# Review of policies on managing and controlling pests and diseases of honey bees

## Evidence profile on *Varroa*

This is the evidence profile on *Varroa* which was developed during the policy review. **Part 1** sets out an overview of *Varroa*, biology, current policy and impacts. **Part 2** summarises the main points from discussions on *Varroa* by the Review Group including insights on beekeeping practices and behaviours provided by Bee Inspectors and beekeeping representatives (note: Part 2 seeks to capture the main points from discussions and are not attributed).

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Information sources: Random Apiary Survey results have been provided by the National Bee Unit.

## Part 1 - Overview of *Varroa*

**Biology - impacts on productivity and/or mortality of colony, sources and means of spread, susceptibility of bees.**

References: Rosenkranz et al. (2010) Journal of Invertebrate Pathology, 103: S96-S119

1. **Background**

*Varroa destructor* was originally confined to *Apis cerana* but shifted to *A. mellifera* during the first half of the last century. The parasite is now dispersed worldwide except Australia and is considered a major threat for apiculture.

2**. Life cycle**

The life cycle of *V. destructor* is closely linked to honey bee host and lacks a free living stage. There are 2 phases in the life cycle of *Varroa* mite females;

(i) A phoretic phase on adult bees
(ii) A reproductive phase within the sealed drone and worker brood cells

The male and nymphal stages of the mite are short lived and only found within sealed brood cells. Life expectancy for the mites varies from 27 days to 5 months. During the winter *Varroa* mite females live on adult bees in the cluster.

3. **Pathology**

The mites cause damage to individual bees by sucking substantial amounts of hemolymph from both adult bees and preimaginal host stages within the sealed brood cells. This severely affects bee development and weakens the adults bees. In addition *Varroa* is a vector for several honey bee viruses. Before *Varroa* occurred the bee viruses were considered to be a minor problem for bee health. Combined infections with both *Varroa* and viruses appears to have a synergistic effect. Synergistic effects are also likely when infection with *Varroa* is combined with other pests and pathogens, environmental factors, chemicals, weather patterns and climate change. Severe infection by *Varroa* leads to Varroosis which manifests as bees with stunted abdomens or deformed wings, dead imago bees and rotting pupal remains. Ultimately uncontrolled population of *Varroa* mites in a colony leads to collapse resulting in a colony loss.

4. **Sources and means of *Varroa* spread**

The *Varroa* females are transported to brood cells for their reproduction or spread by foraging and swarming bees. Mites can also be introduced when forager bees or drones enter neighbouring colonies or by robbing. Routine beekeeping practices can also lead to spread of *Varroa*. There have been a small number of findings of *Varroa* in imported consignments from other EU member states and third countries. Details of imports from EU and third countries over the last 5 years are at Annex A. Although all consignments have to be accompanied by a health certificate demonstrating freedom from specific pests and diseases (i.e., American foulbrood, Small hive beetle and *Tropilaelaps* mites) there is no requirement regarding *Varroa*.

5. **Impacts**

*Varroa* has already had a major impact on beekeeping. It is a new parasite of *A. mellifera* and therefore a balanced host-parasite relationship has not yet developed. In addition beekeepers do not have long term experience in dealing with this pest. It has spread almost worldwide

within a short period of time. It is now difficult to find a '*Varroa*-free' honey bee colony in the UK, although remote areas of northern Scotland and some islands remain free of this pest. Without the application of suitable *Varroa* controls at the right time, most of the honey bee colonies in temperate climates would collapse within a 2-3 year period. Regular treatment has lead to a substantial increase in beekeeping costs and an increased risk of chemical residues in honey bee hive products. Repeated losses due to failed *Varroa* control is thought to be one of the main reasons why many beekeepers have given up keeping bees.

A recent assessment on the impact of invasive species estimated the annual cost of *Varro*a to UK beekeeping as over £27m (reference William F.E. *et al* 2010).

6. **Treatments**
*Varroa* control is not easy as there are many decisions a beekeeper has to make in order to minimise the impact of this pest on their bees. Many different products are available for the control of *Varroa* (see full list in the NBU's advisory booklet 'Managing *Varroa'* www.nationalbeeunit.com). These are most effective when used in combination with other control methods based on husbandry techniques (for an integrated approach to *Varroa* control). Timing of treatment is crucially important. Late application can result in failed treatment which will lead to colony loss.

