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Growers take leap with MSU advice

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Helping farmers in Kyrgyzstan and Tajikistan

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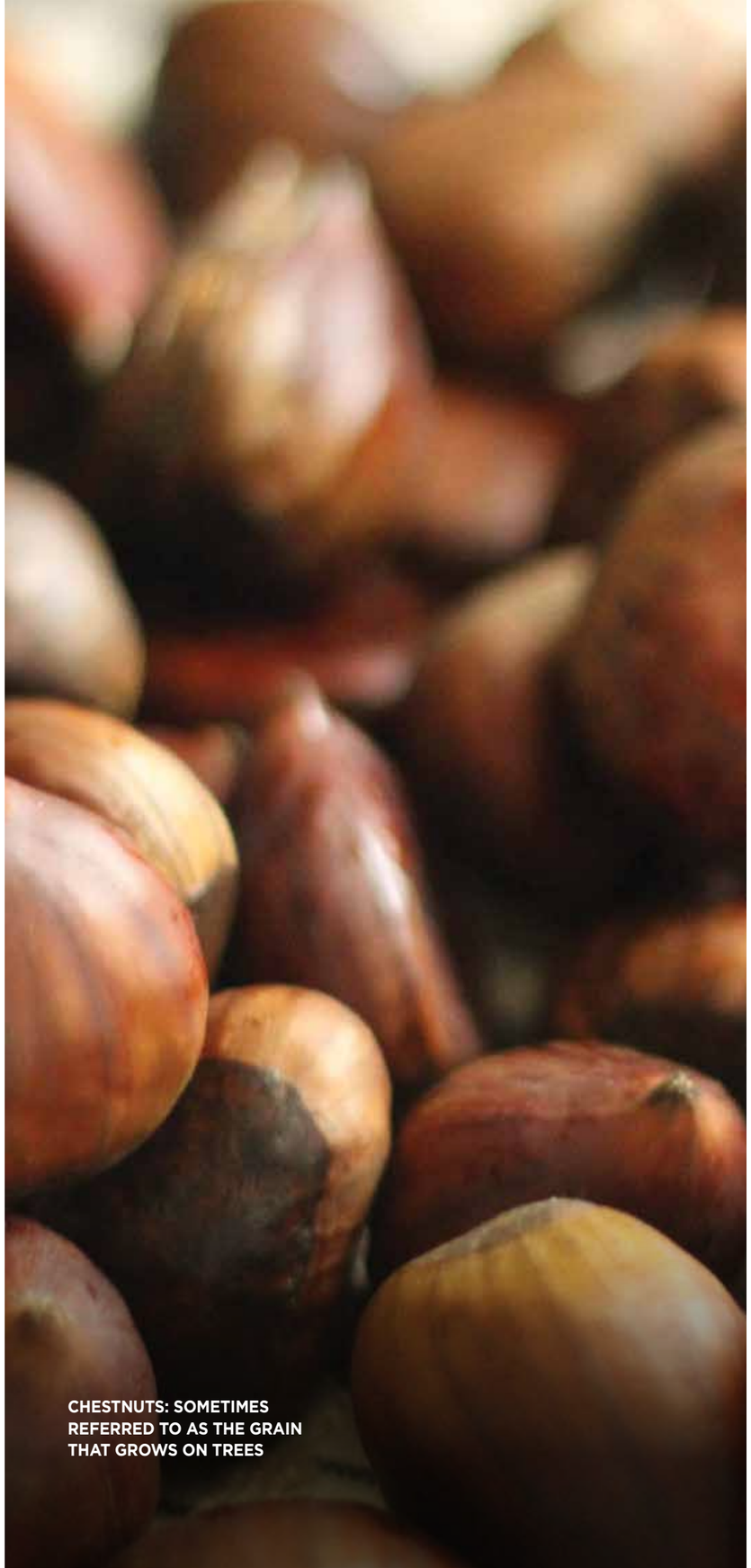

CHESTNUTS: SOMETIMES REFERRED TO AS THE GRAIN THAT GROWS ON TREES

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ON THE HOME FRONT

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Food is MSU's foundation – and its future

Food – it's vital to everyone. That's why I'm thrilled to be working for Michigan State University (MSU) AgBioResearch, with the rewarding job of sharing lots of impactful food-related stories with you. For MSU AgBioResearch, food is a high priority. We have more than 325 scientists with expertise from plant and animal agriculture to human health and nutrition, and from climate change to value chain enhancement.

In this issue, we have several articles about food – from chestnuts to crayfish and potatoes to cherries. And this is just a sampling. You'll also read about MSU's strong commitment not only at home in Michigan, but overseas as well. One story focuses on the work MSU has done in two countries in Central Asia after the collapse of the Soviet government. MSU is believed to be the first university to assist farmers in this part of the world in building sustainable food system models through teaching and education.

This effort was the brainchild of Karim Maredia, who has also led and been a part of several global projects funded by the United States Agency for International Development, the Food and Agriculture Organization of the United Nations, the World Bank and the Bill and Melinda Gates Foundation. Most recently Dr. Maredia was honored by the Indian Council of Food and Agriculture for his pioneering contributions in food and agriculture, particularly in bridging partnerships between Africa and India. He is one of many world-class scientists helping MSU impact lives around the world.

Founded in 1855 as the Michigan Agriculture College – and the pioneer land grant university, MSU has deep roots in food. MSU AgBioResearch was formed some three decades later with the charge to provide scientific data to farmers in order to improve sustainable production in the most timely and efficient manner. Starting in 1960, MSU would go on to establish an unrivaled global footprint as well.

There is no question that food has been our foundation and food is our future. MSU remains committed to leading the way when it comes to food production, especially now as the world faces the daunting task of finding ways to feed 10 billion people by 2050. MSU researchers are seeking solutions and leading important projects on how to improve food production while protecting and preserving our natural resources.

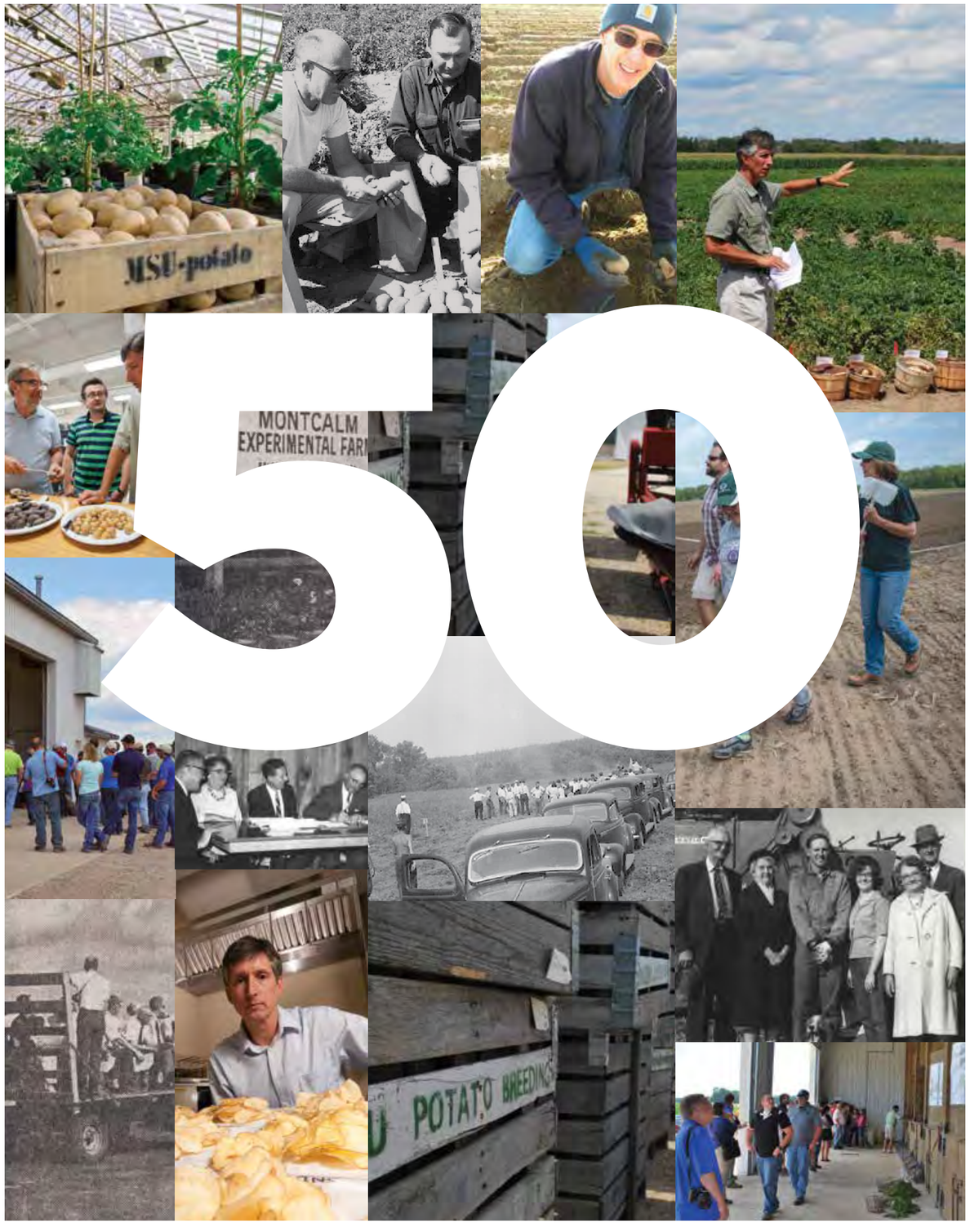
Communicating that science is a huge topic within the research community. With external funding agencies pushing for specific communication components in grant submissions, with some even requiring videos, there is an even greater need to articulately relay information on important food topics.

Our researchers are dedicated to working toward a food secure world, and addressing the wicked problems of access to nutritious food, and food waste. Spartans have a unique ability to address these issues at the highest intellectual point and are uniquely equipped to make it understandable for the masses.

In a somewhat related side note, don't forget to sample the beer from New Holland Brewing Co. made from 100 percent Spartan barley – a century-old crop that MSU created and has now resurrected for the Michigan craft beer industry. It should be available at limited tap houses in and around the Lansing and Grand Rapids areas this fall.

As always, I hope you enjoy this issue!

Holly M. Whetstone



CELEBRATING

50 YEARS AT MSU MONTCALM RESEARCH CENTER

POTATO PROGRESS:

The potato is intrinsically linked to the history of America. Originating in the Andes Mountains of South America, the hardy tuber traveled aboard Spanish explorers' ships to Europe, where it spread throughout the continent. It eventually returned home to the Western Hemisphere in the cargo holds of colonists in search of new lives, land and treasures in about 1620.

Today, Michigan boasts a vibrant potato industry. The state is the No. 1 producer of potatoes for the chipping industry and eighth overall in potato production. The Michigan potato industry annually generates approximately $1.24 billion, accounts for more than 3,200 jobs, and involves 70 farms and nearly 50,000 acres.

Growing up in Sutton, Massachusetts, Richard Chase had little idea just how much his future would be linked to the potato.

Though he helped grow and harvest potatoes, among many other crops, at his family's farm, it wasn't until he graduated from Rutgers University and was hired by the Michigan State University (MSU) Department of Crop and Soil Sciences (now the Department of Plant, Soil and Microbial Sciences) that he received his first potato assignment. The year was 1962.

BY JAMES DAU, STAFF WRITER

"Potatoes weren't on my agenda back then," said Chase, who would go on to spend his 40-year career at MSU. "As a new MSU faculty member, I was very happy to have a focus, however. Especially on a crop that was so important to the state."

At the time, much of the MSU field research on potatoes took place at the Lake City Research Center in the north central region of the Lower Peninsula. However, the majority of production was happening farther south in the lighter, sandier soils of Montcalm and Bay counties. A search ensued to find a new home for potato research. Ultimately, researchers settled on Lakeview in Montcalm County, which had more than 17,000 acres of potatoes and was situated in the heart of Michigan potato country.

SINCE THE CENTER IS IN A REAL POTATO-GROWING AREA, **FARMERS PAY PARTICULAR ATTENTION TO WHAT'S GOING ON THERE**

It was there, through the Montcalm County MSU Extension office, that Chase met potato grower Theron Comden, who also was the director of the county's conservation district. Comden arranged to lease 40 acres of available land in the district to start the Montcalm Research Center in 1966.

"Comden was very sincere in wanting to make farm technology available to people so they could learn," Chase said.

The research trials in Montcalm began a year later in 1967, with Chase serving as faculty coordinator. The new center provided not only land, but consistent irrigation and pest and disease management tailored to fit each trial's specific needs. Researchers brought their expertise, and soon Montcalm was bustling with activity.

The new location was a boon for growers as well. Its accessible location in the midst of a vibrant potato region allowed Chase and fellow researchers and staff members to hold field days to showcase advancements and provide equipment and technique demonstrations for farmers across the region.

"Since the center is in a real potato-growing area, farmers pay particular attention to what's going on there," Chase said. "They have a better feeling about the results because they know the information is coming from an area where they're also farming."

PARTNERSHIPS FOR A CHANGING INDUSTRY

Ten years after the founding of the Montcalm Research Center, the Michigan Potato Industry Commission (MPIC) was created under state law to foster and promote the Michigan potato industry around the country and around the world. A priority of the organization has been to help ensure that Michigan potatoes remain not just competitive, but superior in the global marketplace. A significant part of the MPIC mission from the beginning has been to support potato research. Ongoing projects at the center proved worthy beneficiaries of that support.

"The Montcalm Research Center was a natural place to focus our efforts because the research farms drive agricultural innovation in the state," said Ben Kudwa, who served as MPIC executive director from 1986 until 2012. "Even before my time, they were providing the industry with the varieties and practices it needed to stay competitive, and that has only continued over the years."

Kudwa worked closely with Chase through many dramatic changes in the industry. For much of its history, Michigan predominantly produced potatoes for the fresh market, but economic changes during the 1970s and 1980s saw increased demand for potato chips, and in that, Chase and Kudwa saw an opportunity for Michigan.

"Many of us in the industry, as well as Dr. Chase, believed we could find a niche for chipping potatoes," Kudwa recalled. "Through various industry and research efforts, we did, and we've been riding that horse ever since."

Supplying the potato chip industry required a different kind of potato, however. Chipping potatoes require a higher dry matter content – the volume of solids in the potato as opposed to water – than potatoes for the fresh market, and the researchers at Montcalm set out to develop varieties that fit the bill. The result of their efforts yielded such varieties as Kalkaska and Liberator, and Manistee, which found acceptance not only in Michigan but beyond the state borders.

Another key need of the chipping industry is long-term potato storage. To better serve the needs of growers, a pair of demonstration storage facilities was built – one in 2000 and another in 2009 – on property adjacent to the center. Researchers have been able to quickly assess the long-term storage viability of the varieties they develop at the center to ensure that Michigan potatoes continue to meet the highest requirements of the industry.

About 70 percent of Michigan potatoes are used in the potato chipping industry and serve the entire potato market east of the Mississippi River. Thanks are due in large part to the varieties and technology pioneered through the close partnership between MSU and the potato industry.

A STRONG VISION FOR THE FUTURE

After Chase retired in 2002 and Kudwa in 2012, the partnership has continued under a new generation of researchers who are helping shepherd the Michigan potato industry into the 21st century. Dave Douches, professor in the MSU Department of Plant, Soil and Microbial Sciences and

After Chase (left) retired in 2002 and Kudwa (right) in 2012, the partnership has continued under a new generation of researchers who are helping shepherd the Michigan potato industry into the 21st century.

David Douches's breeding trials are the largest program at the Montcalm Research Center.

MONTCALM RESEARCH CENTER CONTINUES TO LEAD THE WAY IN MANY OF THE INDUSTRY'S NEW FRONTIERS.

director of the MSU Potato Breeding and Genetics program, took over the reins from Chase as faculty coordinator of the center.

