

National Pest Alert

Soybean Rust

Phakopsora pachyrhizi and *P. meibomiae*

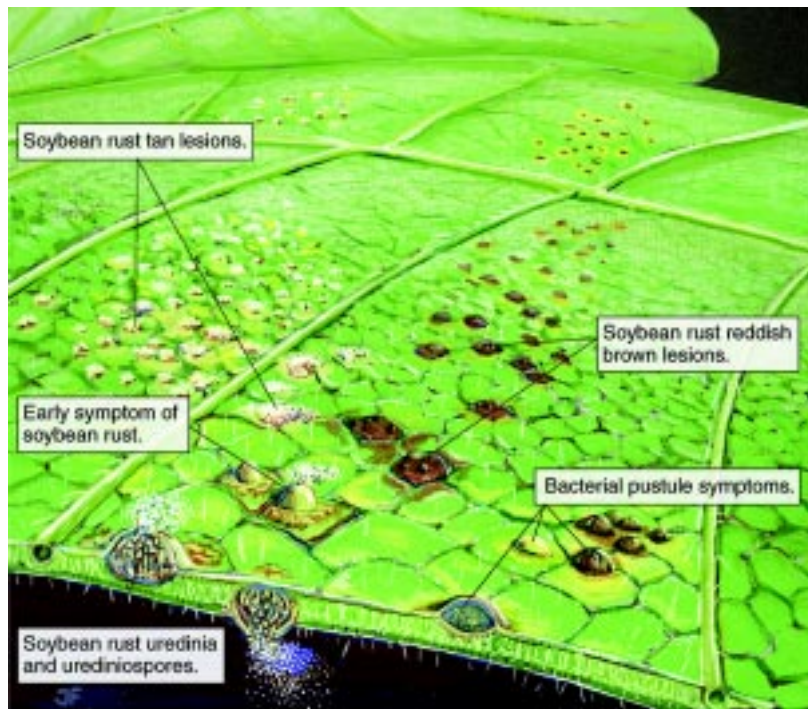
Distribution and Transmission

Two fungal species, *Phakopsora pachyrhizi* and *P. meibomiae*, cause soybean rust and are spread primarily by windborne spores that can be transported over long distances. Asian soybean rust, *P. pachyrhizi*, the more aggressive of the two species, was first reported in Japan in 1903 and was confined to the Eastern Hemisphere until its presence was documented in Hawaii in 1994. Currently, distribution of *P. pachyrhizi* includes Africa, Asia, Australia, Hawaii, and South America. *P. pachyrhizi*'s rapid spread and severe damage with yield losses from 10 to 80% have been reported in Asia, Brazil, Paraguay, South Africa, and Zimbabwe. The less aggressive soybean rust species, *P. meibomiae*, is present in the Western Hemisphere, including Puerto Rico. *P. pachyrhizi* and *P. meibomiae* have not been detected in the continental United States as of May 2003.

Seedborne transmission has not been documented, although seed lots may contain contaminated plant debris capable of spreading the pathogen. Clouds of spores are released if infected plants are disturbed by wind or by individuals walking through rust-infected areas. Individuals who are sampling for soybean rust may transport spores from one area to another on clothing. If clothing is exposed to spores, care should be taken to prevent the spread of soybean rust to uninfected locations.



Symptoms of high infection (left) and low infection (right) levels of soybean rust within a soybean field.



Soybean rust lesion types and characteristics of early symptoms of soybean rust and bacterial pustule.

Host Range

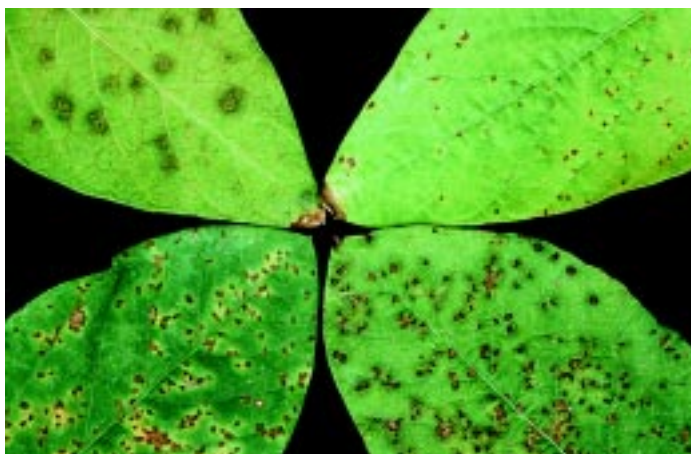
P. pachyrhizi infects more than 90 species of legumes. Principal hosts include soybean (*Glycine max*), wild soybean (*G. sojae*), kudzu (*Pueraria lobata*), jicama or yam bean (*Pachyrhizus erosus*), snap and dry bean (*Phaseolus vulgaris*), yellow lupine (*Lupinus luteus*), and cowpea (*Vigna unguiculata*). Kudzu is widespread in the United States and could serve as a reservoir for the soybean rust pathogen. The broad host range of this fungal pathogen increases the likelihood of rapid spread once introduced into the United States.



