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Utilizing and developing our resources to enhance quality of life

Farm & Home RESEARCH

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South Dakota State University · College of Agriculture & Biological Sciences · Agricultural Experiment Station

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CONTENTS

Farm & Home RESEARCH

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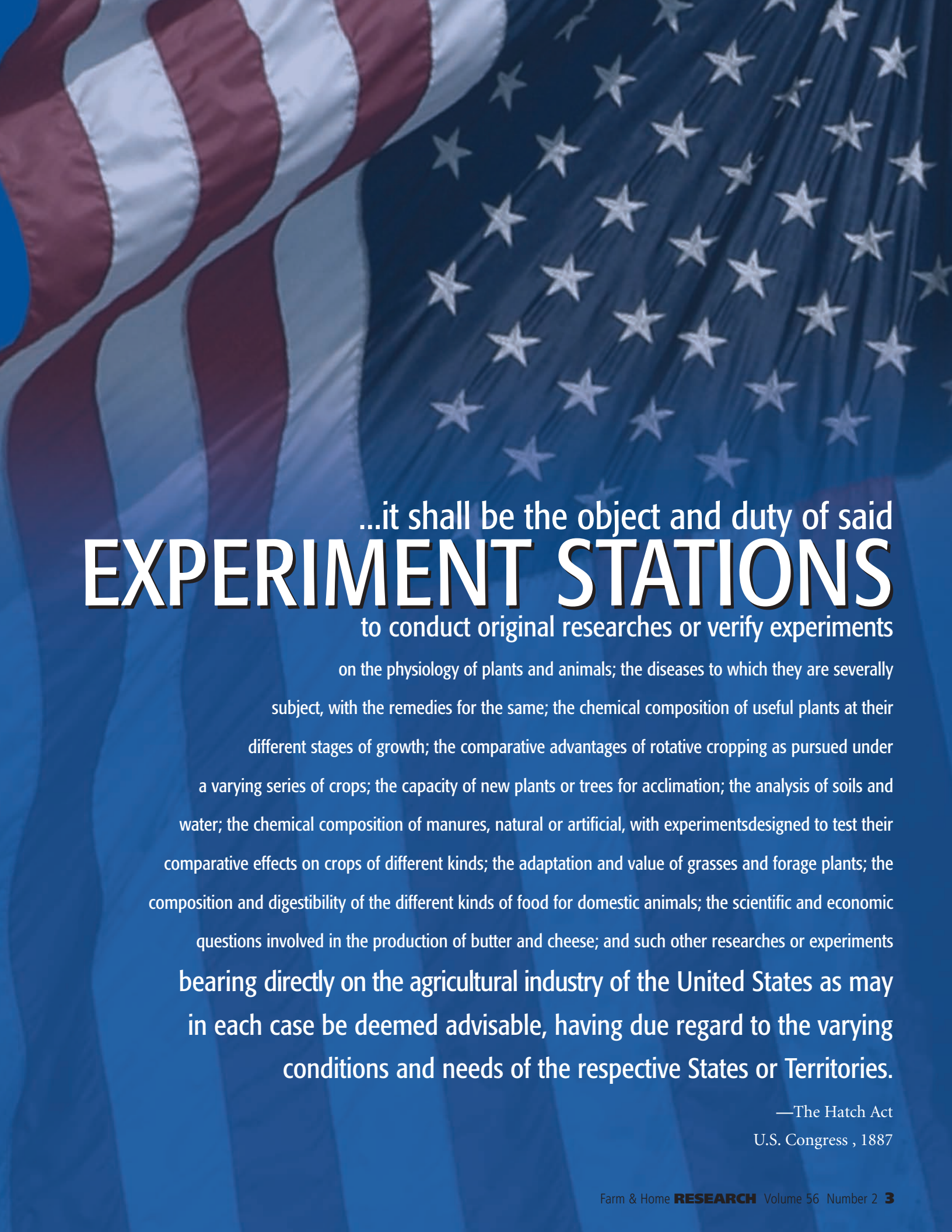


