



The purpose of this report is to describe the research work that is being done by the Danish Federal Beekeeper association in co-operation with beekeepers from all over Denmark. Some of the investigations are being done in co-operation with the project group, "Beekeeping", which is the authoritative state organ for bee diseases, to which reports of e.g. AFB must be reported.

The research is done to produce results for the benefit of practical beekeeping. The results are put into guides. These guides are used by consultants and Varroa-inspectors at meetings and courses given at local beekeeper associations and for articles in Tidsskrift for Biavl (The Danish beekeeper association magazine).

Co-operation with the Hosts of the research ensure that tests are done under actual field conditions. A special committee, established by the head of the Danish Beekeeping Federation, is responsible for the research. Frequently meetings are held with this group; proposals are submitted for approval and ideas and plans are discussed. There is co-operation with consultants and researchers from the other Nordic countries and Lithuania. Ideas and practical field research methods in the use of ecological Varroa treatment methods are exchanged.

The report comprises the following items :

Nosema tests
Test of production queens
Long-time test of formic acid
- free formic acid
- krämer plates
Test of formic acid evaporation tools

-universal tools
-Burmeister
- Apidea- Nassenheider
oxalic acid test
- wintering bee strength
- spring test
- repeated treatments through the season
- autumn treatment
- aftercare after other treatments
queen imprisonment and formic acid
treatment of catch frames.

A Discussion

In the Varroa tests there have been asked for a more precise measure of the effectiveness of the various methods and the effectiveness of the combination of the methods. The Main part of the tests have more been pointing against testing of methods to see how the bees and the effect of method's have worked for a number of years .It is not possible in the very same test to make exact measure of the effect of the methods and at the same time look at how the method's are working in the practical beekeeping. A more exact measure of the effect of the method's will involve, that after the test treatment there should be a treatment with pesticide to be able to calculate the percentage effect of the test treatment.

Because the test Host , With whom is co-operated, didn't want to risk pesticide rest in material and products it has until now not been possible to make aftercare with pesticides like Fluvalinate and Apistan. In many test is the treatments duplicated or there have been done an aftercare with lactic acid or oxalic acid, and there by is produced numbers for the effectiveness of the method's. At a final pesticide treatment it is not always sure that all the rest mites are killed. Practical experience shows that re-invasion and low activity in the bee families late at the season can lead to Wrong conclusions.

Final will an eventual resistance development could blur the real result. In the part of the beekeeping that still want to develop ecological Varroa treatment method's it must also get highest priority to develop method's

that over years keeps the varroa pressure at a level , Where it will not harm the bee-families.

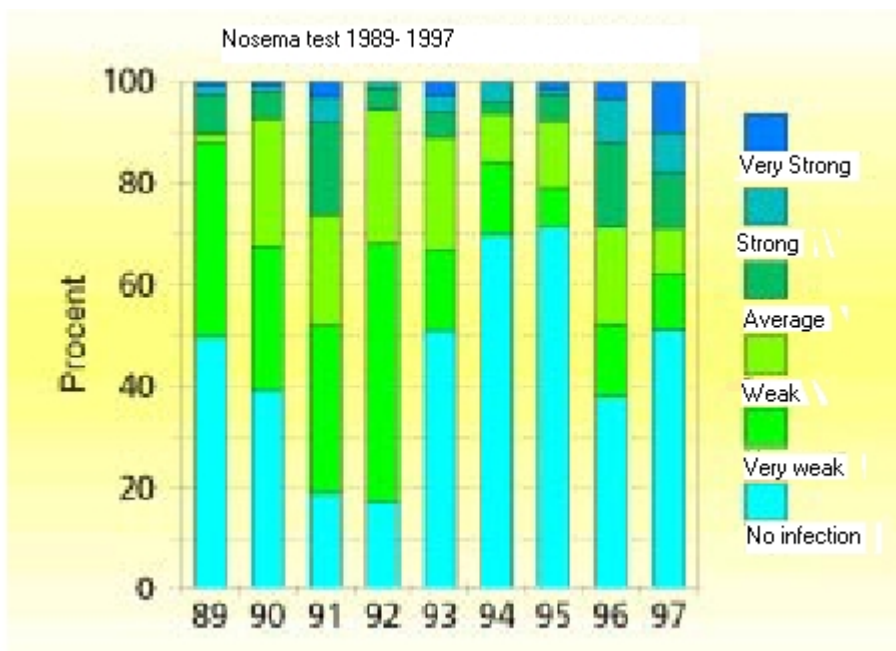
NOSEMATEST

In the early spring the test hosts are asked to take 60 live bees from hives involved in the different tests. These bees are killed by freezing and are analysed by Sandagergård at Vejle for Nosema. The analysis is done in the following way :

no spores, no Infection;
 0-0,5 mill. spores a bee, very weak infection;
 0,5-2 mill. spores a bee, weak infection;

2-5 mill. spores a bee, strong infection;
 more than 5 mill. spores a bee, very strong infection.

The results from the last nine years of testing are shown in the Graph below. The numbers of samples taken are 150-250 a Year. In 1997, 182 samples were taken.



Taken by testing apiaries from all Denmark. The stress from nosema in 1997 is not that strong as in 1996

Quality control of breeding queens



This arrangement is offered to queen breeders who want to get their pure Mated queens judged at three agreed visits in the season. The queens are judged for Swarming, Steadiness and aggressivity.

The queens have before the judgement carried out a whole production season. In the first production year the queenbreeders have selected pure mated sister series. The succession is described as a row of queens and the added Drone genetic in each generation.

