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## Notifiable honeybee pests & diseases

### INTRODUCTION

The honeybee industry plays an essential role in the Australian economy. Whilst honey production and associated bee products are valued at \$101 million, the value of honeybee pollination services to honeybee pollination dependant crops is in excess of \$4 billion.

A major threat however to the viability of these industries is the potential impact from a number of the notifiable honeybee pests and diseases listed in **Table 1**.

In order to protect these industries, the *Livestock Act 1997* specifies a number of biosecurity measures all beekeepers must comply with, including:

- acquiring a knowledge of notifiable honeybee pests and diseases
- being registered - this assists in maintaining communication (eg. increasing awareness via factsheets, and ensuring contactability in the event of an incursion)
- keeping records of specified biosecurity related management practices
- inspecting hives as often as necessary to minimise inter-hive spread and/ or hive death
- notifying the existence or suspected existence of a notifiable honeybee pest or disease
- implementing reasonable measures to control European foulbrood and eradicate all other notifiable honeybee pests and diseases

### NOTIFICATION

The *Livestock Act 1997* states that if a person knows or has reason to suspect that honeybees or honeybee products owned by or under their control are affected with, or have died from, a notifiable pest or disease, the person must:

- report the existence or suspected existence of the notifiable pest or disease to an inspector by the quickest practicable means; and
- give the inspector further information as required

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## SA NOTIFIABLE HONEYBEE PESTS AND DISEASES

South Australian notifiable honeybee pests and diseases, and recommended sampling and notification details, are listed in **Table 1** and outlined in **Tables 2a-2b** to **5a-5b**.

**Table 1. List of SA notifiable honeybee pests and diseases, including recommended sampling and post-detection procedures**

Name	Tables	Summary of recommended: sampling frequency and sampling method(s)	procedures following detection
<b>American foulbrood (AFB)</b> <i>Paenibacillus larva</i>  (* honey samples are mandatory if own ≥ 20 hives)	2a-2b	<ul style="list-style-type: none"> <li>each hive owned: in Spring, in Autumn, prior to moving to pollination, after +ve honey result, when suspect brood found, and if hive strength unexpectedly significantly declines, by shaking bees off each brood frame and visually inspecting brood, and collecting a smear from detected/ suspected brood</li> <li>each hive owned*: 1-3 months prior to re-registration, by collecting a minimum of 20 mL honey per hive (immediately following a visual inspection)</li> </ul>	<ul style="list-style-type: none"> <li>identify suspected/ affected hive and record details</li> <li>close hive, making sure no hive components/ hive products are exposed</li> <li>decontaminate equipment/ PPE prior to moving to next hive</li> <li>notify a Biosecurity SA Apiary Inspector by the quickest practicable means (preferably immediately and before leaving apiary), and advise if hive is dead/ being robbed</li> <li>submit smear(s) to approved laboratory if notifiable disease suspected/ unsure/ to confirm diagnosis</li> <li>submit honey sample(s) to approved laboratory for registration/ if notifiable disease suspected</li> </ul>
<b>European foulbrood (EFB)</b> <i>Melissococcus plutonis</i>	2a-2b	<ul style="list-style-type: none"> <li>each hive owned: in Spring, in Autumn, when suspect brood found, and if hive strength unexpectedly significantly declines, by shaking bees off each frame and visually inspecting brood, and collecting a smear from detected/ suspected brood</li> </ul>	
<b>Africanised honeybee</b> <i>Apis mellifera scutellata</i>	3a-3b	<ul style="list-style-type: none"> <li>each hive: that exhibits unexplained Africanised honeybee type behaviours or unexplained Asian honeybee type size/ colouration/ behaviours, by collecting a sample of as many symptomatic bees as possible</li> </ul>	<ul style="list-style-type: none"> <li>identify suspected/ affected hive/ colony and record details</li> <li>close hive, making sure no hive components/ hive products are exposed</li> <li>decontaminate equipment/ PPE prior to moving to next hive</li> <li>notify a Biosecurity SA Apiary Inspector by the quickest practicable means (preferably immediately and before leaving apiary), and advise if hive is dead/ being robbed</li> <li>retain samples for collection by a Biosecurity SA Apiary Inspector after killing specimens by:               <ul style="list-style-type: none"> <li>freezing overnight (preferred), or</li> <li>covering in methylated spirits diluted with 20% water</li> </ul> </li> <li>follow the directions of the inspector, including regarding collecting further samples, decontamination, and moving equipment</li> </ul>
<b>Asian honeybee (AHB)</b> <i>Apis cerana</i>	3a-3b	<ul style="list-style-type: none"> <li>each colony/ bee: that exhibits Asian honeybee type size/ colouration/ behaviours, by collecting a sample of as many symptomatic bees as possible/ taking photos</li> </ul>	
<b>Braula fly</b> <i>Braula coeca</i>	4a-4b		
<b>Tropilaelaps mites</b> <i>Tropilaelaps clareae</i>	4a-4b	<ul style="list-style-type: none"> <li>each hive: that exhibits suspect Braula/ Tropilaelaps/ Varroa like symptoms, parasitic mite syndrome, and if hive strength unexpectedly significantly declines, by undertaking an alcohol wash/ sugar shake on 300 foragers</li> </ul>	
<b>Varroa mites</b> <i>V. destructor</i> , <i>V. jacobsoni</i>	4a-4b		
<b>Tracheal mite</b> <i>Acarapis woodi</i>	5a-5b	<ul style="list-style-type: none"> <li>each hive: that exhibits unexplained Tracheal mite/ ABPV like symptoms, and if hive strength unexpectedly significantly declines, by collecting a sample of as many symptomatic bees as possible</li> </ul>	
<b>Acute bee paralysis virus (ABPV)</b>	5a-5b		

