Wolfgang Wimmer

Handbook of heat treatment against the Varroa

Third edition with the Duplex frame box

Prologue Prof. Dr. Wolf Engels

With testimonials of beekeepers using hyperthermia and the Duplex frame box:

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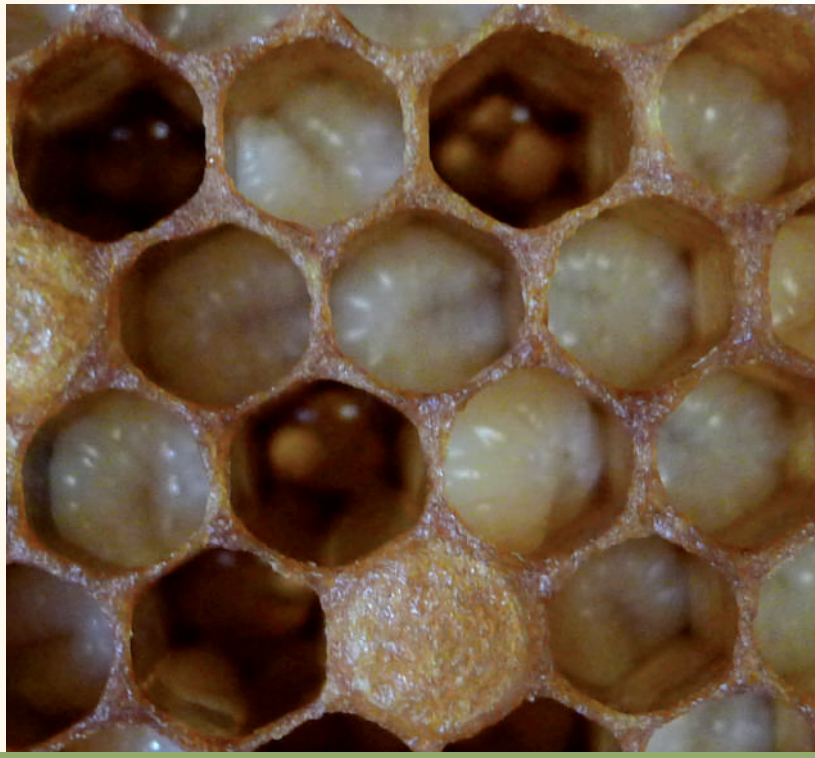


Prologue

The long way of hyperthermia

Prof. Dr. Wolf Engels, Brazil Center, University of Tübingen

In the late 1970s, the Varroa mite arrived in Germany. Here as well as in some eastern neighboring countries one tried first to destroy the infested colonies. This had no effect, as the mites were quickly distributed by the bees to many hives of the surrounding area. Next, the large crop protection companies developed chemical control methods based on acaricides.

Of the various applications, the strips with the active ingredient were the easiest to use, and they are used worldwide until today. Two disadvantages soon became apparent: in a few years the mites developed resistance to the previously effective active ingredients. The second big disadvantage was that the toxic residues were found in the wax, where they accumulated over time. The acaricides also got into the honey. Then organic acids were introduced, and they are still the most common form of mite control.

When carefully applied at the right time, the mite infestation can be kept below critical thresholds. The idea to obtain queens with increased hygienic behavoiur to Varroa mites through targeted breeding has not yet seen significant success, although some progress has been achieved. In recent years, massive colony losses have occurred, especially in the USA. No major cause has been found yet, but Varroa mites often seem to be involved. At the end of the eighties we were looking for possibilities of a biotechnical, chemical-free Varroa control. The first step was an improved method for the removal of drone brood. The edge of the brood nest was identified as the optimal position of the drone frame. While working with two brood chambers the drone frames were alternately hooked on the right and left position during the main breeding season and removed every two weeks when capped. Although the mite infestation pressure could be effectively reduced, the removal of the drone brood as sole control measure was only sufficient in very weakly infected colonies.

As an additional option, we tested how the already known heat sensitivity of Varroa mites could be exploited in an effective procedure. Peter Rosenkranz examined with a temperature chamber the ideal temperature ranges the female Varroa mites preferred. We were surprised that they did not choose the brood nest temperature of around 35 °C, but rather a bit colder conditions.

Next we tested the temperature range that causes damage to the mites. The mites did not survive 10°C over the normal brood nest temperature. Similar experiments with bee pupae confirmed their significantly lower heat sensitivity. By now, we know specific aspects of the cell biology of mites and honeybees which cause these differences.

It was impossible to increase the temperature in the hive to the extent that would damage the mites. The worker bees always tried to prevent overheating, especially in the brood nest, by intensive fanning and settling of rapidly evaporating water droplets. The bees managed to avoid the overheating of the hive and as a result the mites survived (undamaged) these attempts.

After a number of other experiments we finally found out how hyperthermia would work against the Varroa mites. In a three-year field test with 50 hives, we were able to prove that, after drone brood removal, the bees treated only with hyperthermia evolved normally, had good honey yields, and became so strong that they could be split into several new colonies.

It was thus shown that an effective control of Varroa can be performed solely with hyperthermia. However, this requires constant monitoring of the level of infestation, especially in autumn, and might involve treating again hives with hyperthermia when necessary. In addition, a suitable device is needed to treat frames with the capped

brood, free from adult bees (bees are brushed away). .
Only a few years ago Prof. Dr. Wolfgang Wimmer developed in Vienna a new device for the control of Varroa mites.
In 2011 this new device, called the Varroa Controller, was introduced on the market. It consists of a thermally insulated housing and runs the treatment program automatically.
An important milestone was reached in the long way to hyperthermia. The desire of many beekeepers to be able to keep the mite infestation low without the use of chemicals thus became a reality.

Content

Handbook of heat treatment against the Varroa

1. Fascination and motivation

They populate the earth since millions of years. They have developed a "business model" that can indeed be called "sustainable". Which other species besides the honeybees can look back on such a long success story? Who can claim to be so immensely useful to others? I do not think this or that living being is not useful, indeed many are disappearing everyday, but the bees shall not die out. This would cause substantial damages, impossible to compensate for.

We all value honey, propolis, and beeswax especially from our own beehives. But we also know that the true value of the bees is in the pollination. Ensuring food security through pollination is the added value brought by honeybees, and thanks to the professional and many hobby beekeepers taking care of the beehives. In some places around the world pollination fees are paid when beehives are placed in orchards at flowering time, knowing that with bees in the immediate vicinity, crop yields can be significantly higher. Experts quantified the value of pollination by honeybees at 22 billion Euros in the European Union. This makes honeybees the third most important livestock in agriculture.

And they are masters of adapting, as shown by this bee colony that swarmed in May, but was only found in October hanging on a cherry tree. Three brood frames were reared in the artfully arranged, natural open-air bee colony, even during cold and rainy days.

Despite all their adaptability, bees are in danger - almost every day we read about alarming bee mortality. There are several causes for this. A major cause of bee mortality seems to be the Varroa mite. This parasite harms and threatens the bee colonies. When weakened they are often no longer able to withstand additional stress factors. Previous attempts to combat the Varroa mite with chemical substances are increasingly less effective. In addition, due to climate change, we are observing completely new weather extremes, especially in the last five years.

Unfortunately for the beekeepers (and the bees), this allows the Varroa mites to develop in an optimal way.

Bee colony hanging in a cherry tree in October.
(Photo: Karl Neubauer)

Did you know that...?

...the bees can produce their own fuel to fly, food, medicine, and building materials from just three raw materials (pollen, nectar, and water)?, and that the colony (as a super organism) is able to continuously maintain constant temperature and humidity in the hive under various climatic conditions and thus perfectly master heating, cooling and humidifying? Flying distances are optimized and limited. If a bee flies too far, it will only be able to return with small amounts of food, and will therefore look for closer sources of food. This list could continue with more fascinating examples of the bees´ adaptation and survival strategies.

Bee collecting pollen.
(Photo: Wolfgang Wimmer)

There is a need for a new approach in fighting against the Varroa mites, that can be used any time in the beekeeping year, and that controls this dangerous parasite of the bees. We have written this handbook to present beekeepers such a new approach, and to introduce the method of heat treatment (Hyperthermia).

It should be said that the treatment with heat is actually not that new. At the beginning of the nineties, researchers at the University of Tübingen gained experience with hyperthermia. At that time, Prof. Engels successfully treated 50 bee colonies over three years, exclusively applying hyperthermia against the Varroa mites.

A device was also developed at that time to perform hyperthermia treatments of the bees. The device did not penetrate the market. Nevertheless, some of the devices produced at that time are still in use. We started developing a new product in 2008 - the Varroa Controller. Prof. Engels supported us with his expertise in this product development process, for which we are very thankful.

Furthermore, I would like to thank Dr. Adriana Díaz for her excellent research, without which this handbook would not have been possible, as well as Michael Preisel for his wonderful drawings and illustrations. Special thanks also go to the fellow beekeepers who contributed with updated testimonials for in chapter 7 or provided new ones for this third edition. I would like to particularly mention Mr. Wilfried Ammon, who contributed to the handbook, not only through his enormous knowledge of beekeeping, but also with his excellent photos.

The aim of this handbook is to explain the topic of heat treatment against the Varroa mites, and to answer the many questions we have received on the method. The goal was to write an easily understandable handbook, which translates research results into information to be used in practice. It should not be seen as a piece of scientific work, instead, the scientific findings are presented in a way that you can work well with them. We are looking forward to your feedback, ideas for improvement, and suggestions, by writing us at:

info@varroa-controller.com

One chapter in this handbook is focusing on the Varroa Controller. This product is available for renting (in various EU countries) since the spring of 2011, and can be purchased since June 2011. Still, it was more important for us to write about the method of hyperthermia than about the Varroa Controller as such.

What else can I do now?

More and more beekeepers know this situation: after the honey harvest, a treatment with formic acid was immediately carried out, even perhaps a second one. But after a few weeks the natural Varroa fall was again very high. Bees were still breeding brood, and an oxalic acid treatment was therefore not possible. Moreover, the nights are too cold or too humid for doing another formic acid treatment. Here you would want a different method against Varroa mites. Such method is now available - the heat treatment. Also known as hyperthermia.

2 Why do we need something new?

In recent years one can observe significantly warmer weather conditions in autumn. Temperatures between 15° and 20°Celsius are no longer rare. With such temperatures the bees break up or or do not even form the winter cluster, and there is a lot of flying activity, almost like in spring. This is nice to look at, but its consequences can be very dangerous.

In addition, the cultivation of oilseed rape, mustard, phacelia and other crops offer a rich supply of pollen very late in the year when the bees are still flying due to warm temperatures.

As a consequence, the bees remain breeding or start to breed again. Even if it is not strong breeding, it is enough to give the Varroa mite the chance to further reproduce. Experienced beekeepers in different locations confirm that there were no breaks in breeding during the past winters, and that the bees reared their brood well into the winter months.

Under such recently unusual warm autumn weeks, the Varroa mite can develop to a point that endangers the bee colonies. At this time the summer treatment is long time ago and the mite population can continue to grow with no constrains. The so called "treatment of the remaining mites", which is usually done in December, cannot be completed because it requires a broodless colony, otherwise it does not work. It then comes to last minute measures to produce a broodless colony, for example by violently unsealing the remaining brood with a honey uncapping fork.

Flying bee and Blue Tansy (Phacelia).
(Photo: Wolfgang Wimmer)

A storm accompanied by a southerly wind, a tropical night and a drought

An unusual and extremely warm November is coming to an end

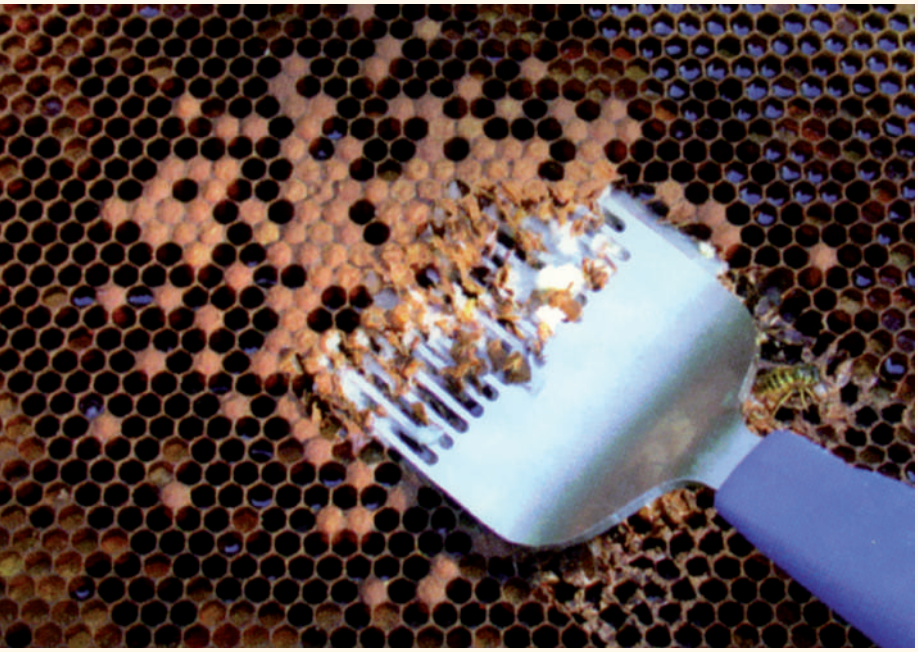
This year the golden October lasted until the end of November. View of Weiler Duvin, entrance into Val Uastg.
(Photo: Keystone/Amo Balzarini)

The 2011 November was not a typical November. There were many cloudy days at middle altitudes, but overall the temperatures exceeded the normal recorded averages, and in many locations there was no rainfall at all.

Clipping from the NZZ

29.11.2011

(Source : NZZ)



Opening the bee brood with a honeycomb uncapping fork (Source: Imkerfreund, November 2011)

The situation clearly shows that there is an urgent need for a new method to effectively counteract these mites that cause damages to the bees. This method should work any time in the beekeeping year: during the warm autumn weeks, as described before, as well as early in spring; and even in the summer, if necessary. Ideally, this new method should leave no residues in honey, wax, or propolis, and at the same time, shall not cause stress to the bees, because they are already more than challenged (e.g., with taking care of the brood in the autumn-winter season).

