

## Rust Diseases of Corn in Nebraska

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Identification and management of rust diseases of corn are discussed in this NebGuide.

### Introduction

Two rust diseases of corn occur in Nebraska. Common rust of corn occurs every year to some extent, and is caused by the fungus *Puccinia sorghi*. The other rust disease, southern rust, is caused by *Puccinia polysora* and occurs less frequently in Nebraska. Both diseases can increase in severity rapidly, particularly if infection occurs early in the growing season and favorable environmental conditions persist for extended periods of time.

Timing of disease development and its severity determine the extent of yield loss. Yield loss estimates of up to 45 percent have been reported in Florida, due to severe southern rust. For each 10 percent leaf area infected by common rust,

approximately 6 percent of yield loss was reported in Illinois sweet corn.

### Symptoms and Identification

#### Common Rust

The most useful characteristic that differentiates common and southern rust is the location of sporulating pustules (pustules where spores are produced). Common rust pustules frequently occur on both the upper and lower leaf surfaces. Pustules of the common rust fungus tend to be circular to elongate, darker in color (*Figure 1a*), less densely scattered, and slightly larger than those of southern rust on the upper leaf surface. Pustules darken in color later in the season as the fungus produces teliospores instead of red urediniospores.

#### Southern Rust

In contrast to the pustules of common rust, those of southern rust are circular to oval, light cinnamon-brown to orange in color and predominantly on the upper-leaf surface (*Figure 1b*). Pustules tend to occur only sparsely on the leaf underside, but may occur abundantly on the leaf sheath (*Figure 2a*). Haloes can be observed in some hybrids around pustules

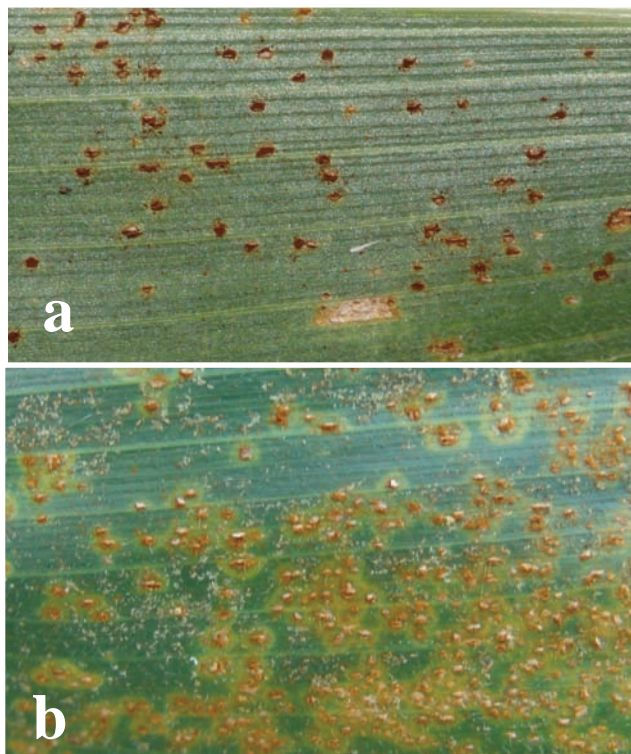


Figure 1. Magnified pustules of the common rust fungus, *Puccinia sorghi* (a) and southern rust fungus, *Puccinia polysora* (b).

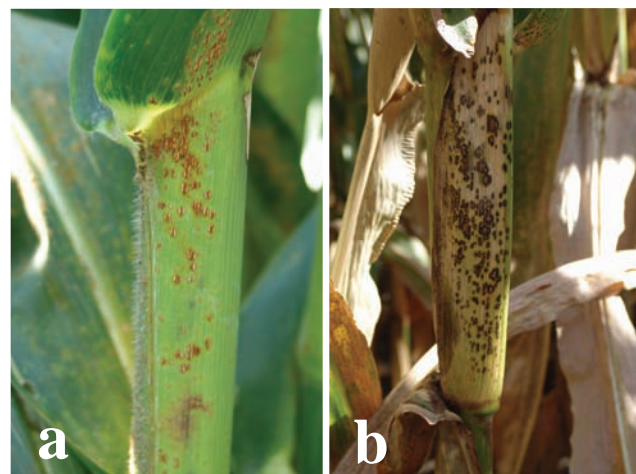
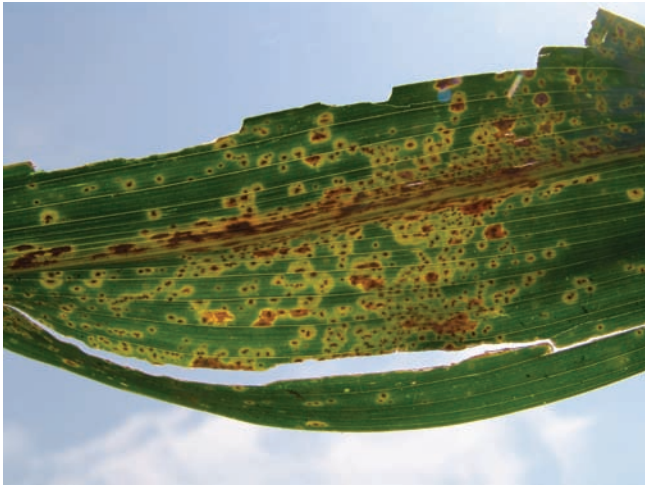


