

A New Product with Formic Acid for *Varroa jacobsoni* Oud. Control in Argentina. I. Efficacy

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With 1 figure and 1 table

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Summary

An organic product based on formic acid in a gel matrix was evaluated for use in *Varroa* control under autumnal climatic conditions in Argentina. Twenty colonies each received two gel packets with formic acid in two applications and numbers of falling mites were registered. After this treatment colonies received two other acaricides in order to compare efficacy. Average final efficacy in colonies treated with the organic product was 92% with a low variability. The gel matrix kept an adequate formic acid concentration inside the colonies with only two applications. This product is, therefore, a good alternative for *Varroa* control because it is organic, easy to use and presents a low variability in final efficacy between colonies. No queen, brood, or adult honeybee mortality was registered.

Introduction

Many chemicals have been used in an attempt to control the parasitoses caused by the mite *Varroa* which is dispersed throughout the world (Milani, 1992–93).

At the beginning of 1990 the first case of a decrease in the efficacy of Apistan for *Varroa* control was detected (Loglio and Plebani, 1992; Lodesani et al., 1995). According to Milani (1995) this was caused by a mite population resistant to the active ingredient fluvalinate. This research also demonstrated that mite populations presented cross-resistance to flumetrine and acrinatrane, two others pirethroids usually used for *Varroa* control. Because of this, in the last few years research into *Varroa* control using products of natural origin has been intensified.

Formic acid is an organic acid that is usually found as a natural component in honey and has a strong effect against mites. The first research on *Varroa* control using formic acid was performed in Germany at the beginning of the 1980s and later in other European countries (Ritter and Ruttner, 1980; Wachendorfer et al., 1985). As for most of the organic substances used in *Varroa* control, formic acid has two main problems: a high variability in its efficacy against the mite and a difficult (and sometimes dangerous) application method for the beekeepers.

In relation to the last point, a gel formulation is the application method that presents promise for the future; firstly, because it is possible to reduce the number of applications and secondly because efficacy variability between colonies is reduced. At present, little

research has been done on Varroa control using formic acid in a gel matrix and results have been variable (Clark, 1994; Nelson et al., 1994; Feldlaufer et al., 1997).

During the past 5 years, the National Institute of Agricultural Technology and some National Universities have joined in the Beekeeping Development Integrated Project (PROAPI) to develop an organic product for Varroa control based on formic acid in a gel matrix, that is commercially known as BeeVar. In this study the efficacy of BeeVar in Varroa control is evaluated under autumnal climatic conditions.

Materials and Methods

Field trials were carried out in March and April 1999, in the experimental apiary of Arthropodos Laboratory, near Mar del Plata city. The average temperature registered during this period was 14°C (range 9–19°C).

Twenty colonies were used that had been previously standardized for bee population, brood area and honey and pollen stores. Hive bottoms specially adapted for collection of dead mites were placed in each colony.

All colonies received two BeeVar gel packets during the experiment. The BeeVar formulation consists of 200 g of formic acid in 68% gel. At the beginning of the experiment a BeeVar gel packet was placed over the frames in the brood chamber (Fig. 1) and falling mites were counted after 1, 7 and 15 days. After the last count, the gel packet was replaced with a new one and falling mites were counted 16, 21 and 28 days after the beginning of the experiment. Then, the gel packet was removed and the colonies received four flumethrin strips (registered trade name: Bayvarol®, supplied by NEXCO SA, Buenos Aires, Argentina) and a first dose of oxalic acid of 50 ml per hive (concentration: 30 g/l). After 7 days a further oxalic acid application was given at the same dose. Bayvarol®, strips remained in the colonies for 4 weeks. Falling mites were counted throughout this period.

The efficacy of BeeVar was calculated as $[(\text{number of dead mites during formic acid treatment})/(\text{number of dead mites in the whole treatment})] \times 100$.

Results

The efficacy of the BeeVar treatment in Varroa control was determined by comparing the number of falling mites registered during the BeeVar treatment period with