## IDENTIFICATION OF SA NOTIFIABLE HONEYBEE PESTS AND DISEASES

Because beekeepers have responsibilities regarding pest and disease management, they must have sufficient knowledge to:

- undertake hive inspections in a manner that will best achieve detection of pests and diseases, as often as necessary to minimise inter-hive spread and/ or hive death
- differentiate between and identify the various honeybee pests and diseases
- take samples suitable for confirmatory laboratory diagnosis, including annual honey samples for American foulbrood if owning 20 or more hives
- notify an inspector if hives are affected or are suspected of being affected with a notifiable honeybee pest or disease
- control honeybee pests and diseases to prevent hive death and/ or further spread

Even with this knowledge, it is still essential that an inspector is notified if hives are affected or are suspected of being affected with a notifiable honeybee pest or disease, or showing suspicious/ unusual symptoms; given that:

- it is important to diagnosis symptoms as soon as possible; with laboratories able to diagnose samples even if field differentiation is difficult (eg. due to limited numbers of affected brood or incomplete development)
- beekeepers can still confuse *P. alvei* symptoms with AFB; even though EFB is stress related and tends to occur in Spring and Autumn whilst AFB can occur at any time, and later stages of both EFB and AFB affected brood are relatively easy to differentiate
- the other notifiable honeybee pests and diseases are exotic (so most beekeepers would not have seen actual symptoms before), whilst some also have non-specific symptoms that cannot be correctly diagnosed outside of a laboratory

**Tables 2a-2b to 5a-5b** are provided as a guide to assist beekeepers in differentiating between the notifiable honeybee pests and diseases, but must be used in conjunction with more detailed information, including information available on the following websites:

- <http://www.planthealthaustralia.com.au/industries/honey-bees/>
  - Biosecurity manual for beekeepers
  - Pest fact sheets
- <http://www.planthealthaustralia.com.au/resources/training/biosecurity-online-training/>
  - Biosecurity for beekeepers online course
- <http://beeaware.org.au/pests/>
  - Pest fact sheets
- <http://www.afb.org.nz/diagnosis-of-common-honey-bee-brood-diseases>
  - Diagnosis of common honey bee brood diseases and parasitic mite syndrome

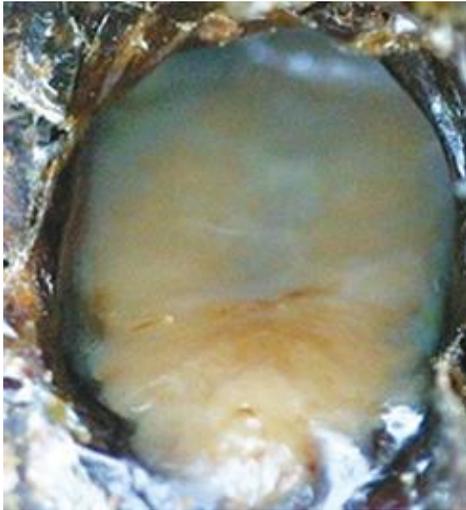
**2. American foulbrood and European foulbrood** (Bacterial diseases, present in Australia - although AFB & EFB not in KI, AFB not in NT & EFB not in WA)

AFB, EFB and *Paenibacillus alvei* (a secondary infection associated with EFB) are bacterial diseases that kill brood, whilst AFB if not eradicated can kill many hives. Field identification is based on differing brood symptoms. Field confirmation can be achieved using Vita test kits, otherwise laboratory confirmation is recommended.