One of the challenges of managing *Varroa* is that the mites have developed resistance to many of the synthetic varroacides used. Rotation of the varroacides used and avoiding using the same varroacide year after year can help overcome this problem. Breeding bees which are tolerant to *Varroa* or which have effective grooming or hygienic behaviour leading to lower levels of mite infestation is thought to be a promising method for *Varroa* control. However many attempts have been made to develop this approach and to date none of these have been successful.

EU and national legislation permits the importation of other *Varroa* treatments (and medicines) not authorised in the UK for use in bees under the Cascade which requires a decision by a veterinary surgeon.

## Geographical distribution of *Varroa* across England and Wales (E&W)

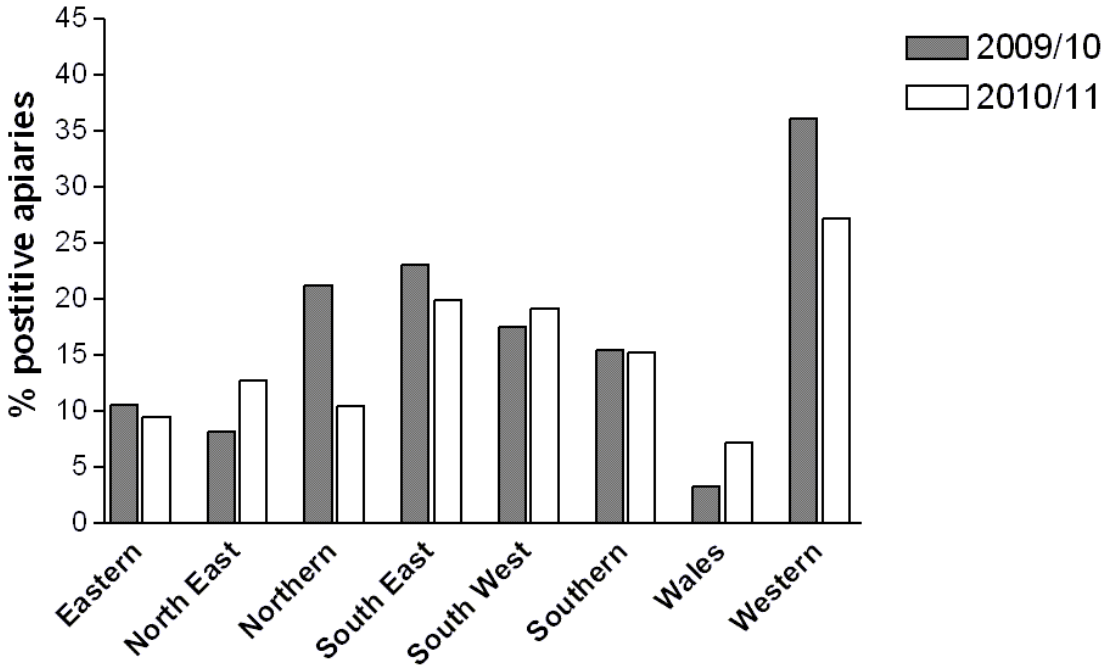
1. **History of *Varroa* introduction to the UK**
*Varroa destructor* was first reported in Western Europe in the late 1970s. Since its discovery in the south of England in 1992 this parasitic mite has spread to infest colonies of honey bees throughout the UK. Its management has now become a routine part of honey bee husbandry. By 2001, the mites had developed resistance to pyrethroid *Varroa*cides such as 'flumethrin' or 'tau-fluvalinate', which are the active ingredients of the proprietary *Varroa*cides 'Bayvarol®' and 'Apistan®'. Using these products on colonies of bees infested with such mites has little impact on the mite population. The incidence of such resistance has increased (page 26 of the NBU's 'Managing *Varroa'* booklet includes a map of pyrethroid resistant apiaries for 2009). Control of the mites is therefore becoming more difficult due to lack of effective, easy to apply alternative treatments. As a result, *Varroa* mites continue to be the most serious economic pest of honey bees across many areas of England and Wales.

