APILIFE VAR: A NEW VARROACIDE WITH THYMOL AS THE MAIN INGREDIENT

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INTRODUCTION

In Switzerland all honey bee colonies are infested by the ectoparasite *Varroa jacobsoni.* Every year more than 90% of the colonies are treated with strips that contain the pyrethroids fluvalinate or flumethrin. Extended use of pyrethroids, however, results in residues accumulating in the wax and, thus, the quality of bee products is jeopardised[1,2,20]. In different regions of Italy the efficiency of the varr acide Apistan is now reported to be insufficient'. Recent tests suggest that strains of mites resistant to fluvalinate have appeared in northern Italy[12]. It is therefore necessary to find new ways of integrated varroa control. The active substances used should be found in nature and should be without risk for consumers of bee products. Moreover, the residues produced should not accumulate in wax. Besides formic, lactic and oxalic acids, 'Apilife VAR', a product which has been authorized for use in Italy, fulf ils such requirements. Apilife VAR is composed of a vermiculite tablet 5 x 9 x 1 cm (porous ceramic sponge), impregnated with a mixture of thymol (76%), eucalyptol (16.4%), methol (3.8%) and camphor (3.8%). The varroacidal effect of the principal active substance (thymol) has been described in studies performed in Italy and Russia'.

Because of the simplicity of application and the compatibility of its various components with food, we have tested Apilife VAR. Other research institutes have also carried out studies[7,8,9,10,13,17] , and these results are integrated in the following account. No research has been done for tropical, subtropical and arid zones.

SIMPLICITY OF USE

If possible, the colonies must be fed immediately after the honey harvest. To ensure success, it is recommended that the treatment commence as early as possible in late summer (August under Swiss climatic conditions), where average daily temperatures for the following six weeks do not fall below 12 C for long periods. Ideal average daily termperatures are between 15 and WC. We have not tested the treatment under higher temperatures. The vermiculite tablet is laid on the upper part of the brood combs (fig. 1). Application from below considerably reduces the efficiency and should therefore not be considered. To prevent the bees from gnawing the tablet, a metal lattice through which bees cannot pass should be put between the brood comb and the tablet (fig. 2). After three to four weeks, depending on the degree of infestation, the first vermiculite tablet is removed and replaced by a fresh one. After another three to four weeks, the second tablet is also removed. Thus, the treatment lasts six to eight weeks in total.

FIG. 1: Placing the vermiculite tablet in the centre of the hive on the brood combs. Treatment from the bottom is not advisable, since it reduces the efficiency considerably.

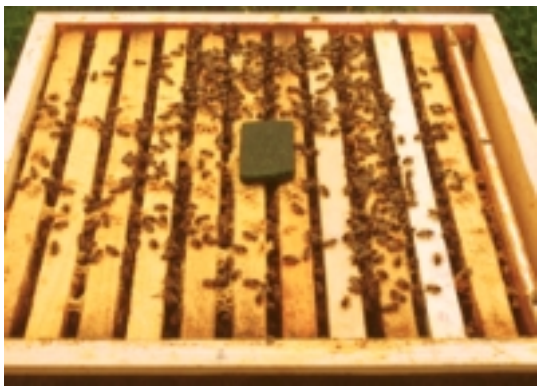
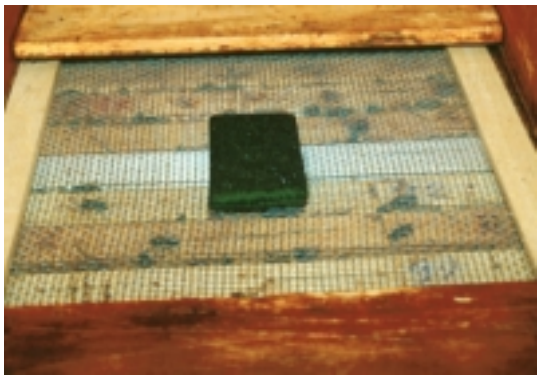


FIG. 2: To prevent the bees from gnawing the tablets, it is recommended that a metal lattice be placed between the comb and the tablet through which bees cannot pass.



