U.S. Department of Agriculture Agricultural Research Service

Agricultural Research

1989

Year of the Bee?

Excerpt From
January 1989

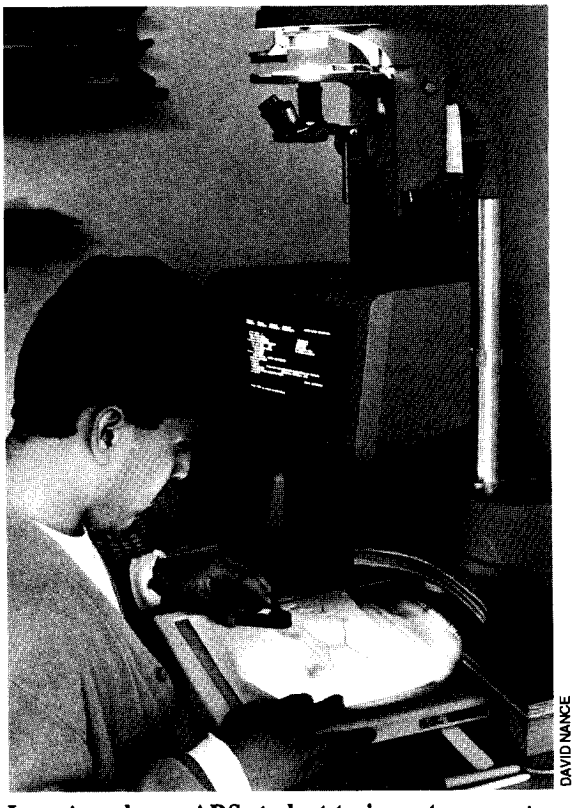
Year of the Africanized Bee?

To take a quick break, Dom Martinez left his station counting shipping cargo on the state-run docks at Mobile, Alabama, and stepped outside the warehouse. He looked up at a wall and saw about 200 bees.

Since officials are always checking the docks for imported insects, Martinez called the local office of USDA's Animal and Plant Health Inspection Service.

Two minutes later, Plant Protection and Quarantine Officer Glen Landau, who was doing a routine ship inspection not far away, got a call over the radio attached to his belt. The message: possible Africanized bee infiltration.

Within 5 minutes, he was there. He took his bee suit, insecticide, and nets out of the back of his car and suited up for action.



DAVID NANCE

Juan Aranda, an ARS student trainee at Weslaco, Texas, scans magnified images of honey bee body parts into a computer. The computer then calculates the probability that the bee was Africanized. (88BW2140-34)

As had happened the previous 8 times Africanized bees were suspected to be in Mobile, Landau collected 100 of the bees in his net and killed the rest with spray—in case they were Africanized. The difference between this case and the others, however, is that this time—September 26, 1988—Africanized bees *had* found their way into the United States. Over the next few weeks, Landau and colleagues would set up traps in a 2-mile radius of the docks and alert beekeepers in a 10-mile radius of the infiltration—all to be on the lookout for other bees.

But how did he know these were Africanized bees and not the average domestic European honey bees already here? After all, the bees look the same.

He knew because he had sent the 100-bee sample, preserved in alcohol, by overnight express parcel service, to the Beneficial Insects Laboratory in Beltsville, Maryland. That laboratory, part of the Agricultural Research Service, provides expert identification of Africanized bees 24 hours a day, 7 days a week, including holidays.

At the lab, Steve Sheppard and Robyn Glass used FABIS (for Fast Africanized Bee Identification System) to check the sample. FABIS was developed by ARS' Thomas E. Rinderer and colleagues at the Honey Bee Breeding, Genetics, and Physiology Laboratory in Baton Rouge, Louisiana.

They mounted the forewings of 10 randomly selected bees on slides and projected them, enlarged, onto a screen. They measured the wings and checked the results against a chart of standard wing specifications for each kind of bee. The result: probably Africanized.

