CALS genomicists aim to save citrus from 'greening'

July 17 2009, By Chris Bentley

Magdalen Lindeberg, senior research associate in the College of Agriculture and Life Sciences, leads an effort to sequence the genome of a mysterious pathogen that is devastating the citrus industry. Image: Chris Bentley

(PhysOrg.com) -- It has been a dismal two decades for the 450-year-old Florida citrus industry: On top of the constant pressure from hurricanes, a citrus canker epidemic shrank U.S. citrus production by roughly one-third in the 1990s, despite an eradication campaign by the U.S. Department of Agriculture.

Now a recently introduced disease known as citrus greening, which, in the words of a USDA entomologist, causes juice from infected fruit to "taste like jet fuel mixed with Vicks VapoRub," threatens to be the most devastating blow yet for domestic citrus production. The search for a solution has brought researchers from around the world together in a

race to save a troubled industry, with the College of Agriculture and Life Sciences (CALS) exporting its "local expertise in genome analysis and bioinformatics," according to plant pathology senior research associate Magdalen Lindeberg.

While the pathogen responsible is believed to be a variety of a bacterium called Candidatus Liberibacter, scientists have been unable to conclusively determine the cause of citrus greening because the bacterium cannot be routinely cultured independent from its host, a small insect known as a psyllid.

To get around these issues, CALS scientists are using an advanced method for sequence analysis -- known as metagenomics -- to identify the Ca. Liberibacter DNA from a genetically mixed population of environmental samples. Researchers are also looking to similar bacteria that cause zebra chip disease -- named for the dark striations it creates in chips made from infected potatoes -- as an alternative approach for understanding Ca . Liberibacter's basic biology.

"There are a number of groups who are basically competing to try to culture it and get the complete genomic sequence," said David Schneider, a USDA-Agricultural Research Service (ARS) scientist and adjunct associate professor of plant pathology at Cornell. Still, he said, this class of organisms is not well understood, so the mechanisms of virulence are not known. "Without that basic knowledge, it's hard to proceed."

Once a psyllid delivers the bacterium into a citrus plant, infected trees may not show symptoms for years. Before dying early, trees with citrus greening will produce misshapen, undersized green fruit without economic value.

Meanwhile, the psyllid continues to spread as far as Texas and

Louisiana, and most recently to southern California. The disease was first identified in China -- where it is know as Huanglongbing -- during the 1920s and was likely introduced to the U.S. via international transport of small ornamental plants during the 1990s.

"Genome analysis methods developed at CALS are transferrable to many, many systems," Lindeberg said. "I think the potential for improved diagnostics will be of particular interest in developing countries." Lindeberg will attend an annual meeting of the American Phytopathological Society in August for a special session on citrus greening with guest speakers from around the world.

In the fight against citrus greening, orchard management problems are proving to be a substantial obstacle. Private citrus growers facing bankruptcy have abandoned tens of thousands of acres of land in recent years. Lindeberg said these "feral orchards" act as petri dishes for Ca. Liberibacter. "If a hurricane goes through, it basically blasts the orchard all over the state."

While the abandoned orchards are privately owned and thus difficult to manage, Cornell scientists, in partnership with other national universities, hope to produce cultivars resistant to citrus greening that may stop the spread of the disease before it is too late. "We are very much at the start of a true collaboration period," Lindeberg said.

Provided by Cornell University (news : web)