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# Pine Needle Diseases in Arkansas

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Several fungal diseases attack needles of pines. Some of the diseases can be lethal to pines, while others are merely unsightly. Treatment, or lack of it, must be based on the threat presented by the disease compared to the cost of treatment; therefore, careful attention must be paid to disease identification. Unfortunately, positive identification of several of these diseases is difficult. This fact sheet presents the five major pine needle diseases in Arkansas plus symptoms of some pest and environmental problems which show similar symptoms.

## Needle Rust

Needle rust, caused by fungi in the *Coleosporium* genus, is a relatively benign but unsightly infection of pines. It is especially prevalent on the needles of young trees. Needle rust causes very little economic loss but often generates questions from landowners. The disease is characterized by distinctive yellow to orange wings or teeth on pine needles (Figure 1). Severe infections have a striking appearance and quickly get a landowner's attention. Infected needles often die and drop off. If enough needles are lost, tree growth will slow down until the needles are replaced; however, the disease rarely causes significant or permanent injury to pines. Christmas tree plantations may be economically impacted by this fungus.

### Biology and Disease Cycle of *Coleosporium*

Needle rust requires two hosts, a pine and an herb, to complete its life cycle. The herb often is a goldenrod (*Solidago* sp.) or an aster (*Aster* sp.), but it may be any of several other herbaceous plants. Spores, which have overwintered on the pine needles, produce cup-like structures below the surface of the needles in the spring (Figure 2). These mature into the wings or teeth that draw the attention of landowners (Figure 3). At maturity the teeth split open and release spores that are carried by winds to the leaves of the alternate hosts. Within a few days, these spores produce orange fruiting bodies on the bottom surface

**Figure 1. *Coleosporium* produces distinctive wing- or tooth-like orange fruiting bodies on pine needles.**

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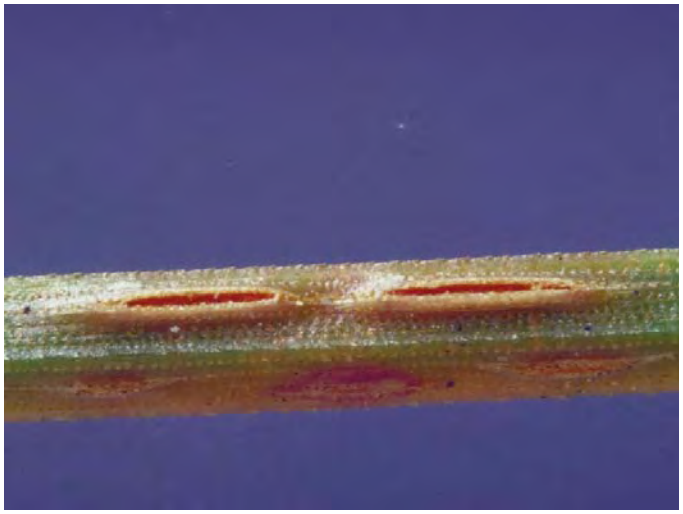

**Figure 2. In its early, stages *Coleosporium* produces spermagonia below the needle's surfaces. These mature into fruiting bodies.**

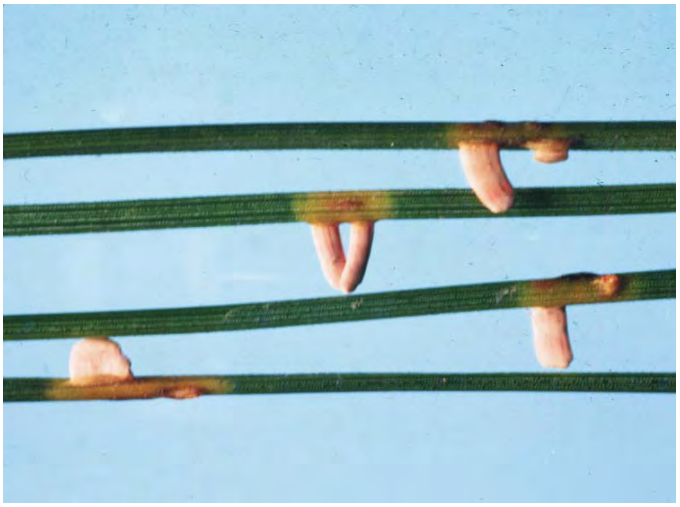

**Figure 3. The cup-like structures of *Coleosporium* (in Figure 2) mature into tooth-like fruiting bodies.**

of the host leaves (Figure 4). The fungus runs through several cycles of spore production until late summer, when it produces spores that reinfect the pine needles and resume the annual life cycle in the spring.

