The Proposed Honey-bee Regulated Zone in Mexico[1]

by T. E. RINDERER, J. E. WRIGHT, H. SHIMANUKI, F. PARKER, E. ERICKSON and W. T. WILSON
U.S. Department of Agriculture
Agricultural Research Service

The Bee Regulated Zone represents a combination of current research solutions to Africanization.

WITHOUT human intervention, the Africanized honey-bee population will continue its expansion through Mexico and reach the United States about 1989 or 1990. The Agricultural Research Service has developed a conceptual bee-regulated zone (BRZ) to be located in southern Mexico to prevent the northward movement of Africanized bees. This BRZ would permit the unimpeded use of European bees in U. S. agriculture. We present here the description of the components of the BRZ and how it would function.

The European bee types now inhabiting the United States are productive, gentle, and adapt easily to varied and complex beekeeping management. The nature of European bees has helped make the U. S. beekeeping industry a success. The interconnected enterprises of queen breeding, package bee production, honey production and pollination services all rely on the good characteristics of European bees. However, the notably poor characteristics of Africanized bees — their tendency to vigorously defend their nest, to swarm often, to abscond, and to store only small amounts of honey — could change virtually every management procedure used in U. S. beekeeping today. These changes would decrease the profitability of keeping bees and cause some beekeeping enterprises to become economically unfeasible. Sixty U. S. and Canadian beekeepers recently visited USDA-ARS facilities in Venezuela to work with Africanized bees. They unanimously agreed at the conclusion of their trip that the presence of Africanized bees in the United States would be disastrous to beekeeping. Honey bees in the United States are as valuable to crop growers as they are to beekeepers. More than 90 food, fiber and seed crops, valued at nearly $20 billion annually, are dependent upon or benefited by bee pollination. Production statistics from 1980 show that the value of the entire U. S. honey crop was about $118 million; in the same year, just the value of almonds produced in California (and pollinated mostly by honey bees) was over $322 million. Current research shows that Africanized bees are difficult to manage for agricultural pollination.

The monetary damages that Africanized bees are predicted to cause to agriculture generally are enormous. According to a Georgia Department of Agriculture estimate, Africanization in their state alone could cost $90 million per year. States with larger agricultural economies, such as California, Texas and Florida (all of which are within the expected range of Africanized bees), can expect to be similarly affected. Recent studies have shown Africanized bees have a greater tolerance for cold climates than originally thought; it may be possible that Africanized bee colonies might exist in almost all of the United States and some parts of Canada. Thus, the impact of Africanized bees might be far greater than originally estimated.

Two swarms of Africanized bees were identified in the southernmost Mexican state of Chiapas in December 1986. The bees are expected to spread up the Pacific coast until they reach the Isthmus of Tehuantepec (see Fig. 1), where one front will turn northward and continue up the Gulf of Mexico coast.

Because of the bees' presence in southernmost Mexico, and their expected continued spread, the Agricultural Research Service (ARS) of the USDA has recommended the BRZ — a biological "barrier" — at the Isthmus of Tehuantepec. The Isthmus extends from the Pacific coast northward to the Gulf of Mexico coast across parts of the states of Oaxaca and Veracruz. The zone would be about 135 miles long and 100 miles wide. The Isthmus site was chosen for several reasons, the primary one being that it is the narrowest part of Mexico, and therefore the easiest and least expensive to regulate. The country is fairly flat at the Isthmus, with mountains to the east and west. Also, the road system throughout the region is sufficient to make most areas accessible.

The BRZ is considered necessary to stop the Africanized bees' northward progress. The BRZ is an area of intensive beekeeping of both managed and feral honey bees. The BRZ is elastic in the sense that research inputs would constantly improve the technology used. However, changes would preserve the integrity of the program.

The BRZ would be operational within a year. Work would be concentrated initially on the Pacific side of the Isthmus, an area where we expect Africanized bees will first enter the BRZ. Although time is short, the BRZ can be implemented. Any Africanized bee swarms penetrating beyond the Isthmus before the BRZ is fully operational will be identified and destroyed.

The BRZ has several important characteristics. First, regulators would concentrate their efforts in a relatively small area. Second, the activities in the BRZ are structured so that new technology could be blended into the existing procedures immediately after development. Third, the comparative usefulness of various management procedures will quickly become evident as

[1] Address correspondence to: Honey-Bee Breeding, Genetics, and Physiology Laboratory, 1157 Ben Hur Road, Baton Rouge, Louisiana 70820.

