# TWIG WEEVIL DAMAGE TO DOUGLAS-FIR SEEDLINGS AND A FIELD TEST OF DURSBAN FOR CONTROL

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The Douglas-fir twig weevil, *Cylindrocopturus furnissi* Buch. (Coleoptera: Curculionidae), is a small weevil, which breeds in young stem tissue of Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) on the west side of the Cascade Range. The distribution and biology of the twig weevil have been described and published (*2*).

To date, this weevil has been an occasional problem for Christmas tree growers in the Pacific Northwest. Damage to Christmas trees is generally confined to a few infested lateral branches and occasionally the terminals of trees several feet in -height. However, in 1976 *C. furnissi* was found infesting newly planted Douglas-fir plantations in the Willamette Valley of Oregon. Feeding by weevil larvae resulted in serious dieback and some mortality among seedlings.

Because insects that affect the survival and growth of young trees are important in intensively managed forests, an effort was made to document aspects of the 1976 outbreak. During 1977, information was collected on type of damage, susceptibility of seedling types, extent of damage, and potential of Dursban 4E (chlorpyrifos), a product of Dow Chemical International, as a control agent.

## Methods

Damage survey. In 1977, 133 2+1 seedlings were examined for the distribution and symptoms of weevil attack. The descriptions developed from this examination were used in classifying seedlings during surveys of weevil damage in five recently established Douglas-fir plantations near Springfield and Cottage Grove, Oregon. During the survey, seedlings were categorized into the following groups: (1) no weevil damage, (2) weevil attack pitched out, (3) discolored stem tissue from larval feeding, (4) weevil-caused terminal or lateral dieback, and (5) mortality from weevil damage. Personnel familiar with weevil damage examined a total of 1,700 seedlings located on a 200 0.004-hectare (0.01-A) regeneration survey plots within the plantations. All plantations were site class II or III and the majority of seedlings were 2+1, although some 2+0 seedlings and 1+0 plugs were present.

**Insecticide test.** Portions of two Douglas-fir plantations south of Cottage Grove, Oregon, were selected for the insecticide trial. The 2+1 stock at these sites was heavily infested with twig weevil.

The life cycle of this insect suggested that an insecticide applied in late July or early August should reduce adult weevil numbers prior to the main egg-laying period, and thus prevent additional damage to seedlings that year. Dursban 4E was selected as the agent for twig weevil control.

Two types of chemical tests were conducted. The first involved the screening of various Dursban concentrations to determine safe and effective levels. The concentrations tested were 0 (check), 0.2, 2, and 4 percent active ingredient (a.i), using water as the carrier. Insecticide was sprayed on the main stem to runoff with a backpack sprayer in late July 1977. Seedlings were evaluated for phytotoxic symptoms in August and for weevil damage in November.

The second test involved an operational trial of 2-percent Dursban applied to 2+1 seedlings by crews using backpack sprayers The area treated was less than 4 hectares. The effectiveness of this trial was gauged by the measured reduction of adult weevil populations following treatment. This approach involved sampling adult weevils with a sweep net by bending seedlings over the net and shaking them to dislodge insects. The number of live weevils falling into the sweep net was then recorded. Preliminary sampling with a sweep net in the summer of 1977 indicated that 2+1 seedlings with visible 1976 damage had significantly more insects than undamaged seedlings. For this reason, sampling of adult weevils during the insecticide trial was confined to seedlings with weevil-caused dieback. A pretreatment sample of weevils on 40 seedlings was made August

1,1977; the 2-percent Dursban treatment was applied on August 10 and 11, and samples were taken of the posttreatment area and the unsprayed check area on August 18. The average number of weevils per seedling was compared using the Student-Newman-Keuls test.

