

ROOT ROT ON CONIFERS IN THE LAKE STATES

BY
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According to the flyer I received, I'm supposed to talk on root rot on conifers in the Lake States nurseries. I'd like to talk about the one that's causing the most trouble first, and then I'd like to branch out into other diseases.

How many of your nurserymen here today have *Cylindrocladium* root rot in your nurseries. I'd like a show of hands. Come on now, up with the hands, let's not be bashful. It looks like over half of you have it in your nursery at the present time.

Cylindrocladium scoparium. This fungus has a very wide host range. It attacks most of our conifers in the Lake States nurseries, and to make things a little more difficult, it also attacks a variety of plants which may be around your nursery. This includes most of the legumes, and such plants as watermelons, ...roses, and cucumbers, so that by controlling it just on your nursery stock, you can't always get rid of it. There are three cover crops that are very resistant to this fungus, these are flax, wheat and barley. I'd like to show a few slides that show some symptoms of this disease. Many of you are probably more familiar than I am with these symptoms, but for you fortunate few who don't have *cylindrocladium* in your nursery, maybe we can give you some idea of what you will run into. The first is damping off, both pre-and post-emergence. At this point, you probably couldn't tell it from the other types of damping off due to *Rhizoctonia* and *Pythium*. The seedlings will become shrunken, dry up and turn red, and look just like the rest of the damping off symptoms. The next symptom and the one that you'll see the most in the nursery is your root rot symptom. In this case the fungus, of course, attacks the growing root tips - it starts at the tips and moves backwards towards the root crown.

The first slide is the host range as far as our Lake States conifers. As you can see, it does a pretty good job. It doesn't leave many out. This table is based on a greenhouse study - the soil was inoculated with the fungus, and then the seedlings were planted. The only one we've got here that didn't show any symptoms of mortality was white cedar. This next slide, of course, is a white pine, and here you've got this main symptom pattern, no roots, that's your problem. As for the disease cycle on *Cylindrocladium*, many of you may be familiar with this, it overwinters in the roots in the form of micro-sclerotia, that's a big-sounding word for a very tiny resistant resting stage that the fungus has. This is the stage that causes all the problem. It also overwinters in needles that are infected, and haven't dropped off. The following spring these micro-sclerotia that are in the soil will germinate,

and they'll infect the growing tips of the new seedlings and the transplants. When you have infected needles above ground on trees that are infected, the fungus will start growing again in the spring and produce conidia, which is a spore stage. These conidia can move through the air, they're windblown, and they will infect other needles and cause the needle blight stage. This is a symptom that some of you may not be familiar with. It shows up if you have a very high humidity in your nursery. I'll have a few slides later that will show this in more detail.

Cylindrocladium root rot can be controlled with soil fumigation, but this fumigation has to be deep down to at least 12". The current recommendations for fumigants are: Methyl bromide at 450 to 600 lbs. per acre; Trizone at 200 lbs. per acre, and some nurseries are also using Mylone at 125 lbs. per acre of active ingredients. This gets to be pretty expensive. Mony in 1961 estimated his cost of Methyl bromide treatment, at \$388/acre with the methyl bromide costing 590 per pound. Kimberly-Clark ran a cost analysis on their Knife River nursery, where they were controlling root rot on black spruce. They paid a little more for their Methyl bromide - 64 a pound - they applied it at about the same rate, 450 to 550 lbs. an acre. In their seed beds they computed their cost, including labor, at \$788.00 an acre, and around \$750.00 an acre in their transplants. That's a lot of money. When you put that on 1,000 tree basis it was 28 per thousand. That isn't so bad, but for their transplants it was \$4.30 per thousand.

Trizone is probably being used more now than Methyl bromide, and that's a little cheaper. At the current price of \$1.30 per lb. for the Trizone, costs are running around 5425.00 an acre. Of course, you get some of this back in terms of increased vigor on your trees - they have better color, they're larger than your other stock, and you get a big return on your weed control using these fumigants. This cuts your weeding costs down considerably.

