2007

G07-1766 Rust of Dry Bean

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NebGuide

Published by University of Nebraska–Lincoln Extension, Institute of Agriculture and Natural Resources

G1766

Rust of Dry Bean

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Rust is a disease that affects dry beans and can dramatically reduce yields. Integrating cultural, host resistance, and chemical management practices can help protect crops.

Rust is an important disease that affects dry beans in eastern Colorado, western Nebraska and adjacent regions in the Central High Plains. The disease is caused by the obligate fungus *Uromyces appendiculatus* which has caused periodic epidemics in the region since the 1950s. Yield losses from the disease have been documented to exceed 50 percent in some situations.

Signs and Symptoms

Rust symptoms initially appear as small yellow or white slightly raised spots on upper and/or lower leaf surfaces *(Figure 1)*. These spots enlarge and form reddish-brown or rust-colored pustules, also called uredinia, which are about one-eighth inch or smaller and contain thousands of microscopic summer repeating spores called urediniospores. Under favorable conditions, these spores can reinfect plants and continue the disease process, or can serve as a method of long-distance dispersal of the pathogen. Pustules may be surrounded by a yellow border *(Figure 2)*. Spores are readily released from pustules and give a rusty appearance to anything they contact, hence the name of the disease. Rust can be distinguished from other foliar diseases because the rust-colored spores will rub off, while with other foliar diseases, nothing rubs off.

Figure 1. Early uredinial pustules consisting of small, raised white spots.

Figure 2. Advanced uredinial pustules surrounded with yellow borders containing reddish-brown repeating spores.

Severe infections cause leaves to curl upward, dry up, turn brown, and drop prematurely. A severely rusted bean field often appears scorched *(Figure 3)*. Pod set, pod fill and seed size can be reduced if infection is severe. Green pods, and occasionally stems and branches, also may become infected and develop typical rust symptoms. However, bean rust is not seedborne.

Figure 3. Severely infected bean plants.

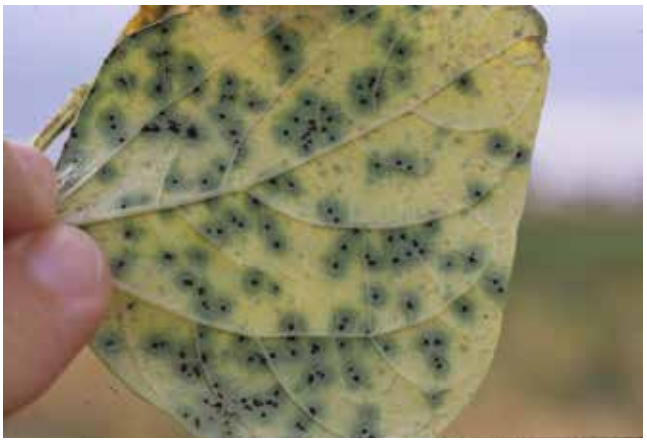

Figure 4. Pustules late in season containing dark, overwintering teliospores.

Near the end of the season, pustules undergo a subtle change and form telia containing brownish-black winter spores (teliospores shown in *Figure 4)* signaling the end of the current infection cycle *(Figure 5)*.

Source of Infection and Spread

Two potential sources of rust inoculum (spores) that initiate an epidemic are locally overwintered teliospores and airborne urediniospores blown in from distant bean fields *(Figure 5)*.

Rust spores, particularly teliospores, overwinter in bean straw in some regions of the U. S., including the Central High Plains. Teliospores germinate in the spring and produce basidiospores that are aerially dispersed onto volunteer or new bean plants in late May or early June. Volunteer beans within fields of irrigated winter wheat are often unnoticed sources of inoculum. Bean plants become infected by basidiospores, which initiate specialized types of white pustules called pycnia and aecia *(Figure 5)*. These pustules are visible for only a few days and are difficult to detect. Spores produced from these pustules (aeciospores) eventually infect other bean plants and the characteristic reddish-brown repeating (urediniospores) spore stage develops, usually on the leaves. This has contributed to rust epidemics in this region and is a factor in northern bean-growing states such as North Dakota and Minnesota.

Rust usually appears in the Central High Plains midsummer after pod set, when urediniospores from distant bean production areas to the south and/or urediniospores and aeciospores from infected local volunteer beans are transported by wind and deposited on leaves. These spores germinate to produce structures that enter a leaf through the plant stomates (breathing pores) *(Figure 6)* and develop within host tissue to form a small white uredinial spot or blister *(Figure 1)* in 5 to 7 days and mature reddish-brown pustules *(Figure 2)* in 10 to 14 days.