Figure 2. Larger pustules of the southern rust fungus, *Puccinia polysora* on the leaf sheath. Pustules can appear darker in color later in the season (b) as the fungus begins producing teliospores instead of the lighter-colored urediniospores (a).



**Figure 3.** Haloes surrounding southern rust pustules can be observed in some hybrids.

when leaves are backlit (*Figure 3*). The pustules are usually more densely clustered than those of common rust. And, like common rust, the pustules can darken in color later in the season as the spore type changes (*Figure 2b*).

The major characteristics of the two rust diseases are summarized in *Table I*.

**Table I.** A comparison of corn rust characteristics (*Figure 4*).

Characteristic	Common Rust	Southern Rust
Causal agent	<i>Puccinia sorghi</i>	<i>Puccinia polysora</i>
Pustule location	Both leaf surfaces	Mainly upper leaf surface
Pustule color	Brick red, golden brown to cinnamon brown	Light cinnamon-brown to orange
Pustule distribution	Sparsely scattered	Dense clusters
Optimal temperatures	61-77°F	77-82°F
Management	Resistance, fungicide application, and planting early	



**Figure 4.** Dense clustering of orange, southern rust pustules (left) compared to the sparsely scattered, reddish-brown pustules of common rust (right).

## Disease Development

Most rust diseases, including common and southern on corn, are caused by obligate parasites that require living plant tissue in order to survive. Thus, these pathogens cannot survive the winters in Nebraska.

Viable urediniospores must travel north into Nebraska every year from warmer southern climates where these fungi overwinter. The incidence and severity of disease development depends largely on weather conditions and the reactions of corn hybrids.

Rust fungi only require six hours or more of either relative humidity  $\geq 95$  percent or leaf wetness for spore germination and infection, but differ in their optimal temperature range.

Urediniospores, formed in the pustules, cause repeated secondary infections and may be produced at high numbers. In fact, up to 5,000 spores have been reportedly produced per common rust pustule indicating the tremendous reproductive capacity of rust fungi.

Southern rust tends to cause greater yield loss than common rust, reportedly up to 45 percent. Severe epidemics of southern rust have been rare in Nebraska. The epidemic of 2006 can be blamed on the simultaneous development of above-normal night temperatures and excessive rainfall in August. Severe infections (*Figure 5*) can impact yield by causing leaf damage leading to defoliation and premature senescence, but the disease often develops late in the season, which minimizes its impact on yield.



**Figure 5.** Severe southern rust.

There are five spore stages in the disease cycle of the common rust fungus. In North America, initial and repeated infection is by urediniospores that are blown into the area annually on wind currents. Urediniospores produced on corn serve as secondary inoculum locally and are spread great distances to corn in temperate regions, such as the U.S. Corn Belt, where they serve as primary inoculum for disease development. The fungus only overwinters in tropical and subtropical areas, so there is no accumulation of fungal inoculum in Nebraska fields or debris that will infect during subsequent growing seasons.

Urediniospores serve as both primary and secondary inoculum for initial and repeated infections, respectively,

for the southern rust fungus. Although, in Nebraska, the fungus produces dark teliospores later in the season (*Figure 2*), they do not germinate and are considered unimportant in the disease cycle. No alternate hosts have been identified for this fungus and urediniospores and teliospores are the only known spore stages. Similar to the common rust fungus, the southern rust fungus overwinters in tropical and subtropical areas, so disease and inoculum from the previous year do not contribute to future disease severity.

Potential exists for some important secondary effects of rusts. Severe rust can cause premature defoliation of plants. The plant's priority is to fill grain with the resources provided by the leaves. When the leaves can no longer act as the source for these nutrients, the plant cannibalizes the stalk to obtain them. Removing resources from the stalk weakens it, predisposing it to stalk rots and lodging, both of which can adversely affect yield.

## Management

Some years, rusts can be severe in Nebraska. This situation requires applying management strategies to reduce the yield impact of the disease(s). A number of management options are available to treat for rust diseases of corn, ranging from resistant hybrids, fungicides, or cultural practices.