So they went on to step 2: a complete morphometric (body measuring) analysis. They measured forewings, hind wings, hind legs, and abdominal sternums in many different places and angles, for a total of 25 separate measurements. Then they entered all the data into a computer, which gave them

© SCOTT CAMAZINE/CORNELL UNIVERSITY

Practically indistinguishable from their European cousins, Africanized honey bees are noted for savagely defending their hives.

a figure indicating probability of Africanization—in this case, 99.4 percent. "That's pretty close to a definite yes," Sheppard says. He alerted Landau that the bees were Africanized.

The scientists at the lab have a research plan to develop new methods of distinguishing between the two kinds of bees—methods that analyze molecular, chemical, and immunological differences.

In fact, ARS has 4 locations with 11 scientists conducting research on the Africanized bee. The goal of that research: to stop or slow the spread of the bee northward into the United States from Mexico and if that's not possible, to learn how to cope with it.

Research Gone Awry

The Africanized bee situation can be traced back to a research project that went awry. In 1956, a Brazilian geneticist imported African varieties of *Apis mellifera* and bred them with European varieties in Brazil. His purpose: To improve tropical honey production by creating a honey bee well suited to hot climates.

But the experimental colonies were accidentally released before the geneticist could assess the hybrid bee's characteristics.

Unfortunately, those characteristics, according to scientists at the ARS Baton Rouge lab, include less honey

production and less efficient pollination. Research showed that compared to European bees, Africanized bees collect nectar with less sugar, carry smaller loads, make longer trips, and don't communicate as much with fellow bees about good nectar locations.

Since these bees threaten to come to the United States, beekeepers and farmers fear for their businesses. And with reason: Bees produce $150 million worth of honey and pollinate $20 billion worth of crops every year.

But perhaps more frightening to people is the Africanized bees'

"People sometimes refer to these bees as more aggressive, but that's not really an accurate term. What they are is more defensive."

Thomas Rinderer, ARS geneticist, Baton Rouge, Louisiana

reputation for stinging in greater numbers and with less provocation than European bees. Although their venom is no more poisonous than that of their European counterparts, the greater number of stings can lead to shock and possibly death in a victim.

When provoked, the bees will also chase a suspected hive molester a lot farther—up to a mile; the European type generally gives up after a few dozen feet.

"People sometimes refer to these bees as more aggressive, but that's not really an accurate term," says Rinderer of the Baton Rouge lab. "What they are is more defensive." He explains that the bees are simply defending their hive. European bees do so, as well, but not as fiercely.

And he adds, there is some good news to the story. Interbreeding with native European populations has made each generation of the Africanized bees gentler. "The bees in Mexico are not the same as the ones in Brazil and certainly not the same as those in Africa." What that means is that the

JACK DYKINGA

ARS plant physiologist Gerald Loper adjusts a bee trap that will be suspended from a balloon tethered 25 to 50 feet above the ground. Once the drones have been drawn near by a synthetic queen bee pheremone, cigarette filters dyed to look like queens lure them into the trap. Radar trailer in background is used to track groups of drones in flight. (0587X431-24)

more desirable characteristics of European bees have softened the negative ones of the original Africanized hybrids.

USDA officials are taking full advantage of this definite—albeit slow—tendency to change genetically with interbreeding. Two USDA groups about 500 miles south of the U.S. border—at Veracruz in the east and Oaxaca in the west—have been importing and releasing gentle European bees to interbreed with Africanized bees there. They also trap swarming bees in bait hives and destroy them with suffocation by sealing the hive in a plastic bag.

ARS research at the Baton Rouge lab contributed to the knowledge necessary to implement the program, and scientists there continue to support control efforts.

The two units started as a project between the Mexican government and USDA to trap and kill the bees in 1986. That has slowed the bees some; by expert projections, they could have arrived in south Texas in 1987 or 1988, Rinderer says. But they're still 500 miles south of the border.

In case the bees do come to the United States, ARS scientists hope to help beekeepers and the public be ready. Research to do this follows.

Stopping and Controlling Africanized Bees

H. Allen Sylvester and colleagues at the Baton Rouge lab are "mapping," or identifying and locating, the genes of European bees. "We want to genetically engineer a strain of the more gentle domestic bees that will outcompete the Africanized bees in some way," Sylvester says. For example, a bacterium called *Bacillus larvae* causes one of the worst honey bee diseases, called American foul brood. The scientists hope to find a way to modify European honey bees to produce a bacterium-killing protein called cecropin (sakropin). The gene that allows insects to do this has been identified in a moth; now Sylvester and Rinderer are working to find a way to get that gene into honey bees.

