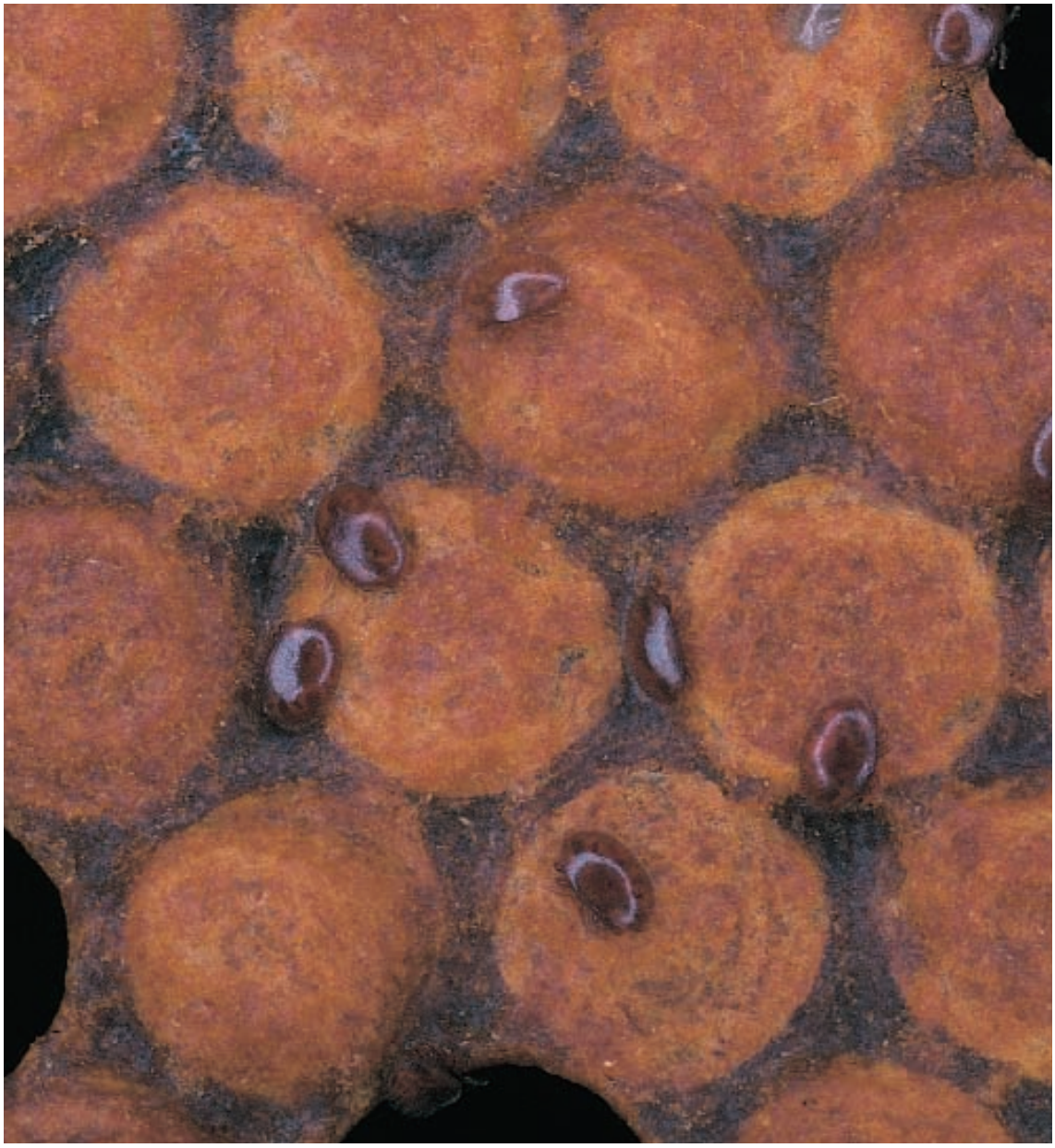
Managing varroa



About this leaflet

This leaflet describes how you can recognise, monitor and control the serious parasitic mite of honeybees commonly referred to as varroa. But, there is no single quick-fix and many approaches depend on the vagaries of the season, your method of beekeeping and factors such as the size of your colonies and the timing of honey flows. You will have to use trial and error until you are successful.

The important thing to remember is that with experience you will control varroa successfully provided you follow the basic rules that are outlined in these pages.

Your responsibilities as a beekeeper

Fig 1 Successful beekeeping now depends on effective varroa management.

Legal requirements

There is a Statutory Infested Area (SIA), administered jointly by MAFF and the National Assembly of Wales Agriculture Department (NAWAD), that includes all of England and Wales.

Beekeepers intending to ship bees or used hive parts to other areas of the UK from this SIA must contact MAFF Horticulture Division (England) or NAWAD (Wales) for permission (see addresses at the end of this leaflet).

There is a separate SIA in Scotland. Details of current restrictions should be obtained from the Scottish Executive Rural Affairs Department (SERAD).

Imports of bees into Northern Ireland are prohibited.

Varroosis is a notifiable disease under the Bee Diseases Control Order 1982. All **new** suspected cases in England and Wales must be reported to the Central Science Laboratory National Bee Unit (NBU). Samples should be sent for confirmation, together with the beekeeper's name and address, apiary name and location (Ordinance Survey grid reference).

Some important facts

- Varroa cannot be eradicated and will spread to every apiary in the UK, as it has done elsewhere. But you can control the mite to harmless levels by prompt treatment.
- Monitor your colonies for varroa, even if you think it is not there. Treat them when mites are found. Doing nothing is not an option.
- If you do not treat you will lose colonies and these will be a serious source of infestation for your neighbours.
- In the future, your success will depend upon routinely monitoring for mites and applying timely control.