...it shall be the object and duty of said

EXPERIMENT STATIONS

to conduct original researches or verify experiments

on the physiology of plants and animals; the diseases to which they are severally subject, with the remedies for the same; the chemical composition of useful plants at their different stages of growth; the comparative advantages of rotative cropping as pursued under a varying series of crops; the capacity of new plants or trees for acclimation; the analysis of soils and water; the chemical composition of manures, natural or artificial, with experimentsdesigned to test their comparative effects on crops of different kinds; the adaptation and value of grasses and forage plants; the composition and digestibility of the different kinds of food for domestic animals; the scientific and economic questions involved in the production of butter and cheese; and such other researches or experiments

bearing directly on the agricultural industry of the United States as may in each case be deemed advisable, having due regard to the varying conditions and needs of the respective States or Territories.

—The Hatch Act
U.S. Congress , 1887

MEETING 'COMBINED CHALLENGES'

For American farmers and ranchers, probably the most important year in history was 1862. President Abraham Lincoln and Congress passed the Homestead Act, created the Department of Agriculture, and passed the Morrill Act that created a land-grant university in every state and territory and every state that would be formed in the future.

And the second most important year in America's agricultural history? It might be 1887.

That's when Congress approved the Hatch Act to establish "agricultural experiment stations" in each state. The idea of a "station" suggests visible bricks and mortar, but Director Kevin Kephart of the South Dakota Agricultural Experiment Station said that's not really what is meant. The "station" is simply the banner organization that oversees agricultural research conducted at the state's land-grant institution, he says.

Some of the genius of the Hatch Act, Kephart says, is that it recognized the "varying conditions and needs" of the states.

That's implicit in the injunction to study plant diseases, soil and water, and the adaptability and acclimation of plants and trees. One central or even several regional research institutions can not carry out those functions nearly as well as state-based land-grants can, he adds.

Even within South Dakota, Kephart says, there are wide variations in seasonal rainfall, temperature, soil types. All of those factors present challenges to the living things that dwell in those regions, whether plants, animals, or humans.

"Here at SDSU we have a term for those combined challenges that living things face," Kephart said. "We call it 'biostress.' The name of one of our facilities, the Northern Plains Biostress Laboratory, refers to the fact that a great deal of our work across all disciplines involves adapting our crops, livestock, and communities to the challenges of living in the Northern Great Plains."

Though the word "biostress" had not yet been coined at the time Congress passed the Hatch Act, Kephart points out that the idea of managing biostress has been a guiding principle for the South Dakota Agricultural Experiment Station—and every other experiment station—from the very start.

THE VERY FIRST RANGE RESEARCH STATION IN THE U.S. was the South Dakota Agricultural Experiment Station's Cottonwood Range Research Station, founded in 1909. A good part of the range and livestock research that takes place there addresses biostress. Range scientists are digging through decades of data stretching back into the 1940s to find the best indicators of forage production.

AT THE ANTELOPE RANGE RESEARCH STATION near Buffalo recent projects include participation in a four-state study to evaluate weaning, backgrounding, and finishing management strategies for beef and sheep producers.

THE FIRST AGRICULTURAL FIELD STATION IN THE NORTHERN GREAT PLAINS was the Central Crops and Soils Research Station at Highmore, founded in 1899. During its first century it was the first field station in the United States to test durum wheat, smooth bromegrass, and Russian olive trees.

TURNING 50 YEARS OLD THIS YEAR is the Northeast Experiment Farm north of Watertown. With research tuned to practical applications, the farm has made major contributions in providing varieties and production techniques that increase the agronomic, economic, and environmental performance of crops in this part of the state.

HERBICIDES, CROPS, INSECTICIDES, LIVESTOCK MANAGEMENT, AND FARM PRACTICES continue to be evaluated at South Dakota Agricultural Experiment Station farms, which also include Brookings Agronomy Farm, the Southeast Research Farm near Beresford, and Dakota Lakes Research Farm near Pierre.

