# Enhancing the Tech Team Program for the Commercial Beekeeping Industry

**Project No.:** **13-POLL5-Spivak**

**Project Leader:** Marla Spivak
University of Minnesota
1980 Folwell Ave, 219 Hodson Hall
Saint Paul, MN 55108
612.644.4798
612.625.5299
spiva001@umn.edu

**Project Cooperators and Personnel:**
Dennis vanEngelsdorp, University of Maryland
Katie Lee and Megan Mahoney, University of Minnesota
Rob Snyder and Ben Sallmann, UCCE – Butte County

## Objectives:

The goal of this project was to help commercial beekeepers reduce honey bee colony losses through two objectives: 1) develop treatment thresholds for the parasitic mite, *Varroa destructor*, including how the thresholds vary with beekeeper management, and presence of other diseases and pests, and 2) quantify the success of beekeepers selecting for the hygienic behavior trait, a natural defense bees have against multiple brood diseases and parasites. Both of these objectives are being accomplished through collaboration with the Bee Informed Partnership and Tech-Transfer Teams.

## Interpretive Summary:

Using the Honey Bee Tech-Transfer Team infrastructure through the Bee Informed Partnership, we have collected data to aid commercial beekeepers through developing a *V. destructor* threshold and determining the success of breeding programs selecting for hygienic behavior. Commercial bee colonies are tracked throughout the year, with samples take to determine *V. destructor* and *Nosema spp.* loads and general colony health. By assessing how different *V. destructor* levels contribute to mortality, we are developing *V. destructor* treatment thresholds for commercial bee colonies. Bee breeding is a method with great potential to help control *V. destructor.* We have worked with commercial bee breeders in California and the Upper Midwest to aid in the identification of potential breeders that are highly hygienic. We will be comparing levels of *V. destructor* and signs of disease with the corresponding hygienic level of colonies. We will also compare the hygienic level of each operation selecting for hygienic behavior over time to measure how successfully the trait is being integrated into different lines of bees.

## Materials and Methods:

The Midwest Honey Bee Tech-Transfer Team (led by Katie Lee) sampled colonies of 15 commercial beekeepers based in Minnesota and North Dakota who travel to California for the pollination of almonds. The Tech-Transfer Team sampled about five apiaries for each

beekeeper, and ten colonies in each apiary. A majority of the colonies were sampled four times from June 2013 to February 2014. Colonies were rated for different hive health metrics (population of adult bees, queen status, brood pattern, disease or pests visually present) and 300 adult bees sampled from a frame of brood to assess the levels of *V. destructor* and *Nosema spp*. We also recorded beekeeper management data, including treatments, doses, feed, and colony shipping.

The 300 bee samples were taken in a 4oz. bottle filled approximately 1/3 full with a mixture of saltwater and dish soap to preserve the bees. All of these samples were processed by Dennis vanEnglesdorp's lab at the University of Maryland for the determination of the *V. destructor* and *Nosema spp.* levels. To estimate the *V. destructor* infestation, the samples are shaken for 25 minutes, and strained to separate the mites from the bees. The mites are counted and recorded. The bees are weighed, and then 100 bees counted out and weighed to estimate the weight per bee. This number is then used to calculate the total number of bees in the sample. The *V. destructor* level is reported as mites per 100 bees. The 100 bees counted out from each sample are used to estimate the *Nosema* level in the colony. The bees are put into a plastic bag, mashed up, 1 ml per bee added (100 ml total), and the slurry put on a hemocytometer slide. The spores are then counted and converted to millions of spores per bee using methods described by Cantwell (1970).

Hygienic behavior was quantified using the liquid nitrogen test (Spivak and Reuter 1998a). We selected a comb with capped pupae and twisted a 3" PVC tube into the comb over the pupae. We poured 10 oz of liquid nitrogen into the tube to freeze-kill the pupae. The number of cells that were not sealed pupae were counted (160 total cells in a 3" circle). Once thawed, the tube was removed and the comb placed back into the colony. In 24 hours, we checked the comb to count the number of cells not completely cleaned by the bees and the number of cells partially cleaned. The level of hygienic behavior is ranked based on how many cells the bees cleaned out. The more cells cleaned out, the more hygienic the colony is considered to be. A highly hygienic colony will completely clean 95% or more of the pupae.

