INTEGRATED VARROA MITE MANAGEMENT THROUGHOUT THE SEASONS

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on the website www.veto-pharma.com
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Summary

1. Why manage Varroa mites?

If you're a beekeeper, you'll already be familiar with *Varroa destructor*, the parasite linked to the weakening and death of colonies. There are many resources available today explaining its biological cycle and how to identify it correctly, including the Varroa Guide published by Véto-pharma (you can download it from www.veto-pharma.com or scan the QR code).

Varroa is harmful both to the individual bee and to the entire colony, weakening it to the point of death in a state of "varroosis".[1] "Varroosis" is the name of the disease caused by the various impacts of the varroa mite on the colony:

- Varroa causes wounds by feeding on adults or larvae/pupae in the capped brood,
- It takes proteins from the bee fat body (its main resource) and haemolymph (= the bee's blood). This leads to weight loss and developmental abnormalities, with a particular impact on reduced lifespan, flight time and return to the hive.[2]
- The parasitized bee's immune system can be altered, which in turn facilitates the multiplication of viruses.[2]

Varroa is a vector for viruses, including the notorious deformed wing virus (DWV). The presence of DWV has been shown to be strongly correlated with the spread of Varroa mites in a given area.[3]

The impact of the various viruses linked to Varroa, and DWV in particular, can be seen in morphological deformations (reduced abdomen, atrophied or deformed wings) and in the observation of mosaic brood with dead emerging bees. Depending on the mite load and the number of worker bees affected, the colony will start by reducing its production, then become weaker, and finally collapse.[4]

The consequences of infestation can be seen throughout the season, with a particular occurrence in autumn.[5] Damage can increase very rapidly at this time, as the Varroa population continues to grow while the bee population declines. Colony mortality due to Varroa mites is very often observed in winter or during the spring restart.

REMEMBER: Even in the absence of visible signs, varroa infestation can have harmful consequences for the health of colonies and the honey harvest.

What about honey production?

?

A study of lavender honeyflow showed that colonies arriving in the field with more than 3 varroa mites per 100 bees produced an average of 3 kg (6.6 lbs) less honey per hive, compared with colonies with fewer than 3 varroa mites per 100 bees. Above 5 varroa mites per 100 bees, an average of almost 6.5 (14.3 lbs) kg of honey is lost per hive.[6]

Climatic changes also seem to influence mite loads in autumn, since they increase the periods conducive to brood rearing throughout the season, which favors Varroa multiplication. The presence or absence of a brood-free period in winter will also influence the multiplication of the parasite. Differences can also be seen in bee subspecies (races) that rear large quantities of brood earlier in the spring, compared with others that start more slowly.[7]

The conclusion today is clear: varroa can no longer be managed in the same way as it was when it first arrived in the 1980s. The "one treatment per year on the same date" strategy has proved its limits. From now on, you need to design your strategy according to the current year's infestation, and be extra vigilant in order to be able to adapt it quickly in the event of a change.[8] This requires a certain amount of foresight and additional knowledge, which you will discover in this guide.

1. Rosenkranz P, Aumeier P, Ziegelmann B. Biology and control of Varroa destructor. J Invertebr Pathol. 2010 Jan;103 Suppl 1:S96-119. doi: 10.1016/j.jip.2009.07.016. Epub 2009 Nov 11. PMID: 19909970.
2. Van Dooremalen, Coby, et al. «Winter survival of individual honey bees and honey bee colonies depends on level of Varroa destructor infestation.» PloS one 7.4 (2012): e36285.
3. Fanny Mondet, Alban Maisonnasse, Andre Kretzschmar, Cédric Alaux, J Vallon, et al. Varroa: its impact, methods for assessing infestation and control methods. Agronomic Innovations, 2016, 53, pp.63-80.
4. Genersch, Elke. «Honey bee pathology: current threats to honey bees and beekeeping.» Applied microbiology and biotechnology 87 (2010): 87-97.
5. Frey, Eva, and Peter Rosenkranz. «Autumn invasion rates of Varroa destructor (Mesostigmata: Varroidae) into honey bee (Hymenoptera: Apidae) colonies and the resulting increase in mite populations.» Journal of economic entomology 107.2 (2014): 508-515.
6. Mondet F., Maisonnasse A., Kretzschmar A., Alaux C., Vallon J., Basso B., Dangleant A., Le Conte Y. – Varroa : son impact, les méthodes d'évaluation de l'infestation et les moyens de lutte
7. Smoliński, Szymon, Aleksandra Langowska, and Adam Glazaczow. "Raised seasonal temperatures reinforce autumn Varroa destructor infestation in honey bee colonies." Scientific reports 11.1 (2021): 1-11.
8. Vercelli, Monica, et al. «A qualitative analysis of beekeepers' perceptions and farm management adaptations to the impact of climate change on honey bees.» Insects 12.3 (2021): 228.

Photo credit : ©Klass de Gelder – Bee with deformed wings.

2. What is Integrated varroa mite management?

In the European Union, Integrated Pest Management (IPM), which originally concerned plant production, is defined by Community Directive 91/414/EEC of 15 July 1991: *"The rational application of a combination of biological, biotechnical, chemical, physical and cultural measures [...] to keep the presence of harmful organisms* ***below a threshold at which economically unacceptable damage or loss occurs.***

IF WE APPLY THE DEFINITION OF INTEGRATED PEST MANAGEMENT TO VARROA, WE AIM TO COMBINE:

1

Sanitary management of colonies, combining good beekeeping practices with active monitoring of the mite load throughout the season.