"For me, the research farm is a very critical site for us to conduct the agronomic evaluations of our breeding materials," Douches said. "We also run our genetic experiments and our disease and insect nurseries there. We're highly invested in the Montcalm Research Center and its management to ensure that we continue to get good results from our work."

Over the past 14 years, Douches has seen the research center expand in both land and scope to increase its capacity to serve Michigan agriculture. MSU purchased additional land to the south of the original site and has leased another 37 acres beyond that. More land means that the researchers have more space not only to continue their research trials, but also to rotate their crops among more fields to keep the soils at the research center healthy and improve long-term viability.

Douches's breeding trials are the largest program at the center, but they are far from the only ones. He shares the site with nine other MSU researchers who work on every aspect of potato agriculture, including soil health, pest and disease management, and water use. The center has also become the second-most important home of university dry bean research behind the Saginaw Valley Research and Extension Center in Frankenmuth.

Potatoes remain the primary focus, however, and the strong partnership with MPIC has ensured that the center's research programs remain tailored to the needs of Michigan potato farmers.

"Our industry's research probably wouldn't get done without the Montcalm Research Center," said Michael Wenkel, executive director of the MPIC. Wenkel succeeded Kudwa in 2012 after a 17-year career at the Michigan Farm Bureau. "It's become part of the culture of our industry, and we're proud of our commitment to supporting the center and the research that happens there."

In addition to continued variety development, Wenkel says one of the key future research efforts is a renewed emphasis on soil health to ensure the long-term viability of the Michigan potato industry.

"We're continuing to broaden our team and look at how all these aspects play a role in helping potatoes," Wenkel said. "We're trying now to look beyond just producing high yields to see the bigger picture."

Chris Long, MSU Extension potato specialist, affirms that the strong ties between industry and the university will be the key to the future of Michigan potatoes.

"We have a strong partnership with the Michigan potato industry, and there's no better symbol of that than the Montcalm Research Center being adjacent to the MPIC demonstration storage facilities," Long said. "An outsider looking at it would think it was all one research farm. The facility continues to improve, the university continues to maintain it and run research programs through it, and the industry continues to support it. It serves as a touchstone for the agricultural community of the whole region."

The Montcalm Research Center continues to lead the way in many of the industry's new frontiers.

"In my experience, the Michigan potato growers have been very responsive to the advancements that have come out of the center," Chase said. "They were always looking for new ideas and techniques, and we were able to help provide them with answers to their needs."

To learn more about the Montcalm Research Center, visit agbioresearch.msu.edu/centers/montcalm. ▯

BY CAMERON RUDOLPH, STAFF WRITER

A SILENT ANIMAL SICKNESS

Professor Paul Bartlett

Bovine leukemia virus is mostly unnoticeable, but its impact on farms is opening the eyes of MSU researchers

For many years, the U.S. dairy industry has primarily focused its attention on a few costly diseases, including mastitis (an infection of the udder), bovine viral diarrhea and lameness. But that lens is slowly shifting to a lesser-known virus that is a likely contributor to many other cattle illnesses.

Researchers, including a team at Michigan State University (MSU), are looking at bovine leukemia virus (BLV) – a retrovirus that causes infection in dairy and beef cattle, and can lead to cancerous disease. In the 1970s, less than 10 percent of U.S. dairy cows were affected by the virus. Today, MSU experts estimate that more than 40 percent are BLV-positive. Surveys by the U.S. Department of Agriculture (USDA) suggest that 83 percent of dairy herds in the country have at least one BLV-infected cow.

Experts say the large escalation in occurrence is primarily because not much attention has been paid to the virus, plus it is extremely difficult to detect.

About 5 percent of BLV cases result in a cancerous tumor known as lymphoma. Tumors can appear in numerous places from easily visible lymph nodes in the neck to ones hidden inside organs. In fact, the USDA reports that BLV-induced lymphoma is the chief reason for U.S. cattle condemnation at slaughter, accounting for nearly 14 percent of beef and 27 percent of dairy rejections.

While the tumors are relatively rare, about 30 percent of BLV infections result in persistent lymphocytosis — a very high number of blood lymphocytes that are associated with immune system dysfunction.

"This is a tricky disease because there is no obvious physical manifestation of BLV infection in most cases," said Paul Bartlett, a professor in the Department of Large Animal Clinical Sciences (LCS) within the MSU College of Veterinary Medicine. "If BLV disrupts the immune system, the animal becomes susceptible to many kinds of opportunistic pathogens. Most producers don't realize that BLV may be playing a role in making their cows more susceptible to other diseases."

A complicating factor in controlling BLV is that transmission from one cow to another is possible in many ways. Infected white blood cells can appear in several bodily fluids, such as blood, semen and colostrum, meaning that some routine on-farm practices can lead to new infections.

The most common sources of transmission include reusing hypodermic needles and obstetrical sleeves, as well as dehorning, tattooing, ingesting contaminated colostrum and milk by calves, blood exchange during breeding and fly bites.

With any retrovirus such as BLV, there is the potential for spread across multiple species. Current research suggests that BLV is not a health threat to humans, but studies are ongoing.

More than 20 countries in Europe, Asia and Africa have eradicated the illness through testing and culling positive animals. The size of the U.S. cattle herd, coupled with the pervasiveness of BLV, makes that method largely unrealistic. In most instances, producers wanting to address BLV in the U.S. must consider management strategies to reduce transmission.

As researchers learn more about BLV, the urgency behind solving the problem heightens. Since 2010, MSU has received nearly $2.5 million to study BLV, mostly from USDA's National Institute of Food and Agriculture (NIFA).

A DAIRY DILEMMA

Bartlett is leading the MSU charge against BLV along with LCS professor Ronald Erskine. While crunching some numbers for a separate mastitis study in 2010, Bartlett and Erskine noticed a trend.

The duo saw that cattle with BLV responded less strongly to the vaccine used to prevent bacterial mastitis. Bartlett and Erskine believed this was evidence that the immune system was disrupted.

Professor Daniel Grooms

"Once Ron and I noticed that BLV was affecting the immune response, it became apparent that we needed to look into it further," Bartlett said. "Before 2010, the literature on BLV's impact on cattle was very minimal. We received some funding, and that's when we started to really find some interesting things. There was some conflicting information published about milk production and longevity, and we wanted accurate measures of any damage caused by BLV."

A 1996 USDA study concluded that as the occurrence of BLV rises in a herd, milk production goes down. Bartlett and Erskine endeavored to test those findings in Michigan. The MSU duo performed an analysis of 104 herds around the state and found a decrease in milk production similar to that of the USDA project. For every 10 percent increase in prevalence, producers lost an average of 209 pounds of milk annually for each cow.

Bartlett and Erskine also determined that herds with higher prevalence rates of BLV tended to be younger. The revelation led to a second study aimed at cow longevity.

The initiative utilized a test called ELISA that gives researchers a count of antibodies against BLV. The presence of these antibodies indicates that an animal has the infection.

Tracking 3,849 animals from 112 herds for more than a year and a half, Bartlett and Erskine found that cows with antibodies against BLV were 23 percent more likely to be removed from the herd. This could be from dying naturally or through culling. Each cow was classified into one of four categories based on the amount of antibodies: negative, low positive, medium positive or high positive. As the number of antibodies increased, the survival probability decreased.

"Not so long ago, we used to think that BLV didn't have any real impact on the farm beyond the occasional tumor," Bartlett said. "But we're showing that infected cows don't live as long, suggesting that the welfare of the animals could also be adversely affected.

"Milk production suffers as well, so there are a host of issues caused by this infection that haven't always been apparent. That's why we're tackling the issue now and devoting resources toward educating our producers, as well as developing new management techniques to control BLV transmission."

REACHING OUT TO PRODUCERS

The incidence of BLV infecting at least one animal in a beef herd is 39 percent, slightly lower than in dairy herds. Daniel Grooms, a professor and chair of LCS, received NIFA funding to examine the longevity of beef cattle in Michigan and beyond.

Grooms and his team are measuring the prevalence and impact of BLV in an ongoing two-year project sampling 3,500 cows from the Great Lakes region. Each cow has been screened for the disease and is being closely evaluated to see if the virus develops. Grooms said it is likely that BLV will negatively affect beef cattle longevity, as shown in previous dairy herd studies.

"There hasn't been as big of a focus on beef operations, so there are a lot of unknowns," Grooms said. "We've done such great research with dairy, and that has guided some of our initial work. In addition to overall beef research, I'm very interested in how bulls factor into the spread of BLV, so we've moved into that area as well."

Each spring prior to the breeding season, Grooms conducts a series of bull fertility exams throughout Michigan. He has collected blood samples from bulls in three of the last four years and determined the frequency of BLV to be between 30 and 40 percent. Grooms indicated that semen or reproductive secretions from an infected bull could be a potential source of transmission, which could create further disease development in the U.S. and potentially impact trade with other countries that have adopted strict BLV-free policies. Grooms and his team are continuing to evaluate the risk of bulls in transmitting BLV during breeding.

Funding from the Michigan Alliance for Animal Agriculture, a joint venture between MSU and animal agriculture industry groups, has aided researchers and MSU Extension educators in providing significant outreach efforts.

"We have a ways to go in research and implementation of management strategies, but producers have been very responsive to new information," Grooms said. "They obviously want to do what makes the most economic sense, but they also really care about the animals. They want to do what they can to improve health and welfare of their cattle. As we generate more information and awareness, BLV will get the attention it deserves."

For more information on BLV and to learn more about MSU's research, visit BLVUSA.com. ▯

A 1996 USDA study concluded that as the occurrence of BLV rises in a herd, milk production goes down.

BY JAMES DAU, STAFF WRITER

Blazing new food paths in reborn region of Central Asia

A two-part exploration of two countries within that region: Kyrgyzstan and Tajikistan.

PART ONE

KYRGYZSTAN: Building capacity for a sustainable agriculture industry

CHRISTMAS DAY, 1991. KYRGYZSTAN ACHIEVED FULL INDEPENDENCE, ENDING AN ERA OF SOVIET RULE STRETCHING BACK TO THE END OF WORLD WAR I. THOSE LIVING IN THE MOUNTAINOUS NATION IN CENTRAL ASIA SUDDENLY FOUND THEMSELVES GOVERNED BY ELECTED OFFICIALS IN THEIR OWN CAPITAL OF BISHKEK.

While the change brought freedom, it also brought challenges; among them, food and agriculture. Suddenly, the newly reborn country found itself responsible for its own institutional infrastructure, something previously under tight Soviet control. This was only complicated by the political, cultural and linguistic isolation that was inherited from the previous government. Up until then, contact with Western scientists and resources had been deemed a national security threat, and access to English-language materials, which made up the bulk of agriculture research, was heavily restricted.

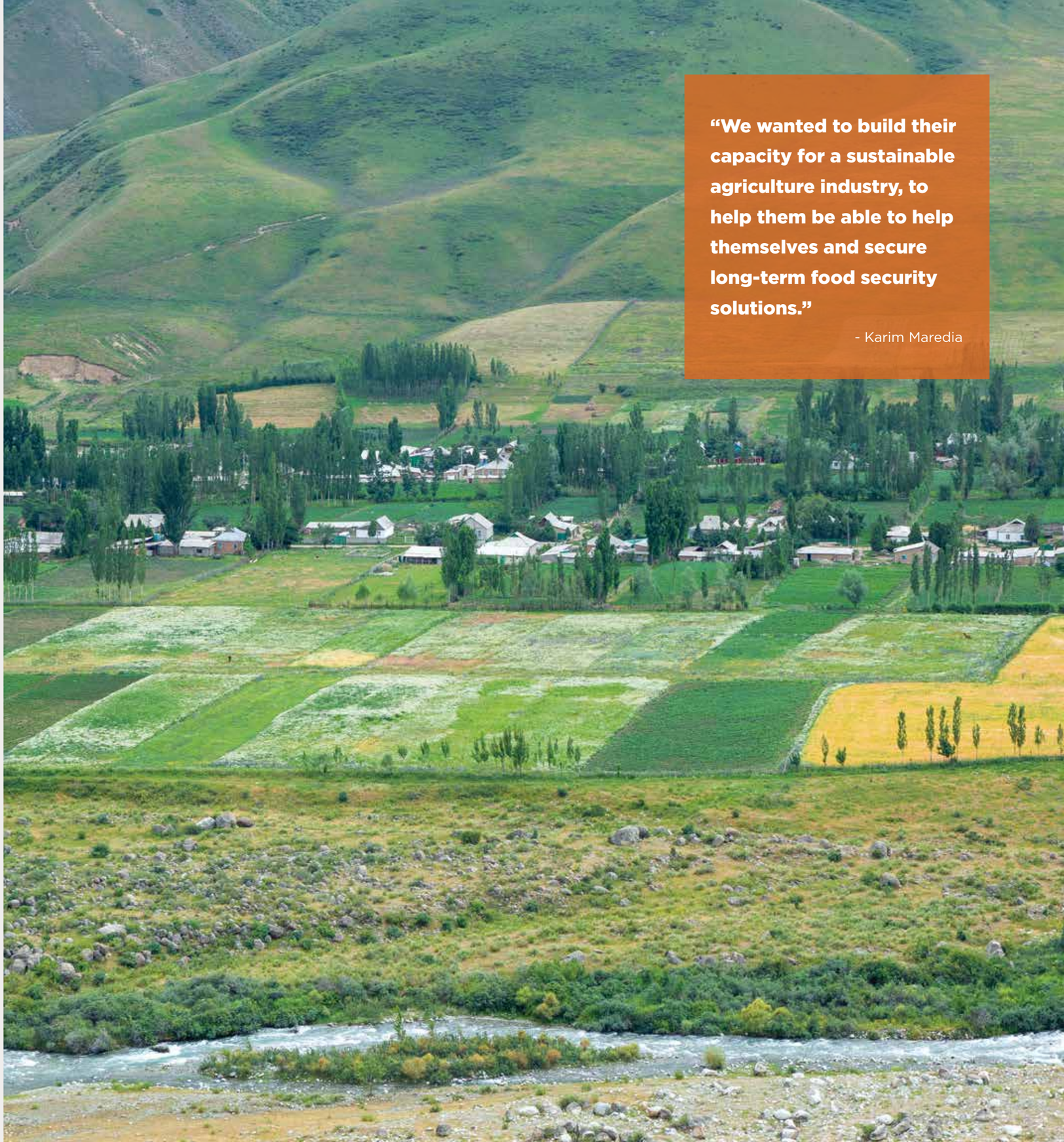
As a result, Kyrgyz farmers had been left without access to the latest advancements – in particular, pest management methods and technologies. They continued to rely heavily on chemicals for disease and insect control, which eventually contaminated the soil and water.

Murat Aitmatov, a professor at Kyrgyz National Agrarian University (KNAU) in Bishkek and director of its Center for Bio-Cultural Diversity, was all too familiar with the challenges confronting his homeland.

"After the Soviet Union collapsed, many people who had never farmed before suddenly found themselves having to do so," Aitmatov recalled. "They were teachers, veterinarians, doctors. They didn't have enough information or training in agriculture, so they ended up using a lot of chemicals."

The need for new, innovative solutions for Kyrgyzstan's food and agriculture industry was clear, and it nabbed the attention of researchers at Michigan State University (MSU).

BY JAMES DAU, STAFF WRITER



"We wanted to build their capacity for a sustainable agriculture industry, to help them be able to help themselves and secure long-term food security solutions."

- Karim Maredia

48%
of Kyrgyzstan's labor force work in agriculture.
Agriculture also accounts for approximately 18 percent of Kyrgyzstan's gross domestic product
(Source: CIA World Factbook)

Approximately 6.7% of Kyrgyzstan's farmland is used for crop production;
the rest is dedicated livestock pasture.
(Source: CIA World Factbook)

Due to its mountainous terrain, animal agriculture, particularly dairy cattle, beef cattle and sheep, remains the country's largest agricultural sector. *(Source: FAO Statistics Division)*

Potatoes rank as the most prevalent food crop grown in Kyrgyzstan, which produces over 1.3 million tons annually.
Maize and wheat are its top cereal crops, with over 570,000 and 540,000 tons produced each year, respectively.
(Source: FAO Statistics Division)

25% of Kyrgyz farmers produce potatoes as a main crop with 97 percent of these farmers being smallholders.

