crop INSIGHTS

Common and Southern Rust in Corn

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SUMMARY

- Persistent moist weather conditions encourage the development and spread of rust in corn fields.
- Unlike other major foliar diseases of corn in North America, the rusts do not overwinter in the Corn Belt. Infections in this region result from spores carried northward with prevailing weather systems from the Southern U.S.
- Distinguishing common rust from southern rust is important. Common rust rarely causes significant yield losses in corn, but severe southern rust can decrease yields.
- Common rust is favored by cool, humid conditions, found on upper and lower leaf surfaces, and distinguished by elongated red to cinnamon-brown pustules.
- Southern rust is favored by high temperature and humidity, found on the upper leaf surface only, and more orange or reddish-orange in appearance. Pustules are small and circular, with a pinhead appearance.
- In recent growing seasons, southern rust has occurred further north in the Midwestern U.S. earlier in the season than is typical for this disease.
- Several fungicide choices are available to help protect corn from leaf damage due to common and southern rust.
- Corn stalk quality is closely tied to leaf function. Where leaf diseases have occurred, growers are encouraged to monitor stalk quality as corn maturity progresses.

INTRODUCTION

Rusts are fungal leaf diseases that can spread rapidly in corn fields when wet weather patterns persist over a large geography for an extended period of time. Rust outbreaks generally occur during the ear-fill period of corn growth. Unlike other major foliar diseases of corn in North America such as gray leaf spot (*Cercospora zeae-maydis*) and northern corn leaf blight (*Exserohilum turcicum*), the rusts do not overwinter in the Corn Belt. Rusts develop first in southern corn fields, and then may spread into primary corn-growing states. Movement is by windblown spores that travel northward with prevailing weather systems.

Figure 1. Southern rust symptoms visible in the upper canopy of corn in Johnston, Iowa (Sept. 11, 2017).

Two kinds of rust can affect corn in North America – common rust (*Puccinia sorghi*) and southern rust (*Puccinia polysora*). Although these rusts have similar life cycles on corn, their impact on the crop can be very different. Consequently, it is important for growers to recognize which rust disease is occurring. This article will explain the life cycles of common and southern rust, explore the weather conditions that promote rust development, and describe the symptoms of each disease, including the characteristics that distinguish them from each other.

COMMON RUST

Lifecycle

Common rust can be found in corn worldwide in environments with ample moisture, mild temperatures, and high humidity, which favor disease development. The pathogen that causes common rust has a complex life cycle and requires two host species to complete its life cycle. The sexual stage of the life cycle occurs primarily in subtropical regions where *Oxalis* species (wood sorrel) serve as the host. The asexual stages of the life cycle occur on corn. Teliospores (thick-walled resting spores) overwinter in tropical and subtropical regions and provide the primary source of inoculum in subsequent seasons.

Urediospores can be spread over large distances by wind and disseminate into temperate regions during the spring and summer where they infect corn. In North America, rust spores already present in southern corn fields historically move northward with southerly weather patterns which move moisture from the Gulf of Mexico to the Midwest. These weather systems provide most of the moisture needed throughout the growing season for millions of corn acres in the U.S.

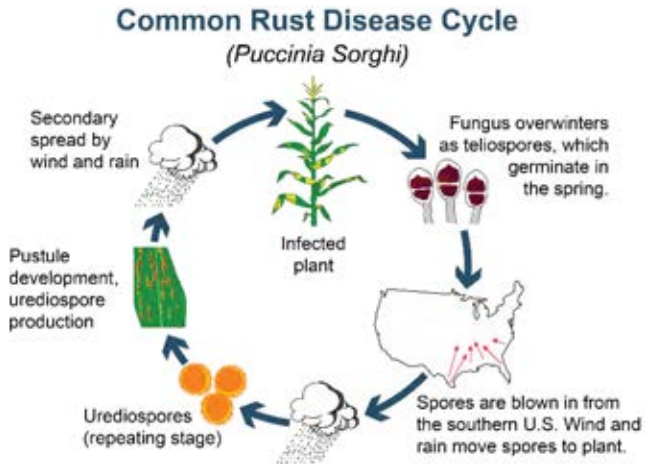

Figure 2. Common rust disease cycle.

Common rust development is favored by relatively cool temperatures (60 to 77°F) and humid conditions. Hot, dry conditions typically slow down or stop the development of the pathogen. Common rust can be found throughout corn-producing regions in the U.S. and southern Canada where it most commonly occurs at low levels.

Symptoms

Common rust starts out as small flecks on the leaves, which develop into small tan spots, then brick-red to cinnamon-brown colored pustules. These pustules blister on both the upper and lower surface of the leaf, and turn dark brown to black late in the season. Pustules have an elongated, jagged appearance (Figure 3).

