Africanized Bees: An Overview

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ALL PREDICTIONS were that the Africanized honey bee would find its way to this country sometime between 1988 and 1990, but in July and August, a startling discovery was made when colonies of Africanized bees were found near Bakersfield, California. Even though the appearance of these colonies in the United States is an isolated case, the bees' presence affirms the inevitable: the Africanized honey bee is coming to the United States and, as a result, commercial beekeeping and the system of honey bee crop pollination will never be the same.

Africanized bees are extremely defensive and hard to manipulate for profitable honey production and effective pollination. For many decades, beekeepers in this country have enjoyed a comfortable co-existence with the European honey bee, a relatively mild-mannered and easily managed bee.

It is against the law to import Africanized honey bees into the United States. But laws and inspection sites cannot stop the bees from flying on their own into the country, or from being transported into the country unknowingly. For example, there is a strong possibility that the bees found in California came in with some oil-drilling equipment that had been used in different locations around the world.

The Africanized honey bees are descended from *Apis mellifera scutellata,* whose native territory is the savanna country of eastern and southern Africa. The bees were imported to Brazil in 1956 in an effort to improve that country's honey production. Beekeepers desired a bee more adapted to their hot, humid, tropical climate.

Since then, Africanized bees have taken over almost the entire continent of South America, and have moved north to El Salvador and Honduras. Guatemala is next, then Mexico, and then the United States.

By examining what happened to one South American country — Venezuela — after Africanized bees took over, Americans can see how dramatically beekeeping and related industries could be affected.

The last stage of a colony defense test in an Africanized apiary. (USDA photo)

When Africanized bees first came to Venezuela in 1976, honey production for the country was 580 metric tons per year. The country had at least 18 modern commercial beekeepers. Honey production was so good that it exceeded the demands of the local market. An organization was formed by six beekeepers to pool resources and export 100 metric tons of honey to Europe.

During the next five years, as Africanized bees quickly took over, honey production dropped to less than 100 metric tons per year. Now, only two full-time commercial beekeepers are still in business, and only one of these firms employs full-time helpers, but its staff has been reduced. These two beekeepers continue to operate despite reduced honey production, in part because of increased honey prices protected by a strong tariff.

Africanized bees are the sole cause of the near collapse of the Venezuelan beekeeping industry. The bees' swarming and absconding tendencies, as well as their excessive defensive behavior, were too difficult for most beekeepers to manage.

What might happen in the United States? Why should this country be concerned about the coming of the Africanized bee? This country has much more at stake with its beekeeping industry than Venezuela or most other countries. The profits of the beekeeping industry in the United States are about $150 million annually, but when all the agricultural production which is linked to beekeeping is included, that figure rises to $11 to $20 billion a year. Aside from honey, more than 200 crops are dependent or benefit from bee pollination. Those crops range from fruits and vegetable seeds to seeds of forage which is grown to be eaten by animals that give us a variety of foods including meat, cheese, eggs and even catfish.

The impact on beekeepers will be serious if Africanized bees populate the United States. The bees' presence will revamp beekeeping practices and will necessitate changing many apiary sites. In an industry whose profits stand at about $150 million, it may cost up to $45 million to make all the changes. To the average consumer, that means yet another jump in the price of food.

Since the beginning of this decade, the Agricultural Research Service has sought to discover what impact the bees will have on this country and how to deal with these bees, or how to keep this country from becoming Africanized.

One way this agency is carrying out this goal is by funding a special project with Africanized bees in Venezuela. This project is handled by the staff at the Honey-Bee Breeding, Genetics & Physiology Research Laboratory in Baton Rouge, Louisiana. Members of the staff have adjunct professorships in Louisiana State University's Department of Entomology, and it is through this connection with LSU and the USDA that several graduate students help with the Venezuelan project.

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The project was begun in Sarare, Venezuela, in 1982, and involves working with about 200 standard field colonies of both Africanized and European bees. Three bee seasons have passed since the research began, and the fourth season began in October, 1985. The project is scheduled to last five to seven years.

