SOLUTIONS

SPRING 2012

In the Eye of the Beholder
Native plants could be keeping beneficial secrets

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A persistent pest stages its comeback

The State of Minnesota's Trees
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Plotting a New Landscape
Small fields may equal big eco-benefits

College of Food, Agricultural and Natural Resource Sciences
UNIVERSITY OF MINNESOTA

Photo by Mary Buschette

Carrie Pike of the Cloquet Forestry Center provides an overview of the center's research at Alumni and Friends Day on Oct. 13.

Solutions magazine is published twice a year for friends, alumni, faculty, staff and students at the College of Food, Agricultural and Natural Resource Sciences. Like the college, the magazine focuses on how science leads to solutions for today's problems in food and agricultural systems; global climate and environmental change; biodiversity; and bioenergy and bioproducts.

CFANS is composed of six divisions, 13 academic units (two are held jointly), nine research and outreach centers throughout Minnesota, the Bell Museum of Natural History and the Minnesota Landscape Arboretum. The college also participates in many interdisciplinary centers and cooperatives.

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***Solutions* Managing Editor:**
Becky Beyers
bbeyers@umn.edu • (612) 626-5754

***Solutions* Designer:**
Sara Specht
sspecht@umn.edu • (612) 624-1746

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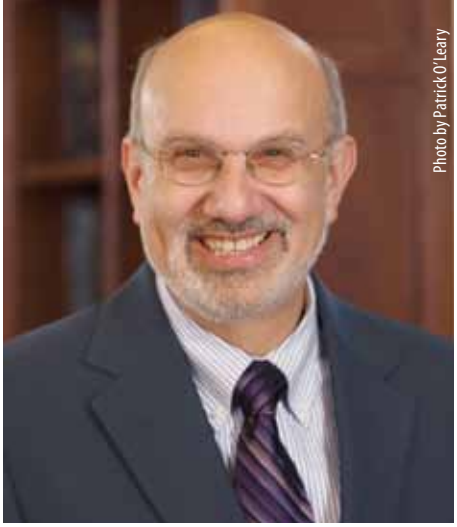


Photo by Patrick O'Leary

From the Dean

The Morrill Act in Action

A century and a half ago, university scientists and agriculture had few direct communication channels. Advances were being made in the applied sciences, but bringing those advances to the farms where they could make a difference in people's lives was not always easy.

The passage of the Morrill Act changed all that. Named for its sponsor, Rep. Justin Morrill of Vermont, the act gave large tracts of land to states with the provision that the land be sold and the proceeds used to establish colleges in agriculture, engineering and military science—hence the name "land-grant" colleges.

Here in Minnesota, the university was established in 1851 but had fallen on hard times until the Morrill Act made it the state's land-grant university. Today, CFANS is one of the university's most visible examples of the land-grant mission, with our three pillars of teaching, research and outreach.

As you'll see in this edition of *Solutions*, the Morrill Act's core idea remains important: to take the innovations that can only be created in university laboratories and classrooms and turn them over to the citizens who can use the innovations and build on them. While Minnesota's needs and demographics may have changed in the past 150 years, we're still here working on solutions to agriculture and natural resource challenges. I hope you enjoy reading the stories in this issue that highlight that work.

Allen S. Levine ('73–M.S., botany; '77–Ph.D., nutrition), Dean

Calendar of CFANS events featured on back cover

On the cover: Graduate student Cece Martin studies native plants that may contain properties useful to cosmetic producers. Photo by David Hansen

Photo courtesy Ken Ostlie

Photo courtesy Ken Ostlie

Photo by Scott Bauer, USDA Agricultural Research Service, Bugwood.org

Photo by John Obermeyer

Left, from top: Roots are eaten away up to the stalk, causing corn plants to fall over, called lodging. Toppled corn stalks following high winds are often the first warning farmers get of a corn rootworm infestation. Corn rootworm larvae shortly after hatching. Western corn rootworm beetles emerge and feast on an ear of corn. Next page: Northern corn rootworms, dominant in Minnesota, overwinter better than the western species and were the first to adapt to crop rotation practices. Ostlie has been investigating problem fields throughout the region since the first reports of Bt-resistant rootworms in 2009.

Entomologists study why a persistent corn pest may be staging a comeback

The ROOT of the PROBLEM

By Sara Specht

If survival in nature depends on the ability to adapt, then the corn rootworm must be the fittest bug in the field.

To the frustration of farmers and researchers, the insect acclimated to every type of control thrown at it, from pesticides to crop rotation, until genetically modified corn worked an insecticide into the plant itself. Corn varieties genetically spliced with *Bacillus thuringiensis* (Bt) bacterium quickly became the standard in fields across the region and seemed to be such a miracle cure for rootworms and other harmful parasites that farmers could forgo chemical pesticides altogether.

But now it seems corn rootworms are adapting again, and with the state's most valuable agricultural commodity at risk, scientists are struggling to get a handle on the developing problem.

Entomologist Kenneth Ostlie has been in cornfields across southern Minnesota since reports of a rootworm resurgence began in 2009, trying to identify the source of the resistant pests and to help farmers learn how to deal with ailing fields. What he has found so far, he says, is a series of problem areas that, while not yet widespread, hint at a potentially larger issue in the coming years.

"My concern is that we're in a tip-of-the-iceberg situation," Ostlie says. "Here we are three years after the problem first emerged, and we're just getting a solid handle on which Bt traits are developing resistance. There's a broad geography involved, so the traits and hybrids have to be common and widespread. This could have been developing for longer than we know, and we don't know what to do about it."

Photo courtesy Ken Ostlie

Photo by David Hansen

Fighting Adaptation

Corn rootworms haven't always posed the threat they do today. Rootworms have an annual life cycle: They lay eggs in the summer, hatch in the spring, feast on corn roots as larvae and emerge as beetles to lay eggs. That damage to the root system causes cornstalks to fall over or get blown down by storms. While rootworms quickly developed resistance to carbonated hydrocarbon pesticides, they were effectively controlled by rotating crops. If any crop other than corn is growing in the field when the eggs hatch, the larvae die.

But in the 1960s and '70s, scientists started noticing Northern corn rootworms hatching in rotated cornfields. At first they thought the insects might have adapted to lay eggs among soybeans to prepare for the following corn planting. Instead, they found that a small number of rootworms had developed an extended diapause period, in which the eggs would remain in a field for two or even three years to hatch when corn returned.

"Usually we think of resistance in terms of insecticides, and both Northern and Western corn rootworms developed resistance to soil insecticides," Ostlie says. "But extended diapause caught everyone by surprise because we don't think of insects developing resistance to cultural practices. Many growers had gotten rid of insecticide application equipment and had embraced crop rotation. This turned the tables. Every field became a potential risk for rootworm attack."

The problem had exploded by the mid-'90s, when more than half of the rootworm eggs sampled showed selection for extended diapause. But in 1996, seed companies introduced corn genetically modified to produce the Bt toxin, a natural insecticide that ruptures the intestines of corn rootworms and other targeted pests when it is eaten. While Bt corn traits aimed at Northern rootworms, the dominant species in Minnesota, were about 20 percent less effective than traits aimed at other insects, when combined with crop rotation and refuge planting the transgenic varieties appeared to control the rootworm problem.

Resistance in a New Economy

Ostlie has spent the past three years researching why rootworm control is suddenly slipping. Testing on adult rootworm beetles collected in 2009 problem fields confirms that they've developed resistance to several common Bt traits from multiple seed companies. The results show anywhere from 2.5 to 4.5 times as many rootworms surviving the Bt toxin than in 1996, and the recovery delay from Bt damage for surviving insects reduced from 12 days to just one.

The next step is identifying the possible causes for such a sharp increase in Bt resistance. Ostlie believes it stems partly from noncompliance with resistance management at the field level. The Environmental Protection Agency requires seed companies to include management technology agreements with farmers that require planting non-transgenic corn near Bt corn. The idea is to produce non-resistant beetles that mate with those that survive hatching in Bt fields, which in turn should dilute the resistance genes.

Photo by David Hansen

Photos courtesy Ken Ostlie

Above: A problem cornfield in Eyota, Minn., in 2009 shows the extent of the problem farmers are facing. This field was planted with refuge rows: the 20 rows of Bt corn show extensive patches of fallen corn from rootworm damage, while the four refuge rows of non-modified corn fared better with soil insecticide use.
Left: Lodged corn causes a loss for farmers in both yield and harvesting time. It also costs the growers time due to "volunteer corn" the following year, where lone corn plants will grow from unharvested lodged plants in fields planted with soybeans or another rotated crop.

