

Post-Pyrethroid Varroa Control, Using a Combination of `Apiguard` and Oxalic Acid by Wally Shaw

Introduction

Pyrethroid resistant mites are spreading rapidly and when they do reach your area it will probably catch some beekeepers by surprise. It is important to have effective and well-rehearsed alternative methods of control in place to avoid serious colony losses. The methods described here are two of many that have been used around the world to control Varroa. For us they have proved effective over the last 8 years (since 2001), amounting to about 350 hive/years. With reasonable precautions, the methods (and the substances involved) are safe for both the beekeeper and the bees. The combined cost is approximately the same as for pyrethroid strips (`Apiguard` costs about the same as strips and the cost of oxalic acid syrup is negligible at about 5p/hive, if you make up your own solution). The level of skill required is no greater than for pyrethroid strips but the hives do have to be opened a total of 4 times instead of 2 (3 times for `Apiguard` and 1 for oxalic acid). The greatest hurdle may be persuading beekeepers that it is safe to open hives and trickle liquid over the bees in the middle of winter. It is a widely held dogma of British beekeeping (`Don't open a hive unless you are comfortable in your shirt sleeves`) that this will do irreparable harm to the colony. Believe me, it does not harm them at all - in my experience. Oxalic acid has been widely used in Europe in much colder climates than ours. There are reasons to suppose that Varroa is unlikely to become resistant to thymol (the active ingredient of `Apiguard`) nor to oxalic acid. The double treatment, at different times of the year with different substances, makes the development of resistance even less likely. The staggered treatment also protects against the most likely period for a colony recruiting mites from external sources - the autumn when untreated hives and feral colonies are most likely to collapse.

Safety

Oxalic acid is a poison but not an acute one - it can be obtained without signing the Poison Register. In the standard rat test it is slightly less than 3 times more toxic than thymol. To put this in perspective, 2 trays of `Apiguard` contain 25g of thymol but the average treatment with oxalic acid is less than 1g/hive. A healthy diet, including a daily intake of vegetables and fruit, gives us humans regular exposure to oxalic acid and our metabolism handles this with no adverse consequences. Spinach contains up to 1% (dry weight) oxalic acid. However, there is evidence that inhalation of oxalic acid is more dangerous than ingestion - causing inflammation of the lining of the lung. Spraying oxalic (an alternative method of application) needs protective equipment and care during the process (ie. avoiding windy conditions). Application as a vapor (eg. the Isering oxalic acid vaporizer) is potentially very dangerous and not to be lightly undertaken. The trickle method, described here, only requires the use of rubber gloves when handling or applying the material.

Equipment Required

- a) **Although not absolutely essential, it is recommended that a hive to be treated with `Apiguard` is fitted with an open-mesh/Varroa floor with a catch tray.** A mesh floor probably enhances the efficacy of `Apiguard` by removing from circulation mites that have not received a lethal dose of thymol, ie they can not hop back on a passing bee when they are feeling better.
- b) **A hive with an open-mesh floor MUST also have some sort of top insulation and the means of closing-off all top ventilation.** An insulated cover board using 25mm polystyrene insulation is the best solution - rather than an insulated roof. **Note** - polystyrene insulation must always be protected from the bees, who will quickly chew holes in it.
- c) **You MUST also have some sort of spacer to provide clearance under the cover board (or between the two boxes) so that the bees have unimpaired access to the tray of `Apiguard`.** The use of 1"/25mm deep mini-ekes is recommended. The top bee-space of a Smith or Langstroth hive is not sufficient.
- d) A 50ml graduated plastic syringe with a wide bore needle (1mm bore/17 gauge) is required to deliver the oxalic acid solution in a **well-controlled manner**. Delivery straight from a syringe (no needle) is difficult and it is suspected that some bees have been over-dosed and killed in this way. To avoid accidents, the point of the needle should be ground off, leaving a square end.