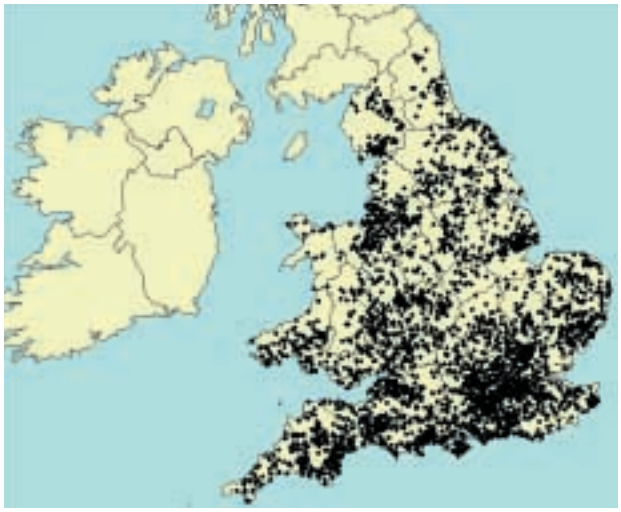


Fig 2 Confirmed varroa cases in England and Wales (1999).

Fig 3 A beekeeper preparing to move colonies – check that your planned move is allowed before you go to the trouble.

Cover photograph: varroa mites on comb of sealed worker brood

Varroa biology

Latin name	*Varroa destructor (formerly known as Varroa jacobsoni)*
Host	*Apis cerana* (Asian honeybee & natural host); recent exotic pest to Western honeybee, *Apis mellifera*
The problem	Unlike *Apis cerana* our honeybee has no natural defences, and infested colonies are eventually killed by the mite.
Technical name of infestation	Varroosis
First found in UK	1992 (Devon)
Present world wide status	Present on all continents except Australia
Present UK status	Endemic in England and Wales; present in south and central Scotland; absent in Northern Ireland (but present in neighbouring Eire)

Fig 4 Female varroa mite.

Lifecycle

Varroa is an external parasite that lives exclusively on honeybees, feeding on their haemolymph (blood). To breed, the adult female mite enters a brood cell just before the cell is capped over, where she remains in the brood food until the cell is sealed. She then feeds on the immature bee and begins to lay eggs.

Mating between mite offspring (brother and sister) occurs within the cell. Mature female mites leave the cell when the host bee emerges. Males and any remaining immature females die, unable to survive outside the sealed cell. With heavy infestation, two or more female mites may enter the same cell to breed.

Mites prefer to breed in drone brood, but are also well suited to infest worker cells of the European honeybee. In winter, when brood rearing is restricted, mites over-winter solely on the bodies of the adult bees within the winter cluster, until brood rearing commences the following spring.

Life-span

During the summer, female varroa mites may live for 2–3 months. During the winter, or broodless periods, they can live much longer, feeding on adult bees. Mites cannot survive more than a few days without bees to feed on (e.g. on combs or equipment).

How varroa spreads

Varroa mites depend upon adult bees for transport, through the natural processes of swarming, robbing and drifting (see *'Mite invasion'*).

However, it is the beekeeper moving bees over long distances, often unaware of the mites' presence, which is the principal means of spread.

Fig 5 Adult female and immature varroa mites on worker pupa.

The signs of varroa

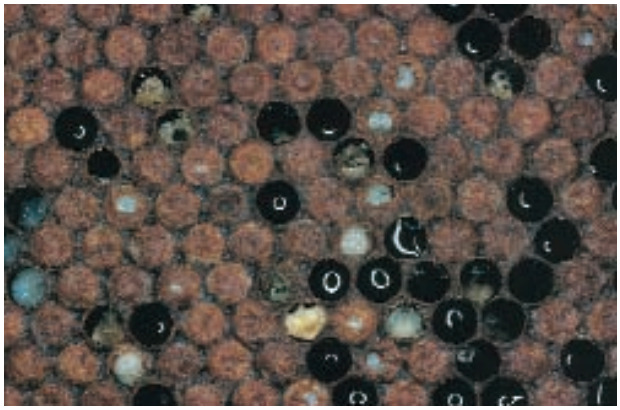


Fig 6 Damaged brood – a sign of severe infestation.

When mite numbers are low, there is no obvious effect on the colony, and infestation is often unnoticeable. But heavily infested colonies may show severe reductions in brood rearing and foraging. Mite populations will increase in poorly managed apiaries until they reach levels that the colonies can no longer tolerate. Colonies then seem to lose social organisation and disband (referred to as ***colony collapse***). The size of the mite population that causes collapse varies greatly between colonies (the reason for this is not fully understood) but may be as low as 2,500 mites.

Effects on individual bees

Heavily infested bees can be physically or physiologically damaged by varroosis, during their development.

Harmful effects include shorter lifespan, weight loss, wing and limb deformity and, possibly, reduced natural resistance to infections.

Fig 7 Worker bee with deformed wings and abdomen.

Effects on colonies

Heavily infested colonies may show no obvious signs of harm up until late summer, and produce good honey yields. However, a closer look will show mites on adult bees and heavily infested drone and worker brood, often with many mites per cell.

Severe infestation slows the replacement of old adult bees with healthy young bees. Colony collapse can then occur very quickly, frequently between two to four weeks. Many colonies may collapse during August and September while others may succumb during Winter.

The signs of colony collapse

- A sudden decrease in the adult bee population.
- Bees with deformed wings and abdomens.
- Numerous varroa mites on remaining bees and in brood cells.
- Various abnormalities of the brood (e.g. bald brood, poor brood pattern, patches of neglected and dead brood – discoloured brown and partly removed by the bees). ***Caution: make sure that these signs are not caused by foul brood infection. (See CSL/MAFF leaflet 'Foul brood disease of honeybees: recognition and control' PB3053.)***

Viruses

In heavily infested colonies some otherwise harmless bee viruses are thought to multiply to harmful levels. Current thinking is that some damage from varroosis result from such infections. In the UK, the secondary viral infections Slow Paralysis Virus (SPV) and Deformed Wing Virus (DWV) are believed to become more prevalent in heavily infested colonies.

There is no specific treatment for bee viruses, but they are unlikely to cause a serious problem if the beekeeper applies varroa treatments effectively.

Mite invasion

The movement of mites in large numbers from heavily infested or collapsing colonies into others nearby, spread by bees plays a key role in rapid mite build-up. It can occur at any time of the year when bees are active.

Colonies rob collapsing colonies in the apiary, or in nearby apiaries. Bees from collapsing colonies abscond from their hive with the robbing bees causing the mite population to increase very rapidly in the robbing colonies.

In areas of high colony density with heavily infested colonies, the rate of mite invasion can be extremely high, and populations may build up to damaging levels within a season.