NEW PARTNERS, NEW OPPORTUNITIES

Kyrgyzstan did not stand alone for long. In the wake of the Soviet collapse, the International Center for Agricultural Research in Dry Areas (ICARDA), a nonprofit international agricultural development organization operating across Africa and Asia, established a regional office to facilitate the development of the fledgling agricultural sector. MSU was among ICARDA's partners at the time, the only land-grant university from the United States to join the organization's consortium for Central Asia and the Caucasus.

Karim Maredia, MSU professor in the Department of Entomology and program director for the World Technology Access Program, said the agricultural challenges facing Kyrgyzstan quickly became apparent. In 2005, he was awarded a small planning grant from the Feed the Future Innovation Lab for Integrated Pest Management (IPM) at Virginia Technological University, funded by the U.S. Agency for International Development (USAID), to explore a collaborative, multi-institutional effort to connect the countries of Central Asia with the global IPM community and improve agricultural capacity.

"The countries we traveled to had limited resources to dedicate to agriculture, and they had very little capacity for research or an extension system," Maredia said. "All the earlier work was done by non-governmental organizations, which came and went for different projects but rarely stayed. We wanted to build their capacity for a sustainable agriculture industry, to help them be able to help themselves and secure long-term food security solutions."

During the first year, Maredia and a team of faculty members from MSU and the University of California, Davis, traveled to Kyrgyzstan and two of its neighboring nations – Uzbekistan and Tajikistan – to assess the situation and determine where efforts would best be spent. They identified wheat, potatoes and tomatoes as the crops with the highest food security significance. Then they hired a research fellow from each of the countries to implement the new programs in the field. The team chose Aitmatov to be the Kyrgyzstan rep.

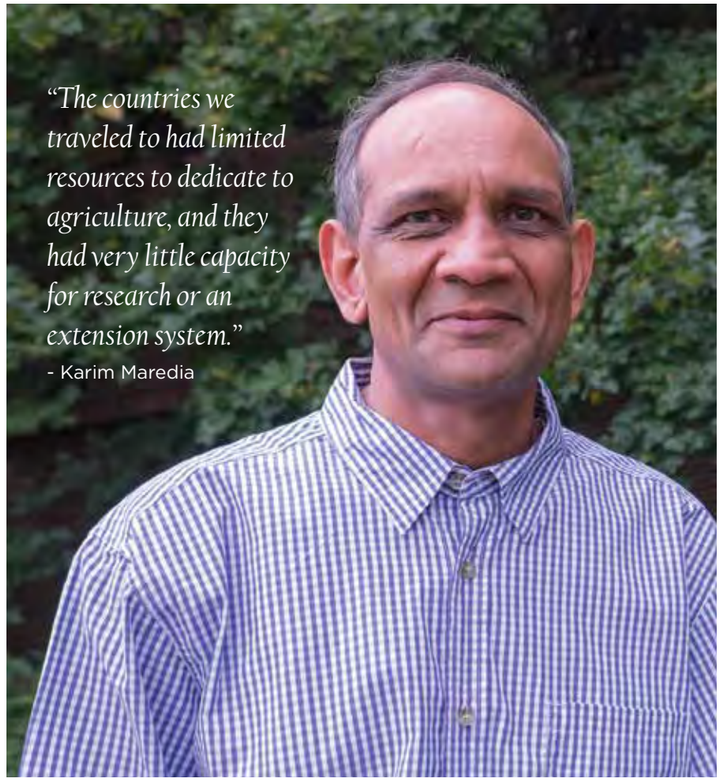
"Aitmatov had a keen interest to work with farmers, to bring new information to them," Maredia said. "We didn't want to just bring modern IPM science to the country – we wanted to put it into the hands of the farmers. Murat knew the farmers and could teach them in their own language. Our entire project benefited a great deal from his involvement."

Aitmatov and his colleagues from Tajikistan and Uzbekistan traveled to MSU in the summer of 2006 for a two-week IPM training course. Aitmatov ended up staying a month longer, during which time he met George Bird, professor in the MSU Department of Entomology, who also happened to be a member of the MSU team that had traveled to Central Asia the year before. Bird showed Aitmatov the Student Organic Farm (SOF) at MSU.

SOF was founded to provide practical, hands-on training to MSU students interested in sustainable, organic agriculture. Over time, the farm expanded its operation and opportunities to encompass year-round farming, a challenging prospect given Michigan's harsh winters and uncertain springs. Cold storage and hoop house technology was added and students were allowed to sell the produce they cultivate locally.

MSU's successful operation inspired Aitmatov to think of ways to do similar work in his home country.

"Kyrgyzstan used to have similar ideas, like training students at hoop houses, but we lost all that when the Soviet Union collapsed," he said. "I was impressed with how the students at MSU worked together to grow and sell the food, learning about the whole agricultural process from start to finish."



"The countries we traveled to had limited resources to dedicate to agriculture, and they had very little capacity for research or an extension system."
- Karim Maredia

Aitmatov took the SOF concept back to Kyrgyzstan, along with a number of techniques such as using multiple plastic layers to insulate the crops. He established agricultural field schools based on the SOF model and began training a new generation of Kyrgyz farmers and researchers using the practical, modern technologies he discovered at MSU.

"Having such a field school in Kyrgyzstan has been irreplaceable," Aitmatov said. "You can't just read about these techniques in a book or hear about them in a classroom – you have to see them in the field. It is better to do something once than to listen to people talk about it 100 times."

One of the first issues that Aitmatov and his international colleagues tackled was testing new crop varieties better suited to his country's rugged landscape. With a significant percentage of farmers living and working at 3,937 to 11,154 feet above sea level, having access to high-elevation cultivars that were also pest- and disease-resistant was of critical importance.

"Murat was very interested in season extension technologies – how a farmer could continue to grow things in the coldest parts of the year," Bird said. "He's also a great engineer, so he was able to take our ideas back home and develop them under his own conditions."

Aitmatov and his colleagues selected 30 potato cultivars from MSU and took them to Kyrgyzstan so the farmers could test them for pest and disease resistance in the region. Two of the varieties were eventually approved for use and continue to be grown by the region's farmers.

"We did a potato field day, where farmers could dig the potatoes and make chips from them," Aitmatov said. "It was the first time any of them had seen a purple potato. They were able to try the different kinds and compare them and talk about them. Everyone who came that day remembers it and still talks about it now."

Over 1500 farmers received training through field schools like those founded by Aitmatov across the region.

Ecologically based IPM efforts were introduced for wheat, potato and tomato, all critical food security crops in the region.
These include virus-free seeds, soil and seed treatments to reduce fungal pathogens, disease- and pest-resistant cultivars and bio-pesticides such as Neem oil. All of this has reduced farmer reliance on chemical inputs.

In addition to the three students from Central Asia who received graduate training at MSU, 15 students underwent training at research sites across the region through collaboration with local universities. Also, 16 regional scientists attended training short courses on international agroecology, IPM and sustainable agriculture at MSU, taking this knowledge back to their home countries.

The project consortium received the 2008 Consultative Group for International Agricultural Research (CGIAR) King Baudouin Science Award for Outstanding Partnership for Sustainable Agriculture in Central Asia.

The project team also introduced the concept of using beneficial insects to control agricultural pests and lessen the need for chemical pesticides. By incorporating plants that attract beneficial insects, such as dill, in their regular crop rotation cycles, farmers were able to cultivate beneficial insect populations that fed on harmful insects. They also found ways to put to use the insect-luring crops, such as in canned products for sale.

A NEW GENERATION

With the field school established, students began flocking to learn about Aitmatov's innovative approach to agriculture. Among them was Saltanat "Salta" Mambetova, who joined the student field school in 2008 during her third year at KNAU. She and her classmates spent their time working to adapt hoop house technology so tomatoes could be planted well in advance of the usual season, as well as testing tomato varieties for drought tolerance.

In her second year at the field school, Mambetova presented her work at an international IPM forum held in Bishkek, and it was there she crossed paths with Maredia's project.

"I met many professors from MSU at the forum," she recollected. "Dr. Maredia noticed my work and asked me if I'd like to come to MSU for graduate school. At the time, I thought it was just a dream."

Two years later, however, that dream proved anything but. Thanks to a grant from the Central Asia IPM project, Mambetova left home at the age of 22, speaking little English, and came to MSU. She studied under potato breeder David Douches, a professor in the Department of Plant, Soil and Microbial Sciences.

"Before I left, my mom told me that this was my choice to go, that I was going on an adventure very far from home, and so I had to finish what I planned and then come back," Mambetova said. "When I first came to MSU, I was so scared – the culture shock, the language barrier – I thought it was all too much. But the people who surrounded me, my friends, the people in the potato program, they helped me adjust and become stronger. Now looking back, I would do it all again."

Under Douches's tutelage, Mambetova learned much about potato breeding and genetics. This is extremely important – Kyrgyzstan is the second highest consumer of potatoes per capita globally, behind only Belarus. The country also relies heavily on the crop to ensure food security, but potatoes face major pest and disease threats.

Her graduate work focused on developing potato varieties to help farmers in her home country protect their crops from the most damaging pests and diseases – Colorado potato beetle, golden nematode, late blight and common scab.

Mambetova and the Douches lab selected two varieties, Missaukee and Dakota Diamond, as the most promising from a pool of 30. These varieties are currently undergoing final testing before being made available in Kyrgyzstan.

Bringing the fruits of her labor back home has always been Mambetova's goal.

"It's very important I bring what I've learned back home," she said. "Our universities want to have more of an exchange of research ideas, students and faculty so that we can learn new ways of doing science and applying that in the field. The collaboration with MSU has been very significant."

Her work has also benefited the people of Michigan. Immediately after completing her master's degree, Mambetova was approached by William Kirk, professor in the MSU Department of Plant, Soil and Microbial Sciences, who offered her a position in his lab as a Ph.D. student.

Mambetova continues her work with potatoes, using varietal lines developed by Douches's lab but focusing on developing late blight resistance and fungicides to help Michigan growers.

In the future, Mambetova wants to return home to pass on what she's learned.

"I've changed a lot through the opportunities that the Central Asia IPM project gave me," Mambetova said. "I definitely feel a responsibility to take what I've learned and bring it to others. The teaching here at MSU is so different from what I had before, so I would love to take that back home to teach others."

A LASTING IMPACT

It's been 10 years since Aitmatov joined Maredia's project team, and the Central Asia IPM project has now ended. The impact, however, will continue in future decades.

"Of all the projects I've worked on, I take great satisfaction in this one," Maredia said. "MSU entered a mostly unknown area and produced a lasting important impact and forged new international partnerships."

The efforts helped break the region's isolation in the wake of the Soviet collapse. They also introduced new, innovative IPM efforts as well as extension and science outreach to help Kyrgyzstan build its capacity for continuing domestically.

"That's what we are about here at MSU, after all," Maredia said. "Sharing knowledge, training people and building local capacity to solve pressing problems in food and agriculture globally."

For Aitmatov, the project meant a revitalization of his country's agriculture.

"My only regret is that I couldn't learn these methods and techniques earlier in my career," Aitmatov said. "But taking this knowledge into the fields, communicating with farmers and growers, that's why I'm happy and still feel young. I have to thank God I was able to meet the highly regarded professors at MSU who helped us achieve all this." ▯

KYRGYZSTAN LEARNS FROM TECHNIQUES TAUGHT AT MSU

Upper left:
(From left) Karim Maredia, Murat Aitmatov and George Bird

Upper right:
Teaching Kyrgyz students about wheat pest management

Middle right:
Local farmers observing new crops

Lower left
Saltanat Mambetova in Michigan State University's potato breeding lab.

Middle left:
Researcher collaboration

PART TWO

TAJIKISTAN: Integrated pest management brings better agriculture

TAJIKISTAN WAS ANOTHER NATION LEFT GRAPPLING FOR SELF-SUFFICIENCY IN THE WAKE OF THE SOVIET UNION COLLAPSE. IN FACT, TAJIKISTAN WAS IN A PARTICULARLY DIRE PLACE. THE COUNTRY HAD PRODUCED VERY LITTLE FOOD. BY GOVERNMENT MANDATE, TAJIK FARMERS GREW MAJOR CASH CROPS SUCH AS WHEAT AND COTTON AND RELIED ON IMPORTS FROM OTHER SOVIET REPUBLICS TO PROVIDE THE FOOD CROPS NECESSARY TO FEED THE 4 MILLION PEOPLE IN THE MOUNTAINOUS COUNTRY. THAT AGREEMENT BECAME NULL SEPT. 5, 1991, WHEN TAJIKISTAN DECLARED ITS INDEPENDENCE FROM THE SOVIET UNION. BY CHRISTMAS OF THAT YEAR, THE COUNTRY STOOD ON ITS OWN. WHILE MANY CELEBRATED, OTHERS WORRIED – LARGELY ABOUT HOW THEY COULD CHANGE THE AGRICULTURAL LANDSCAPE TO PROVIDE FOOD INSTEAD OF COMMODITIES.

Tajikistan ranked as the poorest nation in Central Asia, and the end of the Soviet era did little to change that. In fact, the breakup of the Soviet Union dealt a significant blow to the fragile Tajik economy, prompting 15 percent of its population – primarily men – to leave and seek employment opportunities elsewhere.

This left many of the nation's farms in the hands of women, children and the elderly, and agricultural knowledge – both through experience and extension education – in short supply. Agricultural production had declined by more than 55 percent by 1997, with little sign of improving. Tajik entomologist Nurali Saidov, trained during the Soviet period, witnessed the change.

"Like the rest of Central Asia, Tajikistan had to transition from a centrally planned monoculture agricultural system to a more diversified one that met our food needs," Saidov said. "It was a challenging adjustment, particularly during that time."

RECONNECTING WITH THE WORLD

In 2005, the U.S. Agency for International Development (USAID), through a grant administered by the Feed the Future Innovation Lab for Integrated Pest Management at Virginia Tech, sent a team of researchers from Michigan State University (MSU) and the University of California, Davis to assess the state of agriculture in Central Asia and identify ways they could help.

As the only USAID Feed the Future focus country in the region, Tajikistan ranked near the top of the priority list, alongside neighbors Kyrgyzstan and Uzbekistan. Karim Maredia, MSU AgBioResearch scientist and director of the MSU World Technology Access Program, would oversee much of the work done in all three countries and was one of the first to arrive there.

"We found that these former USSR countries had to be reconnected with the world and modern science after their long isolation under Soviet control," said Maredia, a professor in the MSU Department of Entomology. "There had been a number of new approaches and innovations in agriculture, and in integrated pest management (IPM) specifically, that had developed in the past decades that could add to what the Central Asian researchers were doing."

With limited government funding for research and no effective outreach to farmers, the agricultural community in Tajikistan lacked the resources to improve the situation. Before the arrival of the MSU team, a series of non-governmental aid organizations had tried to help the region, but the scope and duration of their projects had never been sufficient to make lasting improvements.

Of critical importance to USAID was helping improve Tajikistan's wheat production.

"Wheat is the staple food security crop in Central Asia," Maredia said. "If you go to Indonesia, rice is life, but in Tajikistan, wheat is the first bread – the most important food source they have. On top of that, because of their mountainous terrain, only 8 percent of their land is arable. They have to make the absolute most of what they have."

BY JAMES DAU, STAFF WRITER

IF YOU GO TO INDONESIA, RICE IS LIFE, BUT, IN TAJIKISTAN, WHEAT IS THE FIRST BREAD – **THE MOST IMPORTANT FOOD SOURCE**

Doug Landis (right) with farmers in Tajikistan

Bringing Tajikistan up to speed with current science-based agricultural practices would take more than just a few meetings with farmers – it would take collaboration with institutions and scientists intimately familiar with the country and its circumstances.