The economic landscape has changed in the past several years, though, affecting corn growers' decisions. About 8.1 million acres of corn were planted in Minnesota in 2011, up from 7.7 million acres in 2010, and with corn prices and demand increasing, there has been a great incentive for farmers to overlook the hassle of resistance management practices. Refuge planting has decreased, and some farmers have even stopped rotating their crops.

"Growers have started to adopt the perspective that the class was 20 percent empty—they are losing money on the refuge," Ostlie says. "The common factor if you look at the problem fields is that they are corn-on-corn over multiple years, using the same traits involving multiple hybrids. All the signs are pointing at resistance to these traits, which raises some serious issues, and not just for the growers deciding what to do next year."

Seed companies and the EPA are struggling with how to proceed. Halting production or planting of certain hybrids could put seed corn availability at risk, which could lead to large price swings. Seed producers have begun stacking different Bt traits within their varieties to try to maximize efficiency, but Ostlie worries that including any of the traits already showing resistance may only increase the problem.

Planning for the Future

For now Ostlie and his team are trying to determine if there are new management practices farmers can use to deal with problems as they arise. There are a variety of management options, but little data to recommend any particular choice to prevent a recurrence once fields show new rootworm resistance. One element the team is looking at is how nitrogen fertilizer affects the plants and their production of the Bt toxin. Farmers apply nitrogen to their fields to increase yield, but there hasn't been any characterization of whether nitrogen affects the Bt protein in corn roots.

"I'm hoping this could help problem fields, or that it will give us a better understanding of what we really need to look at for how and why these transgenic plants perform out in the field," says Tricia Franz, a master's degree student in Ostlie's lab. "Because so much is looked at in lab and in small trials, but there's tons of variability when you take things out into the field. Maybe this will give us some insight into how to deal with new problem fields."

The team expects to see a dramatic increase in soil insecticide use to combat rootworms, even though chemical insecticide options have decreased since Bt corn widely replaced them. Rootworms can be controlled to some extent by pesticides and crop rotation, but history has shown that both Northern and Western rootworm species have adapted to both, so the management plan has to be more complex.

"To be fair, at the moment there's not a huge number of fields involved," Ostlie says. "But we're on the edge of something. The next few years are going to be about demonstrating how at risk these traits are, and how well these varieties with stacked Bt traits are going to function. That will tell us just how big this underlying problem is." ■

Long Live the King

A lantibiotic from the human gut may be a super-preservative

It's the same old story: while exploring the wilds of a jungle, a scientist stumbles upon a miracle cure. Only this jungle is much closer to home—the flora of the human gut. And this stunning discovery just might bring a super-preservative to local grocery store shelves.

It all started because Daniel O'Sullivan, a researcher in the Department of Food Science and Nutrition, wanted to know why Probiotic bifidobacteria seem to become toothless when they are fermented for use in foods like yogurt. Probiotics naturally reside in the flora of the human large intestine and help fight harmful bacteria to keep the gut healthy. O'Sullivan mapped the genome of a human-grown sample of Probiotic *Bifidobacterium longum* and discovered that it was actually bigger than a lab-cultivated specimen.

"They say the lion rules the jungle, and it's very well suited to doing that. In evolutionary terms, if you take the lion out and raise it in a house, it becomes a pussycat," O'Sullivan says. "That's what we saw happen when we took the Bifidobacteria out of the jungle in the gut and put it in a nice pure culture and pampered it. It lost its claws."

In this case, the Bifidobacteria loses chunks of DNA that it no longer needs to compete in a pure culture. One of those lost pieces is a previously unknown anti-microbial lantibiotic called bisin. Lantibiotics naturally combat foodborne pathogens, and some are commonly used as food preservatives. But while other lantibiotics kill only gram-positive bacteria, bisin is the first discovered that can protect against both those and gram-negative bacteria, like *E. coli* and *Salmonella*: the sources of over half of the United States' food recalls every year. Bisin apparently fights these bacteria so effectively that treated foods could last almost indefinitely.

As a naturally occurring peptide, bisin doesn't pose the health risks that chemical food preservatives can, and it has already been characterized as safe for consumption. And since bisin is chemically related to a lantibiotic preservative already in widespread use, nisin, O'Sullivan says the processes are already in place to apply it to food ingredients.

Photos by David Hansen

There is one last barrier to getting bisin onto the market—getting bifidobacteria to produce it anywhere other than the intestinal jungle. O'Sullivan is back in the lab trying to understand on a molecular level how to induce bisin production in a laboratory or industrial fermenter. He says once they learn how to flip that switch, it will be ready to be licensed and put on the market.

"This is a very stubborn bug," O'Sullivan says. "We know how to switch on production of bisin, but then it switches itself off. If we can get rid of that stubborn off switch, bisin has a lot of potential as an antimicrobial tool for food safety and maybe pharmaceutical applications." *–Sara Specht*

PLOTTING A NEW LANDSCAPE

BY BECKY BEYERS

PERENNIALS AMID TRADITIONAL CROPS MAY GENERATE BENEFITS FOR BIOMASS AND INSECT CONTROL

All photos by David Hansen

If the saying is true and good things really do come in small packages, then a research project at the Rosemount Research and Outreach Center may just be on the right track.

A five-year project that began last summer involves putting sixteen 15-meter by 20-meter plots of perennial crops smack-dab in the middle of much larger fields of corn and soybeans. The idea is that integrating perennial biomass crops with traditional crops in a new kind of landscape might result in ecological and economic benefits, says Gregg Johnson, an associate professor in the Department of Agronomy and Plant Genetics and one of the project's principal investigators.

"The idea that you would deliberately plop a prairie into a cornfield—it's unique," says Jim Eckberg, a Ph.D. student who is working with Johnson on the project. Other researchers have looked at the water and soil benefits gained from perennial crops, but until now no one has looked at how other

ecosystem services—pest control and wildlife habitat—also might benefit. And no one has considered how actually planting different kinds of crops together might differ from what happens when they are in side-by-side fields.

The field-within-a-field plantings at four sites in Rosemount were intentionally selected and will be carefully monitored over the life of the study. In 2011, the project's first year, all of the sites were surrounded by corn; this year, they'll be located in soybean fields. At each site, a pathway through the main crop field leads to an interior opening with a 10-foot-wide border separating the annual and perennial crops. Each of the four research areas includes a site with hybrid willows, another containing native perennial flowers and grasses, and a combination of willows and native plants.

Each plot includes tall towers for insect sticky traps that can be used to track insect populations. If, as the researchers suspect will happen, the perennial plants attract natural enemies (other insects) of soybean aphids, farm producers could reduce their pesticide use.

Benefits from Insects

"We're trying to figure out if biofuel crops can be helpful with biocontrol of soybean aphids, which are a major problem for soybean producers," says George Heimpel, a professor in the Department of Entomology who is a co-investigator on the study.

"We already know that more diverse habitats tend to attract more of the beneficial insects that prey on soybean aphids," he says. "What's not clear yet is if there will be enough (insects) to make a difference in biocontrol, and also whether

Photos by David Hansen

Scientists Jim Eckbert and Gregg Johnson examine how fast-growing willows have fared near the end of the first growing season.

this particular diverse set of plantings will attract the right insects, or if this is the right scale to attract the right number of insects."

Soybean aphids' natural predators include lady beetles, minute pirate bugs, lacewings, hoverflies and parasitoids; all have different reasons to be attracted by the perennial plantings at the Rosemount site. For example, lacewings will be attracted to the pollen and nectar, but lady beetles want pollen and other small insects that could be found on the plants. Those food preferences will affect how the beneficial insects move between the new plantings and the traditional crops, Heimpel says.

"What I'm really excited about is that we'll be figuring out how these bugs use the plants," Heimpel says. "What is it about the plants that brings in more of the insects?" By catching the insects, counting them and then analyzing what they ate, scientists will understand much more about the relationship between plants and insects. This past winter, Eckberg and others examined hoverflies that were caught in the traps last summer and had pollen in their stomachs, Heimpel said. Analyzing the pollen will help provide clues to which plants attracted the hoverflies.

Ideally, the study will identify a combination or combinations of plants and beneficial insects that clearly help control soybean aphids, he says. "Then we have a practical outcome. Farmers will know what to expect and we can figure out how these ecological services can best work together."

The project, which is funded by the U.S. Department of Agriculture's National Institute of Food and Agriculture, is part of a larger effort to identify sustainable bioenergy projects in many states. In addition to the Rosemount sites, College of Biological Sciences professor David Tilman (a co-investigator) and his Ph.D. student, Margaret Kosmala, are conducting similar work at the Cedar Creek Ecosystem Science Reserve, where potted soybeans are placed next to plots of native prairie for similar insect collection and analysis.

Diversifying plantings

Along with ecological benefits, the new plantings are being examined for economic benefits to farmers. Johnson has studied willows as a biomass crop, both at Rosemount and at the Southern Research and Outreach Center in Waseca, for more than a decade "so we know more about managing the willows as a crop."

