Varroa research at lACR -Rothamsted: progress and prospects.

Article · January 1998

CITATIONS
0

READS
23

1 author:

Norman Carreck
University of Sussex
171 PUBLICATIONS **3,870** CITATIONS

SEE PROFILE

Varroa research at IACR- Rothamsted: progress and prospects

Norman L Carreck includes details of the new biological control project

Recently, three MAFF-funded projects at IACR-Rothamsted on *Varroa jacobsoni* were completed, so it seems appropriate to summarise the main findings, and then to introduce the current and future projects. The first two projects were entitled: 'Causes of mortality in honey bee colonies infested with the parasitic mite *V. jacobsoni*', and 'The rôle of *V. jacobsoni* in the epidemiology of honey bee pathogens'. They were completed in March 1997.

The research aimed to determine whether the damage to colonies infested by *V. jacobsoni* was associated solely with parasitisation of adult bees and pupae by the mite, or whether it was due to an increased incidence of other pathogens. Previous research funded by the EU, undertaken by Brenda Ball on infested colonies in Germany, had identified acute paralysis virus (APV) as a primary cause of adult bee and brood mortality[1]. The recent work built on this past experience and aimed to compare infested and uninfested colonies in the UK, not only to identify the primary pathogens but also to indicate differences in the prevalence of pathogens associated with the presence of mites.

Although the earlier studies had shown that the mite affects the type and prevalence of pathogens[2], its role as an activator and vector of infections was unclear. The projects studied the incidence, persistence and spread of pathogens in bee and mite populations, and used population studies to investigate whether the relationship between the mite and pathogens was density-dependent. Associated laboratory and field studies on the longevity of parasitised bees, coupled with analysis and identification of pathogens, also aimed to determine whether mite feeding in the absence of secondary infections caused adult bee and brood mortality.

Slow Paralysis Virus

Work began in April 1993 in Devon, and over the course of the year, regular sampling and analysis showed that, in contrast to findings on mainland Europe, where APV was the major cause of mortality, in Britain slow paralysis virus (SPV) proved to be the primary cause of adult bee and brood mortality late in the season[3,4]. More recent work has found similar results, both in Devon and in Hertfordshire, although cloudy wing virus (CWV) and deformed wing virus (DWV), previously known only as infections of adult bees, have also shown a marked increase in prevalence, and have been identified in both dead adult bees and brood. APV has been found only rarely as a cause of mortality in infested colonies in the UK.

Laboratory studies investigating the direct effects of mite feeding in the absence of viral pathogens, detected no difference between the development time and emergence of pupae maintained without mites or infested with up to five mites at the white eyed

stage of development. Similarly, no difference in longevity was detected between uninfested young bees and those artificially infested with one, two or three mites after emergence[5]. These results suggest that, at least in the laboratory, the parasitisation of pupae and young bees in the absence of pathogens has minimal effect.

Viruses detected in mites

The experience gained during the field studies, involving large-scale sampling of infested colonies in this country, has provided important information on the early detection of bee pathogens. Dead bees were collected from dead bee traps at colony entrances, mites were collected from floor inserts, and brood and live bees were collected from within colonies. Analysis showed that of these samples, the mites themselves are the best indicators of virus presence, because infected bees often die away from the hive and thus are not available for analysis. In 1994, SPV could be detected in mites two months before it could be found in dead bees or live bees or brood. In dead colonies, frequently no pathogens are detected in the bees remaining in the cluster, providing no clue as to the cause of mortality of the remainder of the bee population.

The field studies, involving bee and mite population estimates, indicated that the incidence of SPV is indeed dependent on the degree of mite infestation. SPV infections became established initially in those colonies with the largest mite populations, and occurred in late Summer, at the time when diminishing numbers of brood cells led to multiple infestation. Of the colonies studied, all of those that died showed infections by one or more viruses. In contrast, colonies in which no viruses were detected could survive with relatively large mite populations.

A third MAFF-funded project at IACR-Rothamsted entitled: 'The induction of virus replication in honey bees parasitised by *V. jacobsoni*' was completed in March 1998 by Colin Denholm, who is registered for a PhD at Keele University. The project aimed to determine the mechanism of virus induction in infested bees, and to identify possible causes of the differences in damage due to mite infestation and associated virus infection between bee populations. These studies have shown that there are significant differences in the incidence of inapparent virus infections both between and within colonies. Virus replication can be induced most effectively in the laboratory by the injection of foreign proteins, and substances introduced into the haemolymph of bees during mite feeding, such as components of mite saliva, may have similar effects in nature. However, much still remains to be learned about the immune response of bees to mite parasitisation and virus infection[6,7].

Mite populations and viruses

In April 1997, IACR-Rothamsted and the CSL National Bee Unit began a new collaborative three-year project funded by MAFF. It is entitled 'The development of improved control strategies for *V. jacobsoni* by integrating research on mite populations and virus epidemiology'. The project aims to bring together the research on virus epidemiology at IACR-Rothamsted with the CSL research on mite population development undertaken by Dr Stephen Martin since 1993[8], and to provide a coordinated approach to the development of improved methods of reducing the damage to bee colonies infested with *V. jacob-*

soni. It will investigate the relationship between mite populations and virus incidence, to determine the critical density of mites and the time of year that damage due to associated infection occurs. The effectiveness of acaricide treatment in limiting mite population development and virus incidence, and the timing of treatment will also be evaluated to provide beekeepers with soundly based practical advice.

