ENDEAVORS

Highlights of University of Nebraska-Lincoln Agricultural Research Division research

2003-04

ARD shares discoveries with citizens statewide

Welcome to the 2003-04 issue of Endeavors, which features a brief look at some of the diverse and exciting research by scientists in the University of Nebraska's Agricultural Research Division.

As part of NU's Institute of Agriculture and Natural Resources, the Agricultural Research Division (ARD) is the university's primary agricultural research component and Nebraska's Agricultural Experiment Station.

Today's ARD scientists are building on a long and strong tradition of scientific leadership that expands knowledge and provides innovative, practical information for Nebraskans and the nation. They conduct basic and problem-solving research to enhance Nebraska's food and agriculture industry; its families, communities and businesses; and its environment, natural resources and quality of life.

To make the most of our human and financial resources, ARD focuses our research endeavors in key areas that stakeholders tell us are most important and on priority needs that offer the highest long-term potential payoff for Nebraska.

Endeavors offers a sampling of our efforts to serve the current and future needs of Nebraskans through research and discovery.

For more information, visit the ARD Web site at http://ard/unl.edu or read more of our research stories in Research Nebraska magazine at http://ard.unl.edu/nebraska.html.

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Building herbicide resistance into broadleaf crops

Dicamba herbicide has long helped control broadleaf weeds in corn, wheat and other grassy crops, but it's off-limits to broadleaf crops such as soybeans and vegetables.

That could change soon. An NU biochemistry team has discovered how to develop genetically enhanced broadleaf crops that can withstand dicamba spraying.

Dicamba-based herbicides, sold under trade names such as Banvil and Clarity, are relatively inexpensive and easy on the environment because the chemical disappears quickly in plants and soil.

For the raw material to instill dicamba resistance, NU scientists looked to the source that makes the herbicide environmentally friendly. They identified a soil bacteria that easily breaks down this synthetic chemical.

Researchers identified and isolated the gene responsible for dicamba inactivation in the bacteria. They inserted the gene into the chromosome of tobacco, which they used as a model broadleaf plant. They grew out transgenic plants and tested them to determine if their technique provided resistance. It worked.

Along the way, they made several other key discoveries, including how to modify the gene to target DNA of the cell's chloroplast. Using the chloroplast helps instill greater dicamba resistance. Chloroplast genes also are inherited through the maternal side, not through male pollen. That means when the gene is inserted into the chloroplast DNA, the transgenic crop can't spread resistance to other plants through pollen.

Scientists have grown dicamba-resistant tomatoes and tobacco in the greenhouse. Tobacco plants sprayed with the equivalent of 25 pounds of dicamba per acre – 50 times the typical field application – show little or no damage.

Now, they're concentrating on producing dicamba-resistant soybeans, and plan to create resistant canola and cotton. They hope to field test their dicamba-resistant soybeans in the next two years. NU is patenting this new technology.

Biochemist Don Weeks (right), graduate student Mark Behrens and lab manager Sarbani Chakraborty examine genetically engineered tobacco plants resistant to the widely-used herbicide dicamba. Their discoveries should lead to dicamba-resistant broadleaf crops such as soybeans.

Carbon sequestration research points to storage potential

NU research is beginning to reveal how best to store carbon in soil, improve crop production efficiency and protect the environment.

Interdisciplinary teams are collaborating on comprehensive research to quantify and better understand carbon sequestration, or storage, in irrigated and dryland crop systems. IANR scientists are tackling studies of diverse aspects of the entire system – from roots to atmosphere. They are comparing how crops, farming practices and other factors influence carbon storage on a field-scale.

Using state-of-the-art field research facilities, scientists continually measure the amount of carbon that enters and leaves crop fields. NU's facility is one of about 150 worldwide capable of taking these measurements and the only one at an agricultural site.

Preliminary findings point to the potential for storing significantly more carbon in cropland, while boosting crop yields and using inputs, such as fertilizer and irrigation, more efficiently. Researchers also are quantifying the benefits of using corn to produce ethanol fuel to help reduce fossil fuel use. Atmospheric levels of carbon dioxide, a major greenhouse gas, are climbing because of fossil fuel use.