**Table 2a. Field differentiation between Healthy brood and American and European foulbrood infected brood**

Progressive change in symptoms progressing (→) from larvae (L) through propupae (Pr), pupae (P) and advanced pupae (Ap) to adult (A)			
Capping	Position in cell	Colour	Consistency
<b>Healthy brood</b>			
<ul style="list-style-type: none"> <li>Uniform shape (concave or convex) and colour (same as comb)</li> </ul>	<ul style="list-style-type: none"> <li>(L to Pr) Curled in cell → to fully extended on cell floor</li> <li>(P to A) Fully extended on cell floor</li> </ul>	<ul style="list-style-type: none"> <li>(L to Pr) Pearly white colour</li> <li>(Ap to A) → to tan then adult coloration, with eye colour → to pink to black</li> </ul>	<ul style="list-style-type: none"> <li>(L to Pr) Segmented, turgid, remove entire</li> <li>(Ap to A) Adult form visible, remove entire</li> </ul>
<b>American foulbrood infected brood</b>			
<ul style="list-style-type: none"> <li>If capped, typically sunken, greasy and discoloured, sometimes with irregular perforations/ partially chewed</li> </ul>	<ul style="list-style-type: none"> <li>(L to Pr) Fully extended on cell floor, may have slight constriction between head and thorax (slight residual 'head' swelling may be present)</li> <li>(P) If present, pupal scale retains head shape with tongue (&lt;0.5mm wide) protruding toward cell roof</li> </ul>	<ul style="list-style-type: none"> <li>(L to P) Uniform - dull white to light brown → to coffee-brown to dark-brown → to scale black-brown colour</li> </ul>	<ul style="list-style-type: none"> <li>(L to Ap) Segmentation loss, flaccid, initially watery, not ropey but rarely can remove entire → to ropey thin even thread (often 25mm + long when coffee brown to dark brown) which 'snaps back' → to scale which is not ropey, adheres to cell base</li> <li><b>Odour:</b> Fishy, musty in heavy infections</li> </ul>
<b>European foulbrood infected brood</b>			
<ul style="list-style-type: none"> <li>If capped, typically sunken, appear discoloured, sometimes with irregular perforations/ partially chewed</li> </ul>	<ul style="list-style-type: none"> <li>(L to Pr) Coiled at cell back, twisted in cell, or often in half-moon shape around cell front</li> <li>May include 'tongue-like' remains (but 1-2mm wide) and adheres to cell roof</li> </ul>	<ul style="list-style-type: none"> <li>(L to Pr) Mottled - dull white to light yellow (white gut contents may be visible → to tan to yellow → to scale black-brown colour</li> <li>(L to Pr) White tracheal tubes often visible</li> </ul>	<ul style="list-style-type: none"> <li>(L to Pr) Segmentation loss, flaccid, watery, not ropey, often can remove entire → to lumpy-rubbery → to scale which is dry, rubbery, removable from cell</li> </ul>
<b>European foulbrood infected brood with secondary infection of <i>P. alvei</i></b>			
<ul style="list-style-type: none"> <li>If capped, typically sunken, can appear greasy and discoloured, sometimes with irregular perforations/ partially chewed</li> </ul>	<ul style="list-style-type: none"> <li>(L to Pr) Fully extended on cell floor</li> <li>May include 'tongue-like' remains (but 1-2mm wide) and adheres to cell roof</li> </ul>	<ul style="list-style-type: none"> <li>(L to Pr) Mottled -dull white to light yellow → to tan to yellow → to scale black-brown colour</li> <li>(L to Pr) White tracheal tubes often visible</li> </ul>	<ul style="list-style-type: none"> <li>(L to Pr) Segmentation loss, flaccid, watery, not ropey but rarely can remove entire → to rubbery-ropey, lumpy thread (&lt;25mm) and doesn't 'snap back' → to scale dry, sometimes rubbery, not ropey, removable from cell</li> <li><b>Odour:</b> Strong, unpleasant - especially when larvae coffee brown-dark brown</li> </ul>