Then, beekeepers would have the bacterium-resistant strain in their hive yards and could set out honey baits with foul brood spores mixed in. The honey would attract any honey bee that comes along into eating it. The genetically engineered European ones, because of their new gene, would kill the bacterium hidden in it, but nonresistant Africanized bees would die.

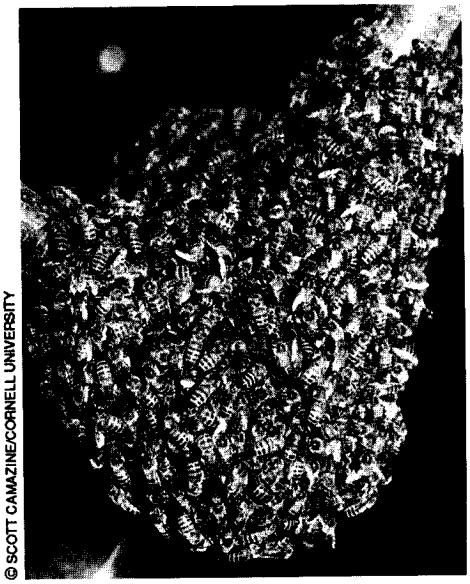
WILLIAM RUBINK

Bait hives are assembled by Mexican Department of Agriculture technicians near Ciudad Victoria in eastern Mexico. The hives provide nesting places for Africanized bees that will later be destroyed. (88BW1395)

Rinderer says his group is also working on finding natural and synthetic compounds to subdue the bees. One winner: a mosquito repellant developed by ARS in the 1950's, called Deet, which is now in more than 30 insect repellants on the market. Deet quickly subdues bees in lab tests. Although the bees eventually recover, Deet makes them stop stinging completely at the moment, giving a victim time to run away. "It's kind of like Mace in that it temporarily debilitates them," Rinderer says.

He points out that Deet would have to be sprayed in the air near the person or animal being stung. In tests, spraying the compound directly on the skin before the attack was not as effective at subduing the bees as was permeating the air with it at the moment of attack.

For national parks and other outdoor public areas, the scientists have developed a system for trapping and killing



© SCOTT CAMAZINE/CORNELL UNIVERSITY

Africanized bees are likely to swarm several times a year, accounting for their rapid propagation. This swarm, near Tapchula, Mexico, was destroyed.

Africanized bees in a way that is environmentally sound. Officials could put out a sugar syrup bait and check to see what kind of bees have responded to it, Rinderer says. If Africanized bees are

there, they would put a couple of drops of poison in the syrup to kill the bees. "Since there is no spraying, risk to the environment is minimal," he says.

Detecting and Attracting Bees

At the Carl Hayden Bee Research Center in Tucson, Arizona, scientists are tracking bees with radar as they search for mates to learn exactly how far and where a queen goes to find a group of males. They hope to fill beekeepers in on how far and in what direction a queen flies to mate. "That way, a beekeeper could check her probable destination for Africanized males before letting her fly to mate," says Gerald Loper. If Africanized males are there, the beekeeper could replace them with European males.

Also, by learning where males gather to mate, areas where Africanized bees may spread could be predicted so that their arrival could be anticipated and they could be destroyed.

Another project is developing the best hives for trapping swarms of Africanized bees. Scientists have worked out exactly which odors attract these hybridized bees and how much room they like when they select a new nest. If Africanized bees arrive, these custom-made hives could be set out to trap bees and monitor areas for spread. If Africanized bees do move in, they could be destroyed.

William Rubink, of the Honey Bee Research Laboratory in Weslaco, Texas, has set up three lines of traps, each 115 miles long, in northern

Can't Tell Your Bees Apart? Bar Code 'Em!

Bees in Tucson are sporting a few extra stripes these days—bar codes like those found on packaged foods and other merchandise.

