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ENDEAVORS

Highlights of University of Nebraska–Lincoln Agricultural Research Division research
2007-2008

The University of Nebraska–Lincoln's Agricultural Research Division has no equal in Nebraska: It is the state's only public entity charged with conducting agricultural research. Given that a recent study shows that nearly one in three jobs in Nebraska is tied to agriculture, that makes ARD a leader in building Nebraska's future.

ARD is a division of the University's Institute of Agriculture and Natural Resources (IANR), which links it to the University's extension and teaching programs. It also is tied to a network of agricultural research at land-grant universities nationwide.

IANR scientists' research takes on issues of great importance in Nebraskans' lives. They improve the quality of life for citizens across the state, making important contributions to the state's agriculture, food industries, environment, the well-being of families and community development. Research occurs in fields, feedlots, the natural environment, homes, yards, gardens, labs, and cities and towns.

ARD scientists also teach students or educate Nebraskans through UNL Extension, ensuring we share the discoveries, knowledge and advancements made through research with Nebraska citizens and our students.

Hundreds of research projects are under way at any one time. This 2007-08 edition of Endeavors provides an update on just some of them. Within these pages, you'll get a taste of the breadth and depth of ARD's work.

For more information, visit ARD's Web site, <http://ard.unl.edu>.

We also welcome your questions and comments. Please contact the ARD office, 207 Ag Hall, P.O. Box 830704, University of Nebraska–Lincoln, Lincoln, NE 68583-0704; phone, (402) 472-2045.

New approach delays soybean irrigation, maintains yields

UNL scientists are developing a new approach that delays soybean irrigation until early pod formation in July, relying on stored soil moisture and early-season rainfalls while still helping produce high yields.

Researchers have tested the approach on University plots the last two growing seasons and plan to try it on a half dozen or so Nebraska farmers' fields in 2008.

The project builds on years of research into soybeans' drought resistance and the best methods of irrigation. About 50 percent of Nebraska soybeans are irrigated.

Typically, producers plant soybeans in early May and begin irrigating in June. In years with average or above-average early-season rainfall, that can result in too much water being applied to plants.

Too much moisture can result in taller and leafier soybean plants that can lodge later and are more susceptible to disease. Avoiding too much early irrigation, on the other hand, encourages soybean plants to develop stronger, healthier root systems that grow deeper in search of moisture.

In most years there's enough stored moisture and enough rainfall to get soybeans through the early weeks of growth.

On average, soybeans grown with deferred irrigation on University plots in 2006 yielded about 83 bushels an acre, slightly more than the 78 bushels yielded under a season-long irrigation approach. Similar results were recorded in 2007.

Those results are particularly impressive given the drought conditions that prevailed on East Campus plots in June and July.



In most years, young soybean plants don't need to be irrigated until early pod formation in July.

Soybeans need about 19 inches of water from planting in early May to harvest to yield about 85 bushels. If they don't get any of that from early-season rains, producers will have to catch up with irrigation once deferred irrigation begins in early July. But if early-season rains are normal, the deferred approach could reduce the amount of irrigation water applied throughout the season.

After the approach is tested in farmers' fields in 2008, UNL hopes to develop computer tools through UNL Extension that will help producers improve their irrigation timing to achieve high yields with a more efficient strategy.

New group focuses on bioenergy crops in the Midwest

Nebraska, along with 12 other north central region states, has the potential to produce one-half to two-thirds of the nation's perennial bioenergy crops and crop residues. This puts the region in the national spotlight as Congress considers federal farm policy that will help shift the country's energy reliance from the Mideast to the Midwest.

The North Central Bioeconomy Consortium, or NCBEC, a 12-state collaborative effort of the directors of the Departments of Agriculture, Cooperative Extension Services and University Agricultural Experiment Stations, unveiled plans in 2007 to help guide this transition by coordinating policy and research in the region.



In addition to Nebraska, states involved in NCBEC include: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, North Dakota, Ohio, South Dakota and Wisconsin.

The NCBEC received a \$100,000 grant from the Energy Foundation of San Francisco to coordinate regional public policy development and research for a renewable energy future. A strategic partnership has been formed with the Great Plains Institute of Minneapolis, Minn., to assist in coordination, facilitation and implementation of the 12-state consortium agenda.