Mylone, of course, is the cheapest of the three, because it does not require a polyethelene covering over the nursery beds. Costs are running around \$185.00 an acre, at 125 lbs. of the active ingredient per acre. I have a few objections to using Mylone. First of all, we've had inconsistent results with it. Sometimes it has controlled Cylindrocladium and sometimes it hasn't. It also will give you a seedling that has an excessive height to diameter ratio, the seedlings have a low specific gravity as well, and one other big problem with Mylone is the damage that it may cause to your seedling bed or transplants if you haven't gotten all the chemical out of the soil before you plant. I'll have a slide a little later showing what happened to us on one of our experiment plots. We put the Mylone in and we waited three weeks before planting, but it was cold weather, it was done in May, we planted the first part of June. I think the Wisconsin Conservation Department now is recommending putting tomato plants into your transplant beds ahead of time, and leaving them there for four

days. This is the sensitive test for Mylone's presence and in our experience, if you're going to use Mylone, I think this would be a wise investment, because it does do damage if there's a little left in the soil, and if you just get slight damage, you won't know if this is from the Mylone or if it's from the *Cylindrocladium*. If we can go back to the slides again, I'd like to show a few of the slides showing Methyl bromide application. We better run through these fast, because I think Daryl Benson is going to give you the full picture over at Eveleth on this a little later in the week.

This is needle blight. It can be controlled with a periodic spray program. I don't know how many of you are having trouble with this at the present time. You may be having it in a mild form and not even know it, but Copper A at 4 lbs. to 100 gallons and Fermate at 2 lbs. to 100 gallons will control the needle blight stage. This is with a 3-week interval between sprayings. We used Tween 20 as a spreader and Plyak as a sticker. As far as other control methods for *Cylindrocladium*, some people are using Captan at the present time in their transplant water if they're keeping their transplants wet while they are moving from one area to another. This is okay. It helps prevent spread from one plant to another, but I got the impression from some people that they think that they are actually eradicating *Cylindrocladium* from the tree by dipping it in Captan, and this isn't so. Captan is not an eradicant at all. This micro-sclerotia which is present in the dead roots or in the root cortex is so resistant to any chemicals that I know of no treatment that you can use at the present time that will kill the fungus that won't kill the tree. So if you think you're getting rid of *Cylindrocladium* on your stock by dipping it in Captan, you better check your literature because it just doesn't work that way.

There's one control that I left for last, and I'd like to step on a few people's toes this morning, this control is, don't accept material from other nurseries. I know of at least three nurseries now in the Lake States that brought in transplant stock from other nurseries because they weren't growing them from seedlings - they brought them into their nurseries, and now they have *Cylindrocladium*, they want to know, what they can do to get rid of it. You can't get rid of it, you can control it, but you can't eradicate it. It will be all around your nursery, it can be spread on your tools, it's apt to be present in this needle blight stage, on any of the trees around the nursery, it's apt to be on your clover that's on the edges of your paths. Once you've got it in your nursery, you're going to have to learn to live with it. But the best control I know of is, don't accept nursery stock from other nurseries. I know there's a lot of pressure on some of you at the present time to take in stock, especially experiment stock, but they are really asking for trouble. If you've got a clean nursery and you don't have *Cylindrocladium*, fight them to the last drop, because if you bring stock in from a nursery that's got *Cylindrocladium*, I don't care what you do to that tree, unless you put it in a chamber and treat it with Methyl bromide for a long period and in the process kill the seedling, you're not going to get rid of it, and you're going to have your nursery infected. I don't know how much stronger I can make that point.

Before I go on to any of the other diseases, are there any questions on *Cylindrocladium*.

Question: What effect would this have on planting?

Skilling: As far as we can tell, and there are some tests out at the present time, once your tree gets out into the outplanting site, if it makes it through the first year, chances are, it will recover. What evidently happens is, *Cylindrocladium* is a poor competitor with some of the other micro-organisms in the soil. In the nursery bed where your stock is close together, it does quite well. Get it out and mix it in the forest in the soil that's got a lot of other organisms in it and we can't isolate it after about three months. It seems to disappear. We were worried about this for a long time. We thought we might be taking *Cylindrocladium* and putting it out into all of our plantations, but this doesn't seem to be the case at the present time.

Question: Could this be one of the sources of failure being recognized as such? That failures that might be laid to drought, or something like that?

Skilling: It's possible, although if they're grading the stock at the time it's going out, they'll catch most of the trees that have bad root rot symptoms, so I wouldn't think that it's a major cause of plantation mortality at the present time, if you've got a grading program, and you're pulling out your weak stock. The major symptom, of course, is that the plant hasn't any root system left, and that tree would normally get thrown out in the grading process.

