



Mechanical and biological control of the white pine weevil

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**Laurentian Forestry Centre
Information Leaflet LFC 28**

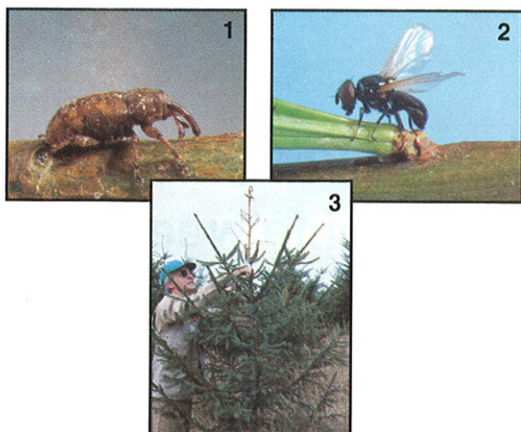


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Cover

Photo 1. White pine weevil at the adult stage (Photo: C. Moffet)

Photo 2. Fly whose larvae are predators of the weevil (Photo: C. Moffet)

Photo 3. Weevil-infested terminal shoot (Photo: C. Moffet)

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Cette publication est également offerte en français sous le titre «Lutte contre le charançon du pin blanc : intervention manuelle et lutte biologique» (Numéro de catalogue GCC Fo29-4/28-1997F).



Why use mechanical control?

It is not the adult white pine weevils but rather the larvae (immature stage) living under the bark (Figs. 3B and 3C) that kill the leaders. Since the larval stages are spent under the bark, annual pruning and collection of these shoots can completely eradicate the new generation.

This method, called manual or mechanical control, is still the simplest, most effective way



Figure 3A. Close-up of predatory larvae.
(Photo: T. Arcand)



Figure 3C. Close-up of weevil larvae.
(Photo: C. Moffet)

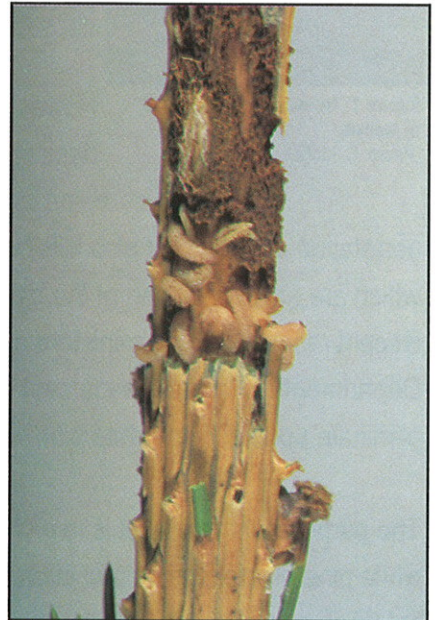


Figure 3B. Larvae of the weevil and of a predatory fly. Note that the fly larvae are smaller than the weevil larvae.
(Photo: C. Moffet)

to treat young plantations beginning at age 5 or 6, when the infestation is incipient (fewer than 5% of the trees are infested annually).

Biology of the weevil

Although the white pine weevil produces only one generation of larvae per year, the adults have a lifespan of several years, during which they can reproduce. In spring,



Figure 4. Adult weevils on a Norway spruce leader.
(Photo: C. Moffet)

weevil activity begins in late April or early May. At that time, adult weevils, which have overwintered in the leaf litter under a host tree, make their way to the leaders to feed and mate (Fig. 4). Damage caused by the adults is minor and limited to small feeding punctures. Resin droplets that glisten in the sun around these punctures are a sign of the insect's presence. Over a 6-week period beginning in early May,



Figure 5. Feeding punctures in the bark. Females lay their eggs in these punctures.
(Photo: C. Moffet)

the females lay eggs, mainly in the upper part of leaders. A careful inspection will reveal tiny black dots (Fig. 5), each of which marks a spot where a female weevil has laid between one and five eggs (Fig. 6). A single female can lay up to 100 eggs on the leader of one or more trees.

