

Asian soybean rust

Asian soybean rust is a serious disease of soybeans caused by the fungus *Phakopsora pachyrhizi*. Until recently this disease did not occur on soybean in the western hemisphere but it spread to South America in 2001 and was found for the first time in North America in November 2004. A second, similar-looking rust fungus, *P. meibomia*, also infects soybeans but is much less virulent and occurs primarily in the western hemisphere. It is important to differentiate between these two rust species but this can only be done reliably using molecular techniques. Both *P. pachyrhizi* and *P. meibomia* infect numerous leguminous plant hosts.

Phakopsora pachyrhizi Syd. & P. Syd., Ann. Mycol 12:108. 1914

Spermogonia and aecia unknown.

Anamorph sori (Malupa-type) amphigenous, mostly hypophyllous, circular, minute, pulverulent, whitish becoming pale cinnamon-brown, scattered or in groups on discolored spots, subepidermal becoming erumpent, cone-like, 1-2 mm diam, surrounded by paraphyses, with a central opening; paraphyses cylindrical to clavate, 25-50 × 6-14 µm, slightly thickened at the apex, colorless to pale yellowish-brown; anamorph spores sessile, obovoid to broadly ellipsoidal, 18-37 × 15-24 µm, wall 1-1.5 µm thick, minutely and densely echinulate, colorless to pale yellowish brown, sometimes pale cinnamon-brown in age; germ pores (2) 3-5 (-10), equatorial or scattered on equatorial zone, or occasionally scattered on and above the equatorial zone, usually inconspicuous.

Telia hypophyllous, minute, 0.15-0.5 mm across, often intermixed with anamorph sori, chestnut brown to chocolate brown, subepidermal, crustose; teliospores one-celled, irregularly arranged in 2-7 layers, variable in shape, angularly globose, oblong to ellipsoidal (10-) 15-26 × 6-13 µm, wall 1-1.5 µm thick, slightly thickened at the apex (-3 µm), colorless to yellowish brown.

Hosts: *Glycine max* (soybean), *Glycine soja*, *Pachyrhizus erosus*, *Pueraria lobata* and *Vigna unguiculata* are the principal hosts according to Ono et al. (1992) although many other host plants are also reported.

Geographic distribution: Asia and Australia, and more recently from Africa, North America (Hawaii and the southeastern U.S.) and South American.

Asian soybean rust caused by *Phakopsora pachyrhizi* was first observed in Japan in 1902. Until recently the pathogen was distributed throughout Asia and Australia. It was reported from Hawaii in 1994. In the late 1990's Asian soybean rust was found in Africa and in 2001 was reported in South America. As of 2004, Asian soybean rust in the Americas is known from Argentina, Bolivia, Brazil, Paraguay, and Uruguay. In November 2004 *Phakopsora pachyrhizi* was found for the first time in Louisiana and, soon thereafter, in other southeastern U.S. states.

Many earlier reports of *Phakopsora pachyrhizi* in the Americas are erroneous. The reports of *P. pachyrhizi* prior to 1992 actually refer to *Phakopsora meibomia*, a similar-looking rust that also occurs on soybeans and numerous other legumes. In a monograph of the genus *Phakopsora* Ono et al (1992) discussed the morphological differences between *P. pachyrhizi* and *P. meibomia*, although it is difficult to separate them based on morphology with certainty. A molecular test for differentiating these species was published by Frederick et al (2002) and its use is essential for the accurate identification of these two species.

SEM Photographs by Beth Richardson and Charles Mims, Departments of Plant Biology and Plant Pathology, University of Georgia.

References:

- Frederick, R.D., Snyder, C.L., Peterson, G.L., and Bonde, M.R.** 2002. Polymerase chain reaction assays for the detection and discrimination of the soybean rust pathogens *Phakopsora pachyrhizi* and *P. meibomia*. *Phytopathology* 92: 217-227.
- Ono, Y., Buritica, P., and Hennen, J.F.** 1992. Delimitation of *Phakopsora*, *Physopella* and *Cerotelium* and their species on Leguminosae. *Mycol. Res.* 96: 825-850.

