Farm Forestry Series No. 24

Teagasc
Agriculture and Food Development Authority

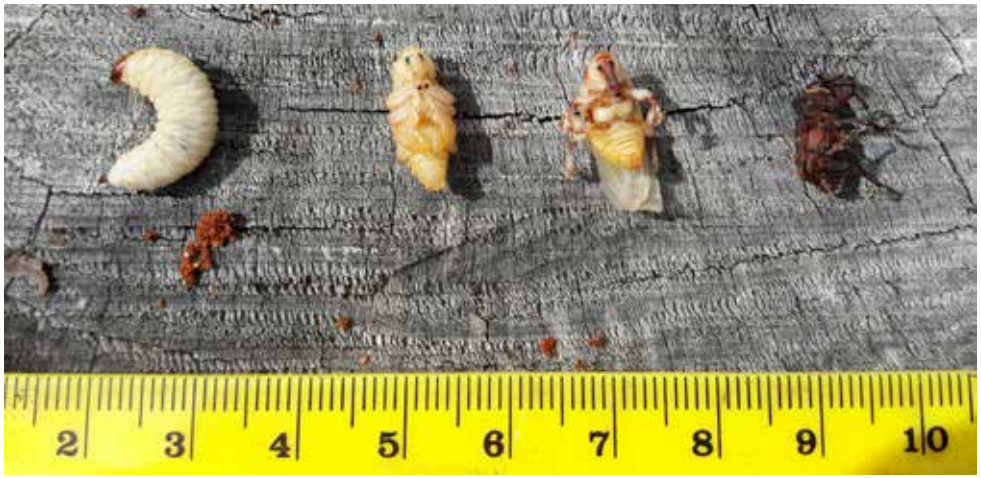
Managing Pine Weevil
Methods and Options

Large pine weevil

The adult large pine weevil, *Hylobius abietis*, feeds mainly on the bark of conifers, but also on other woody plants. Feeding damage to young trees can cause growth loss, deformation or the loss of the entire tree. This makes the large pine weevil **the most important reforestation pest** in Ireland. The species has been in Ireland since at least the early 20th century. It is estimated that pine weevils kill about 50% of unprotected conifers. However, there is a lot of variation between sites depending on pine weevil population levels.

Costs for reforestation may substantially increase with pine weevil damage (i.e. replanting of killed trees) or the prevention of damage (e.g. cost of control measures).

