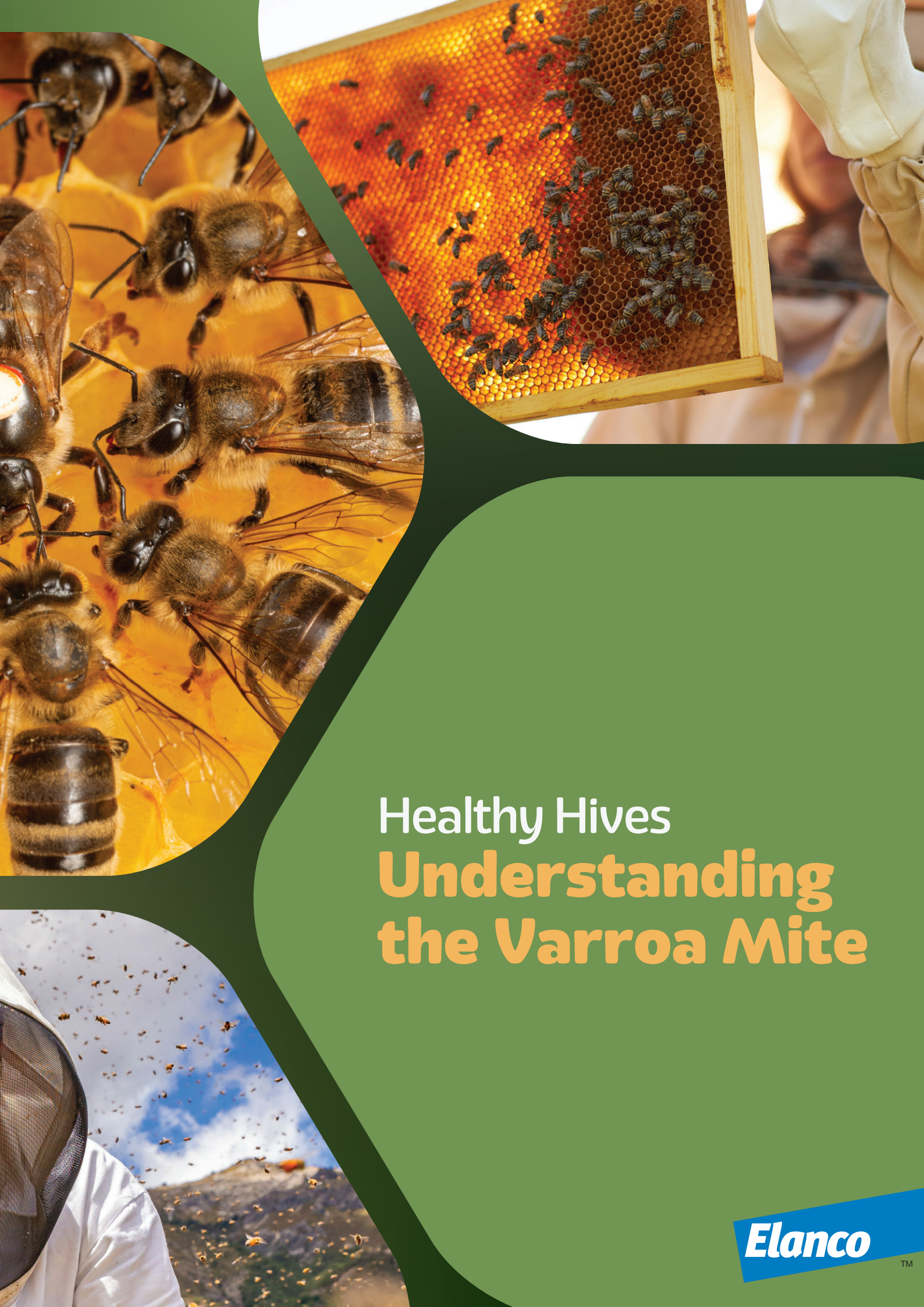




Healthy Hives

Understanding the Varroa Mite

Elanco

TM

- 
- 2 Honey Bees**
Small Insects, Big Impact
 - 3 Varroa Destructor**
A highly destructive parasite
 - 3 Varroosis: Infestation of Honey Bee Colonies**
 - 4 Biology of the Parasite**
 - 5 Reproduction Process of the Varroa Mite**
 - 7 Life Span and Population Growth**
 - 9 Varroa Mite Effects on Bees**
 - 9 Infestation by the Varroa Mite**
 - 11 Transmission of Honey Bee Viruses**
 - 12 Most Important Honey Bee Viruses**
 - 13 Parasitic Mite Syndrome**
 - 14 Combating the Varroa Mite**
 - 15 Advantages and Disadvantages of Different Survey Methods**
 - 16 Control Measures**
 - 19 Varroa Resistance**
Prevention, Management, and Integrated Pest Management.
 - 21 Pest and Disease Control**
Autumn efficacy of Bayvarol™ for controlling Varroa
 - 25 Research and Future Treatments**

Honey Bees



The work that honey bees do is of great importance to humans. Many crops, for example, rely on pollination by bees and other insects. This is why protecting and improving bee health is vital.

Although honey bee colonies have increased worldwide over the past 60 years, bee health remains a challenge.

One of the most destructive threats is *Varroa destructor*, a parasitic mite now found in nearly every part of the world.

With only a few effective control methods available, combining these with good beekeeping practices, it is possible to minimise the harm caused by Varroa and better manage its impact.