Their overall goal of this ongoing research is to answer practical and scientific questions about storing carbon under cropping schemes in Nebraska and the north-central United States. Specifically, findings will help researchers identify cost-effective management practices farmers can use to boost carbon storage.

Society, the environment and farmers all could benefit from farming practices that increase carbon sequestration, IANR researchers say. Storing more carbon in cropland could help reduce the amount of atmospheric carbon dioxide, a major greenhouse gas, and farmers someday might be paid to store more carbon in their land. Increasing soil carbon also improves soil quality and reduces erosion.

Identifying important genes could lead to controls for dangerous *Listeria* bacteria

Listeria is a tough guy even among bacterial troublemakers.

A prime culprit of foodborne illness, it causes more food industry recalls than any other organism. And it survives in refrigerated, high acid or high salt conditions commonly used to process and preserve food.

Researcher Chao Zhang (above) loads dishes containing genes into a microarray machine. He's part of IANR Food Scientist Andy Benson's team that is discovering important genetic differences in different strains of Listeria.

NU food scientists are exploring the genetics behind *Listeria's* durability and adaptability in an effort to find ways to control it. An IANR food microbiologist heads long-term research to identify genetic differences among the 13 known *Listeria* strains. Because three of these strains account for more than 90 percent of Listeriosis in humans, scientists hope to identify the genes that make these three strains particularly dangerous.

This team already has made discoveries that eventually could lay the foundation for *Listeria* controls.

Using a comparative genome analysis, the IANR researchers are identifying minute genetic differences among all 13 strains. They're focusing on significant differences they believe are linked to *Listeria's* adaptability and ability to cause illness.

By tracking genetic selection, researchers let nature point the way to potentially important genes that give some *Listeria* strains a competitive advantage. This approach has revealed some novel and promising discoveries.

So far, two types of genes stand out: gene encoding cell surface proteins and regulatory genes that turn processes on or off. The team is investigating some especially promising genes.

This basic genomics work someday could yield information to help the food industry guard against *Listeria*. For example, better understanding gene functions could lead to an antimicrobial treatment that blocks *Listeria*.

Better understanding selenium's benefits

Discoveries by IANR biochemists should help better understand selenium's beneficial role in human health.

The Nebraska scientists think they have identified the complete set of human selenoproteins by using powerful computer programs they developed to scour genetic databases. Selenium, an essential micronutrient, is linked to cancer prevention, male reproduction, aging, immune system function and other health-related processes.

Scientists think selenoproteins are responsible for most of selenium's health benefits so it's important to identify and explore how they work.

Selenoproteins have been difficult to identify, but the new computer tools they devised allowed the team to fully analyze the human and mouse genomes using the new computer tools. Their complexity had confounded earlier analytical tools.

Researchers identified seven new selenium-containing proteins in humans and mice. Combined with the 18 previously known human selenoproteins, scientists believe they've identified all of the selenium-containing proteins in the human body. About half of all human, mouse and other animal selenoproteins were identified in the UNL lab.

This research was conducted in cooperation with Spanish scientists and funded by the National Institutes of Health.

With all the selenoproteins identified, scientists can more fully study the micronutrients' role in human and animal health, and link selenoproteins to specific beneficial health effects of selenium.

A clearer look at root pests' noshing habits

An NU entomologist's invention is providing a clearer, more realistic look at rootworms' feeding habits and behaviors.

Rootworms feed on tender corn roots, weakening and sometimes killing the plant. Understanding the worm's behavior is especially important since Nebraska farmers spend more money controlling them than any other insect.

Since rootworms feed underground, there's been no good way to observe their behavior. Traditionally, studying rootworms meant digging up the plant, washing the pests off the roots and counting survivors of a given pesticide treatment. This doesn't provide much insight about what goes on in the soil.

To get a better look, an IANR entomologist developed a clear gel that provides soil-like nutrients. By growing corn in gel-filled tubes in the lab under conditions that mimic a cornfield and then placing rootworms in the gel, scientists can observe the worms feeding and learn much more about their behavior and habits.