2. **Results from the Random Apiary Survey (RAS)**

In 2009, Defra commissioned the National Bee Unit to undertake an assessment of the national picture of honey bee pests and diseases (with the intention of using this assessment to inform the future honey bee pest and disease control programme, including establishing agreed outcomes). The NBU undertook this assessment from 2009 to 2011 by undertaking a random survey of some 4600 apiaries (RAS) including apiaries with single and with multiple colonies.

The RAS confirmed our understanding that the *Varroa* mite was widespread in apiaries across England and Wales. NBU inspectors recorded high levels of *Varroa* at one in every six apiaries visited. The reporting of varroosis (i.e. bees with stunted abdomens or deformed wings, dead imago bees and rotting pupal remains) varied significantly between regions as shown in Figure 1 below. For example, in the first year of the survey nearly 36% of the apiaries visited in the NBU's western region had varroosis compared with low levels of 10% or less in the north eastern region and in Wales in the same year.

**Figure 1. Regional prevalence of Varroosis observed during the RAS inspections (source NBU)**



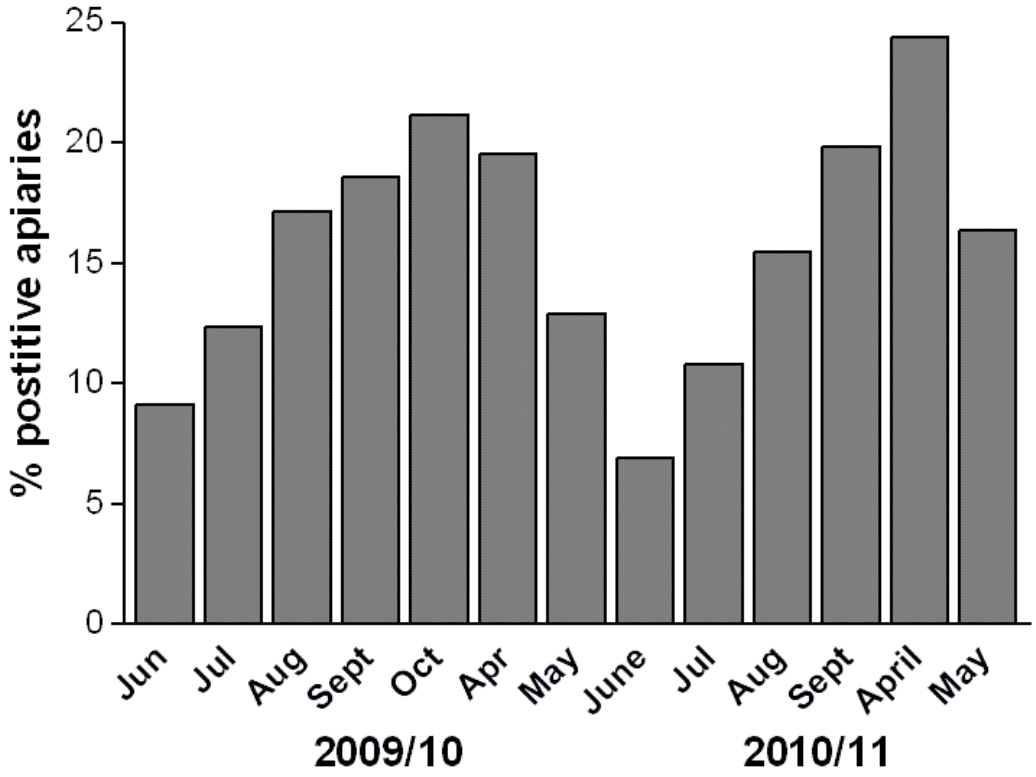

The RAS also provided additional data on viruses associated with *Varroa*. Five of the honey bee viruses are transmitted by *Varroa* - acute bee paralysis virus (ABPV), deformed wing virus (DWV), Israeli acute paralysis virus (IAPV), Kashmir bee virus (KBV) and slow paralysis virus (SPV). The RAS identified all these viruses with DWV being the most common (66% of apiaries tested positive in year 1 and 75% in year 2). ABPV was the next most common (6.5% of apiaries tested positive in year 1 and 11% in year 2). SPV, KBV and IAPV were far less prevalent with fewer than 2% of apiaries testing positive for SPV and fewer than 0.5% of apiaries testing positive for KBV and IAPV. This is an important result because IAPV and KBV have been correlated with Colony Collapse Disorder (CCD) in the United States. However no

symptoms or cases of CCD were reported in any of cover 19,000 colonies assessed as part of the RAS.

