UofA UNIVERSITY OF ARKANSAS DIVISION OF AGRICULTURE
Cooperative Extension Service

Agriculture and Natural Resources

FSA7547

Rust Diseases of Wheat

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Introduction

Stripe rust, leaf rust and stem rust are three historically important wheat diseases that occur in Arkansas. In severe epidemics, all three rust diseases can significantly reduce yield.

Stripe rust is currently the most severe rust disease. Stripe rust caused a 7 percent loss to the wheat crop statewide in 2000, but certain untreated fields suffered an estimated 50 percent or higher yield loss. Extensive fungicide applications were used on at least 350,000 acres to control the fast-moving epidemic. Stripe rust epidemics have occurred every year and in every region of the state since 2000, and it has become the most important foliar disease of Arkansas wheat.

Leaf rust was the most common rust disease in Arkansas before 2000 and still occurs ever year. Losses to leaf rust can be substantial under the right environmental conditions, but in recent years, the disease has developed too late in the spring to cause widespread yield loss.

Stem rust has caused some of the greatest wheat losses in recorded history, but a combination of resistant varieties and a lack of inoculum has made stem rust rare in Arkansas. However, new races continue to evolve, and it is possible that stem rust may again cause epidemics in the future.

Cause

Wheat rusts are caused by three related fungi:

- Stripe rust is caused by *Puccinia striiformis f. sp. tritici*.
- Leaf rust is caused by *Puccinia triticina*.
- Stem rust is caused by *Puccinia graminis f. sp. tritici.*

Symptoms

Stripe rust is called yellow rust in most parts of the world. It can be distinguished from other rusts by the dusty yellow urediniospores produced in lesions that grow systemically in leaves. Symptoms from overwintering infections occur on leaves closest to the ground and tend to cover the entire width of leaves rather than being in stripes (Figure 1). Infection spreads to nearby plants and creates distinct 'hot-spots' (Figure 3) that can be seen from a distance by heading time. Symptoms on upper leaves are restricted by leaf veins and develop into the characteristic long, slender stripes from which stripe rust gets its name (Figure 2).

Depending on variety, heads may become infected and yellow spores can be produced on the tissue surrounding the seed (Figures 4 and 5). Near crop maturity, black pustules (telia) that do not open form in stripes on both sides of the leaves.

Teliospores produced in these pustules do not cause disease on wheat and will likely not be seen.

Leaf rust attacks only leaves and can be distinguished by the dusty, reddish-orange to reddish-brown urediniospores produced in oval pustules on the upper surface of leaves (Figure 6). Pustules are small (up to 1/16 inch or 1.5 mm long) and, unlike stripe rust, do not form in stripes. Several to many pustules can be found on a leaf. Leaf rust can be found from fall through crop maturity, but it is most common in April and May. Black pustules (telia) may be produced in leaf rust lesions late in the season, but their spores (teliospores) do not cause disease on wheat.

Stem rust attacks both leaves and stems (Figure 7). On leaves, pustules are oval to diamond-shaped and much larger (up to 3/8 inch long) than those produced by leaf rust. Unlike leaf rust, stem rust pustules produce spores on both sides of the leaf. Pustules on the stem are elongated vertically and have jagged pieces of torn epidermis along the sides. Dusty, reddish-brown spores are produced on both leaves and stems. If stem rust occurs in Arkansas, it typically won't develop until after flowering.

Disease Cycles

The disease cycles for all three rust diseases are similar under Arkansas conditions. Urediniospores are the only functional spore stage, are produced only on living host plants and can be spread over long distances by wind. Urediniospores that cause initial infections in Arkansas wheat fields likely were produced in areas to the south or west of Arkansas. Continuous moisture for longer than six hours is required for spores to germinate and infect plants, so dew is more effective than rainfall for promoting germination and infection. New spores are produced 10 to 20 days after infection and are blown to other leaves, plants and fields. Differences in disease development among the three rust diseases are largely due to different responses to temperature for the three rust fungi.

Stripe rust has the lowest optimal temperature range (50 to 60 degrees F). If stripe rust infects leaves in the fall, the fungus grows slowly and usually survives the winter if the infected leaves survive. Spores produced on the lowest leaves during the winter and early spring clump together and spread only short distances. This limited spread causes stripe rust to develop in distinct foci or "hot spots" in which nearly all lower leaves within the hot spot are diseased. Once stripe rust develops on upper leaves, spores are spread over longer distances. Stripe rust will continue to develop until night temperatures are consistently above 65 degrees F.