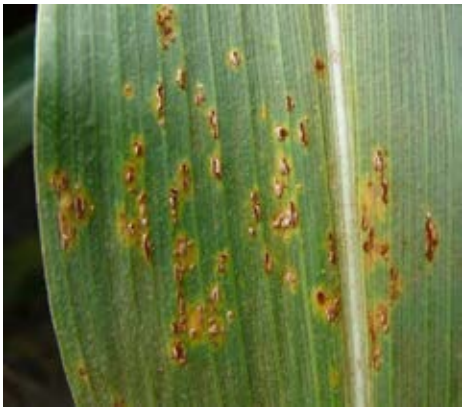

Figure 3. Common rust pustules on a corn leaf.

SOUTHERN RUST

Lifecycle

Southern rust (also known as Polysora rust) is favored by high relative humidity and high temperatures and therefore tends to be confined to tropical and subtropical regions more than common rust. In seasons with higher than average temperatures, southern rust can spread into temperate regions where it can impact corn yield. In North America, southern rust usually occurs later in the growing season and is more prevalent in the southern states. Southern rust does not occur as often from year to year as common rust, but it is usually more severe when it does occur. The disease can develop very rapidly during warm, humid conditions, and its effects can be devastating.

Unlike common rust, the pathogen that causes southern rust is not known to have an alternate host. Urediospores are the sole source of inoculum for both primary and secondary infection. Although teliospores are produced, they have not been shown to germinate, and consequently do not play a role in the disease cycle. At the start of the growing season, urediospores from infected corn residue are spread by wind and rain on to growing corn plants. Infection of these plants produces spores that serve as secondary inoculum and can be disseminated over hundreds of miles by wind.

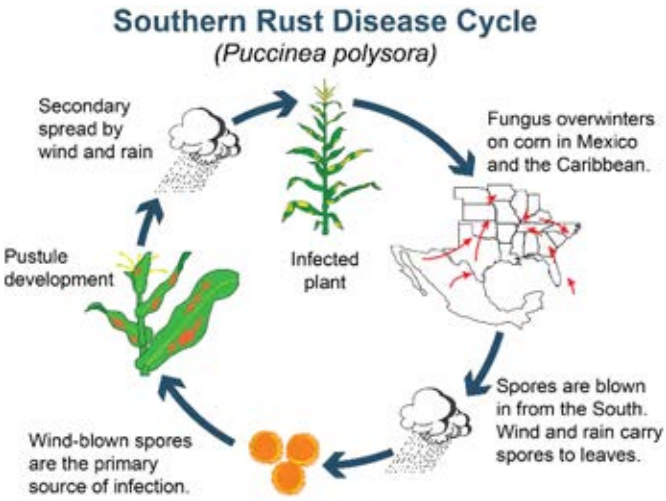

Figure 4. Southern rust disease cycle.

Symptoms

Southern rust looks very similar to common rust, but several characteristics distinguish the two. Southern rust pustules are usually confined to the upper leaf surface, while common rust is found on both upper and lower surfaces. Southern rust is more orange or reddish-orange in appearance, while common rust is red or cinnamon-brown. Southern rust pustules have a circular appearance (Figure 5), while those of common rust have an elongated, jagged appearance.

Figure 5. Southern rust pustules on a corn leaf.

Photo from Eric Alinger, Pioneer Field Agronomist.