Treatment with `Apiguard`

`Apiguard` (a polymer gel containing 25% thymol) can, in an emergency, be used at more or less any time of year except mid-winter. A daytime temperature of about 10°C (or better 15°C) is necessary for the treatment to be fully effective - but the temperature within the hive is obviously the key factor. Treatment while honey supers are in place is to be avoided to prevent the risk of tainting the honey. Hive volume (the space occupied by the bees) should be kept to a minimum during treatment with `Apiguard` - or any other vapour mediated miticide. **You should not have extra supers, cleaner boxes or tray feeders on top of the hive unless they are isolated (there is an air-tight barrier) from the space occupied by the bees. This is to prevent dilution and loss of thymol vapour.**

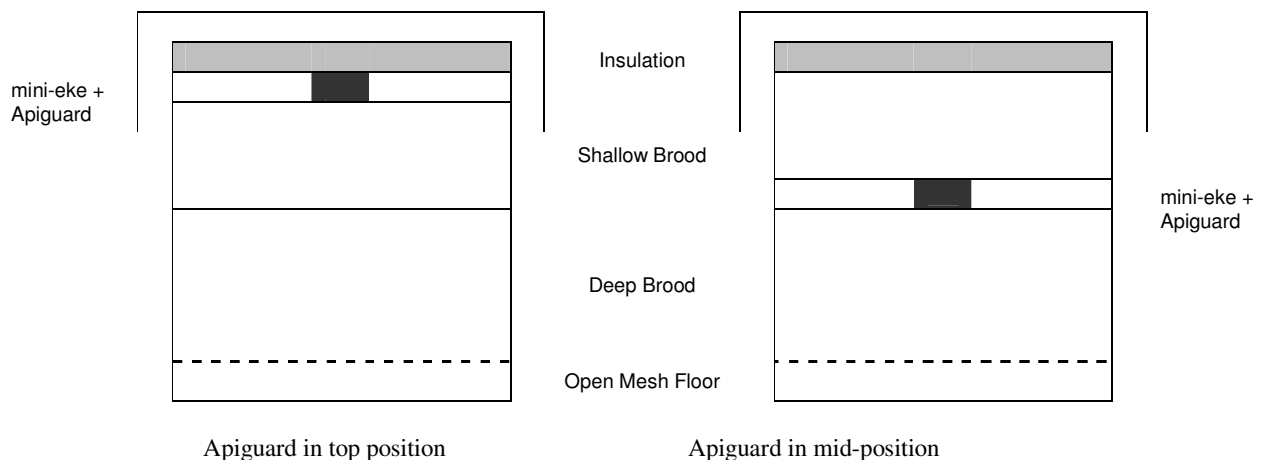
Autumn Treatment with `Apiguard`

The normal time for treating with `Apiguard` is in the autumn (August and/or September – same as with pyrethroid strips). Correct timing of the treatment is vital:-

- i) **If there is a high population of mites in the hive (2000+) then treatment MUST commence as early as possible in August. It may even be necessary to take a premature honey harvest.**
- ii) If the number of mites in the hive is reasonably well under control (500-2000), then treatment can be safely delayed to the end of August or the beginning of September.
- iii) If the hives are going to the heather then, unless there is a very low number of mites (less than 500), you have got a problem – when to treat? In this situation, it may be safest to give the hives a half treatment (1 x 50gm tray of `Apiguard`) in late July (removing the lowland honey crop first). A second treatment should then be given after the return from the heather (mid-September). However, it should be clearly understood that two staggered `Apiguard` treatments will be less efficient than two consecutive ones. This is because some mites will be safely out of harms way in the brood during both treatment periods. However, winter treatment with oxalic acid should deal with any mites that have that have escaped in this manner. The first tray of `Apiguard` normally kills 70-80% of the mites and the second tray 20-30% (of the total number of mites killed by 2 consecutive trays of `Apiguard`). The distribution of kill between the two trays can vary considerably, depending on the timing of brood rearing before and during the treatment period - I have seen a 20/80 split.

But how do you know how many mites are in the hives in order to make these (informed) decisions? Uncapping of drone brood during the season will have given you some idea of how many mites are present. A more accurate method of estimating the number of mites present in a colony is supposed to be through an estimate of natural mortality. **A catch tray should be fitted to the mesh floor for 5-7 days in early to mid-July. The number of fallen mites is counted and divided by the number a days to give a daily average. This figure multiplied by a conversion factor of 30 (ie. daily fall x 30) should give a good estimate of the total number of mites in the hive.** However, my experience of trying to estimate mite populations by natural mortality suggests that it is not quite as straightforward as it is supposed to be. There are wide variations in fall over time and a single sample does not seem to be a reliable guide. Mite activity is driven by the supply of brood and it is probably variations with time that causes part of the problem. The bottom line is, that I have not found monitoring mite fall in July to be a useful guide to the mite population in the hive as subsequently revealed under treatment. As an extreme example, a hive that yielded 0 (zero) mites during 7 days of monitoring in mid-July, 4 weeks later produced a fall of 6,000 mites under treatment! My suspicion is that, under conditions of natural mortality, bees engaged in hygienic behaviour intercept the majority of dead and dying mites and prevent them from even reaching the mesh floor. The only high natural mortality falls (10-20+ mites/day) I have seen is with hives is that do really contain high mite populations (10,000+) and are already showing signs of dysfunction. When this state has been reached, I presume the hygienic activity is reduced or simply overwhelmed. If this interpretation is correct, it implies mite falls under treatment are always an underestimate.