EFFICIENCY

If the recommendations for use are followed, and if the temperatures are high enough, an efficiency of approximately 97% may be obtained using Swiss hives (sideopening hive with combs parallel to the entrance, comb surface area 9.3 dm[2,6,15] (table 1, CH). The efficiency in the Ritter hives (table 1, R) and in the Zander singlestorey hives[7,8,15,16] with a comb surface area of 9.3 dm^2 and 8.1 dm^2, respectively, was similar; but in the Dadant hives with a comb surface area of 11.3 dm it was slightly lower (92%) (table 1, ID) [18]. A decrease in efficiency was observed for two-storey hives, however. The efficiency was 74-95 %[7,8,9,16,17] after a six to eight week treatment. In these two hive systems, differences in efficiency between colonies were noticed, probably clue to fluctuations in thymol concentrations found in the air within this type of hive[6]. In the Swiss hives, constant thymol concentrations were measured during the whole treatment. Efficiency also depends on the external temperature: if the average daily temperature remains below 12º C for several days, the efficiency of the treatment will be lower (table 2). It is important to note that the location of the hives may also exert an influence[16].

Year	Place	Typ of hive	Number of colonies	Efficiency of treatment with "Apilife Var" per colony %	Mite fall after treatment with "Apilife Var"			Mite fall after control treatment with Perizin		
					Mean	Min	Max	Mean	Min	Max
1990	Säriswil A	CH	20	96.4	986	365	1704	37	3	168
	Hergiswil	CH	20	99.0	2453	917	4509	24	6	59
1991	Oeschberg	CH	12	93.7	277	19	859	18	0	64
	Grangeneuve	CH	12	95.6	1067	257	2355	55	5	143
	Säriswil A	CH	10	96.4	300	170	539	10	1	20
	Münsingen	CH	12	99.1	657	178	1338	5	1	13
	Hergiswil	CH	11	98.5	337	95	742	5	0	24
	Säriswil B	CH	11	98.2	151	87	284	3	0	9
	Salez	CH	9	98.7	223	67	431	3	0	15
	Bellchasse	R	16	96.7	713	469	1317	24	2	49
	Galmiz	D	19	91.7	986	465	1862	92	5	235

TABLE 1: Efficiency of Apilife VAR during the studies of 1990 and 1991.

Two 4-week treatments, each with a new tablet, were applied. In the Swiss (CH) and Ritter (R) hives, which were placed in a bee house, the average efficiency was 97%. In the Dadant (D) hives a lower efficiency (92%) and a greater efficiency variation was obtained. It should be noted that it is not the efficiency expressed as a percentage that is decisive, but the number of mites failing after the control treatment (in this case performed with Perizin). If the number of mites is below 100 after the control treatment, the Apilife VAR treatment may be regarded as sufficient.

CONTROL OF TREATMENT IS IMPERATIVE

A high treatment efficiency cannot be expected under all conditions; therefore controls of treatment results are of great importance. Two weeks after the treatment, the natural mite fall should be measured using a bottom board with metal lattice that allows mites to be collected. Thus, it is possible to evaluate the number of mites surviving the treatment. if the mite fall is less than one mite per day, the *V. jacobsoni pop*ulation will remain below the tolerance threshold until the next treatment in August of the following year, provided reinvasion of mites is not a problem (table 3). This means that a mite population of less than 100 individuals can be expected'. in colonies where more than one mite falls per day, another treatment with lactic acid, oxalic acid or Perizin may be necessary If the drone brood is removed two or three times in spring, a natural fall of three mites per day is then acceptable. If mites are counted later in the season, it is not possible to interpret the results in the same way.

Place	Typ of hive	Number of colonies	Colonies with more then 1 Varroa/day nat. mite fall	Natural mite fall 2 weeks after "Apilife Var" treatment Varroa per day		
				Mean	Min	Max
Säriswil	CH	26	16	2.30	0.10	7.30
Münsingen	CH	24	8	1.10	1.00	5.00
Hergiswil	CH	23	0	0.01	0.00	0.10
Salez	CH	21	3	0.60	0.00	5.50
Reinach	CH	6	1	0.80	0.30	1.50
Grossdietwil	CH	3	0	0.60	0.30	0.80
Rüti	CH	9	6	3.30	0.40	10.70
Mengenstorf	CH	10	7	2.30	0.20	8.80
Bellechasse	R	23	3	0.60	0.00	5.30
Bellechasse	D	7	4	2.00	0.10	4.90
Champittet	D	8	0	0.03	0.00	0.20
Rossinière	D	10	10	4.77	1.14	12.64
Joressans	D	9	7	2.71	0.14	8.00
Noyerraz	D	16	5	0.86	0.00	4.36
Total 1993		195	70			

TABLE 2. Efficiency of Apilife VAR during the studies performed in 1993.

