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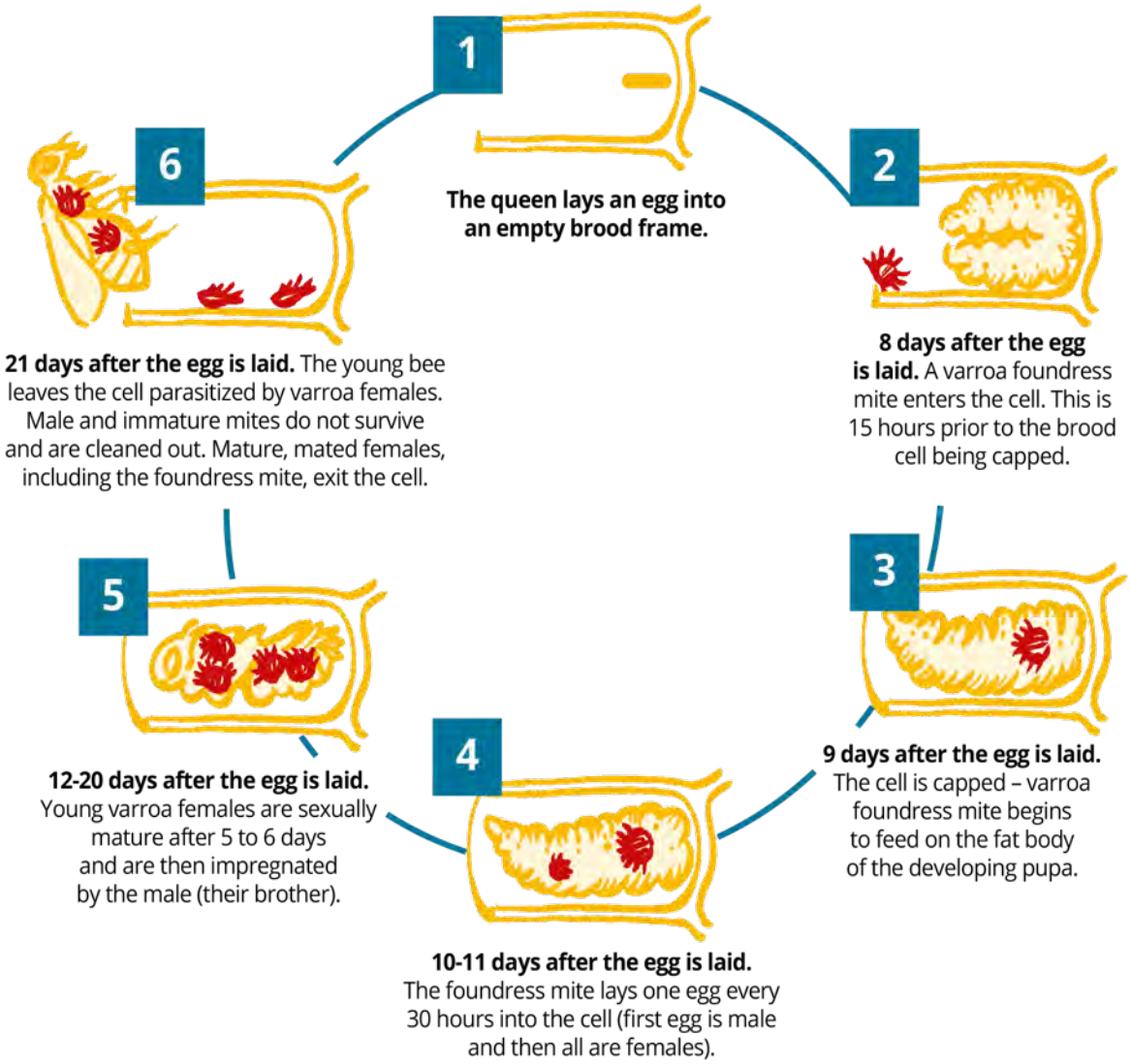
Biology of the varroa mite

Understanding mite population dynamics

Varroa ► Reproductive cycle in the brood



The reproductive cycle of the varroa mite entirely takes place in the capped brood cells.

