Varroa

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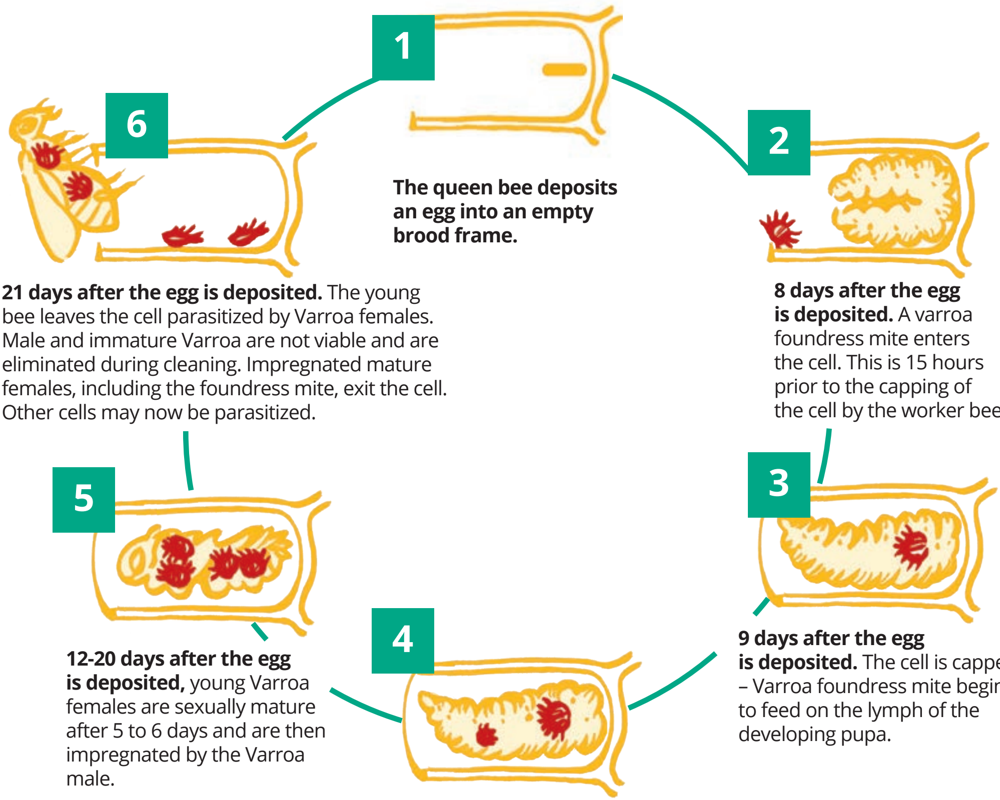
Biology of the Varroa mite: what you need to know to understand its population dynamics

The reproductive cycle of Varroa takes place entirely in the 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** in the worker (female) brood[1-2].
- At least **2.2 new female mites** in the drone (male) bee brood, which is the most attractive for Varroa[1-2].

Principal stages of Varroa's reproductive cycle



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

2 **8 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.

3 **9 days after the egg is deposited.** The cell is capped – Varroa foundress mite begins to feed on the lymph of the developing pupa.

4 **10-11 days after the egg is deposited,** the foundress mite lays 1 egg every 30 hours into the cell (first egg is male and then all are females).

5 **12-20 days after the egg is deposited,** young Varroa females are sexually mature after 5 to 6 days and are then impregnated by the Varroa male.

6 **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.

KEY POINTS

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 3 or 4 successive reproductive cycles during their life by penetrating a brood cell just before its capping[2].

Phoretic phase: The duration of the phoretic phase (Phoretic Varroa = on adult bees) between 2 reproductive cycles is variable. An impregnated young female must necessarily mature in phoresy around 7 days (from 5 to 14)[3] 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[4] 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 1 and 2 months in the summer and between 6 to 8 months during the winter in the absence of brood.

