# BIOSECURITY
# OR
# DISEASE RISK MITIGATION STRATEGY FOR THE AUSTRALIAN HONEY BEE INDUSTRY

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## Introduction

In a broad sense, biosecurity is a set of measures designed to protect an animal population from transmissible infectious agents at a national, regional and individual farm level. They are designed with the emphasis on managing risk without affecting profitability through excessively strict precautions.

At the farm level it involves a systematic approach of producers on an industry wide basis in providing protection against the entry and spread of disease and parasites. Poor biosecurity will contribute to the likelihood of the occurrence and severity of a disease outbreak and may burden governments and industries with unnecessary costs.

Biosecurity for the honey bee industry is therefore about managing risk to prevent the introduction of diseases to an apiary and to prevent the spread of diseases between apiaries or to a disease free area. Beekeepers practising preventive biosecurity measures will be implementing emergency diseases preparedness. The application of preventative biosecurity measures will also limit the impact of endemic diseases so their application makes sense from economic, social and bee welfare perspectives.

The ability of an industry to withstand an outbreak of an emergency animal disease and the sum total cost of its control will be influenced by each individual farmer's biosecurity plan and its effective operation.

The Government and Livestock Industries' Cost Sharing Deed for Emergency Animal Disease Response (known as EAD Response Agreement) includes an obligation by each industry party, to develop a program that minimises the risk of disease introduction and spread.

## The Honey Bee Industry Biosecurity Plan

In developing the biosecurity plan the honey bee industry has considered the following key factors,

- understanding the targeted diseases and parasites,
- their modes of transmission,
- key risk factors for each mode,
- key factors to exclude the disease and parasites,
- a system to ensure the program is carried out,
- joint on-going surveillance of colony health.
- jointly maintain state response teams to assist government in the event of an incursion of an exotic disease or parasite.

Targeted diseases and parasites include not only exotic diseases but also endemic diseases that have a significant impact on production or trade.

In essence the biosecurity plan aims to minimise the risk of introducing pathogens into the bee colony. It should ensure a rapid response to stop disease and parasites spreading within or between colonies

Under the industry's quality assurance initiative "B-Qual"®, it recognises that the entry of new pathogens, or new strains of existing pathogens, can devastate performance and profitability. It encourages beekeepers to implement management practices that reduce the potential for the introduction, production and spread of disease and parasites.

The generic biosecurity plan should be followed wherever possible, although practices may differ across Australia. Beekeepers and governments must be aware of their obligations under the various State Apiaries Acts. However, in the event of an incursion of an exotic disease AUSVETPLAN becomes the operating document for the outbreak.

Advantages of a biosecurity plan for the honey bee industry are: -

- Reducing the possibility of entry and spread of disease and parasites.
- Lessening the social and financial impacts of an outbreak.
- Reduce the possibility of substantial losses being incurred in a disease and/or parasite outbreak.
- Reduces the beekeeper's liability

## Main Diseases or Pests:

A. Endemic Diseases or Pests

In reviewing the disease status of the Australian honey bee industry it was concluded that two diseases are of significance. They are American Foulbrood (AFB) and European Foulbrood (EFB), and specific preventative and control measures would need to be included in the formal biosecurity plan.

Other diseases and pests can be controlled or their impact lessened by good production practices, complying with the B-Qual Program and implementing measures for the prevention and control of both AFB and EFB.

1. **American Foulbrood.** (AFB, *Paenibacillus larvae ss larvae)*
   (i). Means of spread – infected honey/pollen/honey bees/propolis/hive materials and apiary equipment coming into contact with bees. Also, by foraging bees robbing infected products and materials and by adult bees drifting into clean hives from infected hives.
   (ii). Survival – AFB survives in a spore stage in larvae, in the scale form/honey/all other bee products/hive materials/apiary equipment, spores have an estimated life of >70 years.
   (iii). Incubation period – larvae <53 hours are more susceptible to infection than older larvae. Spores of *P. larvae* germinate approx. 24 hours after ingestion by the larva. After germination the bacteria multiply in the midgut and penetrate to the body cavity through the gut wall. Larvae die probably from a septicaemic condition at the late larval-prepupal stage at about 10 days of age.

