

ABATE

Integrated reduced-chemical control of *Hylobius abietis* in Sitka spruce

PROJECT TEAM

Dr Christine Griffin, NUI Maynooth*
 Dr Aoife Dillon, NUI Maynooth
 Dr Robbie Girling, NUI Maynooth
 Prof. Martin Downes, NUI Maynooth
 Dr Patrick Walsh, Galway-Mayo IT
 Michael Moran, Galway-Mayo IT
 Martine Blaix, Galway-Mayo IT

* Address correspondence to:
christine.griffin@nuim.ie

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OBJECTIVES

The objective of the ABATE project is to reduce reliance on chemical insecticides in reforested sites by developing biological control measures for the major insect pest, the large pine weevil (*Hylobius abietis*). The organisms investigated as control agents are: insect-killing nematodes; stump-colonising fungi; insect-killing fungi and parasitoids (*Bracon hylobii*). The main objectives for 2007 were to:

- bring nematode control closer to operational level in Ireland.
- overcome barriers to success of Bracon augmentation programmes.

PROGRESS

Nematodes: large-scale field trials

The efficacy of two species of entomopathogenic nematode against weevil populations in spruce and pine stumps was investigated. The species tested were an indigenous nematode, *Heterorhabditis downesi*, and the exotic nematode, *Steinernema carpocapsae*. The latter is used by the Forestry Commission on a semi-operational level in the UK and in 2007 was applied to 150 ha of Coillte forests over 10 sites. Of these 10 sites, four were selected for destructive sampling of stumps to determine the percentage of weevils parasitised, and six were selected to monitor emergence of adult weevils and non-target beetles following nematode application.

Nematodes were applied to the soil around the stumps and made their way under the bark to parasitise the weevils. Destructive sampling of stumps three weeks after the nematodes were applied showed that on each of the sites the level of parasitism was highest in *H. downesi*-treated stumps. Overall *H. downesi* parasitised 49 and 42% of *H. abietis* in spruce and pine, while *S. carpocapsae* parasitised 12 and 15%, respectively.

Ten adult *H. abietis* emerged from each untreated spruce stump, while more than four times as



The large pine weevil, *Hylobius abietis*.

many emerged from pine (averaged across sites). There was a trend for a reduction in the number of *H. abietis* adults emerging from nematode-treated stumps on all sites tested. On one pine site, the number of weevils emerging from *S. carpocapsae* and *H. downesi*-treated stumps was reduced by 71 and 81%, respectively, relative to untreated stumps (Figure 1). Emergence data confirmed that nematodes are equally effective in stumps of both tree species, and that in general *H. downesi* is nearly twice as effective as *S. carpocapsae* for *H. abietis* control.

Three of the sites to which nematodes were applied in July 2007 were partially replanted within five weeks with approximately 500-1,000 Sitka spruce seedlings. The level of weevil feeding damage was disappointingly high. However, sites were only partially replanted, so weevils outside the replanted area may have moved in to feed, thus increasing the number of weevils feeding on each seedling. In order to adequately test whether entomopathogenic nematodes can reduce the number of *H. abietis* emerging from stumps sufficiently to prevent substantial seedling losses, entire sites will need to be replanted and the damage assessed.

Bracon hylobii

Natural population trends of *B. hylobii* were assessed using emergence traps in 2007. *B. hylobii* emerged from late-April/early-May to late November. There were two main peaks of emergence (mid May and late July) followed by a smaller peak in late August. A similar pattern was recorded in 2006.

A method of rearing large numbers of *B. hylobii* in pine weevil larvae in the laboratory was developed and proved a very successful and a relatively easy way of breeding large numbers of the wasp for inundative release.

An inundative release of *B. hylobii* was carried out during the second week of June. Cocoons (1,200 per site) were released onto four clearfell sites. Inundative release of wasps onto sites failed to raise the average percent parasitism in the release area above background levels. Reasons for this are still not fully understood but retention of wasps in a target area warrants further investigation.

