

Drip Treatment With Oxalic Acid: Trials during 1999/2000 and Recommendations for Central Europe

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Winter treatment is extremely important in some alternative control strategies against Varroa because the majority of mites are destroyed that would otherwise constitute the basis for next year's population. These are mites that either survive the autumn treatment or they enter the colony by re-invasion.

The drip treatment with a solution of sugar and oxalic acid has proved successful for treatment in autumn. This method is simple, quick, cheap, and very effective in broodless colonies [8]. However, under certain conditions it can weaken the colonies in spring. Trials have been carried out within the framework of a joint European research project in Switzerland and other countries in order to develop a more suitable treatment. Based on our own results and those of other European institutes we are now able to make recommendations for the beekeepers in Central Europe.

Design of the experiment 1999/2000

Oxalic Acid Solutions Tested

The trials in 1998/1999 have shown that the so-called Italian method, i.e. a solution of 60 g oxalic acid dihydrate (OA dihyd.) in 1 litre sugar syrup 1:1, combats Varroa mites effectively, however, it is not well tolerated by bees. If half the amount of oxalic acid dihydrate is used, the effectiveness decreases and varies between colonies. Moreover, it has been proved that the addition of sugar in the drip solution is essential to ensure a good treatment outcome [3].

Solutions differing in their OA content - always below the one of the Italian solution, but at least 30-g OA in 1 litre sugar syrup - were used in our trials during 1999/2000. A solution with a lower sugar content was tested because several observers had obtained a better bee tolerance with it.

The bee colonies were treated with one of the following freshly prepared solutions:

0 g OA dihydrate / litre sugar syrup 1:1 (sugar / water weight ratio)

30 g OA dihydrate / litre sugar syrup 1:1

37 g OA dihydrate / litre sugar syrup 1:1

45 g OA dihydrate / litre sugar syrup 1:1

45 g OA dihydrate / litre sugar syrup 1:2

The first solution contained no OA and served as a control in these trials. The amount of 45-g OA in 1 litre sugar syrup is the formulation we recommended provisionally last year [3].

The trials were carried out in 200 colonies in 10 different apiaries distributed throughout Switzerland. Four apiaries had Dadant and the others, Swiss hives, all were equipped with a Varroa screen and collecting tray. The test colonies had been treated with formic acid or thymol in August / September. 5 – 6-ml oxalic acid solution was dripped directly on the bees in each occupied bee-space. The treatments were carried out from October 29 until December 9, 1999 at a temperature above 4° C. Since oxalic acid has no effect on Varroa in the brood, it is important that the colonies should be broodless

Effectiveness of the Treatment

For estimating the surviving mites, a control treatment was carried out no earlier than 3 weeks after the oxalic acid treatment. [6]. The cumulative mite fall after the oxalic acid and the control treatments was assumed to be 100 %.

Over-wintering and Spring development of Colonies

Since bee tolerance is an important criterion in the assessment of drip treatment, colony strength was recorded in autumn, and in the following spring according to the Liebefeld Method [5]. In the «Wohlei»

apiary, colony strength was estimated three times at the beginning of the year in order to determine spring development.

Results

Effectiveness against Varroa Mites

The average effectiveness of the drip treatment with various solutions is summarised in table 1.

Caution must be exercised when evaluating the results obtained from the «Grangeneuve» apiary. The number of Varroa measured after the control treatment suggests a re-invasion in the 6 weeks between the drip treatment (15.11.99) and the control treatment (26.12.99) (Table 2)

Table 2: Number of dead mites after control treatment

Apiary	0 g OA dih / 1 l sugar s. 1:1		30 g OA dih / 1 l sugar s. 1:1		37 g OA dih / 1 l sugar s. 1:1		45 g OA dih / 1 l sugar s. 1:1		45 g OA dih / 1 l sugar s. 1:2	
	average	max.	average	max.	average	max.	average	max.	average	max.
Boden	532	1523	9	40	11	16	4	8		
Chaux de Fds							11	55	12	57
Frümsen							7	19	11	85
Grangeneuve							66	572	132	971
Hofen			12	19	6	34				
Landikon			17	29	8	18	2	7		
Pfeffikon			3	6	1	6	1	2		
Schwand	368	955	30	149	9	21	11	197		
Wohlei	447	1708	15	21	8	24	10	30		
Zweisimmen					6	34	4	15		

