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**Africanized Honey Bee Task Force
Action Plan**

University of California
Agricultural Experimental Station

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Research Objectives

The objectives and recommendations outlined below are based on the premises that the preservation of a strong queen-rearing industry is essential to the continued successful use of honey bees in California agriculture and that there are no **solutions** to the problems created by the imminent Africanization of California honey bee populations. Instead, research should focus on developing **programs** that can be implemented by the industry that minimize these problems. These programs must become permanent components of honey bee management systems and will require continuing funded research. Funding for some of the outlined research already exists in the form of a contract for \$100,000 per year between CDFA and the University of California, Davis. The research is directed by Dr. Robert Page, Associate Professor, Department of Entomology. Funding for this project expires June 1992 and should be extended beyond that period in order to be effective.

Objectives, needed research and funding status are listed below in a rough order of priority. Priorities are difficult to assign and will probably change as we learn more about the actual impact of Africanized honey bees on California.

1. Objective (Phase 1): Maintaining European Commercial Bees

The initial research objective is to develop methods with which queen producers can continue to provide commercial honey bee stocks that are free of any influence of Africanization, eg., European bees. The maintenance of non-Africanized bees may be achieved in two ways: 1. importation of

desirable stocks from outside California (eg. non-Africanized areas of the North America, Europe, New Zealand, or Australia) and 2. by maintaining breeding populations that are closed to the genetic influence of Africanized bees.

1.1 Recommended Research: Importation and quarantine facilities

Research is needed to provide sufficient quarantine procedures to allow safe importation of disease-free, non-Africanized honey bee stocks. Current methods of quarantine require the use of large facilities that are wasteful of space, allow too few queens to be in quarantine at one time, are costly to build and maintain, and result in low survival of queens.

Currently, we have the capability of keeping caged queens alive and laying eggs in incubator environments for days or weeks. We need research to extend this period to months or years. If we can extend this time, then we will be able to maintain entire captive closed breeding populations of hundreds of queens in laboratory "quarantine" facilities.

Additional funding of \$30,000 per year for 3 years will be necessary for this research.

1.2 Recommended Research: Closed breeding populations

Research is needed to develop methods for protecting the genetic integrity of our current honey bee stocks from the influence of Africanized bees. Methods for maintaining genetically-closed populations have been

developed and implemented by some queen breeders throughout North America. However, the methods are labor intensive because they require instrumental insemination of large numbers of queens and, as a consequence, are not likely to be practiced by many queen producers. Therefore, the development of more easily-executed methods are needed if we expect to supply sufficient stock for the needs of California beekeeping. Research is needed in three areas: 1. local control of natural matings, 2. maintaining captive, laboratory populations, and 3. development of improved methods of instrumental insemination.

Funding for this research is covered by the CDFA/UC Davis contract.

1.2.1 Local control of mating areas - In order to control the genetic composition of a population, we must control the males with whom queens mate. (Queen honey bees each mate with a large number of drones. Matings occur only while queens and drones [males] are in flight at specific locations away from the hives and apiaries.) This can be accomplished by allowing queens to mate only in isolated areas that are free from the males of feral (wild, unmanaged) honey bee colonies. The higher elevations of the Sierra Nevada, the dryer parts of our California deserts, and our off-shore islands may provide natural isolated sites. Research is needed to locate isolated mating areas.

An alternative is to temporarily establish locally isolated areas by eliminating the drones from the feral colonies and supplying the area with a large number of drones from suitable stocks. Methods are needed for locating and eliminating feral, presumably Africanized, colonies that are within flight

range of "mating apiaries". (Mating apiaries are established by queen producers for the sole purpose of getting large numbers of virgin queens mated to drones in the area.) Methods for eliminating free-flying Africanized (or other unsuitable) drones should also be developed in order to achieve at least temporary control over matings. In addition, we need to determine how to best position drone source hives so that high proportions of proper matings take place.

Funding for this research is covered by the CDFA/UC Davis contract.

1.2.2 Maintaining captive populations - Breeding populations of honey bees can be kept completely isolated from Africanized bees if they are maintained exclusively in the laboratory. As discussed in section 1.1 above, queens can already be maintained with groups of workers for periods of days or even weeks. With additional research, it is quite possible that we could determine the additional requirements needed to maintain them in captivity for their entire natural life span of 1 or 2 years. An ultimate goal would be to make such small captive colonies entirely self-sufficient, producing queens, workers and drones.

Additional funding will be needed for this research. The \$30,000 per year for 3 years recommended under section 1.2 above will be sufficient for both of these research objectives.

1.2.3 Recommended Research: Improving instrumental insemination technology

Some queen breeders will use instrumental insemination (II) to maintain their selected stocks. These individuals will need improved methods to increase speed and decrease the costs associated with II. It is important that queen producers diversify in the programs they use. Some may use natural mating in isolated areas, some import non-Africanized stock from outside California, while others maintain closed populations by instrumental insemination.

Additional funding of \$15,000 per year for 3 years will be needed for this research.

2. Objective (Phases 1 and 2): Selective Improvement of Available Stocks

The second objective is to develop selective breeding programs that are directed toward the improvement of the available stocks of bees present in California. This objective differs from objective 1 because there will be no attempt to completely exclude Africanized bees. This is necessary for commercial queen producers to continue using their current management practices to produce the large numbers of queens needed to supply California beekeepers.