The queenbreeders judgement and measure of crop put together with the results of a nosema-test the spring where the queens participate in the quality control, the basic data, which can be read in the queen control report. To give the breeding material a high security level of disease tolerance the agreement is expanded in a way that by second visit is agreed a chalky brood test of sealed drone brood. And at the third visit a cleaning test of freeze killed sealed worker brood.

In the quality report can be read more about the results of those test. 10 queenbreeders

have in 1997 participated with a total of 39 breeding

TEST BEEYARDS

Production queens, which is sold are tested by 10 different test hosts. Each Host are wintering in a queen from each team, so that there will be wintering in 10 beeyard with equal combining of queens. The Queenbreeder gives extra four queens for replacement of those queens that get lost at the introduction of the new queen in the late summer the Year before the test Year. The Hosts judge the swarming tendency the aggressivity, the calmness. The honey crop is measured and nosema test is done. The test gives a full impression of the crop possibilities and other use factors by using production queens bought at skilled queenbreeders.

The results of the tests 1997 can be read in Tidsskrift for Biavl issue 1 1998 and in the report about quality control of breeding queens.

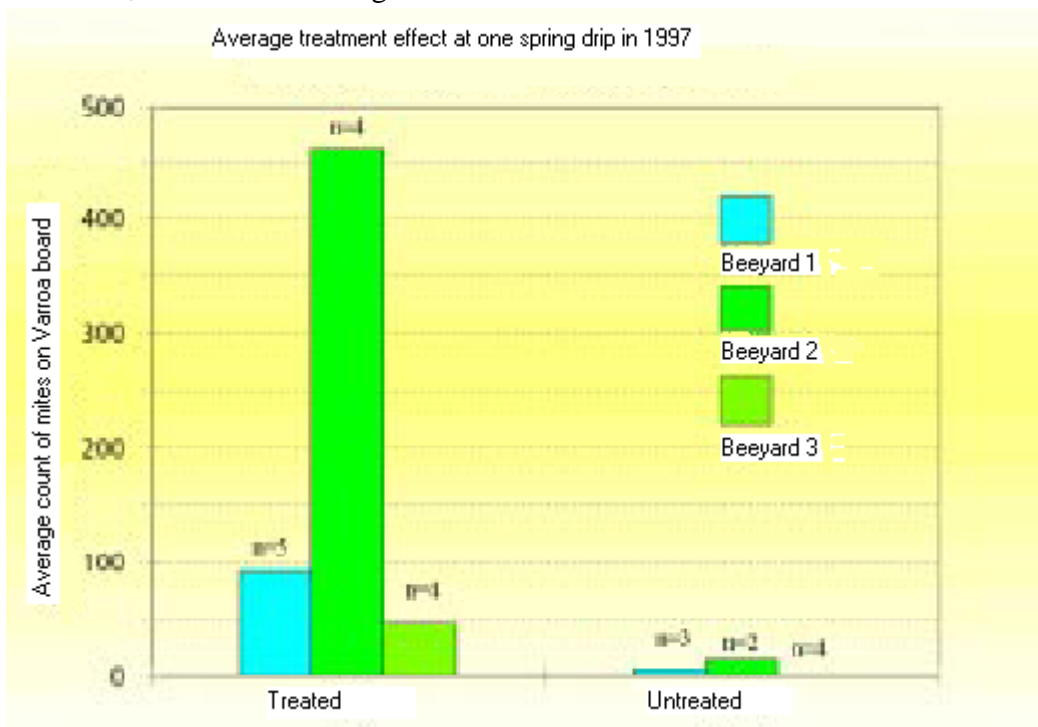
DRIP TREATMENT WITH OXAL ACID-/SUCKER DISSOLUTION IN THE SPRING

As supplement to Drone brood removal, Queen imprisonment, Formic acid, lactic acid and oxalic acid treatment done by spraying in the autumn, is a Varroa treatment test, where oxalic acid are given to the bees in a sucker dilution in 1997. The interest for this method arises from reports from Germany and Italy. From Sweden (Ingemar Fries) is reported damage on bee families treated by spraying in the autumn. Damages is also seen in Denmark where doses used on each frame are miscalculated, more than 3-4 ml 3% oxalic acid dilution each Frame side (12x10 frame measure) in oxalic acid treatment or late treatment in autumn (after the mid of October). There is though good experience with one spray, where the above mentioned dose and conditions are kept. In some of the tests has the use of spraying with oxalic acid been an aftercare to the use of formic acid. There have not in those tests or in many beefamilies in practice been winter losses of bee families or lowered spring development

that could be tracked to the use of oxalic acid. The method of giving oxalic acid in a sucker dilution can give a significant lightening of the burden of workload in opposite to the spraying method because the treatment time is about half a minute a beehive and the frames has not to be taken out of the hive. In tests of this Year is made a mix of *1 kg Sucker, 1 l water and 100 gram oxalic acid*. From this mixture is given 3-3½ ml each frame gate. The mixed quantity is equal to treatment of about 60 families. The doses are given directly into the frame gates in a thin jet from a onetime injector. See the Frontpage picture. The method is called "Dripping" In the late summer 1996 is created some nucs which are sprayed 3 times during their build up. Those nucs have surrendered the winter will full satisfaction. In autumn 1997 is wintered a lot of beefamilies which are dripped one or two times with oxalic acid and a part which are

sprayed with oxalic acid one time. Also in 1997 is made nucs which are dripped with oxalic acid 3 times and treated with formic acid one time. Tests are also done at three test hosts in the early spring with spring treatment with the dripping method before the was brood of importance. As seen from the graph below, the method had a good effect. In

single queenless beefamilies and by repeated treatments in one of the beeyards it has shown that the method has no effect of importance after the families has started to produce sealed brood. The tests has not in 1997 shown with sufficient certainty if the bees can stand the treatment. But a graph showing the number of frames with bees in the hives in spring 1998



Spring dripping With oxalic acid in three different beeyards. About the half of the families was dripped while the rest is control families.

should give a clue.



