Chapter 16

Introduction to *Varroa* Disease

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Beekeeping is an important component of present strategies for sustainable agriculture and integrated rural development programmes. Bee diseases are one of the main problems for beekeepers. This is independent of the number of colonies kept and is world-wide. The outbreak of disease can destroy the beekeeping industry of a region if no method or treatment is available or if the disease is not managed properly. Usually disease in a colony is first detected by beekeepers on the basis inspecting for clinical symptoms. This is only possible with training and experience. Control methods and quarantine measures (in the case of infectious bee diseases) should follow this inspection. Clinical symptoms are in some cases not sufficient to clarify which disease actually threatens the colony. In order to clarify the specific disease, laboratory diagnosis has to follow inspection by the beekeeper.

In most cases, diseases such as infestation with the parasitic mites, *Varroa jacobsoni* or *Tropilaelaps clareae*, are first noticed by the beekeeper once infestation rates have already reached destructive levels. These mites are a problem only for the exotic hive bee, *A. mellifera*, since the original hosts, *A. cerana* and *A. dorsata*, have developed a balanced host-parasite interrelation

Parasitism and reproduction of *Varroa* in *Apis cerana japonica*

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The incidence of parasitic *Varroa* mite on *Apis cerana japonica* is very low or zero. A survey of nest debris from the floors of colonies in traditional hives (from different localities and separate from *A. mellifera*) showed that 50% (n = 20) of the colonies were weekly infested.

In *A. cerana japonica* colonies, female adult mites usually reproduce only in drone cells mainly because the sealed duration of worker cells is too short to allow full development of *Varroa* offspring. There might also be chemical factor(s) because *A. cerana japonica* worker pupae attracted less mites than *A. mellifera* worker pupae in a choice experiment in the laboratory, and 37% of *Varroa* that invaded worker cells either could not lay eggs or had delayed oviposition if it occurred.

Apis cerana japonica drone pupae seem not to be chemically resistant because an abnormally heavily parasitised queenless colony in late-phase drone production was observed. The parasitic incidence for adults was 5.3% for workers and 10% for drones; 38.4% of 700 drone cells were invaded by *Varroa*. It is likely that maximum of 5–7 female mites per drone could be produced. This reproduction rate is comparable to that for *A. mellifera* drones.

during evolution. The parasitic incidence of *V. jacobsoni* in *A. cerana* is known to be low and notable damage is not published. The main reasons for this are thought to be the limited reproduction of *Varroa* in *A. cerana* in seasonally occurring drone brood and defensive behaviour by the bees towards the mites. However, Yoshida *et al.* (1995) in Japan observed mite reproduction within worker cells in colonies of *A. cerana japonica*, and abnormally high parasitic incidence of drone cells in a worker-laying colony. These observations were made in natural colonies that were isolated from *A. mellifera*. Dying colonies with abnormally high parasitic incidence may serve as a source of dispersion of *Varroa* to other healthy colonies.

Status of Disease in *Apis mellifera* and *Apis cerana* in Asia

Varroa jacobsoni and *T. clareae* are no threat to beekeeping with *A. cerana*. However, in most Asian countries *A. mellifera* is endangered by *V. jacobsoni*. The mite externally parasitises adult bees, feeds on their haemolymph and reproduces on their brood. Favourable reproduction conditions stimulate mite population growth to the extent that colonies die from *Varroa* infestation (varroasis) within a few years if it is not controlled.

Commercial beekeepers are known to migrate *A. mellifera* colonies in order to explore different bee flora. This leads to an increased exchange of disease within bee species and colonies, and between geographic regions. There is a large variety of bee diseases present in Asia caused by viruses, bacteria, fungi, protozoa, parasitic mites and predators (Matheson, 1995). Some resulted in part from importation of exotic bees into Asia, which is not yet controlled by all governments.

A ranking of presently existing bee diseases is intended to identify the worst bee diseases to face beekeepers in Asia. *Varroa* mite is perceived by only a few respondents to a questionnaire handed out during the workshop as the most critical pest or disease. *Tropilaelaps clareae* is more destructive in Asia. Since chemical acaricides are used intensively by most commercial beekeepers in Asia, *Varroa* does not yet cause the problems seen in other countries. Statistical analysis of the questionnaire revealed that predatory birds are claimed to be the worst problem for beekeeping in Asia followed by wax moths, *Varroa*, European Foul Brood, *Tropilaelaps*, wasps and hornets, American Foul Brood, chalkbrood and sacbrood. Nosema disease and tracheal mites are only mentioned by 11.7% of the respondents. For *A. cerana*, Thai Sac Brood Virus Disease is mentioned as the worst problem followed by European Foul Brood.

Evaluation of Control Methods Currently Used in Asia

In many cases, beekeepers around the world are not able to identify bee diseases by clinical symptoms. Consequently, they are not familiar with potential negative impacts on their colonies. Moreover, lack of training means that some symptoms are misinterpreted to the extent that beekeepers treat colonies without identifying the causative organizm. For example, some beekeepers regularly treat colonies with acaricides but had never seen a *Varroa* mite on bees or even dead mites on the hive floor.

In Asia, the use of chemical control predominates; biotechnical and 'soft-chemical' methods are rarely used. *Varroa* is mainly controlled by chemical acaricides and since there is no regulation for the use of chemicals in bee colonies by any government in Asia, any available, marked or self-made products are used. Sulphur dust, Mavrik sticks, Klartan, Apistan, Bayvarol and Folbex represent some of the large variety of products. Sulphur dust is widely used and it is found to be at least partially successful, but its effectiveness still needs to be determined. Sulphur dust applied to the colony can lead to contamination of honey. Side-effects can create new problems. The use of acaricides may cause sublethal residues to accumulate in beeswax, and in the future form the basis for development of resistance by the mites to chemicals presently applied. In Vietnam, various biotechnical methods are used successfully by professional beekeepers to control *Varroa* and *Tropilaelaps*. *Varroa* is controlled by trapping and *Tropilaelaps* by creating a broodless period (Dung et al. 1997).

Potential Control Methods for the Future

Since chemical control methods have limitations, and are too expensive or sometimes not available for small-scale beekeepers, other control methods should be tested under local conditions. Requirements for such control methods are independence from outside resources; lack of residues in honey and wax; low costs; and practicality for beekeepers. A mixture of management, biotechnical and soft-chemical control methods are needed.

Preliminary data from applied research work in the Philippines using formic acid show success in controlling *V. jacobsoni* and *T. clareae* (Boecking and Sito, 1999). Short-time treatments with formic acid during the night revealed promising results and correspond well with data already published. Moreover, investigations showed that formic acid treatments against *V. jacobsoni* are highly effective against *T. clareae* too. Long (1998) successfully applied 15% formic acid combined with 3 ml of oil of marjoram under Vietnamese tropical climate conditions in a long-time treatment with average mite mortality of 97.98 ± 1.18%.

Also some data and practical experiences are available about the use of soft-chemical and biotechnical control methods against *Varroa*, but as of now no general recommendation can be given for use under the diverse and specific conditions of the many Asian countries. For this, research is required in order to apply integrated pest management systems that have been used successfully in one situation to the specific conditions of each Asian country.

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