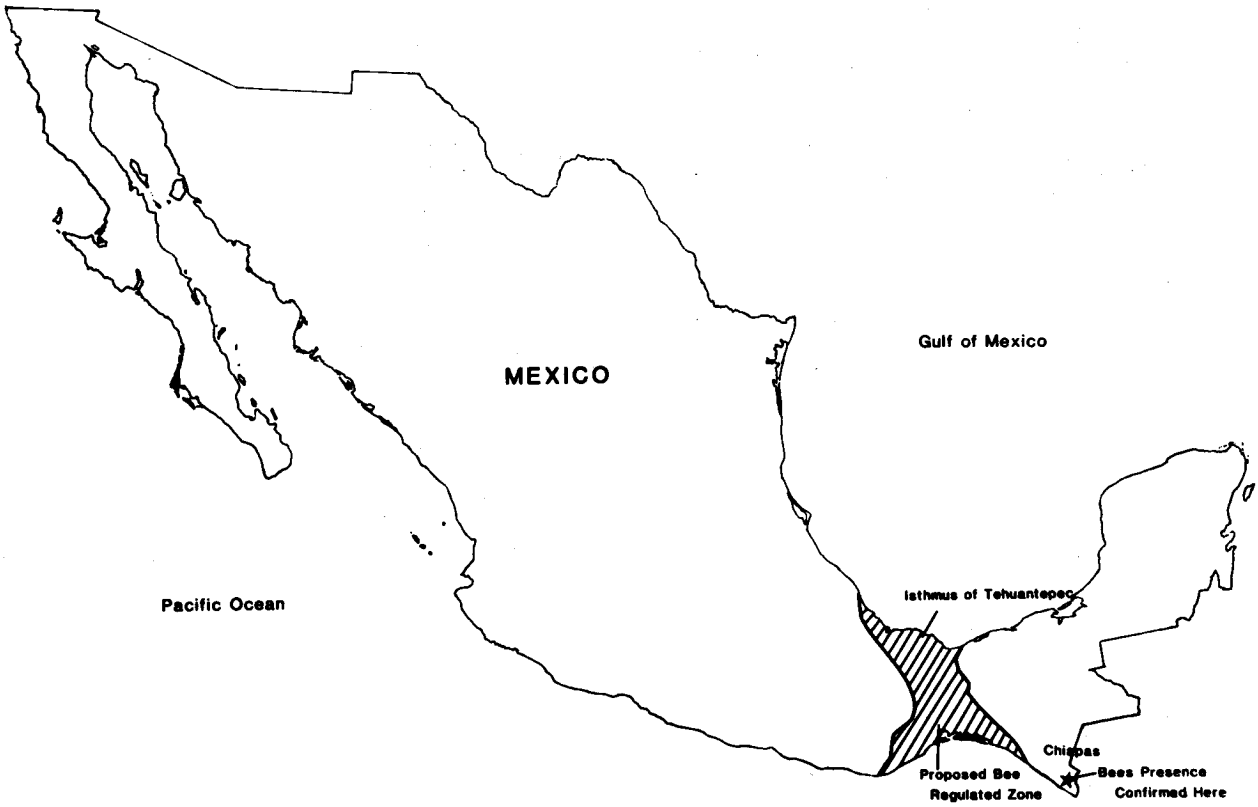

Fig. 1

the program develops; the structure of the program will permit the BRZ to evolve toward concentrating on the most productive activities. Fourth, it is a species specific program which only affects honey bee *(Apis mellifera)* populations.

The management procedures proposed for the BRZ are based upon the processes of Africanization as described by research. The BRZ procedures are split into six major categories, each based on a specific process of Africanization. They are presented here in a problem/solution format.

PROBLEM ONE: There is a possibility that Africanized bees will be moved northward through Mexico by people who transport the bees either on purpose or inadvertently.

SOLUTION: Several steps have been identified to prevent any transportation of Africanized bees past the BRZ. First, a quarantine would be established whereby movement of bees northward past the BRZ would be prevented. This is acceptable to the Mexican beekeepers, since currently they only rarely transport bees across the Isthmus.

Regulators who operate agricultural checkpoints (to stop the passage of Mediterranean fruit flies and hoof and mouth disease, for example) are already in place and operating around the Isthmus area. These agricultural checkpoints and regulatory personnel would be directed to conduct an Africanized-bee quarantine.

Inspection checkpoints would also be established at docks to check ships arriving from ports in areas where Africanized bees are present. In addition, ships docking enroute at a port in a heavily infested area could be inspected before departure.

