Reducing Mite Populations through IPM

By Frank Gellatly and Jason Learner, NBU

Integrated pest management (IPM) involves using a combination of varroa control methods throughout the year depending upon the level of infestation, as Frank Gellatly and Jason Learner explain.

One of the most important principles of varroa control is to ensure that the mite population going into winter is as low as possible so that those bees carrying the colony into spring are as healthy and long-lived as possible. Likewise, we need to ensure that during the spring and summer, when the hive has the greatest amount of brood for mites to reproduce in, we keep mite populations low to ensure their levels do not reach a point where colony damage occurs.

Back in the 1990s, keeping mite populations low was initially achieved using synthetic pyrethroids, such as Bayvarol and Apistan. However, their widespread and continued use resulted in varroa mites developing resistance to their active ingredients. This led to treatments that contain thymol and oxalic acid, which have served beekeepers well for many years. When used correctly the licensed 'softer' products, such as Apiguard, Thymovar, ApiLife Var, Oxuvar, Mite Away Quick Strips and Api-Bioxal, remain very effective treatments, without having to use harder synthetic chemicals.

Drone removal as part of an IPM strategy to reduce varroa mite numbers in a hive. All photos are courtesy of The Animal and Plant Health Agency (APHA), Crown Copyright.

Chemical treatments have normally been applied when supers are not on the hive to avoid any risk of residues contaminating the honey. This remains the case apart from Mite Away Quick Strips, where the manufacturers have recommended that the treatment can be applied with the supers on the hive and with the entrance block out. An open mesh floor monitoring board can be left in or taken out, but beekeepers may receive a 5% reduction in efficacy should they be left out; if the monitoring board is taken out, the 5% reduction in efficacy will still result in a 90% success. Formic acid is a naturally occurring organic acid and treatment with the supers on does not give rise to residues in the honey.

