

Moss Control in Container-Grown Conifer Seedlings

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A combination of X77 surfactant and Captan 50W controls moss in Douglas-fir, western hemlock, or noble fir container seedlings. Applications made on cool, cloudy days prevent seedling injury.

Successful growing of greenhouse container seedlings requires a highly skilled adherence to specific cultural practices. Included in these practices is a rigorous disease control program. High humidities and optimum temperatures in Pacific Northwest greenhouses allow rapid buildup and growth of a multitude of disease problems.

Moss is one of the pests that can hinder container seedling growth. Although not technically a "disease," excessive moss growth in the small cavities can severely disrupt conifer seedling growth in several ways. Moss can choke the very young seedling, causing stunting and chlorosis by successfully competing for nutrients and light. A thick moss mat can produce a water-repellent surface, thus depriving the lower part of the cavity of its share of nutrients and water.

To date, the most common method of moss control has been to place coarse granite grit

on the surface of the growing medium after sowing. The grit may be applied at seeding or later. To be effective, moss control must be done at its first appearance. The development of a selective chemical control for moss that is safe for a wide range of conifer species would provide an alternative to the grit, which is not always totally successful. A chemical application would not only be more thorough, but also significantly cheaper than the grit from the labor standpoint.

The possibility that mosses might be selectively killed while leaving the seedling uninjured was discovered while routinely screening fungicides for control of damping off and other root disease fungi. We found it necessary first to wet an unusually thick crop of moss with a surfactant to allow penetration by the fungicide and water carrier. We noted that, in some cases, only 24 hours later the wetting agent had killed back the moss. Further tests with drenches of a high rate of Captan 50W mixed with surfactant for root diseases showed even better moss control. The treatment appeared to desiccate the mosses completely and rapidly.

Materials and Methods

A moss control test was established at the Washington State Department of Natural Re-

sources container nursery in Bellingham. Eight commercially available surfactants were tested for moss control and phytotoxicity to Douglas-fir (*Pseudotsuga menziesii*) and western hemlock (*Tsuga heterophylla*). Combinations of surfactants and Captan 50W fungicide were also evaluated on noble fir (*Abies procera*), western hemlock, and Douglas-fir.

All of the treatments were applied as a spray to seedlings growing in styroblock containers. Treatments were applied with sufficient liquid either to wet the moss or to run off on the seedling foliage. The rate of liquid applied varied with the density of moss or size of seedling and was equivalent to 7 to 10 gallons of spray per 1,000 square feet of treated area. Observations for phytotoxicity and degree of moss control were made 7 and 14 days after treatment, and tree measurements were taken 30 to 60 days after treatment.

Surfactants were tested at three rates of application: 2.5, 5.0, and 10.0 gallons per 100 gallons of water. Captan 50W was similarly added at 20, 40, and 80 pounds per 100 gallons of water.

Results and Discussion

X77 was the least phytotoxic of the eight surfactants evaluated (table 1). Only three wetting agents are shown be-

Table 1.—Effects of three surfactants on the growth of Douglas-fir and western hemlock¹

Treatment ²	Rate/100 gal/water	Western hemlock ³			Douglas-fir ³		
		Height	Caliper	Weight	Height	Caliper	Weight
X77	5	104	106	93	107	96	107
VWR 1	5	99	99	81	91	77	115
TrTad	5	84	86	81	103	77	75
Control	0	100	100	100	100	100	100
X77	10	100	96	98	104	92	104
VWR 1	10	100	99	106	87	81	83
Tryad	10	80	74	59	122	81	88
Control	0	100	100	100	100	100	100

¹Height, caliper, and weight are expressed as percentage of control, which is considered 100 percent.

²X77 is a wetting agent from Chevron Chemical, Ortho Division. VWR 1 is a special wetting agent from Van Waters and Rogers, Inc. Tryad is a dispersant, activator, and emulsifier from Kalo Laboratories, Inc.

³Data are based on four replications of 40 trees each.

cause the others were too phytotoxic to the seedling. Plant height, stem caliper, and total weight of both Douglas-fir and western hemlock seedlings were not significantly reduced by X77. The data are based on one application with measurements made 60 days later. A later similar test with X77 plus Captan 50W was made in the department's Olympia research greenhouse. Results were the same.