2. **European Foulbrood.** (EFB, *Melissococcus pluton*)
   (i). Means of spread – infected honey/pollen/honey bees/hive materials and apiary equipment coming into contact with bees. Also, by foraging bees robbing infected products and materials and by adult bees drifting into clean hives from infected hives.
   (ii). Survival – the *M. pluton* cell is non spore forming. The bacterium may survive outside a bee larva eg. in faeces or wax debris for an estimated 6 months.
   (iii). Incubation period – generally larvae 2-3 days of age become infected. Infection occurs when a larva consumes food contaminated with *M. pluton*. The bacterium becomes established in the midgut and commences to multiply. Larvae generally die at 3-5 days of age, however death can occur at any age up to the young adult stage. . Following death, larval remains may rope similar to AFB, with the most prominent bacteria present being *Paenibacillus alvei. Beekeepers need to submit a sample to determine if it is AFB or EFB.*

B. Exotic Diseases or Pests

1. **Tropilaelaps Mite** (*Tropilaelaps clareae*)
   (i). Means of spread – mites are transmitted by drifting bees, interchange of infested brood combs, robbing and swarming bees, caged queens and on apiarist's clothing. The mites can be transferred between colonies and between apiaries through normal apiary management practices. Adult mites are extremely active on the frames.
   (ii). Survival – the life cycle of the mite is synchronised with that of the host and they will only persist in a hive with adult bees and live brood. Adult mites are not able to survive more than 2-4 days away from bee brood. They have been observed to drop off adult *Apis mellifera* in swarms and packaged bees after two days away from the brood.
   (iii). Incubation period – the life cycle commences when one or several female mites enter a brood cell containing a late instar worker or drone larva (3 days or older). Eggs are usually laid on the

cuticle of the host larva. A developmental sequence of egg, larva, protonymph, deutonymph and adult occurs during the late larval and pupal development of the host bee.

**2. Varroa Mite** (*Varroa destructor*)

(i). Means of spread – Varroa may be spread when hive components containing infested brood or adult bees are interchanged during normal management practices. The movement of hives and queen bees by beekeepers is a very effective means of transmission. In Australia, the spread of infestation would be very quick due to the migratory nature of the beekeeping industry. The mites can attach themselves to other flower-visiting insects and there may be some transfer of mites to and from bees visiting the same flower.

(ii). Survival – without food, the mites die in about three days. They overwinter between the sclerites of adult bees.

(iii). Incubation period – adult *V. destructor* females lay 2-5 eggs shortly before the brood cell is capped. Eggs are laid on the bottom of the cells, on the walls and sometimes directly on the larvae. Egg development takes 1-2 days. Complete development (egg to adult) takes 8-10 days for females. Mating occurs in the brood cell. Young females will lay eggs in other cells after two weeks. They usually live for two months. The adult female is very mobile. It readily transfers between adult bees.

**3. Varroa Mite** (*Varroa jacobsoni*)

This mite is essentially restricted to its host, *Apis cerana*. While it can enter brood cells of *Apis mellifera* it is unable to reproduce there.

(i). Means of spread – Varroa may be spread when hive components containing infested brood or adult bees are interchanged during normal management practices. The movement of hives and queen bees by beekeepers is a very effective means of transmission. The mites can attach themselves to other flower-visiting insects and there may be some transfer of mites to and from bees visiting the same flower.

(ii). Survival – without food, the mites die in about three days. They overwinter between the sclerites of adult bees.

(iii). Incubation period – adult *V. jacobsoni* females lay 2-5 eggs shortly before the brood cell is capped. Eggs are laid on the bottom of the cells, on the walls and sometimes directly on the larvae. Egg development takes 1-2 days. Complete development (egg to adult) takes 8-10 days for females. Mating occurs in the brood cell. Young females will lay eggs in other cells after two weeks. They usually live for two months. The adult female is very mobile. It readily transfers between adult bees.

**4. Braula Fly** (*Braula coeca*)

They are currently found in Tasmania but not on mainland Australia

(i). Means of spread – the spread of Braula is mainly by swarming colonies and through the interchange of hive components from apiary to apiary. Colonies become infested by bees drifting from colony to colony, by strong colonies attacking and robbing weak colonies, and by mechanical transport of infested materials (such as bees, combs, queen cages) as part of normal apiary management practices.

(ii). Survival – they overwinter as adults on adult bees and are able to survive in a bee colony without the presence of brood. They are not known to be able to survive in the absence of adult bees.

