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White Pine Weevil, *Pissodes strobi*: Risk Factors, Monitoring and Management

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Strategic Importance

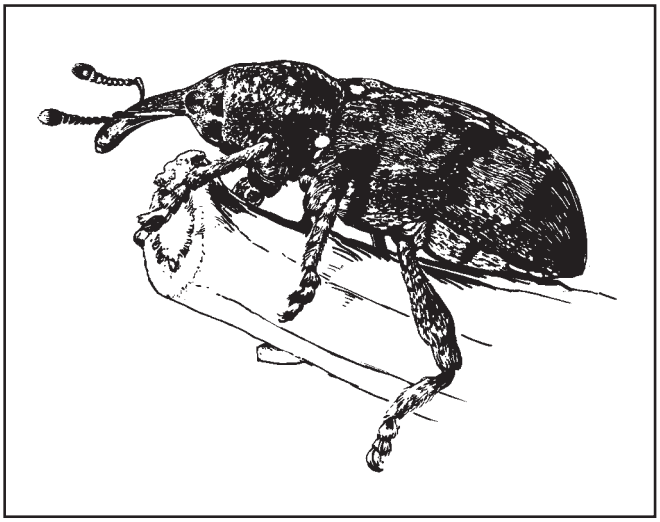
The white pine weevil, *Pissodes strobi*, is a serious pest of young white and Engelmann spruce, and their hybrid referred to as "interior spruce". It also attacks Sitka spruce in coastal British Columbia as well as pine and spruce in eastern Canada and the United States. Weevil attack can reduce growth by as much as 40% in heavily attacked stands in high hazard zones. The most severe attacks occur in relatively open, fast growing stands that are 10 to 30 years old and between 2 and 20 m tall - stands which may have received considerable forestry investment to encourage maximum growth. The weevil begins to attack spruce plantations when they are about five years old.

Eggs are laid at the tip of the leader, just under the apical bud, in feeding punctures which are then covered with a fecal plug. After hatching, the larvae burrows downward consuming the phloem thereby destroying the tree's apical shoot or leader. Although weevil attack does not kill trees, it reduces growth and deforms the stem. This reduces both tree volume and wood quality.

In British Columbia, spruce is a major commercial species. Since 1984, more than one billion interior spruce seedlings have been planted. In addition, investments in spacing and brushing juvenile stands have become substantial. Now, many of the plantations are entering an age where they are susceptible to weevil attack. In order to protect investments in juvenile spruce stands, managers must consider current weevil attack levels and the danger of increasing weevil populations by opening high-risk stands in preparing prescriptions.

The Forest Practices Code does require forest health evaluations within operational plans. These evaluations consist of detecting conditions which indicate a forest health risk, conducting pest incidence surveys, and creating pest management strategies.

In addition to plantation assessments, weevil populations in adjacent, naturally regenerated stands must also be considered. The spruce weevil is a natural component of sub-boreal ecosystems and often infects forests after wildfires have removed the overstorey and created conditions favorable for the weevil.



Adult spruce weevil

Evaluating the Risk of Weevil Attack

The risk of weevil outbreak should be evaluated before investing in forest management activities such as planting, brushing or spacing. The following factors affect the risk of weevil outbreaks:

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Stand age:
Spruce is most susceptible to attack between 10 and 30 years of age.

Site index and growth rate:
Long leaders with thick bark provide more food and oviposition sites, so they tend to provide conditions for increased weevil populations. (Interestingly, resistant families also tend to be fast growing.)

Heat accumulation:
The amount of heat accumulated through the growing season will determine the weevil's ability to successfully complete its development cycle. Heat accumulation is expressed in degree-days. Interior stands located where heat accumulation over a year exceeds a threshold of 785 degree-days above a base of 7.2°C are particularly susceptible to weevil attack.

Increased spruce planting may be considered where slope, aspect and elevation reduce the probability of reaching this heat threshold level.

