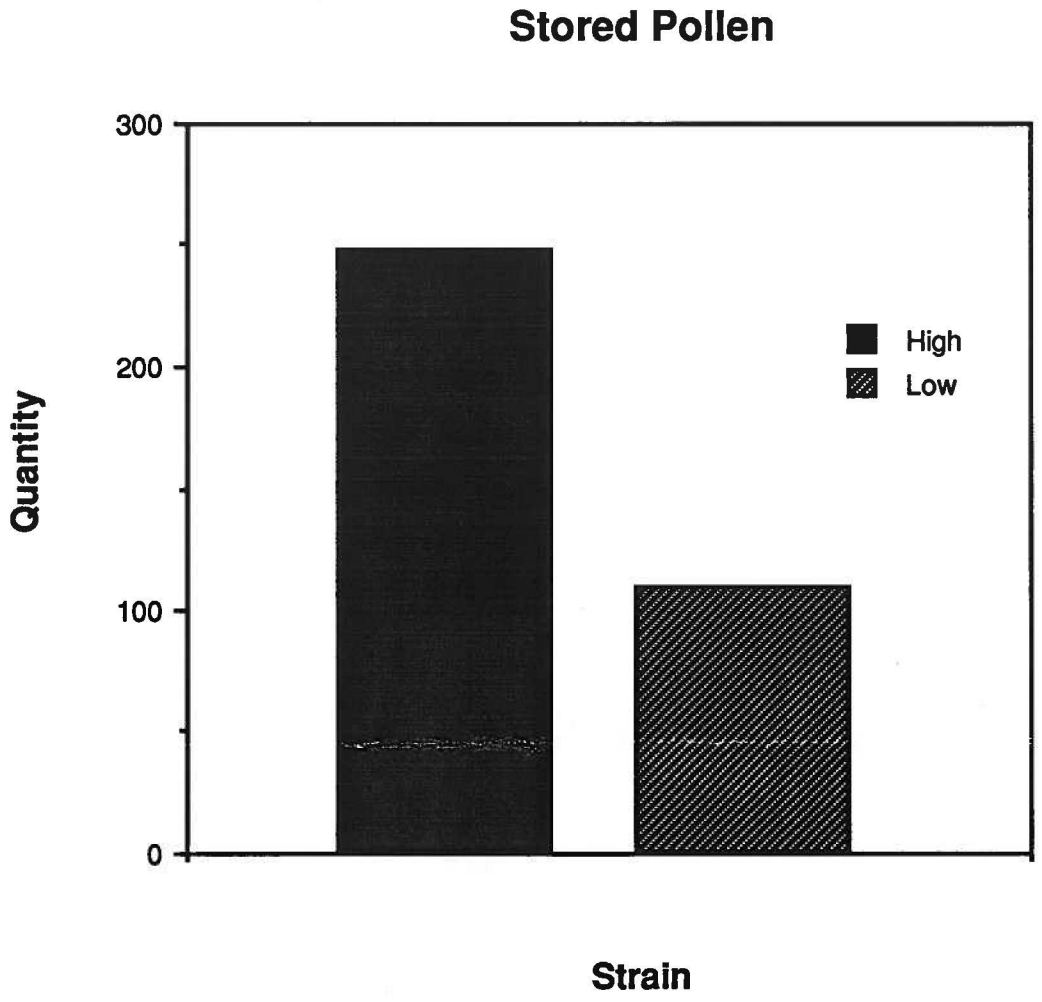

Figure 1. The average quantity of stored pollen (in $cm^2$) in colonies of the high and low pollen hoarding strains.

Colonies of the high and low strains had no differences in the numbers of foragers observed at the entrance during periodic interval samples. However, the colonies of the high strain had more than twice as much pollen stored (Figure 1), 18% more pollen foragers, and a 29% higher ratio of pollen to nectar foragers (Figure 3). We have also now confirmed that pollen and nectar collecting are traits that covary genetically. If you selectively increase one trait, like pollen collecting, then you decrease the other, like honey production. This places a serious constraint on what we can expect from selective breeding.

