CHEMICAL AND BIOLOGICAL CONTROL OF CYLINDROCLADIUM ROOT ROT IN CONIFER NURSERIES

J. G. Berbee*

In the long-term management of tree nurseries , the view expressed by Emeritus Professor S. A, Wilde is correct. This view holds that drastic chemical treatments of soils for pest control are certain to affect adversely the soil ecosystem. Nonspecific soil treatments applied to control a relatively small number of pathogenic fungi certainly destroy a much larger number of beneficial soil microorganisms. Still, in the short term, drastic soil treatments may be necessary to maintain the continuity of nursery production.

CHEMICAL CONTROL

Root rot of conifers caused by Cylindrocladium floridanum is an example of a disease problem in Wisconsin's forestry nurseries that has required drastic action, During the past decade, continued economic production of pine and spruce transplants would not have been possible without implementation of soil fumigation, initially with Vorlex (40 gal/acre , injected 6" deep) , and more recently with Mylone (200 lb active/acre disced into the soil) _ In experimental trials , these two fumigants proved as effective in root rot control and weed control as methyl. bromide (either alone or with various proportions of chloropicrin) . Trees produced on fumigated soils not only had a higher (10%) water content, but were 50% or more larger on a dry weight basis than those grown on nontreated soil, With soil fumigation, shoot/root ratios were still satisfactory (<4.0). Although soil fumigation did not eliminate mycorrhizae, Mylone treatments clearly decreased the populations of certain mycorrhizal fungi, Soil fumigation has reduced greatly the mortality of conifer transplants , but has not eliminated sublethal root infections . In an effort to obtain better control by fumigation, split applications of Vorlex (20 gal/acre) and of Mylone (100 lb active/acre) are being evaluated. (Mylone is most effective in the upper 4" of soil, while Vorlex works best at a depth of 4 to 8") To the nursery operator, the main advantage of these materials over methyl bromide is that tarping with polyethylene after treatment is not required; a water seal is adequate.

As a less damaging alternative to soil fumigation for root rot control, root dips of transplants in benomyl (1 oz active/gal of water) have been evaluated in Wisconsin over a 4-year period. Large-scale field tests of this treatment have been undertaken in cooperation with John E. Borkenhagen at Hayward, Wisconsin, with Kenneth E. Wojahn at Griffith, Wisconsin Rapids , and with Richard F. Camp at Boscobel,Wisconsin State Forestry Nurseries. In this cooperative work with

*Professor of Plant Pathology and Forestry, Department of Plant Pathology, University of Wisconsin in cooperation with the Wisconsin Department of Natural Resources

the Department of Natural Resources, benomyl root dip treatments have been thoroughly tested on red pine, eastern white pine, Norway spruce and white spruce. On all 4 of these species, root rot control with this treatment generally has been as good as or better than that obtained with a combination of Mylone **soil** fumigation and captan root dips. Root treatment with benomyl increased the numbers of certain mycorrhizal fungi, but provided neither the weed control nor the growth stimulation obtained with soil fumigation. Shoot/root ratios were satisfactory (3.5) with the benomyl treatment. The effectiveness of this treatment, as compared to soil fumigation, was particularly apparent in nursery trials during 1973 involving white and Norwa.y spruces at Griffith State Forestry Nursery. On a trial basis, benomyl root dip treatment of conifer transplant stack is recommendable. A specific EPA clearance may be required for the routine application of this treatment in nursery practice and for its application to conifer stock for sale. Appropriate clearances will be sought.

ENRONMENTAL FACTORS

An understanding of environmental factors affecting the development of Cylindrocladium root rot and stem canker provides some basis for prescribing nonchemical control measures. Since it is a warm weather disease, Cylindrocladium root rot can be minimized by avoiding transplanting during unseasonably warm periods. Since washing the roots of transplants increases greatly the amount of root rot, this operation can simply be avoided or either captan (0.5 oz active/gal) or benomyl (1.0 oz active/gal) can be added to the wash water 'to avoid the build-up. Since development of the very damaging lower stem canker phase of this disease, particularly on eastern white pine, requires a prolonged period (18 days) of moist conditions, seedbed and transplant beds should be planted at economic minimum densities to maximize internal aeration and, thus, to discriminate against the disease.

BIOLOGIC CONTROL

A promising degree of biological control of Cylindrocladium root rot has been achieved with certain nursery cover crops used as green manures. In trials at Griffith State Forestry Nursery, incorporating either flax or of sorghum-Sudan-grass (Hi-Dan 35) cover crops into the soil for two successive growing seasons significantly reduced the amount of C. floridanum in the soil. After these crops had been incorporated biannually into the soil for two additional growing seasons, soil root rot potentials were reduced to insignificant levels. Flax and sorghum-Sudangrass, each seeded at a rate of 30 lb/acre, are recommended as green manure crops for reducing Cylindrocladium root rot in Wisconsin's forest tree nurseries. Legumes, including soy beans, are highly susceptible to C floridanum and are not to be used for cover crops in nurseries where Cylindrocladium is known to occur. A frost-resistant flax crop would be preferred for early spring plantings.

During the frost-free growing season, sorghum-Sudangrass probably would be used because it provides more organic matter for incorporation into the soil.

in Wisconsin, the main thrust of continuing UW-DNR cooperative research on soil-borne nursery diseases will concentrate on the development of effective biological control measures to replace as soon as possible currently recommended chemical treatments of nursery soils