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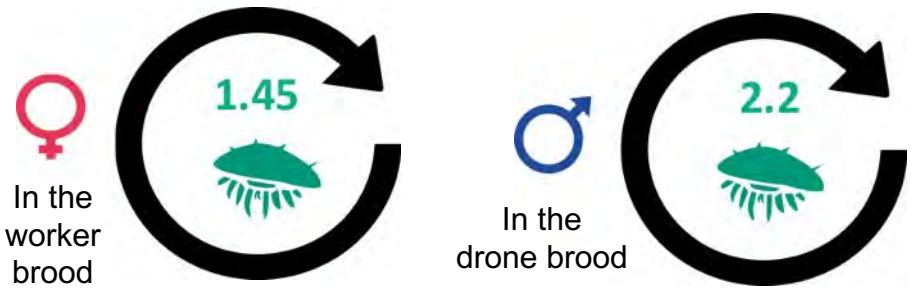
Varroa ► Life cycle

Understanding the life cycle of varroa:

- **Only mated females survive outside the brood** and parasitize adult bees in the "phoretic" life stage.
- The duration of **phoretic phases** between two reproductive cycles in the brood is variable. **Average: 7 days** (5-14 days).
- **Varroa females can go through 3 to 4 successive reproductive cycles.**
- **The lifespan of varroa mites is adapted to the bee's lifecycle**:
  1-2 months in summer and 5-6 months in a brood-free winter period.

Varroa mites multiply rapidly.
One cycle produces:



Drone brood is more attractive and heavily infested than worker brood.

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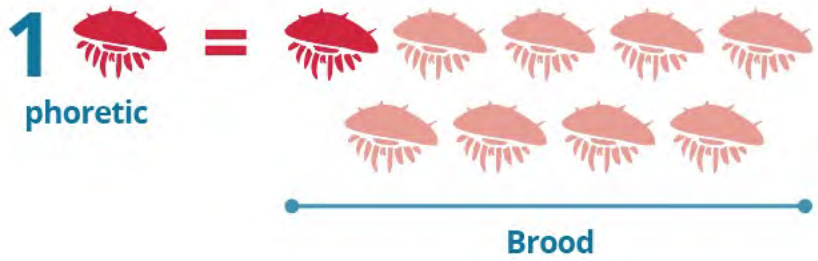
Varroa ► Infestation

50 to 90% of the mites
are located in the **capped brood cells**[1-2-3].



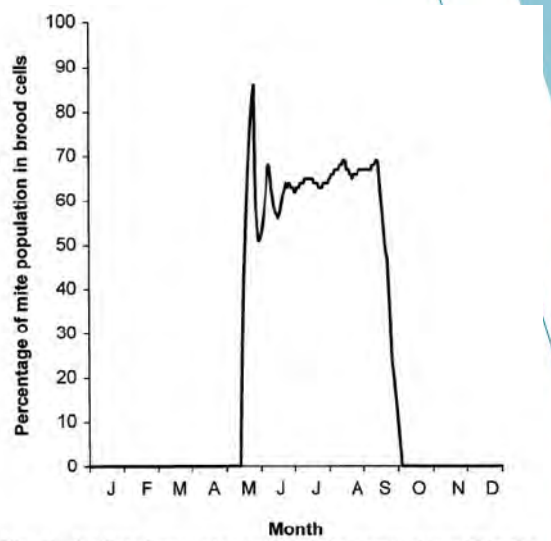


Fig. 11. Predicted percentage of the mite population within the sealed brood during the year.

MARTIN SJ (1998a). A population model for the ectoparasitic mite *Varroa jacobsoni* in honey bee (*Apis mellifera*) colonies. *Ecol. Model.*, **109**, 267-281.

1 - Biology and control of Varroa destructor. Rosenkranz P., Aumeier P. and Ziegelmann B. Journal of Invertebrate Pathology, Vol.103 - supplement (2010) S96–S119.
2 - A population model for the ectoparasitic mite Varroa jacobsoni in honey bee (Apis mellifera) colonies. Martin S., Ecological Modelling 109 (1998) p. 267–281.
3 - 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.

