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1. Does the arrival of Varroa mite and subsequent changes in viral strains mean a higher threat to local bees?

The spread of Varroa and associated viruses undoubtedly cause problems to beekeepers anywhere in the world, and Hawaii is no exception. Based on our work, the arrival of the Varroa mite to our islands was followed by a general increase in the virulence of DWV. That is more bees were exposed to higher levels of viral particles. And those virus strains that were passed along were those that appeared to be more "compatible" with the mite.

The widespread distribution of DWV via mite infection and the higher titer of virus/bee means more colonies will experience a decline in population and will become more susceptible to other pests and diseases. Weaker colonies are more likely to collapse, especially when climatic conditions are harsh, for example during droughts, or excessive rain, or when forage is temporarily unavailable.

2. Are the honeybees in Hawaii more affected by the mite arrival compared to their mainland counterparts?

No. Although the viral landscape in Hawaii has changed dramatically compared to pre-Varroa conditions, the newly established DWV viral strains are similar to those in the mainland US and it does not appear that the local beekeepers are currently experiencing larger colony losses than mainland as a result of Varroa or the viruses.

However, the arrival of Varroa and the spread of DWV among colonies does mean that Hawaiian beekeepers now have to contend with larger colony losses than they did before the mite. This means more time, effort, and money per colony to manage and control the mite levels.

3. Do the beekeepers need to worry about the mite or the viruses?

Both. The beekeepers need to understand that although it is possible for a honeybee colony to support a large mite population, at least for a few months, the large number of mites, go hand in hand with a large level of viral infection and disease. Weak, stressed colonies are less productive, that is they yield less honey and provide fewer bees for pollination, a condition which is detrimental to the beekeepers and farmers alike.

Applying control treatments for the mite results in a decrease of the proportion of DWV infected bees within the colony and will result in a more robust and stable colony.

4. Do the changes in viral strains reported by your study make the Hawaiian bees less desirable for commercial use?

No, there is no evidence that the viral strains that have become established in Hawaii after Varroa introduction are in any way more harmful to the bees than those found elsewhere in the world.

5. When Varroa was first discovered in Hawaii there were reports of catastrophic losses among beekeepers. Has the situation improved?

Yes. Prior to Varroa arrival to Hawaii, colony losses/year were apparently lower on the islands than the mainland. During the first couple years after the mite was detected, colony losses reached peak numbers as beekeepers learned how to manage and control the mite. Once the beekeeping community learned what products to use and how often to treat the losses began to decline.

6. Has the arrival of Varroa and the spread of DWV affected feral bees?

Yes. Prior to the arrival of Varroa the feral colonies in the islands were very abundant and provided pollination services to farmers and backyard growers. These colonies however are not immune to the mite, nor the virus, and began to die out, creating a need for more managed pollinators for many bee dependent crops.

7. In what way is this study helpful to beekeepers in Varroa infected islands?

The local colonies have obviously already experienced great changes in viral levels and strains due to the Varroa introduction, and our study is somewhat of an "after the fact" explanation to their colony losses.

However, the local beekeepers will benefit from understanding the relationship between the obvious disease symptoms, such as malformed wings, and the urgent need for mite control. Knowing that as mite abundance increases, the DWV levels increase exponentially, should motivate the beekeepers to focus on establishing a mite control program in their apiaries. The Varroa mite and associated viruses are not going away, and consequently the more knowledge we gain into the mechanisms of infection, viral strains, and their effects, the better prepared we will be in the future to respond to changes and/or new diseases that may appear.

8. What methods of mite control are available to local beekeepers?

- There are now a number of products that have been approved for mite control on the islands. They range from organic compounds (such as thymol and formic acid) to synthetic chemicals. Local beekeepers should learn more about the pros and cons of each treatment.
- Selective breeding of bees that display hygenic characteristics has been proven to reduce mite infestation levels.
-The UH Honeybee Project has a website where the growers and beekeepers can find information on sampling methods for Varroa, treatment thresholds, and recommendations.

9. In what way does this study help those beekeepers in islands that are Varroa free?

Introduction of the mite is always detrimental to apiculture and colony sustainability. Beekeepers in Varroa free islands should increase their vigilance and protect their bees. Moving bees, hive products, or even bee equipment between islands should be strongly discouraged.

10. What about other honeybee pests or diseases?

There are currently two other major sources of concern for local beekeepers. The small hive beetle (*Aethina tumida*) and a disease caused by a fungus called *Nosema ceranae*. We are currently working with growers on establishing strategies for treatment and control.

The UH Honeybee Project
www.uhbeeproject.com
(808) 956 9268
(808) 956 2445
email: ethel@uhbeeproject.com

Univerisity of Hawai'i at Manoa
College of Tropical Agriculture and Human Resources

Plant and Environmental Protection Sciences (PEPS)