Factors Favoring Epidemics

Rust development is favored by cool to moderate temperatures (70° to 85° F) with moist conditions that result in prolonged periods of water (more than 10 hours) on leaf surfaces. Rain, dew, and sprinkler irrigation are common sources of moisture. Cool, wet conditions during May and June favor early season infection of volunteer beans by the overwintering stages. The same conditions during July and August will affect the rate of disease development and spread to new beans. Repeating disease cycles may occur at 10- to 14-day intervals under favorable conditions.

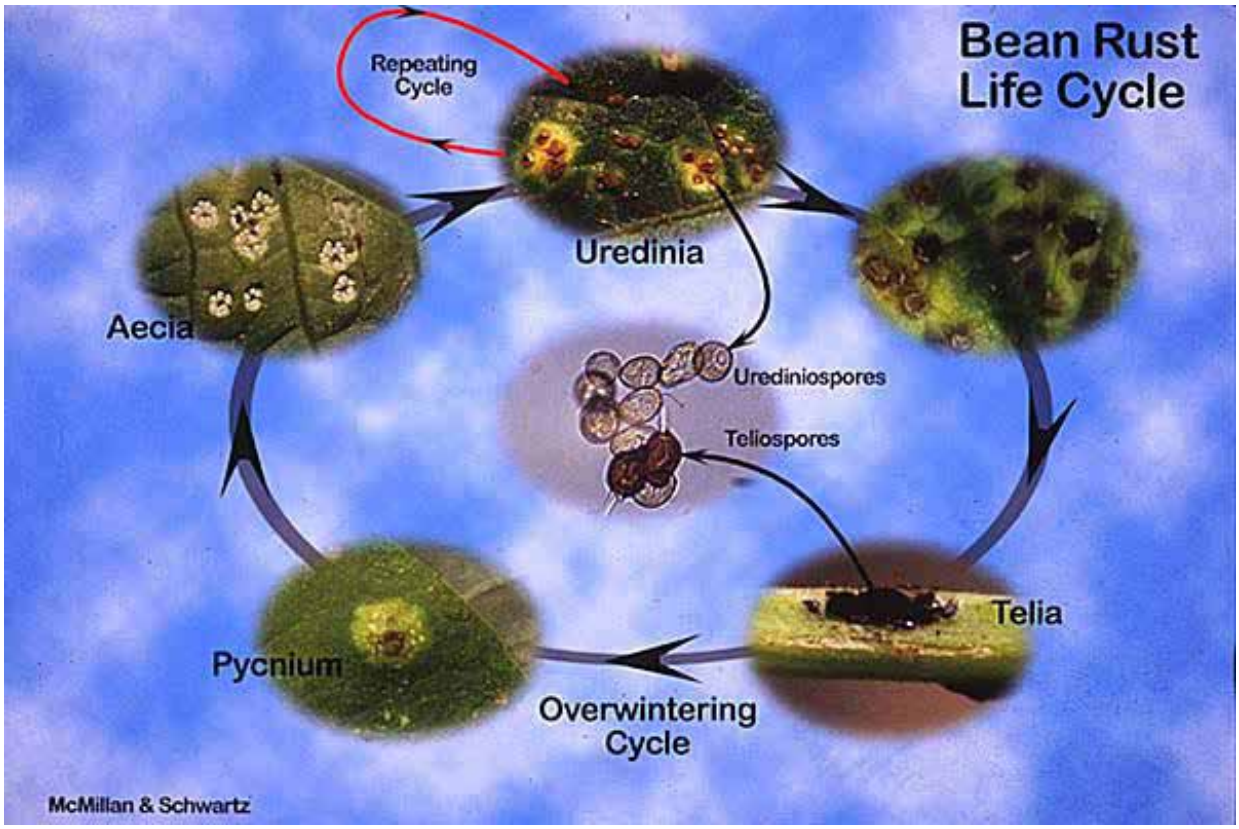

Figure 5. Life cycle of rust disease in dry bean.

