UNIVERSITY OF GEORGIA
Warnell School of Forestry & Natural Resources
GEORGIA FORESTRY COMMISSION
SOUTH CAROLINA FORESTRY COMMISSION
PINE PANDEMIC PREPAREDNESS PLAN
WSFNR-24-25A
September 2024

# Brown Spot Needle Blight and other Needlecasts: Emerging Diseases of Loblolly Pine

Colton D. Meinecke, Caterina Villari, and Elizabeth McCarty,
*Warnell School of Forestry and Natural Resources, University of Georgia;*
Rhys A. Eshleman, *Department of Plant Biology, University of Georgia*

## TAKE HOME POINTS

- Fungal needle diseases that cause premature shedding or death of the needles are a growing threat to loblolly pine forests in the southeast United States.
- These needle diseases are known as needlecasts or needle blights.
- The most damaging needle disease is brown spot needle blight, caused by the pathogen *Lecanosticta acicola*.
- There are currently no management options to suppress needlecasts or needle blights in loblolly pine forests.
- Needle diseases are a top research priority in the southeast. University scientists, government agencies, and the timber industry are working together to understand and reduce needle disease impacts on pine forests.

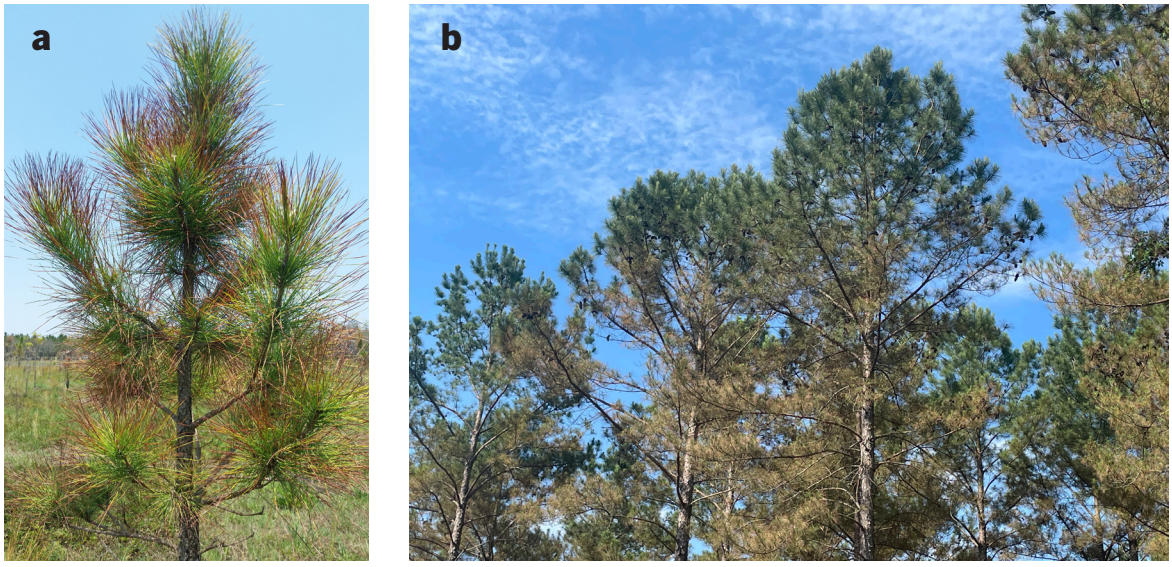


**Figure 1:** ***General symptoms of needlecast (a) and brown spot needle blight (b).*** Ashley Hopper and Elizabeth McCarty, University of Georgia

## INTRODUCTION

Pine needle diseases that cause premature needle shedding or needle death have recently become among the most pressing threats to forests in the southeast US. These needle diseases are commonly called needlecasts or needle blights. Despite the different names, needlecasts and needle blights share similar biology, and for simplicity, we will treat them as one single type of disease. These needle diseases are visually similar (Figure 1) and very difficult to distinguish based on symptoms alone. However, different types of needlecast and needle blight are caused by different fungal pathogens and affect pine stands differently. The damage that these diseases cause to loblolly pine (Pinus taeda) forests is not fully understood yet. Before recent years, fungal needle diseases rarely caused problematic damage to loblolly pine. However, needle disease outbreaks have been reported throughout the region in the last decade. Brown spot needle blight (BSNB) is currently the most damaging needle disease in the southeast. It is important for forest professionals and growers to understand the signs, symptoms, and seasonality of needle diseases to recognize when an outbreak has started and the potential damage it may cause.