The MSU team met with and hired three local researchers, one from each country, to coordinate the team's outreach efforts. Saidov was among them, seeing in this an opportunity to make a difference in his home country. His expertise in entomology and organizational skills immediately impressed MSU AgBioResearch entomologist Doug Landis, who was the lead project scientist in Tajikistan. And the skills would prove invaluable for the long-term success of the project.

"He was well-versed in the biology and ecology of the country, but more than that, he was a great organizer and liaison," said Landis, a professor in the MSU Department of Entomology. "He reached out to all sorts of local resources that we didn't even know existed, as well as scientists and students at the local university. He facilitated all of our activities in country."

FIGHTING INSECTS WITH MORE INSECTS

One of the key areas that the team identified for Tajikistan was updating its knowledge of IPM, a broad-based approach to pest control that incorporates multiple tactics from chemical sprays to the introduction and maintenance of beneficial insect populations. Of particular interest to the team was the potential to adapt research on beneficial insects conducted by Landis's lab in Michigan to Tajikistan.

Since coming to MSU in 1988, Landis has spent most of his career

IPM wheat demonstration plot in Tajikistan, testing the resistance of the Ormon variety to yellow rust diseases. Left to right: Murat Aitmatov (Kyrgyzstan), George Bird (MSU Entomology), Nurali Saidov (Tajikistan), Karim Maredia (MSU Entomology)

studying how well landscapes support predatory and parasitic insects and the impact of that on agriculture.

"One of the ways we can control pests on farms is by providing habitat that attracts the insects that prey upon crop pests," Landis explained. "Research we conducted in Michigan showed that we can not only attract them, but we can improve the lifespan and egg-laying capacity of parasitic wasp species by providing them with flowering plants alongside crop fields."

In Tajikistan, two pests present a major threat to wheat crops: the sunn pest and cereal leaf beetle. Both pests serve as prey for a variety of parasitoid wasps. By utilizing these natural predators, Landis and his team saw an opportunity to reduce Tajik farmers' reliance on expensive and toxic chemical sprays.

Though the same scientific principles apply in Michigan and Tajikistan, the types of flora are different. Before the team could develop companion plantings, they first had to identify which native species of plants would make suitable habitat for Tajik wasps. This led Saidov and a group of local botanists to pursue a series of expeditions into the mountains of Tajikistan to find the right plants for the job.

Saidov and his team gathered 50 candidate plant species, which they pared down to five major species with overlapping life cycles capable of providing insect nourishment throughout the year. By planting them in strips alongside wheat fields, the scientists found that they were an effective means of attracting and sustaining healthy wasp populations. In trials, wheat plots with companion plantings invariably yieled 30 percent more than those without companion plantings. In some cases, that number rose to as high as 60 percent.

"One of the coolest things about research projects like this one is how the knowledge you bring transfers to the people," Landis said. "It's not always clear how it's going to find its way through the population, what route it's going to take, and sometimes it takes surprising turns that even we don't expect."

PUTTING KNOWLEDGE IN THE RIGHT HANDS

Adapting modern IPM practices to Tajikistan's environment was not enough, however. Leaving behind a population of farmers trained in the practices and capable of developing and passing on that knowledge to the next generation was the only way to ensure that MSU would leave an impact that lasted beyond the project's 10-year lifespan.

Saidov led efforts to coordinate a series of farmer field schools. The research team would visit agricultural communities around the country to demonstrate the new IPM techniques and teach farmers about implementation.

"The farmer field school was the main approach we used to get these tools into the hands of farmers," Saidov said. "We brought our findings to them, presented them in their own language, so they could continue to use and understand them for years to come."

More than 1,500 farmers and agricultural students were trained directly through the farmer field school programs, with another 15 students receiving more intensive training through collaboration with Tajik Agrarian University. In addition, the team produced over 20 publications detailing their findings and how to implement them. They were produced in multiple languages and disseminated in the local communities.

Professor Karim Maredia in Tajikistan.

"I'm very proud of the way we left them with tools and training they did not have before," Maredia said. "They have new ideas, new ways of thinking about these problems and a new vision for agriculture."

Today, Tajikistan's agricultural production has climbed back to nearly the same level it was during the Soviet era. After the success of the initial project, Saidov has moved on to a new program – still funded by USAID – focused on bringing improved vegetable production technologies.

"The importance of food crops such as wheat and vegetables in the region is growing," Saidov said. "We're enhancing our food and nutritional security and shifting our food policy and strategies toward that goal. The training and opportunities we received from the MSU-led team has helped us reach where we are now." ▯

Spotted wing drosophila proves formidable fruit foe

BY CAMERON RUDOLPH, STAFF WRITER

WHEN A TINY INVASIVE FLY – THE SIZE OF A GRAIN OF RICE – CALLED SPOTTED WING DROSOPHILA (SWD) FIRST ARRIVED IN CALIFORNIA FROM ASIA IN 2008, RESEARCHERS WEREN'T OVERLY CONCERNED. ENTOMOLOGISTS WERE CONFIDENT THAT MANAGEMENT PROGRAMS COULD BE DEVELOPED QUICKLY AND THE RISK TO THE SOFT-FLESHED FRUIT THAT THE PEST COVETS COULD BE MITIGATED.

But that outlook changed the following year when the insect was reported more than 2,000 miles away in Florida. This revelation gave researchers, including Michigan State University (MSU) small fruit entomologist Rufus Isaacs, great pause.

"When they found SWD in Florida in 2009, that's what really got the alarm bells ringing," Isaacs said. "It meant that this wasn't just a West Coast issue anymore. MSU sent me to a meeting about this pest in Oregon shortly after it was found in Florida, and when I came back it was clear we needed to get ready here in Michigan."

MSU researchers didn't want to take any chances, especially with a statewide fruit industry valued at more than $375 million per year. In 2010, Isaacs received his first SWD grant from Project GREEEN (Generating Research and Extension to meet Economic and Environmental Needs), a partnership among MSU AgBioResearch, MSU Extension and the Michigan Department of Agriculture and Rural Development. Project GREEEN works with commodity groups to find solutions to plant agriculture challenges in Michigan.

Isaacs, along with other fruit extension specialists and extension educators, set traps to monitor for the insect. Researchers used small plastic containers covered with holes and filled with an attractant (at first apple cider vinegar and now a mixture of sugar and yeast) and a sticky trap. In early fall 2010, a few flies were collected from a monitoring site in southwest Michigan. They were later positively identified as SWD by the MSU Diagnostics Services lab and then U.S. Department of Agriculture (USDA) taxonomists in Beltsville, Maryland. Since then, the invasive pest has been discovered across the Lower Peninsula.

Left: MSU entomologist Rufus Isaacs works with his students and staff in the laboratory collecting data and examining SWD. Right: Close-up of SWD by G. Arakelian, LosAngeles County Department of Agricultural Commissioner/Weights and Measures.

The destructive effect of SWD on fruit (left) and a close-up of the insects.

Most of the SWD research led by Isaacs has been in collaboration with blueberry and raspberry growers. His early work involved testing already-registered pesticides and determining their efficacy. Other options his group has studied include physical exclusion, where growers place netting around and on top of crops as they begin to ripen.

In 2015, Isaacs and Matthew Grieshop, an organic pest management expert at MSU, were awarded a grant from the USDA's National Institute of Food and Agriculture (NIFA) to study long-term solutions with researchers at the University of Georgia and other institutions. The goal is to develop new growing practices and test organic approaches to managing SWD.

Isaacs, as well as MSU entomologists Larry Gut and Ke Dong, is working in conjunction with North Carolina State University to study insecticides, biological controls and cultural control approaches. The group also aims to understand how this pest might develop resistance to insecticides. This project is funded by USDA's Specialty Crop Research Initiative (SCRI), a program of NIFA.

"There is a community of natural enemy insects that attack SWD in Asia," Isaacs said. "With the SCRI grant, one of the objectives is to look at biological controls. This pest can build up in wild areas where growers can't manage them easily, but if biological controls can help to reduce the population pressure, it should allow control measures applied in the fields to work much better. Risk assessments are underway to determine if the Asian biological controls are a viable option here in the U.S."

It will take a large group of researchers to tackle this problem, Isaacs says, but he is encouraged with the urgency expressed by funding agencies.

"We've gone from a lot of people getting small, local funding for research to now also being coordinated nationally through these two recent grants," Isaacs said. "Since this is a national problem now, we need to address it with a national team of researchers."

GAINING KNOWLEDGE

The biggest obstacle to finding a control mechanism is that SWD is very different from other pests. Females are equipped with a serrated ovipositor that can puncture healthy fruit and deposit up to 100 eggs per day. Adult flies may live for weeks under the right climatic conditions and there are no distinct generations, making targeted treatments difficult. Instead, populations begin to rise in the spring and peak in the fall. Additionally, researchers say little is known about SWD behavior.

Gut and doctoral student Danielle Kirkpatrick are attempting to develop better monitoring tools by learning about how far SWD travel.

"A primary focus of Danielle's research is studying how far the flies move and at what distance traps attract flies," Gut said. "In other words, what's the trapping area of a trap? Right now we can't really use the tools as effectively as possible if we don't really know how far apart to put them. So far, it appears they are moving pretty good distances, much farther than we thought."

Researchers agree that spraying is the most cost-effective approach currently, but a lack of options has overwhelmed some growers. In an effort to lessen dependency on pesticide application, Gut and Grieshop have received Project GREEEN funding to test non-spray control methods.

COMBATING SWD

Upper left:
Phil Korson

Upper right:
Lab work at NWMHRC

Middle right:
MSU researcher Larry Gut

Lower right:
SWD on fruit. Photo: Hannah Burrack, North Carolina State University

Lower left:
MSU graduate student Heather Leach emptying trap

Middle left:
Spotted wing drosophila trap

Gut, Grieshop and postdoctoral research associate Juan Huang are using attract-and-kill tactics that were first studied with Japanese beetle and oriental fruit moth. The two-year project examines the use of small nylon pouches that hang from trees and bushes. The pouches are treated with insecticides and filled with attractants such as pheromones or food to lure and kill the insects on contact. In the lab, researchers determine how long the pest needs to be exposed to the insecticide for 100 percent mortality. Then, in the field, cameras monitor wild insect interactions with the nylon bags.

This year, the Michigan Tree Fruit Commission, with support from the peach and plum industries, awarded Gut a grant to observe SWD with multiple peach and plum varieties. After collection, Gut traps the fruit with several flies to monitor behavior. While the industry wants to get out in front of the pest to prevent major threats, Gut said he believes that adding to the knowledge base on host selection and insect behavior will be most important.

"Treating is also difficult because we don't know a lot about what SWD are doing in the winter," Gut said. "It's a critical piece of information that we're trying to find. Once it gets colder, they change their morphology and physiology and become a winter morph. It's a much larger, darker, cold-tolerant form of the insect. We're hoping that the population shrinks at this time to a level that, if we find out where they are, we can treat these low levels of the winter morph and end up creating a situation where the population doesn't build as high in the summer and fall."

THE NO. 1 CHERRY PRIORITY

Cherries occupy a critical space in Michigan's fruit production portfolio with an industry valued at nearly $100 million per year. Cherry research is conducted around the state by MSU scientists, particularly at the Northwest Michigan Horticulture Research Center (NWMHRC) in Traverse City, Michigan, and the Trevor Nichols Research Center (TNRC) in Fennville, Michigan.

These two locations are where Gut and Nikki Rothwell, the center coordinator for NWMHRC and an extension specialist, have been conducting a series of pesticide efficacy trials for SWD. Thin skin on tart and sweet cherries makes them particularly vulnerable. When SWD found its way to Michigan, Rothwell hoped cherry growers could avoid an unmanageable population.

A JULY HAILSTORM COMPLICATED MATTERS FURTHER BY DAMAGING FRUIT IN THE REGION. **GROWERS WERE LEFT WITH INJURED CHERRIES, A HAVEN FOR SWD BREEDING.**

"Once SWD came to Michigan, we started to monitor the situation for cherries but weren't extremely worried," Rothwell said. "We thought the cold winters would help, and cherry harvest was over before the SWD population got out of control late in the summer and into fall. That seemed to hold true until 2015. This year, we found them even earlier."

Funding from Project GREEEN and the Michigan Cherry Committee has helped Rothwell and Gut perform ongoing laboratory tests of several insecticides at NWMHRC and TNRC — with mixed results thus far. Although a breakthrough hasn't happened yet, Phil Korson, the president of the Cherry Marketing Institute, is grateful to have a team of researchers dedicated to the cause.

"Half of the supply of tart cherries in the U.S. are grown in northwest Michigan, so we are fortunate as a state to have excellent researchers working with growers on SWD," Korson said. "The industry has supported research, and MSU has received several national grants. I'm confident that, with the resources we have, our team will lead the way in developing a holistic plan for this pest."

In addition to encountering SWD earlier in 2016, a July 8 hailstorm complicated matters further by damaging fruit in the Traverse City area. Growers were left with injured cherries on trees or on the ground, a haven for SWD breeding.

Rothwell and her team dealt with this challenge in various ways, including physically destroying the fruit by shaking it to the ground and using equipment such as a truck to crush it. Ideally, this would make the cherries less appealing to SWD. She saw positive results from the tests but is interested in long-term control.

"MSU is trying to stay out in front of this issue as much as possible," Rothwell said. "We have experts doing a lot of great work, of course, but we are also making ourselves available to address the growers' concerns. The continued partnership among universities, commodity groups and growers will be essential."

"SWD is really the No. 1 priority of the cherry industry at this point," Gut added. "This pest threatens raspberries, blueberries and has now gotten into cherries, so we need to find a management strategy that works as quickly as possible. There is no one-size-fits-all solution. We've gotten more resources through grants, and now we need to continue the work." ▯

Couple's bike ride inspires creation of cider house

With more than 200 wineries and nearly 15,000 acres of sprawling vineyards in Michigan, wine lovers have oodles of options — particularly in the northwest region of the state. But for those looking for a fermented alcoholic beverage of a different sort, especially one made from locally grown apples, Tandem Ciders has it covered.

Nikki Rothwell, coordinator of the Northwest Michigan Horticultural Research Center (NWMHRC) at Michigan State University (MSU), and her husband, Dan Young, opened the cidery in fall 2008.

A tandem bicycle trip Rothwell and Young took in England inspired the name of the business located just north of Suttons Bay, Michigan. The rest is the product of hard work.

The couple met while Rothwell was earning her doctorate from the University of Massachusetts Amherst and Young owned a microbrewery in the area. Young's interest in English beer led the pair to make the cycling voyage, where they tasted several brews throughout their stay. Dissatisfied with their experience, the drink of choice quickly changed.

"Many of the beers were warm and flat, so we started drinking more ciders," Rothwell said. "Dan was interested in brewing beer, but it got us thinking about whether cider would be an option. When we decided to move to Michigan, we saw there were tons of apples, but not much cider. It's been an exciting ride ever since."

Today, Tandem Ciders serves a devoted community of friends, family and cider connoisseurs, including regulars who visit daily. While several tasting rooms shut down in the winter, Tandem Ciders remains open year-round. Movie nights and euchre tournaments fill the barn-shaped building with laughter and camaraderie – the couple's ambition all along.

"It's really about the community," Rothwell said. "Dan is an innovator in that he had the foresight to see that these local ingredients, especially for cider, would be a great selling point, even before that movement has taken hold all over the country. Now most wineries around here have some sort of cider available, too. We're really grateful for all of the support we've had, and I hope our customers get as much enjoyment out of it as we do."

As center coordinator at the NWMHRC, Rothwell works with a community as well — a group of growers who rely on research to aid in the decision-making process. From pest management strategies to extension information, Rothwell said she relishes the chance to help the agriculture industry.