Researchers used the gel in studies that showed rootworms feed differently on conventional corn than on Bt corn for rootworms. This new genetically modified corn will be widely available next spring so scientists needed to understand how the pests respond to it.

On conventional corn, worms feed longer on one part of the root, pruning it and causing injury, these studies showed. On Bt corn, rootworms tend to take small bites and move around, causing minimal damage. Some rootworms feeding on Bt corn die right away; others appear to starve.

The gel technique can be adapted to study other root-feeding insects; its patent potential is being investigated.

New tool helps check buffer strips' effectiveness

While most everyone agrees planting strips of vegetation between fields and streams helps protect water quality, there's been no practical way to tell how well a strip performs under real-world conditions.

Variously called vegetative, conservation or riparian buffer strips, these plantings of grasses, shrubs or trees filter sediment and chemical runoff from fields and reduce the amount that reaches waterways.

Hydrologic Engineer Dean Eisenhauer (left) and Surface Water Engineer Tom Franti examine an experimental buffer strip.

IANR biological systems engineers head a team that developed a simple, accurate device that measures water flowing into and out of buffers so performance can be assessed in the field. Their sampler captures a tiny but representative fraction of the water flowing through the buffer. Lab analysis of the sample reveals how well the strip does at keeping contaminants from streams.

Knowing how much water and sediment flow through a strip and into a stream is important because nutrients and pesticides hitch a ride on the soil particles. When less water and sediments leave the strip, fewer contaminants reach the stream.

The IANR-developed sampler will help scientists better assess buffer strip design, construction and performance. The team is developing a similar version for natural resources and conservation agencies to use.

Accurate field measurements are especially important because buffer strips are the focus of several federal, state and local water quality protection efforts.

The team hopes that devising a tool that quantifies buffer strips' performance under Great Plains field conditions will help spur more research into their design and effectiveness.

Molecular Nutritionist Janos Zempleni (left) has discovered key roles for biotin, or vitamin H, in human health. Here he watches graduate student Gabriela Camporeale inject a sample into a chromatograph.

Vitamin may have role in preventing cancer

NU nutrition science research points to important new roles for biotin in cell biology, including the possibility that it helps prevent cancer from taking hold in human tissue.

Biotin, or vitamin H, is a water-soluble vitamin found in foods such as grains, yeast, egg yolk and liver. Scientists know it best for its role in helping cells carry out biochemical processes necessary for human metabolism and growth. But relatively little is known about its broader health implications and how it interacts with DNA.

Research by an IANR molecular nutritionist is expanding the understanding of biotin's importance and sparking international attention. He found that biotin facilitates the repair of damaged DNA in cells, which if left unrepaired, could lead to a tumor. His research also indicates that biotin may help keep rebel cells in check.

Findings from this research someday may aid human health, especially for people with a decreased ability to metabolize biotin. About one in 60,000 people is born with the disorder.

Researchers hope further studies will show whether people with the defect are at higher risk of developing cancer sometime in their lives and whether biotin supplements would decrease that risk.

The team developed a method for detecting biotin's binding sites on DNA. The university is patenting this invention. Today, it's a tool for scientists studying biotin but someday it could play a part in cancer diagnosis.

Pinpointing genetic key to sterile plants

Nebraska plant scientists have discovered the genetic key to creating male sterile plants, which are important in plant breeding and hybrid seed production.

Scientists have long known that changes in plant cells' mitochondrial DNA trigger the sterility mutation. Following the genetic trail, the team re-created the mutation in the lab and found a gene in the cell nucleus that controls mitochondrial changes.

Plant Geneticist Sally Mackenzie inspects an Arabidopsis *plant. Her team used the plant to identify the genetic key to male sterility in plants.*

By inserting foreign DNA into this gene, researchers turned it off, observed changes in the mitochondria and pinpointed which change triggers male sterility.

This technique induces stable male sterility. The foreign DNA that caused the original genetic change can be removed, and the plant remains sterile and is not considered transgenic.

The IANR researchers studied *Arabidopsis* as a model plant because its entire genetic code is known. All plants carry the gene that affects the mitochondria so their findings have wide application.