Needlecast and needle blight infections generally start during the growing season when spores of the pathogens germinate and infect fresh, new needle growth. The diseases can remain dormant through the winter months until the conditions begin to warm. In late-winter to early-spring the fungi begin infecting and killing needle tissues, causing disease symptoms. The pathogens then reproduce in dead needle tissue and develop fruiting bodies (reproductive structures) that erupt from the needles and release their spores in wet weather.

Overall, the symptoms of needlecasts and needle blights caused by different pathogens are visually quite similar. Needle disease symptoms are most visible in the early-spring or late-winter because older needles become discolored with mottling, spots, or bands. Discoloration may be yellow, red, and become gray over time (Barnard and Ash 1998). Infections progress to cause needle tips or entire needles to die. Often the needle will appear green toward the base with distinct discolored, dead tips. The pathogens develop fruiting bodies within the discolored or dead portions of the needle. Infected needles are typically concentrated in the lower crown of mature trees but are often observed on all parts of sapling crowns (Barnard and Ash 1998).

The potential damage caused by needlecasts and needle blights depends on a variety of factors, the most important of which is the pathogen. Since different pathogens cause different kinds of needlecasts and needle blights, knowing which pathogen is impacting a stand is critical to understanding the risks of the outbreak. The following sections highlight the importance of BSNB as a destructive disease, and how it differs from other less damaging, periodic needlecasts.

## BROWN SPOT NEEDLE BLIGHT (BSNB)

### History and Distribution

Brown spot needle blight is a highly destructive needle disease caused by the pathogen *Lecanosticta acicola*, which in the past was called *Mycosphaerella dearnessi* or *Scirrhia acicola*. The BSNB pathogen was first observed causing disease on grass-stage longleaf pine (*Pinus palustris* L.) in 1932, in North Carolina (Siggers, 1932). Through much of the 20th century, BSNB was an important disease of young longleaf pine, and BSNB continues to routinely impair longleaf pine regeneration efforts in the southeast US (van der Nest et al., 2019). Historically, BSNB has also been a common issue in Christmas tree farms, where the dense and highly valuable crowns are damaged by needle loss (Skilling and Nicholls, 1974). BSNB occurs throughout North America and most often in the southeast US on southern pines (van der Nest et al., 2019). Over time, BSNB was introduced to other countries on infected and contaminated plants. Invasive populations are now established and spreading in Japan, South Korea, China, Russia, and 17 European countries (Tubby et al., 2022). Planted and natural pine forests abroad are severely impacted by BSNB, and governments worldwide consider the disease a major threat to pine forest health (van der Nest et al. 2019; Ogris et al., 2023).

**Figure 2:** ***Brown-spot needle blight on mature loblolly pine. Note the faded lower crowns with treetops still green.***
Elizabeth McCarty, University of Georgia

In recent years, BSNB outbreaks have consumed large acreages of loblolly pine (Figure 2), and the disease is currently more aggressive than other needle pathogens in the southeast. Most outbreaks are in Alabama, Mississippi, Louisiana, and Arkansas, but BSNB is increasing in frequency and severity on loblolly pine throughout the region.

### Life Cycle

On loblolly pine, BSNB infections often first become apparent in early spring, but they can occur at any time of the year. Pathogen spores are transmitted by wind or rain and germinate on pine needles under wet conditions. The BSNB pathogen infects new as well as older needles. Symptoms develop quickly as the fungus kills the infected tissue. Reproductive structures, also called fruiting bodies, form in and around the dead tissue and release spores that can infect new needles. Needles from infected trees that have fallen to the ground are the main source of spores in the environment, but the pathogen may also spread from diseased and dead needles that are still attached to the tree. A primary difference between BSNB and other needle diseases is that the BSNB infection and symptom development can occur within the same season.

## Signs, Symptoms, and Damage

Shortly after BSNB infection, yellow spots form on the needle. As the discolored areas grow, distinct brown spots and bands appear at the center (Figure 3). The dead areas expand and merge over time, eventually girdling the needle and killing the tissue out to the tip. *Lecanosticta acicola* has distinctive green-brown, asexual spores (Figure 4) which will emerge from fruiting bodies that develop near the dead spots or throughout the dead needle tips. When erupting from the needle surface, the asexual fruiting body often creates two openings along the sides from which the dark green-brown spore mass emerges (Figure 5). Sexual fruiting bodies have not yet been observed on loblolly pine.

While infected needles are often observed on all parts of sapling crowns, they are typically concentrated in the lower crown of mature trees (Figure 2). Diseased needles often shed prematurely, although some needles can remain attached, particularly the newest growth. The result is partial or full crown defoliation or trees with a "bottle brush" appearance due to defoliation of the entire branch except a new flush of needles at the branch tip (Figure 6).