Tab. 1: Efficiency of oxalic acid drip treatments, in percent, 1999/2000

Variants			0 g OA dih. in 1 litre syrup 1:1	30 g OA dih. in 1 litre syrup 1:1	37 g OA dih. in 1 litre syrup 1:1	46 g OA dih. in 1 litre syrup 1:1	46 g OA dih. in 1 litre syrup 1:2
Apiary	n	ml *	Mean SD	Mean SD	Mean SD	Mean SD	Mean SD
Boden Ê	6,7,7,7	39	3.4 (a) ** 0.1	97.0 (b) 0.3	98.0 (b) 0.2	98.9 (b) 0.5	
Chaux de Fds Ê	5, 5	38				97.4 (a) 0.1	96.7 (a) 0.6
Frümsen Ê	10, 9	33				91.5 (a) 0.9	89.1 (a) 1.4
Grangeneuve Ê	12, 10	35				93.9 (a) 3.3	88.0 (a) 3.8
Hofen Ë	8, 8	45		96.8 (a) 0.4	97.7 (a) 0.9		
Landikon Ë	8, 8, 8	49		95.2 (a) 1.4	97.8 (a,b) 0.4	99.0 (b) 0.2	
Rüteli Ë	6, 6, 6	45		98.3 (a) 0.7	99.7 (a) 0.3	99.8 (a) 0.9	
Schwand Ê	6,6,6,6	41	9.2 (a) 1.3	93.4 (b) 1.6	97.8 (b) 0.5	97.3 (b) 1.1	
Wohlei Ê	5,5,6,5	46	1.9 (a) 0.3	96.8 (b) 0.5	98.3 (b) 0.3	98.4 (b) 0.2	
Zweisimmen Ë	10, 9	44			97.7 (a) 2.3	98.8 (a) 0.2	

Control treatment: Ê One Perizin treatment

Ë Spray treatment with OA

* average dosage per colony

** Means within a line followed by different letters are significantly different ($p < 0.05$)
Multiple t-test (Tukey) after an angular transformation (Snedecor and Cochran, 1980)

In all apiaries a success rate of more than 90% resulted with oxalic acid solutions of 30, 37 and 45 g OA in 1 litre sugar syrup 1:1. Only in four of a total of 146 colonies treated with one of these solutions were more than 50 surviving Varroa found (except «Grangeneuve»). This number should not be exceeded in order to avoid a rapid increase in the mite population before the next possible treatment in following August. It can be assumed that in the four colonies with more surviving mites, small amounts of brood were present. The effectiveness of the three solutions did not differ significantly, the one of the 30 g solution was slightly less than the two others. Therefore, this concentration is probably the lowest limit and cannot be reduced any further without negatively affecting the efficiency. These observations confirm our results from 1998 achieved with the same solution (decrease and greater variation of the efficiency compared to the higher dosages) as well as those of Büchler [1].

The lower sugar content of the solution with the sugar / water weight ratio 1:2 seems to have a negative influence on the effectiveness (Table 1); however the difference is not significant. The trials in 1998/99 had already demonstrated the significance of the sugar content. The role of the sugar is uncertain since the bees do not ingest the solutions orally (Ritter, personal communication). Perhaps the solution adheres better, increasing the effectiveness by contact with the bees.

Bee Tolerance

Four solutions of sugar syrup 1:1 were tested in three apiaries. The colonies in the «Wohlei» and «Boden» apiaries were obviously weakened during the winter, regardless of the solution used (fig. 1). Even in the colonies treated with sugar syrup up to 40% of the wintered bees were lost – a sign of unfavourable wintering conditions. The losses in the «Boden» apiary are possibly due to a late honeydew harvest.

In all cases the best wintering results were achieved by the solution without oxalic acid. The losses increase with an increasing OA content of the solutions.

In the «Schwand» apiary the losses caused by the various treatments hardly differed. Only the colonies treated with the 45 g solution were slightly weakened.