The heat treatment with the Varroa Controller is such a new method. It can be used any time in the beekeeping year, provided there is still sealed brood, and the outside temperature is at least 18° Celsius.

To understand the way the Varroa Controller works and its effects one shall know more about the life of the Varroa mite itself.

The following chapters also explain how the heat treatment (hyperthermia) against the Varroa works and why it is successful by "only" treating the capped bee brood.

How shall it continue?

If these particularly warm autumn weeks should occur more regularly, then only a treatment in summer (e.g., after the harvesting of honey in July) will not be enough. From then on there will be four months until November - too long time to wait when brood is still present. Then an autumn treatment would be also required. One can not continue the same old way, as there are many unknown factors. Will there be brood in December or not? If not, a treatment will be necessary in the coming spring because there was no winter treatment. To continue in this path, with doing only a summer treatment, and then a treatment of remaining mites, seems increasingly unsafe for overwintering the bees.

3 The beauty and the beast

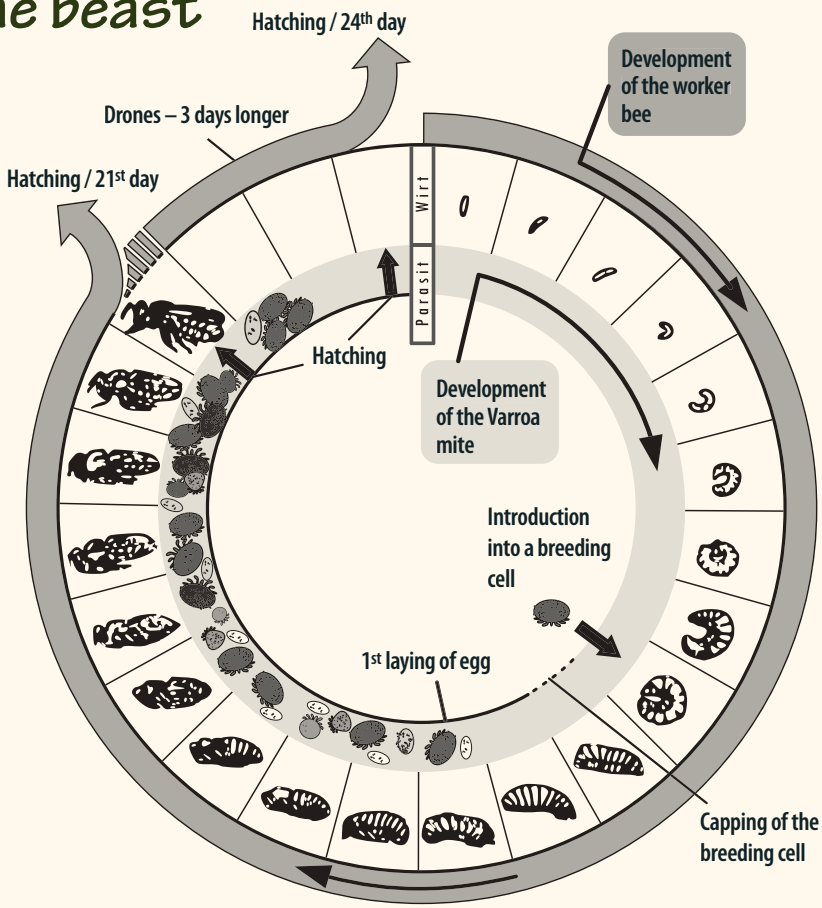
As a beekeeper one knows how the development of the honey bee works. Nevertheless this development process is briefly presented here, especially with the focus on the aspects that relate to the development process of the Varroa mite.

3.1 The development process of the bee

Stages of development of a worker bee – a quick review:

- 3 days egg stage – standing, inclined and then lying egg.
- 6 days larval stage - a larva hatches on the fourth day, is fed royal jelly, and then only a mixture of honey and pollen.
- 12 days pupa stage - on the 10th day the larva stretches and spins a cocoon. The adult bee hatches on the 21st day.

The Varroa mite lives in two ways in the hive: one way is attached to the adult bees, preferably the nurse bees, and another way, inside the capped worker and drone brood, where it reproduces.



Joint development process of a bee and a Varroa mite (Source: Bieneninstitut Kirchhain, 2012)

How about the Varroa mite - when does it come into play?

On the 9th day the bee brood is about to be capped. The female Varroa mite goes into the brood cell, and is trapped in the cell with the bee larva on the 10th day. Indeed very convenient, right? Now we know exactly where the mites are, and can take them out easily. That´s exactly what we will do - more on that later. "Stop" I hear you saying "there are still the Varroa mites that sit on the bees, what about them?" I say "Patience, we will take care of these too". How to do that comes later on.

What happens when the Varroa mite leaves the bee and goes inside a breeding cell?

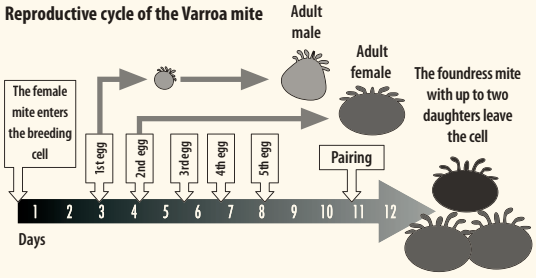
This is a very important question in terms of combating the mite, and is closely related to the development of the bee itself. The formation of eggs in the ovary of the foundress Varroa mite is stimulated when the bee larva emits a volatile, chemical stimulus through its cuticle. One speaks of "oogenesis". As long as the mite parasitizes on the adult bees, the egg formation is on hold. We will be able to use this insight later.

3.2 The development process of the Varroa mite

First, the female mite (also called foundress mite) goes into the breeding cell and hides "submerged" inside the larvae food between the bee larva and the bottom of the cell. The bee larva uses up the food few hours after capping the cell. The foundress mite then uses her mouthparts to pierce the larva causing a wound on the bee larva to feed on the hemolymphe and the bee's fat body - a vital organ much like the liver of humans.
The larvae just before the stage of capping, especially larvae of the winter bees generation have a large fat body that forms nearly 100% of its body weight.

The fat body has nine important functions:

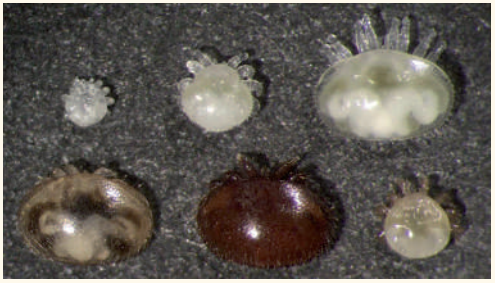
- it is a reservoir of energy and mobilizes nutrients,
- it detoxifies pesticides,
- it assists with osmoregulation,
- it helps functioning the immune system,
- it regulates a temperature,
- it participates in metabolic activities,
- it helps synthesize functional proteins and fat,
- it is a reservoir of the protein vitellogenin that regulates hormonal dynamics of the worker bees with regard to different roles in a hive, immune functions and longevity of the worker honeybees and queens,
- it is a reservoir of juvenile hormone that directly influences development and metamorphosis of a honeybee.



(Source: Rosenkranz, P., Aumeier, P., Ziegelmann B., 2010)

Later on also its offspring will feed the same way. The damage caused by the female mite and its offspring disturbs the further development of the larva. Mites parasitizing on the larva compromise its immune system and make it vulnerable to diseases and viruses transmitted by the mite. Without Varroa, the larva´s strong inmune system would be quite capable of coping with pathogens. But the Varroa mite greatly reduces the larva´s ability to do so.

During the period of about three days (about 70 hours) after the brood cell is capped, the female mite is eating and building her strength from the larva´s fat body. Then she starts the egg laying, and every 30 hours an egg follows. In doing so she manages to lay five eggs inside a worker brood cell, and six eggs inside a drone brood cell. The first egg is always a male progeny. The development of the young mite is progressing in various stages. At first the egg turns into a so-called protonymph, then into a deutonymph. The total development time is 5.8 days for a female mite, and 6.6 for a male offspring.



First row: Three nymph stages of the female mite
Second row: newly hatched female mite, foundress mite (dark), and male mite

What would be the population of Varroa mites in July, when there would be 100 mites in the bee hive in February?

Assuming 100 mites in February, this number will raise up to 200 mites in March, 400 mites in April, 800 mites in May, 1600 mites in June, and 3200 mites in July. These are theoretical figures under the assumption that nothing is done against the propagation of the mites. More comes in the next chapter.

As a result, the male descendant is the first to be completely developed. Since the mite reproduction can occur only in the brood cell the male descendant begins to mate with the first female offspring. This sibling pairing takes place several times. After 20 hours, another female offspring is fully developed and the male continues mating with it. Only fully developed mites are viable in this process of development. In total, there are 1.3 to 1.45 new fertilized female mites in the worker brood (On average), when infested by a single foundress mite. In the drone brood, however, this is significantly more - on average 2.2 to 2.6. Both figures refer to infected brood cells with one foundress mite. For infested brood cells with multiple foundress mites, figures might be higher.

With the hatching of the bee, fertilized young female mites leave the brood cell and unfertilized female mites and male mites die. The foundress mite also leaves the cell, and completes an average of three to four reproduction cycles during her entire life. Now it is clear why the drone brood is important, because it is five to ten times more infested with mites than the worker brood. The chances of the Varroa mite to better mate are clear. This knowledge on the biology of the mite is important, especially concerning the colony treatments during the year.

Inside the hive: The reproduction of mites is exponential.

The development described before explains why the Varroa mite proliferates very quickly within a short time. The dynamics of the growth of the mite population depends on many factors, and requires a complex modeling, but observations have shown that the population of Varroa mites in the bee colony doubles each month.

Externally: The incoming of Varroa mites from outside – the re-infection.

A summer treatment would be usually required when there is a high number of Varroa mites in the hive. Depending on the effectiveness of the treatment, one could expect a significant reduction of the mites in the hive. However, weeks later it might be observed that the Varroa infestation is high again, which can not be explained by the normal population growth in that short period of time. Often there are untreated or poorly treated hives in the vicinity, which are already weakened by the mite. Foraging bees, that go into such weak hives during summer robberies, carry back Varroa mites from these weak hives into their own.

Studies have shown that up to several hundreds of mites per week can enter the hives this way. This often destroys the results of the previous treatment. Once in the hive, the mite can continue to reproduce in the brood, and damage the bee colony during the sensitive phase of late summer-early autumn.

At this point it is almost impossible to completely eliminate the Varroa mite from the hives. It can only be kept under control. Therefore it is important to ensure that a certain amount of Varroa mites is not exceeded. This thresholds depend on various factors, such as the strength of the colony, the season, and breeding activity.

Why do we find both, bright and dark Varroa mites in the hive debris?

Well, these are the male and the undeveloped female offspring that died when the bee hatched. As long as we find them we know that the Varroa mite continues to propagate in the hive. This is an important sign for the watchful beekeeper!

The English Ministry of the Environment - the Food and Environment Research Agency (FERA) – defines 1000 mites in a normal hive in spring and early summer as the threshold. Below that level, the condition of the hive might not be critical. The threshold is, though, much lower during the colony population decrease in late summer as Varroa mites transmit and activate various bee viruses. Towards the end of the beekeeping season viruses often become more virulent (probably due to the sibling mating among Varroa offspring). Therefore, we recommend to follow the results of the German research project that defines 300 mites in a hive with about 10 000 winter bees - as such 3% as the threshold.

It is certainly not about being able to determine a certain number of mites, but rather to perform a permanent control of the infestation level of Varroa in the bee colony. Those who know the status of the mite population can take countermeasures on time to control the mite.

Bee damaged by the Deformed Wing Virus (Source: Rosenkranz, P., Aumeier, P., Ziegelmann B., 2010)

3.3 The damage caused by the Varroa mite

How does the mite harm the bee? There are two types of harm: on the one hand the direct damage to the individual bee and, on the other hand, the long-term damage to the entire bee colony. This is called varroasis - a disease of the bee brood.

Damage to the individual bee

The Varroa mites perforate and feed mainly on bee´s fat body. It causes various pathologies observed in the later life of the affected bees, such as early onset foraging, reduced overwintering success, reduced lifespan, viral transmission, difficulties with metabolic functions, ability to navigate properly, low immune system, weight reduction, behavioral changes such as poor navigation, as well as changes in the breeding and collective performance.

In addition, viral infections are transmitted through the wounds that the mite causes to the bee larvae while feeding on the fat body. The following viruses are transmitted by the Varroa mite:

- DWV (Deformed Wing Virus)
- ABPV (Acute bee paralysis virus)
- SBV (sacbrood virus)
- KBV (Kashmir bee virus)
- IAPV (Israeli Acute Paralysis Virus)

A known, visible damage is caused by the Deformed Wing Virus. In general there is no treatment against the viruses, therefore the Varroa mite has to be combated to avoid virus infections.

Damage to the bee colony

The injured individual bees are part of an entire bee colony, which consequently also suffers damage. These damages to the whole population have a special effect during the population decrease phase, when the number of bees declines but the number of mites continues to increase. If the decreasing brood is then massively infested, the entire bee colony is at risk. The infestation of brood cells with many mites often causes the colony to collapse.

There are damages to the bee colony, even with low Varroa loads. The colony shows the following symptoms:

- Reduced increase in bee population and thus less honey production
- Brood with holes and lower bee replacement rates
- Deformed bees, not able to fly
- Bees with shorter lifespan
- Drones with less chance of mating

The Varroa population must be kept below the "damage threshold" to limit these negative effects. This damage threshold, as indicated before, strongly depends strongly depends on various factors, such as overall strength of colony and breeding conditions, the season, environmental factors, and the presence of viruses. **The only factor that the beekeeper can handle is limiting the population of Varroa mites.**

When do I need to control the natural fall of Varroa mites?