Adult pine weevil



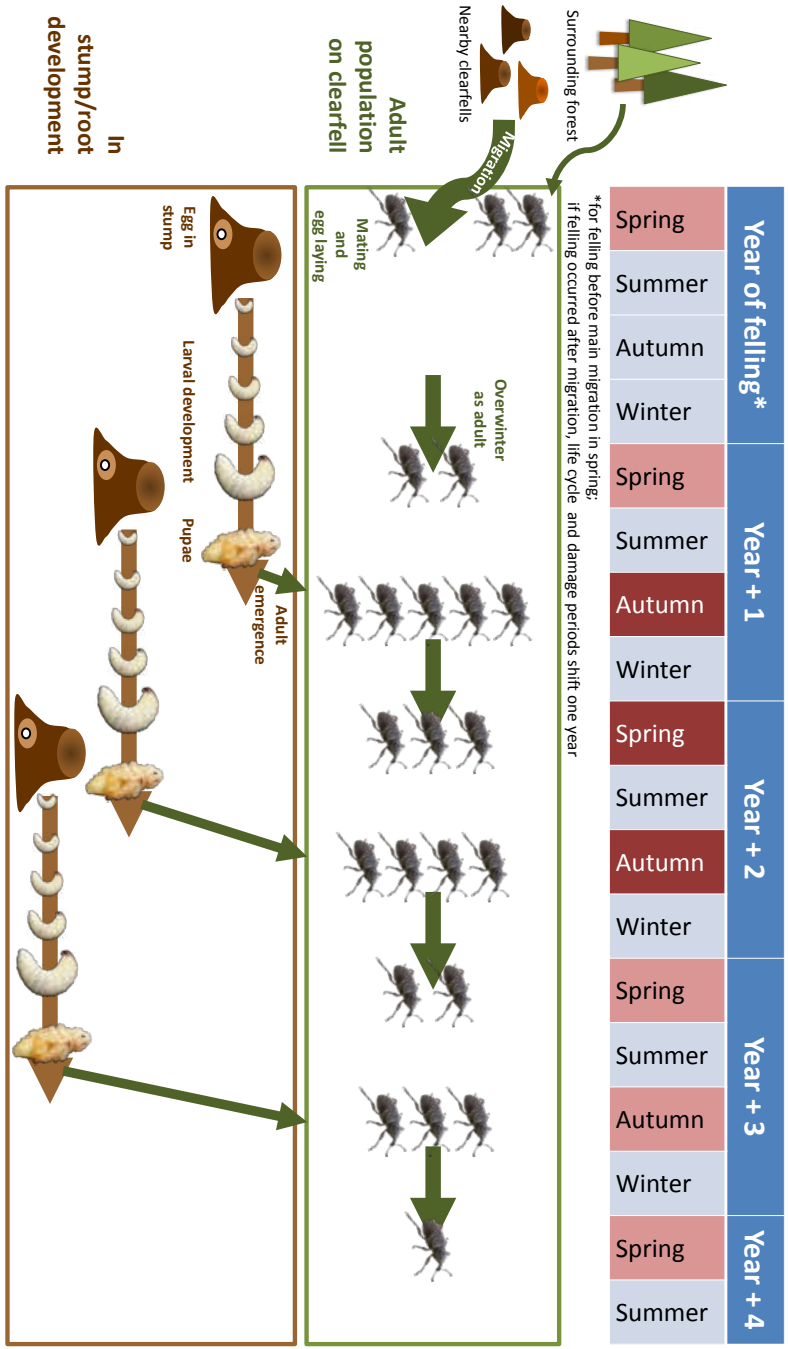
Development stages of the pine weevil (from left to right: larva, pupa, newly developed adult, adult) [picture: S. Labaude]

Pine weevil damage on young conifer

Reforestation – Risk for Pine Weevil Damage

Reforestation sites are at risk of pine weevil damage, whereas afforestation sites usually are not. This is due to the **life cycle** of the pine weevil. The pine weevil has its major migration period in spring (May to July). Adult pine weevils are attracted to clearfell sites by the smell of recently felled conifer stumps. If transplants are present, they feed on their bark (spring feeding). Adult weevils lay eggs close to roots and stumps and the larvae develop in the stump. The larvae are yellow-white with a broad brown head and no legs. They often form a C-shape when at rest. Pupae are white to cream coloured. New adults emerge from the stumps the following year and feed again on the young trees (late summer/autumn feeding). Adult pine weevils are approximately 15 mm long and are black to brown-black with yellow spots and bands on their body. Damage can occur year round whenever temperatures are sufficiently warm for weevil activity.

Stumps may be suitable for breeding for up to **five years**. Therefore, there is a risk for pine weevil damage up to five years post-clearfell.



Schematic life cycle and population dynamic of pine weevil on a clear-fell.

Seasons of high adult activity during which the majority of damage is expected are marked red, but damage can occur in other seasons as well. The highest adult population is expected one or two years after felling. Larval development occurs in the stumps/roots of the harvested conifers. [larva and pupa pictures: S. Labaude]

Risk Factors for Pine Weevil Damage

Factors increasing the risk of damage:

- Previous crop: Pine weevils only develop in **conifer stumps**. They develop faster and in higher numbers in **pine** than in spruce.
- Neighbouring forests: Adult weevils occur in relatively small numbers in standing forests, while **other clearfell areas** in the landscape increase the risk of pine weevil damage. Both are sources of adult pine weevil that can migrate between sites.
- Transplant species: Adult pine weevils attack all woody species, but conifers are preferred.
- Vegetation: **Grassy vegetation** provides shelter for pine weevil and thereby increases pine weevil damage on transplants.
- **Clearfell age:** Due to the life cycle of the pine weevil, damage on clearfell areas occurs for up to five years post felling, with declining severity after the second year *(see page 10 for details)*.
- **Season:** Most damage usually occurs during spring and autumn, when adult activity is high *(see page 4 for details)*.