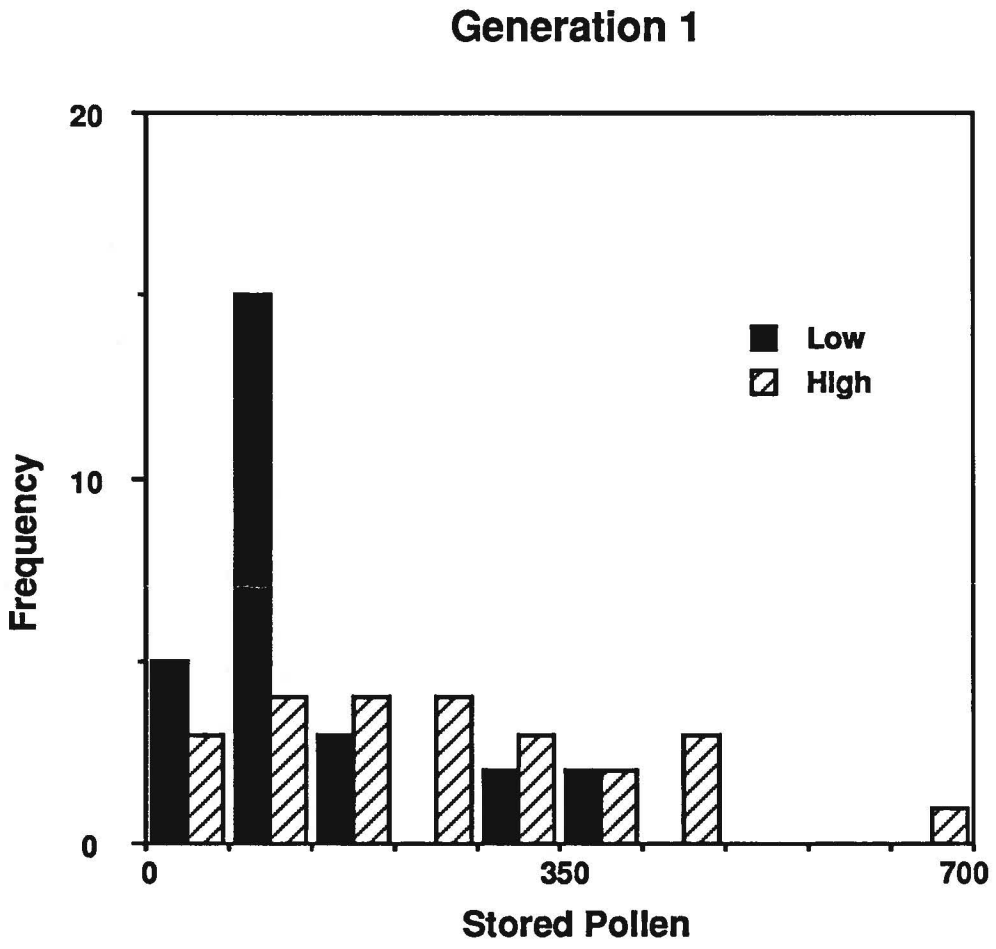

Figure 2. The number of colonies (frequency) of the high and low pollen hoarding strains that had different measured amounts of stored pollen (in $cm^2$) after one generation of selection.

We have now completed two generations of selection and will test our second generation in the almond orchards in the spring of 1991. Also in 1991, we will take these high pollen hoarding bees and breed them for two additional generations and begin releasing the stocks for field testing to see if they are superior pollinators. This development program will most likely require two to four years of stock testing and production before we will be able to determine their usefulness in commercial pollination.