Stand composition:
Reducing ambient temperatures and heat accumulation by providing shade from deciduous overstorey trees has been effective in reducing weevil attacks. The presence of an overstorey reduces weevil damage by making the stand shadier and cooler. Normal flight and oviposition behaviour may be disrupted under these conditions. Also, shaded trees have thinner leaders and branches which contain less food for the weevil, and this reduces the chance of a defect after an attack.

A low percentage of spruce per hectare reduces the overall food supply for the weevil and results in low weevil populations.

Stand density:
Trees in dense plantations sustain lower defect rates.

Landscape heterogeneity:
Landscape design should avoid large continuous areas of similarly aged single-species plantations. An age class mozaic is preferred.

A Sequential Sampling System

Effective pest management programs for white pine weevil require regular monitoring to determine if existing populations and damage levels are at or near levels that require a shift in management strategy. High weevil populations, for example, may warrant a delay in thinning. Post-treatment assessments are also required to determine the efficiency of control measures.

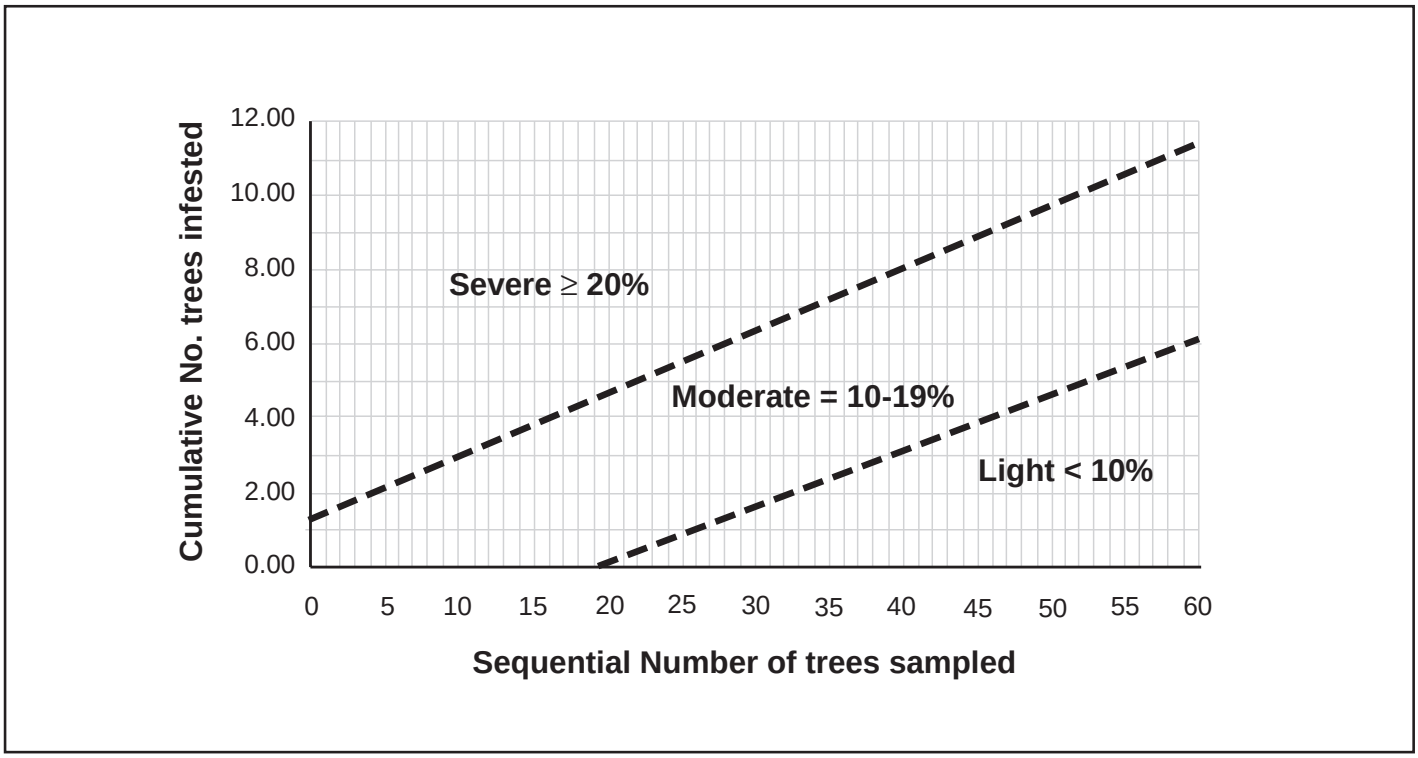

Figure 1. Sequential sampling for Pissodes strobi

Dead leader about eight months after attack.

Regular sampling methods usually require a fixed number of samples. However, these methods will invariably be inadequate at low pest densities and excessive at high pest densities.

Sequential sampling is a system designed to determine if damage is at light, moderate or severe levels. Sampling only continues until the cumulative number of infested trees exceed a decision line of severe or of moderate shown in Figure 1.

Infestations of white pine weevil are classified as:

- Light if the proportion of trees with current weevil damage is less than 10%;
- Moderate if the damage levels are between 10% and 19%; and,
- Severe if 20% or more of the trees are attacked.

Start the sequential sampling system by dividing the stand area into a grid and assigning coordinates. (A 10 x 10 grid of any size will suffice.) Using random numbers, select 60 random X,Y coordinate points, keeping track of the sequential order of selection. Do not use duplicate or replacement numbers selected by the random number process. Assign each of the coordinate points numbers (from 1 to 60) that indicate the order in which the 60 points were selected.

