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Control of Western Dwarf Mistletoe With the Plant-Growth Regulator Ethephon

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Abstract

Ethephon (Ethrel[R]), an ethylene-releasing plant-growth regulator, was applied with a hydraulic sprayer to ponderosa pine *(Pinus ponderosa* Dougl. ex Laws.) infected with dwarf mistletoe *(Arceuthobium campylopodum* Engelm. f. *tsugense* (Rosend.) Gill) in the Emmett Ranger District, Boise National Forest. Abscission rates of 60 to 100 percent of dwarf mistletoe shoots were consistently achieved with applications in both July and August of 2,400 p/m of ethephon plus surfactant. Ethephon did not kill the endophytic system of the parasite in the host tissue; new shoots began developing on some of the infections within 2 months after treatment. One year later, most of the female and all the male plants flowered. Results indicated a shorter period of shoot abscission for this dwarf mistletoe. Normal pollen production is interrupted for the year of treatment only, and seed production and dispersal will occur in the second year after treatment.

Keywords: Dwarf mistletoe control, ethephon.

Introduction

Dwarf mistletoes are the most widespread forest diseases in the Pacific Northwest, infecting 41 percent of the commercially forested area in eastern Washington and Oregon (Bolsinger 1978). In the forests of the Intermountain West, more than 3.3 million acres are infected by the plant parasites (Johnson and Hawksworth 1985). The effects of dwarf mistletoe parasitism on trees—growth loss, branch and stem deformity, loss of vigor, and premature death—can seriously affect forest-management objectives.

Control of dwarf mistletoes is centered on silvicultural methods of destroying infected branches or trees to prevent infection of uninfected stands. On September 1,1987, the Environmental Protection Agency approved use of a growth-regulating chemical called ethephon for reducing the spread of dwarf mistletoes.

Ethephon causes mistletoe shoot abscission but does not seem to affect the root system of the parasite embedded within host tissue. By abscising the seed-bearing shoots, however, seed dispersal and spread of the parasite are delayed until new seeds can develop. This delay could allow time for regeneration to become established under infected host trees before they are removed. Treatment is recommended for high-value trees only (recreation areas, administrative sites, or homesites) and has limited use in commercial stands (Johnson and Hawksworth 1989).

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Research with ethephon has been conducted on the following *Arceuthobium* species (Hawksworth and Wiens 1972):

- Lodgepole pine dwarf mistletoe (A *americanum* Nutt. ex Engelm.) in Colorado and California
- Black spruce dwarf mistletoe *(A. pusillum* Peck) in Minnesota
- Southwestern dwarf mistletoe *(A. vaginatum subsp. cryptopodum* (Engelm.) Hawksw. & Wiens) in Colorado and New Mexico
- Douglas-fir dwarf mistletoe *(A. douglasii* Engelm.) in Oregon
- Western larch dwarf mistletoe *{A. lands* (Piper) St. John) in Oregon
- Western dwarf mistletoe *(A. campylopodum* Engelm. f. *typicum* Gill.) on Jeffrey pine *(Pinus jeffreyi* Grev. & Bali) in California.

Shoot abscission ranges from 70 to 100 percent for most tests using ground-based equipment.

Our study objective was to test the efficacy of using a hydraulic sprayer with ethephon at two application times to control western dwarf mistletoe (A *campylopodum)* on ponderosa pine *{Pinus ponderosa* Dougl. ex Laws.).

Methods

A 22-year-old ponderosa pine plantation with moderate-to-heavy dwarf mistletoe infection was located within the Emmett Ranger District of the Boise National Forest. Fifty-two infected trees were selected and tagged at the base. From the lower crown of each tree, one to four dwarf mistletoe branch infections were selected and identified by a numbered metal tag. To delineate the size of each infection, the branch was tied off with yarn at the outer margins of the infection. Dwarf mistletoe shoots in each infection were counted before treatment and 4 weeks after treatment. A photographic record was made of selected individual infections and trees. All trees were randomly assigned one of two application dates (July or August). On each application date, 13 trees were sprayed with 2,400 p/m of Ethrel^{R} (4-percent active ingredient ethephon) plus 0.1-percent Wilbur Ellis R-11 (surfactant).' The other 13 trees served as controls and were treated with water and surfactant.

High-volume sprays of either water or ethephon were applied to all study trees by using a hydraulic sprayer. The crown of each tree was sprayed until runoff during morning applications with temperatures ranging from 65 to 80 °F. Abscission rates were evaluated 4 weeks after each application date by counting the remaining shoots of each tagged infection.

Results and Discussion

Abscission rates ranged from 60 to 100 percent (average 95 percent) for both application dates. Effectiveness of treatment did not differ with application date (table 1). For the few infections where less than 90-percent abscission occurred, inadequate spray coverage may have been responsible because infections were always near the interior of the tree or on a more protected exposure on the branch. One tree from each application date exhibited a phytotoxicity symptom; the older foliage turned reddish brown! Others have reported this phenomena as well (Frankle and Adams 1989, Nicholls and others 1986); no cause has been identified.

'The use of trade and company names is, for the benefit of the reader; such use does not constitute an official endorsement or apprbval of any service or product by the U.S. Department of Agriculture to the exclusion of others that may be suitable.

Table 1—Number and percentage of abscission of dwarf mistletoe shoots on ponderosa pine before and 4 weeks after spray application

Date sprayed	Treatment	Shoots			
		Before	4 weeks after	Abscission rate	Shoots regrown at 1 year
				Percent	
July 13, 1989	2,400 p/m ethephon	1,800	109	94	87
	Control	1,463	1,361	7	
August 7, 1989	2,400 p/m ethephon	1,458	55	96	82
	Control	1,626	1,696	0	

Two months after they were sprayed, many of the infections had begun to regrow (55 percent for the July application and 76 percent for the August). The regrowth was only small "nubs"; few mistletoe plants with more than one internode were observed. After 1 year, all the treated male plants were flowering, thereby suggesting that pollen production was reduced in the year of application only. Also, all but two of the female infections were in flower after 1 year. Twelve percent of the July-treated female infections and 4 percent of those treated in August produced a few seeds (1 -20) the next year. Although differences were not directly calculated, this represented a significant reduction from the seed production of the control infections, which often had hundreds of seeds. Those female infections producing seed in 1 year did not have complete abscission after treatment, which suggests that seeds formed on residual plants.

These results differ from others (Johnson and Hawksworth 1989, Nichols and others 1986) who report an expected pollen and seed elimination of 3 to 5 years with ethephon applications on other dwarf mistletoes. All the previously reported efficacy trials were made on spring-flowering dwarf mistletoe species. The accelerated regrowth and flowering of ethephon-treated *A. campylopodum* may be relevant to its fall flowering habit. Our results suggest that applications of ethephon from midsummer to late summer will successfully reduce the spread of western dwarf mistletoe by reducing seed production by 2 years. A ground-based hydraulic sprayer allows for fairly good coverage on midsized trees.

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