Rice blast research reveals details on how a fungus invades plants

June 18 2013

A study by an international team of researchers has shed light on how the rice blast fungus, *Magnaporthe oryzae*, invades plant tissue. The research shows that there are two ways in which a disease-causing fungus can secrete proteins into plants. The finding is a step towards learning how to control rice blast disease. Credit: University of Exeter

Like a stealthy enemy, blast disease invades rice crops around the world, killing plants and cutting production of one of the most important global food sources. Now a study by an international team of researchers has

shed light on how the rice blast fungus, *Magnaporthe oryzae*, invades plant tissue. The finding is a step towards learning how to control the disease, which by some estimates destroys enough rice to feed 60 million people annually.

The team, from the Halpin Laboratory at the University of Exeter, in collaboration with Kansas State University and the Iwate Biotechnology Research Center in Japan, found that the fungus has evolved two distinct secretion systems that facilitate its invasion into rice plants. The results of the study are published in the journal *Nature Communications*.

Professor Nick Talbot from Biosciences at the University of Exeter said: "This discovery shows that there are two ways in which a disease-causing fungus can secrete proteins into plants. This is a big step forward for plant pathology and might eventually offer new strategies to control crop diseases important in food security. The project was a truly international collaboration with observations being painstakingly checked and validated by students working in different continents over the last two years."

Barbara Valent, Distinguished Professor of Plant Pathology at Kansas State University said: "Knowing that a special secretion system is required for disease is significant, because it means we can block this system without harming other fungi that are critical for healthy ecosystems.

Researchers know that to cause plant diseases, pathogenic micro-organisms secrete proteins, called effector proteins, into the host plant's tissue, the proteins suppress the plant's immunity and support the pathogen's growth. The goal of the study was to learn if fungi need different secretory systems to aid their invasion into host plants."

Rice blast has been known throughout recorded history and occurs in all

countries where rice is grown, including the U.S. In 1985, wheat blast emerged as a new disease sharply reducing wheat yields in Brazil. So far, wheat blast has only spread within South America and has not been detected in the U.S. Valent is now leading a team of scientists focused on developing resources for rapid identification and elimination of the disease if it should arrive in U.S. wheat regions.

Two of the authors on the paper, Yasin Dagdas and Yogesh Gupta, are prestigious Halpin Scholars at the University of Exeter. The Halpin PhD studentship programme, funded by Dr Les and Mrs Claire Halpin, who are alumni of the University of Exeter, trains the next generation of molecular plant pathologists from developing countries in order to build local expertise that can be use to combat rice blast disease and serious agricultural threats to food security. A third student from Exeter, Tom Mentlak, was funded by a prestigious Sainsbury Plant Science Studentship and now works with Cambridge Consultants.

Speaking about their key contributions to the study, Prof. Talbot said: "This work was led at Exeter by three extremely talented students who forged close links with laboratories in the USA and Japan. They worked exceptionally hard and are a great credit to the University."

Rice blast disease is a threat to global food security and is closely related to wheat blast, a newly emerging disease that threatens wheat production in Brazil and which is spreading across South America. Because rice and wheat are the most important food staples worldwide, learning about these diseases is incredibly important to ensuring global food security.

The researchers found that the rice blast fungus *Magnaporthe oryzae* has evolved a novel secretion system for effectors that go inside the plant cell. In contrast, effectors that end up in the space outside the plant cells are secreted by a classical system, which is shared by organisms from fungi to humans.

In this study, the international team focused on investigating how the fungus secretes effectors during invasion of rice tissue by producing strains secreting effectors linked to fluorescent proteins from jellyfish and corals. They performed microscopy to watch the fungus secreting these fluorescent proteins as it grows inside rice cells, and noticed that normal treatments that block protein secretion didn't stop those effectors that end up inside rice cells.

Identifying how these processes function will advance understanding of how disease micro-organisms evolve and will prove pivotal in controlling blast disease.

More information: www.nature.com/ncomms/2013/130 … /abs/ncomms2996.html

Provided by University of Exeter