Prevention and treatment of diseases and pests of honeybees: the world picture

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Prevention and Treatment of Diseases and Pests of Honey Bees: The world picture

1. The world spread of honey-bees before and after man’s intervention.

The different species of honey-bee (apis) evolved in the Old World - in Africa and Asia - before the end of the Pliocene period about two million years ago. Mammals, including primates, evolved much later. Chimpanzees have been observed getting honey from bees’ nests by using various tools they made for the purpose, so it seems likely that when man (Homo sapiens) evolved perhaps 250,000 years ago, he also hunted for bees’ nests, harvested the combs and ate the contents. When bees were kept in hives, however, they could be moved from one place to another, and this provided opportunities for bee diseases and parasites to spread to bees in other places.

One type of movement was ‘migration’, in which beekeepers gave their bees access to extra honey flows. This was already done in the Ancient World, although through quite small distances. If, as was usual, more than one beekeeper used the same migratory site, pathogens and parasites could be transmitted between bees owned by different beekeepers.

A later, and more significant, type of movement of hives was the transport of colonies of Apis mellifera to regions without honey-bees. An Assyrian relief from the 700s BC (Figure 1) records that a certain Mesopotamian ruler ‘was the first to bring bees that make honey from the mountains, and to keep them in his garden’.11

In all the above receiving countries, the bees were kept in traditional hives until movable-frame hives were introduced there in the late 1800s. After movable-frame hives were in use, the bees were also taken to Pacific islands, for instance:

<table>
<thead>
<tr>
<th>from</th>
<th>to</th>
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<tbody>
<tr>
<td>1857</td>
<td>USA</td>
</tr>
<tr>
<td>1962</td>
<td>New Zealand</td>
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There was much less movement of the Asian hive bee Apis cerana. It is believed that ‘some centuries ago’ nomadic people took hives of Apis cerana from the lower Indus valley across Baluchistan to parts of Persia near the Gulf.14

In 1856/86 Apis cerana was transported along the Indonesian chain of islands, across the Wallace Line and as far as Irian Jiaya, the western part of the island of New Guinea. In 1857 the bee reached the eastern part, Papua New Guinea, and the Australian Quarantine and Inspection Service was alerted to monitor its possible entry into the country.16 The reason for the alert was the possible contact of Apis cerana with Apis mellifera in Australia and the consequent transfer of mites that can parasitize both species: Varroa, Asian mite, and Acarapis woodii.7 (tracheae mite acarine Isle of Wight Disease). In addition, Kashmir bee virus infecting Apis cerana can also infect Apis mellifera.

2. The world spread of honey-bee diseases and pests

We know that bee diseases existed, and were treated, in the Ancient World. For instance, between 330 and 30BC Aristomachus in Greece said that the following help should be given to bees which are sick: ‘first, all the diseased combs should be removed and entirely fresh food placed for the bees, and then they should be fumigated.’ Disorder s recognised in Ancient Greece included starvation, dysentery, and failure to rear brood. Book IV of Aristotle’s Historia animalium (40.626b) referred to ‘a diseased condition indicated in a lassitude of the part of the bees and in malodorosnss of the hive’, which may have been the bacterial infection later known as European foul brood. In Ancient Rome, Columella recommended the use of light traps near the hives at night in autumn to attract wax moths, and Jan van der Stratt illustrated this activity around 1590 (figure 2).

Relief from the mid 700s BC showing Shamash-res-usur, the ruler of Assyrai who first took bees there and kept them in his garden (Istanbul Archaeological Museum).

The transport of Apis mellifera outside the Old World came much later and had very wide consequences. At the end of the middle Ages honey-bees were taken from Spain or Portugal in Europe to several groups of Atlantic islands previous without them:12

from | 1400s | Portugal
     | 1454  | Spain
     | 1554  | Portugal

to | Madeira and Santo Porto
    | Canaries
    | Azores.