Virtually complete moss control was achieved when Captan 50W was combined with X77 and applied to western hemlock and noble fir styroblock-grown seedlings. Tables 2 and 3 present examples of the types of control and phytotoxicity ob-

served in these tests. The X77 was used at 2.5 to 10 gallons per 100 gallons of water, and Captan 50W was added to this at 40 to 80 pounds per 100 gallons.

No phytotoxicity was observed when the optimum rates (2.5 to 5 gal X77 plus 40 to 80 lb Captan 50W/100 gal water) were used and applied under ideal weather conditions. Control of 95 percent indicates that after 30 days the moss was brown and no regrowth was visible. We noted some regrowth of the moss after 30 days in treatments where it had been unusually thick or nearly mature.

Two lots of noble fir were treated—one in which the trees had previous foliar damage and one appearing normal. As

shown in table 2, the application of X77 at the 2.5-gallon rate in combination with Captan 50W was not phytotoxic to the seedlings, but when the X77 rate was increased to 10 gallons, seedling phytotoxicity was observed. Treatment with 10 gallons X77 plus 80 pounds Captan 50W per 100 gallons was phytotoxic on the noble fir that had some foliar injury before treatment.

Application of the X77-Captan 50W combination to western hemlock seedlings under two greenhouse conditions demonstrated that the treatment can be very phytotoxic if applied under high-temperature conditions (table 3). Temperatures in excess of 75° F combined with sunshine may result in extreme phytotoxicity. Ninety-seven percent of the western hemlock seedlings treated at 80°F with sunshine were injured, while no injury was observed when treatments were applied in a normally cool greenhouse (table 3).

Conclusions

Applications of X77 and Captan 50W in experimental and limited commercial trials have demonstrated that virtually complete control of moss can be obtained. We recommend the following application rates and precautions: Douglas-fir, western hemlock, and noble fir do not show phytotoxicity fol-

Table 2.—Effects of combinations of Captan and X77 on noble fir¹

Application rate/100 gal/water		Tree ³ injury	Moss ⁴ control
Captan ²	X77	lb	gal
A.	0	0	20
	0	2.5	15
	80	2.5	15
	80	10.0	8
B.	0	0	0
	40	2.5	0
	80	2.5	0
	40	10.0	3
	80	10.0	0

¹Trees in group A had prior foliar injury. Trees in group B had little or no prior injury.

²Captan 50W is a wettable powder fungicide (Ortho).

³Tree injury is the percentage of seedlings within each treatment with foliar injury, but is not necessarily related to treatment.

⁴Under moss control, 95-percent lull or control indicates that the moss was brown and no regrowth was observed 60 days after treatment.

lowing applications of 2.5 to 5 gallons of X77 plus 40 to 80 pounds of Captan 50W per 100 gallons of water. Increasing X77 to 10 gallons per 100 gallons of water will cause seedling phytotoxicity. Twenty pounds of Captan per 100 gallons of water may be marginal for moss control and over 80 pounds may cause seedling phytotoxicity.

Nursery workers should spray sufficiently to wet the moss thoroughly or to the point of run-off on seedling needles. Application in this manner will result in 7 to 10 gallons of chemicals per 1,000 square feet of treated area. Applications should not be made in sunlight or when greenhouse temperatures are over 75° F. We suggest spraying in the late afternoon on a cloudy day.

Control results will be best when moss is treated while it is still small, instead of waiting for thick moss mats to develop. In thicker mats, regrowth may occur following treatment. One or more repeat applications at 2- or 3-week intervals may be necessary to achieve satisfactory control.

We recommend testing small areas before commercial treatment. Seedling phytotoxicity will vary with species, stage of growth, vigor, and environmental conditions. Disease control will also be achieved with the application.

Table 3.—Effects of temperature on the degree of phytotoxicity to western hemlock seedlings caused by combinations of X77 and Captan

Rate/100 gal/water		Greenhouse temperature			
Captan	X77	60-65° F		80-90° F	
		Tree ¹ injury	Moss ² control	Tree injury	Moss control
lb	gal.	%	%	%	%
0	0	0	0	0	0
40	2.5	0	95	64	95
80	2.5	0	95	51	95
40	10.0	0	95	86	95
80	10.0	0	95	97	95

¹Tree injury is the percentage of seedlings injured by the treatment.

²Under moss control, 95 percent indicates moss was brown and no regrowth was observed 30 days after treatment.