2

Treatments and biotechnic methods.

3

A reflection on the annual journey of the colonies.

The aim is to keep the level of infestation below the threshold at which damage or economically unacceptable loss occurs.

We are therefore moving from a reactive system ("I'm going to treat after the last honey flow") to a preventive system: "I prevent varroa mites from reaching a threshold that is damaging to my colonies".

3. Importance of winter bees

For effective management of the parasite, there is one essential point to remember. The control measures taken **throughout the current year** will determine:

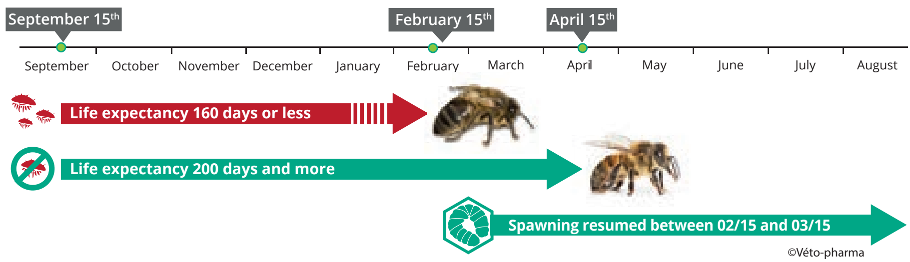
- **Winter survival** of colonies.
- Infestation at the start of the following spring, and thus **the vitality of surviving colonies.**

These are the winter bees that will play a crucial role in the new season. They generally appear between August 15 - September 15, depending on the region. If they are in good health, these overwintering bees will live for an average of 200 days or more (compared with 1 to 2 months for summer bees).

THE IMPORTANCE OF WINTER BEES[9,10]

The average lifespan is estimated at between 160 and 200 days. This variation will make the difference between the strength of the colonies the following spring and their survival.

Modeling the survival of a batch of overwintering females born on September 15



But it is these winter bees that must nurture the new generation of bees between mid-February and mid-March. They will enable the colony to restart the following spring. Their good health, their reserves of **vitellogenin*** and, of course, their numbers in the colony will enable the first brood and future generations of bees to be cared for. This period, when the old and new generations overlap, is a crucial time for colonies' build-up.

What is vitellogenin?

Vitellogenin is a storage protein produced by the bee, generated using proteins and carbohydrates provided by pollen and nectar. It is involved in storage and immunity, resistance to oxidative stress, lifespan, secretion and social feeding, regulatory behaviour, etc. It decreases as the bee's tasks evolve: in large quantities in nurse and overwintering bees, it virtually disappears in foragers.

Poor health and short lifespan of winter bees will inevitably have deleterious consequences for the following season.

If the winter bees don't survive to a date sufficient to ensure the rearing of summer bees, the colony will collapse.

If they have survived but are in a weakened state, so will the new generation.

As you can see, the good health of overwintering bees is crucial to ensuring the colony's survival in winter and the strength of the new generation of summer bees. But how do you keep your overwintering bees healthy? Infestation must be kept as low as possible throughout the beekeeping season. This is the whole principle of "integrated varroa mite management".

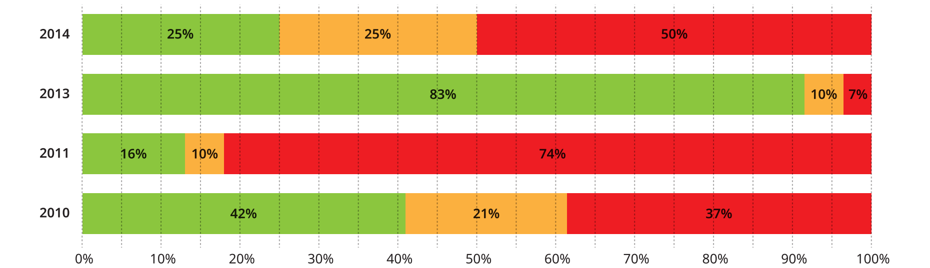
9. Remolina SC, Hughes KA. Evolution and mechanisms of long life and high fertility in queen honey bees. Age (Dordr). 2008 Sep;30(2-3):177-85. doi: 10.1007/s11357-008-9061-4. Epub 2008 Jun 22. PMID: 19424867; PMCID: PMC2527632. « Queen honey bees live on average 1–2 years whereas workers live on average 15–38 days in the summer and 150–200 days in the winter.»
10. Anton Imdorf, Kaspar Ruoff, Peter Flur (2020), Colony development in honey bees, Aroscope. « Indications of the average lifespan vary between 15 and 48 days in summer and 170 and 243 days for winter bees. »

4. Five preconceived ideas to forget

1 “ COUNTING IS POINTLESS, IN ANY CASE I'M GOING TO TREAT. ”

Counts are the first pillar of a good Varroa control strategy.

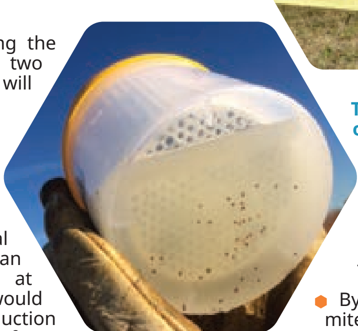
Distribution of varroa infestation by year, according to a reference threshold



The graph above11 shows the level of Varroa infestation in different years in the hives of a single apiary in Alsace. In green: less than 3,200 varroa mites at the end of the season. Orange: 3,200 to 4,200 varroa mites at the end of the season. Red: more than 4,200 varroa mites at the end of the season.[12]

The worst enemy in the fight against Varroa is habit, since no two seasons are alike. One year, you might find low infestation rates while the following year will present much higher numbers. Infestation rates can vary drastically from hive to hive as well. At the end of the season, it's possible for hives in the same apiary to have infestations of less than 500 Varroa mites, while others may have as many as 17,500.[13]

As you can imagine, applying the same treatment routine to two radically different situations will not produce the same result.