Scientists have long tried developing male sterile plants through various methods, but sources of male sterility are limited or nonexistent in some crop plants, and the trait can be unstable, with some plants reverting to fertility. The team's technique has potential for producing non-transgenic and stable male steriles.

Sterile plants don't produce pollen so sterility also eases concerns that genetically modified crops will spread their enhanced genetic characteristics to wild plants.

NU has filed for a provisional patent on this technique. The team hopes to work with an agribusiness to make sterile males commercially available in a variety of crops.

Major study yields info to enhance child care

Research by NU family scientists is expanding knowledge about child care quality and characteristics of child care providers in Nebraska.

The College of Education and Human Sciences researchers are collaborating with UNL's Center on Children, Families and Law on a major study for the Midwest Child Care Consortium.

There are few large-scale child care studies. This UNL study is the only one of its kind that represents all types of child care in the U.S. Department of Health and Human Services Midwest region. Iowa, Kansas and Missouri also are part of the project, which includes infant/toddler and preschool centers, licensed family home providers and license-exempt providers.

Findings will guide child care improvement and help legislators and others developing child care policies.

This study shows child care quality in Nebraska is comparable to child care nationwide. Thirty-four percent of Nebraska's child care was rated good; 44 percent, minimal or mediocre; and 14 percent, poor.

In Nebraska, the majority of providers regard child care as their profession, have been providing child care for more than five years and intend to stay in the field. All these pluses come despite full-time average earnings of $14,700 in Nebraska, below the poverty level for many providers.

While the team found several strengths in Nebraska child care, they found ways to improve child care. For example, low-income children receiving subsidies sometimes receive lower quality care. Researchers recommend offering incentives to boost quality.

Findings help protect allergic consumers

Food allergies are a hot issue for consumers and food makers alike.

NU's Food Allergy Research Program, or FARRP, is an international leader in studying food allergies from a food industry perspective. Food companies from six countries help fund the program and IANR scientists work closely with industry to help protect allergic consumers. Their research provides tools and information to help industry better test for allergens and helps allergenic consumers become more confident that processed foods contain only what's listed on the label.

FARRP tackles diverse allergy-related issues but is best known for developing fast, simple, accurate tests processors can use to check for traces of allergenic foods on equipment or in products.

An NU-developed test for almonds and an improved egg test were commercialized in 2003. Neogen Corp. of Lansing, Mich., markets these along with test kits for peanut and milk protein to food processors under a licensing agreement.

IANR scientists also are working to define the exact trace levels, or threshold doses, of different allergenic foods that cause a reaction in the most sensitive people.

Food processors prepare different foods on the same equipment, which is cleaned before a new product is processed. Processors and regulators need to know the level at which an allergen causes reactions in order to protect allergic consumers. The team recently finished a threshold study on eggs; other trials are in progress.

Another study showed soybean oil doesn't cause reactions in people allergic to soybeans. That's because the widely used oil contains no protein, the trigger for allergic reactions.

Food Scientist Sue Hefle watches as Debra Lambrecht, a research technologist, uses an NU-developed test to check for the presence of hidden milk in a non-milk food product.

Insecticide resistance offers clues to controls

NU entomologists are learning from the past to preserve future insect-fighting tools.

In the early 1990s, insecticides used to control adult western corn rootworms began to fail in some central Nebraska counties. The major corn pest had become resistant to methyl parathion, an organophosphate insecticide.

NU scientists set out to learn as much as possible about this problem to help farmers and to prevent history from repeating itself.

They helped farmers identify alternatives to adult rootworm control, mapped the extent and spread of resistance, and encouraged practices to limit further development. More recently, they identified the biochemical and genetic mechanisms for organophosphate resistance and discovered how resistance is inherited, and developed a test to check rootworms for resistance.

Working with a Mississippi State colleague, NU researchers have incorporated their findings into a computer model that simulates field conditions and predicts how long a rootworm control will be effective, based on factors such as management and cropping practices. They verified the model's accuracy by comparing it to what happened with resistance in Nebraska.