### Results

**Damage description.** Examination of infested 2+1 seedlings for dieback and patches of larval feeding revealed thai 90 percent of the damage was concentrated on the main stem. The appearance of stem damage varied directly with the intensity of weevil infestation. Light larval feeding resulted in scattered patches of reddish-brown bark that contrasted with green undamaged tissue. Heavily infested trees had a swollen appearance in the vicinity of larval wounds and frequent dieback of tissue above the wound (fig. 1). The dieback produced by larval feeding can easily be mistaken for frost damage. Splitting dead stem tissue to find larvae or "L-shaped" pupation chambers in the wood (fig. 2) is the most reliable method for separating weevil damage from other types of dieback.

**Damage survey.** Twig weevil damage was detected at all five plantations. Weevil damage was concentrated on planted 2+1 and larger natural seedlings, with little or no damage on 2+0 seedlings and 1+0 plugs.

**Figure 1.—***Weevil-caused dieback of 2+1 Douglas-fir seedling.* (Photo courtesy of L. N. Kline).

Mean damage levels were calculated from the data on 2+1 seedlings from all five plantations (fig. 3). An average of 16 ± 12 percent ( $\bar{X}$ ± 95 percent confidence interval) of the seedlings examined suffered serious damage, dieback, or mortality; however, most of the seedlings with dieback should eventually recover. In the most heavily damaged plantation, 24 percent of the 2+1 seedlings either were killed or suffered dieback from weevil attack.

All plantations examined had been planted in the winter of 1975-76 and were heavily damaged the following summer. The fact that the weevils bred only in living Douglas-fir suggests that the weevil populations initially built up in trees bordering clearcut areas, and subsequently attacked newly planted seedlings.

