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INCIDENCE OF PESTS IN BLACK SPRUCE SEED ORCHARDS IN ONTARIO

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CATEGORY: Pest impacts
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INTRODUCTION

One strategy for tree improvement programs is the use of seed orchards. Due to the initial investment and intensive management required, seed orchards are arguably the most expensive plantations in Canadian forestry. Pests can seriously affect the health and survival of trees in newly established orchards. To date, most insect and disease research effort has concentrated on cone and seed pests, due to their obvious impact on seed production. Excellent summaries of these pests have been produced (Hedlin et al. 1981, Sutherland et al. 1987, Turgeon and de Groot 1992). However, the impact of insects and diseases that affect foliage and woody tissue has not been studied to the same degree. These can cause whole-tree mortality and affect potential cone and seed production by decreasing tree vigor and causing branch mortality.

In Ontario, seed orchard establishment on a large scale is a recent phenomenon — most black spruce (*Picea mariana* [Mill.] B.S.P.) orchards were established in the 1980s. To address the shortage of information, the Forest Insect and Disease Survey (FIDS) Unit undertook a 3-year survey of seed orchards in Ontario to develop an inventory of pest problems and to determine the relative abundance and impact of each.

APPROACH

Sixteen randomly selected black spruce seed orchards were evaluated from 1990 to 1992 by FIDS field staff. Damage levels (Fig. 1) were assessed on the basis of incidence for nonfoliar pests as follows: trace–light (T–L) damage = 1–5% of trees affected and moderate–severe (M–S) damage = > 5% of trees affected. For defoliating pests and frost, damage was based on average defoliation levels: trace–light damage: 1–25% and moderate–severe damage = > 25%.

PEST INCIDENCE AND IMPACT

1. Armillaria Root Rot *Armillaria* spp.

Armillaria affected 38% of the black spruce orchards evaluated in all years (Fig. 1), but generally less than 1% of the trees were killed annually. However, levels of 6% annual mortality were encountered in 1990 and 1992 (Fig. 2). Orchard trees are often under periodic stress and are vulnerable to this disease, which usually causes whole-tree mortality. Armillaria can spread rapidly throughout sections of an orchard because of the close proximity of trees and the frequent root grafting that occurs.

2. Spruce Needle Rust *Chrysomyxa ledicola* Lagerh and *C. ledi* Alb. & Schwein

This disease was observed in 41% of the evaluations (Fig. 1). In affected orchards incidence of needle rust was high in all years, with up to 100% of the trees affected (Fig. 2). Damage due to defoliation was rated at only trace to light levels. This rust has been previously documented as causing severe defoliation during moist years, but impact is generally considered minimal and control is only justified in epidemic situations.

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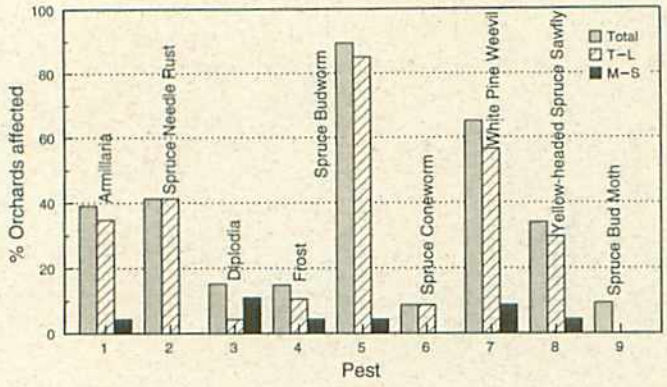
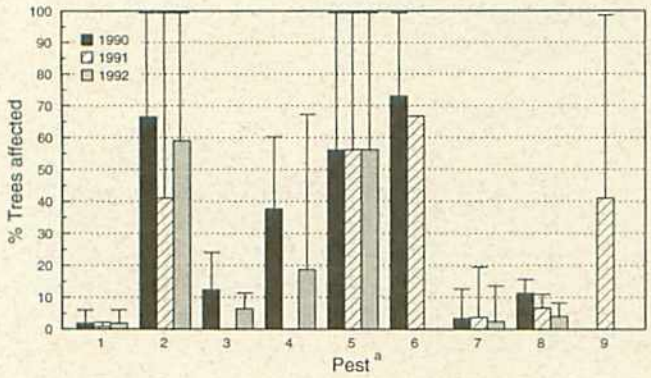


Figure 1. Frequency of pest occurrence and damage levels (trace to light [T–L] and moderate to severe [M–S]) in black spruce seed orchards during the period 1990–1992.



a 1. Armillaria
2. Spruce needle rust
3. Diplodia
4. Frost
5. Spruce budworm
6. Spruce coneworm
7. White pine weevil
8. Yellowheaded spruce sawfly
9. Spruce budmoth

Figure 2. Average percent of trees affected by pests in black spruce seed orchards. Note: T-bars mark the maximum pest incidence.

3. Diplodia Tip Blight
Sphaeropsis sapinea (Fr. : Fr.) Dyko & B. Sutton

This disease was evident in 15% of the evaluations. Damage was assessed at moderate to severe levels in 11% of the evaluations. Diplodia was encountered during the survey and affected an average of 12.4 and 7% of the trees in 1990 and 1992, respectively, in infested orchards. However, infection levels were as high as 24% (Fig. 2). The disease, which typically causes a tip blight, can kill significant portions of the upper stem (Fig. 3).