Many beekeepers are reluctant to use chemical control in beehives because honey is marketed as a 'natural' and 'pure' product. In addition, there is growing evidence that populations of mites resistant to tau-fluvalinate, the active ingredient of *Apistan*, have appeared. The problem was first noted in Italy, but resistant mites are now known to be in Belgium, and a separate instance of apparent mite resistance has recently been reported in Florida, USA. It is therefore highly likely that within a few years mites resistant to both *Apistan*, and the similar active ingredient flumethrin, found in *Bayvarol*, will be present in the UK.

Biological control methods

This has raised the question of using biological control methods, but unfortunately no naturally occurring pests or pathogens specific to *V. jacobsoni* have so far been identified. Mites are, however, known to be susceptible to a range of fungi and bacteria. For many years, both IACR-Rothamsted and Horticulture Research International, Wellesbourne (formerly the National Vegetable Research Station and the AFRC Institute of Horticultural Research) have been experimenting with fungi and bacteria for the biological control of insect pests. For example, one current pro-

ject at IACR-Rothamsted involves the use of honey bees to transport spores of the fungus *Metarhizium anisopilae* to oilseed rape flowers to control pollen beetles[9], and protocols for testing the effects of biocontrol agents on beneficial insects, such as honey bees, have been established[10,11].

Following a short feasibility study, MAFF has recently announced funding for a new four-year project entitled 'Biological control of *Varroa jacobsoni*', to be carried out jointly by IACR-Rothamsted and HRI Wellesbourne. This will enable the appointment of an additional graduate scientist at each site.

The search for fungi and bacteria

The initial stages of the project will involve the collation of strains of fungi and the bacterium *Bacillus thuringiensis* of known activity against mites, which are held at HRI, IACR-Rothamsted and other research institutes in the UK, as well as in the Netherlands and the USA. Approximately 100 strains will then be screened for their effectiveness against *V. jacobsoni*. Once useful strains are identified, they will be tested for their effects on beneficial insects including, of course, the honey bee, but also ladybirds, predatory mites, and representatives of the other important insect orders. It will then be necessary to study the physiological characteristics and epidemiology of such useful strains, in order to determine their persistence and spread in the hive and in the field, and finally to develop suitable methods for their application within the hive.

Whilst there is a risk that a suitable biocontrol agent, which is effective against *V. jacobsoni* but is harmless to honey bees and other beneficial arthropods, may not be identified within the four years of the project, the potential benefits are considerable. Due to the apparent uniformity of the *V. jacobsoni* population, and the consistency of conditions within bee hives, it is likely that a biocontrol agent found to be effective under UK conditions will be equally effective worldwide. ❖

References

1. Ball, BV. (1985) APV isolates from honey bee colonies infected with *V. jacobsoni*. *Journal of Apicultural Research*, **24**, 115-119.

2. Ball, BV & Allen, MF. (1988) The prevalence of pathogens in honey bee colonies infested with the parasitic mite *V. jacobsoni*. *Annals of Applied Biology*, **113**, 237-244.

3. Ball, BV. (1997) Varroa and viruses. In: *Varroa! Fight the mite*. IBRA. pp 11-15.

4. Carreck, NL. (1994) The Rothamsted Varroa project. *Bee Craft*, **76**, 209-213.

5. Carreck, NL. (1996) Update on Varroa research at Rothamsted. *BBKA News*, **106**, 2-3.

6. Denholm, CH. (1997) Viruses and Varroa. *Bee Craft*, **79**, 113-116.

7. Denholm, CH. The induction of virus replication in honey bees parasitised by *V. jacobsoni Oudemans*. Central Association of Bee-Keepers (in press).

8. Martin, SJ. (1997) *V. jacobsoni* population biology research in the UK. *American Bee Journal*, **137**, 382-385.

9. Butt, TM; Carreck, NL; Ibrahim, L & Williams, IH. Honey bee mediated control of pollen beetle (*Meligethes* spp.) by the insect-pathogenic fungus, *Metarhizium anisopilae*. *Biocontrol Science and Technology* (in press).

10. Butt, TM; Ibrahim, L; Ball, BV & Clark, SJ. (1994). Pathogenicity of the

entomogenous fungi *Metarhizium anisopilae* and *Beauveria bassiana* against crucifer pests and the honey bee. *Biocontrol Science and Technology*, **4**, 207-214.

11. Ball BV; Pye BJ; Carreck NL; Moore, D & Bateman RP. (1994) Laboratory testing of a mycopesticide on non-target organisms: The effect of an oil formulation of *Metarhizium flavoviride* applied to *Apis mellifera*. *Biocontrol Science and Technology*, **4**, 289-296.

[Norman Carreck, NDB, works in the Entomology & Nematology Department, IACR-Rothamsted, Harpenden, Hertfordshire. AL5 2JQ.]