Small Insects,
Big Impact

Varroa Destructor

A highly destructive parasite

Varroosis: Infestation of Honey Bee Colonies

The tiny but highly destructive *Varroa destructor* mite is the greatest threat to the Western honey bee (*Apis mellifera*). Without human intervention, a colony in an infested hive will typically collapse within three years.

Beyond the direct threat of the Varroa mite, there is also the risk of mite-vectored diseases, which have become more widespread and further weaken honey bee colonies. Much like ticks, the parasitic Varroa mite transmits viral infections that can become more virulent and are often fatal to both adult bees and their brood.

Finding effective solutions to combat this mite remains a challenge. Despite ongoing research, no simple or long-lasting treatment has been developed, and a stable, Varroa-resistant strain of the Western honey bee has yet to be bred.

Biology of the Parasite

Body structure

As its name suggests, *Varroa destructor* is a highly destructive parasite.

These small, sightless arachnids have piercing-sucking mouthparts and use sensory hairs across their bodies to detect their environment. Their flattened shape and suckers (apoteles) on their feet allow them to grip the bee's body more effectively.

Varroa mites use their mouthparts to pierce a bee's exoskeleton. It was once believed that they fed solely on the bee's haemolymph, a body fluid similar to blood, but recent research suggests they primarily consume the bee's fat body.

BODY STRUCTURE:

Idiosoma (main body section).

The hairs on the top and bottom of the mite's body are used as mechano- and chemo-receptors.

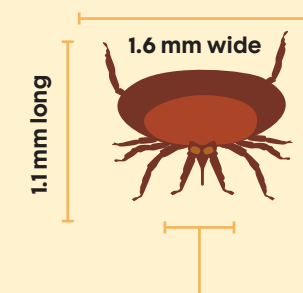
Gnathosoma - piercing-sucking mouthparts.

The mite has four pairs of legs.

Gender Differences

Male and female Varroa mites differ significantly - females are larger, heavily sclerotised, and the only ones capable of penetrating honey bee brood and adult bees.

FEMALE MORPHOLOGY:



Flattened body

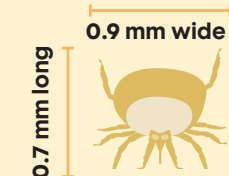
Dark reddish-brown in colour

Heavily sclerotised
(hard, protective outer layer)

Chelicerae

Consist of three segments, with two teeth at the end of their jaws

MALE MORPHOLOGY:



Yellowish-white in colour

Rounded body

Can only survive in capped brood cells

Sensory Perception

Varroa mites navigate by distinguishing between light and dark, using highly developed sensory hairs to detect temperature, moisture, and chemical changes. Their acute sense of touch helps them move through the hive and pick up the smallest vibrations.

Their front legs function like insect antennae, allowing them to sense their surroundings. Research also shows they can smell and taste through a sensory organ in a small cavity on their front legs, enabling them to locate brood cells with remarkable accuracy.

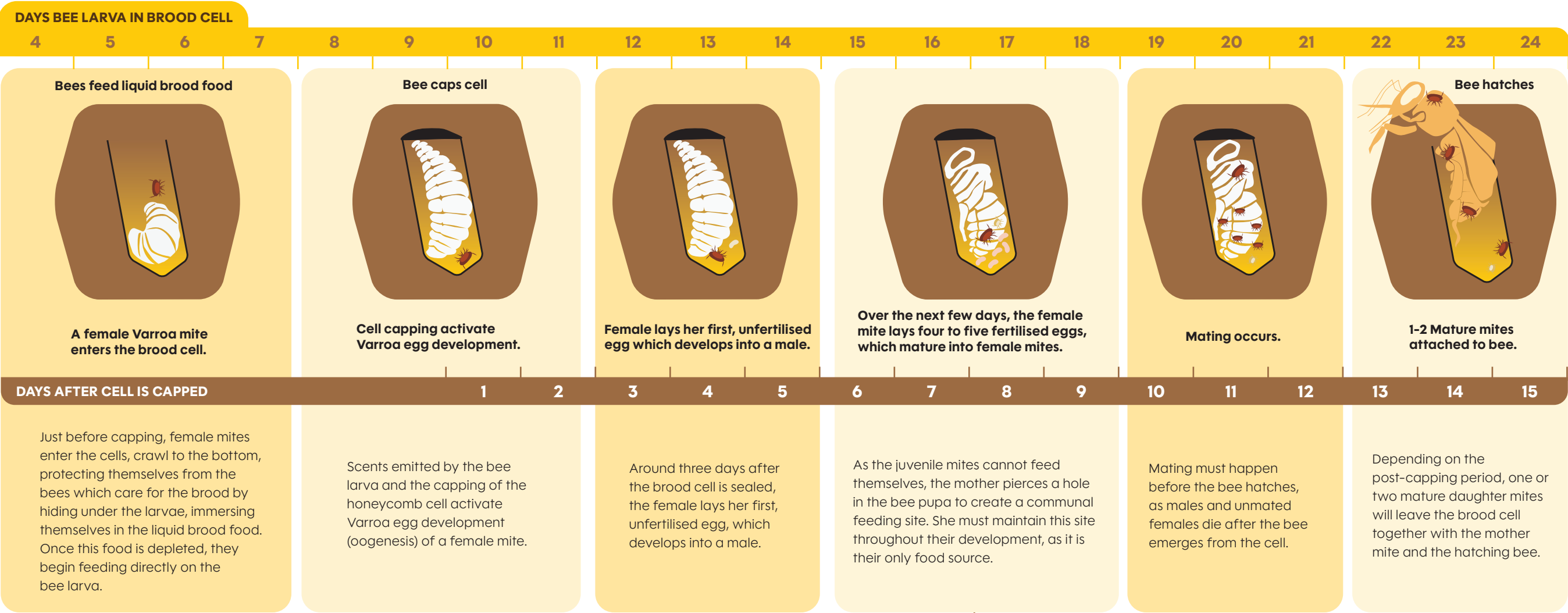
Reproduction Process of the Varroa Mite

The Varroa mite parasitises both adult honey bees and their brood. While female mites can survive outside brood cells by attaching to adult bees, reproduction occurs only in sealed brood cells.

