

Research in the news

Scientists Land \$14.4 Million Grant to Improve Fruit Quality



Hungry to make fruit better for longer, Michigan State University scientists will lead a four-year, \$14.4 million grant-funded research project. The grant is the largest awarded by the U.S. Department of Agriculture's Specialty Crop Research Initiative since its inception in 2007.

MAES horticultural scientist Amy Iezzoni heads the RosBREED project, aiming to combine emerging DNA sequence and research findings to improve the quality of apples, peaches, cherries and strawberries — key species in the globally important botanical family *Rosaceae*.

The project involves scientists from 11 U.S. institutions, including several land-grant universities such as MSU, Washington State University and the University of Minnesota; USDA labs; and six international partners from the Netherlands, South Africa, New Zealand, Chile, France and the United Kingdom.

Selective breeding of most rosaceous species during the past 6,000 years has made today's varieties bigger and juicier than their wild cousins. Worldwide consumption is increasing, but producers remain under pressure from international competition, costs, pests and disease.

"This is a watershed year for *Rosaceae*, with the peach, apple and strawberry genomes being sequenced," Iezzoni said. "Yet a huge gap exists because this DNA-based information is rarely applied to improve plant breeding for the development of new fruit cultivars. These crops provide vital contributions to human health and well-being, and the associated production and processing industries collectively make up the economic backbone of many U.S. rural communities."

The project is part of the USDA's National Institute of Food and Agriculture program, which funds multiyear, multi-institutional collaborative projects. RosBREED

follows earlier genomic, genetic and breeding programs focused on rice, wheat, barley, conifers, potatoes and tomatoes.

"RosBREED is rooted in our vision that the common ancestral origin of this diverse plant family can be harnessed to leverage knowledge and resources across commodity boundaries," Iezzoni said. "This project exploits similarities among the genomes of three fruit-bearing species of *Rosaceae* — *Malus* (apple), *Prunus* (peach and cherry) and *Fragaria* (strawberry) — to develop practical applications. Collectively, these three lineages represent the majority of the fruits produced and consumed in the United States."

Mobile Lab Allows MAES Researcher to Study Air Quality, Health Effects



A new mobile air research laboratory will help a team of researchers led by an MAES scientist better understand the damaging health effects of air pollution — particularly, why certain airborne particles emitted from plants and vehicles induce disease and illness.

Jack Harkema, university distinguished professor and MAES pathobiology and diagnostic investigation researcher, will deploy the 53-foot, 36,000-pound lab — dubbed "AirCARE 2" — throughout southern Michigan, including metropolitan Detroit.

"The mobile laboratory allows us to analyze 'real-world' pollution in communities that may be at risk," he said. "We can study why certain ailments, such as asthma, cardiovascular disease and even obesity, may be more pronounced after exposure to particulate air pollution."

With about 450 square feet of indoor laboratory space, the \$400,000 center helps researchers study fine and ultrafine particles in air pollution. These small particles have been found to increase mortality and morbidity among susceptible people with preexisting health conditions such as heart disease.

Housed in a converted semitrailer, the mobile laboratory pulls air from the

surrounding atmosphere through an air-particle concentrator, allowing the scientists to selectively collect the particles and analyze for chemical components that may be responsible for damaging health effects.

Researchers can study the subtle effects of controlled particle exposure on both laboratory animals and human subjects, looking for clues on why and how pollutant particles are so harmful to the heart and lungs. Harkema works closely with environmental and biomedical researchers from the University of Michigan on the projects.

"We know particles in the air can exacerbate preexisting respiratory and cardiovascular disease in people," Harkema said. "We need to understand why. There are many different components to air pollution, and we want to determine which of these are most harmful and where they come from."

The addition of the new mobile laboratory allows Harkema and U-M collaborators Robert Brook, a cardiologist, and Gerald Keeler, an atmospheric scientist, to conduct a new study funded by the Environmental Protection Agency. As part of the project, Harkema, Brook and Keeler will deploy AirCARE 2 in rural southeastern Michigan to study the cardiovascular health effects of transported air pollution originating from distant emission sites in Michigan or adjacent states.

Miscounting Bioenergy Benefits May Increase Greenhouse Gas Release



A fixable error in the way carbon is counted in current U.S. climate legislation and in the Kyoto Protocol could undermine efforts to reduce greenhouse gas emissions by using biofuels, says a premier group of national environmental and land use scientists.

"The promise of biofuels made from biomass is huge, from both climate mitigation and economic perspectives," said Phil

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Robertson, MAES crop and soil scientist and one of the authors of the paper "Fixing a Critical Climate Accounting Error"

published in the Oct. 23 issue of the journal *Science*. "But the promise could come up short if we don't pay attention to the details. One of the most important details is how the benefits of carbon capture are tallied. If we miscalculate the carbon benefits, we may find out later that our policies and practices are counterproductive — that they don't have the positive impact on climate that we want them to have."

Robertson also is a member of the Great Lakes Bioenergy Research Center, a partnership between Michigan State and the University of Wisconsin-Madison funded by the U.S. Department of Energy to conduct basic research aimed at solving some of the most complex problems in converting natural materials to energy.