Usually five to seven people work at the Venezuelan research station — about three scientists, one or two graduate students and one or two technicians during the active bee season from October to April. Two Venezuelans have been hired to help at the station and keep the bees during the rainy season when research is generally impossible.

The USDA has a contract with a Venezuelan commercial honey company, Miel Primavera. This company serves as a local patron to the project, and often contributes its own resources to the work.

The results of the research at the research station so far have been very enlightening. Much has been discovered about the behavior and reproduction of the Africanized bee. We are beginning to learn how the United States might deal with this bee.

Brief summaries of some of this research are highlighted in this article.

DEFENSIVE BEHAVIOR: The project has included several studies of the Africanized bee's defensive behavior. In one research test, when a colony was presented with a threatening object, a "following" behavior was observed: an alerted worker recruited other bees by opening her sting chamber with her sting extended, and ran into the colony. The extended sting released alarm chemicals, which communicated the alert to the other bees. These bees in turn recruited still others.

Data showed that Africanized bees responded to the object of disturbance about three times faster than European bees. Also, the number of alerted bees leaving the colony to attack the threatening object was about twice as high as with European bees. Finally, Africanized bees stung the object eight to ten times more than the European bees.

Another test showed that Africanized bees have five times as many guards in their nests as European bees.

Higher humidities will increase the intensity of Africanized bees' responses. Bees will more likely show their quickest, most vigorous defensive behavior in hot, humid conditions. In the United States, this could be all year in humid areas with tropical or subtropical climates, or during the summer months in more temperate areas.

Beekeepers must wear full protective clothing when working an Africanized bee colony. Recommended are a veil, a protective suit usually made of rip-stop nylon, gloves, boots and tape to seal openings. Obviously, this additional gear and the time required to prepare for work at the apiary site and the discomfort of working inside this gear during the summer months will be more costly for beekeepers.

Normal working conditions in an Africanized honey bee apiary. (USDA photo)

APIARY CONSTRAINTS: The Africanized apiaries must be set up far away from people and animals. The minimum recommended distance is 200 meters, but a distance of 500 meters is preferred. The implications of this requirement are that apiary locations for Africanized bees will be harder to find. Apiaries that are shielded in some way, for example, by the presence of trees, are less likely to cause problems for neighbors.

Having apiaries in remote locations causes problems for beekeepers. In Venezuela, road conditions to the remote locations often are poor, especially during the rainy season. Another concern with remote locations is the problem of night-time thieves who steal honey, and in doing so destroy colonies, without fear of people being nearby. Ironically, Africanized bees run from smoke more than European bees. Since at night honey bees cannot fly, a smoldering rag will clear honey supers of bees. In effect, those thieves are using standard South African honey harvesting techniques.

Beekeepers must spend more time and energy in public relations with their apiary neighbors. Many people living close to the apiary are likely to be frightened that the bees will sting them and their animals. In Venezuela, beekeepers have successfully dealt with this problem by (1) telling neighbors that Africanized bees are a more serious problem for beekeepers than for the general public, (2) telling them that Africanized bees are not kept in the apiaries, and (3) when asked, immediately eliminating troublesome bees in the area whether or not they are Africanized and whether or not they are in the apiary. They sometimes put fewer colonies on each stand or provide separate stands for each colony. Fewer colonies per apiary helps reduce the general level of defensive behavior and the possibility of the neighbors or nearby livestock being disturbed.

Since Africanized bees tend to follow a person or object disturbing the colony, beekeepers find it necessary to drive around the area close to the apiary until the bees quit following the vehicle. Otherwise, the bees follow the vehicle out of the apiary to the vicinity of other people and livestock.

At least two people are needed to effectively work Africanized bees, with one person smoking the colony while the other does colony handling. The bees are controlled to a degree by smoking but "recover" too quickly for one person to do both tasks.