BSNB damage to needles reduces light capture and water evaporation from needles. This reduces the tree's ability to make energy and grow. The secondary impacts of BSNB include reduced stem growth and stand productivity and increased likelihood of other insect and disease issues. Repeat defoliation can occur when the newest flush of needles becomes infected from nearby spore sources. Mortality due to BSNB is uncommon but can occur with repeat defoliation and secondary stressors, such as drought, flooding, or attack by other pests and diseases.

Currently, there are no decision-making guidelines for BSNB infected stands, and the outcomes are often uncertain. Low BSNB incidence and severity may not progress to economically damaging levels. Landowners should work with forestry professionals when making management decisions.

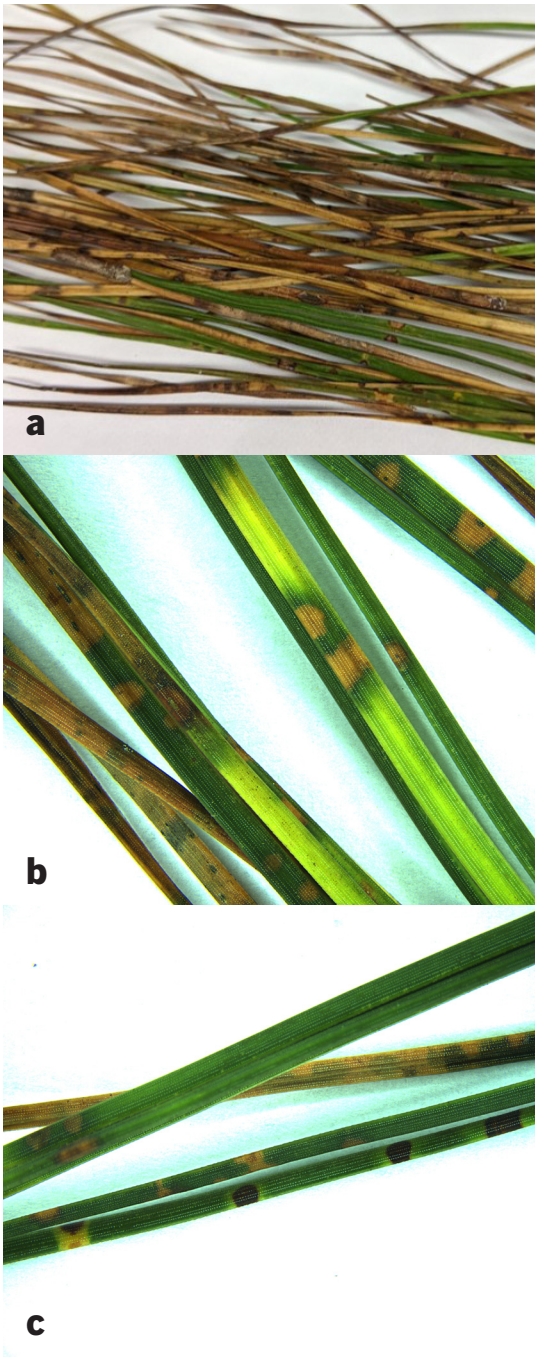


**Figure 3:** ***Symptoms of brown spot needle blight on loblolly pine needles, including distinctive dead spots and bands surrounded by yellow discoloration and dead needle tips (a). Closeup of brown spot needle blight symptomatic needles with characteristic yellow (b) and darker (c) spots and bands.*** Colton Meinecke and Elizabeth McCarty, University of Georgi*a*

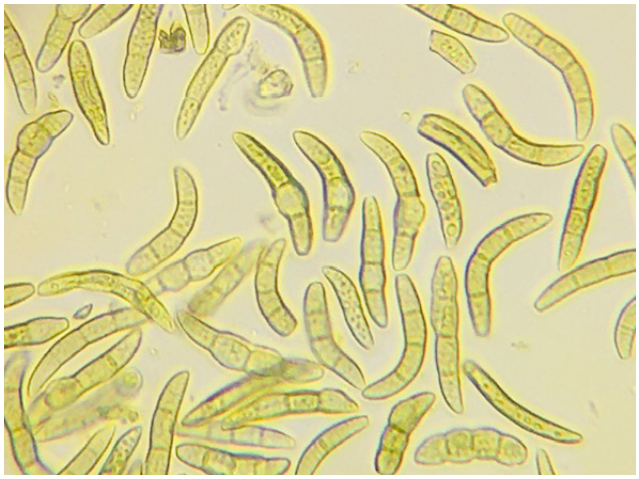

**Figure 4:** *The green-brown multicelled spores of the BSNB pathogen* Lecanosticta acicola*, as seen under a microscope.* Rabiu Olatinwo, USFS Southern Research Station.