Eventually, the computer model should provide more accurate predictions about the outcomes of different management approaches and show how best to use new insect control technologies.

Entomologists Blair Sigfried (left) and Lance Meinke check western corn rootworm beetles being raised in a lab.

The NU team's ultimate goal is to identify ways to preserve the effectiveness of new insect control tools, such as Bt corn for rootworms and other environmentally friendlier technologies.

Findings from NU's extensive research on Nebraska's unfortunate but unique rootworm resistance situation should help regulators, industry and producers merge existing and new technologies to develop management practices that are sustainable for the long-term.

WeedSOFT takes guesswork out of weed control

Growers and their advisors tap into years of agricultural research every time they fire up the WeedSOFT weed management program developed at NU.

IANR agronomists designed the software to help users make better informed weed management decisions. It takes the guesswork out of weed management and provides economic, environmental and regulatory information for specific crops and weed problems

WeedSOFT incorporates the latest research and information. Introduced in Nebraska in 1992, WeedSOFT has been expanded and improved annually. It has evolved into a comprehensive decision-support system available for seven crops and is being adopted across the region. The crops covered include corn and soybeans in all states, plus sorghum, wheat, dry beans, sugar beets and alfalfa in Nebraska and two other crops in a few states.

Users say it's a valuable diagnostic tool. They appreciate the program's unbiased, science-based information.

WeedSOFT now is used by nearly 600 people in at least six states. As part of an Integrated Pest Management project to improve weed management and reduce herbicide use, researchers in several states are promoting wider use of this software. State-specific versions of WeedSOFT now are available for Indiana, Illinois, Kansas, Missouri, Wisconsin and Nebraska.

Research shows that WeedSOFT is helping users reduce crop herbicide use and associated costs, improve weed management and reduce weed-related yield losses. A survey of WeedSOFT users in six states showed this software is responsible for about $13 million annually in cost savings and increased earnings for crop producers.

Making the most of bromegrass pastures

Smooth bromegrass provides plentiful, high quality forage during spring calving season and often again in fall. But the grass wears thin in summer and hurts cattle performance.

NU range and forage scientists are exploring ways to diversify eastern Nebraska's predominantly bromegrass pastures. The goal: provide more nutritious, reliable fare through the summer and take full advantage of the pastures throughout the season.

IANR research showed that interseeding three legumes — alfalfa, birdsfoot trefoil and kura clover — into the bromegrass boosts productivity, feed availability and forage quality in pastures from July through September.

Legumes helped improve beef gains by 25 to 40 pounds per acre. That translates into about $10 to $20 an acre of additional income.

Unlike brome, legumes don't require fertilizing once they're established, which cuts costs. Planting and establishing legumes in existing bromegrass is difficult, but research continues to improve the effectiveness of interseeding.

Native warm-season grasses such as indiangrass, big bluestem and switchgrass also show promise in complementing bromegrass.

A key is finding a grazing system that makes the best use of both cool- and warm-season grasses. NU researchers developed an early-season grazing strategy for warm-season tallgrasses that improves the efficiency of their use through the growing season. Early grazing on warm-season grasses helps slow their rapid growth and make them leafier and more nutritious later.

This grazing research already is paying dividends. Researchers documented about a $7 million economic benefit among 1,600 graziers who participated in NU Cooperative Extension workshops based on IANR research.

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New *E. coli* controls showing promise

Intensive NU research on *E. coli* O157:H7 is yielding information about controlling this potentially deadly bacteria in cattle before slaughter.

The latest findings show a new vaccine and a beneficial bacterial feed additive each significantly reduced *E. coli* O157:H7 in feedlot cattle, and using both may offer added protection.

In two summers of feedlot trials, steers received either: a developmental vaccine, a commercially available *Lactobacillus acidophilus* bacteria as a direct-fed microbial or no treatment. During 2002, some steers received both the vaccine and feed additive.

The vaccine proved most effective at reducing the proportion of cattle shedding *E. coli* in manure. Vaccination reduced *E. coli* prevalence an average of 59 percent, compared with unvaccinated steers.

