Anderson, N. A., French, D. W., & Bugbee, W. (1962). A New Disease of Conifer Seedlings in the Lake States. *Minnesota Farm and Home Science*, *19*(3), 3–20.

A New Disease of
CONIFER SEEDLINGS
In the Lake States

N. A. Anderson, D. W. French, and Wm. Bugbee

A SERIOUS ROOT AND NEEDLE BLIGHT DISEASE of pine and spruce in Minnesota, Wisconsin, and Michigan forest and ornamental tree nurseries has caused losses ranging from 10 to 20 percent to more than 90 percent.

This disease is caused by the fungus *Cylindrocladium scoparium* Morgan. Most of the damage has been to seedlings in the transplant beds, but the disease has occurred in both seedling and transplant beds. The fungus has been found in 12 nurseries in the three states so it is widely distributed and probably not restricted to these states. So far the disease has remained a nursery problem.

On black spruce, white spruce, and blue spruce, symptoms become evident during the first or second summer in the transplant beds. The seedlings turn yellow and the current year's growth usually droops.

The death of the roots is responsible for the symptoms of the above-ground parts. It begins at the tips and proceeds up the root. The fungus invades the cortex of the root and forms resting structures (microsclerotia). The diseased cortex is easily peeled from the root. With red pine the needles become chlorotic (yellow) and then become reddish-brown.

Infected trees and the soil from beds with infected seedlings have been examined for plant parasitic nematodes. In most cases the population of parasitic nematodes was very low. In these same nurseries the application of nematocides failed to control the disease. While nematodes may be a contributing factor to the disease, they are not the primary agents.

To determine the cause of the disease, isolations were made from diseased roots using different agar media. Three species of Fusarium and one of Cylindrocladium were consistently recovered from the diseased roots and the fungi were inoculated into healthy seedlings planted in sterile soil. The three types of Fusarium were not parasitic either alone or in combination with each other. Up to 100 percent of the pine and spruce seedlings inoculated with Cylindrocladium in the greenhouses were killed within 3 months.

HOST RANGE

To determine the susceptibility to attack by the fungus, 13 species of conifer and 4 species of broad leaf 2-year-old seedlings were inoculated and an equal number left uninoculated. The results are in the table.

The pines as a group were more susceptible than the spruces. Black spruce was more susceptible than either white or Norway spruce. The results obtained in the greenhouse agreed with observations made in the field. The only conifer species tested that was apparently immune to the disease was northern white cedar. None of the hardwood species appeared to be susceptible.

Results of inoculating a variety of tree species with *C. scoparium*

Host	Number of trees inoculated	Percent of trees killed
Conifers		
Balsam fir	50	70
Norway spruce	50	50
White spruce	50	70
Black spruce	250	94
Blue spruce	100	75
Jack pine	50	100
Mugho pine	50	100
Austrian pine	50	100
Red pine	50	100
White pine	50	78
Scotch pine	50	100
Douglas fir	50	22
Northern white cedar	50	0
Hardwoods		
Silver maple	25	0
Siberian pea	25	0
Hackberry	25	0
Cottonwood	25	0
American elm	25	0

(Continued on page 20)

Fig. 1. Black spruce seedlings with needle blight.

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Conifer Seedlings—

(Continued from page 3)

When the needles of pine and spruce seedlings were inoculated and incubated for 2 to 4 days in a saturated atmosphere, the Cylindrocladium fungus invaded and killed the needles (figure 1). Current year's growth of needles was more susceptible than the older needles. Once it invaded the needle the fungus formed thick-walled resting structures similar to those in infected roots. These microsclerotia also formed abundantly in agar media in the laboratory (figure 2).

CONTROL

Of several fungicides and biocides applied to infected nursery beds only methyl bromide provided adequate control. Methyl bromide gas is applied to the soil prior to planting. The application cost is about $400 to $600 per acre.

The soil must be retreated about every 2 years because the fungus can reinvade nursery beds within this time. The fungus produces spores on infected needles and these spores may be carried some distance to reinvade treated soil. Also, the infected needles containing the resting structures (microsclerotia) of the fungus can fall to the ground and the fungus can resume growth.

Therefore, soil fumigation and a fungicide to control needle blight are necessary to completely control this disease. It is possible that certain cultural practices can be developed that would establish less favorable conditions for the fungus. Studies are in progress to determine the best combination of control measures so that the cost of seedling production can be reduced and disease-free stock produced.