The willows planted in 2011 in the small Rosemount plots were about 3 feet tall by early October; in three years they'll grow to about 25 feet, at which point they can be harvested as a biomass crop. The trees established well because of spring and early-summer rains, Johnson says, but were hampered somewhat by deer nibbling on them and the lack of fall rainfall.

At first glance, the native perennial plantings plot could pass for a suburban back yard dropped into a field, with asters, black-eyed Susans, bergamot and hyssop. But the plants were carefully selected for their ability to attract insects as well as how they can co-exist, Eckberg says. Grasses in the plots, which can become dominant, are minimal so that the flowering plants can thrive. "We have to have some pollen and nectar producers in order to attract beneficial insects." Nearly all the seeds planted in the first year came up, he says, and the team will be watching closely this spring to see which, if any, don't survive the winter.

Like any biomass crop, the trees and plants can be used for energy production, but economics are an issue, Johnson said. "But if you gain benefits from the insects and you can sell the biomass, it might make these crops more viable from the farmer's point of view."

All three types of sites also may have bonus ecological benefits, Eckberg says; they may provide habitat and food for pollinators (bees), small mammals and birds.

"The whole idea is to gather information about how different parts of the ecosystem can benefit from a landscape like this in a way that's economically practical," Johnson says. "What does that environment need to look like in order for a producer to make it work?" ■

Algae Answers

Tiny algae offer huge potential as biofuel producers

On a commercial scale, algae and bacteria are like oil and water: they aren't supposed to mix.

Algae as a source of oil for biofuels has been the source of all sorts of research, because it grows fast, produces lots of oil and can be grown in large quantities without using much land.

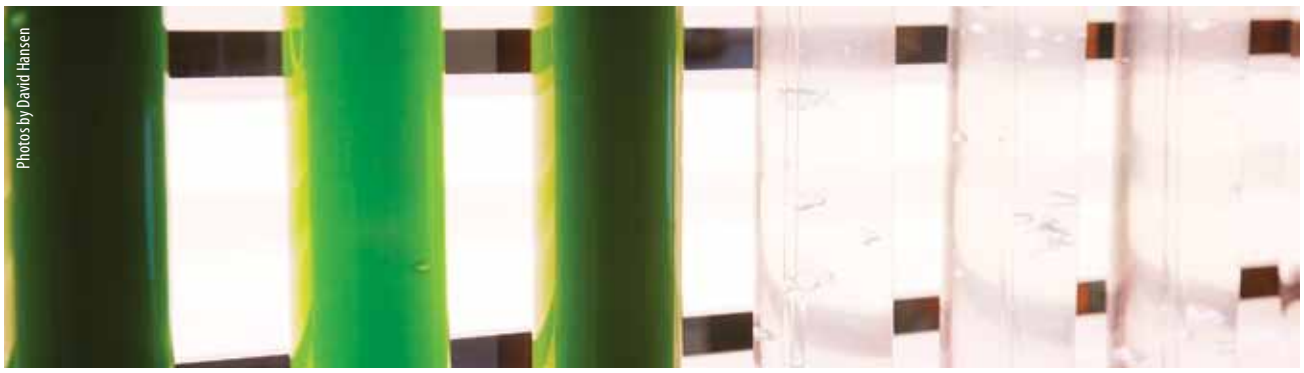
Most researchers produce algae in a relatively bacteria-free environment. Brett Barney, an assistant professor in the Department of Bioproducts and Biosystems Engineering is taking a different approach by trying to build on the relationships where bacteria and algae already co-exist and help each other. He believes that certain cyanobacteria—also known as cyanos—offer the greatest potential for applications to help algae grow either independently or in symbiotic relationships.

Like some agricultural crops, these cyanos can fix nitrogen and have mutually beneficial relationships. If they can co-exist with algae, they might help the algae grow without the need for additional nitrogen fertilizers. That could be an enormous boost for algae as a biofuel source. "If you take the oil from algae, but have to provide a lot of nitrogen fertilizer that is produced by burning part of that oil, that's not cost effective," he says. "But what if you could use organisms that fix nitrogen to help grow the algae, and provide this nitrogen directly?"

Barney's research team is studying a wide variety of algae and how they interact with bacteria. Some algae grow fast, some are better oil producers, others have the characteristics needed to survive in a difficult environment. The ideal strain for biofuel production would be able to do all three, he says. At the same time, Barney and his team are looking at which bacteria provide the most benefits to algae; some of the algae strains won't grow at all unless bacteria are present. That raises a question: What benefit do bacteria get from algae, and how can that benefit be quantified?

Brett Barney's lab studies how algae and bacteria co-exist and what benefits they might gain from each other.

The three-year project began last fall and is funded through the University of Minnesota's Initiative for Renewable Energy and the Environment. Barney, who joined CFANS in 2009, has worked extensively on similar issues as a researcher in industry and at other universities. As with many biofuels research projects, duplicating lab results in a large-scale environment will be a challenge, Barney says. "But on the other hand, we've had hundreds of years growing traditional crops. It hasn't been that long that we've been growing algae." *–Becky Beyers*



Photos by David Hansen

Seeley to be keynote speaker at 'Classes Without Quizzes'

Classes Without Quizzes is coming to the St. Paul campus on Saturday, March 31. This year's program features Minnesota meteorologist, climatologist and media personality Mark Seeley as keynote presenter. The annual half-day event sponsored by the CFANS Alumni Society also includes presentations from additional CFANS faculty on a range of topics, aimed at helping the public understand how research in the college affects Minnesotans' daily lives. Other topics on the 2012 program include invasive species, cancer-preventing vegetables, cold-climate grapes and wine, and the new USDA cold-hardiness plant zones. For more details, or to register, visit www.cfans.umn.edu/AlumniFriends/Events/CWQ.

College begins planning for new agricultural research network

Faculty from across CFANS are planning a long-term agricultural research network. The network will enable researchers to use the college's statewide Research and Outreach Centers to conduct experiments important to agriculture, food systems and natural resources.

"Long-term research allows us to plan ahead for society's agricultural and ecological needs," said Greg Cuomo, head of the Division for Translational Research and Outreach. "This project will better equip us to address issues that may not be prioritized today, but that are likely to become urgent in the future. This may include questions such as 'How will we continue to produce enough food for a growing population? How will we maintain our water and natural resources while increasing food production?' It's essential to address these issues," Cuomo said.

The network would be unique among U.S. research universities. Environmental scientists have a similar model, but no other university is studying long-term agricultural questions. The project will allow CFANS to develop partnerships across the university, and may eventually set the framework for a national model.

Three planning teams have been organized to get the project running. Cuomo expects these groups will set a path for the future by this fall, and that project work will begin in 2013.

Schmitt named associate dean for Extension in CFANS

Mike Schmitt has been named associate dean for Extension in CFANS. He's been senior associate dean for University of Minnesota Extension the past four years and is a faculty member in the Department of Soil, Water and Climate. He's also a veteran of CFANS administration, having been an associate dean before moving to Extension.

Mike White becomes head of animal science department

Longtime faculty member Mike White ('80–B.S., wildlife; '86–Ph.D., animal sciences) has been named head of the Department of Animal Science. White is a Morse-Alumni Distinguished Professor whose research focuses on the cellular and molecular regulation of muscle growth and development. He teaches courses in animal growth and development, world food production, the environment and citizenship, and a study abroad course on food system sustainability in Italy. He replaces department head Jim Linn, who retired from the university on Sept. 30.

Muehlbauer to lead plant biology department

Gary Muehlbauer is the new head of the Department of Plant Biology, effective March 1. The professor of agronomy and plant genetics conducts research on the molecular genetics of wheat and barley and has been director of graduate studies for the Plant Biological Sciences Program. He earned his Ph.D. at the University of Minnesota in 1994 and joined the agronomy and plant genetics department faculty in 1997. The plant biology department is part of both CFANS and the university's College of Biological Sciences.

Hill chosen for McKnight Land-Grant professorship

Assistant professor Jason Hill ('04–Ph.D., plant biological sciences) of the Department of Bioproducts and Biosystems Engineering has been chosen as one of six new University of Minnesota McKnight Land-Grant professors. The program is aimed at advancing the careers of promising junior faculty at a critical point in their professional lives. Recipients hold the title for two years and receive a research grant in each of those years and a research leave in the second year. Hill joined the department last fall after working as a research associate in the Department of Applied Economics and in the university's Institute on the Environment.

