



futures

MICHIGAN
AGRICULTURAL
EXPERIMENT
STATION

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**MAES Research:
Outstanding in
the Field**



Outstanding in the Field

No matter their official names — experiment stations, research farms and complexes, or experimental forests — all are part of a network of campus laboratories and off-campus field research facilities that make up the Michigan Agricultural Experiment Station at Michigan State University. The 14 outlying field stations plus the on-campus research farms focus on the research needs of the agricultural and natural resources industries and rural communities in their particular locations. Projects range from work on forestry and cellulosic ethanol in the Upper Peninsula to cherries in Traverse City, and from wine and juice grapes on the west side of the state to dry beans and sugar beets in the Thumb. One of the facilities, the Kellogg Biological Station in Hickory Corners, conducts extensive research on sustainability and other environmental issues and includes a bird sanctuary, a farm, a dairy and biological laboratories.

In this issue of *Futures*, you can read about some of the research taking place at the 14 outlying MAES field research stations around the state — the amount of research being conducted makes it impossible to cover everything in just one magazine. All this research is aimed at providing growers and commodity groups with the critical information they need to stay competitive and productive, and to help them keep pace with a constantly changing social and economic environment. Research that is done locally is key in agricultural research.

“Michigan’s climate, soil profile and growing season vary dramatically from north to south and east to west, so, for example, recommendations for growing alfalfa in the Upper Peninsula are different from those for growing it in the southern counties of the Lower Peninsula,” says MAES Director Steve Pueppke. “The west side of the state is home to a thriving horticulture and specialty crop industry, and conditions in the Saginaw Valley are ideal for dry beans and sugar beets. The research coming from these stations is a big reason why Michigan’s agri-food industry remains so competitive and viable.”

Established in the 1880s to bring scientific rigor to agriculture, the MAES network of research stations has remained true to the broader mission of supporting Michigan agriculture while creating the research base to address new programs and initiatives to help strengthen Michigan’s economy and enhance the quality of life of people in Michigan, the nation and the world. In addition to agricultural production research, MAES scientists are investigating topics that range from alternative energy and biofuel production to childhood obesity, community development, environmental

stewardship, food safety and the quality of life of Michigan youth and families.

All of the stations are closely aligned with MSU Extension; some of the facilities are home to both MAES researchers and MSU Extension educators.

“Collectively, the MAES and MSU Extension represent programs that serve hundreds of thousands of Michigan residents with a \$1.062 billion impact on the state,” says MSU Extension Director Tom Coon. “Every dollar that the state invests in these two organizations leverages an additional \$2.33 in federal funds and external contracts, grants and other revenues to serve the state’s residents. In short, we are one of the best resources the state can invest in, especially during these trying times.”

The field stations allow MSU graduate and undergraduate students to have hands-on research experience outside the lab, working under the same conditions experienced by the people who are going to use the results.

“Working with insects in the lab is one thing, but I think you really have to see the ebb and flow of insect cycles to fully understand the research,” said John Wise, research coordinator at the Trevor Nichols Research Complex. Research at Trevor Nichols is aimed squarely at achieving one goal: developing effective ways to control the insects and diseases that attack fruit and then getting the most current and critical information out to growers through a variety of methods. “We use infrared night vision goggles to monitor and count how many insects come out at night and at dawn and dusk. You have to be there to do that type of research. You can’t do it in a lab on campus.”

We hope you enjoy this issue of *Futures* on projects being conducted at the field research stations and that it helps you understand a little more about the Michigan Agricultural Experiment Station and the research it funds. If you have comments about this issue or would like to subscribe (it’s free!), send a note to *Futures* Editor, 109 Agriculture Hall, Michigan State University, East Lansing, MI 48824-1039, or send an e-mail to depolo@msu.edu. You also can call 517-355-0123.

For the latest information about MAES research and events, I invite you to subscribe to the free MAES e-mail newsletter. Sign up by visiting the MAES Web site at www.maes.msu.edu/news.htm. You also can view this and past issues of *Futures* on the Web site by clicking on the “research publications” link.

∴ Jamie DePolo

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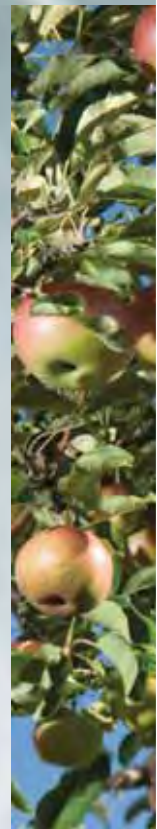


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The Michigan Agricultural Experiment Station:

Outstanding in its Field(s)



Agricultural experiment stations were established to help the United States become the most effective and efficient producer of food and fiber in the world.

World-class faculty members and state-of-the-art research operations across the state make the Michigan Agricultural Experiment Station one of the best in the country.



For many, the words “agricultural experiment station” conjure images of semi-remote rural test plots of wheat, corn and soybeans and pasture lands spotted with grazing, ear-tagged livestock.

Indeed, when legislation was passed in 1887 to establish a nationwide network of agricultural experiment stations (*see page 9*) through the U.S. land-grant college system, its main goal was to provide federal aid to support the research and educational outreach activities necessary to improve American agriculture and the life of the farmer.

“The notion behind establishing agricultural experiment stations was that there needed to be a state-federal partnership to bring science to agriculture,” said Steve Pueppke, MAES director. “If you look back at the 19th century, many U.S. farmers were in great debt, and there was simply no capacity or coordination anywhere in the country to answer very practical questions related to agricultural production. It was also recognized that farming was a really tough, back-breaking life, and that many farmers were isolated from other farmers and from discoveries and innovations that might help them.”

Rooting for the Home Team

The MAES was created on February 26, 1888. It consisted of an on-campus laboratory, a few rented or donated off-campus properties for field experiments and a handful of scientists. Early research efforts contributed to the development of hybrid corn, which doubled the yield of corn plantings; the development of the Red Haven peach, one of the most widely grown varieties in the world; the establishment of the sugar beet industry in Michigan; the creation of a botanical garden with more than 5,000 species and varieties of plantings; and a program to help eradicate bovine tuberculosis in the United States.

“More than 120 years later, the MAES remains true to its broader mission in support of Michigan agriculture while creating the research base to address new programs and initiatives that will drive Michigan into a prosperous future,” Pueppke said.

In on-campus research facilities and at 14 field stations across the state (*see page 7*), 324 MAES researchers from six colleges at Michigan State University — Agriculture and Natural Resources,

2009 FIELD DAYS AND OTHER SPECIAL EVENTS

- **JULY 21-23**
Ag Expo
Ag Expo Field, MSU Main Campus
- **July 25**
Forage Demonstration Day
Lake City Experiment Station
- **July 27-31**
Turfgrass Producers International Summer Convention and Field Days
Kellogg Center, MSU Campus
- **July 29**
20th Annual MSU Viticulture Day
Southwest Michigan Research and Extension Center
- **August 7**
MSU Garden Day
Wharton Center, MSU Campus
- **August 19**
Pasture Based Dairy Facility Open House
Kellogg Biological Station
- **August 19**
Turfgrass Field Day
Hancock Turfgrass Research Center, MSU Campus
- **August 20**
2009 Northwest Michigan Horticultural Research Station Open House
Northwest Michigan Horticultural Research Station
- **August 20**
Potato and Dry Bean Field Day
Montcalm Research Farm
- **August 20**
MSU Student Organic Farm Tour
MSU Campus
- **August 24-26**
Sustainable Biofuels and Food Production Tours
Kellogg Biological Station
- **August 25**
2009 Field Day
Saginaw Valley Research and Extension Center
- **September 20**
MSU Student Organic Farm Tour
MSU Campus
- **September 22**
Field Day
Trevor Nichols Research Complex
- **October 4**
Share the Harvest
Kellogg Biological Station
- **October 12**
MSU Student Organic Farm Tour
MSU Campus

Communication Arts and Sciences, Engineering, Natural Science, Social Science and Veterinary Medicine — provide answers to questions that are important to Michigan citizens.

In addition to agricultural production research, MAES scientists are investigating topics that range from alternative energy and bio-fuel production to childhood obesity, community development, environmental stewardship, food safety and the quality of life of Michigan youth and families.

Research projects are funded through a mixture of state, federal and private funds. In Michigan, state contributions represent more than 80 percent of the total MAES base budget. Michigan commodity organizations contribute research funds to improve production, processing and marketing of their respective products. Foundations and industries contribute funds toward basic and applied research.

Strengthening the MAES Lineup: MSU Extension

Complementing the national agricultural experiment station system is another key land-grant university player, Extension, which was created in 1914 by the Smith-Lever Act.

“Colleges and universities had the reputation of being remote, difficult to access and off-limits to people with common needs, so



The agrifood industry is one of the few bright spots in Michigan's struggling economy. MAES Director Steve Pueppke (left) and MSUE Director Tom Coon oversee programs that serve hundreds of thousands of state residents with a \$1 billion-plus impact on Michigan. MAES researchers and Extension educators are working to foster a globally competitive agricultural system.

the establishment of experiment stations set the stage for understanding a need to take the university enterprise and make it more present and relevant in community settings,” said Tom Coon, MSU Extension director. “That began the legacy that eventually included Extension as a way of ensuring that there’s a physical presence of the university in every county in the state.”

Today, MSU Extension educators, in concert with on-campus faculty members and MAES field stations, serve every Michigan county with programming focused on agriculture and natural resources; children, youth and families; and community and economic development.

A WINNING LINEUP: THE MAES FIELD RESEARCH NETWORK

The Michigan Agricultural Experiment Station is not just one building or location where experiments and laboratory work takes place. In addition to the main office and research facilities located on the MSU campus, the MAES system also includes 14 field research stations located across the state. These locations are geographically situated so that researchers can focus on the needs of a particular location.

1. Clarksville Horticultural Experiment Station

(established 1974)

9302 Portland Road
Clarksville, MI 48815
616-693-2193

Research focus: small fruits and tree fruits
www.maes.msu.edu/clarksville/index.htm

2. Dunbar Forest Experiment Station

(established 1925)

12839 S. Scenic Drive
Rt. 1, Box 179
Sault Ste. Marie, MI 49783
906-632-3932

Research focus: forestry
www.maes.msu.edu/dunbar/index.htm

3. W.K. Kellogg Biological Station

(established 1928)

37000 E. Gull Lake Drive
Hickory Corners, MI 49060
269-671-5117

Research focus: agronomy, dairy management, integrated pest management, aquatic biology, water quality, waterfowl management and natural area management
www.kbs.msu.edu

4. W.K. Kellogg Experimental Forest

(established 1932)

7060 N. 42nd Street
Augusta, MI 49012
269-731-4597

Research focus: forestry
www.maes.msu.edu/ressta/kelloggforest/index.htm

5. Lake City Experiment Station

(established 1928)

5401 W. Jennings Road
Lake City, MI 49651
231-839-4608

Research focus: beef cattle and forage management
www.maes.msu.edu/lakecity/index.htm

6. Montcalm Research Farm

(established 1966)

4747 McBride Road
Lakeview, MI 48850
989-365-3473

Research focus: potato production
www.maes.msu.edu/montcalm/index.htm

7. Muck Soils Research Farm

(established 1941)

Rt. 3, 9370 E. Herbison Road
Laingsburg, MI 48848
517-641-4062

Research focus: vegetable production in organic soils
www.maes.msu.edu/mucksoil/index.htm



8. Northwest Michigan Horticultural Research Station

(established 1979)

6686 S. Center Highway
Traverse City, MI 49684
231-946-1510

Research focus: tree fruit, especially cherries
www.maes.msu.edu/nwmihort/index.htm

9. Fred Russ Forest Experiment Station

(established 1942)

2673 Marcellus Highway
Decatur, MI 49045
269-782-5652

Research focus: forestry
www.maes.msu.edu/fredruss/index.htm

10. Saginaw Valley Research and Extension Center

(established 1971)

9923½ Krueger Road
Frankenmuth, MI 48734
Phone: 989-781-1160

Research focus: dry beans, sugar beets and related crops
www.maes.msu.edu/ressta/saginawvalley/index.htm

11. Southwest Michigan Research and Extension Center

(established 1987)

1791 Hillandale Road
Benton Harbor, MI 49022
269-944-1477

Research focus: vegetables, fruit, ornamentals and field crops
www.maes.msu.edu/swmrec/index.htm

12. Trevor Nichols Research Complex

(established 1967)

6237 124th Avenue
Fennville, MI 49408
269-561-5314

Research focus: tree fruit pests
www.maes.msu.edu/tnrc/index.html

13. Upper Peninsula Experiment Station

(established 1899)

P.O. Box 168, E3774 University Drive
Chatham, MI 48916
906-439-5114

Research focus: dairy management, forage crops
www.maes.msu.edu/upes/index.htm

14. Upper Peninsula Tree Improvement Center

(established 1986)

6005 J Road
Escanaba, MI 49829
906-786-1575

Research focus: forestry and forest biomass production
www.maes.msu.edu/uptic/index.htm

15. East Lansing Field Research Facilities, MSU

(established 1888)

246 Spartan Way
East Lansing, MI 48824
517-355-3272

Research focus: forestry entomology, botany and plant pathology, animal science, crop and soil sciences, and horticulture

“Collectively, the MAES and MSU Extension represent programs that serve hundreds of thousands of Michigan residents with a \$1.062 billion impact on the state,” Coon said. “Every dollar that the state invests in these two organizations leverages an additional \$2.33 in federal funds and external contracts, grants and other revenues to serve the state’s residents. In short, we are one of the best resources the state can invest in, especially during these trying times.”

Competing in the Big Leagues

These are indeed tough economic times for the country and for Michigan. Rising unemployment rates, home foreclosures and a troubled auto industry continue to challenge the state’s economic sustainability.

One of the few bright spots in the state’s struggling economy is the agrifood industry, which experienced a 12 percent growth in 2007.

“Agriculture is a stabilizing influence on the state’s economy,” Pueppke said. “At \$71 billion in total economic impact, it accounts for almost 20 percent of the state’s overall economic engine and employs one-quarter of the state’s work force.”

Agriculture is Michigan’s second largest industry. With its 10.1 million acres of farmland, Michigan produces more than 200 commodities on a commercial basis and is second only to California in agricultural diversity.

“MAES researchers and Extension educators from a range of disciplines are working to foster a globally competitive agricultural production system and are providing the research underpinnings for many of the state’s agricultural success stories,” Pueppke said. “In many ways, the MAES is the research and development arm for Michigan’s agricultural sector.”

One of the unique and perhaps most important features of the MAES is its field stations. Stations are centrally managed by the MSU Land Management Office (LMO) (*see page 10*) and located across the state where they can best serve the needs of Michigan’s diverse agriculture.

“Although the MAES on-campus laboratories generate important, leading-edge research, its outlying field stations have the added advantage of focusing research and outreach activities on the agricultural and natural resources needs of particular parts of the state,” said Chuck Reid, LMO director. “This specificity is invaluable to growers, commodity groups and the retail agriculture industry and helps inform MAES research priorities.”

“Michigan’s climate, soil profile and growing season vary dramatically from north to south and east to west, so, for example, recommendations for growing alfalfa in the Upper Peninsula are different from those for growing it in the southern counties of the Lower Peninsula,” Pueppke said. “The west side of the state is home to a thriving horticulture and specialty crop industry, and conditions in the Saginaw Valley are ideal for dry beans and sugar beets. The research coming from these stations is a big reason why Michigan’s agrifood industry remains so competitive and viable.”

The MAES field stations are also unique within the national agricultural experiment station system, Coon said.

“For example, if someone wants to do work on fruit trees, they come to the MAES Northwest Michigan Horticultural Research Station, a premier research facility for horticultural production and



MAES Associate Director John Baker, a veterinarian and professor of large animal clinical sciences, helps oversee much of the field station research that focuses on livestock.

fruits such as wine grapes, plums, peaches, apricots, pears and cherries,” he explained. “We’ve had scientists from other universities take a sabbatical and base their operations out of one of our stations because of their unique assets. You’re not going to find the kinds of stations we have here in Michigan in Iowa or Illinois; their stations are pretty much dedicated to corn, beans, cattle and hogs. In short, we have some exceptional resources, and we’re recognized for that.”

If You Build It...

Field station research and Extension programs also help drive Michigan’s 21st century economy by supporting alternative energy and biofuels research and investigating food safety and security issues. Urban issues such as rehabilitation of brownfield sites, public health programs, entrepreneurial consulting and nutrition issues are also key.

