Kenneth Lorenzen

Norman E. Gary

Worker bee collects pollen and nectar from an almond blossom. Below, beekeeper unloads hives for honey production in a safflower field.

How Africanized honey bees will affect California agriculture

Robert E. Page, Jr.

Africanized honey bees are expected to invade Southern California within the next 3 years. How far they will spread and how they will affect the agriculture of this state are of great concern. This article discusses the origins, current status and expected impact of Africanized bees on California agriculture.

Honey bees are thought to be directly or indirectly responsible for nearly half of California's $18 billion agricultural industry. California depends on honey bees to pollinate 47 different nut, fruit, vegetable, and forage seed crops with a cash value of $1.8 billion annually. The transportability of honey bees is essential to their role as pollinators of California's agricultural cornucopia. Pollination services are bought and sold and, as a consequence, bees are trucked up and down California's highways from crop to crop satisfying pollination contracts. The imminent arrival of Africanized honey bees in California within the next 2 to 3 years threatens the foundation of the honey bee pollination service industry and those agricultural commodities that depend on bees. Once feral Africanized honey bees arrive in California, it will be extremely difficult to maintain hives with pure European honey bees — and Africanized bees are not amenable to commercial methods of transportation.

Origins of Africanized honey bees

Honey bees are not native to the New World and were originally imported from Europe. European races are adapted to temperate conditions and commercial use: They are not very defensive and tolerate the disturbances associated with commercial management. However, European honey bees were not well suited to tropical habitats, such as southern Brazil, where they proved unproductive. In 1956, an eminent Brazilian geneticist imported African queen bees from South Africa and Tanzania to begin a breeding program — marking the origin of the Africanized honey bee. While African races of honey bees are well adapted to the tropics, they have many characteristics that are objectionable for commercial use: (1) extreme defensive behavior, (2) high reproductive rates (swarming) that result in reduced colony productivity due to the loss of worker bees, and (3) the tendency to abandon the hive when disturbed. It was the goal of the breeding program to cross African and European bees and select out the bad characteristics of each, resulting in a kind of tropical super bee.

However, by 1962 it was apparent that something had gone wrong. Brazilian beekeepers were complaining that their bees were very fierce and unmanageable. Researchers realized that African bees, or the hybrids that resulted from cross mating with Europeans, had become established in an area the size of Great Britain, and that this feral population was expanding its range at an alarming rate. Now, 35 years after their introduction, the direct descendents of those bees introduced into Brazil from Africa have spread across two continents. Although there are indications of some hybridization with European bees along the front of population expansion, many colonies have characteristics that appear purely African. In their wake, Africanized bees have left little evidence of the populations of European bees that once existed. Instead, it looks like one exotic genotype (the African) has replaced another exotic genotype (the European). Africanized bees have also left the bee industries of South and Central America in shambles, apiaries abandoned, honey production depressed, and beekeepers demoralized and out of business.

Current status

The recent expansion of the feral, Africanized population into southern Texas represents the "eastern front" that has spread along the Mexican coast of the Gulf of Mexico. It is separated from the "western front" by the high plateau of Mexico. The western front has spread along the Pacific Ocean and the Gulf of California and is now moving up the Sinaloa Valley. The growing population of feral colonies of Africanized bees spread north along the western front about 500 km over the past year. At this rate of spread, Africanized bees will reach the southern border of California in about 2 or 3 years.

Beekeeping in the Sinaloa Valley is migratory. Bees are trucked as far north as Mexicali on the border of California. It is

likely that Africanized colonies transported near the border may abscond or swarm and end up in California as "point source" introductions well ahead of the expanding front. It is doubtful that these point source introductions will have any real impact on California honey bee populations except that they may result in premature alarmist responses and government-mandated restrictions on the movement of honey bee colonies as occurred in Lost Hills, California in 1985 (Gary et al., *California Agriculture* Nov-Dec 1985, pp. 4-7).

Possible impact on California

Africanized bees will significantly affect California agriculture because of their potential impact on public safety. Commercial hives of European honey bees frequently replace queens, and queens are likely to mate with feral Africanized drones, producing colonies with Africanized characteristics including extremely defensive behaviors. Africanized bees have been called "killer" bees in the mass media because of reports of occasional fatalities associated with severe stinging episodes when unwitting humans come into contact with colonies defending themselves. Statistics show that 89 persons died in Mexico as a consequence of defensive behavior by Africanized bees in the 5 years since they arrived in Mexico. It is hard to gauge the added risk to public safety of Africanized bees relative to European bees because fatalities also occur as a consequence of the defensive behavior of European colonies of bees. Although any injury is regrettable, the threat to the general public by Africanized bees will remain insignificant compared with other daily risks. However, public concern will be high and education programs should be enacted to minimize potential danger.