4. Frost

Frost damage was evident in 12.5% of the orchards evaluated (Fig 1). Damage was assessed at trace to light levels in 10.5% of the evaluations, with little effect to the tree. Damage to potential cone production is less certain. Moderate to severe damage was evident in 2% of the evaluations. Incidence of frost in affected orchards is potentially high, with as many as 60 to 67% of the trees affected in 1990 and 1992, respectively (Fig. 2).

5. Eastern Spruce Budworm
Choristoneura fumiferana (Clem.)

Spruce budworm was the most commonly observed pest in black spruce seed orchards and was found in 87% of the evaluations (Fig 1). The average incidence of infection was consistently between 50 and 60%, with up to 100% of the trees affected in a given orchard (Fig. 2). Although damage to orchard trees is potentially high when the insect is at epidemic levels, only 4.2% of the orchards received moderate to severe levels of defoliation during the course of the study. Low levels of defoliation, while not affecting tree vigor, can significantly reduce future cone crops due to feeding on flower buds. In addition, heavy defoliation is known to inhibit cone production for up to several years.

6. Spruce Coneworm
Dioryctria reniculelloides Mut. & Mun.

This insect was found in 9% of the orchards (Fig. 1). The incidence of infection was considered high in affected orchards in 1990 and 1991 (Fig. 2). Up to 100% of the trees in affected orchards were infested with spruce coneworm in 1990, although damage was rated at trace to light levels. In 1992, spruce coneworm was not detected in FIDS seed orchard surveys. In all cases the pest was found in association with spruce budworm, thereby making it difficult to determine its impact on the host tree. Like spruce budworm, this pest can significantly reduce cone crops by feeding on flowers.

Figure 3. Black spruce orchard tree attacked by diplodia tip blight.

7. White Pine Weevil
Pissodes strobi (Peck)

This insect was present in 65% of the evaluations. Both the incidence of the pest in orchards and damage levels were generally low (Figs. 1 and 2) although moderate to severe damage was evident in 9% of the evaluations. An average of 3% of the trees were affected each year and up to 20% of the trees were infested in one orchard (Fig. 2). This insect can cause significant losses in black spruce cone crops on young cone-bearing trees (2–3 m) if the terminal leader is attacked (Fig. 4).

Figure 4. Black spruce orchard tree attacked by white pine weevil. Note the mortality in the upper, cone-bearing portion of the tree.

8. Yellowheaded Spruce Sawfly
Pikonema alaskensis (Roh.)

Yellowheaded spruce sawfly was detected in all years in 34% of the evaluations (Fig. 1); however, the incidence of this insect in affected orchards was relatively light, with a maximum of 15% of the trees affected (Fig. 2). Damage was generally at the trace to light levels, but moderate to severe defoliation was evident in 4% of the evaluations. Severe and repeated defoliation can result in loss of tree vigor and mortality. The insect is known to concentrate its attack on previously defoliated trees (Ives and Wong 1988) and this may increase the likelihood of damage to orchards.

9. Spruce Budmoth
Zeiraphera canadensis Mut. & Free

This insect was detected in 9% of the evaluations (Fig. 1) but affected up to 99% of the trees in those orchards (Fig. 2). The organism was only encountered in 1991 during the surveys. The impact of this pest was not determined by the survey because it was always found in association with spruce budworm — damage caused by the two insects is similar. The economic impact of this insect on plantation trees has not yet been established. However, since feeding is restricted to the developing bud, impact to potential cone crops is possible.

MANAGEMENT IMPLICATIONS AND CONTROL MEASURES

FIDS surveys indicate that the majority of orchards sustained only trace to light levels of pest damage over the 3-year survey. However, incidence of many potentially harmful pests was found to cause significant damage in individual orchards and/or was recorded at high levels, thereby indicating the potential for damage. Seed orchard trees are often under stress and this can predispose them to attack or increase their vulnerability to pest damage. Due to the value of orchards and individual orchard trees, damaging levels of insects or diseases are unacceptable. Routine pest monitoring and control is recommended because of the relatively small size of seed orchards and the opportunity for intensive management.

A preventive strategy is the best defence. This can be accomplished by choosing seed orchard sites in areas where evidence of Armillaria is minimal, by establishing orchards away from swampy areas where the alternate hosts (*Ledum groenlandicum* [Oeder] and *Chamaedaphne calyculata* [L.] Moench) for spruce needle rust occur, and by not planting in frost pockets.

In orchards with severe Armillaria problems, consultation with a forest pathologist is recommended.

Sanitation, involving the removal of diseased branches and severely affected trees, can reduce the impact of diplodia. Control of weevil through mechanical or chemical means is recommended in black spruce orchards.

Control measures, such as the use of pesticides, should be considered for spruce budworm and budmoth when either heavy defoliation or flower loss is observed or when an outbreak is observed in the surrounding area.

Some control can be provided by foliar applications of *Bacillus thuringiensis* (B.t.) or by applying systemic insecticides on foliage, the soil, or via stem injections and implants (Turgeon and de Groot 1992).

Control of sawfly is suggested when successive severe defoliation is likely.

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