Feeding the *Lactobacillus acidophilus* feed additive reduced *E. coli* prevalence an average of 35 percent, compared with untreated steers in a two-year study.

While *E. coli* prevalence varied greatly across time and pen to pen, it consistently was lower in cattle that received the vaccine, the direct-fed microbial or a combination of the two, compared with untreated pens.

In 2002, IANR animal and veterinary scientists also evaluated the effectiveness of the vaccine/*Lactobacillus* combination and found it boosted overall control somewhat. The combination provided an additive effect.

Vaccine for the NU trials is being developed by a Canadian alliance, including the University of British Columbia, the University of Saskatchewan's Vaccine and Infectious Disease Organization, the Alberta Research Council and Bioniche Life Sciences Inc., a biopharmaceutical company. Bioniche expects the vaccine could be available in the United States in 2004, pending completion of studies and receipt of regulatory approvals.

The *Lactobacillus* feed additive, produced by Nutrition Physiology Corp., is commercially available and already used in some feedlots.

Songbird-predator interactions in wetlands key to increasing birds' breeding success

Nebraska's Rainwater Basin is widely regarded as essential for migratory waterfowl, but its role for songbirds isn't well known.

An NU wildlife ecologist hopes his team's research to better understand how songbirds and animal predators interact will aid basin management and restoration efforts.

Max Post van der Burg, a graduate research assistant, (left) and Wildlife Ecologist Larkin Powell band a female red-winged blackbird at a Rainwater Basin wetland in Clay County, Neb.

Rainwater Basin wetlands are scattered across south central Nebraska. Less than 10 percent of the once vast wetlands remain. Wildlife agencies and others are working to preserve and restore this habitat.

IANR researchers are identifying wetlands restoration strategies that make habitat attractive to the 12 or more native songbird species that nest there. That includes minimizing chances birds will fall prey to animal predators, such as skunks, raccoons and sometimes opossums. This combination also should attract waterfowl.

In summers 2002 and 2003, researchers charted songbird nests and nesting success on basin wetlands, and tracked animal predators that eat songbirds and eggs. They believe it's the first such research conducted in the basin during breeding season.

Results so far indicate songbird nesting success depends on how attractive a wetland is to animal predators. Not surprisingly, the fewer the predators, the better the nesting success rates. And predators tend to favor wetlands close to others.

Mammalian predators' impact is so significant that restoring wetlands in ways that reduce their influence should improve nesting success. Steps might include planning for larger, somewhat remote wetlands and providing a border of upland habitat, which may buffer the wetland birds from foraging predators.

Based on their findings, researchers will develop recommendations about how to enhance songbird breeding success.

Customized information aids diet changes

Most young adults eat pretty lousy diets. Their meals fall far short on fruits and vegetables at a time when they're starting to be on their own and establishing eating habits that often last a lifetime.

An IANR nutrition scientist is working to quell this trend. She is collaborating on an 11-state study to understand why young adults eat so few fruits and vegetables and how to change these behaviors.

Her preliminary research identified the best methods for reaching young adults with nutrition information.

Using these NU College of Education and Human Sciences findings, her team developed new, customized approaches to encourage young adults to improve their habits. They designed newsletters, manuals and other information tailored to different stages of readiness to change. Research shows that customized information is much more effective than a one-size-fits-all approach. These materials are being tested nationwide.

Results of this research will be the foundation for a broader national nutrition campaign targeting other groups and individuals with information tailored to an individual's stage of change. That should boost chances of improving their eating habits for the long term.

Exploring groundwater's role in salt marshes

Better understanding groundwater's role in southeast Nebraska's salt marshes may help preserve these rare wetlands.

An IANR hydrogeologist/geochemist and his School of Natural Resources colleagues want to learn how groundwater moves under and feeds salt marshes, found mostly in Lancaster and Saunders counties. They're analyzing the groundwater's chemical content and how it reaches the surface to replenish marshes.

Salt marshes are rare outside coastal areas. Nebraska's saline wetlands occur mainly in Salt Creek's floodplain in Lancaster and Saunders counties. Their salinity comes from groundwater passing through underground rock formations containing salts deposited by a sea that covered Nebraska more than 100 million years ago.