THE LONG VISION of President Lincoln in 1862 and the establishment of state experiment stations in 1887 began a stream of agricultural scientific work that has benefited people across the globe, Kephart says. "The land-grant vision is known to have produced the most successful educational system in the world. We continue our commitment to that vision."◆

Science-based research helps South Dakota

'feed the world'

THE CORE OF THE SOUTH DAKOTA AGRICULTURAL EXPERIMENT STATION IS AGRICULTURAL PRODUCTION. Working with and for farmers and ranchers, the Agricultural Experiment Station helps boost grain yields, year in, year out. It provides the sound scientific basis for efficient, cost-effective livestock production and management and marketing methods. Benefits from its research project spread from farm and ranch to communities nearby and throughout the state, and South Dakota's agricultural bounty truly helps "feed the world."

THE BOOST TO YIELDS CAN BE AS SIMPLE as planting the top-yielding varieties in South Dakota State University's annual crop performance trials, Bob Hall, plant science professor, says.

The Agricultural Experiment Station makes public the list of top-performing varieties after Hall, who has a dual appointment as Extension crops specialist and project leader of the crop performance testing program, summarizes the results from each year's trials.

"On average, the top-performing group in hard red spring wheat will outyield other varieties by about 7 bushels per acre," Hall says.

For barley, one of the top-performing varieties gives an average yield advantage of 6 bushels; for oats, it's 21 bushels. For corn, averaged over all maturities, the advantage to the top-performing varieties is 20 bushels. Top-performing soybean varieties, averaged over all maturities, give the grower an advantage of about 6 bushels over other varieties.

Plant breeders pay keen attention to the trial results. Experimental varieties that haven't been released are sometimes tested so that breeders can see how they perform in different areas of the state.

Fulfilling the land-grant mission set by its framers back in 1887 is the Agricultural

Experiment Station's soybean breeding program. That mission: to perform agricultural research that fits the "varying conditions and needs" of individual states.

The achievement of that goal: high-yielding group 0 through II soybean varieties adapted to the western and northern fringes of the U.S. soybean production region.

Roy Scott, Agricultural Experiment Station soybean breeder, centers his research on yield stability, protein concentration and oil improvement, and stress tolerance. Specific research areas have included Phytophthora root-rot tolerance, carbon isotope discrimination for evaluation of water stress tolerance, genetics and agronomy of seedling vigor, and planting date effects on yield, protein, and oil.

THE SOYBEAN CYST NEMATODE (SCN) HAS BEEN MONITORED ever since damage was first confirmed in 1995 in Union County. The nematode was detected in Hutchinson County for the first time in 2004, bringing to 19 the number of South Dakota counties where the pest is found.

SCN is the most damaging pest of soybeans in the U.S., and losses across the soybean growing region are estimated at $1 billion annually.

The nematode is a small, plant-parasitic roundworm (*Heterodera glycines*) that feeds on the roots of soybean plants, says Jim Smolik, Agricultural Experiment Station plant nematologist. Of around 1,100 soil samples processed in 2004, nearly 45% tested positive for SCN. That is up from 2003, when about 32% of the 750 samples analyzed at SDSU were positive for SCN.

Producers can use resistant varieties and crop rotations to fight SCN, Smolik says. Yields of the resistant varieties in a 2004 test in Turner County were 26 to 80% higher than the susceptible variety.

A WINTER WHEAT BREEDER HAS BROUGHT NATIONAL RECOGNITION to the South Dakota Agricultural Experiment Station. The Wheat Quality Council, a national group of milling and baking industry representatives, plant breeders, and others in the wheat industry, meets

regularly to evaluate new wheat varieties. In February 2005, Amir Ibrahim's experimental line of hard white winter wheat from the South Dakota Experiment Station and called SD97W609 won Best of Show.

"SD97W609 really makes a very nice, bright white loaf of bread," Ibrahim says.