'10 Plants That Changed Minnesota' seeks nominations

Which plants changed Minnesota and transformed how we live today? The Minnesota Landscape Arboretum wants to know and is encouraging the public to nominate specific plants for "10 Plants that Changed Minnesota: Growing Solutions to How the World Lives Today," a new initiative to build awareness of the crucial role plants play in nourishing and sustaining life on Earth. The program is being spearheaded by Mary Meyer ('93–Ph.D., plant breeding and genetics), professor in the Department of Horticultural Science. A VIP academic and community panel will choose the 10 most important plants from the entries submitted.

"We hope to start discussions in classrooms around the state that will encourage students to look at plants in a whole new holistic approach to learning," Meyer says. "We will continue and enliven the conversation online and through print media, as well as onsite visitor experiences at the Arboretum."

The initiative will include Arboretum-based freshman and public seminars about historically significant plants and plants of the future. Nominations will be accepted through April 15 and may be entered at www.arboretum.umn.edu; in person at the Arboretum or by mail to 10 Plants, Minnesota Landscape Arboretum, 3675 Arboretum Dr., Chaska, MN 55318.

Siehl Prize for Excellence in Agriculture honors 3 Minnesotans

A longtime state agriculture commissioner, a University of Minnesota economist who works to improve agricultural productivity around the world and a wheat farmer with a long record of community service are this year's recipients of the prestigious Siehl Prize in Agriculture.

The prize is awarded annually by CFANS in three categories: knowledge (teaching, research and outreach), production agriculture and agribusiness. This year's winners are:

Bruce Hamnes, production agriculture: Since taking over his family's Stephen, Minn., farm in the early 1960s, he has served on agricultural lobbying and advisory groups at the local, state, national and international levels. As a small-grains producer, he helped lead research initiatives of the Minnesota Wheat Council and Wheat Growers and later worked with national organizations to expand international wheat markets. He also played an important role in developing leadership programs through the Northwest Minnesota Foundation.

Gene Hugoson, agribusiness: As Minnesota's agriculture commissioner for 15 years—in three different administrations—his priorities were expanding markets for agricultural products and enhancing the protection of the state's food supply. The southern Minnesota farmer also modernized the agriculture department and was elected by his fellow state ag commissioners to lead their national association.

Philip Pardey ('86–Ph.D., agricultural economics), knowledge: The University of Minnesota professor of applied economics uses science and technology to help alleviate hunger through his strategic analyses for development foundations, agribusiness companies, governmental and non-governmental agencies. The native of Australia is co-founder of Harvest Choice, a Gates Foundation-funded initiative that gathers and analyzes agricultural productivity data to help address food needs in developing nations.

The recipients will be honored at a May 24 ceremony on the university campus with World Food Prize president Kenneth Quinn as keynote speaker.

The Siehl Prize was created in the early 1990s by a generous gift from New Ulm-area livestock breeder and businessman Eldon Siehl, a dedicated philanthropist who had a lifelong interest in agricultural systems. Siehl was concerned that people were losing touch with their agrarian roots and wanted his gift to ensure that achievements in agriculture would be recognized and celebrated. Recipients receive a $50,000 award as well as a sculpture and lapel pin designed by Minnesota artist Thomas Rose especially for the Siehl Prize.

U of M celebrates 150 years as a land-grant university

Throughout 2012, universities across the country will mark the 150th anniversary of the Morrill Act of 1862, legislation that laid the groundwork for the public research university's ongoing mission of learning, discovery and engagement for the common good.

As one of the country's original land-grant institutions, the University of Minnesota is proud of its history as a land-grant research university and remains dedicated to its mission of promoting access to higher education and collaborating to advance knowledge benefiting communities, the state and the world.

The university will celebrate its land-grant mission with UMN Land Grant 150, encompassing wide-ranging events and activities that explore the university's land-grant legacy; examine the impact of the university's campuses, programs, and collaborations across the state and world; and define a land-grant vision for the 21st century.

New Natural Resources Library coming to St. Paul campus

Libraries on the St. Paul campus are busy this spring as materials are being moved to prepare for the opening of the new Natural Resources Library, a merged version of the Forestry and the Entomology, Fisheries and Wildlife (EFW) libraries that will be housed in Hodson Hall. Once the merger is complete, the current Forestry Library space in Skok Hall will be reconfigured as a student study and group collaboration space. The new Natural Resources Library will house high-use materials from both the Forestry and EFW collections. Remaining low-use print materials (most of which are available electronically) will be transferred to Magrath Library or another campus library.

Faculty, staff honored for teaching and advising excellence

Two CFANS faculty members—Dennis Becker of the Department of Forest Resources and Ulrike Tschirner of the Department of Bioproducts and Biosystems Engineering—are among five university faculty who will be honored in April as recipients of the university's Morse-Alumni Award for outstanding contributions to undergraduate education. Sheryl Bolstad, senior academic adviser in the college's student services office, is one of four advisers across the university who will receive the John Tate Award for high-quality academic advising.

OVERHEARD

"The hope is that it would steer producers to meet consumer demand to be more responsible about water quality."

—Deborah Swackhamer, co-director of the Water Resources Center, interviewed about the nation's first test site (in Minnesota) for a novel federal program designed to stem the flow of pollution into the Chesapeake Bay, the Gulf of Mexico and the Mississippi River.

"So it's one strike and you're out. With all these new trees coming on each year, you won't have space unless you thin out the duds. . . But it is kind of nerve-racking, because you want to give the tree a chance to do its best. No one wants to be known as the guy who killed the next Honeycrisp."

—David Bedford, apple breeder at the Horticultural Research Center, interviewed in the New Yorker about developing new apple varieties.

"It's pretty much now or never."

—Peter Sorensen, professor in the Department of Fisheries, Wildlife and Conservation Biology, speaking at a legislative news conference about the urgent need for an aquatic invasive species research center at the university to deal with zebra mussels and Asian carp.

"If it were, it would be widespread. There would be everyone using it. There would be one heck of a market for it. And so, I don't really believe there is such a thing."

—Gary Reineccius, head of the Department of Food Science and Nutrition, interviewed by a local TV station on whether certain foods like oysters or chocolate can increase romance or romantic feelings.

"What I really do is work for you – to see that you are taught by superb faculty, that you are supported in your aspirations, and that you are able to get the best education possible."

—Karen Hanson, new University of Minnesota provost, in a video sent to students in her first weeks on the job.

New undergraduate majors, courses to be offered soon

Faculty teams working on new and updated undergraduate major programs in CFANS continue to make progress.

Two new majors are being developed—subject to approval by college and university leaders—and likely will launch in fall 2013:

- Several existing major programs are joining an integrated major focused on the plant sciences that incorporates new requirements for experiential learning, interdisciplinary work and a global perspective. Those requirements were approved by CFANS faculty in May 2011. The new major also will include entomology and plant pathology, two CFANS departments that until now have offered only graduate studies.
- A new major in food systems will allow students to study along several tracks, including food production, food policy and intercultural/international foods. The program is heavily based on a learning-by-doing approach with several required courses that will allow students to develop practical food skills. Faculty from 11 departments across the university are involved in creating this new major.

A third major, agricultural education, will expand its leadership and communications track with the addition of new courses and faculty beginning this fall.

In addition to the new majors, 10 faculty groups submitted proposals this fall for new and revised courses and majors; five groups were awarded funding for further study and development of the new material. Their proposals included a variety of ideas and topics, from a new study-abroad program in Nepal to an overhaul of courses in the Environmental Science and Policy Management program to a course that uses cutting-edge technology to teach students about food systems around the world.

The college's undergraduate strategic plan was developed in 2009 to address employers' needs for student skills as well as students' changing interests and demographics. Since that time, several faculty task forces have worked on how to make the necessary changes, with input from students, staff, alumni, employers and other stakeholders.

In the Eye of the Beholder

By Becky Beyers

Partnership with Aveda links cosmetics and biofuels through native-plant components

Cece Martin spent last summer combing through Minnesota's roadside ditches, along railroad tracks and on public prairie lands, looking for native plants.

She doesn't know yet exactly which plant—or more likely, plants—she was looking for; she collected a variety of species, and if all goes well, at least one of them will contain a combination of antimicrobial and antioxidant activity that could be used to preserve cosmetics and other products.

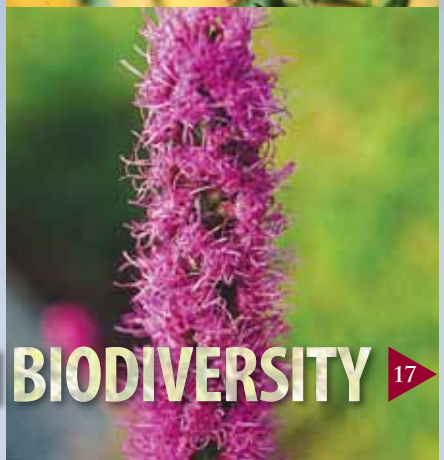
Martin, a plant biological sciences PhD student, is one of the CFANS researchers involved in a new partnership with Twin Cities-based Aveda Corp. to develop products from natural ingredients found in native Minnesota plants. Since Martin collected the plants' genetic materials from locations around the

Photo by David Hansen

Photo by David Hansen

Cece Martin uses cutting-edge technology to evaluate the compounds within the plant materials she's gathered, including (right) leadplant, roundhead lespedeza, fireweed, wild licorice and blazing star.