OXCAL ACID – DRIPNING OR SPRAYING – ONE OR TWO TIMES

At a beekeeper at Sealand is oxalic acid used as aftercare with use of spray and drip after formic acid treatment in 3 beeyards with normal production families. The plan was carried out as follows:

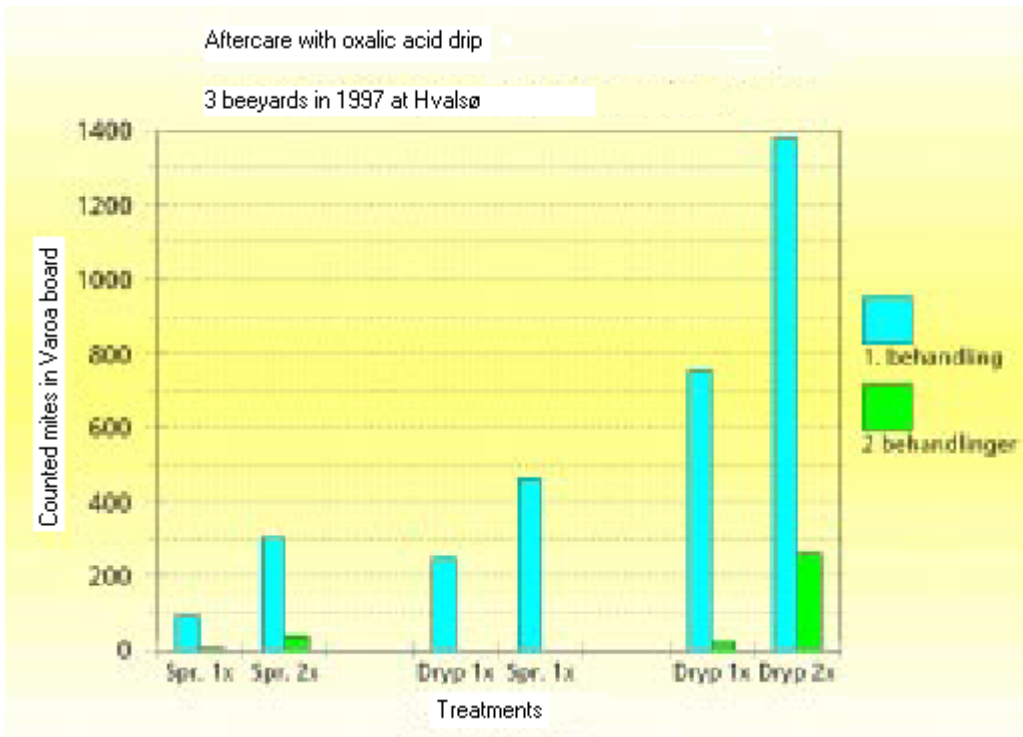
Beeyard 1: Spray one or two times with one week interval

Beeyard 2: Spraying one time or dip one time.

Beeyard 3: Drip one or two times with 10 days interval.

Average results are seen from the graph below.

As seen from the Graph there have not been the same amount of mites in each beeyard. The beefamilies which have got second treatment in beeyard 1 and 3 is partly chosen between the families which have the most dropdown at the first treatment. The results shows that treatment with formic acid in start of august with krämerplates under this conditions should be followed up with a later aftercare. The test cam primarily be used to monitor eventually differences in wintering of the beefamilies and the spring development. Honey samples are taken but not yet analysed.



Test in 3 Different beeyards with comparison between spraying and drip of oxalic acid. Drip with oxalic acid has shown a good result. Only a few mites are counted by the control treatments

Drip with oxalic acid have shown a good result Only a few mites drops down at control treat-ments.



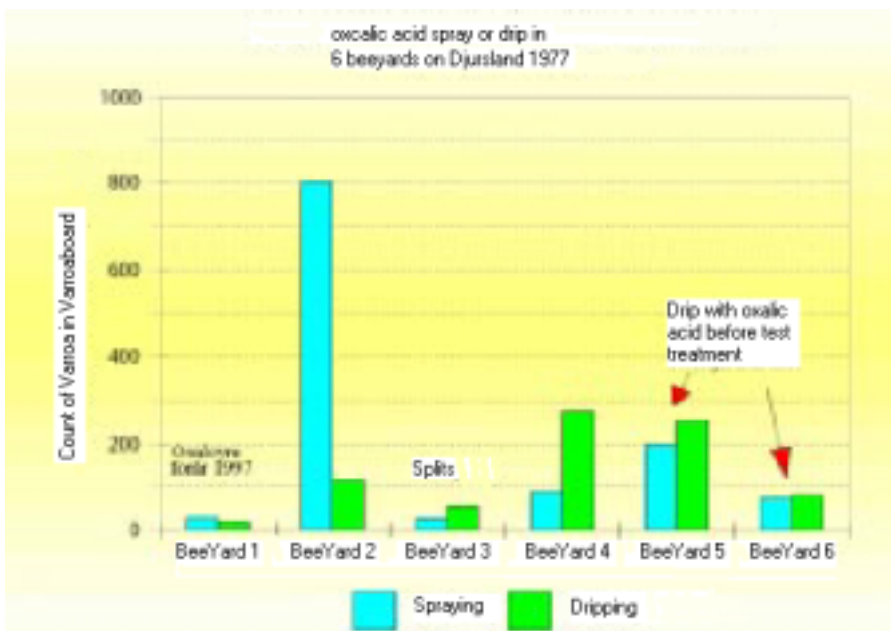
At a beekeeper on Djursland is oxalic acid used in the following ways:

Comparison between Drip and Spray at different times after Honey harvest.