(iii). Incubation period – development from egg to adult takes 16-23 days. The female Braula lays its eggs on the inner or outer surface of the wax cappings of honey cells and sometimes on the walls of cells, not in brood cells. Subsequent development is beneath the cappings. The larva makes a tunnel several cells in length using wax fragments which it gnaws from the cappings. The tunnel is thin at first and expands as the larva grows. The larva obtains food from pollen and possibly from wax. When fully grown it pupates in the tunnel. Adult Braula flies emerge and attach firmly to adult worker bees, queen bees and occasionally to drones.

**5. Tracheal Mite** (*Acarapis woodi*)

(i). Means of spread – the main method is the interchange of hive components as practised in normal apiary management procedures. The introduction of mites into an apiary appears to be due to drifting bees, robbing bees or by the introduction of infested colonies or queen bees.

(ii). Survival – mite reproduction is normally limited to one complete generation per host bee regardless of the life span of the bee. Female mite longevity has been estimated at 35 days. Young mites begin dispersing from infested bees when the bees are approximately 14 days old.

(iii). Incubation period – female mites enter the tracheae of worker bees within 24 hours of the emergence of bees from their cells. Male and female mites are present in the first pair of thoracic spiracles of adult bees, and may be found in air sacs in the head and abdomen. A female mite lays 5-7 eggs within 3 or 4 days of entering the tracheae. Eggs hatch after 3-4 days and develop into adult mites over the next 11-15 days. Adult bees of all castes and of any age can become infested but bees older than 9 days are less susceptible. The susceptibility of bees to infestation diminishes rapidly from their first day of life.

**6. Asian Bees**

The three main species of Asian honey bees are the Asian honey bee *(Apis cerana*), giant honey bee *(A. dorsat*a) and dwarf honey bee *(A. florea*). There are four recently identified species, Apis andreniformis, Apis koschevnikovi, Apis nigrocinta and Apis nuluensis. The Asian species are tropical species of honey bees closely related to the European honey bee *(A.. mellifer*a) used for commercial purposes in Australia.

The Asian species exhibit behavioural traits that make them unsuitable for commercial management and it is possible for them to carry and transmit serious exotic diseases and pests. For example *Apis. dorsat*a carries *Tropilaelaps clareae* and *Apis cerana* carries *Varroa spp.* Limited data is available on the disease status of A. andreniformis, A. koschevnikovi, A. nigrocinta and A. nuluensis however, they could be expected to compete for food and nesting sites with Australian native bee species and *A. mellifera*. There could possibly be issues with pollination of weed species also.

If feral populations of Asian bees became established in commercial beekeeping areas of Australia they could act as a source of infection of major bee diseases or pests to commercial apiaries of *A. mellifera.* Drones of *Apis cerana* are capable of mating with *A. mellifera* queens producing non-viable offspring.

(i). Means of spread – introduction of the Asian species of honey bees and the parasites and diseases normally present in their colonies is most likely to occur from swarms on sea cargo, air cargo and passenger flights from Asian countries or Papua New Guinea, arriving at Australian ports. The possibility of the illegal importation of queen bees and escort bees into Australia for breeding purposes is of major concern.

(ii). Survival – once established in Australia, the three species would spread quickly through areas with suitable climates. The species are reported to swarm up to 20 times each year with *A. dorsata* swarms reported to migrate over a distance of several hundred kilometres. *A. cerana* is reported to be spreading at a rate of between 50 and 100 km each year in the highlands of Papua New Guinea and swarms have occurred on Torres Strait islands which lie in the Torres Strait Protected Zone. They have not swarmed to islands further south and it is not expected that they will under natural conditions.

(iii). Incubation period – similar in most respects to *A. mellifer*a.

**7. Africanised and Cape Honey Bees** (Apis mellifera scutellata and its hybrids, Apis mellifera capensis)

(i). Means of spread – establishment of Africanised and Cape honey bees in Australia is likely to occur if a beekeeper imported one or more queen bees for breeding and assisted with their distribution by means of normal beekeeping management practices.

(ii). Survival – once introduced Africanised bees could occupy all of the populated areas of mainland Australia with the exception of the cooler areas of the eastern highlands and desert areas of central Australia. *A. mellifera scutellata* readily hybridises with other honey bee subspecies. Once Africanised bees become established in an area they are likely to persist.

(iii). Incubation period – similar to European races of *A. mellifer*a.

