

THE CONTROL OF *VARROA JACOBSONI* (ACARI:GAMASIDA) BY MEANS OF ORGANIC ACIDS

M. EGUARAS,
Sandra QUIROGA
O. GARCIA
ARGENTINA

Introduction

Numerous trials of control started at the moment when the *Varroa jacobsoni* mite began to spread in the entire world, fact which had as a result a massive mortality of the *Apis mellifera* colonies.

In the beginning, the anti-*Varroa* agents were administered to the affected colonies under the shape of fumigating strips, by means of pulverization, evaporation, etc. Later on, the trophilaxis phenomenon was used, in order to administrate preparations, and in the '80 s, the methods of slow release of the active principle, administered by means of PVC strips (KOENIGER and FUCHS, 1989), appeared.

Despite the high efficiency of many of these acaricides, their indiscriminate utilization, as well as their improper application generated a decrease of the expected effect, mainly by the appearance of the resistance generated by the mites to the main components of the preparation (LOGLIO and PLEBANI, 1992; LODESANI et al., 1995).

In the present report, we presented the degree of efficiency of two organic acids, the lactic and the formic acids, in the control of *V. jacobsoni*, in the bee colonies with brood. Both these acids began to be increasingly used for the control

of this parasitosis, as they have a low toxicity for the bees and as they are among the natural components of honey.

Materials and Methods

The present study was effected in July and August 1995, in the apiary of the arthropod laboratory, close to the Mar del Plata city, in the General Pueyrredón area. We worked with groups of 7 colonies, which had brood during the period of the experiment. We administered lactic acid and formic acid to these colonies, as anti-*Varroa* agents.

The lactic acid we used during the treatment was administered under the shape of 15% hydric solution. The administered dose was of 5 ml on each side of the frames, the application being done by means of an atomizer, in very small drops.

The formic acid was applied as 60% hydric solution, which was left to evaporate out of two plastic vessels of 20 ml each, which had been put on the bottom of the hive.

Both treatments were repeated every week (two applications a week).

In order to control the efficiency of both these acids, after the third week since the beginning of the treatment, the following formulas

were applied: (a) lactic acid, together with two strips of fluvalinate, in its commercial form: Apistan^R, in the group of colonies treated with formic acid; (b) formic acid, with two fluvalinate (Apistan^R, as above) strips, in the group of colonies in which the lactic acid was tested.

We placed a movable tray on the bottom of each hive, in order to collect the mites that died as a result of the treatment applied. These mites were collected twice a week.

The efficiency of each of the treatments applied was calculated after the following formula:

$$\% \text{ efficiency of the lactic acid} = \frac{\text{mites that fell with lactic acid}}{\text{mites that fell after both treatments (lactic acid + Apistan/formic acid)}} \times 100$$

$$\% \text{ efficiency of formic acid} = \frac{\text{mites fallen with formic acid}}{\text{mites fallen after both treatments (formic acid + Apistan/lactic acid)}} \times 100$$

Results

Table 1 presents the results obtained by using lactic and formic acid as anti-*Varroa* agents in colonies of bees with permanent brood, all along the period of the experiment. A significant difference between the two acids was noticed, the formic acid being definitely more effective.

The lactic acid pointed out an average mortality of 68.5% of the total number of mites present in the colony. The efficiency of this acid varied during the treatment, with a reduction of the mortality in the second week of treatment (figure 1).

The utilization of the formic acid in repeated treatments twice a week, in the brood hives, proved to be extremely efficient in the control of *Varroa jacobsoni*. The average mortality of the mites present in the colony was over 90% (Table 1). As in the case of the lactic acid treatment, the formic acid pointed out a reduction of the efficiency during the sec-

ond week of treatment, only to increase again during the third week.