Left: Photo by David Hansen.
Right, from top, photos by: Chris Evans, River to River CWMA, Bugwood.org; Chris Evans, River to River CWMA, Bugwood.org; Howard F. Schwartz, Colorado State University, Bugwood.org; Steve Dewey, Utah State University, Bugwood.org; John D. Byrd, Mississippi State University, Bugwood.org.



state last year, the research team has been analyzing the collection, trying to find the active compounds that could be used in a commercial product application. The team includes Martin's advisers, Adrian Hegeman, assistant professor in the Department of Horticultural Science, and Don Wyse, professor in the Department of Agronomy and Plant Genetics and a longtime advocate of alternative, sustainable cropping systems.

Aveda, which makes plant-derived beauty and personal-care products, concentrates on using naturally derived ingredients and sustainable production, harvesting and processing practices. If a market can be developed for native plants like the ones now being pursued, they could provide the kind of alternative agricultural crop that Wyse and his fellow advocates of a multi-functional, sustainable agricultural landscape have been seeking for decades.

The search

Martin looked for plants on established prairie land in the northern, western and southern parts of the state, collecting samples—with permission—of more than 100 plants from state parks, natural areas, University of Minnesota properties and along roads and railroad tracks. "It took just as long to find them as you would imagine it might," she says with a smile. She was looking specifically for forbs, which are relatively small and grow in a tallgrass prairie ecosystem, and for other plants that previous tests in Wyse's laboratory had shown had medium to high levels of antioxidant and antimicrobial activity. Some seeds she collected were replanted on a St. Paul campus plot for a separate research project involving how different environments might affect the sought-after properties.

The plants are evaluated using a complex set of procedures and measurements, says Hegeman. The exact technique depends on the plant: in some cases, scientists simply wash the secretions off the plants' leaves, using organic-certified ethanol as a solvent. In others, the sought-after materials are more deeply embedded in a plant's flowers, stems or leaves and require a different approach.

"It turns out that some of these chemicals are water-soluble, so ethanol is a simple way to get the phytochemicals out," Hegeman says. "You basically put the materials and ethanol in a blender and make a kind of slurry. Then you can dry or freeze or store it" for later analysis.

"It's kind of like making tea," Martin explains. "Very high-proof tea," Hegeman says.

The plants also contain chemicals that the researchers don't want, he adds. Once the unwanted components are removed, the remaining material gets analyzed by such methods as liquid chromatography/mass spectrometry. The results will show the presence of thousands of compounds as well as activity, which then can be further analyzed for activity and purity.

Scientists are trying to find ways to speed up the process, Martin says. "So if we have

hundreds of extracts found in a plant, and we see a range of antimicrobial activity, we could pick one compound that we see in the spectrum and see how its profile matches to the activity."

"We know how to identify compounds, but it's a slow process," Hegeman says. "So we're looking at ways to apply metabolomic strategies and see if that works just as well."

Hegeman's research focuses on the phytochemical composition of plants, he says: the basic knowledge of how and why the plants make phytochemicals, and how they help the plants survive. "What we want to do is take advantage of those innate actions. In the same way that genomics work involves finding what genes are in organisms and what they do, we're trying to find out what the phytochemicals are in these plants and what that biodiversity brings."

The connections

Just like Martin's search for plants with the right characteristics, Don Wyse has been searching for the right mix of people, technology and will.

For more than a dozen years, the professor in the Department of Agronomy and Plant Genetics has been part of a community within the college looking for ways to diversify Minnesota's landscapes with ecologically and economically viable new crops.

The partnership with Aveda is the result of some of those efforts. "This is how ideas develop into enterprises," he says. "We've been interacting with scientists at Aveda for 12 years and have been working to identify which native plant extracts have microbial activity. Until now, we haven't been able to turn that into a commercial enterprise."

What changed? Hegeman arrived in 2007 and college and university leaders invested in the lab equipment that makes his work possible. At the same time, Aveda's leadership team decided to enhance its support of the research collaboration between the university and Aveda.

The project was a natural fit. "We have the opportunity to explore alternate economic benefits for local farmers by working with them to grow native or naturalized plants that thrive in the Minnesota landscape," said Tim Kapsner, senior research scientist for Aveda. They need only be planted once and can be harvested year after year with less chemical input than traditional crops, and can grow in environments that might not support food production.

"A dialogue has naturally occurred between Aveda and the University of Minnesota because of who we are and what we do," Kapsner says. "One of the coolest things about my job is doing what I do every day, and having people like Don Wyse seek me out to lay a cool idea on me."

Wyse believes native plants could become a viable enterprise for agricultural producers. "You can develop a complete enterprise, just like we've built corn and soybean enterprises," he says. The native plants, however, would be a mix of species rather than a monoculture and would be perennial rather than annual. Along with the compounds used in cosmetics, the plants' other materials could be harvested and used as renewable fuels.

"The whole idea is that we can change the landscape with the right economic pull," Wyse says. "It's not about just planting another annual or perennial crop. It's about thinking through what kind of landscape structure you want, and how certain crops can help you achieve that."

Still, he didn't expect cosmetics would be part of the equation when the process began, he says. "I started out looking for biofuel crops...and we might end up making lipstick." ■

Top: Don Wyse sees the new partnership as part of a larger effort to create landscapes that are sustainable both ecologically and economically. Below: Adrian Hegeman's arrival in CFANS helped catalyze the effort to develop new products from native plants.

Photos by David Hansen

A Tailored Pair of Genes

For ancient plants, two genes were definitely better than one

In the wake of the disaster that killed the dinosaurs, the ancestors of today's crop plants reinvented themselves.

They doubled their genomes, and in that single act set the stage for feeding the world 60 million years later.

In a study published last fall in the journal *Nature*, researchers from CFANS and other institutions recount how sequencing the genome of a model, alfalfa-like legume revealed the monumental benefits that flowed when the ancestor of legumes acquired an extra copy of every gene. The study was the result of a collaboration among 124 co-authors at 31 institutions in eight countries.

The findings may help researchers genetically engineer legumes to do a better job of meeting the world's rising demand for nitrogen, the backbone of all protein and a major nutrient in fertilizers.

Legumes supply nitrogen through a partnership (called symbiosis, Latin for "living together") with bacteria that live in the roots of the plants and turn inert nitrogen from the air into a biologically usable form. The process is called nitrogen fixation.

"Legume symbiosis with nitrogen-fixing bacteria is the largest source of natural, nonsynthetic nitrogen fertilizer in agriculture," says first author Nevin Young, a professor in the Department of Plant Pathology. "Understanding and leveraging symbiosis is the only possible way anybody can think of to expand the amount of natural fertilizer that gets into crops. The discovery [of genome duplication's role] is important in understanding how that symbiosis works."

To visualize that role, think of genes as jobs. Suppose one person is handling two jobs; he or she may well be mediocre at both. But if you could duplicate the person, you would get two people who could specialize and thus do each job better. That's what most plants, including the common ancestor of legumes, did with their genes nearly 60 million years ago.

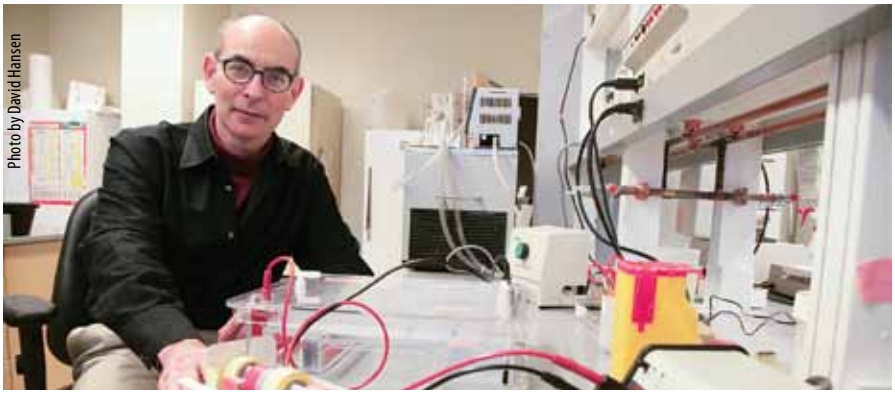


Photo by David Hansen

Using the legume *Medicago truncatula* as the model, the researchers studied the fates of two genes in the ancestral plant, starting with the doubling of those (and all other) genes several million years after an asteroid struck Earth. That famous catastrophe occurred 65 million years ago.