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Varroa ► Infestation

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Spread of varroa from one hive to others by:
Robbing of weakened colonies,
Drift of drones or worker bees

Responsible of large reinfestation:
In Summer: up to 70 Varroa mites / colony / day[1]
Total for one year: < 200 mites to > 4,000 mites / colony[2]

Robbing may involve colonies > 1 km away[3]

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Swarming causes a reduction of 15 to 20% of the varroa mite population in the original colony,[4-5] mainly in apiaries that are not overstocked.[6]

1 - GREATTI M, MILANI N, NAZZI F (1992). Reinfestation of an acaricide-treated apiary by Varroa jacobsoni. Exp. Appl. Acarol., 16, 279-286.
2 - IMDORF A, CHARRIÈRE JD, KILCHENMANN V, BOGDANOV S, FLURI P (2003). Alternative strategy in central Europe for the control of Varroa destructor in honey bee colonies. Apiacta, 38, 258-285.
3 - RENZ, M., ROSENKRANZ, P., 2001. Infestation dynamics and reinvasion of Varroa destructor mites in honey bee colonies kept isolated and in groups. Apidologie 32, 492–494.
4 - 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.
5 - 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.
6 - Seeley, Thomas D., and Michael L. Smith. "Crowding honeybee colonies in apiaries can increase their vulnerability to the deadly ectoparasite Varroa destructor." Apidologie 46.6 (2015): 716-727.

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Varroa ► Infestation

EFFECTS OF VARROA ON INDIVIDUAL BEES

Varroa bites and feeds on the bees' fat body[1]

- Dramatic reduction of body mass (-11% to -18%)[2]: proteins (-27% to -50%)[3] and lipids
- Disruption of the bees' behavior and tasks of the bees (brood feeding: hypopharyngeal glands -13% to -31%[4], foraging: wing deformations[5], reproduction: sperm production[6]…)
- Permanent harm to the cuticle – bite does not heal.
- Transmission of viruses (DWV ABPV KBV IAPV SBV) and other infectious agents

→ Weakening of the immune system and general physiology

→ Stress and loss of productivity, disturbance of colony organization

→ Entrance of bacteria, fungi, chemical agents, ...

Reduced lifespan of bees (-50%)
and higher risk of colony collapse, especially during winter.

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 - KOTWAL S, ABROL DP (2009). Impact of Varroa destructor infestation on the body weight of developing honeybee brood and emerging adults. Pak. Entomol., 31, 67-70

3 - WEINBERG KP, MADEL G (1985). The influence of the mite Varroa jacobsoni OUD on the protein concentration and the haemolymph volume of the brood of worker bees and drones of the honey bee Apis mellifera L.. Apidologie, 16, 421-436.

4 - SCHNEIDER P, DRESCHER W (1987). Einfluss der Parasitierung durch die Milbe Varroa jacobsoni Oud. auf das Schlupfgewicht, die Gewichtsentwicklung, die Entwicklung der Hypopharynxdrüsen und die Lebensdauer von Apis mellifera L.. Apidologie, 18, 101-110.

5 - BOWEN-WALKER PL, GUNN A (2001). The effect of the ectoparasitic mite, Varroa destructor on adult worker honeybee (Apis mellifera) emergence weights, water, protein, carbohydrate, and lipids levels. Entomol. Exp. Appl., 101, 207-217.

6 - SCHNEIDER, P; DRESCHER, W; RATH, W (1988) Die Folgen eines unterschiedlich hohen Varroa-Befalls während der Puppenentwicklung auf die erwachsene Biene, Teil 2: Einfluss auf Gewicht, Verweildauer im Volk, Ausflugaktivität und Spermienzahl der Drohnen. Allgemeine Deutsche Imkerzeitung 22: 54-56.

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Varroa ► Infestation

3% mite infestation

- 5kg average loss

A NIAR* study indicates that only a 3% infestation of phoretic varroa mites can cause an average production loss of 5 kilos (11lbs) in a summer lavender honey flow or as much as 13 kilos (28lbs) per year.[1]

*National Institute of Agronomic Research

1 - Maisonnasse, et al, 2014.

