

***Hylobius abietis* – recent research, and
new guidance, on alternative methods of
protection and integrated management**

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- The most serious pest of young trees on conifer restock sites.
- Kills all species of newly planted trees.
- Annual UK impacts estimated as £7m – £40m.



- Historically damage has been prevented through spraying trees with synthetic pyrethroid insecticides, permethrin, alpha cypermethrin, cypermethrin.
- Applied to stems of young trees either in horticultural tree nurseries (in industrial buildings), or 'top up' spraying of individual young trees in the forest.

- Concerns over toxicity of cypermethrin to aquatic life.
- Priority substance in Water Framework Directive.
- Voluntary certification schemes discourage its use.

- Collaborative effort across private and public sector.
- 2009 – 2015 recently reported on.
- 30 experiments, more than a 100 different treatments.
- Wide range of alternative methods of protection investigated.

Are there viable chemical and non-chemical alternatives to the use of conventional insecticides for the protection of young trees from damage by the large pine weevil *Hylobius abietis* L. in UK forestry?

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In UK forestry, the synthetic pyrethroid insecticides alpha-cypermethrin and cypermethrin have been used for many years to provide protection for young trees planted on restock sites from damage by the large pine weevil, *Hylobius abietis* L. However, concerns over the toxicity of these insecticides to aquatic life if misused have led to a search for alternative forms of protection. This paper describes a detailed programme of efficacy experiments undertaken between 2009 and 2015 to find replacements for these products. Over 50 combinations of chemical and non-chemical approaches were tested on 16 different sites. Of the alternative synthetic insecticides tested, applications of 0.037 g a.i. stem⁻¹ acetamiprid provided high levels of protection from *Hylobius* browsing damage on young Sitka spruce (*Picea sitchensis* (Bong.) Carrière) trees, without causing any phytotoxic symptoms, and gave comparable levels of protection to those achievable using alpha-cypermethrin or cypermethrin. Acetamiprid is less toxic to aquatic life than alpha-cypermethrin or cypermethrin and has not been linked to bee decline. Applications of 0.0129 g a.i. stem⁻¹ chlorantraniliprole also showed promise, and this relatively low toxicity non-neonicotinoid insecticide merits further study. Although imidacloprid and thiacloprid also provided good levels of protection, their use in forests is not now permitted due to concerns over their potential impacts on bees and drinking water, respectively. Whilst the natural product insecticide spinosad, and the entomopathogenic fungal control agent *Metarhizium anisopliae* (Metschn.) Sorokin, gave only limited protection in our work, they may have some future potential if methods of deployment can be improved. Other chemical and non-chemical approaches tested, but found to be largely ineffective in UK conditions, included the natural product insecticides azadirachtin, maltodextrin and pyrethrins, the synthetic insecticides lambda-cyhalothrin and spirotetramat and a wide range of repellents, flexible stem coatings and physical barrier products. However, we conclude that physical barrier sleeves such as MultiPro® and BioSleeve® may have a limited role as a partial substitute for the use of insecticides in the UK in some circumstances, but only if on-site populations of *Hylobius* are predicted to be low.

Introduction

The large pine weevil (*Hylobius abietis* L., hereafter referred to as ‘*Hylobius*’) is a major pest of young trees planted to restock recently clearfelled forest sites in the UK and the rest of Europe (Långström and Day, 2007; Willoughby et al., 2017). In the UK, preventing *Hylobius* damage has been estimated to cost the forest industry at least £4 million per year (Leather et al., 1999) (nearly £7 million in 2019, adjusted for inflation), but if indirect impacts such as delays to revenue received are included, total

losses are estimated to be ~£40 million per year (Moore, E. Wilson, I.H. Willoughby, T. Connolly, I. Sayyed, K. Leslie, et al., in preparation).

An even-aged high forest silvicultural system encourages high populations of *Hylobius* to develop in coniferous forests, as large volumes of fresh woody material left on site after cutting, especially the stump and root systems of harvested trees, attract the insect to breed in large numbers (Eidmann, 1985). Adults mate and lay their eggs in cut stumps, roots and other debris,

- Multiple natural product insecticides, repellents, bioinsecticides and flexible stem coatings tested, but all unfortunately largely ineffective.
- Some techniques reported as effective in Scandinavia don't work reliably here, it's thought due to larger *Hylobius* population sizes.



- Physical barriers can work in the UK, but only where *Hylobius* populations are low.
- And only as part of an integrated approach (with suitable stock type, ground prep, weeding, on sheltered sites).

Acetamiprid, chlorantraniliprole, and in some situations the physical barriers MultiPro® or Kvaæ® wax, can be alternatives to traditional synthetic pyrethroid insecticides for the protection of young conifers from damage by the large pine weevil *Hylobius abietis* L.