Split of beefamilies –Drip/or spray to times plus aftercare with krämerplates.

The Graph show the result from 6 beeyards

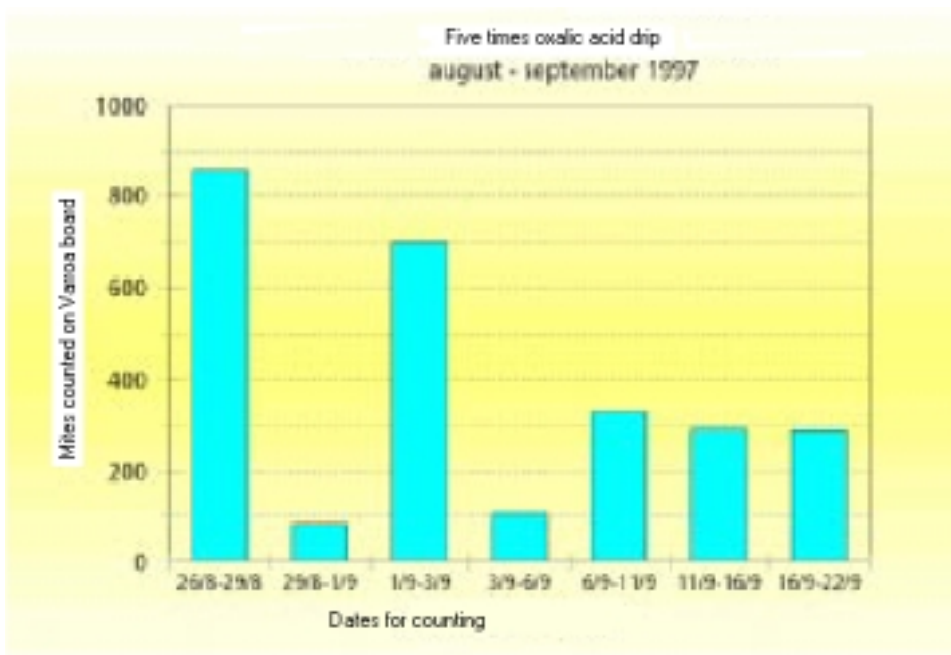
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Comparison between Drip and Spray at different times after honey harvest

In another beeyard on Djursland is treated with 5 times drip with five days between each drip from end of august. The bee strength was in connection with the fourth and fifth

drip reduced from 10 framegates to 5 to 6 framegates The following Graph shows the results of the test.



Five times dripping with oxalic acid in a row during the brood rearing period didn't give a satisfaction result

There can not be seen a connection in the unexpected and drastically drop in bee strength in proposition to the number of Varroa mites in the individual bee families. In several bee families only a few mites are present and the drop in bees strength has been so and so equal in the bee families. So what

happened is more like poison damaged du to the treatment. By inspection of single families in January 1998 they looked normal but small.

To investigate eventually damaged on ability to winter and the spring development is in autumn 1997 wintered more beeyards where

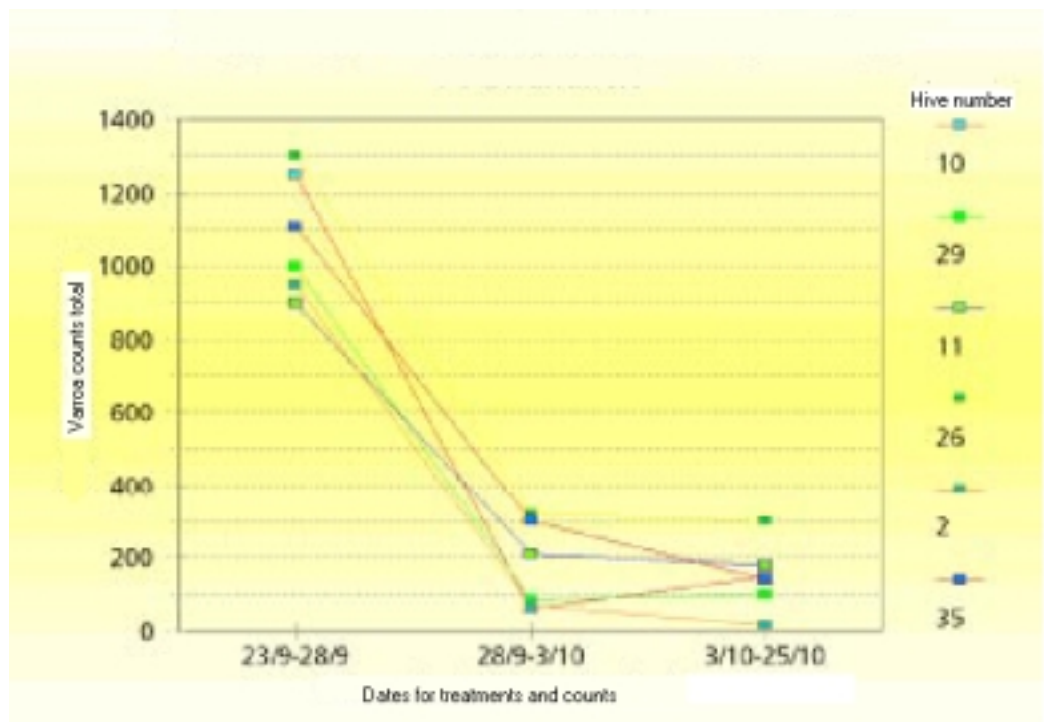
oxalic acid is used by dripping one or two times as only treatment or as supplemental

treatment (Without counting of drop down mites).