Experience has shown that it is smart to look at the mite fall during the whole bee year. It is not sufficient to wait until August for inserting the bottom (Varroa) tray in the hive. A constant observation is an important element of an effective treatment to an effective treatment against the mite.

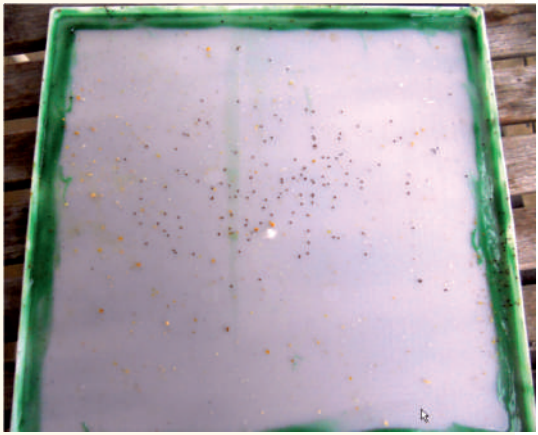
This handbook advocates for a very low damage threshold to ensure the viability of the bee colonies. It is possible to maintain this damage threshold by means of controlled heat treatment, as will be shown in the next chapters.

4 Trust is good, control is better.

The Varroa mite has become a major threat in beekeeping, and this is why we need to control it and keep its population within limits. This is one essential requirement for successful beekeeping. Today, observing the hives only once or twice per year is not enough anymore. A constant monitoring is needed, especially in autumn.

Monitoring the level of infestation within the bee colony can be simplified by the right choice of hive, whereby the bottom board of the hive is important. An open mesh floor, allowing the debris and dead mites to fall on a mite catching tray below, can ease significantly the monitoring work. This open bottom board and catch tray allow the monitoring of the natural mite without opening the hive or disturbing the bees. An experienced beekeeper can draw a conclusion on the colony's state from the monitoring of the mite fall. Therefore, assessing the mite fall represents one central element of mite treatment. It is important to know the level of infestation to decide how and when to take action against the mite.

One can estimate the total population of mites within the hive by the counting of fallen mites in the debris. The counting should be done daily over a period of at least one week, 10 days are even better to make sound conclusions. Average daily mite fall can be then calculated per colony. Shorter observation periods may result in uncertain estimates.



Bottom tray with insect lime at the edges, for a reliable count of dead Varroa mites
(Photo: Wolfgang Wimmer)

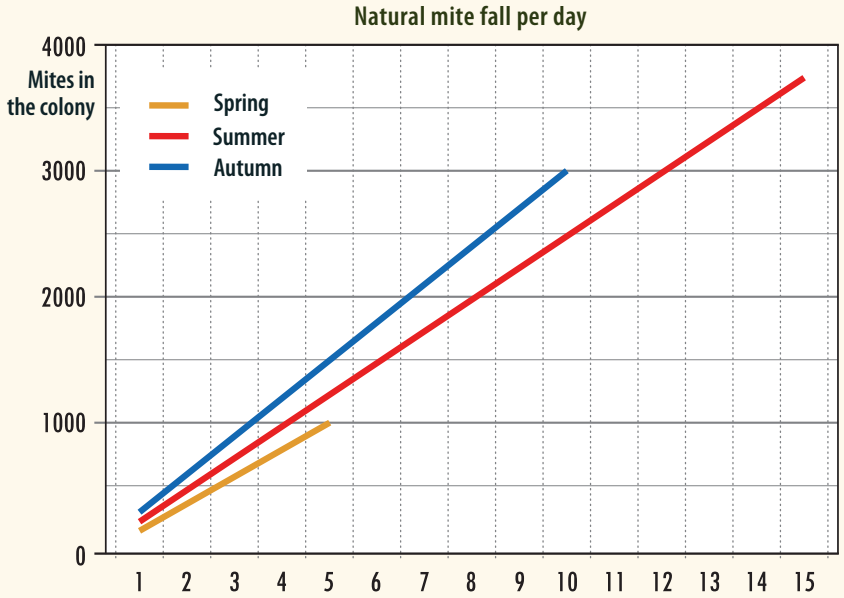
What could go wrong when monitoring the mite fall?

Many insects, for instance ants, like protein rich debris. They go on to the bottom (mite) tray, where the dead mites fall and take them away. This alters the result of the mite counting. By painting the sides of the bottom tray with sticky insect lime, one can avoid this problem. Three to four cm wide lines of lime at the tray's edges are enough. Insect lime, originally used for the protection of trees, is available in the gardening section of do-it-yourself shop. There are also bee friendly limes in organic quality. Without such help e.g., the insect lime in the bottom tray, a reliable counting of the Varroa fall (and estimation of the population in the hive) is not possible. Caution: Vaseline or other fats which are often recommended for the purpose of keeping ants away actually do not hinder the ants to take away the dead mites from the bottom tray!

4.1 The conversion factor

Once the average of the natural mite fall per day has been assessed, one can derive an estimate of the Varroa population inside of the hive by means of a conversion factor. The value of this conversion factor depends on the season: in spring it is about 200, in summer it is 250, and around 300-500 in autumn (Depending on the size of the colony and if it is still breeding, and whether its located in lowlands, mountains, or in the vicinity of poorly treated hives).

The monitoring of the daily mite fall, and the extrapolation to the total population using the corresponding conversion factor as shown below, is the first steps to know the level of mite infestation in the hive, and this which is necessary for avoiding the mite damages to the bees, and succesully keeping healthy hives.



How precise is the counting and the extrapolation to the total number of mites?

Indeed these calculated figures are estimates and depend on different conditions (e.g., the hatching of drones). Nevertheless, the method is good enough to give orientation for an effective mite treatment. In this case we can say "it is approximately right and not exactly wrong".

4.2 The reproduction rate

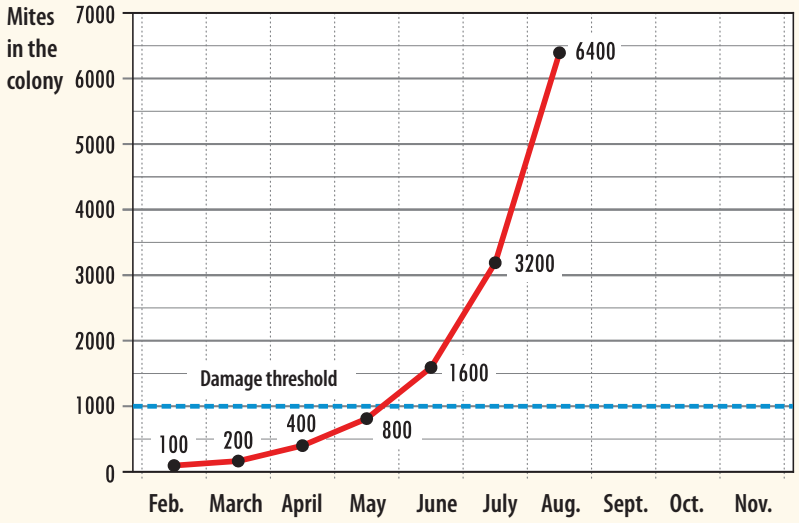
Knowing the total population of mites within the hive at a certain time is important, but not sufficient. It is necessary to recall the knowledge from chapter 3, dealing with the reproduction rate of the mites. Without entering in too many details concerning the biology and reproduction of the mite, the most important fact is that the mite reproduction rate is doubling per month; namely, the number of Varroa mites **doubles each month**.

This doubling each month means that the reproduction rate is non-linear, as shown in the graph below:

Each mite in month 1 will turn to be 16 mites in month 4; 32 mites in month 5; and 64 mites in month 6. If there are 100 mites in the bee colony in February and no measures are taken against these mites, the population will grow up to 6400 mites until September. This would mean in practice that the colony may collapse shortly before July or between July and August due to Varroasis - the end of the colony.

One has to intervene to avoid this to happens, but when and how?

Uncontrolled mite reproduction in a bee colony – doubling per month



As discussed previously, there are different views on the tolerance (threshold value) of mites within a bee colony.

Many experienced beekeepers have observed that their bee colonies endure less and less mites. The threshold seems to decrease over time. Caution is advised with respect to the different mite tolerance figures. We follow the British Environmental Ministry, which estimates a threshold of 1000 mites. This means that a bee colony can endure about 1000 mites without being seriously threatened. The threshold during the colony population decrease in late summer is defined even much lower. The beekeeper should try that the hives stay below the threshold (e.g., 3% of mites in relation to the number of bees) to avoid damages, especially before and during the overwintering period. Later on in chapter 6 we will explain different strategies to keep bellow this threshold.

4.3 The places to find the mites

So far we know the reproduction rate of the mites, how to calculate their total population, and the recommended damage threshold for the colonies. Is this enough to decide on a treatment strategy? The answer is no, one piece of information is still missing.

Where is the mite actually?

One needs to know the location of the mite, and when is the mite there. This information is important to decide on the treatment to choose, and might determine the success of such treatment. But it also needs to be said that the mite is not always where one expects it to be.

In principle, the mite can be found only in three different locations within the bee hive. Refreshing from chapter 2, the mite reproduces in the worker and drone brood. The mite needs to be sealed into the brood cells to reproduce. These are two clear places to find the mites. The third place is the result of the natural cycle of the mite reproduction. The mites also parasitize on the body of the adult bees.

It is not very useful to treat the adult bees against the mites when the majority of the mites are inside the bee brood. The distribution of the mites changes between these three different locations during the beekeeping year. This is the third important piece of information for a successful treatment concept.

In **spring** 80% of the mites are inside of the bee brood. One quarter (25%) stays in the drone brood. The majority (55%) is found in the worker brood. One fifth (20%) parasitize on the adult bees.

This distribution changes over the year – in **summer** 70% of the mites stay inside of the bee brood, with one fifth (20%) in the drone brood and 50% in the worker brood. 30% of the mites stay on the adult bees. In **autumn** there are no drones anymore. Only 60% of the mites are inside of the bee brood and 40% stay on the adult bees.

Summarizing the four important findings:

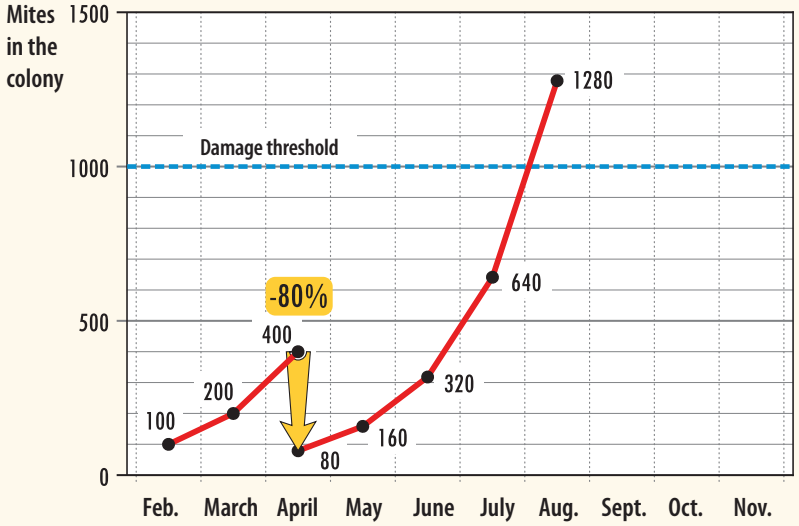
1. The exponential reproduction rate: doubling per month.
2. The average mite fall per day and the conversion factors to estimate the total population of mites inside the bee colony.
3. The damage threshold of 1000 mites per hive when the number of bees is progressively increasing, and 3% of mites per hive when the number of bees is decreasing.
4. The distribution of mites in the worker brood, the drone brood, and on adult bees.

As long as those four findings above are taken into consideration, there are no limits set to creativity, regarding the strategy and treatment method against the mites.

With this knowledge everyone can create his or her own treatment strategy. Strategies to keep the mite population below the threshold value are discussed in chapter 6.

4.4 The principle of hyperthermia

Now, looking again at the example starting from 100 mites in February, and with the doubling each montth (exponential rate), what would be the mite infestation level in September (after a spring treatment)?



Mite reduction effect of a heat treatment in spring

When does it make sense to treat the bee brood?

Well, obviously in the spring. Four fifths (80%) of the mites are there. They are enclosed in the breeding cells and thus easy to eliminate.

The graph clearly shows a different picture. Instead of the total burden of 3200 mites in July, and 6400 in August, there are only 640 mites in July, and 1280 mites in August.

What was done?

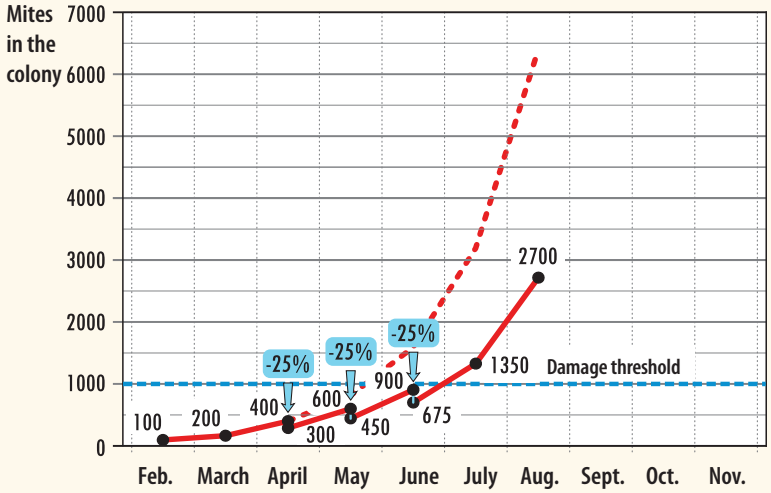
A heat treatment was carried out with the Varroa Controller in April. Since February the mite had time to double its numbers each month (for two months). 400 mites developed from originally 100 mites. We know that 80% of these mites, that is 320 mites, are in the bee brood (worker and drone brood). Assuming that we treat both brood types with heat, only 80 mites remain attached on the adult bees. We cannot get rid of these mites with the treatment of the brood.