The IANR researchers determined that groundwater at the sites is between 15,000 and 35,000 years old. They also found the groundwater has salt concentrations as high as 15,000 milligrams per liter, fairly salty but less than the 35,000 milligrams per liter for seawater.

Now the IANR team wants to understand how and when that salty groundwater reaches the surface to feed surrounding marshes and to identify the origin of the salt in water within wetland soils and the underlying aquifer.

This information could help save threatened salt marshes, which don't appear to be getting as much salt as they used to. Researchers are working to quantify potential salinity changes.

Microbes could enhance ag profitability

Soil microbes are workhorses in complex processes essential to healthy plants and soils.

An IANR soil microbiologist thinks these microorganisms could help make agriculture more profitable and sustainable if we learn enough to enhance their beneficial but invisible efforts. She is studying microbial communities and how agricultural practices such as tillage or fertilization influence them.

Soil microbes perform all sorts of beneficial tasks such as converting plant residue to rich, stable humus, improving crop nutrient and water use, and enhancing soil structure.

By examining microbial communities under diverse conditions from golf greens and crop fields to native grasslands and forests, this NU team is learning how microbes fare in different environments.

The team uses lipid fingerprinting, a biochemical technique, to identify different communities. This produces a distinct profile representative of the entire microbial population in a soil sample. Researchers use these profiles to compare microbial communities, gather historical information and chart changes over time.

In a study of a dryland wheat-fallow system in western Nebraska, the microbiologist compared microbial fingerprints under fallow and growing wheat fields that were plowed or no-tilled. She found significant differences that suggest a relationship between tillage and microbial communities' long-term resiliency.

Rhae Drijber, a soil microbiologist, collects a soil sample amid native grasses. Drijber studies the underground ecosystem integral to healthy plants and soils.

The soil microbiologist is particularly interested in microbes' role in stabilizing organic matter in sandy soils because of these soils' importance to Nebraska and their vulnerability worldwide.

Eventually, findings from this research could point the way for developing new management approaches designed to boost beneficial microbes. That, in turn, should improve soils, ag productivity and the environment.

New Sandhills calving system reduces scours

Diarrhea, or scours, is a leading cause of illness and death in beef calves. In some herds, nearly all young calves get scours and up to 10 percent die of scours-related illness.

NU veterinary scientists have developed a new system that should help ranchers reduce scours in their herds.

Treatment expenses coupled with calf performance and death losses can cost individual ranchers thousands of dollars annually.

IANR veterinary scientists have designed a new Sandhills Calving System that should help ranchers reduce scours in their herds. While it's tailored to Sandhills ranches, it can be adapted to other calving operations.

This system reduces calf exposure to the germs that cause scours by keeping older and younger calves in separate pastures and by moving pregnant cows to new calving areas where their calves are born in pastures free of scours-causing germs.

Tests on two Sandhills ranches that use different calving schemes showed the system significantly reduces calf illness, treatment costs and medication costs as well as the need for antibiotics.

For example, the system eliminated scours deaths and cut associated costs 24-fold in a three-year study on a 900-head ranch. The ranch lost 7 percent to 14 percent of its calves to scours before adopting the NU system and has had no deaths since.

The ranch owner estimated he saved $40,000 to $50,000 annually since implementing the calving system, thanks to having more calves to sell, improved calf performance and greatly reduced treatment costs.

The team is teaching veterinarians and ranchers how to adopt this scours prevention strategy.

glimpses at ARD research

● IANR scientists are working on low-cost ways to help small communities reduce or eliminate arsenic from their drinking water. Arsenic occurs naturally in groundwater and has been linked to cancer. A School of Natural Resources research team is exploring ways to reduce arsenic levels in groundwater that cost less than drilling new wells or removing the contaminant from water supplies. Researchers are working with 10 small towns across Nebraska. They're among the more than 75 small public water systems statewide that may have trouble meeting the new lower federal limit of 10 parts per billion of arsenic in drinking water by 2006. Most of these systems serve fewer than 3,300 people; estimated costs for them to comply with this rule could top $120 million statewide.