At another beekeeper on Djursland is dripped three times with oxalic acid after heather honey harvest. The results are shown in the following graph. This treatment shows likewise other tests a high level of efficiency and because the families was practical free of

brood by second and the third drip treatment the families was likely wintered in with very few Varroa mites. The over wintering and spring development will be discussed in next years test report

Six beefamilies dripped three times with oxalic acid/sucker dilution in autumn 1997



Varroa treatment and production of small families

At a beekeeper in Thy is wintered in 5 groups small families with 2 x 10 small families in

each group. The small Families is treated against Varroa with oxalic acid after the following plan :

*Group 1:
Mated queens
1,5 litre young bees*

Group a: Sprayed 2 times with 5 days interval.
Group b: Dripped times with 5 days interval.

Group 2:

Mated queens

1,5 litre young bees.

1 sealed brood frame

Group a: Sprayed 2 times with 5 days interval.

Group b: Dripped times with 5 days interval.

Group 3:

Mated queens

1 sealed brood frame

1 litre young bees.

Group a: brood frame treated in closed super with 2 x 25 ml 85% formic acid for one houer

The bees are sprayed 2 times with 5 days interval.

Group b: The bees are sprayed 2 times with 5 days interval.

Group 4:

Mated queens

1 sealed brood frame

1 litre young bees.

Group a: Sprayed 2 times with 5 days interval.

Group b: Dripped times with 10 days interval.

Group 5:

Mated queens

1,5 litre young bees.

1 sealed brood frame

Group a: Dripped 2times

Group b: Dripped 4 times.

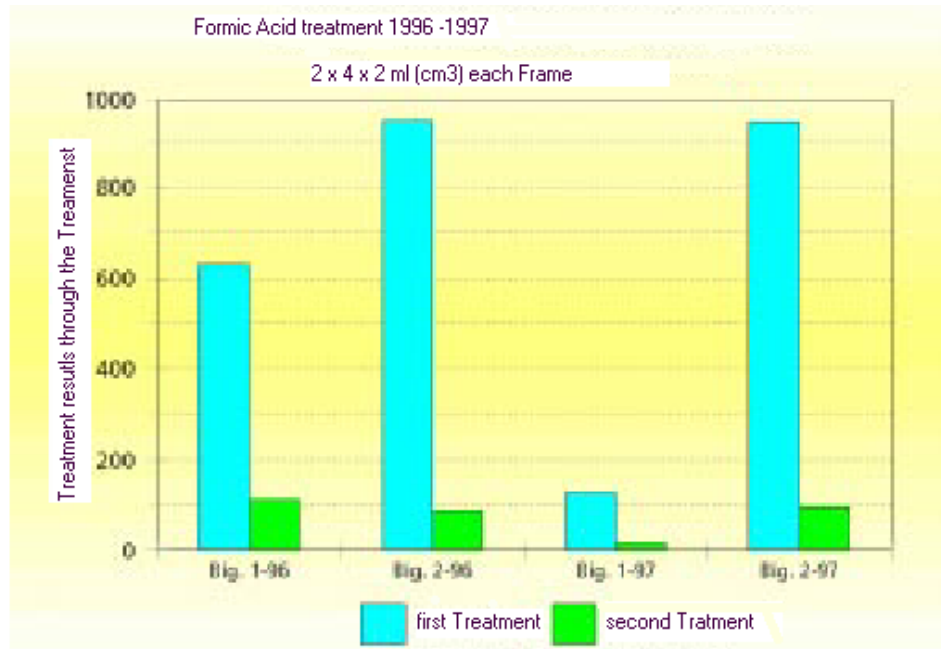
Because of few mites in the families there have not been particularly big dropdown after the treatments. And it has not been possible to

note big differences between the treatments. It might be possible that the test has influence on the over wintering of the small families.

Two apiaries near Tjele has been tested using 60% Formic acid 2 x 4 days. 2ml formic acid is applied on each comb gate with bees. It is the second year the test has been done in the two bee-yards. The purpose of the test is to follow the effect of the treatment through more than one year. the results for the last two seasons are shown in the following graph.