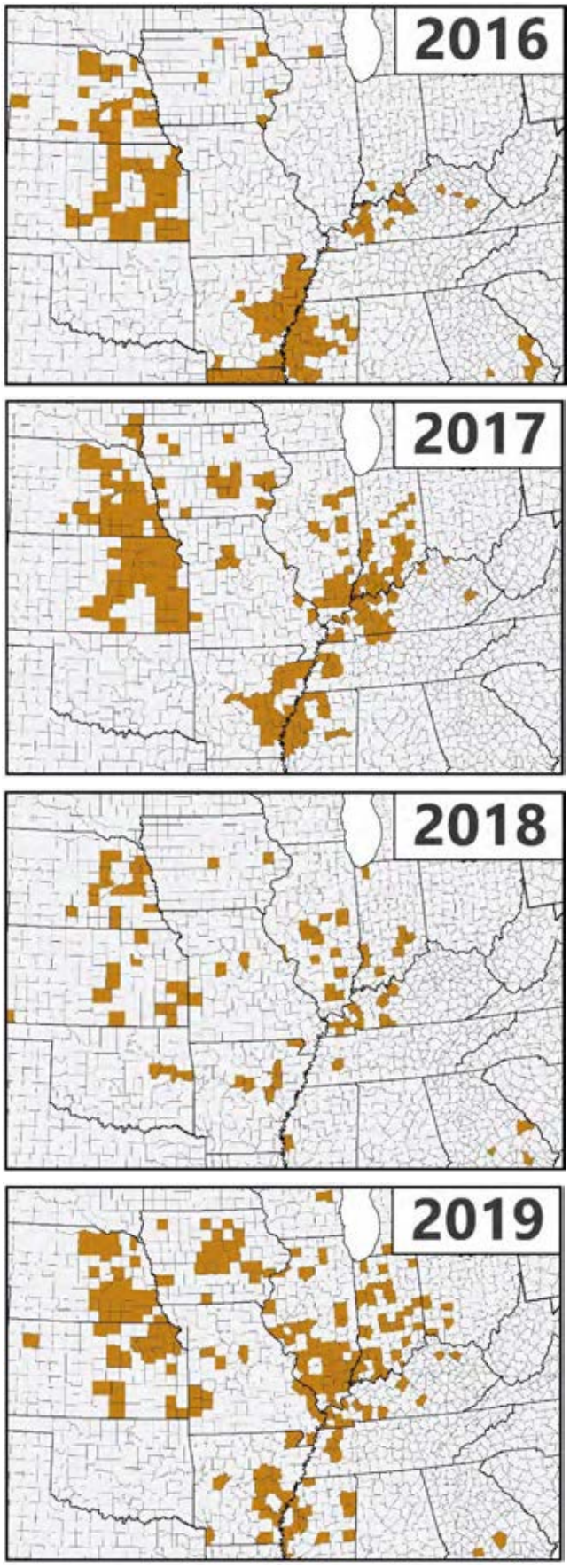

Figure 6. Confirmed detections of southern rust in corn through the first week of September during the 2016 to 2019 growing seasons. (Source: https://corn.ipmpipe.org)

Expanded Range of Southern Rust in Recent Years

Historically, southern rust has not been a frequent disease of corn in the Corn Belt. In recent growing seasons, however; it has appeared further north earlier in the season than is typical, with confirmed detections in several counties in Indiana, Illinois, Iowa, Nebraska, and Kansas and even some cases in South Dakota and Wisconsin (Figure 6). Southern rust was prevalent at the Corteva Agriscience research station in Johnston, Iowa in 2017. The increased prevalence of southern rust in the Corn Belt makes it important for growers to be able to distinguish it from common rust.

Table 1. Distinguishing characteristics of common rust vs. southern rust.

	Common Rust	Southern Rust
Pathogen	*Puccinia sorghi*	*Puccinia polysora*
Ideal Environment	Cool – warm Moist 60-77 °F	Warm – hot Moist 77+ °F
Appearance of Pustules	Large, circular to elongated	Small circular, pinhead appearance
Color of Pustules	brown to cinnamon-brown	Reddish orange
Location of Pustules	Both upper and lower leaf surfaces Infects leaves only	Upper leaf surface May also infect husks

YIELD LOSS FROM RUST

Both rust diseases of corn can cause substantial yield losses under severe disease pressure; however, southern rust generally poses a greater risk to corn yield than common rust. Yield loss due to rust depends on timing of infection, amount of leaf area damaged, and location of damaged leaves on the plant. If significant damage to upper leaves occurs early in the life of the hybrid, yield losses will be higher. If damage is confined to lower leaves of the corn plant or occurs in the later reproductive stages of development, little economic loss would be expected. Consequently, the latest-planted corn in an area is at higher risk for yield loss due to leaf diseases.

Common rust usually does not reach levels in the Corn Belt that would justify a fungicide application; however, severe infections can occur under conditions favorable for disease development. Such conditions were experienced in several Midwestern states in 2009, a growing season that was characterized by lower than normal temperatures throughout much of July and August (Lutt et al., 2016). Pioneer fungicide research trial locations in Illinois and Indiana experienced intense common rust pressure in 2009. At one research location in Indiana, the average yield response to fungicide treatment was over 22 bu/acre (Jeschke, 2017). Yield response to fungicide treatment varied greatly with common rust pressure at the research locations and hybrid genetic resistance to common rust (Figure 7 and 8).

