

Over 20 honey bee viruses have been identified. Some are rare and incidental while other viruses appear endemic in most beekeeping areas. Not all viruses are equally pathogenic. However, there are few species that are highly virulent and are often associated with the collapse of colonies that have been stressed or weakened by other pathogens. Honey bee viruses are natural obligate parasites of honey bees, which means they can't live outside their host. Some viruses are known parasites of the Asian Honey Bee (*Apis cerana*) and have mutated to parasitize the European Honey Bee (*Apis mellifera*).

Virus species that have been identified in British Columbia include:

- *Kashmir Bee Virus (KBV)* – KBV was first diagnosed in British Columbia in the early 1980s in imported honey bees from New Zealand. The diagnosis was not viewed with great concern as the pathogen didn't cause any symptoms in the honey bees. KBV was diagnosed again in 2004 following reports of unexplained losses in apparently healthy colonies. Follow-up surveys showed widespread distribution at low incidence levels.
- *Israeli Acute Paralysis Virus (IAPV)* – IAPV was first described by Israeli researchers in 2004. (*Despite its name, IAPV is not unique to Israel*). The virus is highly virulent and has commonly identified in colony losses in North America and Europe.
- *Chronic Paralysis Virus (CPV)* – This virus has been confirmed in British Columbia but with a very low incidence level.
- *Acute Bee Paralysis Virus (ABPV)*
- *Deformed Wing Virus (DWV)*
- *Black Wing Queen Virus (BWQV)*

Background

It is assumed that honey bee viruses have been associated with bees for a long time. Only recently, much more attention has been given to these viruses and their role in bee health. The introduction of parasitic mites and Varroa in particular, has drawn the attention of viruses and their impact on honey bees.

Bee viruses can't transmit themselves but rely on other organisms for being introduced into the honeybee host. When in the 1980s KBV was first diagnosed in BC bees, there was little concern because parasitic mites had not been introduced to North America yet. Viruses had little chance to cross the protective barrier of the bee's cuticle or gain entrance to the body cavity of the host.

Following the introduction of parasitic mites especially Varroa, the role of viruses in bee health became evident. The physical damage caused by mite parasitism enabled viruses to be directly introduced into the body cavity of bee brood and adult bees.

The precise pathology of each bee virus may not be entirely understood, but their impact has increased significantly. Some bee viruses such as KBV are RNA-viruses and belong to the newly established family Dicistroviridae. RNA viruses are very small (in comparison to DNA-viruses) and associated with the mitochondria of host cells.

This interest Honey bee viruses have received greater interest since the 1990s with the advent of parasitic mites. Prior to the introduction of mites, viruses

Kashmir Bee Virus (KBV) was diagnosed in the Fraser Valley in the spring of 2004.

The virus had previously been diagnosed in British Columbia in the early 1980s, in honeybee stock originally imported from Australia and New Zealand. At that time, well before the Varroa mite arrived, no symptoms had been observed and therefore, KBV was not a concern.

In the late 1980s, researchers in Europe and the US reported that KBV was a highly contagious and virulent pathogen in the presence of Varroa mites. Over the years, little information became available about KBV and its distribution and impact, since colony losses were mostly attributed to mite parasitism or other causes without proof. KBV and other viral honeybee agents may not have received much attention because disease symptoms were generally not as definitive as others, while laboratory analysis required expertise and resources.

The precise distribution of KBV in North America is not known. KBV was detected in 1995 in a small US survey of seven states. All states were positive: California, Florida, Maine, Minnesota, New York, Texas, and Washington. It has been suggested that the virus is endemically present throughout most of North America's honeybee population.

KBV Origin and Classification

The Kashmir Bee Virus is a natural disease of the eastern honeybee *Apis cerana*. After the introduction of the western honeybee *Apis mellifera* into the distribution range of *A. cerana* in southern Asia, the virus made a "species-jump" and began to parasitize its new host.

Disease Spread

KBV's virulence is made possible because of its association with the Varroa mite. Mites carry the viruses externally and internally. By piercing the honeybee's cuticle, they transfer viral particles into the host's tissue. The bee's pupal stage appears most susceptible to infection. In the confined space of the capped pupal cell, viruses are not only transferred from mite to bee, but also from mite to mite. After several mite generations in the honeybee colony, the majority of mites will be KBV carriers. As more bees become infected, the transfer of food, grooming and other physical contact between bees facilitates the further spread of the virus.

It is not known whether the honey bee tracheal mite (*Acarapis woodi*) and Nosema (*Nosema apis*) are viral vectors as well. Since these pathogens cause tissue damage in the tracheal tubes and epithelial cell wall of the midgut of adult bees respectively, they may play a role in the introduction of viral agents into the host's body cavity.

Expression of Virulence

At this time, the causes that trigger virulence are unclear. Throughout the 1980s, the presence of KBV in BC colonies was an academic curiosity, as the virus remained non-virulent or in a latent state. Even after the introduction of Varroa in British Columbia in 1990, there were no reports of viral infestations. In recent years, occasional incidents of colony losses that could not be attributed to common honeybee diseases may have involved KBV.

Some studies have shown that high mite levels result in high virulence. This correlation can be readily accepted as large numbers of KBV-carrying mites contribute to the rapid spread of the virus throughout the bee population, while stress caused by mite parasitism increases the honeybee's susceptibility to viral infection. However, surveys carried out by BC Ministry of Agriculture indicate that KBV virulence also occurs when Varroa infestation levels are low or non-detectable.

Field Symptoms

There is no prescribed set of symptoms confirming KBV in the field. Definitive diagnosis is carried out in the laboratory through Polymerase Chain Reaction (PCR) analysis. However, beekeepers may observe various symptoms that may point to viral infection. These include:

- Weakening of the colony without any apparent presence of brood diseases and mites.
- Increasing numbers of dead or dying bees on the inner cover, landing board or in front of the hive. Dying bees may be trembling and display uncoordinated movement.
- Affected bees are partly or completely hairless where the upper surface of the thorax is especially dark.
- Older adult bees have a greasy or oily appearance while recently emerged bees may appear opaque as if pigmentation of the tissue had not been completed prior to emergence.

Sample Collection and Diagnosis

For definitive identification, whole adult bees must be analyzed in the laboratory. Adult bees are highly perishable and need to be preserved as best as possible after collection. The following collection method is recommended:

- Collect live bees from the hive entrance or in front of the hive. Select bees that appear hairless and greasy.
- Collect 10 live adult bees by squeezing their head-thorax and place in a **paper** lunch bag or paper envelope. Do **not** place bees in a plastic bag, wrapping or container.
- Mark the sample bag or envelope with your name and corresponding hive number or apiary and place in a freezer for 24 hours.
- Submit sample bag(s) to the Apiculture office for analysis.
- KBV diagnosis of a sample of bees collected from one colony does not mean the viral infestation is limited to that single colony. Due to the highly contagious nature of KBV, the entire apiary is suspect and should be considered KBV positive. As a result, a single composite apiary sample can also be collected, with a number of colonies contributing bees to the sample.

Remedial Action

There is no product available for KBV control. Most viral infections become evident when bees have been stressed due to other diseases, weather conditions or management practices. Some bee stocks have shown higher susceptibility to viral infection than others; this can be remedied by replacing the queen with a queen from another source.

To minimize the impact of KBV and other viral infections:

- Reduce stress to bees by applying good management practices.
- Provide plenty of food stores, especially pollen.
- Keep mite levels low through frequent monitoring and applying mite control products when necessary.
- Apply hygienic management practices in the apiary.

For more information, contact the Apiculture office in Abbotsford at 604-556-3129 / 604-556-3152.