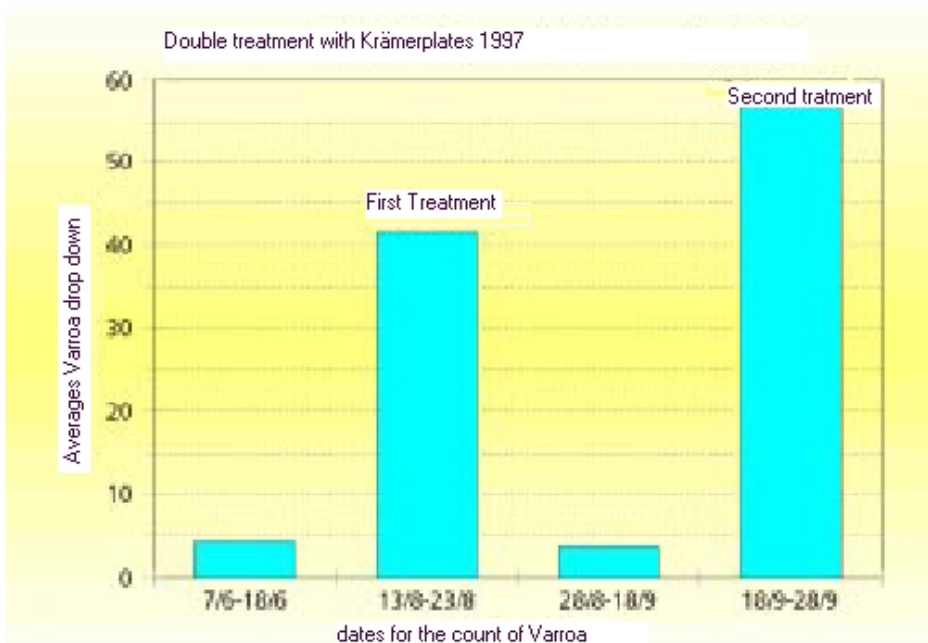
In beeyard #1 mite fall is less in 1996 than in 1997. In apiary #2 the mite fall has been the same for both years. The test hosts have the opinion that there was a heavy re infestation in apiary #2 by reason of untreated nearby colonies. *The numbers of Varroa mites in the beeyard has no significant influence on the bees.*

Double Formic acid treatment (2 x 4 x 2 ml Formic acid each. frame). The duration of the test is over two Years



An apiary near Rønnede is on the second year of testing using double Krämer plates. The results from 1997 are shown in the lower

Graph. The number of Varroa mites is still very low.



Double Krämerplate treatment. The small columns are natural Varroa dropdown

TEST OF DIFFERENT FORMIC ACID EVAPORATORS

Different formic acid evaporators were tested in Thy. Each evaporator was tested in 2 to four families so the averages must be treated with caution, because in many cases there was a large variation in. The test is also not large enough to draw firm conclusions between the different evaporators. The dropdown during and after the tests suggest that the effect on Varroa was moderate and with a full kill under the control treatment. All evaporators were tested in a evaporation chamber on the

colonies in trough hives. The evaporation chamber was covered with plastic and jute sacks.

The tests were done after the heather honey harvest from 27 September to 5. October 1997 and all colonies covered 10 frames. 85% formic acid was used in all the evaporators. No queens were lost in any of the 13 colonies. As well as the results of the tests, the advantages and disadvantage of using the different evaporators is discussed.



Nassenheider:

In the horizontal layout (The evaporator is placed on an absorbent cloth over the frames) there is a risk, that the evaporator will overturn. It can not be transported when filled with acid. Further directions are needed about the ratio between the evapoaration chamber and the size of wick. The evaporation was the highest of the tested types.



Liebefelder evaporator:

Easy to fill and to transport when filled. It is easy to adjust and can not be overturned. It is not certain if the wick must be changed every year or if it can last for several years.



Apidea fordamper

Apidea evaporator:

Same comments as for the Libefilder evaporator.



Universal fordamper

Universal evaporator:

Easy to fill and can be transported when filled. The lid is tight fitting and so it can be stored filled for a longer time. It is not certain if it is necessary to change the gravel with each use. The evaporator was tested with the openings upward. It is possible the result might have been different if the openings were placed facing the bees. The holes were easy to regulate, but it would be desirable to have more instruction about how open the holes should be. Similarly there is uncertainty about cleaning and refilling.

Krämerplates:

Practice is needed to fill with the acid. They can be transported when full. They are difficult to adjust optimally (making the

correct numbers of holes according to the conditions). They are cheap.

Purchasing :

Currently only Krämerplates and the Nassenheider evaporator can be bought in Denmark.

Type of evaporator	Average evaporation a day	Average drop down of mites 14 days	Average drop down with one after treatment by 15% lactic acid the 18/10 1997
Nassenheider horizontal	18,3	515	20
Libefeller evaporator	9,7	159	3
Apidea	8,5	72	3
Universal evaporator	7,7	87	5
Krämerplates	10,9	149	5

HOMEMADE FORMIC ACID EVAPORATOR AND AFTERCARE

An evaporator was tested by a beekeeper near Juelsminde for two years consecutively. In 1996 the test was controlled by doing an after-treatment with lactic acid and oxalic acid. The effect of the treatment with formic acid this year (17/08 and 03/09 1997) showed that the

colonies had significantly less mites than in the year before.

By the after-treatment with lactic acid showed a quite considerable drop down of mites and the bees was re-treated



Test with home-made evaporator. By control aftercare with use of lactic acid a possible re-invasion of mites showed up.



Home constructed formic acid vaporator.

Part of the letter is shown here.