Development of Varroa mites in a comb cell:

Development stages

 Unfertilized mite egg	Fertilized mite egg 
 Male protonymph	Female protonymph 
 Male deutonymph	Female deutonymph 
 Young male mite	Young female mite 
 Adult male mite	Adult female mite 
↓	
Protochrysalis	
 Adult male mite stays in the cell and dies	Immature female mite stays in the cell and dies 



Mating behavior and reproductive success

The mites remain in the cell for 12 days with the developing worker brood and up to 14 days with the drone brood.

The longer development period of 24 days for drone brood makes their cells preferred by Varroa, and therefore drone cells are typically infested five to ten times more often than the worker brood.

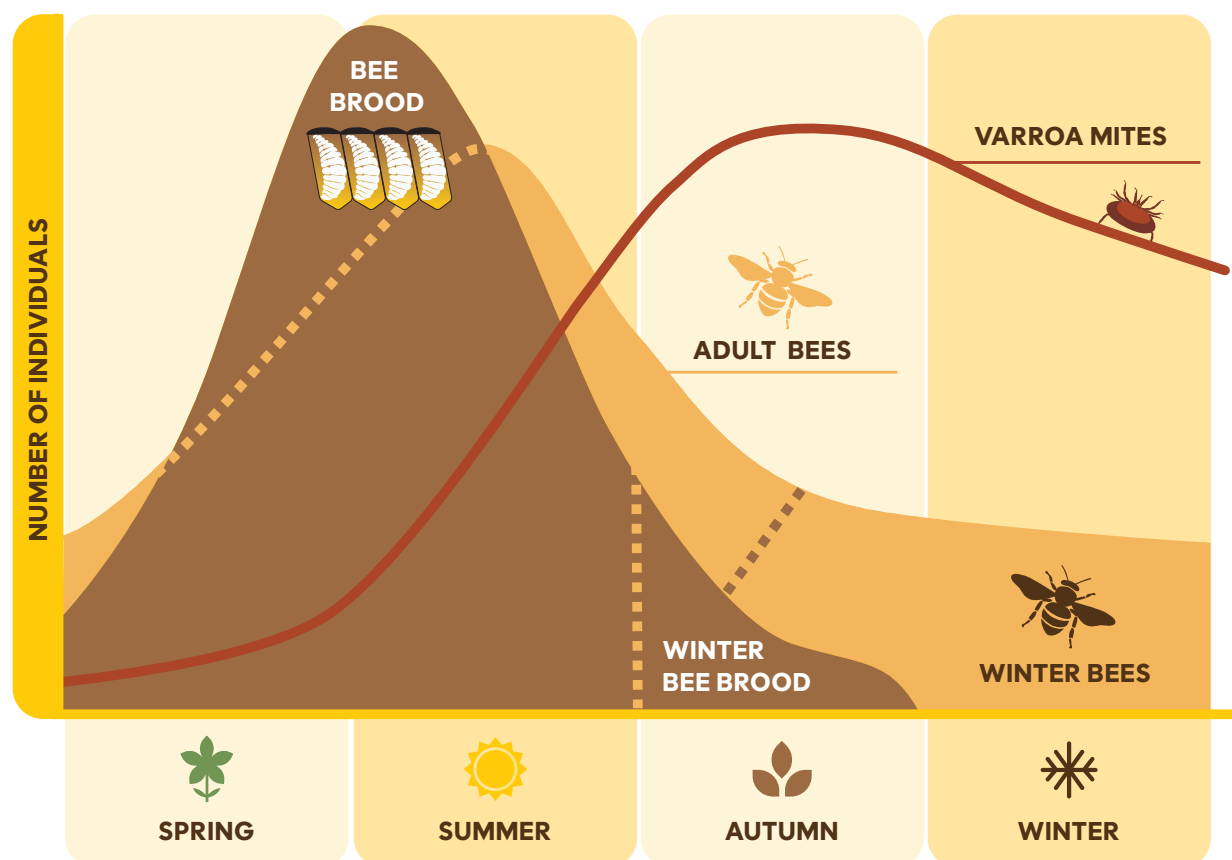
The nymphs are white and take six days to develop into adult females, while males need around seven days to mature.

The honey bee drone brood cell is infested five to ten times more often than the worker brood cell.

Life Span and Population Growth

Under temperate climatic conditions, the Varroa mite's life span is two to three months during the summer and six to eight months in winter. The parasite is highly dependent on its host, as it can only survive for up to seven days without bees and their brood.

Development of the Varroa population in an infested honey bee colony under temperate climatic conditions:



“ The Varroa population in a beehive can **double every four weeks** during the honey bee breeding season. ”

Assuming a starting population of
50 mites,

This can lead to a population of around
3,200 mites
by the end of summer.