Grassy vegetation on a replanted clearfell

Factors decreasing the risk of damage:

Transplant properties: **Bare-rooted planting stock** and transplants with a **large root collar diameter** can withstand more pine weevil damage. Hence survival of these plants is better.

Soil preparation: **Mounding** makes it more difficult for the pine weevil to reach the transplant.

Soil properties: Pine weevils avoid **mineral soil.** Transplants in mineral soil patches, such as where mounding throws up mineral soil on a peat site, get less damaged.

Alternative food sources: **Brash** left on the clearfelled site can potentially be used as an alternative food source while still fresh but the effect will be short-term. **Woody vegetation** on site such as brambles may also provide food for weevils.

Forest management type: **Continuous cover forestry** has fewer stumps and transplants per unit area while the standing trees are an alternative food source for the weevils. Therefore, pine weevil populations do not reach the same concentrations as on clearfell sites and cause less damage.

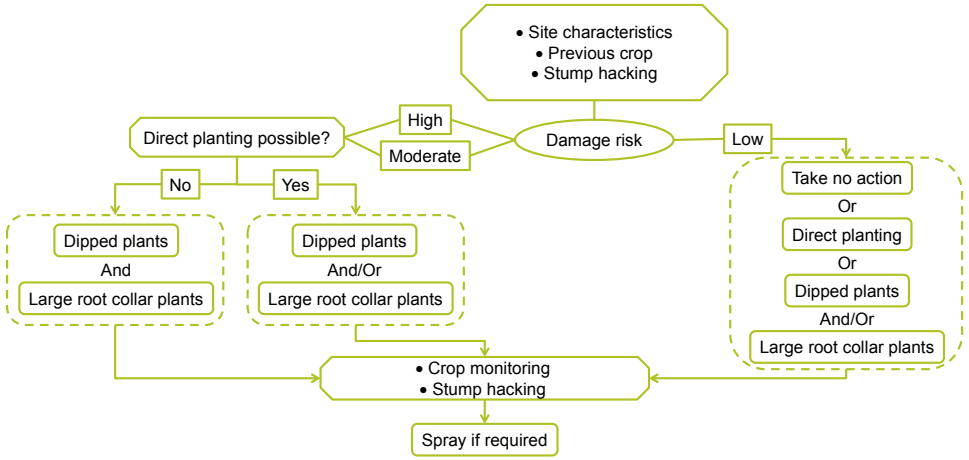
Planting in mounds and/or mineral soil can reduce pine weevil damage

Fresh brash can be used as alternative food source by pine weevil

Integrated Pest Management

Integrated Pest Management (IPM) is a sustainable pest management approach that takes the ecology of the pest species into consideration and employs a variety of pest management methods which can be used singly or combined. IPM aims to take into account the costs and benefits of each method regarding its impact on producers, society and environment.

An important part of IPM is to use protection methods at the right time when there is a need for protection. Therefore the prediction of the damage risk is essential.



Example of a decision support flow chart [modified based on Coillte]

Predicting Risk of Damage

Predicting the risk of pine weevil damage allows decisions to be made about whether to use insecticide, and the optimal timing of its application.

The expected pine weevil population and therefore damage risk is assessed in Ireland with stump hacking (see next page) in association with clearfell characteristics *(see page 5)*. This method should be viewed as an indicator and is not 100% accurate.

In the UK, the risk of pine weevil damage is estimated using billet traps and clearfell characteristics.