At Christmas time I was visiting an elderly beekeeper (87 years old) to speak with him about the varroa situation at he's bees. I got my worst presentiments fulfilled. He has not at any time treated against Varroa and did hardly not know what varroa was about and was sure of that he had none. It must be pointed out that the distance between he's and mine hives is about 500 metres. As the conversation went on he suddenly asked me if I thought that the reason that all he's bees has abandoned their hives and was flown away was because of the Varroa. Now he had only one left. He had had eleven beefamilies at the start of the year, and now there was only one left. That means that all

At the second aftercare the families was divided in two groups. The one half was retreated with lactic acid and the other was treated with oxalic acid. Further more five beefamilies which earlier was dripped with 2-3 times with oxalic acid was sprayed with lactic acid. Result of the test is shown in the following graph. The very high dropdown showing up by the aftercare is very surprising on

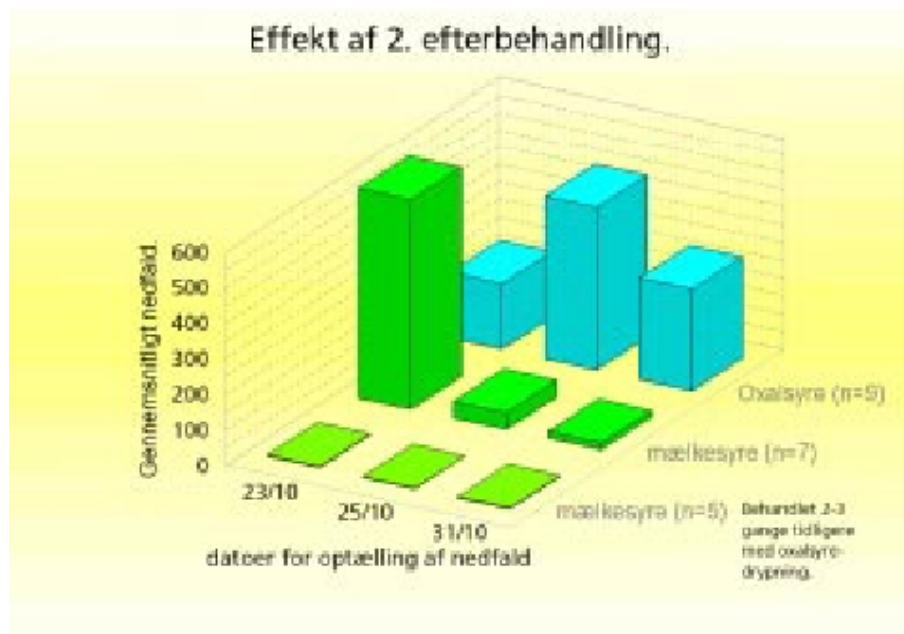
the background of the relative low dropdown after the formic acid treatment. In mid January we got a letter from the test host that very well explained the reason

he's bees has flown to my place with all their hanging on varroa and diseases etc. All the bees has run away late August and in September. They had abandoned both brood and feed, the last of he's families would probably dies out in the winter and the man said that he would stop beekeeping and not have bees again, and that might be god enough.

With such a beekeeper in the neighbourhood is it not easy to do a varroa fight because to make satisfying varroa treatment in August finding a few mites and think that it is

controlled and then get so big a re-invasion in September-October is not very nice. It

strengthen the conviction that the late varroa treatment in October is very necessary.



Test with home-made vaporator. By control aftercare with use of lactic acid a possible re-invasion of mites showed up.

CLEANING ABILITY

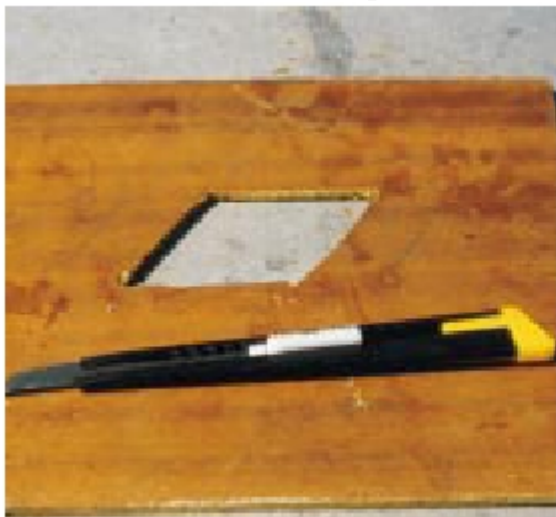
To improve the disease handling and maybe the varroa tolerance is among queen breeders an interest for a test of the cleaning ability in the bee family.

It has been discussed if there in the test should be used freeze killed brood or a piece of sealed brood which is damaged by needle stick through the cell covering. By freeze test is observed how big a part of 100 freeze killed cells is cleaned out after three days. By the needle test method is observed how many of 50 needle harmed cells are cleaned out after 12 hours. For the second