Enough to destroy
even a strong honey bee colony of
30,000 to 40,000 bees
over the winter.



Varroa Mite

Effects on Bees

Infestation by the Varroa Mite

Scientists identify robbing as the primary method of Varroa transmission between beehives. From late summer to autumn, as food sources become scarce, honey bees begin stealing winter stores from weaker colonies. Beehives infested with Varroa mites and weakened bees are particularly vulnerable to such attacks. As the mites latch on to the invading bees, robber bees not only return with food but also carry new parasites.

Worker bees also frequently drift, flying into beehives other than their own after foraging, allowing contact between different colonies and even apiaries, making it difficult for beekeepers to prevent transmission. A high density of honey bee colonies in an area further increases the spread of the parasite through drifting and robbing. As a result, hives treated for Varroa mites remain at risk of reinfestation from untreated or inadequately treated colonies. This phenomenon of reinfestation, once underestimated, is now recognised as a major factor in critical Varroa infestations, especially in late summer and autumn.

Swarming is a colony's natural reproductive method. When the brood nest becomes overcrowded, about half the worker bees, along with the old queen, leave to start a new colony, taking some Varroa mites with them. This temporary break in brood production slows Varroa reproduction, but once the new colony begins, the mites start mating again inside the new brood cells, and their cycle resumes.

In a weakened colony, for example, after swarming or robbery, the risk increases as around two-thirds of the Varroa mites reside in sealed brood cells during the breeding season. This increases the chance of the remaining bees becoming infected by viruses or weakened. In the worst case, the colony dies, or the honey bees may leave the hive in autumn, when

Varroa infestation peaks. If swarming occurs under emergency conditions in autumn, the bees leave with the queen to seek a new home, abandoning the infested hive in an effort to try and ensure the colony's survival.

Mites can spread when beekeepers create new colonies through splitting. This involves removing brood combs and worker bees from an established colony to form a queen-less nucleus colony. The remaining nurse bees raise a new queen, while a split can also be made with only adult bees, starting an artificial swarm. Once placed on brood-free combs, the queen lays eggs, and a new colony forms.

In swarm prevention splits, the old queen and hive are moved to a new location, and a new hive with some brood, nectar, and pollen is placed in the original position. Foraging bees from the old hive return to the new hive and raise a new queen from young larvae.

Although splitting aids in the spread of Varroa mites, it can also help reduce mite populations. As the amount of brood decreases, the level of infestation is lower in the split colonies than in the parent hive. An additional Varroa treatment when splitting, forming artificial swarms, or removing the queen to break the brood cycle further reduces the mite infestation in the new hive.

Ways the Varroa Mite can spread

Natural and assisted reproduction of colonies are other ways by which the Varroa mite can spread.



The Varroa mite spreads from hive to hive through contact between bees from different colonies, even those **several kilometers apart.**

Transmission of Honey Bee Viruses

Most honey bee viral diseases exist in a latent form within colonies. Viruses spread through social interaction within the hive, and in some cases, they can be transmitted by Varroa mites. Depending on the infestation level, these vectored diseases can become visible immediately or after several years.

One common virus is the Deformed Wing Virus (DWV), which affects both brood and adult bees. While adult bees may show no visible signs, if the virus infects the pupae, the young bees develop deformed wings and cannot fly, leading to a shortened life span.

The Varroa mite also transmits other viruses, such as the Acute Bee Paralysis Virus (ABPV), which affects both adult bees and brood. It primarily infects fat body cells and salivary glands but does not produce visible symptoms. When the mite transmits ABPV into the bee's hemolymph, it spreads to vital organs, including the brain, impairing orientation and development, which can be fatal.

Infections with DWV and/or ABPV are particularly harmful to winter bees, as they significantly impair their ability to survive the winter months.

The Varroa Mite harms Honey Bees in various ways:

Weakening the bee's immune system,
causing more acute disease progression.

Transmitting viruses
that spread quickly within and between bee colonies.

Directly transmitting viruses into the bees' hemolymph
so previously harmless viruses may hereby become lethal.

Most Important Honey Bee Viruses

VIRUS	SYMPTOMS AND CHARACTERISTICS
ACUTE BEE PARALYSIS VIRUS (ABPV)	The virus is present in the bees' fat body and salivary glands, but in most cases, the infection does not cause visible signs. However, ABPV can reach the bee's brain through the hemolymph, causing behavioural anomalies. Bees become disoriented (e.g. flying to the wrong hive), show disturbed development, and die within a short time. The virus also affects winter bees' ability to survive until spring.
CHRONIC BEE PARALYSIS VIRUS (CBPV)	Overt signs include black coloured, hairless, trembling bees which are unable to fly. Affected bees are often seen around the hive entrance. Infestation may sometimes cause dysentery. Excrement spreads CBPV throughout the hive.
ISRAELI ACUTE PARALYSIS VIRUS (IAPV)	This virus was first described in Israel in 2004, where infected bees were seen with shivering wings, a symptom that progressed to paralysis and bees dying outside the hive. IAPV is spread in the hive via bee excrement. The Varroa mite can also carry the virus and, once transmitted into the bees' hemolymph, it very quickly kills both pupae and adult bees.
SLOW BEE PARALYSIS VIRUS (SBPV)	This infection typically produces no visible symptoms in bees. However, the Varroa mite transfers the virus directly into the bee's hemolymph, where the infection can be deadly.
DEFORMED WING VIRUS (DWV)	This widespread virus affects bees at all developmental stages. Initially, the infection does not cause any obvious symptoms, but if the Varroa mite transfers the virus to a pupa, the emerging bee will develop deformed wings. The adult bee is unable to fly and has a shortened life span.
SACBROOD VIRUS (SBV)	This virus typically infects brood fed with infected worker jelly. Diseased larvae fill with liquid and their bodies lose their structure within the tough, sac-like outer layer (exoskeleton). Eventually, the larva dies and dries out. A dark scab forms on the head of the dead larvae. Although adult bees typically do not show visible symptoms of SBV, they develop faster, collect less food, and die sooner.
KASHMIR BEE VIRUS (KBV)	This infection proves fatal to adult bees within a very short time. The Varroa mite increases the spread of this virus within the hive. Symptoms include black hairless bees and dead and dying bees inside and outside the hive.
CLOUDY WING VIRUS (CWV)	This virus spreads through the air in the entire beehive. Varroa mites enhance the infection of the brood. Severely infected adult bees may have opaque wings.