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 much more heavily infested than worker brood cells (8 to 10 times more)[5-6-7-8]. 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.

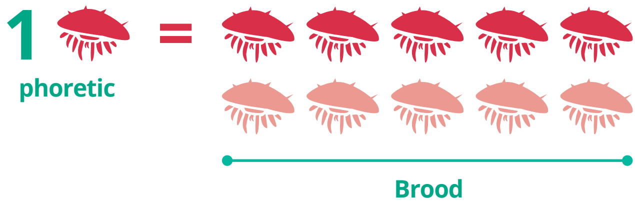
Spread of Varroa: Spread of Varroa from one hive to others (mostly due to the robbing of weakened colonies, but also due to drifting of drones or worker bees [returning to the wrong hive], or the reduction of worker population) plays an important role in the Varroa population dynamic. Various studies have shown large quantities of reinfesting Varroa that vary according to the season and colonies of up to 70 Varroa mites per colony per summer day[9] or throughout the year from less than 200 to more than 4,000 mites per colony[10]. Robbing may involve colonies more than 1 km away[11].

Swarming: Swarming causes a momentary stoppage in the Varroa population explosion, due to the broodless period of around 3 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% of the Varroa population present at the time in the original colony[12-13].

SPECIFIC POINTS

50 to 90% of Varroa are located in **capped brood cells**[14-15-16].
Cell caps thus protect the largest part of the Varroa mite population during the application of intermittent non-long-term treatments.

1 Varroa mite visible on one bee
= 5 to 10 Varroa mites present in the brood



Monitoring: key points

Varroa monitoring is used to estimate the **level of infestation** of a colony in order to optimize the treatment period and strategies. Ideally, monitoring should take place at least **twice per year** (in the spring and at the end of the honey flow).

An effectiveness check can also be conducted following a Varroa treatment. The check must be conducted on a minimum of **20% of the colonies** of each apiary (see table below).

The results must be carefully interpreted, and have to take into account all of the factors that may influence the number of Varroa mites found, including: monitoring method used, number of bees in the sample, population of bees in the hive, time of year, overall health of the colony, and geographic location of the hives.

Size of apiary	Number of colonies to be tested
≤ 5 apiaries	All colonies
Between 6 and 20 apiaries	5 to 8 colonies
> 20 apiaries	Minimum of 8 colonies

METHODS OF DETECTION AND ESTIMATION OF VARROA POPULATION

Alcohol washing of bees:

Consists of **washing bees** (around 300) with alcohol (dish washing detergent diluted in water may also be used). Phoretic Varroa from bees on brood frames are detached, and counted. Care must be taken to avoid including the queen in the sample. Find her and protect her.

Objective: Determine the percentage the percentage of phoretic infestation (# Varroa/100 bees) by dividing by the number of bees in the sample. Using a graduated measurement (1/2 cup) makes it possible to avoid precisely counting the number of bees each time.

Monitoring of natural mortality of Varroa by the use of sticky boards:

Counting the number of Varroa mites that **fall onto a greased piece of cardboard, or plastic,** which is referred to as a sticky board. A screen or mesh floor should be placed above the sticky board to prevent the bees from touching the board.

Objective: This method consists of establishing an **average rate** of Varroa per 24 hour day. Thus, 12 Varroa observed over 3 days = 4 Varroa/day.

De-capping of drone and/or worker broods:

Involves de-capping 200 or more male brood cells and then removing the brood for counting.

Objective: While this method is precise, it is also destructive to the colony and very time-consuming. Also, it is important that the sample be exact in order to be representative complete. Lee (2010) and Martin (1998) recommend extrapolation to determine the colony's population, together with counting of phoretic Varroa.

Time of monitoring	Objective
Early spring	Early detection makes it possible to **plan** effectively and **assess** the need for springtime treatment.
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 (is when brood is absent) or early next spring.

