Varroosis
Summary

Introduction

1. This note provides a brief summary of the Disease and Product analysis prepared by a DISCONTOOLS group of experts covering Varroosis. 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/ and can be downloaded by selecting Disease Database, then the specific disease and highlighting the variables of interest. This is completed by selecting "create a report" which can then be downloaded as either a PDF or Excel spread sheet.

Disease profile

2. *Varroa destructor* is an external parasitic mite of honeybees and is found worldwide except Australia and some parts of Oceania, Europe (north of Sweden, Åland Islands, FIN, Isle of Man, UK, Ile de Ouessant, FR), and the centre of Africa. It is now endemic in Europe where it was first reported in the 70'. It is an established obligate parasite which cannot survive without its host, the honeybee, for more than 2 weeks. Reproduction occurs only on honeybees *Apis mellifera* and *Apis cerana.* It attaches to the body of *the adult bee*, and breeds within the colony by laying its eggs within capped brood and feeding on the *bee* larvae. Different virulent haplotypes of *Varroa* have been identified (e.g. Korean, Japan type), as well as acaricide resistant strains. Different genotypes/haplotypes are found, but in Europe there is only one "virulent" haplotype (the Korea haplotype) present. The *Varroa* mite is also a known disease vector and can transmit and activate certain viruses which are often only pathogenic if *Varroa* mites are involved. In one case *Deformed wing virus* (DWV) appears to be more virulent after its replication in the parasite.

3. 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 such as DWV. When *Varroa* was first introduced in the European honeybee population, the time from the start of the infestation to colony mortality was 1-3 years. Colony collapse depended on parasite pressure and often with a high bee mortality late in season. Today colonies may collapse due to *Varroa* mite infestation within the same year if not properly managed. However, differences do exist based on geographical location (latitude), infestation pressure, colony density 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 and other beekeeping management measures can also contribute to transmission and spread.

Risk

4. Colony losses are directly related to *Varroa* infestation if the parasite is not properly controlled. This leads to a decrease in the number of honeybee colonies for pollination (pollination ecosystems for both wild flora and crops) 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 and there is a need to encourage chemical testing for *Varroa* control. A stand-alone development for a new chemical entity exclusively for treatment of Varroosis does not seem to be commercially viable due to a too high investment cost for toxicological and efficacy studies, etc. Also coupled with a relatively small market and an uncertain return on investment. Therefore, a strategy for *Varroa* control should be developed and consolidated.

Diagnostics

5. Not only are *Varroa* mite loads important for diagnosis but also for the development of clinical signs of the disease (PMS, Parasitic Mite Syndrome). There is a need for the development of sensitive tests for diagnosis. A diagnostic tool for an early and easy detection of the disease is needed along with a tool to assess the colony health in relation to immunity, virus loads and stress status. No commercial kits are available but standardised methods are available from the OIE. Almost all honeybee colonies in the EU are infested with *Varroa* mites and therefore, quantitative diagnostic tools are required. A reliable and easy to apply method is needed especially in order to test of the efficacy of certain treatments and detect possible resistance to treatments used to control *Varroa*. A diagnostic tool should be also essential for an infestation based diseases control (IPM). PCR methods are available to detect and quantify viruses spread by the mite. All known viruses can be investigated depending on the available standardized and validated protocols.

Vaccines.

6. 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 requires more research. There is a major knowledge gap on honeybee immunity and a more general problem of the possible application of vaccines within the beehive. 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

7. 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. In the case of the synthetic pyrethroids, more information is required on their mode of action and the dynamics of mite resistant development. An “easy to apply” resistance test is required and more knowledge on whether resistance management by the beekeeper is feasible. In the case of Coumaphos more information on mite resistance is required and whether or how the removal of residues from beeswax can be achieved? This is true also for pyrethroids. There is a question of whether resistance and residue management is practical and feasible.

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

Knowledge

9. More research on the *Varroa* biology, physiology and host-parasite relationship is required. Knowledge gaps exist on honeybee immunity as very little is known about immunity at both the individual honeybee 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 interaction. More research on possibilities and feasibility of biological control is urgently required to include control of mite reproduction, mating and host finding. At 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 the *Varroa* problematic and several research groups are working on this topic. Until we are so far, we need in the meanwhile to extend the methods to control *Varroa*.

Conclusions

10. *Varroa* represents an extremely dangerous pest with limited availability of effective and easy-to-apply control methods. The available diagnostic methods are not satisfactory. The active ingredients used for the control of *Varroa* mite infestation have been identified already 25-30 years ago, both synthetic like amitraz, bromopropylate, cymiazole, coumaphos, tau-fluvalinate, flumethrin, and “natural” like organic acids and essential oils. Most of them were derived from agriculture and adapted for controlling *Varroa* infestation. Since then the improvements were concentrated on improved formulation of active substances, improved mode of administration, removal from the market of those too pollutant and integrated control strategies (IPM). The revision of the EU regulation on veterinary medicinal products accompanied this process. Despite the increased availability of veterinary medicinal products (many of them with the same active substance, e.g. formic acid, oxalic acid, amitraz, thymol, coumaphos), treatment strategies overall are poor and need to be integrated with improved beekeeping management strategies. In addition, common recommendations for diagnosis and control by veterinary/extension services is often lacking, are poorly followed by beekeepers or has insufficient coverage of the territory.