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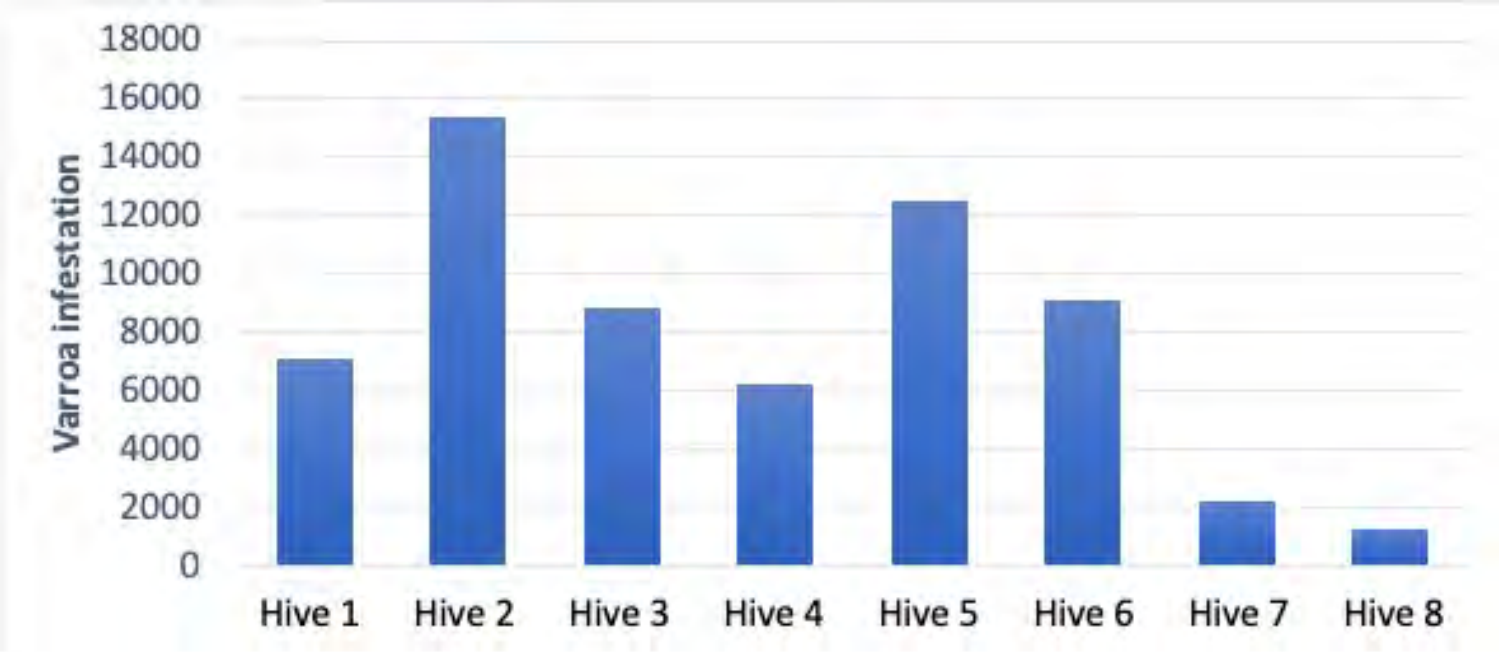
Monitoring + treatment = winning move!

The main enemy in the fight against varroa mites is the force of habit.

Mite infestation in one apiary varies **from one hive to another**

Infestation variation within the same apiary at the end of the 2014 season in France (2014 was a year of high varroa infestation)[1]



According to the ADA Alsace, France.
an average of 5% - 10% of the hives in a single apiary can reach infestation levels far above the apiary average.[2]

1 - Data from the Véto-pharma apiary in 2014 in Chaillac, France – Total mite fall of each hive recorded during a 10-week conventional varroa mite treatment, followed by a control treatment.

2 - BALLIS A. (2015) Varroa infestation in Alsace, Speech at the ADA Franche Comté General Assembly. Alsace Regional Chamber of Agriculture.