"I'm lucky that I got to come home to Michigan, and I get to work at a place like MSU that's so supportive," Rothwell said. "We have a strong backing from growers who are really invested in our research. We are in a position to assist them because of MSU's commitment and the industry's support, and as an extension professional, you can't ask for more." ▯

Nikki Rothwell with her husband Dan Young at Tandem Ciders.

Name: Nikki Rothwell

Title: Center Coordinator, NWMHRC; MSU Extension Specialist

Joined MSU: September 2004

Education:
Ph.D., Entomology, University of Massachusetts Amherst

M.S., Entomology, Michigan State University

B.A., Biology, Western Michigan University

Hometown: Kingsley, Michigan

Muse (person who has most influenced and/or inspired me): My grandmother was tough. She was a first-generation American from Germany. I love that she was a strong woman.

Favorite food: Homemade pizza. Every Friday night is pizza night, and people stop by to enjoy it with my family.

Best song for a wedding/party: "You Shook Me All Night Long" by AC/DC

Book I'd recommend: : "Balzac and the Little Chinese Seamstress" by Dai Sijie

On my bucket list: I'd like to own a small apartment in New York City. I love it, and I'd like to be able to visit whenever.

Favorite vacation: After the cherry harvest each year, I go to Lake Michigan with my family, usually to the Harbor Springs area.

On a Saturday afternoon, you'll likely find me: Gardening or preparing to entertain. My husband and I love to have people over to our home, and I love cooking.

A major research breakthrough I'd like to see in the next decade: A long-term management plan to deal with spotted wing drosophila.

Family: My husband is Dan Young, and we have a 4-year-old daughter, Sadie.

Person (living or dead) whom I'd most like to have dinner with: Julia Child (chef) and Jim Harrison (author and poet from Michigan). I feel like that would be a very interesting duo to chat over dinner.

Best part of my job is: Building relationships with growers. We are able to respond to their needs, and they support us so much.

If I wasn't a researcher, I'd be a: A chef. I enjoy trying new things, and that would be a different challenge each day.

Something many people don't know about me is: When I was younger, I wanted to be in the Rockettes.

Words of advice to a young scientist: Find a passion and stick to it. Scientific breakthroughs don't happen overnight, but if you work at it you can have a big impact.

I went into this field of study because: I worked at the NWMHRC when I was 21. I thought it was the coolest job. I told my boss at the time, Gary Thornton, that I'd have his job someday. Little did I know that it would come true when I came back to MSU in 2004, and then I became the center coordinator after that. This job allows me to help people, which is our main objective as extension professionals.

WANTED: CHESTNUT GROWERS

Michigan State University grows chestnut industry, with demand far outpacing supply

• BY HOLLY M. WHETSTONE, EDITOR •

AMIDST A FRAGRANT GROVE OF TALL, SILVERY-BARKED TREES AT THE MICHIGAN STATE UNIVERSITY (MSU) CLARKSVILLE RESEARCH CENTER, ROGER BLACKWELL IS LOOKING FOR A FEW GOOD GROWERS.

"You can still have your grapes and apples, but you may want to think about putting in 10 acres of chestnuts for diversification purposes," said Blackwell, president of Chestnut Growers, Inc.– a grower cooperative in Michigan. "I could sell a million pounds of chestnuts tomorrow if I had them. The world stage is set for Michigan chestnuts. The only thing lacking are growers willing to establish orchards."

The pitch leaves many attendees at the annual field day event crunching numbers, scratching their heads and doubting recent investments in high-density Honeycrisp apple trees and young wine grapes in particular. Public calls, such as this one, to enlist new growers are typically a no-no in agriculture, where overproduction can quickly cause markets to crash and crops to go unharvested and left to rot. But chestnuts are an exception.

"I think what's unique about chestnuts that I haven't seen in other horticultural crop systems is that the industry wants new growers. They're trying to recruit new growers, and they're supporting them as well," said Erin Lizotte, MSU Extension educator. "There's a market for new growers, and it's one of those situations where they need all of the chestnuts and they want to support anyone who is willing to contribute to that."

Like many other growers, Josh Springer admits he was a skeptic at first. But in spring 2015, he decided to take the plunge. He purchased over 50 acres in four locations throughout lower Michigan and is planting chestnut trees at each of the sites. He said he was convinced not only by Blackwell, but by MSU as well, to make the investment in a commercial chestnut growing operation.

"I think chestnut growers are seeing that there is less risk involved, in large part because of the MSU research," Springer said. "There are scientific data to back up these claims."

Blackwell concurs and credits MSU for transforming the once backyard hobby into a burgeoning industry. Today, Michigan ranks No. 1 in the United States in number of chestnut growers and chestnut acreage. Much of the newer acreage is due to hobbyist growers taking chestnuts more seriously and investing in additional land to plant the trees for commercial production.

"If it wasn't for Michigan State University, I wouldn't be growing chestnuts," Blackwell said. "Dr. Dennis Fulbright is really the guy who made it happen. Together, we are literally growing a chestnut tree industry in Michigan."

THE RISE, FALL AND REBIRTH OF CHESTNUTS

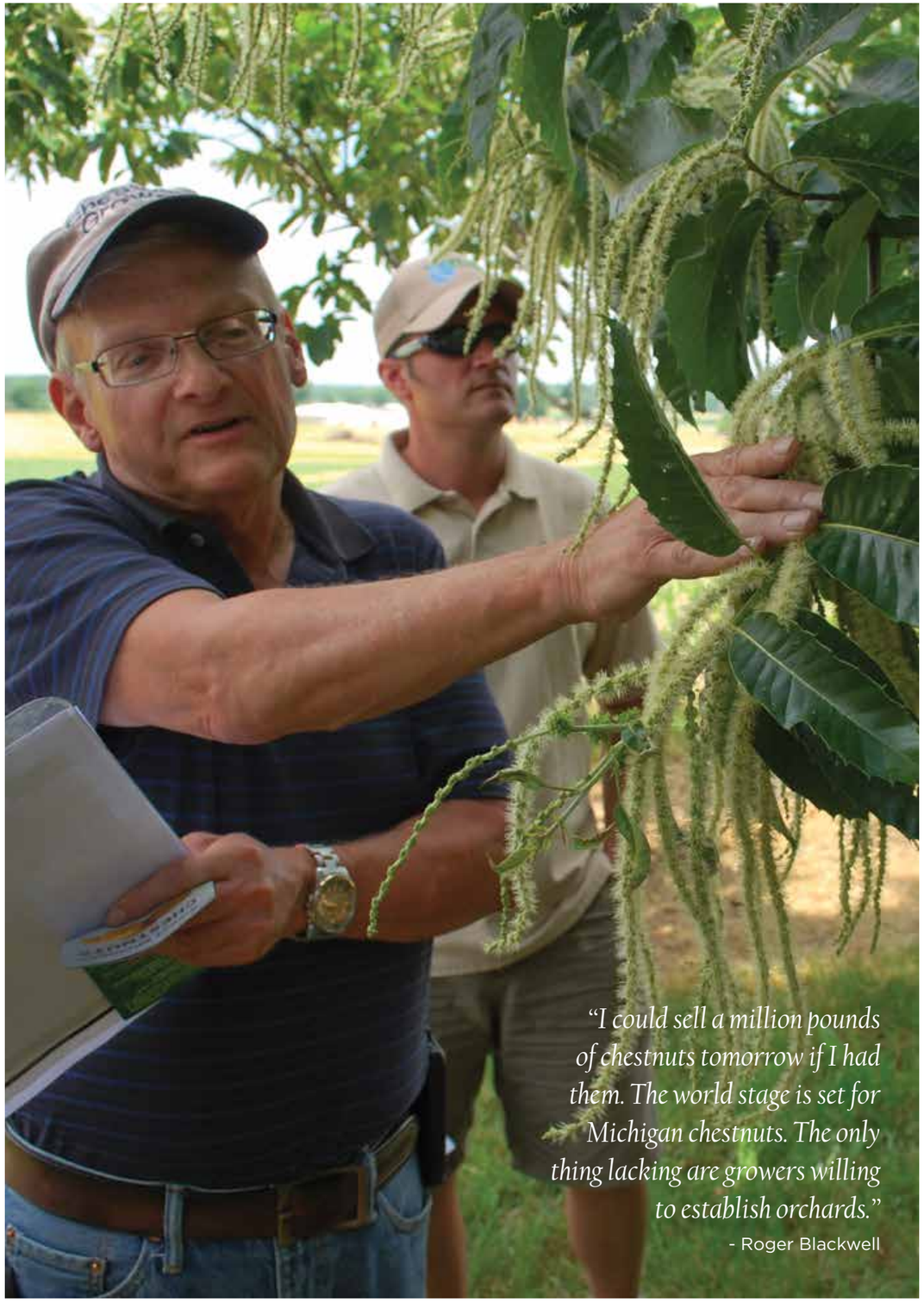
In the late 1800s, one in every four trees in the Appalachian Mountains or eastern forest was a chestnut. The nuts were small and served as food for animals, and the sturdy trees were primarily used as timber. But a fungal infection known as chestnut blight singlehandedly destroyed the industry. In the first half of the 20th century, blight claimed some 4 billion mature American chestnut trees, making them a distant memory for many.

U.S. farmers began to replant chestnut trees in the latter part of the century but faced serious struggles. Hearing grower concerns, Fulbright – a plant pathologist – spearheaded an initiative to begin a full-fledged chestnut research program at MSU.

"It's strange that a plant pathologist would start a horticulture crop research program because we just don't normally do that," he said. "Typically, we take care of our plant disease and go on with that. But no one at the time was looking at chestnuts and chestnut blight, which is the fungal disease limiting chestnuts."

In the late 1990s, two Extension educators – one from Leelanau County and another from Antrim County – came to MSU for a forestry meeting and began asking questions on behalf of chestnut growers. They wanted to know if the university was going to help the growers, and if not, they wanted to know why. Fulbright, who had been looking at chestnut blight, was at the meeting.

"I think most in the room could have told the difference between a Chinese chestnut and an American one, but that's about it," he said. "This assessment of the original orchards – 'Why weren't they producing chestnuts?' – was the starting point.



Roger Blackwell inspecting chestnuts in June during the early development of the bur.

A lot of people waited six, seven, even eight years with no chestnuts coming off their orchards. That got us really interested."

Under Fulbright's guidance, the MSU chestnut research program launched in 2000. It has four areas of concentration:

- Genetics and orchard establishment.
- Horticultural care.
- Harvest, storage and processing.
- Marketing.

Researchers quickly realized that one of the largest issues facing the industry was that growers were planting Chinese chestnut trees that were not adapted to conditions in the United States. Michigan growers, like those in California, Washington and Oregon, were guilty of farming with what researchers called "inferior germplasm." Once the right trees were discovered, Fulbright said, MSU was able to graft the trees and grow them on campus with decent yields. Shortly afterwards, growers began to produce nuts – lots and lots of nuts.

MORE SOLUTIONS THAN QUESTIONS

It wasn't long before growers had more questions on everything from where to purchase the trees to disease and pest management. Even Blackwell, who operates a successful orchard in Montague, Michigan, said he had a failed attempt at growing chestnuts in the early '90s. But that, he said, was before MSU had a foothold in the industry and started providing much-needed answers.

The top threat continues to be chestnut blight. Though not all chestnut trees are susceptible to blight, the high-yielding Japanese-European hybrids typically planted in Michigan are. Fulbright, however, discovered a native, naturally occurring compound that controls chestnut blight. Shown to be effective in research trials, the compound is going through a federal regulatory process so it can be marketed and sold to growers.

Springer, who received his Ph.D. in understanding chestnut blight and its biological control with MSU associate professor Andy Jarosz, plans to eventually sell the compound through a new company he formed called Chestnut Orchard Solutions. Although started for selling the biological control, the business has expanded to offering professional advice and consultation on chestnut production.

"When you tell growers that the trees are susceptible to chestnut blight, that's definitely when you have to do a bit of convincing," Springer said. "But when you tell them that we have the solution and they no longer need to worry, they're usually on board."

Lizotte, who specializes in chestnut production and works closely with growers throughout Michigan, adds that chestnuts are in a really positive space compared with many other commodities.

"Blight is treated as it arrives, and it's treated with a biological control that was found natively. The pests we deal with are generalists – they affect a lot of horticultural crops, and we have a lot of information on how to control them with registered products,"

WANTED: MICHIGAN CHESTNUT GROWERS

Upper left:
MSU researcher Dan Guyer

Upper right:
Chestnut saplings being loaded for transportation

Middle right:
Tree ripe for harvesting

Lower middle:
Poster for Jolly Pumpkin Ales' annual Chestnut Jubilee, featuring chestnut beers

Lower left:
Harvested chestnuts

Middle left:
MSU researcher Dennis Fulbright

she said. “That’s the best of what you can possibly get. I think that’s really exciting. Chestnuts are something we can produce organically unless something major shifts in the future.”

One invasive pest does pose a small challenge – the Asian chestnut gall wasp. Fortunately, Lizotte said, damage has been minimal because there is a natural predator that is effective at controlling it. Plus, one cultivar – ‘Bouche de Betizac’ – has shown resistance to the pest. Fulbright said the MSU research team was the first to tell growers to plant the cultivar because of its natural resistance to the Asian chestnut gall wasp.

“Plus, we have the advantage of being the last chestnut producers in the world to deal with this pest, so there’s a ton of information out there,” Lizotte said. “Comparatively, when we think of other invasive pests, this isn’t one that is going to run away with the industry.”

With pest and disease management pretty much squared away, growers began wondering about ways to harvest. That’s when Dan Guyer, MSU professor of biosystems and agricultural engineering, was called upon.

“This was at a time when we were really building this industry – as Dennis said, from farm to fork – and slowly making sure we have markets and developing those very carefully,” Guyer said. “So we’re at the point now, everything is going pretty well, when the question arises: ‘How do I pick them up and harvest them and get them to these markets?’”

Fortunately, Guyer said, he didn’t have to start from scratch. He looked to Europe, where chestnuts had been harvested for food for centuries. The equipment varies from a nut wizard – a circular wire hopper that rolls over the chestnuts and collects them – to a mechanical harvester that operates similarly to a street sweeper.

Guyer said a midsized harvester about the size of an ATV would give growers an ideal midrange option. He said several Michigan growers are trying to figure out how to share one of the mechanical harvesters to reduce costs.

MAKING IT WORK

With research and outreach experts lined up to work in areas from genetics to disease management, it wasn’t long before the MSU Product Center got into the mix. In 2002, the MSU Product Center formed its first grower cooperative – Chestnut Growers, Inc.

“With Tom Kalchik’s guidance and steering us in the right direction, we established our first co-op,” Blackwell said. “A steering committee met in 2001, and in 2002, we had our incorporation papers. We’re probably one of the only actual chestnut cooperatives that is a full-fledged cooperative. We have the most members.”

Today, MSU also has two research centers where chestnut studies are ongoing: Clarksville Research Center, which focuses on the fresh market, and Rogers Reserve in Jackson, focused primarily on processing. And a new business called Treeborn is working to create value-added products from fresh chestnuts.

“I think that if we didn’t have the companies rolling out, we wouldn’t really be able to say that we’ve started an industry in Michigan,” Blackwell said. “And with the cooperative rolling out of this initiative as well, it really gets the growers and MSU involved together.”

Blackwell, who also serves on the board of Chestnut Growers of America, said growers from other states have expressed envy at the Michigan industry because of its close ties to MSU.

“No other state has an MSU. No other state has a Dr. Dennis Fulbright and a Dr. Dan Guyer. Many don’t have the Extension service,” he said. “MSU has been by far the most supportive. No one else has that. To be honest, I wouldn’t be growing chestnuts – I would have gotten out of this a long time ago.”

MSU researcher Dennis Fulbright (right) with Roger Blackwell, a Michigan grower, at Clarksville Research Center.

“And conversely,” Lizotte adds, “we have people in the industry who think of this as a business and run it as such, and that’s what we need. There’s always a struggle with start-up crops about hobbyists versus commercial growers, and I think people like Roger have really provided that leadership. There are very few industries that have been set up in such a calculated way as chestnuts in Michigan have.”