So it's important to start monitoring early in the season so that you know where you stand, and can take emergency measures if your hives exceed critical thresholds. By doing so, you can avoid excessive infestations at the end of the season, which would reduce your honey production and jeopardise the survival of your colonies over the winter.

Similarly, an infestation that is not measured after an end-of-season treatment also presents a risk of not detecting a residual varroa load that is too high or of concealing a reinfestation.

The counts can be carried out in a few different ways:

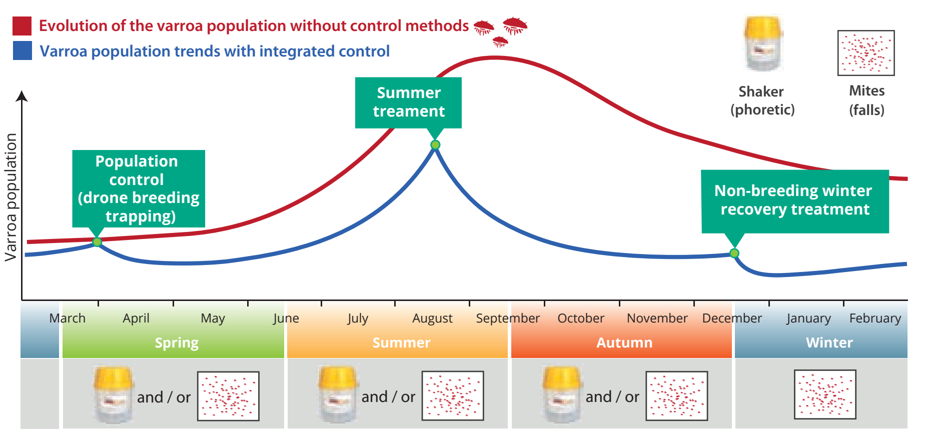
- By counting the number of phoretic mites in a sample of 300 bees via :
  - -Alcohol Wash
  - -Sugar Roll Test
  - -CO2 Injection
- By counting the daily number of varroa mites on sticky boards.
- By counting mites inside the capped brood: 200 cells of drone brood are skewered and the number of infested cells is counted.

11. BALLIS A. (2015) Infestation Varroa en Alsace, Intervention à l'AG d'ADA Franche Comté. Chambre d'Agriculture Régionale d'Alsace
12. The threshold of 3,200 to 4,200 varroa mites has been described in the literature as a level of infestation in season that causes an economic loss for the beekeeper (lower production and increased risk of mortality).
13. ITSAP : https://itsap.asso.fr/pages_thematiques/ravageurs-maladies/suivi-dinfestation-varroa-phoretiques-chutes-naturelles/

Photo credit : ©lantapix - Adobe Stock – Counting varroa mites on sticky boards. ©Camilius Lay - Counting phoretic mites with Varroa EasyCheck.

We recommend at least 4 periods of monitoring during the year, which you can find in the section "How to manage varroa throughout the seasons"

Modelling the development of the Varroa population without any control method VERSUS with integrated control



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TO FIND OUTMORE about monitoring Varroa infestation monitoring:

DOWNLOAD THE GUIDE VARROA VÉTO-PHARMA

VISIT THE WEBSITE VARROA EASYCHECK

2 “I WILL TREAT IN SEPTEMBER AFTER MY HARVEST, IMPOSSIBLE BEFORE.”

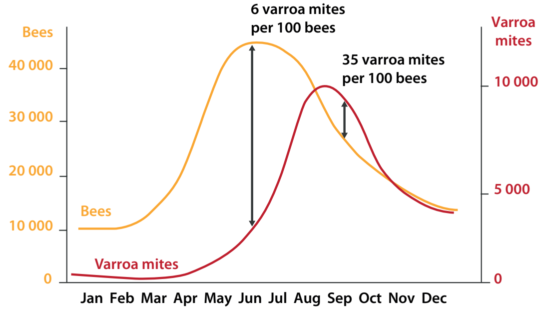
Starting management in September means exposing the overwintering bees to a strong impact from varroa mites and the viruses they carry. As a reminder, it is the good health of the overwintering bees that will ensure their survival over the winter and the strength of the colony when it restarts.

The decline in the bee and brood population over the autumn, combined with an increase in the Varroa population, means that the number of Varroa mites per bee and per brood cell is increasing.

This can be seen in this diagram[14], where the ratio explodes dangerously in September.

The impact is therefore catastrophic for the overwintering bees and the colony. It is vital to avoid this situation by adopting a **control strategy** that keeps the infestation at an acceptable level throughout the season, and avoids a situation that is difficult to control.

Modelling the development of bee and varroa populations and varroa mites in a temperate climate[14]



In late summer/early fall, the number of varroas increases while the bee population decreases, dangerously increasing the number of varroas per 100 bees.
A colony with such a high level of infestation will probably not survive.

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3 “IF THERE ARE STILL VARROA MITES AFTER TREATMENT, THE TREATMENT HAS NOT WORKED.”

