



Honey Bee Stock Improvement Program

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Project Cooperators

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Objectives:

1. Enhancement of genetic diversity of domestic commercial stocks through the importation honey bee semen from select lines of European bees.
2. Develop a protocol for the safe and practical international exchange of honey bee germplasm.
3. Provide technology transfer of the skills required for honey bee stock maintenance.

Summary:

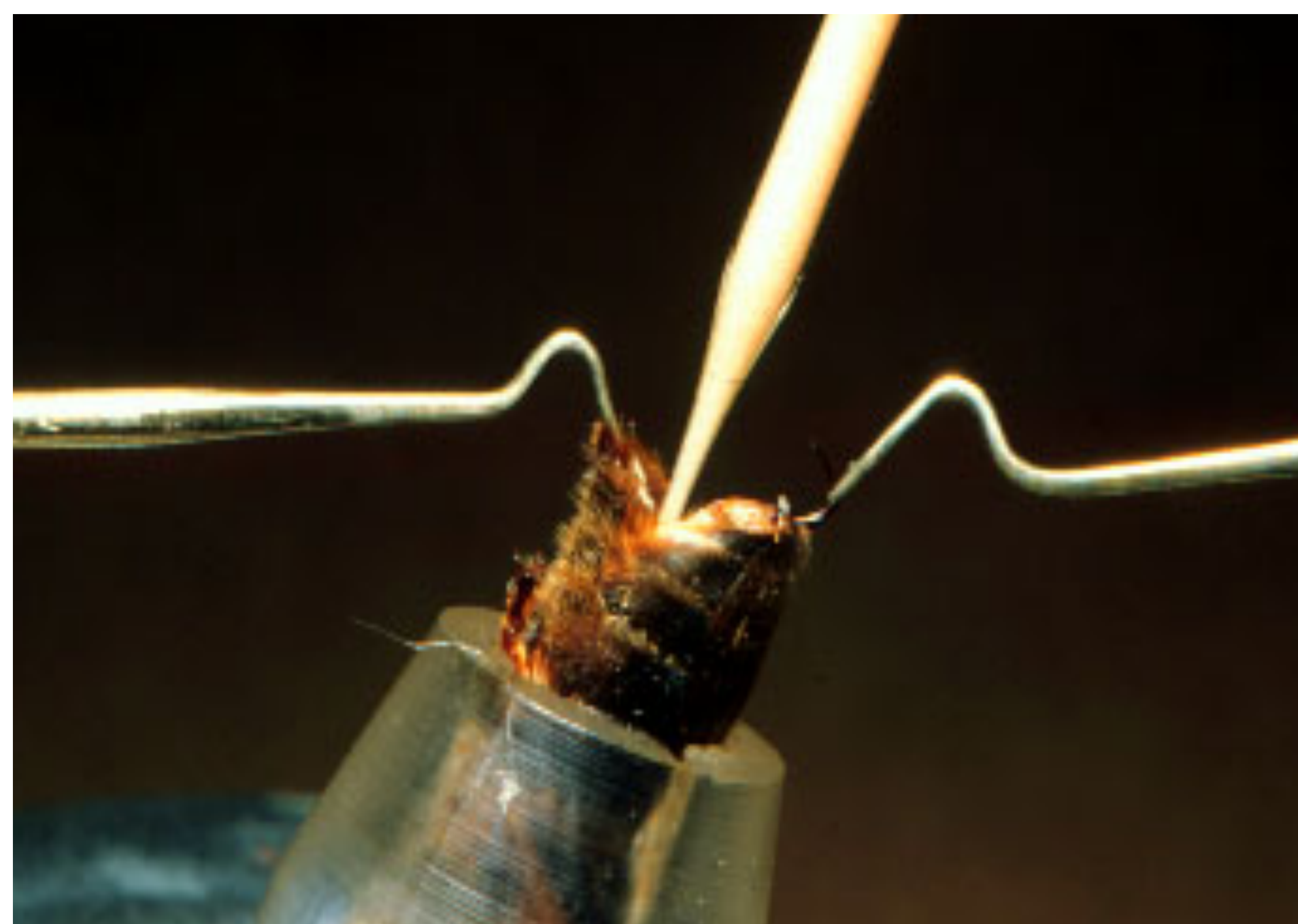
Pollination of California almonds as well as other crops is dependent upon a healthy, sustainable beekeeping industry. Beekeepers and growers continue to be faced with declining colony numbers due to compounding and interacting factors. The narrowing honey bee gene pool used to restock colonies nationwide is a concern. The focus of our on-going project is to enhance genetic diversity and assist the queen producers in selection and maintenance of breeding stocks. We have imported honey bee germplasm from abroad to enhance our domestic breeding stocks and to provide access to programs selecting for increased levels of resistance to pests and disease. To facilitate this process we are establishing protocols for the