“The MAES has one goal — to make Michigan’s economy as viable, environmentally sound and sustainable as possible,” Pueppke said. “The leading-edge, Michigan-oriented research coming out of our field stations and on-campus research facilities will keep us competitive and leverage the additional expertise and resources necessary to achieve this objective.”

Recent examples of this leveraging power include landing a large share of the U.S. Department of Energy’s \$135 million, five-year funding for the Great Lakes Bioenergy Research Center and the award of a four-year, \$5.4 million grant to improve the quality, yield, drought tolerance and disease resistance of potatoes and tomatoes, two of the world’s most important crops and significant contributors to Michigan’s agricultural economy.

“All this research is aimed at providing growers and commodity groups with the critical information they need to stay at the top of

PLAYING IN THE NATIONAL LEAGUE: MANAGING THE FIELD STATION SYSTEM

In 1862, legislation establishing the U.S. Department of Agriculture and a national land-grant college system began the legacy of a unique state-federal partnership to provide a system of agricultural research organization, administration and development essential to the advancement of the nation's agricultural industry.

As agricultural production became an increasingly significant contributor to America's economy, the research mission of the land-grant university system was strengthened in 1887 with the creation of a national network of agricultural experiment stations. That same year, the Association of American Agricultural Colleges and Experiment Stations was created to help support and facilitate this new college-station relationship.

"Having a state and federal appropriation arrangement gave agricultural experiment station directors an internally managed budget to get things done," said MAES director Steve Pueppke. "This allowed for a tremendous degree of coordination because you had the financial resources to determine what needed to be done; it was just a matter of hiring the right people and putting the projects in place."

As research matured and stations expanded to include more scientists and outlying field stations, a variety of mechanisms were put in place to help coordinate the collective efforts of the national system. In 1888, the U.S. Department of Agriculture created the Office of Experiment Stations (OES) to serve as the center of the exchange of information between the stations and to assist in formulating research policy for the nation's agricultural experiment station system. To help improve administrative procedures related to the system, the Experiment Stations Committee on Organization and Policy (ESCOP) was created within the OES in 1905 to bring station directors together to handle continuing business, organization and policy issues on behalf of the state agricultural experiment stations.

"Together, ESCOP and the Office of Experiment Stations formulated and implemented a plan to improve the quality

of scientific research in experiment stations, particularly related to scientific investigations whose solutions would have broad applicability to agriculture nationally," said Pueppke, who is serving as the 2008-2009 ESCOP chair. "For Michigan, our state investment in the MAES allows the federal government to invest a portion of money — about \$6 million annually — that buys us into a system where we share information and coordinate things across state lines."

To broaden the applicability of the research generated from these stations, legislation was passed in 1946 to dedicate funds for regional research, with an emphasis on multistate projects. As a result, four regional associations of agricultural experiment station directors were formally established over the next two years: the North East Regional Association, the North Central Regional Association, the Southern Association and the Western Association.

Regional affiliations are based on common geography and problems. The MAES belongs to the North Central Regional Association (NCRA), which consists of agricultural experiment stations in 12 states: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota and Wisconsin.

"The North Central Region conducts about 40 percent of the nation's multistate research, so we're far and away the biggest regional association," said Arlen Leholm, NCRA executive director, ESCOP executive chair and former MSU Extension director. "Our purpose is to coordinate research efforts so that we're more effective in reducing duplication and tapping the capacity of the region."

The opportunity to work together regionally has a number of benefits, Leholm pointed out.

"A recent example is the North Central 506 Project, a rapid response initiative directed at issues that need immediate research/outreach attention as the bioeconomy continues to expand," he said. "The NCRA pulled resources from all 12

states to look at biorefining systems for corn ethanol in the North Central Region. Everyone benefitted because we had scientists from all of the universities involved. Projects like this really leverage sharing and resources and tap the talent of many institutions. Another benefit is that this project will serve as a foundation for a whole series of other projects."

Collaboration at the regional and national levels produces joint projects that also will generate more dollars to do mission-oriented research that is good for the private sector and also for the public sector through the universities, Pueppke added.

"For example, NCRA is currently working with private sector participants on a bioenergy solutions initiative to help develop a framework for collaboration using best practices related to ethanol production," he said. "The intent is to make it easier for the private sector to tap into the land-grant institutions in these states and to learn from past experiences so we don't have to start from scratch each time. We've worked very hard on this the past couple of years."

Today, the agricultural experiment station network and all of its related entities are part of an umbrella organization known as the Association of Public and Land-Grant Universities (formerly the National Association of State Universities and Land-Grant Colleges), which encompasses 186 public research universities — including 74 land-grant institutions — 3.5 million undergraduate students, 1.1 million graduate students, 645,000 faculty and professional staff members, and nearly \$30 billion in annual research dollars.

"It's an interesting model, and I don't know that it's been replicated, especially in terms of a state-federal partnership," Pueppke said. "It has a huge number of mechanisms at all levels to keep people talking with one another, communicating and coordinating. This is extremely important because it will require all of us working together to come up with new approaches and fresh thinking if we are to be successful in securing a sustainable future locally, regionally and nationally."

∴ Val Osowski

their game and help them keep pace with a constantly changing playing field,” Pueppke said.

“The MAES field stations play an integral role in helping farmers work through production problems,” said Ben Kudwa, executive director of the Michigan Potato Industry Commission. “Agricultural production is dynamic and complex. Social issues, new pests, pests developing resistance to common methods of control, new crops and crop varieties, and better and more efficient production techniques are all areas where field stations help provide comprehensive, science-based solutions to industry challenges.”

“Agricultural experiment stations are key to us,” added Phil Korson, president of the Cherry Marketing Institute, a national research and promotion group that represents U.S. cherry growers, and executive director of the Michigan Cherry Committee and the Michigan Association of Cherry Producers. “It’s where the rubber meets the road; it’s where we test new science before we move it to the farm. These stations are integral to keeping our industry sustainable in the future and competitive in the global economy.”

Playing to Win

“Today’s problems are very complex,” Coon said. “Solutions require the expertise of numerous disciplines and the collaboration of many partners. Operating synergistically with the MAES and other MSU units, MSU Extension will continue to extend the university’s knowledge resources to all Michigan citizens and assist them in meeting their learning needs through a variety of educational strategies, technologies and collaborative arrangements.”

Pueppke agrees.

“The continued success of the MAES will depend on the innovative research and fresh thinking that comes from our field stations and from maintaining close partnerships and collaborations with MSU Extension, federal and state agencies, commodity groups and other key stakeholders,” Pueppke said. “The MAES is the one research entity working today that can bring all these players and resources together to deliver a winning game plan that will help transform Michigan’s economy.”

∴ Val Osowski

COVERING ALL THE BASES: CENTRALIZED MANAGEMENT KEY TO MAES FIELD STATION SUCCESS

Just as behind every successful ball club there’s a good general manager, the ability of the MAES to maintain a winning operation with its on-campus facilities and 14-outlying-station roster relies on the management expertise of the MSU Land Management Office (LMO).

The concept of a land management office at MSU was developed in the late 1970s by then-vice president for operations and public affairs Jack Breslin and MAES associate director Jacob Hoefer. Its purpose was to centralize the maintenance and operations of off-campus properties, provide adequate facilities and equipment for research and education, and improve community relations at off-campus properties.

“The idea was that, in order to conduct relevant research and outreach programming for commodities critical to Michigan’s agricultural economy, oversight of these off-campus properties was essential to keeping them properly funded and maintained,” said Chuck Reid, LMO director. “So budget lines were created for each of the facilities, and funds were disbursed directly through the LMO; previously, funding came through a particular department.”

The LMO was officially established July 1, 1979, and was charged with the responsibility for management of MSU proper-



LMO Director Chuck Reid

ties and facilities including the 14 off-campus MAES field stations. Management responsibilities of the six-member campus-based office include budget development, personnel, improvement and maintenance of physical facilities, community relations, planning and evaluation, documentation and reporting, and conducting special assignments as necessary. In addition to its central office staff, the LMO has on-site staff members at most of the properties that assist with daily oversight responsibilities.

There are several advantages to being centralized, Reid pointed out.

“Overseeing the whole operation allows us to look for efficiencies across the

system,” Reid explained. “For example, if one station has a need for something, another station may have a surplus and we can match that up. We also save a great deal of money by combining purchases and having multiple trade-ins. There are also great cost efficiencies in equipment sharing. We had a recent situation where one station requested a deep tillage implement, and we subsequently discovered that two other stations needed the same thing, so, rather than buy three implements that are rarely used, we bought one and they shared it.”

Reid, who is a member of the national Research Center Administrators Society (a group whose membership includes many agricultural experiment station and extension administrators) believes that having an office dedicated to the centralized management of agricultural experiment stations is unique within the land-grant university system.

“Other states have a model where they have a staff member or two on-site to help with management and coordination, but I haven’t seen the capacity we have to volume purchase and coordinate operations and equipment the way we do. It’s a winning combination that covers all the bases.”

∴ Val Osowski

“It is my hope that the property that kind Providence has brought me may be helpful to many others and that I may be found a faithful steward.”

— W.K. KELLOGG

THE W. K. KELLOGG BIOLOGICAL STATION: In a League of its Own

for biological research, the Kellogg Biological Station (KBS) has an all-star lineup. Its more than 3,200 acres make KBS the largest of 14 outlying field research facilities that make up the Michigan Agricultural Experiment Station at MSU and one of North America’s oldest and most prominent inland field stations.

KBS was established in 1928 when cereal magnate and environmentalist W.K. Kellogg donated his farm and some of his property in southwestern Michigan to the Michigan Agricultural College (now MSU) to help expand its research capacity beyond the main campus. Today, KBS encompasses a bird sanctuary, a farm and dairy, biological laboratories, an education and conference center, and an MSU Extension land and water unit (*see box on page 13*). The nearby W.K. Kellogg Experimental Forest is closely affiliated with the station. ▼



KBS IS A WAY TO EXPERIENCE THE RICHNESS, EXPERTISE AND DIVERSITY OF THE RESEARCH, EDUCATIONAL PROGRAMMING AND OUTREACH ACTIVITIES THAT MSU HAS TO OFFER ON A SMALLER SCALE.”

In addition fulfilling all the duties that come with serving as director of KBS, MSU distinguished professor Kay Gross also continues to conduct her own research program and work with students. Gross considers the Hickory Corners station to be a micro MSU and expects that KBS will soon have a connection with every college at the university.



The KBS roster includes 12 resident faculty members — including six whose research is supported by the MAES — who are engaged in year-round, place-based research and education. KBS faculty members and their students are known nationally and internationally for research in ecology and evolutionary biology in both natural and managed systems. KBS also attracts researchers from around the world as visiting scholars.

LOADING THE BASES

With its state-of-the art research facilities, on-site research staff, educational offerings and a strong commitment to public outreach, KBS could be considered a micro MSU, said Kay Gross, KBS director and MSU distinguished professor.

“Although the majority of the resident faculty come from the colleges of Natural Science and Agriculture and Natural Resources, KBS has strong linkages with the MSU colleges of Education, Social Science and Veterinary Medicine, as well as the Lyman Briggs and James Madison colleges, and growing interactions in the colleges of Engineering and Communication Arts and Sciences,” she said. “I believe that soon, we’ll be able to say that we have a connection with every college at MSU.”

In the education arena, KBS offers a variety of graduate and undergraduate courses and programs and has a strong and growing K-12 component.

“In 2008, 25 undergraduate students took part in internship and research opportunities at KBS,” Gross said. “We also offer summer field courses, a summer institute to bolster ecological and mathematical connections, and a fall-semester residential program with coursework, internships and hands-on training for undergraduates. In addition, KBS graduate students and MSU faculty members work directly with science teachers in 12 rural school districts near KBS to improve science curriculums.”

KBS also hosts a variety of public lectures and work-

shops. Offerings include a “Dessert with Discussion” program to offer community members an opportunity to meet MSU scientists and discuss a variety of ecological and environmental issues; “Wild Wednesdays,” a family-oriented summer program at the Kellogg Bird Sanctuary that includes topics ranging from “Tricky Tracks” to “Incredible Insects”; a native landscape series for homeowners interested in how to use native plants in their gardens; and a field ornithology course for adults.

“In short, KBS is a way to experience the richness, expertise and diversity of the research, educational programming and outreach activities that MSU has to offer on a smaller, less overwhelming scale,” Gross said. “We are in a fairly densely populated area compared with most field stations, so that gives us research, educational and outreach opportunities that other field stations don’t have.”

BUILDING ON PAST SUCCESS

Among the first of the MAES field stations to be established, KBS has the advantage of longevity in its research endeavors.

“There is value in the long-term scheme of things,” said Phil Robertson, MAES crop and soil sciences researcher. “There are not very many sites, either nationally or in Michigan, where researchers can study the same process or populations over the long term with any confidence that they’ll be able to return to the site later and continue the measurements to look for long-term change.”

Team KBS *at a glance*

Located halfway between Kalamazoo and Battle Creek in southwestern Michigan, the Kellogg Biological Stations provides a variety of programs and experiences to Michigan residents.

Kellogg Bird Sanctuary

With 180 acres of diverse habitats accessible on the 40-acre Wintergreen Lake and a 3/4-mile hiking trail, the Kellogg Bird Sanctuary is one of North America's pioneer wildlife conservation centers. KBS researchers, for example, have been instrumental in efforts to reintroduce native populations of trumpeter swan back to the wild in the Midwest, and in the 1930s the sanctuary was credited with saving the Canada goose from extinction. The sanctuary features hundreds of waterfowl and a wide variety of birds of prey and game birds. Public offerings include monthly classes and sanctuary tours, a summer day camp and an annual two-month field ornithology course. The sanctuary also provides information on pollinator and rain gardens. A picnic area meeting place, Spruce Lodge, is also available on site.

Kellogg Farm

The Kellogg Farm was established in 1928 as one of the initial gifts of W.K. Kellogg to the Michigan Agricultural College (now MSU) to showcase the most modern farming techniques to Michigan residents. Today, the farm is an integral part of KBS and supports leading-edge research, educational and outreach programs focusing on row crop production, dairy, and alternative biofuel cropping systems and their role in the agricultural landscape. It includes a farming systems center that supports research on a number of crops and cropping systems important to southwestern Michigan, and a dairy center that maintains a registered Holstein herd and was recently converted to a pasture-based production system to help address the needs of small- and medium-sized dairy farmers.



Extension Land and Water Unit

Created in 1999 to address the concerns of non-point source pollution, land use issues and agricultural consequences of land use change, the Extension Land and Water Unit brings a multidisciplinary team of Extension educators to KBS to conduct integrated research and Extension programs in sustainable agriculture, bioenergy, water quality and land use. The unit provides information to the public in the form of bulletins and fact sheets on topics such as shoreline management, potential effects of algal blooms, sustainable agriculture, field crop ecology and water quality.

W.K. Kellogg Conference Center and Manor House

KBS offers a full-service, year-round conference center surrounded by 32 acres of gardens and landscapes. Last year, more than 11,500 visitors took part in workshops, conferences and special events at the center, on the historic summer estate of W.K. Kellogg, which overlooks beautiful Gull Lake.

AFFILIATED UNIT

W.K. Kellogg Experimental Forest

The W.K. Kellogg Experimental Forest is one of 14 outlying MAES field stations and one of four administered by the MSU Forestry Department. What 65 years ago was eroded farmland has been revitalized through the planting of more than 150 species of trees to create a 716-acre forest. The forest is known worldwide for research on tree breeding and genetics, planting techniques, and plantation establishment and management. Much of the research that developed the Spartan spruce — a hybrid that combines the color and drought resistance of a blue spruce with the softer needles and rapid growth rates of the white spruce — was done at the Kellogg Forest. Tours are offered to show visitors the inhabitants of the forest, as well as help them learn to identify various types of trees by their individual characteristics. The forest is also open to the public for biking, hiking, horseback riding and cross-country skiing, and also has several interpretive trails.