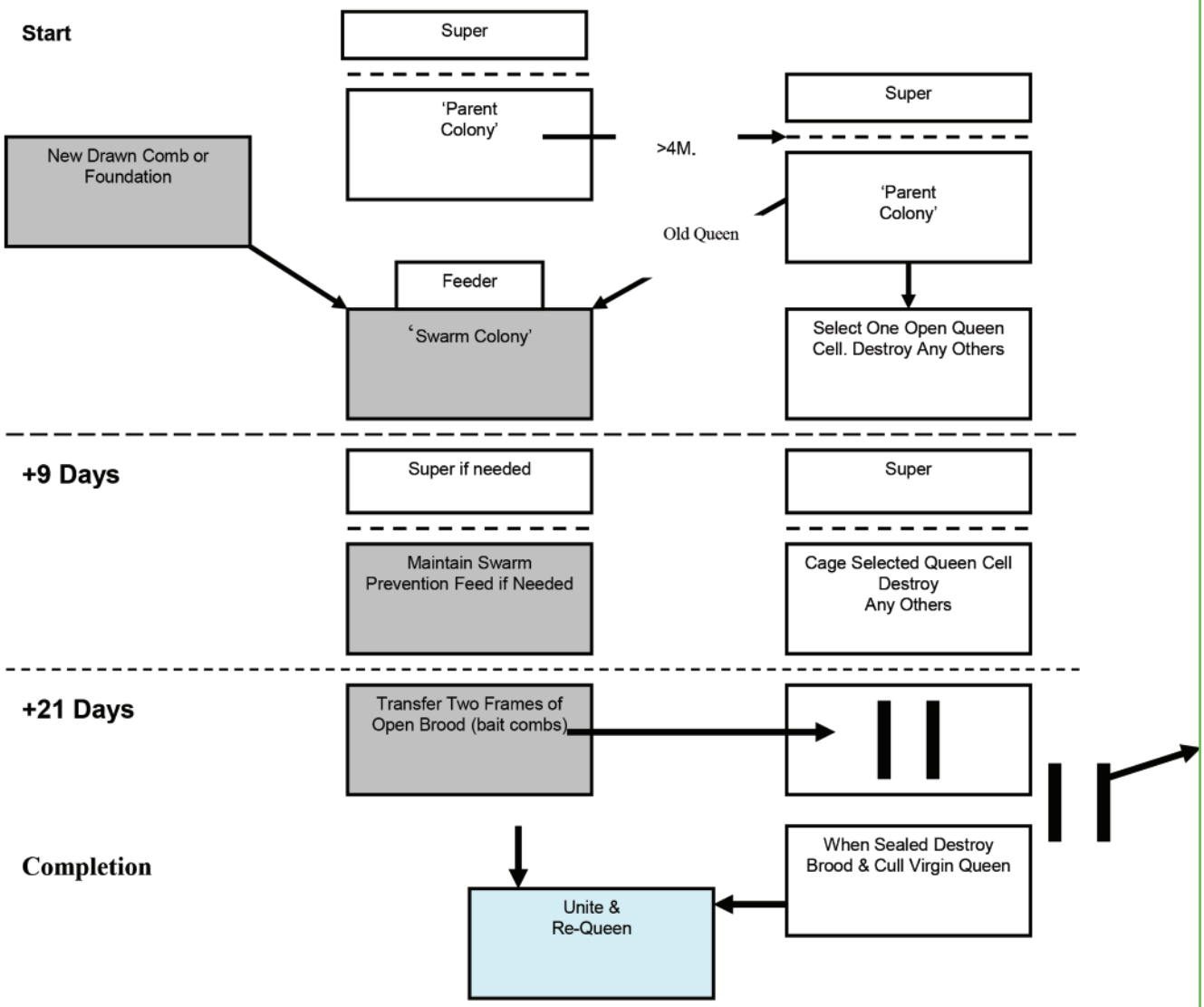
Methods of varroa control

Control methods can be divided into two groups: management methods, the 'biotechnical methods' and medicinal controls, the 'varroacides'. In practice, the most effective varroa control results from using a combination of methods at different times of the year depending on the level of infestation. This is known as 'Integrated Pest Management' or 'IPM'.

Integrated Pest Management is a principle now widely used in agriculture, especially where it is desirable to keep chemical inputs to a minimum. Significantly, no attempt is made to completely eradicate the pests. Instead, the aim is to keep pest populations below the level where they cause significant harm by using a combination of controls applied at different times of the year; more or fewer controls are employed depending on the levels of pests present. This is a much more effective approach than the alternative of waiting until pest numbers have reached a damaging level before applying controls or applying the same controls each year regardless of pest numbers.

During the summer biotechnical control methods can be used to keep mite levels below a damaging threshold by using the principle of IPM. All biotechnical controls exploit the fact that mites reproduce in bee brood. Therefore, unsealed brood can be used to attract varroa mites into their cells to feed off of the developing larvae. Once the cells are sealed, the mites are trapped and the frame can be removed and destroyed, along with the varroa. Some of the techniques for carrying out this procedure are listed overleaf.

Diagram illustrating the control of varroa using an artificial swarm



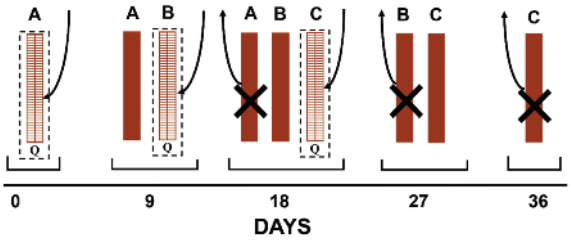
The artificial swarm technique

One of the most effective ways of removing high amounts of varroa from a colony without using chemicals is by creating a brood break, usually incurred during swarming. The brood break presents a hiatus in varroa's ability to reproduce rapidly in brood and this, as mentioned above, allows you to add frames of unsealed brood to trap varroa and destroy them. With this procedure removal of more than 90% of the varroa population is often achieved. To create a brood gap the beekeeper can use a method known as 'artificial swarm control'; this combines swarm control with varroa control. Because the colony rears a new queen, it is only suitable for use in the swarming season and it may be necessary to take precautions to prevent absconding in the artificial swarm, such as placing a queen excluder below the brood chamber until the queen has laid eggs.

The procedure, illustrated in the diagram above, requires moving the parent colony to one side of the original site to a position at least four metres away. Next, place a second hive containing newly drawn comb or foundation on the site of the original hive. You will then need to find the queen from the original hive and place her in the new box of comb or foundation. You can either do this by caging her or, if you are not confident in picking her up, you can shake the frame she is on into the new hive. Foragers will return to this hive creating the artificial swarm. After nine days, remove all but one queen cell from the parent colony. The cell can be protected in a queen cell nursery cage, which prevents the virgin queen from leaving the hive to mate, but allows worker bees access to care for her. After three weeks all brood in the parent colony will have hatched. Transfer two bait combs of unsealed brood from the artificial swarm to the parent colony and, when they are capped, remove and destroy them. At this stage cull the virgin and introduce a new queen to the parent colony. The old queen in the swarm can be removed later and the two colonies reunited.