## Needle Casts

"Needle cast" is a catch-all term for infections caused by more than 20 different fungi. Biology and disease cycle of the needle casts vary between genera. The three major needle cast fungi are covered by this fact sheet. The fungi infect needles at different times of year and under a variety of conditions. As a result, observable symptoms may appear at any time of year. Symptoms are similar enough among genera that it is difficult to identify the particular fungus with certainty. Most landowners first notice the infection when needles start to turn brown and drop off. The

**Figure 4. In early stages, the *Coleosporium* fruiting bodies look like yellow smudges. In later stages, the fruiting bodies look like orange dots.**

only major economic losses from needle cast occur in Christmas tree stands and tree nurseries.

The most visible symptom of needle cast is red or brown needles within the crown of a pine. In severe cases, the entire crown may brown, giving the impression that the tree has died from a bark beetle attack. Fortunately, in the case of needle cast, only the needles are dead. The brown needles will eventually drop off, and the tree will produce new needles and survive. Since bark beetle infestations can be a serious problem, it is important to determine the cause of the needle browning. Examine the trunk of the tree for insect entrance or exit holes, and examine the needles for the spots characteristic of fungal infections.

### Biology and Disease Cycle of Needle Casts

***Lophodermella* Needle Cast** – In Arkansas these fungi attack loblolly pine. Infection of young, developing needles occurs in the summer. At that time, the fungus penetrates into the needle but causes no visible symptoms. Infected needles initially turn reddish brown the following spring then fade through the summer (Figure 5). The fungus develops fruiting bodies during early summer. Needles are cast when they mature. During wet summer weather, the fruiting bodies split open and release wind-borne spores that settle on young, developing needles.

Time of needle browning will give some evidence that this fungus is to blame. This fungus causes needles to brown during the spring and drop in the summer. *Lophodermella* infections are characterized by brown needles with dark fungal fruiting bodies (Figure 6). These will be visible with a hand lens.

**Figure 5. *Lophodermella* infections appear in the spring when the needles turn brown.**

**Figure 6. Fruiting bodies of *Lophodermella* look like lens-shaped dark spots on the needles.**

***Lophodermium* Needle Cast** – One *Lophodermium* species, *L. seditiosum*, is known to be a virulent pathogen of loblolly and shortleaf pines. A few other *Lophodermium* are weakly pathogenic to loblolly and shortleaf pines. Spores of *L. seditiosum* infect wet needles during late summer. The fungus penetrates the surface of the needle and causes an infection visible as yellow spots during late fall and winter