## Plant Resistance

Deployment of resistance is a management strategy used in the southeastern United States, but is not a focus of breeding efforts in much of the Midwest because rust diseases are not

a persistent and significant annual threat to corn production here. Consequently, only about 18 percent of seed companies represented in Nebraska evaluate their hybrids' reactions to common rust and only five percent provide hybrid ratings for reactions to southern rust.

## Fungicides

There are numerous fungicides labeled for use on corn (*Table II*) that can effectively control rust diseases with timely application. However, a fungicide application typically costs \$15-20/acre (including \$5/acre cost of application), often making it uneconomical. It should be carefully considered on #2 yellow dent corn. When corn prices are low, fungicide applications are most likely to provide economic returns when applied shortly after infection on a susceptible hybrid with a high yield potential or with higher economic value, such as seed, white, or popcorn. Evaluate weather forecasts before applying to determine if weather conditions favorable for disease will likely persist, particularly high humidity and warm temperatures.

The infrequency of rust development in Nebraska has prevented the establishment of reliable treatment threshold data under local conditions. Fungicide trials for corn rust control from other states typically show results on seed corn or sweet corn. Data from Illinois trials on sweet corn suggest that applying fungicide when common rust severity over the entire plant was less than 15 percent provided the most effective control. However, the recommended treatment thresholds for common rust of sweet corn in the state of New York are lower, at only one percent, which is

**Table II. Fungicides labeled for corn.\***

<i>Systemic Products</i>	<i>Active Ingredient</i>	<i>Mode of Action</i>	<i>Rate/A</i>	<i>Pre-Harvest Interval (days)</i>
Headline® (BASF)	pyraclostrobin	Preventative	6-9 oz	7
Quadris® Flowable (Syngenta)	azoxystrobin	Preventative	6-9 oz	7
Tilt® (Syngenta)	propiconazole	Curative	4 oz	30
PropiMax® EC (Dow AgroSciences)	propiconazole	Curative	4 oz	30
Folicur® 3.6F (Bayer CropScience)	Tebuconazole	Curative	4-6 oz	36
Quilt® (Syngenta)	azoxystrobin + propiconazole	Both	10.5-14.0 oz	30
Stratego® (Bayer CropScience)	trifloxystrobin + propiconazole	Both	7-10 oz	30
<b>Contact (Preventative) Products Containing Chlorothalonil</b>				
Bravo Ultrex® (Syngenta Crop Protection)			0.7-1.8 lb	14
Echo® 720 Agricultural Fungicides (Sipcam Agro USA, Inc.)			1 ¼-1 ⅝ lb	14
Echo® 90DF Agricultural Fungicides (Sipcam Agro USA, Inc.)			1.5-2.0 pints	14
<b>Contact (Preventative) Products Containing Mancozeb</b>				
Dithane™ DF, Dithane DF Rainshield™, Dithane™ M45 (Dow AgroSciences)			1.5 lb	40
Dithane™ F-45 (Dow AgroSciences)			1.2 qt	40
DuPont™ Manzate® Pro-Stick™			1.5 lb	40
Manzate® 75DF (Griffin L.L.C.)			1.2 qt	40
Manzate® Flowable (Griffin L.L.C.)			1.5 lb	
Penncozeb® 4FL (Cerexagri-Nisso L.L.C.)			0.8-1.2 qt	40
Penncozeb® 75DF (Cerexagri-Nisso L.L.C.)			1.0-1.5 lb	
Penncozeb® 80WP (Cerexagri-Nisso L.L.C.)			1.0-1.5 lb	

\*Fungicides listed represent the best information available.

equivalent to only six rust pustules per leaf. Other management complications include the fact that rusts, particularly southern rust, tend to develop late in the season. This limits fungicide options because of pre-harvest interval (PHI) restrictions. Data from North Carolina suggests that applying fungicide for control of rust within two weeks of black layer development (during the dough stage) is unlikely to provide economic returns.

### **Cultural Practices**

Younger leaf tissue is more susceptible to fungal infection than older, mature leaves. Delaying disease development until crops are more advanced reduces the likelihood for yield loss. In regions where rusts are more consistently a problem, some producers avoid disease or minimize its effects by not planting late or by using shorter season hybrids. By doing so, they have a more mature and resistant crop in the field when rust spores arrive and sometimes disease can be completely avoided altogether.

#### **Disclaimer**

Reference to commercial products or trade names is made with the understanding that no discrimination is intended of those not mentioned and no endorsement by University of Nebraska–Lincoln Extension is implied for those mentioned.

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#### **Corn**

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