Current Status of Varroa Mite Control by Dewey M. Caron

The World of Bees is as old as Langstroth removable frame hives or as new as beekeepers wishing to 'save the bees' utilizing non-traditional Top Bar/Warré hives, (natural comb without use of foundation). As our smallest livestock, bees are really no different from other animals we own/manage. They too need some care and attention to survive and prosper to meet our objectives.

New beekeepers (sometimes to their dismay) discover that Varroa mites have drastically altered traditional ways of keeping bees. Since their arrival into the U.S. honey bee population mites have upped the degree to which we administer stewardship.

Varroa mites suck the blood of adult bees and the pupal brood stage. By puncturing the bee exoskeleton to feed, they enable pathogens such as viruses to invade bee bodies. Their assistance goes further with one of the deadliest viruses, Deformed Wing Virus (DWV), as they actually enhance its replication. Honey bees, with weakened immune systems from lack of proper nutrition, other diseases such as the adult disease Nosema, plus heavy usage of numerous pesticides in their environment, are dying in record numbers. It is the bee version of a viral flu epidemic.

As in the case of humans, some bee-flu strains are more deadly than others. The DWV virus seems to be one of these. Lacking a flu vaccine to administer to our bees, as bee stewards we need concentrate on the vector, the varroa mite, *Varroa destructor*. This mite pest is susceptible to several chemicals and there are several techniques useful to keep mite populations at lower levels. Successful beekeepers can combine chemicals with management techniques, termed integrated Pest Management (IPM), to seek to manage mite population levels in a season-long approach to minimize virus epidemics in managed colonies.

We NEED the bee for pollination of about 1/3rd of the products we eat daily. Although small, the honey bee is vital to human food supply and diversity. The NEW beekeeping to insure healthy bees is highly interventive, technology- and input-intensive. Beekeepers need follow Best Management Practices (BMPs) and utilize inputs to best control varroa while insuring top-quality in the hive products of the bee we so highly prize. Bee products and their environment affect not just the bee but also ourselves.

Mite control is never simple - we are, in effect, seeking to control a 'bug on a bug', one which spreads and enhances flu in bees.

How to control Varroa

Calendar-driven control, without knowing the mite population level, is not effective, nor are strategies based on single-tool approaches. Effective control starts with knowledge of the varroa mite life cycle and an accurate determination of the mite population. Experience dictates that we should seek to keep mites below a 2-3 % adult (bee) population infestation level as higher mite populations may negatively impact colony survival and/or productivity.

Decisions on when and what control to utilize begins with knowing how many mites are present. Samples of 300 adult bees, taken from brood frames and washed of their mites, using alcohol, low-sudsing soap or powdered sugar, has been demonstrated to be the most effective and reliable measure of adult bee infestation. Samples should be taken of colonies several times during the year but most especially post-harvest, continuing into the fall population decrease phase of colony seasonal cycle. Sampling following treatments, can confirm treatment effectiveness.

Details on how to take 300 bee samples and wash them of their mites is available on the Honey Bee Health Coalition Tools for Varroa Management http://honeybeehealthcoaltion.org/varroa/ It is free.

Chemical Controls

Many beekeepers are reluctant to use chemicals around their bees. Beekeepers are well aware that chemical pesticides kill bees. Chemicals have been demonstrated to harm colony population buildup, have been shown to contaminate beeswax, and, to lesser extent, honey. Beekeepers consider honey bees and their products as pure and natural. We know from past experience that chemicals are not the solution and, all too often, create more problems than what we seek to solve. They can, however. be highly effective in varroa mite control and reduce the possibility of a bee-flu epidemic when used correctly.

Using pesticides, like feeding bee colonies sugar syrup, are externalities, tools beekeepers can elect to use, just like our hive tool or smoker. As caring bee stewards, tools, used judiciously and properly, can help us toward better stewardship of our bees.