In the laboratory, the life expectancy of female *B. hylobii* was increased approximately three-fold when food of a relatively low sugar concentration

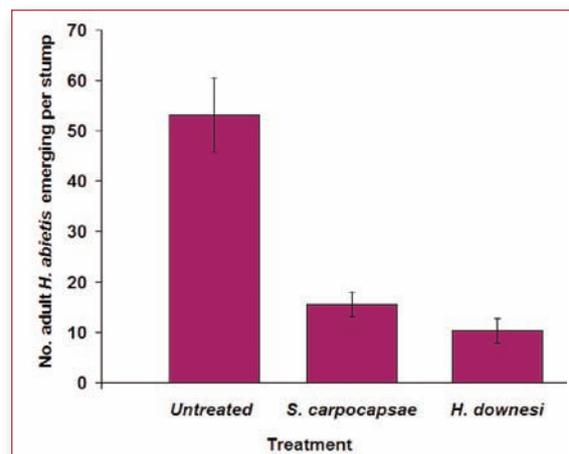


Figure 1: Number (mean \pm SE) of *H. abietis* adults emerging from pine stumps at Glendine Forest, Co Laois. Tents were erected within one week of nematode application. Emergence was recorded over a 3-month period (n = 20 stumps per treatment).

(25% honey solution) was continuously available. There was a trend for unfed newly emerged female wasps to choose honey over a weevil larva (Figure 2a). These experiments suggest that newly emerged *B. hylobii* females may put the need for food before the need to parasitise. If this is the case it would also suggest that in a clearfell site where the availability of non-host food is limited *B. hylobii* may leave that site or area in search of food. This may in part explain why attempts to increase parasitism by enhancing populations have not proved successful. There was no evidence of conditioning of oviposition choice in *B. hylobii*. Female wasps did not exhibit a preference for weevil larvae in bark of the tree species (Sitka spruce or lodgepole pine) in which they had themselves developed (Figure 2b).

ACTIVITIES PLANNED

- Completion of the analysis of non-target beetle biodiversity and abundance.
- *Bracon* diapause and the possible existence of hyperparasitoids will be investigated in 2008.

OUTPUTS

Dillon, A.B., Moore, C.P., Downes, M.J. and Griffin, C.T. 2007. *Integrated pest management of the large pine weevil – reducing breeding site suitability, inundative application of entomopathogenic nematodes, and the ensuing tritrophic interactions. Natural enemies and other multi-scale influences on forest insects.* IUFRO