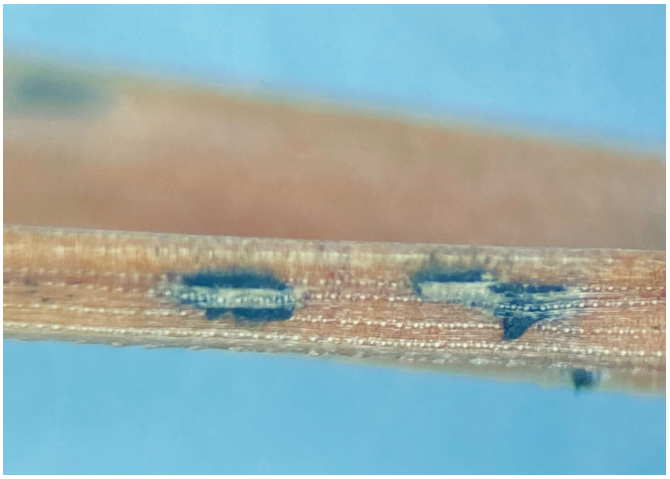

**Figure 5:** *The asexual fruiting structures, of Lecanosticta acicola erupting from a loblolly pine needle.* Rabiu Olatinwo, USFS Southern Research Station.

**Figure 6:** *Pines may produce a new flush of needles after older foliage is infected and shed, resulting in the "bottle brush" appearance of branches.* Rabiu Olatinwo, USFS Southern Research Station

## OTHER NEEDLECASTS OF LOBLOLLY PINE

**Caused by *Lophodermium, Rhizosphaera, Ploioderma* spp., among others**

### History and Distribution

Other needlecasts of pines can be caused by a number of different fungal pathogens, including *Lophodermium, Ploioderma*, and *Rhizosphaera* species, although other pathogens may be involved (Barnard and Ash, 1998; Ata et al. 2024). Historically, needle diseases caused by these fungi were grouped together and referred to as needle browning or just simply needlecast (Boyce 1951; Barnard and Ash 1998). These needlecast fungi are native to the southeast US and are widely distributed. These fungi are also generally not well studied, and they rarely caused significant or lasting damage on loblolly pine. However, since the mid-2010s, needlecast incidence and outbreaks have been on the rise within loblolly pine forests throughout the southeast US.

**Figure 7:** ***Needlecast causing faded crowns on loblolly pine.*** David Jenkins, South Carolina Forestry Commission.

### Signs, Symptoms, and Damage

While the symptoms of these types of needlecast are broadly similar with trees displaying discolored and dead needles and fading crowns (Figures 7 and 8), the fungal signs can help indicate a specific pathogen. *Lophodermium* and *Ploioderma* needlecast pathogens typically form distinctive fruiting bodies. These are black, round to football-shaped structures with a single slit down the middle (Figure 9). Inside are long, clear casings that contain multiple serpentine spores (Figure 10). In the case of the needlecast pathogen *R. kalkhoffii*, small black fruiting bodies develop and erupt from stomata on the underside of the needle, appearing as lines of black circles (Figure 11).

The inner portions of the lower crown are most heavily impacted by needlecast infections. Infected needles stand out as red-brown until, as described by the name of the disease, they drop prematurely. Unlike BSNB infections, in the case of these less aggressive needlecasts, the needles that develop in the current growing season remain green and attached to the plant.

The impacts of these types of needlecast are limited to the defoliation of the previous year's needles. Reduced growth may result from severe cases and, as with other diseases, the stress of infection can increase the likelihood of damage by other insects and fungi. Outbreaks are often episodic and rarely persist for multiple years. Most of these types of needlecast do not cause mortality on their own.

**Figure 8:** ***Symptoms of needlecast on loblolly pine, including the partial and total death of needles.*** David Jenkins, South Carolina Forestry Commission.

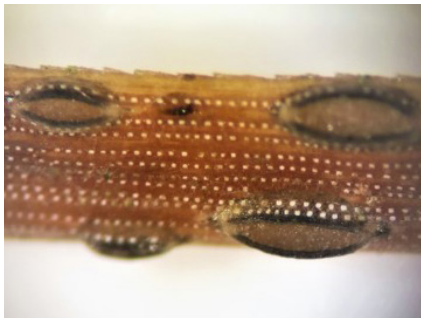

**Figure 9:** *Large, football-shaped sexual fruiting bodies of Lophodermium species.* Jaesoon Hwang, USFS Forest Health Protection.