ABSCONDING: Another trait of the Africanized bee that causes grief to beekeepers is their tendency to abscond. The colony will simply leave the hive.

In our experience, absconding has two forms. With disturbance-induced absconding, bees leave shortly after a disturbance, generally within a day, but certainly within a week. Disturbance-induced absconding most frequently occurs with swarms that are recently hived. As a colony establishes a brood nest, the chance of disturbance-induced absconding diminishes greatly. Still, a major disturbance, such as transferring a feral colony to beekeeping equipment, can result in absconding. Caging queens over brood combs with queen excluder cages or screening hive entrances with queens excluders helps, but does not eliminate disturbance-induced absconding. Sometimes worker bees abandon a caged queen and abscond without her. Standard beekeeping operations with established colonies cause little to no disturbance-induced absconding.

Resource-induced absconding occurs when nectar and pollen flows stop, especially when colonies are low on reserve food. However, even with colonies having some stored food, the end of a flow can induce absconding. If the bees are continually fed small amounts of sugar syrup, they are much less likely to abscond. Therefore, beekeepers must be very careful about following feeding schedules.

SWARMING: Africanized bees tend to swarm repeatedly throughout the season. Research at the field station in Venezuela has shown that they may swarm every four to six weeks. This swarming seriously reduces honey production.

Standard swarm-prevention techniques — decreasing crowding in brood nests and destroying queen cells produced in preparation for swarming — have been successful in reducing the tendency of Africanized bee colonies to swarm.

FERAL COMPETITION: When Africanized bees abscond or swarm, another unfortunate circumstance develops. These bees form feral colonies — wild bees not managed or owned by anyone. Competition for nectar and pollen resources develops between the managed colonies and the feral populations. Large feral populations reduce the honey yields of commercial apiaries. Records kept by one Venezuelan bee company show reductions in yields of 60% or more, apparently stemming from competition for nectar and pollen from large numbers of feral bees.

REPRODUCTIVE BIOLOGY: One of the goals of the project is to determine how and why Africanized bees spread so quickly, and take over colonies previously inhabited by European bees. One study has shown that part of their reproductive advantage lies in their large drone populations. Drones often leave their Africanized colonies and take up residence in a European colony. There, their presence reduces European drone production. Meanwhile, at the Africanized colony they left, more drones are being produced in response to the absence of the drones that left.

In one experiment, 90 percent of all drones in an apiary of mixed Africanized and European colonies were Africanized.

If for some reason a European colony loses its queen, or the queen becomes weak, the colony is very vulnerable to an Africanized bee takeover. An Africanized queen will come in with a handful of workers and replace the European queen.

An ironic twist is that Africanized drones weigh significantly less than European drones and produce fewer spermatozoa. However, the mucous glands of Africanized drones are larger than European drones, in proportion to each bee's body weight. The precise role of mucous in natural mating is unclear. It is known that it is related to the "mating sign," and may be involved in competition among drones for greater representation of their sperm in the final contents of the queen's spermatheca. If such is the case, Africanized drones could be equally competitive with European drones in spite of their lower spermatozoa counts.

Most crucial to the project's success is discovering quick and accurate techniques to identify Africanized bees.

FORAGING AND HONEY PRODUCTION: A major difference between European and Africanized bees is that European bees tend to forage in groups, and Africanized bees usually forage individually. Tests have shown European foragers perform more recruitment dances, and that the dances last longer. A greater proportion of the bees in a European colony forage.

Bees with tendencies toward group foraging are highly dependent upon communication and recruitment. As a result, they will have either high or low success rates in foraging. High rates occur when there is a plentiful nectar supply, and low rates occur when scouts find only a few nectar sources not of sufficient value to stimulate recruitment. Bees which are primarily individual foragers have higher success rates in weak nectar conditions.

In many of the United States, especially the southern ones where the Africanized bees will thrive, the period of good nectar availability is spring — in April, May and June, with a peak in May. In summer and fall, nectar-flow conditions are weak, and of course, practically non-existent in winter.