Southern rust is generally more damaging to corn than common rust due to its ability to rapidly develop and spread under favorable conditions. In a Pioneer research study conducted near Camilla, Georgia in 2014, treatment with DuPont™ Aproach® Prima fungicide significantly reduced

southern rust symptoms and increased corn yield by an average of 20 bu/acre (Poston, 2014a). Fungicide yield response of individual hybrids ranged from 10 to 38 bu/acre. Yield losses in excess of 80 bu/acre due to southern rust have been reported from university research trials in Alabama (Hagan, 2017). Southern rust has increased in importance in the Southern U.S. and has appeared more frequently in Midwestern states in recent years, making careful monitoring and correct identification of the disease critical for making management decisions.

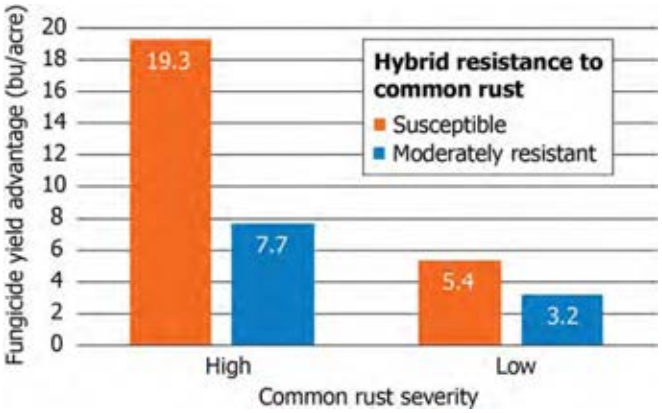

Figure 7. Average fungicide yield response of hybrids with low resistance (3 on a 1-9 scale) and moderate resistance (4-6) to common rust in Pioneer research trials in 2009.

Figure 8. A hybrid susceptible to common rust (3 on a 1-9 scale) treated with a fungicide (left) compared to the same hybrid, non-treated, showing severe common rust (right) at a Pioneer research location in Illinois in 2009.

Figure 9. Southern rust in a plot treated with DuPont Aproach Prima fungicide (left) vs. a non-treated plot (right) near Camilla, GA in 2014 (Poston, 2014b).

Severe localized epidemics of common and southern rust in past years have generated interest in the usefulness of treating with fungicides to prevent further disease development. The chances for a profitable return from spraying are greater when rust outbreaks are severe and corn prices are high. To be profitable, fungicide applications must be made in a timely manner before rust has spread throughout the canopy, and before corn plants are near physiological maturity.

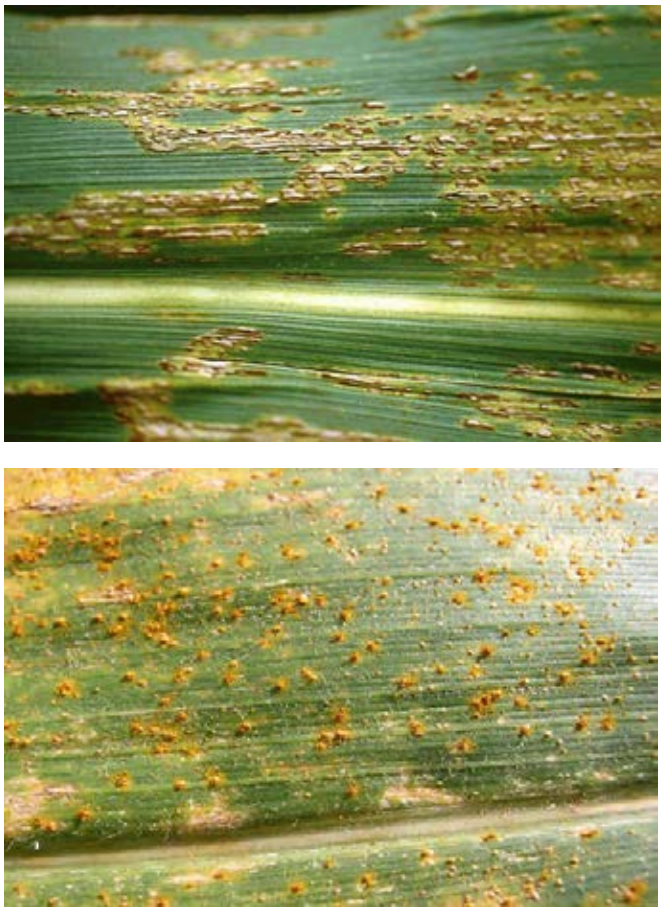

Figure 10. Typical symptoms of common rust (top) and southern rust (bottom) on corn leaf.