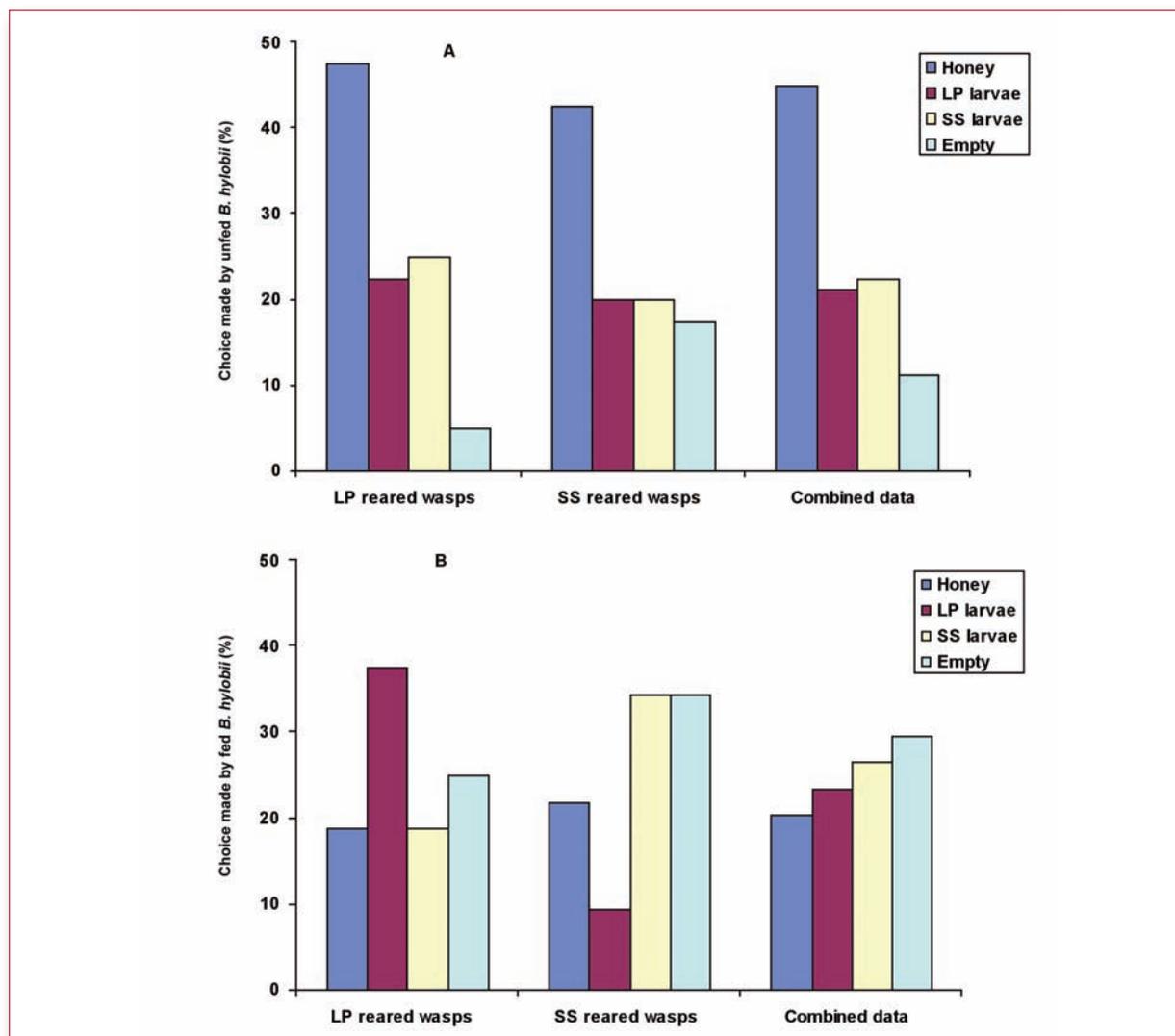


Figure 2: Choices made by (A) unfed and (B) fed (prior access to honey) female *B. hylobii* reared in Sitka spruce (SS) or lodgepole pine (LP) when exposed to volatiles from: *H. abietis* larvae feeding on SS or LP bark, honey or an empty chamber, in a 4-arm olfactometer (n = 32-40 wasps per tree species).

Meeting, Vienna, Austria 9-14 September 2007.

Dillon, A.B., Ward, D. Downes, M.J. and Griffin, C.T. 2007. Optimizing application of entomopathogenic nematodes to manage large pine weevil, *Hylobius abietis* L (Coleoptera: Curculionidae) populations developing in pine stumps, *Pinus sylvestris* L. *Biological Control* 40: 253-263.

Dillon, A. 2007. Coillte in-service training. *Assessment of H. abietis management options following application of nematodes*. Roscrea, Ireland, 17 October 2007.

Harvey, C., Ennis, D., Dillon, A.B., Meade, C.V. and Griffin, C.T. 2007. *Using AFLP to study coexistence of exotic and indigenous strains of Steinernema feltiae in a forest ecosystem*.

Association of Applied Biologists Meeting London 11 December 2007.

Ennis, D., Girling, R.D, Dillon, A.B. and Griffin, C.T. 2007. *Do entomopathogenic nematodes reduce feeding by adult pine weevil?* Association of Applied Biologists Meeting London 11 December 2007.

Moran, M., Walsh, P. and Blaix, M. 2007. *Biological control of Hylobius abietis using the parasitic wasp Bracon hylobii*. Galway Science and Technology festival, 12-25 November 2007.

An outline of the work carried on *B. hylobii* by GMIT was given to Coillte area managers on an ad hoc basis throughout the year.

Results from the ABATE project have been used during lectures and field trips in the Forestry and the Environment course at GMIT, and the Applied Ecology course at NUIM.