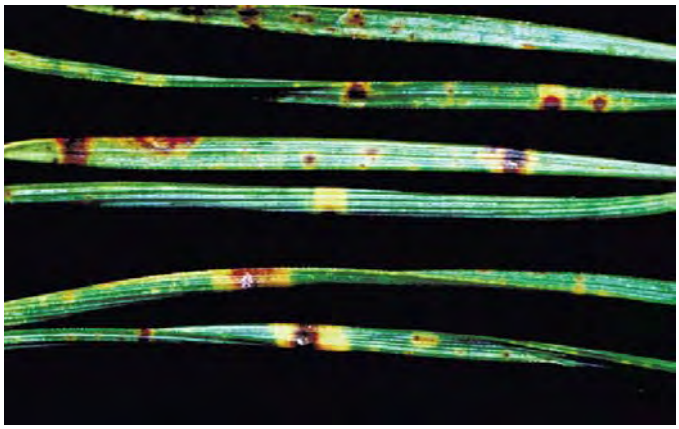

**Figure 7. *Lophodermium* infections initially appear as yellow spots in the needles during fall and winter.**

**Figure 8. By late spring or summer, *Lophodermium* turns needles brown. Part of the needle may remain green.**

(Figure 7). By spring the needles will show brown spots with yellow margins. As the spots enlarge, the needles turn yellow and then brown. This usually occurs in early to mid-spring. Some of the infected needles may remain partly green (Figure 8). Dead needles drop off in early summer. The fungus produces fruiting structures in late summer. During wet weather, the fruiting structures release spores which then infect wet needles.

To identify this fungus, consider the season during which needles browned. This fungus causes pine needles to brown during the spring and drop during early summer. It also causes needles to develop yellow spots during the fall.

***Ploioderma* Needle Cast** – In Arkansas these fungi attack loblolly and shortleaf pines. Infection of young, developing needles occurs in early summer, when the spores are released during wet weather. They germinate on and penetrate young needles.

**Figure 9. Initial *Ploioderma* infection appears as yellow spots on first-year needles.**

**Figure 10. Late in the spring, *Ploioderma* develops black spots in the surface layers of the needles.**

Symptoms of infection appear as yellow spots that develop on the needles during the winter (Figure 9). As the infection progresses, the yellow spots turn brown and eventually gray in late spring. The base of some needles will sometimes remain green. Needles drop during spring and summer. During late spring, fruiting bodies develop under the epidermis of the leaf (Figure 10). These appear as elliptical black spots. The fruiting bodies release spores during wet weather in early summer. This fungus is also known as *Hypoderma*.

*Ploioderma* infections are similar to *Lophodermium* in causing needles to brown during the spring and drop during summer. Both *Lophodermium* and *Ploioderma* cause black spots to appear below the needle surface. The black spots caused by *Lophodermium* are elliptical, sometimes nearly round. Those caused by *Ploioderma* are much narrower, often nearly linear (Figure 11).

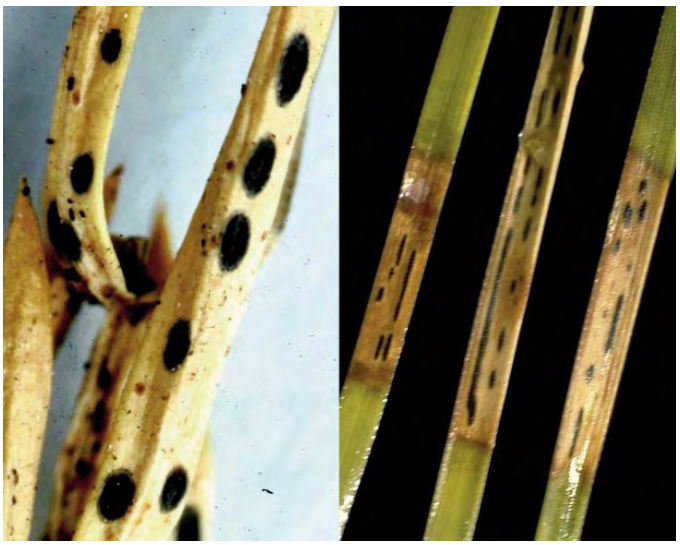

**Figure 11. *Lophodermium* spots (left) are wider than those of *Ploioderma* (right).**

## Brown Spot Needle Blight

In Arkansas the fungus *Mycosphaerella dearnessii* attacks loblolly and shortleaf pines causing brown spot needle blight. Brown spot infections can occur throughout the year but occur most commonly during the warmer months.

### Biology and Disease Cycle of Needle Blight

The disease cycle of brown spot is complicated. Infection occurs in the spring and early summer during wet weather when the spores are spread by splashed or blown water droplets. The spores start to grow on the needle surface and then penetrate into the needle. The fungus incubates within the needle for one to seven months then produces the fruiting bodies. During late summer, the fruiting bodies mature and start to release spores. Spore release continues the following spring, when most of the spores are released.

