Scientists sequence genomes of two major threats to American food and fuel

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An international team of researchers co-led by a University of Minnesota scientist has sequenced the genomes of two fungal pathogens -- one that threatens global wheat supplies and another that limits production of a tree crop valued as a future source for biofuel.

The sequencing of the genetic codes of wheat stem rust pathogen (*Puccinia graminis*) and poplar leaf rust pathogen (*Melampsora larici-populina*) is expected to help researchers develop control strategies to address worldwide threats to wheat fields and tree plantations. The study, which was published this week in the early online edition of the Proceedings of the National Academy of Sciences, was a six-year collaborative effort of USDA's Agricultural Research Service (ARS), the U.S. Department of Energy, the National Science Foundation, the Broad Institute of MIT and Harvard, the University of Minnesota and the French National Institute for Agricultural Research.

The study represents the first genome-wide characterization of any rust fungus, a diverse group of more than 6,000 species, according to Les Szabo, a lead researcher on the project. Szabo works at the ARS Cereal Disease Laboratory on the university's St. Paul campus and is a member of the plant pathology department faculty.

Rust fungi are obligate biotrophs that depend on living tissue of their hosts for survival. These pathogens secrete proteins that enable them to block the host plant's defenses and steal nutrients. The research uncovered evidence that both pathogens have a large repertoire of

"effector" proteins, an indication that they likely have adapted and co-evolved with their host plants, according to the study authors.

Because they need a host to survive, the pathogens can't be cultured in a laboratory and are notoriously hard to study. But the genetic sequencing opens a window into the never-ending arms race between these pathogens and their hosts, Szabo said.

Wheat stem rust has caused major epidemics of both barley and wheat worldwide. A new strain known as Ug99 has recently spread across Africa and into Central Asia, and is able to overcome most of the stem-rust-resistant wheat varieties developed over the past 50 years.

Poplar leaf rust can cause losses of up to 50 percent of annual growth in poplar tree plantations. Poplar is an important crop for the wood industry and is becoming increasingly important to the biofuel industry in the United States and Europe because their rapid and significant biomass production.

"These pathogens pose a great threat to two very important agricultural crops. The more we can learn about them, from the molecular underpinnings of the pathogenicity to their survival and spread, the better we will be able to develop effective, safe and long-lasting control strategies," said Marty Carson, ARS-CDL research leader. ARS is USDA's principal intramural scientific research agency, and the research supports the USDA priority of developing new sources of bioenergy and promoting international food security.

The team's sequence data, gathered since the projects began in 2004/2005, has been released in GenBank, a genetic database administered by the National Center for Biotechnology Information at the National Institutes of Health.