Mite-targeted pesticides (termed miticides or acaricides) can kill mites and, when used properly, not cause undue harm to bees or the bee hive. Several classes of chemicals have been used. There is one highly-effective synthetic pesticide (Apivar™) that mites have yet to develop widespread resistance to. The treatment period is over 2-3 bee generations (42-56 days) and it should not be used when bees are storing honey. To delay development of mite resistance, a single chemical or chemicals in the same "family" should not be used repeatedly during the season. Three other synthetic chemicals, once useful in mite control, Apistan™, Checkmite +™, Hivestan™ are no longer recommended, due to widespread mite resistance.

Two classes of miticides are permitted for organic honey production. Essential oils (two compounds, Apiguard™ and ApiLife Var™) are fumigants that work best within a 65-85 °F range. Three acids (Oxalic, Hops Beta acids (HopGuard II™) and Formic Acid (in formulation MAQS™ can be highly effective. The first two are only effective on the phoretic mites on adult bees and are recommended only in broodless periods or when there is little capped brood present (as for example after requeening). Formic acid in commercial product MAQS™ actually penetrates capped brood cells to eliminate reproducing mites. So far mite resistance to oils or acids has not developed. Acids are not as likely to be incorporated into beeswax (as are the synthetic miticides) and are often common in honey.

The oils and acids work best in a narrow temperature range and on smaller colonies. They may cause brood and/or queen loss, especially in initial use. They may only reduce a population of mites and might not be as effective in mite elimination as Apivar. Oils and acids are caustic and can be harmful to the beekeeper thus prudent safety precautions are recommended. This means gloves, goggles as minimum, respirator for acids formic and oxalic recommended (required for oxalic when used as fumigant).

Non-Chemical control

Beekeepers have several techniques available to assist colonies in keeping mite levels at lower levels. Most are not as effective in killing mites as he chemical pesticides, by themselves, or when mite populations are elevated, but are useful in an Integrated Mite Control program. Many are only marginally effective at keeping mite population lower and may be very labor-intensive.

Basic sanitation (bee bio-security) can help keep colonies healthier and therefore more resistant to mites. Not transferring bees or materials from one hive to another is a basic bee biosecurity measure. There may be times when it is useful to transfer a brood frame to a weak colony or one that is apparently queenless. Transfer of bees or brood are often useful early in the bee colony development cycle, when mite numbers are lower; this transfer can make a significant difference in bee colony growth. Growing colonies so they expand faster than mites can reproduce is good bee biosecurity (at least until the mites “catch up”).

Likewise transferring brood frames out of colonies preparing to swarm (once swarm cells are started) or to create more colonies (termed dividing or splitting – a popular, sometimes effective swarm control technique when done at the appropriate time) can result in young, growing colonies. The new splits, when requeened with selected queen stock showing some resistance (tolerance) to mites, are considered one of the best non-chemical means of combatting varroa mites.

Other bee biosecurity is painting hives distinctively to reduce drifting. Siting bees in sunny sites, providing each hive with a distinctive look/orientation, compared to arranging all colonies with same color scheme, sited in a straight line and all facing the same direction is recommended. Use of landmarks in the apiary also reduces drifting, a major means of spreading mites from a highly infested (susceptible) colony – termed a ’mite- bomb’ – to colonies with fewer mites.

Replacing solid hive bottom boards with a bottom screen is a passive mite measure that indirectly helps bees keep mite populations lower. Likewise air circulation, inside and outside the colony, helps keep mite numbers lower. Reducing drone cells in a colony helps too, as mites reproduce 3X faster when they infest drone (versus worker) brood.

We can use a drone brood trap technique to actively reduce mite population buildup in the developing spring colony. When we insert a drone foundation frame, or put a shallow frame into a standard (deeper frame) brood box, and the bees build drone cells followed by the queen laying unfertilized (drone) eggs in those cells, allows us to remove and discard the capped drone brood, eliminating the mites reproducing inside those cells. It is labor intensive and only works if bees are willing to rear drones.

Likewise we can create a brood interruption in a bee colony and effectively reduce the rate of mite buildup. The mites need capped brood and when we remove most capped brood and interrupt the normal buildup, or more likely when the colony is near population peak and colonies do not need brood to store surplus, we can seriously interrupt mite reproduction, slowing down mite buildup in a colony. We help the colony help itself.