There is often confusion between the effectiveness of the medicine and the result desired by beekeepers.

$$\text{Treatment efficacy} = \frac{\text{Number of varroa killed at the end of the treatment}}{\text{Total mite load (mites that died during treatment + mites that survived the treatment).}}$$

The level of efficacy required by the European Medicines Agency for the field trials needed to register a new medicine is **95% for synthetic substances** (e.g. amitraz, flumethrin, tau-fluvalinate) and **90% for non-synthetics** (known as "natural", such as thymol, formic acid, oxalic acid). These percentages are therefore taken as references for "good efficacy" of treatments.

However, depending on the initial infestation of the colony, 90/95% efficacy will not give the same result in terms of residual infestation (= number of varroa mites remaining in the colony after treatment): **If the infestation is too high at the start of treatment (as shown in the table below)**, there will potentially be an excessively high residual mite load, an even greater potential for the redevelopment of infestation (especially if the brood persists into the late season). Not to mention the harmful effects of viruses, which persist for several weeks after the parasite has been managed.

The treatment may have been 90-95% efficacious, but the residual infestation will be too high and could wrongly be interpreted as treatment failure. Because the outcome can vary greatly, depending on the initial infestation, it's important to determine mite load before ever applying a treatment.

That's why it's important to **determine the mite load before applying the treatment**, because the outcome can vary greatly depending on the initial infestation. In the event of a high residual infestation, remedial measures will need to be put in place to continue to reduce the infestation and try to limit the impact on the colonies.

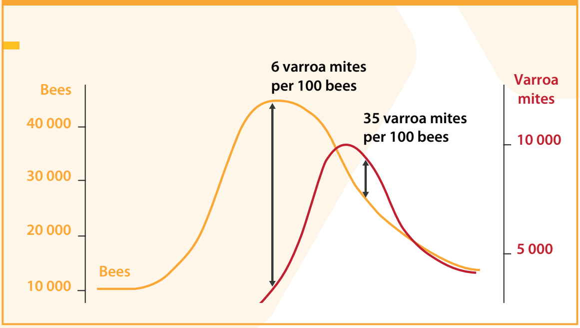
	Authorized treatment for **NATURAL BEEKEEPING**		Authorized treatment for **CONVENTIONAL BEEKEEPING**	
Initial infestation	Treatment efficacy: **90%**	Residual infestation	Treatment efficacy: **95%**	Residual infestation
500 mites	450 dead varroa mites	50 varroa mites remaining	475 dead varroa mites	25 varroa mites remaining
2 000 mites	1 800 dead varroa mites	**200 varroa mites remaining**	1 900 dead varroa mites	**100 varroa mites remaining**
10 000 mites	9 000 dead varroa mites	**1 000 varroa mites remaining**	9 500 dead varroa mites	**500 varroa mites remaining**

According to standards established some time ago, the aim is to achieve a residual infestation at the end of treatment **of less than 50 varroa per colony.**

4 “TREATMENT APPLIED IN SUMMER, NO NEED TO THINK ABOUT IT ANYMORE!”

As explained above, despite the end-of-summer treatment, residual loads can still be high. The Varroa population can then redevelop very quickly. In addition, there is a real risk of reinfestation through plundering or drift, as illustrated in the opposite diagram.[14-15] Management will then need to be supplemented by other actions, , like the application of a winter treatment in colonies. Although winter treatment can, to a certain extent, manage this residual infestation, **it will not prevent the death of colonies that have been too badly affected in previous months.** It cannot be stressed enough that varroa infestation must be managed **throughout the season**, not just at the end of summer.

Modelling the speed of development of the Varroa population following reinfestation



14. The National Bee Unit (Animal & Plant Health Agency, UK) – Managing Varroa, 2017
15. Wendling, S., 2012. Varroa destructor (Anderson et Trueman, 2000), Un acarien ectoparasite de l'abeille domes- tique Apis mellifera Linnaeus, 1758. Revue bibliographique et contribution à l'étude de sa reproduction. Thèse d'exercice Vétérinaire, Ecole Nationale Vétérinaire d'Alfort, France.

5 "DESPITE SUMMER TREATMENT, MY COLONIES DIED IN WINTER. RESISTANCE?"

Before concluding that this is resistance, we need to take a look at the situation. We open the register and the monitoring book and go back over the history of the colonies and their management in order to answer the following questions:

- What were my colonies like? **Were they strong?**
- Was there a lot of brood, a large harvest and therefore **probably a lot of varroa mites**? More open or capped brood?
- What were **the results of my counts before**, during and after my treatment?
- Have any **biotechnical measures been implemented** during the year to reduce infestation?
- **What were the dates** when I applied my treatment or started to manage varroa?
- **How did** I apply the treatment? For how long?
- Has there been **reinfestation** from a neighboring apiary?
- What was the **treatment history** of these colonies the previous year?
- Was there enough **pollen and nectar in the fall to build my winter bees**? Poor fall flower development can limit winter bee production.

When we look at these issues, we realise that a high post-treatment mite load is not systematically synonymous with resistance, and that many parameters come into play. Integrated pest management also aims to identify these parameters and take them into account.

What is resistance?

« The resistance of a strain (or race) of insect to an insecticide corresponds to the development of an ability to tolerate doses of toxic substances that would be lethal for the majority of individuals in a normal population of the same species. » (WHO, 1957).