Divide the coordinate point list into two groups numbered 1-30 and 31-60. In the first group, examine the tree closest to each of the identified X,Y coordinates for weevil damage as you move through the stand, in the most efficient manner. After sampling the first group, plot the cumulative number of attacked trees onto Figure 1, maintaining the order in which the coordinates were originally selected.

If either of the decision lines have been crossed, then you have gathered enough information to make a reliable estimate of the infestation level in the stand (it is either severely or moderately infected) and there is no need to do more sampling. If, after the first 30 samples, the cumulative attack line is still in the moderate zone, then more information is needed, and you need to sample the trees nearest to the entire second group of points (31 to 60). The data from the second group of sample points should be plotted on Figure 1 in the order in which the points were first selected. After the second 30 points have been plotted, the infestation level in the stand can be reliably estimated as either light, moderate, or severe.

This method will save a significant amount of time and money when classifying stands for treatment.

Management Tools

The objective of weevil management is not to eradicate populations but to reduce populations by restoring ecosystem balance. Insecticides are no longer considered an appropriate treatment for white pine weevil because of potential adverse environmental effects.

Forest areas with a high probability of weevil attack may warrant a silvicultural prescription which integrates:

- High density planting;
- Reducing the spruce component;
- Favoring a species mixture with a deciduous overstorey; and,
- Planting weevil-resistant trees.

Weevil control techniques include:

- Clipping infested leaders when feasible and only if the infestation rate is very low and plantations are very young. This method is more effective in isolated plantations;
- Planting mixed species to slow weevil population build-up;
- Planting seedlings from resistant families or provenances;
- Delaying spacing and/or thinning; and,
- Conserving deciduous trees and keeping stand density high until the spruce reach a height where susceptibility diminishes; and,
- Planting species other than spruce next to infested stands.

In collaboration with the British Columbia Ministry of Forests, a number of resistant provenances, families and

individual trees have been identified. Mass propagation of these genotypes is being commercially developed by B. C. Research Inc. When resistant planting stock becomes available, it will be important to deploy the resistant trees as a mixture of genotypes. This will reduce the chances of the weevil adapting to the resistant stock.

Additional Reading

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