The spots characteristic of brown spot may appear at any time of year. Symptoms of infection appear as pale yellow to light brown spots that often enlarge to encircle the needle. Often only the end of

the needle dies (Figure 12). A brown spot infection resembles a *Ploioderma* infection in that the needles have bands of brown tissue and often only the ends of the needles will brown.

**Figure 12. *Mycosphaerella* infections start as yellow to brown spots that enlarge to girdle the needles and cause the ends to die.**

## Control Measures

Most of these fungi are difficult to distinguish in the field. The fungus usually must be cultured in a laboratory for positive identification. Your county extension agent can help you send samples to Extension's Plant Disease Diagnostic Clinic at Lonoke for analysis. Fortunately, it often is not necessary to know which of these fungi has infected a tree. Effect on the tree will be similar for most of the fungi, and the same treatment, if any, will be applied regardless of the fungus.

Decisions about control measures and treatments depend greatly on landscape setting, size of the tree and purpose for which the tree is grown. Small, isolated trees are easy to treat, but large trees or large numbers of trees can be very difficult and prohibitively expensive to treat. These fungi are rarely lethal to large trees. Therefore, in some cases, it may not even be necessary to treat a tree or stand. On most sites, these diseases will only be a problem during wet years.

Several fungicides are available to treat needle rusts, casts and blights on Christmas trees in commercial settings. A few fungicides are also available for homeowner use. Current fungicide recommendations can be obtained from your county extension agent or from Cooperative Extension Service publication MP154, *Arkansas Plant Disease Control Products Guide*.

The best strategy for curing needle diseases is to prevent them. Seedlings are inspected at the nursery before they are packed for shipment; however, seedlings should be inspected for fungal diseases **immediately prior to planting**. Should infected seedlings be found, return them to the nursery for replacement. Do not plant infected trees.

### Forest Trees

Young trees are more vulnerable to needle rusts, casts and blights. During the first five years after planting, plantations should be monitored for outbreaks of fungal infection. Seedling mortality in heavily infected stands should be monitored to determine whether replanting is necessary. On a forest-wide scale, fungicides are not commercially feasible. These fungi primarily infect the lower branches of trees. As the trees grow in height, less of the crown will be highly susceptible to infection. Needle rusts, casts and blights should not pose a serious threat to stands more than five years old.

### Christmas Tree Plantations

Christmas trees are quite vulnerable to needle rusts, casts and blights. While the diseases are not typically lethal to Christmas trees, the damage to the foliage destroys the value of the trees, at least for that season. Good sanitation is the best control measure in Christmas tree stands. Infected trees should be removed and burned. It may also be necessary to treat nearby trees with a fungicide to kill fungus that has already spread. Steps can be taken to reduce incidence of foliar infections in stands with a history of disease problems. Since some infections spread from dead needles that have dropped from the tree, raking and burning this leaf litter can reduce infection rates. Contaminated tools spread fungal diseases as well. Any tools including clippers, shears, rakes and tractors that contact an infected tree can spread the fungus to additional trees. Clean cutting tools after each tree. Avoid brushing trees with tractors and trailers. When it is not possible to avoid brushing trees, clean tractors and trailers daily. Contaminated clothing can spread fungal diseases too. Wash field clothing often, and change clothing as soon as is practical after leaving an infected stand.

### Ornamental Trees

Ornamental pines are also susceptible to needle rusts, casts and blights. While repeated infection and defoliation may kill small trees, the main impact of rusts, casts and blights is aesthetic. Occasional infections and infections in the lower crown of large trees will not kill the tree. If treatment for aesthetic reasons is desired, a fungicide may be applied to small trees. Spraying large trees is impractical. Since some infections spread from dropped needles, rake dropped needles from under the tree and burn them. Moist environments under low crowns are reservoirs of fungi. If fungal infections occur often, prune the lower limbs to improve air circulation and reduce humidity under the crown. This will help reduce the chances of fungal infection. For more information on pruning branches, refer to Cooperative Extension Service publication FSA5011, *Ten Easy Ways to Kill a Tree (And How to Avoid Them)*.