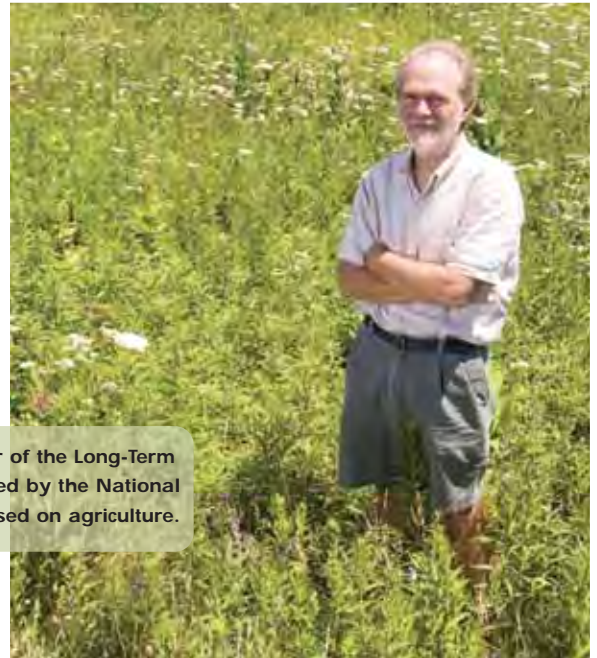
∴ Val Osowski





THERE ARE NOT VERY MANY SITES . . . WHERE RESEARCHERS CAN STUDY THE SAME PROCESS OR POPULATIONS OVER THE LONG TERM WITH ANY CONFIDENCE THAT THEY’LL BE ABLE TO RETURN TO THE SITE LATER AND CONTINUE THE MEASUREMENTS TO LOOK FOR LONG-TERM CHANGE.”

MAES crop and soil scientist Phil Robertson serves as director of the Long-Term Ecological Research (LTER) project, one of 26 such sites funded by the National Science Foundation. The MSU site is the only LTER site focused on agriculture.



“Another advantage the station has, not just in the state but nationally, is the diversity of research that is conducted here,” Robertson continued. “This is possible because KBS encompasses agricultural lands as well as forests, old fields, wetlands and lakes. It allows us to take a landscape perspective that is incredibly valuable for understanding how all of these systems interact — and it is a perspective that is missing from most other field stations.”

KBS offers a diversity of landscapes and habitats. Researchers have access to 18 on-site lakes that, together with wetlands, cover 16 percent of the landscape. They also study a wide variety of row crop agriculture systems, 70-year-old hardwood forests, 40-plus-year-old conifer plantations, and local streams and rivers, including Augusta Creek and the nearby Kalamazoo River.

Translating research findings and delivering them to producers, commodity groups and the broader community are also key components of the KBS mission.

“KBS has, for example, a very strong program in agricultural sustainability, and faculty members are very active in communicating information about cover crops, rotations and other sustainable practices to both conventional and organic producers,” Gross said. “We’ve also developed local and regional expertise in the use of landscape design to reduce the impact of lawn fertilizers on lakes and streams. Our researchers and Extension educators work closely with leadership teams in stream and water quality associations and use the KBS grounds themselves — which abut Gull Lake — as a demonstration area for various lakeside landscaping practices. We’re also working with local growers interested in conservation stewardship practices related to landscapes.”

WINNING NATIONAL ACCLAIM

KBS contributions to ecological science and evolutionary biology are nationally renowned.

“One of the reasons that KBS is attractive to science funding agencies such as the National Science Foundation (NSF) and the U.S. departments of Agriculture and Energy is that there is a commitment by the university to maintain the site for the long term to address basic questions that are important to society,” Robertson said.

KBS is home to one of the 26 NSF Long-Term Ecological Research (LTER) sites, which represent a broad variety of ecosystems, such as tundra, forest, grassland, desert and wetland sites. The MSU site, established in 1988, is the only LTER site focused on agriculture. As a whole, the network is committed to addressing fundamental questions about how ecosystems work and environmental education, both formal and informal. Research at the KBS LTER site examines how biodiversity — plants, animals and microbes in agricultural landscapes — contributes to farm productivity, environmental performance and profitability.

“And after more than 20 years of successful research at MSU and other LTER sites, many in agriculture are recognizing the substantial value of long-term interdisciplinary work at a single location and are suggesting that a network of agricultural sites could help to address many of the important challenges facing agriculture today,” said Robertson, who serves as director of the MSU LTER project. “So now scientists from around the country are asking the USDA to create a network of sites like MSU’s.”

The latest addition to KBS is a field center for the Great Lakes Bioenergy Research Center (GLBRC). In

2007, MSU and the University of Wisconsin-Madison received a Department of Energy (DOE) grant to establish the GLBRC, one of three DOE bioenergy research centers in the country. MSU received approximately \$50 million — the largest exclusively research-based federal grant in MSU history — for basic research over the next five years aimed at solving some of the most complex problems in converting biomass to advanced fuels. The KBS GLBRC field center, associated with the LTER site, is the principal site studying biofuel sustainability in the nation.

Experimental plots have been established at KBS with eight alternative biofuel crops, including both grain and cellulosic crops such as switchgrass, miscanthus, poplar trees and various combinations of native grasses, including restored prairie. These experimental plots will enable KBS researchers and other scientists to determine which biofuel crops will be most productive and environmentally sustainable and how to reduce the competition between food and fuel production.

“The objective is to create model systems that can predict the environmental performance of biofuel crops everywhere,” Robertson said. “The center as a whole puts MSU at the forefront of helping to make the United States independent of foreign oil while creating future jobs and further encouraging alternative energy investment in Michigan. Investing in sustainability research

can inform another,” he said. “For example, we have 20 years of LTER research showing that the 12 to 15 species of ladybird beetles in southwest Michigan are important predators of aphids, a major soybean pest, and that the beetles occur in different habitats around soybean fields. Because we know this, we can tie into questions we might ask in GLBRC systems, such as what effect does planting more corn and less soybean in biofuel landscapes have on the ability of ladybird beetles to control aphids in the remaining soybeans? It’s a synergy that really pays off.”

KBS research in the coming years will include a focus on pasture-based dairy systems to better address the needs of small- and medium-sized farmers both locally and nationally who are looking for alternatives to conventional dairy practices (*see page 16*).

“This new pasture-based system will provide a way to look at alternative animal production systems that can be integrated with LTER and GLBRC questions, further enhancing the value and impact of this important research,” Robertson said.

A WORLD SERIES CONTENDER

The reputation of KBS as a premier ecological and evolutionary research station is very sound, Gross said.

“When I go to scientific conferences nationally and internationally, people almost always know about KBS,”

she said. “In addition to having world-class faculty members, we have an incredibly strong track record of training outstanding graduate students who go on to become very successful in their work.”

The foresight of MSU in continuing to support a first-class experiment station network has resulted in KBS being recognized nationally as a leading field station and, consequently, MSU as a leader in promoting field biology, Robertson said.

“That legacy is clearly paying off now that we know the importance of understanding specific environmental issues in complex working landscapes — everything from biofuels to

genetically modified organisms to invasive species,” he said. “You can’t just look at these things in isolation in individual fields. You have to look at how these organisms and other ecosystem properties change across entire landscapes if you want to understand the environmental controls and performance of these systems at scales that matter to society.”

∴ Val Osowski



MAES plant evolutionary ecologist Jennifer Lau (*right*) works with Sandra Erwin and Robert Snyder in a KBS greenhouse. KBS is home to a field center for the Great Lakes Bioenergy Center, a partnership between MSU and the University of Wisconsin-Madison funded by the Department of Energy. Field center scientists are studying biofuel sustainability.

now will help to avoid environmental regret later.”

Robertson added that there are also benefits to having a number of these large-scale projects at a single location.

“Even though projects such as the LTER and GLBRC are funded independently and many of the questions they seek to answer are asked independently, you often find unexpected ways in which results from one project

Fielding a New Farm System: The KBS Pasture-Based Dairy

This summer, the Kellogg Biological Station (KBS) dairy herd will hoof it to a new pasture-based dairy facility.

Construction on the new facility began last fall and will be completed by this summer. The pasture dairy will consist of two pastures: a larger, 160-acre pasture for lactating animals and a smaller, 35-acre pasture for developing heifers and dry cows. A free-stall barn with a milking parlor will be located in the middle of the larger pasture. At full capacity, the facility will house 120 cows.

“The creation of this pasture-based dairy facility is a logical extension of the strong tradition of ecological research at KBS,” said Kay Gross, KBS director. “Integration of the row-crop and dairy production research programs at the station provides a unique opportunity to examine agriculture from an integrated, whole-system perspective.”

Research conducted at the conventional dairy facility established at KBS 24 years ago has made significant contributions to advancing the efficiency, safety and profitability of dairy operations locally, regionally and nationally.

“Although the conventional dairy operation at KBS has been very successful over the years, we felt there was a need to establish a dairy research and education facility that would complement other sustainable agricultural research programs at KBS,” said Mat Haan, KBS pasture dairy project coordinator. “We see transitioning to a pasture-based system as a niche market for us; it’s something that’s not being done in many places. We also want to develop a system that better addresses the needs of small- and medium-sized dairy farmers.”

“The facility will provide an excellent venue for education and outreach programs that will demonstrate how ecological, social and economic principles can be evaluated in the establishment of a smaller scale dairy management system that is an alternative to the large, more conventional farm model,” Gross said. “If you’re going to be working with dairy producers in the community, some of them will be doing pasture, some will be doing organic and some will be doing confinement. It’s important to be knowledgeable about the whole spectrum of options available to dairy farmers. The new KBS dairy will support research that will allow farmers to make informed decisions about which of these systems works best for them.”

Perhaps the most novel aspect of the new dairy is the two robotic milking systems installed in the dairy’s parlor.

Robotic milking systems were developed in Europe and became commercially available in the early 1990s. They spread throughout Europe, reached Canada in the late 1990s and the United States about eight years ago.

“There are a number of robotic dairies in New York and Minnesota and states surrounding them,” Haan said. “The first



robotic dairy in Michigan opened this spring at a conventional dairy operation in the Port Huron area.”

Using robotic milkers has several advantages, Haan said.

“Because the robot is a voluntary system, cows are free to come and go as they choose throughout the day,” he said. “If a cow decides she wants to milk at two o’clock in the morning, she can, as opposed to the farmer bringing the whole herd together and working them through the parlor in one big group. With a robotic milking system, a cow has the choice of when she is milked.”

There are also a couple of benefits from the producer’s standpoint, Haan continued.

“The robot has sensors that take a lot of data on every cow,” he said. “For example, it will measure the cow’s body weight, total milk yield and milk quality. So every time a cow is milked, the farmer gets a lot of information that might not be available in a conventional milking parlor. The information is readily available and integrated, allowing the producer to make better management decisions.”

Another benefit of a robotic system is that the farmer doesn’t have to be present for scheduled milkings.

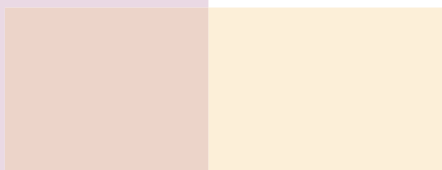
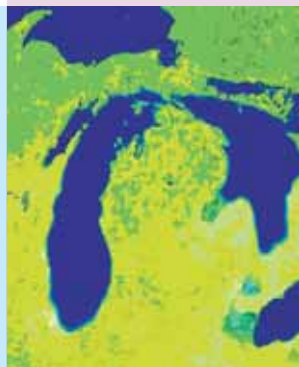
“Currently, at a conventional dairy operation, someone has to be there to milk at 5 a.m., again at noon or so, and then at 5 p.m. or 6 p.m. in the evening — three times a day, 365 days a year. With the robots, if a dairy farmer wants to go to his/her son’s soccer game or a local PTA meeting, there’s that flexibility. It gives these farmers a chance to be more involved with their community and with their families because they don’t have to be tied down to the regular milkings. It’s a win-win for the animals, the farmers and the communities in which they live.”

A grand opening and open house for the dairy will be held from 1 to 4:30 p.m. Aug. 19. The event is open to the public and will include a tour of the new pasture dairy.

“Producers or anyone interested in visiting the dairy can come to the open house and learn about the technologies we’ll be using and the research we’ll be doing,” Haan said. “Aug. 19 will be a big day around here.”

∴ Val Osowski

The Fruitful Four



West coast MAES field research stations help maintain the star power of the Michigan fruit industry.

The benefits Lake Michigan bestows on the state seem endless: beautiful nature scenes and sunsets; a cool vacation retreat in the dog days of July and August; fishing, boating and other water sports; plus a bountiful supply of fresh water and the distinctive-from-outer-space Michigan outline.

But it's Michigan fruit growers who are the recipients of what might be one of the lake's biggest advantages: the moderating influence it has on the climate of the state's western coast. It makes Michigan the country's No. 1 producer of blueberries (Michigan produces more than 40 percent of the nation's blueberry crop), tart cherries (Michigan produces more than 77 percent of the nation's entire tart cherry crop) and Niagara grapes; the No. 2 plum producer; the No. 3 apple producer; and the No. 4 producer of all grapes, according to statistics



MAES FIELD RESEARCH STATIONS THAT FOCUS ON FRUIT

✦ **Clarksville Horticultural Experiment Station**

The 440-acre Clarksville station is the closest field station to campus, about 40 minutes west of the main MSU campus in East Lansing. Besides studying tree fruit and small fruit, such as blueberries, scientists also are looking at wheat scab and weed control in a number of crops. All research at Clarksville seeks to make production more profitable and efficient for growers while using environmentally responsible methods to control pests.

✦ **Northwest Michigan Horticultural Research Station**

Initially conceived by the Northwest Michigan Horticultural Research Foundation, a group of fruit growers from Manistee, Benzie, Leelanau, Grand Traverse and Antrim counties, the Northwest station's 100 acres of land and buildings is owned by the foundation and leased by the MAES. A board of directors made up of foundation members helps set the direction for research projects. While cherry research makes up the majority of work at the station, researchers also study apples, plums, wine grapes, peaches, apricots, pears, chestnuts, hazelnuts and other horticultural crops with potential for northwest Michigan.

✦ **Southwest Michigan Research and Extension Center**

One of the younger MAES field research stations, the Southwest Michigan Research and Extension Center began as an idea of area fruit and vegetable growers who wanted a facility that shared their weather, soils and pest issues and could respond to issues quickly. A partnership between the state, MSU and growers, plantings at the center started in 1988. A hub for both research and education, the center encompasses farm buildings, a conference center and the Berrien County MSU Extension Center. Research projects at the station cover just about all fruits and vegetables grown in the area, including grapes, peaches, tart and sweet cherries, strawberries, blueberries, raspberries, Christmas trees, snap beans, pumpkins, tomatoes, chestnuts, melons, eggplant, zucchini, and apples.

✦ **Trevor Nichols Research Complex**

Trevor Nichols, a writer and part-time farmer, willed his 80-acre farm in Allegan County to MSU in 1967. A member of the Lakeland Fruit Growers League, Nichols was keenly interested in the future of the fruit growing industry. Today, the Trevor Nichols station encompasses 175 acres and grows just about every type of fruit produced commercially in Michigan so scientists can study new and improved techniques for controlling the pests that attack fruit, preserving both growers' profitability and environmental quality.

from the U.S. Department of Agriculture. Michigan also produces significant quantities of strawberries, sweet cherries, peaches and pears.

A large percentage of Michigan's fruit growers are located in the Lower Peninsula counties that hug Lake Michigan. And though much fruit research takes place on campus, the four MAES field research stations scattered along the state's west side offer growers a chance to see the results of fruit research done in a real farm setting, on similar soils and under the same weather conditions that they face.

"Growers appreciate that our research is done in a real farm setting, that what we do can be done in a commercial orchard," said Phil Schwallier, researcher at the Clarksville Horticultural Experiment Station, in Ionia County, who also serves as MSU Extension district horticulture marketing educator. "We're the university's front door to the grower community. The area growers all know us, and they know that if we can't answer a question, we know who can."

In addition to the Clarksville station, the Northwest Michigan Horticultural Research Station, in Traverse City; the Southwest Michigan Research and Extension Center, in Benton Harbor; and the Trevor Nichols Research Complex, in Fennville in Allegan County, all have a major fruit focus. *(See box at left for more detailed descriptions of each fruit research facility.)*

"The four fruit stations are complementary but have just enough overlap so we can help each other out if issues come up," explained John Wise, MAES entomology scientist, who serves as research and Extension coordinator at Trevor Nichols. "I know that I can look to the Northwest station if I need cherries to test a new pest control method."

"All the outlying MAES research facilities have an Extension component," said Tom Zabadal, MAES horticulture scientist, who coordinates research activities at the Southwest station. "We host a number of meetings for growers, and we allow visitors any day during daylight hours. When growers can actually see the research plots, it makes the research more relevant and believable."

"Growers are always stopping in," said Nikki Rothwell, research coordinator at the Northwest station, who also serves as MSU Extension district horticulture educator. "We're the only research stations in the country doing tart cherry research, so we have a very strong bond with our growers. Because our work is done under the same variables as the growers', they find our data very valuable."