Parasitic Mite Syndrome

From *"Control of Varroa: A guide for New Zealand beekeepers"*
M Taylor and M Goodwin.

Parasitic Mite Syndrome (PMS) describes the range of abnormal brood symptoms that occur with high varroa levels. The symptoms were first noted in the mid 1990's in colonies with infections of both varroa and tracheal mites by beekeepers and the Bee Research Laboratory at the United States Department of Agriculture. PMS is seen in varroa infested colonies in New Zealand when they have not been treated. The development of PMS is not uniform as it changes with the rate of varroa infestation.

PMS is usually associated with colony collapse if the hive is not promptly treated for varroa. It affects all brood and symptoms can appear at any time of the year, although they are more prevalent in mid-summer and autumn as the varroa levels increase.

Not all symptoms described below are necessarily present in a colony that has PMS.

ADULT BEE SYMPTOMS OF PMS INCLUDE:

- Presence of Varroa in the colony
- Reduction in colony population
- Crawling or crippled bees.



BROOD SYMPTOMS OF PMS INCLUDE:

- Chewed and sunken brood cappings that appear as spotty brood patterns. The appearance is similar to that of American foulbrood and Sacbrood.
- Various shaped brood ranging from "c" shaped larvae in the bottom of the cell through to prepupae lying along the side of the cell wall.
- Colonies with PMS can also harbor other diseases such as AFB and Sacbrood virus so other diseases must be considered during diagnosis. Symptoms of PMS will often disappear if the colony is treated to reduce varroa numbers. However even if the mites are controlled, PMS may have damaged the colony to such an extent that it dies.
- Parasitic mite syndrome is a sign of heavy Varroa infestation.



Combating the Varroa Mite

To protect the health of their honey bees, it is essential that beekeepers control the Varroa mite. The key task, especially in late summer, is to minimise colony infestation levels to protect winter bees from both the mites and the viruses they transmit. This is crucial for ensuring a healthy population of winter bees, which are essential for the colony's survival during the colder months. In warmer climates with little or no broodless period, beekeepers must closely monitor Varroa levels and manage infestations accordingly.

Diagnostics

Before implementing control measures, beekeepers should periodically check whether their hives are infested with Varroa mites and assess the infestation levels. These findings can help determine the appropriate control method. Infestation levels should also be monitored during and after anti-mite treatments to evaluate efficacy.

STICKY BOARD



One detection option is using a sticky board, which is placed under the brood box of the beehive for 24 to 72 hours. Dead mites and debris fall onto the board, enabling beekeepers to count the daily mite drop and estimate the severity of the infestation.

The sticky board is a very simple (diagnostic) method to roughly estimate the mite infestation in the hive and regularly monitor for the presence of *Varroa*. The natural death rate of the mites depends on colony strength and breeding activity, which should be considered when interpreting the survey results.

Varroa treatment is crucial to ensure sufficient numbers of healthy winter bees that survive the five to six cold months.

POWDERED SUGAR METHOD



Another technique is the powdered sugar method, where approximately 500 bees are collected from the brood frames, dusted with powdered sugar, and shaken in a jar. This prevents the mites from clinging to the bees, allowing them to be separated and counted. This method should only be performed in dry weather, ensuring both the bees and sugar are dry.

The washing method requires approximately 300 bees to be removed from the hive. After washing them with water and detergent in a jar, the mites are separated, and both bees and mites are counted to calculate the infestation level. Although the bees are sacrificed using this method, it does not impact colony development or performance, and the accurate data helps guide protective actions.

Both the powdered sugar and washing methods estimate the number of phoretic mites, which are those feeding on adult bees.

Advantages and Disadvantages of Different Survey Methods

ADVANTAGES

DISADVANTAGES

STICKY BOARD

- Simple monitoring of Varroa infestation levels
- Additional information on the colony's state obtained from hive debris (e.g. robbing activities, small hive beetles)
- Frequent monitoring possible

- Results influenced by colony strength and breeding activity in a colony
- Results may be influenced by wind and ants removing dead mites
- Higher operating costs due to the cost of sticky boards

POWDERED SUGAR

- Results not influenced by colony strength
- Survey possible under any weather conditions
- Level of phoretic mites in the colony easy to determine

- Dry weather required to prevent powdered sugar from becoming sticky and clumping
- Assessment of mite infestation levels dependent on breeding activity in the colony, which can vary throughout the season

WASHING

- Results not influenced by colony strength
- Level of phoretic mite infestation in the hive easy to determine

- Some disturbance of the colony as a result of sampling
- Assessment of mite infestation levels dependent on breeding activity in the colony, which can vary throughout the season

Control Measures

Various biological, physical, chemical, and biotechnical options are available to combat the Varroa mite in the hive. To effectively protect honey bee colonies, beekeepers must address the rapid increase in mite numbers during late summer to autumn with effective treatments to protect the brood of winter bees.