Sandhills dunes more stable than once thought

Two years after removing the vegetation from several Sandhills dunes, UNL researchers started seeing signs of erosion.

That indicates the dunes may be a lot more stable than once thought.

The finding came as a team of UNL researchers studies the history of grassland destabilization and how long- and short-term climate changes might affect the Sandhills' stability.

Conducted on about 30 acres of the former Barta Brothers Ranch near Rose, a 6,000-acre Sandhills ranch donated to UNL in 1996 by brothers Jim and Clifford Barta, the research began with creation of 10 circular plots, each somewhat larger than a football field. Researchers used herbicide to kill all the vegetation on several of them.

The plots continued to be treated with herbicide and kept free of vegetation for one to two years. Researchers monitored such information as the coverage of live and dead plants, root mass, organic matter in the soil and sand movement to determine stability of the plots.

The results indicated the Sandhills may be more stable than previously believed. Vegetation was allowed to return to one set of plots initially treated with herbicide after one year. These plots showed a



A UNL team is studying how long- and short-term climate changes might affect the stability of the Nebraska Sandhills.

large amount of weed growth, but no soil erosion.

While the research made significant progress in studying the balance between soil, vegetation and water in the Sandhills, additional study is needed to determine what happens when sand dunes begin to erode, or become mobile.

The ongoing research, part of the Sandhills Biocomplexity Project, a \$1.8 million National Science Foundation-funded project, is designed to study what would happen to the Sandhills if something such as climate change caused a loss of vegetation on the sand dunes.

Another goal of the biocomplexity project is to lay groundwork and infrastructure for future UNL studies in the Sandhills.

Take 'may contain food allergen' labels seriously

While more and more foods are bearing alert labels, cautioning consumers the products might accidentally contain an allergen, the new labels, such as those that say may contain peanuts, also may be creating confusion for the people they are intended to help.

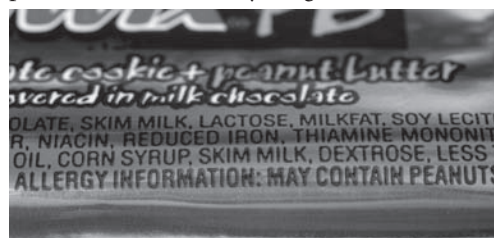
Food allergies affect 6 percent to 8 percent of infants and young children and

3.5 percent to 4 percent of adults in the U.S.

Since avoiding allergenic food is the primary approach for preventing an allergic reaction, these consumers have become avid ingredient readers.

Law requires foods with highly allergenic ingredients such as peanuts, soy or milk to be disclosed in plain language.

However, alert labels are voluntary and variable. Alert labels indicate the possible presence of allergens from shared processing operations such as the use of shared equipment or facilities.



See **food allergen labels**

on page 3

Advanced infrared camera expands hydrology research

An advanced infrared camera that can see thermal contrasts as small as two-tenths of a degree Fahrenheit has the potential to greatly expand water and environmental research being done by UNL.

The camera will allow closer examination of Nebraska's unique hydrology. Looking little different than a handheld digital video recorder, the camera is the latest weapon in an already high-tech arsenal used by UNL's Center for Advanced Land Management Information Technologies to produce real-time, remote-sensing data used by researchers on a wide variety of projects.

Though infrared cameras are not new, the ThermaCAM-SC640 has imaging capabilities far advanced of mainstream infrared cameras typically used by law

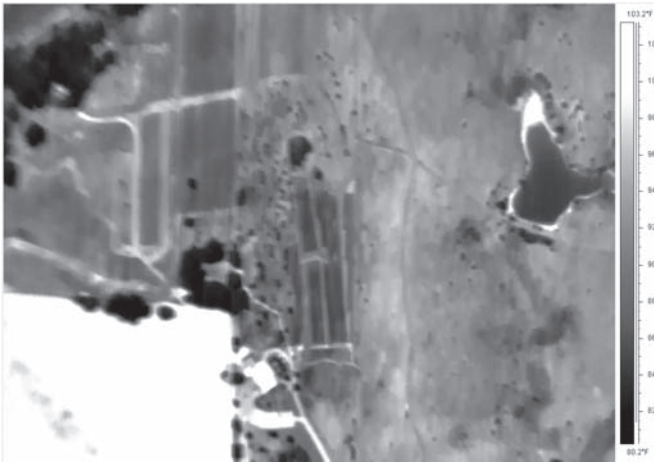
enforcement or the military. It can see differences in thermal images in the 7.5 to 13 micron range, which means it is more useable for most earth science research purposes.