In 2000, a new population of the stripe rust fungus appeared in Arkansas and quickly replaced the old population. The new population is better adapted to cause disease at temperatures higher than the optimal range.

Leaf rust has an intermediate optimal temperature range (60 to 70 degrees F). If leaf rust infects leaves in the fall, a noticeable epidemic commonly occurs before winter. Heavily rusted leaves die during the winter, also killing the rust fungus in these leaves. In southern Arkansas, some leaf rust usually survives winter in lightly infected leaves. In northern Arkansas, however, most leaf rust dies during the winter even if the infected leaves survive. Because the leaf rust population is at a low level in the spring and environmental conditions are not optimal for disease development until after heading stage, leaf rust usually does not become severe until late in the growing season.

Stem rust has the highest optimal temperature range (75 to 85 degrees F). This requirement for high temperatures limits stem rust development to the time from flowering to maturity. However, stem rust can develop quickly during this short period and cause large yield losses.

Control

Resistance

Planting resistant varieties is the best way to control wheat rusts. Resistant varieties significantly reduce both infection and spore production, which reduces spread to surrounding fields. Because stripe rust has been the most significant rust disease since 2000, it is very important to choose a variety with resistance to stripe rust.

All rust fungi have the ability to develop new races that can overcome the resistance in wheat varieties. Although this happens periodically, breeders and pathologists work constantly on new sources of resistance to ensure resistant varieties are always available.

Resistance ratings are available in the most recent Arkansas Wheat Update <www.uaex.edu> and should be consulted when choosing a resistant variety for your farm.

Chemical

All fungicides listed in the newest MP154, *Arkansas Plant Disease Control Products Guide* <www.uaex.edu>, should be effective against rusts. Chemical control is more effective when rust diseases are identified on susceptible varieties early in the growing season. In fields planted with moderately resistant or resistant varieties, a fungicide application may not be necessary even if some disease occurs. Fields planted with moderately susceptible or susceptible varieties should be scouted regularly, and any sign of disease may warrant a fungicide application (particularly in the case of stripe rust). In fields planted with very susceptible varieties, two applications may be necessary to achieve a moderate level of control – another good reason not to plant very susceptible varieties, particularly to stripe rust.

Other

Crop rotations and modified tillage practices are not effective against rusts. Triazole seed treatments suppress fall rust infections, but they have not been shown to be of benefit under Arkansas conditions. Planting an early maturing variety may reduce the impact of leaf rust and stem rust.


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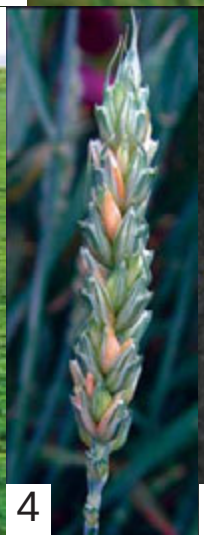
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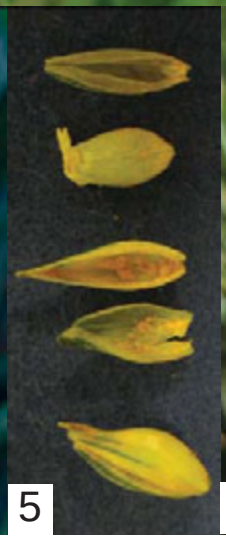
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Figure 1. Early stripe rust infection *(Photo by Jason Kelley)*
Figure 2. Characteristic stripe rust pustules on wheat leaf *(Photo by Sam Markell)*
Figure 3. Stripe rust "hot spot" in wheat field *(Photo by Rick Cartwright)*
Figure 4. Infection on wheat head *(Photo by Char Hollingsworth and Sam Markell)*
Figure 5. Tissues surrounding wheat grain *(Photo by Char Hollingsworth and Sam Markell)*
Figure 6. Leaf rust pustules on wheat leaf *(Photo by Sam Markell)*
Figure 7. Stem rust infection on stems and leaf *(Photo by Rick Cartwright)*

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FSA7547-PD-11-06N