Question: Is there any way to account for why this shows up more positively in transplants than seedlings? You take seedlings that are supposedly inoculated and leave them go from a 2-0 over to a 3-0, and you don't see any symptoms at all, but you transplant that seedling and it goes to pieces.

Skilling: I'm not sure on this. I'm guessing a bit. It's possible that it's caused by the shock of the transplanting reducing the vigor of the tree for a short period, giving the fungus a chance to really get moving. But don't quote me on that, I don't know. I can't give you a good answer on that.

Question: This disease is also highly tied up with weather conditions, isn't it.

Skilling: Oh, I wouldn't say so, no.

Question: There are times at transplanting when you don't get it at all, and then on the other hand you do.

Skilling: This is the most variable fungus that you can find. I can remember when we were putting experiment plots in and testing different chemicals against *Cylindrocladium*, you never knew what was going to work. Sometimes your control would look beautiful **and** your treatments wouldn't show through. At Chittenden about 10 years ago we had some plots in, and you could never be sure what was going to work. We eventually came up with a control, but when we were first trying several different chemicals, quite often our check plots would look the best. This thing can vary tremendously, but whether it is a factor, and how important, I don't know.

Question: If you isolate the fungus from the needle? Down into the roots?

Skilling: Oh, yes you can get it on the needles. It doesn't follow the seedling down into the roots. What would usually happen there, your needles would die and drop off and get into the soil. Probably it would never hit the roots on that particular tree that year. It would perhaps catch it the next year. That's not the normal way of spread in the nursery. It isn't from the needles into the roots. The normal spread is from plant debris in the soil that already has this resting stage, this micro-sclerotia, this germinates in the spring, that's where you get your root rot symptoms. Any other questions?

Question: I was just wondering, is this root rot, this fungus, is it peculiar to certain soil types, or certain Ph. ranges - I mean, can you distinguish it?

Skilling: It's especially bad on heavier soils, or the wet soils, but you can find it on almost all of them. I know some very nice sandy loam nurseries that have plenty of *Cylindrocladium*, so I wouldn't count on that keeping it out of my nursery.

Question: But then the other question would be, say with respect to affecting deciduous stock as easily as affecting say, conifer stock?

Skilling: We haven't worked with this much on deciduous stock so I'm going to have to watch myself here. It does hit a lot of the deciduous trees. I don't have a host range with me this morning on that, so I'd better not say much about that, but it does hit a number of deciduous trees. We haven't had real serious problems that I know of in our nurseries, at least, they haven't been reported to us.

Question: Just out of curiosity, have you noticed it on black walnut?

Skilling: No, I haven't, at least, I haven't received any reports on that. Most of our reports, in fact, all the reports we have had were on conifers.

Question: How long do these controls last? - - - Three years?

Skilling: Yes, I believe so, on the 3-0 seedlings, now if you were doing 2-1 at the time of transplanting, you'd have to refumigate, but if you're leaving them in for three years in the bed.

Scleroderris canker. In the Upper Peninsula of Michigan, especially on the Ottawa National Forest, we were perplexed by a disease problem for a number of years. We tried without success to isolate a Pathogen, and we blamed it on just about everything we could think of. Last year, through a stroke of good fortune and help from our Canadian neighbors, we found out what Pathogen was, and now of course we can isolate it every time. But it turned out that it took a special set of circumstances, a special incubation temperature to get it out in culture. This fungus is called Scleroderris lagerbergii. That's quite a mouthful. You may know it by the old name of Jones' disease when it was a plantation problem. The hosts that it's bothering most in the Lake States are red pine, jack, and Scotch. Of these three, it's hitting red worst. In the outplanting test that the Lake States Station has at the present time, all the red pine are dead and the jacks are still dying. There's about 50% mortality in the jack and Scotch, but the red pine are a complete loss. This fungus has a wide range. It's been known in Europe since 1912, and it's been giving them problems since 1912. It's a cold weather fungus and it gives the most trouble in Europe in the Scandinavian countries and in the Swiss Alps, and it's giving us the most trouble in the northern areas - we have problems in the plantations, especially in frost pockets, although when I say frost pockets, I'm not thinking necessarily of the characteristic kettle-hole type of area. You can have a frost pocket on a very level field where you don't get drainage of the air, so that sometimes frost pockets can be foolers. Now, the symptoms of Scleroderris are several. The one that you might see in the nursery at the present time is a bud drought symptom, and what I mean by bud drought is, in the spring the buds look dry, and they don't start growing, or they may grow maybe an inch or two and then the tree just starts to dry up and dies. The first plantation symptoms would be, dead laterals showing up. You might think it was possibly snow breakage, on closer inspection if the socket wasn't ripped out, you'd think, well maybe we've got a little spittlebug in here. But there's no sign of spittlebug either. The fungus has two spore stages, one is wind disseminated, and the other is usually disseminated by rain. The fungus enters the needles, goes into the side branches, and then on into the main stem, and girdles the main stem. In a way it acts quite a bit like blister rust in that it follows the same general pattern of killing.