The camera is often used with other data collection equipment mounted on a single-engine Piper Saratoga aircraft operated by CALMIT researchers and staff.

Its sensitivity, coupled with the high resolution of the images produced by the camera, should make it possible to identify where groundwater discharges into a stream or other body of surface water, for example.

Used either by itself, or in conjunction with other sensors the aircraft can carry, the new camera allows for the preparation of high-resolution temperature maps useful in many water and earth science research projects.

Currently, the camera is being used to study groundwater flow through lakes, such as Crescent Lake in Garden County, alkali lakes in Sheridan County, toxic algae blooms in Dodge County, outcrops of the Ogallala aquifer and the canopies of wetlands in Garden County and to study sub-irrigated meadows near Whitman.



An infrared camera produces real-time, remote-sensing data for water and environmental research. Although not as clear as in the original color, this image shows the James Arthur Vineyard north of Lincoln.

food allergen labels continued from page 2

These labels, for example, may say: manufactured on equipment with peanuts, manufactured in the same facility with peanuts or may contain peanuts.

To determine whether consumers with food allergies heeded these warning labels, ARD food scientists and scientists at the Food Allergy and Anaphylaxis Network conducted consumer surveys and analyzed food products bearing advisory statements regarding peanuts.

Of the 179 products that bore a variety of alert statements for peanuts, 7 percent did contain peanuts.

Peanuts were in 2 of 51 foods that bore a "may contain" statement and 7 of 68

labeled "made in the same facility."

Consumer surveys found that consumers increasingly are ignoring advisory labeling. While a consumer may encounter a product that contains peanuts only one out of 100 times, it's still something to be taken seriously.

Scientists hope this research will lead the Food and Drug Administration to establish thresholds and better educate the public about alert statements.

Additional support for this research was provided by the Food Allergy Research and Resource Program, the Food Allergy and Anaphylaxis Network and Mt. Sinai School of Medicine.

UNL-based Drought Mitigation Center has new leadership

The UNL-based National Drought Mitigation Center has new leadership.

Longtime climatologist Mike Hayes assumed the position in August. Hayes, who had been with the center since its inception more than 10 years ago, replaced NDMC founding director Don Wilhite, who became director of UNL's School of Natural Resources.

Hayes began at the NDMC as a climate impacts specialist and was promoted to associate director of the center in 2006.

Over its history, NDMC has been directly and indirectly involved with drought planning efforts at state, tribal and local levels, with a result that overall preparedness for dealing with droughts has improved worldwide.

Mitigation is the process of planning before the onset of drought to reduce vulnerability to it, rather than response, which tends to be more expensive. In addition to working with governments on drought planning, the NDMC was a founding partner in the widely published U.S. Drought Monitor.

Recent partnering with the U.S. Department of Agriculture's Risk Management Agency has enabled other research expansion, such as the satellite-based Vegetation Drought Response Index and the related Vegetation Outlook, the Drought Impact Reporter and Risk Reduction for Ranchers. The center also is developing methods for quantifying economic impacts of drought and the Drought Atlas and Decision Support System.

NDMC also conducts research with sponsors such as the National Aeronautic and Space Administration, National Oceanic and Atmospheric Administration and other agencies within the U.S. Department of Agriculture.

Carbohydrates in milk can help block bacteria

Certain carbohydrates found naturally in milk can help prevent harmful bacteria from settling in the gastrointestinal tract and causing disease, UNL research shows.

The carbohydrates, known as galactooligosaccharides or GOS, are structurally similar to the sugars that line cells inside the GI tract and to which bacteria attach. The research showed the bacteria can be “fooled” into attaching instead to the GOS and then be flushed through the intestinal tract without it sticking around.

The galactooligosaccharides reduced the adherence of the bacteria by about 70 percent in the research.