Smaller Cherry Trees May Mean Bigger Profits

Traverse City identifies itself as the world's cherry capital and it's not hard to find cherry pies, jams, sausage, candy, fudge and all manner of other items made from or adorned with cherries in stores there. The cherry is one of the world's oldest cultivated fruits; cherry growing started in 300 B.C. Cherries were brought to North America in the 1600s, and modern cherry production began in the mid 1800s, according to information from organizers of the National Cherry Festival (held every July in Traverse City). Peter Dougherty, a Presbyterian missionary, first planted cherry trees on Old Mission Peninsula in 1852. To the surprise of everyone who lived in the area, the trees thrived and all the naysayers began planting trees. Michigan's first commercial tart cherry orchards were planted in 1893 near the site of Dougherty's first trees and the industry was solidly established by the early 1900s.

Located just north of downtown Traverse City, the Northwest station is the hub for cherry research in the area, much of it suggested by growers looking for new ways to remain competitive and environmentally sustainable.

Two new plots of high density tart cherry trees were planted this spring to demonstrate to growers how these new production systems might work for them. The trees are on dwarfing rootstocks, which means the cherry trees are smaller and start producing fruit earlier, in approximately 2 to 3 years, compared with 4 to 6 years for trees on conventional rootstocks. Because the trees and their canopies are smaller, the number of trees per acre can increase dramatically — up to 500 in some cases — compared with about 100 trees per acre in conventional cherry orchards. Smaller trees also would allow cherry growers to take advantage of new harvesting equipment that doesn't shake the trees' trunks.

“Growers appreciate that our research is done in a real farm setting, that what we do can be done in a commercial orchard.” — PHIL SCHWALLIER



Phil Schwallier, MSUE district horticulture marketing educator, focuses much of his research on plant growth regulators at the Clarksville Horticultural Experiment Station.

“About 90 to 98 percent of Michigan cherries are harvested mechanically,” Rothwell explained. “Some of the harvesters are machines that fit around each individual tree, shake the trunk and catch the cherries in what look like upside down umbrellas,” explained Rothwell. “The goal is to have a continuously moving harvester that can be driven through the orchard rows without having to stop at each tree. We want to improve efficiency with the new harvesters, but we really want to start harvesting cherries when the trees are younger. Small trees and our current shakers are not a good fit.”

Shaking the trunk can damage young trees, so growers usually don’t mechanically harvest cherries until the trees are about 6 years old. But because a continuously moving harvester wouldn’t shake the trunks and damage the tree, the fruit could be harvested earlier.

“A system like this would allow growers to start earning money earlier than they do now,” Rothwell continued. “Poland supposedly has a commercially available continuously moving harvester, but I haven’t seen that yet. However, our growers know this technology is out there and they’re really behind this project. It could be a really big shift for our industry, and there’s a lot of interest in the technology. We have terrific growers up here — they’re very creative, innovative and willing to try new things. We’re lucky to work with such progressive farmers.”

The Northwest station also is home to a number of variety trials for tart and sweet cherries, wine grapes and apples.

“We’re always getting new sweet cherry varieties into the station,” Rothwell said. “We’re the main evaluation site for sweet cherries in the state. Unfortunately, most of our varieties come from the West Coast, which has very different climate conditions compared to Michigan. We need to find varieties that fit our situation and a thorough screening process is the only way growers will be able to plant new sweet cherries.”

Farther south, at the Clarksville station, about 25 acres are devoted MAES cherry breeder Amy Iezzoni’s work, as well as rootstock evaluations.

“The entire Michigan tart cherry industry is based on one variety, the Montmorency,” explained Schwallier. “We heavily support Dr. Iezzoni’s breeding program, which is aimed at getting more diversity into the industry. Right now, everything is harvested at the same time and then we’re done. The new varieties ripen over a 6- to 8-week period, so there would be a

longer opportunity for harvest.”

Iezzoni also maintains tart cherry breeding plots at the Southwest station and Bill Shane, MSU Extension district fruit and marketing educator, conducts sweet cherry rootstock and training system research there as well.

The Apple of Michigan’s Eye

The apple tempted Adam, caused Atalanta to lose a race, helped Newton discover gravity and was spread around the United States by a man named Johnny. In Michigan, apples contribute up to \$700 million to the state’s economy, according to statistics from the Michigan Apple Committee. More than 7.5 million apple trees are in commercial production in the state and thousands more dot backyards and fields, keeping families, horses and other farm animals, and wildlife happily munching for much of the year.

Apple growers use several plant growth regulators (PGRs), compounds that mimic the action of naturally occurring plant hormones, to thin fruit, extend the shelf life of the fruit, and control when the trees flower and set fruit. Because the industry depends heavily on PGRs, studying how each one affects each apple variety grown in the state is a long-term project for scientists at Clarksville.

“Every variety has a different response to a PGR,” Schwallier explained. “Weather conditions play a big role as well. We have to study a PGR for at least 3 years before we’re sure how it will affect a crop so we can make recommendations to growers. We’re heavily involved in testing PGRs before they go on the market.”

About 26 to 30 varieties of apples are grown in Michigan, and between 10 and 12 PGRs are approved for commercial use. The average apple grower probably uses about five PGRs per year. A fruit grower who has cherry and peach trees in addition to apples probably uses about eight PGRs per year.

“Finding out what doesn’t work is just as important to growers



MAES entomology scientist John Wise coordinates research and Extension activities at the Trevor Nichols Research Complex. Scientists there study new and improved ways to control fruit pests.

“Working with insects in the lab is one thing, but I think you really have to see the ebb and flow of insect cycles to fully understand the research.” — JOHN WISE

as discovering what does,” Schwallier said. “Some PGRs can cost about \$250 per acre to apply, which is very expensive. Growers are very appreciative if we can tell them that a product isn’t going to work on a particular variety or in a particular weather situation because we’re stopping them from wasting money.”

MAES scientists also have helped discover some unintended benefits of PGRs. Apogee is a PGR that inhibits production of gibberellins, plant hormones that cause shoots to get longer. MSU researchers at Clarksville were some of the first to notice that Apogee suppresses fire blight, a highly contagious apple disease caused by a bacterium that attacks the blossoms, leaves, shoots, branches, fruit and roots of the tree. Apogee doesn’t affect the bacterium, but protects the tree by limiting the tree’s growth and spread.

Located in southwestern Ionia County, the Clarksville station is in prime Michigan apple country — Kent and Ottawa counties are two of the top apple producing areas in the state. A number of apple growers — especially those putting in new orchards — have shifted to high density plantings on dwarfing rootstocks, which have 500 or more trees per acre. The trees top out at about 12 feet tall and are grown using trellis fencing or stakes as a scaffolding system. Even though the trees are smaller, they produce the same size and number of apples per acre as larger trees, so the smaller trunks need some extra support. The shorter trees make the fruit much easier to pick. Unlike cherries, apples are too delicate to be mechanically harvested and must be picked by hand each fall. Schwallier helps oversee experiments evaluating dwarfing apple rootstocks as well as trials on various training systems, such as the tall spindle and vertical axe. He also helps teach growers who want to use these production systems.

“Our goals are squarely in line with what our growers want,”

Schwallier said. “More efficient, less expensive and simpler ways to do things that produce higher quality fruit and preserve environmental quality.”

To help achieve the last aim, Clarksville began transitioning a parcel of land from corn/soybean production to organic apple production in 1998. Trees were planted in 2000. Michigan is wetter and warmer than the apple growing regions of Washington and New York, the country’s other big apple producers. Apple growers here face more disease and insect pressure and consequently use more chemicals to control pests.

Apple growers who wanted to meet the growing demand for organic produce had limited pest control options and few demonstration sites until the Clarksville organic project started. The project has been certified by the Organic Crop Improvement Association since 2003.

Scientists have implemented a number of pest control strategies in the organic apple plot, including intense pest scouting and monitoring, ground covers, mulching, vegetative barriers to keep out insects, trapping insects, and releasing predator insects and providing habitat for them. A self-guided tour is available for the plot, and signs explain the various techniques being used to enhance soil biodiversity, promote tree health and productivity, and control pests.

“Growers don’t want to implement a change until they can see that it works on a large scale,” Schwallier said. “At the field stations, we take the risks so the growers don’t have to.”

The CURTEC sprayer, developed by MAES agricultural engineer Gary Van Ee and technician Richard Ledebuhr, both of whom are now retired, was one change that Schwallier demonstrated at Clarksville that has been adopted by a number of apple growers. Using a curtain of air instead of the conventional air-blast spray method, the CURTEC sprayer reduced the volume of pesticide used by 50 percent per application, saving growers more than \$100 per acre and reducing the potential for pesticide drift.

“The CURTEC sprayer was the perfect example of the value of field stations and the land-grant mission,” Schwallier said. “It was designed and built by MAES researchers, demonstrated by MSU Extension and adopted by growers. We ran a demo of the sprayer here when it was developed in 1995. Now there are 25 to 30 of those rigs in commercial orchards around here because growers saw that it worked. That’s something we can be proud of.”

Great Grapes

The earliest known language, Sumerian, has a word for “grape,” and descriptions of grape and wine production have been found in the hieroglyphics of the fourth dynasty of Egypt. The ancient Greeks disinfected battle wounds with wine. In the 1800s, red wine was mixed with water to prevent cholera and typhoid fever. About 15 years after the U.S. Civil War ended, Thomas Welch, a strong supporter of temperance, created the first unfermented “wine” — essentially grape juice — for his church in southwestern Michigan to use during services. According to the Michigan Grape and Wine Industry Council, the drink quickly became popular and the Welch’s Grape Juice Company was formed.

The first iteration of Michigan wineries were based on Concord and Niagara varieties and produced sweet, fortified wines that were hugely popular in the 1940s and ‘50s. In the 1960s, however, consumers began to prefer the drier table wines common in Europe, which caused a huge

“When growers can actually see the research plots, it makes research more relevant and believable.” — TOM ZABADAL

evolution in Michigan wineries. (The juice industry continued to do well with the Concord and Niagara varieties.) New hybrid varieties of wine grapes were planted, and new vineyards and wineries began to dot the western coast of the state. Today, Michigan has 14,600 acres of vineyards and 64 commercial wineries. The grape and wine industry adds more than \$700 million to the state’s economy, an amount that includes related tourism activities. In 2008, Michigan wines received more than 800 medals in regional and international competitions.

“About 90 percent of MSU’s grape research — that includes juice, wine and table grapes — is done at the Southwest Michigan Research and Extension Center,” said research coordinator Zabadal. “The juice industry is here and so are a number of wineries, so it makes sense that the research is done here as well. We’re also a peach facility, conducting breeding and variety testing, and the Michigan Peach Sponsors are very supportive of that work.”

About 90 percent of the grapes grown in Michigan are used for juice, with about 2,000 acres devoted to wine grapes. The economic impact of the two crops is more similar than acreage figures would suggest.

“Wine is incredibly value-added,” Zabadal explained. “Though we grow many more juice grapes, the amount of wine

grapes we grow has about the same economic impact.”

If juice grape research could be summed up in one word, it would be “mechanization.” Zabadal explained that growers want to lower the costs of production while increasing yields. If harvesting, pruning and shoot positioning can be done with a machine, the cost is much lower than doing all this work by hand. The first mechanical harvester, introduced to Michigan in 1969, revolutionized the juice industry.

“I think the industry would have collapsed without it,” he said.

All the juice grape research is done in partnership with the National Grape Cooperative, which buys about 95 percent of Michigan grapes.

When Zabadal started his MSU career in 1989, mechanical pruning was the focus of a number of studies. Van Ee and Ledebuhr, the same scientists who developed the CURTEC sprayer, built a mechanical pruner, tested and demonstrated it at



Tom Zabadal, MAES horticultural scientist, coordinates research activities at the Southwest Michigan Research and Extension Center. “All the outlying MAES research facilities have an Extension component,” he says.

the Southwest center, and commercialized the device, which is still used by a number of growers in southwestern Michigan. The researchers also developed a cane positioning device that puts the grape vines in place for pruning.

Currently, Zabadal is testing a shoot positioning device, a machine that spreads out the shoots coming off the main part of the grapevine to make them a better target for pruning. Spreading out the shoots also allows more sun to get to the main vine area, which helps the vine keep producing fruit each year.

“Other universities are developing shoot positioners,” Zabadal said. “But ours is better. We’re in commercial production and hope to have it on the market soon.”

Zabadal also is studying weed control for juice grape varieties, as well other cultural practices to improve productivity and

efficiency, including pruning strategies to avoid spring freeze damage. Because mechanical pruning takes less time, growers can prune vines later in the season, and that can mean a lower risk of frost damage.

Michigan's wine grape industry has grown steadily since hybrid varieties were first planted in the 1950s and the first *Vitis vinifera* grapes were planted in the 1970s. Zabadal said that about two-thirds of the state's wine grape acreage is less than 20 years old, and that operators of the state's current vineyards and wineries are enthusiastic about expanding the industry.



Nikki Rothwell, research coordinator at the Northwest Michigan Horticultural Research Station, also serves as MSUE district horticulture educator. "Because our work is done under the same variables as the growers', they find our data very valuable," she says.

"The Southwest center sponsored a winery establishment conference in February, and it sold out very quickly," he said. "The industry is very supportive of what we're doing."

Wine grape research at the Southwest center focuses heavily on new variety evaluation and viticultural practices. MAES scientist Paolo Sabbatini, who came to MSU in 2007, conducts a number of cultivar evaluation projects at the center. Zabadal estimated that about 25 new wine grape varieties, split evenly between whites and reds, are currently being studied. Because many red varieties are susceptible to colder temperatures, they're more challenging for Michigan growers. Michigan white wines have won numerous awards and are well-respected among enthusiasts. Michigan reds, though very good, have not achieved the mass acclaim of the whites.

"Merlot is the most cold-tender variety," Zabadal explained. "Growers have had problems getting those grapes through the winter. The most challenging part of the wine grape industry in Michigan is winter."

To help growers, MAES and other Michigan State scientists teamed up with researchers at Penn State, Ohio State and Cornell

to develop a new publication, "Wine Grape Varieties for Michigan and Other Cold Climate Viticultural Regions," that was named Extension Publication of the Year by the American Society for Horticultural Science (publication number CD007, available through the MSU Extension Educational Materials Distribution Center online: <http://web2.msue.msu.edu/bulletins/>). The publication includes recommendations on techniques to overwinter vines, how to evaluate winter injury and how to offset any injuries that do happen.

Grape growers in southwestern Michigan have more problems with fruit rots than do growers in the northwestern part of the state, so Southwest center scientists are studying ways to combat those diseases as well.

"We're the only station in the country doing tart cherry research, so we have a very strong bond with our growers."

— NIKKI ROTHWELL

"Fruit rots can't be controlled with fungicides alone," Zabadal said, "so we're looking at cultural techniques that work in conjunction with the fungicides."

Berry, Berry Good

One of the few fruits native to North America is the blueberry. The sweet tang of blueberries delights the palates of humans, bears and a number of other creatures. Michigan growers harvested a record amount of blueberries in 2008 — 110 million pounds (about 32 percent of the U.S. total), valued at \$124 million. Most Michigan blueberries are grown in Allegan, Berrien, Muskegon, Ottawa and Van Buren counties, where soil and climate conditions are ideal.

MAES blueberry breeder Jim Hancock does a good bit of his research on campus, but field evaluations are done at the Southwest center, which is in the heart of blueberry country. In 2002, Hancock released three blueberry varieties that were developed specifically to meet the needs of Michigan growers.

"Michigan growers get the most money for their blueberries at the end of the season because we're the last state that has berries left," Hancock explained. "So our goals were to develop varieties that were late-maturing and stored well."

The three varieties — Liberty, Aurora and Draper — were the first major varieties released in 10 years (it usually takes about 20 years to create a new blueberry variety) and are now planted on several thousand acres.

Other scientists also are working to ensure that Michigan growers remain atop blueberry hill. MAES horticultural scientist

Eric Hanson conducts projects on blueberry production techniques and management strategies for weeds at the Southwest center. Pollination is critical to blueberry production, and bees do almost all the pollination for blueberries. Honeybee and other pollinator populations have been declining, so MAES entomologist Rufus Isaacs is studying ways to attract native bees and other pollinators to blueberry fields. Working with Doug Landis, another MAES entomologist, and graduate students Anna Fiedler and Julianna Tuell, Isaacs helped rank 54 native plants according to their ability to attract beneficial insects, including pollinators. Isaacs and Tuell are also studying other ways, such as providing nesting boxes and modifying cultural practices, to attract native bees to blueberry fields. The researchers also conducted the first comprehensive survey of native bee populations in the state's blueberry crop.

"A long-term goal of our research is to help blueberry growers make sure their crops get maximum pollination each year," Isaacs said. "This depends on having a diversity of pollinators to get the pollen moved from flower to flower."

