

BIOAG FINAL PROJECT REPORT

TITLE: Working Title - Methods for Practical Field Selection of Honey Bee Colonies, and Rearing Queens and Drones.

Final Title – Selection Methods for Honey Bee Breeding

PRINCIPAL INVESTIGATOR(S) AND COOPERATOR(S): Timothy Lawrence, Susan Cobey, Steve Sheppard, and Darrell Kilgore

ABSTRACT: There is increasing interest in honey bee stock improvement in response to the continuing high annual loss of colonies and the desire to minimize in-hive chemical treatments to control bee parasites and diseases. In addition, the African honey bee poses a serious concern for beekeepers and the public at large. Individual beekeepers, small groups of beekeepers, beekeeping clubs, commercial queen producers, and beekeeping organizations are attempting to address these challenges. Honey bees are unique in that selection is primarily based upon behavioral traits at the colony level. The colony is a dynamic and complex social unit, highly responsive to changing environmental conditions. Sensitive to inbreeding, colony productivity and fitness are dependent upon the maintenance of adequate genetic diversity. A colony is a dynamic unit, and selection is based upon evaluating several traits under changing conditions. A unique challenge for the breeder, is to select for uniformity and consistency while maintaining adequate genetic diversity to ensure fitness. The video that our team produced provided a straightforward methodology to select productive colonies with reduced incidence of pests and diseases, from within large populations while avoiding inherent inbreeding problems. The basic concepts presented establishes a guideline to apply to the interests and needs of a variety of honey bee breeding programs.

PROJECT DESCRIPTION

A 28-minute video that gives beekeepers a guide to a pragmatic approach to the selection based upon behavioral traits at the colony level. The emphasis of the video is on how to conduct practical field tests that work well with beekeeping operations. It also includes a review of essential practices to rear high-quality queens and drones. Mating behavior and how to increase control of mating areas.

OUTPUTS – AND EXTENSION JUSTIFICATION

- Overview of Work Completed: we completed the video (see <http://vimeo.com/380776410>), which is just a little over 28 minutes.

We completed four days of video recording in Western Washington and three days of recording on the Pullman campus. Unfortunately, weather conditions during the two days of planned

shooting in Western Washington in 2018 were not conducive for bee flight. We were able to capture a great deal of in hive and lab shots but needed to reshoot scenes on drone collection and flight, and infield bee work. We were able to have both Darrell Killgore and Matt Ziegler complete the western Washington footage on June 25th and 26th of 2019. We were also able to capture some additional footage in Pullman in mid-June but were not successful in obtaining the image of the queen copulating with drones in the air; however, we were able to use some of the queen flight footage in the final product. In the end we were able to capture sufficient video footage to complete this project.

- **Methods, Results, and Discussion:** The writing of the script was a joint effort lead by Susan Cobey and Tim Lawrence with input from Steve Sheppard. The script went through several rewrites before we commenced shooting of the video. During the 2018 filming, we were unable to complete all video shots due to inclement weather during the time the video crew was available. Thanks to the no-cost extension granted by BioAG, we were able to complete most of the infield sequences, interviews, and much of the necessary b-roll footage, and the project is now complete.

We were successful in acquiring funding from Western SARE for \$71,500 to include a new video on cryopreservation and an update to a 2006 award-winning video on Honey Bee Instrumental Insemination and Queen Rearing. These new videos will allow the Honey Bee Selection and Breeding video to refer to these other sources rather than belaboring them within the context of this video.

- **Publications, Handouts, Other Text & Web Products:** The video has been made available to the beekeeping community via [Vimeo](#). As indicated above, we were successful in acquiring a Western Regional SARE to produce two new videos that will be companions to this video on selection and breeding. The first of these will be a redo of an award-winning video by Sue Cobey on Instrumental Insemination, and a second one on cryopreservation of honey bee semen. This trifecta on all aspects of honey bee selection and breeding will provide a robust framework for beekeepers (hobbyist, sideline, and professional)

- **Outreach & Education Activities:**

We are working with Kim Flottum from the trade publication Bee Culture to highlight the release of the video on the national podcast "Beekeeping Today." This podcast will most likely occur in mid-January 2020. We will also be posting links to this video and encouraging every beekeeping organization in Washington and Oregon to share with their members. WSU conducts annual workshops on queen rearing and selection, and this video has been used in that course in 2020 and will also be used in coming years. Part of the SARE grant we received will also fund a Conference for beekeepers and researchers where this video, as well as the video on instrumental insemination and cryopreservation of honey bee semen, will be shown and highlighted. The conference will allow us to query participants on the videos, how they will implement the information contained in the videos and other needs they may have in a breeding and selection program.

IMPACTS

- Short-Term: Increase awareness in the process of selection of honey bees for improved stock improvement and disease resistance.
- Intermediate-Term: Increase the number of beekeepers engaging in-stock selection and breeding programs for stock improvement, locally adapted stock, disease resistance, and reduced susceptibility to parasites such as Varroa destructor.
- Long-Term: Less dependence on chemical control for varroa, American foulbrood, viruses, and other parasites and pathogens.

ADDITIONAL FUNDING APPLIED FOR / SECURED:

We were successful in acquiring an additional \$71,500 through western SARE that will cover the cost of two new videos – instrumental insemination and cryopreservation of honey bee semen. The SARE Grant has up to \$10,000 in additional funding for graphic augmentation of the selection and breeding video funded under the BioAG grant. The graphics will allow us to illustrate some of the concepts that complicate honey bee breeding, including sex determination, inbreeding, and high rates of recombination that occurs in honey bees. Additional funding from SARE will support a conference on honey bee breeding and selection that will focus on the topics of these videos. The support for the two new videos will allow us to streamline those aspects in the selection and breeding program – where we can mention them but refer them to the other videos for further information. These new videos will allow us to focus our attention specifically on the breeding and selection of honey bees using the closed population method without getting bogged down in some of the tools needed to be successful.

GRADUATE STUDENTS FUNDED: Not applicable

RECOMMENDATIONS FOR FUTURE RESEARCH: Analysis of beekeeping stock improvement programs by beekeepers. One area of particular interest is how effective local beekeeping organizations can be at the collective selection of locally adaptive stock using techniques discussed in this educational video. This video is unique in focusing on the breadth of information needed to implement a honey bee breeding program successfully. The funding from SARE will allow us to conduct workshops to ascertain additional needs for beekeepers to implement honey bee breeding selection programs.