Véto-pharma
Committed to apiculture

veto-pharma.com

VARROA GUIDE

SECOND EDITION

Second edition, January 2020

For any inquiries: info@vetopharma.com

CONTENTS

VARROA: WHAT ARE VARROA MITES AND HOW DO THEY AFFECT HONEY BEE COLONIES ?

> *Varroa destructor* is an acarid mite present in the majority of colonies throughout the world. They represent a major threat to honey bee health today.

New research indicates that Varroa feeds on the fat body of honey bees, not on their haemolymph as previously assumed.[1] This feeding weakens and eventually kills the insect. For example, parasitized bees have a lower body mass than others. Their nutritional reserves are decreased, as are their immune defenses.[2]

When the mite feeds on the bee, it pierces the bee's cuticle and holds the wound open with its lateral lips. This **allows a variety of viruses and pathogens to invade the bee's body.**[3] The weakened and infected bee develops a complex disease called Varroosis.[4]

LIFESPAN REDUCTION

The life expectancy of infested honey bees is shortened by Varroa mites, creating a serious problem for winter bees that must survive until spring when honey bee populations normally increase.[5] **Studies have found that winter colony losses increase with higher levels of Varroa mite infestation.** Losses can be expected even at a three percent infestation or three fallen mites on the sticky board in December[6], and can increase rapidly with higher infestation levels.

DEGRADATION OF THE BEE'S ACTIVITY

Honey bee activity levels are reduced by Varroa:

- Varroa parasitism decreases the learning ability of foragers, which impairs flight behavior, orientation, as well as success returning back to the hive.[7] In infested colonies, foragers take longer to return to the hive, and losses of foragers are increased. Some workers do not die outside the hive, but return to the wrong colony, increasing honey bee drift. Drift increases the transfer of Varroa mites to neighboring colonies.
- Heavy Varroa infestations will also increase colony queen supersedure (replacement of the old queen), and can also affect recently fertilized queens that are introduced into the colony.[8]
- Parasitized drones have the ability to fly, but sometimes their sperm production decreases, making them less active in reproduction.[9]

VIRUS AND PATHOGEN INOCULATION

***Varroa destructor* transmits a variety of pathogens when it punctures the bee's cuticle.**

Both parasitized bees and Varroa mites may contain one or more of the following viruses:

- *Deformed Wing Virus* **(DWV)**
- *Israeli Acute Paralysis Virus* **(IAPV)**
- *Acute Bee Paralysis Virus* **(ABPV)**
- *Kashmir Bee Virus* **(KBV)**
- *Chronic Bee Paralysis Virus* **(CBPV)**
- *Slow Paralysis Virus* **(SPV)**
- *Black Queen Cell Virus* **(BQCV)**
- *Cloudy Wing Virus* **(CWV)**
- *Sacbrood Bee Virus* **(SBV)**

DECREASE IN HONEY PRODUCTION

As it might be expected, colony honey production is also reduced by Varroa pressure. A study conducted by the French technical institutes ADAPI, INRA and ITSAP, shows that in early lavender flow, an infestation rate of three mites per 100 bees is sufficient to significantly reduce the production of lavender honey by the colony. The honey loss can be as high as 11 pounds per hive in a typical year, and as high as 28 pounds per hive in some years.[10]

> Deformed Wing Disease (DWV) is the most visible virus in Varroosis due to its obvious symptoms. It is transmitted by *Varroa destructor* in more than 90 percent of apiary stocks, and is also found in more than 60 to 90 percent of adult bees, and in 20 to 60 percent of pupae.

This transmission is worrying, since the weakened immune system of the parasitized bee is more susceptible to viruses than a healthy bee. **Deformed Wing Disease is transmitted by Varroa destructor in more than 90 percent of apiary stocks.It is also found in more than 60 to 90 percent of adult bees, and in 20 to 60 percent of pupae.**[11] An examination of affected worker bees will show wing and body deformities. Infected bees die prematurely and cannot perform all their tasks. Larvae will also show evidence of deformities. Emerging bees are often unviable, and die soon after emergence. Worker bees will eliminate these damaged bees from the hive. The only means of controlling this virus is to control Varroa mite infestation.

In addition to virus diseases, the susceptibility of bee colonies to other pathogens also increases when they are parasitized by Varroa mites. *Varroa destructor* could also be a vector of fungi.[12] Spores of various fungal agents are found on its surface, some of which, such as *Ascosphaera apis*, are known to be potential pathogens of the honey bee.[13] They are often transmitted in quantities lower than necessary to trigger an illness. There are also bacteria on the Varroa cuticle, including *Paenibacillus larvae*, the American foulbrood agent. **The parasite could contribute to the spread of the bacteria from one colony to another.**[14]

Tracking Varroa infestation allows better management and improved profitability. It is very important (and cost-effective) to regularly screen for the level of colony infestation to secure the production of honey.

BIOLOGY OF THE VARROA MITE : WHAT YOU NEED TO KNOW TO UNDERSTAND ITS POPULATION DYNAMICS

INTERESTING FACTS

The reproductive cycle of Varroa takes place entirely in the bees' capped brood cells, beginning with a single previously impregnated female individual, the foundress mite.