SCOUTING AND TREATMENT GUIDELINES

If applied properly and in a timely manner, fungicide treatments can be effective in protecting corn leaves from foliar diseases. Whether the treatment will provide an economic return is often difficult to predict. To help with this decision, the University of Illinois gives the following fungicide treat-ment guidelines for rust and other foliar diseases (Bissonnette, 2000):

- Scout for fungal leaf diseases 2 weeks before tasseling to 2 weeks after tasseling.
- At that point, at least a 15% whole-plant infection is needed to justify a fungicide treatment.
- Also consider these factors to make a reasonable decision:
  - First, consider the weather. Fungi in general and rusts in particular need free water (on the leaves) and continued wet weather to continue to flourish.
  - Next, consider the probability of other fungal leaf blights developing in the field and in your particular

hybrid. Cropping history and corn residue levels can affect development of diseases such as gray leaf spot.

– Consider the price of corn and cost per application.

FUNGICIDE APPLICATION

Timely foliar fungicide applications can help reduce leaf damage due to common or southern rust.

Table 2. Foliar fungicide efficacy on common and southern rust in corn (Wise, 2019).

Fungicide	Active Ingredient(s)	Common Rust	Southern Rust
DuPont™ Aproach®	picoxystrobin	VG-E	G
DuPont™ Aproach® Prima	picoxystrobin + cyproconazole	U	G
Affiance® SC	tetraconazole + azoxystrobin	G-VG	G
Fortix® SC Preemptor® SC	flutriafol + fluoxastrobin	U	VG
Headline® SC	pyraclostrobin	E	VG
Headline AMP®	pyraclostrobin + metconazole	E	G
Priaxor®	pyraclostrobin + fluxapyroxad	VG	VG
Quilt Xcel®	azoxystrobin + propiconazole	VG-E	VG
Stratego® YLD	trifloxystrobin + prothioconzole	E	G
Trivapro®	benzovindiflupyr + azoxystrobin + propiconazole	U	E

G = good, VG = very good, E = excellent, U = unknown or insufficient data to rank product

Getting the application on early enough, and achieving good coverage of the upper leaf canopy are essential for control of rust with fungicides. For aerial applications, a minimum of 5 gal/acre of water should be used. For ground application, use a minimum of 20 gal/acre of water and hollow cone nozzles with spray pressure of at least 30 to 40 psi. However, spray pressures greater than 40 to 50 psi are not recommended, because they create small droplets that do not penetrate to the ear zone.

For ground applications on corn greater than five feet in height, the following spray strategy is recommended:

- One nozzle spraying over the top of the whorl or plant, and
- A drop nozzle on either side of the row to spray the ear leaf zone.

Always read and follow product label recommendations when using any fungicide.

STALK ROTS OFTEN FOLLOW LEAF DISEASES

Stalk quality is closely tied to leaf function. Loss of leaf area by disease lesions reduces the amount of photosynthate produced by the leaves. When the demand for sugars from developing kernels exceeds that produced by the leaves, the plant takes structural carbohydrates from the stalk to meet the need. The stalk is weakened, fungi invade and stalk rots develop (Figure 11). If lodging occurs, harvest loss may result.

Where leaf diseases have occurred, growers are encouraged to monitor stalk quality as corn maturity progresses. To detect stalk rot occurrence, pinch stalks at two internodes near the base of the plant in several areas of the field. If the stalk collapses, advanced stages of stalk rot are indicated. Another test is to push plants sideways six to 12 inches at ear level. Stalk rot is indicated if plants break over rather than returning to vertical. Agronomists suggest that fields be scheduled for early harvest if 10 to 15 percent of the stalks are rotted.

Figure 11. Corn stalk showing substantial pith degradation in the lower internodes. Weather conditions and foliar diseases at this site favored carbohydrate remobilization from the stalk, which allowed stalk rot pathogens to invade.

SILAGE FROM RUST-INFECTED CORN

The Integrated Crop Management Newsletter (Iowa State U.) provided the following information about harvesting rust-infected corn for silage (Munkvold and Farnham, 1999):

"Producers who intend to chop and feed rust-infested corn silage may wonder about the forage quality and potential animal health risks. Forage quality may be lowered primarily because of the early death of the plant. Producers should monitor the crop to ensure that it is harvested at the optimum moisture content for ensiling (60 to 70 percent).

There are no known toxic effects from feeding rust-infected corn silage. If the forage is ensiled, the ensiling process generally creates enough heat and acids to kill the fungus and detoxify the forage. In addition, the sugars and other by-products that are produced during the ensiling process should overwhelm any unpalatable tastes that the rust may impart.

If working in the open in rust-infested fields, it would be advisable to wear a respirator to avoid the inhalation of the rust spores. Initial exposure to the rust spores may result in a hypersensitivity to the spores upon subsequent exposures. Severe respiratory ailments have been known to develop causing pneumonia and other similar human health problems."

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