Discussions

The results obtained in the treated colonies point out clear differences between the two groups of colonies. If the two administered acids had a mite killing effect, the formic acid proved to be much more efficient. The utilization of this acid, applied twice a week, had an efficiency of 91% (with values between 89% and 96%). These values correspond to the data obtained by other researchers as well (BUHLMANN, 1991: 90%; KAFTANOGLU et al., 1992: 93%; ARCULEO et al., 1993: 74%—93%; KRAMER, 1993: 95%). According to MUTINELLI et al., (1994), the efficiency of the treatment increases in the case of the application of formic acid at short intervals of time, because this would allow us to ensure the permanence of high acid concentrations, for at least one complete capping cycle. This method

Table 1

The Average Number of Dead Mites in the Brood Colonies Treated with Lactic Acid and with Formic Acid. The Application of Two Treatments a Week, for Three Consecutive Weeks

Week	Average number of fallen mites	% of the total
<i>Lactic acid</i>		
First	206	9.2
	427	19.1
Second	171	7.7
	121	5.4
Third	314	14.1
	207	9.3
Fourth	84	3.7
Total	1530	68.5
Control (fluvalinate + formic acid)	702	31.5
Total number of fallen mites	2232	100

Week	Average number of fallen mites	% of the total
<i>Formic acid</i>		
First	123	9.0
	240	17.7
Second	158	11.7
	124	9.1
Third	310	22.8
	193	14.2
Fourth	98	7.2
Total	1245	91.7
Control (fluvalinate + lactic acid)	112	8.3
Total number of fallen mites	1357	100

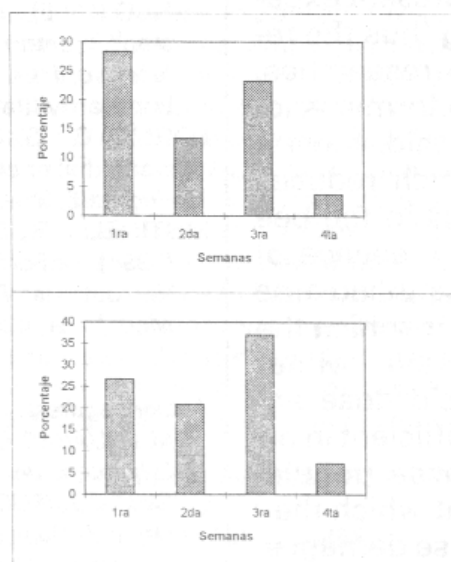


Figure 1 — Percentage of Dead Mites in the Brood Colonies during the Four Weeks of Treatment with Lactic Acid (above) or with Formic Acid (below). (Vertically: the percentage of dead mites; Horizontally: the weeks of treatment)

of application was the most used one during our experiment, by means of two treatments a week, fact which allowed the elimination of over 90% of the total number of mites present in the colony, in only three weeks (figure 1).

In the group of colonies treated with lactic acid, the mite killing effect was more reduced. On the average, only 68.5% of the mites died (the recorded values being between 67% and 70%). The recorded values were lower than the ones in the previous researches (KRAUS, 1991: 88—97%; KRAUS, 1992: 97%). As the lactic acid is effective only on the mites present outside the brood cells, the effect of the treatment would increase when the quantity of brood in the hive would decrease. For the studied area, the treatment applying period was optimal (the smallest brood area in the entire year), and the efficiency of this treatment will not increase in any other period of the year.

On the basis of the present experiment and confirming thus the results of the previous researches, we may state that the formic acid, as well as the lactic acid, have a mite killing effect, which reduces the *Varroa* populations in the bee colonies, even in the presence of the brood. Yet, for the studied area and during the period in which the test was effected (the winter months), the lactic acid dose applied proved to be insufficient in order to reduce the *Varroa* populations under the level at which they would continue to cause damages, and, therefore, it must be associated with another way of control, be it chemical or biotechnical.

On the contrary, the formic acid has a high level of efficiency, as well as a rapid and easy way of application, thus being a good alternative to the synthesis acaricides.

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Author's address:

M. EGUARAS, O. GARCÍA
Laboratorio de Artrópodos. Depto de Biología
Sandra QUIROGA
Depto de Química
Universidad Nacional de Mar del Plata
Funes 3350 — 3^{er} piso
7600 Mar del Plata
ARGENTINA