Varroa - Integrated pest management

Managing *varroa destructor* (varroa) can be a difficult and complex task. Integrated Pest Management is a sustainable treatment and management strategy that reduces costs, labour, effects on bees, and residues in hive products, allowing the honey bee industry to remain strong.

What is integrated pest management?

Integrated pest management (IPM) is a process for solving problems caused by pests while minimising risks to crops, livestock, humans, and the environment. IPM uses a tiered approach where different treatments are justified at different levels of infestation by the pest in question. The major goal of IPM is to reduce resistance to synthetic pesticides.

How does IPM work?

IPM is a multi-step process, explained by the pyramid below (Figure 1). The first is identifying the levels of infestation by a pest at which management becomes necessary to avoid losing hives (the economic threshold). Beekeepers should be regularly monitoring their mites loads so that they can respond appropriately. Monitoring should be completed after control actions to check efficacy.

Different control tactics are then used to make sure the pest population stays below this threshold. As the level of infestation increases, treatment strategies further up the pyramid are justified. In this factsheet, we explain how an IPM program for managing varroa could work.

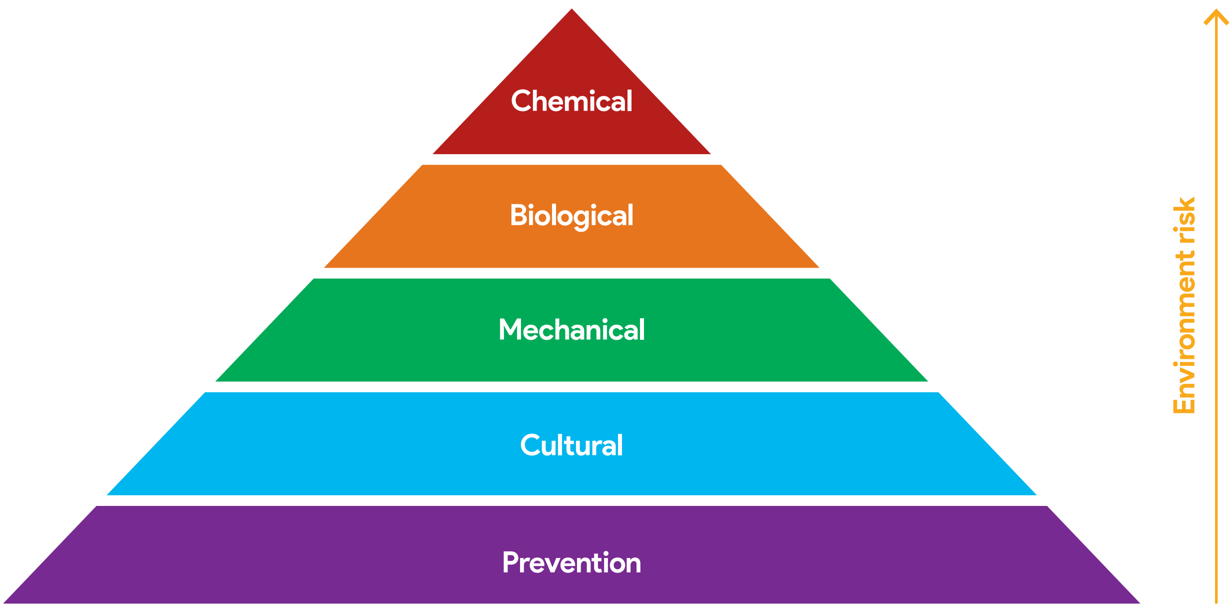

Figure 1. An integrated pest management framework for managing varroa.

Prevention

The cornerstone of the IPM pyramid is prevention, which involves stopping varroa infesting hives in the first place. Once varroa is established in an area, preventing it from infesting hives is very difficult. However, beekeepers can take steps to slow the spread of varroa within their apiaries and to neighbouring apiaries. This may include removing colonies with high mite loads, removing weak colonies, and reducing drift and robbing. With regular monitoring, beekeepers can assess whether the infestation is at a level where they need to take action. Monitoring is vital to the success of IPM, as it is impossible to decide what control mechanism to use without knowing how severe the infestation is.