Varroa multiply rapidly. One cycle produces:

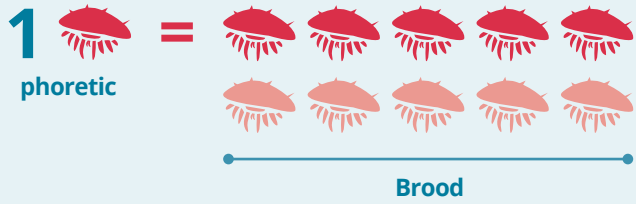
- At least 1.45 new female mites when reproducing in the worker (female) brood.[15-16]
- At least 2.2 new female mites when reproducing in the drone (male) bee brood, which is the most attractive for Varroa due to the longer development period of drones.[15-16]

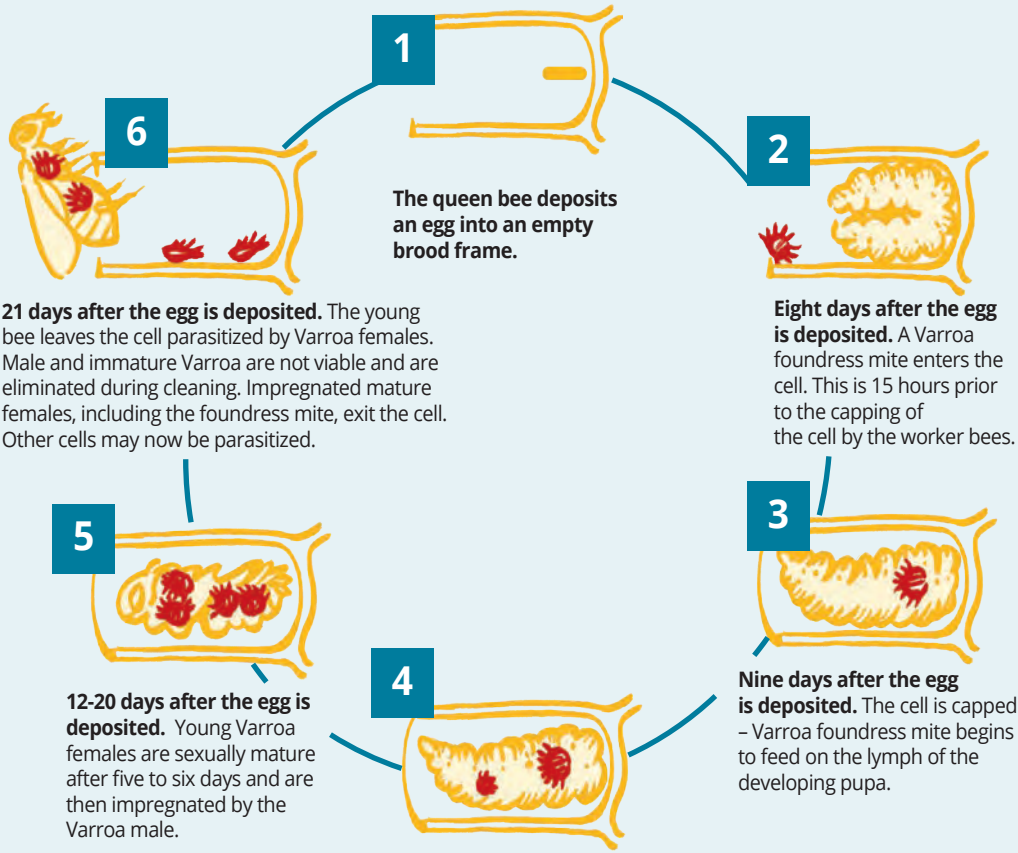
In colonies with brood, mite populations double about once a month, and even more quickly when the colony has large amounts of drone brood, or when Varroa is transmitted from neighboring colonies.[17]

50 to 90 percent of Varroa within a colony are located in capped brood cells.[18-19-20]

Cell caps thus protect the largest part of the Varroa mite population during the application of knock-down or flash treatments.

"50 to 90 percent of Varroa within a colony are located in capped brood cells."[18-19-20]





The queen bee deposits an egg into an empty brood frame.

Eight days after the egg is deposited. A Varroa foundress mite enters the cell. This is 15 hours prior to the capping of the cell by the worker bees.

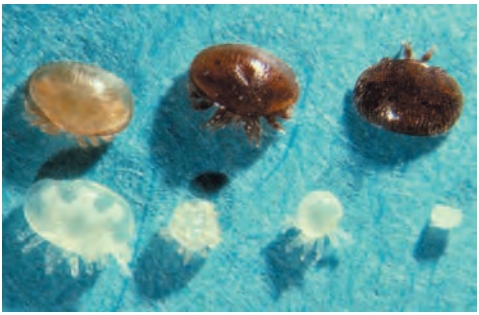
Nine days after the egg is deposited. The cell is capped – Varroa foundress mite begins to feed on the lymph of the developing pupa.

10-11 days after the egg is deposited. The foundress mite lays one egg every 30 hours into the cell (first egg is male and then all are females).

12-20 days after the egg is deposited. Young Varroa females are sexually mature after five to six days and are then impregnated by the Varroa male.

21 days after the egg is deposited. The young bee leaves the cell parasitized by Varroa females. Male and immature Varroa are not viable and are eliminated during cleaning. Impregnated mature females, including the foundress mite, exit the cell. Other cells may now be parasitized.

THE LIFE CYCLE OF A VARROA MITE



REPRODUCTION: Varroa mite reproduction occurs in honey bee brood cells, during the 12 – 14 day capped phase. Most female Varroa will carry out up to three or four successive reproductive cycles during their life by penetrating a brood cell just before its capping.[16]

PHORETIC PHASE: The duration of the phoretic phase (referring to mites on adult bees, *versus* within the capped cells) between two reproductive cycles is variable. An impregnated young female must necessarily mature in phoresy for around seven days (from 5 to 14)[21] before it can infest a cell at the right stage, and carry out its first reproductive cycle. However, the phoretic phase is not vital subsequently[22] and depends mainly on the availability of nearby cells to be infested at the right stage of development.

LIFESPAN: The lifespan of the parasite is adapted to the bee's life cycle. A female can live for between one to two months in the summer and between six to eight months during the winter in the absence of brood. [23]

SURVIVAL: Only impregnated Varroa females, called foundress mites, can parasitize adult bees and survive outside the brood. Males do not survive after the young adult bee emerges (the same is true for non-impregnated females). They die of hunger (or dehydration) and are thrown to the bottom of the hive by workers when the cell is cleaned.

INFESTATION: In the beekeeping season, male brood cells are 8 to 10 times more heavily infested than worker brood cells.[24-25-26-27] The impact and level of infestation are therefore less perceptible, except when the male brood is reduced, thus provoking a mass transfer of the Varroa population toward the worker brood, which has a sudden impact on a single age group, and may lead to collapse when the infestation level is very high.