This example shows the importance of the spring treatment. On the one hand because it interrupts the doubling reproduction rate, on the other hand because it targets the majority of the mites that are in the brood.

It is also important that one does take action instead of waiting too long. Waiting until the mite population has reached full strength and endangers the bee colony is the wrong way to go. Taking countermeasures on time is the way to success. With the heat treatment you can, for the first time, intervene anytime in the bee season against a high Varroa pressure, long before the bee colony is seriously endangered.

4.5 Drone brood removal

The previous findings can also be applied by means of removing the drone brood. Taking the example of 100 mites in February with uncontrolled growth as starting point, one can remove drone brood three times in a row to get good results in reducing the Varroa pressure. This technique slows downs the mite population growth. It is important to take care of the drone brood by removing it or by treating it with heat.



Mite reduction effect by removing drone brood three times in the spring

5 The course of a heat treatment

This chapter describes the process of heat treatment with the Varroa Controller and provides tips and hints for using the machine. The Varroa Controller is a machine especially developed for heat treating the breeding frames of the honey bee colonies.

5.1 The Varroa Controller

The special features of the Varroa Controller are the computer controlled electronics for the heat treatment process, as well as the use of a high precision sensor for the measurement of the temperature. The combination of exact program control and the most accurate temperature measurement ensures the evenly warming of the bee brood, and avoids overheating. The multi-layer housing ensures optimal thermal insulation, and allows energy efficient heating.

Just as the natural humidity of the hive, in the treatment chamber of the Varroa Controller there is humid air during the treatment, generated by an ultrasonic humidifier. A robust, powerful fan ensures a targeted distribution of the warm and moist air.

The Varroa Controller is very user-friendly - the beekeeper only has to insert the capped brood frames, place the temperature sensor into the brood frame, and this frame in the center

The main elements of the Varroa Controller
(Source: www.varroa-controller.com)

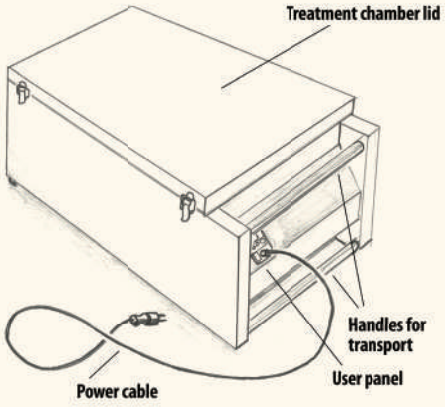
of the treatment chamber, close the lid, and press the start button to start the program. Then the treatment runs fully automatic and the remaining treatment time is shown on the display. At the end of the treatment there is a sound indicating that the treatment is complete, and the brood frames can be returned to their original colonies.

The Varroa Controller is designed to be used on-site at the apiary, but also where there is no connection to the mains Then the Varroa Controller is powered with a generator.

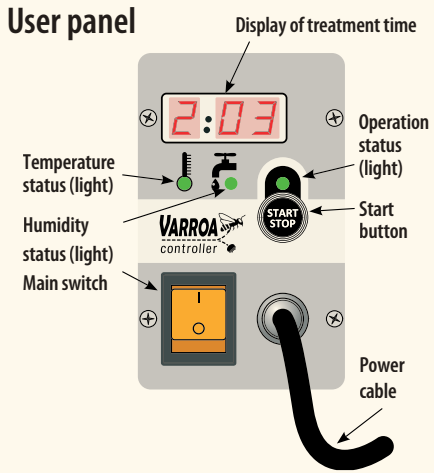
5.2 The seven steps of heat treatment

Step 1

The first step is to place the Varroa Controller horizontally at the location of the treatment. The device must be protected at all times from blazing sun or rain. The ambient temperature at the time of treatment should be at least 18° C. The use of the device is straight forward in a stationary apiary, but often the hives are freestanding in field locations without electricity. The Varroa Controller is designed to work with as little power as possible, so it can be operated with a small generator if necessary. The generator shall deliver at least 800 W continuous power. (Please note that sometimes the manufacturers only indicate the maximum power, please ask for the value for the continuous power of the generator). Before operating with a generator, please make sure that it is correctly grounded according to the manufacturer's instructions.



The control panel of the Varroa Controller is very easy to use. There is a main switch and a start button. When the main switch is turned on, the Varroa Controller starts to work to reach the temperature and the humidity in the treatment chamber of the device, just like the conditions in a hive.



What happens when something happens?

The treatment is started and suddenly someone stumbles over the cable and the Varroa Controller is accidentally unplugged. What should be done now? Does the treatment have to be restarted from the beginning? No, not needed at all! The device is smart enough to "remember" where it was in the program, and when plugged back to power it continues reliably right from this point on. But if too much time elapses, e.g., if the device was unplugged for more than 20 minutes, then the treatment should be stopped and restarted completely again.

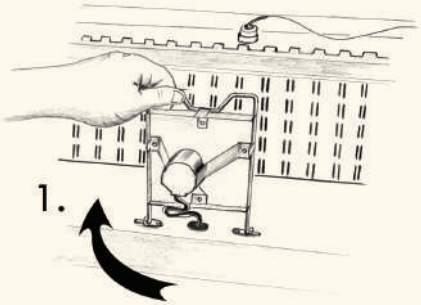
Water must be added to the device before it can be turned on by means of the main switch.

Step 2

To fill in the water, open the lid of the machine and lift up (1) the humidifier in order to take out the water container.

Fill up the water container with distilled water until you reach the water level.

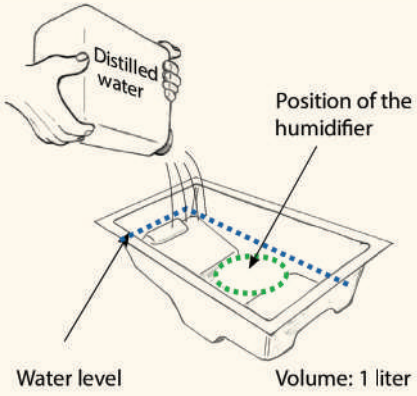
Put the water container back to its original position inside the treatment chamber. Move the humidifier back to the horizontal position.



The volume of the water in the tank is enough is enough for at least two consecutive treatments.

As soon as the water tank is filled and in place, and the lid is closed, the heat treatment can start.

Filling the water tank
Source: www.varroa-controller.com



Caution:
Always use distilled water since hard water can cause the membrane of the ultrasonic atomizer to accumulate scale, and as a result, less water fog is released into the treatment chamber. As such bee brood could dry out during the treatment.

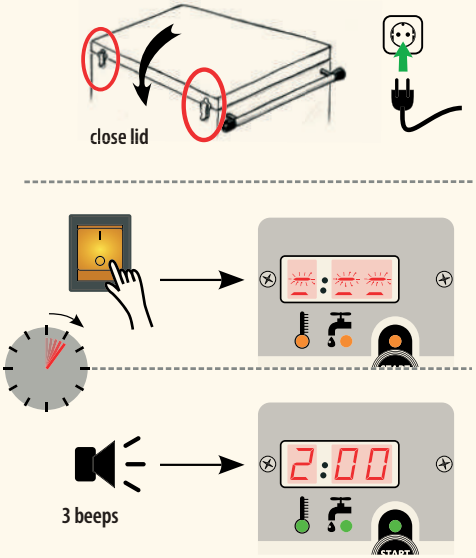
Removal of the capped brood frames
(Source: www.varroa-controller.com)

Step 3

The device is set up correctly and filled with distilled water. Put the sensor holder on top of an empty frame in the middle of the treatment chamber and close the lid. Switch on the Varroa Controller by pushing the (orange) main switch.

The machine now starts preheating. This is indicated through the three status lstatus LED lights, illuminating in orange, and with upwards rising beams in the display.

During preheating and later filling, the temperature sensor should always be placed on an empty frame.

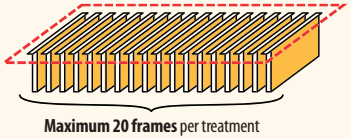


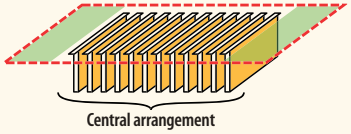
Please do not insert any brood frames in the machine before hearing the three short beep signals, which indicate that the machine reached the right temperature to begin the treatment. Simultaneously with the beep signal, with the beep signal, the display shows the planned treatment duration (e.g. 2:00, corresponding to two hours). This is also another indication that now the brood frames can be placed inside the machine.

Step 4

The Varroa Controller has reached the treatment conditions and now you can place up to 20 brood frames inside. These shall be prepared so that they are free of nursing bees, and protected from cooling.

You do not have to treat always 20 frames, you can also treat less frames.





What's going on?

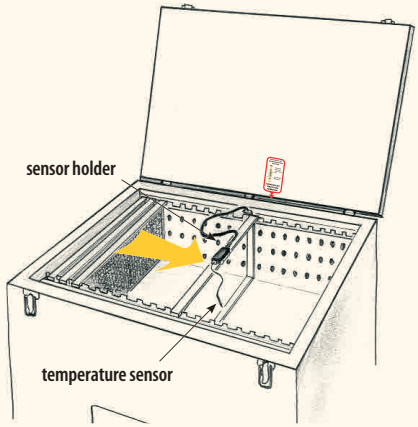
You follow exactly the instructions in the user manual, but the device does something completely different. As soon as you switch on the main switch, a program runtime is shown on the display. What is to be done? Quite simple: reset the machine by pressing the start button for five seconds. Then the device is ready to start again, and behaves exactly as described here.

Can I mix different frame sizes for one treatment?

You use the frame size Zander, Breitwabe, Langstroth, Dadant or any other type of frames, but have a honey frame in the honey supper. Working without queen separator might result in breeding that extended up to the honey supper. Now you want to treat the large and small brood frames at once - is that possible?

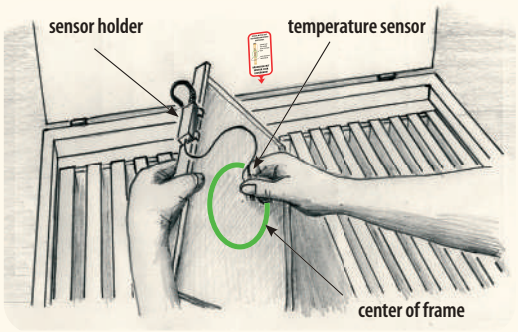
No, that will not work. You shall not mix different frame sizes!
Large brood frames need more heat than small ones. The device only regulates correctly if equal sized frames are treated. What can be done is that one runs a treatment with only small frames - that works fine. Mixing is not possible.

Now you can hang the bee-free frames with the capped brood. You open the lid and hang the prepared brood frames one by one. Make sure that the brood is hung in the preheated Varroa Controller immediately, to avoid colling of the frames. The last frame removed from the hive shall come into the middle of the machine, and takes the place of the empty frame that was holding the temperature sensor before. – this is the frame where you will insert the temperature sensor.



Step 5

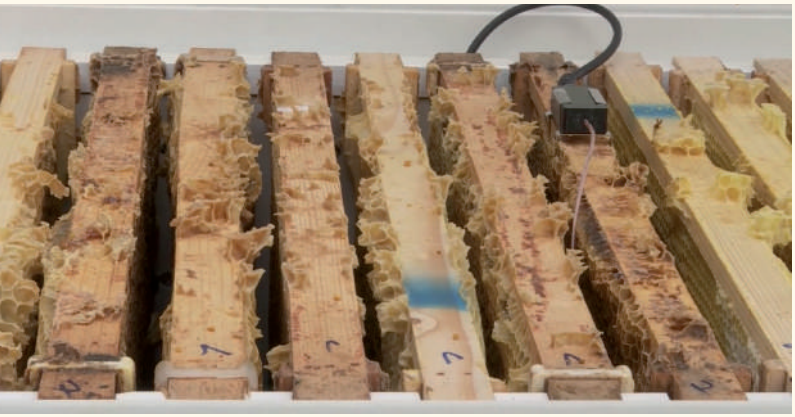
The inserting of the temperature sensor is a delicate step that determines the success of the treatment. If the temperature sensor is inserted incorrectly, the heat treatment will not work properly..

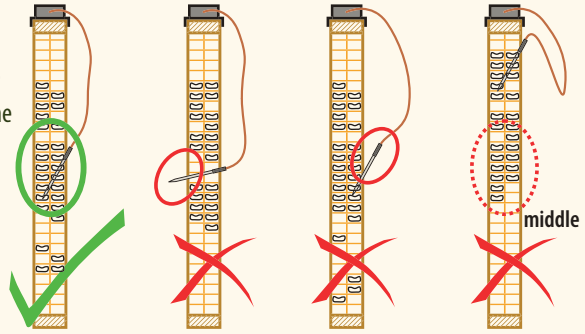


Positioning of the temperature sensor
Source: www.varroa-controller.com

There are 4 points to pay attention to:

1. A well developed capped brood frame
2. The frame with the sensor is in the middle of the Varroa Controller
3. The temperature sensor is in the middle of this capped brood frame
4. The sensor is completely inserted but does not pierce through the brood frame.





Filled device before program start
(Quelle: www.varroa-controller.com)

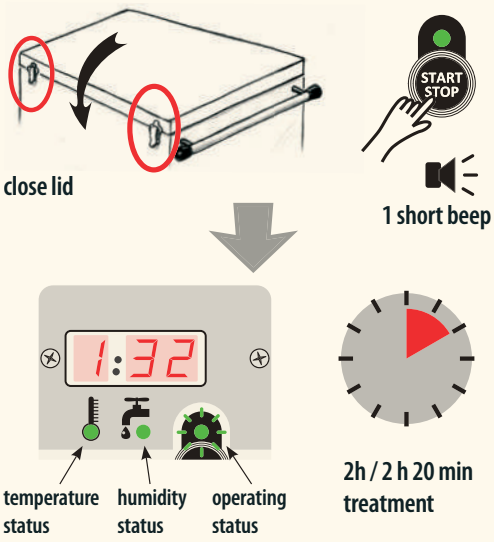
Done! Now the program can start.