Beekeepers should combine appropriate control measures and practice integrated apiculture to meet the needs of the bees.

Varroacides: Chemical Methods for use during the Breeding Season

ORGANIC-BASED VARROACIDES

FORMIC ACID

Formic acid is a chemical varroacide that effectively protects bees from the Varroa mite. This liquid compound vaporises and disperses throughout the hive in gaseous form, penetrating even the sealed cells to kill the mites feeding there.

This not only protects the adult bees but also the developing brood. Formic acid rapidly reduces mite infestation levels. However, temperature plays a crucial role in this treatment.

Formic acid is therefore primarily used by beekeepers in countries with mild climates, typically as the main control method in late summer after the final honey harvest.

THYMOL

Varroacides based on thymol are evaporated in the hive from cellulose wafers or gel carriers. The concentration of the substance that builds up in the air poses no risk to bees but is toxic to the Varroa mite, causing the mites to fall off the bees and die.

Thymol-based products are most effective at temperatures between 20 – 25°C but have limited efficacy at temperatures below 15°C and should not be used at temperatures over 30°C.



Acaricides are a group of pesticides used to control mites and ticks, products specially developed to combat the Varroa mite are known as varroacides.



SYNTHETIC VARROACIDES

In addition to organic acids like formic acid, synthetic varroacides are another chemical control method. These products have been specifically developed to control parasitic mites without harming honey bees. When used according to labels, these compounds can be highly effective, unless the mites have developed resistance to them.

AMITRAZ (APIVAR, APITRAZ)

Products containing the active ingredient amitraz do not directly kill the mites but paralyse them, causing them to fall off the bees and die of starvation. Bees pick up the active ingredient via a plastic strip hung between the combs in the central brood chamber. The honey bees spread the compound throughout the hive through their social interaction.

COUMAPHOS (CHECKMITE, PERIZIN)

Products based on coumaphos are also spread among the bees via plastic strips hung between the frames in the hive. Bees pick up the active ingredient when they rub against or crawl over the strips, passing the compound on to other bees in the hive through social interaction. Coumaphos is not available in New Zealand.

FLUMETHRIN (BAYVAROL)

A plastic strip embedded with the active ingredient is hung between the combs in the central brood chamber. The bees pick up the active ingredient when they crawl over the strips, then distribute the compound evenly during social interaction in the hive. When mites are attached to adult bees, they come into contact with the active ingredient and subsequently die.

TAU-FLUVALINATE (APISTAN)

This active ingredient adheres to the bees' bodies when they crawl over or rub against plastic strips hung between the combs in the central brood chamber. The chemical substance is transferred to other bees in the hive through social interaction, killing the Varroa mites attached to adult bees.

OCTANOATE ESTERS

Sucrose octanoate esters, which occur naturally in plants, have pesticidal properties. Researchers discovered these when investigating why tobacco leaves were not attacked by mites and certain insect pests. Sucrose octanoate esters act as biopesticide contact insecticides with rapid knock-down ability.

Varroa mites can develop resistance to synthetic varroacides active ingredients over time, making them ineffective.

Beekeepers should rotate varroacides and use multiple control methods to prevent resistance.

Chemical Methods for use outside the Breeding Season

ORGANIC-BASED VARROACIDES

LACTIC ACID

Lactic acid is an effective spray treatment. When colonies are broodless, a 15 percent lactic acid solution can be sprayed lightly and evenly on both sides of the combs. Young, broodless colonies can be treated at any time.

OXALIC ACID

Oxalic acid is primarily used in winter to control Varroa in broodless colonies. It is trickled onto the bees in the spaces between combs, where it adheres to their bodies and is spread throughout the hive via social interaction. In some countries, heat evaporation of technical oxalic acid is also a registered treatment method. This treatment should only be applied after the final honey harvest, as honey cannot be collected until the following spring.

HOP BETA ACID

Hop beta acid is another treatment option, applied using cardboard strips saturated with the acid and placed between brood frames. To prevent contamination, honey and wax from the brood chambers should not be harvested during treatment. For best results, hop beta acid should be used when little to no brood is present in the hive.

Biotechnical Methods

In addition to main and follow-up chemical treatments in late summer and winter, biotechnical methods offer an effective way to control Varroa mites. These physical approaches help reduce mite populations without the use of veterinary products or chemicals and can be applied at any time, including during the foraging and breeding period.

CUTTING OUT DRONE BROOD

Varroa mites infest drone brood cells five to ten times more frequently than worker brood cells. To take advantage of this, an empty drone comb is placed near the brood-rearing area in the hive. Every two to three weeks, once the drone brood is capped, the comb is removed and discarded, significantly reducing mite levels during the breeding season. Since drones are still raised in other parts of the hive, there are always enough to mate with virgin queens on their mating flights.