**Figure 10:** *The serpentine sexual spores of Lophodermium species, and the casing in which they are held.* Jaesoon Hwang, USFS Forest Health Protection

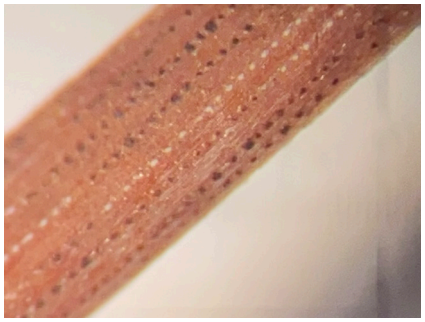

**Figure 11:** *Rows of Rhizosphaera fruiting bodies emerging from the stomata of infected needles.* David Jenkins, South Carolina Forestry Commission.

## CONCLUSION

Scientists and foresters do not fully understand the scale or long-term impacts of needle diseases in loblolly pine forests. Universities, government agencies, public, and private institutions working together throughout the southeast US are studying needle disease management strategies. However, currently there are no stand management recommendations or pesticide options to prevent or reduce the severity of needle disease outbreaks in loblolly pine forests. The best approach is to employ good general stand management practices that reduce stress and improve tree vigor, such as planting in well-drained soils and not overstocking stands. Maintaining air circulation in stands may reduce humidity and therefore the likelihood of infection. Stands with severe, repeated, and persistent levels of BSNB infection should be monitored for the occurrence of pine bark beetle infestations and other secondary pests and diseases that may contribute to tree mortality. Contact your County Extension agent or state forestry agency to learn more about needle diseases and work with forestry professionals to maintain forest practices that promote healthy pine stands.

## LITERATURE CITED

[1]Barnard, E. L., and Ash, E. C. 1998. Needlecasts of pines in Florida. Florida Department of Agriculture & Consumer Services, Plant Pathology Circular No. 388:1–4.

[2]Siggers, P. V. 1932. The brown-spot needle blight of longleaf pine seedlings. Forestry 30:579–593.

[3]van der Nest, A., Wingfield, M. J., Janousek, J., and Barnes, I. 2019. *Lecanosticta acicola*: A growing threat to expanding global pine forests and plantations. Molecular Plant Pathology 20:1327–1364. doi: 10.1111/mpp.12853

[4]Skilling, D. D., and Nicholls, T. H. 1974. Brown spot needle disease – biology and control in Scotch pine plantations. USFS.

[5]Tubby, K., Adamcikova, K., Adamson, K., Akiba, M., Barnes, I., Boroń, P., et al. 2023. The increasing threat to European forests from the invasive foliar pine pathogen, *Lecanosticta acicola*. Forest Ecology and Management 536:120847. doi: 10.1016/j.foreco.2023.120847

[6]Ogris, N., Drenkhan, R., Vahalík, P., Cech, T., Mullett, M., and Tubby, K. 2023. The potential global distribution of an emerging forest pathogen, *Lecanosticta acicola*, under a changing climate. Frontiers in Forests and Global Change 6. doi: 10.3389/ffgc.2023.1221339

[7]Ata, J. P., Burns, K. S., and Stewart, J. E. Needle pathogens of Rhytismataceae: Current knowledge and research opportunities for conifer foliar diseases. Forest Pathology 54(1):e12851. doi: 10.1111/efp.12851

[8]Boyce, J. S. 1951. *Lophodermium pinastri* and needle browning of southern pines. Journal of Forestry 49(1):20–24.

[9]Skilling, D. D. 1975. *Lophodermium* needle cast of pine. In: Forest Nursery Diseases in the United States. USDA Forest Service Agriculture Handbook No. 470: 67–68.

## AUTHORS:

Colton D. Meinecke[1] Rhys A. Eshleman[2] Caterina Villari[1] and Elizabeth McCarty[1]
[1]Warnell School of Forestry and Natural Resources, University of Georgia
[2]Department of Plant Biology, University of Georgia

Funding statement: This publication was produced with funding from the United States Forest Service Southern Research Station and the Rapid Outcomes from Agricultural Research Program from the foundation for Food and Agriculture Research.

## SUGGESTED CITATION:

Meinecke C.D., Eshleman R.A., Villari C. and E. McCarty. 2024. Brown Spot Needle Blight and Needlecast: Emerging Diseases of Loblolly Pine. University of Georgia Warnell School of Forestry and Natural Resources and the Georgia Forestry Commission, WSFNR-24-25a. 8 Pages.