The prevalence of varroosis fluctuated seasonally, with the prevalence increasing through the beekeeping season reaching a peak in the autumn before dropping over the winter period (see Figure 2). This pattern fits with the main recommended treatment periods for *Varroa* management which are autumn and winter.

Reports of varroosis or detectable levels of DWV in an apiary (in the survey) were both clearly linked to poor apiary health reaffirming that *Varroa* and its associated viruses do have a clear impact on beekeeping success.

**Figure 2. Seasonal variation in the levels of Varroosis observed during the RAS inspections (source NBU)**




**Current policy on *Varroa***

**History .** Defra's Bee Health Programme was extended in the 1980's to include the *Varroa* mite as a notifiable pest and an annual search was carried out for this pest. In 1992, *Varroa* was first detected in England. Despite its notifiable status, the mite became widespread across most of the UK and in 2006 it was deregulated and the statutory controls ceased. Following these changes, the NBU has continued to provide training and advice under the programme but ultimately it is the beekeepers responsibility to manage the pest.

**Current policy** seeks to improve effective management of *Varroa* by all beekeepers to

minimise impacts on colonies particularly colony losses which is implemented by the NBU by guidance and advice on *Varroa* management, and training on *Varroa* management during inspection visits to apiaries and at training events organised by associations or others. For example, in 2011, the NBU carried out nearly 9,000 inspection visits to beekeepers which involved an element of 1:1 training and were involved with nearly 900 training events attended by over 26,000 beekeepers which included topics on *Varroa*.

The Healthy Bees Plan (published by Defra and Welsh Government in 2009) provided fresh impetus to existing policies to improve beekeepers' management of pests and diseases in their apiaries, including *Varroa*, particularly by improving training and education. For example, the Healthy Bees Plan has:

- funded beekeeper trainers to attend C&G 7303 Award in Preparing to Teach in the Lifelong Learning Sector (PTLLS) courses to improve their delivery of training courses;
- subsidised the NDB's short courses on specific beekeeping topics for beekeeper trainers;
- subsidised BBKA's course in a case which is aimed at improving the consistency and quality of the associations' training; and
- funded four pilot roadshows in 2010 delivered by the NBU in Wales, South West, North West and Eastern regions with the main focus was on management and control of *Varroa*.

It is difficult to assess the effectiveness and impact of the NBU's education and training on *Varroa* management but it is in high demand and appreciated by beekeepers. Feedback from the four pilot roadshows (under the Healthy Bees Plan) attended by 270 beekeepers (through end of course feedback sheets) confirmed that these events were well received and successful. Subsequently, 20 attendees selected at random were asked by Fera whether they had changed their beekeeping practices as a result of the roadshow, and whether they would attend another training workshop. Almost all reported a willingness to attend future training and around 70-75% had changed their beekeeping practices to some degree as a result of attending the roadshow, particularly regarding changes to improve *Varroa* management and hygiene practices. All reported that they would willing to pay for future events. Advertisements in the beekeeping press show that training events provided by organisations in the private sector are charging rates of £50 or more per student per day, indicating that beekeepers are willing to pay for training.

The limited treatment options available to beekeepers is recognised as a serious issue for beekeepers and , in response, the Veterinary Medicines Directorate (VMD) has developed an action plan on the availability of medicines for bees. This includes working with private vets to improve the availability of authorised treatments from other EU Member States (under the cascade) and reducing the fees to medicine manufacturers which submit bee treatments for approval.