Oligosaccharides already were known to stimulate growth of healthy bacteria in the gastrointestinal tract, but this is the first research to show their potential usefulness as a decoy for the harmful bacteria.

The research was done using enteropathogenic *E. coli*, which causes diarrheal diseases in children, but preliminary data suggest the well-known *E. coli* O157:H7 is similarly affected by the approach.

Galactooligosaccharides occur naturally in cow and human milk. This may offer partial explanation for why nursed babies don't get as many gastrointestinal infections as formula-fed infants. GOS can be developed into a food ingredient made from milk sugars, which means infant formula manufacturers could add them to their products.

Galactooligosaccharides already are added to many foods made in Asia and Europe, including dairy foods, granola bars, crackers and breakfast cereals.

The research has been done with tissue cell cultures so far. Further research will test the approach on animals.

Tending human tendons using ultrasound

A UNL biomedical engineer is developing a new approach to measuring human tendon injury that could lead to earlier detection and improved treatment.

The scientist, working with colleagues at the University of Southern California and Madonna Rehabilitation Hospital in Lincoln, is trying to improve early detection of tendon degeneration due to age, overuse or a systemic disease known as tendinosis. The condition can strike tendons in both the legs and arms.

Typically, magnetic resonance imaging is used to assess potential tendon injury, but that process is expensive and cannot determine the degree and stage of injury. Scientists set out to see if ultrasound, a more cost-effective procedure, could determine the existence of tendon injury even before there's pain and also measure its severity.

They gathered about 1,000 ultrasound images of selected tendons in the legs of 40 subjects in California and Lincoln — 10 with no known tendon injury, 10 with suspected tendon injury, 10 runners susceptible to tendon injury and 10 individuals with spinal cord injuries whose leg use is minimal.

Analysis of the ultrasound images with



Greg Bashford, UNL biomedical engineer, conducts an ultrasound on a tendon. Bashford is part of a research team developing a new approach to measuring tendon injury.

different software approaches determined with more than 80 percent accuracy whether the subject had sustained injury to the tendon, resulting in tendinosis.

Ultrasound images of healthy tendons show tissue organized in parallel bundles. Images of damaged tendon show bundles that are disorganized with, in some cases, thicker sections of tissue.

These findings could have important ramifications for patients dealing with tendon damage. Earlier detection allows for greater success with therapy rather than relying on surgery.

Research studies effect of one-time tillage on no-till

A team of IANR scientists found conducting a one-time tillage does not necessarily destroy the agronomic and environmental benefits gained by continuous no-till, but still recommends avoiding the practice in most cases.

While many U.S. farmers use continuous no-till when growing crops year to

year, some caution a one-time tillage would destroy the soil quality gained by no-till farming.

Using no-till farming can increase yield, reduce erosion, improve soil quality and reduce cost and time requirements due to fewer field operations. However, some farmers may want to till for such problems as difficult weeds, compacted soil or to reduce the risk of phosphorus loss.

While the scientists found the one-time tillage did not reduce soil organic matter, soil physical properties and yield, it did not have a positive effect on soil properties or yield. One time-tillage also reduced the risk of phosphorus runoff.



IANR scientists have found that one-time tillage on no-till farmland might be justified to correct a problem in the field but otherwise should be avoided.

See **Research** on page 5

IANR, cattle feeders partners in cattle research

A \$1.1-million expansion and improvement project at the UNL Research Feedlot north of Scottsbluff is the fruit of a vital partnership between the University and cattle feeders, a major sector of Nebraska's largest industry.

Dedicated in May, the expansion and other improvements will enable the feedlot to conduct precision research into the most important questions facing livestock feeders. The feedlot's location ensures that research is carried out in the same real-world conditions faced by livestock producers in the Northern Plains.

The project, begun in 2003, received significant support from the region's feeding industry; much of the funding for the expansion and improvements came from private donors, some of it through the University of Nebraska Foundation.

The project added 61 new pens to the existing 44 pens. In addition, improvements were made to the cattle handling facilities, including a state-of-the-art

squeeze chute and scale. Also in the works are a micro-nutrient machine, additional grain storage and new working facilities. The new pens are of uniform size, shape and slope. Feed bunk space and availability are uniform. This will improve the consistency from pen to pen.

