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Fusiform Rust in Arkansas

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Fusiform rust, caused by the fungus *Cronartium quercuum* f. sp. *fusiforme*, is the most destructive disease of loblolly and slash pine in the southeastern United States. It causes the greatest economic losses in pine plantations but also can cause significant losses in seed orchards and natural pine stands. Although severe disease may occur in Arkansas at times, fusiform rust is a more serious problem south and east of the state, from eastern North Carolina to central Louisiana (Figure 1). Loblolly pine is the only species native to Arkansas which is susceptible to fusiform rust.

The disease is characterized by spindle-shaped galls on branches and stems of pines. In some cases, the galls may be round or irregular. Fusiform rust galls frequently completely girdle and kill trees less than five years old (Figure 2). Older trees can survive infection indefinitely but will be structurally weakened (Figure 3). The structural damage reduces the quality and value of the stem and increases the chances that the stem will break during wind or ice storms.

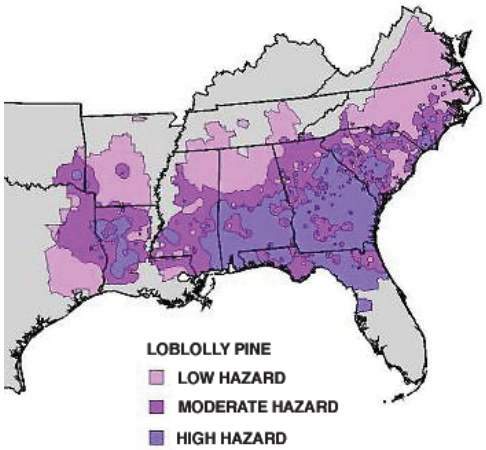

Figure 1. Range and frequency of fusiform rust infections in the southeastern U.S. Infection rates for the hazard classes are: low = 0 to 9 percent, moderate = 10 to 30 percent and high = 31 to 100 percent.

Figure 2. Fusiform rust has girdled this young pine stem. It will not survive.

Figure 3. This fusiform-infected stem will survive the infection but is more susceptible to breakage.

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Biology and Disease Cycle of *C. quercuum* f. sp. *fusiforme*

Fusiform rust requires both pine and oak for completion of its life cycle (Figure 4). In the fall and winter, galls exude droplets of liquid called pycnia which contain pycniospores (Figure 5). Four months to several years later, during the spring, the galls produce yellow to white aecia at the former locations of the pycnia. The aecia are filled with yellow to orange aeciospores, which are wind-disseminated (Figure 6). The aeciospores infect the immature leaves of red oaks but cause no economic damage to oaks. On oaks, the fungus first produces small yellow structures called uredinia within two weeks of infection (Figure 7). The uredinia produce and release urediniospores which reinfect the oak upon which they developed. The reinfected sites develop hairlike or whiplike structures called telia (Figure 8). Telia produce teliospores which germinate and produce four basidiospores each. The basidiospores are released at night and are carried by wind to the succulent young needles and cones of susceptible pines. The fungal infection eventually spreads from the needles and cones into the branches or stem of the tree where it lives for years and produces the characteristic galls, completing the complicated life cycle of fusiform rust. It takes two years or more to complete the life cycle.

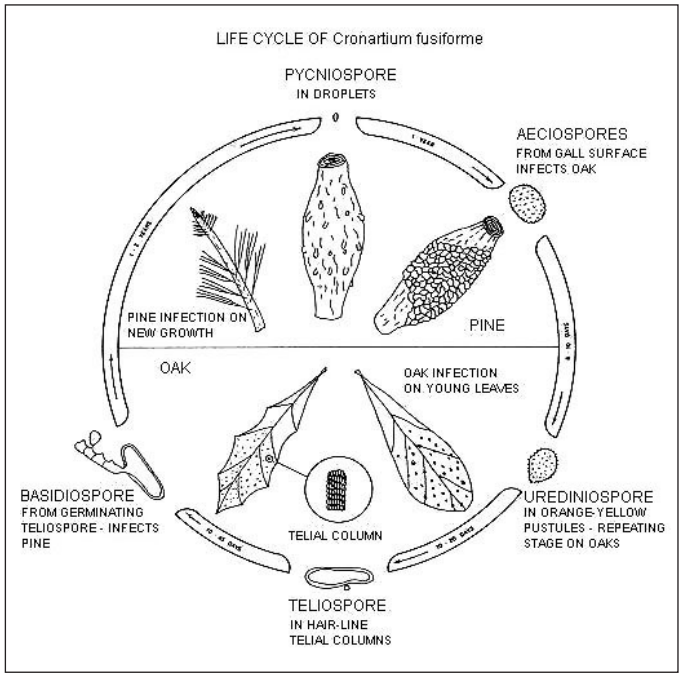

Figure 4. Life cycle of fusiform rust.

Figure 5. Pycnia of fusiform rust.