● Three new wheatgrasses developed jointly by USDA Agriculture Research Service and NU scientists should provide new high-quality hay and grazing options across the region in the coming years. The new cultivars are Beefmaker and Haymaker, both intermediate wheatgrasses, and NU-ARS AC2, a Fairway-type crested wheatgrass. High-protein, readily digestible Beefmaster is recommended as a pasture grass for yearling beef steers. Haymaker provides high yields as a cool-season hay crop in low-rainfall areas. NU-ARS AC2, adapted to semiarid regions, is shorter than standard crested wheatgrasses. It should provide genetic diversity and high, stable yields when used to reseed cool-season pastures in the mid- and short-grass parts of the central and northern Great Plains. A limited supply of Beefmaker seed is available; seed for the other two cultivars could be available in fall 2004.

● NU scientists recently launched a major study of Nebraska's Sandhills with help from a $1.8 million National Science Foundation grant. An IANR ecosystems ecologist heads research exploring the complex interactions that drive this rare ecosystem, stabilize the grass-covered hills and perhaps even influence regional climate. Researchers with diverse expertise are collaborating on this comprehensive effort to develop an integrated, broad-based understanding of the Sandhills system. Results also could help expand understanding of potential impacts of global climate change. Research plots will be set up at NU's Barta Brothers Ranch near Rose and NU's Gudmundsen Sandhills Laboratory near Whitman.

● Rural Nebraskans strongly favor regional cooperation. More than 80 percent of rural residents who responded to NU's eighth annual Nebraska Rural Poll agreed communities working together to generate new businesses are better able to create quality jobs for residents. About 75 percent agreed retailers who work together can provide a better variety of goods and services; 60 percent agreed that combining community or county services in a region will improve access to services. Poll findings have implications for rural policy, community leaders and planners.

● The best way for farmers and ranchers to take advantage of economical byproduct feeds from the state's ethanol industry is to use them in dry instead of wet form, IANR animal science research shows. While wet byproducts work well for feedlots, researchers found dried byproducts work best for operations where cows and calves primarily graze. Feeding dry byproducts as a protein-energy supplement to heifers on Sandhills winter range reduced costs about 20 percent or more than $12 per head, compared with feeding hay. That translates to a potential annual savings of roughly $10 million statewide if all Nebraska cattle on rangeland were fed dry byproducts.

● Turfgrass seed production is a budding high-value alternative crop for Nebraska's Panhandle, thanks partly to NU research and extension efforts. IANR research results provide information on planting dates, the best varieties, fertility and water requirements and production practices that work well in the Panhandle. Extension staff use these findings to work with the region's new grass seed production association. Panhandle grass seed production has jumped from about 300 acres in the late 1990s to 2,000 acres with net returns of $800 to $1,000 per acre, or about $2 million total income for grass seed producers. There is significant potential for further growth.

● Improved crop yields and other windbreak benefits are well-documented, but farmers planning new windbreaks need to know which layouts are most cost-effective. An IANR agricultural economist developed a computerized economic model to identify optimal windbreak spacings for a crop field, considering their yield enhancements, costs and the space taken out of crop production. His model estimated net returns for corn and soybeans using different windbreak layouts and cropping scenarios. Findings should aid windbreak planning.

● When it comes to pig feed, there's no difference between genetically modified and conventional corn. In one study, IANR animal scientists compared pig growth and percent lean in pigs fed Bt corn for rootworms or conventional corn. In another, they compared nutritional value and nitrogen digestibility for young pigs fed Roundup Ready corn and those fed conventional corn. Neither study revealed significant differences. Pigs fed genetically modified corn perform as well as those fed conventional corn. This is one of several NU livestock studies that found no difference in feed value between genetically modified and conventional crops.

● Streams with sandy bottoms are more likely to have healthy populations of fish than those with silty or mucky bottoms. And streams lined with woody or other forms of natural vegetation are more likely to have healthy populations than those bordered by crops or bare ground. These are among preliminary findings of ongoing IANR research to better understand how land use and streamside characteristics influence stream health. Findings might be used in recommendations on how best to manage land along streams.

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