Collaborating queen producers supplied virgin queens that were crossed with the imported semen. We also created various crosses to incorporate and test the imported stocks with domestic commercial lines. To determine the compatibility and economic value of the imported stocks and the various crosses, and to establish a distribution and stock maintenance program, we are working closely with the California queen producers.

Reproductive Technology Development

Honey bee eggs are excellent candidates for stock exchange, they provide a complete genetic package, are prolifically produced, and the three day egg stage allows for transport. We developed a method to transfer eggs in isolation, allow for pathogen testing and long distance transport. Using a pair of fine forceps with the application of micro-bore tubing to the distal pincers, eggs were removed from



The Instrumental Insemination of a Queen Bee
international exchange of honey bee germplasm. We developed an egg transfer system and are studying the transmission of viruses between donor queens and their embryos. To provide technology transfer, an essential aspect, we are working closely with the California Bee Breeders Association to develop long term selection and stock maintenance programs. Annually, specialized short courses are offered at UC, Davis. We are also partnering with Marla Spivak's Tech-Transfer Team and Steve Sheppard's Honey Bee Health Program in our outreach programs.



Egg Transfer System

beeswax comb and placed in sterile plates for transport. We have successfully hatched the transferred eggs in vitro and in vivo and reared the larvae into queens. The egg transfer system methodology offers a practical and efficient means for the international exchange of honey bee eggs.

To assess the relationship of viral transmission between donor queens and their eggs, we surveyed commercial apiaries in California and Louisiana. Queens, six months, or older, and 50 of each queen's eggs were collected from 100 colonies, representing the major U.S. commercial breeding populations. Samples were analyzed using RT-PCR for the presence of eight viruses: acute bee paralysis virus (ABPV); black queen cell virus (BQCV); chronic bee paralysis virus (CBPV); deformed wing virus (DWW); Israeli acute paralysis virus (IAPV); Kashmir bee virus (KBV); sacbrood bee virus (SBV); and slow paralysis Virus (SPV).

Our results, summarized in the table below, indicate that of the eight viruses tested, only three, BQCV, DWW and IAPV, were detected in both queens and eggs. The percentage of detectable virus was generally lower in the eggs as compared to the queens. This may indicate that the mode of transmission from various hive constituents to the queen, or between the queen and her eggs, is reduced. DWW and BQCV were the most prevalent, although a higher rate of transmission between queens and eggs was observed with IAPV. Overall, these preliminary results suggest the mode of transmission of virus from the queen to her eggs does not appear to be strong and may vary among viruses.

	ABPV	BQCV	CBPV	DWW	IAPV	KBV	SBV	SPV
Queens	0%	88%	0%	95%	27%	0%	0%	0%
Eggs	0%	3%	0%	56%	23%	0%	0%	0%

Viral transmission between queens and their eggs



Technology Transfer

Ongoing technology transfer support and assistance in stock selection and maintenance is an essential component of this project. We are working with the California Bee Breeders Association to distribute and test stocks and established practical breeding programs.

Annually, we continue to offer three specialized beekeeping short courses in the skills required to develop and maintain honey bee stocks. Classes are conducted at UCD, Laidlaw Honey Bee Biology Facility and structured to provide hands-on practical field and classroom training. The classes offered are:

