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Agricultural Research Division 114th Annual Report 2000

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On the cover: The Scotts Bluff National Monument, a prominent, natural landmark, is a memorial to the emigrants who moved America westward on the historic Oregon, California and Mormon trails. The massive promontory, or bluff, rises 300 feet above the North Platte River, opposite the city of Scottsbluff. Named for Hiram Scott, a fur trapper, the 3,000-acre site was designated a national monument in 1919. Photography by Brett Hampton
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Our Mission

The mission of the Agricultural Research Division in the Institute of Agriculture and Natural Resources at the University of Nebraska-Lincoln is to conduct problem-solving and fundamental research that addresses priority issues facing Nebraska's agricultural and food industries; provides the knowledge base essential for managing our natural resources; promotes family well-being and community development; and educates future scientists through hands-on experiences.
It is a pleasure to provide you with a copy of the 114th Annual Report of the University of Nebraska Agricultural Research Division (ARD). This report is our opportunity to inform you about our research programs and accomplishments and to allow us to assess the progress and effectiveness of our collective efforts to develop new knowledge. After examining this report, we hope that you will agree with our assessment that ARD research has provided new technology and knowledge for Nebraskans that will improve the profitability of their enterprises, enhance environmental quality, and improve their quality of life.

This report provides some highlights of research accomplishments, a listing of scientists and research associates, awards and honors received by our faculty and graduate students, outputs from our research projects, and the ARD financial report for the period July 1, 1999 to June 30, 2000. This report was compiled in compliance with the intent of the law of the State of Nebraska that established the Nebraska Agricultural Experiment Station on March 31, 1887.

The ARD is the primary research component of the Institute of Agriculture and Natural Resources. outlined in the Research Highlights section are some of the significant accomplishments of our faculty during the past few years. Included among these accomplishments are: (i) identifying a yield drop associated with inserting the Roundup Ready gene in soybean varieties; (ii) estimating the economic impacts of large swine operations on rural communities; (iii) evaluating air chilling of poultry carcasses as a means of reducing the incidence of pathogens; (iv) characterizing muscle tissue to improve the value of beef chuck and round; (v) developing technologies to return CRP land to crop production; (vi) measuring nutrient intake by teenage girls concerned about their weight; and (vii) evaluating techniques to monitor the development of resistance to Bt toxin among European corn borer populations.

We continue to be excited about our research programs and the scientists who work diligently to solve today’s problems and help provide the knowledge necessary to address the issues that will arise in the future. The ARD was created to serve the people of Nebraska and the nation. We welcome your input on our current research efforts and on your needs for research information.

Darrell W. Nelson
Dean and Director
Agricultural Research Division
IANR-developed test reveals differences in \textit{E. coli} populations

Using a new genetic fingerprinting technique they developed, IANR food scientists have found surprising differences in populations of the potentially deadly \textit{E. coli} 0157:H7 bacteria.

The Nebraska team found two genetically distinct \textit{E. coli} 0157:H7 populations in cattle — one that causes human food poisoning and another that is seldom found in people with gastrointestinal illness. This research suggests that a significant portion of 0157:H7 strains in cattle — as much as two-thirds — are either non-virulent, meaning they are incapable of causing disease, or they’re not easily transmitted to people.

This could be good news for public health and for cattle producers.

The genetic technique developed by the team is called octamer-based genome scanning (OBGS). It allows researchers to pinpoint where genetic differences exist on \textit{E. coli}’s DNA and offers a means for rapidly cloning and identifying the genes at those DNA sites. Using OBGS, researchers are able to gain a clearer picture of the genetic differences of \textit{E. coli} 0157:H7 populations — relationships that previously have not been well-understood.

The OBGS method has practical applications in the development of a more sensitive test of \textit{E. coli} 0157:H7 isolates. Researchers are using OBGS to pinpoint the exact genetic differences between populations so a much simpler test that can discriminate between the two can be developed. Such a test would make extensive testing, such as in feedlot populations, much easier.

Lab monitoring corn borers’ susceptibility to Bt

Using tests he developed, an IANR entomologist monitors European corn borers nationwide for potential resistance to Bt, the natural insecticide.

His lab tests corn borer populations from U.S. corn growing areas annually for changes in Bt susceptibility. Bt corn’s long-term effectiveness depends on preventing this multi-million dollar corn pest from becoming resistant to Bt. Detecting potential changes early is critical to nationwide Bt resistance management efforts.

Annual testing should provide early warning if resistance begins to develop in certain corn borer populations. The goal is to spot changes before resistance becomes widespread so steps can be taken to preserve Bt’s effectiveness.

So far, so good, tests show. While there are limits to the tests’ sensitivity, researchers saw no susceptibility changes in the first five years Bt corn was in use. Corn borers nationwide remained susceptible to Bt toxins.

IANR entomologists began working with seed companies in 1993, before Bt corn was commercialized, to establish baseline information on corn borer susceptibility to Bt across North America. Baseline information allows them to detect potential susceptibility changes as Bt plantings expand.

This lab is responsible for assessing and keeping records on corn borer Bt susceptibility nationwide. This research is funded by seed companies, which must provide annual susceptibility measurements as part of federal requirements for selling Bt seed corn.
Tracking movements of moths aids Bt management

Understanding European corn borer moth movements under different field conditions should help reduce the risk of this major corn pest developing resistance to Bt corn.

IANR entomologists studied European corn borer moth movements in irrigated and dryland cornfields for three years. Their findings provide a clearer understanding of moth movements, especially in irrigated corn. Bt corn is genetically engineered to produce a natural insecticide toxic to corn borers and other caterpillars.

Previously, it generally was thought that moths typically leave fields before mating. Most earlier moth dispersal studies involved dryland corn in Iowa. IANR researchers needed to know what happens in Nebraska’s large irrigated fields.

They found some surprises. Results showed that many female moths stay close to home, especially in damp, humid irrigated fields. This research also showed that moth movements differ in irrigated and nonirrigated fields, that moth dispersal is highly variable and that field conditions significantly influence that movement.

This information about moth movements under different field conditions is aiding decisions about where to locate non-Bt corn plots that provide European corn borer refuges amid Bt corn. Refuges are among strategies mandated to prevent or slow development of Bt resistance among corn borers. Seed company recommendations for refuge planting distances, which every farmer who plants Bt corn must follow, are based partly on this Nebraska research.

Scientists are using the results to explore ways to develop more accurate models to predict corn borer movements and mating patterns. They continue studying moth movements.

Studies probe turf, forage grass seed production

Turf and forage grass seed is being produced on a small but increasing number of acres in Nebraska’s Panhandle.

The region’s climate is well-suited to grass seed production, which offers a new cropping option to help the region’s farmers diversify their operations. IANR researchers and Cooperative Extension specialists are providing research results and information producers need to grow grass seed in the Panhandle.

NU studies have provided information about factors such as seed planting dates, the best grass and forage varieties, fertility and water requirements and production practices. Research honed management procedures for producing excellent yields of high-quality turf and forage grass seed under irrigation. These findings have been shared with interested growers during field days and educational sessions.

About 1,500 acres of grass seed were harvested in the Panhandle in 1999, up significantly from about 300 acres three years earlier. It’s estimated that grass seed production now contributes about $1 million annually to the region’s economy.

Many girls’ diets barely sufficient nutritionally

Thin is in. Media messages and social pressure to be thin are so strong that some girls cut nutritional corners to meet unrealistic weight goals. IANR research shows. Striving for an ideal body shape prompts them to eat diets barely sufficient for growth and development.

An NU nutritionist and graduate student examined diets of 230 Nebraska girls ages 8-17. They found girls as young as age 8 thought about dieting. From age 11 up, girls studied were already dieting and researchers found their diets low in key nutrients. Dieters ate fewer calories and consumed significantly less calcium, other minerals and vitamin B-6 than non-dieters.

Participants averaged about 850 milligrams of calcium daily, far less than the recommended 1,300 milligrams for girls 9-18, putting them at risk for osteoporosis later in life.

Researchers also examined body image and found most participants preferred ideal body shapes thinner than their actual figures, likely reflecting “thinner is better” messages.

This NU College of Human Resources and Family Sciences study found that girls’ diets tended to become less adequate with age. Researchers recommend educating girls about nutrition, healthy weight goals and realistic body images before age 8 to combat messages that risk their long-term health.
Molecular Geneticist Kulvinder Gill (left) and Wheat Breeder Steve Baenziger examine patterns of DNA from different wheat lines. They head a team of IANR scientists studying a major gene responsible for yield in wheat.

Zeroing in on major gene responsible for wheat yield

Yield is a pivotal crop trait, yet little is known about which genes influence yield and how they function.

An IANR agronomy team is on the trail of some answers. They’re zeroing in on what they believe is a major gene responsible for yield in wheat. They’ve already narrowed the gene’s location to a small segment on the tip of one of wheat’s 21 chromosomes.

Their research suggests a single gene is responsible for boosting yields 14 percent to 16 percent. Their findings so far are particularly significant because yield is extremely complex and scientists long have thought it’s unlikely that a single gene would have a major yield influence.

In the early 1990s, an IANR wheat breeder identified the chromosome at the heart of the current research using unique wheat lines developed at NU in the 1950s. Since that discovery, IANR scientists have scrutinized this chromosome. They’ve narrowed their search, identified molecular markers associated with yield and are using molecular biology tools to pinpoint the gene’s location.

While it’s complex, slow work, the team expects to find and clone the yield gene. This functional genomics research offers the chance to decipher the genetic mechanisms responsible for yield. In the long-run, the gene and the knowledge gleaned from this research eventually could be incorporated into NU’s wheat breeding program.

Reduction of dietary phosphorous economic, environmental plus

Reducing dietary phosphorous in feedlot cattle makes economic and environmental sense.

Two years of research by IANR animal scientists showed feeder cattle get more than enough phosphorous in their diets without supplements and can perform well on less. While excess phosphorous doesn’t hurt or help cattle, it’s an unnecessary expense and an environmental concern if excess phosphorous reaches lakes or streams.

IANR animal scientists studied the effects of reducing dietary phosphorous on feedlot calf and yearling performance and on the amount of phosphorous in manure.

They fed about 60 percent less phosphorous than is typically fed in the cattle industry and could not create a diet low enough to see any effect on the cattle.

Feeding only enough phosphorous to meet animal needs meant less wound up in manure. Reducing dietary phosphorous 34 percent for calves and 44 percent for yearlings reduced phosphorous in manure 38 percent and 59 percent, respectively.

This clearly shows supplemental phosphorous is an unnecessary expense and that excess phosphorous winds up in manure. When manure is applied to land as fertilizer, excess phosphorous can wash off fields and pollute surface water.

Industry thinking about dietary phosphorals is changing, partly because of these findings. Feedlot nutritionists now are aware of phosphorous overfeeding and most Nebraska feedlots no longer buy this supplement. Instead of worrying about feeding enough phosphorous, feeders and nutritionists are looking for ways to feed less.

Reducing phosphorous content in feed so cattle get only what they need and as little as possible gets in manure is the goal.

Rust-resistant pinto providing economic benefits

Nebraska is among the nation’s top dry edible bean producing states. During the early 1990s, rust epidemics severely damaged pinto bean crops in southwestern Nebraska. Facing yield losses and costly fungicide treatments, producers asked the university for help.

IANR’s dry bean breeding team developed the first pinto bean with rust resistance, which included resistance to three common bacterial diseases. NU released the high-yielding pinto, called Chase, at the Nebraska Dry Bean Growers Association’s request. It became available in 1995 as an interim variety to address an urgent situation.

Other rust-resistant varieties now are available, but Chase was the only one when it was released. The multiple disease resistance meant farmers didn’t need to use fungicides on fields planted to Chase, and it yielded 7 percent to 10 percent more than the average of other pinto in 1990-98 trials.

While color concerns have limited Chase’s use, an IANR agricultural economist’s analysis found this variety is providing economic benefits. This analysis found that Chase’s superior yields and disease resistance are generating at least $5 million in total direct
economic benefits for growers in Nebraska and surrounding bean growing regions during its projected 1995-2002 life span. That’s based on a $25-$35 per acre yield benefit and a $5 per acre production cost savings.

**Wet byproduct feeds research has big payoff**

Wet byproducts from Nebraska’s growing ethanol and grain processing industry have become a major cattle feed source in the past decade and now provide millions of dollars in economic benefit annually.

An IANR agricultural economist’s analysis showed that feeding byproducts wet instead of drying them provided cumulative net economic benefits of about $212 million in Nebraska from 1992 through 1999. Annual net economic benefits grew from $1 million in 1992 to an average of $42 million in recent years as new processing plants opened and more feedlots fed wet byproducts. Nebraska’s ethanol production capacity grew more than any other state’s during the 1990s. Only one of the state’s seven wet and dry milling plants now dries byproducts. The rest sell byproducts wet.

**Team devises simple way to test pens of cattle for E. coli**

Capitalizing on cattle’s habit of chewing and licking, IANR researchers have devised a simple, effective, economical way to test pens of cattle for *E. coli* 0157:H7.

After experimenting with some fancy sampling techniques, they found that simply hanging pieces of rope around a pen in the evening works best. Within two hours, over half the cattle — plenty for a representative sample — chew or lick the ropes, leaving traces of the organisms they’re carrying. Ropes are removed and lab tests determine *E. coli*’s prevalence.

Researchers knew that devising an economical way to test whole pens of cattle without testing individual animals was important for research and for on-farm food safety efforts. Cattle are fed and marketed as pens so looking at them as a group makes sense.

Researchers are refining the test and using it in *E. coli* research. Ultimately, they want to make it a practical tool producers could use to match *E. coli* intervention strategies to specific pens of cattle.

IANR studies showed rope tests are more sensitive than manure samples for detecting *E. coli* prevalence in pens. Manure samples accurately identify only high prevalence pens where more than 40 percent of cattle are shedding *E. coli*. Rope tests detect such pens plus medium prevalence pens where at least 16 percent of cattle are shedding. If no *E. coli* is recovered, pens are considered low prevalence.

The test is helping researchers compare conditions in high, medium and low prevalence pens. They want to identify potential risk factors such as time on feed, temperature and pen conditions.

**Meat scientists find beef chuck, round are undervalued**

Much of the meat in the beef chuck and round deserves a better fate than being ground and slapped between two hamburger buns, an IANR study shows.

The two-year study extensively profiled the muscles that make up the beef chuck and round, and was the largest study of its kind. Results show that many of the muscles that traditionally are ground should have a higher-value use. This research was motivated by a 1997 cattle industry report that found chuck and round values had decreased more than 20 percent — a huge loss considering that these cuts make up the majority of the weight of the beef carcass.

Collaborating with the University of Florida, IANR researchers extensively

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**Meat Scientist Chris Calkins measures the thickness of a cut of beef round. In the largest study of its kind, Calkins and other researchers profiled beef round and chuck muscles.**
Profiled more than 5,500 muscles. The Nebraska meat scientists analyzed muscles for nutritional and biochemical traits important to value-added processing. They performed more than 25,000 different tests, including measurements of color, fat and moisture content, pH, water-holding capacity and amount of connective tissue.

Their findings: great variation exists in these muscles, and many have a higher quality and warrant a better use than traditionally given.

Results have been compiled in a user-friendly booklet, published by the National Cattlemen’s Beef Association. The Cattlemen’s Beef Board funded the study. The team also is developing an educational CD-Rom. This definitive information can be used to develop new value-added products that will benefit producers and consumers.

Study finds mixed effects from large swine operations

Large-scale swine operations have mixed effects on the counties where they are located, IANR research shows. Researchers in NU’s Center for Applied Rural Innovation studied large swine operations’ social and economic impacts. They reviewed 15 years of pork production patterns in Nebraska and five other states. They defined large operations as those with 1,000 or more head.

This study compared quality-of-life indicators such as income, taxes, population and jobs in counties with stable pork production to similar counties where production significantly expanded. Analyzing 15 years of information provided a longer-term perspective on swine operations’ growth patterns and socioeconomic impacts on counties.

They found that counties with big swine operations lost more population and had higher property taxes than stable production counties. Retail sales remained competitive in large-scale swine operation counties, while per capita incomes increased and poverty decreased faster than in stable production counties. All counties studied lost both farm jobs and swine operations, but counties with large swine operations lost farm jobs and swine operations more slowly.

Researchers found the pace of change in Nebraska’s swine industry has been slower and the scale of operations smaller than in the other states studied. Between 1988 and 1996, Missouri lost nearly 60 percent of swine operations, but counties with large swine operations lost farm jobs and swine operations more slowly.

Exploring ways to take safer chicken to market

Chickens chilled with cool air may be less likely to be contaminated with disease-causing organisms and last longer in stores than broilers cooled in water, IANR research indicates.

This research by an IANR food and veterinary science team was conducted at MBA Poultry in Tecumseh, Neb., which opened in 1998 as the United States’ only federally inspected air-chilled poultry plant. Scientists compared MBA’s air-chilling processing with the immersion-chilling used at other U.S. plants. While MBA’s closing and bankruptcy sale in 2000 delayed research, the team hopes to continue working with the plant’s new owners.

A critical processing step, chilling lowers carcass temperature to inhibit bacterial growth. Air chilling, during which broilers are chilled individually on an assembly line with a draft of cold air, is widely used in Europe. U.S. processors chill broilers in tanks of flowing cold water. It’s thought the risk of cross-contamination is greater with immersion chilling since broilers come into contact with each other. Immersion chilling also leads to water retention in the broilers. Emerging USDA labeling regulations would require poultry processors to specify how much water they contain.

The IANR team compared MBA’s air-chilled broilers with those from an undisclosed immersion-chilling plant. Both sets had roughly similar counts of non-disease-causing bacteria. However, air-chilled broilers had less Salmonella and Campylobacter, bacteria that can cause food-borne illness. The air-chilled chickens also had significantly fewer psychrotrophs, bacteria that grow at refrigeration temperatures and cause spoilage.

Unlocking genetic keys to latency of herpes viruses

An IANR veterinary scientist’s genetics research is on the leading edge of breakthrough theories about how herpes viruses cause disease and perpetuate themselves in people and cattle. These theories offer hope for new herpes vaccines and treatments.

He focuses on two viruses, Bovine Herpes Virus 1 (BHV-1) and the closely-related human herpes simplex virus type 1 (HSV-1). Both cause infection by traveling to neurons, specialized cells that transmit messages to the brain. Viruses replicate by commandeering the genetic machinery of the host cells, usually killing the cell and causing disease symptoms. But when BHV-1 or HSV-1 infect a neuron, the virus often shuts off, entering a latent state and allowing the neuron to survive.

How and why herpes viruses become latent are questions this research seeks to answer. Latency helps the virus survive in a person or animal by keeping infected host cells alive and allowing the virus to periodically reactivate and infect other host cells. If
researchers could prevent a virus from becoming latent, they could develop better vaccines and slow or stop virus transmission.