The processing facilities use Individual Electronic Identification. Each animal has an electronic ear tag that is scanned directly to a database. The electronic scale weighs animals and a sophisticated computerized system records the data. This way, performance data for



The expansion of the UNL research feedlot north of Scottsbluff is the result of a partnership between the University and cattle feeders.

each animal is tracked electronically. Researchers can monitor each animal's performance and, when necessary, trace back individual animals.

Also, water intake to each pen can be measured

independently. UNL's Panhandle Research Feedlot may be the nation's largest research feedlot with capabilities for individual pen water intake measurements. This uniformity will provide greater precision.

Research continued from page 4

Research is continuing to determine if carbon sequestration and soil organic matter will eventually be increased.

With that, scientists say a one-time tillage, conducted once in 10 or more years, might be justified to correct a problem in the field, but otherwise should be avoided unless the ongoing research finds a significant impact on the potential for carbon sequestration and increasing soil organic matter.

Scientists found there was not a significant increase in carbon dioxide emission from the soil with tillage, compared with continuous no-till, and that tillage

treatments did not affect soil microorganisms, grain yields or soil aggregate stability.

Researchers also found that nutrients and soil organic matter were well redistributed with plow tillage to reduce stratification of available nutrients, but disk and chisel tillage did not effectively redistribute nutrients.

This research received funding from the International Sorghum and Millet Collaborative Research Support Program, or INTSORMIL.

These research findings were published in three papers in the 2007 July issue of *Agronomy Journal*.

Medical, animal researchers to collaborate

UNL's Agricultural Research Division is partnering with the University of Nebraska Medical Center and other collaborators on developing research and educational opportunities that bridge human and animal health.

Don Beermann, former head of UNL's Department of Animal Science, was named to coordinate the One Health Initiative. Beermann also was named director of the Institutional Animal Care Program in the Office of the Vice Chancellor for Research.

Beermann will be responsible for providing professional direction for the care and use of animals in research and teaching within UNL facilities, and he will administer the UNL program for laboratory animal care and housing.

The appointment capitalizes on Beermann's background as an animal science administrator, researcher and educator, as well as his ongoing interest in relating human and animal physiology.

Beermann assumed both positions Aug. 1.

Rural Nebraskans not the retiring type, poll shows

Worries about health care loom over rural Nebraskans' retirement dreams – even for those who are decades away from their golden years, the Nebraska Rural Poll shows.

The poll also found that more than half of rural Nebraskans think the ideal retirement age is somewhere between 55 and 64, but most don't expect to retire that soon. Even when they do retire, the poll shows, many rural Nebraskans expect to continue working in some fashion, some because they need to for basic income or health insurance, but others because they want to remain active.

The 12th annual poll asked 6,400 residents of Nebraska's 84 rural counties a number of questions about retirement plans, including a dozen focusing on health care. Results are based on 2,680 responses.

Eighty-six percent of respondents cited health care as an important retirement issue.

Concern about health in retirement was reflected elsewhere in the poll. Seventy-four percent of respondents cited proximity to health care as a factor in their decisions on where to live in retirement. Fifty percent said availability of assisted-living facilities is an important consideration in deciding where to live.

Health care also is a factor driving rural Nebraskans to continue working past retirement age, with 34 percent citing it as a reason. However, health care ranks below other reasons for working, including meeting basic income needs and keeping mentally and physically active.

About 55 percent of respondents said 55-64 was an ideal retirement age, with nearly 30 percent saying 65-70. But only one-third who endorsed a younger retirement age expect to have enough income to retire that early.

Sixty-nine percent of respondents expressed concern about having enough income in retirement. Younger respondents actually are more worried about outliving their income than older respondents, the poll shows.

About 40 percent of rural Nebraskans expect to continue working after they retire, according to the poll.

In another key Rural Poll finding, only about 10 percent of rural Nebraskans plan to leave the state when they retire, but many are uncertain of their plans.

IANR returns 15 to 1 benefit for each tax dollar

The Institute of Agriculture and Natural Resources at the University of Nebraska–Lincoln annually returns at least \$15 in benefits to Nebraskans for every dollar of state support, making it “a primary engine for economic and social sustainability,” a 2007 study says.

