Plant Communication, Raspberry Future, Orchard Efficiency

Posted by steven.reynolds | October 26, 2011

Plant Communication Breakthrough

Traditional thought holds that a disease-causing organism has to penetrate a plant to initiate resistance. Now, two Washington State University scientists have established that a barley plant recognizes an invader and begins to marshal its defenses within five minutes of an attack. The discovery, along with the scientists' successful cloning of barley's disease-fighting gene and the pathogen's signaling gene, could help to revolutionize the battle against cereal crop enemies such as stem rust. Unless carefully controlled, stem rust has the potential to destroy a grower's entire crop.

Historically, stem rust has caused the loss of millions of bushels of grain and millions of dollars. Meanwhile, new threats are on the horizon. For example, Ug99 is an evolving wheat pathogen that poses a dangerous threat to global food security, especially in developing countries.

"Now that we understand how the plant pathogen interaction mechanism works, we hope we can manipulate it to build resistance in plants," said Andy Kleinhofs, professor of molecular genetics in WSU's Department of Crop and Soil Sciences. With further research, he added, that understanding could lead to new, more effective ways to battle crop diseases such as stem rust and Ug99.

"It will take time for research on Ug99 to see if the mechanism works the

same as in this case," Kleinhofs said. "If it is the same, we could use the technology to defeat Ug99."

Andy Kleinhofs and Jayaveeramuthu Nirmala. Photo by Brian Clark/WSU

Kleinhofs and Assistant Research Professor Jayaveeramuthu Nirmala focused their research on understanding Rpg1, a gene that provides barley with resistance to the pathogen that causes stem rust. Rpg1 is unique in that it has provided durable resistance in barley over the past 60 years, Kleinhofs said. His laboratory team previously successfully cloned that resistance gene, which when combined with the recently discovered genes that activate it, delivers a one-two punch against stem rust.

It was while monitoring the activity of those combined genes that Kleinhofs and Nirmala observed and documented communication between the barley plants and stem rust spores. In the process, the researchers identified the proteins recognized by the Rpg1 resistance gene and saw the series of signals that tell the plant to protect itself. "It is clear that the plant recognizes the pathogen within five minutes of the spore touching the leaf," said Camille Steber, a research geneticist for the U.S. Department of Agriculture's Agricultural Research Service at WSU.

The plant's initial reaction to attack is invisible to the human eye, Nirmala said, but she succeeded in monitoring subtle changes in plant chemistry that demonstrated the plant not only recognized it was under attack but was starting to muster its resistance. Visible signs of the stem rust spore's impact come within an hour, when pad-like lesions connecting the spore to the leaf cell begin to appear.

A reviewer of Kleinhofs' and Nirmala's recent paper in the Proceedings of the National Academy of Sciences said the discovery "will probably open a whole new avenue of research of plant-pathogen interactions." Steber said the discovery is a game-changer for plant scientists. "This is the first example where the lock-and-key of cereal-pathogen response is clearly understood," she said.

Kleinhofs called his and Nirmala's understanding of the signaling that was

going on between plant and pathogen "one of those 'Eureka!' moments. There is still a lot to be learned," he added. "As with any new discovery, more questions arise than have actually been answered, but it is a good start."

-Kathy Barnard

For more information on research in the WSU Dept. of Crop and Soil Sciences, please visit http://css.wsu.edu/.

Mapping the Future of Raspberries

It takes a long time–14 years on average–to develop a new cultivar of red raspberry using traditional methods and, even then, breeders can't always accomplish what growers and consumers want. Understanding consumer and grower needs and refining breeding processes to develop cultivars that meet those needs is the focus of a new nationwide grant being led by Washington State University.

Scientists at WSU Puyallup and the Pullman campus have received a $50,000 planning grant from the U.S. Department of Agriculture's Specialty Crops Research Initiative to lead a team of researchers throughout the United States and Canada in gathering grower input. They'll ask what the next cultivars of red raspberry should look like in terms of yields, fruit size, firmness, disease susceptibility and machine harvestability, among other things, and what they should taste like. The information they gather will set the stage for a much larger grant to actually bring the latest genomics and genetics research to bear on developing those cultivars.

"Taking the time to listen to consumer and grower needs and map out a plan absolutely will help speed up raspberry breeding," said researcher Patrick Moore, a scientist stationed at WSU Puyallup, "but perhaps more importantly, we'll be more likely to come up with the things we really need and want out of future cultivars. We'll have a better product."

Moore, along with Associate Professor and Sensory Scientist Carolyn Ross and Extension Specialist Catherine Daniels, will work with counterparts at Salve Regina University, University of Illinois, Brigham Young University, North Carolina State University, Cornell, USDA's Agricultural Research Service and Agriculture and Agri-Food Canada to systematically seek and analyze input from red raspberry growers, processors and consumers. The first of those listening sessions/workshops will be held in Ohio in January.

One aspect of the sessions will be discussion of some of the costliest pests of

red raspberries, such as root rot, raspberry bushy dwarf virus and nematodes. “All of these diseases are tailor-made to be addressed by the latest molecular techniques in use,” Moore said.