How to detect and monitor varroa

Varroa is often missed by beekeepers until infestation is severe, by which time it may be too late to save the colony. You must check regularly for mites and never assume that your colonies are varroa-free.

Recognising varroa

Fig 8 Varroa mites on adult bee.

Female varroa mites are easily recognised by their flat, reddish-brown oval bodies (1.6 x 1.1mm).

Fig 9 The bee-louse, Braula coeca.

The bee-louse, *Braula coeca* (a wingless fly that lives harmlessly on adult bees) may be confused with varroa. It can be distinguished from varroa by its more rounded shape and its six legs which are readily visible on both sides of its body.

Monitoring varroa

When you find varroa for the first time, you must regularly estimate the level of infestation throughout each season. Infestation will build up more quickly in some years than in others and more quickly in some apiaries than others.

A control programme that was effective one year will not always be effective in another. Monitoring your colonies routinely can tell you how mite infestation is developing. You can then use this information to decide what control methods will be appropriate and when. The NBU has developed a method that allows you to predict when treatments are needed (see CSL/MAFF leaflet '*Varroa jacobsoni:* monitoring and forecasting mite populations within honey bee colonies in Britain' PB3611 or 'The CSL Varroa Calculator').

We advise you to monitor at least a representative proportion of colonies in an apiary, since the level of infestation may vary a lot. Monitoring only one colony may give results that are unrepresentative.

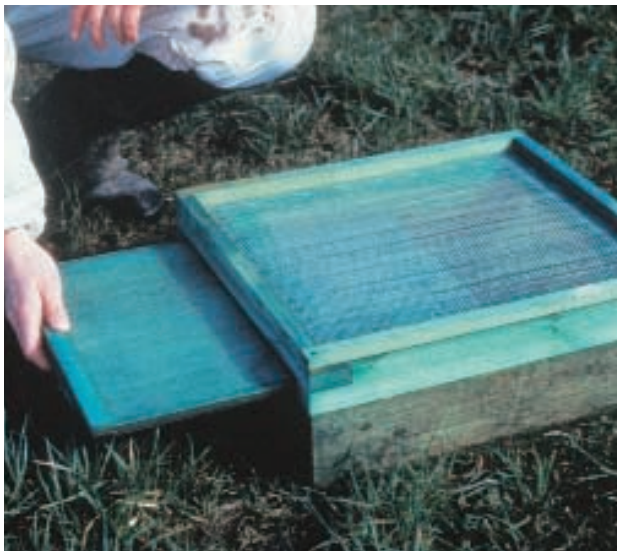


Fig 10 A typical varroa floor with 3mm metal mesh and a mite catching drawer underneath.

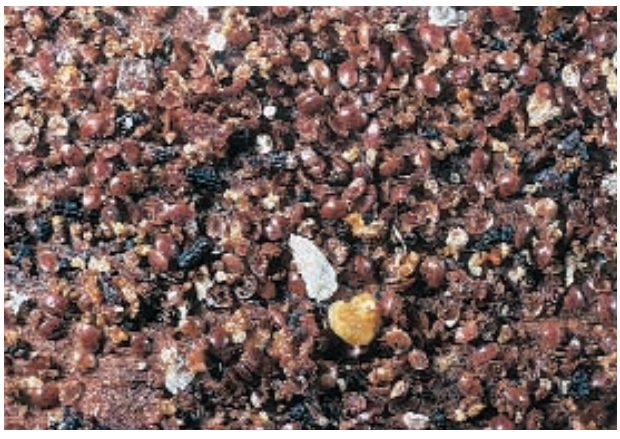


Fig 11 Hive floor debris containing mites.

Proprietary varroa-strip treatment (e.g. Bayvarol, Apistan)	Pros and cons
● Use a purpose-made mesh varroa-floor, or a sticky card or plastic insert to cover the existing hive floor, with a 3mm mesh to stop bees removing dead mites. ● Apply the varroa treatment following the label instructions. ● Look for dead or dying mites on the floor after 24 hours. If mites are found, continue with a full treatment. ● Proprietary strips are extremely effective. The number of mites present on hive floors after full treatment will give you an idea as to whether the infestation level in your apiary warrants a more frequent treatment regime.	✔ very sensitive, capable of detecting very few mites ✔ gives a rough idea of infestation level at same time as treatment ✘ dependent on varroacide use

Drone brood uncapping	Pros and cons
● Select an area of sealed drone brood at an advanced stage (pink-eyed) as this is least likely to disintegrate when removed. ● Slide the prongs of a honey uncapping-fork under the domed cappings, parallel to the comb surface, and lift out the drone pupae in a single scooping motion. (Fig 17) ● Varroa mites are easily seen against the pale drone bodies. Repeat until at least 100 cells have been examined. ● Estimate the proportion of pupae that have varroa mites on them. Roughly, a 5% drone brood infestation is light; 25% and above are severely infested (see CSL/MAFF leaflet '*Varroa jacobsoni:* monitoring and forecasting mite populations within honey bee colonies in Britain' PB3611).	✔ quick and easy to use ✔ can be used during routine colony inspections ✔ gives instant indication of infestation level ✘ unlikely to detect a very light infestation

Natural mite mortality ('mite drop')	Pros and cons
● Maintain the colony on a mesh varroa-floor with a collecting drawer underneath. Remember to remove floor debris regularly during the summer to prevent severe wax moth infestation. ● At intervals examine the floor debris and count the number of varroa mites. Convert this to a daily 'mite drop' figure by dividing by the number of days since the last measurement. ● If there is a lot of debris (e.g., after winter) mites will be very difficult to find. Mix the debris with methylated spirit in a large container. Most dead mites will float to the surface whereas wax and propolis particles will sink. ● The natural mite drop in a colony is closely related to the size of the varroa population. Colony collapse is very likely before the end of the season if average daily mite drop for a normal colony exceeds the following: Winter/Spring =0.5 mites; May=6 mites, June=10 mites, July=16 mites, Aug=33 mites, Sep=20 mites (see CSL/MAFF leaflet PB3611).	✔ capable of detecting very few mites ✔ can give a good idea of infestation level ✔ colony is not disturbed ✘ needs additional equipment ✘ monitoring takes several days ✘ encourages wax moths if debris accumulates

How to control varroosis

Fig 12 Comb trapping – an effective biotechnical control method.