SPREAD OF VARROA: The spread of Varroa from one hive to others (mostly due to the robbing of weakened colonies, but also due to drifting [returning to the wrong hive], of drones, or worker bees or the reduction of worker population) plays an important role in Varroa population dynamics. Various studies have shown large quantities of re-infesting Varroa that vary according to the season[28], and colonies of up to 70 Varroa mites per colony per summer day[29], or throughout the year from less than 200 to more than 4,000 mites per colony. Robbing may involve colonies more than 1 km away.

SWARMING: Swarming causes a momentary stoppage in the Varroa population explosion, due to the broodless period of around three weeks linked to the emergence of the new queen, and the movement of part of the phoretic Varroa population departing with the old queen and its swarm. This reduction represents around 15 to 20 percent of the Varroa population present at the time in the original colony.[30-31]

MONITORING: AN IMPORTANT PRACTICE THAT COULD SAVE YOUR COLONIES

> Varroa monitoring is used to estimate the degree of Varroa infestation, optimize the time of treatment, and confirm that treatment was successful.

Monitoring also makes it possible to choose the most efficient control product, determine if treatment is needed soon, or if you can wait until later in the year. Knowing your hives' Varroa levels in the late summer and fall will aid in making treatment decisions at that time, and help ensure that your colonies do not enter the winter with high mite loads. This will help reduce winter colony losses, and give you stronger spring colonies. The cost of replacing a colony of honey bees, feeding the new hive, and lost honey production is a good argument in favor of regular monitoring.

HOW OFTEN SHOULD MONITORING BE PERFORMED?

Monitoring should take place at least three times a year, and ideally four times:[17]

In early spring, at the end of the honey flow, and once more after the late summer treatment (in fall) to find out the infestation level before overwintering. A fourth check can be performed on broodless colonies before overwintering (November).

"Accurately assessing and understanding mite population is the basis of an Integrated Pest Management (IPM) control strategy. Waiting too long to confirm elevated mite population numbers is risky. A delay in treatment can reduce a colony's likelihood of survival over the winter and contribute to spreading mites to other colonies."

> Monitoring should take place at least three times a year, ideally four times:
> In the spring, before and after the late summer treatment and before overwintering (November).

Here is a good example of a monitoring schedule that will help ensure healthy colonies by keeping Varroa under control:

Time of monitoring	Objective
Early spring	Early detection makes it possible to **plan** effectively and **assess** the need for an early springtime treatment without honey supers
Following a possible springtime treatment	**Confirm** effectiveness of springtime treatment.
During a honey flow*	**Detect a massive Varroa build-up** and plan possible intermittent treatment between honey flows.
Late July – August	**Choose the best-suited late-season treatment** depending on the level of infestation.
September – October - December	**Ensure effectiveness** of autumn treatment and **assess the need** for additional treatment in winter (when brood is absent) or early next spring).

**Particularly in areas where there are large number of hives belonging to different beekeepers.*

KNOWING IF THE TREATMENT WAS SUCCESSFUL

It is very important to know Varroa levels before, and after treatment. Very high Varroa numbers prior to treatment will make Varroa reduction more difficult, and possibly allow virus levels to climb to the point where loss of the colony is likely, despite later reduction. Varroa numbers higher than five mites per 100 bees puts the colony at great risk. Monitoring after treatment will prove the effectiveness of your control effort, or indicate possible re-infestation due to robbing or drifting of bees.

IS MONITORING TIME WELL SPENT?

While monitoring Varroa infestation levels can be a time-consuming process, the information gained is well worth the investment. Avoiding the cost of replacing dead colonies, lost honey production, and the unavailability of colonies for pollination or production of queens, or nucs is a good reason to monitor infestation levels. Some beekeepers follow a strict routine and treat their colonies against varroa always at the same calendar date(s) or in the same week. We now know that Varroa control is not that simple, and conditions will vary each year. Monitoring aids beekeepers by providing valuable information about when to treat, and how many times. For example, failing to treat when needed can result in a dead colony, and not treating a colony because infestation levels are low saves the cost of an unnecessary treatment.

How many colonies should be sampled for Varroa mites?

Size of apiary	Number of colonies to be tested*
≤ 10 hives	All colonies
≤ 20 hives	6 to 10 colonies
> 20 hives	25% minimum (at least 8 colonies)

**It is recommended to sample colonies from the center and the edges of the apiary*

MONITORING METHODS AND RECOMMENDATIONS

There are two monitoring methods that are recognized as providing the most reliable information for making decisions regarding Varroa treatment and control: an alcohol wash, and a powdered sugar roll. The CO2 gas application method is quite new, but research conducted in Europe indicates this method produces accuracy rates similar to those obtained by an alcohol wash. There are also other methods, like sticky boards and decapping of drone broods, that are less reliable, and/or difficult to interpret.

ALCOHOL (OR SOAP) WASH

> The alcohol wash method has been recognized as the most accurate, reliable and economic option for beekeepers.

This method consists of immersing a sample of bees into a container of alcohol to detach the phoretic mites so they can be counted. This method is the most consistent in terms of delivering accurate results, and is commonly practiced by beekeepers, apiary inspectors, and scientists throughout North America.

1. Use a honey jar and fill it about half full with rubbing alcohol (winter windshield washer fluid for cars works well).
2. Collect 30g of bees (about 300 bees) from one or more brood frames, and place them into the half-filled jar. **Be careful not to include the queen in this sample, as** this method kills the bees. Make sure you carefully examine the frame from which bees are being collected so that the queen is not included in the sample.
3. Swirl the jar containing the sample bees for about one minute to dislodge mites from the bees.
4. If you are using a device like the Varroa EasyCheck that contains a filtering screen, you can count the mites directly. If not, you can separate the bees from the liquid by straining the contents of the jar through a fine sieve. A mesh size of eight openings per inch is small enough to catch bees, but large enough to allow the liquid and the fallen mites to flow through it. Count the mites in the strained liquid. The liquid can be reused many times if you filter it through a very fine screen after counting the mites.