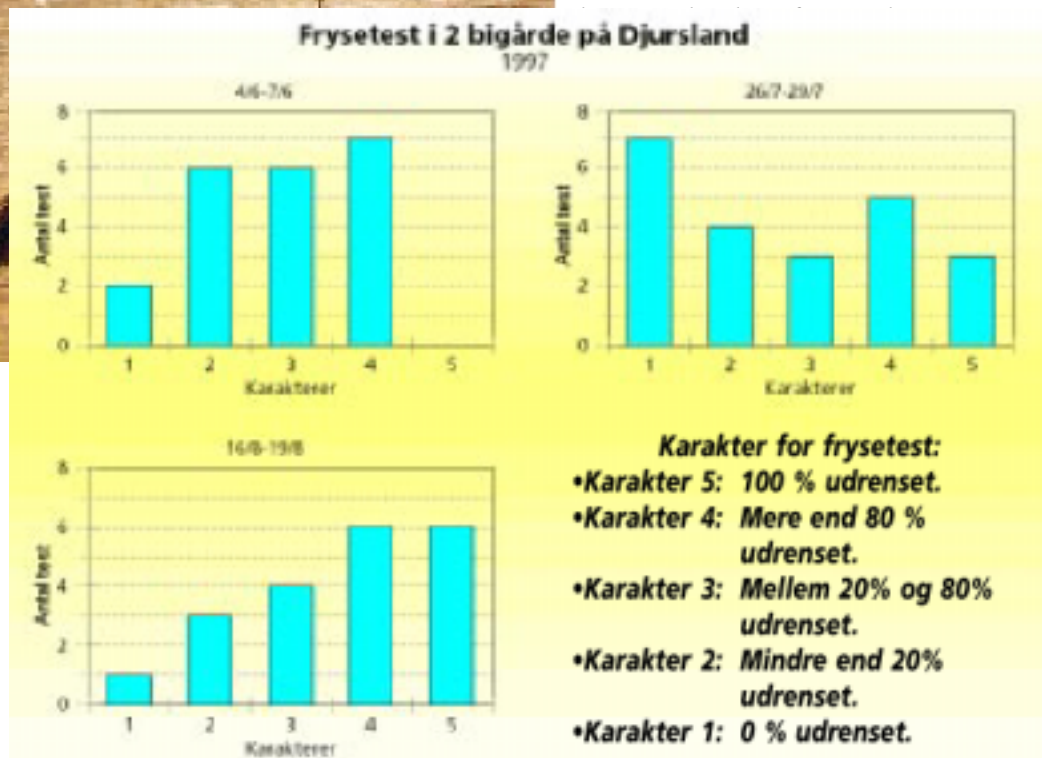
year in a row is in two beeyards at Djursland made freeze tests in the same beefamilies in two beeyards. In 1998 is the freeze test second and third time been compared to the needle test. In 1997 is the freeze test done in 22 beefamilies. In four beefamilies is the needle test duplicated three times in conjunction with second and the third freeze test. In the graph that follows is the distribution of the freeze test on the three test rounds. At the test mid August is the results from last year confirmed, that bees clean out

better late in the season than early in the season. In the overview on the next is the result from the cleaning out test put together with the cleaning out test of the needle method. At the freeze test is used the grades which is used in the breeding work and with the needle is calculated percent of cleaned out cells of 50 cells. If the results of the needle test is converted to grades the grades are limited to 2,3 and 4. hereby attains

less variation than by using grades. 53 percent of the needle test is equal to the grade 3 (cleaned out 20-80 percent) When the needle test is tried out three times at the same time in the same beefamilies are big differences on the cleaning out ability for two of the four beefamilies seen where this is tested. When the test methods is compared it shows that beefamilies clean out freeze killed and needle killed brood very differently



Freeze killing. A stanley knife is used to cut out a rhombi which cover 100 cells with brood of same age. The comb piece is put into the freezer for 24 hours and is



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Comparison between the freeze test method and the needle test method

By the freeze test is the grades used in the breeding work used and by the needle test is the percent of cleaned out cells of 50 used.,

Hive. Freeze test grade for cleaning out
 cleaning out percent needle test

			4/6	7/6	26/7	27/7	16/8
19/8	29/7	29/7	29/7		19/8		19/8
19/8							

Ramten skov									
316	3	2	4	-	28	28	30	16	26
215	4	4	5	18	46	32	46	46	52
184	4	2	5	26	12	18	70	38	26
256	1	4	3	26	36	36	10	30	32
232	3	1	4	6	-	-	20	-	-
110	4	5	5	16	-	-	18	-	-
303	2	1	2	6	-	-	12	-	-
347	3	4	3	22	-	-	18	-	-
417	3	2	4	16	-	-	6	-	-
126	3	3	5	32	-	-	28	-	-
271	4	1	-	42	-	-	-	-	-
118	2	1	3	18	-	-	16	-	-
Stenvad Hede									
379	2	2	4	2	-	-	10	-	-
371	2	3	4	10	-	-	8	-	-
224	2	1	3	12	-	-	4	-	-
408	3	3	2	14	-	-	52	-	-
406	2	4	2	30	-	-	6	-	-
415	-	1	5	8	-	-	28	-	-
407	4	5	-	82	-	-	-	-	-
375	4	4	4	24	-	-	24	-	-
344	1	1	1	6	-	-	0	-	-
367	4	5	5	66	-	-	18	-	-



QUEEN IMPRISONMENT

A beekeeper at Aarhus has done a test using Queen imprisonment with vertical queen excluder in Readan hives (Plastic hives). The queen imprisonment is done in second super with queen excluder on top and bottom of the super. A vertical queen excluder has limited the space for the queen to two frames. Each duration of the imprisonment has been 9 days. The first imprisonment that started 17/7 has showed that only 8 of the 24 queens started laying eggs because new wax was used. At the second and third imprisonment all 24 queens was laying eggs, when partial build out combs was used. 18 days after the start was treated with formic acid for one hour in a closed super without bees. 2 x 25 ml 85% formic acid over and under the frames. At second and third treatment the combs was given back to the families. The time used taking care of the bees are accurate registered, and the time used extra is less than 10 minutes a family com-

Pared to the families normal treated with formic acid. The main part of this extra time was used in waiting for the formic acid treatment of the catch frames. By the treatment with oxalic acid in mid October is counted mites in eight of the 24 beefamilies, and the drop down was an average of 92 mites, which is the same level as beefamilies that instead off queen imprisonment were treated normal with formic acid.

END OF REPORT