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Gene Hunters Tackle Crop Diseases

Norwich scientists are on the trail of some of the most economically damaging organisms that infect crops worldwide. Their latest targets are the parasitic water fungus that causes powdery mildew and the water molds that cause late blight in potatoes and tomatoes and downy mildew in cruciferous vegetables and other crops.

"We have been studying the late blight pathogen for a while," said Professor Sophien Kamoun, Head of the Sainsbury Laboratory on the Norwich Research Park. "In separate research we are trialling plant genes that mediate blight resistance, while in this latest study we have learnt more about how the pathogen itself evolved and which genes we should focus on to tackle it."

The scientists compared the genome of the potato blight pathogen to the genomes of four sister species that infect plants as diverse as morning glory and the ornamental four o'clock. These closely related pathogens are from Mexico, the centre of origin of the late blight pathogen.

The analysis showed that some sections of the genome are slow to evolve and are highly similar between the sister species. Other sections are more dynamic and allow the pathogen to quickly jump hosts to infect and adapt to new plant species.

"Our aim is to develop resistance to genes from the stable, slowly-evolving region of the pathogen's genome," said Professor Kamoun.

"This should be more disruptive to the pathogen's ability to evolve new races."

Published in the same edition of the journal *Science* are two studies focusing on mildews. Like the late blight pathogen, the parasite that causes downy mildew is a kind of water mold or oomycete. The oomycetes are fungal-like organisms that have evolved from marine algae. Downy mildew causes yellow patches and fuzzy white mould on the leaves of many crops including crucifers, maize, grapes and lettuce. Powdery mildew is a fungal disease of barley that is most damaging in cool, wet climates.

"A major focus of our research is sustainable agriculture," said John Innes Centre Director Professor Dale Sanders.

"We need to help breeders and farmers generate good quality food and other agricultural products in an environmentally sustainable way. One way of doing so will be to develop crops that are resistant to pathogens and pests. Such crops will reduce the need to spray pesticides

and fungicides and they will give better yields, as less will be lost to disease."

The genomes of the parasites have been sequenced in separate research collaborations, one involving John Innes Centre scientists and the other The Sainsbury Laboratory. The genomes were compared with those of closely related species.

Analysis revealed that the parasites have discarded many genes. They have become specialised to live solely on their plant host and have dispensed with the genes that would be needed to survive elsewhere. Instead they have focussed on genes that help them stealthily take control of host cells. The genome sequences reveal large numbers of effector proteins, the molecules that invade plant cells to suppress plant immunity.

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