Step 6

Once the temperature sensor has been inserted, check again all the brood frames so that they hang straight downwards and not crooked, so that the air can freely flow between the frames. If a thick comb should be a hindrance here, the frame must be adjusted or maybe even turned over. The air flows from the front to the back and it is important that it can flow freely and unhindered between the frames.

After all the frames have been correctly positioned, the lid is closed and the program is started by pressing the start button.

A short beep sounds and the time count down is shown in the display. You can read the remaining treatment time in hours and minutes. The status LEDs are now green. That means the program is working and the beekeeper earns a break.

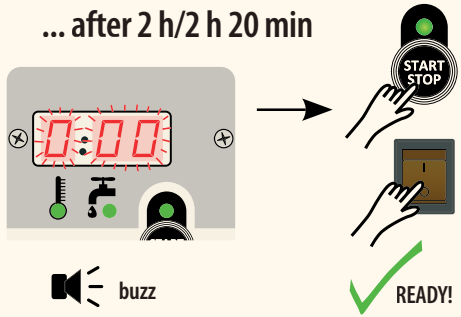


Label the brood frame on the top of each frame

When looking through the brood, I usually mark the brood frames by writing the hive number on the top of the frame. Now when you hang back the frames this is very helpful. I know exactly which brood frame belongs to to which hive.

The treatment lasts two hours with the VC Standard model, and 2 hours and 20 minutes with the XLarge model (for the large frames Dadant, Jumbo, etc). During this time, the lid shall always be closed. Even short-term opening is not allowed.

After the two hours, there will be continuous sound (buzz) that indicates that the treatment is complete.



Now the stop button has to be pressed briefly. This silences the continuous tone.

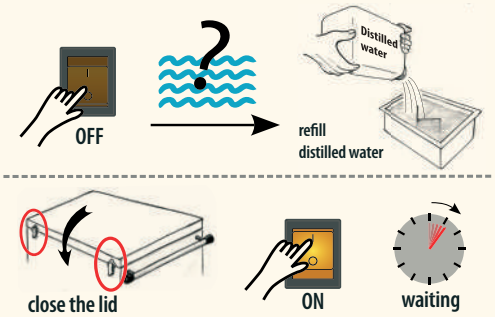
The warm brood frames can be returned to the hives. The nursing bees immediately take care of the brood and with that, the treatment is over. Usually, some bees hatch during the treatment.

Step 7

You now have to decide if you want to do continue with another treatment or not. The water tank holds water for at least two treatments. So if you want to follow up with a second treatment, you can do it immediately. After the second treatment, however, you should check and refill the water tank. When you have finished your treatment(s), you need to clean the treatment chamber.

You must then **empty the water tank!** The Varroa Controller must never be moved with a filled water tank - not even a few meters. Whenever you want to move the device, the water tank **must** be removed first.

It is advisable to run the device briefly with the removed water tank, empty treatment chamber, and in the drying mode according to the instructions in the user manual.



What happens if I forget to refill water between the second and third treatment?

The water level is permanently monitored. The machine shows an error message on the display when there is a low water level. To continue with the treatment simply turn off the main switch. Open the machine, refill the water tank, tank, close the lid, and press the main switch to continue the treatment.

Why is there still water?

After completing two treatments and finishing your work, you remove the water tank and notice that there is still a lot of water in the tank. Did the humidification not work? Do not worry - the humidification has certainly worked well, since the humidity is permanently monitored.

The Varroa Controller is easy to clean, but the rails to hang the frames can collect wax and propolis. Therefore, one can easily remove these rails to clean them outside the machine. For devices that are rented by beekeepers to beekeepers, they should be cleaned and disinfected after every completed treatment cycle to avoid the transfer of diseases.

5.3 After treatment

The brood frames are back in the hives. It will take some time until the bees hatch, and therefore the dead mites to fall off these open brood cells. It is now necessary to clean the Varroa catching trays that have been applied with insect lime, and to insert them to observe the success of the treatment. Depending on the development of the treated bee brood, the hatching occurs faster or slower. But for a maximum of twelve days, the entire treated bee brood has hatched. Experience shows that there may well be another two days with higher mite fall - the cells are still cleaned and cleared from dead mites.

From the 14th day after the treatment, the normal, but now significantly reduced, natural mite drop sets in again.

Brood after heat treatment
Source: www.varroa-controller.com

What if I want to know right away?

If you want to partially open the treated brood right after the treatment to see if the mites are actually dead, then please note that the mites are not dead immediately. Heat shock proteins are formed by the heat, leading to permanent cell damage causing the death of the mite. This happens in the timeframe of 25 to 50 hours after the treatment. So if you want to check please wait, otherwise you might still find living mites.

6 Use of heat treatment in the bee year

In this chapter the three main treatment strategies hyperthermia, for the spring, summer and autumn, are presented. When performing heat treatment as described in these three seasons you will no longer lose hives to the mite.

In principle it is possible to do the heat treatment any time as soon as there is bee brood. The following indications point out times in the beekeeping year, when this is particularly effective to control the mites in a safe way.

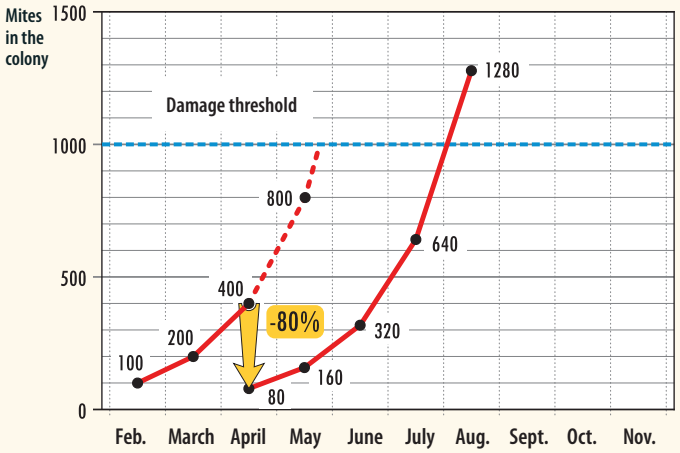
6.1 Spring: clarity from the beginning

In spring the Varroa mite is developing in the brood. We know how it develops and at its growth rate - the population of mites is doubling per month. This proliferation can be "elegantly" disrupted by heat treatment, by killing the fertilized, reproductive female mites in the brood. We also know that 80% of the mites are in the capped brood cells. So this 80% of the mites can be very easily removed and heat treated. We start again from our previous example, with 100 mites in February and can see the effect of heat treatment on this 80% of mites located in the capped brood.

Under normal development conditions of the Varroa mite, it turns out that 100 mites would be 400 mites in April, and the Varroa population would be 800 mites in May. However, if you intervene with a heat treatment of the capped worker and drone brood, you can reduce the Varroa population from 400 mites to 80 mites (The 20% of mites that are attached to the adult bees will remain and eventually will also continue to reproduce). As a result, in May there will be 160 mites and not 800 mites. This is the essential effect that will turn out to be crucial in the further course of the bee year.

Typical food offer in the spring
Source: Wolfgang Wimmer

If no more Varroa treatments were done, these 160 mites in May would develop to 1280 mites in August. Without any heat treatment at all, there would be 6400 mites in August instead. With high probability this bee colony would have already collapsed and, in the worst case, would have also infected other colonies with its mites.



The impact of the heat treatment in spring

When treating the sealed brood, it is important to treat at a time when there is as little breeding as possible but with relatively many mites in the brood. The aim should be to treat a maximum of two to three frames per colony, so that there is a high concentration of mites in these brood frames, and secondly, you will need relatively little time to do this treatment. The Varroa Controller can hold up to 20 frames. 10 hives are thus treated in two hours, when having max. two brood frames per colony. In April there are apiary locations with already many frames with capped brood. In this case, the heat treatment has to be done earlier. Heat treatment can basically be done any time. This advantage will also strike in the later course of the beekeeping year, when it comes to treatment in autumn. The only condition to do heat treatment is having an ambient (outside) temperature of at least 18° Celsius.

Can one also treat the drone brood?

In the literature there are indications of damage to the sperm quality of drones by heat treatment. However, these are referred to a sudden increase in temperature shortly before the hatching of the drones. The warming up of the brood within the Varroa Controller takes place very slowly, and so far we have not been able to identify any problems. On the contrary, some bee breeding stations in Austria and Bavaria use the Varroa Controller to treat the "father" colonies.

If you want to be sure you can count back six weeks (40 days of drone life span and capping stage from the day the queens are brought to the breeding station). This day is the last day that drones should be heat treated. This ensures that the drones that are available for fertilization have grown with the lowest number of Varroa mites, and have not even experienced the heat treatment. This is a very good way of using the advantages of heat treatment for the father colonies as well.

6.2 Summer: work very efficiently with the duplex frame box

Many beekeepers who are interested in hyperthermia can now imagine that they can efficiently perform a heat treatment with the Varroa Controller on a relatively little number of brood frames. Normally, the heat treatment is performed when the newly developed capped brood is spread in two to three frames. Depending on the location this might be around middle to the end of March, but in some locations it can also be earlier. The important thing is that you do not overlook this timing. With the normal capacity of the Varroa Controller for 20 frames you can easily treat the capped brood of ten colonies in only two hours.

But what about summer?

Strong colonies build up a lot of brood during the spring. A bee colony increases fivefold to sixfold from winter to mid summer. In this time of expansion a heat treatment would be very time consuming, since a lot of capped brood would need to be treated. An exception is removing part of the brood for creating new colonies. The capped brood is removed and can be immediately treated with heat before forming new nucleus colonies. These new colonies will have an optimal start without mites.

But back to the productive hives - here there are more brood frames. The pressure of the mites rises dangerously if you wait too long. How can one elegantly solve the issue of treating soon, and not having too much capped brood at the time of treatment?

In beekeeping we are used to think in longer timelines. An action today will only show results in two to three weeks. In addition, we are also challenged to use always resources in a smart way, to get the best out of the bees and ourselves. The issue described above is not much different. If I want to have little amount of brood at a specific time, I have to take action and lay the foundations for it some weeks before.

The theoretical background

As we already know, most of the mites are in the capped brood. It would be particularly clever if we could have colonies with minimum brood at the time of honey harvest. Then we would know that the mites have no other option than to go into this limited brood to reproduce. That´s exactly what we´re going to do, reducing the brood to a minimum at the time of honey harvest. We want the bees to use all their energy to collect honey, and not continue breeding at the time when it already reached the peak of its strength. In old times the beekeepers used to kill the queens, so that the colonies gathered more honey and reared a new queen. But we do not want to go that far.

Essentially this is about making our bee colonies fit, so that they can take care of the brood after the honey harvest (e.g. mid of July) without the Varroa mite being dangerous to them. The changing climatic conditions demand this type of summer treatment since bees find blossom until the end of November. In some places soil enriching plants such as oilseed rape and mustardare blooming even until December due to unusually warm temperatures. Under these conditions the bees then continue to breed, and the Varroa mites continue to reproduce. Therefore, the aim must be to "turn around" the bee year, by eliminating most of the mites in the hives at the time of the honey harvest, and thus ensuring that the colonies are fit for the coming increase of the mite population from July onwards - A doubling of the mites up to mid-August, a quadruple up to middle of September, an eightfold increase up to mid October, and a sixteenth-fold increase in mites up to mid-November.

Under such new climatic conditions the complete removal of mites must take place at the time of the honey harvest, latest by the middle of July. The successful wintering will be decided in mid-July. Those colonies that have a low Varroa population by mid-July can better resist the massive increase of the mite population until the end of the year. Otherwise it is almost certain that these colonies will collapse.

How can you significantly reduce the mite population in the hives by the middle of July, how does that work? In the following section we show how to do that, and how you can get five more benefits out of the proposed procedure.

The duplex frame box

As you might have guessed, to reduce the bee brood you have to restrict the egg laying activity of the queen. For this purpose you can use a frame box, where you can lock the queen for a specific period of time. We developed the duplex frame box as a clever accessory to use in combination with the Varroa Controller.

This duplex frame box is made entirely of a thin aluminum sheet, is very durable, and holds two frames. The lid closes tightly, preventing the escape of the queen when placed inside the frame box. The aluminum sheet is laser cut, rounded at all edges and holes, so that the wings of the bees are not damaged when going through. This aluminum construction allows that the duplex frame box can be cleaned with steam (e.g., in the wax melter) after its use. This is a decisive advantage, as the bees might seal part of the frame box with propolis and wax.

The new duplex frame box
Source: www.varroa-controller.com/dwt

Why a duplex frame box and not a simple queen caging box? This is easily explained: because we want to give the queen enough space for laying eggs, otherwise the transition from full to reduced breeding activity would be too strong. In addition, it should be ensured that there are enough open brood cells for the mites to go in. The mite finds the cells through the smell emanating from the open brood. This is another important argument for offering space for at least two brood frames. In Zander size, two brood frames contain around 12000 cells. When the queen is caged in the duplex frame box for a period of 24 days, she will have in total tthree (Zander) frames with a total of about 18000 cells for laying eggs. Considering that under optimal conditions a queen can lay up to 2000 eggs a day, the cell availability in the duplex frame box is certainly constrained, but it is still more than enough to keep colonies from rearing new queen cells outside the frame box.

The actual application

The three breeding frames are indeed sufficient because the duplex frame box is used beginning from mid summer onwards, when the bee colony is at the peak of its strength ,and is still collecting honey. A duplex frame box is assembled for each managed hive. Then one removes the honey supper and sets it aside. The next step is to find the brood frame where the queen is laying eggs (usually a brood frame where there are fresh eggs and small larvae). One takes out this frame carefully, makes sure that the queen stays on it, and puts it inside the duplex frame box. A second frame, one with only a wax foundation, is also placed inside the duplex frame box.

