Current Research at the USDA, SEA, Bee Breeding and Stock Center Laboratory in Baton Rouge, LA[1]

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ABSTRACT

The history, facilities, staffing, and present mission of the U. S. Department of Agriculture's honey bee research laboratory in Baton Rouge, Louisiana, are discussed briefly. The current program includes research in bee breeding-genetics, bee breeding technology, and Africanized bees, as well as the maintenance of mutant lines and other special stocks.

THE BEE Breeding and Stock Center Laboratory continues a history of Federal honey bee research in Baton Rouge which stretches back 50 years. During these 50 years, laboratory facilities, personnel, research missions, and the American beekeeping industry have all changed.

In 1928, W. J. Nolan, apiculturist with the U.S. Department of Agriculture, was temporarily assigned to Baton Rouge, Louisiana, to organize a research laboratory for the purpose of studying problems associated with the Southern beekeeping industry. Later in the same year two research men were hired, Dr. Warren Whitcomb, Jr., as director, and Dr. Everett Oertel, as apiculturist, to staff the new Southern States Bee Culture Laboratory.

In 1961 the title of the Baton Rouge unit was changed to Bee Breeding Investigations Laboratory to reflect the breeding and genetics work being performed largely by Drs. O. Mackensen and W. C. Roberts. Dr. Roberts became head of the newly formed Bee Stock Center in 1967 and Dr. N. M. Kauffeld was promoted to leader of the Bee Breeding Investigations Laboratory. In 1969 construction of the laboratory and office building known as the Honey Bee Stock Center was completed, and its staff assumed the function of the collection, maintenance, and distribution of "genetically defined stocks having historic, economic, and scientific usefulness" (Roberts 1972). Funds for this facility had been appropriated by the United States Congress as a result of vigorous support by the late Senator Allen J. Ellender and his friend of long standing, the late Mr. E. C. Bessonet, a well known queen breeder, who with his family, operated a commercial beekeeping business at Donaldsonville, Louisiana for many years.

In 1974, the two groups were merged into a single unit, The Bee Breeding and Stock Center Laboratory, with Dr. J. R. Harbo in charge.

A chronology of the directors of the USDA honey bee research laboratories at Baton Rouge (partially from Oertel 1976) follows:

Southern States
Bee Culture Laboratory

W. J. Nolan — 1928 (July and August)
W. Whitcomb, Jr. — 1928-1961

Bee Breeding
Investigations Laboratory

O. Mackensen — 1961-1963
W. C. Roberts — 1964-1967
N. M. Kauffeld — 1967-1974

Bee Stock Center

W. C. Roberts — 1967-1973
J. R. Harbo — 1973-1974

Bee Breeding and Stock
Center Laboratory

J. R. Harbo — 1974-1977
T. E. Rinderer — 1977-present

The laboratory is currently staffed by eight scientists. Also, we have recently filled some technical positions and now have nine technical and clerical personnel. Additionally, some students are hired during the bee season.

FACILITIES

Our main facilities are located on the Ben Hur Farm of Louisiana State University approximately 2 miles south of the campus on Ben Hur Road, a short distance west of Nicholson Drive Extension (La. Route 30). They consist primarily of a laboratory and office building, a newly completed laboratory building, and a large metal building. Upon completion, the metal building will include rooms for inseminating queens, housing incubators for experimental use, preparing artificial diets, emerging drones and queens, maintaining colonies during winter, and testing pheromones. In addition, we have 18 apiaries that support about 450 colonies and 1,000 nuclei during the most active part of the year.

BEE BREEDING AND GENETICS

One major responsibility of the laboratory is bee breeding and genetics. We are working on the development of better ways of selecting breeding stock. Field observation techniques that are currently in use have often been successful, but field observations are not entirely reliable, and rates of success need improvement. We are developing laboratory techniques that will allow us to measure stock qualities more precisely and more rapidly. Then when we combine a variety of character measures into a single evaluation score, we will have what is called a selection index, a way of measuring the relative net merit of bee stock. Development of a selection index will allow honey bee breeders to develop stock with both repeatable and predictable success. A number of the present staff is working in this area.

Dr. Anita Collins, a recently appointed research geneticist, is working with a laboratory method she developed to measure bees' response to the alarm pheromone released when they sting. Bees from different colonies respond differently. Dr. Collins is investigating: (1) the genetics of the differences in response to alarm pheromone, (2) the effect on the behavior of bees by the various components of

alarm pheromone, and (3) the details of defensive behavior in bees.