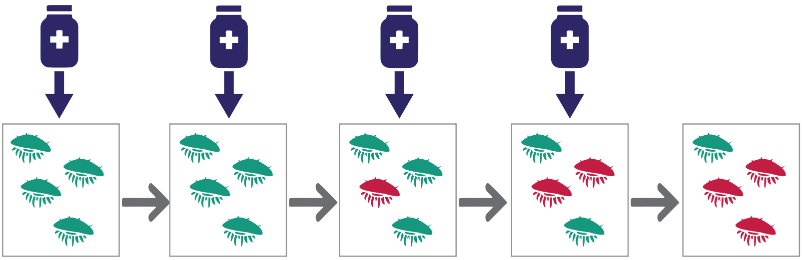
Resistance is therefore the adaptation of the parasite to a drug treatment, enabling it to survive and continue to reproduce.

THE PARASITE ADAPTS IN 3 POSSIBLE WAYS: [16]

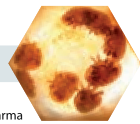
1. **PHYSIOLOGICAL RESISTANCE** ; By modifying the target of the drug (modification of the receptor targeted by the molecule) or by detoxifying the drug more effectively.
2. **PHYSICAL RESISTANCE** for example by thickening of its cuticle.
3. **RESISTANCE BEHAVIOURAL** avoiding the drug.

THIS ADAPTATION CAN BE PASSED ON TO THE NEXT GENERATION.[17]

Repeated application of the same drug can make some varroa mites resistant. They adapt to survive subsequent applications of the drug.



Acquired resistance develops in varroa progeny.



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NOTE: Incorrect use of a product can accelerate the reduction in a parasite population's response to an active ingredient. For example, leaving treatments in colonies for longer than recommended (throughout the winter), reducing the dose recommended on the label or combining treatments in an unapproved manner".

16. Mallick A., 2013. – Action sanitaire en production apicole : gestion de la varroose face à l'apparition de résistance aux traitements chez Varroa destructor. Thèse VETAGRO SUP LYON, France.
17. Higes, M., Martín-Hernández, R., Hernández-Rodríguez, C.S. et al. Assessing the resistance to acaricides in Varroa destructor from several Spanish locations.Parasitol Res 119, 3595–3601 (2020). https://doi.org/10.1007/s00436-020-06879-x

5. Treatments and biotechnics: what tools are available?

TREATMENTS

There are a variety of treatments for Varroa mites, each based on different active ingredients that are registered for use in honey beehives. Always refer to the product labeling for instructions on use. Ensure you only utilize treatments that are registered for use in a beehive, signifying that the product has undergone thorough testing for safety and efficacy, non-toxicity, and minimal residue levels.

	ACTIVE INGREDIENT	PARTICULARITIES
Conventional beekeeping	Amitraz	Contact treatment. Strips to apply between brood frames. Long-lasting treatment that targets varroa mites over several cycles. The strips must be removed at the end of the treatment. **Rotate occasionally with another active ingredient, on the veterinarian's or technician's recommendation, to preserve the efficacy of this active ingredient over time.**
	Flumethrin (Authorized in Canada and European Union but not in the USA)	Contact treatment. Strips to apply between brood frames or at the entrance to the hive, depending on the product. Long-term treatment that targets Varroa mites over several cycles. The strips must be removed at the end of the treatment. **Rotation treatment - resistance can quickly develop.**[18]
	Coumaphos (Authorized in the USA but not in Canada or the European Union)	Contact treatment. Strips to apply between brood frames. Long-lasting treatment that targets phoretic varroa mites over several cycles. The strips must be removed at the end of the treatment. **Risk of residue accumulation.**[19] **Rotation treatment - resistance can quickly develop.**[20]
	Tau-fluvalinate	Contact treatment. Strips to apply between brood frames. Long-lasting treatment that targets phoretic varroa mites over several cycles. The strips must be removed at the end of the treatment. **Rotation treatment - resistance can quickly develop.**[18]
Natural and conventional beekeeping	Formic acid	The only molecule capable of penetrating capped brood. Efficacy and safety dependent on temperature conditions. Be careful to respect them.
	Oxalic acid	Treatment by dripping or sublimation: efficacy depends on the absence of brood, which determines its use.
	Hops (USA and Canada only)	Contact treatment. Strips to apply between brood frames. Long-term treatment that targets varroa mites over several cycles. The strips must be removed at the end of the treatment. Temperature-dependant.
	Thymol	Treatment in the form of gel or impregnated waffles, to be applied to the frame heads and repeated several times. Temperature-dependant.

LEARN MORE HERE

18. N. Milani (1995), The resistance of Varroa jacobsoni Oud to pyrethroids: a laboratory assay Apidologie, 26 5 (1995) 415-429. DOI: https://doi.org/10.1051/apido:19950507.
19. Premrov Bajuk, B., Babnik, K., Snoj, T. et al. Coumaphos residues in honey, bee brood, and beeswax after Varroa treatment. Apidologie 48, 588–598 (2017).
20. A scientific note on Varroa destructor resistance to coumaphos in the United States, Jeff S. Pettis, Apidologie, 35 1 (2004) 91-92

What is an "active ingredient"?

It is the molecule present in the treatment which gives it its therapeutic properties. A treatment may contain molecules which are not active ingredients, and which are then called "excipients" (for example, to improve the administration and preservation of the product).

CONVENTIONAL BEEKEEPING,

The active ingredients available are amitraz, flumethrin and tau-fluvalinate. These active ingredients are incorporated into carriers that allow the treatment to act for several weeks, covering several brood cycles and therefore successive generations of varroa mites. This is known as long-term management.