Types of treatment

'Biotechnical' – The use of husbandry methods to reduce the mite population. Takes advantage of traits in mite lifecycle.

'Varroacides' – The use of chemicals to kill mites. Applied in feed, topically on adult bees, as fumigants, contact strips or by evaporation

The aim of varroa control

The fundamental aim of controlling varroa is to keep the mite population at all times below the level that can cause harm to the colony. It's not necessary to kill all the mites in the colony for effective control. However, the more mites that are left behind, the quicker they will build up again to harmful levels.

Biotechnical methods

Popular with small-scale beekeepers who want to minimise the use of varroacides. The most successful methods work by trapping mites in brood combs which, once sealed, are removed from the colony before the young bees and mites emerge. Some trapping methods can be quite effective, slowing mite population build-up and reducing the frequency that varroacides need to be used.

You must be an experienced beekeeper to be successful with some methods (e.g. 'comb-trapping') where good timing and colony management skills are critical. In heavily infested areas biotechnical methods alone will not be sufficient and a varroacide treatment programme will need to be used as well.

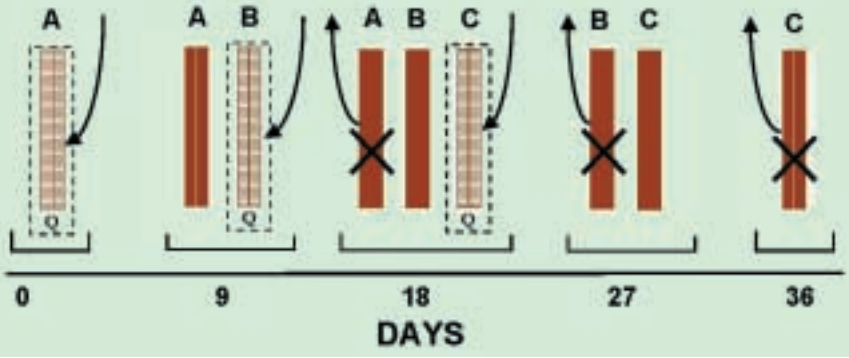


Fig 13 Comb trapping timetable. The queen ('Q') is caged for 9 days on three combs ('A', 'B' and 'C') in succession. These each remain in the colony for a further 9 days while varroa mites enter the brood cells to breed. The combs containing mites 'trapped' in sealed brood are then removed. See 'Comb Trapping' (page 8) for details.

Advantages and disadvantages of biotechnical methods and varroacides

	Advantages	Disadvantages
Biotechnical methods:	✔ Do not require the use of chemicals ✔ Can be combined with summer management ✔ Usually inexpensive	✘ Not sufficient if used alone ✘ Time-consuming ✘ Need a high level of beekeeping skill ✘ Misuse can harm colonies ✘ Only effective if infestation is moderate
Authorised varroacides:	✔ Proven efficacy and safety ✔ Convenient to use ✔ Can often be used alone	✘ Mites may develop resistance ✘ Residue problems if misused
Unauthorised 'alternative' varroacides:	✔ Can sometimes be very effective ✔ Relatively cheap ✔ Natural products (usually)	✘ Residue problems if misused ✘ Mites may develop resistance ✘ Harmful to beekeeper and bees if misused ✘ Efficacy can be variable

Method	How to use	Main features
Drone brood removal	• Place two or three shallow combs in the brood chamber in Spring, and allow the bees to build natural drone comb beneath them. Another option is to use an empty deep frame fitted with a starter strip of foundation to avoid possible misshapen comb. • When a drone comb is full of sealed drone brood (infested with varroa), cut it from the frame **before it emerges** and destroy it. The frame can be re-used immediately. • Repeat the process several times in the season for maximum effectiveness.	✔ easy to use ✔ no special apparatus required ✔ no varroacide used ✔ well tolerated by colony ✘ time-consuming ✘ useful, but limited efficacy
Comb trapping	• Confine the queen to a worker comb 'A' using a purpose-made comb-cage (available commercially). • After 9 days confine her to a new, empty comb 'B' and leave comb 'A' in the brood chamber to become infested with mites. • After a further 9 days remove comb 'A' (now sealed). Confine the queen to a new comb 'C', leaving comb 'B' in the brood chamber. • After 9 more days remove comb 'B'. Release (or replace) the queen, leaving comb 'C' in the brood chamber. • After 9 more days, remove comb 'C'.	✔ can be very effective ✔ no varroacide used ✔ more bees recruited to foraging ✘ time-consuming ✘ requires good beekeeping skill ✘ can harm/weaken the colony if used without regard to time of season (e.g. late summer)
Artificial swarm	• Move parent colony to one side of the original site, at least 4 metres away. • Place a second hive containing newly drawn combs and the queen (alone) on the original site to house the artificial swarm. Foragers will return to this hive creating the artificial swarm. • After 9 days remove all but one queen cell from the parent colony. The cell can be protected in a queen cage which prevents the virgin queen from leaving the hive to mate, but allows worker bees access to care for her. • After 3 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 later be removed and the two colonies reunited.	✔ combines swarm control with varroa control ✔ removes a high proportion of varroa mites present ✔ new queen introduced ✘ only suitable for use in the swarming season ✘ it may be necessary to take precautions to prevent absconding in the artificial swarm – such as placing a queen excluder below the brood chamber for a few days
Open mesh floors	• Fit a mesh varroa-monitoring floor (without a collection tray) to the hive. • A lot of mites falling from the colony are usually alive. The mesh floor allows these to drop out of the hive rather than returning to the colony. • Used in conjunction with other control methods this method helps keep mite numbers down.	✔ open mesh floors removes some live varroa ✔ no debris on floor to encourage wax moths ✔ improves hive ventilation ✘ can use collection tray to measure mite drop when required ✘ not sufficient if used alone

Using varroacides

'Hard' versus 'soft' varroacides

Some beekeepers like to distinguish between varroacides by calling them '*hard*' varroacides (synthesised proprietary chemicals) or '*soft*' varroacides (chemicals that may be synthesised but which are also found in nature, e.g., formic acid, essential oils). This is misleading. Many so-called 'soft' chemicals are quite harmful in concentration. A better distinction is between *authorised varroacides* (veterinary medicinal products fully tested for efficacy and safety) and *unauthorised alternative varroacides* (use of natural, generic substances in non-approved applications – see 'Non-medicinal curative substances').