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

Detection calendar as part of integrated treatment

Time of monitoring	Alert thresholds estimated for USA. Thresholds dependent on multiple factors; must be adapted to each operation.		
	Washing with alcohol	Sticky boards (strong hives - 30.000 bees)	Checking of capped drone brood
Early spring	1% of Varroa on average	5 Varroa mites per day on average	4% of cells infested
Between 2 honey flows	3 %	10 Varroa mites per day	5 %
Late July – early August	5 %	30 Varroa mites per day	
Late August – September in the absence of summertime treatment	5%*	30-50 Varroa mites per day*	

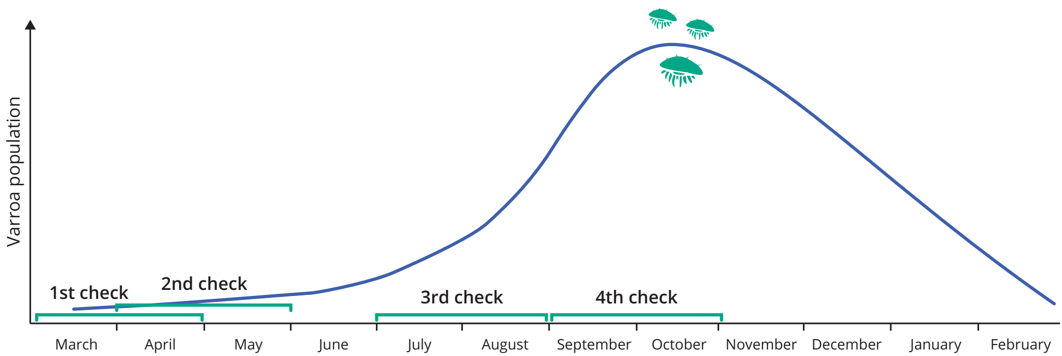
Sources: 17, 18 and 19.

*If thresholds are not reached, outside-brood checking will suffice.

Note on interpretations of infestation checks: The data available to us comes from studies conducted abroad (Canada, USA, England, Switzerland...)[17-18-19] and must be interpreted with caution as it is not perfectly adapted to the diversity of conditions in USA. Threshold may vary with geographic area and local experts should be consulted. In some cases, even if infestation measured is below these thresholds, it is more secured treating rather than waiting. Do not hesitate to refer to your local expert.

Modeling of the development of the Varroa population

In a colony without treatment or egg-laying blockage in season, but with prolonged stoppage of wintertime egg-laying.