PACKING IT UP

Growers turned to Fulbright and Guyer again when they realized they needed help with storage. They worked with a graduate student to determine the optimum materials with which to treat the nuts, the best storage procedures and the right temperatures. After that, they researched an x-ray scanning process that allows the bad nuts to be culled from the good ones.

“It’s all a continuum, with the process going from looking at genetics to making a chestnut-flavored beer,” Guyer said. “The storage and the sorting is where I originally planned to contribute to the industry development, but then we had to go back and look at processing. We had to find a way to get these respiring/living chestnuts processed and stabilized so that we can store them as frozen, dried or some other form to be subsequently turned into value-added products. And get them peeled – that’s the first step in all of that.”

Fulbright said processing fast became a priority because in 2001, when the cooperative was formed, many commodity groups were facing tough pricing, and people were scrambling to come up with value-added products.

“If you go back to the era, almost every crop was overproducing and their prices were plummeting, and cherries were 9 cents a pound in Traverse City,” he said. “We said, let’s start with processing because we know that someday we will overproduce. We’ll be the smart guys and we’ll have all of these products out there. Guess what, we never overproduced, and that’s because we can’t grow enough fresh chestnuts for our fresh and value-added markets.”

“There are very few industries that have been set up in such a calculated way as chestnuts in Michigan have.”

– Erin Lizotte, Integrated Pest Management Educator at Michigan State University Extension

Since about 2008, Blackwell said, the cooperative has been focused on the fresh market.

“A lot of the customers want chestnuts through the end of December, but we usually sell out by the first week of November,” he said. “And the price has always gotten better each year.”

Though the cooperative worked a bit on the value-added products, Blackwell said they have been able to fill the quality fresh market. As soon as they’re harvested, the nuts are taken to the Clarksville Research Center and put into a storage unit kept at 32 degrees F. They are cleaned, sanitized and packed – but not for long.

“We do ‘just in time packing’ and get chestnuts to our customers to sell within a week or so. Then we’ll resupply so that they’re turning over the fresh product,” Blackwell said. “They’re in the produce aisle at the grocery store, and we want those chestnuts to sell.”

THE GRAIN THAT GROWS ON TREES

There is no question that the United States is late in discovering chestnuts as food. In China, the average person consumes between 2 and 3 pounds of chestnuts per year. They are also popular in Spain, Portugal, Italy, France and Turkey.

But ask shoppers at Detroit’s Eastern Market if they’ve ever had a chestnut and most will say no, according to Blackwell.

“Most people think it’s going to taste like any other nut, but no, it’s different,” he said. “To me, it’s more like a potato. It’s starchy. You could live on chestnuts. They’ve got protein, vitamins A, C and E, and you can make them into a lot of different things.”

Unlike other nuts, chestnuts do not have oil. Many compare it more to a grain like wheat or corn, since it can be ground into gluten-free flour. In fact, somebody long ago termed chestnuts “the grain that grows on trees.”

The starchy nuts consist largely of water – 55 percent, to be exact. They are most known for being eaten roasted – thanks to the Christmas song line “Chestnuts roasting on an open fire,” but the options have broadened.

They are a popular ingredient of chefs worldwide, from the puree used in Paris to make pastries to the chips used to flavor beer at the Jolly Pumpkin brewery in Dexter, Michigan. In fact, demand is so strong that the large nuts command a premium price – sometimes two to three times that of other specialty crops.

With a situation so ideal, it’s difficult to imagine a time when chestnuts didn’t flourish in Michigan.

“There is a big opportunity here for producers,” Lizotte said. “I think 10 years ago if you had talked to a tart cherry grower about this, it would have been a different world. The cost of the trees would have been scary, but now as we see high-density apples going in and hop production, the cost per acre of establishing chestnuts does not look outlandish anymore.”

For more information, visit chestnuts.msu.edu. ▯

PROTECTING THE MICHIGAN LANDSCAPE

Researchers work to ensure sustainability of Michigan's hunting heritage

BY CAMERON RUDOLPH, STAFF WRITER

Michigan residents take full advantage of the abundance of natural resources at their fingertips, especially in terms of hunting. According to the Michigan Department of Natural Resources (MDNR), Michigan ranks third in the U.S. in hunter participation. Hunters contribute more than $2 billion to the state's economy through trip-related expenditures and equipment purchases.

But the picture isn't entirely rosy. A plethora of wildlife pressures – from disease and climate change to illegal hunting – have created a situation that has captured the interest of scientists.

"There is a rich history of hunting and overall enjoyment of the outdoors in Michigan, something we want to preserve for generations to come," said Gary Roloff, an associate professor in the Department of Fisheries and Wildlife at Michigan State University (MSU). "Wildlife in our state is threatened by a number of things, and it's our responsibility as scientists to understand more about how we can minimize the impacts of negative environmental stressors."

"They root around in the soil and can destroy vegetation and crops, eat food that native species rely on, and they can threaten domestic pork operations."

- Gary Roloff

Researchers at MSU want to conserve the animals, the environment and the multibillion-dollar industries utilized by many. Sometimes that means removing an invasive species from the equation.

A PIG PROBLEM

Researchers from MSU, MDNR, U.S Department of Agriculture Wildlife Services and the University of Michigan-Flint are roughly midway through a five-year project in which they aim to learn about the ecology of feral swine. They want to develop management recommendations and, ultimately, eradicate feral swine from the state.

Most feral swine belong to the category of Russian boar, also known as the Eurasian boar, although some are domesticated pig escapees. Pigs were first introduced to the U.S. in the 1500s as a game animal and food source for European explorers. Over time, wild pigs — which can grow to well over 300 pounds — have become a favorite target for hunters, particularly in southern states where the population has exploded. More than five million now inhabit the country, causing more than $1.5 billion in damage to agricultural lands and forests.

The animals also carry various diseases that can spread to humans, pets and domestic livestock. Harm to the pork industry, a $500 million per year business in Michigan, is a major concern.

Controlling feral swine populations is difficult due to the rapid rate of reproduction. Both genders become sexually mature as young as six months, and females can have multiple litters of four to six piglets or more per year.

"The good news is that there are likely less than 1,000 feral swine in Michigan," Roloff said. "The bad news is that they reproduce quickly, are extremely adaptable and can have significant detrimental effects on crops and the environment.

"They root around in the soil and can destroy vegetation and crops, eat food that native species rely on, and they can threaten domestic pork operations. However, Michigan is in a good position to remove this threat from the state."

While researchers believe Michigan is ahead of the eradication curve nationally, little is known about how feral swine interact with the environment in the upper Midwest. Roloff's team is actively capturing pigs in cooperation with property owners, primarily in the hotbed counties of Gladwin, Midland, Ogemaw and Arenac. The pigs are fitted with collars that use wireless monitoring and are then released. Via satellites, the collar records the animal's location every 30 minutes, and users are able to view maps that show how many times each location has been visited.

Steven Gray, a graduate student of Roloff's, has been reviewing data and conducting field work to assess environmental damage from the swine.

"What we're seeing is that feral swine have a larger home range than we anticipated," Gray said. "Michigan doesn't have a lot of pigs relative to other states, so they have more room to roam. They like woody wetland areas where they can wallow in the mud, and we see large spots where they've rooted for grubs or other food. Just a few pigs can do a massive amount of damage, and we're trying to quantify that."

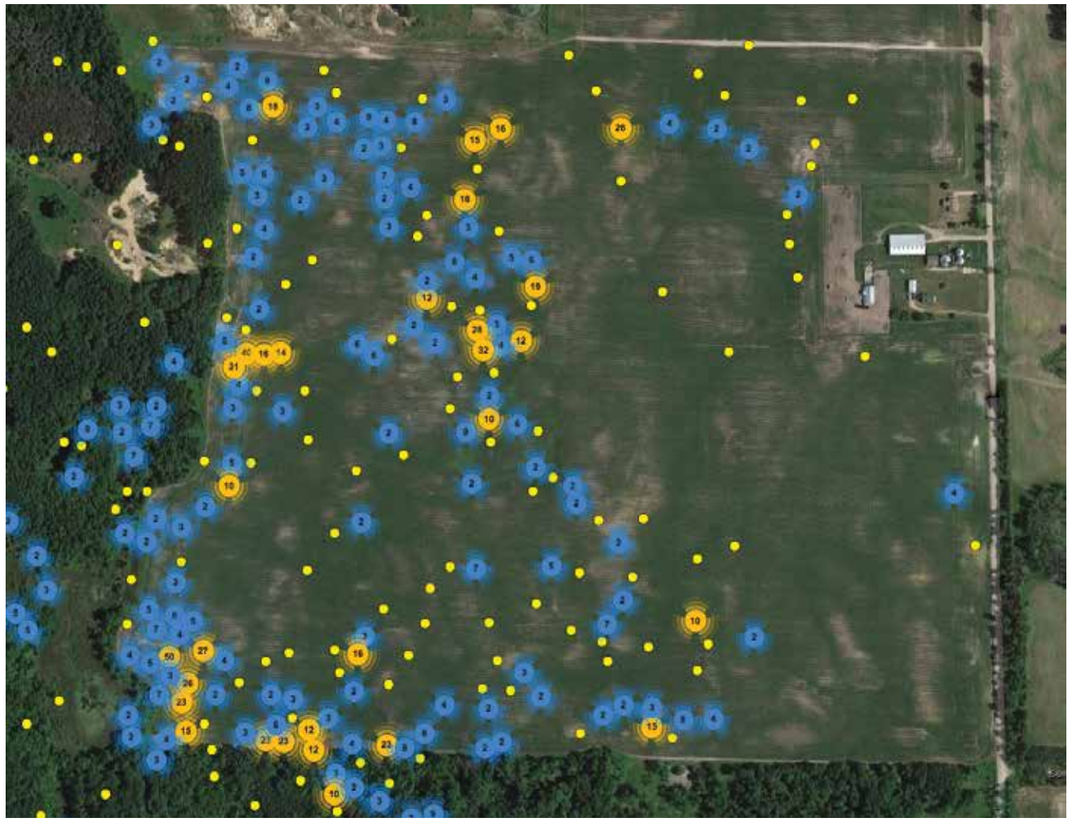
To further track feral swine locations, University of Michigan-Flint scientists are using environmental DNA.

The technology allows researchers to take samples of water or soil, for example, and test for the presence of feces, urine or other traces of the pigs. This will help researchers determine if feral swine have been truly removed from a given location.

In addition to funding research, Michigan has taken steps to curb the feral swine population with assistance from the public. The state enacted an invasive species order in 2011 that prohibits the possession of Russian boar. Furthermore, residents with a valid hunting license are allowed to shoot feral pigs on sight while hunting. Also, private property owners don't need a license if shooting on their property.

"Pig hunting is engrained in the culture of many southern states, but in Michigan we already have a variety of larger game animals for hunting such as turkey, deer and bear," Roloff said.

"With feral swine, we run the risk of upsetting the balance of our ecosystems and potentially causing a lot of environmental damage, while also presenting health risks. Great progress has already been made to get rid of feral swine in Michigan, so we need to continue that momentum."



GPS data on collared pigs is recorded every 30 minutes. On this farm, the smaller yellow dots represent a single visit to a particular spot while the blue dots indicate 1-9 visits and the larger yellow dots, 10 or more visits.

PROTECTING THE MICHIGAN LANDSCAPE FOR HUNTING

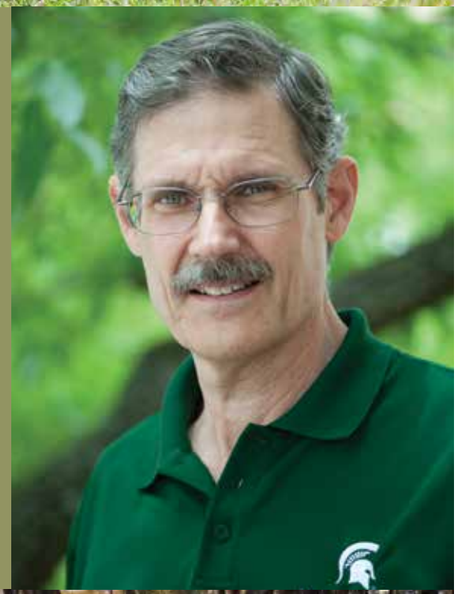
Upper left:
Steven Gray, a Roloff graduate student

Upper right:
DNR field photo of Michigan turkeys

Middle right:
William Porter

Below:
The feral swine roam and cause damage throughout the year

Middle left:
Gary Roloff



ENSURING SUCCESS FOR AN ICONIC SPECIES

Wild turkeys are one of the most revered birds in North America and a common spectacle for nature lovers throughout the Great Lakes region. But not long ago, turkey sightings in Michigan were relatively rare. Populations were wiped out in the late 19th century due to habitat destruction and unregulated hunting, leading to a reintroduction effort that began in the 1950s.

Populations of the large bird increased steadily in Michigan from the 1950s through the 1990s, when wild turkeys expanded to occupy nearly all available habitat in Michigan. Since the early 2000s, the numbers have begun to stabilize.

A team led by William Porter, the Boone and Crockett Chair of Wildlife Conservation at MSU, sought to determine if the current level of turkey harvest by hunters is sustainable.

"Historically, a rule of thumb has been that the wild turkey population could withstand just shy of 10 percent harvest each year," Porter said. "But we saw that this recommendation was based on conditions that were extremely favorable for turkey nesting and raising young. When we looked at more average conditions, it turns out that close to 10 percent harvest may be too much."

The wild turkey is the second most popular hunted animal in Michigan behind deer, with roughly 100,000 hunters taking to the woods each year. Hunters harvest more than 30,000 turkeys annually, putting Michigan No. 7 in the U.S.

Numbers of wild turkeys have grown robust enough to support two hunting seasons in Michigan. A fall season allows hunters to take a turkey of either sex, but it's spring hunting that generates the most interest. Spring is mating season for turkeys, and hunters go afield to lure gobblers by imitating the call of hens.

"Those who hunt turkeys in the spring will say that matching wits with a gobbler is like no other outdoor experience," Porter said. "As the interest in hunting grows, we have to make sure that the wild turkey population can sustain the annual harvest."

A RULE OF THUMB HAS BEEN THAT THE WILD TURKEY POPULATION COULD WITHSTAND JUST SHY OF 10 PERCENT HARVEST EACH YEAR. BUT WE SAW THAT THIS RECOMMENDATION WAS BASED ON CONDITIONS THAT WERE EXTREMELY FAVORABLE FOR TURKEY NESTING AND RAISING YOUNG. WHEN WE LOOKED AT MORE AVERAGE CONDITIONS,

IT TURNS OUT THAT CLOSE TO 10 PERCENT HARVEST MAY BE TOO MUCH.

Hunting representatives have been involved throughout the project, an aspect Porter believes has been essential.