The IANR scientist's early work included discovery of a gene that encodes a latency-related protein. More recently, he was the first to demonstrate that the latency-related protein inhibits programmed cell death and may promote latency. The latency-related gene acts like a switch. When it's on, the virus produces the protein, cell death is inhibited, and the host cell and virus survive. Finding a way to switch off the gene could be a way to treat viral diseases.

**Fore! Team seeks environmentally friendlier greens**

Faster, smoother, more consistent putting greens with less fertilizer? It sounds like a golf course superintendent's dream, but it may become a reality, according to preliminary results from a five-year NU study.

In search of better putting greens with less environmental impact, IANR turfgrass scientists built four sets of experimental greens at NU's John Seaton Anderson Turfgrass Research Facility near Mead. Each set consisted of a control green built with the commonly-used, U.S. Golf Association-sanctioned sand/peat root zone mixture; the other green included 5 percent silty clay loam soil in the mix.

Researchers then applied two different nutrient treatments to the greens for the crucial grow-in process. One preplanting treatment used 3 pounds of nitrogen, 1.5 pounds of phosphorous and 2 pounds of potassium per thousand square feet. The second, accelerated method used nutrient concentrations about double those rates.

Greens grown with the soil mixture have shown no negative effects, belying the conventional wisdom that soil particles tend to block water infiltration and make the putting surface too hard. These greens also have bounced back more quickly from injury and aeration.

Greens given the higher-nutrient, accelerated grow-in treatment did grow in more quickly, but were more susceptible to disease and developed a shallower root system, which can cause long-term problems.

**Project explores Nebraska's carbon storage potential**

Increasing atmospheric concentrations of carbon dioxide ($CO_2$), a major greenhouse gas, are raising concerns about potential global warming.

Reducing fossil fuel use is the long-term solution, but storing, or sequestering, carbon in soil might buy time for broader efforts to cut fuel use. Farmers eventually might be paid for storing extra carbon in their soils.

Carbon cycles through soil naturally. Plants take in $CO_2$ for photosynthesis and carbon mostly enters soil when plants die. Eventually it recycles back into the air. The challenge is finding ways to store more in soil. Many farming practices that improve soil quality and boost crop yields enhance carbon sequestration.

IANR scientists from agronomy and the School of Natural Resource Sciences are heading interdisciplinary research to understand the carbon sequestration potential of Nebraska's highly productive, irrigated farms. They want to identify factors controlling carbon sequestration in irrigated and dryland crop systems and develop cost-effective ways to increase it.

They're launching a comprehensive project measuring how much $CO_2$ enters and leaves fields daily under different conditions, thanks to major U.S. Department of Energy grants. They're also testing existing simulation models that predict carbon sequestration rates based on yields, management and other factors to determine which work best under Nebraska's irrigated conditions.

**Renovating housing mix boosts small towns' vitality**

More and more rural communities and counties have declining populations and an increasing proportion of older residents.

An IANR consumer scientist studied how an aging population affects the vitality of rural communities and the implications for housing policy. She and a colleague analyzed 1990 and 1980 U.S. Census Bureau data from 834 rural counties in the 12-state North Central Region, which
includes Nebraska.

The researchers found that 71 percent of these counties had a decreasing population and an increasing proportion of residents age 65 and older, indicating that younger people were moving away. Twenty-four percent of the counties had an increasing population and an increasing proportion of elderly, indicating retirees were enticed to move to the county. Two percent of the counties had a decreasing population and a decreasing number of elderly.

Communities with declining and aging populations often have a smaller proportion of residents in the labor force, less per capita earnings, lower county populations, and residents, on average, have less education.

In this study, as the proportion of elderly increased, income per capita was slightly higher and the proportion of residents below the poverty level tended to decrease. However, rural communities often have single family homes and nursing homes but lack housing that supports semiautonomous living. They also often have older housing lacking the amenities considered standard by younger families.

The NU College of Human Resources and Family Sciences researchers found that rural communities appear to benefit from having a diversity of residents, housing, and employment, but they will have to be creative to provide the appropriate housing mix.

### IANR studies show Roundup Ready soybeans yield less

Roundup Ready soybeans simplify weed control, but they yield somewhat less than conventional soybeans, IANR research found.

IANR studies in 1998 and 1999 found that Roundup Ready soybeans yield 6 percent less than their closest conventional relatives, called sister lines, and 11 percent less than high-yielding conventional varieties. Roundup Ready soybeans contain a gene that prevents damage from Roundup Ultra, the most popular non-selective, glyphosate-based herbicide.

Researchers studied two potential causes for lower yields in Roundup Ready soybeans — spraying with Roundup or the gene insertion process. Their first study showed herbicide spraying had no effect. A second study focused on effects of the gene insertion process.

In dryland and irrigated field studies in weed-free situations at four locations, they compared five Roundup Ready cultivars, their sister lines and high-yielding conventional cultivars. They controlled weeds with conventional herbicides and by hand. Roundup wasn’t used so scientists could compare yields without that variable complicating results.

Researchers found that Roundup Ready soybeans’ lower yields stem partly from the gene insertion process. The types of soybeans into which the gene is inserted account for the rest of the yield penalty. Today’s Roundup Ready varieties probably were developed from higher-yielding parents.

Researchers said yield differences don’t seem to worry farmers, who continue planting Roundup Ready soybeans because of the system’s simple, effective weed control. The Roundup Ready system may be more profitable than conventional soybean systems if weeds can’t be controlled using conventional means, they said.

### Improving switchgrass for viable biomass fuel

Switchgrass, a Nebraska native prairie grass, could become a major source for renewable fuel. Research at NU aims to help make this possibility a reality.

The U.S. Department of Energy (DOE) has selected switchgrass as its top crop candidate for biomass fuel conversion. Biomass fuels are produced by extracting the sugars from plants and converting them to a renewable liquid fuel — ethanol. DOE is developing the conversion technology and aims to have it in place by 2010.

A USDA-Agricultural Research Service plant breeder at NU is developing high-yielding, high-performance switchgrass varieties ready for full-scale biomass production when the technology is ready. He collaborates with several IANR agronomists on everything from switchgrass genetics to the best herbicides for switchgrass establishment. Thanks to his early research and foresight, NU is a leader in developing switchgrass into a viable biomass fuel source.

His extensive collection of Midwestern switchgrass germplasm made NU an early player in this effort. A DOE grant to evaluate germplasm for yield potential and stability grew into a comprehensive program to develop improved cultivars and management practices to maximize biomass.

Switchgrass is especially promising because it can grow on marginal land and is high-yielding and environmentally friendly. Early NU trials yielded 6 tons per acre in a single cutting, a figure that could easily increase 30 percent with hybrid varieties. A USDA study predicts switchgrass could bring $40 per dry ton as a bioenergy crop, increasing Nebraska’s annual net farm income by $83 million.
A few more glimpses at ARD research ...

- A five-year IANR study on how best to return Conservation Reserve Program acres to crop production helped Nebraska land-owners recoup these acres as CRP contracts expired. The CRP to Crops project explored residue management, weed control, fertilizer and tillage strategies for corn, soybeans and grain sorghum at a site near NU’s Haskell Agricultural Lab in northeast Nebraska. Tours let producers see firsthand which management options worked best. Researchers shared findings fresh from the field to fill the urgent need for CRP conversion information. This research concluded in 1999.

- Most Bt corn pollen falls in or near cornfields before most monarch butterfly caterpillars emerge, IANR research shows. First-year results of an entomology study of five Bt cornfields found most pollen fell within 5.5 yards of the field, with the highest pollen counts within the first yard. None was found on milkweed more than 44 yards from fields. This study also found that while milkweed often grows near cornfields, there’s little threat to the monarch caterpillars that feed on milkweed because 95 percent of corn pollen is shed before caterpillars develop.

- Three new NU-developed hard red winter wheat varieties recently became available for farmers. The new wheats - Culver, Millennium and Cougar - all were jointly released by NU and USDA’s Agricultural Research Service. IANR and USDA scientists collaborate on Nebraska’s wheat breeding and development program. Culver and Millennium are high-yielding varieties. Culver is best adapted to southwestern and south central Nebraska; Millennium grows best in southwestern and western Nebraska. Cougar works best for situations where planting to moisture is needed or where lodging resistance is particularly important. It was released primarily because of exceptional straw strength.

- NU animal scientists are helping to test a promising new procedure for sorting male from female sperm cells for livestock production. Colorado State University developed the sperm-sorting technique. Researchers at NU’s West Central Research and Extension Center near North Platte tested the procedure by artificially inseminating yearly heifers and later using ultrasound to check fetuses’ sex. First-year results of the IANR study looked promising. If second-year findings are equally positive, sorted semen for cattle soon could become commercially available.

- A decline in retail sales in many rural Nebraska communities accelerated during the 1990s regardless of the ag economy’s strength. An IANR agricultural economist and a graduate student tracked Nebraska retail sales trends from 1970 to 1998. They found the state’s metro areas pulled sales away from regional trade centers and local main streets in droves during the 1990s. By 1998 the state’s six metro counties claimed 69 percent of Nebraska’s taxable retail sales, up from 49 percent in 1980. Taxable sales percentages in non-metro counties dropped from about 51 percent in 1980 to 37 percent in 1998.

- Legacy, the latest improved turf-type buffalograss from IANR’s turf breeding team, became commercially available in 2000. The newcomer boosts better color than earlier NU turf buffalograss releases and is better adapted to grow in the northern United States. Todd Valley Farms of Mead grows and sells the new cultivar under a university licensing agreement. Like IANR’s other improved buffalograsses, Legacy needs half the water and far less mowing, fertilizer and chemicals than most other turfgrasses.

- Purple-colored waste lagoons are a welcome sight for livestock producers. They have less odor than conventional grayish lagoons because their naturally occurring purple sulfur bacteria feed on odor-causing organic compounds. IANR biological systems engineers studied ways to manage and encourage purple sulfur bacteria growth. This research provides insights about what factors determine whether lagoons turn purple. Findings should help producers encourage these invisible purple odor-eaters.

- Proper manure management is an economic and environmental concern for Nebraska’s livestock industry, which generates about 27 million tons of animal waste annually. University of Nebraska agronomists are studying how to manage manure applications, timing and tillage practices to make the most of its crop nutrients and protect the environment. They’re studying runoff and a variety of other agronomic factors. First-year results showed manure provides a temporary protective cover that reduces runoff from fields during the critical April-to-July period when soil is most vulnerable to heavy runoff. Manure application timing and tillage strongly influence the degree of runoff protection.
T
he impact and quality of ARD research can be assessed in many ways. One measure of excellence is the recognition researchers’ work receives from peers and from those who benefit from the research. A number of ARD faculty members are widely recognized as leaders in their disciplines, and a number received international, national, regional and/or state honors.

Many ARD faculty also serve as officers or directors in their professional societies and state, regional, national and international organizations. Some are editors and associate editors of professional journals. We applaud their efforts in furthering the knowledge and professionalism of their disciplines.

Agricultural Economics

Sam Cordes received the Founder’s Award from the Rural Policy Research Institute.

Agronomy

P. Stephen Baenziger received the Distinguished Service Award from the Nebraska Crop Improvement Association, and was elected Chair-Elect of Section O (Agriculture, Food, and Natural Resources) of the American Association for the Advancement of Science.

David Baltensperger was inducted into the Nebraska Hall of Agricultural Achievement.

Kenneth G. Cassman received the Fellow Award from the Crop Science Society of America.

John Doran received the Technology Transfer Award from the USDA Ag Research Service, was a nominee for the “Onassis Prize for the Environment” from the Onassis Foundation in Athens, Greece, and was elected President-Elect of the International Soil Ecology Society and the Soil Science Society of America.

Charles Francis received the Honorary Doctor of Science Degree from the faculty of Agriculture and Forestry, University of Helsinki, Finland.

Gary Hergert received the Fellow Award from the Soil Science Society of America.

Martin Massengale received the Lifetime Trustee award from the Nebraska Council on Economic Education and the Agricultural Education Award for Outstanding Service to Agriculture from the Triumph of Agriculture Exposition.

Lowell Moser was inducted into the Nebraska Hall of Agricultural Achievement.

Gail Wicks received the Fellow Award from the Weed Science Society of America.

Animal Science

Mary Beck received the Helene Cecil Leadership Award from the Poultry Science Association and the Distinguished Alumna Award from Westhampton College, University of Richmond, Virginia.

Don Beermann was named an Honorary Fellow by the American Association for the Advancement of Science.

Mike Brumm received the Animal Management Award from the American Society of Animal Science and was inducted into the Northeast Community College Agricultural Advisory Committee’s Hall of Honor.

Chris Calkins received the Signal Service Award from the American Meat Science Association.

Rodger Johnson received the Oklahoma State University Animal Science Advanced Degree Graduate of Distinction Award.

Rick Koelsch was named Engineer of the Year by the Nebraska Section of the American Society of Agricultural Engineers and received the American Society of Agricultural Engineers Blue Ribbon Award for “Manure Matters” Newsletter, 1999 Educational Aids.

Roger Mandigo was the first recipient of the Wendell Burgher Beef Industry Award presented by the Institute of Agriculture and Natural Resources.

Merlyn Nielsen received the Animal Breeding and Genetics Award from the American Society of Animal Science.

Dale Van Vleck was named a Fellow by the American Society of Animal Science.

Biochemistry

Ruma Banerjee was selected as an Established Investigator by the American Heart Association and was selected Chair-Elect, Gordon Research Conference on Enzymes, Coenzymes and Metabolic Pathways ‘01 by the Gordon Research Conference.

Raymond Chollet was elected Co-Chair of the Gordon Research Conference on “CO₂-Fixation and Metabolism in Green Plants” in Oxford, U.K., and was elected Co-Chair of the Gordon Conference during Summer 2002 in the United States by the Gordon Research Conference.

Carolyn Price received the NSF Career Advancement Award from the National Science Foundation, and was selected Co-Chair for the NIH workshop on Chromatin and DNA replication by the National Institutes of Health, Co-Organizer of the Eppley Institute Short Course on Cancer Biology by the Eppley Institute faculty, Session Chair for the Cold Spring Harbor Conference on Telomeres by the conference organizers, and Session Chair for FASEB Summer Conference on Ciliate Molecular Biology by the conference organizers.
Biological Systems Engineering

Bruce Dvorak received the University of Nebraska-Lincoln College of Engineering & Technology “Multidisciplinary Research Award”.

Glenn J. Hoffman received the Hancor, Inc. Soil and Water Engineering Award for Distinguished Accomplishments in Advancing the Science of Soil and Water Engineering through Research, Leadership, and Administration from ASAE.

Dennis Schulte received the University of Nebraska-Lincoln College of Engineering & Technology “Multidisciplinary Research Award”.

Darrell G. Watts received the Pioneer Award for Research and Extension Education Enhancing the Management and Protection of Nebraska’s Groundwater Resources from the Nebraska Water Conference Council and IANR.

Wayne Woldt received the University of Nebraska-Lincoln College of Engineering & Technology “Multidisciplinary Research Award”.

Entomology

Fred Baxendale received the Tree Planters State Award for Backyard Farmer from the Nebraska Statewide Arboretum, the Herbert H. Davis Recognition Award to the Turfgrass Science Team from the Nebraska Golf Hall of Fame, the Epsilon Sigma Phi Team Award as a member of the Urban Pest Management Team, and was a member of the Festival of Color Team which won the IANR Team Effort Award.

Leon Higley received the Teaching Award of Merit from the University of Nebraska-Lincoln Chapter of Gamma Sigma Delta and the Distinguished Award in Teaching from the North Central Branch of the Entomological Society of America.

Shripat T. Kamble served as a National Director-Elect for the Board Certified Entomologists and Chair of the Examining Committee-Board Certified Entomologists of the Entomological Society of America, and was a National Chair for the National Conference on Urban Entomology.

Lance J. Meinke, Blair D. Siegfried, and Mike Scharf received the USDA-ARS Technology Transfer Award as part of an interdisciplinary team recognized for outstanding cooperative efforts involved in the development, conduct, and evaluation of the Areawide IPM program for corn rootworm.

Robert K.D. Peterson received the Entomology Educational Project Award for the “Insects, Disease, and History” Web Site from the Board Certified Entomologists, Mid-America Chapter.

Food Science and Technology

Mindy Brashears received the Agricultural Communicators Education Silver Award for the video, “Introduction to the Principles of HACCP.”

David S. Jackson received the “Outstanding Presentation in Cereal Chemistry” Award from the Corn Refiners Association for a presentation given at the American Association of Cereal Chemists Annual Meeting.

Horticulture Department

Dermot P. Coyne was invited to present the Maiben Memorial Lecture at the Annual Meeting of the American Society for Horticultural Science and was selected Chair of the Hall of Fame Committee for the American Society of Horticultural Science.

Roch E. Gaussoin received the Outstanding Young Scientist Award from the Nebraska Chapter of Sigma Xi, and as a member of the Turfgrass Science Team received the Herbert H. Davis Memorial Award from the Nebraska Golf Hall of Fame.

Garald L. Horst, a member of the Turfgrass Science Team, received the Herbert H. Davis Memorial Award from the Nebraska Golf Hall of Fame.

Dale T. Lindgren was recognized for 25 years of Federal Civil Service. A pink-flowered carnation released by Bluebird Nursery was named “Dr. Dale Lindgren.”
Terrance P. Riordan received the Gamma Sigma Delta Research Award and, as a member of the Turfgrass Science Team, received the Herbert H. Davis Memorial Award from the Nebraska Golf Hall of Fame.

Robert C. Shearman, a member of the Turfgrass Science Team, received the Herbert H. Davis Memorial Award from the Nebraska Golf Hall of Fame.

School of Natural Resource Sciences

John Holz was selected to attend the Dissertations Initiative for the Advancement of Limnology and Oceanography Symposium at the Bermuda Biological Station for Research, sponsored by the American Society of Limnology and Oceanography, the National Science Foundation, and the European Commission and was recognized for Outstanding Research in Lake Restoration, Protection, and Management by the North American Lake Management Society.

Shripat T. Kamble served as a National Director-Elect for the Board Certified Entomologists of the Entomological Society of America, Chair of the Examining Committee-Board Certified Entomologists of the Entomological Society of America, and a national Chair for the National Conference on Urban Entomology.

David Wedin received the Junior Faculty Excellence in Research Award from the Agricultural Research Division.

Veterinary and Biomedical Sciences

Dale M. Grotelueschen received the Extension Award from the Nebraska Chapter of Gamma Sigma Delta.

Jeffrey D. Cirillo received the Junior Faculty Excellence in Research Award from the Agricultural Research Division.

Textiles, Clothing and Design

The Textiles, Clothing and Design Department received the American Textile Manufacturers Institute Award of Excellence.

Rita Kean received the Fellow Award from the International Textile and Apparel Association.

Family and Consumer Sciences

Mary Ellen Rider received the New Specialist Award from the Nebraska Cooperative Extension Association.