Both of the ancestral genes had performed dual functions. One was to help nitrogen-fixing bacteria infect the roots of the legume and enter into symbiosis with the plant. In this arrangement, the bacteria supply the plant with nitrogen so it can make protein, and in return, the plant supplies the bacteria with energy.

The ancestral genes' second function was to help the plant's roots interact with soil fungi that supply the plant with minerals, notably phosphorus, which the plant could not wrest from the soil by itself.

With the genome doubling, each ancestral gene now came in two copies. The researchers found that each copy evolved a different specialty: one involved with the plant's interactions with nitrogen-fixing bacteria, the other governing its relations with soil fungi. Both functions improved, and the ancestral legume evolved into many species, including top performers like soybeans, peas, beans and peanuts, which supply most of the protein consumed by humans.

Because of the similarity between the two plants, "everything we discover about Medicago is directly applicable to alfalfa," a major forage crop, Young says. The work will help scientists help legumes produce more nitrogen and phosphorus fertilizer.

"There are a lot of problems with fertilizers in water, and we spend a lot of money on synthetic fertilizer," says Young. "To keep agriculture sustainable, plants and people who grow plants will have to do a better job utilizing naturally occurring nutrients like nitrogen and phosphorus. [Besides legumes] the only way to make fertilizer is through mining or [fossil-fuel-intensive] factories.

"Plants can only do it with help from bacteria and fungi, and the discovery we made is important in understanding how that works." *–Deane Morrison*

This story originally was published in UM News.

THE STATE OF MINNESOTA'S TREES

BY BECKY BEYERS

Editor's note: We sat down with four CFANS tree experts at the end of 2011 to talk about how Minnesota's trees survived a year of drought, fire and invasive species. Department of Forest Resources professors Gary Johnson, Marvin Bauer and research associate Lee Frelich joined Department of Entomology assistant professor Brian Aukema for a roundtable discussion.

Q. Let's start with Emerald Ash Borer. What happened in 2011, and where are we headed?

Brian Aukema: We found a couple of new infestations over the summer in the metro area that had both been there since 2007 and 2008. (It takes a little while to detect that trees have been infected with Emerald Ash Borer). So we know it is spreading, and that's not unexpected. The ash trees in Minnesota, like most in North America, have never seen this insect before and are not equipped to deal with it, so we'll continue to lose ash in the metro area and many other parts of the state.

It's a matter of slowing the spread, not stopping it. Right now we're going through our toolkit of management practices, quarantines, education—trying to keep people from moving firewood, which can slow the rate of introduction in new areas of the state. We're also trying some new tools, like biological control agents. Along with the Minnesota Department of Agriculture, we're introducing stingless wasps, which may be one more tool. But it's not going to stop the spread.

Lee Frelich: We have 900 million ash trees in Minnesota. A lot of those are black ash in northern Minnesota swamps, which aren't much for timber but provide great wildlife habitat. It would be a great loss for biodiversity in Minnesota if all those trees go.

Q. Let's talk about some of the other hardships for Minnesota's trees in 2011.

Frelich: The Pagami Creek fire was the biggest in the Boundary Waters since 1875, but if you look back in history it's really not that unusual. From 1910 to the 1990s there were hardly any fires. But when you consider the last 400 years, we are returning to normal. The BWCA is like a sleeping giant that's woken up, and we can expect more of these frequent large fires. There is no control over the big fires—all we can do is get people out of the way. The intensity is just too high.

While it's normal for that ecosystem to have these big fires, there are hints that we're going to see even more of these big fires than occurred historically because of climate change. It's too early to tell for sure, though.

We are also seeing some invasive species in the burned areas. Earthworms are spreading very rapidly through the Boundary Waters area, which will have a huge ecological impact in terms of drying out the soil and reinforcing the impact of droughts, allowing nutrients to leach out of the terrestrial system and into the aquatic system. It makes the landscape more nutrient-poor where trees are growing, and

After a year of drought, insects, windstorms and fire, how healthy are Minnesota's urban and recreational forests?

1) Trees line a city street in south Minneapolis 2) Close-up of adult female Asian gypsy moth 3) Gypsy moth caterpillar feeding on white oak 4) Climate change is affecting the growth of Minnesota's boreal forests 5) Serpentine galleries created under tree bark by Emerald Ash Borers 6) New plants grow after fires spread through the BWCA in 2007 7) Emerald Ash Borer 8) New trees sprout from the ashes of a burned forest 9) Scientists are collecting seed samples from green ash before the emerald ash borer spreads statewide 10) Paper birch trees near Lake Superior are dying in large numbers due to drought periods.

Photos by: David Hansen (1, 4, 6, 8, 9, 10); USDA APHIS PPQ Archive, USDA APHIS PPQ, Bugwood.org (2); John H. Ghent, USDA Forest Service, Bugwood.org (3); Daniel Herms, The Ohio State University, Bugwood.org (5); Pennsylvania Department of Conservation and Natural Resources - Forestry Archive, Bugwood.org (7).

adds to drought stress. We see that in maple trees throughout the state already. All of our maples in the southern two-thirds of the state are in an earthworm-invaded system, and they're showing the exaggerated effects of drought stress.

Gary Johnson: Similar things are happening in the urban forest, but it's not new. All these stresses have been going on for awhile, but a couple things have exacerbated it. One is reliance on too few tree species: We have way too many maples. The urban environment is so hostile to trees that the lifespan of a tree is only about 30-40 years in an urban area. The natural environmental stresses are different in urban areas, because we don't have old trees and the younger trees are prematurely stressed.

We always have drought situations—boulevards and parking lots, and the concrete parking lots and impermeable surfaces. But this year will be interesting—I have never ever seen the soil as dry as it was this autumn. Because it's so dry, the soil is going to be a lot colder this winter and it's going to be below freezing temperatures much deeper in the soil. All you need is 15 degrees Fahrenheit, and the roots start dying.

Frelich: Even though the air temperatures have been warmer, the soil is colder, because there's no snow cover. And that's a bad combination, drought and deeply frozen soil.

Johnson: Brian was talking about the impending loss of trees in the southeastern part of the state—it's nothing compared with western Minnesota. We've done surveys of most communities around the state and in the metro area it's 20 to 30 percent ash trees, but in many western Minnesota communities, it's not unusual for ash to represent 40 to 65 percent of a community's tree population.

It becomes a huge social issue, especially in greater Minnesota. Who's going to pay for the removal of these trees? Who's going to pay for the planting and reforesting? These are communities that the state has turned its back on in terms of local aid to government. The towns are broke and the median incomes are way below the metro area. How are people going to pay for this? Ash trees can't be left dead and standing. Within two years they become highly hazardous. They're very, very brittle—they're going to damage property, they're going to damage utility lines. So it's not a situation where you can say "we'll get to it when we can."

In western Minnesota especially, the trees are the only protection from the wind—there's no topography that slows down that wind in the winter. In a community like Morris where you have the potential to lose half of your trees, that's pretty significant. People will pay more for fuel and it will be a decline in their quality of life. And it's a long-term issue—it will be 30 to 40 years before they can re-establish their community forests. I just hope they don't plant all maples (laughs).

Photos by David Hansen


Frelich


Aukema


Bauer

Marvin Bauer: My work is a little different—Brian, Gary and Lee are studying the trees themselves, whereas I'm mapping the land cover for Minneapolis, St. Paul and Woodbury. Trees are a very important part of urban communities with aesthetic, environmental and economic benefits, including air quality, water quality, stormwater management, energy conservation and property values. There are a lot of good reasons for cities to want to have a healthy urban forest. If you want to preserve and manage the current forest as well as plan for the future, that starts with knowing what you already have—that's why we set out to map the tree cover using remote sensing—satellite imagery and data.

With that combination of tools, we mapped the urban land cover—trees, water, streets, parking lots, grasses and shrubs—down to about every 2 feet. You can see individual trees and map them. The cities can combine that data with other maps and use it for analysis and planning.

Cities do this for some of the reasons Gary suggests. Trees are critically important to cities. If we lose them, that's going to be problematic. There's a lot of value there—the cities are interested in preserving the current tree cover and enhancing it. Knowing where you could plant additional trees is an important question to be answered.

Q. What's next? It all sounds pretty grim. Should we be worried about trees in our state?

Johnson: Trees become more vulnerable as their health declines. They can't tolerate normal stresses like a healthy tree can. The trees are so stressed already that they can't tolerate normal events. Then every once in awhile you have these catastrophic insects or diseases come along like the Emerald Ash Borer, where it doesn't matter if a tree is healthy or not—they're just going to eat it. These pests will kill their hosts. But it's the normal things that are a big problem: Most insects and diseases that bother trees tend to be opportunistic—they go for the weaker trees. It's a combination of poor selection of trees and poor siting that's left them vulnerable, and that's exacerbated by dramatic changes.