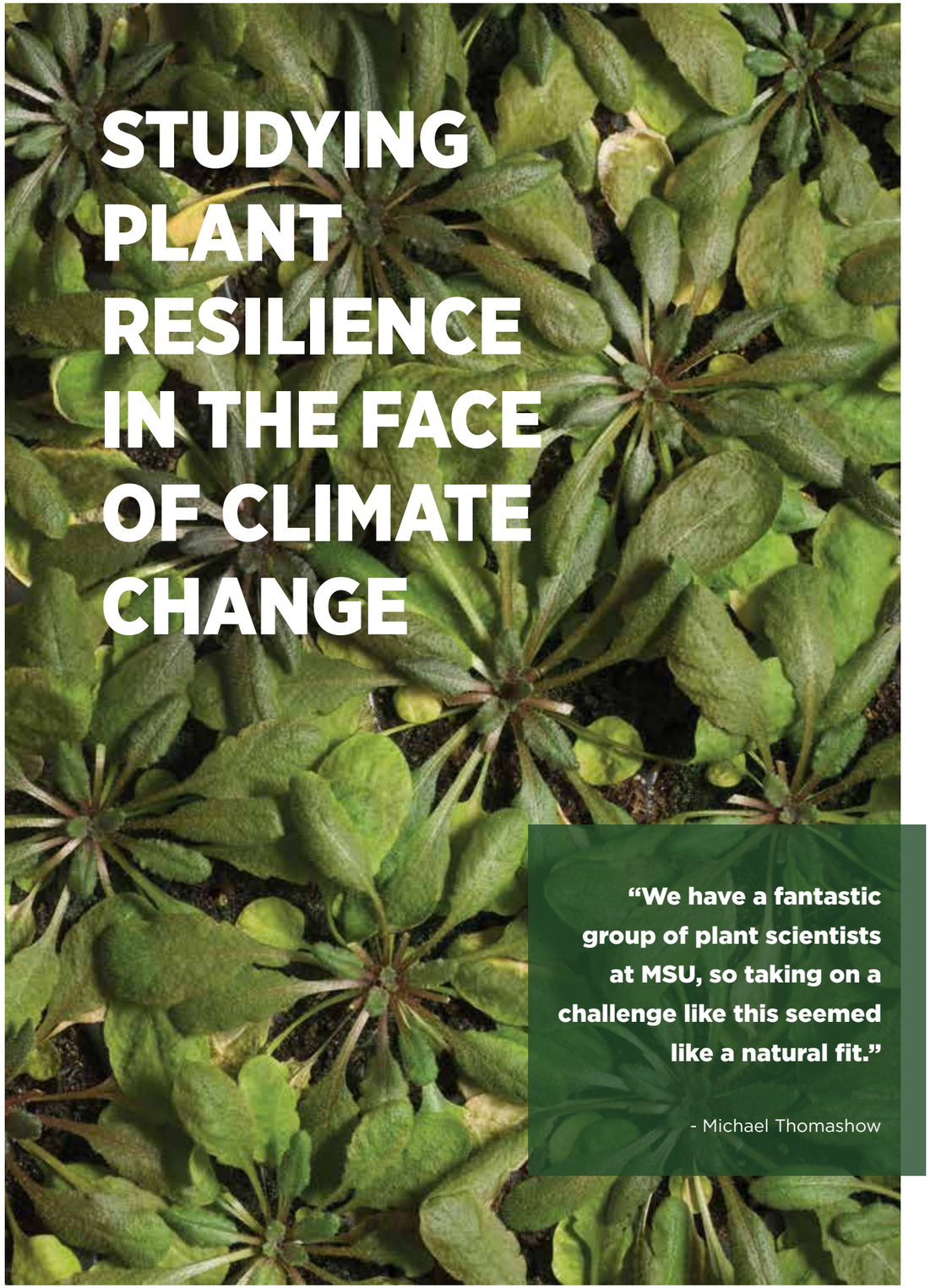
"Over the last 30 years, Michigan hunters and the MDNR have created one of the best records of information on turkey populations that exists anywhere," Porter said. "Because of that, we have a really good idea of where the population stands. We've only been able to achieve this because of a strong partnership with the hunting community."

The project began with an analysis of factors that likely drive change in turkey populations. Potential options for management were then incorporated to be assessed. As the process moved forward, researchers drew on the knowledge of wildlife managers, hunters, farmers and other stakeholders to build sophisticated statistical models that predict responses of turkey populations to potential management options. Currently, findings are being used to develop recommendations for future management programs.

Porter foresees little change in hunting regulations in the immediate future. Traditionally, regulations in Michigan have been focused on protecting populations from overharvest and ensuring a high-quality hunting experience. The research shows that Michigan has been wise to sell hunting licenses through a quota system similar to the one used for deer, as opposed to open-ended sales of licenses for small game such as rabbits. License quotas allow for careful management of the number of turkey hunters and consequently control the harvest each year.

"The system has produced some of the most abundant wild turkey populations and the highest-quality hunting anywhere in the country," Porter said. "The research identifies the pressure points that are likely to be important in the future. We'll keep monitoring the situation, and the findings from the research will allow Michigan to be prepared to deal with those pressures should they arise." ▯

STUDYING PLANT RESILIENCE IN THE FACE OF CLIMATE CHANGE



"We have a fantastic group of plant scientists at MSU, so taking on a challenge like this seemed like a natural fit."

- Michael Thomashow

BY CAMERON RUDOLPH, STAFF WRITER

IN 2015, MICHIGAN STATE UNIVERSITY (MSU) UNVEILED THE GLOBAL IMPACT INITIATIVE, A STRATEGIC PLAN TO TACKLE SOME OF THE WORLD'S MOST PRESSING CHALLENGES. THE PLAN CALLS FOR THE ADDITION OF 100 NEW FACULTY MEMBERS IN EDUCATION, ENERGY, THE ENVIRONMENT, FOOD AND HEALTH, AND ENCOURAGES CURRENT FACULTY TO SUBMIT PROPOSALS TO ENHANCE RESEARCH THAT BUILDS UPON MSU'S STRENGTHS.

Michael Thomashow, a University Distinguished Professor in the Department of Plant, Soil and Microbial Sciences, saw this as an opportunity. He solicited the assistance of fellow MSU plant science experts Gregg Howe, Brad Day and Sheng Yang He to develop a project that addresses the growing world population's need for more food produced with fewer resources under increasingly difficult conditions.

Together, they drafted a plan for the Plant Resilience Institute (PRI), where scientists will use basic research to pinpoint the biological mechanisms that stimulate plant resilience — the ability to adapt to stress caused by pressures from the climate and the environment, among others. Gaining this understanding will be crucial to increasing crop yields. The MSU Board of Trustees approved the PRI concept in April 2016.

"The challenge went out from MSU administration to propose ideas that take our research to the next level," said Thomashow, who serves as director of the PRI. "Producing the amount of food needed to feed 9 billion people by 2050 just isn't possible using only the current tools. We need to be innovative and develop some new approaches. We have a fantastic group of plant scientists at MSU, so taking on a challenge like this seemed like a natural fit."

The group has added C. Robin Buell, Thomas Sharkey, Ashley Shade and David Lowry, all faculty members from the College of Natural Science.

This past summer, the inaugural research under the PRI umbrella began. The objective of the institute is to be flexible and responsive to emerging issues facing agriculture.

Plants encounter biotic stresses such as pathogens and pests, and abiotic stresses ranging from extreme temperature to drought. Thomashow indicated that these abiotic threats are intensifying because of climate change, which is having a devastating effect on plants' built-in defenses. To combat this, the researchers have identified three areas of emphasis for the PRI's initial work:

- High temperatures have a harmful effect on plant processes, but how plants will perform in and adapt to an increasingly warmer world remains unknown.
- Plants, just like humans, are intimately associated with microorganisms that have a profound influence on their physiology. Researchers want to determine what functions the microbes serve and how they help promote plant resilience to environmental challenges.
- Legumes are essential to nutrition and healthy diets around the world. The PRI will conduct research to identify mechanisms of stress tolerance that can be used to improve legume varieties to better adapt to changing climate conditions — less water and land, and rising temperatures.

"The breadth of plant science research at MSU provides a tremendous opportunity to work collaboratively to find new solutions to meet the demands for food and other plant-based products," said Howe, the associate director of the PRI. "Much of what we think about farming is focused on what goes on above ground, but we want to really delve into what happens below ground at the

about how plant-microbe associations fend off a whole host of potential problems."

Funding for the PRI is currently provided by MSU AgBioResearch, the College of Agriculture and Natural Resources, the College of Natural Science and the Global Impact Initiative. Researchers aim to turn the initial seed support into external grants once projects have made progress.

Along with doing research, Thomashow and Howe will be hiring new faculty members over the next few years as part of the Global Impact Initiative, and providing overall administration and identifying technology needs for the PRI.

"The university has made a very significant investment into this institute," Thomashow said. "We've received funds to purchase specialized growth chambers that allow us to simulate various climate situations, as well as the latest technology in genomics. And adding new faculty members with expertise in areas that complement our current researchers will bolster our plant sciences program even further.

"We're building on a long history of excellence at MSU with the introduction of research institutes that have grown to international acclaim. We already have great agriculture and plant science programs here, and we want MSU and the Plant Resilience Institute to be a destination for scientists to come and solve some of the critical problems of our time." ▯

THE PLANT RESILIENCE INSTITUTE (PRI) FOUNDING MEMBERS *(Pictured left to right:)*

David Lowry
Assistant professor
Department of Plant Biology
College of Natural Science

Gregg Howe
MSU Foundation professor
Department of Biochemistry and Molecular Biology
College of Natural Science

Thomas Sharkey
University Distinguished Professor
Department chair of Biochemistry and Molecular Biology
College of Natural Science

Ashley Shade
Assistant professor
Department of Microbiology and Molecular Genetics
College of Natural Science

Robin Buell
MSU Foundation professor
Department of Plant Biology
College of Natural Science

Michael Thomashow
University Distinguished Professor
Department of Plant, Soil and Microbial Sciences
Department of Microbiology and Molecular Genetics
College of Agriculture and Natural Resources
College of Natural Science

Sheng Yang He
University Distinguished Professor
Department of Plant Biology
Department of Plant, Soil and Microbial Sciences
Department of Microbiology and Molecular Genetics
College of Agriculture and Natural Resources
College of Natural Science

Brad Day
Associate professor and associate department chair for research
Department of Plant, Soil and Microbial Sciences
College of Agriculture and Natural Resources

A learning year: High infestation of wheat disease gives researchers plenty to study

Storms and strong winds out of the west often herald the return of spring to Michigan and the rest of the Midwest, bringing with them warm temperatures, refreshing rains and the promise of a new growing season. This welcome end to frigid conditions, however, is not all that accompanies these westerly gales.

BY JAMES DAU, STAFF WRITER

Stripe rust on wheat

The fungal pathogen *Puccinia striiformis f. sp. tritici*, more commonly known as wheat yellow or stripe rust, is often a passenger of these wind gusts. This year, the parasitic disease reached epidemic proportions, exceeding historic levels to become the most significant yield-reducer on Michigan's 500,000 acres of wheat.

Wheat, the third largest cereal grain in Michigan, contributes more than $388 million to the state economy annually, according to the Michigan Wheat Program. This makes the threat of stripe rust a significant problem. Fortunately, Michigan State University (MSU) researchers are developing new tools and tactics that can be applied in the field to mitigate the effects of stripe rust and keep the wheat supply healthy and secure.

First described in 1777, stripe rust is one of three rust diseases that afflict wheat plants, alongside the more common leaf and stem rusts. Stripe rust, which takes its name from the highly visible rust-colored pustules it leaves in streaks on wheat leaves, is an obligate parasite, meaning it mines nutrients from its host plant. Initially taking root beneath the plant's epidermis, it destroys the chloroplasts necessary for photosynthesis, effectively starving the plant of needed energy, after which it reproduces by erupting the pustules through the epidermis and onto the surface of the leaf.

Particularly, and most destructively, stripe rust infects the flag leaf – the large leaf that provides the majority of the plant's energy and is responsible for as much as 80 percent of its final yield. Without a functional flag leaf, the plant simply cannot survive.

Dennis Pennington, wheat systems specialist with MSU Extension, has witnessed firsthand the destruction stripe rust has had on Michigan farms.

"We're seeing anywhere from 10 to 15 percent yield reductions across the state, and up to 50 percent in fields where we have very severe infections," Pennington said. "It came about a month early this year when temperatures were moderate and nights were cool, which really allowed the disease to get going. We also had a lot of acres planted with wheat varieties that were susceptible to it. It was the perfect set of conditions for the epidemic that we saw to develop."

WHEAT CONTRIBUTES MORE THAN $388 MILLION ANNUALLY

The reason stripe rust arrived as early as the first week of May remains a matter of scientific debate. Hypotheses range from a mild winter that allowed the pathogen to survive in Michigan for the entire year, to strong weather systems moving up from the south early in the year, bringing more stripe rust than usual.

Whatever the cause, the fungal pathogen is capable of dispersing and spreading to new fields rapidly.

Pennington said there are two important measures farmers can take to protect their crops. The first is diligent field monitoring and appropriately using fungicides. One reason the disease is particularly challenging is that by the time the distinctive rust-colored stripes appear in the field, the disease has already been developing for about two weeks. This makes proactive applications essential.

"If you see stripe rust in the field, you have to have already been doing something for it," Pennington said. "We have about 40 varieties of wheat that are susceptible to the disease, and if a farmer is growing one, they need to be proactive about it so they can protect the flag leaves and keep their crop growing."

A SILVER LINING

The sudden prevalence of stripe rust in the state this year also brought with it a silver lining. With so much of the pathogen present, collecting data in wheat test plots on MSU's East Lansing campus became more feasible than in previous years. MSU AgBioResearch plant pathologist Martin Chilvers, along with graduate student Mikaela Breunig, conducted experiments to determine which fungicides were most effective against the disease.

"Before this year, we wouldn't have even considered spraying for stripe rust," Chilvers said. "But this year, with how prevalent it was across so many fields, is causing us to change our mentality some. We're working on ways to allow farmers to better manage for the disease and protect their crops."

By planting multiple small wheat plots and treating each with a different fungicide application, Chilvers and his team were able to measure the impact of different products, concentrations and application times on stripe rust. Chilvers expects to have the field trial data available to the public later this fall.

The opportunity to collect further data on stripe rust in Michigan has yielded benefits for the second major tactic for combating stripe rust – choosing the right variety. Using resistant wheat varieties, farmers can reduce their fungicide costs without risking losing their crops to stripe rust.

There are currently 40 wheat varieties susceptible to stripe rust used in Michigan. MSU AgBioResearch wheat breeder Eric Olson is working with his team to bring more resistant varieties to the table.

"We don't get stripe rust like this every year, so we don't always have the opportunity to work on it like this," Olson said. "That's been the real impact this year. By having a lot of stripe rust available, it's putting a lot of selection pressure on our variety trials in the field. We're going to have a very good idea of which varieties are resistant after this."

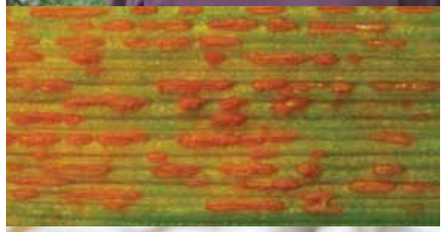
Olson's team has discovered that over half of the elite, high-yielding wheat breeding lines carry genes for stripe rust resistance, a fact that was unknown until the researchers were able to record accurate observations of plants in the field. The MSU team is currently mapping the genes associated with stripe rust resistance and transferring them into wheat varieties grown in Michigan.

Developing a new wheat variety can take up to nine years, despite the cutting-edge genomic technologies available at MSU. Olson has also taken steps to help farmers with more immediate needs. Conducting variety trials this past summer, his team discovered several varieties currently available that showed high levels of immunity to stripe rust.

"Two of the top varieties – Venus and DF105R – showed near-immunity to stripe rust," Olson said. "Not only do they have high resistance, they are very high yielding. Stripe rust is probably the most persistent problem of the three wheat rusts and can cause the most damage, so it's important that growers have the right tools to manage it."

MSU researchers approach problems such as stripe rust from a variety of angles, whether that means improved cultivars, effective chemicals, the best field practices or, more likely, a combination of them all. Their goal is to provide growers with the right tools for each of their unique farms.

"The high infection we had this year was a blessing as well as a curse," Pennington said. "While it made a lot of trouble for farmers, we were able to learn a lot more about it —how it behaves in our state and how our varieties and fungicides interact with it. Nobody could have predicted this epidemic, but if it happens again, our farmers will have better information and tools to handle it." ▯



TOP AND BOTTOM PHOTO: Up to two weeks can pass between stripe rust infecting a field and showing physical signs, making it more important than ever for farmers to take proactive steps to manage it.

2nd FROM TOP: DENNIS PENNINGTON
MSU Extension wheat systems specialist Dennis Pennington has been working with Michigan's wheat farmers throughout the epidemic, providing them with advice and tools to help protect their crops and livelihoods.

