Adult female *Varroa* mite courtesy of the Animal and Plant Health Agency, Crown copyright.

The Lifecycle of the *Varroa* Mite

By Eleanor Attridge, County Cork BKA

The *Varroa* mite is the greatest threat the honey bees have to their survival. It weakens the immune system and can lead to very high winter losses as a result. It is a parasitic mite that acts as a vector for viruses. It switches off the honey bee immune system, which in turn leaves them more susceptible to colony collapse, affecting pollination of our crops and creating a detrimental effect on our agriculture. The species is believed to have jumped from *Apis cerana* to *Apis mellifera* and worked its way across the European continent into the British Isles.

It is an oval-shaped mite that clings to the honey bee and can tuck itself neatly into the folds in the exoskeleton of the honey bee. It can be seen on the honey bee in the phoretic stage of life. The mite hops onto the honey bee and hitches a ride to the next colony to spread the infestation or climbs off again to enter into the brood nest to reproduce. Adult females have two stages in their lifecycle; dispersal and reproductive. The male does not live outside the brood cell. Mites can overwinter on honey bee clusters for up to six months and will start the reproductive phase as the honey bee colony starts expanding in the spring.

The mature female mite is brown, oval-shaped, 1.00 to 1.77 mm long and 1.50 to 1.99 mm wide, and has eight feet-like suckers that attach themselves to the honey bee. The immature females are lighter in colour. They can be found in capped cells along with the male mite. Both male mites and immature females dehydrate once the brood cell is uncapped leaving only gravid females to re-infect the next brood cell.

A fecund female emerges from the brood nest when a young bee hatches out. She will either find another larva about to be capped to get into the next brood cell or can be seen on the honey bees themselves tucked into the cuticle of the bee or on its back.

Reproductive stage

When a larva is about to be capped, i.e., four days after the egg hatches for female honey bees and seven for drones, it releases a kairomone to tell the honey bees to cap the cell. The fecund female mite has become sexually mature and is now called a foundress mite. She reacts to the kairomone by taking advantage of the situation by entering the brood cell.

Kairomone:
A chemical that is emitted from an organism of one species and detected by another organism from a diferent species.

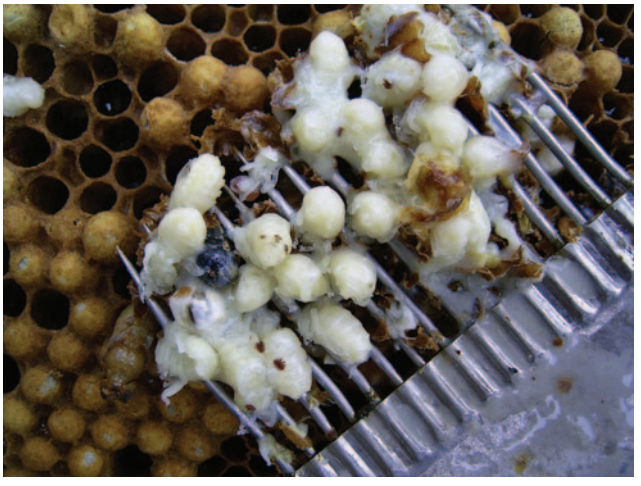
More than one foundress may enter the cell. She hides in the brood food at the bottom of the cell and sticks up a peritreme, which acts like a snorkel, to help her to breathe. Honey bees cap the larvae in the cell with a mixture of wax and pollen, so both the larvae and hidden mites can breathe. Once the larvae consume the brood food, the foundress mite is released. The mite then pierces the cell wall of the larvae to feed upon it. Some research alludes to the mites feeding from haemolymph but in more recent research with electron microscopy, the evidence points to mites consuming fat bodies, which are similar to the liver in mammals.[1] The mite defecates at the top of the cell. 72 hours after the cell is sealed the foundress mite lays her first egg, which is male as it is unfertilised; every thirty hours thereafter female eggs are laid and they are fertilised. There are several stages to the development of the *Varroa* egg to the adult mite. From protonymph to deutonymph to adult over a period of 5–6 days for the male, ensuring he is sexually mature to mate with his siblings or other mites within the cell if more than one *Varroa* enters the cell before its sealed. The female mite takes 7–8 days to mature fully. She will mate with the male mite in the cell and she will emerge with the hatching brood. The male mite and underdeveloped females die from dehydration once the cell is uncapped and the brood emerges. The daughter mite takes six days to mature, however, the foundress that will also emerge if it is her first time laying, will go straight back into the brood nest to repeat the process. *Varroa* mites prefer the drone larva, because it takes three days longer to hatch out producing a higher number of female mites to repopulate the next generation. As the season progresses the number of mites in the colony increases exponentially and one mite can 'become' 15 in four months.

Varroa mites can have up to seven brood cycles in laboratory conditions. However, in normal conditions within a hive this ranges from 1.5–3 cycles, depending on the colony conditions, the time of year and if they entered a worker or drone cell. A honey

Varroa mite life stages

Dispersal or Phoretic stage when the female mite lives on adult bees and can be transported and dispersed within a colony and to other colonies.

Reproductive stage when female mites (called 'foundresses') enter worker and drone brood cells during the day before they are sealed, hiding in the brood food. Once the mature honey bee larva has consumed all the brood food, the *Varroa* mite starts laying her eggs. The first, laid around 60 hours after capping, is always a male and subsequent eggs, laid at around 30-hour intervals, are females.