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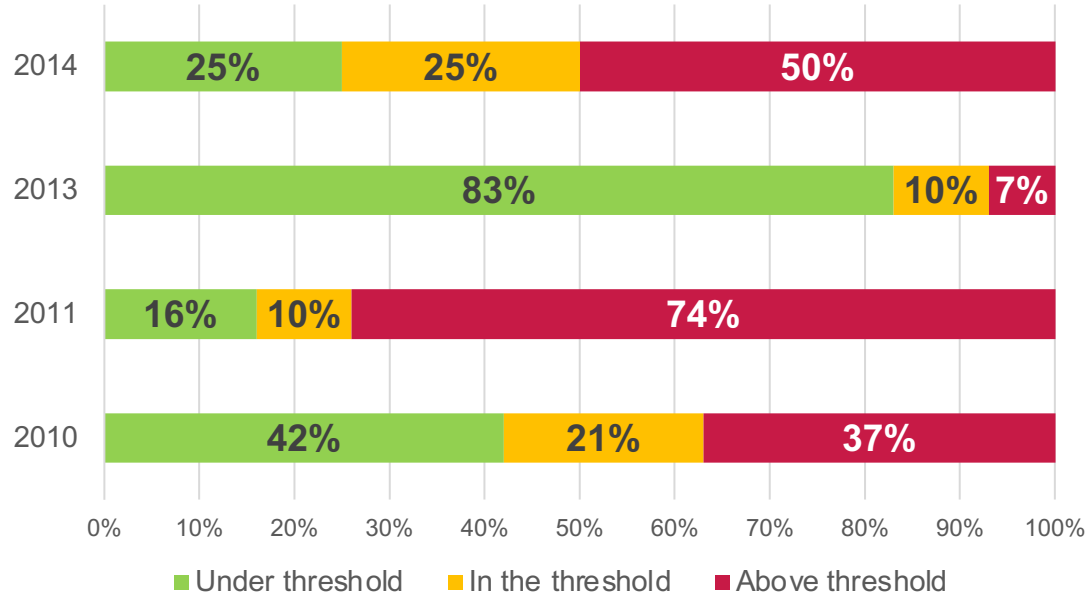
Mite infestation in one apiary varies **from one year to another**

Case on infestation variation in the same apiary in the Alsace Region (East of France), at the end of the season (2010 to 2014)[1]



Mite infestation in 2013 and 2014 required different management in the same apiary.

A fix treatment on the same calendar date **does not work for all beekeeping years.**

The threshold of 3,200 to 4,200 varroas was described in the literature as a level of infestation triggering a financial loss for the beekeeper (lower production and increased mortality risk).

1 - BALLIS A. (2015) Varroa infestation in Alsace, Speech at the ADA Franche Comté General Assembly. Alsace Regional Chamber of Agriculture.

2 - DELAPLANE, K S; HOOD, W M (1999) Economic threshold for Varroa jacobsoni Oud. in the south-eastern USA. Apidology 30: 383-395.