MIDDLE: Stripe rust takes its name from the rust-colored pustules it forms on wheat leaves, though the worst of the damage it does to plant takes place beneath the epidermis, where it destroys chloroplasts and deprives the plant of its means of generating energy.

2nd FROM BOTTOM: ERIC OLSON
Eric Olson leads MSU's wheat breeding program. The recent stripe rust epidemic has given his team a wealth of data from which they can breed wheat varieties with greater resistance to the disease.

BY JAMES DAU, STAFF WRITER

On the RADAR:

Hunting invasive crayfish in Michigan rivers and streams

IN THE SUMMER OF 2013, MICHIGAN ANGLERS BEGAN NOTICING SOMETHING STRANGE: CARCASSES OF LARGE CRAYFISH, BLOOD RED IN COLOR, ON THE BANKS OF LAKE MACATAWA IN WEST MICHIGAN'S OTTAWA COUNTY. THE CRUSTACEANS WERE IDENTIFIED AS RED SWAMP CRAYFISH, A PARTICULARLY AGGRESSIVE SPECIES HAILING FROM THE SOUTHEAST UNITED STATES THAT HAS STEADILY INVADED EVERY CONTINENT EXCEPT ANTARCTICA.

Their presence has left a path of local ecosystems in turmoil. Fearing Michigan might be next on the crayfish's advance, the Michigan Department of Natural Resources (MDNR) turned to the Michigan State University (MSU) Department of Fisheries and Wildlife for assistance.

Red swamp crayfish are the most widely consumed crayfish in the world, which is in part to blame for their worldwide expansion. Exported alive across oceans and international borders, some invariably escape their confines and take up residence in streams and wetlands, wherever they happen to land. This brings with them complications for the wildlife, environments and human communities that already call those places home.

Known for rapid reproduction and aggressive burrowing behavior, red swamp crayfish pose serious threats to wetlands, which they can drain; dykes and dams, which they can undermine; and native crayfish species, which they can supplant. In many cases, red swamp crayfish disrupt local food webs because, being larger than native species, they are unsuitable as a food source for predatory fish.

In 2014, when Kelley Smith began his master's degree program at MSU, crayfish were not on his professional radar. That changed when MDNR put out a call for proposals from researchers to execute a statewide survey of Michigan's rivers and streams in search of evidence of the red swamp crayfish. The southern Ohio native had just completed two and a half years as a contractor for the U.S. Geological Survey's fisheries division when Michael Jones — Peter A. Larkin professor of quantitative fisheries in the MSU Department of Fisheries and Wildlife and MSU AgBioResearch assistant director of natural resources programs — approached him about a crayfish research project.

"Growing up, I was always mucking around in creeks and catching crayfish, so I was already aware of them and the issues they pose," Smith recalled. "Professionally, fieldwork and survey design are my strongest suits, which all came together to make this project really appealing to me."

Once Smith began his work, he was joined by Brian Roth, MSU AgBioResearch ecologist and invasive species expert.

"We knew from talking with other crayfish researchers that they had already made a foothold in Ohio, in the Sandusky Bay area on Lake Erie," Roth said. "That's close enough for concern, so we knew we had to develop a better grasp of the crayfish situation here in Michigan."

Jones stayed on the project as well. As the co-director of the Quantitative Fisheries Center, he is familiar with statistical models and the uncertainty that comes with estimating wildlife populations across large expanses of terrain.

The last statewide survey of crayfish in Michigan was conducted in the 1930s, with the most recent data coming from a partial survey

"Growing up, I was always mucking around in creeks and catching crayfish, so I was already aware of them and the issues they pose."

- Kelley Smith (right)

Professor Brian Roth capturing crayfish.

conducted in 1975. The last 40 years had seen numerous shifts in Michigan's environmental and ecological makeup, however, and that data was simply no longer sufficient for the task at hand.

In order to find statistically valid evidence of red swamp crayfish in Michigan, assess the risks they pose and craft an accurate picture of the state of all crayfish populations throughout the state, the team decided to conduct their own statewide survey. The task would take two years, but the results would inform Michigan's natural resources policy for much longer.

WALK SOFTLY AND CARRY A BIG NET

"All it takes is a five-gallon bucket, a pair of waders and a net on a long pole," Roth explained how the team collected data on crayfish. "Kelley and his field technicians waded the streams, overturning rocks on the bottom and scooping with the nets to see what they could find."

This method, called dip netting, was adopted because it could be implemented across the diversity of Michigan river and stream systems, allowing for consistent results. Many streams in the state, for example, feature coarse substrates like boulders or stone cobbles that would render other techniques unusable.

MDNR HAS PLACED NEW RESTRICTIONS ON IMPORTING ANY **NON-NATIVE LIVE CRAYFISH, INCLUDING RED SWAMP CRAYFISH**

While data collection may have been simple, selecting the streams for sampling was not. Using the MDNR stream database, the agency's collection of information on every river and stream in the state, the team randomly selected streams, and segments of those streams, in every region of Michigan. This gave a statistically valid estimation of crayfish populations throughout the state without having to tackle the task of surveying each and every stream. In the first year, the project only had funding to survey the Lower Peninsula, but the MDNR was so satisfied that they extended it for a second year in order to cover the Upper Peninsula as well.

Gauging wild populations of crayfish was only one aspect of their work, however. In order to fully assess the risk of invasion Michigan faced, the team had to look for other ways crayfish could arrive. One of the team's hypotheses regarding the origin of the first red swamp crayfish carcasses found by anglers was they had been purchased for live bait and escaped. As this is similar to how the crayfish had first become established in other regions, they decided it was worth investigating. At the time, it was legal under Michigan law and MDNR policy to import live red swamp crayfish for personal consumption, and there was concern they were also being brought in for other purposes, not only for bait, but as pets or classroom science projects.

Smith and his team identified and visited numerous bait shops, pet stores and seafood markets to assess the potential for red swamp crayfish to enter the state. They also surveyed 157 public school science teachers regarding use and disposal of live crayfish.

GOOD NEWS AND BAD NEWS

After two years and surveying hundreds of stream sections in the Upper and Lower Peninsulas, Smith's team did not find any live red swamp crayfish in the wild, nor did they find that stores or classrooms presented a particularly serious invasion gateway.

"In general, we didn't find that there was one pathway that was by far the most likely through which an invasion could occur," Jones said. "Instead, we found that we have to pay attention to all of them."

In response, MDNR has placed new restrictions on importing any non-native live crayfish, including red swamp crayfish, in order to limit potential invasion.

"Red swamp crayfish are still a concern, because the Ohio population is still located very close to Michigan, but we were relieved to find out they weren't already here," Roth said. "Your best opportunity to control any invasive species is very early, before they get firmly established, and we know now that we have that chance to take preventive action."

The team did uncover a more comprehensive picture of the crayfish population in Michigan than had been available since the first statewide survey 80 years ago. Having such a complete data set will allow MDNR officials to make sound, science-based, natural resources management decisions that will impact anyone who relies on Michigan's ecosystems, from recreational anglers to commercial fishermen to anyone buying local seafood at the store.

The lack of red swamp crayfish was certainly welcome, but not all of the insights derived from the project were so optimistic. Smith discovered that another invasive species, the rusty crayfish, has spread significantly in the last 40 years.

"They've gone from being in just a few counties to spreading across the entire Lower Peninsula and into the Upper Peninsula," Jones said. "From our findings, we can say that rusty crayfish are present in about 60 percent of our watersheds. Of equal importance is what that means for our native species."

While not all of the data has been processed, Smith said he learned from similar research conducted in Wisconsin that rusty crayfish frequently outcompete native species, such as northern crayfish and northern clearwater crayfish, pushing them into less desirable habitats where they are exposed to greater fish predation. By cutting vegetation with their pincers, they have also threatened important fish populations like bluegill and bass, whose young rely on vegetation for shelter.

In addition to finding the extent of rusty crayfish expansion, the team was able to describe the most desirable habitat conditions. In streams with beds of rock or stone cobble, for example, rusty crayfish spread rapidly and displace nearly all native species. In streams with more malleable beds of mud or sand, however, native species have proven resilient despite their new neighbors.

THE IMPORTANCE OF CRAYFISH

Crayfish, though ubiquitous, have not historically received the same level of research interest or funding as other common aquatic organisms. Smith, Roth, Jones and their team hope the findings will help people recognize the importance of crayfish to the state's ecology and perhaps drum up more research funding.

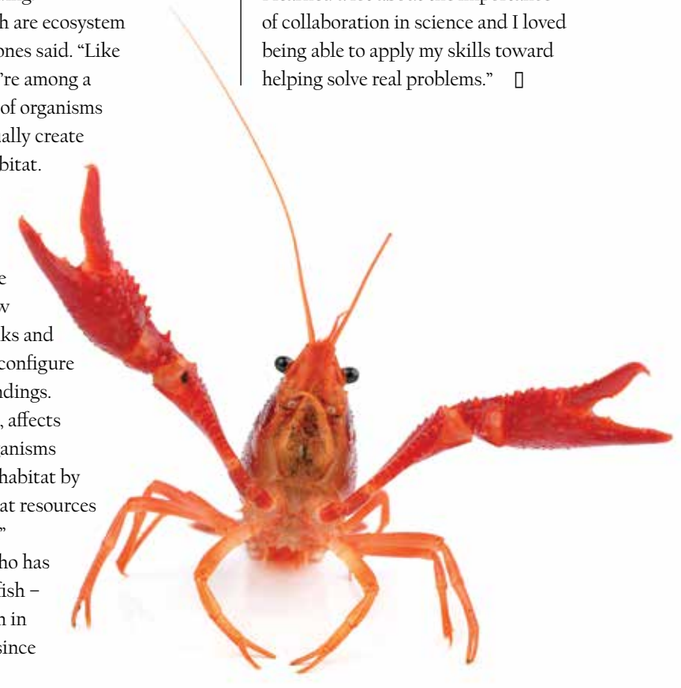
"Crayfish are ecosystem engineers," Jones said. "Like beavers, they're among a small subset of organisms that can actually create their own habitat. They can cut vegetation with their pincers, move rocks, burrow into riverbanks and otherwise reconfigure their surroundings. That, in turn, affects the other organisms sharing that habitat by changing what resources are available."

Roth, who has studied crayfish – rusty crayfish in particular – since his doctoral work at the University of Wisconsin, is already seeing growing interest in the freshwater crustacean.

"If you look around the state and talk to natural resource managers and conservation officers, they know crayfish are important parts of the ecosystem," Roth said. "The thought of non-native species coming into Michigan is concerning to a lot of people, and our study highlights the changes that have already taken place in the last decades. There needs to be repeat monitoring and studies on how they impact food webs, and we hope this work serves as a springboard for that."

For Smith, the project was more than an important step in improving natural resources management.

"I basically got funding to camp for three summers and see a lot of backcountry streams that a lot of people just don't get to," Smith said. "Crayfish are a keystone species, and having healthy populations – meaning not too many and not too few – benefits every part of the ecosystem. I learned a lot about the importance of collaboration in science and I loved being able to apply my skills toward helping solve real problems." ▯



BY HOLLY WHETSTONE, EDITOR

The pasture isn't always greener on the other side: Or is it?

MSU center helps to lead way in developing new regenerative grasslands certification

Since being established in 1928, the Michigan State University (MSU) Lake City Research Center (LCRC) has been a leader in studying forage and beef production systems and potato breeding and genetics. Now, with many research milestones under its belt, the center is venturing where no other university has gone before.

LCRC is the first accredited Savory Institute hub to be affiliated with a university. The Savory Institute, which currently has 30 global hubs and plans to expand to 100 by 2025, was co-founded by Allan Savory in 2003. Savory founded the non-governmental organization in an effort to encourage a comprehensive systems approach in agriculture to manage resources, particularly grassland degradation. The approach has become known as holistic management.

Savory's method takes into consideration not one, but several factors impacting ecosystem health and is said to mimic nature's way of regenerating overgrazed land, increasing its biodiversity, improving water retention and soil health, and sequestering carbon. The hubs provide holistic management training and implementation support for farmers, ranchers and land managers. The specific charge of the new Savory hub in Lake City, the first of its kind to be associated with a university, is to examine soil health and carbon sequestration in pasturelands.

In June a working group with members from the United States and as far away as China, Australia and Europe convened for a week at the MSU research facility in Lake City. Their mission was to develop the metrics to use in ranking regenerative grasslands and determine a set standard for a beef marketing label to be announced this fall. The group was led by Pablo Borelli, who directs a Savory Institute hub in Argentina.

"Grasslands are Savory's wheelhouse," Borelli said. "A big portion of what we do is on ecosystem processes, degrading grasslands. For example, in California we've seen that damage from drought and lack of water can be restored with proper grazing techniques – those mimicking the natural grazing of bison and elk herds that roamed the land."

Meeting participants sniffed the soil, counted cow pies and inspected grasslands for insects, among many activities, all in an effort to create a list of outcome-based criteria for rating grasslands.

"The purpose of this meeting was to develop and agree on a set of global standards across the Savory Hub structure to monitor carbon in a land-to-market approach," said Doug Carmichael, farm manager of the LCRC. "Effectively they want to develop a food label that states the food you are buying is coming from a farm that is restoring the existing land's tilth."

Jason Rowntree, MSU cattle researcher and faculty coordinator at LCRC, said that holistic management, a decision-making framework for land improvement and profitability, is at the heart of the Savory program. Holistic management takes a 10,000-foot view of a subject, according to Rowntree, while most research is focused on one specific topic.

"When we do research, we tend to reduce agriculture into different disciplines [from] which we get good data, no doubt about that," said Rowntree. "But at the same time we don't tend to look at it as a functioning system. If we take one aspect out of a functioning system to do research, that whole system has changed because [only] that one part was looked at."

Rowntree said he is pleased that the leaders of the MSU College of Agriculture and Natural Resources are forward thinking in allowing for innovative approaches such as this project. He said another goal of the summer 2016 meeting was to train the trainers, who will become third-party verifiers, on how to rate grasslands. In late 2016, the Savory Institute expects to announce a beef marketing label related to the holistic management practices they advocate.

"In the process, we are hoping to create one of the largest global databases for monitoring ecosystem services, with MSU serving as the data analysis arm," said Rowntree.

MSU is playing a key role in supplying the scientific rigor to a grasslands monitoring process that is easy for farmers and ranchers to understand and consider adopting, Rowntree continued. Once the monitoring system is launched, producers will be able to enroll their farms with the hub and work to become certified as regenerative grasslands operators. ▯

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Facility Focus: Northwest Michigan Horticultural Research Center

Founded in 1979, the Northwest Michigan Horticultural Research Center (NWMHRC) is located on 100 acres of Michigan's picturesque Leelanau Peninsula and in the midst of the five counties that produce 83 percent of the tart cherries in Michigan. Though the smallest of the four Michigan State University (MSU) AgBioResearch fruit research facilities, it fulfills a crucial research niche in support of Michigan's fruit industry and, more specifically, tart cherries.

Michigan is the No. 1 producer of tart cherries in the country, providing approximately 75 percent of the annual national supply. As the sole tart cherry research center in the country, 65 percent of the NWMHRC research is focused on this fruit, while the rest of the projects support other important Michigan crops, such as sweet cherries, apples, plums and hops. Its scientists have made vital contributions in the areas of integrated pest management, horticultural production, value-added processing, fruit marketing and farm financial management.

NWMHRC embodies the close, collaborative relationship between MSU AgBioResearch, MSU Extension and Michigan's agricultural industries. Privately owned by the Northwest Michigan Horticultural Research Foundation —the only MSU AgBioResearch center to hold this distinction —NWMHRC is leased to MSU for $1 per year.

"Because the center is privately owned, we can focus on the research that matters most to the industry," said Nikki Rothwell, NWMHRC coordinator. "We've developed a great relationship over the years with industry groups, and we're fortunate to have their support."

For more information: agbioresearch.msu.edu/centers/nwmihort.