Its high-yielding potential and good winter survival ability will make it attractive to growers. But it's millers and bakers who are already asking the South Dakota Wheat Commission when growers will start producing it."

Miller interest is fanned because the experimental line has the flour color that will make an attractive bread without bleaching. It also lacks the pigments in red wheats that are associated with bitterness, so it won't require as much sugar in processing. All those attributes can add up to a healthier bread, Ibrahim says.

A hard white winter wheat called 'Wendy' already has been released but is recommended mainly for West River growers because of the tendency of white wheats to sprout if there is rain during harvest. The new experimental line has good sprouting resistance, so it's possible that growers will be able push the production area farther east.

Ibrahim adds that other hard white winter wheat varieties in development will be good multi-purpose varieties. These varieties can be sold to the domestic market for bread making or to the Asian market for making noodles.

WHITE-HULLED OATS ARE PREFERRED BY MILLERS AND HORSE OWNERS. The color of the oats, or lack of it, appeals to consumers, marketers, and growers alike.

With this in mind, SDSU's Agricultural Experiment Station is developing white-hulled and hulless varieties that will possess superior agronomic traits and grain qualities. Its two latest varieties, 'Reeves' (hulled) and 'Buff' (hulless), were released in 2002. Two sibling lines, one of which is proposed for release, are being tested in the 2005 South Dakota, North Dakota, Minnesota, and Iowa Standard Variety Yield Oat Trials.

Hulless oats are mainly used for feed and forage; however, there are specialty markets developing, says Lon Hall, project leader for oat breeding. "Desired traits in these lines include high oil and high protein content for feed grain and low oil, high beta-glucan, and high protein for milling. Millers and organic growers have also shown interest in hulless oats for human consumption."

Another area of oat development that Hall is pursuing is in improving palatability and digestibility in the forage lines.

SCAB RESISTANCE IN SPRING WHEATS HAS BEEN AN EXPERIMENT STATION PRIORITY since 1995. Karl Glover, Experiment Station spring wheat breeder, heads the project.

Scab in spring wheat can be devastating. In the wet year of 1993, scab cost South Dakota spring wheat producers an estimated $80 million that one year alone.

On a related research project, Yang Yen, associate professor, is selecting DNA markers for scab resistance for marker-assisted breeding in spring wheat. Brazilian germplasm, he says, seems to have good resistance to head scab.

FIELDS HAVE A LONGER MEMORY THAN FARMERS DO when it comes to management practices that affect soil nutrients such as phosphorus and potassium, says Dave Clay, Agricultural Experiment Station plant scientist.

With Newell Kitchen, USDA Agricultural Research Service soil scientist, Gregg Carlson, and J. Kleinjan, Agricultural Experiment Station plant scientist and research associate, respectively, Clay has used historic photographs to explore an easily overlooked problem: how land management choices of previous decades in South Dakota and Missouri fields can skew soil sampling results unless producers take those past practices into account.

Soil samples taken within areas where livestock were once kept may have elevated phosphorus and potassium levels for decades after the animals have been removed, Clay says. The higher soil nutrient concentrations in these samples will result in lower fertilizer recommendations, which may lead to large portions of production fields being under-fertilized.

Former home sites and fence lines, past cropping practices, and old roads, railroads, stock ponds, and feedlots need to be taken into account in the soil sampling protocol, Clays says. "Historical aerial photographs provide clues to past management. In the United States photographs as early as 1930 can be obtained from the USDA's Farm Service Agency offices."

THE SDSU PRECISION AGRICULTURE CONSORTIUM IS A PRIME EXAMPLE of how Agricultural Experiment Station scientists, Extension personnel, and farmers cooperate, says Gregg Carlson, Agricultural Experiment Station agronomist and and co-founder of the Consortium.

Precision farming is the "intensive management of agronomic production to increase profitability of farming systems," says Carlson.