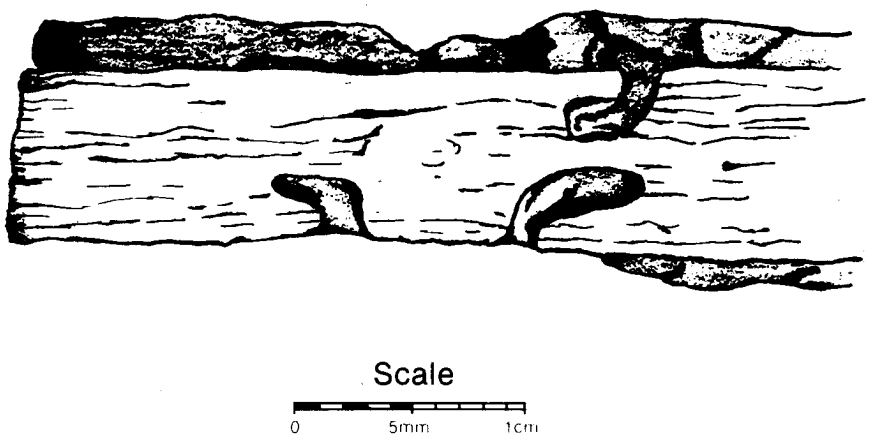


**Figure 2.—***A split section of dead stem showing the twig weevil's characteristic pupation chamber.*

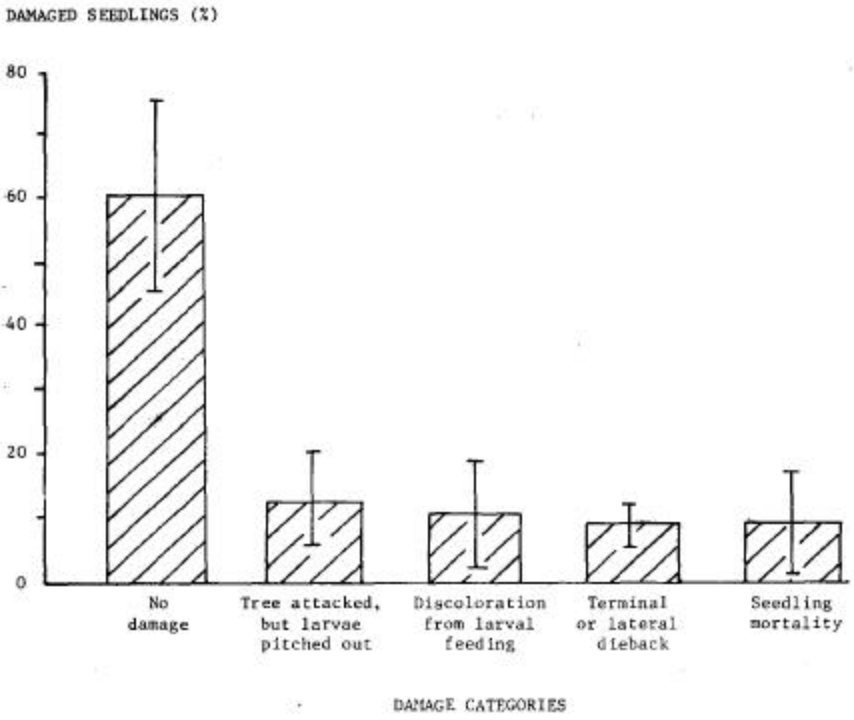


**Figure 3.—***Categories of twig weevil damage on 2+1 Douglas-fir seedlings in 1977 plantation surveys near Springfield and Cottage Grove, Oregon (mean t 95-percent confidence interval).*

**Insecticide test.** Results of the screening test of different Dursban concentrations were inconclusive because of a general decline in weevil damage during 1977. Among untreated check trees, the rate of infestation declined from 38 percent in 1976 to 12 percent in 1977 (table 1). Although differences in damage between the check and Dursban treatments were not statistically significant, the Dursban treatments were consistently lower than the check. No phytotoxic symptoms were observed in any of the Dursban treatments. The collapse of the weevil infestation conforms with previous observations on the rapid increase and decline in weevil numbers (*2*).

In the operational trial, effectiveness of the 2-percent active ingredient Dursban treatment was judged on the basis of reduction in adult weevils. The number of weevils collected after the Dursban treatment was significantly different from both the pretreatment sample and the posttreatment check (table 2). Weevil numbers were relatively stable between August 1 and August 18 on untreated seedlings, but on Dursban-treated seedlings, the numbers declined 97 percent.

**Table 1.—***Comparison of 1976 and 1977 damage among seedlings treated with different concentrations of Dursban on July 29, 1977*

| Treatment (July 1977) | Trees treated | Damaged in 1977 | Damaged in 1977* |
|---|---|---|---|
| | *No.* | *Percent* | *Percent* |
| 4.0% Dursban | 60 | 33 | 0 |
| 2.0% Dursban | 60 | 45 | 0 |
| 0.2% Dursban | 60 | 45 | 2 |
| Check | 60 | 38 | 12 |

* Between-treatment differences in 1977 damage were not statistically significant ($p < 0.05$).

**Table 2.—***Comparison of weevil numbers before and after the 2 percent active ingredient Dursban operational trial.*

| | Pretreatment | Posttreatment | |
|---|---|---|---|
| | | Check | 2 % a.i. Dursban |
| Trees sampled | 40 | 40 | 40 |
| Average weevils/tree* | 1.03a | 0.78a | 0.03b |
| SE $\bar{x}$ | .29 | .16 | .16 |

*Means followed by the same letter are not significantly different, Student-Newman-Keuls test ($p < 0.05$).

## Discussion

From the standpoint of plantation forestry, the twig weevil is a threat primarily to newly planted 2+1 plantations in years when drought or other factors favor high weevil populations. In this study, significant weevil damage occurred only 1 year. Consequently, there is no indication that the weevil will develop into a chronic problem at the sites studied.

The historical abundance of the twig weevil is difficult to judge because the effects of larval feeding are easily confused with frost damage. Within the last decade, twig weevil damage in Oregon was sufficient to be reported in 1968 and 19741, and in 1975 and 1977 (*3,4*). Weevil damage to Douglas-fir reproduction in cutover areas has also been reported in northern California (*1*).

Tests of Dursban for twig weevil control are promising. However, to employ an insecticide against this insect effectively, it is necessary to anticipate damage. At present, knowledge of the factors that favor high weevil populations is insufficient to predict accurately when damage will occur.

[1]Personal communication with L. N. Kline, Entomologist, Insect and Disease Section, Oregon State Department of Forestry, Salem.

## Literature Cited

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