Dr. James J. Lackett, a research entomologist who has a history of interest in pollination and has just recently received his Ph.D., will this spring begin a program designed to incorporate the pollen-gathering activities of bees in the selection index. It will become increasingly important that bees rented for pollination are known to be intensive pollen collectors. Also, it is important to be able to balance pollen collection and nectar collection in selected stocks of bees.

Dr. Thomas E. Rinderer, appointed as laboratory director last August, is working with both resistance to Nosema disease and longevity in bees. He has developed a technique to individually feed known numbers of *Nosema* spores to worker bees and thereby is able to measure worker bee response to infection with *Nosema*. He has found that both response to *Nosema* and longevity of bees vary substantially. Consequently there is good likelihood that both characteristics can be improved in bee stocks by selective breeding. He plans to verify this with selection experiments starting next spring.

Dr. Rinderer has also done some work with a hoarding behavior test developed by Drs. Kulincevic and Rothenbuhler at The Ohio State University. This test measures how quickly caged bees remove sugar syrup from a feeder and store it in a comb. Using this test, Dr. Rinderer found that empty comb is a stimulus for hoarding behavior. This discovery led to experiments this past spring in which he found that large amounts of empty comb given to field colonies increase honey production. A full report of these discoveries will soon appear in the *American Bee Journal*.

Dr. H. Allen Sylvester, another newly appointed research geneticist, has assumed responsibilities for bringing honey production into the selection index. He has found that hoarding behavior, as measured by the lab tests, also varies substantially in bees, and will begin selection experiments this spring with a test to verify the usefulness of this trait as an element in the selection index. Dr. Sylvester has recently finished a summer-long project designed to make the hoarding test as efficient as possible. Next year he will be attempting to develop other tests that will further aid in estimating the honey production potential of bee stocks.

Dr. Kenneth W. Tucker, a research entomologist with strong training and many years of experience in bee genetics, also is working on projects associated with the selection index breeding scheme. While on a recent trip to South America, he noticed that the alarm pheromone of Africanized bees could be quite easily smelled by humans when they are stung. He has since worked out a scheme for comparing bees on the basis of the amount of alarm pheromone they produce that is quite simple to use. Dr. Tucker is working cooperatively with Dr. Murray Blum of the University of Georgia to refine and verify the testing procedure.

For a number of years Dr. Jerzy Woyke of the Agricultural University of Warsaw, Poland has extensively studied instrumental insemination, diploid drones, and population genetics of sex determination in honey bees. His work has been supported by research grants from the USDA authorized by Public Law 480. During recent years, Dr. Tucker has served as the USDA scientific representative in conjunction with this research.

BEE BREEDING TECHNOLOGY

While we have responsibilities in bee breeding, we also have research responsibilities for the technology associated with breeding-related management.

Dr. John R. Harbo, research entomologist, recently decided to step down as laboratory director so he could devote more time and energy to his research. He has been working on a long-term project to improve our ability to store honey bee semen for breeding purposes. This project has met with some success. He has frozen honey bee semen in liquid nitrogen, thawed it, and instrumentally inseminated queens that subsequently laid a certain percentage of worker brood. He is now checking whether the freezing process causes genetic damage in the sperm cells. If he finds it doesn't, he will have taken a major step in the development of a technique to maintain honey bee genetic material.

Dr. Harbo is also interested in the quality and quantity of eggs laid by queens. He has several experiments in progress in these areas which may either generate management technology or may develop into specific tests that can be incorporated into the selection index program.

Dr. Ross A. Nielsen, research entomologist, has noticed that very young worker larvae vary in physical characteristics. Some of them look similar to drone larvae and others look very different. He is beginning a project this spring to determine whether the worker larvae that look most "female" will prove to be the best larvae to graft for queen production. To do this he will be looking at such characters as graft acceptance, queen appearance, colony acceptance of queens, and quality of brood pattern.

Mr. Jon L. Williams, research entomologist, also has projects in the breeding technology program. He is in the initial stages of a study of the physiology of honey bee sperm and eggs in relation to the process of fertilization. Factors associated with the maintenance of spermatozoa in the queen's spermatheca, sperm activation, and sperm-egg interaction will be studied in detail. The scanning electron microscope is being utilized in this work. The ultimate goal of his research is the development of technology for artificial fertilization of honey bee eggs.