Research is needed in two areas: 1. selection of queen stocks that provide good, manageable colonies when mated with drones (European and Africanized) from both commercial and feral colonies; and 2. determination of the amount of cross-mating between selected queens and Africanized drones that is allowable and still maintain manageable, commercial colonies.

2.1 Recommended Research: Selection for reduced defensive behavior

The need for "safe bees" for pollination will dominate the concerns of California's agriculture. Current pollination practices will create serious problems if we depend on highly defensive Africanized honey bees. These practices include the frequent transport of bees along state highways and the concentration of large numbers of colonies in agricultural plots that are near populated areas or farm workers. Both transporting and maintaining bees in high densities results in greater defensive behavior.

Selective breeding programs will be developed to select stocks that are less defensive so that more "mismatings" can be tolerated. If successful, this should relax requirements for "drone control" in mating areas and reduce the costs and efforts of queen producers.

Funding for this research is covered by the CDFA/UC Davis contract.

2.2 Recommended Research: Selection for improved pollinating efficiency

Breeding for high pollination efficiency will be initiated. Easy selection methods will be developed that can be used by queen producers. If pollination efficiency can be improved, then perhaps fewer colonies will be needed to pollinate any given crop. Fewer colonies may mean fewer management problems. High pollen collecting stocks that show low defensive behavior will be naturally mated in commercial mating apiaries to determine their suitability for pollination services. Selection for increased pollen collecting has already been successfully demonstrated.

Funding for this research is covered by the CDFA/UC Davis contract.

2.3 Recommended Research: How much cross-mating can be tolerated?

Studies of drone and queen flight range and distribution are needed to determine how to **minimize cross mating** between commercially produced queens and Africanized drones. Methods need to be developed where individual queen producers can assess the degree of cross mating occurring with queens from their own mating apiaries. Studies will be conducted to determine how many Africanized drones a queen can mate with and still maintain a safe, commercially-acceptable colony.

Funding for this research is covered by the CDFA/UC Davis contract.

3. Objective (Phases 3 and 4): Improving the Genetic Composition of the Feral Population

Following Africanization, research will be conducted to determine the efficacy of improving the genetic composition of the feral bee population. Attempts will be made to convert Africanized populations back to European-type bees by selectively eliminating Africanized colonies, Africanized drones from mating areas, and "flooding" areas with large numbers of European drones. Limited, local success may be attainable following adequate studies of mating biology, reproductive dynamics, and the ecology and distribution of feral colonies.

The execution of this research will depend upon continuation of the current CDFA/UC Davis contract for 2 additional years beyond the current 5 year funding period.

4. Objective (Phases 1, 2, and 3): Identification of Africanized Bees

Improved, rapid methods for analyzing mitochondrial and nuclear DNA will be developed for determining the spread of Africanized bees throughout California.

4.1 Recommended Research:

Current identification techniques work well enough to follow the progress of "Africanization" but are often slow and laborious. New, dependable techniques will be developed in order to conduct a survey of feral and commercial bee populations prior to the beginning of Africanization. These will then form the baseline data for comparison after Africanization begins. Identification of Africanized and non-Africanized bees will be important to all research objectives.

Funding for this research is partially covered by the CDFA/UC Davis contract. However, any extension of the use of the identification procedures beyond the scope of developing techniques will require additional funding. Additional funds of about \$50,000 per year will be required for conducting the survey of feral bee populations and documenting the extent and range of Africanization in California.

5. Objective (Phase 3): Development of New Apicultural Practices

New apicultural practices will be developed that will reduce defensive behavior of Africanized colonies used in commercial beekeeping operations.

5.1 Recommended Research:

Research needs may include methods for manipulating colonies, transporting bees, apiary organization, finding queen honey bees, dependable defensive behavior tests, and development of bee repellents that can be used to disrupt defensive behavior. Additional research will be needed to manage Africanized colonies for pollination services and honey production.

Many of these research objectives will by necessity have to be conducted during phase 3, after the expiration of the current CDFA/UC Davis contract. They will, therefore, be dependent on extension of those funds.

6. Objective (Phases 2 and 3): Provide Accurate Information about Africanized Honey Bees for Public Dissemination

Some research needs to be directed toward sorting out fact from fantasy about Africanized honey bees in order to keep the public informed and to aid in policy decisions relating to them.

6.1 Recommended Research:

The list presented below is meant to reflect the kinds of questions that may be addressed toward this objective. It is not comprehensive and some of

these questions may have already be adequately answered by other research groups:

- a. What is a "safe" zone around Africanized colonies and how sensitive are they to disturbance?
- b. How defensive are swarms compared to established colonies?
- c. Is there a difference in defensive behavior between reproductive and migratory swarms?
- d. Are Africanized honey bees effective in pollinating monocultured agricultural systems?
- e. Are they good honey producers?
- f. Do Africanized honey bees "invade" hives of European bees?
- g. What are the preferred nest sites of Africanized bees?
- f. How abundant are they in our towns, cities, parks, agricultural areas, forests, etc.?

Funding for research addressing these most of these questions is probably covered by the CDFA/UC Davis contract. However, additional funds may be needed to cover research directed toward some specific elements.