**Table 2b. Field differentiation between Healthy brood and American and European foulbrood infected brood (not all pictures to same scale)**

Healthy brood	American foulbrood	European foulbrood	European foulbrood with <i>P. alvei</i>
			
<p><b>Healthy larva</b> (Unknown)</p>	<p><b>AFB infected larva</b> (Dr. M. Goodwin, M. A. Taylor)</p>	<p><b>EFB infected larva</b> (Rob Snyder)</p>	<p><b>EFB + <i>P. alvei</i> infected larva</b> (M. Stedman)</p>
			
<p><b>Healthy pupa</b> (Dr. M. Goodwin, M. A. Taylor)</p>	<p><b>AFB infected pupa</b> (Dr. M. Goodwin, M. A. Taylor)</p>	<p><b>EFB infected larva</b> (Rob Snyder)</p>	<p><b>EFB + <i>P. alvei</i> infected larva</b> (M. Stedman)</p>

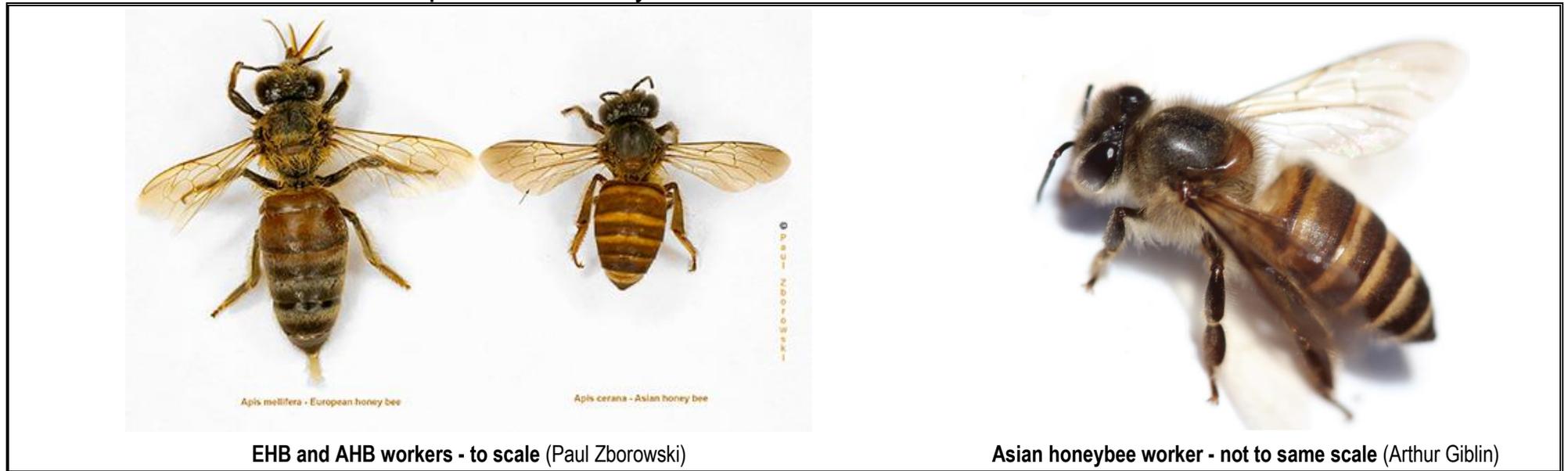
**3. Africanised honeybee and Asian honeybee** (Honeybees, not present in Australia - although *A. cerana javana* strain confined to Cairns/ Townsville in Nth QLD)

Africanised honeybee and Asian honeybee are both invasive pests that carry a number of exotic pests and diseases, and compete with and attack European honeybee colonies. Field identification of Africanised honeybees is difficult and is based solely on differing behaviours, whilst Asian honeybees can be differentiated from European honeybees based on size, colouration and behaviours. Laboratory confirmation is required.