Educational programs will greatly aid in reaching quarantine goals. Demonstration apiaries of Africanized bees could be established in areas south of the BRZ so people could observe the characteristics of Africanized bees that complicate management. These apiaries would serve as examples and help to discourage intentional introductions of Africanized bees north of the BRZ. Persons who have hands-on experience with Africanized bees do not want to use these bees in their beekeeping operations. A project team also would be organized to provide education to the public and members of the apiculture community on conforming to the BRZ's quarantine needs.

PROBLEM TWO: Africanized bees produce prime swarms frequently. These swarms are a major factor in the Africanization process in new areas.

SOLUTION: Bait hives to collect swarms of Africanized bees would be located at strategic points throughout the BRZ. Research has identified several hive characteristics that attract swarms. The bait hives will have the scent of recently occupied nests and the temperature inside would be kept relatively low through the use of insulation and shade. The hive would be a simple cardboard box hung in a tree, partially covered with a plastic bag to protect against the weather. The box's internal volume should be about 40 liters. Other swarm boxes or bait hives would be utilized as new technologies become available. BRZ workers would inspect these bait hives, destroy the hived swarms and collect bee samples for identification.

An office would be designated in each local area to receive reports of swarms from people living in the Isthmus area. BRZ project personnel would destroy the swarm, collect bee samples, and pay a bounty to the person who reported the swarm.

As another means of finding feral colonies within the BRZ, the proposal also incorporates collecting and identifying samples of individual foraging bees in the Isthmus. Project workers will collect adult honey bees from flowers and plants with insect nets and collect foragers from bait stations. If these bees are found to be Africanized, project workers would go back to the area where the foragers were collected, find the nest from which the bees came, and destroy or requeen it.

PROBLEM THREE: An Africanized queen with a small number of workers often takes over a hive occupied by European bees. The European queen is killed, and the colony becomes Africanized in about six to eight weeks.

Colonies which are queenless or have ineffective queens are especially attractive to these "parasitizing" invading Africanized queens.

SOLUTION: Special attention will be paid to European bee colonies in the BRZ to ensure that queens remain European. Precautions such as excluders or traps will be used to limit the entry of Africanized queens into managed European colonies. All rustic hives will be replaced by modern moveable-frame equipment so queen certification can be performed easily. Queens in European colonies in the BRZ must be painted or marked so that regular checks of the queens will be easy to make every two to four months. Also, team members must locate and register all managed bee colonies, and issue instructions on how beekeepers must manage their colonies to comply with the needs of the BRZ. Beekeepers in the area will be instructed not to let their European colonies go queenless for long periods because queenless colonies are attractive to Africanized queens and bees. Requeening of a European colony that has lost its queen or has a weakened queen must be carried out quickly. Beekeepers might be paid for their BRZ activities.

One colony in each apiary might be used as a trap for Africanized queens. The queen in such colonies will be caged, or removed. Thus, conditions are created to attract invading Africanized queens. These hives can be fitted with a trap that collects any queens which attempt entry.

The cooperation and support of the area beekeepers is central to the program. They would have the major role in creating conditions that would lead to the success of the BRZ. The project would support them by providing equipment, training, and the security of survey and detection work, and also by subsidizing their labor. The ultimate success of the project, however, would rest on the beekeepers' activities and cooperation.

PROBLEM FOUR: Africanized bees have a significant mating advantage due to their tendency to produce large numbers of drones. With a greater number of drones in an area, queen matings with Africanized drones are more likely.

SOLUTION: Several general aspects of the program, such as finding and destroying Africanized colonies and swarms, and maintaining European apiaries, will address this problem. Additionally, Africanized drones will be captured and killed. Drone traps, developed by ARS's Baton Rouge honey bee laboratory, which use queen pheromone as a lure have been used in Venezuela to collect many thousands of Africanized drones.

With additional research, drone traps can be used directly to destroy Africanized colonies. The traps would be set up so that the drones pass through a dispenser which applies an insecticide. When the drones return to their hives, insecticide would be spread throughout the colonies. Ideally, the insecticide would be safe and work specifically on honey bees; this might be accomplished by using a chemical which inhibits egg laying by the queen, or one that interferes with brood development. Either case would lead to the death of the colony. This type of in-

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Project Totals

3,872 Apiaries

38,700 Colonies

15,600 Drone Traps

140,800 Bait Stations

140,800 Bait Hives

1,144 Employees

220 Vehicles

88 Work Sites

1 Headquarters

Fig. 2

secticide delivery system would permit continued beekeeping in the area, if drone flight from the commercial European colonies was prevented.