Alcohol (or soap) wash

How to calculate your Varroa mite infestation:

Note: *This method can be applied for alcohol wash, powdered sugar roll and CO2.*

Divide the number of mites counted by the size of the sample (300 bees), then multiply by 100. The result will indicate mite infestation as a percentage. ***For example, if y****our sample contained 300 bees (1/2 cup), and you counted 12 mites, dividing 12 by 300 gives you .04. Multiply .04 by 100, to obtain your infestation percentage, which, in this case, is four percent.*

POWDERED SUGAR ROLL

This method is similar to an alcohol wash, but uses powdered sugar, instead of alcohol, to dislodge the mites.

1. Place a 30g of bees (about 300 bees) from the brood frames into an empty jar, being **careful not to include the queen. Though it is much less likely that you will kill bees performing this test, it could be stressful on the queen.**
2. Place a mesh cover (eight openings per inch) over the jar.
3. Add one to two tablespoons of powdered sugar though the mesh top onto the bees.
4. Roll the jar until bees are evenly coated with the powdered sugar.
5. Set jar in the shade for three to five minutes. Take your time, as this allows the bees and mites to warm up, and encourages the mites to turn loose.
6. Turn the jar upside down and swirl for one minute to drop the mites, and the powdered sugar, through the mesh lid onto a flat surface. The powdered sugar will contain the dislodged mites. Count the mites.
7. If conditions are windy when performing this method, shake the jar indoors, or shake the powdered sugar into white bucket containing water. The powdered sugar will dissolve, and the remaining mites can counted on the surface of the water.
8. Calculate the mite count per 100 bees, as with alcohol wash.
9. The bees can be released into the hive, or at the hive entrance.

CO2 GAS APPLICATION

The principles of CO2 application are similar to both the alcohol wash and powdered sugar roll methods. In the CO2 method, however, both bees and mites are rendered unconscious by exposure to carbon dioxide gas. The sample of anesthetized bees is then gently shaken in the sample container, causing mites to fall from the bees and through holes in the bottom of the container. Like the powdered sugar method, this process generally does not kill the bees, though a small loss is possible. As always, first locate and isolate the queen when gathering a sample to avoid harming her. Research conducted in Europe indicates results that are similar in accuracy to those obtained by an alcohol wash.

How to conduct CO2 monitoring

1. Place 200 or 300 worker bees (20g or 30g of bees) in sampling container provided for this purpose. Alternatively, you can add bees to the fill line printed on the container.
2. Use CO2 injector tube to inject gas as directed to anesthetize the sample bees. Shake the bees for 30 seconds. Varroa mites will be dislodged from bees and fall through holes at the bottom of the sample container.
3. Count the mites and put the bees back in the hive where they will recover. Dispose of the fallen Varroa mites, as most will still be alive.
4. Calculate infestation rate as instructed on page 15.

NATURAL MITE FALL ON STICKY BOARDS

This monitoring method exploits the fact that a few mites are continually falling from honey bees in the hive as a result of the bees' self-grooming behavior. Sticky boards capture the falling Varroa mites, normally over a two- or three-day period. Fallen mites are counted to arrive at an estimate of how many mites fall during a 24-hour period.

To conduct a sticky board survey, a sheet of cardboard or rigid plastic coated with vegetable shortening or oil is inserted beneath the brood area of a hive, often under a screen bottom board. After 24, 48, or 72 hours, the board is removed, and the mites trapped on the sticky surface are counted. Leaving the board in place for two or more days yields a more accurate count, but after three days, pollen and debris accumulated on the board can interfere with accurate counting. The mite count is divided by the number of 24-hour periods that the sticky board was in place, providing an average 24 -hour mite fall count.

How to calculate your mite infestation using sticky boards:
Divide the number of mites counted into the number of 24 hour days. The result is the average number of mites per day.

For example, a sticky board is left in the hive for two days (48 hours), and 30 fallen mites are counted. Divide 30 by 2 24-hour periods, which gives you a 24-hour count of 15.

The disadvantage of this method is that mite counts can be inconsistent as the number of mites that fall will correlate to the population of the colony. This inconsistency makes it more difficult to evaluate the need for treatment. If practiced on a regular basis, say every two weeks, sticky board counts may give a beekeeper a general sense for any increase in infestation, which should then encourage evaluation by other methods, such as alcohol washes.

DE-CAPPING AND EXAMINATION OF DRONE BROOD

This method involves de-capping drone (male) brood cells, removing the pupae, and counting the Varroa upon the pupae. While small numbers of pupae may be checked in this manner, as few as 20, more accurate results are obtained with checking large numbers, 100, or even 200 pupae. This also results in a count of the mites in brood, different from mites on adult bees. The results will vary with the amount of brood present in the colony, and is time consuming. Like sticky boards, this method is more often practiced as a survey to indicate the presence of Varroa. Followed up with of alcohol washes, or powdered sugar rolls.

How to calculate your mite infestation when uncapping brood:

Number of cells with Varroa mites / number of total uncapped cells * 100 = % of infestation

