WSU's On Solid Ground: An apple a day, Big Data, Potato Crops, Cereal Grain Defense, Poplar Products

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An apple a day could keep obesity away

WSU scientists have concluded that non digestible compounds in Granny Smith apples may help prevent disorders associated with obesity. The study, thought to be the first to assess these compounds in apple cultivars grown in the Pacific Northwest, appears in this month's *Food Chemistry*.

"We know that, in general, apples are a good source of these nondigestible compounds but there are differences in varieties," said food scientist Giuliana Noratto, the study's lead researcher. "Results from this study will help consumers to discriminate between apple varieties that can aid in the fight against obesity."

The tart green Granny Smith apples benefit the growth of friendly bacteria in

the colon due to their high content of nondigestible compounds, including dietary fiber and polyphenols, and low content of available carbohydrates.

Despite being subjected to chewing, stomach acid and digestive enzymes, these compounds remain intact when they reach the colon. Once there, they are fermented by bacteria in the colon, which benefits the growth of friendly bacteria in the gut.

The study showed that Granny Smith apples surpass Braeburn, Fuji, Gala, Golden Delicious, McIntosh and Red Delicious in the amount of nondigestible compounds they contain.

Golden Delicious, Gala, Granny Smith and Red Delicious apples. (Photo courtesy of USDA ARS)

"The nondigestible compounds in the Granny Smith apples actually changed the proportions of fecal bacteria from obese mice to be similar to that of lean mice," Noratto said.

The discovery could help prevent disorders such as low-grade, chronic inflammation from a disturbed balance of bacterial communities in the colon. This results in microbial byproducts that can lead to diabetes, Noratto said.

"What determines the balance of bacteria in our colon is the food we consume," she said.

Reestablishing a healthy balance of bacteria in the colon with dietary choices such as Granny Smith apples stabilizes metabolic processes that influence inflammation and the sensation of feeling satisfied, or satiety, she said.

The study was funded with an Emerging Research Issues Internal Competitive Grant from the WSU Agricultural Research Center.

—Sylvia Kantor

$1.5 million grant to advance 'big data' for genomic research

The National Science Foundation has awarded scientists at WSU $1.5 million to help meet the growing needs of the data-driven genomic science

community. The Tripal Gateway project will build on existing cyberinfrastructure to enhance the capacity of genomic databases to manage, exchange and process "big data."

"In a single day, some modern DNA sequencers can output as much data as the human genome," said WSU's Stephen Ficklin. "We expect the deluge of data to continue to grow exponentially."

Ficklin, the lead investigator and a research scientist in horticulture, said that just as computers have seen dramatic improvements that have lowered costs and allowed for mass production, DNA sequencing technologies are undergoing a similar transition. The challenge is no longer affordability of DNA sequencing, he said.

The WSU project is one of 17 grants totaling $31 million in the NSF Data Infrastructure Building Blocks (DIBBS) program.

Sharing information

Genomic research relies on community databases—websites that house genomic, genetic and breeding data—for use by scientists working in the same research area; for example, cotton, cacao (chocolate) or plants in the rosaceae family like apple, cherry and pear.

By creating ways to easily share data between community databases, on demand, researchers will no longer have to navigate between multiple websites to obtain the information they need.

"Genomics scientists who can access large data sets but have limited resources for storing, sharing and analyzing them will benefit from this work," Ficklin said.

The three-year project will use software-defined networking technology to quickly transfer large data sets between computational resources and the database to support data sharing and analysis. Ultimately, it will link existing community databases for fruit and hardwood trees as well as legumes into a larger network of online research databases.

Tripal software

The project is based on open-source software known as Tripal, originally developed by Ficklin and Meg Staton at Clemson University and significantly enhanced by Dorrie Main at WSU and Kirsten Bett at the University of

Saskatchewan.

Tripal is used by at least 24 different plant and animal databases, including the Genome Database for Rosaceae and community databases for 24 crops developed by the Main lab. Main is a co-investigator on the new project.

The project team also includes Sook Jung, WSU, and colleagues at Clemson University, the University of Tennessee, and the University of Connecticut.

—Sylvia Kantor

An unlikely collaboration harms potato crops

A common potato virus and a fungus-like pathogen can work together to damage the crop, WSU researchers have discovered.

The study published this summer by the *American Journal of Potato Research* found that *Potato virus S* (PVS) breaks down late blight resistance in potato. The implications will impact potato breeding programs, as they must now take the virus into consideration during breeding for potato late blight resistance, said Hanu Pappu, the Sam Smith Distinguished Professor in plant pathology.