Dosage: 2 applications, each of one tablet. Duration: 6-8 weeks. During the course of this investigation, we controlled the efficiency of the treatment by counting the natural mite fall during the two weeks after the treatment. Of 195 colonies, 70 had a natural mite fall exceeding one mite per day. Therefore, the treatment was insufficient for these colonies. These poor results, compared to those obtained in the 1990-1992 trials, are due to low outside temperatures during the whole treatment period (the mean daily temperatures in Liebefeld during the treatment periods were 14.8º C in 1992 and 13.3º C in 1993).

Place	Typ of hive	Number of colonies	Mite fall after treatment with "Apilife Var" per colony	Natural mite fall per day			
				October 92		July 93	
				Mean	Max	Mean	Max
Hergiswil	CH	20	434	0.1	0.5	0.1	0.4
Grangeneuve	CH	29	312	0.2	0.6	3.1	5.9
Baar	CH	24	700	0.2	0.7	3.8	11.6
Säriswil	CH	21	342	0.3	1.0	3.3	18.9
Bellechasse	R	22	191	0.3	0.8	0.3	1.0
Salez	CH	15	590	0.7	3.8	0.6	2.6
Zweisimmen	CH	18	1051	0.9	2.2	0.3	1.1
Münsingen	CH	19	1096	1.7	6.4	19.9	84.9

TABLE 3. Control of the efficiency of the Apilife VAR treatment.
The natural mite fall during the two weeks immediately after treatment is a reliable indication of the efficiency of the treatment. With the exception of the apiary in Münsingen, the natural mite fall in October 1992 was below one mite per day. In those cases the mite population remained below the tolerance threshold until treatment was carried out the following year (see natural mite fall July 1993). In the apiary in Münsingen, most of the colonies had already exceeded the tolerance threshold at the end of July 1993.