Fighting Fruit Pests

Research at the Trevor Nichols Research Complex is aimed squarely at achieving one goal: developing effective ways to control the insects and diseases that attack fruit and then getting the most current and critical information out to growers through a variety of methods.

Registering new pesticides for use is an expensive, time-consuming process — justifiably so, considering that all involved want to make sure each compound is effective on its target but safe for humans, animals and the environment. Developing a new pesticide can take 7 to 8 years and cost between \$50 million and \$100 million. To offset the cost, most companies develop pesticides for the most widely grown crops: corn, wheat, soybeans and cotton, which are seeded on millions of acres across the country. But crops planted on fewer acres (called specialty crops), such as fruits, need pest control solutions, too. The Food Quality and Protection Act, signed into law in 1996, changed how the U.S. Environmental Protection Agency (EPA) regulates pesticide use and required that the EPA reregister all compounds registered before 1984. Chemical companies began dropping products used to control pests in specialty crops because the size of the market didn't justify the cost of registration (or reregistration) and the continued manufacture of the products.

Since 1963, Interregional Research Project No. 4 (IR-4) has worked with growers and chemical companies to register pesticides for use on specialty crops. Four regional labs participate in the program, including one at MSU. Twelve Midwestern states run their registration projects through MSU, which then works with the other regional labs and the IR-4 headquarters at Rutgers University to obtain national registration for a product.

Trevor Nichols is an official IR-4 good laboratory practices research center and conducts more testing on chemical residues in fruit than any other facility in the region. Researchers at the station have established a screening program for new reduced-risk compounds to control fruit pests that helps them identify potential new candidates for EPA registration.

"This station has met special EPA requirements, including not harvesting or selling any of our fruit, so we can work with experimental pest control compounds that aren't registered yet," explained research coordinator Wise, a 20-year veteran of the station. "We're one of the few facilities in the state that is capable of conducting this work. We can intentionally build up high populations of pests to study how well a new treatment works. This IR-4 work is done as a service to the specialty crop industry, and the leadership of each fruit commodity group is well aware of the work we do here."

Scientists at Trevor Nichols are also heavily involved in studying pest control techniques that can be used by organic fruit growers. Pest monitoring and scouting are key components of a strong integrated pest management program. Instead of routinely spraying whether pests are in the crop or not, growers apply chemicals only when pest populations reach levels that will harm the crop. MAES plant pathologist Annemiek Schilder is testing a variety of Organic Materials Review Institute-approved fungicides to control grape and blueberry diseases. New and better techniques for monitoring pests, such as using plant volatiles to attract insects and building new trapping systems, are developed at the station. MAES entomologist Isaacs has done some of his research on plants that attract native pollinators at Trevor Nichols, as well as projects on using cover crops to control insect pests.

"We also support [MAES entomologist] Larry Güt's codling moth pheromone mating disruption research," Wise explained. "About 25 to 30 percent of our apple acreage is devoted to that."

Pheromone mating disruption floods an apple orchard with the scent of female codling moths, considered the worst apple pest in Michigan, to so overwhelm and confuse the male moths that they can't find a female and mate. No mating means no larvae, the wormy stage that bores into apples, leaving the fruit full of holes and impossible to sell. At Trevor Nichols, researchers are evaluating various ways to place the pheromone sources in orchards, including twist-tie tags, microencapsulated sprays and a microsprayer developed by MSU agricultural engineers.

Trevor Nichols also is home to a new rainfall simulation chamber, which can be used to evaluate how rain affects pesticides in the field, as well as the amount and environmental impact of any pesticide wash-off/run-off.

"A number of chemical companies have these types of units, but I'm not aware of any other public institution that has a rainfall simulation chamber for fruit research," Wise said. "We're very excited about the research it allows us to do."

Like all the MAES field research stations, Trevor Nichols hosts graduate students during the summer, giving them a unique opportunity to immerse themselves in the research.

"Working with insects in the lab is one thing, but I think you really have to see the ebb and flow of insect cycles to fully understand the research," Wise said. "We use infrared night vision goggles to monitor and count how many insects come out at night and at dawn and dusk. You have to be there to do that type of research. You can't do it in a lab on campus."

::: Jamie DePolo

maes research squashes (and beets) the competition

*Field station studies allow
growers to see results without
travelling to campus*

Michigan ranks second nationally in the sheer diversity of crops the state grows, and this variety is especially obvious in vegetables. The state is the country's top producer of black beans, small red beans and cranberry beans, pickling cucumbers, squash and vegetable-type bedding plants. It ranks second in production of dry beans overall, fresh market carrots and celery, and is in the top 10 for asparagus, navy beans, snap beans, light red kidney beans, processing carrots, sugar beets, dark red kidney beans, pumpkins and potatoes.

Mirroring this diversity, a number of MAES field research stations focus on vegetable research, with three stations focusing on vegetables almost exclusively. Scientists at the Saginaw Valley Research and Extension Center in Frankenmuth conduct considerable research on dry beans, sugar beets and affiliated crops; the Montcalm Research Farm in Lakeview hosts research on potatoes and dry beans; and the Muck Soils Research Farm in Laingsburg is home to studies on carrots, celery, onions, lettuce, potatoes and other vegetables. Some breeding and variety trial research can be done on campus, but field station test plots are grown under the same weather, pest and soil conditions faced by area farmers.

"It's important to conduct research on the questions asked by growers at facilities that are actually in the growers' areas," said Jim Kelly, MAES dry bean breeder, who serves as research coordinator at the Saginaw Valley Research and Extension Center. "Farmers feel more involved and have more confidence in the results when they can actually see the fields and the crops — they have confidence that the research has relevance to them and their practices. As researchers, we can react to whatever happens that year. It's a direct application of research."

"The soil types at the Montcalm Farm aren't available on campus," added Dave Douches, MAES potato breeder and Montcalm research coordinator. Douches also conducts potato research at the Lake City Experiment Station in Lake City and the Muck Soils Farm. "The Montcalm Farm is in the middle of Michigan's potato growing area and allows us to mimic commercial production."

"The Muck Farm has been particularly valuable for research on foliar diseases of potatoes and other vegetables," said Darryl Warncke, MAES crop and soil scientist,

MAES crop and soil sciences researcher Darryl Warncke has coordinated research at the Muck Soils Farm since 1976. The farm is one of only three muck research facilities in the United States.



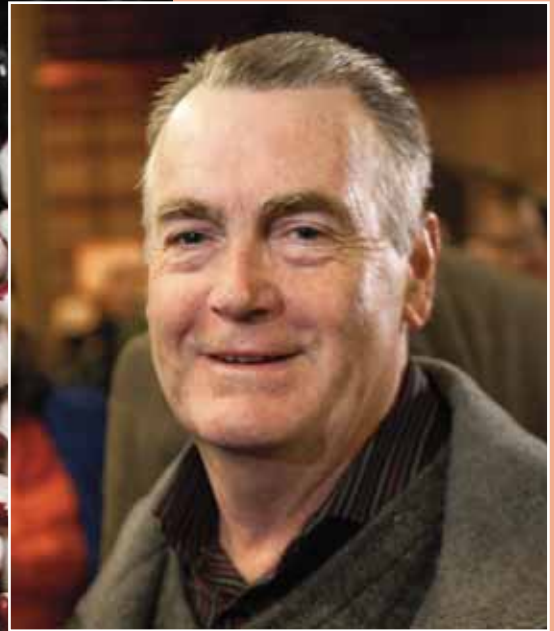
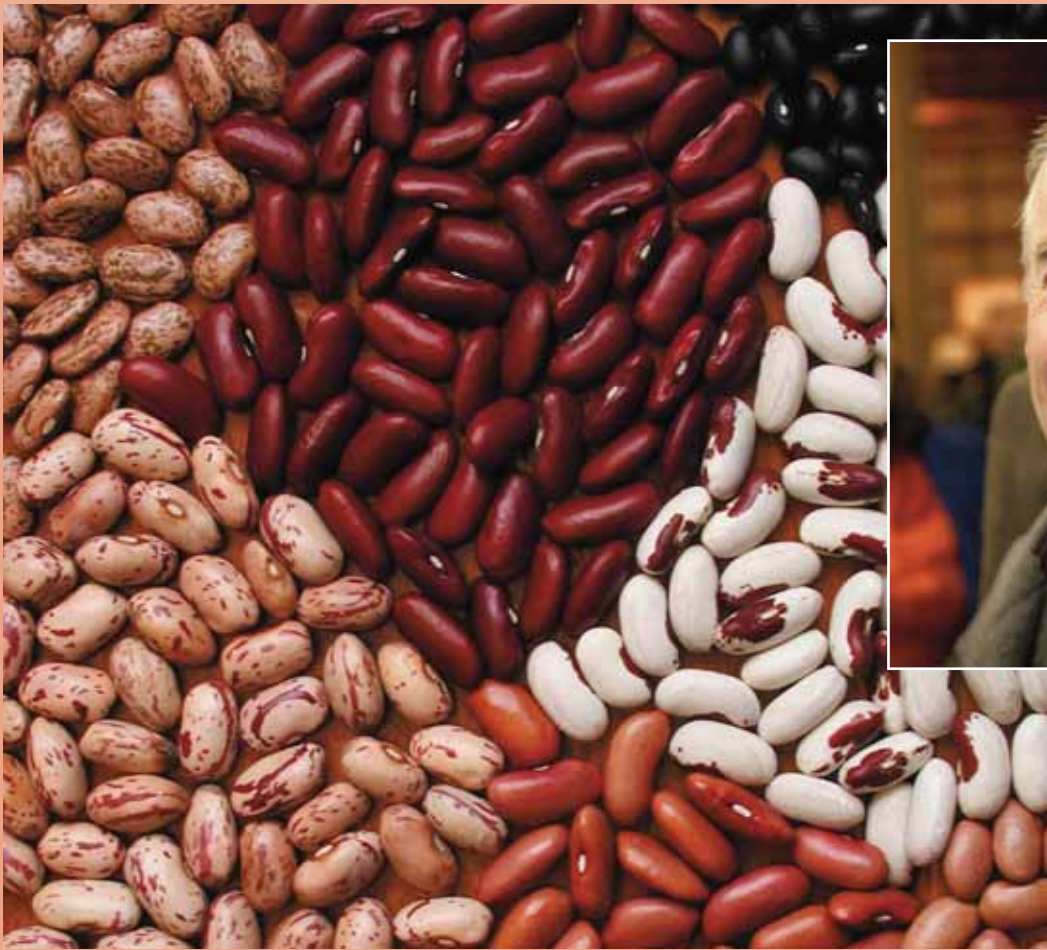
who has coordinated research at the farm since 1976. “Quite a bit of potato late blight research has been done there, too. Because the farm is isolated, new controls and management techniques can be tested without any risk to growers. The potato growers have been very supportive of the research conducted here.”

● A New Research Home in the Thumb

Established in 1971, the 120-acre Saginaw Valley Bean and Beet Research Farm was a partnership between the Farms and Industry Manufacturers Beet Sugar Association, the Michigan Bean Shippers Association and the Michigan Bean Commission, which purchased land in Saginaw and leased it

to MSU for use as a field station. From its inception, the main focus of the Bean and Beet Farm was to develop and introduce profitable new technologies for dry bean and sugar beet production systems. Research to develop upright-growing beans, which keep seed pods off the ground and dramatically improved yields, and new bean and beet variety development were done at the Bean and Beet Farm. MSU scientists, many of them affiliated with the MAES, released 40 varieties of beans in the 20th century.

Earlier this year, the MAES relocated and renamed the Saginaw Valley field station to expand research opportunities and improve grower access to research results. The 250-acre Saginaw Valley Research and Extension Center opened



Jim Kelly, MAES dry bean breeder, serves as research coordinator at the Saginaw Valley Research and Extension Center. The MAES relocated and renamed the facility earlier this year to expand research opportunities and improve grower access to research results.

April 3 in Frankenmuth. The former research farm is being donated to MSU to sell.

“We needed more land to expand our mission and to more fully meet the needs of an important agricultural region in Michigan,” said Doug Buhler, MAES associate director. “We’re also looking forward to developing more of a focal point for MAES, MSU Extension and MSU programs in the Saginaw Valley/Frankenmuth area with this new location.”

“Michigan’s climate, soil profile and growing seasons vary dramatically from north to south and east to west, so the geographic locations of MAES field stations are critical to providing accurate, economically relevant information to growers,” Kelly added. “Although very uniform, the soil types at the former farm were representative of only about 5 percent of the soils in the region. If you’re doing fertility research, you need to have a wide range of soils. The new farm better represents the soil types and weather variables of the area, which is important because the climate can change every 10 miles due to the lake effect.”

The new research farm also is located in an area close to where the state’s major cash crops — sugar beets, beans, corn, wheat and soybeans — are grown.

“The previous site was a little out of the mainstream because it was on the west side of Saginaw,” Kelly continued. “It was less convenient for farmers to visit.”

“We’ve created a great opportunity for bean growers and

processors in Michigan to have a strong basis for research,” said Bob Green, executive director of the Michigan Bean Commission. “There is close collaboration between MSU scientists and industry research at the facility. It brings everyone together so anything new and cutting-edge gets transferred to the industry fairly quickly.”

“Extensive research was performed at the old Saginaw Valley Beet and Bean Research Farm that helped advance the dry bean and sugar beet industries in Michigan,” said Ray VanDriessche, director of community and government relations for the Michigan Sugar Company. “The cooperative working relationship between MSU and these groups has produced research that has allowed Michigan growers to be national leaders in a variety of commodities, and the new farm will allow us to strengthen that leadership. There also will be an opportunity to conduct research on other rotational crops, such as corn, wheat and soybeans. These are crops we already have in rotation with sugar beets and dry beans, so it makes for a very good fit.”

Kelly said that all the research that was under way at the former farm will move to the new site this year, and new plots will be started.

“We could possibly do some of the research on campus, but it wouldn’t have the immediate application,” he said. “In my own bean breeding research, for example, I like to have test plots in the actual production areas. Varieties behave

differently depending on weather and soil type. A variety that doesn't perform under real-world production conditions doesn't do anyone any good. The bottom line is that we need to be where the growers are."

● Special Spaces for Spuds

Michigan potato growers' average yield in 2007 was 350 hundredweight per acre, a record high for the state. The total crop — nearly 15 million hundredweight — was valued at more than \$123 million. To help keep the industry thriving, Michigan potato growers depend on research done at the Clarksville, Lake City, Montcalm and Muck Soils farms for information on new varieties, storage, insects and diseases.

"The field stations are multifunctional," Douches said. "Each one has conditions that make it a good location for certain research, whether it's variety testing or disease studies."

Late blight, a potato disease caused by the water mold *Phytophthora infestans*, can spread rapidly in wet, hot conditions — such as those in Michigan in the summer. When conditions are right, the disease can kill all the foliage in a potato field within 3 weeks of infection. Besides the leaves, the pathogen can infect potato tubers at any time in the field as well as while the potatoes are in storage. The spores that spread the disease can live through the winter in piles of cull potatoes and can infect seed potatoes used for planting the next year. The disease is always a threat for Michigan growers, so fields are carefully monitored for the first signs of the

disease — small dark lesions on the lower leaves of the potato plants. With funding from Project GREEN, the state's plant agriculture initiative at MSU, a network of late blight risk monitoring stations has been set up around the state. Available via the Web at www.lateblight.org/forecasting.php, the site allows a grower to click a link close to his or her farm to see if late blight has been reported.

Though no potato varieties are completely immune to late blight, Jacqueline Lee and Missaukee, varieties developed by Douches and released by MSU in cooperation with the Michigan Potato Industry Commission (MPIC), are considered highly resistant.

Willie Kirk, MAES plant pathologist, focuses almost all of his research on potato diseases, including late blight. Each year, he and visiting scientist Phillip Wharton release spores and induce a late blight epidemic at the Muck Soils farm to study new cultural controls and fungicides. Kirk and Douches also collaborate on the program to breed late blight resistance into new potato varieties.

"The Muck Farm has emerged as an ideal place to do late blight research because it's isolated and the cool, humid conditions at the farm allow late blight to take hold," said Ben Kudwa, MPIC executive director. "Michigan potato growers have a unique relationship with MSU and the MAES field research stations. This is an academic, technical and industry partnership that has greatly helped farmers keep late light under control. Containing a disease that caused



MAES potato breeder Dave Douches conducts field trials of new potato varieties at several of the field stations, including the Montcalm Research Farm.





