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Screening of Sitka spruce genotypes for resistance to the white pine weevil using artificial infestations

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Abstract

Sitka spruce (*Picea sitchensis* (Bong.) Carr), white spruce (*P. glauca* (Moench) Voss) and Engelmann spruce (*P. engelmanni* (Parry)) plantations in British Columbia (B.C.), Canada, have come under serious attack from the white pine weevil, *Pissodes strobi* (Peck) (Coleoptera: Curculionidae). This pest attacks and destroys the terminal leader of the tree, causing serious growth losses and stem deformities. Since 1993, we have conducted a series of screening trials to search for spruce with resistance to the white pine weevil. Spruce tree selections from across the range of the species have been planted in several replicated trials. At 12 of these trial sites, in order to accelerate the screening process, local insect populations were augmented by adding reared weevils to the site. Results from our two oldest trials, at Jordan River and Cowichan Lake (planted in 1994), both on Vancouver Island, B.C., indicate that screening for weevil resistance can be effectively accomplished by using the weevil population augmentation method. Consistent selections could be obtained in trials with as few as 10 replicates per family. If weevil attack rates of 50% cumulative attack are obtained, then consistent selections may be obtained in as little as 4 years, which is a fairly quick turn-around time for studying resistance in trees.

Keywords: Spruce; Weevil; Genetic resistance; Screening; Pest management

1. Introduction

The white pine weevil, *Pissodes strobi* (Peck) (Coleoptera: Curculionidae), is the most serious insect pest of spruce regeneration in British Columbia (B.C.), Canada. This insect causes damage to Sitka (*Picea sitchensis* (Bong.) Carr), white (*P. glauca* (Moench) Voss), and Engelmann spruce (*P. engelmanni* Parry), as well as to their hybrids, which, in western Canada, are routinely referred to as interior spruce. *P. strobi* has one generation per year, but adults can live for up to 4 years (McMullen and Condrashoff, 1973). Eggs are laid from late April to June in punctures made by the female in the bark of the apical shoot (leader) grown in the previous season, and the emerging larvae feed downward in the bark phloem, eventually killing the terminal leader (Silver, 1968). Destruction of the leader reduces overall tree growth and causes stem deformities (Alfaro, 1989), and thus has a devastating impact on spruce regeneration in western North America. Damage from this insect has forced forest managers to drastically reduce the planting of Sitka spruce in most of coastal B.C., Washington and Oregon (Heppner and Turner, 2006). This is unacceptable, given both the excellent growth and wood characteristics of Sitka spruce and the need to maintain conifer diversity in coastal ecosystems. In the interior of B.C., reforestation with white spruce is now also threatened by *P. strobi*.

Although several control options for *P. strobi* have been investigated, none have proven to be entirely effective (Cozens, 1983; Alfaro and Omule, 1990; McLean, 1992; Rankin and Lewis, 1994; Taylor and Cozens, 1994). Selecting and breeding trees with insect resistance provides one of the most hopeful avenues for minimizing the damage caused by *P. strobi*, particularly if combined with other control techniques (Alfaro et al., 1995). Early screening for weevil resistance, based on observations of attacks on naturally infested provenance trials, indicated three geographic sources of Sitka spruce resistance in B.C.: the Big Qualicum River area on eastern Vancouver Island, an area near Haney in the Fraser River Valley, and the Skeena River area of B.C.'s mainland (Alfaro and Ying, 1990; Ying,

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