## Pest and Environmental Symptoms

Factors other than disease can cause pine needles to turn yellow or brown and even fall off the tree. Some of these are covered below.

### Pinewood Nematode

The pinewood nematode (Figure 13) causes pine wilt, which can resemble foliar diseases. Pinewood nematodes are spread by southern pine sawyers (Figure 14). Usually, the first visually noticeable symptoms of pine wilt appear three to four weeks following infestation with pinewood nematode. The needles of the tree will become a light grayish-green then turn yellow and brown. Typically, the needle color change occurs uniformly throughout the tree, but depending upon environmental factors and the size of the tree, the change may occur branch by branch. The needles remain intact for six to twelve months after the tree has died.

Another symptom of pinewood nematode infestation is reduced resin production. The site of a cut limb of a healthy tree will be covered with a sticky resin, but hardly any resin will be produced by a diseased tree. Also, the branches and twigs of an infected tree will become brittle.

There is no practical treatment for trees infested with pinewood nematode. The best strategy for avoiding pinewood nematode and pine wilt is to plant native pines or resistant cultivars. The chance of infestation can be reduced for ornamental pines by watering to avoid drought stress. When harvesting known infected stands, schedule the harvest around the reproductive cycle of the beetle, which lays its eggs from July to September. Debarking the stems which must remain onsite will help reduce the spread of nematodes to other trees by reducing habitat for the sawyer beetle. If only a few diseased trees are discovered, they should be quickly cut and buried or burned.

**Figure 13. The pinewood nematode is a small roundworm about 1 mm (1/32 inch) long.**

**Figure 14. Several species of sawyer beetles can transmit pinewood nematodes.**

### Senescence

Trees lose leaves in the fall, and pines are no exception. Pines produce new needles and lose old needles every year. Pines differ from hardwoods in that needles are retained for two growing seasons instead of one. During the summer, pines have two sets of needles – those produced this year and those produced last year. In the fall, the needles produced last year will be shed and only one set of needles will be carried through the winter. In the spring, a new set of needles will be produced and two sets will be carried through the summer. Needles shed because of normal senescence have a more uniform color than needles shed because of disease. Diseased needles are often mottled and/or contain black spots.

### Lightning Strike

Lightning strike can cause portions of or all of a tree's crown to die. Since these needles do not go through the normal senescence process, they may remain attached to the tree for some time

(Figure 15). Needles killed by lightning should not show the mottling characteristic of diseased needles. Most trees that have been struck by lightning will also have a wound extending down the tree trunk to the ground (Figure 16).

**Figure 15. Lightning strike can kill part or all of a pine's crown. Dead needles will be a uniform color instead of mottled.**

**Figure 16. Most lightning strikes can be distinguished from disease by the scarred trunk.**

### Nutrient Deficiencies

Nutrient deficiencies can cause tree crowns to yellow (Figure 17). Examine the needles for evidence of fungal infection. This will usually take the form of black spots and/or mottling of parts of the needle. If no evidence of fungal infection is observed, suspect nutrient deficiency. Positive diagnosis of nutrient deficiency requires nutrient analysis of the foliage. Your county extension agent can help you send a sample to the University of Arkansas Diagnostic Service Laboratory at Fayetteville. If a nutrient deficiency is identified, conduct a soil test to determine which soil amendments should be added and in what quantity to remedy the deficiency. Your county extension agent can help you send a soil sample to the University of Arkansas Soil Testing and Research Laboratory in Marianna.

**Figure 17. Nutrient deficiency should be suspected when needles show a uniform yellowing or browning.**

## Conclusion

Several fungal diseases attack the needles of shortleaf and loblolly pines in Arkansas. These pathogens may kill young trees if they defoliate trees in several successive years. Larger trees are rarely killed by needle diseases; however, growth may slow a bit. Pine seedlings are much more vulnerable to needle diseases because they are small and have small crowns. This fact makes needle diseases a very real threat to pine seedling nurseries. Needle diseases also threaten Christmas tree production, not because the diseases kill the trees but because yellow needles and bare twigs destroy their aesthetic value.

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