Aukema: Insects are so good at finding stressed trees. They're super-sleuths. If a tree is stressed, they'll find it. They'll show us where the boundaries are—it's true in urban and other environments. I've been looking at eastern larch beetle since I got here a year ago. I was amazed when I went up to Cotton (Minnesota) and looked at tamarack bogs. Eastern larch beetles like stressed trees and they'll rattle around in a stand for 2-3 years and take out a few trees, and then disappear. But these beetles have been active here for 10 years and they're working their way north, all the way up to Lake of the Woods. You have the same or less precipitation over a longer growing season, plus some drought stress, and you could have two generations of the eastern larch beetle per year.

It's reflective of the changing environment and maybe the landscape. We're seeing an increasing rate of insect invasions—we've got gypsy moth coming in from the east and it's moving fast. Minnesota's not immune. Who's to say that this summer we won't find Asian longhorn beetle in maples in Minneapolis? That would be a matter of "Whoa! OK, now we have to take out 4,000 maples on top of the 10,000 ash that have been infested and killed," and who knows what's next after that?

We are getting better at detecting them, and that's important. But the rate of insect introductions is increasing. That reflects greater urbanization, increasing global trade. And travel barriers have been reduced.

Johnson: We've inventoried trees in communities across the state, and I can tell you that in most places the three most common trees are maple, ash and spruce. You ask a pathologist which trees are most at risk for disease and he'll say 'maple, ash and spruce.' Ask an entomologist and he'll say "maple, ash and spruce." And then you go to a community and tell people to stop planting so many maple, ash and spruce, but people don't want to change. It's a social battle.

Frelich: I think with the changing climate we can look forward to higher drought frequency and more evaporation so more drought stress even with the same amount of rainfall. More big derechos, like the windstorm we had on July 1. It leveled 120,000 acres of forest when it got into northwestern Wisconsin. We'll see more of those in a warmer climate, more drought and more bug problems. There are trees that are wind and drought resistant—burr oak, hackberry, elm, Kentucky coffee tree, American basswood. Those species of trees all grow in Kansas and Minnesota; maybe we should be looking at some of these forests we can already find on the landscape as ecological blueprints for future forests.

Johnson: I do see communities are improving in engaging citizens. More communities have water plans—the city of St. Paul gives you a device called the "water gator" to water trees on the boulevard. They give them to you, so the homeowner can take responsibility. Spend a dollar a week on water, and the new trees will be much healthier. St. Paul is not unique—a lot of communities are doing similar things. There's more information, more civic engagement despite the economic problems we're dealing with. So we've got that going for us. ■

Visit solutions.umn.edu to see Gary Johnson's recommended Minnesota trees.

Bird Collision Mortality from A to Z

Over the long term, birds will survive

We humans have created a large number of barriers for migrating birds—skyscrapers, communication towers, buildings with glass facades, and so forth. Conventional wisdom and evidence of dead birds at the base of these structures might lead to a belief that these obstacles are decreasing the abundance of birds. Not so, according to a new study by CFANS researchers.

Professors Todd Arnold, Department of Fisheries, Wildlife and Conservation Biology, and Robert Zink, Bell Museum curator of birds, wrote "our analyses suggest that this conspicuous source of mortality has had no discernible effect on long-term population dynamics among North American landbirds." The authors described collision mortality as an "added burden" for bird populations that are already in decline for other reasons.

For their study, Arnold and Zink looked at 47 tower collision studies from Eastern North America, as well as three unpublished data sets on landbird collisions with urban buildings in Chicago, Ill., Toronto, Ontario, and New York, N.Y. An estimated 60,000 communication towers are scattered throughout eastern North America, and an estimated 70 percent of migrant birds fly through at least one major metropolitan area during each migration season.

Some species of birds are more prone to colliding with towers or buildings than others. Arnold and Zink found that for buildings the top five "super-colliders" were 25 to 57 times more likely to collide with a building than expected by chance. In contrast, the bottom five species of "super-avoiders" were 105 to 208 times less likely to collide with a building than expected by chance. The range of vulnerability was even greater for species affected by towers. In general, birds that migrate over long distances and most often at night are most likely to appear on the list of super-collider species.

Night-flying birds frequently collide with skyscrapers after becoming disoriented by building lights, especially during inclement weather. Migrating birds that make stopovers in urban areas are especially vulnerable to colliding with low-level windows as they forage in unfamiliar environments.

Although Arnold and Zink argue that preventing bird collisions is unlikely to lead to increasing bird populations, collisions with towers and buildings nevertheless claim a large number of birds each year, and for many urbanites, encounters with migrating birds too often involve finding their bodies on the sidewalks. Simple design solutions can greatly reduce this mortality.

"Bird-Safe Building Guidelines" details the reasons birds collide with buildings and offers best practices in the design and retrofit of all structures—from landscaping to lighting to glass choices—to reduce their impact on birds. The publication is a first step in promoting understanding and adoption of bird-safe strategies to the people—building designers and operators—who are best able to make choices that create a better environment for birds. The guidelines are available from Project Bird Safe: mn.audubon.org/project-birdsafe.

–Martin Moen

Photo by David Hansen

Still Relevant After All These Years

A message from CFANS Alumni and Constituent Relations director Mary Buschette


Photo by Mike Lee

This year the University of Minnesota is celebrating, along with universities across the country, the 150th anniversary of the passage of the Morrill Act that established the land-grant university. Land grants were created in an era when a college education was viewed by some as esoteric...nice, but not necessary. The land-grant idea emphasized practical, relevant, applied education to improve the country through research, teaching and outreach.

As we look forward to the next 150 years, that is still needed. Land grants continue to give students the skills to launch a career *and* the well-rounded experience to advance in that career.

A unique aspect of a degree in food, agriculture or natural resources at a research institution like the U of M is the opportunity for students to participate in all aspects of the land-grant mission of discovery, learning and engagement. Students work in labs with professors and researchers and get hands-on experience in searching for answers to challenges such as developing resistance to cereal diseases or minimizing the impact of invasive species. With the new technologies available in our interactive classrooms, students learn from faculty but also work collaboratively with and teach each other. And through internships and service learning activities, they engage with the communities where they work and share the knowledge they've gained as a student.

What lies ahead for the next 150 years? How do we take the vision that was appropriate in 1862 and apply it in 2012? CFANS has been exploring that through a strategic planning effort assessing the current programs in the college. Faculty, with input from students to stakeholders, are considering new majors that address current needs and concerns and are exploring new and innovative ways to deliver education. Alumni and friends of CFANS will have an opportunity to support student development through activities such as the mentor program, providing internships and serving as valuable resources to students in our college.

In the weeks and months ahead there will be a variety of ways to engage with the college and university as part of this celebration. I hope you will participate, but also remember that supporting the university's mission of discovery, learning and engagement will continue to be important as we look forward to the next 150 years.

For the Common Good
150 years
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Classes Without Quizzes

April 20
University of Minnesota Alumni Association annual celebration

April 24
Borealis Night of Excellence

July 13
Golf Scramble for Scholarships
Les Bolstad Golf Course

October 7–13
University of Minnesota Homecoming 2012

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z.umn.edu/cfansas2011

Multi-generational Mentoring

Nutritionists help open students' eyes to future possibilities

Photo by David Hansen

Pam Whitehead, left, and Brenda Jacob had such good experiences as mentor and mentee that they now work together at General Mills, and both are currently mentors for CFANS students.

Sometimes a random match can spark a whole series of inspirations.

Brenda Jacob became Pam Whitehead's mentor in 2008 when Whitehead was a nutrition major; today they are colleagues at General Mills and fellow mentors of a new crop of students eager to explore the possibilities of a career in food.

Jacob is a senior scientist responsible for labels on food products who became a mentor when she joined the CFANS Alumni Society board. She had earned her undergraduate degree in nutrition and was working as a research dietitian and graduate student when she first ventured into the food industry.

"When you think about it, if you want to have an influence on the quality of the food supply, being in the food industry is the way to do it," Jacob says. Soon she was hired full-time at General Mills and has stayed for 23 years. Now, as a mentor, she uses her experience to introduce students to career possibilities they might otherwise not encounter. She's given tours, arranged for meetings with experts in all parts of the company and even has run into the Trix rabbit and the Lucky Charms leprechaun when giving student tours.