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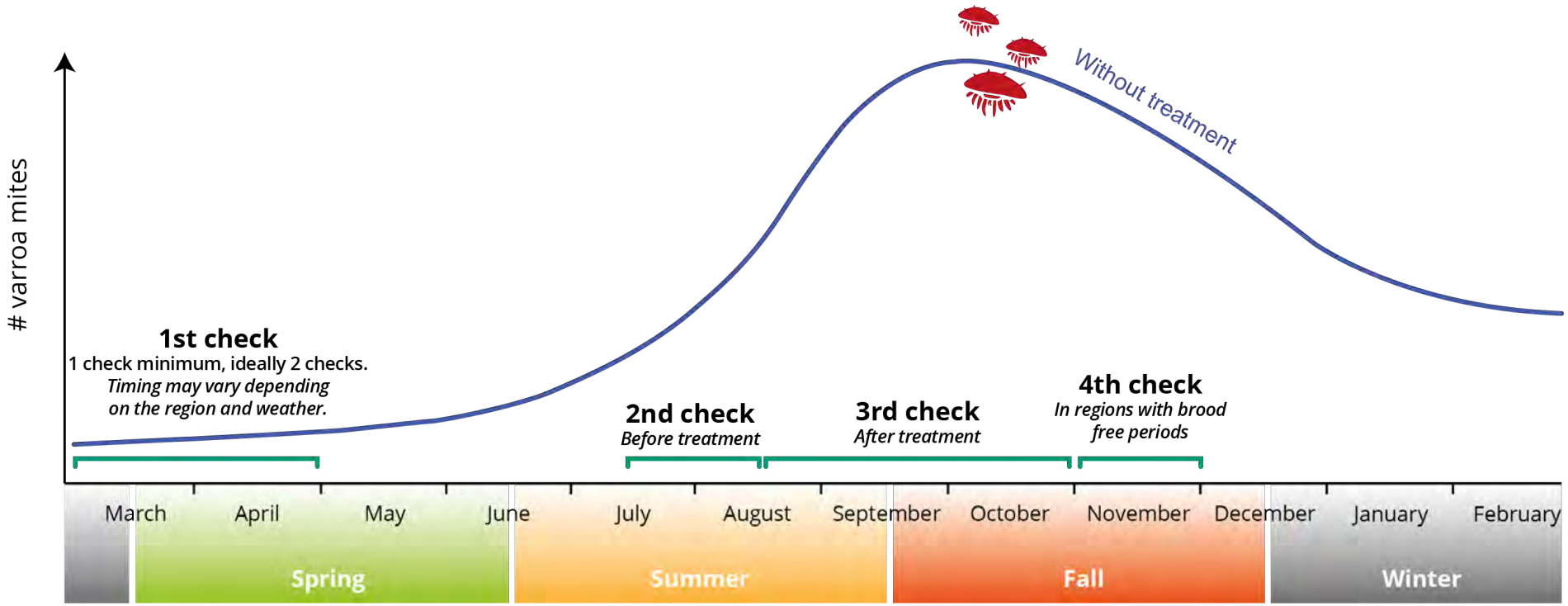
Treatment plan ► Monitoring is key

Adapt your treatment schedule
according to the mite infestation levels in your hives !

Modeling of varroa population development
In a colony without treatment and a single brood-free period during wintertime.



Honey Bee Health Coalition, Varroa guide 6th edition (April 2017):
« Generally, a beekeeper should perform Varroa monitoring assessments at least four times during the year »

