DISCONTOOLS

Varroosis
Summary

Introduction

This note provides a brief summary of the Disease and Product analysis prepared by a DISCONTOOLS group of experts covering Varroosis of honey bees. They reviewed the current knowledge on the disease, considered the existing disease control tools, identified current gaps in the availability and quality of the control tools and finally determined the research necessary to develop new or improved tools. Full details are available on the web site at http://www.discontools.eu/.

Disease profile

1. *Varroa destructor* is an external parasitic mite of honey bees and is found worldwide except Australia (but detected in New South Wales in June 2022) and some parts of Oceania, Europe and the centre of Africa. It is now endemic in Europe. It is an established obligate parasite which cannot survive without its host. Reproduction occurs only on honey bees of the species *Apis mellifera* and *Apis cerana*. It attaches to the body of the adult bee, and breeds within the colony by laying its eggs within brood cells and feeding on the bee larvae. Different genotypes/haplotypes are found, but in Europe there is only one “virulent” haplotype (the Korea haplotype) present. The *Varroa* mite is a known disease vector and can transmit and activate certain viruses.
2. Clinical signs are detectable in the case of severe infestation with almost 100% mortality if not treated. The symptoms are often due to the associated bee viruses. Colonies may collapse due to *Varroa* mite infestation within the same year if not properly managed. However, differences exist based on geographical location (latitude), infestation pressure, colony density, honey bee genetics and beekeeping management. *Varroa* can be easily transmitted between colonies in the same apiary and transmitted over the bees’ flight range (2-3 km) through robbing, swarming or drifting. Moving colonies/migratory beekeeping, leaving hives untreated, balancing hives by putting combs or bees from one colony to another, and other beekeeping management measures can also contribute to transmission and spread of the disease.

Risk

3. Colony losses are directly related to *Varroa* infestation if the parasite is not properly controlled. This leads to a decrease in the number of honey bee colonies for pollination and decreasing income for beekeepers. Losses of this important pollinator also has an impact on crop production. New veterinary medicinal products are required for *Varroa* treatment and control. A stand-alone development for a new chemical entity exclusively for treatment of Varroosis does not seem to be commercially viable. Final users of acaricides need to be properly educated concerning the use of the veterinary medicines, being able to optimise their efficacy, depending by the climatic context (e.g., proper temperatures, in case of essential oils and formic acid), the way of administration, the dosage and the biology of the bee colony (e.g., absence of brood, in case of the use of oxalic acid).

Diagnostics

4. There is a need for the development of sensitive tests for early and easy diagnosis of the disease, along with tools to assess colony health in relation to immunity, virus loads and stress status. No commercial kits are available but standardised methods are available from the WOAH. Almost all honey bee colonies in the EU are infested, but at different levels, with *Varroa* mites, necessitating the development of quantitative diagnostic tools. Methods are needed to test the efficacy of treatments and to detect acaricide resistance. Molecular methods are available to detect and quantify viruses spread by the mite. All known viruses can be investigated depending on the available standardised and validated protocols.

Vaccines.

5. No vaccines are available. At present there are two approaches for vaccine development: the RNAi technology and the Trans-Generational Immune Priming (TGIP), but both require more

research. The development of vaccines will require the identification and isolation of target proteins of *V. destructor* and the identification of immune-relevant genes in bees.

Pharmaceuticals

6. Several types of treatments are used. These include i) Synthetic pyrethroids (tau-fluvalinate and flumethrin, mostly used as strips), ii) Coumaphos (trickling and strip), iii) Amitraz which is widely used in the commercial “beekeeping world” (used as strips or fumigation), iv) Organic acids: formic acid, oxalic acid, lactic acid and v) Essential oils: mainly thymol products, some other substances with potential. Questions arise with all these treatments. For a sustainable approach, low hive impact active substances (organic acids and essential oils) should be preferred to high impact ones that can be more persistent in the hive matrices with risks of residues and mite resistance development. In the case of the synthetic pyrethroids and coumaphos, more information is required on their mode of action and the dynamics of mite resistance development. Currently, there are no procedures available for removal of residues from beeswax. An “easy to apply” resistance test is required and more knowledge on whether resistance management by the beekeeper is feasible.

7. The list of regulatory approved veterinary medicinal products varies from country to country with limited or no availability of veterinary medicines in some countries. However, the cascade system can be used, in agreement with the competent national authority. It will be important to avoid negative selection pressure on the parasites by use of medicines as this could lead to resistant *Varroa*.

Knowledge

8. More research on the *Varroa* biology, physiology and host-parasite relationship is required. Knowledge gaps exist on honey bee immunity as very little is known about immunity at both the individual honey bee level and colony level. The suppression of the innate humoral immune system of the host by (i) introduction of salivary gland secretion into the puncture site and (ii) transmission of bee viruses needs further investigation. More information is also needed about host-parasite interactions. More research on possibilities and feasibility of biological control is urgently required to include control of mite reproduction, mating and host finding. The adoption of proper biotechnical measures can be pivotal to improve the efficacy of pharmacological treatments. From a long-term perspective, the development of selection criteria for the breeding of honeybees naturally tolerant/resistant to *Varroa* will offer the best way to manage Varroosis. Several research groups are working on this topic. Until we are so far, we need in the meanwhile to extend the methods and strategies to control *Varroa*.

Conclusions

9. Varroa represents the most relevant parasite of honey bees in most countries worldwide, with limited availability of effective and easy-to-apply control methods. The available diagnostic methods are not satisfactory. Awareness and training is needed to guarantee efficient treatments avoiding unwanted side effects such as mortality of honey bees, residues in hive products, and development of acaricide resistance. The active ingredients used for the control of *Varroa* mite infestation have been identified already more than 30 years ago, both synthetic compounds like amitraz, bromopropylate, cymiazole, coumaphos, tau-fluvalinate, flumethrin, and “natural” like organic acids and essential oils. Despite the increased availability of veterinary medicinal products treatment efficacies overall are poor and need to be integrated with improved beekeeping management strategies. Resistance of *Varroa* mites to some of these substances has been detected. In addition, harmonised recommendations and, at the same time, country-tailored procedures for diagnosis and control by veterinary/extension services are often lacking or are not always properly followed by beekeepers, a.o. because of insufficient coverage on the territory.