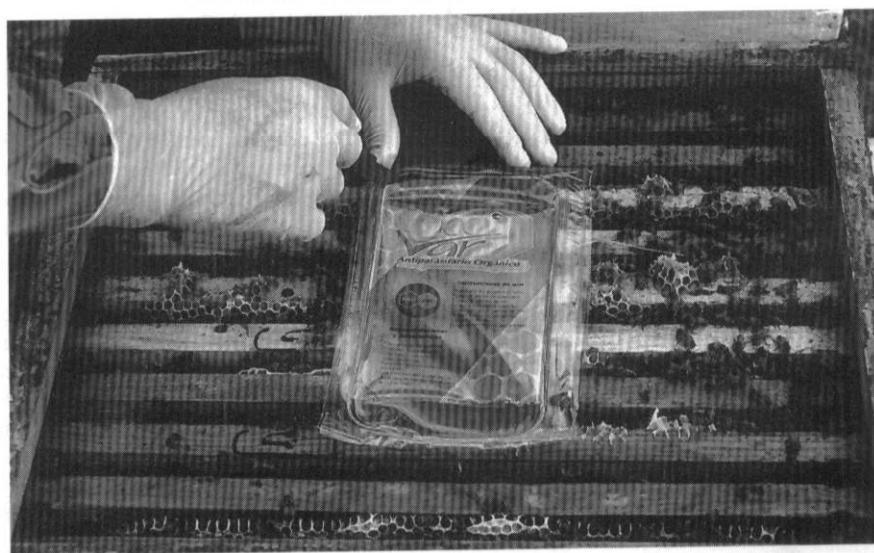


Fig. 1. The application of BeeVar, an organic product containing formic acid in a gel matrix, to a hive.

the total number of falling mites registered during the whole trial (including 28 days after Bayvarol® and oxalic acid treatment).

The results are presented in Table 1. The average final efficacy in colonies treated with BeeVar was 92% with a low variability (efficacy range was 85.9–97.6%). The highest mortality was registered during the first 15 days (first application), with an average efficacy of 63%. However, the second application increased final efficacy and reduced variability.

When the BeeVar treatment had finished, colonies had an average of 4.5 brood combs and seven combs covered by honeybees.

Discussion

The gel formulation with formic acid as the active ingredient, registered with the trade name BeeVar, presents some advantages over the current methods of organic acid, especially formic acid, administration.

Feldlaufer et al. (1997) and Parkman et al. (1999) stated that gel matrices not only conserve all the benefits of the formic acid liquid treatments but also act by delaying acid liberation so that the acid remains for longer inside the colony. This is an important advantage in the many countries where apiaries are distant because it is possible to reduce the number of applications and to get good efficacy.

Much research has demonstrated that good efficacy indices have been obtained using at least three applications of liquid formic acid per colony. (Fries, 1989; Mutinelli et al., 1994; Eguaras et al., 1996; Van Veen et al., 1998). In other cases, three or more applications have not been enough for effective Varroa control (Greatti et al., 1992). In this study, BeeVar had a high efficacy and it was possible to keep low Varroa prevalence indices in the colonies with only two applications. This is possible because the gel matrix keeps an adequate formic acid concentration (10 p.p.m.) inside the colonies for a longer time (15 days).

During the season when this work was done, the average temperature registered was 14°C and it is suggested that two applications 15 days apart will give effective control. However, during spring treatment (when temperatures are higher) one application is enough for Varroa control (unpublished data).

Table 1. Number of falling mites with BeeVar treatment (first application, second application and total number), with Bayvarol® and oxalic acid treatment (chemical shock) and BeeVar efficacy (expressed as percentage)

Colony	No. of falling mites with BeeVar			No. of falling mites with Bayvarol + Oxalic acid	Efficacy of BeeVar (%)
	1st application	2nd application	Total		
1	1223	303	1526	150	91
2	893	484	1377	61	95
3	1042	141	1183	93	92
4	859	364	1223	29	97
5	624	811	1435	52	96
6	882	440	1322	202	86
7	868	231	1099	123	89
8	982	289	1271	79	94
9	787	341	1128	114	90
10	1136	90	1226	108	91
11	1016	292	1308	214	85
12	929	179	1108	93	92
13	1373	28	1401	178	88
14	650	296	946	35	96
15	1063	1068	2131	225	90

This new product, Bee Var, is a good alternative for Varroa control and it does not present the two historical disadvantages of organic products used for the control of this mite. Firstly, it is easy to use, safe for beekeepers and presents low variability between colonies in its final efficacy. Secondly, no case of honeybee toxicity, loss of queens and/or brood or adult honeybee mortality has been recorded.

In Argentina, the use of pyrethroids has been questioned since Del Hoyo et al. (1999) recorded the decreasing efficacy of these products. Other registered products (most of them acting by evaporation or systemically) either have good efficacy only without the presence of brood in the colony or they must be applied many times. This leads to wax residues increasing and, to a minor degree, to honey residues also increasing. Thus, BeeVar appears to be a true and valid alternative for Varroa mite control.

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