Nutritional Science and Dietetics

Kaye Stanek received the Huddleson Award for research from the American Dietetic Association Foundation.

Northeast Research and Extension Center

Michael C. Brumm received the Animal Management Award from the American Society of Animal Science.

Panhandle Research and Extension Center

Alexander D. Pavlista received the Certificate of Appreciation from the United States Department of Agriculture.

Dean Yonts received the ASAE Educational Aids Competition, Manuals or workbooks category—Blue Ribbon Award for Sprinkler Irrigation Systems - MWPS - 30, First Edition, Midwest Plan Service, Iowa State University.

Dean Yonts received the ASAE Educational Aids Competition, Web page category—Blue Ribbon Award for Managing Irrigation and Nitrogen to Protect Water Quality.

West Central Research and Extension Center

Don C. Adams received the Holling Family Award for Teaching Excellence from the Institute of Agriculture and Natural Resources.
One of the primary missions of the ARD research program is to develop the scientists of tomorrow. We are committed to providing exceptional graduate students with the opportunity to work with and learn from our research faculty.

ARD is among the national leaders in research in food production and processing, natural resources management and family sciences. Approximately 689 graduate students are pursuing advanced degrees with ARD faculty. The quality of our graduate students is reflected in the recognition they receive.

Agricultural Economics

Saleem Shaik received the Dr. James B. Hassler Award for Outstanding Research from the Department of Agricultural Economics.

Agronomy

Mine Aslan received the Henry Beachell Fellowship from the Department of Agronomy and the Milton E. Mohr Fellowship from the Center for Biotechnology.

Michael G. Burton received the Milton E. Mohr Fellowship from the Center for Biotechnology.

B. Todd Campbell received the Graduate Student Award from the National Council of Commercial Plant Breeders.

Devinder Sandhu received the Widaman Trust Distinguished Graduate Assistant Award from the Agricultural Research Division.

Martin M. Williams II received the Henry Beachell Fellowship from the Department of Agronomy and the Milton E. Mohr Fellowship Award from the Center for Biotechnology.

Animal Science

Mark Allan was selected as one of five finalists for the Young Investigator Award by the North American Association for the Study of Obesity.

Jesus Arango received the Neil S. and Esther B. Raun International Graduate Fellowship from the Department of Animal Science.

Samar Elnagar received a Graduate Student Award of Excellence in recognition of her outstanding research presentation from the Poultry Science Association.

Galen Erickson received the John Hallman Memorial Award from the Department of Animal Science.

Christy Gladney received the Neal A. Jorgenson Genome Travel Grant from the U.S. Pig Genome Coordinator.

Mohammad Jalal received a Graduate Student Award of Excellence in recognition of his outstanding research presentation from the Poultry Science Association.

Nancy Jerez received the Second Place Award for the M.S. Poster Paper Competition from the American Meat Science Association.

Diane Moody received the Folsom Doctoral Dissertation Award and the Graduate Student Award from the Nebraska Chapter of Sigma Xi.

Curtis Novak received a Graduate Scholarship from Continental Grain.

Janice Rumph received the Frank Baker Graduate Student Essay Award from the Beef Improvement Federation.

Hiroko Taira received a Mary and Charles Cooper/Emma Sharpless Fellowship from the Agricultural Research Division and the College of Agricultural Sciences and Natural Resources.

Biochemistry

Tom Beardslee received the Milton E. Mohr Fellowship for Academic Year 1999-2000 from the College of Agriculture and Natural Resources.

Biological Systems Engineering

Charles M. Hardekopf received a Milton E. Mohr Research Fellowship from the Center for Biotechnology.

Michael Rinkol received a Milton E. Mohr Research Fellowship from the College of Engineering and Technology.

Entomology

Nor Aliza Abdul Rahim received the Myron H. Swenk Fund Travel Award from the Bruner Club Executive Committee.

Leela Alamalakula received the Milton E. Mohr Scholarship from the Center for Biotechnology.

James W. Austin received a Fellowship from the Fulbright Foundation.

Jon Bedick received the Myron H. Swenk Fund Travel Award from the Bruner Club Executive Committee and a Graduate Research and Creative Activity Symposium Award from Graduate Studies.

Tom Clark received the Graduate Studies Fellowship from the Dean of Graduate Studies, the Myron H. Swenk Fund Travel Award from the Bruner Club Executive Committee, an Entomology Graduate Student Training Program Internship from Dow AgroSciences. He won Second Place in the Ph.D. Student Poster Competition and was a member of the Linnaean Team which won Second Place at the Entomological Society of America meetings.

Eric Durham received the Myron H. Swenk Fund Travel Award from the Bruner Club Executive Committee.

J. Lester Figarola received the Shear-Miles Fellowship Award from the Agricultural Research Division.

Fikru Haile received Second Place in the Ph.D. Student Poster Competition at the Entomological Society of America meetings.
Tiffany Heng-Moss received the Graduate Studies Fellowship from the Dean of Graduate Studies, the Graduate Scholarship from the North Central Branch Entomological Society of America Interdisciplinary Grant Program, a Hardin Distinguished Graduate Fellowship from the Agricultural Research Division, and First Place in the Ph.D. Student Paper Competition from the Entomological Society of America.

W. Wyatt Hoback received a grant from the Nature Conservancy, Nebraska Chapter and a Presidential Graduate Fellowship from the Dean of Graduate Studies.

Paula Macedo received the Mary and Charles C. Cooper/Emma I. Sharpless Fellowship from the College of Agricultural Sciences and Natural Resources and the Agricultural Research Division.

Tulio Macedo received the Mary and Charles C. Cooper/Emma I. Sharpless Fellowship from the College of Agricultural Sciences and Natural Resources and the Agricultural Research Division.

Pari Pachamuthu received First Place President’s Prize for oral Ph.D. research presentation at the Entomological Society of America annual meeting.

Effie Riatt Fellowship from the American Medical Association Foundation’s Fellow Program.

Douglas S. Zatechka, Jr., received the Widaman Trust Distinguished Graduate Assistant Award from the Agricultural Research Division.

Peng Zhang received a Midwest Student Biomedical Research Forum Award from the American Medical Association Education and Research Foundation and Pfizer Incorporated Animal Health Research.

Jean Chicoine received the Effie Riatt Fellowship from the American Association of Family and Consumer Sciences.

Susan Meyerle received the Graduate Scholarship Award from the Nebraska Association of Family and Consumer Sciences.

Jun Ma received the Widaman Trust Distinguished Graduate Assistant Award from the Agricultural Research Division.

Ying Zhou received the Lowe R. & Mavis M. Folsom Distinguished Master’s Thesis Award.
The purpose of this new program is to allow outstanding University Honors Program students to conduct research under the direction of a faculty mentor. The program is open to junior and senior Honors Program participants proposing to work with a faculty member who has an ARD appointment. A subcommittee of the ARD Advisory Council selects awardees based on the quality of the proposal. Proposals are authored by the students with guidance from the proposed project mentors.

Agricultural Leadership, Education and Communication

Alana Cent and Catherine Keown received an Honors Award for "Exploring Parental Collaboration in a National Early Childhood Development Program" from the Agricultural Research Division. (S. Fritz, Advisor)

Kristyn M. Harms received an Honors Award for "Pragmatic and Professional Impact of Character Education" from the Agricultural Research Division. (S. Fritz, Advisor)

James P. Rhea received an Honors Award for "Correlation of Beef Longissimus Muscle Tenderness at the 5th Rib and 12th Rib Locations" from the Agricultural Research Division. (C. Calkins, Advisor)

Biochemistry Department

Marissa Carstens received an Honors Award for "Non-symbiotic Plant Hemoglobins" from the Agricultural Research Division. (G. Sarath, Advisor)

Brenda M. Chrastil received an Honors Award for "The Role of Plasmids in the Degradation of the Herbicide, Dicamba, by Pseudomonas maltophilia, Strain DI-7". (D. Weeks, Advisor)

Animal Science Department

A. Mark James received an Honors Award for "Evaluation of the Reversible Phosphorylation of Phosphoenolpyruvate Carboxylase in Leaves of the C4 Plant Maize by Polyclonal Antibody Assays" from the Agricultural Research Division. (R. Chollet, Advisor)

Russell A. Miller received an Honors Award for "In vivo Functional Analysis of a Novel Chloroplast Gene Promoter" from the Agricultural Research Division. (L. Allison, Advisor)

Veterinary and Biomedical Sciences

Katherine Irwin received an Honors Award for "Understanding Cattle Behavior to Maximize Recovery of Food-Borne Pathogens" from the Agricultural Research Division. (D.R. Smith, Advisor)
ARD faculty involved in plant breeding and genetics research make important contributions to the improvement and development of agricultural and horticultural crops. Public breeding programs such as ARD's are essential to the continued enhancement of plant germplasm. These programs provide the resources and flexibility to pursue long-term breeding programs in crops that may not have a current commercial interest. They also can address genetic, cultural and management interactions characteristic of today's agriculture, as well as the future's.

Germplasm releases provide improved genetic material that is integrated into private and public plant breeding programs. Other releases occur as new cultivars (varieties), which are increased through the Foundation Seed Division and then provided to seed companies for production of certified seed. The following releases were made in 1999.

### Agronomy

**Crop:** Foxtail Millet [*Setaria italica* (L.) Beauv.]

**Germplasm Release:** N-Si-1, N-Si-2, N-Si-3, N-Si-4, and N-Si-5

**Scientists:** M.M. Siles, D.D. Baltensperger, L.A. Nelson, A. Marcon, and G.E. Frickel

**Characteristics:** These lines were identified as sources of three pigment (plant color, anther color, and seed coat color) and three morphological (bristle development, earhead density, and seed shape) genetic markers in half diallel crosses among seven parental lines. The pigmentation is purple or green and is conditioned by a single factor, with purple dominant over green. N-Si-2 and N-Si-4 develop purple pigment. N-Si-1, N-Si-3, and N-Si-5 are green throughout the plant, which crossed to N-Si-2 and N-Si-4 produce purple F₁ plants and, in the F₂, the progenies segregate into 3 purple to 1 green ratio. The emerging anthers at flowering are orange with a tinge of varying degree of brown (blackish brown when dry) or white, even when dry. The orange anther color is dominant over white. Seed coat color varies from light buff to brick red. N-Si-4 and N-Si-5 develop light buff seeds, N-Si-1 and N-Si-3 have cinnamon buff seed coats, and N-Si-2 produces brick red seeds. N-Si-1, N-Si-2, N-Si-3, and N-Si-5 develop dense earheads; however, the spikes of N-Si-1 and N-Si-2 are relatively more compact than those of N-Si-3 and N-Si-5. The spike of N-Si-4 is lax. Round seeds are produced by N-Si-1 and N-Si-4, while N-Si-2, N-Si-3, and N-Si-5 develop elliptical seeds.

**Crop:** Grain Pearl Millet (*Pennisetum glaucum*)

**Germplasm Release:** NM-8, NM-9, and NMH-1

**Scientists:** D.J. Andrews and J.F. Rajewski

**Characteristics:** NM-8 is a medium late maturity (+65 days after planting), narrow leaf, dwarf, synchronous tillering (1-2 tillers/plant), bristled (2 cm), purple plant inbred about 0.8 m tall. It has ovate-shaped, purple seeds (7.0 g/1000) and has yellow anthers. NM-9 is a leafy, dwarf, synchronous tillering (1 tiller per plant), non-bristled later maturing (+70 d after planting) purple plant inbred 1.0 m tall with purple grain and a stiff stalk. It has ovate-shaped, purple seeds (6.0 g/1000) and has yellow anthers. The purple pigmentation is light induced and only begins to show after a juvenile phase of about 18 days. The daily growth of the emerging leaf or head is green in the morning, becoming pigmented later in the day. While the lamina of the leaves is purple, the midrib is red. The F₁ hybrid of NM-8 x NM-9 (NMH-1) produces a vigorous plant with 2-3 tillers with lush purple foliage and attractive purple bristled panicles suitable for ornamental use in gardens and urban landscape areas. The hybrid has value to flower seed companies that want to market a new product. It was ranked first out of 10 entries in the 1998 AAS flower section, which was judged at 33 locations in North America.
Crop: Grain Sorghum [Sorghum bicolor (L.) Moench]

Germplasm Release: Restorer Line N312R


Characteristics: The primary utility properties of this line are 1) a good level of stress resistance pertinent to the U.S. Great Plains and as far south as north central Mexico, plus high yield capacity under good conditions, and 2) the ability of the line to simultaneously confer heterosis for both the seed number and seed weight components of yield in its hybrids. N312R is a purple plant, and its hybrids tend to be at the upper level of height acceptability under higher yield Great Plains conditions. The relationship between yield components in selected N312R hybrids differs from the common perception that yields increase when seeds/m² increase, which usually means reduced grain weight. Mid parent mean heterosis for yield in some N312R hybrids is derived from simultaneous heterosis for both seed number and seed weight or heterosis for seed weight without reductions in seed number. The N312R genes for conferring heterotic responses for yield via simultaneous heterosis for seed number and seed weight should be useful incorporations into proprietary commercial lines known to have other desirable characteristics. Also, the stress resistance level of N312R may be of value in many breeding programs, especially where high yield levels during favorable years are of concern.

Crop: Grain Sorghum [Sorghum bicolor (L.) Moench]

Germplasm Release: N316, N317, N318, N319, N320

Scientists: J.F. Pedersen and J.J. Toy

Released By: United States Department of Agriculture Agricultural Research Service and the University of Nebraska Agricultural Research Division

Characteristics: These genetic stocks are near iso-lines of Bwheatland (Btx399) and contain the nuclear male-sterility genes ms1, ms2, ms3, ms7, or others. They have immediate application for basic research of the various nuclear male-sterility genes on sorghum performance or on the performance of breeding systems used for sorghum improvement.

Crop: Grain Sorghum [Sorghum bicolor (L.) Moench]

Germplasm Release: 20 Near-Isogenic genetic stocks (N321-340)

Scientists: J.F. Pedersen and J.J. Toy

Released By: United States Department of Agriculture Agricultural Research Service and the University of Nebraska Agricultural Research Division

Characteristics: These genetic stocks are characterized by white seed/tan necrotic plant color (N321, N322, N323, N324, N325), red seed/tan necrotic plant color (N326, N327, N328, N329, N330), white seed/purple necrotic plant color (N331, N332, N333, N334, N335), red seed/purple necrotic plant color (N336, N337, N338, N339, N340). The 20 sorghum genetic stocks are S8 segregates of a single S3 family from the BC1 generation of the cross (BTx398 ms3 x BTx630) ms3 x BTx630. They were developed with the goal of making seed available to test hypotheses concerning the combined effects of plant color and pericarp color in a similar genetic background. They would be expected to have approximately 97% common nuclear genes with the exception of those controlling pericarp color and necrotic plant color. These genetic stocks have immediate application for basic research on the effects of plant color and pericarp color on sorghum performance, quality, and biotic and biotic stress resistance.
Crop: Grain Sorghum [Sorghum bicolor (L.) Moench]
Germplasm Release: Population NP41B
Characteristics: Traits of value in NP41B are 1) availability of an excellent mid- to full-season B germplasm population adapted to the Great Plains, and 2) a B germplasm population of tan plants with light colored seeds to enhance both domestic and export marketability for superior poultry feed and for food grain use as well as for normal pig and cattle feed uses. It will provide commercial breeders with a good alternative source of tan plant B germplasm. No other tan plant B population is available to commercial breeders. Public breeders may find maturity and height characteristics useful also.

Crop: Corn (Zea mays L.)
Germplasm Release: Inbred N547
Scientists: N.E. D'Croz-Mason and J.E. Foster
Characteristics: N547 is a yellow endosperm maize inbred germplasm with sources of resistance to European Corn Borer Ostrinia nubilalis (Huber) stalk and shank tunneling damage (second generation ECB). Although N547 contains tropical germplasm, it is adapted to Nebraska. It has uniform and open tassels, and at Lincoln, Nebraska requires 72 days to pollen shedding. Synchronization between pollen shed and silk emergence is good with silk emergence beginning two days after pollen shed begins. Plant and ear height range from 1.80 - 2.00, and 0.50-0.90 m. Ears are conical with 12 to 14 rows of dent kernels. N547 has not been evaluated for disease nor other pest resistances.

Crop: Corn (Zea mays L.)
Germplasm Release: Inbred N548
Scientists: N.E. D'Croz-Mason and J.E. Foster
Characteristics: N548 is a yellow endosperm maize inbred germplasm with sources of resistance to European Corn Borer Ostrinia nubilalis (Huber) stalk and shank tunneling damage (second generation ECB). Although N548 contains tropical germplasm, it is adapted to Nebraska. It has uniform and open tassels, and at Lincoln, Nebraska, requires 72 days to pollen shedding. Synchronization between pollen shed and silk emergence is good with silk emergence beginning two days after pollen shed begins. N548 has good combining ability for ECB and produces moderately sturdy medium to tall plants with plant and ear height of 2.00 and 1.00 m. Ears are conical with 12 to 14 rows of dent kernels. It is primarily recommended for use as germplasm for line development.

Crop: Soybean [Glycine max (L.) Merr.]
Variety Release: NE3297
Scientists: G.L. Graef
Characteristics: NE3297 is derived from the cross ‘Parker’ x ‘Asgrow A935’. It is a mid-Maturity Group III cultivar with indeterminate growth habit, white flowers, tawny pubescence, and brown pods at maturity. Seeds are dull yellow with a brown hilum. Over two years of Uniform Regional Tests in 41 environments (1995-96), NE 3297 matured 3 d earlier than ‘Macon’, with slightly higher yield, 10 cm taller plant height, similar
Crop: Soybean (Glycine max (L.) Merr.)
Variety Release: NE3400
Scientists: G.L. Graef
Characteristics: NE3400 is derived from the MSBP1 population, an intermated population using ms2 male sterility to facilitate intermating. It is a mid-Maturity Group III cultivar with indeterminate growth habit, purple flowers, gray pubescence, and tan pods at maturity. Seeds are dull yellow with a buff hilum. Over two years of Uniform Regional Tests (1997-98), NE3400 matured 1 d earlier than Macon, with similar yield, plant height, and seed weight, and 11 g kg⁻¹ greater seed protein content. In Nebraska tests during 1997-93, NE3400 yielded 56.1 bu/a, compared with 62 for Macon. NE3400 matured 2 days later than Macon, with similar lodging score, plant height, and seed weight. It is susceptible to brown stem rot and phytophthora rot.

Crop: Soybean (Glycine max (L.) Merr.)
Variety Release: NE1900
Scientists: G.L. Graef
Characteristics: NE1900 is derived from the MSBP1 population, an intermated population using ms2 male sterility to facilitate intermating. It is a late Maturity Group I cultivar with indeterminate growth habit, white flowers, gray pubescence, and brown pods at maturity. Seeds are dull yellow with a yellow hilum. Over two years of Uniform Regional Tests (1997-98), NE1900 was the highest yielding entry and matured 1 d earlier than Marcus 95, with 2 bu/a higher yield, similar plant height, 10 mg seed⁻¹ lower seed weight, and similar seed protein and oil content. In Nebraska tests during 1997-98, NE1900 matured 3 days earlier than IA2021 and yielded 64.2 bu/a, compared with 63.7 for IA2021. NE1900 had a slightly higher lodging score, similar plant height, and smaller seed weight compared with IA2021. It is susceptible to brown stem rot and phytophthora rot.

