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EFFICACY OF A SYSTEMIC INSECTICIDE IN REDUCING POPULATIONS OF BLACK PINELEAF SCALE (*Nuculaspis californica*)

by Paul T. Flanagan

Abstract. In 2001, 66 ponderosa pines infested with black pineleaf scale near Leavenworth, Washington were selected for an insecticide trial. Twenty-two pines were injected with a systemic insecticide in October 2001; in March 2002, an additional 22 pines were similarly injected. The remaining 22 pines served as a control. Branches were collected in October 2002, and scale density per meter of foliage was compared among the fall treatment, spring treatment, and control trees. Both spring and fall treatments significantly reduced scale densities on 2002 and 2001 foliage. The spring treatment was more effective than the fall treatment.

Key Words. Ponderosa pine; black pineleaf scale; systemic insecticide; plant health; IPM; acephate.

Black pineleaf scale (BPLS) is distributed over a wide range that includes southern Canada, the United States, and northern Mexico. It is becoming an increasingly important pest in the forest – urban interface. In western North America, local populations cause the decline and death of ponderosa pine. Weakened trees are predisposed to attack by bark beetles (Ferrell 1986).

Male BPLS fly in search of females, they mate and lay eggs during June, and eggs hatch in July. First instar larvae (crawlers) are wind-dispersed locally and can infest all needles but show a distinct preference for current-year needles. Soon after settling on a needle, crawlers cease movement, begin to feed, and establish a waxy covering. They

usually become dormant in October. Scale insects begin to feed again in late winter or early spring when daytime maximum temperatures stay above freezing (Ferrell 1986).

The two most important factors that limit BPLS populations are cold temperatures and parasitism (Edmunds 1973). The rapid onset of freezing temperatures in the fall, before scales become conditioned to cold, can result in significant mortality of these insects. Parasitic wasps are often effective at controlling scale populations (Hanson and Miller 1984). An outbreak of BPLS in Spokane during the 1940's and 1950's was strongly correlated to areas receiving high dust fall. A chronic infestation in and around Leavenworth, Washington has resulted in significant mortality of ponderosa pines adjacent to apple and pear orchards. In this case, insecticide drift has apparently reduced parasitism of BPLS by *Prospaltella* near *aurantii* (Howard) to a negligible level (Edmunds 1973).

The objective of this study was to determine the effectiveness of the systemic insecticide acephate in reducing BPLS densities on ponderosa pine foliage.

MATERIALS AND METHODS

During the summer of 2001, 66 ponderosa pines were selected for treatment near the Leavenworth Summer Theatre and Leavenworth Ski Hill. These are high-value trees that provide a visual and noise buffer. Tree number 1 was designated for a March 2002 treatment, tree number 2 was designated for a October 2001 treatment, and tree number 3 was designated for a control. This was repeated sequentially through all 66 trees in order to provide a stratified random sample.

Acephate was used for the spring and fall treatments. Acephate is an organophosphate insecticide that kills insects by disrupting normal nervous system functions. Acephate implants have been used successfully to protect ponderosa pine from ponderosa pine needle miner (*Coleotechnites ponderosae*) in Colorado (Stevens and Leatherman 1982), Douglas-fir from western spruce budworm (*Choristoneura occidentalis*) in Oregon (Koerber and Sandquist 1988), and Chinese hackberry from citricola scale (*Coccus pseudomagnoliarum*) in California (Dreistadt and Flint 1995). The commercially available systemic tree implant Acecap releases acephate (orthene) into primary xylem. An individual Acecap contains 0.875 grams of the active ingredient. A tree with a diameter of 33 cm (13 inches) at breast height would receive 33 * 3.14 / 10.16 = 10 implants. Implants are inserted just inside the inner bark, beginning 15 cm (6 inches) above the ground, with subsequent implants spiraling upward.

In October 2002 a lower needle-bearing branch was cut from each live tree and brought to the Wenatchee lab for analysis. BPLS density was determined with a stereo microscope for 2000, 2001, and 2002 by counting the number of live scales per one meter of needles. Needle length was determined by taking the average length of 10 needles. The Kruskal-Wallis nonparametric test (SAS 1997) was used to test two hypotheses: (1) there is no difference in BPLS densities among treatments; (2) there is no difference in needle length among treatments.

RESULTS AND DISCUSSION

Tree diameters at breast height ranged from 15.49 cm (6.10 inches) to 67.82 cm (26.70 inches). The mean was 38.33 cm (15.10 inches), and the standard error was 1.47 cm (0.58 inches). By October 2002, 15 of the 66 trees were killed by western pine beetles

(*Dendroctonus brevicomis*). The dead trees were distributed rather evenly among the three categories of trees. This level of ponderosa pine mortality is significant but not unusual in the upper Wenatchee Valley. Many of the trees that received acephate had no visible resin response to the implants, an indication of low vigor.

October and March acephate implants significantly reduced the number of crawlers that successfully formed scales on new 2002 foliage ($p<0.006$), and on 2001 foliage ($p<0.027$) (Table 1). BPLS density on 2000 foliage was unaffected by acephate implants ($p<0.60$), probably because older foliage is less desirable to dispersing crawlers.

Table 1. Black pineleaf scale density per meter of ponderosa pine needles.

	Needle Age		
Treatment	2002	2001	2000
Control	97.75 (s.e. 27.28)	178.25 (s.e. 37.26)	113.50 (s.e. 19.99)
October 2001	39.18* (s.e. 13.03)	91.47* (s.e. 16.60)	119.82 (s.e. 27.50)
March 2002	22.06* (s.e. 6.87)	70.00* (s.e. 15.21)	87.59 (s.e. 16.45)

* Significantly different from control (2002: $p<0.006$; 2001: $p<0.027$)

Because most of the annual needle elongation occurs before scale eggs hatch in July, average needle length did not vary significantly among treatments ($p<0.74$). The overall

low vigor of these trees and annual variation in precipitation are also important factors affecting needle length.

On October 2002, unusually low temperatures were recorded in Leavenworth (Table 2). This might provide temporary relief by increasing the mortality rate of scales that were not cold-hardy. However, western pine beetles are actively killing trees, and parasitism by *Prospaltella* wasps has apparently not been effective in reducing the scale population to an endemic level. Repeated injections of acephate might slow the demise of these trees.

Table 2. Daily minimum temperatures for selected dates in 2002.

October 25	-7^0 C
October 26	-7^0 C
October 30	-10^0 C
October 31	-12^0 C
November 2	-13^0 C
November 3	-12^0 C
November 4	-11^0 C

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Entomologist

USDA Forest Service

1133 N. Western Ave.

Wenatchee, WA 98801, U.S.

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