Concern for public safety is likely to result in regulations restricting movement of honey bees in and out of areas where there are feral Africanized honey bee populations. In this event, bees will be in short supply for pollination services. California already has a short supply of bees each spring. For example, for the more than 400,000 acres of almonds under cultivation in California it is recommended that each acre have two hives of bees for maximum pollination efficiency — or a total of 800,000 colonies for almond pollination alone. However, there are fewer than 700,000 registered colonies of bees in California at any one time of the year and about 500,000 of these colonies are moved out of the state by early summer. Restricting the movement of bees out of fear of accidents associated with transporting Africanized bees would further reduce the supply of bees for pollination.

Once the Africanized honey bee arrives, many beekeepers will probably quit beekeeping because it will no longer be enjoyable. This will further reduce the supply of honey bees available for commercial crop pollination and pollination of backyard fruit and nut trees and garden crops. Studies conducted by UC Davis graduate student Ernesto Guzman-Novoa, showed that colonies of Africanized bees responded to test-induced defensive stimuli 7.8 times faster resulting in more than 5.5 times more stings than colonies of European bees. This increase in defensive behavior makes beekeeping laborious because extreme care must be taken in managing and transporting colonies. Beekeepers are already discouraged as a consequence of poor economic conditions in the industry and because of the recent introduction into California of two major parasites of honey bees, *Acarapis woodi* and *Varroa jacobsoni*. These new pests have increased operating costs and the additional expense and problems associated with Africanized bees will be more than many will be able to endure.

Prospects for the future

The California bee industry is relatively small with an annual production of about $55 million. Of this, roughly $10 to $20 million is from the sale of honey and the rest comes from pollination contracts and the sale of queens and bulk bees. However, the impact of the bee industry on other agricultural commodities is enormous. Some commodities such as almonds absolutely depend on the continued operation of pollination services provided by the bee industry. If these services disappear as a result of the Africanized honey bee, almond growers and others will be severely affected. It is imperative the bee industry remain viable through a restructuring of the way pollination services are provided and a redistribution of economic incentives.

Growers will have to share the increased economic burden of beekeeping if they want to have bees to pollinate their crops. Those who are concerned with farm accident liability may require that their contracted beekeepers requeen their colonies regularly with European queens to insure manageable bees and reduce potential risks. If so, they must be prepared to share the costs by paying premium prices for pollination services. In addition, they will have to include the pollen vector (honey bees) in their thinking about crop production. They will also have to bear some of the cost of needed bee research; the bee industry is small and can not support the research needed to deal with its problems — problems shared by the agricultural commodities as well.

Sources of good stocks of honey bees will be needed to replace queens of unmanageable commercial colonies. These stocks will have to be maintained by instrumental insemination to insure the integrity of the stock, or will have to be kept physically isolated from Africanized bees. Honey bee queens mate naturally while in flight with about 17 different males. The only method of controlling their mating is by instrumental insemination in the laboratory. Queens that mate naturally in areas that have Africanized bees are likely to mate with Africanized drones and produce unmanageable or undesirable colonies.

California is likely to be a mosaic of European and Africanized feral bees. Africanized bees are not found in Argentina south of Buenos Aires, suggesting that colder, more temperate climates provide a barrier. California's higher elevations and northern latitudes may provide refuge for European bees, where natural mating of queens with drones of desirable stocks may occur. If so, then we may be able to maintain our queen rearing industry and provide California-produced queens for sale to replace Africanized stocks in commercial hives. If not, queens will have to be purchased from outside the state, causing further damage to the industry through the loss in revenue from sales of queens.

Selective breeding may improve the overall quality of bees available. Selection programs should have these objectives: (1) maintain European stocks of bees because they already have qualities that are desirable for commercial beekeeping; (2) select from among available stocks those that produce manageable, productive colonies when queens mate with Africanized males; (3) improve the commercial quality of whatever stocks are available. Selection, testing, and maintenance of stocks will require an organized program and will be accomplished best by a financially-supported stock center. Financial support for this center should be shared by the bee industry and the agricultural commodities that depend on bees for pollination.

It seems inevitable that Africanized bees will become established within the borders of California. At this time we can only speculate on the extent of their range and impact on California agriculture. However, now is the time to begin thinking about how we will deal with them in our agricultural environment and how we will continue to provide the enormous supply of honey bees necessary to pollinate the crops of our nation's breadbasket — California.

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