ADVANTAGES AND DRAWBACKS OF EACH MONITORING METHOD

Method	Advantages	Drawbacks
Alcohol wash	• Effective and reliable method, results that can be extrapolated for the whole apiary. • Materials inexpensive, especially if you re-use the liquid. • Can be performed at the apiary when you visit it for any reason • Faster than other methods.	• You have to be careful not to include, and kill the queen when sampling. • The sampled bees are killed in the process.
Powdered sugar roll	• Keeps sampled bees alive (less than 10% of sampled bees killed). • Materials very inexpensive. • Moderately accurate. • Can be performed at the apiary when you visit it for any reason.	• Less accurate than the alcohol wash. • Must be performed in dry conditions because humidity may cause the sugar and mites to stick to the bees. • Can result in high variability of results. • Shaking bees is not harmless, and can result in some mortality. [1] • You must be careful not to take the queen in the sample.
C02 gas application	• Keeps sampled bees alive (small number may be killed). • The least stressful method for the bees. • Moderately fast. • Can be performed at the apiary when you visit it for any reason. • As effective as alcohol per a study conducted in Europe by Jiri Danhilik.	• There is currently no "ready to use" product that is economical for widespread use. • Some trials and studies have shown variability of results using CO2. Apparently, the accuracy of this method is dependent upon how it is performed by the beekeeper.
Natural mite falls on sticky boards	• Easy to implement. • Materials inexpensive. • May be undertaken during adverse weather (winter). • May give indication of Varroa increase if practiced over time.	• Not very precise. Mites can be dropped or eaten by ants. The result may vary depending on hygienic behavior of the bees, colony size or time of the season. • Labor intensive. Removal of sticky boards must take place within a few days of installation.
De-capping of drone brood	• Easy to do during apiary visits. • Virtually no material costs. • May give indication of Varroa increase if practiced or time.	• Very time consuming. • Results dependent on the presence of brood, and will vary with season.

Collecting a sample of bees: impact on the colony?

The "sacrifice" of a bee sample may discourage some beekeepers from monitoring their colonies. But you need to think of the sampling like you would a blood test: you take a sample of blood to guide a diagnosis, but it is such a small amount that it has no consequence on your overall health or well-being. The sacrifice of 200 to 300 bees is similar:

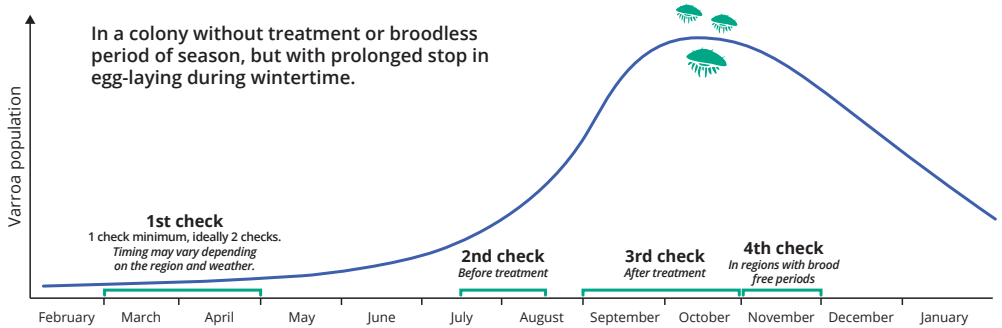
1. Sampling will give information that will improve the health management of the rest of the colony and the entire apiary. The alcohol wash method, which gives accurate results, but does sacrifice bees, will eventually avoid colony mortality.
2. The damage to the monitored colonies should be put in perspective, because a limited loss of bees in season has little consequence in a colony which generally contains between 20,000 and 35,000 individuals, and whose queen can lay more than 2,000 eggs per day (at the peak of laying). The sample taken usually represents less than one percent of the overall population of the hive, and the bees will be quickly replaced.

MONITORING RESULTS AND TREATMENT DECISIONS

Time of the year	INFESTATION LEVEL		
	Alcohol wash Powdered sugar CO_2 gasing *Average sample: 300 worker bees*	**Natural mite falls on sticky board** *Number of mites per day*	
Early spring	≥ 1%	0,5 mites	**Treatment required!**
Between two honey flows	> 2 %	5 mites	
End of season: July – August (before treatment)	> 3 %	10 mites	
Winter (after treatment)	≥ 2 %	1 mite	

Note on interpretations of infestation levels: The thresholds may vary with geographic area due to variations in bee and Varroa populations. Local experts, like bee inspectors or extension specialists, should be consulted. In some situations, even if infestation levels fall below these thresholds, it is better to treat immediately rather than wait. If early treatment is required, it is best to treat the entire apiary to minimize reinfestation and robbing.

Modeling of the development of the Varroa population



CONTROLING VARROA MITES

> A study published in 2010[32] shows that a colony that is infested by Varroa, and not treated, can die in a period of between six months and two years.

VARROA TREATMENTS

The objective of Varroa treatment is not only **to control the infestation** of the colony treated, and to avoid the adverse consequences of Varroa upon overall colony health, but also **to limit the stress caused by parasitic populations and their health impact on neighboring apiaries,** and on the apiary population in general.

A study published in 2010[32] shows that a colony that is infested by Varroa, and not treated, can die in a period of between six months and two years. High bee density combined with a severe Varroa infestation accelerates the death of the colony (Ritter et al., 1984).[33] The failure to treat certain colonies may endanger one or more apiaries.

All colonies should be treated at the same time. Use a product that is registered for use in honey bee colonies to effectively control Varroa while protecting the colony, the quality of honey, and the safety of beekeepers and the environment.

Always read the product label instructions before using a new varroa treatment to ensure the correct dosage, and be fully aware of the constraints of use (suggested temperature, hive ventilation, waiting time to add/remove the supers, etc.).

WHEN TO TREAT?

1 Pre-season treatment:

This treatment is aimed at reducing the level of infestation before placing the first honey supers to ensure that Varroa levels are controlled for the entire season, and to prevent possible collapse of colonies later in the summer. It is generally carried out under the following conditions:

- When wintering conditions have not been favorable due to high mite infestation levels following the late summer/autumn treatment.
- When the brood has been present all winter (even in small amounts), enabling the ongoing increase of Varroa infestations.
- When Varroa populations are high in early spring, due to robbing of colonies that were weakened by high varroa numbers, and drifting of drones.
- Or when the fall treatment was not as effective as desired.

In some European countries, spring treatments are more complicated to realize because of an early onset of the first nectar flow along with the prohibition of treating with honey supers present. In addition, some mite treatments require a waiting period, typically 14 days, between the removal of mite treatments and the placement of honey supers. These requirements must be balanced with the need for Varroa control, the health of bees, and the desire to harvest honey. Alternatively, winter treatments must be considered in these regions.