Eventually we will have bee (queen) stock available that is more resistance (tolerant) to varroa mites and we can get off a pesticide-treadmill. Then screen bottom boards, drone brood removal and brood interruption can have a major impact in keeping mite populations lower. Currently there are some stocks with promise such as Russian queens, Improved carniolan stock, Hygienic bees such as VSH and some beekeeper selected local stock. Selections following a period of intense mite pressure, in which there may be excessively high losses, and breeding from what is called survivor or selected stock show promise. How long before we have a honey bee that can truly resist (tolerate) varroa mites is anyone's guess. Certainly sooner would be better than later.

Integrating controls

Integrating mite control (IPM) basically means seeking to reduce mite populations so they don't rise to damaging levels or slowing mite population increase rise so they do not reach a damaging level until later in the season. This is called an economic injury level. IPM is not anti-chemical but good IPM strategies rely less on chemicals, utilizing chemicals only when other efforts have not succeeded in keeping mite levels below damaging levels. In instances where we have a new pest (varroa), on a highly susceptible host (the western honey bee), chemical controls are often the necessary evil. However any control that relies solely on a chemical is doomed to failure – the pest will, sooner or later, develop resistance. The chemical, is a crutch, giving us time to find other, more ecology sound, long-term solutions for protecting the host bee from the varroa pest.

An example of an integrated approach is combining a broodless period, when all mites will be phoretic on adults with organic acid treatment such as Oxalic acid or HopGuard II. Oxalic acid vapor or drip can be used in the winter (dormant bee season) when colonies are naturally broodless, and once again in the late summer, after inducing an artificial state of broodlessness by caging colony queens for 3-7 days. Oxalic and HopGuard II are acids that leave no residue nor contamination of beeswax comb and are approved for organic honey production.

By August or September, nectar flows are over and a large worker foraging population is no longer needed. Caging a queen will halt brood rearing and decrease the forging population of a hive. Phoretic mite populations will skyrocket on the colony adults, as there will be rapidly declining brood cells to infest. Use of Oxalic or HopGuard II can be employed after waiting several days when the older brood has hatched before new eggs laid by the queen have not yet reached the pupal stage of their development.

Fewer mites equals improved health, and fewer bees equals less food consumed; both circumstances contribute directly to improved winter survival. Brood interruption and caging of queens must be done carefully as colonies still need stores to rear the fat fall bees and time to organize their winter cluster location. As in much of beekeeping timing is everything. And yes it is a bit of work to first cage and later release each queen.

Utilizing chemicals or managements that keep numbers of mites lower may have value when integrated with other techniques/chemicals. Powder sugar dusting of the brood nest after spring inspections may slow mite population growth during the spring. Reducing drone brood in the brood nest might also help, since mites generate offspring at a rate 3 times faster in drone brood. Anything that helps reduce frequency of chemical use is of potential benefit.

Things that don't work

There are many things that have been tried that don't work well enough to be part of an integrated control plan. Food supplements that include essential oils might be useful for bees in general but do not have enough of the essential oils to kill mites. Likewise, things like supplemental feeding, so-called nutrition additives, microbiologicals, management techniques that result in colonies that don't grow in strength or result in colonies that are too weak to pass a winter, are of little use in killing mites or so detrimental to the colony as to make them of little value. When you hear of new treatments that sound too good to be true – they may be.

Varroa Life cycle – counter-clockwise, as adult bees (top) feed and interact with each other, the phoretic varroa mites pass from one to another. Nurse-aged bees (bee on left) with varroa, feed larvae in the brood nest. The varroa mite is able to pass into a brood cell with 5th stage larva (2nd cell left side of comb) where is hides until the prepupa stage forms and the cell is capped (3rd cell down on left). It feeds on the pupa (lowest cell left), producing first a non-fertilized male egg (within 60 hours) and then female eggs after another 24 hours (lowest cell bottom right). The female continues to feed on the pupae and is joined by her immature offspring. The male mite mates with his sister as she reaches adult stage. At adult bee emergence, one (on average) daughter mites is mature if the cell is a worker bee cell(as shown); on average 3 new adult female offspring can mate and mature if the cell is a drone honey bee cell.