Wintering losses alone are not problematic if the colonies recover by the spring harvest. In the «Wohlei» apiary where colony development was measured in spring, the colonies treated with oxalic acid had a shortfall of 1000 to 2000 bees at the end of April (fig. 2).

The comparison of the bee tolerance of the 45 g OA solutions in sugar syrup 1:1 and 1:2 shows that the solution with the lower sugar content was better tolerated (fig. 3).

Photo: The winter Varroa treatment is extremely important in alternative control strategies, either by spraying or as shown in this picture by drip treatment with oxalic acid. It keeps the initial mite population for the following season very low.



Figure 1: Wintering of colonies drip fed with oxalic acid, average and standard deviation, Boden, Wohlei, Schwand, 1999/2000

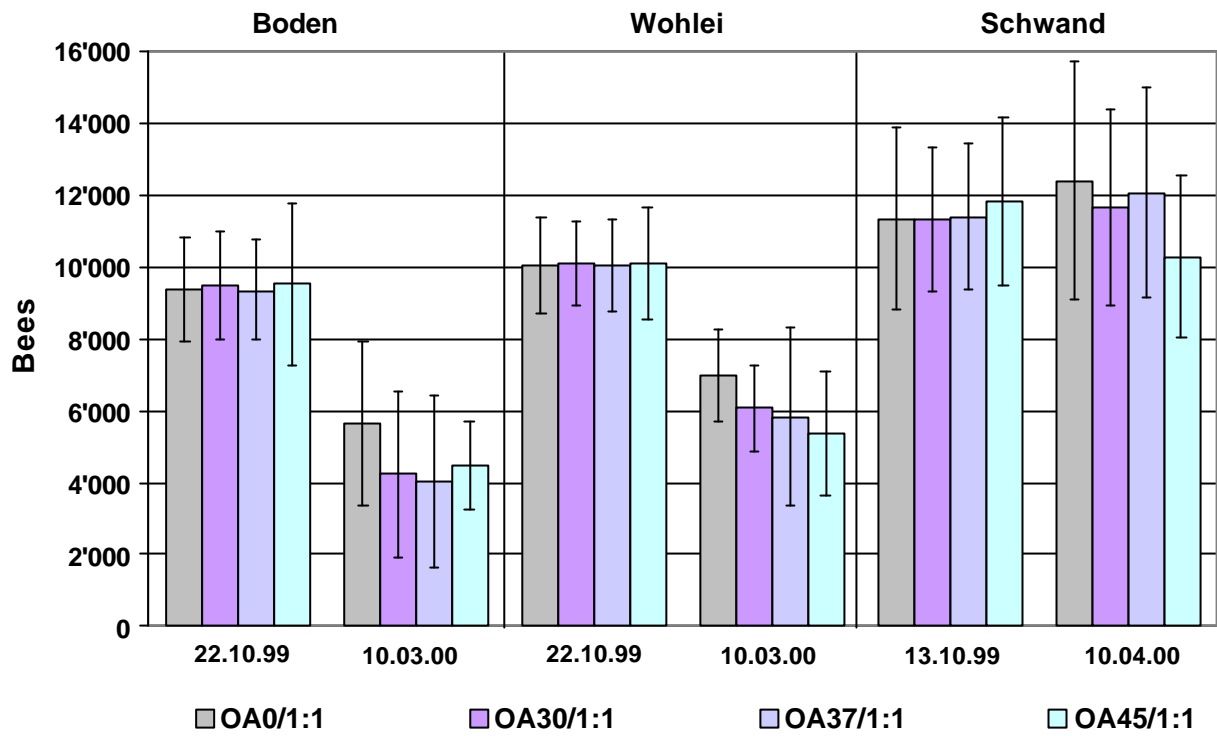


Figure 2: Spring development of colonies subjected to drip treatment with oxalic acid, average, and standard deviation, Wohlei, 1999/2000