Crop: Barley (Hordeum vulgare L.)
Variety Release: P-954
Characteristics: P-954 is a new six-rowed, winter feed barley variety selected from the cross Hitchcock/Maury/Hitchcock. It was released on the basis of its superior winter hardiness, straw strength, and grain yield under dryland conditions. It has rough awns, and its covered kernels have long rachilla hairs and a yellowish aleurone. The spike is medium lax and medium in length. In 20 trials grown in Nebraska (1990-1998), P-954 yielded 56.1 bu/a. This yield was higher than Dundy (49.8 bu/a), Hitchcock (42.4 bu/a), and Perkins (49.9 bu/a). Grain volume weight is similar to that of Dundy and higher than that of Hitchcock. At mature plant height, P-954 is about 2 inches shorter than Perkins and has good straw strength. It flowers similarly to Perkins, but 2 days earlier than Hitchcock and Dundy. P-954 has a similar winter hardiness to Hitchcock and Dundy but is superior to Perkins. It has better resistance to powdery mildew than Perkins and Hitchcock, but is more susceptible than Dundy. It is moderately susceptible to leaf rust and barley yellow dwarf virus. Based on current information, P-954 is best adapted to dryland production in western Nebraska and southern Great Plains where winterkilling is less frequent than in eastern Nebraska.

Crop: Barley (Hordeum vulgare L.)
Variety Release: P-721
Characteristics: P-721 is a new six-rowed, winter feed barley variety released on the basis of its superior winter hardiness, disease resistance, and grain yield under dryland conditions. It has rough awns, and its covered kernels have long rachilla hairs and a yellowish aleurone. The spike is medium lax and medium long. In 17 trials grown in Nebraska (1991-1998), P-721 yielded 50.9 bu/a. This yield was higher than Dundy (47.4 bu/a), Hitchcock (39.7 bu/a), and Perkins (49.4 bu/a). Grain volume weight is similar to that of Perkins, Hitchcock, and Dundy (48 lb/bu). At mature plant height, P-721 is about 1.5 inches shorter than Perkins.
(31 in) and similar to Hitchcock and Dundyl22 (29.5 in), and has good straw strength. It flowers similarly to Perkins, and about 2 days earlier than Hitchcock and Dundyl22. P-721 has a similar level of winter hardiness to Hitchcock and Dundyl22, but is superior to Perkins. It has better resistance to powdery mildew than Perkins and Hitchcock, but is more susceptible than Dundyl22. It is moderately susceptible to leaf rust but has better resistance than Hitchcock and Dundyl22. It is moderately resistant to barley yellow dwarf virus (BYDV) and is superior to Perkins, P-954, and Hitchcock. Based on current information, P-721 is best adapted to dryland production in western Nebraska and southern Great Plains where winterkilling is less frequent than in eastern Nebraska. In areas where BYDV occurs frequently to cause significant yield losses, P-721 would be a preferred variety.

Crop: Hard Red Winter Wheat (Triticum aestivum L.)

Variety Name: Culver (P.I. 606726)


Released By: University of Nebraska Agricultural Experiment Station and the United States Department of Agriculture Agricultural Research Service

Characteristics: ‘Culver’ was released primarily for its superior adaptation to dryland wheat production systems in southern and central Nebraska and similar growing areas in adjacent states. Culver is an awned, white-glumed cultivar. Its field appearance is most similar to ‘Alliance’, although not as yellow-green in color. After heading, the canopy is moderately open and upright. The flag leaf is erect and twisted at the boot state. The foliage is green with a waxy bloom at anthesis. The leaves are glabrous. The spike is tapering in shape, moderately long to long, and middense. The glume is midlong and midwide to wide, and the glume shoulder is sloping to square. The beak is short in length with an acuminate tip. The spike is usually nodding at maturity. Kernels are red colored, hard textured, and oval to elliptical in shape. The kernel has no collar, a large brush of medium length, rounded cheeks, midsize to large germ, and a narrow and shallow crease. The main advantage Culver has when compared to most other available wheat cultivars, within its area of adaptation, is its high grain yield and superior leaf rust resistance in dryland production systems. It is medium in maturity and has a medium length coleoptile. Culver has moderately strong straw strength, and good to very good winter-hardiness similar to Abilene and comparable to other winter wheat cultivars adapted and commonly grown in Nebraska. The overall end-use quality characteristics for Culver should be acceptable to the milling and baking industries.

Plant Pathology

Crop: Dry Bean

Germplasm: BelMiNeb-RMR-6 and -7 erect, short vine, rust and mosaic resistant great northern germplasm lines.

Scientists: J.R. Stavely, J.D. Kelly, J.R. Steadman, D.P. Coyne, and D.T. Lindgren

Released By: United States Department of Agriculture Experiment Station and Nebraska Agricultural Research Division

Characteristics: Multiple disease resistance, upright plant type. BMN-RMR-6 has four genes for rust and mosaic resistance that are in previously released BMN-RMR-4 and -5, but a more desirable combination of plant habit and seed characteristics than these previous releases. BMN-RMR-7 is the first release great northern bean to combine the UR-3 and the UR-4 and UR-11 rust resistance genes.
Copyright and patent protection is an important parameter in research. It is especially important for discoveries and innovations that have a potential commercial application. Therefore, from time to time, the ARD (and the University) may determine that the public good is best served with regard to technology transfer by entering into an agreement with a public or private institution which provides that institution with proprietary interests in specific research. The research of ARD scientists often can lead to a patent. Most of the patents that have been awarded to ARD scientists have been for equipment developments and specialized processes. These patents often are licensed by private industry, with royalties being reinvested in future ARD research. The following copyright and patents were awarded in 1999.

**Agronomy**

<table>
<thead>
<tr>
<th>Patent Title</th>
<th>Method for transforming soybean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patent Number</td>
<td>5,959,179</td>
</tr>
<tr>
<td>Description</td>
<td>Methods and materials for the production of transgenic soybeans are disclosed. Preparation of explants from specific regions of soybean seedlings resulted in improved transformation efficiencies. Incubation of soybean seedlings between about 0 degree C. and about 10 degree C. prior to preparing explants was found to be further beneficial to the preparation of transgenic soybeans.</td>
</tr>
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**Animal Science**

<table>
<thead>
<tr>
<th>Patent Title</th>
<th>A feeding program for the production of feed to produce omega-3 fatty acid enriched eggs and methods for producing such eggs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patent Number</td>
<td>5,897,890</td>
</tr>
<tr>
<td>Scientist</td>
<td>S.E. Scheideler</td>
</tr>
<tr>
<td>Description</td>
<td>Production of omega eggs is a patent for the feeding and management of laying hens to produce eggs enriched with n-3 fatty acids, specifically 250 mg linoleic acid and 100-120 mg DHA. The feeding regime includes feeding flaxseed to hens in a cost-effective program designed to not diminish production of the laying hen. Consumption of omega eggs has been tested in consumer groups and has been found to decrease serum triglycerides in hypercholesterolemic subjects without risk to serum cholesterol levels.</td>
</tr>
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**Biological Systems Engineering**

<table>
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<tr>
<th>Patent Title</th>
<th>Method and apparatus for production of levulinic acid via reactive extrusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patent Number</td>
<td>5,859,263</td>
</tr>
<tr>
<td>Scientists</td>
<td>V. Ghorpade and M.A. Hanna</td>
</tr>
<tr>
<td>Description</td>
<td>The present invention relates to a continuous process for preparing levulinic acid from starch in a reactive extrusion process. In a preferred embodiment the extrusion takes place in a twin-screw extruder having a plurality of temperature zones wherein the starch slurry is preconditioned, extruded, filter pressed, reboiled, vacuum distilled, condensed, centrifuged, whereby the waste effluent from the centrifugation is reprocessed upstream to the preconditioning stage.</td>
</tr>
</tbody>
</table>
**Food Science and Technology**

**Patent Title:** Method for liquefaction of cereal grain starch substrate and Apparatus therefore.  

**Patent Number:** U.S. 5,981,237  

**Scientists:** M.M. Meagher and D.D. Graefman.  

**Description:** A method and apparatus are disclosed for liquefaction of starch derived from cereal grain. A single-screw extruder is utilized to gelatinize a starch substrate providing significant advantage over prior art jet steam cookers. Liquefaction of the gelatinized starch substrate is completed by post-extrusion bioreaction of the starch with a steele-mixer reactor. An alpha-amylase enzyme is utilized to facilitate the liquefaction process. The liquefacted starch substrate is heated after bioreaction to achieve complete digestion of remaining starch inclusions. Liquefacted starch substrates utilizing the disclosed process significantly reduce the amount of energy required in the conversion of starch to fermentable sugars in the production of ethanol.

**Plant Pathology**

**Patent Title:** Transgenic Plants Co-expressing a Functional Human 2-5A System Resist Virus Infection  

**Patent Number:** 5,866,787  

**Scientists:** A. Mitra and R.H. Silverman  

**Description:** This patent is for an anti-viral system that provides broad-spectrum resistance against all economically important virus diseases of crop plants.

**Veterinary and Biomedical Sciences**

**Patent Title:** Nucleotide Sequences and Method for Detection of *Serpulina hyodysenteriae*  

**Patent Number:** 5,698,394; 5,869,630; 6,068,843  

**Scientists:** G.E. Duhamel and R.O. Elder  

**Description:** The invention provides for methods, kits, and composition useful for diagnosis and monitoring of infection of animals with Brachyspira (formerly Serpulina) *hyodysenteriae*. The compositions include a method for detecting the presence of *B. hyodysenteriae* in a biological sample, an oligonucleotide primer and a *B. hyodysenteriae*-specific oligonucleotide probe useful in that method, and an article of manufacture that contains the primers and/or probe. Also provided are an about 2.3-kb DNA fragment derived from genomic DNA of *B. hyodysenteriae* and encoding for an about 56 kDa polypeptide, a recombinant expression vector containing the DNA fragment, the 56 kDa polypeptide and a monoclonal antibody reactive with the peptide, and a method of assaying for antibodies reactive with the 56 kDa peptide.
ARD is one of five divisions within the Institute of Agriculture and Natural Resources (IANR) at the University of Nebraska. IANR was established by the Nebraska legislature in 1973 and has its headquarters on the University of Nebraska-Lincoln East Campus. The University of Nebraska system has four campuses: University of Nebraska-Lincoln, University of Nebraska Medical Center, University of Nebraska at Omaha and the University of Nebraska at Kearney. The University of Nebraska system is governed by an elected Board of Regents and administered by a system and campus administration.

**Administrative Personnel**
(June 2000)

**University of Nebraska**

**Board of Regents**

Robert M. Allen, Hastings
Don S. Blank, McCook
Chuck Hassebrook, Walthill
Drew Miller, Papillion

Nancy O’Brien, Waterloo
Kent Schroeder, Kearney
Rosemary Skrupa, Omaha
Charles S. Wilson, Lincoln

**Student Regents**

UNMC  —  Allison Cushman
UNO   —  William Marunda
UNL   —  Joel Schafer
UNK   —  Ryan Samuelson

**Administrative Officers**

L. Dennis Smith, President, University of Nebraska
James C. Moeser, Chancellor, University of Nebraska-Lincoln
Irvin T. Omtvedt, Vice Chancellor, Institute of Agriculture and Natural Resources and Vice President, University of Nebraska

**Agricultural Research Division**

Darrell W. Nelson, Dean and Director
Dale H. Vanderholm, Associate Dean and Director
Rita C. Kean, Interim Assistant Director/Human Resources and Family Sciences

Steven S. Waller, Assistant Dean and Director
Dora Dill, Administrative Technician
Nelvie Lienemann, Staff Assistant
Diane Mohrhoff, Project Assistant
Shirley McCain¹, Temporary/On Call

¹Temporary appointment
Organizational Chart

Institute of Agriculture and Natural Resources
University of Nebraska-Lincoln
June 2000

Vice Chancellor
Irvin T. Omtvedt

Associate Vice Chancellor
Edna L. McBreen

Dean
Agricultural Research Division
Darrell W. Nelson*

Dean
College of Agricultural Sciences and Natural Resources
Donald M. Edwards

Interim Dean
College of Human Resources and Family Sciences (IANR Research and Extension)
Rita Kean

Interim Dean
Cooperative Extension Division
Elbert Dickey**

Assistant Vice Chancellor
Finance and Personnel
Alan R. Moeller

Director
Conservation and Survey Division
Mark S. Kuzila

Director
International Programs
Arlen Eding

*Director, Nebraska Agricultural Experiment Station
**Director, University of Nebraska Cooperative Extension
Administrative Units Reporting to Agricultural Research Division
Institute of Agriculture and Natural Resources
The University of Nebraska-Lincoln
June 2000

Agricultural/Natural Resources Units

Agricultural Economics
Jeffrey Royer, Head

Agricultural Leadership, Education and Communication
Earl Russell, Head

Agronomy
Kenneth Cassman, Head

Animal Science
Donald Beermann, Head

Biochemistry
Robert Klucas, Head

Biological Systems Engineering
Glenn Hoffman, Head

Biometry
David Marx, Chair

Entomology
Z B Mayo, Head

Food Science and Technology
Steve Taylor, Head

Horticulture
David Lewis, Head\(^1\)
Garald Horst, Interim Head\(^2\)

Plant Pathology
Anne Vidaver, Head

School of Natural Resource Sciences
Blaine Blad, Director\(^1\)
Ted Elliott, Director\(^2\)

Veterinary and Biomedical Sciences
Jack Schmitz

Human Resources and Family Sciences Departments

Family and Consumer Sciences
Shirley Baugher, Chair\(^1\)
Judy Johnson, Interim Chair\(^2\)

Nutritional Science and Dietetics
Marilynn Schnepf, Chair

Textiles, Clothing and Design
Rita Kean, Chair\(^1\)
Pat Crews, Interim Chair\(^2\)

Off-Campus Research Centers

Agricultural Research and Development Center
Ithaca—Daniel Duncan, Director

Northeast Research and Extension Center
Concord—John Witkowski, Director

Panhandle Research and Extension Center
Scottsbluff—Charles Hibberd, Director

South Central Research and Extension Center
Clay Center—Alan Baquet, Director

Southeast Research and Extension Center
Lincoln—Randy Cantrell, Director

West Central Research and Extension Center
North Platte—Gary Hergert, Director

Interdisciplinary Centers

Biotechnology Center
Anne Vidaver, Director

Food Processing Center
Steve Taylor, Director

Center for Grassland Studies
Martin Massengale, Director

Great Plains Regional Center for Global Environmental Change
Shashi Verma, Director

Industrial Agricultural Products Center
Milford Hanna, Director

Center for Rural Community Revitalization and Development
John Allen, Director

Center for Sustainable Agricultural Systems
Chuck Francis, Director

Water Center/Environmental Programs
Edward Vitzthum, Interim Director

IANR Communications and Information Technology
Dan Cotton, Director

\(^1\) Ended appointment during 1999-2000
\(^2\) Began appointment during 1999-2000
IANR Research Facilities

Research by Agricultural Research Division researchers is conducted across the state. Sites include:

- Agricultural Research and Development Center — Ithaca
- Barta Brothers Ranch — Long Pine
- Dalbey-Halleck Farm — Virginia
- Genoa Foundation Seed Farm — Genoa
- Gudmunsen Sandhills Laboratory — Whitman
- Haskell Agricultural Laboratory — Concord
- High Plains Agricultural Laboratory — Sidney
- Horning Forestry Farm — Plattsmouth
- Northeast Research and Extension Center — Norfolk
- Panhandle Research and Extension Center — Scottsbluff
- Sioux County Range — Mitchell
- South Central Research and Extension Center — Clay Center
- South Central Research and Extension Center, Great Plains Veterinary Educational Center, and the U.S. Meat Animal Research Center (USDA) — Clay Center
- Southeast Research and Extension Center — Lincoln
- West Central Research and Extension Center — North Platte
Approximately 334 faculty members have research appointments in ARD. Most have joint appointments, with teaching or extension responsibilities as well. Some faculty have responsibilities other than ARD research (rsch), extension (ext) or teaching (tch). Administrative appointments, as well as appointments with centers and other UNL units or with the USDA Agricultural Research Service (other), also are noted here.

The School of Natural Resource Sciences was formed in August 1997. The School was formed from the merger of the Department of Agricultural Meteorology, Department of Forestry, Fisheries and Wildlife and the Water Center/Environmental Programs. In addition, several faculty from other units within the University transferred all or part of their appointment to the School.

ARD programs depend on many linkages and cooperative arrangements in order to make the most effective use of limited resources and to address problems of mutual interest. The USDA Agricultural Research Service (ARS) has about 25 scientists located on the UNL campus. Historically there has been a very close working relationship between these scientists, all holding adjunct faculty status, and UNL faculty. Four departments contain ARS scientists: the Departments of Agronomy, Entomology, Plant Pathology and Biological Systems Engineering. ARS scientists are noted as USDA in the other category.

UNL scientists also cooperate closely with many ARS faculty at the Roman L. Hruska Meat Animal Research Center (MARC) at Clay Center, Nebraska. There are about 50 scientists at the MARC facility, many of whom also hold UNL faculty status in the Department of Animal Science. MARC scientists are noted as USDA in the other category.

Another federal facility located on campus is the U.S. Forest Service National Agroforestry Center. USFS scientists also work closely with UNL faculty and hold adjunct faculty status. The Departments of Entomology and Forestry, Fisheries and Wildlife have adjunct faculty noted as USDA in the other category.

The USDA Natural Resources Conservation Service has personnel located in UNL facilities at the West Central Research and Extension Center, North Platte. The NRCS professional personnel there as well as those at the federal center, Lincoln, work closely with ARD faculty on a number of natural resources related activities.

The Department of Animal Science has a unique relationship with its industry supporters. Several industry representatives also hold adjunct appointments in the department and are noted as industry in the other category.