Then one places the lid on the top and places this filled duplex frame box in the middle of the brood supper. If you work with two brood suppers, then the duplex frame box shall be placed in the middle of the upper supper. Then the honey supper comes back on top of it. This procedure goes very fast, provided you have experience in finding the queen, and of course, when you work with marked queens.

After this you wait exactly twelve days and come back to check the hives, and remove the duplex frame box. You open it carefully and take out the brood comb on which the queen was originally laying eggs. This brood comb is now fully capped, and the frame with the wax foundation next to it has been built, and very likely there are also eggs in it. In place of the original capped brood frame one puts an empty frame (not a wax ffoundation), so that the queen can lay eggs right away. One makes sure that the queen stays in the duplex frame box, and one closes it again to put it back in the same place inside the hive.

The breeding frame that was removed will be treated right away in the (already preheated) Varroa Controller. Once one works through the hives, or has reached the twentieth hive, one can start the heat treatment of these capped brood frames. After the heat treatment it is best to give these frames to nucleus colonies for their reinforcement.

Now you leave the duplex frame box in the hive for another twelve days. At this point, the two brood frames inside the duplex frame box are then the only open brood in the hive. Consequently the mites can be "trapped" in these two brood frames. The honey is harvested from the honey suppers at the end of the second round of twelve days, namely, on the 24th day after the first placing of the duplex frame box in the hive.

The bees from the honey suppers and from the breeding nest are swept into a box or container. The dark, old frames are sorted out, and the frames with stored pollen are placed back in the hive, together with new frames with fresh wax foundations. One can do this work quickly because the queen is still inside the duplex frame box. Finally, the duplex frame box is opened, the queen is placed is a smaller caging-clip or box, and the bees from the duplex frame box are also swept into the box. The two brood frames are placed in the preheated Varroa Controller. Then the adult bees in the box are treated against the mites parasitizing on them, and then put back into the hive. Last but very important, the queen is released and placed inside the hive, and the colony is immediately fed with about six liters of sugar syrup. The whole procedure takes few minutes per hive, and one achieves perfect conditions for the following weeks and months of the bee year.

The advantages of the system

The combination of using the Varroa Controller and the duplex frame box is optimal for the beekeeper, because at the time of the honey harvest the hatched brood of about ten colonies can be easily heat treated in two hours. This is a great advantage, especially when dealing with a large number of colonies. Other benefits can be achieved aside from the time efficiency.

It is very important and decisive to replace the frames where breeding has taken place over many cycles, namely the dark wax frames outside the duplex frame box. These frames can be removed and melted out, and the hive can get frames with new wax foundations, which the bees can immediately build-up and expand. Starting middle of July the colony has a completely fresh combs, which is also very important in terms of keeping healthy bee colonies. As there is no care of the brood for 24 days when using the duplex framebox, the bees collect more honey, and beekeepers can profit from about 20% more harvest.

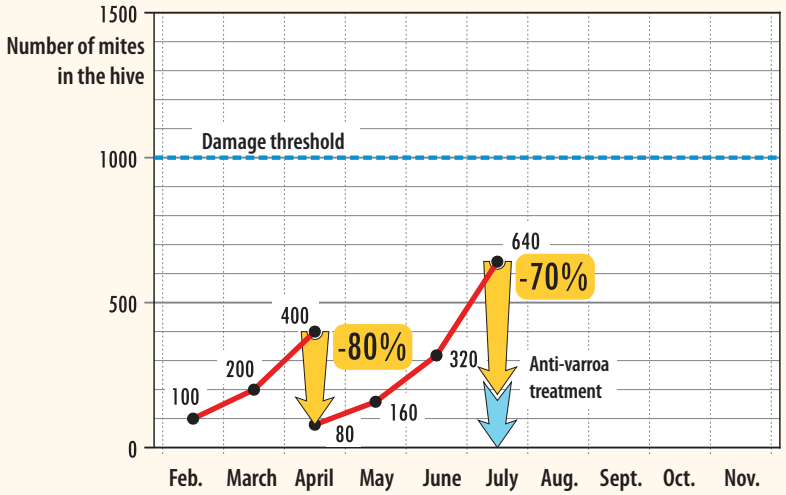
Another advantage is certainly that the two heat-treated brood frames per hive can be used for the reinforcement or building of nucleus. The small colonies used to rear queens in May, which probably have small breeding nests in mid-July, could be strengthened with two such heat-treated brood frames, this means 12000 new bees are added (in the case

of Zander frames) within a period of 12 days. Such as small colony becomes a strong one - this is a real joy to observe.

The key advantage is that, due to the fact that all the breeding frames outside the duplex frame box did hatch during the two consecutive periods of twelve days, and the two breeding frames inside the the duplex frame box have also been removed, the colony is brood free. This allows the beekeeper to remove the remaining mites from the adult bees. The honey has already been harvested, and so the few mites can be treated with the known and permitted methods (depending on the country, e.g., with lactic acid).

Do not be surprised if you do not find many mites because the majority is trapped in the removed capped bee brood, which was successfully treated with the Varroa Controller. This is the cornerstone for the healthy development of the winter bees. The mites were removed; the fresh wax foundations are in place, and the queen that can start laying eggs as there was also appropriate feeding. Now the hives are fit for more months of breeding.

Attention: it is important that you continue monitoring the natural mite fall, as some hives in the surrounding areas might have bees that will bring mites into your treated hives in the next months. As such, it is likely that that an additional heat treatment will be done towards the end of September, or even October in the bee densely populated locations. This treatment can be done relativelly fast, just like the heat treatment perfomed in spring.

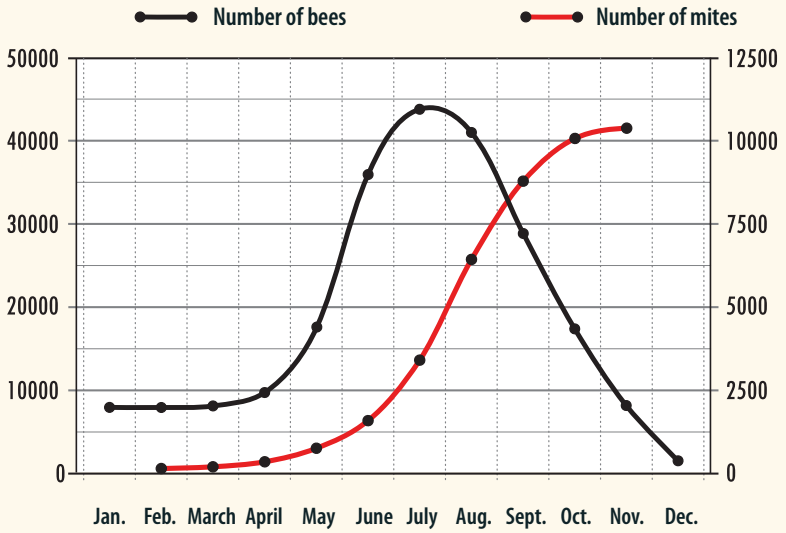


Removal of mites in July by using the duplex frame box

6.3 Autumn: react on time to dangerous threats

The honey harvest is long over, as well as the successful summer treatment with a drastic reduction of the mites. Now one is done with the mites, right? Certainly not, **autumn is a really critical time, one has to be extremely vigilant. Those who do not control and act during autumn may loose everything.**

The number of bees in a colony is sharply reduced in autumn. But when the weather stays warm the bees will continue to breed, although not as much as in the spring, but still enough to give the mites the chance to continue reproducing. In extreme cases the mites continue to double their population each month, but at the same time, the number of bees in the colony is declining. That means that the concentration of mites is higher in relation to the total number of bees. This is very dangerous, because it is different than in the spring, when the number of bees increased faster than the mite population. Although the mite population had doubled each month, by having a faster and larger increase in the bee population in spring, a "dilution" of the mite concentration in the hive did occur.



Development of bees and mites during the year

The bees therefore deserve our attention in autumn, because they might be exposed to a three-fold danger:

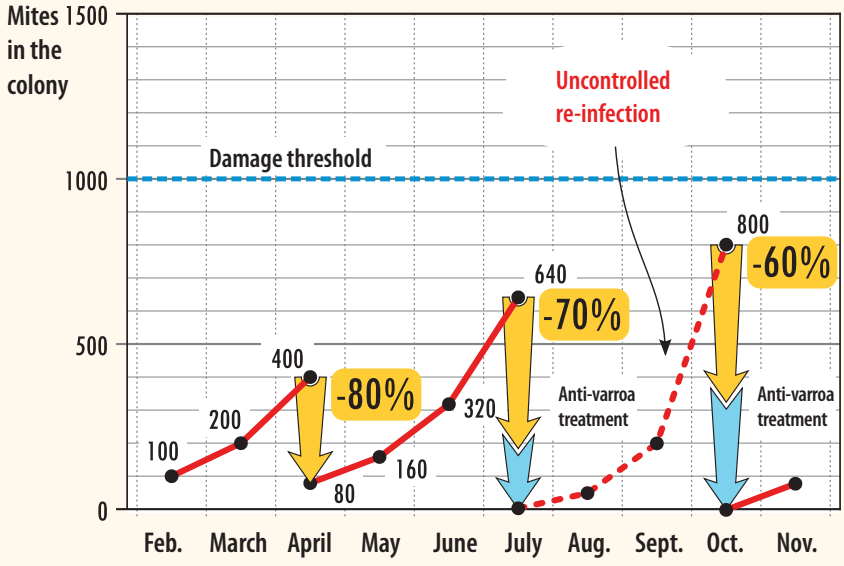
1. Warm weather favors further breeding activity in the hive, and thus the continuous reproduction of the mites.
2. The number of bees drops sharply, while the number of mites continues to double each month.
3. The re-invasion of mites from collapsed and/or robbed hives from the surroundings can also lead to a sudden increase of the mite load within few weeks (i.e., unexpected and uncontrollable re-infection).

The heat treatment of the Varroa proves to be particularly suitable in such a typical autumn situation, especially because it is already too cold and/or too humid for a formic acid treatment in the months of autumn, and the oxalic acid treatment is not effective because of the still present capped brood. In autumn only heat treatment can effectively kill the mites in the brood.

Re-infection: entry of mites attached to bees
Source: Wolfgang Wimmer

Although in autumn there are more mites attached to the adult bees, 60% of the mites are still in the brood. One can simultaneously treat with heat the mites in the brood, and take action against the remaining parasitizing mites on the (winter) bees, aiming at having no more than 3% of mites per colony in October.

Assuming 15000 bees in a colony in October, 3% corresponds to a total of 450 mites. Thus, there is a need to perform another heat treatment, provided the weather conditions in autumn allow for it. This strategy prepares you well for the further breeding activity of the bees far in autumn and winter.



Heat treatment in autumn after re-infection

7 Testimonials - after several years of application of heat treatment

I would like to thank all beekeepers who have accepted my invitation to write about their personal experience with heat treatment. I was happy to get some colleagues who were willing to report their first experience, but also colleagues who have been working with the Varroa Controller for several years now.

7.1 Wilfried Ammon

I learned about Varroa mites in the 80's, when my father was taking care of about 80 honeybee colonies. From the beginning until now, fighting against Varroa mites required applying different methods, and I have also noticed over time how the mites have changed their behavior and adapted. Sometimes I had the impression that the methods used were more dangerous to the beekeepers and to the bees than to the mites themselves. In recent years it has also been discussed that various factors such as warmer winters, poor supply of pollen, decline of bee pastures in meadows and orchards, pesticides use; just to name some of them, have significantly weakened the bee colonies.

That's why in spring of 2011 I was pleased to accept the offer to test out the new equipment, the Varroa Controller. I had the possibilities of making a comparison and evaluate this new device and the treatment, because a part of my 30 beehives I keep in a remote location in the forest.

In the first location (my home apiary) I treated against mites as before, according to the state of the colony development. I applied the method of cutting drone frames, and treatment with formic acid and oxalic acid against the phoretic mites, i.e., all the approved methods.

At the remote forest location (there are more than five other apiaries within the flying distance of my beehives) in early March I put an empty frame for building the drone cells into each of my Zander beehives. My bees were already occupying 10 frames in every hive. I did eliminate these first capped drone frames, and did I put again new empty frames into each colony. At the beginning of April I removed all the bees from the capped breeding frames and did the heat treatment with the Varroa Controller.

The bee colonies were not disturbed by the fact that during the two-hour treatment they were missing some brood frames. During the treatment I replaced the outer empty frames with food reserves, and I had time to clean the bottom of the hives.

Wilfried Ammon, Head of the beekeeping group Zirl in Tyrol, working with the Varroa Controller since early 2011.

Works as queen breeder from the line Carnica Peschetz
Location of bee hives: Tyrol
Number of colonies: 30
He is devoted to beekeeping since his childhood
Frame type: Zander type with Hoffman side parts.

Carnica Peschetz queen line from 1956
Source: Wilfried Ammon

Like every year, this time I managed to do a spring inspection in one day, and now in addition, I heat treated the brood frames with the Varroa Controller. I could observe that the daily natural mite fall increased already two days after the heat treatment, and continued for a few days while new bees were still hatching. As during the first heat treatment the second built drone frame was fully capped, I did another treatment with the capped drone brood, and the rest of the newly capped worker brood frames a few days later. Over the following few days a daily mite fall in the order of up to one hundred mites per day was not a rarity. In the conventionally treated colonies the mite population was steadily rising, but the natural daily mite fall remained remained approximately at the same level.

The amount of work with the Varroa Controller in spring was not significantly higher as compared to other treatment methods, considering that I also performed a full spring inspection of all colonies at the same time when the heat treatment was running.

Now I can look back at more than four beekeeping seasons using the Varroa Controller, and I am convinced that this method of treatment will become more and more important, as more beekeepers are considering how to keep their bees with natural means and without the use of conventional chemicals to kill the mites. The Varroa Controller has been bought for our beekeeping association, and every beekeeper in the association can use it. Each treatment with the Varroa Controller is free of charge for them.