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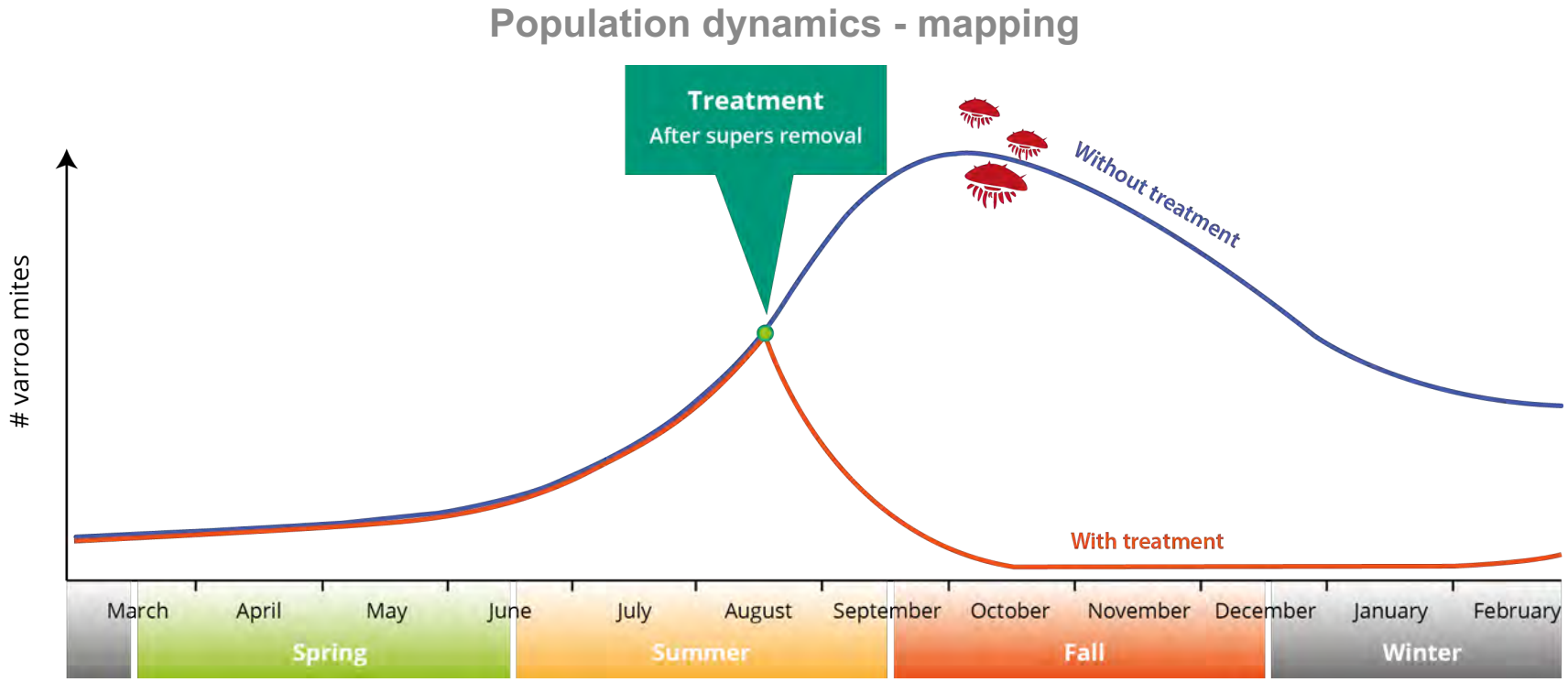
Treatment plan ► End of summer

1 single slow-release treatment at the end of season
(when the level of infestation is considered normal)



Less realistic as treatment thresholds have decreased over the years, possibly due to higher viral loads in colonies and global warming.[1,2]

1 - Le Conte, Yves, Marion Ellis, and Wolfgang Ritter. "Varroa mites and honey bee health: can Varroa explain part of the colony losses?." Apidologie 41.3 (2010): 353-363.

2 - Martin, Stephen J. "The role of Varroa and viral pathogens in the collapse of honeybee colonies: a modelling approach." Journal of Applied Ecology 38.5 (2001): 1082-1093.