Symptoms and Disease Development

Soybean rust symptoms are similar for *P. pachyrhizi* and *P. meibomiae* species. Symptoms begin on the lower leaves of the plant as small lesions that increase in size and change from gray to tan or reddish brown on the undersides of the leaves. Lesions are most common on leaves but may occur on petioles, stems, and pods. Soybean rust produces two types of lesions, tan and reddish brown. Tan lesions, when mature, consist of small pustules (uredinia) surrounded by slightly discolored necrotic area with masses of tan spores (urediniospores) on the lower leaf surface. Reddish brown lesions have a larger reddish brown necrotic area, with a limited number of pustules (uredinia) and few visible spores (urediniospores) on the lower leaf surface. Once pod set begins on soybean, infection can spread rapidly to the middle and upper leaves of the plant.

Environmental conditions impact the incidence and severity of soybean rust. Prolonged leaf wetness combined with temperatures between 59 and 86°F and humidity of 75–80% is required for spore germination and infection. Under these conditions, pustules form within 5–10 days and spores are produced within 10–21 days. High levels of infection in soybean fields result in a distinct yellowing and browning of fields and commonly, premature senescence in plants.



Various stages of soybean rust on soybean leaves.

Identification of Soybean Rust

Molecular analysis provides rapid and accurate identification to differentiate between *P. pachyrhizi* and *P. meibomiae*. Early symptoms of soybean rust resemble bacterial pustule (*Xanthomonas axonopodis* pv. *glycines*) and brown spot (*Septoria glycines*). Soybean rust can be distinguished from bacterial pustule and brown spot by examining the lesions under a hand lens (20×) or dissecting microscope. The mature soybean rust lesion contains cone-shaped pustules with a pore on the top with spores inside or on top of the cone.

Sample Collection Procedures

Collect samples immediately if you suspect soybean rust is present on soybean or other hosts. Place each plant sample in a self-locking plastic bag and maintain under cool conditions (refrigeration). Place samples in sealed paper bags if cool conditions are not available. Once refrigeration is available, each sealed paper bag should be placed inside a self-locking plastic bag before cooling. Leaves should be kept flat by placing them between paper towels or pieces of paper. Record the following information for each sample collected: date; host plant; collector's name; phone number; collection location within field; and location of field, including state, county, township, and nearest road intersection. Global positioning system location information is requested if available. Mark sample containers with a permanent marker and print all information.

Sample Submission

Submit samples to your state's university diagnostic laboratory or Department of Agriculture diagnostic laboratory for identification (contact university extension personnel for the address of the diagnostic laboratory). Each state is developing an invasive species response program as part of the USDA National Plant Diagnostic Network. If samples are identified as soybean rust by state diagnosticians, species verification by molecular analysis will be required.

Management Recommendations

All commercial varieties currently available are highly susceptible. Current research includes screening germplasm for resistance and evaluating fungicide efficacy. Early detection is required for the most effective management of soybean rust. Monitoring soybean fields and adjacent areas is recommended throughout the growing season. Fungicide applications may reduce yield loss, depending on the plant developmental stage, time when soybean rust is detected, and fungicide application method. For efficacy information on fungicides labeled for use on soybean, consult university extension personnel in your state.

For more information on soybean rust, visit our Web site at

<http://www.ncpmc.org/soybeanrust>

This publication was produced and distributed in cooperation with USDA-CSREES Integrated Pest Management Centers, National Plant Diagnostic Network, APHIS, and ARS. For more information regarding the development of this document, contact Susan T. Ratcliffe at sratclif@uiuc.edu or by phone at (217) 333-9656.

Photos courtesy of Glen Hartman (USDA-ARS) and David Riecks (University of Illinois, College of Agricultural, Consumer and Environmental Sciences); scanning electron microscopy of spores courtesy of Morris Bonde (USDA-ARS); and soybean rust illustration courtesy of Joel Floyd (USDA-APHIS-PPQ). Editor: Julie L. Todd (Department of Entomology, Iowa State University). Graphic designer: Gretchen Wieshuber (Studio 2D, Champaign, IL).