Instructions for the use of `Apiguard` are given on the packaging. There are, however, a number of additional details relating to the use of `Apiguard` that need to be observed to ensure maximum efficacy. The 50gm foil tray is opened and placed on the top bars of the upper box on the hive (ie. on top of frames if single box, or the upper box of brood and a half or double brood) **in the space provided by the mini-eke.** If the colony is not very strong and the upper box is not well populated with bees, it is better to position the tray of `Apiguard` between the two boxes using the mini-eke again (see diagrams).



The aim is to get the `Apiguard` close to an active area in the hive so that the bees are fully alerted to its presence and respond by completely clearing the thymol gel from the tray in the 2 week treatment period (thought to be a form of hygienic behaviour). After 2 weeks, a second tray of `Apiguard` should be placed in the hive. If the first tray is substantially cleared, all is well. If it is not, you should consider re-positioning the trays for the second part of the treatment period. Hygienic behaviour in response to `Apiguard` is very variable between colonies; some remove it quickly, some slowly and some even try to propolise it. This year I had quite a small colony that cleaned out a tray of `Apiguard` in less than 4 days! With the type of bees we have on Anglesey (predominantly dark bees), the colony often gets smaller quite quickly in late August-September (as the worn-out summer bees start to die and are not immediately replaced). This is another reason to re-consider the positioning of the second tray of `Apiguard`. The first tray can be left in place or any remaining contents emptied into the second tray. There is no great imperative to remove trays of `Apiguard` at the end of the 4 week treatment period (as there is with pyrethroid strips) but it is good practice to remove empty trays and the mini-eke (to restore correct bee-space) ASAP – do **not** leave it like that all winter, please!

Remember, the catch tray and an insulated cover board, with no top ventilation, should be in place throughout the treatment period. This is to keep the hive warm and encourage bee activity. It will also help maintain a high concentration of thymol vapour. It is also recommended to fit an entrance block to the hive to discourage robbing that can be exacerbated by thymol masking the hive scent.

Note that the presence of `Apiguard` in a hive seems to inhibit the taking of sugar syrup from feeders at the top of the hive. The best strategy is to keep Varroa treatment and feeding as separate operations – which is given priority depends on the state of the colonies (Varroa V's the store cupboard).

When the treatment is carried out correctly, `Apiguard` should kill a minimum of 90-95% of the mites in the colony. Those I checked in 2004 (using a subsequent 6 week treatment with Apistan) showed a 98% or better kill with `Apiguard` alone. This is significantly less than the 99%+ usually achieved with pyrethroid strips (providing you have not got resistant mites, of course) because **it is the number of mites left that really matters.** 98% as opposed to 99% sounds of little consequence but means double the number of mites from which the population re-builds. Hence the necessity to carry out a follow-up treatment with oxalic acid.

Spring Treatment with `Apiguard` (if required)

It is a wise precaution to check the number of mites present in a hive in spring. The number should be low enough to permit the colony to get through the honey season (until August) without building-up a critical number of mites. Providing the treatment last autumn (`Apiguard`) and winter (oxalic acid) were correctly done, the only reason for there being too many mites is spring recruitment from external sources. I have not yet had to spring treat any hive, although there was one case where I probably should have done.

Checking the early drone brood (late March or early April) is probably the best way of assessing the situation. If more than 10% of drone cells contain mites then this should make you suspicious. The interpretation of 10% infestation depends how much drone brood is present; if it is just a few cells and you have opened most, then 10% does not necessarily mean a problem. However, if there is a lot of drone brood and 10% are infested, then this probably requires some attention.

If there is any cause for concern, a further 5-7 day check on natural mortality with a catch tray may help (but bearing in mind the reservations expressed above). Another problem is what conversion factor to use in the spring? The summer factor is 30 and the winter 400, so I suggest you use 100 in March and 50 in April - but that is just a guess.