Authorised varroacides

Veterinary medicines supplied in the UK to treat varroosis must be authorised under the *Marketing Authorisations for Veterinary Medicinal Products Regulations 1994*. Authorisation requires a thorough scientific assessment of data to show that the product meets statutory levels of safety (to bees, the consumer and the environment), quality and efficacy.

An important point you should bear in mind is that European veterinary licensing regulations do not allow a veterinary medicinal product authorised in one member state to be automatically authorised in another. Administration, or importation for the purpose of administration, of a veterinary medicine that is not authorised in the UK is an offence under the *Restrictions on the Administration of Veterinary Medicinal Products Regulations 1994*, as amended.

The table on page 10 refers to some commonly used products in the European Union. It is included for information and to show the differences in authorisation between member states.

A note of caution

The active ingredients of many proprietary varroacides were originally developed to control pests of crops or livestock. When marketed as varroacides, they are specifically formulated for safe and effective use with bees. Home-made concoctions made with the active ingredients of these (often available as agrochemicals) should never be used. This can be harmful to the bees, the consumer and the beekeeper. Misuse in this way has been linked directly to the current mite resistance problem in mainland Europe.

Non-Medicinal Curative Substances (NMCS)

The MAFF Veterinary Medicines Directorate (VMD) is aware that there is a lack of authorised veterinary products available for use in apiculture and this has meant for many years that beekeepers have used substances that they have found to have particular curative properties. The VMD appreciate that beekeepers have relied on these non-medicinal curative substances to allow them to carry out a 'duty of care' to their bees and to fulfil welfare needs. Residues regulations would prohibit the administration of these 'non-medicinal curative substances' only where, if transmitted to honey, they would be likely to be harmful to human health. If the product is not harmful, it can be administered.

Several generic chemicals are applied by some beekeepers for the well-being of colonies, e.g., formic acid. In most cases, no formal testing of efficacy or safety has taken place, and therefore there is a danger that they might be ineffective, harmful to bees or the user, or leave harmful residues in bee products. It is not legal to provide these to others for use as a treatment for varroosis.

No mention of alternative, unauthorised, products in this leaflet should be taken as an endorsement of efficacy, safety, or a recommendation to treat. They are referred to because they are commonly used.

Fig 14 Proprietary varroacide strip in use.

Name	Authorised (See Note 3)	Active ingredient (a.i.)	How applied	How spread within the bee colony	When normally applied	Significant features
Bayvarol® (Bayer)	UK,I,A,D,ROI	Flumethrin (synthetic pyrethroid)	Plastic strips hung between brood combs	Contact	Autumn or early Spring for 6 weeks	Highly effective >95%; can be used during honey flow; too similar to Apistan to use with it as alternating treatment.
Apistan® (Vita Europe)	UK,A,B,Fi,F,I, P,S,E,D,F,G,N,	Tau-fluvalinate (synthetic pyrethroid)	Plastic strips hung between brood combs	Contact	Autumn or early Spring for 6–8 weeks	Highly effective >95%; can be used during honey flow; too similar to Bayvarol to use with it as alternating treatment.
Apiguard® (Vita Europe)	**Not UK**	Thymol	Slow release gel matrix (25% a.i.); two 50g pack treatments with 10–15 day interval	Evaporation, contact, ingestion	Spring or late Summer, after honey harvest	90–95% efficacy with optimum conditions; dependent on temperature and bee activity.
Apilife VAR® (LAIF)	Italy **Not UK**	Thymol, eucalyptol, menthol, camphor	Vermiculite carrier matrix	Evaporation	Autumn for 8 weeks	Temperature dependent; high efficacy up to 70–90% but some variability; Easy to apply.
Apivar® (Biové)	P,E,I,B,F **Not UK**	Amitraz	Plastic strips hung between brood combs	Contact/ systemic	Autumn or Spring/ early Summer for 6 weeks	Highly effective; can be used during honey flow.
Apitol® (Vita Europe)	I,N,G,D,E **Not UK**	Cymiazole	Solution trickled over bees or fed in winter syrup	Contract/ systemic	Late Autumn/ Winter and broodless periods	Ideally needs broodless conditions.
Perizin® (Bayer)	I,D,E,G **Not UK**	Coumaphos (organophosphate)	Solution trickled over bees	Contact/ systemic	Late Autumn/ Winter and broodless periods	Ideally needs broodless conditions.
Formic acid (generic)	**Not UK** (See Note 2)	60 or 80% Formic acid solution	Evaporator kits (commercially available)	Evaporation	Late Summer/ Autumn	Kills mites in sealed brood cells; temperature dependent; efficacy up to 80 to 90% (2 treatments) but high variability; brood and queen loss if misused; highly corrosive.
Lactic acid (generic)	**Not UK** (See Note 2)	Lactic acid solution	Acid solution sprayed over combs of bees.	Contact	Winter and broodless periods	Ideally needs broodless conditions; causes skin burns; respiratory irritant.
Oxalic acid (generic)	**Not UK** (See Note 2)	Oxalic acid solution	3.2–4.2% acid solution in 60% sucrose trickled over combs of bees; 2.5ml per brood comb	Contact (not ingestion, despite sugar presence)	Winter and broodless periods	Ideally needs broodless conditions; 90% average efficacy possible; sugarless solutions have poor efficacy; danger of significant colony weakening; more scientific trials needed; highly toxic by inhalation, ingestion or skin absorption.
Essential oils (generic)	**Not UK** (See Note 2)	Terpenes	Various delivery systems; Frakno frame for thymol (commercially available)	Evaporation or sublimation	Usually Spring or late Summer 6–8 weeks	Temperature dependent; not reliable as sole treatment; honey can be tainted by treatments; can be >90% efficacy. Irritant to skin, eyes and respiratory system.