2 Treatment in the late summer or autumn, just after the honey harvest:

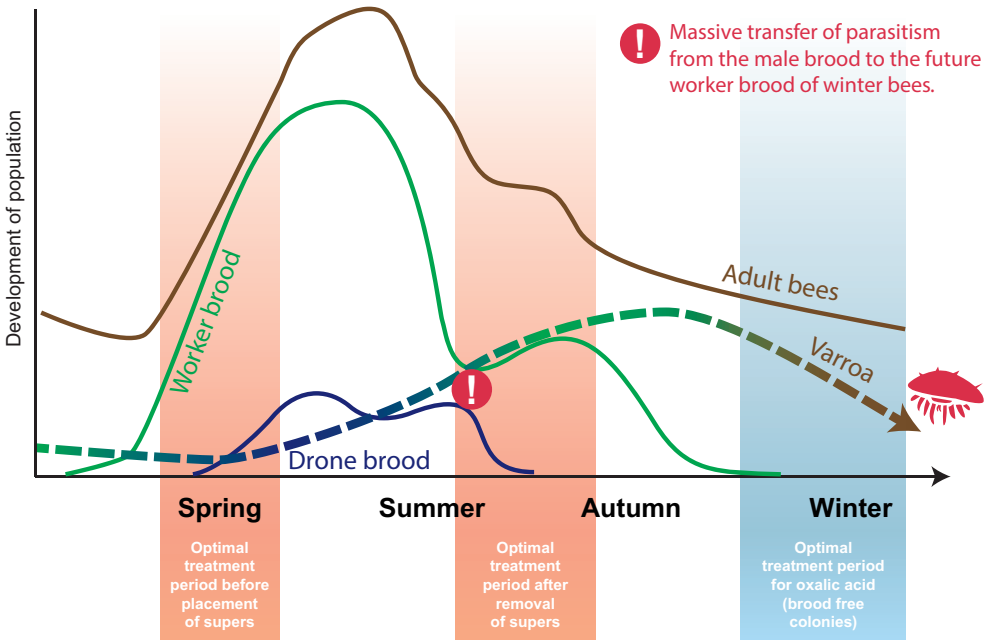
OBJECTIVES:

- **To limit the level of infestation** to avoid the collapse of heavily infested colonies in late summer and early autumn.
- **To reduce Varroa levels in colonies prior to wintering** to have healthier winter bees, and begin the following season with the lowest Varroa levels in hives as possible. To have healthy winter bees, it is important to reduce the number of Varroa on the nurse bees by the fall, and therefore colonies should **be treated as soon as possible after the removal of honey supers.**

DELAYED TREATMENT = HIGHER WINTER LOSSES

By delaying treatment in the fall, Varroa damage to the colony is prolonged. This delayed treatment will make it difficult to eliminate the majority of the parasites, and overcome the effects of Varroa on infested bees prior to treatment. Early treatment will increase winter survival, and contribute to strong spring colonies.

Modeling of the development of various populations throughout the season



While bee and brood populations decrease at the end of the summer, the number of Varroa mites will remain high as long as the brood remains. **Parasitic stress is at its most critical during the months of August through October, as several phenomena occur:**

- Varroa levels increase during the late summer / early fall as honey bee brood increases.
- Resumption of worker-brood production linked to late-season pollen flows.
- Steep reduction in the raising of drones later in the fall, which results in a transfer of Varroa from the drone brood to the worker brood. This more highly infested fall worker brood emerges to serve as the colony's winter bees.
- Progressive drop in the number of bees in the colony, and the emergence of winter bees, whose good health is vital for successful wintering.[34]

OTHER METHODS TO HELP LOWER VARROA INFESTATION

There are several non-chemical Varroa control strategies sometimes practiced by small scale beekeepers. While any of these methods alone result in only a small reduction in the Varroa mite population, combined use of these methods may reduce the frequency of chemical controls. However, it is important to conduct regular monitoring of Varroa numbers, and intervene with chemical applications when Varroa populations increase, threatening colony health.

DRONE BROOD REMOVAL

One commonly practiced non-chemical method of Varroa control is the trapping and removal of drone (male) honey bee brood, with the goal of killing Varroa attracted to this brood for reproduction. One method of achieving this goal is by introducing frames of plastic foundation with drone-cell-sized imprints into the hive at any time when bees are rearing drones. Bees will build full frames of drone-sized cells in which drones will be reared, and these will attract Varroa mites. These frames are then removed after a majority of the cells are capped, and destroyed, typically by freezing. Frames of brood are then re-inserted into the hive, where dead drones and mites are removed by the colony's honey bees. This cycle can be repeated multiple times.

In France, the Alsace Chamber of Agriculture conducted an experiment in 2011 to measure the effects of this technique.

In this study, four trappings of Varroa mites during the season (May to July) helped to limit the outbreak of Varroa population in colonies in summer without affecting the production of honey. However, this practice requires regular monitoring of brood to remove drone frames at the proper time. While the reduction of Varroa achieved with this method does not alleviate the need for chemical control, it can delay the Varroa population development in spring and summer.

COLONY DIVISION AND ARTIFICIAL SWARMING

The division of colonies and the production of artificial swarms may temporarily limit the population of Varroa in a hive due to the lack of egg-laying by the queen when introducing new queens. It is not desired to use this practice to reduce Varroa pressure because divided colonies have reduced productivity, while the population ratio of mites to bees does not decrease significantly.

CAGING OF THE QUEEN

Queen caging is an Italian practice that is beginning to be practiced in France and Germany as well. It consists of caging the queen for 25 days to stop the egg-laying process, so that a treatment can be applied during the absence of Varroa in the brood. This method can result in an increased efficacy, but requires increased labor, and good weather and flowering conditions during the release of the queens.

CONCLUSION

Modern beekeeping requires accurate monitoring of colonies to support decision-making and to meet production goals (intensity of the production of honey, time dedicated to monitor the apiaries, expenses, etc.).