IN THE NATURAL SECTOR,

Oxalic acid, formic acid, hops and thymol are available to beekeepers. The treatments using these active ingredients are available either in the form of "flash" treatments (which may or may not require the colony to be "brood-free"), or in the form of several applications for long-term treatment.

These active ingredients can also be used in conventional beekeeping.

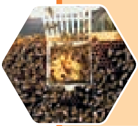
We use the term **« FLASH » TREATMENT** to refer to medications that will target, for a relatively short duration, the varroa population.

ADVICE ON THE CORRECT USE OF VARROA TREATMENTS:

- **Follow the instructions for use,** dosage and duration of application. Remove the product thoroughly at the end of the treatment, in accordance with the instructions for use. As a reminder, Varroa treatments should ALWAYS be carried out in the absence of honey supers.
- **Renew waxes** every three years on average[21-22] - or at least 30% a year, to avoid the build-up of residues. Apart from the question of residues, study has shown that varroa mites are 4x-5x more attracted to old frames! [23]
- **For contact treatments**, such as strips:
  - ✓ Position the strips in the center of the brood, to promote maximum contact,
  - ✓ Scrape with a hive-tool to remove wax and propolis during treatment, and reposition in the center of the brood if the cluster of bees has moved.

21. Al-Kahtani, Saad N., and EL-Kazafy A. Taha. «Effect of comb age on cell measurements and worker body size.» Plos one 16.12 (2021): e0260865
22. ANWAR MOHAMED, AbedelsAlAm, et al. Effect of larval nutrition on the development and mortality of Galleria mellonella (Lepidoptera: Pyralidae). Revista Colombiana de Entomología, 2014, 40. Jg., Nr. 1, S. 49-54.
23. PICCIRILLO and DE JONG, Old honey bee brood combs are more infested by the mite Varroa destructor than are new brood combs (2004). Apidologie 35 (2004) 359–364.

BIOTECHNICAL METHODS



METHOD	PRINCIPLE	BENEFITS	DISADVANTAGES
Queen caging	**Artificially inducing a broodless period** by isolating the queen in a cage kept in the colony for a minimum of 21 days (25 days if there is drone brood)[24] The queen is then released. There are several types of cage and caging times.	Causes a **phoresy** phase.* **The brood-free state enables a flash treatment.**	Preparation and equipment cost. Time-consuming. Loss of some queens during uncaging. Population impact (temporary population decrease) to be considered in the colonies' progression.
Drone brood removal	Exploiting the attractiveness of male brood **to trap Varroa mites and physically remove them** from the colony (using dedicated frames).	**Simple biotechnical method** to implement. **Wax recycling**.	It is crucial to strictly adhere to withdrawal dates; otherwise, there is a risk of causing the opposite effect. Logistics should be planned if large quantities of brood are removed (wax melting). Limited to the male production period.
Worker brood removal	Performing a **complete removal of worker brood** while allowing the queen to restart on a "bare swarm" (several methods available)	Induces a **phoresy*** phase in the colony. **The brood-free state enables a flash treatment.**	Management of removed brood to be planned. Slows down the development of the colony.
Scratching/ scraping of brood.	**Destroying capped brood by scratching it to trigger varroa elimination,** during subsequent cleaning and potentially taking advantage of this 'broodless' situation to apply a treatment.	**Simple**, but ideally done on small quantities of brood during a nectar flow. Triggers a **phoresy phase**.*	Time-consuming.
Splitting colonies	**Distributing mite loads** to restart with a lower infestation level.	Ideally accompanied by a brood break **allowing for a flash treatment**	Does not prevent Varroa from continuing its development. The result will clearly depend on the method used and any additional treatments.
Thermal treatment	**Killing Varroa in brood** by raising the temperature to 41°C (105 °F), a lethal threshold for Varroa, for a specified duration (two hours in some protocols).	Affects Varroa in brood. **Applicable at any time. No residues**.	Different methods, some of which are still experimental. Cost of equipment acquisition. Time-consuming.

*Phoresy / dispersion, what is it?

The terms 'phoresy phase' (or 'phoretic Varroa mites') or 'dispersion phase' refer to adult Varroa mites present on adult bees (as opposed to Varroa mites present in capped brood cells). The only difference is their scientific accuracy: 'Phoretic Varroa mites' describes the association between two organisms in which one (for example, a mite) travels on the body of the other **without being a parasite (i.e., without feeding on the other).** However, this definition is incorrect for Varroa, as it feeds on the bee (primarily on the fat body and hemolymph. The appropriate term **« dispersion phase » or « Varroa in dispersion »** is therefore more accurate.

If we analyze these techniques, we note that achieving a phoretic phase is often one of the sought-after objectives, aiming to expose the Varroa mite to the treatment.

Other objectives aim to reduce parasitic loads by trapping the parasite, eliminating it from the colony, or distributing the parasitic burden.

Note: Some methods have an impact on the colony's development because a decrease in population following the treatment will occur. Therefore, this must be taken into account for spring build-up, honey harvests, and wintering.

©Apimat.ch - Queen caging with Scalvani cage

24. Queen caging: Caging for 25 days gives good coverage of a complete development cycle if there is male brood.

6. How to manage Varroa throughout the seasons:

It is challenging to provide a standard answer to the question of managing Varroa throughout the year. The techniques implemented will depend on numerous factors such as climate, desired harvests, colony routes, beekeeper's expertise, equipment used, and, of course, the levels of Varroa infestation.