Note 1 – I=Italy; D=Germany; G=Greece; N=Netherlands; B=Belgium; ROI=Eire; P=Portugal; A=Austria; F=France; Fi=Finland; E=Spain; S=Sweden
Note 2 – Not authorised in any EU member state, but tolerated in some, e.g., Italy, Greece, Belgium, Austria.
Note 3 – A few products still authorised as pesticides in some countries and not yet as veterinary medicines
Note 4 – Contact the MAFF Veterinary Medicines Directorate for up-to-date information on which varroacides are authorised for use in the UK. See addresses at rear of leaflet.

Applying treatments

Timing your treatments

You should follow the label recommendations of your proprietary treatment. Autumn is a common time for treatment because colony size will be reducing while infestation will be approaching its maximum.

In severely infested colonies treatment must be applied early enough to protect the last few brood cycles that produce the young bees needed for successful overwintering. This could be as early as July in some areas. The timing of late Summer/Autumn treatment will depend upon what treatment you choose. For example, those depending on evaporation require warm conditions to be effective, while those requiring broodless conditions may have to be applied very late in the year.

In heavily infested areas an additional early Spring treatment might be justified particularly if the weather is mild enough to encourage mite re-invasion.

Some proprietary treatments (e.g., Apistan and Bayvarol) can be used quite safely during a honey flow if necessary (although not during comb honey production). This is useful if your local flora does not allow a sufficient honey-free gap for treatment, or if infestation is serious.

Reducing Mite Invasion

However effective your varroacide, inevitably more mites will enter the treated colony from infested colonies nearby. This can be minimised by the following guidelines:

- Always treat all the colonies in an apiary at the same time.
- Overlap treatment time with other local beekeepers. Your local association will help you organise this. But do not wait for other beekeepers to start treating if your bees need emergency treatment.
- Avoid loosing swarms. They may become feral colonies near your apiary and a good breeding ground for mites. Where possible find and remove them.

Chemical residues in bee-products

Residues of treatments in products will be negligible and harmless if you use the following simple rules:

- **Always** follow the label directions supplied with all licensed products.
- **Never** treat immediately before or during a honey-flow, or while supers are on the hive unless this is specifically permitted by the label directions of a licensed product.
- **Only use** varroacides when absolutely necessary. Monitor colonies to help you reach that decision.
- **Use** authorised products with proven track record in preference to alternatives that may lack reliable residue data.

There is a routine veterinary medicine residue testing scheme in the UK that may require samples of your honey to analyse for harmful varroacide residues.

Fig 15 Analyst testing samples of honey for varroacide residues.

The approach of last resort

If you do not have the time or skill to regularly monitor varroa in your apiaries then you must at least find out how other local beekeepers are faring. If they are losing many colonies then the chances are that varroa populations are high and that a lot of people are not treating properly.

Until you have more experience, and as a method of last resort, we would advise you to use a good authorised proprietary treatment (with a reliable efficacy of more than 95%) prophylactically twice a year; once in early Spring and again in late Summer. Reduce this to one Autumn treatment when local losses have reduced.

Safeguard your treatments

Resistant Mites?

Varroa populations will eventually develop resistance to any chemical varroacide, whether proprietary or alternative. Individual variation in a mite population may result in small numbers of mites with resistant traits (e.g., a thicker cuticle that prevents entry of the active ingredient or a metabolism that may break down the treatment before it does the mite damage). These characteristics are genetic and heritable, but often the mites with these unusual traits are reproductively weaker and are initially present as only a tiny proportion of the entire population.

Are you selecting for resistant mites?

It is only when selection pressure is placed on the mite population that any resistant traits may begin to dominate (see Fig 16).

This can happen when a population of mites is exposed continuously to a varroacide leaving only the less susceptible mites alive to breed. Proprietary treatments are designed to be highly effective, but they avoid this selection pressure because the treatment period is relatively short and not all the mites in a colony will come into contact with the treatment in any case. This is why it is important to stick firmly to the label recommendations for treatment periods.

Delay resistance

Mites resistant to one varroacide are likely also to be resistant to other closely related substances. Varroa mites resistant to fluvalinate (Apistan) developed in Italy and have since spread into several other European countries. These mites are also resistant to other pyrethroid varroacides such as Bayvarol.

It is almost certain that varroa resistance to pyrethroids will occur sooner or later in the UK. When this happens, beekeepers will have to use other types of treatment.

You can delay the development of resistance as follows:

- Apply treatments **only when needed**.
- Always use the **full recommended dose** of a varroacide.
- Always **remove used varroacide strips** at the end of the treatment.
- **Do not attempt to re-use strips**, as these will not release a full dose of active ingredient.
- **Alternate treatments** using unrelated, authorised products wherever possible.

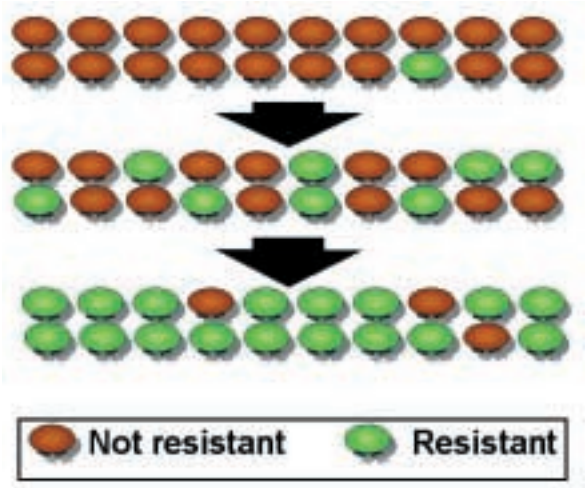


Fig 16 Development of varroacide resistance. Initially only a very few mites are varroacide resistant. However, these mites and their offspring will survive successive treatments, and so over a period of time become more abundant. Eventually they will comprise the majority of the mite population.

Test for Resistance (USDA Beltesville method)

Only tests Apistan strips and only gives **crude indication** (although resistance to Apistan may indicate cross-resistance to Bayvarol). If after testing you still think your mites are resistant **report it to the CSL National Bee Unit**.