**Table 3a. Field differentiation between European, Africanised and Asian honeybees**

European honeybee (EHB)	Africanised honeybee	Asian honeybee (AHB)
<b>Size, colouration and individual bee behaviour</b>		
<ul style="list-style-type: none"> <li>• Adult workers 12-14 mm in length</li> <li>• Colouration varies, with variable number and size of black bands across abdomen</li> <li>• Flight relatively slow and rarely erratic (unless robbing)</li> <li>• When fanning at nest entrance, bees predominately face inwards</li> </ul>	<ul style="list-style-type: none"> <li>• Adult workers are similar in size and colouration to EHB - field differentiation can only be achieved based on the behavioural characteristics listed below</li> </ul>	<ul style="list-style-type: none"> <li>• Adult workers 9-11 mm in length</li> <li>• Colouration more prominent and consistent with evenly sized black bands across abdomen</li> <li>• Flight fast and erratic</li> <li>• When fanning at nest entrance, bees predominately face outwards</li> </ul>
<b>Hive defence and stinging</b>		
<ul style="list-style-type: none"> <li>• May send out 10-20 guard bees in response to minor disturbances up to 7 metres away, and chase intruders for 30 metres</li> <li>• Once agitated, usually defensive for 1-2 hrs</li> <li>• Disturbed colony will result in 10-20 stings</li> </ul>	<ul style="list-style-type: none"> <li>• May send out hundreds of guard bees in response to minor disturbances up to 40 metres away, and chase intruders for 300 metres</li> <li>• Once agitated, usually defensive for several days</li> <li>• Disturbed colony may sting 6-10 times more than EHB</li> </ul>	<ul style="list-style-type: none"> <li>• Much less defensive and prone to stinging compared to EHB</li> </ul>
<b>Swarming and absconding</b>		
<ul style="list-style-type: none"> <li>• Swarm 1-2 times per year</li> <li>• Swarms are larger and need larger volume to nest</li> <li>• Rarely abscond (completely abandon nest) from nesting location</li> </ul>	<ul style="list-style-type: none"> <li>• Can swarm 10 or more times per year</li> <li>• Swarms are small, some not larger than a coffee cup or a softball</li> <li>• Abscond often and relocate to better nesting location</li> </ul>	<ul style="list-style-type: none"> <li>• Can swarm 5-10 times per year</li> <li>• Swarms are small, some not larger than a coffee cup or a softball</li> <li>• Abscond often and relocate to better nesting location</li> </ul>
<b>Selection of nesting site</b>		
<ul style="list-style-type: none"> <li>• Prefer large cavities from 20-80 litres in volume</li> <li>• Typically nest in cavities above ground, in dry locations</li> <li>• Prefer protected locations</li> <li>• Due to larger number of bees starting colony, nests are easier to detect</li> </ul>	<ul style="list-style-type: none"> <li>• Will nest in smaller cavities from 4-20 litres in volume (e.g. water meter boxes)</li> <li>• Often nest in underground cavities or exposed locations (i.e. tree branch)</li> <li>• Do not discriminate between moist and dry locations</li> <li>• Difficult to detect until disturbed</li> </ul>	<ul style="list-style-type: none"> <li>• Will nest in smaller cavities from 2-20 litres in volume (e.g. water meter boxes/ letter boxes)</li> <li>• Typically nest between 4-30 metres above ground</li> <li>• Prefers locations around human habitation, or areas that are open or regrowth</li> <li>• Difficult to detect until disturbed</li> </ul>

**Table 3b. Field differentiation between European and Asian honeybees**



**4. Braula fly, and Tropilaelaps and Varroa mites** (Fly and mites, not present in Australia - although Braula in TAS, and *V. jacobsoni* being eradicated from Townsville)

Braula fly is a pest of minor importance but exotic to some countries Australia exports bees to, and can cause cosmetic damage to comb honey; whilst both Tropilaelaps and Varroa mites weaken both adults and brood, and if not controlled kills many hives. Field identification can be difficult and is based on size, behaviours and effects on bees. Laboratory confirmation is required.