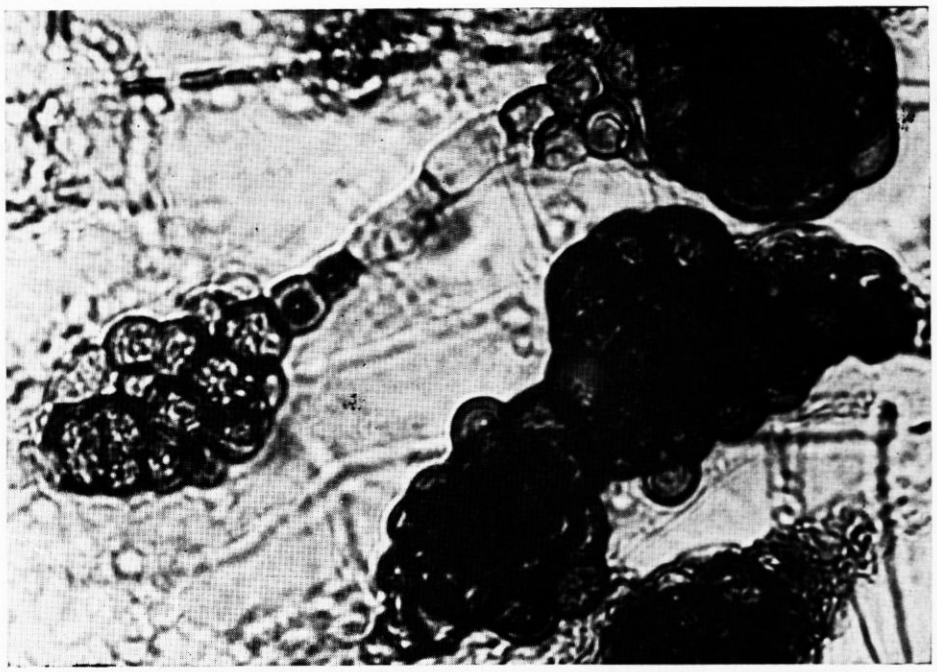

Fig. 2. Microsclerotia of *C. scoparium* which are produced abundantly in sugar.

Bread Wheats—

(Continued from page 16)

texture, and color—are all evaluated by the baker.

After the milling and baking tests are completed, the overall quality of the new wheat samples in comparison to standard varieties grown at the same time and in the same field must be considered. To receive favorable ratings, a new variety must be equal to or better than existing varieties in most of the criteria used. If inferior it is discarded as soon as this inferiority is noticed to be marked and consistent.

Sometimes a new hybrid will appear to have the desired quality factors one year but not the following. Such inconsistencies cannot be tolerated. This is why testing must continue for several years before a decision can be made.

The decision to release a new variety of wheat is not one to be made lightly, nor is it. Each year conferences are held between a number of participating groups to discuss the progress of the breeding program and to consider the release of those varieties that appear, on the basis of years of testing, to be satisfying the requirements.

Only an extremely small number of new hybrid varieties live up to the rigid standards set for them. The vast majority are discarded.

True, many years of work are invariably discarded along with the wheat. However, it is only by setting and maintaining these very high standards that farmers in the hard red spring wheat area can be assured of wheat of uniformly high quality—wheat that will continue to bring premium prices in competition with other wheats on the world's market.

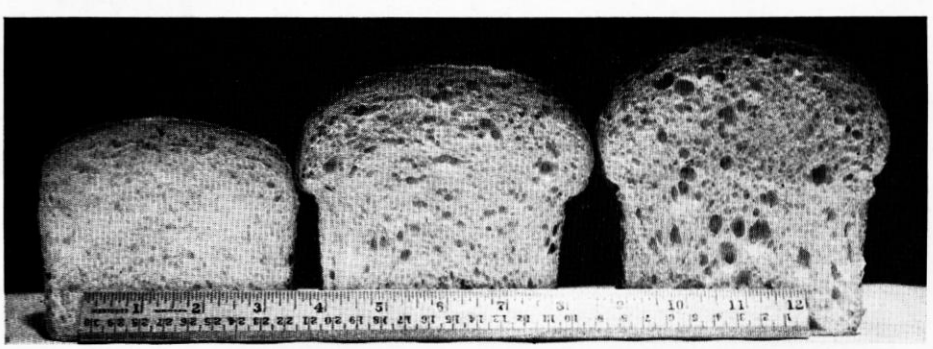

Fig. 2. The same loaves as in figure 1 cut open. The loaf on the left is too dense, that on the right too open. The middle loaf is the most desirable.