The percentages listed represent the proportion of a faculty member’s time assigned to each function. The primary research responsibility is identified for each. All ARD off-campus personnel who are located at Centers are associated with an on-campus department as well [Department/Area of Responsibility]. Faculty rank and assignment percentages are based on the fiscal year 1999-2000 departmental budgets.
## Agricultural/Natural Resources Units

### Agricultural Economics

<table>
<thead>
<tr>
<th>Rank</th>
<th>Rsch</th>
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<th>Tch</th>
<th>Other</th>
<th>Area of Responsibility</th>
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<tbody>
<tr>
<td>Jeffrey S. Royer&lt;sup&gt;3&lt;/sup&gt;</td>
<td>Professor</td>
<td>0.52</td>
<td>0.18</td>
<td>0.30</td>
<td>Head, Director, Center for Rural Community, Revitalization and Development, Rural Sociology</td>
</tr>
<tr>
<td>John C. Allen</td>
<td>Professor</td>
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<td>0.35</td>
<td>0.08</td>
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<tr>
<td>J. David Aiken</td>
<td>Professor</td>
<td>0.45</td>
<td>0.25</td>
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<td>Agricultural and Natural Resources Law</td>
</tr>
<tr>
<td>Azzeddine Azzam</td>
<td>Professor</td>
<td>0.70</td>
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<td>0.30</td>
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<tr>
<td>Maurice E. Baker&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Professor</td>
<td>0.20</td>
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<td>0.80</td>
<td>Natural Resource Economics</td>
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<tr>
<td>Oscar Burt</td>
<td>Adjunct Professor</td>
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<td>0.80</td>
<td>Agricultural Production Economics, Natural Resources, Econometrics and Dynamic Optimization</td>
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<tr>
<td>Dennis Conley</td>
<td>Professor</td>
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<tr>
<td>Sam M. Cordes</td>
<td>Professor</td>
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<tr>
<td>Lilyan Fulginiti</td>
<td>Associate Professor</td>
<td>0.75</td>
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<td>Agricultural Policies/Production</td>
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<tr>
<td>Konstantinos Giannakas&lt;sup&gt;2&lt;/sup&gt;</td>
<td>Assistant Professor</td>
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<td>Food and Agribusiness Marketing</td>
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<tr>
<td>Glenn A. Helmers</td>
<td>Professor</td>
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<td>Farm Management, Agricultural Finance Policy</td>
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<td>Bruce B. Johnson</td>
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<tr>
<td>H. Douglas Jose</td>
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<tr>
<td>Bettina Klaus</td>
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<td>Microeconomic Theory</td>
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<td>Gary Lynne&lt;sup&gt;4&lt;/sup&gt;</td>
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<td>Richard Perrin</td>
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<td>E. Wesley F. Peterson</td>
<td>Professor</td>
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<td>International Trade, Development and Policy</td>
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<tr>
<td>George H. Pfeiffer</td>
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<tr>
<td>Raymond J. Supalla</td>
<td>Professor</td>
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</table>

<sup>1</sup>Ended research appointment during 1999-2000

<sup>2</sup>Began research appointment during 1999-2000

<sup>3</sup>Began head position during 1999-2000

<sup>4</sup>Ended head position during 1999-2000

### Agricultural Leadership, Education and Communication

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<tr>
<th>Rank</th>
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<td>Earl B. Russell</td>
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<td>Susan Fritz&lt;sup&gt;2&lt;/sup&gt;</td>
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<td>Leadership Development</td>
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<td>John E. Barbuto, Jr.</td>
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<td>Leadership Development</td>
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<td>O.S. Gilbertson&lt;sup&gt;2&lt;/sup&gt;</td>
<td>Professor</td>
<td>0.25</td>
<td>0.15</td>
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<td>Agricultural Literacy</td>
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<td>James W. King</td>
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<sup>1</sup>Ended research appointment during 1999-2000

<sup>2</sup>Began research appointment during 1999-2000

<sup>3</sup>Began head position during 1999-2000

<sup>4</sup>Ended head position during 1999-2000
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<td>Head</td>
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<td>Bruce E. Anderson</td>
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<td>Forage Management</td>
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<tr>
<td>Timothy J. Arkebauer</td>
<td>Associate Professor</td>
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<td>Crop Environmental Physiology</td>
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<td>P. Stephen Baenziger</td>
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<td>Small Grains Breeding and Genetics</td>
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<td>Robert M. Caldwell</td>
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<tr>
<td>Max Clegg</td>
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<td>Thomas Clemente</td>
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<td>Achim Dobermann</td>
<td>Associate Professor</td>
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<td>Soil Fertility/Nutrient Management</td>
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<tr>
<td>John W. Doran</td>
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<td>USDA</td>
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<tr>
<td>Rhae A. Drijber</td>
<td>Associate Professor</td>
<td>0.60</td>
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<td></td>
<td>USDA</td>
<td>Soil Microbiology Ecology</td>
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<tr>
<td>Ismail Dweikat</td>
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**Biochemistry**

**Biological Systems Engineering**

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### School of Natural Resource Sciences

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### Veterinary and Biomedical Sciences

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\*1 Ended research appointment during 1999-2000
The Agricultural Research Division hosted 39 visiting scientists and 65 research associates to the campus in 1999-2000. ARD research is complemented and enhanced by these collaborating scientists—it is through the sharing of knowledge and expertise that the field of science is advanced.

### Visiting Scientists

#### Agronomy

**Visiting Scientist:** Fufa Hundera Birru  
**Country:** Ethiopia  
**Expertise/Discipline:** Plant breeding and germplasm evaluation of tef

**Visiting Scientist:** Hikmet Budak  
**Country:** Turkey  
**Expertise/Discipline:** Grain quality and plant breeding - wheat

#### Animal Science

**Visiting Scientist:** Gamal Elsaaawi  
**Country:** Egypt  
**Expertise/Discipline:** Poultry science

**Visiting Scientist:** Ehssan Elansary Abdel Hamid  
**Country:** Egypt  
**Expertise/Discipline:** Poultry science

**Visiting Scientist:** Ji-Woong Lee  
**Country:** Korea  
**Expertise/Discipline:** Animal genetics

**Visiting Scientist:** Xuehong Liu  
**Country:** China  
**Expertise/Discipline:** Animal genetics

**Visiting Scientist:** Namburi Singari  
**Country:** India  
**Expertise/Discipline:** Ruminant nutrition

**Visiting Scientist:** Gary Snowder  
**Country:** United States/Montana  
**Expertise/Discipline:** Animal genetics

#### Biochemistry

**Visiting Scientist:** Raul Arredondo-Peter  
**Country:** Mexico  
**Expertise/Discipline:** Plant biochemistry

**Visiting Scientist:** Fazoil Ataullahanov  
**Country:** Russia  
**Expertise/Discipline:** Biophysics

**Visiting Scientist:** Andrew Blokin  
**Country:** Russia  
**Expertise/Discipline:** Cancer research

**Visiting Scientist:** Chris Chastain  
**Country:** United States/Minnesota  
**Expertise/Discipline:** Plant biochemistry and molecular biology

**Visiting Scientist:** Sylvie Coursol  
**Country:** France  
**Expertise/Discipline:** Plant cell and molecular biology

**Visiting Scientist:** Gloria Esquivel  
**Country:** Portugal  
**Expertise/Discipline:** Biochemistry

**Visiting Scientist:** Weiwei Gu  
**Country:** China  
**Expertise/Discipline:** Biophysics/spectroscopy
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<td>Matthieu Jeanneau</td>
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<td>Ping-Chang Lin</td>
<td>Taiwan</td>
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<td>Hamakwa Mantina</td>
<td>Zambia</td>
<td>Public health</td>
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<td>Victor Vitvitsky</td>
<td>Russia</td>
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<tr>
<td>Mahmoud Ali</td>
<td>Egypt</td>
<td>Apiculture</td>
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<td>Samira S. El Shall</td>
<td>Egypt</td>
<td>Radiation sterility</td>
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<tr>
<td>José Waquil</td>
<td>Brazil</td>
<td>Host plant resistance, integrated pest management</td>
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<td>Hesham M. Gaber</td>
<td>Egypt</td>
<td>Soil chemistry and physics</td>
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<tr>
<td>Zuoxing Liu</td>
<td>China</td>
<td>Dry-land cropping and irrigation technology/agricultural meteorology</td>
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<tr>
<td>Karin Rengefors</td>
<td>United States (Woods Hole Oceanographic Institute)</td>
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<td>Valdir Schaleh</td>
<td>Brazil</td>
<td>Solid waste management</td>
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<td>Steve Schwartz</td>
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<td>Aquatic ecology/zooplankton feeding</td>
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**Entomology**

**Veterinary and Biomedical Sciences**

**Family and Consumer Sciences**
### Agronomy

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<td>John Brejda</td>
<td>Oklahoma, USA</td>
<td>Collection and evaluation of native legumes and forbs</td>
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<td>Tony Buhr</td>
<td>Nebraska, USA</td>
<td>Gene expression in transgenic soybean</td>
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<tr>
<td>Anita Dieleman</td>
<td>Canada</td>
<td>Soil, topology, and pest site characterization data; herbicide treatment maps</td>
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<td>Daniel Ginting</td>
<td>Minnesota, USA</td>
<td>Site-specific manure application</td>
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<td>Julie Huddle</td>
<td>Texas, USA</td>
<td>Long-term vegetation in the Nebraska Sandhills; blowout penstemon</td>
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<td>Anabayan Kessavalou</td>
<td>India</td>
<td>Site-specific manure application</td>
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<td>Gopal Krishnan</td>
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<td>Weed management in corn and soybeans</td>
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<td>Won Jong Lee</td>
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<td>End-use quality of wheat/effects of environment on bread and noodle properties</td>
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<td>Maize chromosome-specific libraries and probes</td>
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<td>Evaluation of soil quality indicators on long-term cropping systems</td>
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<td>Cooperating with INTSORMIL on sorghum and nitrogen research</td>
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<td>Plant patch dynamics to address weed problems in agroecosystems</td>
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### Animal Science

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### Biochemistry

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<td>Konstantin Korotkov</td>
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<td>Michael Scharf</td>
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<td>Research Associate:</td>
<td>Julya Krasohtkina</td>
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<td>Srinivas Parimi</td>
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### School of Natural Resource Sciences

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<td>Xiaomao Lin</td>
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<td>Instrumentation/meteorology</td>
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<td>Rezaul Mahmood</td>
<td>Oklahoma, USA</td>
<td>Modeling/climatology</td>
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<td>Junhua Zhu</td>
<td>Louisiana, USA</td>
<td>High pressure liquid chromatography - mass spectrometry</td>
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### Veterinary and Biomedical Sciences

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<td>Ofelia Chacon</td>
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<td>Emil Berberov</td>
<td>Russia</td>
<td>Microbiology/genetics</td>
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<td>Xiaoxing Cheng</td>
<td>Switzerland</td>
<td>Microbial genetics/pathogenesis</td>
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<td>Parmod K. Mehta</td>
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<td>Delin Liang</td>
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<td>Daniel Perez</td>
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<td>Xiaoli Liu</td>
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<td>Kostyantyn Krysan</td>
<td>Ukraine</td>
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<tr>
<td>Ventzislav B. Vassilev</td>
<td>Russia</td>
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<tr>
<td>Yang Zhang</td>
<td>China</td>
<td>Molecular endocrinology</td>
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Research Projects

Each faculty member with an ARD appointment has a federally-approved research project. A number of faculty have multiple projects. There are 399 research projects that were active for all or part of the 1999-2000 fiscal year in agriculture, natural resources and family sciences. Projects are generally three to five years in duration. Faculty also are part of a national network of Agricultural Experiment Station scientists located at Land Grant Universities across the United States. ARD researchers currently are involved with about 56 regional projects in which they conduct cooperative research with scientists at other universities, addressing problems of regional and national importance. They also participate in approximately 69 regional research committees which serve to exchange information and coordinate cooperative research activities among institutions.

Research projects are listed by departments. An asterisk (*) indicates that the project was discontinued in fiscal year 1999-2000.

You will note codes following the project number. The codes reveal the type of project.

<table>
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<th>Type</th>
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<td>Animal Health</td>
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Hatch: research on all aspects of agriculture, including soil and water conservation and use; plant and animal production, protection, and health; processing, distributing, marketing, and utilization of food and agricultural products; forestry, including range products, multiple use of forest and rangelands, and urban forestry; aquaculture; family sciences, including human nutrition and family life; and rural and community development.

Regional Research: research in agriculture, natural resources and family sciences with regional importance and Nebraska application. Research is a collaborative effort with scientists from other land grant institutions and federal agencies.

State: research on all aspects of agriculture, natural resources, family sciences, and rural development that is supported entirely by state funds.

McIntire-Stennis: research relating to: 1) reforestation and management of land for the production of timber and other related products of the forest; 2) management of forest and related watershed lands to improve conditions of water flow and to protect resources against floods and erosion; 3) management of forest and related rangeland for production of forage for domestic livestock and game and improvement of food and habitat for wildlife; 4) management of forest lands for outdoor recreation; 5) protection of forest land and resources against fire, insects, diseases, or other destructive agents; 6) utilization of wood and other forest products; 7) development of sound policies for the management of forest lands and the harvesting and marketing of forest products; and 8) such other studies as may be necessary to obtain the fullest and most effective use of forest resources.

Special Grants: targeted research projects to address special needs for family sciences, agriculture, and the management of natural resources for Nebraska.

Competitive Grants: includes research in USDA national priority areas.

Animal Health: research to promote the general welfare through improved health and productivity of domestic livestock, poultry, aquatic animals, and other income-producing animals that are essential to the nation's food supply and the welfare of producers and consumers of animal products.

Agricultural/ Natural Resources Units

Agricultural Economics

10-106 rr Private strategies, public policies, and food system performance (A.M. Azzam)

10-117 ln Factors affecting the evolution of world agricultural markets: implications for U.S. policy (E.W.F. Peterson)

10-124 ln Economic analysis of farm management and policy alternatives for improving groundwater quality (R.J. Supalla, J.C. Allen)

10-125 ln Impacts of policies related to water, commodity programs, and energy based inputs on Nebraska farms (G.A. Helmers, D.M. Conley, M.E. Baker)

10-126 rr Impact analyses and decision strategies for agricultural research (R.K. Perrin)

10-130 ln Technical efficiency analysis for livestock and dairy operations in Nebraska (A.M. Azzam, S.M. Azzam)

10-131 ln Selected input markets in agriculture: fuels price risk and tractor demand (D.M. Conley)

10-132 rr Water conservation, competition and quality in western irrigated agriculture (R.J. Supalla)

10-133 sg Partnership for rural Nebraska (J.C. Allen, S.M. Cordes)

10-135 ln Monitoring and analysis of farm real estate market developments in Nebraska (B.B. Johnson)

10-137 cg Evaluation of the productivity environment tradeoff: a Great Plains case study (R.K. Perrin)

10-138 ln Measurement and explanation of the competitiveness of the United States in the markets for beef, soy (L.E. Fulginiti)
Agricultural Leadership, Education and Communication

*24-031 st Impacting agricultural literacy of elementary students and teachers through teacher workshops (O.S. Gilbertson)
24-033 st Distance education policy research: organization and administration (J.W. King, S.K. Rockwell, E.B. Russell)
24-034 st Predictors of leader and follower behavior, and the impact of leadership development (J.E. Barbuto Jr., S.Fritz)

Agronomy

12-002 st Improvement and evaluation of oats and barley (P.S. Baenziger)
12-055 st Genetics, breeding and evaluation of common wheat and triticale for Nebraska (P.S. Baenziger)
12-149 st Breeding sorghum and pearl millet for USA and developing countries (D.J. Andrews)
12-181 st Development of profitable reduced herbicide weed management systems through integration (A.R. Martin)
12-193 st Investigating alternative grain and oil crops for Nebraska (L.A. Nelson)
12-194 st Novel methods for soybean genetic improvement and genomic analysis (J.E. Specht)
12-197 st Tissue and cell physiology of sorghum (M.D. Clegg)
12-198 st Jasmonate regulated gene expression in soybean (P.E. Staswick)
12-201 st Maintenance, increase and distribution of elite germplasm (R. Helsing)
12-202 st Winter wheat germplasm enhancement and performance evaluation (C.J. Peterson, R.A. Graybosch)
12-204 rr Biological and ecological basis for a weed management model to reduce herbicide use in corn (D.A. Mortensen, J.L. Lindquist)
12-215 st Development of integrated weed management strategies to improve Great Plains and Midwest grasslands (R.A. Masters)
12-225 st Studies on the mechanisms found in corn, sorghum and pearl millet which improve N uptake and use (J.W. Maranville)
12-227 st Perennial forage grass breeding for Nebraska (K.P. Vogel)
*12-235 st Influence of novel and alien genes on the end-use quality of hard winter wheat (R.A. Graybosch)
12-238 st Management for sustained production of perennial warm-season grasses (W.L. Schacht)
12-241 st Ecological studies of Nebraska rangeland vegetation (J. Stubbenbeck)
12-242 st Defining and assessing basic indicators of soil quality and erodibility (J.W. Doran, J.E. Gilley, J.R. Ellis, G.E. Varvel)
12-243 st Weed distribution and demography: elucidating pest management principles for reducing herbicide use (D.A. Mortensen)
12-244 st Soil physical relationships for best management practices to protect water quality (W.L. Powers)
12-246 st Efficient and environmentally sound conservation use of nutrients and C from animal manure (J.W. Doran, J.E. Gilley)
12-252 st Biosolids application and soil chemical properties: changes in phosphorus and carbon pools (D. McCallister)
12-253 rr Characterizing nitrogen mineralization and availability in crop systems to protect water resources (D.H. Sander, D.T. Walters)
12-254 st Community structure and functional diversity of soil microbial communities in natural and agroecosystems (R.A. Drijber)
12-255 st Soybean breeding and genetic studies (G.E. Graef)
12-256 st Stability of soil microbial communities under different agroecosystems (R.A. Drijber)
12-259 st Nutrient management for maximizing nutrient use efficiency in sorghum (J.W. Maranville)
12-259 st Assessment of genetic variation for end-use quality traits in soybean (D. Lee)
12-260 st Resource-efficient management of summer annual dryland cereal crops in Nebraska (S.C. Mason)
12-261 st Cropping systems to optimize yield, water and nutrient use efficiency of pearl millet (S.C. Mason)
12-262 sg The relevance of field-specific weed populations to performance of integrated weed management systems (D.A. Mortensen, J.A. Dieleman, A.R. Martin)
12-263 cg Why weed patches persist: dynamics of edges and density (D.A. Mortensen, J.A. Dieleman)
12-264 st Herbage and livestock production from legume/grass pastures (B.E. Anderson)
12-265 st Molecular characterization and manipulation of the wheat genome for crop improvement (K.S. Gill)
12-266 cg Effective use of carbon and nutrients in manure using site-specific application (B. Eghball, J.S. Schepers, C.A. Shapiro, R.B. Ferguson)
12-268 st Ecophysiology of corn - velvetleaf competition (J.L. Lindquist)
12-269 st Crop monitoring systems for uncertain environments: decision aids for managing soil and weather variability (R.M. Caldwell)
12-270 cg Molecular characterization of a major gene cluster of wheat (K.S. Gill)
12-271 sg IPM implementation in a corn/soybean/cotton/wheat system (D.A. Mortensen)
12-272 st Germination, growth, and development of selected perennial forage grasses (L.E. Moser)
12-273 st Selecting wheat and other cereal grains for enhanced end-use performance characteristics (D.R. Shelton, P.S. Baenziger, R.A. Graybosch)
12-274 st Physiological bases of environmental constraints on plant growth and productivity (J.A. Arkebauer)
12-275 rr Marketing and delivery of quality cereals and oilseeds (D.R. Shelton)
12-276 st Gene chips for economically important plants and animals (K. Gill, D. Pomp, K. Arumuganathan, P. Staswick)
12-277 st Quantitative genetics with focus on corn breeding and corn germplasm improvement (W.K. Russell)
12-278 st Dynamic nitrogen management strategies for optimizing maize yield and N use efficiency (D.T. Walters)
Animal Science

