Varroa – Chemicals for treating varroa: Naturally derived or synthetic?

Use of any of the chemicals below must be under strict guidance of your state Department of Agriculture and the APVMA. You must always use a registered product and follow label directions. This factsheet provides guidance only.

A major decision faced by beekeepers managing varroa is whether to use naturally derived, synthetic acaricides or a combination of both. Both have their place but must only be used under the right circumstances. In this factsheet, we explain the difference between naturally derived and synthetic acaricides and how knowing the right time to use one or the other can help maintain resilient beekeeping businesses even in the face of *varroa destructor* (varroa).

Naturally derived arcarisides

Danger to humans

Danger to bees

Residues in hive products

Synthetic arcarisides

Danger to humans

Danger to bees

Residues in hive products

Chemical resistance

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Naturally derived vs synthetic: What's the difference?

Acaricides are pesticides specifically designed to kill mite pests. In the case of varroa, there are many different acaricides that have been used around the world for management. These fall into two categories: *naturally derived* and synthetic acaricides. Both *naturally derived* and synthetic chemicals have their place in controlling varroa. It is important to use an integrated pest management strategy, with multiple tools in your toolkit. These tools should be applied as appropriate to conditions. Colonies should be monitored for mite loads both before application to determine if treatment is necessary, and after application to ensure efficacy.

Naturally derived acaricides

- Include organic acids such as formic, oxalic and hop-beta acids, and plant essential oils such as thymol (extracted from thyme)
- These chemicals are toxins and can be harmful to bees, humans, and the environment if used incorrectly
- Tend to have lower efficacy (kill less mites) than synthetics, so require follow up treatments or use in conjunction with a non-chemical treatment
- Work over multiple sites in varroa's cellular pathways, so they can be used repeatedly without varroa developing resistance

Features	Formic acid	Oxalic acid	Thymol	Hop beta acids
Efficacy	60-90%	~90%	50-90%	~90%
Temperature	10-30 °C	>10 °C	15-20 °C	>10 °C
Kills mites in brood	✓	✗	✗	✗
PPE required				
Potential danger to bees when used CORRECTLY	Toxic to queen at high temperature	Can be toxic to open brood	May reduce queen laing	n to ensu
Residues in wax	✗	✗	✓	✗
Resistance issues	✗	✗	✗	✗
Can be used with honey super	✓	✓	✗	✓
Treatment period	1-4 weeks	Short	2-4 weeks	2 weeks

Where do they fit in?

Varroa cannot develop resistance to naturally derived acaricides. However, as their effectiveness can vary from colony to colony and in different environments and climates, they often require a follow-up treatment or to be used in conjunction with non-chemical treatments.

Off-label use

The acaricides in the table above have been thoroughly tested and are in use by beekeepers around the world. While they each have their pros and cons, they are tried and true acaricides and have been developed by researchers and industry to be safe and effective.

As many naturally derived acaricides are available in other products or can be sourced generically (e.g. plant essential oils), some beekeepers attempt to concoct their own formulations to treat varroa. Despite what they may claim, this kind of off-label use should be avoided and is likely illegal. 'Home brew' treatments have not been tested and there are no approved safety regulations for their use in beekeeping. As we don't know their long term effects, we can't risk these chemicals ending up in honey. Any compounds added to beehives (such as antibiotics or nutrient supplement) currently need to be declared, and naturally derived treatments are no different.

Synthetic acaricides

- Commonly used active ingredients include amitraz, coumaphos, flumethrin and tau-fluvalinate
- Easy to use as they are applied by contact strips
- Initially very effective, killing well over 90% of mites
- Can cause significant residue problems in honey and wax if used inappropriately. To avoid residue issues synthetic acaricides must be used strictly as stated on the label.
- Work on a single site in varroa's cellular pathway, meaning varroa may become easily resistant by mutations in a single target site
- Varroa quickly becomes resistant; effectiveness can drop dramatically if not used in rotation within 2-3 years, and mite populations can remain resistant for years after the product is no longer used due to residues in wax
- Many historically used synthetic acaricides have been abandoned by beekeepers overseas; they no longer work due to increasing mite resistance. This can be avoided by implementing integrated pest management.

Available treatments

The active ingredients mentioned above are the major synthetic acaricides in use throughout the world. However, coumaphos and tau-fluvalinate are being phased out increased numbers of mite populations become resistant to them. In Australia, we recommend products containing amitraz and flumethrin for use in managing varroa.

Features	Amitraz	Flumethrin
Efficacy	75-90%	~90%
Temperature	10-30 °C	>10 °C
Kills mites in brood	✗	✗
PPE required	✋	✋
Potential danger to bees when used CORRECTLY	✗	May increase stress in ault bees
Residues in wax	✓	✓
Resistance issues	✓	✓
Can be used with honey super	✗	✓ In Australia
Treatment period	6-10 weeks	6-8 weeks

Where do they fit in?

Synthetic acaricides are one of the most effective weapons in a beekeeper's arsenal against varroa, but only if they are used correctly and varroa isn't resistant to them. Simply put, synthetic acaricides have their place, but they need to be used responsibly as part of an integrated pest management strategy to ensure that they remain effective.

The problem of resistance

As they seem to work quickly and are easy to use, it may seem as though synthetic acaricides are the only thing needed for varroa management and that all other treatments are complicating the issue. However, if they are used too much, they stop working. In the US, synthetic acaricides are the primary method for managing varroa. Over 30 years later, this has resulted in huge problems for the US honey bee industry. Over reliance on synthetic chemicals means there are large populations of resistant mites. As more and more acaricides have lost their effectiveness, beekeepers are running out of options to treat their bees. Reliance on synthetics means that bees never have a chance to adapt to varroa and develop their own traits for coping with it. In turn, beekeepers who rely on synthetics never have the chance to learn alternative varroa management strategies. The result is an industry drowning in varroa and beekeepers who can lose half their colonies every season according to colony loss surveys. In New Zealand many beekeepers are finding it difficult to afford treatments in the current economic climate and with low wholesale honey prices. They are also seeing resistance arise, and higher colony losses. IPM will help to avoid these problems. Regular monitoring is essential for knowing when to take action and if it has been effective.

Conclusion

Varroa and honey bees have complex interactions and there is no simple way to effectively manage varroa while maintaining optimal bee health. The only way to do this is through an IPM approach that takes all these factors into account. Naturally derived and synthetic acaricides are both critical components of IPM for varroa. By only using these chemicals when appropriate and according to the label, beekeepers can ensure they remain useful and they have the best possible toolkit available for managing varroa. In this way, the Australian honey bee industry can continue to thrive.

References

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Varroa support

This fact sheet is the fourth of a series to support beekeepers to manage varroa. Other tools will also be made available, including webinars and podcasts. You can find all these tools online at AHBIC and AgriFutures Honey Bee & Pollination Program. AgriFutures Australia is working to support beekeepers in conjunction with industry.

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