After 10 days or so, the first eggs hatch, and the young larvae begin to feed on the inner bark tissue. By gradually destroying this tissue, called the cortex, the larvae disrupt the flow of sap to the new shoot. As this happens, the leader stops growing and eventually wilts and dies (Fig. 7). The dead leader may remain on the tree for several months. On eastern white pine, if weevil eggs are laid very early in the spring, it is possible that no shoots will emerge from the terminal bud (Fig. 8).

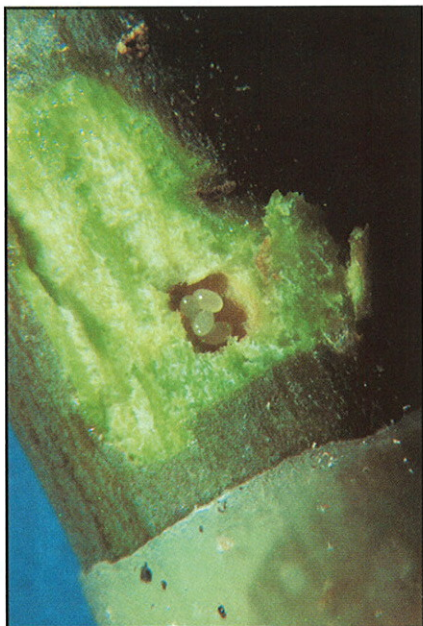


Figure 6. Weevil eggs discovered in a feeding puncture after the bark was lifted.
(Photo: R. Lavallée)

depending on the regions involved and weather conditions during the current year (Table 1). These adults remain on the host trees to feed until the cold autumn weather prompts them to return to the leaf litter, where they will overwinter.

In order to leave the tree stem, the adults have to pierce their way through the bark, leaving a noticeable circular puncture mark about 2 mm in diameter (Fig. 9). Based on what is currently known about the dynamics of this insect, emergence may occur within 35 to 50 days,



Figure 7. Infested Norway spruce leader that has wilted.
(Photo: R. Lavallée)

Pruning of infested terminal shoots

An effective and successful intervention requires good timing: the entire larval population must still be active under the bark and noticeably present on the majority of infested trees, and the procedure must be done before the adults begin to emerge.



Figure 8. Infested white pine leader with little or no noticeable wilting on the annual growth.
(Photo: R. Lavallée)



Figure 9. Punctures in a Norway spruce leader from which insects emerge.
(Photo: C. Moffet)

In the case of Norway spruce and eastern white pine, attacked leaders should be pruned by cutting them back to the whorl below (Fig. 10). If this section of the leader is left intact, it might become infested the following year, killing the entire whorl. Sometimes larvae complete their development at the level of a whorl itself. In such a case, clipping more of the stem would serve no useful purpose because it would be too deformed. Weevils may destroy more than one whorl over the course of a single season. This can happen in the case of a short leader, a very intense attack, infestation of a leader attacked the previous year or infestation of the part that is 2 years old. Pruning

should be adapted to the situation at hand. After this pruning, lateral shoots that grow from the next whorl will compete for apical dominance (Fig. 11). This situation should be corrected the following year.