That's what happened with Whitehead, now a labeling coordinator for the Golden Valley-based food company. "When I met Brenda, she introduced me to this whole new world. I was a nutrition major, but had been oriented toward a hospital or food-service setting. Brenda really showed me there were lots of other possibilities. "

And in turn, Whitehead is doing the same this academic year for her two mentees. One of them, Ann Schmitz, says their relationship has included brainstorming potential employers, arranging for informational interviews and working on practical ways to improve her chances of landing a job when she graduates in December with a degree in nutrition. "It's really been encouraging to have a professional invest so richly in a student when it has little benefit to her own career success," Schmitz says.

Both Jacob and Whitehead emphasize that they do benefit from their relationships with mentees. "I'm a big fan of CFANS, and of being part of the university," Whitehead says. "It was an obvious decision to give back, to do the same kinds of things Brenda had done for me."

Jacob points out that there's another potential benefit for mentors: finding new colleagues. "Pam and I stayed in touch, and after she finished her internship (with another employer) we had an opening. My boss said they were looking for leaders and asked if Pam could do the job. I said 'Not only that, she could do my job, and someday she'll be able to do yours.' That's what employers are looking for, and that's where having had a mentor can make a difference."

–Becky Beyers

Want to **be** a mentor or **have** a mentor?

CFANS mentors and mentees are matched up every fall semester and work together through mid-April. The year starts with a kick-off event where mentors and mentees meet and learn about how they can both benefit. To learn more or to sign up, visit z.umn.edu/mentor.

Can You Identify this Photo?

Where are these snazzy-looking coeds from 1945 waiting in line to buy coffee and other treats? Recognize any of their faces? If you know the answers, let us know at solutions@umn.edu. The person who sends us the correct answer—with extra credit for additional details—will receive a CFANS coffee mug.

Last issue's answer

Several alumni from the School of Home Economics (later the School of Human Ecology) recognized the intense-looking professor working on the dress in this photo—it was Gertrude Esteros, who led the design department from 1950 until her retirement in 1980 (unfortunately, no one who wrote in could identify the student in the photo). Patricia Lalim Falcone wrote in that Esteros was her professor. "I last saw her at the School of Agriculture Reunion in April 2009 on campus. She looked and talked like Meryl Streep in the movie "The Devil Wore Prada" but was ever so much, much more incredibly beautiful and incredibly fashionable. The small scale mannequin in the photo was used for draping original designs in the French Haute Couture manner as would be employed by Chanel, Christian Dior and Yves Saint Laurent, to only list a few famous designers." Esteros, now 98, still lives near the St. Paul campus. Falcone will receive a CFANS coffee mug for correctly identifying the photo.

BY THE NUMBERS CFANS' First Five Years

55 Percentage of Fall 2006 first-year students who are female

63 Percentage of Fall 2011 first-year students who are female

22 Actual number of first-year students from South Dakota, **2006**

37 percentage of U of M bachelor's degree recipients who finished college with no debt, **2006**

34 percentage of U of M bachelor's degree recipients who finished college with no debt, **2011**

93.2 Percentage of CFANS undergrads attending classes full time, Fall 2006

92.9 Percentage of CFANS undergrads attending classes full time, Fall 2011

6 Actual number of first-year students from South Dakota, **2011**

45.1 PERCENTAGE OF CFANS UNDERGRADS FROM THE TWIN CITIES, FALL 2006

44.9 PERCENTAGE OF CFANS UNDERGRADS FROM THE TWIN CITIES, FALL 2011

Sources: Office of Institutional Research; CFANS internal reports

CFANS Development Team

The College of Food, Agricultural and Natural Resource Science's development staff are available to discuss giving opportunities with you and to answer any of your questions. Contact us anytime!

Cynthia Cashman
Chief Development Officer
612.624.7489
cashman@umn.edu

Adam Fischer
Director of Corporate and Foundation Relations
612.625.5766
afischer@umn.edu

Cathy Konat
Development Officer
612.625.5229
kona0006@umn.edu

Jerry Haus
Development Officer, Bee Research and Discovery Center
612.625.4210
jhaus@umn.edu

Shana Zaiser
Associate Development Officer, Bell Museum of Natural History
612.624.0089
zais003@umn.edu

Connie Hempstead
Stewardship & Donor Relations Manager
612.625.2930
hempstea@umn.edu

Living Her Passion

Scholarship helped nontraditional student succeed

Editor's note: Ali Sands, recipient of the Agriculture Future Fund Scholarship, was one of several speakers featured in November at the annual Thanksgiving for Scholarships event. This is an edited transcript of her speech.

One of the reasons I was chosen to receive this scholarship and to share my story is because I'm a "non-traditional" student. Translated, this means that in comparison to the 20-year-old students around me, I'm actually old. I began my career as a University of Minnesota student in 1982, the year that I graduated high school. I went one semester—I think it was actually trimesters or quarters back then—and I took a 27-year semester off.

In that time, I got married, put my ex-husband through three degree programs at the university, raised two children, got divorced, as a single mom put my oldest child through the University of Minnesota and my youngest through a career training program.

I remember telling myself that I didn't want to go to college, that a college degree was not necessary for me. The support system that I would have needed to attend college was not in place for me then.

For the past 10 years, I have owned and operated my own therapeutic massage business. My career has served me well. Yet, massage can actually be a mind-numbing profession for the practitioner. I used writing as an outlet and I'm in the process of publishing my first book. Even so, I was not living my passion. I did some research and found the average adult has seven different careers in a working lifetime. Here I am, 47 years old, the environment is calling and I'm working on career no. 4.

My deepest interest and passion does lie in the environment, specifically coastal ecosystems and invasive species. I'm concerned how our natural environment is being compromised to allow for our human existence. In 2009, I enrolled in Minneapolis Community and Technical College. I attended for two years and with much support from my unceasingly supportive now-husband and my two adult children I decided to pursue an environmental science degree here at the University of Minnesota.

My biggest hurdle as an adult learner has not been managing my time or spending my days studying with 20-year-olds or doing well academically—although I will say that my econ class is giving me a serious run for my money. It has been finding a way to finance my own education while I help my children pay off their student loans. It's also a challenge attending the University of Minnesota full time without compromising my small business and my own financial stability.

I had hoped that my academic merit at MCTC would allow for scholarship awards when I transferred to the University of Minnesota. However, I could never have hoped for the generosity bestowed upon me when I received the CFANS Agriculture Future Fund. This gift allows me less financial stress around incurring student loan debt as I near my goal of graduating in two years, before my 50th birthday. Upon my graduation, my goal is to work as an environmental interpreter educating others on the vital importance of our natural resources. I'm also considering opening a consulting business for green living practices as well as writing as an environmental journalist.

The generosity of the anonymous donors who contributed to the CFANS Agriculture Future Fund is overwhelming to me. I feel validated and supported in my quest to make positive change to our environmental stability. This scholarship has acknowledged to me that following my passion is important at any time in my life. Thank you. *–Ali Sands*

DISCOVER CFANS

The world's fourth-largest food crop, the potato, plays an important part in feeding a growing world population. It's so important, in fact, that 2008 was designated as the "International Year of the Potato." At CFANS, plant breeders, biochemists, pathologists, entomologists and soil scientists are continuing a century-old tradition of working with Minnesota's potato farmers and industry to improve the quality, yield and disease resistance of potatoes; some of that work may have implications well beyond the fields of Minnesota and North Dakota.

A new variety of potato, like the one pictured here, takes about 12 to 15 years to get from inception to market. In a given year, Department of Horticultural Science professor Christian Thill and his potato-breeding colleagues might test as many as 100,000 new combinations of varieties, weeding out the obvious duds in the first year and narrowing the numbers down to about 15 varieties in their eighth year of testing.

Photo by David Hansen

College of Food, Agricultural and Natural Resource Sciences
University of Minnesota

277 Coffey Hall
1420 Eckles Ave
St. Paul, MN 55108

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CFANS 2012 CALENDAR OF SPRING-SUMMER EVENTS

These are some of the many events supported by the College of Food, Agricultural and Natural Resource Sciences. All are open to the public; some may require a registration or fee to attend. Visit www.cfans.umn.edu/Events2.html or contact Honey VanderVenter at 612-625-6710 or hvander@umn.edu for more information.

March 31
Classes Without Quizzes, McNeal Hall, St. Paul campus

April 22–24
Minnesota State FFA Convention, University of Minnesota campus

April 24
Borealis Night of Excellence, St. Paul campus

May 11
CFANS undergraduate commencement, Mariucci Arena

May 24
Siehl Prize for Excellence in Agriculture awards ceremony, McNamara Alumni Center

June 8–9
Bell Museum BioBlitz, Cedar Creek Ecosystem Science Reserve

July 13
Golf Scramble for Scholarships, Les Bolstad Golf Course

July 26
Horticulture Night, West Central Research and Outreach Center

September 4
Fall Semester 2012 begins

September 21
Applied Economics department centennial celebration, St. Paul campus