Early symptoms on soybean leaves. Photo from USDA-ARS-FD-WSRU.



Close-up of early symptoms on soybean leaves. Photo from USDA-ARS-FD-WSRU.



Advanced infection. Chlorotic soybean leaves with uredinia. Photo from USDA-ARS-FD-WSRU.



Close-up of advanced infection. Soybean leaves with uredinia and some chlorotic areas. Photo from USDA-ARS-FD-WSRU.



Uredinia on soybean petiole and leaf. Photo from USDA-ARS-FD-WSRU.



Tan soybean leaf lesions with pale uredinia. Photo from USDA-ARS-FD-WSRU.



Red brown soybean leaf lesions with uredinia. Photo from USDA-ARS-FD-WSRU.



Numerous uredinia (sori) in leaf lesions on undersurface of soybean leaf. Bar = 10 μ m. Photo by John McKemy, USDA APHIS.



Close-up of sori showing cone-like opening on lower surface of kudzu leaf. Bar = 10 μ m. Photo by John McKemy, USDA APHIS.



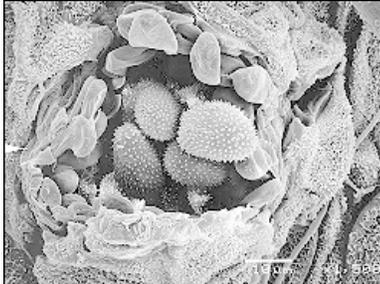
Close-up of uredinium (sorus) on lower surface of kudzu leaf. Note cone-like shape. Bar = 10 μ m. Photo by John McKemy, USDA APHIS.



Photo by Beth Richardson and Charles Mims, Depts of Plant Biology and Plant Pathology, UGA.



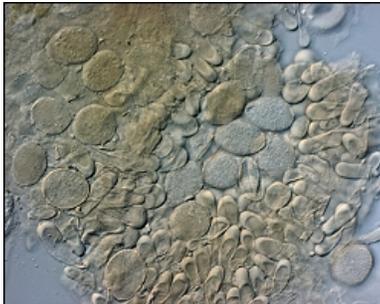
Photo by Beth Richardson and Charles Mims, Depts of Plant Biology and Plant Pathology, UGA.



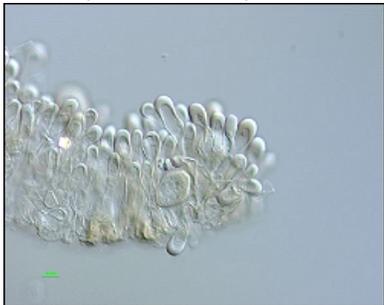
Cross-section of leaf showing telium with two-three layers of teliospores



Squash mount of uredinium showing peripheral paraphyses surrounding urediniospores



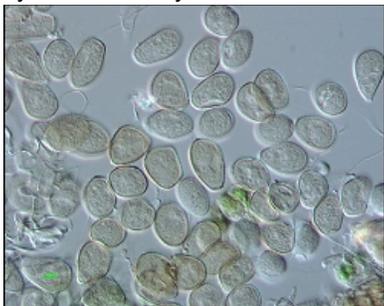
Paraphyses showing thickened apex. Bar = 10 µm. Photo by John McKemy, USDA APHIS.



Uredinial paraphyses which are united at the base and have a thickened apical wall



Urediniospores of *Phakopsora pachyrhizi*. Note range of color from colorless to pale-brown. Bar = 10 µm. Photo by John McKemy, USDA APHIS.



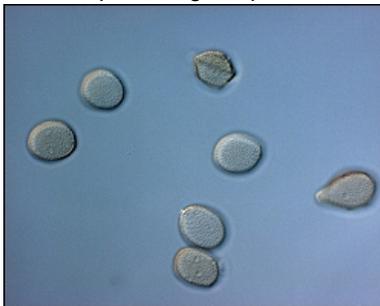
Pale urediniospores, surface view



Pale urediniospores, median view



Pale yellowish-brown urediniospores, surface view.
Notice equatorial germ pores



Pale yellowish-brown urediniospores, median view.
Notice equatorial germ pores