Monitoring the varroa infestation level on a regular basis leads to healthier colonies with increased productivity and better winter survival.

A single treatment is not sufficient to control varroa mite infestations. Global warming and human practices benefit the expansion of Varroa populations. As a result, **the old practice of treating for Varroa mites only once each year should be replaced with a state-of-the-art control strategy** that makes frequent use of Varroa monitoring methods.

SOURCES

1. [Ramsey SD, vanEngelsdorp D. Varroa destructor feed primarily on honeybee fat body not haemolymph. In Simone-Finstrom M. (Ed). Proceedings of the American Bee Research Conference; 2017 Sep 13–15; Galveston Island Convention Center, Galveston TX. Bee World; 2016.]
2. [DeGrandi Hoffman & Chen. 2015. «Nutrition, immunity and viral infections in honey bees.» Current opinion in insect science. 10: 170-176]
3. [Kanbar, G. and Engels, W. (2003). «Ultrastructure and bacterial infection of wounds in honey bee (Apis mellifera) pupae punctured by Varroa mites.» Parasitology Research 90, 349–354.]
4. [Boecking O., Genersch E. «Varroosis—The ongoing crisis in bee keeping.» Journal für Verbraucherschutz und Lebensmittelsicherheit. 2008;3:221–228.]
5. [Dainat et al. 2012. «Dead or Alive: Deformed Wing Virus and Varroa destructor Reduce the Life Span of Winter Honeybees». Applied and Environmental Microbiology. 78(4):981-7.]
6. Dr. Pia Aumeier & Dr. Gerhard Liebig (2015). «Kopf hoch». Article in «Deutsches Bienen Journal
7. [Kralj J., Brockmann A., Fuchs S., Tautz, J. 2007. «The parasitic mite Varroa destructor affects non- associative learning in honey bee foragers, Apis mellifera.» L., J. Comp. Physiol. A 193, 363–377 - 0.]
8. [Cargel, R.A. and T.E.Rinderer(2009). «Effects ofVarroa destructorinfestation on honey beequeen introduction.» Science of Bee Culture, 1(1): 8-13]
9. [Duay P, de Jong D, Engels W. 2002. «Decreased flight performance and sperm production in drones of the honey bee (Apis mellifera) slightly infested by Varroa destructor mites during pupal development.» Genet Mol Res 1:227–232.]
10. Maisonnasse, et al, 2014
11. [Baker, A. C., and D. C. Schroeder. 2008. «Occurrence and genetic analysis of Picorna-like viruses infecting worker bees of Apis mellifera L. populations in Devon, south west England.» J. Invertebr. Pathol. 98:239-242.]
12. [Benoit, J.B., Yoder, J.A., Sammataro, D., Zettler, L.W. 2004 «Mycoflora and fungal vector capacity of the parasitic mite Varroa destructor (Mesostigmata: Varroidae) in honey bee (Hymenoptera: Apidae) colonies.» Int. J. Acarol. 30 (2), 103–106].
13. [Aronstein, K. and Holloway, B. 2013. «Honey bee fungal pathogen, Ascosphaera apis; current understanding of host-pathogen interactions and host mechanisms of resistance.» In: Méndez-Vilas, A. (Ed.), Microbial pathogens and strategies for combating them: science, technology and education. FORMATEX, pp. 402-410.]
14. [De Rycke, P.H., Joubert, J.J., Hossein Hosseinian, S. et al. 2002. Exp Appl Acarol. 27: 313.]
15. MARTIN SJ (1994). Ontogenesis of the mite Varroa jacobsoni Oud. in worker brood of the honeybee Apis mellifera L. under natural conditions. Exp. Appl. Acarol., 18, 87-100.
16. MARTIN SJ (1995b). Ontogenesis of the mite Varroa jacobsoni Oud. in drone brood of the honeybee Apis mellifera L. under naturel conditions. Exp. Appl. Acarol., 19, 199-210.
17. Honey Bee Health Coalition, Varroa guide 6th edition (April 2017)
18. Biology and control of Varroa destructor. Rosenkranz P., Aumeier P. and Ziegelmann B. Journal of Invertebrate Pathology, Vol.103 - supplement (2010) S96–S119.
19. A population model for the ectoparasitic mite Varroa jacobsoni in honey bee (Apis mellifera) colonies. Martin S., Ecological Modelling 109 (1998) p. 267–281.
20. LEE KV, MOON RD, BURKNESS EC, HUTCHISON WD, SPIVAK M (2010). Practical sampling plans for Varroa destructor (Acari: Varroidae) in Apis mellifera (Hymenoptera: Apidae) colonies and apiaries. J. Econ. Entomol., 103, 1039-1050.
21. AKIMOV IA, PILETSKAYA IV, YASTREBTSOV AV (1988). Modifications morphofonctionnelles dues à l'âge dans le système reproducteur des femelles de Varroa jacobsoni. Vestn. Zool., 6, 48-55.
22. DE RUIJTER A (1987). Reproduction of Varroa Jacobsoni during successive brood cycles of the honeybee. Apidologie, 18, 321-326.
23. [Zemene, M., Bogale, B., Derso, S.B., Melaku, S. & Hailu, H. 2015. «A review on varroa mites of honey bees.» Academic Journal Entomology, 8, 150–159.]
24. BOOT WJ, CALIS JNM, BEETSMA J (1995). Does time spent on adult bees affect reproductive success of Varroa mites? Entomol. Exp. Appl., 75, 1-7.
25. BOOT WJ, SCHOENMAKER J, CALIS JNM, BEETSMA J (1995). Invasion of Varroa jacobsoni into drone brood cells of the honey bee, Apis mellifera. Apidologie, 26, 109-118.
26. CALDERONE NW, KUENEN LPS (2001). Effects of western honey bee (Hymenoptera: Apidae) colony, cell type, and larval sex on host acquisition by female Varroa destructor (Acari: Varroidae). J. Econ. Entomol., 94, 1022-1030.
27. FUCHS S (1990). Preference for drone brood cells by Varroa jacobsoni Oud in colonies of Apis mellifera carnica. Apidologie, 21, 193-199.
28. [Sakofski F, Koeniger N, Fuchs S. 1990. «Seasonality of honey bee colony invasion by Varroa jacobsoni Oud.» Apidologie. 21(6):547–550.]
29. GREATTI M, MILANI N, NAZZI F (1992). Reinfestation of an acaricide-treated apiary by Varroa jacobsoni. Exp. Appl. Acarol., 16, 279-286.
30. FRIES I, HANSEN H, IMDORF A, ROSENKRANZ P (2003). Swarming in honey bees (Apis mellifera) and Varroa destructor population development in Sweden. Apidologie, 34, 389- 397.
31. VILLA JD, BUSTAMANTE DM, DUNKLEY JP, ESCOBAR LA (2008). Changes in Honey Bee (Hymenoptera: Apidae) Colony Swarming and Survival Pre- and Postarrival of Varroa destructor (Mesostigmata: Varroidae) in Louisiana. Ann. Entomol. Soc. Am., 101, 867-871.
32. LE CONTE Y, ELLIS M, RITTER W (2010). Varroa mites and honey bee health : can Varroa explain part of the colony losses? Apidologie, 41, 353-363.
33. RITTER W, LECLERCQ E, KOCH W (1984). Observations des populations d'abeilles et de Varroa dans les colonies à différents niveaux d'infestation. Apidologie, 15, 389-400.
34. [van Dooremalen C, Gerritsen L, Cornelissen B, van der Steen JJM, van Langevelde F, Blacquière T. 2012. «Winter Survival of Individual Honey Bees and Honey Bee Colonies Depends on Level of Varroa destructor Infestation.» PLoS ONE 7(4): e36285.]
35. Efficacy tests: Anti-varroa treatments - FNOSAD [National Federation of Departmental Apiarian Health Organizations] 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014 , 2015 and 2016 - France