They are the world's smallest bar codes. Nine stripes, less than one-tenth an inch long, are glued to the tiny hairs on bees' backs at the Agricultural Research Service's Carl Hayden Bee Research Center in Tucson, Arizona. An electronic bar-code reader at the doorway of the beehive records each bee's exit and entrance.

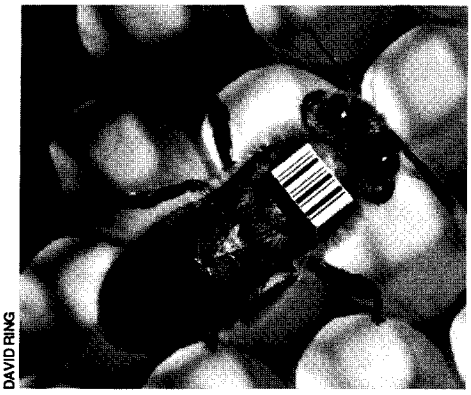
Scientists hope the system will reveal such things as how hard honey bees work collecting pollen and nectar, the number of trips each bee makes, the length of time each spends foraging, and how resistant bees are to pesticides.

"Keeping track of individual bees used to be almost impossible because they all look alike," says entomologist Stephen L. Buchmann. "We couldn't easily monitor bees' leaving and returning to their hives. Now we're keeping a dossier on each tagged bee to record its activity over a long period."

The research findings, kept on a computer for easy analysis, might yield new clues to selecting healthier and more productive bees as parents for future generations of honey bees. Without the electronically read bar codes, research on the often mysterious behavior of honey bees takes an enormous amount of time and excessive handling of bees.

Buchmann got the idea of using bar codes from visits to the local supermarket. Bar codes are found on most packaged foods to keep tabs on product costs and to monitor inventory. In the 1960's, ARS helped pioneer commercial application of bar codes for supermarket use.

Buchmann's challenge was to reduce the postage-stamp-size, or larger, bar codes to a small rectangle less than the width of a bee's back. He succeeded by lowering the typical number of bars from as many as 55 to 9 because he only needed to keep tabs on 100 bees at a time. Standard bar codes can differentiate more than a million items.



DAVID RING

Weighing less than 20-millionths of an ounce, the bar code glued to this worker bee lets researchers automatically monitor the bee's passage through the hive entrance as it goes for nectar and pollen. (88BW2061-11)

Previously, Buchmann marked bees with dyes and paints that often wore off. Other systems required painting a white dot on bees' backs, then hand-painting a number over it after the dot dried.

Not only was this time-consuming, it also involved much handling of the bees, which upset their normal behavior and flawed research findings.

Buchmann says, "Our bar-code paper and glue weighs about one-twentieth as much as the nectar and pollen carried on each foraging trip away from their hives. So the bees behave normally, unaware of what's on their backs."

Buchmann is working with Sprague Ackley, a researcher with INTERMEC Corp. of Lynnwood, Washington, developers of bar codes and scanning equipment.—By **Dennis Senft,** ARS.

Stephen L. Buchmann is in the USDA-ARS Carl Hayden Bee Research Center, 2000 East Allen Road, Tucson, AZ 85719 (602) 629-6327. ♦

Mexico and southern Texas. Located along the Africanized bees' predicted corridor of travel into the United States, the traps are baited with a chemical that lures both types of bees.

The traps will do two things: Let scientists know if and when Africanized bees infiltrate the area and in what quantity, and provide information about existing European populations in the area.

Monitoring European bees now will tell scientists if Africanized bees spread bee parasites and if they change the native bee's body size and swarming behavior. That will give officials in other areas advance warning of what to expect and how fast.

The officials in Mobile, Alabama, haven't had any more Africanized bee trouble, with the possible exception of a couple of stragglers that escaped Landau's spray. The day after Landau collected his sample, a stevedore who works for the same company as Martinez "got the stragglers with a broom and gave them to me," Landau says. Fortunately, beekeepers and the public can rely on research—not brooms—to ready them for the arrival of the Africanized honey bee.—
By **Jessica Morrison**, ARS.

[If you are interested in contacting scientists mentioned in this article, write or telephone the Editor, Agricultural Research, Bldg. 005, Beltsville Agricultural Research Center-West, Beltsville, MD 20705 (301) 344-3280.] ♦