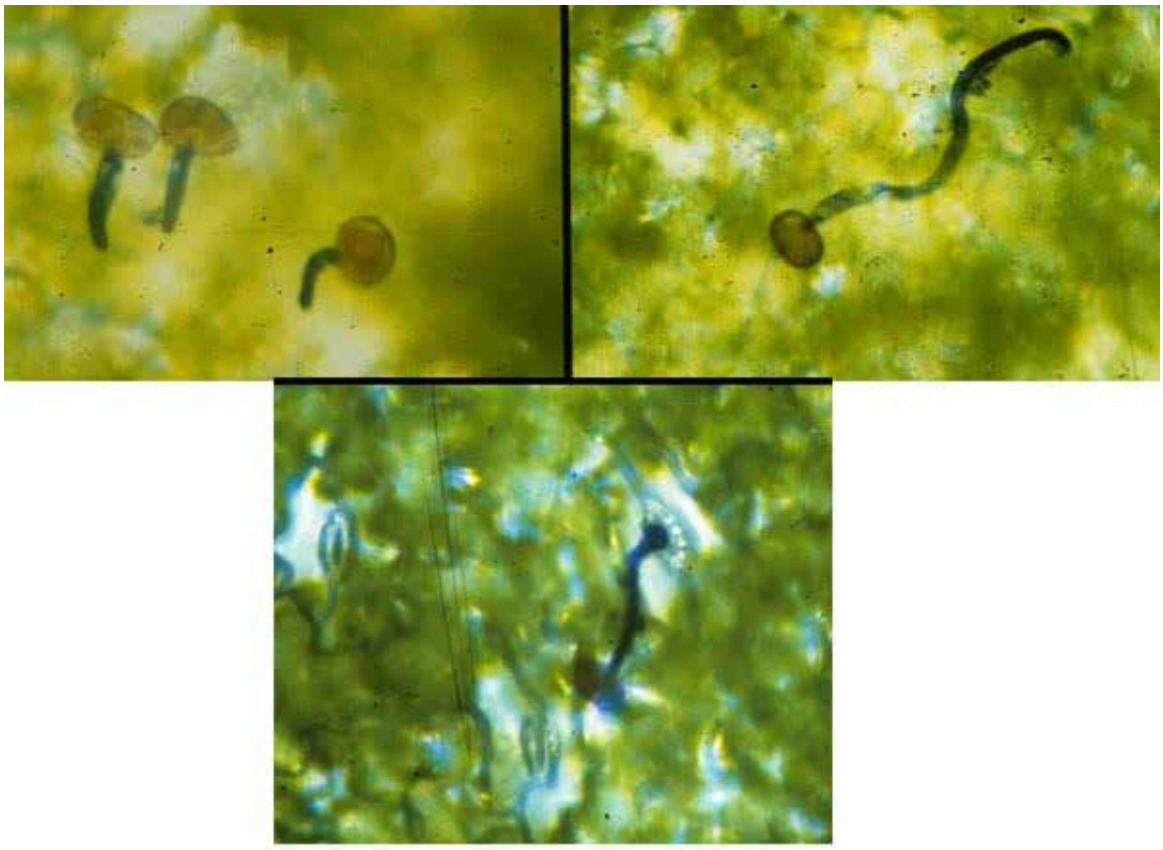

Figure 6. Urediniopsores germinating and penetrating leaf surface through stomates.

The earlier the plant becomes infected during its development, the greater the chance for yield loss. Anything that delays plant maturity, such as late planting, herbicide damage, excess nitrogen or hail damage, increases the potential for significant yield loss in the event that a rust epidemic occurs. This potential also is increased by planting on or adjacent to old bean ground where the rust pathogen survives through the winter. Infection that occurs within 21 days of knifing will not significantly affect yield although the symptoms may be very advanced.

Management

No single disease management technique will prevent rust fungus infection. Integrating management practices (cultural, host resistance, chemical) will provide more long-term and reliable crop protection.

- Cultural practices such as crop rotation and burying bean debris will remove potential sources of inoculum. Planting within recommended periods in this region (May 15 to June 15) will reduce late season exposure to high levels of the pathogen and favorable cool nights that produce dew. Sprinkler irrigation can be timed to avoid foliage staying wet at night for longer than 10 hours.

Most older bean varieties are susceptible to rust. Rust-resistant varieties are constantly being developed and are available for many different market classes, including pinto, great northern, small white, red kidney, and black beans.