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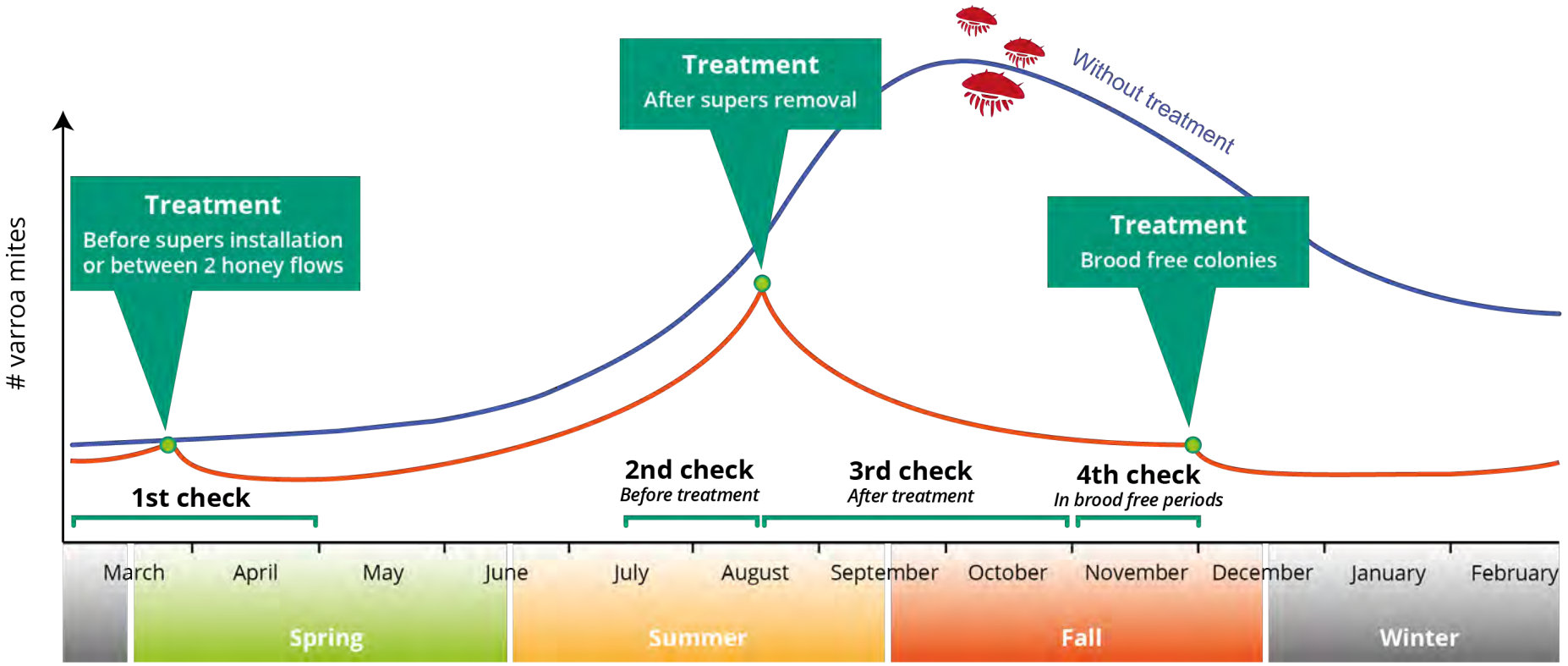
Treatment plan ► Monitoring + treatment

Regular monitoring
+ treatments adapted according to the infestation
= winning move!



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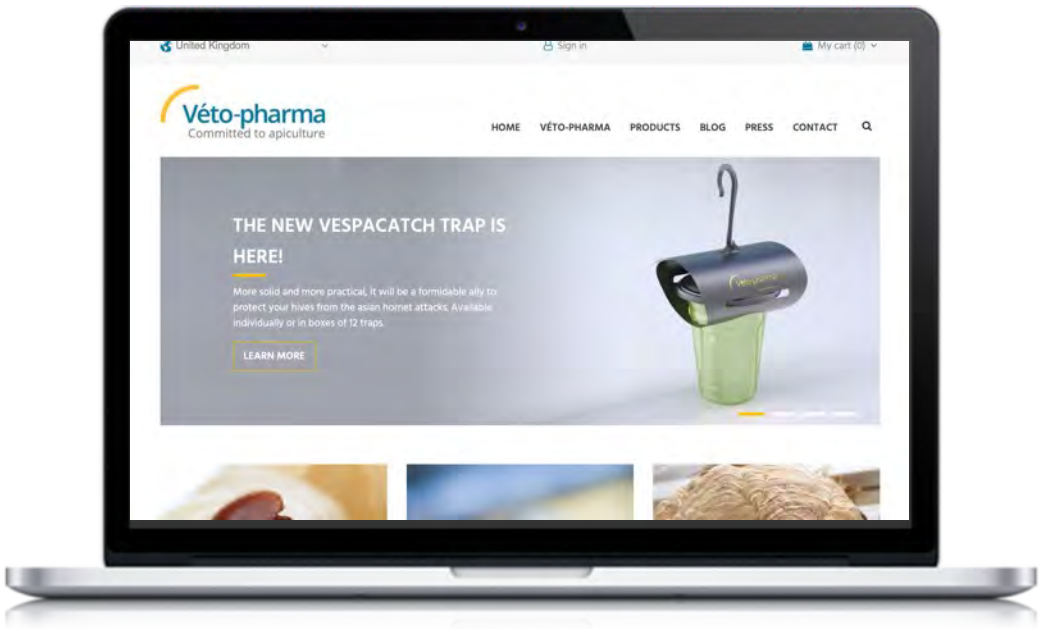
Thank you!



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Merci !
Thank you!
Danke!
¡Gracias!

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