

The Old and the New: Two Needle Diseases of Spruce in North Dakota

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Spruce (*Picea* spp.) is commonly planted in urban and rural landscapes in North Dakota and frequently suffers from needle loss. In general, healthy spruce retain four or more age classes of needles (Fig. 1). Premature needle loss of spruce is the result of a variety of causes: improper planting, environmental stress, insect pests and disease. Rhizosphaera needle cast and stigmata needle cast are two of the most common diseases associated with spruce needle loss in North Dakota (Fig. 2).

Needle diseases cause the most damage when the needles on the lower branches, the shady or wind-protected side and the interior crown stay wet for extended periods or when irrigation water contacts trees. If conditions favor disease development, the symptoms typically progress from the areas that are the most favorable to those that are less favorable during the course of several years (Fig. 2). This may result in only the current-year needles remaining green (Fig. 3), giving trees a sparse and hollow appearance.

Rhizosphaera needle cast and stigmata needle cast infect Colorado blue spruce (*Picea pungens*), white spruce (Black Hills) (*Picea glauca*) and Norway spruce (*Picea abies*). Both diseases have similar signs and symptoms but can cause different amounts of damage and require somewhat different management strategies, making disease diagnosis essential.

Both pathogens may be present at the same location and even on the same needle. Correct identification requires microscopic observations and measurement of the spores. For a small fee, samples can be submitted to the Plant Diagnostic Lab at NDSU for disease identification. Send samples to: NDSU Plant Diagnostic Laboratory, Department of Plant Pathology, 306 Walster Hall, NDSU, Fargo, ND 58102.

For more information about the lab, visit
www.ag.ndsu.edu/plantpath/plant-diagnostic-lab.

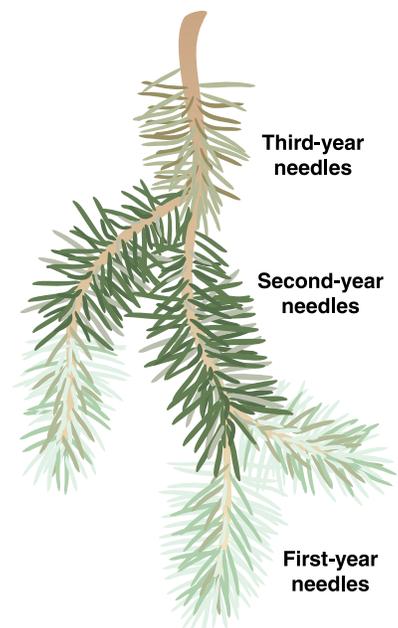


Fig. 1. A diagram of a spruce branch depicting three different age classes of spruce needles.



Fig. 2. Spruce trees infected by a needle cast disease with typical needle loss symptoms on the bottom two-thirds of each tree.



Fig. 3. Two spruce branches showing the typical range of needle cast symptoms on infected needles.

Rhizosphaera Needle Cast

Rhizosphaera needle cast is caused by the fungus *Rhizosphaera kalkhoffii*. This historically has been the most common spruce disease in North Dakota.

Signs and symptoms of the disease: The first symptom that appears is a faint yellow band on a needle. The band gradually expands and changes from yellow to brown to reddish brown or purple. Discolored needles may fall off the tree or remain attached for up to two years. The characteristic sign of this disease is rows of small dark brown or black smooth spherical fruiting bodies (pycnidia) that emerge through the stomatal pores on all sides of infected needles (Fig. 4). Pycnidia are observed easily with a hand lens when mature. On severely infected needles, the pycnidia may appear to the naked eye as continuous fine black lines up and down the length of the needle.

Disease cycle: Rhizosphaera needle cast has a one-year life cycle. In North Dakota, pycnidia produce spores in late May through July during periods of wet weather. These spores are spread by rain splash and will infect all age classes of needles. The first symptoms of the disease on newly infected needles will not appear until spring of the following year. Pycnidia often appear by late May and spores are produced soon after. Needles that remain attached to the tree and those that recently fell to the ground may continue to produce spores.

Disease management

Species selection – Spruce species generally have different levels of resistance to rhizosphaera needle cast. Colorado blue spruce is the most susceptible, white spruce is intermediate, and Norway spruce is resistant. If rhizosphaera needle cast is a concern, consider planting Norway or white spruce. However, an important fact to note is that white spruce appears to be highly susceptible to stigma needle cast. Do not plant susceptible spruce trees near large spruce plantings.

Cultural control – Ensure adequate spacing between trees, plant new spruce trees in sunny locations so needles dry quickly, facilitate air movement to promote needle drying by pruning lower branches of spruce trees, and ensure that irrigation water does not wet trees artificially. Removal of severely infected trees or severely infected branches will reduce the source of spores causing new infections. Interplanting different tree species among spruce trees also will help limit the tree-to-tree spread of this disease. Carefully inspect any new spruce trees that will be planted to ensure they are free of signs and symptoms of the disease. Finally, maintain vigor by

including supplemental fertilization, avoiding sites or conditions too wet or dry for spruce, avoiding damaging herbicide application near the tree, reducing root competition with other plants and avoiding damage to tree roots.