COLONY RENEWAL AND ARTIFICIAL SWARMS

Colony renewal, including methods such as splitting colonies or creating artificial swarms, can also help control Varroa mites. In an artificial swarm, around 1.5 kilograms of bees are removed from the parent colony. As mites primarily reside in brood cells and have less contact with adult bees, infestation levels in young colonies are naturally lower. Since these newly established young colonies are also broodless, they can also be treated effectively before mite populations grow.

Varroa Resistance

Prevention, Management, and Integrated Pest Management

Resistance by varroa to all of the synthetic varroacides has been detected in mite populations in Europe and the United States. Laboratory tests which identify the genetic mutation which impart resistance have been developed. These tests are commercially available in New Zealand. It is important to note that, to date, the mutations which result in synthetic pyrethroid resistance or those which lead to amitraz resistance have not been identified in New Zealand varroa populations.

Beekeepers can help prolong the effective life of the synthetic chemical treatments by adopting an integrated pest management approach. This involves considering all the available options and industry best practice.

Key parts of an integrated pest management approach to varroa control include:

1. FOLLOW LABEL DIRECTIONS:

Read and understand the label. Apply varroa treatments strictly as per the label. This includes position in brood box, length of duration of strips in the hive, disposal of strips and most importantly the number of strips in the hive.

2. TREATMENT ROTATION:

The "hard" chemicals, namely synthetic pyrethroids (flumethrin, tau fluvalinate) and amitraz provide the cornerstone of varroa control. Along with strict compliance with label directions rotation between chemical groups at alternate spring and autumn treatments is considered the most effective way to manage the long term effective life of these valuable products and slow the development of resistance. Repeat use of the same chemical strips time after time will inevitably lead to resistance by varroa to the active used. Intermediate treatments between Spring and Autumn with others such as oxalic acid, formic acid and thymol can be used to support the front-line treatments.

3. MONITORING MITE NUMBERS:

The decision of when to treat for varroa and measuring the success of any treatment program can only be done through objective measurements provided by such as using mite population assessment techniques such as sugar shakes or alcohol washes.

A pre-treatment count of 10 mites/300 bees indicates the hive is under severe challenge – particularly in the autumn as bee numbers begin to decrease. Monitoring will also determine the success of any treatment regime and if further treatments are required.

4. TIMING OF TREATMENTS:

Industry sales data indicates that both the Spring and Autumn hard chemical treatments are being implemented up to six weeks earlier in New Zealand than previously. The days of basing treatment simply on calendar date are gone. The timing of treatments must be based on monitoring mite numbers as described above.

5. REPORTING:

Varroacide products are registered pesticides with the Agricultural Pesticides and Veterinary Medicines Group within the Ministry of Primary Industries and as such, the registrants have a legal responsibility to report all adverse events with MPI.

If you are not happy with the performance of these products, as soon as possible, please contact your distributor with all relevant details. This will allow the manufacturers to support an investigation into any perceived product failings, including the development of varroa resistance.

6. HIVE AND PRODUCT MANAGEMENT:

All colonies located on the same apiary should be treated simultaneously. Inappropriate use of varroacides could result in an increased risk of development of varroa resistant to the product used and ultimately ineffective treatment and colony loss.

“

Remember - successful varroa control requires a continual integrated pest control approach using all of the available tools.

”

Pest and Disease Control

Autumn efficacy of Bayvarol™ for controlling Varroa

Michelle Taylor, Rafael Campos, Duncan Hedderley of Plant and Food Research

An increased concern among New Zealand beekeepers that Bayvarol™ is not controlling varroa populations as well as it used to has led to the need for current comparative data regarding the effectiveness of Bayvarol™ at controlling varroa. After 24 years of using Bayvarol™ to control varroa infestations throughout New Zealand, we set out to determine whether Bayvarol™ still works effectively. Spoiler alert... when used according to label, Bayvarol™ effectively controls varroa infestation in double-brood-box honey bee colonies in autumn in the Waikato.

Varroa destructor is endemic in honey bee populations throughout New Zealand's North and South Islands. Since varroa was first discovered in New Zealand in 2000, beekeepers have primarily relied on the rotational use of three active ingredients (fluvalinate, flumethrin and amitraz) to sufficiently reduce varroa populations so that our colonies survive another season.

Over the years, most of us have lost a colony or 100. Losses associated with starvation, queen loss, AFB, robbing, and forgetting to apply varroa treatments are easy to identify and correct for the next season. In contrast, it can be more difficult to recognise and correct colony losses resulting from the long-term effects of elevated varroa levels in the hives before the next treatment. The effects of increased varroa levels on hives during or post treatment can also be difficult to manage.

Bayvarol™ was registered by Elanco New Zealand in 2000 as an in-hive miticide treatment for varroa infestation. It consists of a plastic strip impregnated with the synthetic pyrethroid flumethrin. This product continues to be used in New Zealand. Over the years the number of reports about a perceived lack of Bayvarol™ efficacy to control varroa have not increased in New Zealand. Varroa populations associated with these reports have been assessed for genetic markers of synthetic pyrethroid (flumethrin) resistance. None of the assessments confirm resistance.

Research method

The objective of this study was to determine whether an eight-week treatment of Bayvarol™, applied according to label (four strips per brood box), controlled population growth of varroa in 32 double-brood-box colonies. Data were also collected from 22 control colonies that were treated with Apivar® according to label (two strips per brood box).

Hives were supplied by a Waikato commercial beekeeper and paired across the Bayvarol™ and Apivar® treatments based on varroa infestation at the start of the trial (colonies contained 1 – 72 varroa per 300 bees). All treatments were applied to colonies in late January 2024 after honey collection.