- Cut a 9mm x 25mm piece from an Apistan strip and staple to centre of a 75mm x 125mm index card.
- Place card in 500ml jar with strip facing inwards.
- Prepare a 2–3mm light metal mesh cover for jar.
- Shake bees from 1–2 combs of a colony into an upturned roof. Scoop 1/4 cup of these (about 150) and place in jar. Ideally two samples per colony and 6 colonies per apiary.
- Place a sugar cube in jar. Cover with mesh lid and store upturned in dark, at room temperature.
- After 24 hours hit upturned jar with your palm over white paper three times. Count dislodged mites.
- Place upturned jar in a freezer, until bees are dead (1–4 hrs). Count remaining mites.
- Calculate % mite kill. Less than 50% indicates you may have resistant mites.

Caution – This method is not a substitute for thorough laboratory testing. Only test colonies with obvious mite infestation that do not seem to respond to recommended treatment. Discard results if total mites per jar = 5 or less.

Integrated pest management

What is Integrated Pest Management (IPM)?

IPM is a principle widely used in agriculture where a pest species is kept at a harmless level by controlling it using a combination of methods each working in different ways and at different times of year. This is generally a much more effective approach than waiting until pest numbers have reached a damaging level before applying controls.

Integrated control of varroa might consist of, for example, using biotechnical methods during the Summer months, followed by a varroacide treatment in early Autumn, and perhaps a second treatment with another product the following Spring.

Benefits of IPM

Such an approach has several benefits.

- Control at several points of the year makes it harder for the mite population to reach harmful levels.
- Including a biotechnical method can slow mite population growth and reduce the need for varroacides.
- Using two or more unrelated varroacides will delay the development of mite resistance.
- Control strategy can readily be adjusted to reflect changing infestation levels.

Choosing an integrated control programme

There is no single ideal integrated programme. There are just too many variations in infestation levels, mite invasion levels, climate, and beekeeping practices. However, as a rule, when mite levels are high, more controls will be needed than at other times.

The table below shows some of the combinations of chemical and biotechnical methods of varroa control used throughout the year by some European beekeepers. An integrated control programme might typically include some of these, but not all of them.

Some veterinary medicine legislation to be aware of

Marketing Authorisations for Veterinary Medicinal Products Regulations 1994, SI 3142.

The Medicines (Restrictions on the Administration of Veterinary Medicinal Products) Regulations 1994, SI 2987.

The Medicines (Restrictions on the Administration of Veterinary Medicinal Products) Amendment Regulations 1997, SI 2884.

Council Directives 81/851 EEC, 81/852 EEC, 87/20 EEC, 90/676 EEC, 90, 677 EEC, 92/18 EEC, 93/40 EEC, 96/23 EEC

Animals and Products (Examination for Residues and Maximum Residue Limits) Regulations 1997, SI 1729

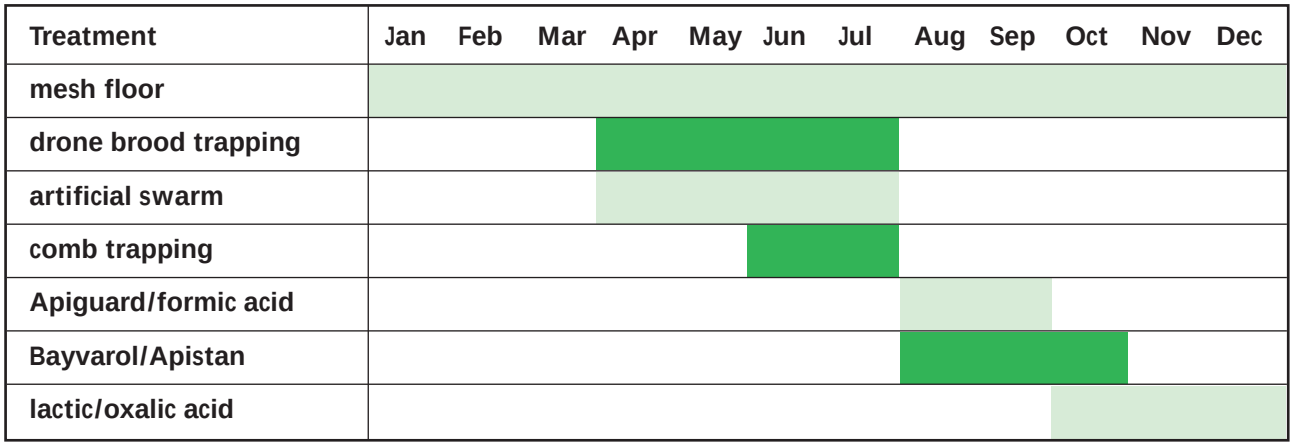
Council Regulation (EEC) 2377/90 laying down a Community procedure for the establishment of Maximum Residue Limits (MRL) of veterinary medicinal products in food stuffs of animal origin.

Council regulation (EEC) 2309/93

Council Regulation (EEC) 541/95

See addresses at end of leaflet for further details

Examples of Integrated Control Methods



Living with Varroa

Experience in the UK

The experience of many beekeepers in the UK over the past few years has been that for the first 2–3 years after varroa arrived, the level of infestation built up slowly, and varroa was easy to control with a single Autumn treatment, often applied quite late in the season.

However after a few seasons, varroa suddenly became much harder to control and mite levels began to increase unexpectedly quickly, particularly where untreated colonies in the locality were causing serious mite invasion problems.

Beekeepers then found that it was vital to treat quickly after the end of the honey flow, and in some cases again in the spring, to prevent damage to colonies occurring. Many who treated too late, or who treated with 'alternative' treatments which were not sufficiently effective lost their bees – up to 30-50% of colonies in some areas.

After the phase of widespread losses, most beekeepers have found that varroa has become somewhat easier to control overall – probably as a result of reduced mite re-invasion following the loss of unmanaged and feral colonies.

However, the infestation has remained unpredictable and mite levels still often increase unexpectedly quickly, requiring a swift and effective response.

A new generation of successful beekeepers are now appearing, for whom the techniques of varroa monitoring and control are simply part of their routine bee husbandry.

Fig 17 Drone brood uncapping – a popular method of routine varroa monitoring.