The study, by Battelle of Columbus, Ohio, was commissioned to capture the benefits of IANR's teaching, research and extension work in Nebraska and to provide solid guidance for setting future priorities. Results are published in the “At Work for Nebraska” study (*atworkfornebraska.unl.edu*).

The study notes a recent finding by the Nebraska Policy Institute that agriculture and agribusiness account for nearly one-third of the state's jobs – up from 25 percent in 1990. As the University's primary arm dedicated to “sustaining, growing and improving agriculture and agriculture-related enterprise in the state,” IANR “is key to the long-term competitive sustainability of Nebraska's high standard of living,” Battelle said in the report's executive summary.

Battelle did not investigate the economic impact of every research and extension program at IANR – hundreds are under way at any one time – but it did delve into a few projects, focusing on IANR's mission areas of agriculture, food



production and natural resource systems; nutrition, health and food safety; environmental sustainability; community and entrepreneurial development; building strong families; and youth development.

The “At Work for Nebraska” report captures the economic impact of IANR programs. It points out that the state's investment in IANR pays off many times over – conservatively estimated at 15 to 1. For example, IANR received \$71.6 million in state funds in the 2005 fiscal year. Here's what taxpayers got in return:

- More than \$750 million in annual benefits from the institute's research, teaching and extension activities. That's measured in improved economic output and savings – in other words, real money in real Nebraskans' pockets.
- About \$338 million in annual benefits through the economic ripple effects of IANR doing business in Nebraska.
- paying employees, buying products and supplies and having that money multiply throughout the state's economy.

New components of plant immunity being identified

A UNL plant scientist's discovery of a previously unknown component in plants' immune systems provides new clues to how plants and humans fend off diseases and how invaders stifle immunity.

The work stems from the researcher's discovery of a protein toxin in a plant pathogen that's also found in several animal pathogens, including those that cause diphtheria and cholera.

As different as they are, plants and animals share some of the same molecular components



Research by James Alfano and other UNL plant scientists is providing new clues about plant immunity and could lead to a better understanding of how both plants and animals defend themselves against disease.

to defend themselves against outside invaders.

The research focuses on a method of infection found in animal and plant pathogens called a type III protein secretion system. To infect a plant, pathogens inject up to 30 proteins into plant cells using this system, which resembles a kind of microscopic syringe. Once inside, the toxic mix of proteins acts like a burglar, cutting wires to a home's alarm system, disabling the

See **Plant Immunity** on page 7

Developing dicamba-resistant broadleaf crops

In a project that began about a dozen years ago, UNL scientists discovered a gene that has been used to create broadleaf crops that tolerate spraying with the popular herbicide dicamba.

Now, even as an industry partner is working to bring dicamba-resistant crops to market, these plant scientists are continuing to explore new and expanded uses for the technology they discovered.

The availability of dicamba-resistant crops means that farmers eventually will have more options for controlling weeds in broadleaf crops such as soybeans, canola, cotton, tobacco and vegetables.

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. But like all broadleaf herbicides, dicamba kills broadleaf crops as well as their weedy cousins so its use presently is limited to corn and other grassy crops.

The UNL team identified soil bacteria that break down dicamba and isolated the gene responsible for imparting resistance. The gene was inserted into a plant's chromosomes, successfully transferring dicamba resistance to the plant.

Researchers also discovered they could modify the gene to target the DNA of the plant chloroplast, where photosynthesis occurs. This approach has significant practical implications. Since chloroplast

genes are inherited through the maternal side, not through male pollen, it eliminates the chance that resistance could inadvertently spread to other plants through pollen.

The team's genetic modification technique has worked in both lab and



Two rows of soybean plants are shown eight days after they were sprayed with dicamba. The plants on the left, which contain the dicamba-resistant gene, are thriving. The plants on the right died.

field trials. For example, soybeans carrying the dicamba-resistant gene were unharmed by dicamba sprayed at a rate of 2.5 pounds per acre, about 10 times the normal application rate.

UNL has patented this technology. In 2005 UNL signed an exclusive licensing agreement with Monsanto Co. to develop crops tolerant to dicamba, using UNL's technology.

Meantime, UNL researchers are testing this approach on other crops and expect further developments.