However, we can discuss the objectives of integrated pest management and the means at our disposal to implement it.

THE OBJECTIVE: Maintaining a sufficiently low infestation level, allowing for the proper development of the colony and ensuring the honey production planned by the beekeeper.

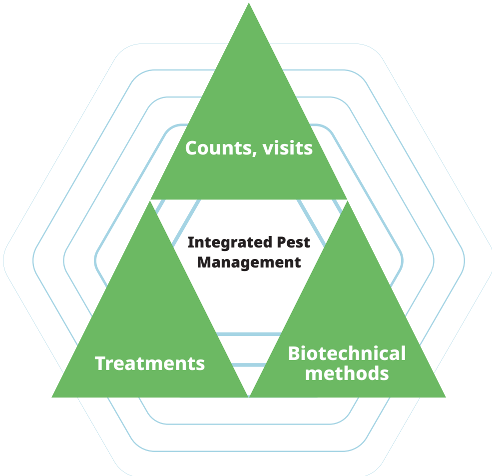
THE MEANS: Biotechnical methods + Treatments + Counting, visits, and observation.

ACTION PLAN: Planning and Adaptation

The colonies' trajectory is planned,

- The dates for visits and counts are scheduled,
- The methods (biotechnics and treatments) are chosen and established in advance.

Then, it's just a matter of adapting to the season and the results of the counts. Management is not compartmentalized: each action taken (or not) has consequences for the future.



4 COUNTS/VISITS TO BE SCHEDULED AT A MINIMUM THROUGHOUT THE YEAR.

1

AT THEBEGINNING OF THE SEASON

to sort the colonies and establish an initial assessment. This determines the trajectory of the colonies for the rest of the season.

2

AFTER THE SPRING HARVESTS

and before the summer harvests to avoid putting colonies already too infested by varroa back into production, and to get an idea of the evolution of the parasitic load.

3

BEFORE SUMMER TREATMENTS

during the last harvest: provides a measure of risk and determines additional actions to be taken. Also allows for an estimation of the initial infestation pre-treatment.

4

AFTER THE END OF SUMMER TREATMENTS

(generally 1 to 2 weeks later): provides an estimate of the residual infestation and the potential need for a winter follow-up treatment.

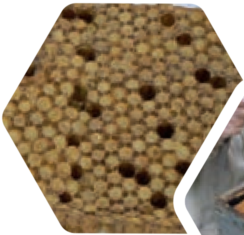
12 MONTHS

Throughout the season: each visit includes an observation phase of signs caused by Varroa. The good practice is always to perform a count in case of doubt. This count should be followed by corrective actions if necessary.

Here are some examples of monitoring or points to consider throughout the season:

IN SPRING

Once the colonies are assessed, a review is made and the trajectory is organized. During this season, the main preventive method that can be used is **drone brood removal**. It is recommended to conduct three trapping cycles, starting in spring.



Drone brood removal
© G. Therville

It is also possible to **apply a medicinal treatment** before the first honey flow if the level of infestation is already too high.

At the beginning of the season, **queen caging or brood removal**, can be used sparingly, as both population for starting colonies. A bit later, consideration could be given to strong colonies just before harvest and depending on how these colonies will be used throughout (harvest, swarm creation, etc.).

Swarm creation is something that can be done in the spring, and throughout the season, in large, healthy colonies. The goal is to achieve a brood-free period that would allow for a quick treatment. Creating an artificial swarm provides a good opportunity to observe both the brood and the bees.

IN SUMMER

In summer, mite levels become criticial and, left unmanaged, can become dangerously high. At this precise moment, the goal is to preserve the future winter bees and the nurses that will prepare them.

Counting can provide valuable predictions: continuation for a final honey flow/possibility of a late honey flow? Or, on the contrary, the need for urgent treatment?

The aim is to rapidly reduce the parasitic loads.

Attempting to achieve a brood-free period to enhance treatments.

During this season, with careful calculation, one can combine:
- **Queen caging** and flash treatment at the end of the honey flow.
- **Brood removal**, coupled with flash treatment.
- **Application of long-term treatments**. These manage the parasite over a more extended period and yield better results if applied during the phoretic/dispersal phase.

In our discussion on biotechnical actions, we mentioned **« brood scratching »**. This technique is particularly effective in areas where certain honey flows—like lavender, and to a lesser extent, sunflower—lead bees to store honey in the brood box. This storage behavior restricts the queen's ability to lay eggs by limiting available space, thereby reducing the quantity of brood that needs to be destroyed to initiate a phoretic or dispersal phase.

IMPORTANT: If egg-laying is intentionally stopped during this period, it is crucial to carefully calculate the restart of egg-laying to ensure an adequate production of winter bees.

NOTE:

In spring, treatments options are limited by production goals – it will be more challenging to find a window of several weeks to apply a 'long-acting' treatment. Shorter treatments will have to be chosen, or alternatively, the colony may need to be removed from the current honey flow.

This is where counts become crucial: a colony that is already too infested will produce little or not at all, and it will be more relevant to remove it from the first honey flow to reduce its parasitic load.

Brood scratching
© G. Therville

FALL/WINTER

Monitoring remains crucial during this period. The following questions need to be considered right after the summer treatments:

Have we succeeded in sufficiently sanitizing the colonies, or is the residual infestation still too high?

If yes, is it due to a significant infestation before treatment, a reinfestation, or resistance to an active ingredient?

In any case, additional actions will be necessary.

