Researchers work to identify how crops may be vulnerable to attack

July 29 2011, By Helen Chappell, McClatchy Newspapers

On farmland around the globe, a silent war rages, between crops and the diseases that attack them. Crop diseases cost the world an estimated $220 billion every year and put millions at risk of starvation.

But with a little help from scientists, crops - and we who depend on them - may soon gain the upper hand.

In two papers published Thursday in Science, an international consortium of researchers report that even dramatically different diseases attack a small set of targets in plants.

By identifying the ways plants might be most vulnerable to attack, the discovery enables crop researchers to focus on protecting these few targets, potentially speeding up the arduous task of developing disease-resistant crops.

The team sorted through more than 8,000 proteins in a small plant related to cabbage to examine the different ways the proteins interact with each other. The result, a tangled map of the plant's chemical defense mechanisms, is akin to the street map of a city.

Just as a street map allows you to visualize traffic flow through a city, a map of a plant's interacting proteins allows scientists to see how it transmits messages about its health - how it detects the presence of a dangerous disease, for instance.

The researchers discovered that just as in cities, a plant's message traffic tends to pass through major intersections; a wreck at one can disrupt traffic across an entire city.

In plants, this makes intersections a perfect target for diseases. By causing a wreck at one of a plant's major message intersections, a disease can devastate the plant's ability to fight back.

The international team tested the cabbage relative's reaction to two very different diseases. The bacteria and mildew they studied are separated by more than 2 billion years of evolution - making the diseases more different from each other than humans are from dinosaurs.

Despite their differences, both diseases went for an overlapping set of targets: the plant's major intersections.

"It's the most exciting thing," said Jeff Dangl, a professor of biology at the University of North Carolina, Chapel Hill, and one of the leaders of the project. Since these diseases are so different yet have similar attack strategies, Dangl said, it suggests that many other plant diseases will attack the same intersections.

Though routing so much of its message traffic through these vulnerable points may seem like a disadvantage for a plant, it does have benefits. If most diseases attack the same targets, a plant can conserve resources and watch just a few hubs to look out for many different diseases.

And that means scientists working to develop disease-resistant crops can conserve their resources, too. The intersections attacked in the study's test plant are similar in many types of plants, ranging from crops to trees to grasses.

"We've really allowed people to zoom in," said Dangl. Instead of sifting through tens of thousands of possible ways to protect a plant, crop disease researchers can now focus on a few hundred.

"It's a powerful piece of work," said Ralph Dean, a professor of plant pathology at North Carolina State University and director of the Center for Integrated Fungal Research, who was not connected with the study. The team's achievement opens doors for disease research, Dean said.

One of the biggest challenges they faced, Dangl said, was organizational instead of scientific. More than 70 researchers in five different countries collaborated on the project.

When their work was finally accepted for publication after five years of research, they held a "virtual champagne toast," Dangl said. "We had to clink our glasses against the video screen."

Complicated collaborations like this are becoming more common, especially in biomedical research, Dangl said. It can be hard to coordinate, he said, but there's a real advantage in bringing together so many scientists with diverse specialties.

According to Nathan McDonald, a recent UNC biochemistry graduate who worked on the project, the study's scale is one of its biggest strengths.

"You can study away for as long as you want in a little lab on one little problem," he said, "but to really understand the complex systems in biology, I think this kind of study is really necessary."