Dr. Kenneth Tucker also has interests in differences in how honey bee stocks accept introduced queens and also in differences in how easily queens from different stocks are introduced. He is exploring ways to predict acceptance of introduced queens with a simplified laboratory test. If he has success with the project we will be able to add acceptance characteristics into our selection index.

STOCK MAINTENANCE

A third responsibility of the laboratory is the maintenance of a number of mutant lines of bees that are important as scientific tools. We now propagate honey bee lines that incorporate one or more of 18 mutations including eye color, eyeless, body color, wing conformation, hairless, and expression of characters of both sexes in a single individual (gynandromorph). Mutant stocks of honey bees are very important as scientific tools inasmuch as they can be incorporated into many types of tests to eliminate the confounding effects of such phenomena as parthenogenesis. For example, eye pigment biochemistry, resistance to American foulbrood, mating behavior, sex determination, pollination activity, fertilization technology, sperm storage, population dynamics, longevity, and bioaccoustics have all been explored with experimental designs utilizing bees identifiably different because of the mutations they carry (Harbo and Rinderer 1978). Also, a number of inbred lines of bees are being maintained and a number of others will be added as we develop scientifically useful stock as a consequence of our breeding ex-

periments. Mr. Eugene Jensen, biological technician and formerly a commercial queen breeder, is in charge of this stock maintenance program.

AFRICANIZED BEE RESEARCH

Our laboratory also has responsibilities for USDA Africanized bee research. Some work, such as basic questions concerning honey bee defensive behavior, can be done in Baton Rouge without using Africanized bees. Work that requires Africanized bees is done in South America.

At the moment, our research program involves the "inhouse" studies of defensive behavior mentioned earlier, which are being done by Dr. Collins and Dr. Tucker, and the funding of a number of outside projects by university scientists. Identification of Africanized bees through computer analysis of adult body structures has been studied by Dr. Howell Daly of the University of California at Berkeley, and Dr. Jerzy Woyke of Poland also has compared bristle counts of Africanized bees with European stocks. Dr. Lionel Goncalves of the University of Sao Paulo at Ribeirao Preto, Brazil, has done some basic work on the effects of climate on Africanized bees. Building on this base, our own work on defensive behavior and the cooperative work with Dr. Blum on alarm pheromone production will give us a good base from which to be able to breed nondefensive bees and deal genetically with the strongly defensive hybrid.

A cooperative agreement was recently arranged with Dr. Walter C. Rothenbuhler at The Ohio State University to evaluate stocks of bees currently available in North America, especially for traits associated with disappearing disease. This project will hopefully give us a better understanding of disappearing disease, a knowledge of the strength and weaknesses of North American stocks of bees as determined by actual tests, and as a consequence, information that will prove invaluable in any breeding program designed to offset the impact of Africanized bees.

Dr. Orley Taylor of Kansas State University has had a USDA grant for the past 3 years to study the behavior and movement of Africanized bees in South America. He has provided valuable information about the swarming behavior, absconding behavior, and the rate of movement of Africanized bees in South America.

All of these projects, including the projects mentioned under the titles of bee breeding and bee breeding technology, are designed to come together and provide us the needed technology to develop a bee breeding strategy which will considerably lessen the impact of Africanization in North America should it occur.

A COLLABORATOR

We feel fortunate to have Dr. Everett Oertel as a laboratory collaborator. Dr. Oertel retired in 1967 after 39 years of service at the Baton Rouge bee laboratories and now is working on the history of beekeeping in North America. We are all enriched by the opportunity to have Dr. Oertel share his experiences and observations obtained during a 50-year career in honey bee research.

LOOKING AHEAD

The recent reorganization that resulted in the Bee Breeding and Stock Center Laboratory has given us a staff of young scientists, good research facilities, and a collection of new programs. In a very real sense the Baton Rouge facility is new, even though the laboratory has historical roots stretching back 50 years. The growth of our young research programs will take time. Good research proceeds in a deliberate step by step fashion. This care assures that approaches and methods that are eventually developed for the industry will have a background of hard scientific evidence that has been examined with thoroughness by us and critically evaluated by colleague-scientists throughout the world. For these reasons our program will be years in its development, and our contributions to the bee industry will come as pieces of technology, one at a time.

This technology will be our product. We will not be producing production stock for beekeepers. Rather we will be supplying information helpful to commercial bee breeders throughout the country such that they in turn can produce improved stocks for themselves, and for other beekeepers.

FOOTNOTE

[1] In cooperation with Louisiana Agricultural Experiment Station.

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