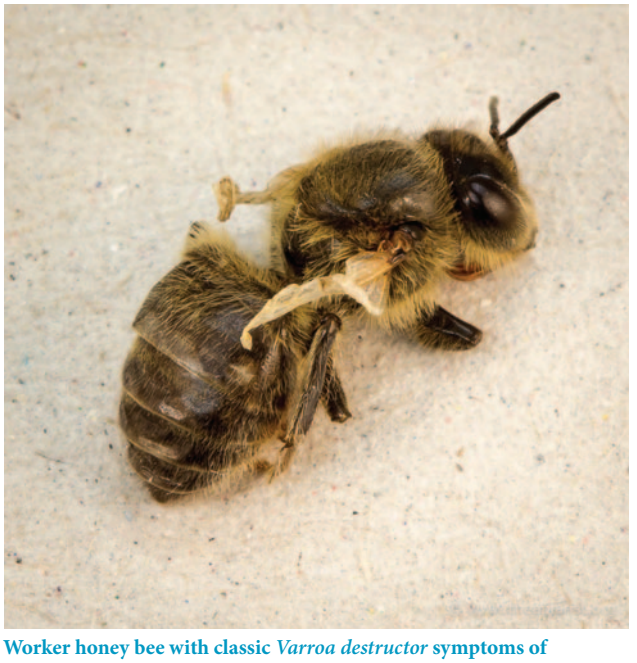
***Varroa* mites on drone brood that has been forked out of drone brood cells, by Gerry Collins.**

worker bee egg from the date it is laid takes 21 days to mature while the drone takes up to 24. The mites have a preference for drone brood, which emits a different pheromone to the worker larva, and it takes longer to emerge allowing the *Varroa* mite to reproduce even faster.

Effect on the colony

Varroa mites feed on the larvae in the sealed cells and are a vector for other viruses. When it emerges and enters the next cell, it brings the virus from the first host to the second, moving freely between host cells once the larvae pupate and emerge as honey bees. Here it transmits the pathogens and viruses to the new host and the cycle continues. The main viruses it is responsible for transmitting are deformed wing virus (DWV) and acute bee paralysis virus.[2] While *Varroa* mite infestations are responsible for reducing the vitellogenin levels and juvenile hormone levels in honey bees, research from the POSH BEE project has concluded that increasing the pollen levels and diversity can help slow down the rapid ageing process.[3]

One *Varroa* can become 15 in four months, spreading the virus loads exponentially within the colony. The essential role of the fat body in hormone regulation, immune response, and especially pesticide detoxification can, in essence, explain the demise of colonies. Incidentally, the POSH BEE project also discovered that exposure to the neonicotinoid clothianidin increased the *Varroa destructors*' fertility, thus increasing the demise of the honey bee colony.[4]



Worker honey bee with classic *Varroa destructor* symptoms of deformed wings associated with DWV infection, by David Evans.

Varroa mite activity can lead to decreased weight in an emerging young bee. This has a major impact on the drone population as the lower body weight affects the amount of sperm those drones now carry and can ultimately lead to reduced ability to effectively mate with the next generation queens. In a summer where the mating conditions are not ideal, this leads to honey bees superseding late in the season or the next generation queen failing to make it through the winter or emerging out of the winter as a drone-layer having run out of viable sperm leading to higher colony losses.

A large amount of research is ongoing since 2007 on the effects of *Nosema ceranae* in conjunction with *Varroa* mite infestations and the accelerated demise of the honey bee colony.

The mite will spread by drifting, bees robbing a weak colony where the mite hitches a flight out to the next colony, movement of drones which are accepted in all colonies, colonies swarming, the beekeeper splitting or making up new stock, transporting colonies from one region to another.

The *Varroa* mites are extremely good at adapting quickly to their surroundings and can quickly build up pyrethroid resistance to chemicals applied to the colony to lower the infestation rate. The beekeeper needs an understanding of the *Varroa* mite's lifecycle and the honey bee's lifecycle to select the most appropriate treatments for the time of year. A system of integrated pest management needs to be designed, rotating biotechnical methods in conjunction with the soft and hard chemicals licenced in the country at the time, rotating the hard chemical medications to prevent pyrethroid resistance. A practice of yearly comb change in spring will help eliminate the residue chemicals and other pathogens in the brood nest to give every colony a fighting chance of survival.

The beekeeper is the guardian of the honey bees and has a responsibility to ensure their survival into the future, by educating themselves on the lifecycle of *Varroa* mites, the pathogens and viruses that evolve as a result of mite damage to the honey bee and the detrimental effects that damage can do to colonies.

References

1. Ramsey SD, Ochoa R, Bauchan, G *et al. Varroa destructor* feeds primarily on honey bee fat body tissue and not haemolymph. *Proceedings of the National Academy of Sciences of the United States of America* 2019; 116(5):1792-1801. https://doi.org/10.1073/pnas.1818371116
2. Cavalloro R. (Ed.). *European Research on Varroatosis Control* (1st ed.). CRC Press, 1988. https://doi.org/10.1201/9781003211464
3. Frizzera D, Ray AM, Seffin E, *et al.* The beneficial effect of pollen on *Varroa*-infested bees depends on its influence on behavioral maturation genes. *Frontiers in Insect Science* 2022; article 864238 https://doi.org10.3389/finsc.2022.864238
4. Annoscia, D., Di Prisco, G., Becchimanzi, A. *et al.* Neonicotinoid clothianidin reduces honey bee immune response and contributes to *Varroa* mite proliferation. *Nature Communications* 2020; 11: 5887. https://doi.org/10.1038/s41467-020-19715-8.

National Honey Show Essay Competition

Each year the BBKA sponsors the National Honey Show Essay Class. Congratulations to Eleanor Attridge, who wrote this essay, which won the 2022 competition.