**Costs incurred by beekeepers to manage *Varroa***

There are five registered treatments in the UK. Two of these products Bayvarol and Apistan are both pyrethroid based. As mite resistance to pyrethroids is now widespread and in many areas, these products can generally no longer be used to treat *Varroa*. Apiguard and Apilife-var retail at about £5 per application; Thymovar is around £6 per hive.
Evidence from a bee farmer (2011): The cost of medication to treat *Varroa* from 2008 to 2010 was £7101.94 to treat an average of 341 hives per year; the average cost per hive was £6.94 during that period. This does not take into account the costs of labour to apply and remove treatments, nor the cost of failed *Varroa* treatments that lead to colony losses.

## Part 2 - Main points made on *Varroa* policy by the Review Group. These points were taken into account in developing the proposed changes to *Varroa* policy.

**1. Status of *Varroa* as a serious pest**

- *Varroa* was the number one problem for honey bees and yet was no longer a notifiable pest. It needed to be actively managed. Some beekeepers simply didn't monitor or take action on *Varroa*. Colony losses due to *Varroa* had [unfortunately] become an acceptable reason for loss for some beekeepers.

- *Varroa* was more of a worry than other pests and diseases due to associated stress on the bees making them more susceptible to other pests and diseases. Managing and controlling *Varroa* was the highest priority for bee farmers and took precedence over EFB and AFB risks.

- To help improve the control of this pest, its status should be raised in the eyes of beekeepers through additional attention to this pest by local and national associations and greater ownership by government/NBU. For example, local associations should be encouraged to put *Varroa* (and disease control) training sessions/lectures high up on their meeting agendas and/or training programmes. Some associations are already doing this, for example running *Varroa* workshops.

- Aspiring and new beekeepers should be carefully informed about the challenges to beekeeping from *Varroa* and the commitment in time and effort that they will need to give if they want to control it (and manage their colonies) effectively together with the eventual outcome of not doing so, i.e., colony losses.

**2. Uptake of best practice advice by beekeepers**

- Whilst advisory materials on controlling *Varroa* are plentiful (and available from many sources – NBU leaflets, BeeBase, local associations, beekeeper authors and press), more needs to be done to improve dissemination of beekeeper-friendly advice to improve *Varroa*

management.

- There were confusing messages on the control of *Varroa* and insufficient clear guidance and/or communication activities to improve beekeepers' management of this pest.

- The difficulties of controlling this pest were recognised. Many beekeepers don't have a good grasp of the control methods including timing of treatments, regular monitoring during the season, adapting treatments to seasons/circumstances (e.g., in response to resistance and other elements of effective integrated pest management (IPM) which was also recognised as a difficult concept for beekeepers to grasp and implement. Costs of treatment was also a significant factor for some.

- Beekeepers were confused about the available treatments, their legal status and temperature requirements for organic acids.

- Whether to use 'hard' (proprietary insecticides) or 'soft'(e.g., organic acids) medicines was an issue for some beekeepers. Some thought that 'hard' medicines were worse for the colony without also recognising that colonies could be killed by inappropriate use of seemingly 'soft' medicines.

- Some (new) beekeepers [mistakenly] assume that a once per year treatment in August or December was all that they needed to do to control this pest.

- Best practice messages and advice on monitoring and treatments should be refreshed to ensure greater clarity including reviewing format for the advice and how best to disseminate (such as a coordinated *Varroa* programme by government and associations).

- In spite of many years of advice from NBU and others on managing this pest, including appealing to beekeepers' common sense, good husbandry (and pest management) was not a high priority for many beekeepers. It may be time to try a different approach to communicating with beekeepers such as appealing to conscientious beekeepers around a welfare message. The development and promulgation of a welfare code for honey bees would help raise beekeepers' awareness and understanding of how to look after their bees and reduce pest and disease risks.

**3. Training beekeepers in *Varroa* management**

- Beekeepers trainers who had not become proficient at managing *Varroa* themselves were [unfortunately] passing on poor advice to their students and on many occasions contradicting sound good practice advice given by bee inspectors and the guidance issued by manufacturers on the dosage, duration and application of treatments.

- The competence of trainers who teach *Varroa* management needed to improve so that their students master effective skills, including understanding of this pest and practical control methods.

- In the short term, the priority for all interested parties – NBU, associations, others – was to focus on raising profile of *Varroa* and on training to improve *Varroa* management including targeting areas with high levels of infestation (varroosis).