Chemical control – Fungicide application at an appropriate timing is a management tool for rhizosphaera needle cast. The timing of these applications is extremely important. The first application should be applied just after bud break when needles are approximately half the size of the previous year's needles. New needles should be protected for a minimum of two months for two to three years. This allows infected needles to be shed and decompose while protecting the new needles.

Stigmina Needle Cast

Stigmina needle cast is associated with the fungus *Stigmina lautii*. This disease rarely was recognized before 2006, but it now is known to be widespread east of the Rocky Mountains in the United States and Canada.

Signs and symptoms of the disease: Symptom development is similar to that of rhizosphaera needle cast. Infections result in narrow yellow bands and immature fruiting bodies that are not easily visible until the following year. Multiple bands and areas of fruiting bodies may develop on a single needle. Bands or entire needles may become discolored, ranging from yellow, purple, tan or reddish brown to brown (Fig. 4). Discolored needles typically remain attached to the tree for an additional year following discoloration. The characteristic sign of this disease is the fruiting bodies (sporodochia) that appear as small, black, fuzzy, round masses in the stomatal pores on all sides of infected needles (Fig. 4). When mature, sporodochia are visible easily with a hand lens and appear as discontinuous black fuzzy lines (Fig. 4).

Disease cycle: *Stigmina lautii* has a two-year life cycle. On most trees, sporodochia develop by late spring the year after infection, mature that fall and produce spores that can cause infections the next spring. Spores typically develop in the spring just prior to new shoot growth. These spores can infect any age class of needle throughout the growing season whenever temperatures are above 50 F.

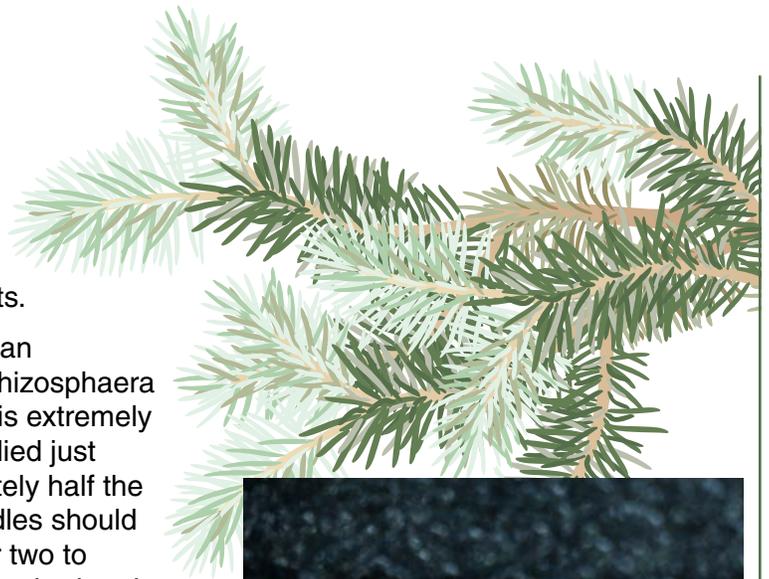


Fig. 4. Comparison of (A) uninfected needle with white stomatal pores, (B) needle infected with *Rhizosphaera kalkhoffii* with characteristic smooth black pycnidia and (C) needle infected with *Stigmina lautii* showing characteristic black, fuzzy sporodochia and spores.

Disease management

Species selection – Planting nonsusceptible tree species should be considered in areas where stigmata needle cast is causing substantial damage, particularly if the disease is present in the same planting. Colorado blue spruce and white spruce are generally highly susceptible. The susceptibility of Norway and black spruce is unclear, although there have been reports of these species infected by *Stigmata lautii*.

Cultural control – Cultural control is similar to that described above for rhizosphaera needle cast.

Chemical control – For landscape trees, shelter belts and Christmas tree plantations, needles should be protected for two months after bud break. Spraying should occur every year to ensure that four or more age classes of green needles are retained on trees (Fig. 1). For nurseries, where certification requires that plants be disease-free, needles should be protected for the entire infection period (about six months in North Dakota: mid-May to mid-October) until the youngest infected needles are cast, likely after four or five years.



General Considerations for Spruce Needle Cast Management

Several tools are available for the management of needle cast diseases of spruce. Using them in the appropriate situations and combinations is the best way to reduce the impact of these diseases.

Disease threshold: The threshold of acceptable disease should be determined when evaluating whether disease management actions should be implemented. The threshold differs depending on the expected tree function. A specimen tree may be expected to maintain a full complement of green needles, while trees in a windbreak may achieve their function with substantial needle loss and some branch death. Needle loss that causes sustained growth reduction threatens the long-term health of a tree.

Typically, new shoots on a branch will have reduced growth if less than three age classes of green needles are present for two consecutive years. Trees also will have reduced growth of new shoots in the upper crown if more than about one-third of the lower crown has less than three age classes of green needles for two or three years. The impact on growth also depends on other factors, such as nutrient availability and stress.

Pesticide management of needle diseases: Fungicides labeled for needle diseases prevent new infections, so apply before spores and free moisture are present long enough for infection. Fungicides may be used if they are registered for the target site in the state where applied (for North Dakota, see the North Dakota Department of Agriculture pesticide database: www.kellysolutions.com/nd/pesticideindex.htm). Before selecting and applying a pesticide, always read and follow the product label; it is the law.

Photos by James Walla, NDSU

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