MONITORING TECHNIQUES OF VARROA RESISTANCE AND ROTATION OF VARROA TREATMENTS

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Summary

For several years, the distribution of varroa resistance to the active ingredients of treatments against Varroa destructor has been identified and monitored especially in Western Europe. The different techniques used for laboratory or field tests, and for the different active ingredients used against varroa are described. The different techniques used are discussed for their accuracy and their role in monitoring. The evolution of the intensity of varroa resistance, in relation to the types of treatments used against the varroa mites, is described. The ideal rhythms of rotation with the different active ingredients are discussed. The example of reversion of varroa resistance to the pyrethroids in Europe will illustrate the different aspects of the rotation strategy.

Introduction

Since the 90s, strains of varroa mites, resistant to the main acaricides against Varroa destructor, appeared in different parts of the world (4). The most studied is the European strain resistant to pyrethroids. It appeared initially in Italy and caused important economic damage to beekeepers. Since then, several institutes and VITA (Europe) Limited have developed assays and organised monitoring campaigns for the quantification of resistance rate in varroa populations (9). Other families of acaricides are now experiencing varroa resistance in diverse regions of the world. Recently, due to the natural decrease of resistance in some areas, monitoring campaigns were also performed to give the actual resistance situation.

Different methods to evaluate varroa resistance

Monitoring methods of varroa resistance can be divided into three categories: field efficacy assays, field kits, and laboratory assays.

Field efficacy assays have the great advantage of being carried out by a wide number of people giving information from every single part of a region. To perform an efficacy assay, a hive equipped with a counting board is given a standard treatment with the acaricide to test. Falling mites are counted regularly. Subsequently, a control treatment allows recovery of the remaining mites. This gives a percentage of efficacy, which can be compared to the efficacy normally expected.

Vita's field kit for the detection of pyrethroid resistance

Field kits exist in simple and short duration assays easy to use at the apiary level (1, 2, 3, and 6). One of them was developed by VITA (Europe) Limited. Generally, they consist of a jar in which mite infested live bees are in contact with the product to test for a given period, and the remaining mites are recovered by another agent, generally a detergent.

Laboratory assays are the usual scientific means of measuring the actual resistance rate of a mite population. Live mites are exposed to a fixed dose of the acaricide in controlled conditions. The percentage of surviving mites allows the calculation of resistance. Several methods have been used, although the Milani method has been used more frequently, on a wide scale, and demonstrated its accuracy for pyrethroids and cumaphos (4, 8).

Some examples of varroa resistance monitoring campaigns

A series of campaigns, covering many countries in Western Europe and using a single method, allowed us to follow the evolution of resistance spread in wide areas (8).
Campaigns in Belgium and in Spain used both laboratory assays and field kits (1, 2) and gave a good indication of the relative advantages of both methods.
The best example of what can be achieved with monitoring programs comes from the UK where since the detection of varroa resistance in 2001, yearly detection operations have been performed with the results published on the internet (7).
In Italy, campaigns performed over several years confirmed the reality of reversion of pyrethroid resistance in full beekeeping conditions and on a large scale (5).

Advantages and disadvantages of the different methods

For each type of method, the key factor for success is a sufficient number of mites tested. When an appropriate method of control is used, this condition is generally only reached at the end of the summer. This means the information must be gathered the previous year.

If the protocol of field efficacy assays is simple, and the amount of material needed moderate, efficacy assays just give indicative information about possible resistance. Because of re-infestation after the tested treatment (several hundreds of mites can enter a colony in a single day), efficacy assays do not give scientifically accurate information. Efficacy trials are also very labour-intensive, mite fall has to be counted over weeks and even months.

Field kits have the advantages of both field efficacy assays and laboratory assays: they need a short training period, the material needed is not expensive, they can be used at a local scale in many apiaries, and the results are obtained rapidly. However, they do not have the same accuracy of laboratory assays. In reality they are only able to detect medium and strong resistance rates.

The inconvenience of laboratory assays is that living mites have to be sent to the lab using courier and the monitoring campaign has to be performed in a limited period because it is rather heavy and few labs are able to offer an analysis facility all year round. But they are presently the most accurate method giving a precise figure of resistance rates. Studies are undergoing to find a new method using genomic cues for evaluation of resistance rates. This would allow work with dead mites in any season.

Reversion of pyrethroid resistance

At least in the case of varroa resistance to pyrethroids in Western Europe, resistance decreases when no pyrethroid is used (5). This was shown both in Italy and France. The resistance rate decreases at a rate of about 50% per year. The time needed to reuse, for example Apistan, would then depend on the initial resistance rate. When resistance has decreased significantly, the acaricide can be used again but for a limited period not exceeding 2 successive years.

Conclusion

The number of efficient medicines against the varroa mite is limited at present as is likely in the future.
To keep a longer life for existing products, it is crucial to rotate products over time. The example of Apistan showed that after the product had not been used for a certain period, the resistant rate of the mite population decreases strongly. The use of tools (field kits or laboratory assays) at a local level allows collection of accurate information on resistant levels. Such tools have been developed for pyrethroids. Development of similar tools for other acaricides would allow provision of much wider information giving the beekeeper the information needed to conduct a targeted rotation programme. Assays and monitoring campaigns should now be considered as providing key information for any varroa control strategy.

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