The transport of honey-bees from Europe to new continents probably started in the 1500s, and it was extended further and further afield until the 1800s:

possibly 1500s | 1617 | Spain
1622 | England
1776 | Scotland
1822 | England
before 1830 | unknown
1839 | Portugal
1839 | England

from | Mexico
     | Bermuda
     | what is now USA
     | Canada
     | Australia
     | Costa Rica
     | Brazil
     | New Zealand.

Flemish beekeepers in their apiary at night, with lanterns to attract wax moths (Jan van der Straat, c 1590)

We do not know much about the spread of bee diseases until recent centuries, when the main cause was the transport of colonies - and later of queens with attendant workers - to distant regions where honey-bee were already present. (When the initial transport had been made, there were no honey-bee to be endangered.) In my other lecture I mentioned effects of some fairly recent introductions of a new race of honey-bee into an area already populated by one race, and some of these introductions have been associated with the spread of diseases or parasites.

However, the arrival of the greater wax moth in the USA around 1800 - presumable with bees sent from Europe - was
The large number of honey bee nests in trees provided further losses stimulated experiments in designing hives which Smith referred to its ravages throughout the country. Opportunities for the moth’s rapid spread, and in 1831 JVC about 1800, Connecticut 1805, Philadelphia 1812, Ohio 1827. Affleck abandoned. 35 dated its entry earlier: in the Boston area 1806, and within two years it had infested so introduced after 1805. Its appearance was reported by the Boston Patriot in 1806, and certainly by 1984. 18 in 1959 Jeffree published a study on the transmission, prevention and treatment of honey-bee diseases and parasites. 18 Another transference of mites between Apis species is believed to have occurred in the Pacific Far East region of what was then the USSR. Varroa jacobsoni had been found on Apis cerana in Java as early as 1904, but it was then regarded as of little or no consequence to beekeepers. It was recorded on the native Apis cerana in the Pacific Far East from about 1950, and after colonies of Apis mellifera were transported there in 1904 or earlier, Varroa successfully infested them also. Apis mellifera queens with workers - and the mites - were later sent from the Far East to European USSR. 17 The mites spread from there to other countries through successive transports of Apis mellifera, and were reported in Bulgaria in 1967. By 1993 the mite was known to be present on Apis mellifera in 34 countries and by 1996 in 47 countries. 31 It is now likely to have reached still others. In April this year the mite was found in South Auckland, New Zealand, where it may well have been present for a few years. 33

A parasite does not normally kill its host, and colonies of Apis cerana can withstand parasitization by Varroa, through grooming and in other ways. But a parasitized colony of Apis mellifera is likely to die. Beekeepers with movable-frame hives can apply various treatments to kill the mites; although this adds to their work, it enable them to continue beekeeping. On the other hand in traditional fixed-comb hives the brood nest is not accessible for inspection, and the beekeepers may see no signs of the mites’ presence for several years. By then the infestation is likely to be so heavy that the colony soon dies. I remember vividly a visit to Turkey in the spring of 1985, when many traditional beekeepers took me to see their apiaries - each with 20 or more hives - only to find the bees dead or dying. Tragically, several aid programmes included the provision of bees, which were sent for instance from Romania to North Africa and from Japan to South America - and (undetected) Varroa mites travelled to new continents with the donated bees.

Unlike Acarapis woodii, Varroa can thrive on Apis mellifera colonies in a wide variety of tropical climates.

3. Transmission, prevention and treatment of honey-bee diseases and parasites

I shall discuss especially the transmission of these diseases as a consequence of the development of world beekeeping. Their prevention depends mainly on two factors: keeping the bees in a suitable environment and under suitable conditions, and preventing contact between them and any other bees carrying a new pathogen or parasite which might be transmitted to them.