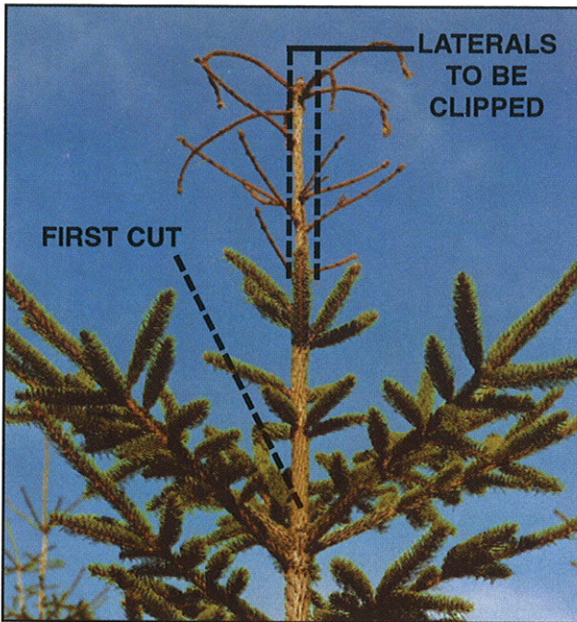


Figure 10. Pruning of an infested leader. Location of the first cut made to kill insects living under the bark. Laterals to be clipped before the infested leader is placed in the bag.
(Photo: C. Moffet)

Intervention period

If at the start of pruning and collecting shoots a few adults are seen emerging, it is not too late to act, but prompt action is essential. As a rule, the clipping of infested shoots should begin around mid-July. A useful phenological indicator for this treatment is the ripening of raspberry fruits in the forest. Obviously, it is more effective to take action at the start of emergence than at the end.

Furthermore, by taking action at the beginning of the recommended

period, plantation owners can increase their chances of protecting the first whorl, which will produce the next terminal shoot.



Figure 11. Multileading of a tree caused by vertical growth of lateral branches.
(Photo: C. Moffet)

Given the weevil's lengthy egg-laying period during the spring, some damage may not become noticeable until later in the season. Hence, 2 weeks after pruning, it is advisable to check for infested leaders, as some of them may not have been visible on the first visit.

Since adult weevils can live and reproduce for several years, even if the new weevil generation has been destroyed completely, the residual population may still be active. The following year,

after the weevil infestation period, it is important to correct the growth of treated trees in the plantation and take steps to prevent further attacks. Failure to carry out this treatment during a given year can favour the weevil population, allowing more annual damage to occur. Our research has shown that intervention can be carried out more quickly in the second year because fewer terminal shoots will have been attacked.

Protecting natural enemies of the weevil

Like all insects, the white pine weevil is preyed on by numerous insect predators and parasites. The larval stages of some fly (cover Fig. 2 and Fig. 3A) and wasp species (Fig. 12) live under the bark of leaders and feed on weevil larvae there.

Consequently, pruning and then burning infested shoots not only eliminates the new generation of weevils but also kills all their natural enemies. Since most of the latter do not emerge until the following spring, mechanical control can be combined with the beneficial action of parasites and predators of the weevil. This can be done by placing the infested leaders, but not the dry lateral shoots, in two (one inside the other) polypropylene plastic bags used to store grain or feed, and closing the bags in order to trap the adult weevils when they emerge. It is crucial to ensure that the bags do not become punctured or damaged during this process. As well, it is important to avoid bagging any shoots with healthy bark because the weevils could continue to feed on them during the fall. If the inner bark is brownish where the cut was made (Fig. 13), weevils are still present and the leader must be cut back even further. Finally, the dry lateral shoots must be removed to avoid cluttering the bags (Figs.



Figure 12. Adult wasp whose larva is a parasite of the weevil.
(Photo: C. Moffet)

14A, B, C). The bags should be hung from a tree within the plantation or on its periphery, above snow level, and kept

there for the winter. The cold will kill any weevils still feeding on shoots inside the bags.

It is now known that the white pine weevil's natural enemies can survive hard winters under these conditions but that adult weevils are killed by the cold and a lack of food. In early April of the following spring, the shoots should be removed from the bags and distributed on branches at mid-crown height within the plantation. This is an environmentally acceptable method which ensures that natural enemies of the white pine weevil can emerge and attack the residual population of weevils when they start appearing in the spring.

Monitoring of the plantation

Once the trees have reached a height of 1 m, plantation owners should carefully watch for signs of damage and promptly prune any infested stems by the method described above. Young Norway spruce plantations that grow on inadequate sites, in heavy, poorly drained soils or near the edge of forests, are the most susceptible to white pine weevil attacks. Outbreaks frequently occur at a single infestation site exhibiting all of the above characteristics. Such sites should be carefully monitored.