In the plantations, one of the best diagnostic characteristics that I know of is a yellow-greenish discoloration under the bark in areas where the fungus is active. If you peel back the bark with a knife, you'll find a pronounced yellow-green color, this has been almost 100% indicator of Scleroderris in plantations that we've looked at; wherever we get that greenish color, we can take that material into the lab, and isolate Scleroderris from it. As far as its economic importance, in Europe it's very severe. I'd like to quote some figures from Sweden, their worst year was 1958. Earl mentioned that we were planting 10-million trees per year in Minnesota - well, Sweden lost 20 million in the year 1958 from this disease in the nurseries, and that's not a very large country. They have a control program going in Sweden for it now, but they figure since 1958 they've lost about 75-million trees from this fungus, as a nursery problem, not as a plantation problem. It causes mortality there too, but they are having their worst problems in their nurseries.

In the United States, we have it in two areas at the present time, and it's in one area in Canada. In Canada it's on the Kirkwood Management Unit which is north of Sault Ste. Marie, Ontario, and it's also in the nursery at Kirkwood as a nursery problem at the present time. In the Lake States, we have it on the Ottawa and the Hiawatha National Forests as a plantation problem, and it's present on the Nicolet National Forest in small amounts. As far as being a nursery problem here at the present time, we have not isolated it from any nursery. We have suspicions, but up to this point, I checked my cultures just before I came to see if I'd finally gotten it out, and Stu, you're still clean, but the reason that we're suspicious, and I think this ought to be brought out; there are a lot of plantations now that are dying within one or two months following planting. We had one last fall that was especially bad. It was a 200-acre plantation on the Kenton Ranger District. The ranger said that he had good planting conditions, moisture was good, temperature was cool, and that 200 acres might just as well not been planted. I'll bet you there isn't one tree in a hundred that's alive now. They didn't start growing this spring. I was out there in early June and those trees were just sitting there, the buds were dry, and a few of them started to grow, and maybe the terminal grew an inch or so, and then the tree died. There isn't one tree out of a hundred left on this 200-acre plantation. It was a wild land type planting, they went in and smashed down the aspen and furrowed, and then hand planted, but they never started growing this spring at all. We have some spring plantings that are also dying within one or two months following outplanting.

So we've been concerned that this disease may have started in the nursery, and that the trees were inoculated in the nursery. According to the Swedes, the symptoms in the nursery are not very strong - you get a needle flecking, you might have a slight yellowing of the foliage, but it would be very tough to recognize it. I'd like the nurserymen to know about this disease, and if you begin to get reports of severe

mortality from so- cause that you're not sure of, especially in the northern areas, we'd like to know about it, and we'd like to take a look at some of that stock. I mentioned that the Swedes are controlling this, and maybe this is the bright spot in the picture - they're using Maneb at 1%. This is a magnesium fungicide, and they're putting it on their new seedlings after they are about four weeks old, they spray them every two weeks. On their transplants they wait until the current year needles are about 1/2 a centimeter long and then they start a 2-week spraying with them. So they do have a control that is working in Sweden at the present time, and if we find it in our nurseries, we should be able to do something about it. First of all, we've got to recognize the problem and then we'll work on it from there. Unfortunately, I don't have any slides of this as a nursery problem - maybe it's fortunate that I don't, but I do have some slides that will show some of the symptoms in the plantations, and if we can have the lights now, we can run through that series.