**Table 4a. Field differentiation between Braula fly, and Tropilaelaps and Varroa mites**

Characteristics	<i>Braula coeca</i>	Tropilaelaps mites	Varroa mites
• Adult female size	• 1.4 mm long x 0.9 mm wide	• 1 mm long x 0.5 mm wide	• 1.1 mm long x 1.6 mm wide
• Colouration - adult female		Reddish brown	
• Colouration - young, and males	• Young and males - white	• Young - white, males - red	• Young and males - white
• Number of legs	• 6	• 8	• 8
• Female location - typical	• On head/ thorax of adult bees (particularly queens)	• In brood cells (sometimes moving quickly on brood frames)	• In brood cells/ on abdomen of adult bees (often partially hidden between segments)
• Additional symptoms	• Narrow meandering tunnels under cappings - particularly in honey cells	• Particularly for Varroa - parasitic mite syndrome (spotty brood pattern, white-yellow larvae with EFB-like symptoms), adult bees stunted and/ or with damaged wings/ legs	

**Table 4b. Field differentiation between Braula fly, and Tropilaelaps and Varroa mites (not all pictures to same scale)**

***Braula coeca***



**Braula fly female**  
(Simon Hinkley, Ken Walker)

**Tropilaelaps and Varroa**



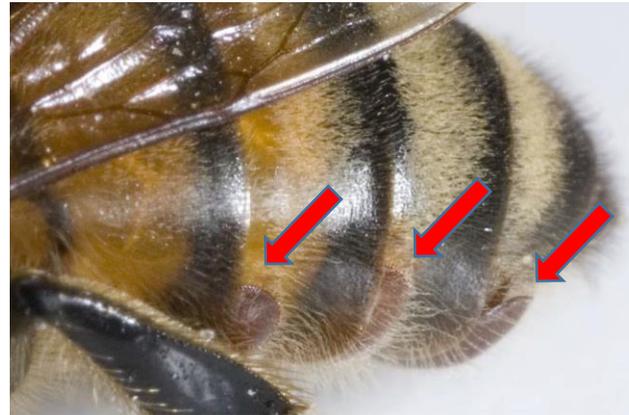
**Varroa mite female (L), Tropilaelaps mite female (R)**  
(The Food and Environment Research Agency - Fera)



**Deformed wings, with Varroa female on bee**  
(Michael Traynor)



**Braula fly on worker bee**  
(Miles Zhang)



**Varroa mites partially hidden under segments**  
(Dr. M. Goodwin)



**Parasitic Mite Syndrome - larvae with EFB-like symptoms + Varroa females** (Rob Snyder)

## 5. Tracheal mite and Acute bee paralysis virus (ABPV) (Mite and Virus, not present in Australia)

Both Tracheal mites and ABPV kill adults, and if not controlled kill many hives. Field identification is difficult and is based on non-specific symptoms similar to those found in honeybees affected by Nosema, pesticide poisoning, and some other viruses. Laboratory confirmation is required.

**Table 5a. Field differentiation between Tracheal mite and Acute bee paralysis virus, and syndromes with similar non-specific symptoms**

Tracheal mite	Acute bee paralysis virus	Syndromes with similar non-specific symptoms
<ul style="list-style-type: none"> <li>Affected adults have sprawled wings (including K-wings, where the hind wings are disconnected from the fore-wings), and an inability to fly, with large numbers crawling around entrance/ remaining in hive</li> <li>Tracheal mite symptoms also include a rapid decline in adult bee population, outbreaks of stress related brood diseases, a lack of an autumn-winter cluster, and hive loss in late winter</li> </ul>	<ul style="list-style-type: none"> <li>Affected adults develop a rapidly progressive paralysis, resulting in trembling, sprawled wings (including K-wings), and an inability to fly. Gradual darkening and loss of hair from the thorax and abdomen may also be apparent</li> <li>Affected brood die before emerging, with the decline in hive strength resulting in collapse within one season</li> </ul>	<ul style="list-style-type: none"> <li>Nosema affected adults may have sprawled wings (including K-wings), and an inability to fly, with large numbers crawling around entrance</li> <li>Nosema symptoms may also include yellow-brown fecal staining on hive during late winter-spring, a rapid decline in the adult bee population, and a slow spring build-up</li> <li>Pesticide affected adults may have sprawled wings (including K-wings), and an inability to fly, with large numbers crawling/ dead around entrance, spinning around, trembling, dead with extended tongues, and/ or missing from the hive</li> <li>Pesticide poisoning also tends to occur during honey/ pollination events</li> <li>No apparent darkening or loss of hair from the thorax or abdomen occurs due to either Nosema infection or pesticide poisoning</li> </ul>

**Table 5b. Field differentiation between Tracheal mite and Acute bee paralysis virus, and syndromes with similar non-specific symptoms**