Drone brood removal

Another, simpler method of comb trapping is known as drone brood removal. The fact that mites actively seek out drone brood for more successful reproduction allows the beekeeper to use this to his or her advantage, most commonly by introducing a shallow frame towards the edge of the brood nest. From April to June the void created is filled by the bees drawing down drone comb. Once it is laid up by the queen and capped, the breeding mites inside are effectively trapped and the whole slab can be cut off and removed. To avoid wastage this can be fed to chickens. The process can be repeated, but it is important that the extra drone brood is removed to a strict timetable otherwise the beekeeper is actively encouraging the build-up of mites in the colony.



The queen caging method of varroa trapping. The queen (Q) is successively transferred to and confined to a new comb, leaving her eggs to develop in the comb she has just left. Each laid-up comb is then allowed to become sealed before it is removed, thereby removing both brood and varroa mites simultaneously.

Queen caging

Another comb trapping technique confines the queen to worker comb using a purpose-made comb-cage (available commercially). Let us call this worker comb 'A' (shown in the diagram above illustrating the procedure and in the photograph above opposite). After nine days confine the queen (Q) to a new, empty comb, comb 'B', and leave comb 'A' in the brood chamber to become infested with mites. After a further nine days remove comb 'A' (now sealed). Confine the queen to a new comb 'C', leaving comb 'B' in the brood chamber. After nine more days remove comb 'B'. Release the queen (or re-queen by introducing another queen) leaving comb 'C' in the brood chamber. After nine more days, remove comb 'C'.

Building IPM into routine beekeeping activities

One of the advantages of biotechnical controls is that their use can often naturally be combined with other beekeeping operations. For example, drone brood removal fits in well with routine swarm control inspections. There are some very effective methods that combine swarm control with varroa control. Such methods are likely to grow in popularity as beekeepers become more familiar with them. Despite these advantages, as a result of their nature, most biotechnical methods are only suitable for restricted periods of the year. Outside these periods they may be ineffective and even harmful to the colony. As a general rule, in heavily infested apiaries biotechnical methods are unlikely to provide sufficient control of varroa if used alone and so will need to be used in conjunction with chemical varroacides.

If you employ methods that slow the growth of the varroa population in your colonies, such as drone brood removal and using open mesh floors (OMF), they will delay the point when the varroa infestation reaches a damaging level, allowing you to treat a little later or to use less efficacious varroacides. The effective use of OMF and drone brood culling should result in an efficacy of 50%. Comb trapping and control using the artificial swarm technique should result in an efficacy of 90%. Their use is helpful to reduce reliance on chemical controls and can be essential where late crops, such as heather or Himalayan balsam, are sought.

Using an OMF results in an average of 20% of mites dropping off bees and being lost to the colony. The OMF improves hive ventilation and you can use the collection tray to measure mite drop when required. So how do you know what levels of mites cause harm? This is a variable quantity depending on what other stressing factors are also placed upon a colony. As a rule in this country, mite populations should be kept below 1,000 mites per colony. In the case of small colonies and nuclei this figure must be set proportionately lower.

How do you check mite populations?

In any integrated control plan, knowing the level of mites in a colony is essential so that appropriate action can be taken. Monitoring three or four times per year is necessary. If mite levels in your area are high you should monitor at least four times each

Trapping a queen with a queen cage courtesy of The Animal and Plant Health Agency (APHA), Crown Copyright.

season; in early spring i.e. February–March to assess the mite population before the spring honey flow, after the spring honey flow, at the time of honey harvest and in late autumn.

Mite populations can be monitored by natural drop from a sticky insert/OMF or by uncapping drone brood. The signs of infestation may not be obvious until your colonies are heavily infested, by which stage they are at great risk. If you see deformed wings or mites on adult bees or mites on the comb, you can assume that some sort of control is overdue. However, there are several methods that can be used to detect the mites and estimate their numbers at a much earlier stage. These include counting dead mites that collect on the hive floor and counting mites inside sealed brood cells. Figures can be input into the varroa calculator on BeeBase to give an estimate of the current mite population in the hive and the recommended time to treat. These methods help you plan the nature and timing of the control methods to use.