The paper authors point out that the greenhouse gas consequences of bioenergy can vary widely, depending on where the plants used to produce the energy are grown. For example, fast-growing biofuel crops grown on abandoned farmland can capture more carbon than existing plants and so reduce greenhouse gas emissions. This would happen because the biofuel crop absorbs more carbon from the atmosphere than would otherwise be stored. But if existing forests are cut down and replaced with bioenergy crops, the carbon released from the soil and mature trees, plus the loss of future carbon storage, is greater than the carbon captured by the bioenergy crops.

Current carbon accounting measures mistakenly exempt all the carbon dioxide emitted from bioenergy, regardless of the source. According to a number of studies, including one by the U.S. Department of Energy, applying current carbon accounting measures globally could lead to the loss of most of the world's natural forests.

"The error is serious but readily fixable," said Tim Searchinger, of Princeton University, lead author of the paper. "The solution is to count all the pollution that comes out of tailpipes and smokestacks, whether from coal and oil or bioenergy, and to credit bioenergy only to the extent it really does reduce greenhouse gas emissions."

"To avoid environmental regret later and protect both private and public investments, we need to get the carbon calculations

correct from the start," Robertson added. "Michigan is particularly well positioned to benefit from correct carbon accounting practices. As the market grows for cellulosic biofuels, Midwest producers will benefit by growing biofuel crops on land not now being used for food production. Correctly crediting our carbon from the start will help to ensure the long-term market value for these fuels, protecting early investments by farmers and refiners."

Time in a Bottle: Scientists Watch Evolution Unfold over 40,000 Generations



A 21-year MSU experiment that distills the essence of evolution in laboratory flasks not only demonstrates natural selection at work but could lead to biotechnology and medical research advances, researchers said.

Charles Darwin's seminal *The Origin of Species* laid out the case for evolution exactly 150 years ago. Now, MAES microbial ecologist Richard Lenski and colleagues document the process in their analysis of 40,000 generations of bacteria, published in the Oct. 19 issue of the international science journal *Nature*.

Lenski, a John A. Hannah distinguished professor, started growing cultures of fast-reproducing, single-celled *E. coli* bacteria in 1988. If a genetic mutation gives a cell an advantage in competition for food, he reasoned, it should dominate the entire culture. Though Darwin's theory of natural selection is supported by other studies, it has never before been studied for so many cycles and in such detail.

"It's extra nice now to be able to show

precisely how selection has changed the genomes of these bacteria, step by step over tens of thousands of generations," Lenski said.

Lenski's team periodically froze bacteria for later study, and technology has since developed to allow complete genetic sequencing. By the 20,000-generation midpoint, researchers discovered 45 mutations among surviving cells. Those mutations, according to Darwin's theory, should have conferred some advantage, and that's exactly what the researchers found.

The results "beautifully emphasize the succession of mutational events that allowed these organisms to climb toward higher and higher efficiency in their environment," noted Dominique Schneider, a molecular geneticist at the Université Joseph Fourier in Grenoble, France.

Lenski's long-running experiment itself is uniquely suited to answer some critical questions — such as whether rates of change in a bacterium's genome move in tandem with its fitness to survive.

"The coupling between genomic and adaptive evolution is complex and can be counterintuitive," Lenski concluded. "The genome was evolving along at a surprisingly constant rate, even as the adaptation of the bacteria slowed down a lot. But then suddenly the mutation rate jumped way up, and a new dynamic relationship was established."

A mutation involved in DNA metabolism arose around generation 26,000, causing the mutation rate everywhere else in the genome to increase dramatically. The number of mutations jumped to 653 by generation 40,000, but researchers surmise that most of the late-evolving mutations were not helpful to the bacterium.

Gene mutations involved in human DNA replication are involved in some cancers. Many of the patterns observed in the experiment also occur in certain microbial infections, "and cancer progression is a fundamentally similar evolutionary process," observed collaborator Jeffrey Barrick, microbiology and molecular genetics postdoctoral researcher. "So what we learn here can help us better understand the course of these diseases."

Thousands of generations later, the MSU experiment continues to evolve.

"Like a lot of science, our study answers some questions but raises many others," Lenski said.

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Reaching Out: Program Aids Foster Care Youth during College Years



The numbers paint a dismal picture. Though some 75 percent of the nation's foster care children say they'd like to attend college, just 13 percent actually enroll — and of those, only 4 percent graduate.

Michigan State University, a national leader in foster care research and outreach, has launched an innovative program to attack the problem.

Foster Care Alumni Services is a comprehensive initiative that offers assistance to MSU students in an effort to help them remain in school and ultimately graduate. Services include community mentoring, scholarships, care packages and help lining up everything from student employment to housing to financial aid.

There's even a summer camp for foster care children still in high school on what to expect in college.

"The MSU foster camp provides young people in the foster care system a chance to have new experiences, learn new skills, meet new friends and dream about a brighter future than the often dismal past that many have experienced," said John Seita, MAES scientist and associate professor of social work.