- NBU staff and its inspectors are occasionally offered fees from beekeeping associations for lectures at beekeeper training events and currently turn them down. Free NBU training possibly downgrades the importance of pest and disease skills, possibly exacerbating poor beekeeping standards.

**4. Control methods and available treatments**

- A treatment strategy is necessary for the whole season, starting with brood examination, in conjunction with year round counts of natural mite drops, and drone brood culling to check mite numbers at the start of the season to help determine how to respond. There was little point in waiting until September/October (pre-winter) to assess *Varroa* status and the management response.

- Developing and maintaining quality stock, e.g., by buying in quality queens, was an important part of a management strategy to minimise pest and disease risks and it was worth considering *Varroa* control from this angle. Or breeding programmes to produce 'fitter' stock. There was little chance of bees developing resistance to *Varroa* in the short term but this remained possible.

- Some beekeepers did not find it a problem to treat their bees for *Varroa*. Methods used included thymol-based products which avoided leaving residues, monitoring mite levels , drone brood and applying IPM to maximise the efficacy of the products.

- It was recognised that the lack of effective medicines limited beekeepers ability to control this pest. Beekeepers and bee farmers wanted a product in which they had confidence and worked, particularly where hives were to be treated in volume - 300+.

- In relation to pyrethroids, the NBU had conducted tests on resistance about 10 years ago and confirmed that the mites had developed resistance to these products. This work had not been repeated recently and it was possible that the mites may have lost this resistance thereby making the products effective again. However, the NBU had carried out limited testing on the re-introduction of pyrethroids on their colonies without successful mite control.

- Firm advice from the NBU on specific actions at certain times of the year, rather than a range of options, would be useful, although it was recognised that being too prescriptive may not always be successful.

- The choice of treatments was potentially confusing. Ranking products based on their efficacy would be helpful, but difficult given that product efficacy is influenced by so many factors including temperature, size of colony, equipment type, and accuracy of application. Although this implied a review of products (which would be subject to availability of resources).

- In the longer term, developing further evidence on IPM and sharing this with beekeepers would also help improve control of this pest (which would be subject to availability of resources). This could include determining the efficacy of pyrethroids in specific geographic regions.

## Annex A - EU imports in the last 5 years (2007 to 2011) (Source: BeeBase)

| Year | Queens | Nucs | Total Consign-ments | Physical checks | Doc checks | *Varroa* found |
|---|---|---|---|---|---|---|
| 2007 | 7741 | 0 | 97 | 6 (6%) | 4 (4%) | 0 |
| 2008 | 5609 | 300 | 99 | 22 (22%) | 15 (15%) | 0 |
| 2009 | 5606 | 12 | 80 | 20 (25%) | 40 (50%) | 3 |
| 2010 | 7291 | 100 | 125 | 19 (15%) | 75 (60%) | 6 |
| 2011 | 4163 | 405 | 86 | 16 (18%) | 37 (43%) | 0 |

### Third country imports in the last 5 years (Source: BeeBase)

| Year | Country of origin | Queens | Consignments | *Varroa* found |
|---|---|---|---|---|
| **2007** | Hawaii | 2118 | 40 | 0 |
| | New Zealand | 690 | 9 | 0 |
| | **Total** | **2808** | **49** | **0** |
| **2008** | Argentina | 150 | 1 | 0 |
| | Hawaii | 3201 | 54 | 1 |
| | New Zealand | 615 | 8 | 0 |
| | **Total** | **3966** | **63** | **1** |
| **2009** | Australia | 300 | 1 | 0 |
| | Hawaii | 4182 | 57 | 4 |
| | New Zealand | 740 | 5 | 1 |
| | **Total** | **5222** | **63** | **5** |
| **2010** | Australia | 650 | 2 | 0 |
| | Hawaii | 730 | 12 | 1 |
| | New Zealand | 1050 | 9 | 0 |
| | **Total** | **2430** | **23** | **1** |
| **2011** | Argentina | 100 | 1 | 0 |
| | Australia | 420 | 2 | 0 |
| | New Zealand | 1242 | 8 | 6 |
| | **Total** | **1762** | **11** | **6** |