



An adult large pine weevil, *Hylobius abietis*.

Controlling pine weevil with natural enemies

The large pine weevil, *Hylobius abietis*, is the most important pest of replanted coniferous sites in Ireland and throughout northern Europe. If left unchecked, it can kill every young tree on a site. Pine weevil is the only forest pest against which chemical insecticide is routinely applied in Ireland and, in accordance with the principles of Sustainable Forest Management, there is a real need to develop an ecologically sustainable management strategy for it. The weevils develop in the stumps of recently cut conifers and emerge as adults which attack newly planted trees, both conifer and



The entomopathogenic nematode *Steinernema carpocapsae*.

broadleaf. Weevils feeding on the bark can kill a young tree within days. The traditional approach is to treat each seedling with insecticide. An alternative, being investigated in the ABATE project funded by COFOR and coordinated by Dr Christine Griffin, is to use natural enemies to kill the developing weevils in the stumps.

Researchers at the Galway Mayo Institute of Technology led by Dr Paddy Walsh are investigating ways of enhancing the efficacy of a parasitic wasp, *Bracon hylobii*. This native parasitoid kills and multiplies on pine weevil larvae. However, levels of natural parasitism are too low to reduce weevil numbers sufficiently. Michael Moran at GMIT developed an efficient way of rearing large numbers of parasitoids for inoculative release. The idea is that, once released, the wasps should multiply quickly in the field. Michael has studied natural populations and found that the wasp has several generations with new adult wasps produced from April to November. His experiments have shown the importance of energy-rich food in prolonging the life of the adult wasps; ensuring an adequate supply of nectar on sites could be an important component of a strategy to enhance the success of these native weevil-killers.

Another candidate for suppressing pine weevil populations is a group of entomopathogenic or insect-killing nematodes. Like parasitoids, these microscopic worms kill and multiply in insects. They occur naturally in soil in a variety of habitats throughout Ireland, including coniferous forests. Nematodes are already marketed for the control of several insect pests worldwide. One advantage over chemicals is that nematodes actively seek out insects. Nematodes applied to the soil surface around stumps can kill weevils inside stumps and half a metre deep in soil. Since they only attack insects, nematodes pose no risk to fish, birds or mammals including humans. The project has made a number of key findings regarding the efficacy and environmental safety of nematodes used against pine weevil. One important finding by Dr Aoife Dillon is that the indigenous species *Heterorhabditis downesi* consistently performs better than any other species trialled, reducing the number of adult

weevils emerging from stumps by an average of 70% compared to 37% for the "industry standard" *Steinernema carpocapsae*. As a result of Maynooth's findings, commercialisation of *Heterorhabditis downesi* is being assessed by a number of biological control companies. Use of nematodes as an alternative to insecticides is being seriously considered by the forestry industry. In 2007 and 2008 Coillte treated a total of 220 hectares, and the outcome is being monitored by the ABATE team.

Obviously, it is important to consider the environmental safety of a widespread application of any organism, and this is a prime consideration of the ABATE project. Results so far are encouraging: nematodes have not been detected outside the treated area, and numbers of applied nematodes on site decline to undetectable levels once the weevils have exhausted the resources of the stump. Aileen Foster is monitoring the non-target insect species emerging from nematode-treated stumps and early indications are that numbers and biodiversity are not reduced compared to untreated stumps.

The project has shown that nematodes are a promising environmentally sustainable way of reducing pine weevil numbers, and may offer a realistic affordable alternative to chemical insecticides.

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A parasitic wasp, *Bracon hylobii*, which attacks pine weevil larvae developing within stumps.