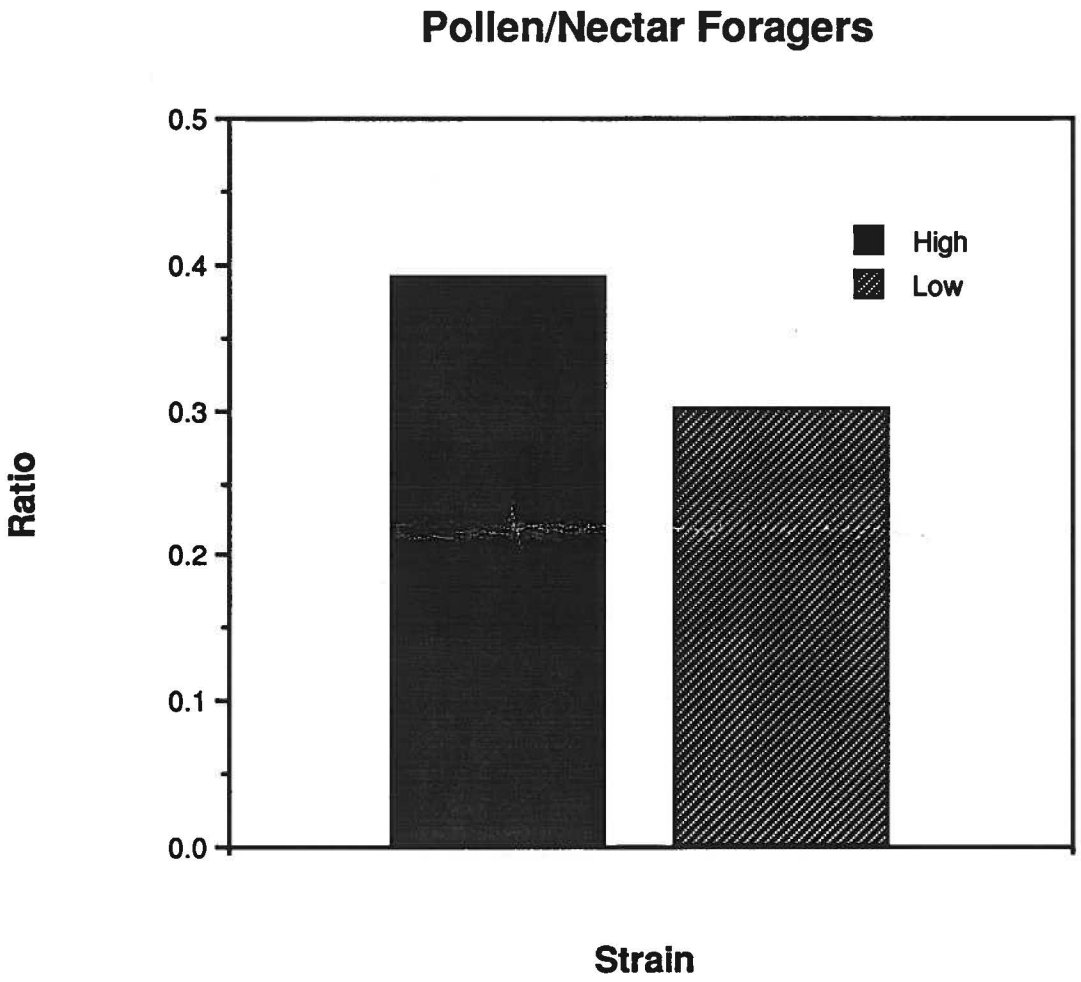


Figure 3. The average ratio of pollen and nectar collectors in the high and low pollen hoarding strains

**4. Research Program in Mexico.**

Our research lab in Mexico is now established. Mr. Ernesto Guzman moved to our location in Ixtapan de la Sal in December. He is initiating genetic studies of defensive behavior with the objective of determining how much cross mating of Africanized drones with European queens can be tolerated in commercial hives. He is also going to document the process of Africanization in that area. This area just began the process of becoming Africanized this summer and fall.