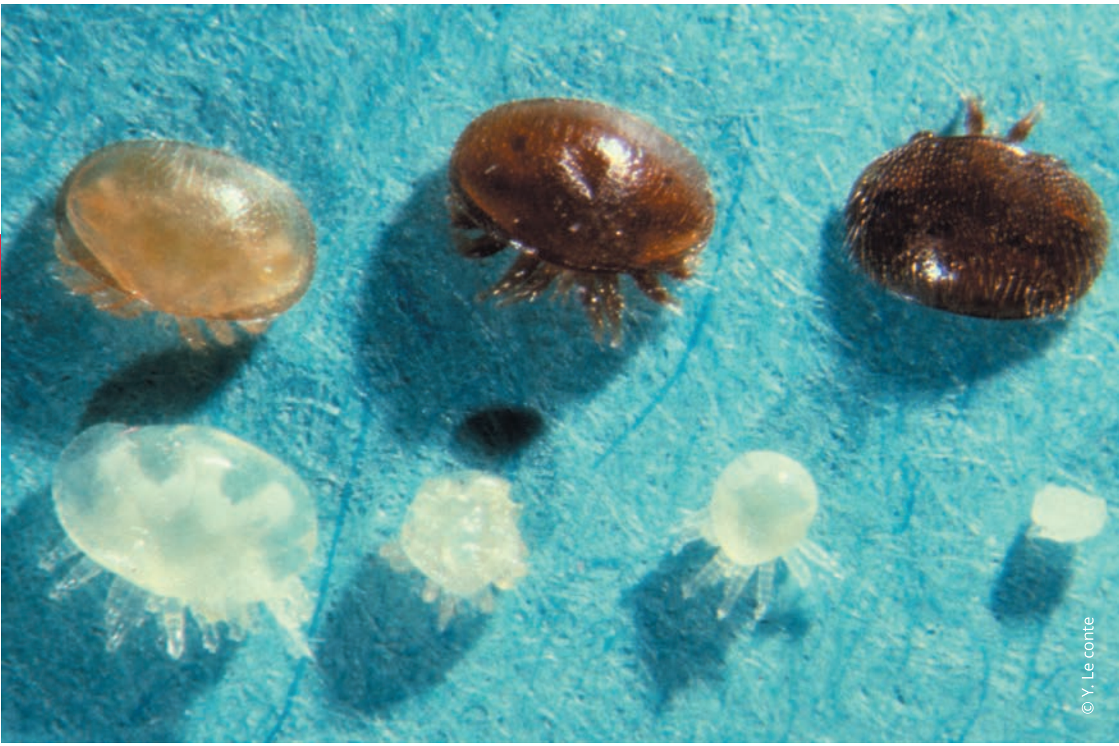


Treatment

Why treat?

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 parasitosis colony health, but also **to limit** more collectively **the stress placed by parasitic populations** and their **health impact** on neighboring apiaries and on the apiary population in general.

A study published in 2010[20] shows that **a colony that is infested by Varroa and not treated can die in a period of between 6 months and 2 years**. This time is determined not only by the ability of Varroa to reproduce in the brood, but also by the stress of neighboring hives. High density of bees combined with a severe infestation of Varroa speeds up the death of the colony (Ritter et al., 1984)[21]. The failure to treat certain colonies may thus endanger one or more apiaries.



When to treat?

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

OBJECTIVES:

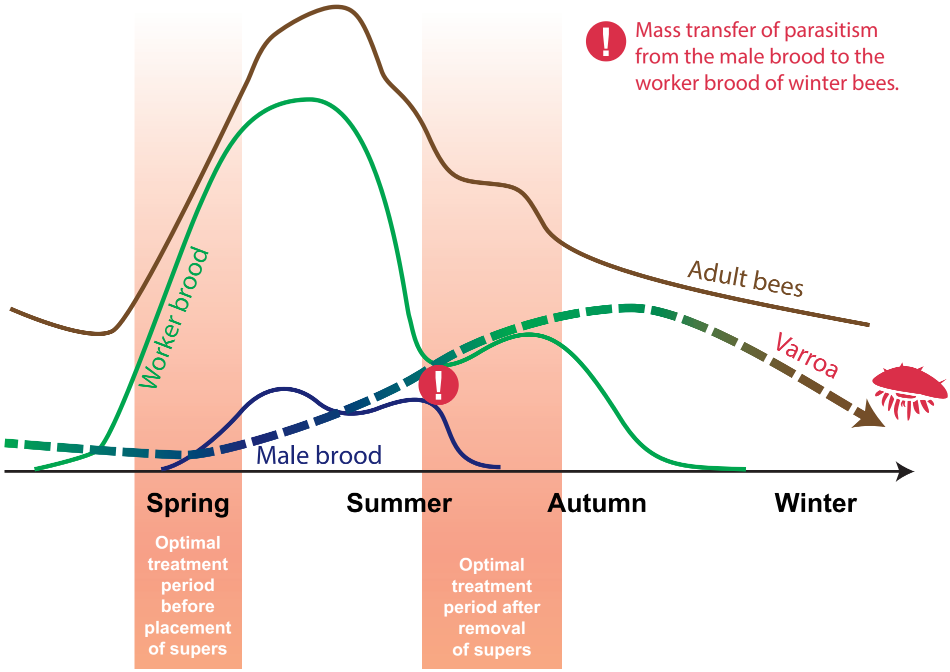
- **To limit the level of infestation** in order to avoid the collapse of heavily infested colonies in late summer – early autumn.
- **To reduce Varroa levels in colonies prior to wintering** in order to have healthier winter bees and to begin the following season with as low Varroa levels in hives as possible. To have healthy winter bees, it is important to reduce the number of Varroa on the nurse bees of these winter bees, and therefore **to treat as soon as possible after the removal of honey supers.**
  During heavy infestations, the later the treatment, the greater the period during which Varroa causes damage to the hive is prolonged. This delayed treatment may make it possible to eliminate most of the parasites, but may not overcome the effects of Varroa on infested bees prior to treatment. Treating early makes it possible to prevent levels of infestation so high that the colony will not survive winter. An early treatment will also help the colony get off to a relatively **good start** the following season.