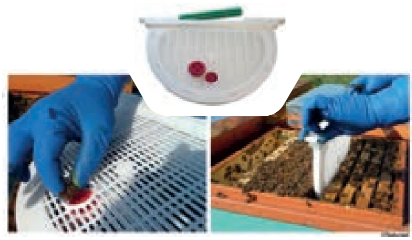
Possibilities may be limited by weather conditions, as temperatures may not allow the optimal use of certain compounds or techniques:

During winter, **if a brood-free period is achieved** (brood-break due to temperature drops), the application of a treatment based on oxalic acid can be beneficial and particularly effective.

Milder winters sometimes make this brood-break very uncertain or non-existent.

Biotechnical methods need to be adapted to local peculiarities.

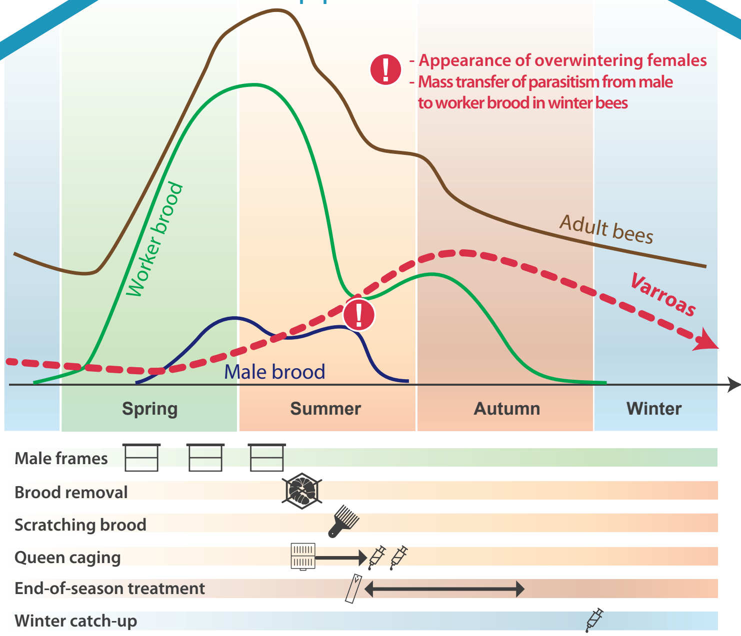
©Klaus Nowottnick - Adobe Stock – Application of a treatment based on oxalic acid in winter.



©Naturapi – Menna cage can be used to achieve a brood break in winter.

TO SUMMARIZE, here's an example of a combination of treatments and biotechnical methods throughout a season. It's up to you to create your annual plan based on your goals and local peculiarities.

Modeling the development of various populations throughout the season, along with associated population control methods.



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7. Climate Change: What Impacts does it have on Varroa Management?

Climate change is a multifaceted global phenomenon that significantly affects the distribution and abundance of a wide range of ecosystems and organisms, including plants and pollinators.[25]

Warmer temperatures can have direct effects on the survival, life cycle, and fertility, also impacting the mutual balance between plants and pollinators (thus affecting domestic honeybees).

As a result of global warming, beekeepers report **declines in production** or changes in the type of production concerning honey flows or pollination services, with both economic and health consequences.

Regarding Varroa, beekeepers establish a correlation between **milder winters**, the absence of brood breaks, and therefore **larger and more challenging infestations**. This compels them to implement additional measures, such as artificial brood breaks through **queen caging or brood removal**, combined with the use of **treatments**.

To confirm this observation, a study conducted in Germany[26] compared sites exposed to varying temperatures during wintering. Brood rearing had started 14 days earlier at the 'warmer' site. A warming simulation (by relocating colonies from one site to another at the end of winter) also showed an earlier onset of brood rearing in the affected colonies (13 days earlier).

Colonies with an earlier start exhibited **three times higher parasitic loads at the end of the season** compared to colonies with a slower start.

Another study[27] also indicates that climate change **promotes higher parasitic loads at the end of the season**, apparently by favoring bee reproduction during specific periods, such as spring or autumn.

25. Vercelli, Monica, et al. «A qualitative analysis of beekeepers' perceptions and farm management adaptations to the impact of climate change on honey bees.» Insects 12.3 (2021): 228.
26. Nürnberger, F., Härtel, S. & Steffan-Dewenter, I. Seasonal timing in honey bee colonies: phenology shifts affect honey stores and varroa infestation levels. Oecologia 189, 1121–1131 (2019). https://doi.org/10.1007/s00442-019-04377-1
27. Szymon Smoliński, Aleksandra Langowska & Adam Glazaczow. Raised seasonal temperatures reinforce autumn Varroa destructor infestation in honey bee colonies. (2021) 11:22256. https://doi.org/10.1038/s41598-021-01369-1

8. Conclusion / Key Takeaways

As you have understood through this guide, effective control against Varroa is based on anticipation, not just reaction. The goal is to **maintain a low infestation level throughout the season** to preserve the colony and avoid a high parasitic and viral load. The primary focus is on **preserving the winter bees** to ensure a successful restart in the colony under the best possible conditions.

Above all, **the strategy is adapted** according to the current season. Each year is unique, and climatic variations will require increasing adaptability to manage Varroa effectively.

To find out more about *Varroa destructor*, you can consult other documents available in our resource library or consult our blog.

RESOURCE LIBRARY:
https://www.veto-pharma.com/resources-library/

BLOG:
www.blog-veto-pharma.com/en

FOR MORE INFORMATION ON INFESTATION MONITORING AND VARROA EASYCHECK:
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