

HONEY BEE  
DISEASES AND  
PESTS



Honeybee viruses  
and viral diseases



- About **20** viruses have so far been identified in association with *A. mellifera*; apart from two with DNA genomes, they are single-stranded **RNA viruses**.



# Pathogenicity of viruses

- The pathogenicity of viruses is the consequence of their replication within the cells of diverse organs of the honeybee.
- When pathogenic, some viruses have a tropism to specific organs, while others can replicate in many organs.
- However, it seems that many **honeybee-infecting viruses** have a **CNS** tropism and are responsible for neurological problems.
- When pathogenic, viruses alter the lifespan of bees.



# Transmission routes

- Viral transmission may be horizontal between bees, vertical from queen to egg, venereal, and/or vector-borne, such as in the case of *V. destructor* or the mite *Tropilaelaps* spp.
- Horizontal transmission can be oral or by contact.
- Viruses are frequently detected in queen ovaries, suggesting a **vertical transovarial transmission** from queen to unfertilized male and fertilized female eggs.
- The acarid *V. destructor* is a vector of many honeybee viruses. The interaction between viruses and *V. destructor* has been termed “**bee parasitic mite syndrome**”
  - *Tropilaelaps* spp.
  - *Acarapis woodi*



# Diagnosis of viral infection

- As clinical signs are rarely pathognomic, the diagnosis of viral diseases should rely on laboratory tests.
- The most sensitive and reliable methods are the PCR and RT-PCR.
- Diagnostic test results should be interpreted in association with
  - clinical signs,
  - beekeeping techniques,
  - blooming environment,
  - Varroa infestation level,
  - and other potential colony-weakening causes.



Chronic bee paralysis virus  
(CBPV) disease: "paralysis"



- CBPV disease, also called paralysis, is a contagious disease.
- CBPV is one of the most widely prevalent viruses, and found worldwide except for the Caribbean islands.
- CBPV is positive-sense, single-stranded RNA virus, and is an unclassified virus.
- The disease pattern is usually characterized by two main syndromes:
  - **Type-1 (paralysis)**
  - **Type-2 (black robbers, little black, hairless black, mal de mai)**



# Clinical signs

- In an apiary, when an outbreak of CBPV occurs within a colony, not all the colonies develop the disease.
- The affected colonies are usually strong, and CBPV outbreaks do not usually cause “massive colony losses”.
- However, CBPV disease may induce high-level losses of workers.
- A large carpet of dead or sick workers in front of the hives is frequently observed when outbreaks occur.



# Type-1 syndrome or paralysis

- Paralysis syndrome is the most serious consequence of CBPV.
- Bee infected by CBPV present the following clinical signs during outbreaks:
  - Abnormal trembling wings and bodies
  - Ataxia
  - Circling
  - Inability to take off or fly, manifested by bees crawling on the ground and up grass stems
  - Bloated abdomens caused by intension of the honey sac with liquid
  - Mortality within a few days



## Type-2 syndrome

- Bees affected by Type-2 syndrome are smaller, with a shortened abdomen.
- The honeybees become hairless and appear dark shiny.
- At the beginning of the disease, bees are able to fly, but soon they begin crawling and trembling.
- They usually die soon after the onset of clinical signs.



- Overt CPBV infection may occur throughout the year, even in winter.
- However, the prevalence of outbreaks is higher in the spring and summer beekeeping season.
- The mite *Varroa* probably plays a role in the transmission of CBPV.
- The disease often regresses spontaneously in 3-4 weeks.



- CBPV may infect immature forms.
- Indeed, it has been found in all the stages of bees, from the egg to the adult.
- In the eggs, larvae, and pupae, the viral load is low and is reported to remain mainly lower than in adult bees.
- The tropism of CBPV is mainly the nervous system though other organs can also be affected.
- The prognosis is usually good, with a spontaneous recovery; however, if the disease persists into autumn, the chances of recovery lessen.
- Confinement (bad weather, failure of nectar flow, starvation, etc.) is reported to be a main cause of the occurrence of “paralysis”.



# Diagnosis

- The occurrence of two or more clinical signs is suggestive of CBPV disease.
- Laboratory diagnosis
  - RT-PCR



# Management

- Minimizing transmission and reducing viral loads within colonies are the two main pillars of the fight against viruses.
- CBPV management involves in particular:
  - Optimal Varroa control to avoid vector transmission of the virus.
  - Overwintering without honeydew.
  - Limiting risks of overcrowded colonies and confinement.
  - Healthy and selected queens and colonies that exhibit good hygienic behavior. Re-queening each year or every two years has become a necessity at the present time.



Deformed wing virus  
(DWV) disease



- Deformed wing disease is a contagious viral disease due to an I flaviridae: DWV
- The clinical signs mainly concern emerging bees (young bees) presenting deformities, and in particular wing deformities, and a reduction of their lifespan.
- The virus has also been identified in asymptomatic colonies.
- Without *V. destructor* infestation, DWV infection remains a covert infection.
- Before *Varroa* pandemic, DWN was unknown as a pathogen.
- The occurrence of the disease is a consequence of the combination of DWV and *Varroa* infestation.



# Clinical signs

- Honeybee deformed wing disease usually occurs at the end of summer and in autumn.
- This viral infection results in deformities of the body, and in particular of the wings, which occur during the metamorphosis of the pupa within the capped cell, where the *Varroa* reproductive cycle takes place.
- The clinical signs are then observed in emerging bees.
- The wings are deformed, stubby and useless.



- The clinical signs also include rounded and shortened abdomens and miscolouring.
- The affected bees are, of course, unable to fly.
- Symptoms of paralysis may also be observed.
- At the colony level, an irregular brood may be observed associated with pupae mortality, cannibalism, and a decrease in the bee population.
- The occurrence of overt DWV infection is always linked to *Varroa* infestation.



- Adult honeybees are reservoirs of DWV and phoretic *V. destructor* are responsible of the spreading of the virus in a colony, between colonies, and between apiaries.
- All honeybee castes and stages may be DWV carriers, though pupae are most at the risk of developing an overt infection.
- Transmission may be vertical, venereal, and transovarial.
- The pathological effects of DWV are entirely linked to its association with *Varroa*.
- Not only does this mite carry the virus, but the virus can replicate within the organism.



- DWV and its vector Varroa play a major role in colony weakening and collapse by causing “bee parasitic mite syndrome”.
- Diagnosis
  - A clinical picture representing early death of pupae, deformed bees, bees without wings or with deformities, and bees with shortened abdomens is suggestive of DWV disease.
  - Laboratory analysis (RT-PCR), associated with clinical examination, allows the diagnosis.



# Management

- Fighting DWV involves prophylactic methods against contributing factors, principally *V. destructor*:
  - control of the mite infestation is essential to limit or even avoid the risks of DWV outbreak and to prevent weakening and collapse, particularly in winter.
- Wintering demands healthy and strong colonies.
- Selection of strains that exhibit good hygiene, with cleaners able to detect and remove from the hive mite-infested and DWV-infected pupae, is an additional prophylactic method.