- Rust-resistant pinto varieties may yield nearly 200 percent more than susceptible varieties when exposed to severe epidemics. However, the value and stability of this resistance can be affected by the variability in pathogen virulence. The University of Nebraska has been conducting work with the mobile rust nursery to monitor area fields for the presence of new pathogen races capable of overcoming resistance incorporated into commercial varieties and advanced breeding lines. This information will guide deployment of rust resistance genes alone or in combinations for future bean varieties. Colorado State University personnel conduct annual surveys throughout bean production areas to monitor for initial infection of previously-resistant varieties and recently-released breeding lines that would signal there has been a change in the rust pathogen races. In recent years, Central High Plains pest management specialists have participated in the national Soybean Rust Sentinel Plot system that monitors legume crops for infection by exotic pests such as Soybean Rust and other diseases, including common rust, bacterial diseases, viruses, and white mold. More information is available at: *http://sbrusa.net/*.

Problems also may arise due to limited availability of rust resistant varieties with other agronomic characteristics that are acceptable to bean growers and the industry. Furthermore, some rust-resistant varieties also may be susceptible to additional and more commonly encountered diseases and insect pests. The effectiveness of current resistance can be extended by integrating the previously described cultural practices and sound use of protectant and/or systemic fungicides.

- To evaluate whether a fungicide treatment is needed, scout fields frequently during blossom and early pod development for initial rust pustules. Infections occurring at or after pod bump and stripe seldom cause eco-

BEAN RUST – FUNGICIDE DECISION STRATEGY

Colorado State University Integrated Pest Management Program

CHECKLIST FOR APPLICATION			**Your Score**
Current Season Rainfall, Dew, Humidity from Planting to V - 4 Stage			
Above Normal: **2**	Normal: 1	Below Normal: 0	
Current Season Temperature from Planting to **V - 4 Stage**			
Below Normal: **2**	Normal: 1	Above Normal: 0	
Forecasted Rainfall, Dew, Humidity Between **V - 4 and R - 4 Stages**			
Above Normal: **2**	Normal: 1	Below Normal: 0	
Forecasted Temperature Between **V - 4 and R - 4 Stages**			
Below Normal: **2**	Normal: 1	Above Normal: 0	
Bean Rotation less than 3 years and/or Volunteer Beans Within 2 Miles from Field			
Yes: **4**	Unknown: 2	No: 0	
Variety Reaction to Rust Races in the Region			
Susceptible: 4	Unknown: 2	Resistant: 0	
Initial Rust Pustules Confirmed on Numerous Plants Prior to R1 (Early Flower)			
Yes: **4**		No: 0	
Initial Rust Pustules Confirmed on Numerous Plants Prior to R4 (Mid Pod Set)			
Yes: **2**		No: 0	
Total Score:			

ENVIRONMENTAL THRESHOLDS (weekly) for Disease Forecast:
Temperature: Normal = average high temperature of 86°F
Moisture: Normal = 0.25 inches of rainfall
DISEASE RISK SUMMARY - If the Total Score was:
more than 15 = **High Risk;** 10 - 15 = **Moderate Risk;** less than 10 = **Low Risk**

Note: As with any pesticide, always read and follow instructions and precautions. Refer to the Dry Bean Growth Stage Chart, and incorporate other Integrated Pest Management approaches such as crop rotation, sanitation, certified seed, plant resistance, tillage, moderate irrigation and fertility, and timely scouting.

(Checklist adapted for the Central High Plains region by Dr. H. F. Schwartz, M. S. McMillan, and K. L. Otto - 6/2007.)

Figure 7. Worksheet for determining strategies for fungicide applications

nomic losses. To help determine the need for fungicide applications, use the worksheet *(Figure 7)* developed in Colorado that is based on cultivar susceptibility, rust severity the previous season, weather data, and date of first sign or symptoms.

For example, if the cultivar is susceptible and the total score is 10 or higher, treatment with a labeled fungicide such as Maneb/Manex® (30-day preharvest interval = phi), Endura® or Headline® (21 day phi), Bravo®/Terranil or Quadris® (14 day phi), should be considered at first confirmed signs of rust (often the R1 to R3 stage) on numerous plants in the field or nearby region. Repeat applications if needed, depending upon disease pressure and the fungicide selected until 14 to 30 days phi or the R7 growth stage is reached, whichever occurs first.

UNL Extension publications are available online at *http://extension.unl.edu/publications*.

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Dry Bean
Issued September 2007