The Consortium uses Global Positioning Satellites (GPS) and Geographic Information Systems (GIS) protocols to accurately monitor yields, combining these data with measurements of soil conditions, water levels, and weed presence. The farmers provide input about their needs and interests and lend their fields to scientific studies.

One of those farmers is Ron Alverson of Chester. He estimates that investment in precision farming equipment, which cost him about $2 per acre, has resulted in cost savings of $7-$10 per acre, partially thanks to the expertise and advice from the Agricultural Experiment Station scientists.

SINCE 1999, EXPERIMENT STATION SCIENTISTS HAVE RELEASED three varieties of spring wheat and two of winter wheat, as well as 4 soybean varieties, 3 oat varieties, 14 inbred lines of corn, and 4 inbred lines of sunflower. They are uniquely adapted to South Dakota conditions.

YELLOW-FLOWERED ALFALFA CAME TO NORTH AMERICA in the first decade of the 20th century when N.E. Hansen, the first U.S. Plant Explorer and South Dakota Agricultural Experiment Station horticulturalist, brought seed back from one of his plant explorations in Asia.

A century later, Arvid Boe, Agricultural Experiment Station forage breeder, has just completed the second year of a 5-year grant to find environmental niches in western South Dakota where yellow-flowered alfalfa has become adapted.

"It is in the process of becoming naturalized," Boe says. "It can propagate without intervention. The seed is being spread naturally, not drilled, not transplanted. That means we have a plant that has become very well adapted to the mixed-grass prairie, which is a very dry, stressful environment. That population will always be there contributing to the forage of the region, and hopefully it will not displace other valuable species."

The study will be useful both to ranchers who want to include hardy, yellow-flowered alfalfa as one of the plants in their range and to land managers who might want to limit the spread of non-native species onto federal, state, or tribal lands.

THE CONSEQUENCES TO LIVESTOCK FROM DRINKING WATER HIGH IN SULFATES—a stress that is unavoidable in some parts of western South Dakota—are being examined by Patricia Johnson, Agricultural Experiment Station beef scientist, and Trey Patterson, Extension beef specialist.

Patterson says it is the total sulfur ingested that negatively impacts animal health. Most of this sulfure comes from water in the form of dissolved sulfate salts. The rest is contributed by certain plants (kochia, thistle, turnips, and rape), grain by-products (corn by-products), and supplements. Grasses are generally low in sulfate.

Patterson's quick rule of thumb: Sulfate intakes below 0.4% of diet dry matter (including the contribution from water) are safe; 0.5-0.6% may be associated with sporadic cases of cattle polio; intakes of greater than 0.7% may be associated with a significant number of (noncontagious) cases of cattle polio or, in less severe cases, reduced feed intake and reduced overall performance, "bad enough," Patterson says.

Each field, each stream, each well is a unique situation, Patterson says.

PIONEERING WORK IN TRACING LIVESTOCK POISONING TO SELENIUM and then also tracing selenium to specific soils brought Agricultural Experiment Station chemists worldwide acclaim as pioneers in the biochemistry and toxicity of the element. Selenium poisoning of livestock is a consequence of the high level of the element in Pierre shale, the parent material for some South Dakota soils.

Current research now turns this problem around and to an economic opportunity for the landowner.

Parts of the world suffer from deficiency of selenium rather than excess. This deficiency poses health problems for humans and livestock in those places.

Jim Doolittle, Agricultural Experiment Station soil scientist, and Sang-Hun Lee, graduate researcher, are examining the effects of different varieties and management practices on selenium content in wheat. The research project could help some South Dakota producers in what were once selenium problem areas find a niche market and premium prices for selenium-rich wheat if they can use management and varieties that better "mine" the selenium from their soil.

ONE OF THE CHALLENGES FOR PRODUCERS ON THE NORTHERN PLAINS is farming temporary wetlands. In some cases, such lands can fall under federal farm program guidelines that identify wetlands as those having hydric soils.

Hydric soils are those that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth of water-loving plants, called hydrophytes.