MSU President Lou Anna K. Simon (*center*) attended the ceremonial groundbreaking of the relocated Saginaw Valley research station in Frankenmuth. Also attending were (*left to right*): Joe Cramer, Star of the West Milling Co. vice president of edible bean marketing; Tom Coon, MSUE director; Charles Bauer, Michigan Sugar Company board member and sugar beet farmer; Steve Pueppke, MAES director; Simon; Jim Byrum, Michigan Agri-Business Association president; Mark Flegenheimer, Michigan Sugar Company CEO; Robert Green, Michigan Bean Commission executive director; Jack Frank, Michigan Bean Commission board member and bean farmer.

the great Irish potato famine is a major accomplishment.”

“The Muck Farm is far away from the state’s potato production area, so late blight spores can be released there with no worry about infecting commercial fields,” Douches explained. “It’s one of the few places in the country where late blight can be studied like that.”

Douches’ breeding program is also hugely important to Michigan growers. By combining traditional crossbreeding programs and biotechnology, he’s released seven new varieties over the past 20 years (it takes 10 to 12 years to develop a new potato variety) and has three others being considered for release. Michigan is one of the country’s top producers of potatoes for chips, and growers want very specific traits in these potatoes: low sugar content, bruise resistance, a high level of solid material and excellent storage ability.

“So we start with that,” Douches said. “Besides late blight, growers also need potatoes to be resistant to scab and the Colorado potato beetle, and to have high yield per acre.”

Douches said the field stations are invaluable to his work.

“As a breeder, I need multiple environments to test the new varieties,” he explained. “If we had only one site, it would narrow our focus. Multiple sites around Michigan give us a better idea of the genetic capabilities of the various lines. There’s really no value to having just one, big experimental farm that does everything. We’re very fortunate to have the stations scattered throughout the state. That allows us to fulfill our mission.

“We’re also very fortunate to have good managers and staff members at the farms and exceptional support from the Michigan potato growers,” Douches continued. “The growers know where the farms are and what type of research is being done. Because it’s in their area, it makes the research more meaningful.”

Potato chip manufacturers need to be able to store potatoes until they’re processed, so storage ability is a key trait for Michigan growers. Most commercial storage facilities house about 10,000 hundredweight of potatoes. If the potatoes at the bottom of the pile are going to succumb to pressure bruises, growers don’t want to plant that variety.

In 2000, the MPIC funded the construction of the B.F. Cargill Demonstration Storage Facility next to the Montcalm Farm. The facility allows Douches and other scientists to simulate potato storage by processors and study if a new variety is susceptible to bruising during storage.

“Processors won’t buy bruised potatoes,” Douches explained. “If a variety doesn’t store well, it won’t work.”

About a year ago, the MPIC built another demonstration storage facility at the Montcalm Farm, this time to study disease control in stored potatoes.

“This storage is separate from the variety demonstration storage building and is in its first year of use,” Kudwa explained.

“This is truly a partnership between the growers, the processors and the university,” Douches added. “The facilities allow us to simulate how potatoes are really stored so the farmer doesn’t have to take the risk.”

● Mucking About

Besides its ideal location for research on potato late blight, the Muck Soils Research Farm is also distinctive for its soil — 55 acres of prime Houghton muck. Muck soils are made up of the well-decomposed remains of plants and other organisms and have a higher moisture concentration than sandy or mineral soils. The soil at the Muck Farm contains about 80 percent organic matter. The research acreage is fenced to keep deer from eating the vegetables.

“The Muck Farm is one of only three muck research facilities in the United States,” Warncke explained. “The others are in Ohio and Florida.”

The majority of muck soils occur in the northern part of the country; Michigan and Minnesota have the largest amounts of peat lands, from which muck soils originate. Muck soils develop in low wetland areas, and ensuring proper drainage can be challenging for growers. Traditionally, muck farmers grew celery, onions, lettuces, radishes, carrots, sweet corn and cabbage. As agricultural technology has improved, some of the crops can now be grown on irrigated sandy soils.

“Some carrot acreage has shifted from muck to mineral soils with the development of better irrigation systems,” Warncke, a soil fertility expert, explained. “With proper irrigation, you can grow some of the vegetable crops on mineral soils.”

Much of the research at the Muck Farm is devoted to evaluating new chemical and cultural techniques to control vegetable diseases, insects and weeds, as well as improving production and yield with new fertilizers and other soil amendments.

“We can do research at the Muck Farm that we can’t do anywhere else,” Warncke said. “We certainly couldn’t do this type of research on growers’ farms. For example, the entomology group studied the life cycle and natural predators of the onion maggot and evaluated the effectiveness of various management techniques. You can’t do that on a commercial farm — the losses would be too great.”

As a result of the research, MAES scientists were able to make recommendations to growers on how best to manage the maggot that included changing spraying habits. The maggots were better controlled and growers were pleased.

Each year, research results are summarized in an annual Muck Crops Research Report and presented each December at the Great Lakes Fruit, Vegetable and Farm Market Expo.

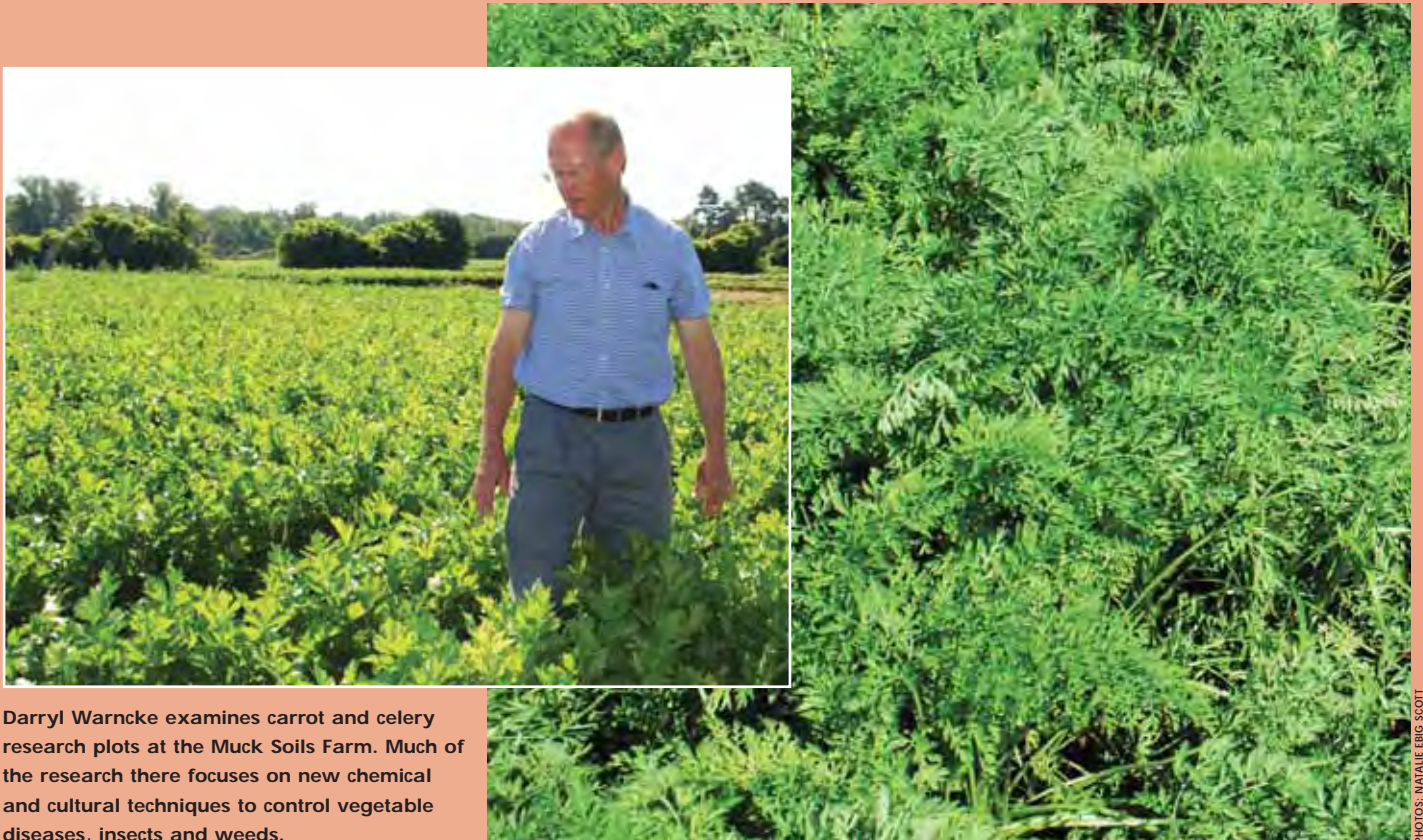
Both Warncke and Muck Farm manager Ron Gnagey are retiring in 2009, but Warncke said the cooperative research will continue.

“The research is a cooperative effort of researchers in the departments of Crop and Soil Sciences, Entomology, Horticulture and Plant Pathology,” he said. “The Land Management Office created a user committee for research coordination to ensure that all the areas were represented.”

Serving on the committee are Chuck Reid, Land Management Office director; Doug Buhler, MAES associate director; Brian Cortright, plant pathology researcher; Walter Pett, entomology researcher; Ray Hammerschmidt, Department of Plant Pathology chairperson; Dave Douches, MAES potato breeder; Mathieu Ngouajio, MAES horticultural researcher; Willie Kirk, MAES plant pathologist; and Mitch Fabus, the new Muck Farm manager, who started April 6.

“Growers are supportive of the facility and have benefited from the work done there,” Warncke said. “Michigan ranks in the top 10 for many vegetables, and research conducted at the Muck Farm helps keep our growers competitive.”

∴∴ *Jamie DePolo*



Darryl Warncke examines carrot and celery research plots at the Muck Soils Farm. Much of the research there focuses on new chemical and cultural techniques to control vegetable diseases, insects and weeds.

PHOTOS: NATALIE EBIG SCOTT

Where's the

Beef?

As spring warms into summer, the covers come off the barbecues and many Michigan residents' minds turn to one thing: beef. Hamburgers, steaks, kabobs, ribs — they all seem to taste better on the grill.

Beef cattle are raised on about 14,400 farms across the state and add about \$295 million to the state's economy, according to numbers provided by the Michigan Beef Industry Commission. With about 9.5 million consumers in the state, the industry estimates that it meets about a third of the demand with local beef.

To keep beef producers and their cattle happy, healthy and competitive, MAES scientists work on campus as well as at field research stations in the northern Lower Peninsula and the Upper Peninsula.

"It's a real asset for us as researchers and for the beef producers that we have these stations," said Dan Buskirk, MSU animal science researcher, who focuses on beef cattle nutrition and has projects at both the Lake City Experiment Station and the Upper Peninsula Experiment Station, in Chatham. "We're basically conducting the research in their backyards, and the producers are very interested in what we're doing."

"The campus beef facilities are great for producers within an hour radius of East Lansing," said Janice Rumph, MSU Extension livestock educator and adjunct associate professor of animal science, who is based at the Lake City station in Missaukee County. "But it's more difficult for producers farther away to fully use them. Local producers stop into the Lake City station almost daily with questions."

"The research can be more focused at the field stations than it can on campus," said Janice Siegford, MAES animal science researcher, who specializes in studies on animal welfare. "The campus farms have multiple users, from students and classes to other scientists, all of whom may be looking at different things. On top of all that, they're trying to be productive. So it's a bit of a juggling act to make sure everyone's needs are met. At Lake City, there's not so much competition, and it's easier to coordinate and work on collaborative projects."

At the Lake City
and Upper Peninsula
field research stations.

Buskirk, Rumph and Siegford are among scientists who receive funding through the Rood Trust Fund, a program set up to support research on agriculture in the northern Lower Peninsula. Most of the projects are funded for a year, and many are conducted at the Lake City station.

Meat That Makes You Go Mmmmm...

Consumers want beef that is flavorful, tender and juicy — all of which are related to how well-marbled the beef is. A well-marbled piece of meat has a good amount of intramuscular fat, which makes the meat hold water and flavor. Beef with little or no marbling can



be tougher and less savory. Figuring out feeding strategies that create well-marbled beef with minimal external fat (back fat, for example) and meet the animals' nutritional requirements has been the focus of much research around the world.

One of Buskirk's projects at the Lake City station is investigating whether supplementing beef cattle feed with glycerin increases intramuscular fat. He had read about research on dairy cow nutrition that involved feeding glycerin to reduce ketosis (a metabolic disorder that often results in low blood sugar). The glycerin

increased blood glucose levels in the dairy cows, and Buskirk wondered if higher glucose levels would improve marbling because intramuscular fat cells use glucose for energy; external fat cells use acetate.

Glycerin is a byproduct of biodiesel production — every 10 pounds of biodiesel produced generates about 1 pound of glycerin — so Buskirk's research also may provide an elegant solution for that industry.

"I think the biodiesel industry would love to have a market for glycerin, rather than having to worry about disposing of it," he said. "Right now, glycerin is more



Animal scientists Janice Siegford and Dan Buskirk are collaborating on studies looking at whether less abrupt weaning strategies reduce calves' stress levels. The research was conducted at both the Lake City and Upper Peninsula field stations.

expensive than corn. But if it does increase intramuscular fat, it may be viable for glycerin to make up 5 or 10 percent of a steer or heifer's diet."

The growth of the state's biodiesel industry also may play a role. If the industry expands, there may be significantly more glycerin available — perhaps as much as 40 million pounds — and that would mean lower prices.

Buskirk has three trials going simultaneously — two at Lake City and one at the Upper Peninsula station. Two groups of calves were fed a diet supplemented with glycerin right after weaning and then transported to campus for finishing. The third group was given glycerin supplements while grazing pasture. Once all the animals are harvested, he'll examine the carcass quality. Besides looking at the levels of intramuscular fat, Buskirk also is evaluating the quality of glycerin as an energy source for beef cattle.

Could Weaning Be a Ball Instead of a Bawl?

During the weaning period, when beef calves are completely separated from their mothers and introduced to feed other than milk, producers often see a halt in growth because the calves spend a good bit of time walking around and bawling for their mothers rather than eating. Some researchers have speculated

that reducing this weaning stress could eliminate the growth check and improve beef quality.

"The calves go through two pretty big stressors," Siegford explained. "Food stress and emotional stress."

To see whether a less abrupt weaning strategy would reduce the calves' stress levels and improve carcass quality, Siegford, in collaboration with Buskirk, looked at two "kinder, gentler" weaning strategies at the Lake City station last year. She also did a similar project at the Upper Peninsula station.

The first, dubbed the fence-line strategy, separated the calves and cows with a fence in an effort to reduce emotional stress while still changing the food source.

"The calves could see, smell and hear the cows — basically everything but touch them," Siegford explained. "The calves didn't bawl as much as calves that were weaned using the abrupt strategy."

The second strategy, called the "two-step," inserted a plastic flap into each calf's nose. The flap, which wasn't implanted and didn't involve piercing the calves' noses, hung down far enough to block the calf's access to the teat, effectively eliminating its ability to nurse.

"With the two-stage study, the calves and cows could be together in the same pen, but there was no nursing," she said.

To measure stress, the scientists measured blood levels of the hormone cortisol. The results showed no differences in cortisol levels between the abrupt and less abrupt weaning strategies.

“Our results showed that the fence-line calves gained a little more weight at 5 and 14 days and also bawled more than the two-step calves,” Siegford said. “The two-step calves grazed more but didn’t gain more weight. We hypothesized that this could have been because the nose flap made it harder to graze, so they had to spend more time doing it to get the same amount of food. But there was no improvement in productivity or carcass quality.”

Siegford said her ultimate goal is to create a toolbox for beef producers that can be mixed and matched as needed or preferred.

“Depending on producers’ facilities or beliefs or the preferences of their consumers, they can use one of several weaning strategies that don’t change productivity or quality,” she said. “This gives them options.”

Siegford’s current project, also at the Lake City station, is testing another weaning strategy, a takeoff on the idea of comfort food. Instead of introducing grain abruptly at weaning, the project put troughs in a cow/calf pasture when the calves were 3 months old

and fed the cows 2 pounds of grain a day for 2 weeks, allowing the calves to become familiar with grain while still nursing. The researchers hypothesized that introducing grain in a non-stressful situation would reduce the calves’ food stress at weaning.