13-036  rr
Management systems for improved decision making and profitability of dairy herds (R.J. Grant, H.D. Jose)

13-055  rr
Biophysical models for poultry production systems (M.M. Beck)

13-086  lu
Sustainable beef growing-finishling systems (T.J. Klopfenstein, T. Milton)

13-087  ah
Relationship of subfunctional corpora lutea to frequency of LH pulses during the periovulatory period of cattle (J.E. Kinder)

13-096  rr
Forage protein characterization and utilization for cattle (T.J. Klopfenstein, L.E. Moser)

13-101  lu
Genetic variation for reproduction and energy utilization (M.K. Nielsen)

13-104  lu
Optimizing the utilization of dietary fiber and lipids by dairy cows (R.J. Grant)

13-105  lu
Nutrition of prolific sows (A.J. Lewis, P.S. Miller)

13-110  rr
Molecular mechanisms regulating skeletal muscle growth and differentiation (S.J. Jones)

13-115  lu
Evaluation of cow-calf weaning management systems to improve economic efficiency (R.J. Rasby, T.J. Klopfenstein, T. Milton, C.R. Calkins)

*13-118  lu
Factors affecting calcium transport in the avian small intestine and egg shell quality (S.S. Scheideler)

*13-119  lu
Nitrogen metabolism in Prevotella ruminicola: a molecular genetics approach (M. Morrison)

*13-120  lu
Testicular modulation of luteinizing hormone secretion (R.J. Kittok, J.E. Kinder, H.E. Grotjan)

13-122  bu
Gastrointestinal structure and function as related to nutrition and body metabolism (E.T. Clemens)

*13-123  ah
Estrogen-calcium relationships during onset of metabolic bone disease in laying hens (M.M. Beck)

13-126  bu
Physiological and management aspects of expression of estrus and ovulation rate in swine (D.R. Zimmerman)

13-127  bu
Measurement and manipulation of carcass traits and influencing fresh meat value (C.R. Calkins)

13-128  ah
Transfer of antibiotic resistance genes between bacteroides and Prevotella species (M. Morrison)

13-129  rr
Positional and functional identification of economically important genes in the pig (D. Pomp)

13-130  lu
Physiological and nutritional aspects of improving reproduction in dairy cattle (L.L. Larson)

13-131  cg
Screening the pig genome for QTL controlling reproduction (D. Pomp, R.K. Johnson)

*13-133  cg
Molecular and kinetic analyses of the adherence of Ruminococcus albus B to cellulose (M. Morrison, R. Grant)

13-134  rr
Integration of quantitative and molecular technologies for genetic improvement of pigs (R.K. Johnson, D. Pomp)

13-135  lu
Recombinant bovine and equine gondotropins (H.E. Grotjan)

13-136  cg
Synthesis and assembly of cellulase binding proteins by Ruminococcus albus (M. Morrison)

13-137  cg
Recombinant bovine gondotropins (H.E. Grotjan, J.E. Kinder)

13-138  lu
Molecular biology of protein degradation and utilization by Prevotella ruminicola (M. Morrison)

13-139  lu
Regulation of gondotropin synthesis and secretion, ovarian follicular development and testicular function pre- and post-puberty (J.E. Kinder)

13-140  lu
Role of adipose tissue in determining energy utilization in cattle (J.L. Miner)

13-141  lu
Nutritional management strategies for sustainable feedlot cattle production (T. Milton, T.J. Klopfenstein, T.L. Mader)

13-142  lu
Value-added processed and manufactured meat products (R.W. Mandigo)

13-143  rr
Enhancing the global competitiveness of U.S. red meat (C.R. Calkins, D.M. Feuz)

13-144  lu
Utilization of phosphorus in cool- and warm-season grass hay by ruminants (D.R. Brink)

13-145  rr
Genetic enhancement of health and survival for dairy cattle (J.F. Keown)

13-146  lu
Factors affecting calcium utilization in the avian and egg shell quality (S.E. Scheideler)

13-147  lu
Interrelationships among liver metabolism, nutrient intake, and growth criteria in growing-finishing barrows and gilts (P.S. Miller, A.J. Lewis)

13-148  lu
Improving the efficiency of nitrogen and amino acid utilization by pigs (A.J. Lewis, P.S. Miller)

13-150  lu
Control of luteinizing hormone secretion in male sheep (R.J. Kittok)

13-151  ah
Estrogen-calcium relationships during onset of metabolic bone disease in the aging hen (M.M. Beck)

Biochemistry

*15-070  st
Development of dicamba-tolerant plants (D.P. Weeks, P.L. Herman)

15-073  rr
Diversity and interaction of beneficial bacterial and fungi in the rhizosphere (R.V. Klucas)

15-076  lu
Hemoglobins in higher plants (R.V. Klucas)

15-078  lu
Genetic modification of chloroplast rubisco (R.J. Spreitzer)

15-080  lu
Characterization of human telomerase (C.M. Price)

15-081  lu
Synthetosome proteins from soybean root nodules (G. Sarah)

15-082  cg
Rubisco phylogenetic correction (R.J. Spreitzer)

15-083  cg
The role of a family of nuclear-encoded sigma factors in plastid transcription regulation (L.A. Allison)

*15-084  st
Regulation of calcium transport (R. Chollet, J.P. Markwell, R.J. Spreitzer)

15-085  lu
Regulation of transcription in plastids of higher plants (L.A. Allison)

15-086  lu
β2 enzymes and hyperhomocysteinemia (R. Banerjee)

15-087  rr
Regulation of photosynthetic processes (R. Chollet, J.P. Markwell, R.J. Spreitzer)

15-088  lu
Enzymology of anerobic CO2 fixation and bioremediation (S. Ragsdale)

15-089  cg
Rubisco phylogenetic correction (R.J. Spreitzer)

15-090  lu
Selenium-containing proteins (V.N. Gladyshev)

15-091  st
Strategies for developing herbicide-tolerant crops (D.P. Weeks)

15-092  st
Plant Proteomics (J.P. Markwell)

Biological Systems Engineering

11-001  st
Evaluation of performance of new tractors (L.L. Levitcus)

11-044  rr
Improvement of thermal processes for food (M.A. Hanna)

11-079  lu
Agricultural tractor testing board: policies and procedures (L.L. Basford, M.F. Kocher, R.D. Grisso)

11-097  lu
Protein film production and evaluation (C.L. Weller)

11-099  lu
Improving field productivity and predicting energy requirements of soil-engaging equipment (R.D. Grisso, M.F. Kocher, L.L. Basford)

11-102  lu
Identification, modeling, and design of plant sensor systems for variable-rate chemical application (G.E. Meyer)
### Biometry

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### Entomology

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<td>Development of resistance management techniques for corn insects in Nebraska</td>
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### Food Science and Technology

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<td>Developing new techniques for improving water quality in livestock facilities</td>
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### Horticulture

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<td>20-010</td>
<td>Improving the yield and quality of agricultural products in Nebraska</td>
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11-010 Managing atrazine runoff losses to improve surface water quality (T.G. Franti)
11-011 Safe and efficient use of electrical energy for irrigation, livestock, and poultry facilities (L. Stetson)
11-012 Bovine rumen contents as a source of industrial enzymes and chemicals (L.D. Clements)
11-013 Using army ammunition plants to process agricultural materials into industrial products (L.D. Clements)
11-014 Whole farm nutrient balance for livestock production systems (R.K. Koelsch)
11-015 Variability in metering devices used in site-specific crop management schemes (L.L. Bashford)
11-016 Hydrologic modeling and engineering for enhancement of vegetative riparian systems (R.M. Brand)
11-017 Characterization and modeling of odor emissions from animal production facilities (D.D. Schulte, S.B. Verma, D. Billesbach, R.K. Koelsch)
11-018 Uptake and metabolic effects of pesticide combinations on mammalian systems (R.M. Brand)
11-019 Consideration of precision in pollution prevention system engineering (W.E. Woldt)
11-020 Improved anaerobic lagoon design and management for odor control (D.D. Schulte)
11-021 Engineering problems of flow measurement and control in agricultural industries (M.F. Kocher)
11-022 Application of fuzzy systems analysis in biological systems engineering (D.D. Jones)
11-023 Development of simulation and optimization models for watershed management (D.L. Martin)
11-024 Improved anaerobic lagoon design and management for odor control (D.D. Schulte)
11-025 Hydrologic modeling and engineering for enhancement of vegetative riparian systems (R.M. Brand)
11-026 Uptake and metabolic effects of pesticide combinations on mammalian systems (R.M. Brand)
11-027 Consideration of precision in pollution prevention system engineering (W.E. Woldt)
11-028 Improved anaerobic lagoon design and management for odor control (D.D. Schulte)
11-029 Engineering problems of flow measurement and control in agricultural industries (M.F. Kocher)
11-030 Application of fuzzy systems analysis in biological systems engineering (D.D. Jones)
11-031 Development of simulation and optimization models for watershed management (D.L. Martin)
11-032 Biometry

23-001 Applications of statistics to research in agriculture (D.B. Marx, W.W. Stroup)
23-002 Stress factors of farm animals and their effects on performance (A.M. Parkhurst)
23-003 Innovative design and analysis of agricultural experiments (W.W. Stroup, E.T. Paparozzi)

17-071 Development of resistance management techniques for corn insect pests in Nebraska (B.D. Siegfried)
17-072 Ecology and management of Diabrotica species (L.J. Meinke)
17-073 Dynamic soybean insect management for emerging agricultural technologies and variable environments (L.G. Higley)

16-044 Molecular mechanisms regulating skeletal muscle growth and differentiation (M.G. Zece)
16-051 Starch technology: production, characterization, and utilization (D.S. Jackson)
16-054 Chemical and physical quality characteristics of horticultural crops and their products (D.A. Smith)
16-055 Food allergies and sensitivities (S.L. Taylor, S.L. Hefle)
16-056 Food allergens and sensitivities (S.L. Taylor, S.L. Hefle)
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16-074 Food allergens and sensitivities (S.L. Taylor, S.L. Hefle)
16-075 Food allergens and sensitivities (S.L. Taylor, S.L. Hefle)
16-076 Food allergens and sensitivities (S.L. Taylor, S.L. Hefle)

16-077 Genetics and biochemistry of stress-response systems in gram-positive bacteria and foodborne pathogens (A.K. Benson and M.G. Zece)
16-078 Evaluation and characterization of antioxidants from plant sources (S.L. Taylor, S.L. Hefle)
16-079 Mapping and site-directed mutagensis of IgE epitopes in a food allergen from soybean (Gly m Bd 30k) (M.G. Zece, J.P. Markwell, G. Sarath, D.E. Wyke)
16-080 Competitive inhibition of food-borne pathogens in meat and poultry products and in cattle (M.M. Brashears)
16-081 Genomic analysis of E. coli O157:H7 populations from cattle and humans (A.K. Benson, R.W. Hultin)
16-082 Marketing and delivery of quality cereals and oilseeds (D.S. Jackson)
16-083 Marketing and delivery of quality cereals and oilseeds (L.B. Bullerman)
16-084 Extrusion processing as a means of reducing fumonisin mycotoxins in cereal foods (L.B. Bullerman, M.A. Hanna, M.M. Castelo)
16-085 CCP identification and validation during poultry production and processing (M.M. Brashears, S.R. McKee, E.A. Walner-Pendleton)

20-040 Genetic improvement of beans (Phaseolus vulgaris L.) and nutritional value for yield, pest resistance and nutritional value (D.P. Coyne, J.R. Steadman)
20-041 Influence of sulfur and nitrogen on the growth and development of ornamental plants (E.T. Paparozzi)
20-050 Cultural practices to minimize environmental stress on vegetable crop production and physiology (L. Hodges, J.R. Brandle)
Plant Pathology

21-012 in Electron microscopy in agricultural research (E.M. Ball)

21-013 in Establishment and management of turf-type buffalograsses (R.E. Gaussoin)

21-014 in Genetics and breeding of dry edible beans (Phaseolus vulgaris L.) with emphasis on multiple disease resistance (D.P. Coyne)

21-015 in Integrated turfgrass management practices (R.C. Shearman)

21-016 in Application of micropropagation and biotechnology to improvement and multiplication of horticultural crops (P.E. Read)

21-017 in Exudate physiology of grasses grown under stress environments (G.A. Horst)

21-018 in Factors affecting prairie forb and grass establishment: interference in sustainable landscape management (G.L. Davis)

21-019 in Breeding and development of buffalograss for the central great plains (T.P. Riordan)

21-020 in Development of glyphosate resistant buffalograss (T.P. Riordan, T.E. Clemente, S. Fei, R.V. Kluess)

21-021 in Exploring plant nutrient interactions in floricultural and ornamental crops (E.T. Paparozzi)

21-022 in Growing and cultural practice impacts on USGA putting greens and their microbial communities (R.E. Gaussoin)

21-023 in Genotypic variability in the cyst and root-knot nematodes (T.O. Powers)

21-024 in Overwinter survival of Heterodera pratensis and associated nematodes in the North Central Region (T.O. Powers, E.D. Kerr)

21-025 in Detection and properties of plant viruses of Nebraska with emphasis on sugar beet viruses (L.C. Lane)

21-026 in Biological control of soilborne diseases of legumes and turfgrass with antagonistic bacteria (G.Y. Yuen)

21-027 in Fusarium moniliforme in cereal grains (M.B. Dickman)

21-028 in Molecular mechanism of fumonisin induced pathogenesis in chicken (M.B. Dickman)

21-029 in Leaf rust virulence in Nebraska and management systems for turfgrass diseases (J.E. Watkins)

21-030 in Mitigation of diseases of dry edible bean stem rot by soybean by managed plant resistance (J.R. Steadman)

21-031 in Entomopathogenic nematodes for biological control of soil-borne nematode and associated nematodes in the North Central Region (T.O. Powers)

21-032 in Molecular analysis of sclerotial development in Sclerotinia sclerotiorum (J.A. Rollins)

21-033 in Environmental effects on plant host-parasite interactions (J.E. Partridge)

21-034 in Broad-spectrum virus resistance in transgenic plants (A. Mitra)

21-035 in Application of PCR based approaches for nematode identification and epidemiology (T.O. Powers)

21-036 in Pathogenic determinants of phytopathogenic fungi (M.B. Dickman)

21-037 in Detection of seedborne bacteria and characterization of bacterial endophytes (A.K. Vidaver)

School of Natural Resource Sciences

12-209 in Procedures for assessing impacts of nonpoint agrichemicals on ground water (R.F. Spalding)

12-239 in Processes associated with long-term fate and detoxification of organonitrogen contaminants in soil (J.P. Shen)

26-025 in Biological and tree-injection methods for controlling tree pests (M.O. Harrell)

26-026 in Factors affecting wildlife diversity and the distribution of rare populations in Nebraska (J.A. Savidge)

26-027 in Integrating biological diversity into managed land-use systems (R.J. Johnson)

27-003 in Exchange of carbon dioxide and other greenhouse gases in vegetated ecosystems (S.B. Verma)

27-004 in Remote sensed estimates of productivity, energy exchange processes and water stress in vegetation (B.L. Blad, E.A. Walter-Sha)

27-007 in Drought: response and policy implications (D.A. Wilhite)

27-008 in Climate and agricultural landscape productivity analysis and assessment in the North Central Region (K.G. Hubbard)

27-011 in Relationships between remotely-sensed spectral properties of vegetated surfaces and biophysical properties (E.A. Walter-Sha)

27-012 in NADP: A long term monitoring program in support of research on the effects of atmospheric chemical deposition (S.B. Verma)

27-016 in Climate change and the winter wheat agroecosystem: experiments and modeling (A. Weiss)

Plant Pathology

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27-016 in Climate change and the winter wheat agroecosystem: experiments and modeling (A. Weiss)
14-039
Research laboratory and animal care facility (J.A. Schmitz, A. Hogg, T.E. Socha)

14-059
Veterinary diagnostic lab system: diagnostic surveillance and disease investigation in Nebraska livestock and poultry (J.A. Schmitz, A.R. Doster, J.L. Johnson, D.M. Grothueschen)

14-077
Molecular genetics analysis of Mycobacterium paratuberculosis and related mycobacterial pathogens (R.G. Barletta)

14-078
Role of group A bovine rotavirus P protein antigenic epitopes in immunity and infection (G.E. Duhamele)

14-085
Research in support of a national eradication program for pseudorabies (F.A. Osorio)

14-086
Molecular characterization of Pasteurella haemolytica leukotoxin-receptor interactions (S. Srikumaran)

14-091
Molecular characterization of MHC class I down-regulation by bovine herpesvirus I (S. Srikumaran)

14-092
The biology of persistent infections caused by porcine reproductive and respiratory virus (F.A. Osorio, A.R. Doster)

14-093
Bovine respiratory syncytial virus glycoprotein interactions in a homologous host cell receptor (C. Kelling)

14-094
Molecular characterization of animal RNA viruses and their interactions with the host (R.O. Donis)

14-095
Interaction of porcine reproductive and respiratory syndrome virus and Salmonella cholerasuis (R.W. Wills, F.A. Osorio)

14-096
Functional analysis of the BHV-1 latency related gene (C. Jones)

14-097
Functional analysis of bovine herpes virus I latency related gene products (C. Jones)

14-098
Monitoring individual animal performance to evaluate beef cattle production and economics (G.P. Rupp, D.D. Griffin)

14-099
cg
Cis-acting elements in the replication of the bovine viral diarrhea virus genome (R.O. Donis)

14-100
cg
Analysis of apoptosis and pathogenesis by bovine herpes virus and BICPO (C. Jones, A.R. Doster)

14-101
cg
Role of E. coli heat-labile enterotoxin-I in diarrhea and septicaemia in swine (R.A. Moxley, R.G. Barletta)

14-102
Strategic plan for an IANR field disease research program at the Department of Veterinary and Biomedical Sciences (D.R. Smith)

14-103
Pathogenic mechanisms of bacterial respiratory pathogens (J.D. Carillo)

14-104
cg
Identification of mycobacterium paratuberculosis virulence determinants (R.G. Barletta)

14-105
cg
The effect of PRRSV on the immune system during acute and persistent infection (F.A. Osorio, F. Zackernman, A.R. Doster)

14-106
cg
Genetic analysis of elements controlling bovine viral diarrhea virus translation (R.O. Donis, C.L. Kelling)