To offset the Africanized bees' mating advantage, drone production in the commercial apiaries i.e., drone flooding) would be encouraged. Trapping Africanized drones and flooding with European drones would be alternated. By doing so, queens mating in the area would mate primarily with European drones. Drone flooding from European apiaries could include the use of specially selected stocks or lines which may be developed to help mitigate Africanization.

PROBLEM FIVE: Africanized drones often move into a hive occupied by European bees. This nest parasitism reduces the production of European drones in that colony, and maintains a greater number of Africanized drones in the general area.

SOLUTION: All of the above-mentioned activities would reduce Africanized drone parasitism. Drone traps, bait hives, drone flooding, the maintenance of European stock in apiaries, Africanized colony destruction resulting from the bounty system and survey and detection efforts, would all lower the Africanized drone population and thereby reduce Africanized drone parasitism. Additionally, maintaining queen excluders on colonies, except when the colonies were being used to flood areas with European drones, would reduce this problem to a low level.

PROBLEM SIX: Unlike European bees, Africanized bees have a strong tendency to abscond either when the colony is disturbed or there is a lack of food. Absconding swarms may travel many miles at a time, which allows the Africanized population to move into new areas rapidly.

SOLUTION: To prevent absconding swarms from going across the BRZ, the zone will be about 100 miles wide. This distance will prevent absconding swarms from easily flying across the BRZ. Research by Isaac Kigatiira in Kenya showed that absconding African bee swarms stop every 20 miles or so to forage for food for a number of days. Bait hives in the BRZ could trap these absconding swarms, especially if accompanying forager bait stations provided a source of food. Reports of swarms from people interested in bounty payment would also result in the destruction of absconding bees.

The tasks involved in these six solutions are adjusted to accommodate seasonal, geographical and ecological realities. The nectar flow season would be the most active period for the BRZ program. Sweep nets would be used for survey and detection during the nectar flow; bait stations would be used during dearths, when competing nectar sources do not exist.

For management, the BRZ would be divided into 88 units, each being a square, 12 miles on each side. Each unit would require the following major equipment and personnel: one supervisor, 10 control workers, two to three vehicles, one central work site, and two identifiers. Each unit would monitor about 44 apiaries (each containing from four to 20 colonies) spaced about 1.8 miles apart; 177 drone traps spaced about 0.9 miles apart; 1,600 bait stations spaced 0.3 miles apart; and 1,600 bait hives spaced about 0.3 miles apart. Each worker would monitor and regulate about 4.3 apiaries or 43 colonies per month, service 17.3 drone traps every day during the periods of trap use, and collect 156.4 bait station or sweep net samples every two weeks. Until bait hives are developed that will kill swarms automatically, these hives will be inspected every two weeks during the swarming season.

Each identifier would process about 1,600 samples every two weeks or less than 10 per hour. These identifications can be accomplished using FABIS (Fast Africanized Bee Identification System) identification procedures (described in the May 1986, *American Bee Journal*).

The overall size of the program is shown in figure 2. The BRZ would clearly be a labor-intensive program, since it relies on visual observations, sample collections and spot destruction of Africanized-bee colonies. Additional programs, such as a large pesticide program, would be less labor-intensive, but would require the elimination of beekeeping in the area and would be ecologically unacceptable.

Moreover, additional activities are recommended. Beekeepers in areas surrounding the BRZ would be encouraged to regulate and protect their managed European-bee colonies. Information would be provided to the beekeepers about the problems caused by Africanized bees and directions as to how they could cooperate with the activities of the BRZ. Some BRZ activities would be usefully employed in areas east of the BRZ. A reduction of the intensity of Africanization in these zones would aid in the success of the BRZ by lessening the number of bees entering the Isthmus.

As the BRZ becomes operational, research will continue to address the problems caused by Africanized bees. The following and other questions require further research:

- Are there quicker and easier methods of identifying Africanized bees?
- Could a more efficient drone trap or better trap placement be developed?
- In order to cause queens to mate primarily with European drones, how many drones are required to flood an area?
- Where should the drone-source colonies be placed?
- What are the mating-flight patterns of drones and queens?
- What is the drone-production potential of feral colonies?
- How do drones select congregation areas?
- Why and how are Africanized queens attracted to queenless colonies?
- Can the more desirable European bee characteristics be bred into Africanized bees?
- How can management techniques control the undesirable characteristics of Africanized bees?
- Can management techniques be developed to lessen defensive behavior?

While research continues into these and other questions, the BRZ represents a combination of current research solutions to Africanization.

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