While swarms of *A. mellifera scutellata* from boats can bring pests and diseases a single swarm is unlikely to provide a sufficient gene pool to establish a population in Australia. Thus it is unlikely that an Africanised bee population would become established at a single entry point. In the event of a swarm of the Cape honey bee becoming established, the risk of this spreading within Australia is very high. If a beekeeper undertook a mass queen rearing program using Africanised stock, however, the general local population would be at risk due to an increased drone population from the raised queens.

The Cape Honey bee (*Apis mellifera capensis*) poses similar threats. Workers of *A. mellifera capensis* drift into and are accepted by colonies of other *A. mellifera* sub-species.
Laying *A. mellifera capensis* worker bees,

(a) mimic a mated queen bee so that the original queen is eliminated in preference for the *A. mellifera capensis* laying worker.
(b) The laying worker is able to lay eggs with a full compliment of chromosomes without mating (thelytokous parthengenesis). An *A. mellifera capensis* queen reared from one of these eggs eventually takes over the hive.

The relocation of *A. mellifera capensis* colonies from southern to northern South Africa has resulted in widespread deaths of managed *A. mellifera scutellata* colonies. It is expected that *A. mellifera capensis* would have a similar effect on the European sub-species of *A. mellifera* used in commercial beekeeping in Australia.

Under the current AQIS supported National Sentinel Hive Program it would be possible to introduce a monitoring program based on sample collection of adult bees. Tests currently exist for *A. mellifera scutellata* but suitable tests would need to be developed for *A. mellifera capensis*.

**8. Small Hive Beetle** (*Aethina tumida*)

(i). Means of spread – the pattern of infestation is poorly understood but the initial introduction into Australia will most likely come from soil containing pupae eg. soil on heavy machinery/containers. Another possible means is from the illegal importation of queens. Further spread will be from the distribution of infected hive materials within and between apiaries and by placing hives on sites infested with hatching beetle pupae.
(ii). Survival – adults live on average for over two months and appear to be able to survive for five days without food or water. Soil conditions determine the resting period and survival of the pupae.
(iii). Incubation period – the eggs hatch into larvae after 2-6 days. After feeding within the hive they pupate in the soil outside the hive. The period in the soil depends on soil conditions and varies between 8-60 days. The duration from egg to adult is about 38-81 days.

## General Awareness of Disease

Beekeepers have obligations under various State and Territory legislations to contact authorities if a notifiable disease or parasite is suspected. The B-Qual Program also has a series of Standards, including biosecurity standards that must be complied with which form part of the industry's biosecurity plan. They include,

- Contacting authorities if a notifiable disease or parasite is suspected.
- Reporting cases of unusual sickness or death to authorities.
- Upon advice undertake appropriate measures.
- Recording details of any treatments.
- Taking action to reduce incidences of external bee activity, for example robbing of weak hives.
- Discourage the open feeding of honey to birds as bees will also feed on this honey which may contain AFB spores

## Introduction of Disease

Exotic Diseases.

Entry at seaports via containerised cargo or vessel holds are considered to present a significant opportunity for the entry of exotic bees and bee parasites. The National Sentinel Hive Program provides surveillance for exotic bees and bee parasites with sentinel hives provided by the Australian Honey bee Industry and cooperating beekeepers.

This forms an integral part of the industry biosecurity plan where "*sentinel hives will be maintained through joint Industry and Government cooperation*".

Endemic Diseases.

Queen bees and escort bees could provide a possible means of disease entry if infected candy is used. Because genetic evaluation of honey bees is difficult, a common practice by commercial beekeepers is to obtain queen bees from a number of suppliers. Therefore, it becomes essential to record details of each supplier and timing of each batch of queen introductions.