14-107
Theroretical and applied molecular biology or porcine gonadotropins (G.B. Shearman)

14-108
cg
Molecular genetic analysis of Mycobacterium paratuberculosis and related mycobacterial pathogens (R.G. Barletta)

14-109
Pseudomonas aeruginosa 035:H7 and salmonella in feedlot beef cattle (D.R. Smith, R.A. Moxley, L.L. Hungerford, J.T. Gray, T.J. Klopfenstein)

14-110
The new relational perspective in developmental psychology and its applications to education and child care (G.P. Edwards)

14-111
Into the heartland: a contextual examination of migration and its impacts on rural Nebraskan meat-packing communities (R.L. Dallas)

14-112
Three cohorts of teenage mothers regional comparisons and sex education (S.T. Russell)

Human Resources
and Family
Sciences

14-020
The role of housing in rural community vitality (E.R. Combs)

14-021
Impact of Head Start on rural children, families, and communities (P.D. Zeece)

14-022
Retirement economic well-being for women in Nebraska and cross-culturally (S.L. Cramer)

14-023
Economic impact of Nebraska households: a comparison of alternative measures (E.P. Davis)

14-024
Family functioning of interracially constituted families (S. Baugher)

14-025
Surviving and transcending a traumatic childhood (J.D. DeFrain)

14-026
High hopes and bright futures: successful teens in Nebraska (D.A. Abbott, W.H. Meredith)

14-027
The impact of welfare reform on women's lives: education, job placement/retention, and resource management (K. Prochaska-Cue, B. Sparks)

14-028
Economic impact of HIV/AIDS on Nebraskans (M.E. Rider)

14-029
The new relational perspective in developmental psychology and its applications to education and child care (G.P. Edwards)

14-030
Into the heartland: a contextual examination of migration and its impacts on rural Nebraskan meat-packing communities (R.L. Dallas)

14-031
Three cohorts of teenage mothers regional comparisons and sex education (S.T. Russell)

14-032
Rural low-income families: monitoring their well-being and functioning in the context of welfare reform (K. Prochaska-Cue)

Nutritional Science
and Dietetics

14-042
Bioavailability of nutrients: a key to human nutrition (J.A. Driskell)

14-043
Health maintenance aspects of dietary recommendations designed to modify lipid metabolism (N.M. Lewis)

14-044
cg
Dietary trans fatty acid influence on atherosclerosis and sterol metabolism (T.P. Carr)

14-045
Using stages of change model to promote consumption of grains, vegetables and fruits by young adults (N.M. Betts)

14-046
Exercise dependence and disordered eating behaviors: instrument development validation and testing (N.M. Betts)

14-047
The metabolic basis of atherosclerosis (T.P. Carr)

14-048
The use of edible films and natural antioxidants to control warmed-over flavor in meats (M. Schnepp)

14-049
Nutritional knowledge, practices, beliefs of caregivers and practices of physicians for young children (K.L. Stanek)

14-050
Health implications of folate and homocysteine as it relates to fruit and vegetable consumption (J.A. Allrecht)

14-051
Assessing managerial and work force development in foodservice management (F. Hamouz)

Textiles, Clothing
and Design

14-019
Assessment of the environmental compatibility of textile and other polymeric materials (P. Cox-Crews)
Situational and personal factors in residential waste management: the impacts of markets, resources, and attitudes (S.M. Niemeeyer)

Family business interaction of work and family spheres (R.C. Kean)

Development of textile end-uses for wheat gluten and other farm commodity derived materials (L.E. Hamilton)

Development of textile materials for environmental compatibility and human health and safety (P.C. Crews)

Impacts of environmental disclosure policies and constraints on housing transaction practices (S. Niemeeyer)

Development of textile materials for environmental compatibility and human health and safety (L. Scheyer)

Panhandle Research and Extension Center

Fertilizer and manure application for production of continuous corn (D.D. Baltensperger)

Weed control systems for western Nebraska irrigated crops and rangeland (R.G. Wilson)

Feed resources and beef production systems in western Nebraska to optimize total efficiency (J.G. Rush, B.A. Weichenthal)

Agricultural enhancement of potato production and utilization (A.B. Pavlota)

Improvement of proso millet and other crops for western Nebraska (D.D. Baltensperger)

Agrichemical control in irrigation runoff water from surface irrigated fields (C.D. Yonts, R.G. Wilson)

The economics of alternative beef cattle marketing and feeding strategies (D.M. Feuz)

Machinery systems management for sugarbeets, dry edible beans, and chicory (J.A. Smith, R.G. Wilson)

Plant germplasm and information management and utilization (D.D. Baltensperger)

Intensification of winter wheat based dryland cropping systems for western Nebraska (D.J. Lyon)

Taking advantage of winter wheat protein premium through late-season nitrogen fertilization (J.M. Blumenthal, D.M. Feuz, E.D. Kerr)

Studies of drought and defoliation effects on range grasses needed to optimize future grazing research (P.E. Reese, W.H. Schacht, J.D. Volesky, L.E. Moser)

Integrated management systems for arthropod pests of wheat and other crops in western Nebraska (S.Z. Knezevic)

Roman L. Hruska U.S. Meat Animal Research Center

Management and operation of the U.S. Meat Animal Research Center (D. Laster)

South Central Research and Extension Center

Soybean production practices and alternative crops within resource-efficient cropping systems for south central Nebraska (R.W. Elmore)

Managing weeds and herbicides for profitable crop production and reduced environmental risks (F.W. Roeth)

Crop insect pest management in Nebraska: biological control and sampling (R.J. Wright)

Formulation of nitrogen fertilization recommendations to maximize economic and environmental goals (B.A. Selley)

West Central Research and Extension Center

Sorghum and corn breeding and corn, sorghum, and wheat variety evaluation under central Nebraska environment conditions (P.T. Nordquist)

Selection and development of native herbaceous landscape plants (D.T. Lindgren)

Improving the profitability and sustainability of Sandhills beef cattle operations (R.T. Clark)

Biologe, ecology, economics and control of major insects affecting cattle in Nebraska (J.B. Campbell)

Production systems and nutrition for Sandhills and Northern Great Plains range (D.C. Adams)

Management of arthropod pests of livestock and poultry (J.B. Campbell, G.D. Thomas)

Management practices to improve reproduction of beef heifers (G.H. Deutscher)

Genotype by environment interactions for sow productivity and early piglet growth (T.E. Long)

Grazing management strategies and systems for Sandhills meadows (J.D. Volesky)
Interdisciplinary Activities

Administration

01-001 General administration of federal fund research (D. W. Nelson)

01-004 Regional research coordination, North Central Region (D. W. Nelson)

Agricultural Research and Development Center

45-001 Field laboratory development (D. Duncan)

Center for Grassland Studies

33-001 Center for grassland studies (M. A. Massengale)

Center for Sustainable Agriculture Systems

31-002 Center for sustainable agricultural systems (C. A. Francis)

*31-003 Biological and economic consequences of flexible crop rotations (C. A. Francis)

31-004 Integrated crop/livestock research for sustainable systems (C. A. Francis, T. J. Klopfenstein, J. R. Brandle)

31-005 Integrated crop/livestock/agroforestry research for sustainable systems in Nebraska (T. J. Klopfenstein, J. R. Brandle, C. A. Francis)

Food Processing Center

19-003 Development and evaluation of food products, processes and markets (S. L. Taylor)

19-004 Midwest food manufacturing alliance (S. L. Taylor)

19-008 Development and quality/safety enhancement of specialty food products (S. L. Taylor)

Industrial Agricultural Products Center

29-007 Industrial agricultural products center (M. A. Hanna)

29-008 Biodegradable plastics from corn starch and soybean oil (M. A. Hanna, V. Miladinov)
While serving the needs of Nebraska’s agricultural producers, agribusinesses, industries, communities and citizens, the ARD places a high priority on being accountable for its resources and documenting impacts of its programs. As in all research institutions, ARD scientists are charged to actively disseminate results of research in scientific journals and technical publications. The division sets optimistic, but reachable, annual goals for scientific publication, theses and dissertations, and other measures of research output. In each of the last three years the goals have been exceeded.

Publications in refereed (peer reviewed) scientific journals represent professional acknowledgment of the value of a research finding to the discipline. ARD scientists have published in a number of different scientific journals during 1999. Faculty also have written books, edited books or contributed chapters for books.

Another major contribution of the ARD research faculty is the education of graduate students pursuing a Master of Science (M.S.) or Doctor of Philosophy (Ph.D.) degree. One responsibility of a graduate degree is the completion of a thesis (M.S.) or a dissertation (Ph.D.).

Publications in refereed journals, books, book chapters, refereed proceedings, theses and dissertations are listed for calendar year 1999.

Journals in which faculty have published in 1999

Agricultural Economics

American Journal of Agricultural Economics
Empirical Economics
Great Plains Natural Resources Journal
Journal of Agricultural and Environmental Ethics
Journal of Cooperatives
Journal of Socioeconomics
The Journal of Rural Health
The Midbank Quarterly

Agricultural Leadership, Education and Communication

Online Journal of Distance Learning Administration
Psychological Reports

Agronomy

Agronomy Journal
American Journal of Alternative Agriculture
Anticancer Research
Applied Engineering in Agriculture
Bioremediation Journal
Biotechniques
Cereal Chemistry
Communications in Soil Science Plant Analysis
Crop Science
Environmental Pollution
Geoderma
HortScience
Journal of Alternative Agriculture
Journal of Cereal Science
Journal of Environmental Quality
Journal of Food and Agricultural Immunology
Journal of Natural Resources and Life Sciences Education
Journal of Plant Nutrition
Journal of Production Agriculture
Journal of Range Management
Journal of Soil and Water Conservation
Maydica
Plant Breeding
Plant Cell, Tissue and Organ Culture
Precision Agriculture Journal
Proceedings National Academy of Science
Rangelands
Soil Science Society of America Journal
Theoretical and Applied Genetics
Transactions of the American Society of Agricultural Engineers
Weed Research
Weed Science

Animal Science
Animal Reproduction Science
Asian-Australia Journal
Behavior Genetics
Biology of Reproduction
Bioresource Technology
Electrophoresis
Genetics
Genetics and Molecular Biology
Journal of Animal Science
Journal of Bacteriology
Journal of Dairy Science
Journal of Food Science
Journal of Muscle Foods
Journal of Range Management
Mammalian Genome
Molecular and Cellular Endocrinology
Obesity Research
Poultry Science
Revista Veterinaria Mexico
Theriogenology
Tissue and Cell

Biochemistry
Archives of Biochemistry and Biophysics
Biochemistry
Biochemical and Biophysical Research Communications
Biotechniques
Journal of Agricultural, Biological and Environmental Statistics
Journal of American Chemical Society
Journal of Bacteriology
Journal of Biological Chemistry
Journal of Food and Agricultural Immunology
Molecular and General Genetics
Molecular Cell Biology Research Communications
Photosynthesis Research
Proceedings of the National Academy of Science
Research Communication

Biological Systems Engineering
Agricultural Water Management
Applied Engineering in Agriculture
Bioresource Technology
Carcinogenesis
Cereal Chemistry
Computers and Electronics in Agriculture
Crop Science
Food Science Biotechnology
Industrial Crops and Products
International Journal of Pharmaceutics
Journal of Agriculture and Food Chemistry
Journal of Animal Science
Journal of Food Protection
Journal of Agricultural Engineering Research
Journal of Animal Science
Journal of Food Science
Journal of Environmental Quality
Journal of Production Agriculture
Lebensmittel-Wissenschaft und Technologie
Plant Cell, Tissue and Organ Culture
Transactions of the American Society of Agricultural Engineers

Biometry
Applied Statistics in Agriculture
Crop Science
Environmental Entomology
Journal of Agricultural, Biological and Environmental Statistics
Journal of Animal Science
Journal of Economic Entomology
Journal of Food Quality
Journal of Production Agriculture
Journal of Statistical Computation and Simulation
Online Journal of Distance Learning Administration

Entomology
American Entomologists
Annals of the Entomological Society of America
Archives of Insect Biochemistry and Physiology
Biological Control
Chemosphere
Comparative Biochemical Physiology Part A
Entomologia Experimentalis et Applicata
Entomology Experimental Applications
Environmental Entomology
Environmental Toxicology and Chemistry
Insect Biochemical Molecular Biology
Insect Molecular Biology
Food Science and Technology

American Journal of Potato Research
Applied and Environmental Microbiology
Bioresource Technology
Cereal Chemistry
Electrophoresis
Enzyme Microbiology Technology
Food Additives and Contaminants
Food and Agriculture Immunology
Food Science and Biotechnology
Industrial Crops and Products
Journal of Agricultural and Food Chemistry
Journal of Food Protection
Journal of Food Quality
Journal of Food Science
Journal of Food Science and Biotechnology
Journal of Membrane Science
Proceedings National Academy of Science
Sciences des Aliments

Horticulture

Agronomy Journal
American Journal of Potato Research
Crop Science
Environmental Entomology
Environmental Pollution
Euphytica
HortScience
Journal of Economical Entomology
Journal of Environmental Horticulture
Journal of Food Quality
Journal of HortScience
Journal of the American Society for Horticultural Science
Plant Disease

Plant Pathology

Archives of Microbiology
Euphytica
Fungal Genetics and Biology
Journal of Biological Chemistry
Journal of Economic Entomology
Journal of the American Society for Horticultural Science
Molecular and General Genetics
Molecular Plant-Microbe Interactions
Phytopathology
Plant Cell Reports
Plant Disease
Virology

School of Natural Resource Sciences

Agricultural and Forest Meteorology
Annals of Entomological Society of America
Bioremediation Journal
Boundary-Layer Meteorology
Bulletin of American Meteorological Society
Environmental Science and Technology
Environmental Toxicology and Chemistry
Great Plains Research
Journal of Chromatography
Journal of Climate
Journal of Economic Entomology
Journal of Environmental Quality
Journal of Environmental Toxicology and Chemistry
Journal of HortScience
Journal of Lake and Reservoir Management
Journal of Production Agriculture
Remote Sensing of Environment
Technology
Wetlands

Veterinary and Biomedical Sciences

Chemical Toxicology
Compendium’s Food Animal Medicine and Management
FEBS Microbiology Letters
Food and Chemical Toxicology
Infection and Immunity
Journal of Animal Science
Journal of Biological Chemistry
Journal of Clinical Microbiology
Journal of Medical Primatology
Journal of Virology
Molecular and General Genetics
Human Resources and Family Sciences Departments

Family and Consumer Sciences
Housing and Society
Journal of Family and Consumer Sciences
Psychotherapy: Theory/Research/Practice/Training

Nutritional Science and Dietetics
International Journal of Sports Nutrition
Journal of Family and Consumer Sciences
Journal of Food Science
Journal of the American Dietetic Association
Metabolism
Nutrition Research
Sciences des Aliments

Textile, Clothing and Design
Business Review
Journal of Family and Consumer Sciences
Journal of Family and Consumer Sciences Research Journal
Textile Chemist and Colorist

Off-Campus Research Centers
Northeast Research and Extension Center
Communications in Soil Science and Plant Analyses
Environmental Entomology
Journal of Animal Science
Journal of Production Agriculture
The Professional Animal Scientists

Panhandle Research and Extension Center
American Journal of Potato Research
Applied Engineering in Agriculture
Crop Science
Great Plains Research
Journal of Agricultural and Resource Economics
Journal of Agricultural Engineering Research
Journal of Animal Science
Journal of Production Agriculture
Journal of Range Management
Journal of Sugar Beet Research
Phytopathology
Transactions of the American Society of Agricultural Engineers
Weed Science
Weed Technology

South Central Research and Extension Center
Geoderma
Journal of Environmental Quality
Journal of Production Agriculture
Pesticide Biochemistry Physiology
Weed Science

West Central Research and Extension Center
Geoderma
HortScience
Journal of Animal Science
Journal of Range Management
Large Animal Practice
Transactions of the American Society of Agricultural Engineers
Weed Science
Research Publications (1999)

Agricultural/ Natural Resources Units

Agricultural Economics

Journal Articles

Aiken, J.D. 1999.
Balancing endangered species protection and irrigation water rights: The Platte River Cooperative Agreement. Great Plains Natural Resources Journal 3:119-158. (J. Series No. 12595)

Asymmetry and stickiness in farm-retail price transmission. American Journal of Agricultural Economics 81:525-533. (J. Series No. 12513)


Rural hospitals and the local economy: A needed extension and refinement of existing empirical research. The Journal of Rural Health 15:189-201. (J. Series No. 12489)


The changing landscape of health care financing and delivery: How are rural communities and providers responding? The Milbank Quarterly 77:483-510. (J. Series No. 12778)


Book Chapters


Research Bulletins


Refereed Proceedings


M.S. Theses

Using the futures market to develop a post-harvest soybean marketing plan basis estimation and other considerations. (G.H. Pfeiffer, Advisor)

The farm-retail price spread and power structure in the food marketing channel. (A.M. Azzam, Advisor)

Ph.D. Dissertations

Dias, W. 1999.
Intra-year strategic planning of crop production under embedded risks. (G.A. Helmers, Advisor)

Intarapapong, W. 1999.
Environmentally adjusted measures of gains from trade liberalization: The case of U.S. corn production. (E.W.F. Peterson, Advisor)

Togoese cereal demand: An application of linear expenditures, Rotterdam and almost ideal demand systems. (A.M. Azzam, Advisor)

Agricultural Leadership, Education and Communication

Journal Articles

Leader's motivation and leader's perception of follower's motivation as predictors of leader's influence tactics. Psychological Reports 84:1087-1098. (J. Series No. 12509)

Incentives and obstacles influencing higher education faculty and administration to teach via distance. Online Journal of Distance Learning Administration. http://www.westga.edu/~distance/jdmainl1.html

Agronomy

Journal Articles

Grasslands and forages of Nebraska. Rangelands 21:5-8. (J. Series No. 12465)

Native wildflower establishment with imidazolinone herbicides. HortScience 34:283-286. (J. Series No. 12180)

Grassland legume establishment with imazethapyr and imazapic. Agronomy Journal 91:592-596. (J. Series No. 12297)

Influence of planting dates and populations on seed yield and plant characters of sunflower in the High Plains. Journal of Production Agriculture 12:38-42. (J. Series No. 12128)


Book Chapters


Refereed Proceedings

Animal Science

Journal Articles

Aydin, G., R.J. Grant, and J. O’Rear. 1999.
(J. Series No. 12475)

A comparison of dietary fiber in ground pork from different laboratories in nutrient analyses of corn and soybean meal. Journal of Animal Science 77:2641-2650. (J. Series No. 12359)

Comparative mapping of 16 equine type I genes by somatic cell hybrid analysis. Mammalian Genome 10:271-276. (J. Series No. 12249)

Storage stability of ground pork containing meat from an advanced meat recovery system. Journal of Food Science 64:69-75. (J. Series No. 12114)


The effect of infusion of urea into the vena cava on feed intake of finishing gilts. Journal of Animal Science 77:3248-3252. (J. Series No. 12457)

Capillary electrophoretic determination of cathepsin D activity using Ortegon Green-labeled hemoglobin. Electrophoresis 20:2945-2951. (J. Series No. 12628)


Synchronization of estrus and fertility in Zebu beef heifers treated with three estrus synchronization protocols. Theriogenology 51:647-659. (J. Series No. 12380)


Estimates of direct, maternal and grandmaternal effects for growth traits of Gobra cattle. Genetics and Molecular Biology 22:363-367. (J. Series No. 12401)

Estimation of direct, maternal, and grandmaternal genetic effects for weaning weight in several breeds of beef cattle. Journal of Animal Science 77:840-845. (J. Series No. 12228)

Comparison of models to estimate genetic effects for weaning weight of Angus cattle. Journal of Animal Science 77:3176-3184. (J. Series No. 12486)


Variance components and breeding values for growth traits from different statistical models. Journal of Animal Science 77:2641-2650. (J. Series No. 12359)

Estrus synchronization of beef cattle with a combination of melengestrol acetate and an injection of progesterone and 17β-estradiol. Journal of Animal Science 77:715-723. (J. Series No. 12161)

Bioassay for growth hormone releasing hormone (GHRH) using a recombinant receptor and cAMP-responsive reporter system. Molecular and Cellular Endocrinology 150:65-72. (J. Series No. 12435)


The effect of dietary wheat middlings and enzyme supplementation. 1. Late egg production efficiency, egg yields, and egg composition in two strains of Leghorn hens. Poultry Science 78:841-847. (J. Series No. 12242)

Responses in ovulation rate, embryonal survival, and litter traits in swine to 14 generations of selection to increase litter size. Journal of Animal Science 77:541-557. (J. Series No. 12239)

Kittok, R.J. 1999.