In a new project at the South Dakota Agricultural Experiment Station, artificially saturated soils will be put into an oxygen-free environment to determine the length of time at different temperatures and different organic matter levels it takes to

develop some of the characteristics such as color change that are associated with hydric soils.

Distinguished Professor Doug Malo says the project of Rebecca Blue, graduate student researcher, will use science to solve what may be a problem in definitions. While current federal guidelines indicate that hydric soils can develop in as little as a week, Malo says that is not necessarily the case for every location in the U.S.

"One question we have is whether the timeline in the federal guidelines is appropriate for the Northern Plains," Malo says. "One week up here may be very different from one week in the Southern Plains because our soil temperatures are cooler and our parent materials are different."

WITH HIGH PRICES ON TRADITIONAL FEEDSTUFFS AFTER SEVERAL YEARS OF DROUGHT, producers are considering alternative feed ingredients. Agricultural Experiment Station scientists are exploring the nutritional value, handling, management, and economic impacts of these products.

Dried distillers grain (DDG), the corn co-product from ethanol production, is high in protein and energy and easily available and affordable across most of South Dakota.

South Dakota's ethanol plants produce about 2.7 gallons of ethanol plus about 17 pounds of DDG for every bushel of corn they process.

The scientists continue to examine dried or wet distillers grains in beef, swine, and dairy diets, and they've also looked at other uses—as a protein source in pet food, for example.

The main research focus remains on utilization of DDG in livestock rations. Agricultural Experiment Station scientists can make solid recommendations based on detailed knowledge of the nutritional value and performance of distillers grains.

Tom and Kathy Fabris, dairy producers near Castlewood put this knowledge to use, implementing a feeding regime of wet distillers grains and cornstalks for their dairy heifers and estimating that their new feeding program saved about $36,000 per year—half their feed costs—while maintaining excellent herd health.

Other Agricultural Experiment Station research on feedlot cattle has indicated that if distillers grains replace corn in 20% of the diet, it would result in savings of $2.32 per animal—a total of $1.4 million for South Dakota cattle feeders.

Distillers grains can replace some corn and soybean meal in swine diets. "You can use about 20% distillers grains for nursery pigs, 20-30% for grow-finishing pigs, 20-30% for lactating sows, and up to 40% for gestating sows," says Hans Stein, Agricultural Experiment Station swine nutritionist.

The cost of added synthetic lysine will determine how much DDG to use, since distillers grains are fairly low in this essential amino acid, Stein adds.

DDG-BASED DIETS PROBABLY CONTAIN ALL THE CRUDE PROTEIN FEEDLOT STEERS NEED, says Robbi Pritchard, Agricultural Experiment Station beef nutritionist. Adding urea pumps up the crude protein to the point the animals can't assimilate all of it, and the excess nitrogen is excreted.

"A high percentage of urine nitrogen ends up degrading into ammonia and heading for the atmosphere," he says. "The optimum, from an environmental and economic standpoint, is going to be where we have nitrogen intake as low as possible before animal performance is affected. What we have to do is find that balance that will work for cattle and the environment."

In another project, Pritchard is studying whether DDG can deliver some of the same benefits as ionophores. Ionophores are classified as antibiotics, because they kill some bacteria. Natural beef programs can't use ionophores, but Pritchard's work could give them a replacement tool.

FIELD PEAS ARE A PROMISING FEEDSTUFF ALTERNATIVE FOR SWINE PRODUCERS. Hans Stein, Agricultural Experiment Station swine nutritionist, and Bob Thaler, Extension swine specialist, have shown that at least 36% of corn and soybean meal in the diet can be replaced with field peas. At current feedstuff prices, this would result in savings of $1-2 per hog.

The added advantage of field peas, says Stein, is that the pig uses more (about 55%) of the phosphorus from the pulse crop than it does from corn or soybean meal (20 to 30%). Since more phosphorus is used by the pig, less is excreted into the environment.

