

Phomopsis Spruce Decline

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Figure 1. A 40-year-old Colorado blue spruce with the symptoms of Phomopsis spruce decline, which includes loss of needles and death of branches. The symptoms started on the lower portions of the tree and have worked their way up the tree.

What is happening to our spruce trees? It appears that many of the spruce have, in near synchrony, begun to lose needles and branches from the bottom up (Figure 1). Depending on to whom you speak, some may call this needlecast, some may call it shoot blight (Figure 2) and still others may call it a canker disease. The reality is that they all may be right and they may all be wrong. Since spruce trees already have a common needlecast disease caused by *Rhizosphaera*, there is a good possibility that *Rhizosphaera* is on the needles of the trees and causing needle loss. Since there are at least two, maybe more, common shoot blights of spruce caused by *Diplodia* and *Phomopsis*, the shoot death that we are seeing could be caused by one or the other or both fungal pathogens. And, the branch death — could that be caused by the common canker disease of spruce called *Cytospora* canker? Yes, that is possible and even probable. We could end this article here by saying that some common diseases of spruce are intensifying due to unknown reasons, probably due to environmental circumstances, and spruce trees are dying or being taken down as the outcome. We could say that and be done with it. But, we don't believe that is the entire story.



Figure 2. Phomopsis shoot (tip) blight of Colorado blue spruce observed in Wisconsin and Michigan nurseries and tree farms.

With the scenario described above, we are leaving out something that could be a major part of the story. It was during the time that our laboratory was studying a new fungus growing on the needles of spruce (we thought that fungus might be the cause of the spruce tree problem), we noticed that the branches on spruce trees in nurseries, on tree farms, and in the landscape had several cankers under the thin bark. These cankers were not associated with the known fungal pathogen *Cytospora*, but instead the fungus *Phomopsis*. These cankers could be quite numerous on trees that had been in place 35 to 40 years or more. The cankers were very difficult to see as the external bark gave few clues as to the location and presence of the cankers below the bark. In a few cases, these cankers wept sap, which is usually diagnostic for *Cytospora*. The leaking sap helped us find the cankers under the bark, which proved to be *Phomopsis*. Sometimes we even found *Cytospora* associated with cankers, but most of the time, we have found *Phomopsis*. Based on our DNA work, the *Phomopsis* found on nursery seedlings can be the same *Phomopsis* that is found in the cankers on mature landscape trees.

At the minimum, the *Phomopsis* cankers are adding another degree of difficulty to the survival of the spruce trees; and at the other end of the spectrum, the *Phomopsis* cankers are trumping all other spruce diseases and are slowly killing the trees. But, we are getting ahead of ourselves. We have not proven that this *Phomopsis* even has the power to cause the cankers on these older mature trees. So far, it has been guilty by association, and there has been a lot of association.

Currently, it appears that Engelmann spruce (*P. engelmannii*), Colorado blue spruce (*Picea pungens*), White spruce (*P. glauca*), and Norway spruce (*P. abies*) are ranked,



respectively, from most affected to least affected. However, we have isolated *Phomopsis* from branch cankers found on diseased branches on all of these tree species in various locations in Michigan. It is clear that Colorado blue and Engelmann spruce are the most susceptible, but all of these species are suffering branch death and *Phomopsis* has been isolated from all of these species.

What's new about *Phomopsis*? *Phomopsis* has been a rare visitor to the nurseries and tree farms in the state. The first major outbreaks were shoot blights (Figure 3) in Wisconsin in the 1980s and a decade later it was found in nurseries and trees farms in Michigan. In both cases, it was declared a different species than the one that our laboratory has been finding. To be fair, current DNA analyses take much of the guesswork out of identifying pathogens. Both Wisconsin and Michigan State University research laboratories used the best methods at the time to determine the species. Our laboratory simply sequences portions of the DNA to make comparisons based on the sequences of other species placed in the database. We are simply saying that the DNA sequences do not match up with their species determination, indicating they may have found a different species than the ones we are finding. If it is a new species, then we have a better case to make in saying this new *Phomopsis* is causing a new branch canker on mature and young spruce trees. But, if it does end up being the same, we need to rationalize how this disease of the spruce nursery and tree farm has moved out to the landscape and begun to cause infections of branches leading to unsightly landscape spruce trees.



Figure 3. A much younger blue spruce than in Figure 1, located in Allendale with symptoms of thinning needles and some branch death. Lower branches were detached and taken back to the laboratory for diagnosis.

Symptoms generally start at the bottom of the tree, where branches thin and needles drop (Figure 3). Shoot tips can become infected if the typical shoot blight symptoms are initiated (Figure 4). Ultimately, these branches will die due to cankers that form along the branches (Figure 5). The symptoms appear to follow a needlecast-like progression being found where moisture stays the longest on the tree including the base of the tree where branching is thickest and rain and dew

remain the longest. But, it does not stop there. The symptoms (dead branches) continue to progress toward the top of the tree (Figure 1). Generally, the crown is the area where needles and branches dry the fastest and therefore, much less disease is found near the crown. However, we have been able to find *Phomopsis* from the lower branches to the top of the tree.

There is another common symptom and that is when the branches appear to become straight and rigid and most of the interior needles turn brown or purple and begin to drop off of the tree. The tips of the branches may be bright blue (if a Colorado blue spruce) and that contrasts with the darker needles of the second and third year needles in the interior. This symptom may be found on most of the tree from the bottom to near the top of the tree. In the late winter and early spring the needles on some trees fell on the top of the late March snow, well before most needlecast infected needles would detach and cast. In most cases, a tree can appear healthy and within two years begin to show dramatic symptoms.

Koch's postulates is the name of the scientific test that plant pathologists use to determine if a microorganism can actually cause disease. We have tested a few of our strains and found



Figure 4. *Phomopsis* shoot blight can be found on the terminal end of the branches from the tree in Figure 2, indicating that *Phomopsis* can be found as a shoot blight on the trees in the landscape.



Figure 5. Typical canker on branch of spruce tree observed in Figure 2. The bark was removed until the canker was discovered. Then, tissue on the edge of the canker was cleaned and sterilized and placed on culture medium. *Phomopsis* was cultured from this canker and others on the branches of the tree in Figure 2. The branch still shows some vigor, but as the canker enlarges, the vigor of the branch will probably decrease.

that some could cause disease on young seedling trees in the greenhouse, but we have not tried to determine if the *Phomopsis* strains isolated from cankers on mature trees can cause cankers on large mature trees. Therefore, we have not proven that the strains found are in fact the actual cause of branch death or appear because the branches are dying. This is what we are currently working on in the laboratory and greenhouse.

The most commonly used chemical to manage *Phomopsis* shoot blight in the nursery and tree farm is thiophanate methyl. But, this is primarily used to manage the shoot blight. Trying to manage infections under the bark (cankers) will be asking a lot of this material.

In summary, we have found cankers on the branches of spruce trees that are showing symptoms of needle loss, shoot blight, and branch death. The symptoms continue to accrue and move upward killing branches of the various whorls or scaffolding. Sometimes it is easy to see right through the spruce trees. We have not proven *Phomopsis* to be the pathogen causing symptoms of the large landscape trees, but we have performed Koch's postulates using young greenhouse-grown nursery trees, so we believe the *Phomopsis* strains in our collection are pathogens. We also believe that other fungal pathogens are still present on these trees and that they also may play a role in the disease we are calling Phomopsis Spruce Decline. Most of the spruce trees in Michigan are still very healthy and trees with the symptoms appear to be in the minority.



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