It is always a nice experience to observe how quiet the bees are after the heat treatment, their cleaning behavior, the feeding, and the performance of the queen improves within each treated colony. The treatment of the first capped brood frames with the developing worker bees in the spring results in to much less parasitized drone brood frames, and some of them may not need to be removed and eliminated at all. The brood from treated hives hatches and develops normally. The bees which hatched just during treatment inside the Varroa Controller will be put back into their hives together with the treated brood frames.

I leave the drones frames to hatch when there is only a low number of fallen dead mites on the monitoring tray after heat treatment, so that they can mate with young queens, and to keep the natural harmony of the bee colony. Each beekeeper should, however, control the natural mite fall and consider whether further heat treatment with the Varroa Controller is necessary, and whether or not it is good to let the number of drones in a beehive increase. In the spring some beekeepers put an empty frame as a building frame in the hive, and remove it completely after capping, immediately replacing it with a half-frame as a drone frame. The half-built frame is an empty brood frame that does not have a built half comb. The drone brood that grows in that lower part can be, either heat treated with the Varroa Controller (and allowed to normally hatch), or it is cut out before hatching. In this way, spring heat treatment and the subsequent removal of the capped drone brood towards the end of April (depending on the location), can reduce twice or up to three times the population of the mites.

According to my observations, in rare cases after heat treatment with the Varroa Controller some hatching bees are immediately removed from the hives. These bees have been infected with mites before being born, and are not viable. When observed under the microscope they show breakthrough development and malformations (Deformed wing virus – DWV), which are caused by the Varroa mites, and not by the heat treatment itself. In my view, possible virus infections of such dead bees should be scientifically investigated, as some bee colonies naturally have higher Varroa sensitive hygienic behavior, and heat treatment of the brood could strengthen this behavior even more. In some cases earlier hatching of adult bees) from marked treated frames could be observed (before the calculated date 21 days) but this did not lead to any negative effects.

As any recommended treatment against Varroa mites, the purpose of heat treatment is to significantly interrupt the reproduction cycle of the mites in a hive, and keep the pressure of the mites at a low level. The possibility to treat the capped worker brood cells with the Varroa Controller already in spring allows the colonies to become Varroa free already before the first capped drones are available in the colony. These hives can grow much

healthier, and have enough bees and brood to form new colonies.

The Varroa Controller provides a very good opportunity to create several new colonies with the heat treated brood frames. The basic requirement for the creation of new colonies is the existence of healthy and strong colonies that can continue developing normally (even without brood frames and young bees taken out). A corresponding number of young mated queens should also be available at this time. In particular, an isolated suitable location minimum 5 km away from the current location of production colonies is preferred.

One or more excess brood frames can be taken out from the healthy bee colonies. Adult bees from different colonies are brushed into a swarm box, and are treated against the mites attached on the adult bees with an approved method. In the meantime the fully capped brood frames without bees are treated in the Varroa Controller. Subsequently, the bees and the brood frames are distributed into few new colonies, and a young mated queen is added to each of them. These young colonies are fed with a sugar pie and transported to a distant location.

It has been shown that the Varroa Controller provides good service for the queen breeding and care colonies. These colonies are treated twice before the breeding starts.

I was often asked by neighboring beekeepers how to treat a large number of colonies with the Varroa Controller, since beekeepers think that treatment against mites can only take place later in the summer, and by then there is a large number of brood frames that would need to be wiped from nursing bees before taking them for heat treatment.

Heat treatment is acid-free involving only heat and water, so it is possible to carry out the treatment as early as spring, as soon as there is capped brood. Often treatment is a question of correct time planning. Since there is always a lot of other work to do at the apiary, I first prepare the brood that needs to be treated, and then I do all other necessary work, while the brood frames are heat treated inside the Varroa Controller.

Whereas treatments involving evaporation of acids require constant checking for appropriate outside temperature, heat treatment provides greater opportunity to maneuver, even during rainy days.

I see the great advantage of heat treatment in that the treatment can be done as soon as the capped brood is available, in spring, and even in autumn. At these times, a smaller number of young bees are present, and no disturbance occurs during the withdrawal and preparation of the brood frames to heat treat (wiping off the nursing bees into the original hive).

The basic requirement is however, that the beekeeper is ready to work with the bees, and regularly performs the monitoring of the natural daily mite fall.

7.2 Konrad Gwiggner

In autumn 2011 I purchased the Varroa Controller. My bees, strongly attacked by Varroa, survived that winter but were too weak, and had to be merged together. Without the Varroa Controller they would have died. That´s how I started the year 2012, with six bee hives, and I increased this number to nine in spring. The year 2012 was very positive for my bees without extraordinary events and no losses.

The year 2013 was again a special year. The forest honey came at the end of July, and stayed for a long period. I have treated my bees twice with the Varroa Controller before the first honey harvest. After the first large harvest of honey I did another treatment with the Varroa Controller. The forest honey did continue, and there were three more harvests that would have never happened without the Varroa Controller.

Konrad Gwiggner – In spite of treatment with formic acid, his bees faced strong infestation with mites. In 2011 he managed to save his colonies thanks to using the Varroa Controller, and since then he is working with heat treatment.

Location of bee hives: Tyrol
Number of colonies: 9 colonies
Type of hive: Zander type with Hoffman side bars

Using chemical treatment would have hindered me from harvesting, because of the application of chemicals to the hives, which means no harvest allowed afterwards.

From my experience in recent years I know that September is a critical month, especially its second half. Mites are found in large numbers in the beehives. I do not want to open a debate about re-invasion, and the beekeepers doing poor or not treatment to their hives at all. Both cases are a reality, and I have to deal with them. If the weather is still warm, as it was in 2014, I can still do heat treatment with the Varroa Controller.

This was not the case in 2013, so it was necessary to use Bienenwohl (A preparation with oxalic acid, citric acid, propolis, alcohol, and essential oils) by the end of October. However these 2013 measures were sufficient to winter all my beehives and continue in 2014.

My fellow beekeepers spoke already in April 2014 about bees with crippled (deformed) wings. Until the beginning of July, many of them have lost large numbers of hives (sometimes more than half of them). The year 2013 left many mites in the colonies, which could further reproduce afterwards in early spring and in the summer of 2014. These colonies collapsed already that late summer. I think we have never experienced a year like 2014, with such a strong pressure from the mite infestation in our region.

While I have strong bees, it is sad to listen to my fellow friends and listen about their colony losses. No more losses, and only joy with my bees - this is my motivation to continue using the Varroa Controller.

How much more work is really needed?

If I look at everything that needs to be done nowadays to keep the mites under control, so that beekeepers can continue harvesting high quality honey - cutting out the drone brood, removing all brood, applying formic acid or Thymol treatment to have partially satisfactory results (otherwise only dead hives which need to be clean), then creating new colonies, and breeding of additional queens; I think that working with the Varroa Controller is quite easy.

I no longer have losses due to the mites. I will be selling beehives to make room for new colonies in the spring of 2015, and hopefully convince several colleague beekeepers about the benefits of heat treatment.

Another argument that nobody dares to say or admit is the price to buy the Varroa Controller. No beekeeper wants to admit openly that the cost of this equipment is too high for his bees.

I have to say that it was also my case. I considered the arguments from both sides when I came to the conclusion that, either I buy this expensive device, or I would have to give up my hobby because I could not find another way to keep the mites under control.

Now, after a few years with this device, the situation looks completely different - everything works and the bees stand the heat treatment very well.

If I would have not bought the Varroa Controller, I would have had to buy another 15 colonies. Without the Varroa Con-

troller in 2013, I would have harvested honey only once, and I would have 132 kg less honey than what I actually harvested. If you multiply 15 productive colonies by 120 Euro (the price of a new colony), plus 132 kg of additionally honey sold, for say 12 Euros per kilo (I usually sell it for 13 Europs/kg), altogether this is 3884 Euros, a much higher revenue than the cost of the Varroa Controller itself. Therefore, the money I obtained that year from my bees, thanks to using the Varroa Controller, was more than the investment on purchasing the device (which I am still having and using afterwards, so it has paid itself).

What do I like the most?

I do not weaken beehives by removing the brood, interrupting the queen breeding nor losing the queen, or by launching a robbery. When I put the heat treated brood frames back to their colonies, the bees immediately take care of the brood and life goes on. The only difference is that the mites in the cells will die, and the bee hives therefore have the best chance for further development. It's a great feeling to strengthen the bees!

I wish all beekeepers would seriously practice Varroa treatment from spring to autumn. Hyperthermia with the Varroa Controller is, in my opinion, the only solution that works at 100%. If we all use it then we can save additional treatments, because we will not allow mites to go so far in May and in June.

I wrote my own experience and conviction. I can 100% recommend this heat treatment device.

7.3 Werner and Fabienne Kron

Dear friends of bees

We all desire that bees survive, because this insect is part of nature, and plays an important role in it. I've learned a lot about beekeeping over the last 50 years, but not everything. I experienced the beginnings of the fight against the Varroa mites, and used organic acids. At the start we were successful with using them, and for a few years it was possible to have good results. Then I had to destroy all my colonies because of foulbrood, which almost broke my beekeeping heart. I started with a single bee hive, and in the first year I harvested 110 kg of honey from this big beehive. This colony did die that same winter, and fortunately, I made some new colonies from it.

I found the Varroa Controller in 2013, and it was my hope to finally have a solution to the problem of the mites. In the same year, I helped in further developing the electronic control unit of the Varroa Controller. This new electronic unit works perfectly, and we have achieved very good treatment results.

Observing the hives from a female colleague active in organic beekeeping, I realized that my bees were missing something compared to hers - she had far more beautiful colonies than mine. It was clear to me that I was neglecting the effect of poisonous substances stressing the bees through the winter feeding. I have been thinking a lot about what I put my bees through. Then I found information about sugar beet on the website of a chemical company, describing the kinds of chemicals that can affect the quality of sugar beets, starting from seeds to their harvesting. I was concerned and immediately shifted to organic sugar. Subsequently, I managed to extend the number of colonies to 8. Thanks to the Varroa Controller, and to the elimination of all chemicals from winter feeding, I have very nice beehives.

Since then I practice beekeeping together with my daughter Fabienne, who was very enthusiastic about using the Varroa Controller from the very beginning. Concerning this testimonial about our experiences, we discussed many

They no longer want any chemicals in their beehives.

Place of Apiary: Emmental / Switzerland
Number of bee hives: 10
Beekeeper since: 50 years
Type of hive: Swiss hive

essential things, and took it very seriously. Fabienne has put together several important arguments. I am proud of this young beekeeper woman, who walks bravely on her own journey, and as such, we would like to share with you the following aspects.

Host - Parasite relationship

The parasite is constantly benefiting from its host by taking nutrients or using its body as the optimal environment for its life. The presence of a parasite can damage its host. Damage often comes from the metabolic products of the parasite, which can lead to poisoning or a serious damage to the cells and the organs of the host, possibly leading to its death. The relationship between mites and bees is an exception. The mites hurt the host (a bee colony) so that the host soon dies. But the single mite behaves much more like a predator, than just a parasite. One animal hurts the other for a short period of time until it dies, because the next host in very close and available (the next single bee) in the same colony. The mite therefore behaves like a parasite only with respect to the whole hive, the unity that is damaged by the mite. It is not in the interest of a single mite to immediately destroy the entire hive. Mites spread across several colonies before they completely destroy an entire colony. Its spreading to hives leads to its survival, to the preservation of its own species.

A honeybee colony

The honeybee colony lives collectively. An individual is part of a complex survival system. The will to survive is collective, just like the way of thinking and procuring food. All processes are simply collective, and serve the higher goal of the survival of the whole population. The colony must therefore be strengthened as a whole. The poison damages the queen and the bees, because it is only after poisoning that we observe disabled, lifeless bees. But what kind of effective alternative solutions can we think of? One wants a hundred percent effective method that bring immediate results. One feels the time pressure, and one believes in miraculous chemical means, but one forgets the collectiveness of the bee hive. It would be more meaningful to create an appropriate ecological space for bees, in which they do not necessarily live under optimal conditions, but where they have a significant advantage over the parasite. It is important to find a way to activate the limiting factors for the parasite, at the same time, with the least influence to the host. So, wherever the host and the parasite respond to a stimulus with different sensitivity, something has to be done to use this stimulus to benefit the host, and increase its survival opportunities. So the host can defend itself, and learn with defensive memory. Over time, the host learns how to deal with the parasites without a human, and the result is based on evolutionary adaptation and environmental advantages (or disadvantages).

The Varroa Controller and the heat treatment

Heat treatment is therefore effective because the bees tolerate higher temperature better than the mites. This means that bee proteins begin to decompose (denaturalize) at high temperatures. Conversely, mites cannot tolerate the heat – their decomposed proteins cause their death.

The heat kill mites in all its reproductive stages. Only the mites that are attached on the adult bees stay still alive in the hive. It is not possible to heat the entire beechive, as bees will always control the temperature - of course collectively acting as one organism.

As the bee larvae tolerates a higher temperature, the mite will not survive it. The bees can learn how to defend against the mites. A prerequisite for the natural eradication of mites is that, the queens as an organism, can gather such experiences.

Humans are not able to improve or replace nature, but the nature, maybe, can replace humans (that is what we are afraid of). Sometimes we want to be more, and possibly do more, so that something good happens. But we should also learn how to not interfere, so that it turns better. This is extremely difficult, it make us feel helpless because as it makes us feel helpless because of not doing things.

Just like the bees, we humans are also a part of something bigger.

With a hearty bee hive greeting
Werner and Fabienne Kron

7.4 Konrad Tabojer

When it was known that residues from the chemical treatment by Apistan stripes used to fight against mites were accumulating in bee wax, I found a solution that involved constantly cutting out the drone brood. It meant hanging three to four times a drone frame, then removing the queen from the colony at the beginning of July, and creating a brood free colony for two to three weeks. I was able to work this way from the beginning of 1990 to 2002, without losing colonies.

Then the first problems occurred, and I had to admit that these measures I have applied so far were not enough.