**Results and Discussion:**

Since May 2012, the Midwest Tech-Transfer Team has sampled 4,593 colonies to quantify levels of *V. destructor* and *Nosema spp*. The colony year we monitor is from June to February, so we are still collecting data for this year and our results are preliminary. We have found that colonies with an adult bee population lower than eight frames in February (common minimum number of frames required for almond pollination) had significantly higher mite levels in August than colonies with eight or more frames of bees, 3.3 mites per 100 bees (± 0.4 SE) compared to 2.1 mites per 100 bees (± 0.2 SE). Anecdotally, one beekeeper's colonies seem to withstand higher *V. destructor* levels in August compared to colonies of other beekeepers. This may be due to the beekeeper treating earlier for *V. destructor* than others; something that we will continue to investigate. Many colonies were (and will be) followed over time with economic and mortality measures recorded, giving us a powerful dataset to show the risks of *V. destructor* to colony survivorship. With three years of data after sampling colonies in February 2015, we will analyze how the Varroa treatment threshold changes under different factors, including location, colony movement, *Nosema* levels, and treatments.

Tech-Transfer Teams performed 739 hygienic tests in the Midwest beekeeper operations in 2012 to 2014, and 3,718 colonies in California operations from 2011 to 2014. In the majority of the colonies tested for hygienic behavior, Tech-Transfer Teams performed hive assessments and sampled for *V. destructor* and *Nosema spp.* All beekeepers that had their colonies tested for hygienic behavior this year had colonies tested for hygienic behavior in previous years. We will use this year's data along with previous year's data to determine the progress of selection for the hygienic trait (graph of progress of California beekeepers in **Figure 1**) and to compare levels of *V. destructor* and the fungal pathogen chalkbrood that hygienic bees are active against (Gilliam et al. 1983, Spivak and Reuter 1998b).

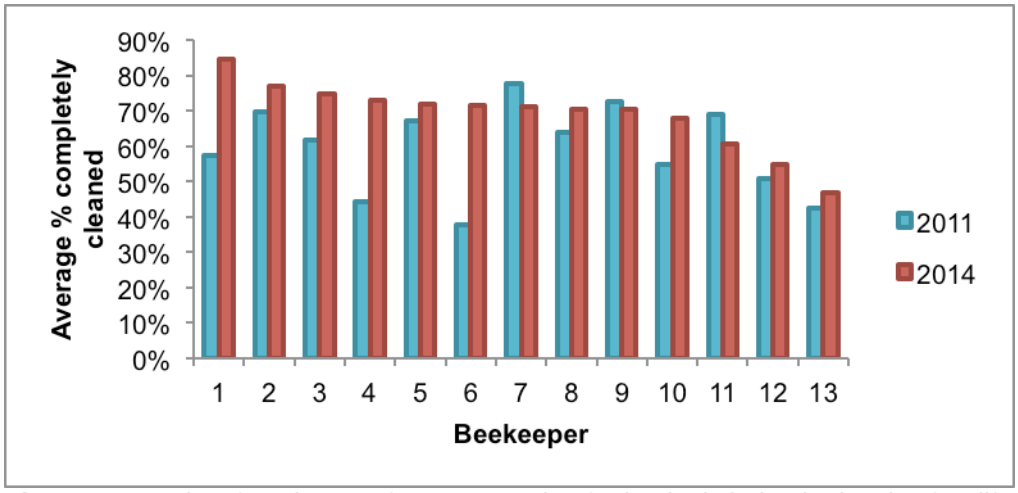


**Figure 1**. Results of Tech-Transfer Team testing for hygienic behavior levels of California beekeepers 2011 vs. 2014. Bees that are more hygienic are more resistant to several diseases and pests.

## Research Effort Recent Publications:

Once our *V. destructor* thresholds results are established and the progress of hygienic behavior selection, we will disseminate the information to beekeepers and researchers through publication in scientific journals, beekeeping journals, and on the Bee Informed Partnership website (beeinformed.org). We can also help implement the results in the real-world through the Tech-Transfer Team's work with commercial beekeepers.

## References Cited:


Cantwell, G.E. (1970) Standard methods for counting nosema spores. American Bee Journal 110: 222–223.

Gilliam M., Taber S. III, and Richardson G.V. (1983) Hygienic behavior of honey bees in relation to chalkbrood disease, Apidologie 14: 29-39.

Spivak, M. and Reuter, G. (1998a) Honey bee hygienic behavior. American Bee Journal 138: 283-286.

Spivak, M., and Reuter, G.S. (1998b) Performance of hygienic honey bee colonies in a commercial apiary**.** Apidologie 29: 291-302.