CONTROL VARROA MITES WITH THE VÉTO-PHARMA PRODUCT RANGE

Véto-pharma develops, produces, and distributes a range of innovative products to support honey bee health. Our expertise guarantees the quality of our products. Véto-pharma is the current leader in Varroa treatments in France and a major key-player in the world, with Véto-pharma products being distributed in more than 35 countries.

5+
million
colonies
treated
per year

Worldwide
Varroa
treatment
leader

35+
countries

VÉTO-PHARMA VARROA PRODUCTS

Varroa EasyCheck: For a quicker, easier and more accurate monitoring!

Varroa EasyCheck is a ready-to-use Varroa mite shaker that makes monitoring infestations more accurate and reliable than ever before.

Fall

Spring

Apivar: The original strip

Apivar is the only amitraz-based apiary product that treats not just one generation of Varroa mites, but several successive generations, reducing mite populations in the hive by up to 99 percent in one application.[35]

Winter

ORGANIC BEEKEEPING

Oxybee: A new oxalic acid!

Oxybee is an innovative and organic varroa treatment based on oxalic acid with glycerol, anise and eucalyptus essential oils, and can be applied via dribbling method. For best results, it should be used when there is no brood in the hive (usually in winter).

APIVAR® 500 mg Amitraz Bee-hive strips for honey bees. Indication(s) for use: Treatment of varroosis due to *Varroa destructor* sensitive to amitraz in honey bees. **Contraindication(s):** Do not use in case of known resistance to amitraz. **Withdrawal period(s): Honey:** zero days. Do not use during honey flow. Do not extract honey from the brood chamber. Do not harvest honey when the treatment is in place. Brood combs should be replaced with new foundation at last every three years. Do not recycle brood frames as honey frames. Read carefully the instructions on the product booklet label before use. **Special precautions to be taken by the person administering the veterinary medicinal product to animal:** This veterinary medicinal product contains amitraz which can lead to neurological side-effects in humans. Take particular care in case of concomitant treatment with monoamine oxidase inhibitors, hypotensive treatment or if you have diabetes. Amitraz may cause skin sensitization. Avoid contact with skin. In case of contact, wash thoroughly with soap and water. Avoid contact with eyes. In case of contact, rinse with plenty of water immediately. Usual beekeeping protective clothes including impervious gloves should be worn when handling the product. Do not eat, drink or smoke whilst handling the product. Keep children away during application of the product. Wash hands after use. Do not inhale or ingest. If side effects are noted, seek immediate medical assistance and show the label to the physician. v0917 **Apivar is a veterinary medicinal product. Please ask advice to your veterinarian, pharmacist or sanitary organization. In case of persistence of clinical signs, consult with your veterinarian.**

OXYBEE powder and solution for 39,4 mg/ml bee-hive dispersion for honey bees. Composition: 1 ml of mixed bee-hive dispersion contains 39,4 mg of oxalic acid dehydrate. **Indication(s) for use :** For the treatment of varroosis (*Varroa destructor)* of honey bees (*Apis mellifera*) in brood free colonies. **Withdrawal period(s) : Honey:** zero days. Do not use during honey flow. **Special precautions:** This veterinary medicinal product is highly acidic and could have irritating and corrosive effects on the skin, eyes and mucous membranes. Personal protective equipment consisting of protective clothing, acid-proof gloves and safety glasses should be worn. **Marketing authorisation holder:** Dany Bienenwohl GmbH, Geyerspergerstr. 27, 80689 Munich, Germany. **Distributed by:** Veto-Pharma, 12-14 rue de la Croix Martre 91120 Palaiseau, France. V0119 **Oxybee is a veterinary medicine. Please ask advice to your veterinarian, pharmacist or sanitary organization. In case of persistence of clinical signs, consult with your veterinarian. Read carefully the instructions on the product label before use.**

varroa easyCheck

By Véto-pharma

For fast, easy and reliable Varroa mite monitoring.

MED-04-EU-N01-01/20

info@vetopharma.com

www.veto-pharma.eu

facebook.com/vetopharma

Véto-pharma

Committed to apiculture