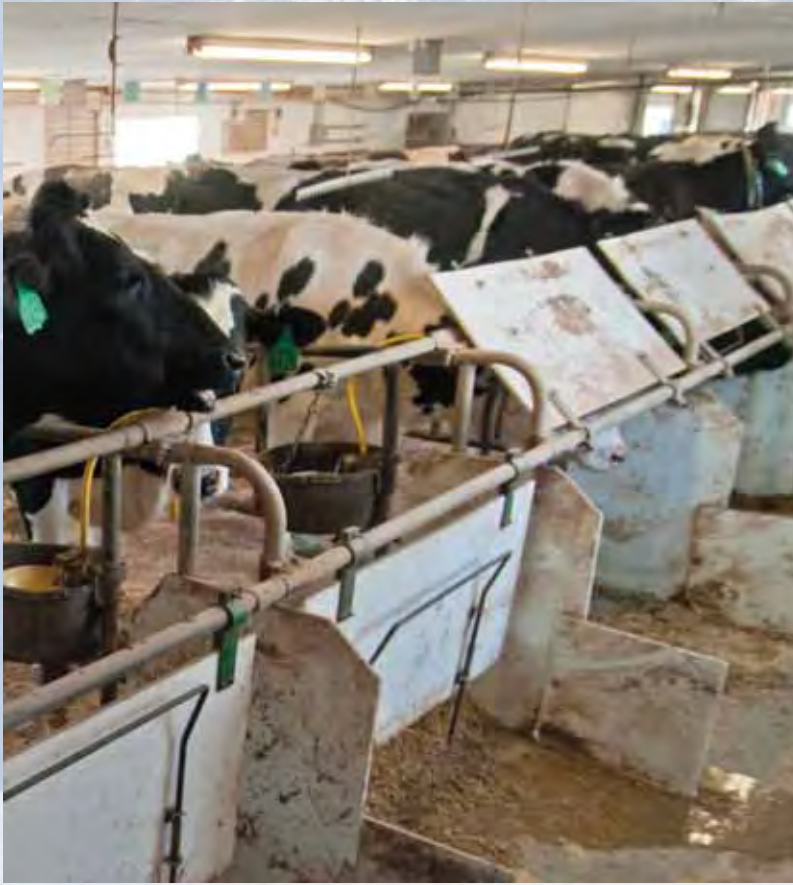
“We knew the cows would hog all the grain and the calves probably wouldn’t get any of it,” Siegford said. “But it gave the calves the experience of being at the trough with their mothers so they could see what all the excitement was about. They could also smell and lick the troughs after the cows were done and smell and lick their dams’ muzzles after they ate. Some of the calves actually did manage to push their way to the trough and eat some grain.”

At 6 months, the calves that had been exposed to grain were abruptly weaned and put into pastures with grain troughs. Other pastures, also with troughs, housed calves that didn’t have early exposure to grain. Though the scientists had only one day to observe the calves because of some malfunctioning equipment, they noted that the calves that had been exposed to grain did eat all or most of the grain in their troughs.

“The calves are on campus now being finished, and I’m very interested to see if there are any improvements in carcass quality,” Siegford said. “We should know in a few months.”



Doo-Hong Min, MAES crop and soil scientist based at the U.P. Experiment Station, conducts a variety of research on forages for beef and dairy cattle, including how tillage practices affect carbon sequestration and greenhouse gas production.



Evaluating Northern Forages

Prompted by producers' questions about mineral supplement recommendations, Rumph is starting a new project to test the nutrient availability in forages grown in the Lake City station area.

"The price of mineral supplements increased dramatically last summer," Rumph explained. "Most of this was based on higher phosphorus prices — phosphorus accounts for up to 65 percent of the cost of many mineral supplements. Producers wondered if they really needed to be adding that much phosphorus to their cows' diets."

Though mineral supplement prices have dropped somewhat this year, the producers' questions lingered. Mineral supplement recommendations were based on rough estimates of the nutritional content of northern forages, but no one had specifically tested forages grown in the area.

"This will allow us to make better recommendations," Rumph said. "We'll know the nutritional value of our forages."

In a companion project, MAES crop and soil scientist Rich Leep is evaluating teff, a major cereal crop in Ethiopia, as a forage crop for northern Michigan. Mainly grown in the United States as a source of gluten-free flour for people diagnosed with celiac disease, teff is becoming more popular as a quality summer forage grass.

Farther north, at the U.P. Experiment Station, MAES crop and soil scientist Doo-Hong Min is extensively testing forages for both beef and dairy cattle, as well as looking at how forage tillage practices affect carbon sequestration and greenhouse gas production.

Min said the research is important because alfalfa is the premium forage for Michigan's dairy industry. Until he began his work, no research had looked at the differences between no-till and conventional tillage practices in alfalfa-based forage systems. Other research around the country has shown that no-till sequesters more carbon than conventional tillage practices.

Min also is examining how grazing practices affect carbon sequestration. Because the animals naturally keep the pasture mowed, producers don't have to use fossil-fuel-burning machinery to cut it, which reduces greenhouse gas production. In addition, the plant bits — roots, leaves and stems — that die in the pasture are stored over time as stable organic carbon in the soil.

Min and forage research assistant Christian Kapp also conduct forage variety trials and post the results on the U.P. Experiment Station Web site: www.maes.msu.edu/upes/forage.htm.

We Have the Same Problems

All the scientists agreed that the field stations give producers more confidence in the results because the research is conducted under the same conditions they're facing.

"Producers in our area are struggling with deer problems and working to keep bovine tuberculosis out of their herds, and they know we're struggling with deer issues, too," Rumph said. "We're working with producers to conduct risk assessments of their farms using the Michigan Department of Agriculture's Wildlife Risk*A*Syst tool and then take steps to reduce any risk that's found, usually with fencing or changing feeding and water storage areas."

"Producers definitely understand the value of long-term research," Buskirk added, "and they keep up with it. They want to know what's sustainable."

"I don't have an MSU Extension appointment," Siegford said. "I'm strictly teaching and research, so doing projects at the field stations gives me access to producers. I try to do applied research and am very appreciative of the producer input and feedback I get. They're very innovative."

∴ Jamie DePolo



The Northern Frontier of Forestry *and Fuel* Research

“If you’re going to do research on trees, it makes sense to do it where the trees are,” said Ray Miller, who oversees forestry research at MAES properties in the Upper Peninsula. Miller also serves as director of the U.P. Tree Improvement Center (UPTIC) in Escanaba and MAES forest biomass development coordinator. “About 80 percent of the land in the U.P. is forested. That’s why the forestry field research stations are here. It makes no sense to have a forest research center in the middle of Berrien County.” ▼

Miller's ease at juggling various jobs and titles even extends to his unofficial "ambassador" duties that come with heading up one of Michigan State's northern-most outposts.

"We're the university's front door in the U.P.," he explained. "The field stations up here are the only thing some people know about MSU — they've never been down to campus. So to them we are Michigan State University. Other universities don't have this network. Combined with MSU Extension, which has offices in just about every county, the Michigan Agricultural Experiment Station network makes MSU unique in its ability to provide research and outreach to the state."

Trees cover 19.3 million acres in Michigan, which is a 5 percent increase since 1980, and more than half of Michigan's land, according to statistics from the Michigan Department of Natural Resources (MDNR). Most of the forested land is in the northern two-thirds

This is good for keeping plants healthy and helping them thrive, but it's a problem for making biofuels. Before the complex sugars can be converted into ethanol or other biofuels, they have to be broken down into simple sugars, such as glucose, by enzymes.

Doing that cost effectively has been the main issue slowing cellulosic biofuel production. Because the process is difficult to do efficiently, it can significantly raise production costs. This is why cellulosic biofuels aren't available commercially. Yet.

"In Michigan, our research and development emphasis is on making renewable fuels from cellulose," said Steve Pueppke, MAES director, who also serves as director of the MSU Office of Biobased Technologies. "Cellulosic biofuel allows the state to tap forestland to make fuel and sidesteps the 'food vs. fuel' issue that has been a subject of controversy."

With three forest research facilities in the heart of the region where forest biomass is produced, the

"The field stations up here are the only thing some people know about MSU ... so to them, we are Michigan State University."

of the state, and Michigan ranks fifth nationally in timberland acres (forestland classified as timberland must meet minimum timber production standards), behind Georgia, Oregon, Alabama and North Carolina.

Though the markets for forestry products have declined in some areas of the state, particularly in southeastern Michigan, the forest industry remains strong in the Upper Peninsula. About 150,000 jobs and approximately \$12 billion of the state's economy are credited to the forest industry, according to the MDNR.

As Michigan moves to shift its economy from one based on nonrenewable resources such as petroleum and coal to one based on renewable resources such as plant material, the state's vast forest resources make it a leader in this new bioeconomy.

Trees and other plants are a huge potential source of energy — each year, the biomass in the Earth's plants captures about eight times the total amount of energy used by people from oil, coal, natural gas, wind, water, etc. But about 90 percent of this energy in fibrous plant biomass isn't readily available because it's locked up in cellulose and hemicellulose, the complex sugars that make tree trunks, grasses, plant stems and stalks, and leaves rigid. Unlike the simple sugars in the grains of plants, such as corn kernels, cellulose and hemicellulose don't dissolve in water.

MAES is poised to help Michigan become a leader in commercial-scale production of cellulosic biofuels.

"We really don't know how much cellulosic ethanol will cost when it comes on the market, but there is a suspicion that it will cost more than ethanol made from corn grain," Miller said. "That said, we also know that the cellulosic ethanol industry will get more efficient, which will bring the price down. And we also may find that there are other biofuels, such as dimethyl ether, that may be better biofuel choices. There's a lot of research work to be done, and we're working to make Michigan a hub for it.

"There isn't one thing that's going to make us energy-independent," he continued. "It's not as simple as substituting one fuel for another. We have to use less and be more thoughtful about how we use it. People are worried about using forests for energy, but we're not talking about turning forests into farms. By working together, we can do this intelligently in a way that benefits both the economy and the environment."

From Forests to Fuels

Michigan State has been conducting research in the Upper Peninsula for more than 100 years. The two oldest off-campus properties are located in the U.P.: the Upper Peninsula Experiment Station (UPES), in Chatham, was established in 1899, and the Dunbar

Forest Experiment Station, near Sault Ste. Marie, was established in 1925. Though most of the research at the UPES focuses on carbon sequestration, forage, and beef and dairy cattle research, the Jim Wells Forest, MSU land near Au Train used for forestry research, is about 20 minutes away. Established in 1986, the U.P. Tree Improvement Center is located in the center of the state's forest industry. Miller manages the three forest research facilities from his base at UPTIC in Escanaba. *(See box on page 38 for more detailed descriptions of each forest research facility.)*

"Dunbar and UPTIC are the two biggest MSU forestry research properties," Miller said. "And the

data. But it makes sense to start that work there because it's so close to the site Mascoma has chosen for its plant."

As the bioproduct industry comes into its own, Miller expects to be able to provide private forestland owners with management guidelines should they be interesting in selectively harvesting some trees to sell to biofuel or bioenergy producers.

"Research on the management of natural forest systems has been ongoing at Dunbar for a while," he explained. "We have data on how best to manage stands in that area."

Biofuel research at UPTIC is a bit further along,



Ray Miller oversees forestry research at MAES properties in the Upper Peninsula. He also serves as director of the U.P. Tree Improvement Center and MAES forest biomass development coordinator. Miller's foresight in planting a poplar plantation in 1997 that was harvested last year has provided the first and only hard data on yields of trees grown specifically for biofuel production in Michigan.

bulk of the research occurs at those two sites."

Much of the ongoing research based at Dunbar is long-term genetics and silvicultural work started in the 1900s, but Miller explained that plans are in place to position Dunbar to tackle some of the issues that the Mascoma Corporation will face as it works to open a commercial cellulosic ethanol production plant in Kinross in Chippewa County, about 5 miles away from the Dunbar site.

"We're going to refocus parts of Dunbar to study forest biomass crops," he said. "We're working to clear the land and establish new plantations of willows and poplars, but it will take about 5 to 10 years until we have our first harvest and can gather any meaningful

mainly because Miller had the foresight to plant clonal trials of poplars and willows soon after being named director in 1988. He also put in a poplar plantation in 1997 that was harvested last fall, providing the first and only hard data on yields of trees grown specifically for biofuel production in Michigan.

"We're using the data to build computer models to simulate production so we can manipulate the variables," Miller said. "Our test plots were small and the productivity wasn't anywhere near what a commercial-size plantation would do. Once the models are done, we can see what happens if we use different equipment."

Miller said scientists also are building a computer

MAES Upper Peninsula Forest Research Properties

✦ Dunbar Forest Experiment Station

A 5,700-acre parcel of land near Sault Ste. Marie, the Dunbar Forest has been part of the MSU Department of Forestry's research, education and demonstration program since 1925. From 1940 through the mid-1970s, the forest hosted planting, cultivation and harvesting research programs, as well as a forest seedling nursery and a field program for forestry and civil engineering students from the main MSU campus in East Lansing. Much of the current research at Dunbar is based on the long-term genetics and silvicultural experiments that were started at the site many years ago. New research is being focused on forest biomass crops that can be used to produce bioenergy, which will help address any issues faced by the Mascoma Corporation as it works to develop a cellulosic ethanol facility in Chippewa County.



✦ Jim Wells Forest

Located near Au Train, between Munising and Marquette, the 440-acre Jim Wells Forest is about 20 minutes northeast of the U.P. Experiment Station in Chatham. The Wells Forest has been part of MSU since 1943, when tax-delinquent land was given to MSU by the state so the profitability of sound forest management could be demonstrated. The property is undeveloped, and researchers use a network of unpaved truck roads to navigate to sites in the forest. The management plan drafted by then-manager Maurice Day in 1946 is still being followed today.

✦ Upper Peninsula Tree Improvement Center

Established in 1986 when MSU bought an 840-acre beef farm in Escanaba, UPTIC expanded to its current size in 1987 when the Mead Corporation donated an adjacent 880-acre tract of cedar swamp. In the mid-1800s, the vast hardwood forests around Escanaba supplied charcoal to the region's pig iron furnaces. The land that would become UPTIC was cleared around 1890 and was incorporated into one of the first dairy farms in Delta County. Unlike other MSU forest research properties that were established on abandoned farms, UPTIC became part of the MAES field station network because it was so far away from agricultural markets. Forest genetics and tree improvement research has been a staple at UPTIC, but a new biofuel research center, operated in collaboration with Michigan Tech and housed at UPTIC, will allow scientists from both universities to work together to find solutions to the most complex problems facing the forest-based cellulosic biofuels industry.

model of the entire forest biofuel feedstock supply chain, which will help forest owners and bioproduct manufacturers get a better idea of how to ensure the supply chain is stable and sustainable. The model also will help answer specific engineering questions, such as the effects of bringing in new systems that have been successful in other areas but are untested in Michigan, such as harvesting techniques used in Sweden that Miller has studied during exchange programs with Swedish scientists. Wood-fired power plants are common in Sweden, a country that lacks natural gas and coal reserves but does have 69 million acres of forestland.

Learning from Sweden

On one fact-finding mission, Miller visited Skelleftea Kraft, a heat and power plant in Hedensbyn, Sweden, that also produces wood pellets (about the size and shape of guinea pig food), which can be burned in stoves to provide heat. The plant provides heat, power and cooling to residents and businesses in about a 4-mile radius around the plant through what's called district heating. In district heating, the plant sends heated water through pipes to each building in the town. The hot water circulates through radiators in each room, so different parts of a house or office building can be warmer or cooler as desired. Homes or businesses that are outside the district heat-

ing area receive bags of wood pellets that are burned for heat. In the summer, when demand for heat and power is low, the plant puts much of its energy into making pellets, which are then stored. In the winter, when heating demands are higher, the plant makes more steam heat.

Miller is intrigued by the concept of a coordinated heat/power/pelletizing plant for the smaller communities across the Upper Peninsula and northern lower Michigan.

"Even if district heating weren't implemented for homes because of concern about hook-up costs or replacing gas forced-air furnaces with radiators, it could be pilot tested in businesses and municipal buildings," he said. "As communities have to replace aging, inefficient power plants, we could test or demonstrate this concept. In some cases, consultants have recommended huge replacement power plants with huge price tags, which small communities don't need and can't afford. I think these smaller, efficient plants have real possibilities for Michigan."

But any sort of wood-burning power plant must have a steady supply of wood to burn. This is why the computer models will be invaluable as the industry emerges.

"We're consulting with a company that makes briquettes from wood waste, as well as a company that wants to open several wood-fired power plants in

the U.P.," Miller said. "But in some cases, they're having trouble getting enough fuel. The models can help us look at the situation holistically and make sure that all users' needs are met."

Because the forest industry is still strong in the U.P., any company using trees to produce fuel or energy is in competition with existing paper mills and other forest product businesses. Still, the state

Martin Dober, MEDC vice president of new markets, said the research at the center will build on work funded through the state's Forest Feedstock Supply Chain Center of Energy Excellence. MSU and MTU received \$2 million through this program to support Mascoma's proposed plant.