COPY THESE PAGES FOR YOUR OWN STUMP HACKING RECORDS

Example Stump Hacking Form

[Modified based on Coillte's stump Hacking Form]

Preparation:

Sample at least five stumps

- Stumps should be spread across the site, not clumped together

Clear the soil away from a quarter of a stump

- at least 40 cm out and 30 cm down from soil level
- include at least one major root and two root-stump junctions

Remove bark from the cleared area using a spade or wood chisel (Stump hacking figures 1-4).

Stump hacking 1

Stump hacking 2

Stump hacking 3

Stump hacking 4 [all four images Coillte]

Sampling:

Count the number of weevil larvae and pupae in each of the five ¼ stumps.

- Pupae can burrow into the wood of the stump itself, so take care to look for circular holes in the stumps (rather than just in the bark)
- Do not include numbers of longhorn beetle larvae in the counts (Longhorn beetle larvae have triangular shaped heads + their body is divided into distinct segments)

Differently sized larvae found in the same stump during stump hacking

Pine weevil pupa [S. Labaude]

Recording:

Location:				**Date:**		
	Stump 1	Stump 2	Stump 3	Stump 4	Stump 5	
Larva						
Pupa						Average
Total						

If the average count per quarter stump on a site felled more than 12 months is

- 5 or more: spraying will be necessary.
- 1 – 5: check site again during weevil feeding periods (April and August).
- 1 or fewer: spraying may not be required

Planted sites should be prioritised for spraying if mainly pupae are found.
Spraying should be delayed on planted sites if mainly larvae are found.

Protection against Pine Weevil Damage

Management options are often classed into four different categories: silvicultural practices, chemical methods, biological control and physical protection.

Currently, after the risk of pine weevil damage is established by e.g. stump hacking, the standard approach in Ireland is to treat the transplants with insecticides.

Many alternative methods to control pine weevil have been tested in different field trials in Ireland and abroad. Certain methods have shown positive effects in other countries, but not necessarily in Ireland. Nevertheless, non-chemical methods can reduce the use of insecticides when risk levels are low or moderate.

Silvicultural methods

Large root collar diameter (RCD) transplants have increased tolerance of pine weevil damage. One of the most important considerations in planting is the right **timing.** Pine weevils cause most damage during spring and late summer *(see page 4)*. Therefore, the **felling date** and the planting time influence the risk of pine weevil damage. Stumps of trees felled before or during the main migration period (May to July) may get colonised in the same year (and produce adults the following year), whereas the stumps of trees felled later usually do not get colonised until the next year, with adults emerging one year later. Felling licences usually require replanting of a clearfell site within two years. Since the pine weevil population is high on a two-year old clearfell site, **direct planting** (also called hot planting or green planting) of large RCD stock may result in trees that are large enough to withstand weevil damage by the time the main attack period occurs.

See also page 5 for other clearfell factors that might influence pine weevil damage risk.

Chemical methods

Insecticides can be applied in the nursery before planting and/or after planting in the field. On clearfells with high pine weevil damage risk, top-up sprays may be necessary. The choice of application method can be influenced by several factors, such as planting time (insecticides are only effective for a certain time after application), costs and environmental exposure.

