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Viruses of honey bees

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Bee viruses are among a number of pathogens that can contribute to the ill health of a colony. Beekeepers need to be aware of bee viruses as well as other disease causing organisms to minimise the impact of these diseases where possible.

Bee viruses are capable of killing honey bees, although under most circumstances the presence of a bee virus does not cause death of the adult bee or larvae. Viruses replicate intracellularly, and a given virus could kill bees. All life forms can be invaded by viruses, although normally each virus type has a very narrow host specific relationship; e.g. a virus that is found in chickens is extremely unlikely to be found in honey bees or cattle. In a few rare cases, viruses will cause periodic infection in other animals. The 'Hendra' virus carried by bats, for instance, can occasionally cause a fatal infection in horses and even humans. No such cross-species movement of virus is known to occur in bee-associated viruses.

Viruses can best be described as particles covered in a protective layer of protein. They enter the living cells of their host and simply replicate. Bee viruses are likely to have a very broad distribution but fortunately most of the time remain benign (do not cause any disease symptoms). Specific bee viruses are capable of infecting bee larvae and/or adult bees. Symptoms of a virus infection are not specific to a particular virus. Viruses infecting bees are very difficult to diagnose, as viral particles are extremely small but electron microscopic techniques are able to identify viral particles. Use of one diagnostic technique compared to another may cause some discrepancies in the identification of the bee virus. Virus particles are constantly mutating; for example in humans we are exposed to a new strain of the flu or common cold virus every year.

In the majority of cases the flu is not fatal to humans, although if the immune system is weak

due to other medical conditions the flu can be fatal. In honey bees, when symptoms of a bee virus are observed, in most cases this is associated with another infectious agent. Viral infections have been strongly correlated with the presence of nosema and varroa mites.

In the process of infecting or feeding on the bee larvae or adult bee, either of these parasites would appear to create an opportunity for viral particles to also enter the body of the bee (larva or adult). In these circumstances the virus particles are able to multiply and spread more readily than if the primary organism (varroa or nosema) was not present. Under these circumstances bee virus infections can be lethal.

Other factors that may increase the impact of viruses could include environmental and nutritional stresses. It is unfortunate that viruses have been difficult to study and thus they have not been researched in depth in relation to their impact on the management of honey bees.

The number of viruses capable of infecting honey bees is still to be determined. Even so, most bee viruses are likely to remain a minor issue in relation to honey bee health and fitness. The following are known virus types within Australia.

Sacbrood

This is a relatively well known virus that infects larvae. Signs of the disease include:

- Partially uncapped cells are scattered amongst healthy brood.
- Larvae die just before pupation begins.
- The dead larvae is initially contained in a watery bag.
- The larvae lies along the base of the cell in a banana or gondola shape.
- The larvae takes on a light-brown appearance.
- The dead larvae turns dark brown and is easily removed from the cell.

Treatments usually include re-queening infected colonies and improving the nutrition of the colonies by providing sugar syrup and pollen.

Black queen cell virus

This virus has occasionally been recorded to be associated with the death of queen cells in commercial queen rearing operations. The virus was thought to be stimulated by lower than ideal temperatures in artificial cell incubators. The literature suggests that this virus is closely associated with nosema disease infections.

Symptoms of the virus include dead queen larvae or pre-pupae after they have been sealed in their cells. These dead larvae become dark brown to black in colour and take on the appearance of worker larvae killed by sacbrood virus.

Kashmir bee virus

Several strains of Kashmir bee virus have been identified within Australia. This is a similar scenario to that described for the different strains of the flu virus which infect humans. There is some debate world-wide as to the naming of new bee viruses as they may well be strains of the Kashmir bee virus. Although thought to be relatively common it has rarely been associated with bee deaths.

Disease symptoms may resemble those of an infection of American foulbrood or European foulbrood. Infected adult bees are likely to have a reduced lifespan, leading to a rapid loss of bees within a colony.

Paralysis virus

This disease is common in adult bees. Affected bees tremble, tend to crawl about the entrance of the hive and are often found climbing onto the stems of grass in the near vicinity of the hive. They can cluster together on the ground or on grass stems close to the entrance of the hive. Their abdomens can appear enlarged with wings dislocated; they also become hairless, dark to shiny black in colour. Dysentery can also be a sign of this disease.

Most of these symptoms are often associated with other ailments including nosema disease or pesticide poisoning and may possibly be associated with these conditions.

Treatments

There are no known cures for any of the bee viruses but good management will help. Management of colonies to prevent losses associated with bee viruses should include:

- regular brood comb replacement

- regular queen bee replacement with a resistant strain of bee, as some strains of bees seem to be more susceptible to some viruses
- not breeding from stock demonstrating any signs associated with a virus infection
- minimising nutritional stresses to a colony by providing sugar syrup and pollen supplement during periods of deficiency
- managing bee colonies to minimise the levels of nosema disease throughout the year.

Summary

Although bee viruses do not historically stand out as a primary pathogen of honey bees in Australia, they have more recently been associated with large numbers of bee deaths in many countries. Viruses associated with honey bees very rarely cause disease-like symptoms. The difficulty in diagnosing bee viruses has meant that there is also very little knowledge on the subject of bee viruses.

Beekeepers need to manage bee colonies to achieve colony fitness throughout the year to minimise the potential impact of bee viruses. Minimising other pests and diseases of the honey bee would seem to be an excellent strategy in controlling any problems associated directly with bee viruses.

Regular queen replacement with strains of bees not exhibiting disease, plus maintaining a good plane of nutrition will minimise any unwanted surprises that may arise due to the presence of bee viruses.

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