RESULTS OF A BEEF STUDY HAVE "REWRITTEN THE TEXTBOOK ON MARBLING," says Robbi Pritchard, Agricultural Experiment Station beef nutritionist. Marbling—intramuscular fat—is one of the primary criteria for determining the value of beef.

Existing beliefs held that marbling was one of the last tissues to develop in cattle and that producers should manage for marbling at the tail end of feeding. Scientists slaughtered Angus steers at five different time intervals from 700 to 1,350 pounds, studying the amount of intramuscular fat at each stage of growth.

The data clearly showed that marbling starts early in the calf's life and increases at a steady rate to slaughter. This finding makes feeding and management when the cattle are young to ensure optimal development of marbling more important than once thought.

FINDING NEW MARKETS IN WHICH TO SELL is another part of the Agricultural Experiment Station's work with production agriculture. Tom Dobbs, Experiment Station ag economist, tracked organic and conventional grain and soybean prices from 1995 through 2003 and produced a 2004 publication that is helpful to producers considering management changes or investments related to organic agriculture.

The price tracking shows that over the period from 1995 through 2003 the ratio of organic to conventional corn prices averaged 1.76. In other words, the price for organic corn was 76% higher, on average, than the price for corn produced with conventional methods.

Other average ratios of organic to conventional prices over the 9-year time frame were soybeans, 2.52; spring wheat, 1.75; and oats, 1.79.

U.S. farmers and ranchers added nearly 1 million acres of certified organic farmland between 1997 and 2001, an increase of 74%, Dobbs says. Meanwhile, certified organic cropland increased by 53%.

One token of how important Dobbs' work is that the USDA Economic Research Service refers to his studies as sources for people who are looking for more information about organic prices.

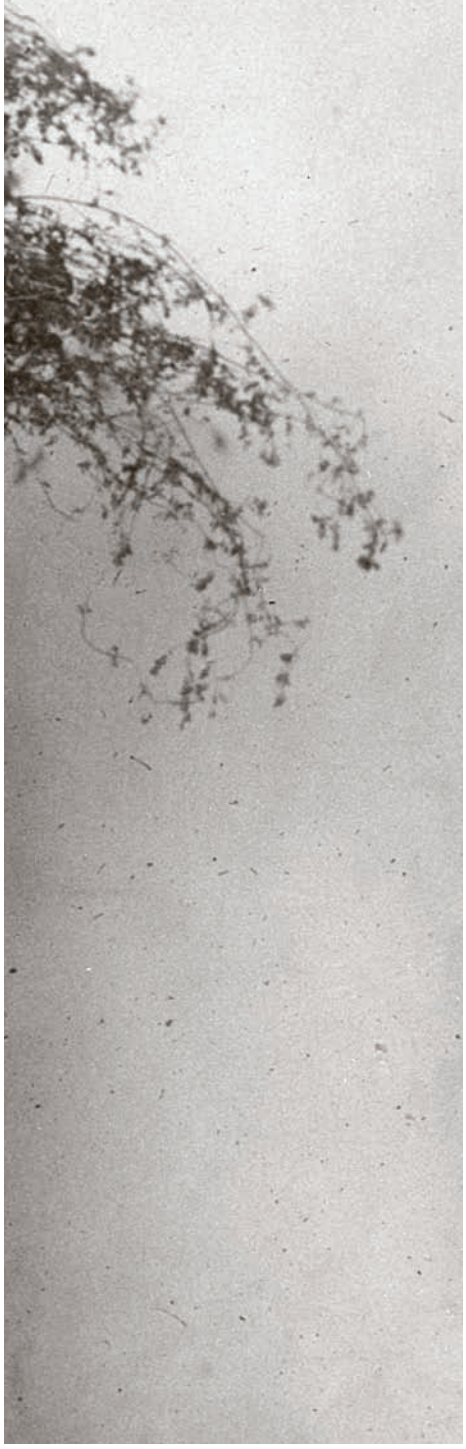
TASTE TESTING VARIOUS PARTS OF THE BEEF CHUCK AND ROUND has shown that four under-utilized cuts, called flat iron, boneless short rib, ranch cut, and round tip center, can be sold as steaks.