He noted that the team will work closely with currently funded efforts, such as USDA’s RosBREED project. RosBREED, a nationwide project that includes other WSU scientists, is focusing on marker-assisted breeding in rosaceaous crops such as apples, peaches, cherries and strawberries. Red raspberries, a part of the Rosaceae family, were not included in the RosBREED grant. “We will be working to develop similar techniques to RosBREED’s only tailored for red raspberries,” he said. “We want to complement their work and coordinate whenever possible.”

Patrick Moore

-Kathy Barnard

For more information on research WSU’s research center in Puyallup, please visit http://www.puyallup.wsu.edu/.

New System Offers Promise of Improved Orchard Efficiency

While widely considered the world’s best, most consistently excellent source of apples, the Washington tree fruit industry now faces serious competition from growers in South America, China, and Europe. That’s why scientists at WSU have joined forces with researchers in New York and Michigan to develop an innovative system for the delivery of pesticides, fertilizers and other inputs vital to an orchard’s health.

Currently, to protect an orchard from a pest outbreak, a worker must drive a tractor hauling a sprayer up and down the rows of trees. As Jay Brunner, an entomologist and the director of WSU’s Tree Fruit Research and Extension Center in Wenatchee, pointed out, there are several inefficiencies in this scenario. The worst is that the orchard manager simply may not have enough

Researchers are hot on the trail of innovations that will improve orchard efficiency.

equipment to cover a large orchard in a timely manner.

Enter the solid-set canopy delivery system. Like an orchard cooling system that sprays water over the entire roof of the orchard, the canopy delivery system would be built into the fixed ("solid-set") trellis system in order to simultaneously deliver inputs orchard-wide.

"This system would remove tractor operators from close proximity with pesticides, so there would be even further reduction of health risks than there already is with our modern, soft pest control chemicals," said Brunner, who is leading WSU's efforts on the project. "We may also be able to get better efficacy from existing pest control materials by reducing chemical drift and application rates." Improving efficacy and reducing pesticide application rates means lower costs for growers–and improved environmental safety for orchard workers as well as consumers.

Brunner said the solid-set canopy delivery project was based on a small-scale proof-of-concept demonstration done by ag engineers at Cornell University in New York and Michigan State University. Scientists from all three institutions are being funded by a two-year grant from USDA.

"We're taking a three-pronged approach," Brunner said. "There are engineering problems to work out, such as optimizing the design of emitters. We are collaborating with Qin Zhang and his team at the Center for Precision and Automated Agricultural Systems at WSU's Irrigated Agriculture Research and Extension Center in Prosser."

The emitters will need to blow spray up into tree foliage rather than onto the ground, and also be tested for drift. "We'll add a dye to the spray," Brunner said," which will allow us to detect movement of spray off site. The dye will also enable us to quantify coverage within the orchard." Zhang and his team have already developed sophisticated computer modeling techniques that will

enable them to perform preliminary testing of proposed emitter designs in virtual orchards, thus cutting down costs and speeding up development time.

Another aspect of the project is economic. “Unless we can develop a system that beats the cost of the way things are done now, no one will adopt the technology,” Brunner said. He is hopeful that the new delivery method will be a winner. “Work in Michigan test plots indicates that large blocks could be treated in just a few minutes,” he said. The ability to treat 20 acres in minutes rather than hours would be a quantum leap in efficiency over tractor-delivered spraying.

The system should be able to do much more than deliver pest control chemicals, Brunner said. “We’re going to be looking at horticultural practices with our colleague Matt Whitting at WSU’s research center in Prosser,” he said. Blossom and fruit thinners, used to maintain optimal fruit size and quality, could also be delivered throughout large orchards using this system, as could sunburn protection and tree nutrients, adding further economic incentive for growers to adopt the system.

“We’re in the planning stages right now, with work beginning later this month,” Brunner said. “We are talking to industry professionals to see what they would want from this system, as well as to understand what they consider the barriers to adoption. And we’re talking with irrigation companies to get help with developing infrastructure and designing new emitters. Next spring, we’ll be installing what we’ve developed over the previous fall and winter in test plots here in Wenatchee as well as in Prosser, and possibly in commercial orchards.”

-Brian Clark

Learn more about the partnership between WSU and the Washington tree fruit industry by visiting http://treefruit.wsu.edu/.

Leave a Reply

You must be logged in to post a comment.

ABOUT
Executive Leadership
CAHNRS Administration
Locations
Departments
Latest News
Learn About CAHNRS

ACADEMICS
Degrees
Graduate Studies
Scholarships
Internships
Careers & Clubs
Visit Academics

RESEARCH
Centers & Facilities
Grant Resources
Intellectual Property
Weekly Published Research
Safety
Visit Research

EXTENSION
About Extension
Programs
Publications
Locations
Impacts
Visit Extension

ALUMNI
Where to Give
Ways to Give
Scholarship Donor Profiles
ReConnect Magazine
Connections Magazine Archive
Visit Alumni

FACULTY & STAFF
Quick Links
Business Services
Budget & Finance Unit
Civil Rights Compliance
Strategic Planning
Visit Faculty & Staff