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Soybean Rust: How Great is the Threat for Nebraska?

By Loren J. Giesler, Extension Plant Pathologist

Soybean rust is a serious foliar disease that has caused significant crop losses in other parts of the world. It was first detected in the United States in November 2004 and has since been identified in several southeastern states. The fact that wind-borne spores principally spread soybean rust suggests it will be a seasonal problem in Nebraska.

Soybean rust, also referred to as Asian soybean rust, is caused by *Phakopsora pachyrhizi*. It is an aggressive pathogen that, in the past 10 years, has spread from Asia to Africa, South America, and now the United States. Yield losses can be severe with as much as 10-80 percent losses reported. Since its arrival in 2001, Brazilian soybean producers have suffered significant yield losses. Soybean rust cost Brazilian farmers \$600 million in fungicide applications in 2002-03 and possibly more than \$1 billion in 2003-04. USDA estimates U.S. losses could range from \$640 million to \$1.3 billion in the first year and \$240 million to \$2 billion in subsequent years, depending on the severity and extent of spread. The big question is: *How will soybean rust impact Nebraska soybean production?*

Symptoms

Soybean rust symptoms are most commonly observed on the leaves and will start in the lower canopy. Lesions also can develop on petioles, pods and stems. Symptom development occurs rapidly once the plant starts flowering and can result in significant levels of defoliation under favorable environmental conditions. Lesions first appear as small yellow and irregularly shaped spots. As the disease progresses, lesions enlarge to 1/16 to 1/12 inch in diameter and are tan to dark reddish brown. Within each lesion are a few to several volcano-shaped uredinia (spore-producing structures). These features can only be seen under magnification (20X recommended). As rust severity increases, plants prematurely lose their leaves and commonly mature early. Lesions from soybean rust can appear similar to other foliar diseases of soybean and can be confused with brown spot and bacterial pustule. See *Identifying Soybean Rust* (EC1892) for more information.

Life Cycle

Spores are produced in great numbers in the uredinia within each lesion and are readily dispersed by wind. Multiple spore cycles can occur throughout a season once the initial spores arrive via wind. The soybean rust fungus will not overwinter in Nebraska and will have to be reintroduced each year, similar to rusts in cereal crops. After landing on a host plant, spores germinate and produce a germ tube that grows across the leaf surface. Germ tubes penetrate directly through cell walls into the leaf. Pustules with spores can develop in 7 to 10 days after initial infection. Spore release from a pustule can continue for up to three weeks.

Soybean rust development is favored by temperatures of 54-84°F (65-80°F is optimum), with relative humidity above 90 percent for more than 12 hours. Soybean rust can be active with daytime temperatures as high as 100°F and possibly higher as long as night temperatures fall into the optimum range for disease development. In order for spores to germinate and infect the plant, six hours of continuous leaf wetness is required. Infection increases with longer leaf wetness periods up to 12 hours. In South America, significant rust development is associated with rain.

Host Range

The reported host range of soybean rust is extensive, infecting more than 95 plant species. This broad host range makes the soybean rust fungus different from other crop rusts which are specific to one host species. On all known hosts the spore type (urediniospore) is the same and can equally infect all the hosts. Soybean is the primary host and is where the most severe disease development has been observed.

Potential Impact on Nebraska Soybean Production

Nebraska is located on the “fringe” of soybean production in the north central states and represents the extremes of growing conditions. Annual precipitation can range from over 30 inches in the southeast corner to less than 16 inches

in the Panhandle. Factors that can reduce soybean yields in Nebraska, such as inconsistent precipitation, may make the soybean crop less vulnerable to soybean rust. Since soybean rust does best at temperatures between 65°F and 80°F and requires moisture for development, the potential for rust to be a significant problem every year in Nebraska is low in rain-fed fields. Irrigated fields, however, could provide more favorable conditions for rust development. The development of soybean rust in Nebraska is expected to vary from year to year as Nebraska's natural environment varies from one year to the next. Based on the USDA soybean rust risk map, which includes ambient weather conditions, Nebraska is predicted to have severe soybean rust problems about 50 percent of the time in most of the state. It is important to note that the risk map does not factor in irrigation and in 2004, 55 percent of the Nebraska soybean crop was irrigated.

Characteristics That Make Soybean Rust Potentially Devastating

Broad Host Range. Soybean rust has 35 leguminous hosts and is reported to infect 95 plant species.

Lack of Resistance in Soybean. Based on USDA evaluations of commercial soybean varieties, there is no resistance in commercial varieties at this time.

Airborne and Repeating. Soybean rust is airborne and spreads via spores. A spore can infect a plant and cause a new lesion producing spores every 7-10 days. Under favorable temperature and humidity conditions, spore production in a field can double every two days. It's estimated that over 400 billion spores per acre per day can be produced.

Large Acreage of Soybeans. There are over 74 million acres of soybeans in the United States which can serve as a continual inoculum source for the disease as it progresses northward each year.

Management

Management will be critical if this disease arrives before or during the susceptible development stages in the soybean crop (flowering through full seed). This disease will be devastating if conditions are favorable and management actions are not taken quickly. For example, in Brazil when fungicides are applied after 10 percent disease severity (10 percent of the leaves have rust) the effectiveness of the fungicide is significantly reduced. One study showed that yields were reduced by 17 percent if a fungicide application was delayed one week after soybean rust was first detected in a field (at R5) and 38 percent if treatment was delayed two weeks. Most producers in South America manage this disease preventatively now because fields with significant rust development were not well controlled

earlier with applications. See *Fungicides to Manage Soybean Rust* (NF634) for more information on labeled products and guidelines for curative and preventative use.

Management guidelines are being suggested based on experiences around the world. We are uncertain how soybean rust will develop in the United States, but the following management actions should be considered. Based on experience in South America, the critical time of protection is from flowering (growth stage R1) through full seed (growth stage R6). A sentinel plot monitoring system will be used in the first few seasons of soybean rust to help soybean producers with application timing.

- If soybean rust is detected in the area but not present in the field, a preventative fungicide can be used.
- If soybean rust is detected in a field, use a curative fungicide or combination of a preventative and curative fungicide if an application is made in that field.
- If disease development potential is unknown, consider preventative application to highest yielding, irrigated fields first – they have the maximum potential for return on the investment.
- In rain fed, lower yielding fields, rust will most likely not be a significant problem every year, since less favorable conditions for yield will reduce the risk of rust development in most cases. Risk in these fields will vary with moisture changes each year.
- Variety maturity also could affect the impact of soybean rust and how long protection is needed.
- Planting date and variety maturity will spread the window of flowering time on your farm and may improve your ability to protect the crop if needed, allowing more time for fungicide application.

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Index: PLANT DISEASES

Field Crops

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