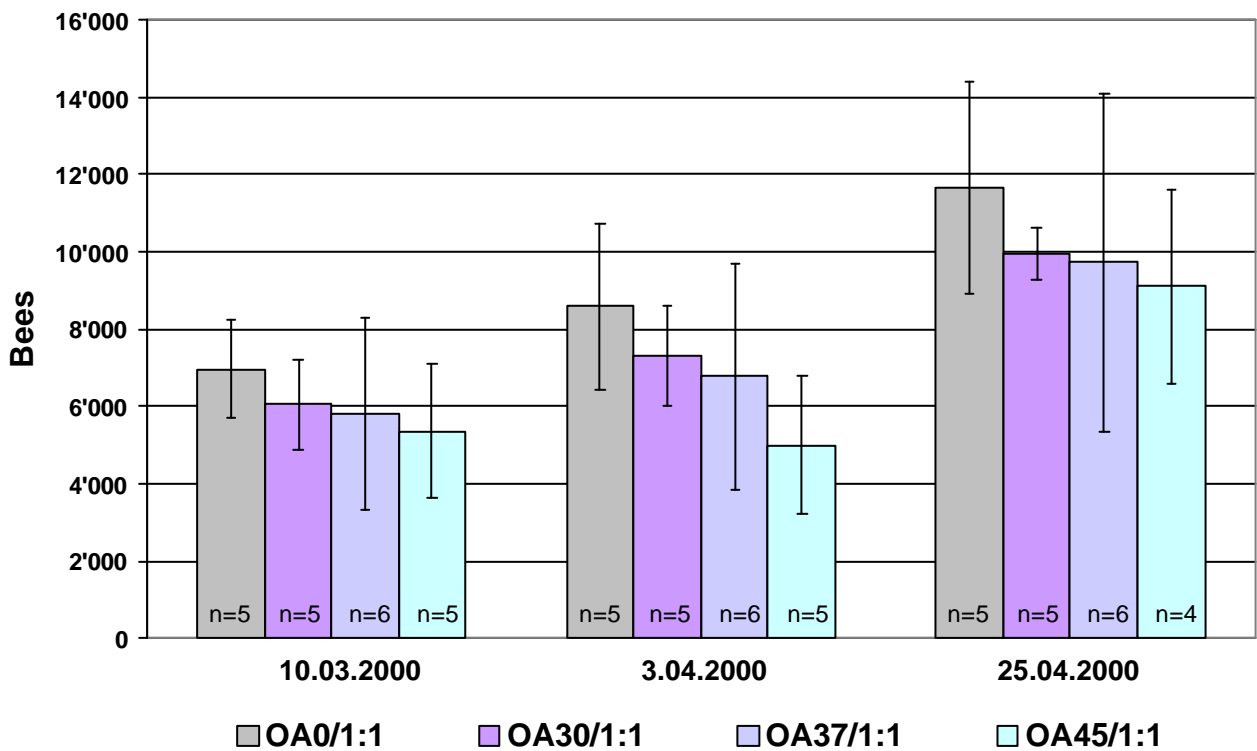
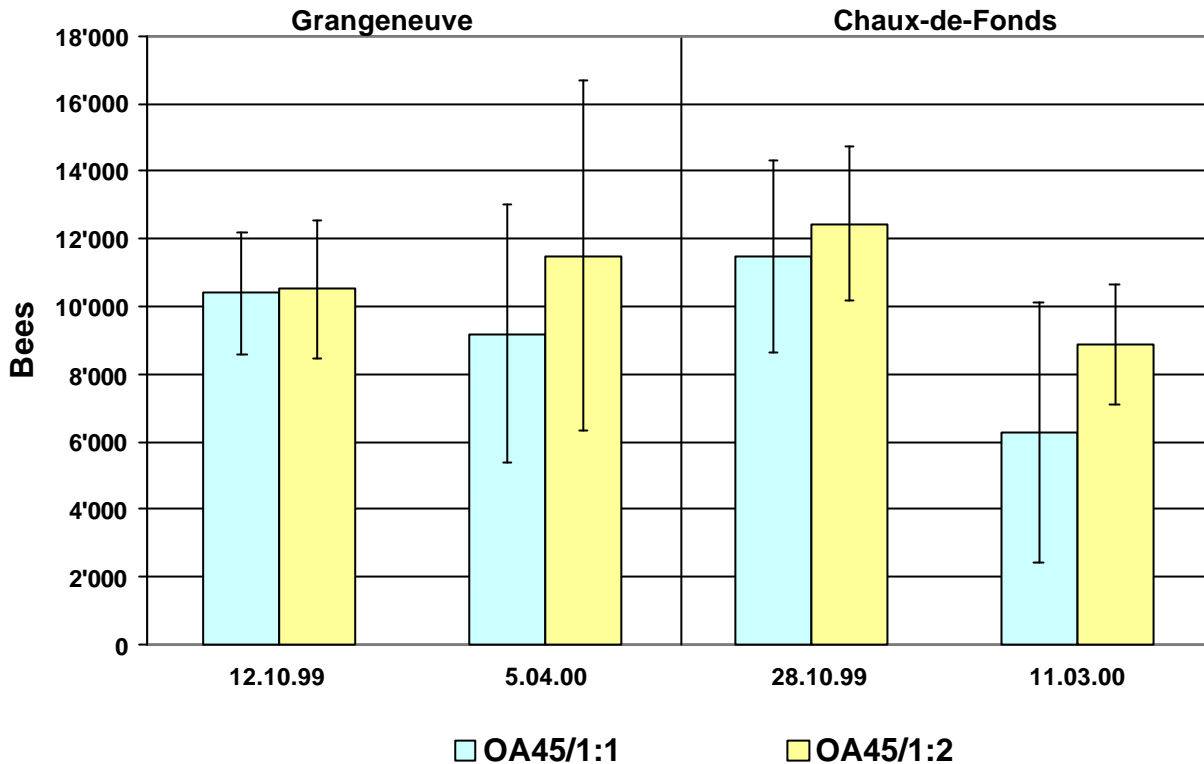