Plant Immunity continued from page 6

defense system from calling for reinforcements and allowing the intruders to enter unimpeded.

The UNL team found that one of the proteins – HopU1 – disrupts the plant's immune system when the disease-causing bacterium *Pseudomonas syringae* injects it into a plant. This disruption helps the pathogen infect its plant host. Researchers found that HopU1 is a type of enzymatic protein – an ADP-ribosyltransferase that had never before been found in plant pathogens. This type of protein is also found in organisms that cause human diseases such as cholera and diphtheria.

After identifying HopU1 as one of the injected proteins, the scientists began

studying which plant components this virulence protein targets. That's key to identifying new components of plant immunity.

The team discovered that HopU1 modifies RNA-binding proteins. Their work suggests that the pathogen disrupts plant immunity by suppressing immunity-related RNA metabolism – part of the process that turns a plant's DNA code into proteins to help fight off infection. A plant lacking one of the HopU1 targets is more susceptible to the pathogen. These RNA-binding proteins, also found in animals, were not previously known to be part of plants' or animals' immune systems.

New software analyzes biofuel production

Biofuel production promises to reduce oil imports, turn crops into energy, grow rural economies and decrease greenhouse gas emissions.

It's a tall order. Determining how individual biofuel plants and their grain supply measure up is critical to the burgeoning industry's long-term success.

In 2007, UNL agricultural researchers unveiled a tool to assess plant performance. Their Biofuel Energy Systems Simulator (BESS) software analyzes total energy yield and efficiency, greenhouse gas emissions and resource requirements for biofuel production systems – from seed to biofuel and byproducts.

Quantifying the environmental impact of individual biofuel systems has environmental, economic and public policy implications. To meet emerging renewable fuel standards or to participate in the growing carbon credit market, plants will have to document their environmental performance.

The user-friendly software is backed by complex modeling tools and extensive scientific data. Users can customize data unique to their operation or explore different scenarios. BESS estimates net energy efficiency and net greenhouse gas emissions for each production component and the whole system. It's more flexible and customizable than existing energy and emissions models.

Researchers envision versions for soybean biodiesel and biomass ethanol production from switchgrass and corn stover.

The free software is available at www.bess.unl.edu.



A new tool from UNL agricultural scientists will enable ethanol plants, like this one at Fairmont, to measure their greenhouse gas mitigation and energy efficiency.

Supplemental nutrition late in pregnancy can produce heftier heifers with improved pregnancy rates

Spring-calving beef cows that receive supplemental nutrition late in pregnancy tend to produce heftier heifers that have improved pregnancy rates later, IANR research shows.

A three-year study, conducted at the University's Gudmundsen Sandhills Laboratory near Whitman, is the first research to demonstrate the impact of late-gestation nutrition on the performance and subsequent reproductive efficiency of heifer calves. The research grew out of an earlier study that focused on decreasing input costs by testing two management practices: early weaning of the cows to improve their body condition headed into winter and feeding a protein supplement to help provide extra nourishment at a time when the dormant Sandhills range falls short of their needs.

Neither practice improved the cows' future pregnancy rates.

IANR researchers decided to follow the progress of the calves produced by these late-supplemented cows. They found that calves from cows that received late supplements were about 60 pounds heavier.

In a subsequent study evaluating late-gestation supplementation, it was found:

- Eighty-eight percent of heifers from



Calves whose mothers receive supplemental nutrition late in pregnancy may be born heavier and, ultimately, have improved pregnancy rates.

cows that received a protein supplement late in pregnancy achieved first-service pregnancy, compared with just 45 percent of those from cows receiving no supplement.

- Ninety-four percent of heifers from supplemented cows eventually became pregnant, compared with 73 percent of those from nonsupplemented cows.

- Heifers from supplemented cows calved eight days earlier on average and had fewer calving problems (69 percent unassisted births, compared with 38 percent for heifers from nonsupplemented cows).

The supplemented group received about 1 pound of a 42 percent crude protein supplement per head per day from Dec. 1 to Feb. 28. Calves whose mothers receive supplemental nutrition late in pregnancy may be born heavier and, ultimately, have improved pregnancy rates.

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For information on how IANR is **At Work for Nebraska:**

<http://atworkfornebraska.unl.edu>

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