Key strategies for effective varroa control

- Use some method of monitoring varroa – whether simple or complex. You need to know if the mite population is building up faster than you thought, or if your treatments are not proving effective. Don't just treat and leave it to chance.
- Don't always assume that a single control method will always be sufficient. Aim to practice integrated-control of varroa using a combination of biotechnical methods and varroacides each working in different ways and at different times of the year. This will give the most effective control.
- Use UK approved varroacides. These have proven efficacy against the mites, and proven safety for bees, the beekeeper and consumer. Strictly follow the manufacturer's instructions. Misuse may risk leaving residues in the bee products and promote the development of resistant strains of mites.
- Avoid treating more often than is necessary. Unnecessary treatments waste time and money and promote mite resistance. It's much better to monitor the infestation and treat only as often as you need to. Where possible, alternate between different types of varroacide. Avoid using one type of product year after year.
- Talk to other local beekeepers about how you are controlling varroa. Aim to overlap treatment periods with them, to help reduce re-infestation problems. Your local Beekeepers' Association should be able to help organise this.
- Never leave infested colonies unmanaged, as they will be eventually be killed by varroa, and in the meanwhile they will re-infest the colonies of other local beekeepers who are trying to control the infestation. If you can't manage your bees you should consider selling or giving them to others who can.
- Remember that what worked last year may not necessarily work this year. Be prepared to be flexible and adaptable, and to change your control programme as circumstances dictate.

Further help and advice

The National Bee Unit

The National Bee Unit is part of the MAFF Central Science Laboratory, a research agency. Established in 1946, it has a long history in practical beekeeping and bee health, providing research, diagnostic, consultancy and extension services to government departments, commerce and beekeepers, in the UK and overseas. It has achieved full compliance under the international OECD Good Laboratory Practice scheme, a measure of the quality of its work.

The majority of the Unit's technical staff are trained practical beekeepers as well as scientists who, together with CSL acarologists, insect virologists, entomologists, chemists and agronomists make an excellent research and advisory centre to help beekeepers.

Fig 18 Central Science Laboratory (CSL).

Current research interests:

- European foul brood control.
- Varroa/bee virus interactions.
- Agricultural impact on bees.
- Varroacide development.

Fig 19 NBU Bee Inspectors provide training and advice on controlling varroa.

Regional support for beekeepers

The Unit's network of Regional and Seasonal Bee Inspectors provides:

- An inspection service for foul brood.
- Advice and assistance to beekeepers year round.
- Training courses in disease control and bee husbandry.

The Bee Health Advisory Panel

CSL hosts a new panel of independent beekeeping and scientific experts, including representatives from national beekeeping organisations. Its aim is to keep the official bee health programme under review, suggest improvements to it and to advise on research and training likely to be of direct help to beekeepers. Please contact the National Bee Unit for more details.

Beekeeping Associations

In many areas beekeeping associations operate local disease control schemes and provide practical advice to members on bee disease recognition and control. Contact your local beekeeping association for details.

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Useful addresses

CSL National Bee Unit (NBU)

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National Bee Unit
Sand Hutton
York
North Yorkshire
YO41 1LZ
Tel: 01904 46251
Fax: 01904 462240
Email: science@csl.gov.uk
http://www.csl.gov.uk/

Ministry of Agriculture, Fisheries and Food (MAFF)

Horticulture Division (HRP 'A')
Eastbury House
30/34 Albert Embankment
London
SE1 7TL
Tel: 020 7238 3000
http://www.maff.gov.uk/

National Assembly for Wales Agriculture Department (NAWAD)

Agricultural Policy Division
Crown Buildings
Cathays Park
Cardiff
CF1 3NQ
Tel: 02920 825111
http://www.wales.gov.uk/

Scottish Executive Rural Affairs Department, (SERAD)

Pentland House
47 Robb's Loan
Edinburgh
Scotland
EH14 1TY
Tel: 0131 2448400
http://www.scotland.gov.uk/

Scottish Agricultural Science Agency

82 Craigs Road
East Craigs
Edinburgh
Scotland
EH14 1TY
http://www.sasa.gov.uk/

European Union

(website for details of European Community legislation in force)
http://www.europa.eu.int/eur-lex/en/

Department of Agriculture, Northern Ireland

Greenmount College of Agriculture and Horticulture
Antrim
Northern Ireland
BT41 4PU
http://www.afni.gov.uk/

MAFF Veterinary Medicines Directorate (VMD)

Woodham Lane
New Haw
Surrey
KT15 3LS
Tel: 01932 336 911
http://www.open.gov.uk/vmd

Her Majesty's Stationery Office (HMSO)

(for copies of UK legislation)
Orders Department
PO Box 276
London
SW8 5DT
Tel: 0870 6005522
http://www.hmso.gov.uk

British Beekeeper's Association

(county and local beekeeping associations)
National Agricultural Centre
Stoneleigh
Warwickshire
United Kingdom
CV8 2LZ
Tel: 02476 696679
http://www.bbka.demon.co.uk/

Welsh Beekeepers Association

(county and local beekeeping associations)
General Secretary
Trem y Clawdd
Fron Isaf, y Waun
Llangollen
Wales
LL14 5AH

Scottish Beekeepers Association

(county and local beekeeping associations)
General Secretary
North Trinity House
114 Trinity Road
Edinburgh
Scotland
EH5 3JZ
Tel: 0131 5525341
http://www.users.zetnet.co.uk/scottish-beekeepers/index.htm

Bee Farmers' Association

General Secretary
Borders Honey Farm
Newcastleton
Roxburghshire
TD9 0SG
Tel: 01387 376737
http://www.beefarmers.co.uk/

Bayer PLC

(varroacide manufacturer)
Animal Health Business Group
Eastern Way
Bury St Edmunds
Suffolk
IP32 7AH
Tel: 01284 763200
http://www.bayer.co.uk/

Vita Europe Ltd

(varroacide manufacturer)
Brook House
Alencon Link
Basingstoke
Hampshire
RG21 7RD
Tel: 01256 473177
http://www.vita.demon.co.uk/

Biové

(varroacide manufacturer)
Laboratoires Biové
Rue de Lorraine
P.O.Box 45
62510 Arques
France
http://www.beekeeping.com/biove

International Bee Research Association

(library and beekeeping information services)
18 North Road
Cardiff
Wales
CF1 3DY
Tel: 02920 372409
Email: ibra@cardiff.ac.uk
http://www.cf.ac.uk/ibra/

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