Figure 6. Aecia releasing aeciospores.

Figure 7. Uredinia on the underside of an oak leaf.

Figure 8. Telia on the underside of an oak leaf.

Identification

One of the best control techniques for any disease is early detection. To this end, a brief discussion of fusiform rust identification is in order. Galls are one of the most recognizable and most easily identified indicators of fusiform rust. During spring the yellowish aecia will make most of the galls easy to recognize. At other times of the year, galls will have bark that is similar in texture and color to normal pine bark. In most cases, gall shape should be readily identifiable any time of year (Figures 2 and 3).

Stages of fusiform rust on oak are also easy to identify but will be much more difficult to locate. Uredinia and telia are quite small and occur on the bottom surface of oak leaves. A hand lens will be helpful. Any small yellow spots or structures on the bottom surface of a red oak leaf should be examined closely with a hand lens. Uredinia will look like clumps of yellow particles on the leaf surface (Figure 9). Telia will look like dark brown hairs on the leaf surface (Figure 10). An infected leaf may have only a few or a few hundred uredinia and telia.

Figure 9. Close-up of uredinia on an oak leaf.

Figure 10. Close-up of telia on an oak leaf.

Occurrence in Arkansas

USDA Forest Service surveys in 2005 showed that less than 11 percent of pine stands in Arkansas had fusiform rust infection rates greater than 10 percent of trees. This is significantly less than the south-wide average of 28 percent of stands and far less than the near 50 percent of stands in Georgia. Several factors are believed to influence fusiform rust infection rates. Arkansas' less humid climate, compared to states south and east of us, may help reduce infection rates. Also, western loblolly pines are more resistant to fusiform rust infection than eastern loblolly pines for reasons not yet fully understood. Forest conditions such as stand density and nutritional status also influence infection rates. Historically, very little data on fusiform rust infection rates has been collected; therefore, long-term trends in infection rates are poorly understood.

Control Measures

Seedlings – Essentially all modern loblolly pine seedling varieties are screened for resistance to fusiform rust. When you order seedlings, make sure to state that you want rust-resistant seedlings. Seedlings should be inspected for fusiform rust prior to planting. Should infected seedlings be found, return them to the nursery for replacement. **Do not plant infected trees.**

Forest Trees – During the first five years, plantations should be monitored for outbreaks of fusiform rust. Heavily infected stands should be replanted. On a forest-wide scale, pruning and chemical control are not commercially feasible. Lightly infected stands should be left alone until the first thinning. At that time, infected trees should be marked and removed. Wounds may make pines more susceptible to fusiform rust infection; therefore, take care to avoid skinning trees when the stand is thinned. Because the fusiform rust life cycle alternates between pine hosts and oak hosts, some have advocated stand protection through using herbicides or prescribed fire to control oaks within the stand. Since fusiform rust spores can be carried up to a mile by wind, eliminating oaks within the stand may not actually reduce the risk of infection in small stands.

Lawn Trees – Loblolly pines in lawns also are susceptible to fusiform rust. To minimize the risk of infection, do not fertilize the soil around pines until they are at least 10 years old. Fertilizing a tree increases the amount of new growth, which creates more sites for fusiform rust infection. Trees more than 10 years old are still susceptible to fusiform rust but are much less likely to be killed by the fungus. In some cases, infections in ornamental pines can be treated. Small galls can be cut out of the trunk; however, great care must be exercised to remove **all** of the infected tissue without weakening the tree excessively. Large galls on the trunk can rarely be successfully removed. Removing enough tissue to completely remove a large gall will render a tree dangerously weak and will increase the likelihood that the tree will break during a storm. This may result in property damage or personal injury. Such trees should be removed. If galls are

on branches and are more than a foot from the trunk, pruning the infected branches offers the best control method (Figure 11). If galls on branches are within a foot of the trunk, the trunk probably is already infected as well. 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)*.

Figure 11. Branches with fusiform rust infections more than a foot from the trunk can be pruned.

Homeowners in south Arkansas, where the risk from fusiform rust is greater, should consider planting loblolly pine from families which are less susceptible. Planting a resistant species such as shortleaf pine might be an even better alternative.

Conclusions

Fusiform rust has not been a major problem in Arkansas during the last 20 to 30 years; however, when an infection occurs in a forest or ornamental tree, the result can deal a financial blow to a small private landowner or homeowner. Vigilance and a few inexpensive steps can help landowners significantly reduce the risk of loss to fusiform rust.

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Photo Credits: Figure 1. U.S. Forest Service Web page, http://www.fs.fed.us/r8/foresthealth/hosf/fusrust.htm. Accessed May 8, 2013. Figure 2, 5, 6, 7, 8, 9, 10 and 11, Robert L. Anderson, USDA Forest Service, Bugwood.org. Figure 3. Clemson University, USDA Cooperative Extension Slide Series, Bugwood.org. Figure 4 adapted from Phelps and Czabator 1978.

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