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ABSTRACT

In UK forestry, the synthetic pyrethroid insecticides alpha-cypermethrin and cypermethrin have been used for many years to provide protection for young trees from damage by the large pine weevil, *Hylobius abietis* L. However, concerns over the toxicity of these insecticides has led to a search for alternatives. In our work, applications of 0.037 g.a.l.stem⁻¹ acetamiprid provided high levels of protection from *Hylobius* browsing, comparable to alpha-cypermethrin or cypermethrin, and without causing phytotoxicity. However, re-application is likely to be required in the second growing season after planting. Our research identified that acetamiprid treated trees can be safely cold stored as part of normal nursery practice. Acetamiprid is less toxic than synthetic pyrethroids. We also found that pre-treating trees with 0.016 g.a.l.stem⁻¹ chlorantraniliprole, a relatively low toxicity insecticide, can be equally effective in protecting trees, and that dye markers can be safely used to help target spays. Our testing of physical barriers such as MultiPro®, and to a lesser extent Kvaæ® wax, suggests they may have a role as a partial substitute for the use of insecticides in some circumstances in the UK and Ireland, but only as part of an integrated approach where on-site populations of *Hylobius* are predicted to be low.

ARTICLE HISTORY

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Introduction

The large pine weevil (*Hylobius abietis* L., hereafter referred to as “*Hylobius*”) is a major pest of coniferous trees used to restock recently clear-felled forest sites in northern Europe, including the UK and Ireland (Långström and Day 2007; Willoughby et al. 2017). Even-aged high forest silvicultural systems encourage large populations of *Hylobius* to develop as fresh woody material left on-site after cutting, especially the stumps and root systems of harvested trees, attracts the insect to breed (Eidmann 1985). Adults lay eggs in cut stumps, roots and other debris, with larvae hatching soon afterwards. Depending on resource quality, habitat and climate, larval development in the UK usually takes between one and three years before adults emerge to feed on the bark of any newly planted trees (Moore 2004; Moore et al. 2004). The periodic emergence of large numbers of adults from stumps, coupled with their persistence on-site results in significant damage to newly planted trees of many species, with browsing occurring repeatedly during the first five years of establishment. Without effective control measures, death of transplants due to *Hylobius* browsing often averages around 50% in the first two years, but mortality rates can reach 100% (Heritage et al. 1989; Leather et al. 1999). Uneven crop establishment can result from replacing

dead plants and successful restocking can be seriously compromised (Willoughby et al. 2004). Unsustainable loss of revenue can result (Moore et al., in prep.).

Traditionally, trees in European forests have been protected from *Hylobius* damage by using insecticides (Långström and Day 2007). However, concerns over the impact of pesticides, if misused, on human health, environmental condition and ecological functioning, has led to the exploration and adoption of a range of other approaches. In the UK, an integrated approach to the management of this pest is recommended (Willoughby et al. 2004, 2017). This includes predicting the likely impacts of *Hylobius* attack using the *Hylobius* Management Support System, based on a model of the *Hylobius* life cycle (Moore 2018). Forest managers can then consider the full range of chemical and non-chemical approaches available to prevent insect damage to young trees, if necessary by using different combinations of techniques. Although research into non-chemical approaches is ongoing, currently insecticides still need to be used as part of the integrated management of *Hylobius* on many sites in the UK and Ireland (Willoughby et al. 2017).

Synthetic pyrethroid insecticides including permethrin, alpha-cypermethrin and cypermethrin have been widely used since the 1980s to control insect pests in agricultural and horticultural crops. They act by preventing transmission

- Insecticides chlorantraniliprole and acetamiprid found to be effective alternatives to synthetic pyrethroids.
- Chlorantraniliprole relatively low toxicity, non-neonicotinoid, not currently approved.

- Results on alternatives published in 3 scientific papers (first two freely available), and 2 trade journal articles.
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Interim guidance on the integrated management of *Hylobius abietis* in UK forestry



Dr Ian Willoughby, Dr Roger Moore and Dr Tom Nisbet

The Research Agency of the
Forestry Commission

- Draws on key findings of the latest published research into alternatives.
- Gives detailed, practical guidance on how to prevent *Hylobius* damaging young trees.
- An integrated approach is recommended.
- Understand life cycle, consider impacts, consider full range of potential approaches if necessary in combination with each other.
- Pesticides should only be used as a last resort.

Interim guidance on the integrated management of *Hylobius abietis* in UK forestry



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- Possible approaches covered in Guide include:-
- *Hylobius* Management Support system.
- Continuous Cover Forestry.
- Good silvicultural practice, weeding ground prep, plant size.
- Mulching / de-stumping
- Fallow.
- Nematodes.
- Physical protection.
- Insecticides - currently often still required on higher population sites.

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- The Guide covers non-chemical, and chemical approaches, and integrating the two (taking an IPM approach).
- Summarises the relative costs, efficacy and potential risks of different options.
- Helps managers to meet requirements of FSC certification.
- Available for free on:-
www.forestresearch.gov.uk/hylobius-management-guidance



- Some alternatives have been identified, particularly for lower population sites.
- But further research, particularly on non-chemical approaches including biological control, that might work on sites with the highest population pressure, is required.

Thank you
for your
attention