The center further strengthens the forest-based biofuel relationship between Michigan State and

"Policy could have a huge effect on the future of Michigan's bioeconomy. That's why we're working so hard to provide sound, science-based information."

grows more trees than it uses and has the potential to grow even more in energy plantations, so meeting the increased demand is possible.

"The infrastructure to harvest and handle trees for cellulosic biofuel production won't be fully developed until there is a market," Miller said. "Policymakers need to look at what will entice biorefineries to locate here, as well as what will entice landowners to cultivate the types of trees needed for biofuel production. Policy could have a huge effect on the future of Michigan's bioeconomy, perhaps even more than technology. That's why we're working so hard to provide sound, science-based information."

Federal Support for Michigan Biofuel Research

Biofuel research at UPTIC got a boost with a \$1.4 million allocation in the federal omnibus spending bill passed in March. The funding created the Forestry Biofuel Statewide Collaboration Center, to be based at UPTIC, and will allow MSU and Michigan Technological University scientists to work together to find solutions to the most complex problems facing the forest biomass cellulosic biofuels industry. The center's funding is from the U.S. Department of Energy and is being distributed by the Michigan Economic Development Corporation (MEDC).

"The center will be a place where new and existing research, development and outreach projects at Michigan State and Michigan Tech can be focused," Miller explained. "We'll be investigating and demonstrating the best ways to use the state's forest resources to expand the state's rural economies in environmentally, economically and socially sustainable ways."

Michigan Tech, about 140 miles northwest of Escanaba in Houghton, which Miller coordinates wearing his forest biomass development coordinator hat. The collaborative research, outreach and economic development programs are overseen by an eight-member Renewable Fuels Working Group made up of four scientists from each university. According to Miller, UPTIC's location made it the logical site for the new center.

"Escanaba is somewhat of a midpoint between Houghton and Sault Ste. Marie, so we can serve as an operations base and an equipment storage facility," Miller said. "We're much closer to Michigan Tech and the proposed Mascoma plant than the main MSU campus, and we have technicians on site that are available to work on projects. Having the field stations up here makes the research more efficient."

The U.P. forestry field stations also provide visibility and accessibility to local forest owners and managers. The fact that the research is done on the same soil types and under the same weather, disease and insect conditions resonates powerfully with local growers.

"When we're making recommendations about what to do with land, we need to have experience with land and trees in that area," Miller added. "We have to have local experience to be credible. People up here are faced with the choice of driving an hour to visit UPTIC and see the results of research that has been done in the U.P. or taking a day to fly down to Lansing and visit campus to see research results that have been done under conditions that are different from what they have. There's really no comparison."

::: Jamie DePolo

Research *in the news*

MAES Discoveries Upend Traditional Thinking about How Plants Make Certain Compounds



Rob Last

An MAES plant scientist helped identify two new genes and two new enzymes in tomato plants; those findings led the research team to discover that the plants were making monoterpenes, compounds that help give tomato leaves their distinctive smell, in a way that flies in the face of accepted thought.

On the basis of years of research, scientists thought that plants always used a specific compound, geranyl diphosphate, to make monoterpenes. But MAES biochemistry and molecular biology scientist Rob Last and postdoctoral researcher Anthony Schillmiller were part of the team that found that tomato plants use a different compound, neryl diphosphate, as the substrate for making monoterpenes. The difference is subtle, but the discovery will change the way terpene research is done. The research was published in the May 25 issue of the *Proceedings of the National Academy of Sciences*.

“Essentially, this work subverts the dominant paradigm about an important and widespread pathway in plants,” Last explained. “For years it was known that monoterpenes are made in a specific way. But there were cases where that pathway likely wasn’t involved, given the kinds of compounds found in specific plants. We showed that in tomato trichomes [small hair cells located mainly on the plant’s leaves and stems], the established pathway is wrong. In the tomato trichome, two enzymes work together to make the monoterpenes in a previously unsuspected way.”

The two newly identified genes, neryl diphosphate synthase 1 (NDPS1) and phellandrene synthase 1 (PHS1), cause the tomato plant to make the new enzymes that produce the monoterpenes.

As the team was sequencing the DNA of tomato trichomes, Schillmiller and Eran Pichersky, of the University of Michigan, noticed that there were many sequences from genes that weren’t supposed to be involved in monoterpene production. Because the sequences were found so frequently, they hypothesized the genes must be making high levels of compounds in the trichome.

“We had to think outside the box to figure out what the function of NDPS1 and PHS1 were,” Schillmiller said. “Our colleagues at the University of Michigan, Eran Pichersky and Ines Schauvinhold, were instrumental in coming up with theories and running the assays.”

Terpenes are the largest class of molecules made by plants — tens of thousands of terpenes have been identified. Some of the known functions of terpenes include attracting pollinators, repelling pests and protecting the plant from diseases, as well as giving many plants their smell and taste. The aroma of many plants, such as mint and basil, come from terpenes.

These new discoveries will allow other scientists to look for similar genes in other plants and perhaps discover new enzymes that make monoterpenes, which could lead to new ways to protect plants from pests.

Other co-authors from MSU are Amanda Charbonneau, biochemistry and molecular biology research assistant; and Matthew Larson and Curtis Wilkerson, of the bioinformatics core of the Research Technology Support Facility; from U-M are Adam Schmidt and Richard Xu.

This research is funded by the National Science Foundation.

‘Green Chemistry’ Could Ease Manufacture, Boost Usefulness of Cancer Drug

Research by MAES chemist Kevin Walker is paving the way for potentially cleaner, more efficient production of cancer-fighting paclitaxel — better known as the blockbuster drug Taxol.

First isolated from the bark of the Pacific yew in 1967, paclitaxel has since been made

by synthetically modifying an intermediate substance isolated from yew needles using toxic solvents or by fermenting cell cultures.

Walker’s method employs natural enzymes instead.

“Pharmaceutical companies could reduce the steps involved in making Taxol,” he said, “while cutting chemical byproducts.”

Walker studies enzymes that assemble the Taxol molecule in *Taxus* plants.

“This process is like painting from a palette,” Walker said. “We can add select colors to the palette from which the enzyme chooses, so the molecule can be crafted in a variety of ways. The enzyme does all the work.”

“A plant enzyme can do in one step what traditional synthetic construction does in multiple steps,” Walker said. “Under our process, the construction of Taxol uses a biological assembly line where each enzyme does its job to create the final product. Particular enzymes on the assembly line can attach slightly different components on the molecular frame to create new-generation Taxol molecules. This can lead to more effective drug variants and eventually better healthcare treatment.”

Taxol “is definitely a frontline drug and is used to treat many cancers,” including those of the breast, lung, head and neck, said Barbara Conley, chief of the MSU Department of Medicine’s hematology and oncology division.

The world bulk paclitaxel market generated revenues of \$195 million in 1997. Potential new uses for conditions such as Alzheimer’s disease and tuberculosis are expected to help boost the world market by 10 percent by 2012, according to Global Industry Analysts Inc.

“The science and technology of plants and natural systems are becoming increasingly relevant in human medicine as scientists look for greater efficiencies and ‘greener’ ways of manufacturing drugs and other healthcare products,” said MAES director Steve Pueppke. “Engaging in research that leads to improvements in human and animal health is a large and important part of the MAES mission.”

Assisting Walker in the research were graduate students Danielle Nevarez, Yemane Mengistu and Irosha Nawarathne. The findings were published in the *Journal of the American Chemical Society* in April.

Research in the news

Research Finds Southwestern Michigan Abuzz With Native Bee Species



How many kinds of bees can the average person name? Most folks throw in the towel after spelling, quilting, honey and bumble. Julianna Tuell, postdoctoral researcher who works with MAES entomology scientist Rufus Isaacs, can name a far greater number, but even she was surprised at what she found in the blueberry fields of southwestern Michigan.

As is the case for all horticultural crops, pollination is a critical step in blueberry production. Typically, domesticated honeybees are put on the job. Growers rent hives that are placed near fields, giving the insects access to the flowers from which they gather nectar and spread pollen from blossom to blossom, fertilizing the year's crop.

Blueberry growers have been concerned about the loss of wild honeybee colonies, which made them more dependent on rented colonies, and wanted to learn more about what other bees help pollinate their crop.

"They were concerned that honeybees weren't interested in some cultivars, and they wanted to know what other options there were," Tuell said.

To help answer the questions, she led a research team that collected, counted and categorized bees found in blueberry fields for 3 years on 15 southwestern Michigan farms. The scientists knew they would find native pollinators in the fields they studied because blueberries are native to North America. What they didn't expect was the sheer number of bee species buzzing in the blueberry blossoms.

"We found 112 species during blueberry bloom, and 166 species overall," Tuell said. "They aren't all visiting blueberries, but at least half of them are contributing to pollination. There's a really wide diversity of bees across the season, with some that pro-

vide pollination during bloom and are also active later in the season."

The team found seven bee species that had never been found as far north as Michigan. These findings, published in the *Annals of the Entomological Society of America*, describe a more diverse ecosystem in managed blueberry fields than scientists had imagined and also mean that growers may have more pollination options than they thought.

"If you have a small field, you're likely to have a large number of these native bees that can provide a portion of the pollination work," Tuell said. "In large fields, growers are more dependent on honeybees because there isn't the density of native bees to do the pollination."

Native bees are active in the fields before, during and after blueberry bushes bloom. Farmers who time pesticide applications to avoid flowering and who don't spray during the day or when it's windy can help these bees survive and be around for the next season.

Tuell and Isaacs are using the research results to help growers time spray applications so natural pollinators aren't affected.

"This research fits with the MSU Extension programming we've done to talk to blueberry growers about conservation strategies they might implement to make their fields more sustainable for native bees," Isaacs said. "We call it the closing of the circle. We got the input from the growers, we did the research, and then the results go back to the growers through workshops and a bulletin to put the information into their hands."

Besides the MAES, the research is funded by Project GREEN (Generating Research and Extension to meet Economic and Environmental Needs), the plant industry initiative at MSU; MBG Marketing; and a C.S. Mott predoctoral fellowship in sustainable agriculture.

New Obesity-Cancer Risk Link Discovered by MAES Scientists

A new link between body fat and colon cancer identified by MAES researchers underscores the need to fight obesity and could lead to new cancer treatment and prevention strategies.

The research is the first to show that high-levels of leptin, a hormone that regulates

body energy, induces precancerous colon cells to produce more of a growth factor that can increase blood supply to early cancer cells and promote tumor growth and progression. Obese people have higher levels of leptin. The study was published in the April 30 issue of *Carcinogenesis*.

"Adipose tissue, or fat, is recognized as a significant risk factor for diabetes and heart disease, but the role of adipose tissue in cancer risk is less understood," said Jenifer Fenton, MAES food science and human nutrition researcher and lead author of the study. "Abdominal fat in particular seems to be associated with the greatest risk for cancer. As your waist-to-hip ratio increases, so does your risk for cancer, especially breast, colon and endometrial cancers."

MAES physiology scientist Julia Busik and Fay Hansen-Smith, of Oakland University, also collaborated on the research.

Some 149,000 Americans will be diagnosed with colon cancer and 50,000 will die from it this year, according to the American Cancer Society. By 2006, more than a million people in the United States had been diagnosed with colon or rectal cancer according to a National Cancer Institute report.

The scientists focused on colon cancer because it affects both genders equally, giving the research broader reach and a larger impact on cancer prevention.

"Trying to address the problem when someone already has a late-stage tumor is not primary prevention," Fenton explained. "Our goal is to understand the active signals and mechanisms involved so we can create opportunities to prevent or interrupt cancer progression early in the process."

Fenton said that while weight loss is the ideal prevention strategy for reducing obesity as a risk factor for colon cancer, 95 percent of all people who lose weight will regain those pounds — and often more — within a year.

"So behavior modification as a prevention strategy is difficult and challenging," she said. "For this reason, continuing research also will include the identification of dietary compounds that may prevent or reduce colon cancer risk associated with obesity in the absence of weight loss."

The abstract of the study "Novel Mechanism for Obesity-induced Colon Cancer Progression" is available online at

Research in the news

<http://carcin.oxfordjournals.org/cgi/content/abstract/30/4/690>.

Besides the Michigan Agricultural Experiment Station, the research also is supported by the National Cancer Institute.

MAES Scientist's Creation Replaces Added Salt in New Heinz Ketchup



A salt substitute patented by Michigan State University is being used in an improved version of Heinz no-salt-added ketchup that's hitting store shelves just in time for the first barbecues of spring.

Created by Kris Berglund, university distinguished professor and MAES forestry and chemical engineering and materials science researcher, and Hasan Alizadeh, former MSU research associate, the product — sold commercially as AlsoSalt — was patented in 1999 and is produced by Diversified Natural Products (DNP) in Scottville, Mich.

"There's no sodium in AlsoSalt," Berglund explained. "It's made from lysine, which is fermented from corn starch. It's an example of the other bioproducts that can be made from some of the same processes that produce ethanol."

The Corn Marketing Program of Michigan, funded by Michigan corn growers, was an early supporter of the research to develop AlsoSalt.

"We're excited to see a large company such as Heinz get behind the product and use it in ketchup," said Jody Pollok-Newsom, executive director.

Joan Watsabaugh, whose company markets and distributes AlsoSalt, was responsible for working with the research and development team at Heinz. She characterized the flavor of the new ketchup as excellent.

"We are proud to be co-branding with Heinz to make ketchup that has only 5 milligrams of sodium per serving. Using

AlsoSalt, Heinz removed the added salt while retaining the delicious flavor people expect from Heinz ketchup," she said.

"We did a lot of ketchup tasting, and you can't tell the difference between the no-salt-added ketchup and the original version," said Debbie Dell, DNP assistant plant manager, who has worked on AlsoSalt since its inception. To meet the new demand, Dell said DNP had increased its production of AlsoSalt.

Berglund noted that the 10-year period between patent date and new product isn't unusual.

"It takes time to successfully commercialize a product," he said.

AlsoSalt is just one of a number of bioproducts that have resulted from Berglund's research. His work has spawned enterprises in Michigan, Sweden and France. Working Bugs, LLC, an East Lansing-based company, and its Swedish counterpart, Working Bugs AB, co-founded by Berglund, identify microbes that could be used in fermentation processes to make products from renewable resources, as well as intermediate chemicals that are used to make other biobased products.

"AlsoSalt production is another example of biorefining that can produce a full complement of biobased chemicals, fuels and other products," Berglund said. "This approach creates a diversified operation that isn't subject to the ups and downs of a single market or product."

U.S. Shorts Critical Animal Research, MAES Scientists Say at Cattle Genome Milestone

The sequencing of the domestic cattle genome, reported in the journal *Science*, could lead to important new findings about health and nutrition, a participating MSU researcher said. But inadequate federal funding jeopardizes important farm animal and biomedical research, said other MAES scientists in the same issue.

Theresa Casey, animal science research assistant professor, joined 300 colleagues around the world in a six-year project to complete, annotate and analyze the bovine genome sequence. Now researchers conclude that the human genome is closer to the 22,000-gene bovine sequence than to those of mice or rats, which are much more common research subjects.

The new data are especially important given the economic and nutritional importance of cattle to humans, said Casey, who studies lactation and mammary gland biology.

But funding for such research is nowhere near adequate, said a group of researchers.

Only \$32 million of the \$88 billion 2007 U.S. Department of Agriculture budget went toward competitive research grants for farm animals, wrote MAES animal science researchers James Ireland, George Smith, Jose Cibelli and colleagues from other institutions. The proportion of the National Institutes of Health (NIH) budget for extramural support of human health research is more than 900 times larger, they said, even though U.S. livestock and poultry sales exceed \$132 billion annually.

With dwindling state and federal support, animal science programs are withering at American institutions, the scientists said. Not only are certain farm animal species facing threats — poultry, in particular, faces loss of breed genetic diversity — but human health studies also might suffer from lack of funding for large-animal research.

Though more difficult and costly to maintain, farm animals are often better research subjects than rats and mice, and size often does matter, Ireland said. Chickens contract hard-to-detect ovarian cancer as humans do, for example, and pigs are highly suitable for obesity, cardiovascular and alcohol consumption research.

"The cow is an excellent model for studies on reproduction in the human," Ireland explained, "because it's one of the few species that actually has follicular growth dynamics very similar to what takes place in humans."

Ireland and colleagues want increased federal consideration for large-animal models in grant awards and for establishment of dedicated research centers. Agriculture and veterinary schools also should recruit "nontraditional faculty members" prepared to interact with the broader lifesciences community, they wrote, to seek NIH funding and help break barriers that isolate agricultural programs.

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