02 Springtime treatment:

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

- When wintering conditions have not been favorable due to high infestation levels following the late summer/autumn treatment.
- When brood has been present all winter (even small amounts), enabling the ongoing increase of Varroa numbers.
- Or when the level of Varroa populations are high in the spring due to robbing of weak colonies by stronger ones, or drifting drones or workers.
- Treatment between honey flows (according the indications of the label : removing strips 2 weeks before introducing the supers): This treatment is aimed at **reducing the level of infestation during a honey flow**, in particular after significant merging, or equalization of colonies. This reduces the mite population for the rest of the beekeeping season and prevents colony collapse in late summer.

Modeling of the development of various populations throughout the season



While the bee population and the brood decrease at the end of the summer, the number of Varroa remains significant as long as brood remains. **Parasitic stress is at its most critical during the months of August through October.**

August through October is a dangerous time for a colony that has not been treated or has been inadequately treated, as several phenomena occur:

- Varroa levels rise during the fall as honey bee brood increases .
- Resumption of worker-brood production linked to late-season pollen flows (ivy...).
- Steep reduction in the raising of drones later in the fall, which causes a transfer of Varroa from the drone brood to the worker brood. This more highly infested fall worker brood will emerge 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.

Varroa treatment with Apivar

Apivar, your best choice for controlling Varroa mites

Active in more than 20 countries

5+ million colonies treated per year

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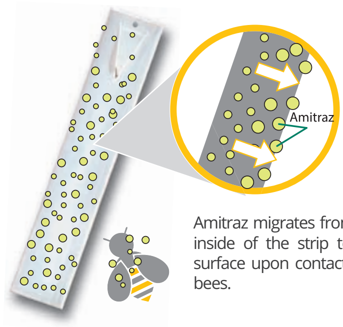
Véto-pharma develops, produces, and distributes a range of innovative products to support **honey bee health**. Our **expertise** guarantees the **quality** of our products, and Véto-pharma is the current **leader in Varroa treatments** in France, and a major key-player in the world, with Véto-pharma products distributed in more than 20 countries.

THE SAFE STRIP

Amitraz controlled-release technology: the Apivar expertise

Apivar works by contact: The active ingredient is delivered continuously over time. As bees walk on the strip's surface they pick up molecules of the active ingredient and then distribute them throughout the colony.



Amitraz migrates from the inside of the strip to the surface upon contact with bees.

Proven effective for more than 15 years

> KILLS UP TO 99% MITES IN 1 APPLICATION

> NO EVIDENCE OF RESISTANCE

Since its development in France, Apivar effectiveness has been subject to a variety of stringent regulatory studies and evaluations. To know more about this studies, please visit our website: **www.vetopharma.com**

Safe for bees and for honey

> NO SIGNIFICANT RESIDUES IN HIVE PRODUCTS

> NO NEGATIVE EFFECT FOR BROOD OR QUEENS

> Kills up to 99% mites in 1 application[1]

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%[1].

www.apivar.net

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MED-04-US-N01-04/15

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