The Potential of Biological Control of Varroa using Entomopathogenic Fungi

Varroa management is an essential part of contemporary beekeeping. The fundamental aim of varroa control is to keep the population below the level where harm is likely (known as the economic injury level), therefore maintaining healthy colonies of bees for the production of honey and other hive products and also for pollination. It is not necessary to kill every single mite for effective control and it is not usually desirable to attempt this. However, the more mites that are left behind, the quicker they will build up to harmful levels again. The current methods used by beekeepers against varroa can be divided into two main categories: varroacides and biotechnical methods which also includes integrated pest management (IPM) or biological control strategies.

Thrips and fungi. Photo by Andrew Cuthbertson.

In recent years varroa has developed resistance to pyrethroids; the active ingredients in the varroacides that until now have most commonly been used to kill them. Resistance has spread widely throughout many parts of the UK posing a new and significant challenge for beekeepers. Therefore, other methods of control are urgently required. This article outlines the potential of using entomopathogenic fungi for the control of varroa.

Biological control of varroa could form part of an IPM system against the pest. Natural enemies of the varroa mite are few and, until recently, included no records of fungal pathogens. Research on natural enemies against mites phylogenetically related with varroa have pointed out the potential of entomopathogenic fungi as promising alternative control agents. It has also been shown that varroa has a high susceptibility to infection by *Beauveria bassiana* and *Metarhizium anisopliae* fungi when the mites are placed directly upon these colonies. Indeed, several species of entomopathogenic fungi have been found to infect varroa mites in laboratory situations.

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Many entomopathogenic fungi have a ubiquitous distribution and a wide host range. Therefore it might be expected that foraging bees could frequently carry fungal conidia into the bee hive from their environment. However, the lack of observed natural infections of varroa mites by these fungi could be due to a combination of hygienic behaviour of worker bees and the harsh environmental conditions in bee colonies.

Although fungi present the advantages of easy manipulation, adaptation to different environments, specificity and penetration directly through the tegument of the host, to achieve successful results environmental conditions to which they will be exposed must be considered since these can influence germination and subsequent host colonisation by the pathogen. One of the most important abiotic factors for entomopathogenic fungi is temperature since it affects its metabolism by altering the production processes of enzymes, toxins, spore germination, development of the germinative tube, penetration, colonization, and reproduction. Also, field studies have been variable; some studies showed good control while others were less successful and some even indicated negative effects on bees. Even though several strains of fungi are toxic to varroa, the high temperatures within a bee colony are deemed to be detrimental to fungal infection. Therefore, to date no biological commercial product for varroa treatment is available.

More recently research in this area has been completed in several countries around the world, with rumours of a product being released in New Zealand soon! Closer to home, Dave Chandler at The University of Warwick and Judy Pell at Rothamsted Research went some way to identify and clarify the taxonomic status of varroa-specific fungi, and are still interested in progressing this area. Given the impact of varroa on honey bees, advances in biological control of this important bee pest will be much welcomed by the beekeeping community.

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