Contact between different colonies of bees can occur within an apiary if hives are placed close together in a long row and

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Distribution of acarine disease, and of susceptible areas based on environmental conditions. January and July temperatures. 27

- distribution of acarine disease
  - [blocked in O] limited records perhaps present
  - range uncertain
The worst scenario has followed the introduction of bees to a new continent, and much of the worldwide spread of Varroa-jacobsoni, and much of the worldwide spread which I will consider later. The development of an effective treatment of diseased or parasitized honey-bees is possible only after its causative organism is identified, and this has necessarily been dependent on advances in various branches of microbiology. The first honey-bee pathogens to be identified seem to have been the bacteria causing the diseases known as European foul brood (in 1885) and American foul brood (in 1907); the names refer to the continent where each was most studied. Current scientific names of the pathogens are Panalvei and Panalvea. The fungus causing stone brood was identified in 1909, and protozoa causing nosema and chalk brood in 1906 and 1916. I have listed these and other dates elsewhere.22

The breeding of Apis mellifera with an increased resistance to Varroa is one possible way forward that is being explored. But I shall not discuss treatment in detail, because I think that in New Zealand you keep up to date with the scientific advances on which treatment can be based.24

4. The present important of oceanic islands in world beekeeping
Honey-bees are not indigenous (native) to oceanic islands, and colonies taken to them have had less subsequent chance of contact with other bees carrying pathogens or parasites. In 1852 the Honolulu Agricultural Society offered a premium to the first person to import honey-bees to the Hawaiian Islands. Early consignments from eastern USA were sent round Cape Horn, but they died in the tropics. A colony sent from California reached Hawaii in 1857, and Italian bees were imported from 1880.15 Afterwards bees infected with American foul brood were taken there, and the disease spread. A period of decline followed, and from the early 1930s beekeeping was neglected. Then in 1949 JE Eckert went to Hawaii from the USA,23 and he found that surviving bees had developed a resistance to the disease. A queen-rearing enterprise was started in 1976, and by 1993 over 140,000 queens were exported annually.

In some other oceanic islands, too, beekeepers have found it more profitable to rear and export queens than to sell honey, since this can yield a higher monetary return and involves lower freight charges. The entry of a new bee disease or parasite in a mainland country given the beekeeper extra work in treating his colonies, and his honey yield may be less. But on an island where the beekeepers' income is derived from selling bees and queens, the industry may collapse because bees reared for sale are no longer acceptable elsewhere.

Prevention of the entry of new pathogens or parasites requires action at several different levels, including effective procedures by relevant government departments. For instance in Australia, a port surveillance project was established in Victoria. At three major ports, a local beekeeper has established sentinel hives in or near the main dock area, and sticky strips placed in the brood nest of his colonies are inspected frequently.

Bee products and beekeeping equipment can also transmit certain pathogens, and many countries have therefore restricted their import. Two beekeepers in New Zealand were recently jailed for attempting to import pollen from China as 'cornflour'.8

Apis cerana reached islands off north Australia from New Guinea by 1993, and it was detected in two incidents in the quarantine area of the port of Brisbane, Qld, in 1999.22 On 16 September a swarm was seen in a ship from Papua New Guinea, from which five bees captured were Apis cerana. On 27 December, a nest of Apis cerana was found on the metalwork of a grader from Papua New Guinea, which contained three queen cells, and Varroa mites were found on some bees and brood. The nearest apiaries of queen exporters were 45km from Brisbane.

The United Kingdom, where Varroa is widespread, had recently not permitted the entry of package bees from New Zealand because of the possible introduction of Kashmir bee virus. However New Zealand Beekeeper for March 2000 announced that the UK would again accept New Zealand bees.32
I have every sympathy with beekeepers in New Zealand in your efforts to maintain your export of healthy colonies. I cannot offer any magic solution to your problems, but I know that you keep abreast of new information from other parts of the world that may help you, and that your Ministry of Agriculture is very active on your behalf. I wish you well in your endeavours to maintain the position you have held in the world market.

References

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