Ethanol washes were used to identify varroa infestation on 300 adult bees (1/2 cup of adult bees) throughout the trial: prior to treatment, and after two, six and eight weeks of treatment. Nine varroa per 300 bees was selected as the population size above which we considered the treatment was not controlling varroa.



Results showed treatments reduced varroa infestation

Regardless of varroa infestation at the start of the trial, the washes showed that Bayvarol™ treatments reduced varroa infestation then consistently kept them at one to four varroa per 300 bees for the entire eight-week treatment. For clarity, the colony that started with 72 varroa per 300 bees had one varroa per 300 bees after two weeks of Bayvarol™ treatment and by eight weeks there were no visible signs of varroa and the bee population was 'normal' for this time of year: in the Waikato this is ~14 frames of bees and 3.5 frames of capped brood.

Sticky boards sealed below mesh floorboards were used to collect each weeks' worth of fallen varroa throughout the treatment (base boards and frames had been cleared to reduce buildup of debris during collection). The number of varroa on each board was counted using machine learning developed by Plant & Food Research. Varroa counts were high for each of the first four days of Bayvarol™ treatment, followed by consistently low weekly counts for the remainder of the trial. Coupled with the varroa wash data, this indicates that emerging (or invasive) varroa were being killed by the Bayvarol™ throughout the eight-week treatment.

Bayvarol™ effectively controls varroa infestation in double-brood-box honey bee colonies in autumn in the Waikato.



“ At the end of the eight-week **Bayvarol™** treatment the amount of **Deformed Wing Virus, Black Queen Cell Virus, and Chronic Bee Paralysis Virus** had reduced in the colonies.

Importance of rotational application of synthetic miticides

We urge you to read the following comparative data in the context that both Bayvarol™ and Apivar® products play a necessary role for varroa control in New Zealand. This is because the rotational application of the active ingredients in the currently available synthetic miticides reduces the opportunity for varroa to develop resistance to the chemicals.

Alongside this, the size of a varroa population determines when you need to treat, not the calendar. For example, if an alcohol or detergent wash indicates that the number of varroa per 300 bees is higher than expected in late summer, treatments should be applied at this time. If high levels of varroa are regularly identified before autumn treatment, then the duration between spring and autumn treatments may need to either be reduced or the treatments swapped.

Our trial data indicates that Bayvarol™ treatments applied after honey collection were more effective and controlled varroa more consistently than Apivar® treatments. The varroa counts on the sticky boards after the first week of Bayvarol™ treatment were four to five times the natural mite fall count that was collected during the week prior to treatment. The remaining seven weeks of sticky board counts stayed consistently low. Coupling this data with the reduction in infestation observed in the ethanol wash data, this indicates that Bayvarol™ controlled varroa throughout the eight-week treatment.

Comparatively, the varroa counts at the end of the first week of Apivar® treatment were two to three times the natural mite fall count and the remaining weekly sticky board counts were consistently higher. The data from the ethanol washes, sticky boards, and bee health assessments indicate that Apivar® was unable to reduce, and in some cases unable to prevent, further increase in varroa infestation over an eight-week period.

Determining acceptable maximum varroa infestation

The exact number of varroa per 300 bees that results in reduced colony production or colony health is difficult to determine as it likely varies with region and season. Our trial indicates that there is a point above which the number of varroa per 300 bees does reduce the number of frames of bees and it is likely between two and nine varroa per 300 bees.

However, the trial was only established to identify the extremes: colonies treated with Bayvarol™ that began with zero to one varroa per 300 bees (well-controlled varroa) had twice as many honey bees after eight weeks than hives treated with Apivar® that began with 10+ varroa per 300 bees (not well-controlled). The three groups in the middle were not significantly different to either extreme. Interestingly, the groups of colonies treated with Bayvarol™ that began with two to nine varroa per 300 bees and 10+ varroa per 300 bees were similar in population size to the group of colonies treated with Apivar® that began with two to nine varroa per 300 bees. This suggests that the effect on colony size should be considered when determining the maximum varroa infestation that you are prepared to allow prior to applying a varroa treatment.

Although our ethanol wash data indicate that Bayvarol™ can control varroa in colonies with up to 72 varroa per 300 bees, we recommend that Bayvarol™ treatments are applied before varroa infestation exceeds nine varroa per 300 bees. This should at least reduce the loss of bees, thus making them more resilient to issues associated with autumn, such as robbing.

Analysis of bee samples by dNature Diagnostics and Research Ltd showed that at the end of the eight-week Bayvarol™ treatment the amount of Deformed Wing Virus, Black Queen Cell Virus, and Chronic Bee Paralysis Virus had reduced in the colonies. Additionally, the resistance mutations L925V, L925I, and L925M (all associated with pyrethroid resistance), and mutations N87S and Y215H (associated with amitraz resistance) were not identified in the varroa samples collected from the Bayvarol™ treated hives.

Autumn provides a good opportunity to develop and adopt methodical and effective varroa treatment plans for next season. Plans should be reviewed annually to keep varroa levels low (measured as varroa per 300 bees).

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Research and Future Treatments

To better understand Varroa, ongoing monitoring is essential.

Long-term observations provide valuable insights into the mite's behaviour and the effectiveness of current treatments. These results help optimise existing Varroa control methods.

Other potential treatment options currently being researched include thermal treatments, ultrasonic applications, RNAi technology, and the development of synthetic or organic-based Varroacides.

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