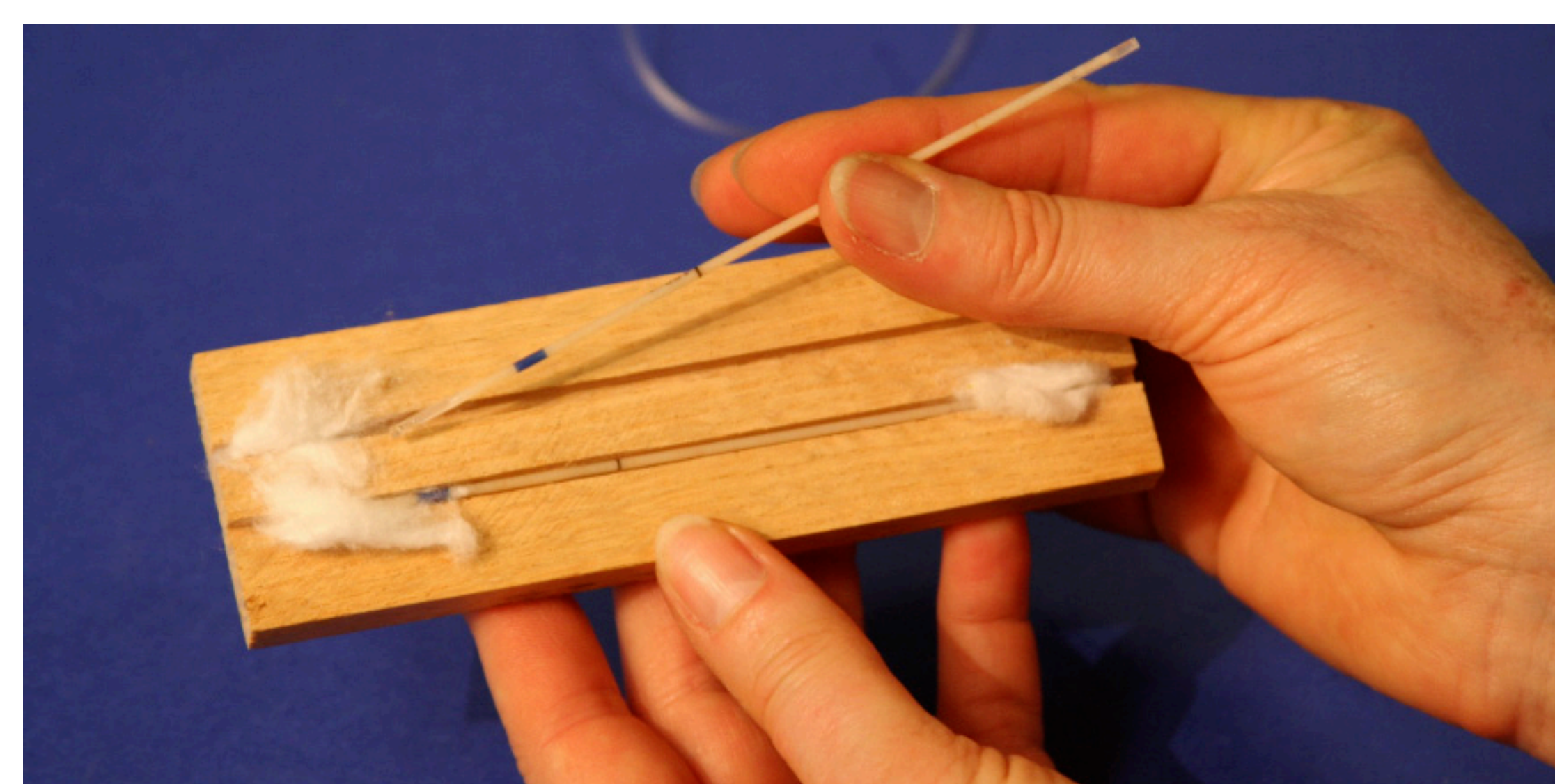
- The Art Of Queen Rearing
- Instrument Insemination & Bee Breeding
- Advanced Techniques In Instrument Insemination



Technology Transfer Classes



The full report of this project is available through the Almond Board. Photos by Kathy Garvey



Stored Honey Bee Semen Ready for Shipment

Enhancement of Commercial Stocks

The honey bee, *Apis mellifera*, not native to the U.S., was founded upon a limited gene pool. Genetic diversity, the raw tools for selection, enhances colony fitness, survival, and lessens the impact of pests and diseases. The focus of our continuing project is to increase genetic diversity of our domestic honey bee populations.

Honey bee semen from 3 subspecies has been successfully imported under USDA-APHIS permits; *A.m. ligustica* from select stocks in southern and northern Italy in 2008, 2009 and 2010, *A.m. carnica* from the German Carnica Association at the Kirchhain Honey Bee Institute in Germany in 2008 and 2009, and *A. m. caucasica* from the Republic of Georgia in 2010. Samples of the imported semen were tested for viruses and the resultant colonies were established in an isolated USDA-APHIS approved quarantine area in eastern Washington in cooperation with Washington State University.