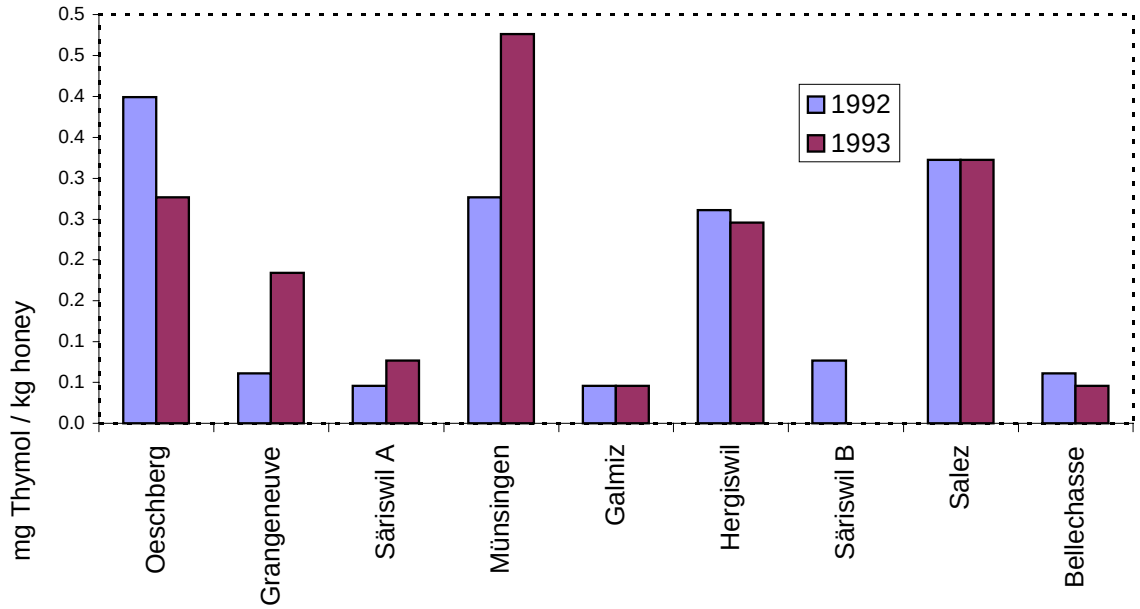


FIG. 3. Thymol residues found in spring honey after a 6-8 week treatment during two consecutive years. Three honey samples were taken from the entire harvest from each apiary. Differences between apiaries are probably due to a transfer of food from brood combs to honey combs. No increase in residues was observed in the second year of treatment.

SIDE-EFFECTS

During our experiments with Apilife VAR we never observed high bee mortality. However, with an overdose, when the thymol concentration in the air of the hive is too high due to incorrect use, large losses of bees may occur[10,11,13].

Because of the strong smell, we recommend treating all the colonies simultaneously: we have never observed robbing during the treatment when all colonies in an apiary are treated at the same time.

In the multiple-storey hives, it may happen that small quantities of brood, located near the vermiculite tablet, are removed by the bees[9,13,16,17]; therefore a reserve of food should always be available between the tablet and the brood nest. The tablet should not be placed between two storeys containing brood. Furthermore, we noticed that open food, placed at a distance of 3-4 cm from the tablet, was often moved. In some isolated cases, when feeding and treatment took place simultaneously, food intake was delayed.

RESIDUES

The active substances used in Apilife VAR are only slightly soluble in water, but they are lipid-soluble. After eight weeks of treatment, thymol residues in wax and food are unavoidable. Due to their high volatility, thymol residues contained in wax diminish rapidly[10] and so accumulation of the product is unlikely even with extended use. However, small amounts might always be present. During the process of melting wax the concentration of thymol is not being reduced[3]. If the combs are aired, the concentration of thymol in the wax decreases rapidly[3].

Of all the other ingredients of Apilife VAR, residues of thymol only were detected in honey[6,9,14,16]. In studies performed in 1992 and 1993 in nine apiaries, the thymol concentration was 0.19 ml/kg in spring honey (min. = 0.05, max. = 0.48 mg/kg) after an eight week treatment (fig. 3). A tendency of residues to increase from one year to the next was not observed.

In 1993, in Hohenheim an average of 0.2 mg/kg of thymol was detected in more than 100 spring honey samples[9]. In honeydew honey, subsequently harvested from the same colonies, an average of 0.04 mg thymol/kg honey was detected. From the point of view of human toxicology, these concentrations are not important. According to the World Health Organization (WHO), thymol residues in food are without danger to the consumer as long as they do not exceed 50 mg/kg. Furthermore, it is supposed that, in apiaries with high thymol concentrations, remains of contaminated feed may have been moved into the honey comb in spring. For this reason, the colonies should not be overfed.

According to the Swiss and European Food Legislation, foreign odours or tastes are not allowed in honey. For this reason it is important to know the perception threshold of thymol in honey. In sensory trails involving more than 500 consumers and the sensory panel of the Federal Dairy Research Institute, honeys containing thymol were tested. Only thymol residues above 1,1 mg/kg in rape or acacia honey were detected. In Hohenheim, only a concentration of 2 mg/kg (other concentrations tested: 0.2 and 0.5 mg/kg) was perceived by the 20 tasters[19] used in the test.

CONCLUSIONS

Apilife VAR is simple to use. It is appropriate especially for the treatment of Swisstype and single-storey hives. if the product is correctly applied and the temperatures are optimal, an efficiency of more than 95% can be expected. In the Dadant and multiple-storey hives, the efficiency is lower and varies considerably from colony to colony. High efficiency is not always guaranteed. With a natural mite fall of more than one mite per day during the two weeks after the application, another treatment may be needed or measures should be taken the following year (e.g. removing drone brood or formation of nucleus) to reduce the mite population. Contrary to some synthetic varroacides, there is no accumulation of residues in beeswax with extended use of Apilife VAR.

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Acknowledgements

We sincerely thank all the beekeepers for their intensive collaboration during these studies as well as Evelyne Fasnacht and Dr. Michael Casey for the English translation.

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