Late blight damage in a potato field.

Pappu teamed with WSU colleague Dennis Johnson, professor of plant pathology, and Ph.D. student Yu-Hsuan Lin, now a postdoctoral fellow at Cornell University, to conduct the groundbreaking research.

More than half of the nation's potatoes are produced in the Pacific Northwest. The potato industry contributes over $3.5 billion annually to Washington state's economy.

Although PVS is commonly found around the world and historically hasn't been a concern for growers in the United States, "it's now demanding attention because of its role in making late blight disease more severe," Pappu said.

Lin developed an experimental system to test for three-way interactions among potato, the late blight pathogen and PVS. She validated the interactions under controlled conditions, which can be used to screen additional potato genotypes.

Pappu said further research is needed to see exactly how these pathogens collaborate at the molecular level, including how the host's genetic mechanisms affect the pathogens.

This research is much more complicated than the typical study, he said. "Now we have to find how two very different pathogens interact with each other and their host.

"Lin's findings underscore the need to keep in mind the dynamic nature of the pathogens," he said.

The project was funded by the Washington State Potato Commission.

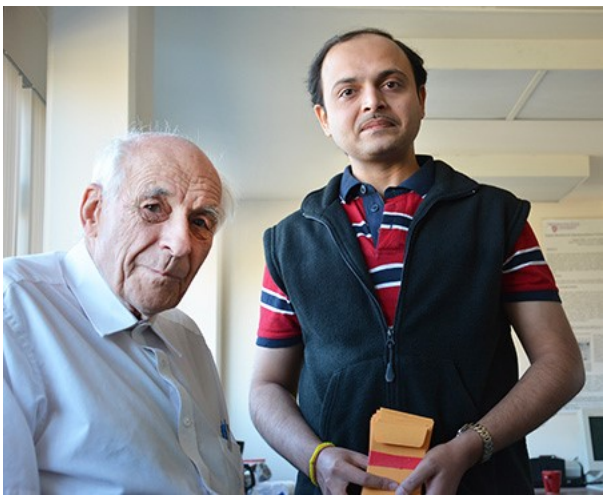
—Scott Weybright

Researchers explain mystery of cereal grain defense

Crop scientists at WSU have figured out how genes in the barley plant turn on defenses against aging and stressors like drought, heat and disease.

Professor Diter von Wettstein and assistant research professor Sachin Rustgi showed that specific genes act as a switch that enables barley to live longer and become more tolerant of stress, including attack by common diseases like mildew and spot blotch.

The finding, reported in the Proceedings of the National Academy of Science, solves a long-standing mystery and offers hope for production of grain crops able to thrive during unpredictable weather and climate change.



WSU researchers von Wettstein, left, and Rustgi. (Photo by Rebecca Phillips, WSU University Communications)

Cereal grains such as wheat, barley, corn and rice need an essential amount of growing time to produce abundant yields. Environmental stressors such as heat and drought can trigger early aging of plants, which slows growth and decreases yield and grain quality.

Von Wettstein and Rustgi discovered that two barley genes, called JIP60 and JIP60-like, play a major role in the protective actions triggered by a key plant defense hormone called jasmonate, or JA.

Like a watchful sentry, JA responds at the first sign of plant distress, producing proteins that prepare the plant to combat excess heat, lack of water or attack by disease organisms. The proteins also slow aging.

Scientists have known since the 1990s that JA plays a role in plant resistance, but von Wettstein and Rustgi are the first to document how that resistance actually takes place.

Rustgi said it was a surprise to discover that JIP60 genes are connected to boron sensitivity and disease resistance in cereal grains. The genes lie in close proximity to these other plant traits, providing a unique target for future crop breeding programs.

"It is possible that we could tweak the JA pathway and increase yields by slowing the aging of plants and making them more resistant to diseases, drought and temperature stress," he said.
The finding is important for grain farmers around the world.

"This year was a good example," said Rustgi. "In Washington state, we had a cold spell in May and June just when winter wheat was flowering. It actually affected the long-term grain yield by causing injury to the plants."

In India and Pakistan, he said, very hot temperatures—up to about 135 degrees Fahrenheit—cause heat injury to wheat, barley and rice.

"It is a problem for farmers who have small plots and are very poor. Any hit causes a significant loss of income," he said.

—Rebecca Phillips

Popularizing poplar products

Keyboards, paints, and fleece jackets all have one thing in common. Each can be produced using a conversion process from renewable poplar trees. The WSU Extension Advanced Hardwood Biofuels Northwest team explains how in this short, informative video.

-Betsy Fradd