

Honey Bee Viruses and Viral Diseases in Honey Bees, *Apis mellifera*

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Honey bees are attacked by numerous pathogens which are significant threats to the health and well-being of the bees, and have been responsible for the loss of two-fifths of the bee colonies in North America in the past decade. Among the pathogens attacking bees, viruses are probably the least understood because of the lack of information about the dynamics underlying viral disease outbreaks. The most crucial stage in the dynamics of virus infections is the mode of virus transmission. In general, transmission of viruses can occur through two pathways: horizontal and vertical transmission. In horizontal transmission, viruses are transmitted among individuals of the same generation, while vertical transmission occurs from mothers to their offspring. Because of its highly organized social structure and crowded population density, the honey bee colony represents a perfect environment for the spread of viral diseases. We conducted studies to investigate the pathways of virus transmission in honey bee colonies using molecular methods. Our studies demonstrated the existence of both horizontal and vertical transmission pathways including food-borne transmission, venereal transmission, vector-borne transmission, and mother-to-offspring transmission in honey bees. Both vertical and horizontal transmission pathways are believed to be important survival strategies for honey viruses not only for their long-term persistence in bee population but also for their establishment in nature. The information obtained from these studies is valuable for enhancing our understanding of the epidemiology of virus infections in honey bees and can be used to predict bee colonies at risk of virus infection, therefore contributing to the development of effective disease control strategies.

Since late 2006, a new and unexplained problem, termed “Colony Collapse Disorder” (CCD), has been devastating massive numbers of honey bee colonies across the continental United States and has resulted in a loss of 50 to 90 percent of the commercial honey bee colonies, causing great concern both nationally and internationally. Viruses have been considered as a possible primary or contributing cause of CCD. A study using a metagenomic approach found that Israeli Acute Paralysis Virus (IAPV) that was originally identified in honey bees in Israel and had not been previously reported in the U.S. had a strong correlation with CCD. Using DNA sequencing and phylogenetic analyses, we provide evidence that IAPV was present in U.S. bees collected several years prior to CCD, and prior to the recent importation into the U.S. of honey bees from Australia and New Zealand. While downplaying the importance of bee importation for the appearance of CCD, these results indicate an urgent need to test specific strains of IAPV for their disease impacts.