During the 2008-09 academic year, MSU identified and contacted former foster care youth attending the university, inviting them to register for services on a newly created Web site. Each student who registered was then contacted by a representative of the requested service provider.

In all, 209 former foster youth were identified and contacted. The program will continue annually as MSU reaches out to new students who indicate that they were in foster care on their federal financial aid forms.

MSU was the first university in the state to offer foster care alumni scholarships, and the program has grown to include an array of services. Foster Care Alumni Services is offered through several university depart-

ments, primarily the School of Social Work and researchers Seita and Angelique Day, both foster care alumni who now work to reform the foster care system.

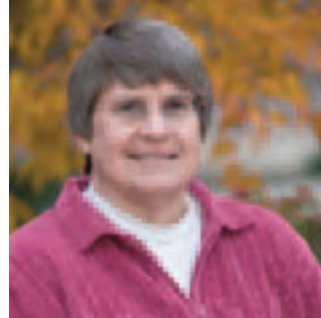
Because Day lacked family support during her college years, she said she "just kind of jumped in blindly and figured it out as I went along."

"This program is designed to ensure that young people interested in coming to MSU don't have to accept that challenge blindfolded," said Day, a research specialist in social work. "Young people coming out of foster care don't have parents or stable adults in their lives that they can go to when they are frustrated or overwhelmed in college — and at that point they may make the decision to drop out."

Other participating MSU departments are the Office of Financial Aid, the Center for Service-Learning and Civic Engagement, MSU Extension, University Housing and the Department of Residence Life.

External support comes from the Capital Area United Way, Learn and Serve America, Michigan Campus Connect and the Comcast Foundation.

MAES Scientist Studies Links between Gastric Bypass, Immune System



Though the massive weight loss associated with gastric bypass surgery has many benefits, some patients may face malnutrition, poor wound healing and infection as their immune systems adjust to the extreme decrease in food consumption, an MAES researcher reports.

Pam Fraker, MAES biochemistry and molecular biology scientist, is working with MSU surgeon Pandu Yenumula at Sparrow Hospital in Lansing to monitor the health of patients undergoing gastric bypass surgery and see what effects the surgery has on the immune system and inflammation.

"The immune system is a very large and complex system, replenishing billions of new

cells each day," Fraker said. "A modest depletion in nutritional intake can have a significant impact on the immune system's ability to defend the body."

Patients undergoing gastric bypass surgery, Fraker said, often see reduced inflammation and improved metabolic status as they lose weight.

"We also are trying to find out if there are any adverse effects of morbid obesity on certain facets of immune defense, and then determine if bypass surgery has beneficial effects," she said.

Using mass spectrometry — which analyzes the elemental composition of blood tissue samples and measures trace metals to monitor patients' nutritional status — Fraker works with patients who are part of the Sparrow Weight Loss Clinic. Her team provides a progressive assessment of the patient's immune defense and measures changes in metabolic profiles and inflammatory factors before and after surgery.

Yenumula, who performs about 20 weight-related surgeries each month, said having Fraker as part of his team provides valuable insight into a patient's health as he or she recovers from surgery.

"When it comes to the morbidly obese, we have lot of research and studies that show the benefits that surgery can have on problems such as diabetes, hypertension, high cholesterol and other issues," he said. "But we need to better understand how the immune system functions and adapts as patients lose weight."

Fraker's work with gastric bypass surgery is funded by the National Institutes of Health and MSU. Though she is working with morbidly obese patients, her research also can be applied to the overweight, which make up 60 percent of all Americans.

Fraker and several other professors at MSU, known as the MSU Metabolic Disease Group, are looking at a group of disorders and avenues of research associated with obesity.

"Our immune system has such an impact on so many facets of our bodies that we need to know what sort of impact the obesity epidemic is having on our immune defense system," Fraker said. "Do viruses survive longer in overweight or obese people? Do normal vaccination levels work effectively? How does obesity affect stem cell biology and bone marrow growth? These are just some of the questions we need to address."

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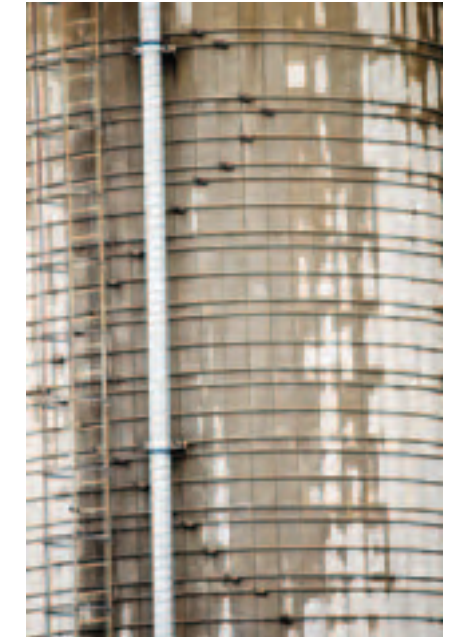
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