Figure 13. Healthy stem section (right) and section destroyed by larvae (left).
(Photo: R. Lavallée)

In older plantations (i.e. those over 15 years of age), it becomes increasingly difficult to monitor for white pine weevils and to prune attacked stems. Keeping weevil numbers down during the plantation's early growing years helps to limit future damage to trees, thereby ensuring a better supply of quality saw timber. Moreover, current data tend to show that the occurrence of weevils declines with the age of the plantation.

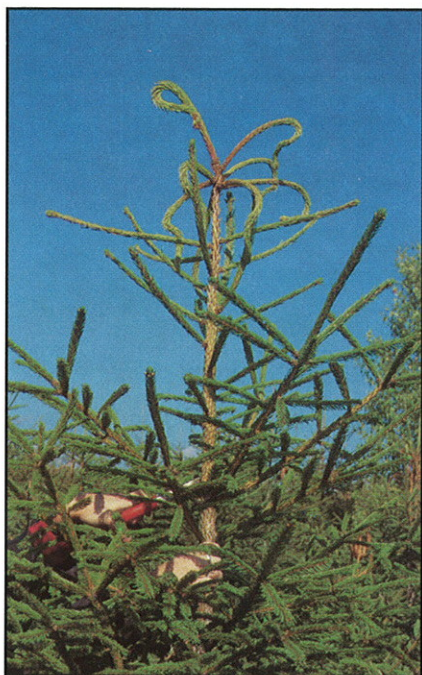


Figure 14A. Pruning a leader at the level of the next whorl.
(Photo: C. Coulombe)



Figure 14B. Pruning a leader at the level of the next whorl: removal of lateral shoots.
(Photo: C. Coulombe)



Figure 14C. Pruning a leader at the level of the next whorl: clipping of the section that is free from larvae.
(Photo: C. Coulombe)

For further information

Anyone with comments or suggestions regarding the techniques or information provided in this leaflet is invited to contact the authors by e-mail: Rlavallee@cfl.forestry.ca or Ccoulombe@cfl.forestry.ca.

You can also consult our section on the white pine weevil on our Web site:
<http://www.cfl.forestry.ca>.

References

- Lavallée, R.; Morissette, J. 1989.** Mechanical control of the white pine weevil. For. Can., Quebec Region, Sainte-Foy, Que. Inf. Leaflet LFC-25E.
- Morissette, J.; Lavallée, R.; Archambault, L. 1995.** Dynamique et impact des attaques du charançon du pin blanc sur l'épinette de Norvège en plantation. Pages 11-20 *dans* R. Lavallée et G. Bonneau (éd.). Compte rendu du colloque sur le charançon du pin blanc. Ressour. nat. Can., Serv. can. for., Région du Québec, Sainte-Foy, Qc et minist. Ressour. nat. Québec, Dir. rech. for., Québec, Qc.
- Therrien, P. 1995.** La répression naturelle du charançon du pin blanc : les organismes impliqués et leur impact. Pages 70-78 *dans* R. Lavallée et G. Bonneau (éd.). Compte rendu du colloque sur le charançon du pin blanc. Ressour. nat. Can., Serv. can. for., Région du Québec, Sainte-Foy, Qc et minist. Ressour. nat. Québec, Dir. rech. for., Québec, Qc.