The effect of mixing on transesterification of beef tallow. Biorosource Technology 69:269-293. (J. Series No. 12168)

Shade and wind barrier effects on summertime feedlot cattle performance. Journal of Animal Science 77:2065-2072. (J. Series No. 12395)


Pegden, R.S., M.A. Larson, R.J. Grant, and M. Morrison. 1999. Adherence of the gram-positive bacterium Ruminococcus albus to cellulose and identification of a novel form of cellulose-binding protein which belongs to the Pil-family of proteins. Journal of Bacteriology 180:5921-5927. (J. Series No. 11973)


M.S. Theses

Al-Suwaigh, S. B. 1999. Utilization of distillers grains from the fermentation of sorghum or corn by dairy cattle. (R. J. Grant, Advisor)


Jerez, N. C. 1999. Adding value to low-quality beef muscles through glycolytic inhibition. (C. R. Calkins, Advisor)


Kitt, S. J. 1999. Effects of feeding betaine to finishing hogs. (P. S. Miller, Advisor)

Koch, J. W. 1999. Endocrine mechanisms and ovarian follicular development in peripubertal heifers. (J. E. Kinder, Advisor)


Ross, R. A. 1999. Precooked bacon manufactured by microwave and double belt conveyor processing systems. (R. W. Mandigo, Advisor)


Wenther, J. B. 1999. The effect of genetic line, diet, sex, slaughter weight, and type of bacon on bacon processing parameters. (R. W. Mandigo, Advisor)

Zhao, F. 1999. The effects of dietary essential fatty acids supplementation on laying hen performance, egg yolk fatty acid profile, and egg functional properties. (S. E. Scheideler, Advisor)

Ph.D. Dissertations


Mejia, I. 1999. Nutritional factors that influence phosphorous availability and indicators of phosphorous status of ruminants. (D. R. Brink, Advisor)


Yen, H. W. 1999. Follicular development, maturation and atresia during the estrus cycle in gilts expressing high and low ovulation rates. (D. R. Zimmermann and R. J. Kitts, Advisors)

Biochemistry

Journal Articles


Mechanism of transfer of the methyl group from (6S)-methyltetrahydrofolic acid to the corrinoid/iron-sulfur protein catalyzed by the methyltransferase from Clostridium thermoceticum: a key step in the Wood-Ljungdahl pathway of acetyl-Coa synthesis. Biochemistry 38:5728-5735.
(J. Series No. 12622)
(J. Series No. 12620)
Spreitzer, R.J. 1999.
Photysyntheses Research Series No. 12620.

Biological Systems Engineering

Journal Articles

(J. Series No. 12263)

Book


Book Chapters

Ragsdale, S.W. 1999.

Ragsdale, S.W. 1999.

M.S. Theses

Duam, W. 1999.
Regulation of expression of the capost's sarcoma associated herpesvirus human herpesvirus-8 early gene ORF57. (C.A. Wood, Advisor)

Ph.D. Dissertation

Biochemical of carbon monoxide dehydrogenase/acetyl-Coa synthase complex and heterodisulfide reductase from methanococcus thermophilus: key enzymes involved in acetolistic methanogenesis. (S.W. Ragsdale, Advisor)

Phosphorus and nitrogen in runoff following beef cattle manure or compost application. Journal of Environmental Quality 28:1291-1210. (J. Series No. 12487)

Rheological properties of amorphous and semicrystalline polyacidic acid polymers. Industrial Crops and Products 10:47-53. (J. Series No. 12253)

Predicting soil detachment from high-discharge concentrated flow. Transactions of the American Society of Agricultural Engineers 42:329-335. (J. Series No. 12106)


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Interill erosion as affected by the application of beef cattle manure. Transactions of the American Society of Agricultural Engineers 42:975-980. (J. Series No. 12447)

Physical and molecular properties of egg-white-lipid films. Journal of Food Science 64:860-864. (J. Series No. 12504)

Diffusion of dialkylaminoles into the rat esophagus as a factor in esophagel carcinogenesis. Carcinogenesis 20:825-836. (J. Series No. 12749)


65


Refereed Proceedings


Book Chapters


M.S. Thesis

Spare, D.P. 1999. Effects of copper and zinc in swine diets on phototrophic anaerobic lagoons. (J.E. Gilley, Advisor)

Ph.D. Dissertations


Fang, Qi. 1999. Preparation and characterization of starch-based foam packaging foams. (M.A. Hanna, Advisor)


Biometry

Journal Articles


Optimization of temperature-glycerol-
pH conditions for a fed-batch fermentation process for recombinant hookworm (Ancylostoma caninum) anticoagulant peptide (AaAP-5) production by Pichia pastoris. Enzyme Microbiology Technology 24:238-245. (J. Series No. 12008)

Applications in survival analysis. Journal of Animal Science 77:147-
153. (J. Series No. 12524)

Nitrte leaching in irrigated corn and soybean in a semi-arid climate. Transactions of the American Society of Agricultural Engineers 42:1621-
1630. (J. Series No. 12462)

Baseline susceptibility of European corn borer (Lepidoptera: Crambidae) to Bacillus Thuringiensis Toxins. Journal of Economic Entomology 92:279-
285. (J. Series No. 12093)

Incentives and obstacles influencing higher education faculty and administration to teach via distance. Online Journal of Distance Learning Administration. http://
www.westga.edu–distance/
jmal11.html

Golf ball deceleration measuring system to evaluate surface uniformity on golf course greens. Crop Science 31:741-
745. (J. Series No. 11940)

Insecticides and obstacles influencing higher education faculty and administration to teach via distance. Online Journal of Distance Learning Administration. http://
www.westga.edu–distance/
jmal11.html

Geostatistical investigation of the small-scale spatial variation of western corn rootworm (Coleoptera: Chrysomelidae) adults. Environ-
mental Entomology 28:266-274. (J. Series No. 12214)

The analysis of over-dispersed count data from single factor experiments: A comparative study. Journal of Agricultural, Biological and
Environmental Statistics 4:258-275. (J. Series No. 12618)

Analysis of over-dispersed count data from single factor study. Applied Statistics in Agriculture 11:73-83. (J. Series No. 12490)

Effect of perennial grasses on Canada thistle Cirsium arvense control. Weed Technology 13:83-
87. (J. Series No. 12248)

Entomology

Journal Articles

Blattus ocellatus Barber (Hemiptera: Lygaeidae): A chinch bug pest new to buffalo grass turf. Journal of Economic Entomology 92:1172-
1176. (J. Series No. 12491)


Comparison of Diatraea saccharalis resistance in wheat inbreds and plant introduction lines. Entomologia Experimentalis et Applicata 92:157-
164. (J. Series No. 12288)

Geostatistical investigation of the small-scale spatial variation of western corn rootworm (Coleoptera: Chrysomelidae) adults. Environmental Entomology 28:266-
274. (J. Series No. 12214)


Fatty acid compositions of phospholipids and triglycerides of selected tissues, and fatty acid biosynthesis in adult periodical cicadas, Magicicada septendecim. Comparative Biochemical Physiology Part A 122:355-362. (J. Series No. 12485)

Trap color and placement affects estimates of insect family-level abundance and diversity in a Nebraska saltmarsh. Entomology Experimental Applications 91:393-
402. (J. Series No. 12590)

Indirect measurement of insect defoliation. Environmental Entomology 28:1136-1139. (J. Series No. 12085)


Genetic similarity among pheromone and volatlin races of Enstroce maliudida (Hulber) (Lepidoptera: Crambidae). Insect Molecular Biology 8:213-221. (J. Series No. 12006)

Baseline susceptibility of European corn borer (Lepidoptera: Crambidae) to Bacillus Thuringiensis toxins. Journal of Economic Entomology 92:279-285. (J. Series No. 12093)

Baseline susceptibility of European corn borer (Lepidoptera: Crambidae) to Bacillus Thuringiensis toxins. Journal of Economic Entomology 92:279-285. (J. Series No. 12093)

Ecoxosidans mediate nodulation reactions to bacterial infections in adults of the cricket, Gryllus assimilis. Journal of Insect Physiology 45:75-83. (J. Series No. 12154)


Chronic effects of atrazine on tolerance of a benthic diatom. Environmental Toxicology and Chemistry 18:1038-1045. (J. Series No. 12165)


Distribution and inhibition of esterase in various body tissues of susceptible and resistant German cockroaches (Dictyoptera: Blattellidae). Archives of Insect Biochemistry and Physiology 42:179-187. (J. Series No. 12704)


Scharf, M.E. and B.D. Siegfried. 1999. Toxicity and neurophysiological effects of liprofil and liprofil sulfone on the western corn rootworm (Coleoptera: Chrysomelidae). Archives of Insect Biochemical Physiology 40:150-156. (J. Series No. 12501)


Food Science & Technology

Journal Articles


Books


M.S. Thesis


Ph.D. Dissertations


Food Science & Technology

Journal Articles


Books


M.S. Thesis


Ph.D. Dissertations


Book Chapters


M.S. Theses


Lenligh, D. 1999. The starch characteristics of elbow macaroni as impacted by dough moisture content, mixing time, and cooking time. (D.S. Jackson, Advisor)


Ph.D. Dissertations


Dormedy, E.S. 1999. Implementation and microbial verification of HACCP systems and HACCP intervention methods in meat processing establishments for the reduction of food-borne pathogens. (M.M. Brashears and A.K. Benson, Advisors)


Horticulture

Journal Articles


Plant Pathology

Journal Articles


M.S. Thesis


M.S. Theses

Kim, M.S. 1999. Molecular genetic studies of annualmia species: Application of molecular genetic tools toward understanding ecological relationships in forest ecosystems. (A.K. Vidaver, Advisor)

School of Natural Resource Sciences

Journal Articles

Remediating hexahydro-1,3,5-trinitro-1,3,5-triazine-contaminated water and soil by Fenton oxidation. Journal of Environmental Toxicology and Chemistry 18:1078-1084. (J. Series No. 12206)

Energy fluxes of an open water area in a mid-latitude prairie wetland. Boundary Layer Meteorology 91:495-504. (J. Series No. 7386)

Surface energy fluxes of phragmites australis in a prairie wetland. Agricultural and Forest Meteorology 91:31-51. (J. Series No. 12252)


Sensitive determination of RDX, nitro-RDX metabolites, and other munitions in ground water by solid-phase extraction and isotope dilution liquid chromatography-atmospheric pressure chemical ionization mass spectrometry. Journal of Chromatography 844:87-95. (J. Series No. 12527)

Drought sensitivity indices for a sorghum crop. Journal of Production Agriculture 12:312-316. (J. Series No. 11909)

Spatial and temporal variability of daily weather variables in sub-humid and semi-arid regions of the U.S. High Plains. Agricultural and Forest Meteorology 93:141-148. (J. Series No. 12531)


Effects of phosphorus reduction on water quality: Comparison of aluminized and untreated portions of a hypereutrophic lake. Journal of Lake and Reservoir Management 15:70-82. (J. Series No. 12301)


Accelerated transformation and binding of 2,4,6-trinitrotoluene in rhizosphere soil. Bioremediation Journal 3:59-67. (J. Series No. 12333)

A revised measurement methodology for complete spectral optical properties evaluating the influence of gaps between elements. Remote Sensing of Environment 66:177-192. (J. Series No. 12294)

A probabilistic evaluation of winter wheat seeding dates on potential soil erosion in the central Great Plains. Great Plains Research 9:75-86. (J. Series No. 11422)

Chronic effects of atrazine on tolerance of a bentilc diatom. Environmental Toxicology and Chemistry 18:1038-1045. (J. Series No. 12165)

Virulence of Metarhizium anisopliae (Deuteromycotina: Hypomyces) strain ESC-1 to the German cockroach and its compatibility with insecticides. Journal of Economic Entomology 92:346-346. (J. Series No. 12145)

Distribution and inhibition of esterase in various body tissues of susceptible and resistant German cockroaches. Annals of Entomological Society of America 92:556-562. (J. Series No. 12416)

Filter strip performance and processes for different vegetation, widths, and contaminants. Journal of Environmental Quality 28:1479-1489. (J. Series No. 12533)

Iron-mediated remediation of RDX-contaminated water and soil under controlled Eh-pH. Environmental Science and Technology 33:1488-1494. (J. Series No. 12224)

The Hastings, Nebraska ground water contamination Superfund site: A case study in logic and illogic. Technology 6:141-149. (J. Series No. 12163)

The effect of data gaps on the calculation of mean temperatures. Journal of Climate 12:1524-1533. (J. Series No. 12324)

The response of muskmelon growth and development to microclimate modification by shelterbelts. Journal of HortScience 34:64-68. (J. Series No. 12100)

Referred Proceedings


Book Chapters


M.S. Theses

Hou, Q.-J. 1999. Soil moisture within the windbreak/crop interface and a comparison of three types of sensors for measuring soil water content. (J.R. Brandle, Advisor)

Moreno-Sotomayer, A. 1999. Gas exchange of corn leaves as a function of age and nitrogen status. (A. Weiss, Advisor)

Ph.D. Dissertations


Oh, B. T. 1999. Transformation and detoxification of 2,4,6-trinitrotoluene by a Pseudomonas aeruginosa strain. (P.J. Shea, Advisor)


Veterinary and Biomedical Sciences

Journal Articles


Book Chapters


M.S. Theses


Textiles, Clothing and Design

Journal Articles


Refereed Proceedings


Ph.D. Dissertation


Off-Campus Research Centers

Northeast Research and Extension Center

Journal Articles


Shapiro, C. A. 1999. Using a chlorophyll meter to manage nitrogen applications to corn with high nitrate irrigation water. Communications in Soil Science and Plant Analysis 30:1037-1049. (J. Series No. 12317)

M.S. Thesis


Ph.D. Dissertation


Panhandle Research and Extension Center

Journal Articles


Horney, M. Spring grazing: A management alternative for Sandhills wet meadows. (D.C. Adams and W. Schacht, Advisors)
ARD receives funding from federal formula funds, industry grants, federal grants and state appropriations. During fiscal year 1999-2000, faculty with ARD appointments obtained grant and contract funds that totaled $23,193,240. This amount represents 47.1 percent of all research grant and contract funds received by UNL. The extramural funds coming to ARD faculty to address problems of importance to Nebraska have a significant direct impact on the state’s economy.

<table>
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<tr>
<th>Federal Formula Funds:</th>
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<td>Hatch Formula ..................... $2,311,502</td>
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<td>Regional Research .................. $ 654,540</td>
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<td>McIntire-Stennis ................... $ 136,805</td>
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<td>Animal Health ...................... $ 137,805</td>
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<td>Total Federal Formula Funds ....... $ 3,240,652</td>
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| State Appropriated Funds .......... $25,976,723 |
| Nebraska Research Initiative Funds $ 2,242,853 |

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<th>Contracts and Grants:</th>
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<td>USDA Cooperative Agreements ....... $1,167,609</td>
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<td>USDA Special and Competitive Grants .. $3,603,557</td>
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<td>Federal Grants - (NSF, NIH, USEPA, AID, DOE) ...... $5,029,841¹</td>
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<tr>
<td>Industry Grants .................... $8,222,493</td>
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<td>Total Grants and Contract ......... $18,023,500</td>
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| Product Sales ...................... $ 6,881,758 |
| Total Expenditures ................ $56,058,995 |

¹$226,974 was included to show actual Agricultural Research Division expenditures reflecting transfers from International Programs.
Agricultural Research Division
Research Investments by Category and Funding Source FY 2000

<table>
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<th>Expenditure Category</th>
<th>State Appropriated and Hatch Funds</th>
<th>Federal Grants</th>
<th>Industry Grants</th>
<th>Revolving Funds</th>
<th>All Funds</th>
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<td>Managerial/Prof</td>
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<td>6.3</td>
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<td>Office/Service</td>
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<td>GRA Stipends</td>
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<td>14.6</td>
<td>1.8</td>
<td>10.7</td>
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<td>5.9</td>
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<td>Supplies and Expenses</td>
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<td>49.5</td>
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## Agricultural Research Division

### Selected Research Program Information

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<th>Category</th>
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<td><strong>Project Information:</strong></td>
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<tr>
<td>Projects at beginning of year</td>
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<td>Projects terminating</td>
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<td>Projects revised</td>
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<td>New projects</td>
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<td>Projects at the end of the year</td>
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<td><strong>Faculty full-time equivalents (FTE)</strong></td>
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<td>130.8</td>
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<tr>
<td><strong>Expenditures for budgeted research faculty:</strong></td>
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<tr>
<td>Federal formula and state approp., $/FTE(^1)</td>
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<td>Grant and contracts, $/FTE</td>
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<td>Product sales, $/FTE</td>
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<td><strong>Outputs from research programs(^2):</strong></td>
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<td>Refereed journal articles</td>
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<td>Research bulletins</td>
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<td>Books and book chapters</td>
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<td>M.S. and Ph.D. theses</td>
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<td>Cultivars and germplasm released</td>
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<td>Patents obtained</td>
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</table>

\(^1\)Includes cost of administration and expenditures from the Nebraska Research Initiative by ARD-affiliated faculty.

\(^2\)A large number of abstracts, technical reports, and other non-refereed articles also are published by faculty each year.