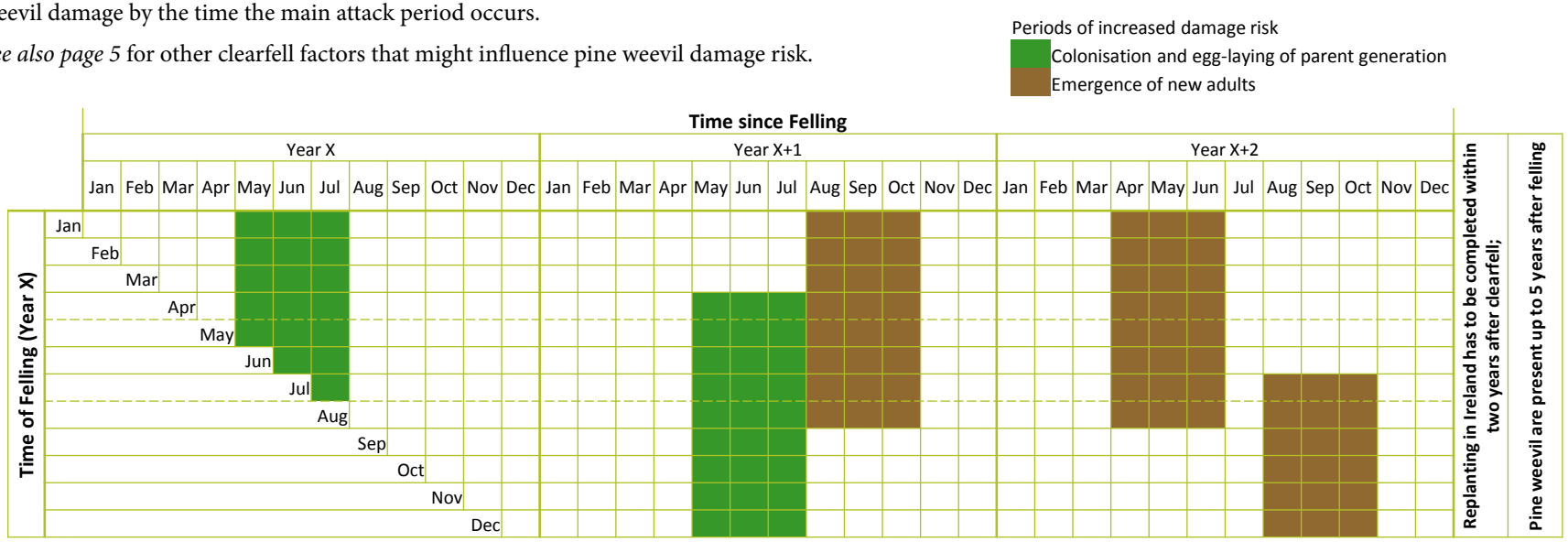
Read the label and follow the guidelines when applying chemicals. As per the Sustainable Use Directive, only a registered professional user or a person operating under the direct supervision of a registered professional user can apply pesticides authorised for professional use.

There is currently [spring 2020] only one insecticide (containing cypermethrin) registered for use in forestry in Ireland. Insecticides containing acetamiprid and chlorantraniliprole have off-label authorisation for use in forestry.

Cypermethrin was until recently the only effective way to control the pine weevil in Ireland. However, it is considered a high hazard chemical for aquatic organisms and is therefore not approved by all Sustainable Forest Management certification standards.

Acetamiprid has been successfully used as plant protection against pine weevil in Ireland and is expected to replace cypermethrin as the standard chemical insecticide against this pest.

Chlorantraniliprole is currently undergoing field trials in Ireland.



Timing of colonisation/egg-laying, adult emergence and damage periods occurring on clearfelled spruce sites. To estimate periods of colonisation, egg-laying and adult emergence, select the month of felling on the left and then move towards the right.

[Adapted from an original illustration (from FCIN061) with permission of Forest Research. ©Crown copyright]

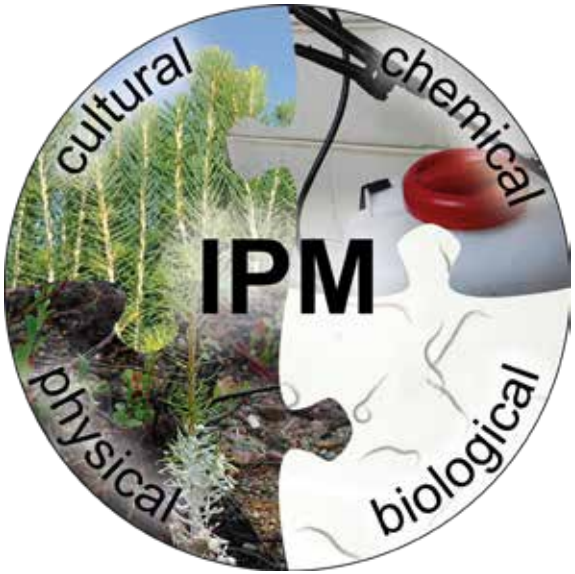
Physical methods

Physical methods are based on preventing access to the bark. **Feeding barriers** are structures, often made of plastic or coated paper, that are placed around the tree, whereas **stem coatings**, often made of wax or artificial rubber, are applied directly to the stem.

