Honey Bee Nutritional Study Bridge Grant: *In-Vitro* Analysis of Several Honey Bee Nutritional Supplements

Project No.: **07-POLL7-DeGrandi-Hoffman**

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Objectives:

The focus of this project is to determine how well specific honey bee diet supplements support bee development and longevity as determined through royal jelly gland development, whole body protein analysis and adult honey bee longevity under controlled laboratory conditions. Newly emerged bees will be placed in holding cages and fed the same dietary supplements as was fed to colonies in Bakersfield during the mini area-wide research project last winter. The specific objectives of the project are as follows:

1. Conduct hypopharyngeal analysis to determine who well specific diets support the development of this critical brood food gland in worker honey bees
2. Conduct whole body protein analysis to determine if differences exist between bees fed different diets.
3. Honey bee longevity will be monitored for each diet.

Interpretive Summary:

The Problem and Its Significance - Almonds are California's largest acreage tree crop, with the Central Valley accounting for nearly 100% of the U.S. domestic production (Connell 2002). Most commercial almond cultivars require pollination for nut set. Honey bee colonies are introduced into orchards to supply these needed pollinators. Parasitic mites, honey bee diseases and the migratory nature of today's commercial apiculture

have changed the face of beekeeping over the past twenty years with greater demands being put on migratory colonies. Beekeepers need to modify their current management practices to mitigate the stresses of migratory apiculture. Many of the management practices used today were developed to optimize honey production not to manage bees during migratory pollination. The development and implementation of innovative management strategies will insure that strong healthy colonies are available for all pollination needs. One of the fundamental components for achieving the goal of healthy populous colonies will be to meet the nutritional needs of colonies especially when flowering plants were not available as often happens when bees are staged for almond pollination..

Within the beekeeping and almond grower's communities, honey bee health and nutrition has become the primary concern and is one of the top research priorities as indicated by both groups in publications and research funding. In response to these concerns, the four USDA-ARS Bee Research Laboratories conducted a joint study in Bakersfield, California using cooperator bees to determine the effects of six different bee diets on colony population growth and disease levels in bees used for almond pollination. The Bakersfield project was funded from the ARS Administrator's Budget ($76,000). Based on information derived from this multi-lab study and requests of the beekeeping industry expressed at a stakeholders meeting earlier this year in Stuart, Florida, the USDA is funding a five year, five million dollar area-wide project between all four USDA honey bee labs to study the impact of supplemental feeding on honey bee nutrition, and determine the best way to maintain honey bee health and increase bee populations for pollination.

Current Research Background - Field feeding trials were conducted last winter (15 November 2006 through 8 February 2007) in which six diet supplements were fed to bee colonies in an isolated holding yard south of Bakersfield, California near the town of Arvin. The area is typical of pre-almond pollination holding yards, in that a large number of colonies are placed there prior to being moved to the almond orchards at the beginning of bloom (early February). Due to the time of year and the large number of colonies in one area there are no nectar or pollen sources available. During the three months that the bees are stationed in these holding yards, supplemental feeding is the only way to stimulate brood production, and without this brood stimulation the bees will not be of adequate strength for early season pollination. Therefore this is an ideal area for testing the efficacy of supplemental diets. The six diets tested in the Bakersfield study were (1) FeedBee, (2) BeePro, (3) MegaBee Patty, (4) MegaBee Liquid, (5) Adee diet and (6)natural pollen. FeedBee is a new product on the market and is manufactured in Ontario Canada. BeePro is a commercial product available from Mannlake, Limited, Hackensack, MN. The MegaBee Patty and MegaBee Liquid are products developed by S.A.F.E. R&D, LLC under a CRADA Agreement with the USDA Carl Hayden Bee Research Center, Tucson AZ. The Adee Diet is a proprietary diet developed and used exclusively by the Adee Honey Company, Bruce, SD. The pollen that was made into patties was collected in Southern Arizona and preserved by a slow drying process and placed under refrigeration. We used the same formulations in this laboratory cage trials

to determine how well the specific diets support morphological and physiological development.

The focus of this project is to expand the above study undertaken in California to include physiological and developmental analysis of bees fed the same controlled diets as fed during the field trials. While the field data from last winter's study will provide valuable insights into how to prepare colonies for pollination, there is more information that could be gleaned from the work that was done in Bakersfield. These additional investigations were designed to keep the momentum of the field study going by performing controlled *in-vitro* laboratory studies. This will allow us to correlate results and better determine how to adequately prepare bees for early season pollination. These studies will help demonstrate the need for broader investigations into honey bee nutrition and act as a bridge between the earlier USDA study done in Bakersfield and the five year Area-Wide project scheduled to begin in 2007/2008.

Materials and Methods - We followed the procedural methods for a caged longevity study as described by Schmidt et.al.(1987). Sixty newly emerged bees were placed in a small Plexiglas and screen feeding cages (9 x 6 x 15 cm). Each cage was provided with water and a 3.5 by 7 cm strip of honey bee foundation wax on which the bees are intended to cluster. The bees were fed their respective diets *at librum*: Adee diet, FeedBee, BeePro, MegaBee Patty, MegaBee Liquid and a control diet of sugar syrup. . Water and 50% sugar syrup was provided as needed to all cages. All cages were placed in an environmental room at hive temperature and controlled humidity (32-34° C and 60% RH). Diet was replaced as needed, consumption noted, and mortality counted on Mondays, Wednesdays, and Fridays. Weekly mean survivorship of the treatments will be contrasted with the controls and any differences will be determined by a one-way analysis of variance.

Results and Discussion **-** At the time of this report, results of these experiments are still being collected. The experiments should be completed and data tabulated in time for Almond Board meetings in the beginning of December.