Cultural control

Cultural control involves making the conditions within the hive difficult for varroa to tolerate. As varroa needs brood to reproduce, mite numbers can be significantly reduced by inducing a 'brood break', a period of broodlessness to bring mite numbers down. Brood breaks can be paired with a chemical treatment to make them more effective. Brood breaks can be achieved by caging the queen, splitting the colony, or requeening.

Alternatively, as varroa mites have a preference for drone brood, beekeepers can significantly reduce the varroa population within a hive simply by removing drone brood. This technique can be taken a step further by placing a frame of empty drone comb in the colony, which will attract mites. Once the frame is sealed, the drone brood and the varroa trapped within it can be removed.

Finally, some honey bees have traits that allow them to tolerate or even thrive in the presence of varroa. These traits can be selected for in breeding programs or by leaving bees to develop resistance naturally.

Mechanical control

Mechanical control means using physical techniques or mechanical devices to remove mites from the colony or prevent them from entering. The most viable method is to use screened bottom boards so that any mites that fall off adult bees or are removed while grooming fall out of the hive and cannot re-enter.

Biological control

Biological controls use living agents to control pests. In the case of varroa, fungi and natural mite predators such as pseudoscorpions have been tested as potential control agents. While there have been promising results in the lab, more research is needed to develop these agents into reliable, commercially available treatments.

Chemical control

Chemical control relies on using chemicals to kill or disable pests, or stop them reproducing. As acaricides (chemicals used to kill varroa) can also be toxic to bees and hazardous to humans and the environment, chemical treatments should be avoided unless other measures have failed to keep mites low. Chemical control is divided into two categories: organic and synthetic acaricides.

Organic acaricides

Organic acaricides are extracted from natural sources and include organic acids and plant essential oils. Even though they come from natural sources, they are still chemical toxins that can be harmful to bees and humans if used incorrectly. Some can leave residues in wax and honey, so they are often used during brood breaks or in between honey flows. The major drawbacks for their use in Australia are the temperatures that they can be used at (typically 10-30 °C), and depending on the chemical, the difficulty in finding breaks between honey flows or brood cycles in which to apply them. However, organic acaricides have a major advantage in that they have multiple sites of activation on varroa's cellular functioning. This means that even after long-term use, varroa does not develop resistance to these chemicals.

Synthetic acaricides

Synthetic acaricides do not occur in nature. They can be highly toxic to varroa, killing over 90% of the mites within a hive. However, unlike organic acaricides, synthetic acaricides have only one site of activation, meaning it may take only a single mutation to make varroa mites immune to the chemical. This means that if these chemicals are used too frequently, mites quickly develop resistance to them, and they are no longer useful. The effectiveness of synthetic chemicals can drop significantly in a single season due to mite resistance, and some previously popular synthetic acaricides have been abandoned by beekeepers as they no longer work.

Synthetic acaricides leave residues in honey and wax, and may not be used within 8 weeks of applying honey supers, depending on registered label instructions. They can also be dangerous to brood if used at higher than recommended doses.

For these reasons, acaricides are at the very tip of the IPM pyramid.

Why does it matter?

IPM is vital for Australia to maintain a resilient beekeeping industry in the face of varroa. While it may seem laborious and expensive compared to simply treating with synthetic acaricides, in the long run IPM is both healthier for bees and the environment and saves money for the industry and individual beekeepers.

By employing practices and treatments that keep mite numbers down without relying on synthetic chemicals, beekeepers can preserve the usefulness of these chemicals. In situations where options lower on the pyramid fail to reduce mite numbers sufficiently, synthetic chemicals can be relied on. Additionally, avoiding widespread chemical use gives the bees time to adapt to varroa and develop their own resistant traits, and keeps brood, honey and queens free from chemical residues improving overall hive health.

In the United States and Europe, varroa management has always relied on synthetic acaricides, which leads to increasingly resistant mites and fewer and fewer effective acaricides available. As a result, the majority of honey bees in the United States and Europe have not developed varroa resistance, and beekeepers there are running out of options for chemical treatment. Beekeepers in these areas still experience significant colony losses every season, even after over 30 years of living with varroa. Annual colony loss surveys show that a large portion of colonies die each year, with varroa being a leading reason

In Australia, we have an opportunity to implement IPM frameworks for varroa from the very beginning. While further research is needed to establish specific treatment thresholds, beekeepers can already start putting preventative measures into practice. By focusing on sustainable solutions, more colonies will survive over the long-term, allowing beekeepers to continue maintaining productive businesses.

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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