Figure 3: Over-wintering of colonies subjected to drip treatment with oxalic acid, average and standard deviation, Grangeneuve, La Chaux-de-Fonds, 1999/2000



Summary (or Conclusions)

Both, the effectiveness as well as bee tolerance have to be considered in order to determine the ideal formulation for drip treatment with oxalic acid. Numerous investigations in Switzerland and abroad [1] demonstrated the difficulty of optimising both parameters. This is confirmed by the following facts:

- An effective Varroa control is possible with both, the 37 and 45-g OA solutions. However, in certain conditions the 45-g solution is less well tolerated by the bees.
- The 30-g OA solution has little effect on the over-wintering rate of bees, but compared with the 37 and 45-g OA solutions it is slightly less efficient.
- A lower sugar content increases bee tolerance, but diminishes efficiency.
- Under certain, non-definable wintering conditions, an increase in bee losses by drip treatment may occur. However, the example of the Schwand apiary shows that this is not necessarily the case.

In a new trial the bee tolerance of a drip application of 35 g OA di. will be compared to that of the OA spraying method, a Perizin treatment, and an untreated control.

Based on our trials over recent years, and on the results partly confirmed by research institutes in Central Europe [2] [7], we can make the following recommendations for the drip treatment with oxalic acid:

RECOMMENDATIONS for the drip treatment with oxalic acid (Switzerland and Central Europe)

Composition of the solution: 35 g oxalic acid dihydrate in 1 litre sugar syrup 1:1

Quantity: 30 ml for a small colony
40 ml for a medium colony
50 ml for a large colony

This quantity corresponds to 5 – 6 ml for each occupied bee-space of a Dadant or Swiss hive.

Time of treatment: In broodless colonies (November – December)

Remarks:

- only **one** treatment in autumn
- drip the solution directly on the bees between the frames
- treat with lukewarm solution
- perform the treatment at an ambient temperature above 0° C
- use only freshly prepared solutions or solutions that have been stored for max. 6 months at a maximum of 15° C
- under certain conditions, drip treatment with oxalic acid may slightly weaken the colonies in spring.
The spray treatment with oxalic acid is better tolerated by the bees (30 g OA dihydrate / litre water, 3-4 ml per occupied frame side); description of spraying method and results see [4];
- wear gloves and safety goggles during the treatment

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Some of the above have been translated and published in English and American Bee Journals, and are also published on our website www.apis.admin.ch/index_e.htm