Considering this, European bees are superior nectar gatherers during strong flows, and Africanized bees are superior during weak nectar flows. Knowledge of the foraging tendencies of both types of bees permits beekeepers to take advantage of the bees' nectar-foraging biological regulators in order to maximize honey production.

One management strategy that entices both Africanized and European bees to forage more for nectar in times of strong-nectar flows is to place additional storage combs in their hives. The opposite holds true in periods of weak nectar availability: less comb in the hives leads them to fill them with more honey. European bees respond more readily to these comb manipulations, while Africanized bees have improved their honey production only slightly as a result of these manipulations.

POLLINATION: Venezuela does not have an organized system of using honey bees for crop pollination, as do many of the intensive agricultural areas in the United States.

Although certain of their crops would probably benefit from a managed increase of honey bees, disbelief by growers and a lack of interest by beekeepers have prevented the development of a pollination industry. Also, despite Africanization and various agricultural practices, Venezuela is still rich in populations of native bees.

Nonetheless, the project has done several experiments related to pollination. Generally, standard practices used for moving bees, even frequently, work well with Africanized bees. The colonies do not abscond, dwindle or decrease their flight activity. The chief objection to Africanized bees as crop pollinators seems to be their defensive behavior. Colony placement is dictated by this behavior rather than crop requirements. The major concern of a beekeeper supplying bees for production would be to create conditions which would eliminate the chance of a stinging episode.

DISTRIBUTION LIMITS: What is the potential area in the U. S. where permanent populations of Africanized bees could develop? We have contributed to answering this question by supporting work in Argentina by Professor A. Dietz, from the University of Georgia.

In over wintering conditions where the bees did not have to stay in continuous, tight, winter clusters, both European and Africanized bees had similar over wintering survival rates. Also, in a study of the distribution of bees in Argentina, they found Africanized bees much further south than predicted. They suggest that climatic factors might not be the only factor limiting the range and distribution of Africanized bees in southern Argentina. Environmental factors such as shortage of water and limited food sources might be just as important.

IDENTIFICATION: Most crucial to the project's success is discovering quick and accurate techniques to identify Africanized bees. Just by looking at the bees, some hints are readily observed. Africanized bees are usually somewhat smaller than European bees, and body parts are differently proportioned. They seem to move about more, almost as if they are nervous or frenzied. They prefer larger nest cavities, and tend to build smaller combs.

In the Americas, almost all colonies of Africanized and European honey bees that are building their own comb can be identified in the field, by measuring the distance spanned by ten worker cells. Statistical analysis of worker-bee body-part measurements can be used to identify bees which are not producing their own comb or are producing comb from foundation. The simplest analysis uses measurements of fore-wing length and correctly identified 86 percent of 86 Africanized and 50 European colonies, with no misidentifications. A multiple analysis of fore-wing length, partial hind-wing length, femur length and "clean weight," correctly identified 91 percent of those samples, with no misidentifications. These procedures were used effectively in the California regulatory action.

GENETICS: — Research in bee genetics continues in the Venezuelan project. But so far, selective bee breeding has not produced especially favorable results. Third generation progeny selected for gentleness and productivity have tempers and productivity levels significantly better than "purebred" Africanized bees, but they are still far less desirable than European stock.

We now know much more about Africanized bees than we once did. Although more research is needed, there are now clear directions toward the solutions to the major problems of Africanized bees. For example, projects aimed at controlling natural mating, even in Africanized areas, are showing promise. Strategies can be developed so that the Africanized bees' presence does not deal a devastating blow to the beekeeping and related food industries in the United States.

Articles with a more in-depth look at some of the subjects discussed briefly here, such as identification techniques, queen bee breeding technology and genetics, will follow.

My thanks to Annette F. Reynolds for her assistance in preparing this article. ●

Reprinted from February, 1986, American Bee Journal
Vol. 126 (2): 98 - 100, 128-129

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