Spring treatment with `Apiguard` should be completed before the supers go on the hive. If you decide treatment is necessary, then one tray over a fortnight should be sufficient, unless you get a large fall of mites, when it would be advisable to use a second tray (to kill further mites as they emerge from the brood).

Treatment with Oxalic Acid

Oxalic acid is a short-lived miticide that only kills mites that are living on the bees (ie. those in a phoretic state) at the time of treatment. It does not kill mites that are in the brood. When there is brood present in a hive, only about 15% of the mite population are normally on the bees (ie. the rest, 85% are in the brood). It follows, therefore, that oxalic acid works best on colonies that are broodless (or near broodless) at the time of treatment. This is the ONLY CONDITION in which one-off treatment with oxalic acid will produce a really good result. It can of course be used on swarms (both natural and artificial) because they will be broodless. It can also be used on colonies in process of re-queening; during the window after all the brood produced by the old queen has hatched out and before the new queen has got brood beyond 7 days old.

Treatment should be delayed until colonies are in a broodless or near-broodless state. In our area, this does not usually occur until mid-December or even January – or not at all in recent years. After the `Apiguard` treatment (in August-September), I always remove the catch tray the reinstate the open-mesh condition. In the early years I used to remove the insulation from the cover board and give generous top ventilation during the autumn. The idea behind this was to promote

a broodless state. Surprisingly, this seemed to have very little effect on the timing of the brood-free period! Our bees seem to be programmed to produce brood despite adverse conditions, so I now follow the lead given by the bees and help them raise brood when they want to by leaving top insulation in place throughout the winter.

The treatment material is 3.2% (w/v) oxalic acid in a 1:1 sugar solution. The recipe for making this is as follows: make up a sugar syrup consisting of 1kg sugar in 1L of water. To this should be added 75g of oxalic acid dihydrate and well mixed. Do NOT boil or heat unnecessarily as this produces high levels of HMF in the treatment solution – equivalent to pre-mature aging. Oxalic acid crystals freely dissolve in syrup at blood temperature. This recipe will make 1.67L of treatment material. Accurate weighing of the oxalic acid is essential because under-strength will give a poor mite kill and over-strength may kill bees! **This sweet solution is poisonous and should be stored securely out of the reach of children – even though the taste is horrible!**

Procedure for treatment with Oxalic Acid by the Trickle Method

- 1) Fill the 50ml syringe with treatment solution (oxalic acid).
- 2) Remove the roof.
- 3) Remove the top box (shallow or deep) with cover board still in place and rest in on the upturned roof.
- 4) Treat the lower box with about 5ml solution/occupied seam of bees.
- 5) Replace upper box.
- 6) Remove cover board and treat any seams of bees as for the lower box (the upper box will often have no bees, especially if the weather is cold)
- 7) Replace the cover board and roof.

This procedure usually takes less than a minute/hive. When delivering the solution, bear in mind the shape of a winter bee cluster. The cluster will be the shape of a ball, with fewer bees (shallower seams) at the sides and front and back, so adjust the flow of the syringe accordingly. It is safe to carry out the treatment in cold conditions with the temperature down to 0°C. If the weather is cold and the bees are well clustered, they will usually not even have got moving until the deed is accomplished. Personally, I prefer to do the treatment under slightly warmer conditions, when the cluster has opened out a bit, but I have no evidence that this gives a better result. However, it definitely does pay to ensure you have the correct bee space between boxes so that they come apart readily without disturbing the bees – it is surprising how many hives do not meet this very basic specification!.

After treatment with oxalic acid, mites may continue to fall for about a fortnight (especially if the weather is cold), after which the catch tray can be removed. With a kill efficiency of 90-95%, the oxalic acid treatment will not only mop-up mites that escaped the `Apiguard` treatment 3-4 months previously, but it will also kill any mites have been bred from the survivors left in the hive or have been recruited from external sources.

The jury is still out on the use of multiple applications of oxalic acid. Some say it is safe and others that it is damaging to the colony. **Until more is known, a safe strategy is not to treat the same bees twice – meaning the workers.** In other words, do not do multiple treatments in winter when the workers live (and need to live) a long time. However, there is greater latitude in summer when there is rapid turnover in worker bees – but there is usually brood present and the treatment is much less effective.

Further reading – Control of Varroa – A Guide for New Zealand Beekeepers, by Mark Goodwin and Cliff Van Eaton (now out of print but can be down-loaded from their Web-site)