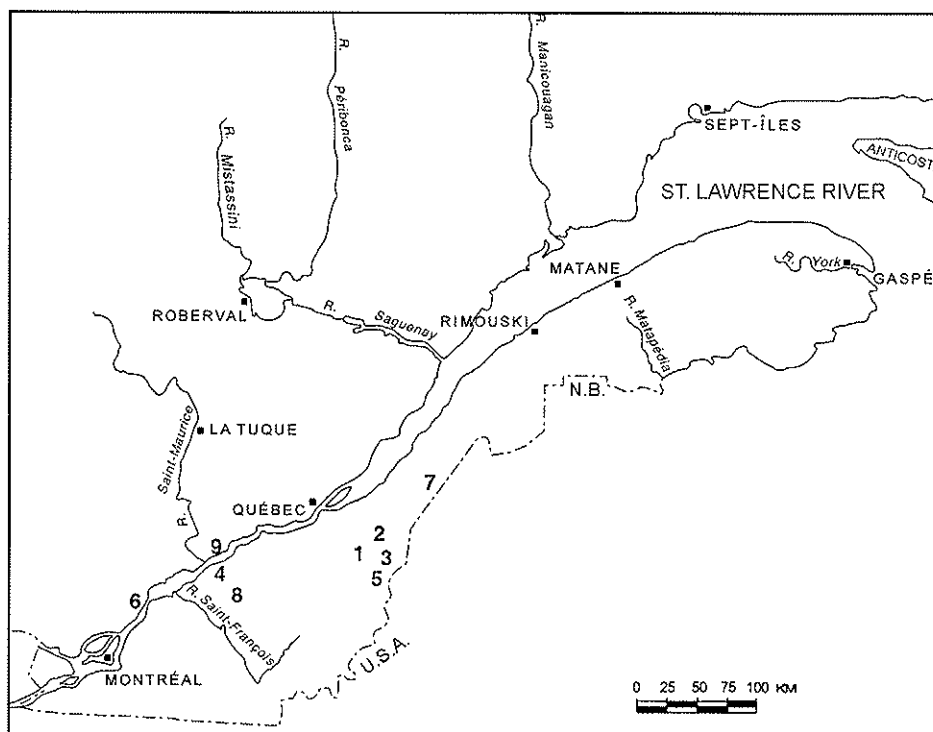
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Table 1. Dates on which various emergence levels were observed in plantations.

Host species	Year of observation	Plantation site*	Percentage of emergence (degree-days of growth) (> 5°C)			Duration (days)	Weather station
			1%	50%	100%		
Norway spruce	1996	Beauceville (1)	August 12 (1112)	September 3 (1403)	September 17 (1558)	36	Saint-Éphrem
	1996	Beauceville (1)	August 9 (1051)	August 29 (1317)	September 26 (1602)	48	Saint-Éphrem
	1996	Saint-Léon-de-Standon (2)	August 15 (1085)	September 3 (1334)	September 30 (1587)	46	Saint-Prospér
	1996	Saint-Cyprien (3)	August 13 (1045)	September 1 (1297)	September 30 (1572)	48	Saint-Prospér
	1996	Saint-Cyprien (3)	August 13 (1045)	September 2 (1308)	September 30 (1572)	48	Saint-Prospér
	1995	Gentilly (4)	July 20 (939)	August 5 (1204)	August 28 (1541)	39	La Pèrade
	1995	Saint-Gédéon (5)	July 27 (907)	August 10 (1137)	September 6 (1493)	41	Saint-Ludger
	1995	Sainte-Béatrix (6)	July 25 (968)	August 8 (1198)	September 6 (1589)	53	Sainte-Béatrix
	1995	Sainte-Perpétue (7)	July 26 (846)	August 20 (1256)	September 11 (1478)	47	Sainte-Perpétue
	1988	Beauceville (1)	August 2 (881)	August 27 (1162)	October 6 (1363)	36	Saint-Prospér
Eastern white pine	1987	Sainte-Eulalie (8)	July 19 (953)	August 18 (1348)	September 7 (1517)	50	Daveluyville
	1995	Saint-Luc (9)	July 20 (998)	August 5 (1264)	September 1 (1660)	43	Nicolet
	1995	Saint-Gédéon (5)	July 27 (907)	August 8 (1103)	September 6 (1501)	41	Saint-Ludger
	1995	Sainte-Béatrix (6)	July 25 (968)	August 10 (1234)	September 1 (1549)	38	Sainte-Béatrix

* The locations of the plantations are shown on the map accompanying this table.



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