- Minimise introduction:
  - Where feasible, only purchase queens, packaged bees, or hives of bees from B-Qual® certified suppliers within Australia.
  - Make every effort to assess health status before purchase and inspect again upon arrival.
  - Beekeepers wishing to import queen bees must apply to AQIS and comply with their entry and release requirements.
- Declarations/Testing
  - If the disease status is not known irradiate all second hand beekeeping hive equipment, or obtain a vendor declaration (excluding equipment used in organic production).
  - Honey culture tests can identify the presence of AFB spores.
- Feed
  - If the disease free status of bee food is not known, do not use non-irradiated bee derived products except in the production of organic products.
  - Buy feed from suppliers who operate under a quality assurance program that has a biosecurity component.
  - Reduce the incidence of external bees foraging at feeding sites, if unsure of the disease status of surrounding hives.
  - Discourage the feeding of honey to birds.
- People
  - Be aware of potential for hive contamination from unwelcome visitors.
  - Ensure security of extraction plant when unattended.
  - Ensure hive materials/honey are not left on the site unsecured.
- Vehicles
  - Be aware of possible contamination from visiting vehicles with bees robbing from equipment and spilt honey.
  - Minimise vehicle movements around the extraction plant and apiary sites.
  - If contamination of vehicles is suspected ensure vehicles are cleaned.
- Ferals
  - Take precautions against swarming.
  - Take precautions against robbing bees.
  - Isolate captured swarms for six months.
- Location
  - Be aware of the increased potential for disease spread in concentrated areas such as pollination sites.
  - Hives should be inspected before placement at sites.
  - Where possible apiaries should not be placed near honey packing, beeswax or rendering factories.
  - Avoid placing apiaries near rubbish tips or known areas where open feeding of honey to birds occurs.
  - Avoid placing apiaries near neglected apiaries or stored used beekeeping materials and notify the relevant Government agency of their presence.

## Spread within the Apiary

- Segregation of introductions
  - Where feasible, isolate and manage newly obtained hives separately for a period and place hives under surveillance for at least six months or until satisfied of their status.
- Further Segregation
  - Each load of bees to be considered a unit with management and controlled transfer of materials.
  - Bee-proof honey and bee materials during transport.
  - Ensure adequate storage conditions to prevent robbing by external sources of bees.
- Health programs
  - Beekeepers should develop a broad-based barrier management system for disease control.
  - Hive components, particularly brood combs are inspected on a regular basis.
  - Appropriate measures for disease control are taken and any treatment details are recorded.
- Decontamination
  - Clean the smoker and hive tool before commencing work at each new apiary and after being used on a suspect diseased hive.
  - If the disease status is not known all second hand beekeeping hive equipment is irradiated (excluding equipment used in organic production) or a vendor declaration is obtained.
  - All second hand extracting equipment is cleaned.
  - Ensure honey containers are cleaned inside and out, dried and sealed.
  - Wastewater is disposed of through a digester or other appropriate method.
- Litter management
  - Dispose of sewage, trash and other refuse in and from buildings and immediate premises in a safe and sanitary manner.
  - Beekeepers agree to abide by Codes of Practice for conserved lands.
  - Honey packing plants minimise access by robbing bees by bee-proofing buildings.
  - Honey spills, exposed bee combs and wax are covered to prevent robbing by bees.

## Spread to other Apiaries

Due both to the migratory nature of the beekeeping industry in Australia and the foraging habits of bees, the spread of specific diseases can be difficult to prevent or contain. Where particular areas are suspected as being disease hot spots, beekeepers must assess the risk of placing hives in those areas. Extra precautions must be undertaken if no alternative sites are available. eg introducing apiaries after flowering has commenced and removing apiaries before flowering has stopped. Many of the practices used to prevent the entry and spread of disease or pests within an apiary can prevent their spread to other apiaries.

- Minimise movements
  - Bee-proof honey and bee materials during transport.
  - Honey and bee materials are secured against external contamination when unattended.
  - Robbing of open hives is minimised when working.
  - Comply with special movement conditions when proposing to move hives interstate.
- Quarantine or Retention

  Where feasible, newly obtained hives are isolated and managed separately for a period and hives are placed under surveillance for at least six months or until satisfied of their status. Under the B-Qual program the Apiary Site Record details the movement of hives.

  With regard to notifiable diseases, powers and control measures under the various Apiary Acts varies from State to State. Enforcement officers may direct that there be no movement of bees or apiary products on or off a property or they may be able to quarantine the property. Control measures may include burning infected bees and brood combs and equipment sterilisation.

  In the event of an incursion of an exotic disease, AUSVETPLAN would come into operation.

## Integration of Biosecurity

- Disease control program
  Part of the plan is that beekeepers should develop a broad-based barrier management system for disease control.
- Quality Program
  As mentioned the B-Qual Program has a series of Standards including biosecurity standards that must be complied with which form part of the industry's biosecurity plan. Overall they form an integrated approach to prevent the introduction of diseases to an apiary and to prevent the spread of diseases between apiaries or to a disease free area.
- Biosecurity for other Industries:
  Beekeepers may be required to comply with biosecurity plans for other industries, including those developed by the Plant Health Committee, for example Fireblight control.