I had to additionally do a formic acid treatment. What sounds fairly common, has become a big problem for me, because in my region for the main treatment against mites already in July, respectively early August it is simply too early in my region. In my area, there is an extensive nectar flow during the late summer. On the other hand, waiting until mid-September, or until the end of the breeding to apply the formic acid treatment was too risky and late. Moreover, such a strong substance is a massive disturbance to the colony system, which is very opposed to my beekeeping will.

After several bad years, I decided to stop my beekeeping practice in 2008. But soon I discovered that I could not live without bees, because I had been around bees since I was a six years old boy.

Soon I started looking for ways to keep the mites in check. I encountered the Varroa Controller, which was just new on the market. My desire to have bees again finally helped me make the decision for this new, and not just cheap device.

In 2010, I started beekeeping again, bought three Zander hives and two new colonies. By the end of July I had treated my hives twice in ten days. A number of mites fell down: after first treatment approximately 1000, and after the second treatment, still around 200 mites. In mid-August, the natural daily mite fall was zero.

I was happy, because in September I was able to take another 25 kg of honey from each of the hives, and leave enough honey in the beehives the winter period. But at the end of September, the natural daily mite fall grew up again slowly. However, I did not do any further treatment because in the spring I had planned a proper treatment of the colonies against the mites.

Nevertheless, one of my three colonies was a victim of mites, or rather of my enthusiasm from having the Varroa Controller. But one learns that the situation is different each year. The monitoring of the tray placed at the bottom of every hive for natural daily mite fall is currently accompanying me, because it does not help me if in September the hives have almost zero mites, but the hives of other beekeepers are collapsing and are robbed by my bees (which then bring mites to my hives). This was also the case this year (2014), when the mite numbers were climbing up from zero mites per day at the beginning of September to 10 to 15 mites by the 20th of October. It is therefore necessary to constantly monitor this development and to have the method, and the instrument to efficiently fight against mites even in the fall.

Changing climatic conditions, and cultivated oilseeds in agriculture such as mustard, buckwheat, and phacelia (blue tansy) allow the bees to bring pollen and even nectar until the end of November. I use the Varroa Controller again, when I find out in autumn that the natural daily mite fall is too high. I treat my hives twice every 14 days, and I can catch the mites, which were on the adult bees at the time of the first treatment, because during the second treatment (after 14 days from the first one) they are locked in the brood cells, so I don´t miss them.

The last treatment with the Varroa Controller I did this year was on October 30th, with three (!) brood frames from each colony. I once again treated the bees with powdered sugar in November.

Until today (December 12th, 2014), the bees are not yet brood free, and have a natural daily mite fall from 1 to 3 mites per day. However, all the bee hives are very strong, with six to nine frames across the two Zander supers. I am not planning any further treatment at this time. Since I've been using the Varroa Controller, I have no winter losses other than to my first year with the Varroa Controller.

The time consumed, which many people are constantly criticizing, is for me as a hobby beekeeper with six hives, negligible. Moreover, for me the possibility of another honey harvest in September is a great advantage. Since the efficiency of the treatment is very high, the time and material costs of creating new colonies are eliminated - with the exception of those colonies created for sales. In addition, my queens have significantly longer lifespan - my oldest is four years old.

Konrad Tabojer is happy that the Varroa Controller allows him the possibility of a late honey harvest.

Place of apiary: Solenau near Wiener Neustadt
Number of bee hives: 6
Beekeeper since: his childhood
Type of hive: Zander type

Kurt Tratsch considers the Varroa Controller to be a central element of organic keeping of bees.
Place of apiary: various locations
Number of bee hives: 210
Organic certified
Beekeeper since 29 years
Frame type: Zander

7.5 Kurt Tratsch

My name is Kurt Tratsch, and I am glad that I can contribute to this publication. I am a professional beekeeper. I have been working with bees for 29 years, and since 2005 I do it professionally.

Together with my wife, we are currently keeping around 210 colonies. The number varies, but I am convinced that it is particularly important to us that we have taken a step forward by fighting varroa mites in a natural way, without the use of any chemicals.

What really helps us is the Varroa Controller. In connection with the Duplex frame box, we have no problems to keep the Varroa mites well under control.

However, I have to say that we use diagnostic trays in our hives throughout the year, and the first thing I do when I come to an apiary is that I pull out the tray, and check how many mites have fallen. It not unusual that we find no mites in one hive, whereas three hives away, we find 7 mites. So what is essential in the control of the varroa mites is that we diagnose the colonies. I consider that as the most important thing in today´s beekeeping. Only if I know what's going on in my hives, then I can act accordingly. The possibilities are fully open with the Varroa Controller.

There is nothing easier than, once I see that the Varroa pressure is quite high, to take capped brood frames from the hive, and to put it inside the Varroa Controller to do the heat treatment. I collect the brood combs and take them home, in the case I don´t have the Varroa Controller with me. Then, I treat them in the Varroa Controller at my home apiary, and I observe the colonies where I insert the treated frames.

To create new colonies without the mites is also very simple. To these brood combs, which I have previously treated in the Varroa Controller, I add about 1 kilo of bees which I previously treated against mites with, for example, oxalic acid – so I get rid of the mites attached on their bodies. In this way we have the opportunity to really give the new created colonies a good starting position, as they have a very small number of mites, and a new queen is added, so the colonies can develop accordingly.

I have 11 different locations for my hives, one is in Lower Austria, this is the remotest apiary with about 127 km away from my home, and all others are around 30 km around my home place.

With my wife we treat about 30 bee colonies with three Varroa Controllers per day. That works out without any problems, when there are only 3 to max. 4 frames of capped brood. So the timing is very, very important. I'd even say, it is most relevant for a good colony development in the early spring, and also for the end of the year. The better I work at the beginning, the better results I have over the whole season. Obviously, as I have already wrote it, I have to keep monitoring, because not all colonies are the same, not all colonies develop the same way. There are always some which lag behind, or

there are some who simply explode, when there is a very good queen. So in any case, it is absolutely necessary to keep observing.

In summer, it is very, very important to have a limited breeding nest. I work with the regular Zander frames, and I keep only one brood chamber with 10 frames. In June I isolate the queens to lay the eggs only in the duplex frame box for a period of 2 times 12 days, so I can easily treat only 1 or 2 capped brood frames per hive, which makes the work with the Varroa Controller very efficient. Because there is no other brood in the hive at that time, it is also quite easy to carry out the treatment of the remaining mites, which can then be done with lactic acid, or with oxalic acid, or any other substance that is approved. After the heat treatment, depending on the colonies' conditions, the frames either come back into the hives, or they are used as brood frames for new colonies. In this way, I have the certainty that I have killed 90% of the mites in each colony. In mid-summer I have the mite infestation very well under control.

And in autumn, and in the late autumn, when there is no breeding anymore, then of course we have to treat the remaining mites again with with any approved substances.

I always say, no matter if I have 20 bee colonies, 50 bee colonies or 100 or even 200, I'd say even 300, you just have to be alert. You have to create a work plan that specifies which steps to take and when, and this concept has to be continuously pursued. Very, very important once again, is the monitoring. To know what's going on in the bee hives. Only if I keep checking, and I know what is going on with my bees, then the results are so that the hives are full, not just with bees, but also with honey. In this sense, I wish all the best with the Varroa Controller and the duplex frame box.

Friends, it works!

7.6 David Ratzberger

As an organic certified beekeeper I've been looking for a method to tackle the problem associated with the mites. I came across the Varroa Controller at a rental location in Upper Austria, and wanted to try it out. The tests were very positive and I was convinced to buy it. I got some other beekeeper friends convinced for this idea, and together we bought two Varroa Controllers. Since we all have many colonies, we have chosen to use the device in such a way that each of us has access to both devices at the same time, to be able to treat 20 to 30 colonies in one day.

The spring treatment can be done very easily. For the summer treatment, I use a duplex frame box to isolate the queen on two frames. I do this in all my 75 colonies. This means that even a large numbers of colonies can be easily treat with with two devices at once.

The practical application begins 24 days before the last honey harvest. It is essential to have the queens marked, to easily look for them. Selected capped brood frames are treated with the Varroa Controller, and after the heat treatment, they are used to strengthen the new colonies.

On the 24th day, I take out almost all mites that are locked inside of the capped cells of these two capped brood frames. In addition, I take out old frames without brood and treat the bees with oxalic or lactic acid, so I can also get rid of the mites attached on the adult bees at that same time. Then the bees removed from the mites are swiped over the freshly built combs with pollen and honey reserves, and returned to their original hives. The queen is placed in the center of the brood nest, and the sugar pie is placed on the top of the frames. The advantage is that bees are rapidly crowded together. The brood frames are taken out, and again heat treated with the Varroa Controller, and thus the new colonies are strengthened.

The combination of the Varroa Controller and the duplex frame box is very valuable to me, as it brings several advantages:

- The performance of the queen is very well assessed from observing the brood in the two brood frames. I am exchanging about a third of my queens at that time. Acceptance of new queens runs without problems, as bee colonies are brood free.

- It is possible to get 5 to 6 kg of additional honey per hive, because bees do not have to take care of so many breeding cells, and instead they can fly more to collect nectar.

- The complete renewal of the brood nests with new wax is possible, as the basis for the bee´s health.

I achieve that my bee hives are completely treated in July, and they can further develop a healthy generation of winter bees during the late summer / autumn. In my beekeeping I follow the organic principles, so it is important for me to keep my hives free from foreign substances, and that the combs are constantly renewed with my own wax without any residues. I have been using the Varroa Controller since 2012, and I am very happy with it.

David Ratzberger likes the combination of restricting the brood with the duplex frame boxes and using heat treatment.

Place of apiary: Behamberg / Upper Austria
Beekeeper since his childhood
Number of bee hives: 75, organic certified
Type of frames: Zander and Dadant types, with low honey suppers

8 Everyone profits

The heat treatment against Varroa mites brings a number of benefits to beekeepers, bees and, ultimately, consumers.

The most obvious benefit is that we now have a device and a method that can be used against mites any time during the beekeeping year (any time when there is brood, in spring or even in fall).

Late honey flow: sun flower
Source: Wilfried Ammon

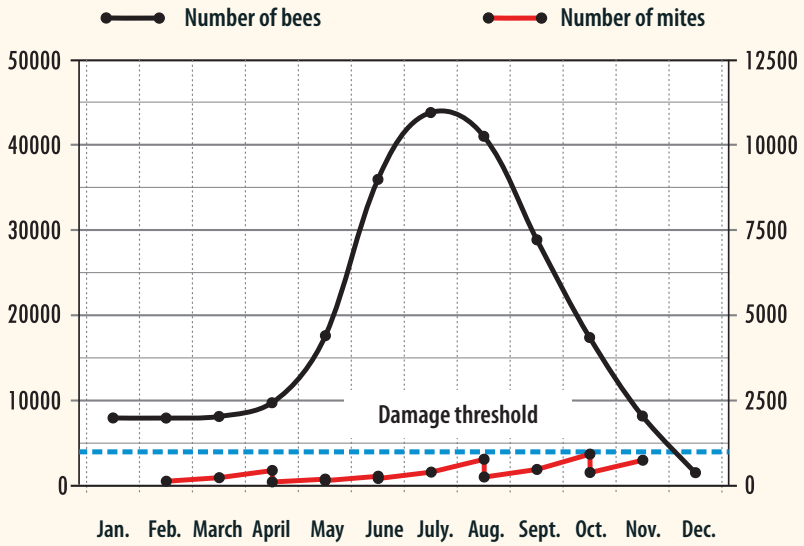
The second big advantage of this treatment is that it is done without chemicals. This means that there is no risk from occupational injuries. Moreover, the bees do not get in contact with any chemical products.

On the side of bees, it means that there is no growth of resistant mites. From the side of honeybee products, it is ensured that no residues of chemicals remain in the wax, propolis, or honey.

A third advantage relates to the method itself, since heat treatment against Varroa mites has guaranteed results after each treatment. Formic acid treatment is often difficult to predict, as it depends to a large extent on the outside temperature and humidity, and oxalic acid treatment shows result after up to several weeks. Heat treatment instead shows a reliable result within 12 days. In addition, heat treatment can be repeated at any time. With chemical treatments, this is very limited. Repeated use of Formic acid can lead to queen losses, and multiple use of Oxalic acid on the same generation of bees causes their poisoning.

Most importantly, the heat treatment is most effective where most of the mites are found, namely, on the bee brood.

There is another advantage from the economic point of view, it is possible to secure a late honey harvest. If the colonies with a small brood size are already treated in spring against the mites, there is still enough time to wait before treatment in summer, and harvest late honey flows. The conventional beekeepers working with organic acids usually. The harvest has to be done much earlier, because of the higher pressure of the mites.



The ideal course of a successful Varroa strategy with heat treatment: the Varroa population stays below the threshold of causing damage to the hives.

I am hoping that you find a way for you and your bees to take advantage from heat treatment against mites and give the mites no chance! In this manual we explained the the successful strategies to stay below the damage threshold throughout the beekeeping year.

However, staying below this threshold can only be achieved if you break the reproduction of the mites, by using heat treatment at the optimum time. Then you can keep the mites really under control, buts it is also imperative that the entire population of mites is constantly monitored and controlled, as described in this handbook.

I wish you success in this work.

Have you inserted a Varroa mite monitoring tray?

Wait! Do not forget to put insect lime against the ants.

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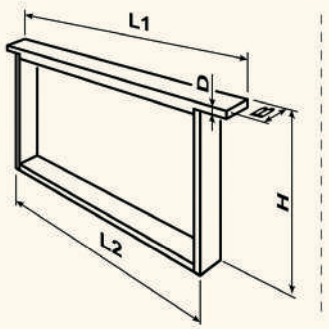

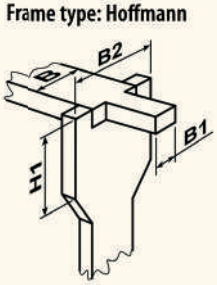

www.varroa-controller.com

A new method was needed to give Varroa mites no chance to harm the colonies, and which would be easy to use anytime during the entire beekeeping season.
This publication allows the beekeepers to get familiar with heat treatment heat treatment - a new method against the Varroa mites without the use of chemicals.

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