Many of the physical methods were developed in Scandinavia where they are successfully used. Trials in Ireland were not as successful, probably mainly due to the much larger pine weevil populations here. They may be effective where weevil populations are low. Broadleaf trees that are protected from deer by shelters will also be protected from weevil damage, as long as access through or under the shelter is prevented.

Biological methods

Biological control uses natural enemies to kill the pine weevil. The most tested natural enemies are insect killing **nematodes**. These are applied to stumps with the aim of reducing the overall population of weevils by killing the larval stages. Nematodes were successful in reducing populations in field trials in Ireland. To be successful they need to be applied on a landscape level, as otherwise, adults can migrate in from neighbouring clearfell areas. The labour intensity and practicalities make this method expensive and difficult to use at present.



Integrated Pest Management protection categories
[Pictures by C. Hellqvist, P. Lillis and F. Fedderwitz]

Outlook: Future management options

An integral part of successful IPM against the pine weevil is knowing when damage risk is high and thus when to apply plant protection. Therefore, understanding how clearfell factors influence pine weevil, with a view to risk prediction, is very important.

Furthermore, it is important to improve our understanding of pine weevil population dynamics. There are currently two peak damage periods: late spring and late summer/ autumn. However with a warming climate, development will be faster and the feeding period may be extended.

Methods of all four categories of IPM are constantly developed, both in Ireland and abroad. More knowledge and research of alternative methods is essential to provide more options in the future. Examples of these could be:

- Certain genotypes (varieties) of tree species could be more tolerant to pine weevil damage than others.
- While current chemicals might be restricted in the future, alternative chemicals with other modes of action are being tested.
- Improved versions of physical protection are being developed for bare-rooted planting stock.
- Other natural enemies and natural product insecticides are being tested and application methods for biocontrol agents may improve.

For further information

Controlling the large pine weevil, *Hylobius abietis,* using natural enemies. Coford connects, Silviculture/Management No. 15. Department of Agriculture, Food and the Marine, Dublin, Ireland. http://www.coford.ie/media/coford/content/publications/projectreports/cofordconnects/ccn-sm15.pdf (2008) Dillon A & Griffin C

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Interim guidance on the integrated management of *Hylobius abietis* in UK forestry. The Research Agency of the Forestry Commission, Forest Research, UK. https://www.forestresearch.gov.uk/documents/607/FR_InterimguidanceonmanagementHylobiusabietis_2017.pdf (2017) Willoughby I, Moore R & Nisbet T

Notes

Teagasc Forestry Services

Research

Our research covers many aspects of the life cycle of a forest from seedling to sawdust. Research is carried out in Teagasc research centres in state-of-the-art laboratories and growing facilities and on privately owned farm forests throughout Ireland.

Advice

Teagasc provides objective and independent advisory services to all private landowners on forestry related matters. Teagasc forestry advisors provide free, independent and objective advice on any technical or financial aspect regarding forestry.

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Teagasc offers a wide range of QQI certified practical courses. Topics can include formative shaping of broadleaves and timber measurement. A forestry qualification from Teagasc enables students to develop wide ranging and interesting careers.

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For more information:

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This leaflet can be read in conjunction with:
Teagasc Farm Forestry Series No. 16: Management of Young Forests
Teagasc Farm Forestry Series No. 19: Continuous Cover Forest Management
Teagasc Farm Forestry Series No. 20: Reforestation following clearfell

Contact Details:
Teagasc Forestry Development Department
Mellows Campus, Athenry
Co Galway H65 R718
Tel.: +353 (0)91 845200
www.teagasc.ie/forestry

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