"Currently these four muscles go into roasts or ground beef, but they could be value-added if they were marketed as steaks," says Duane Wulf, Agricultural Experiment Station meat scientist.

Consumer taste tests have shown that palatability of these cuts is ranked on par with traditional steak cuts such as ribeye, tenderloin, and top sirloin. Increased consumer acceptance of the innovative cuts could potentially raise carcass value by about $3.67 for the producer.

Meat scientists have also probed consumer preferences for the size of a ribeye steak. Steaks cut from five different sizes of ribeye were packaged and sold at a grocery store at a similar price per pound. It turned out that size did not matter; all cuts sold comparatively well. Producers, on the other hand, try to limit ribeye size to 15 square inches, a figure based on the needs of the food industry for uniform sizes.

However, this study shows that, based on consumer preferences, there is no need to aim for a uniform ribeye size. When producers try to limit ribeye size, they also limit the size of roasts, ground beef, and other steaks, Wulf says. If they allow for larger ribeye size, producers will also get more of everything else, thus adding value to the carcass, he adds.◆



Not scientific puzzles or problems.

PEOPLE

THE WATERTOWN PUBLIC OPINION OF JANUARY 21, 1925, WAS ENTHUSIASTIC: Plant scientist N.E. Hansen, "the horticultural wizard of State College at Brookings," had just released 25 varieties of hardy northern grapes that would stand up to the extremes of the South Dakota climate.

Within a short time, the newspaper said, the state could grow grapes that could equal those of New York or Michigan.

That lavish praise may be excessive by today's standards. But it also offers a good lesson in what drives yesterday's and today's scientists of the South Dakota Agricultural Experiment Station:

Not scientific puzzles or problems. People.

A MUCH LARGER SHARE OF SOUTH DAKOTANS LIVED ON FARMSTEADS in 1925. Fruits such as grapes were important to the region's quality of life, explains Agricultural Experiment Station Director Kevin Kephart.

"Hansen, just like today's agricultural scientists, was responding to a perceived need," Kephart says.

Not one of Hansen's grape varieties remain in common use today. "But it is noteworthy that a different grape from the Agricultural Experiment Station, Ron Peterson's 'Valiant' from 1983, is in widespread use in the western and northern fringes of the Midwest.

"Growers say that it may be the hardiest grape anywhere—and all because scientists perceived a need that science could fill," the director adds.

MILK THAT HELPS LOWER THE RISK OF HEART DISEASE AND CANCER is the potential result of a study conducted by David Schingoethe, Agricultural Experiment Station distinguished professor of dairy science. The project concerns the cow herself and it tracks how changes in her diet could increase the presence of conjugated linoleic acids, known to have cancer-preventing benefits, in her milk.

WHILE IT HAS OTHER STERLING QUALITIES, REDUCED FAT CHEESE doesn't have the appeal in terms of texture and flavor to consumers that full fat cheese does. Improving the quality of low fat dairy products is the goal of Ashraf Hassan, Agricultural Experiment Station dairy scientist.

Hassan's research shows that, if reduced fat Cheddar cheese is made with exopolysaccaride-producing cultures as well as debittering cultures, the quality of the cheese is enhanced, making it comparable to full fat cheese products.

FROZEN DESSERTS MAY TASTE RICHER after work by Bob Baer, Experiment Station dairy scientist, and Shishir Ranjan, graduate student. They have found that a higher level of milk fat improved the sensory attributes of ice cream, even though ice cream with lower levels of milk fat has smaller ice crystals.

They also found that double homogenization of the ice cream mix reduces the size of ice crystals, potentially leading to improved texture and greater consumer acceptance.

IMPROVED EFFICIENCY IN CHEESE PRODUCTION AND BETTER UTILIZATION OF BY-PRODUCTS is the project of Vikram Mistry, Agricultural Experiment Station scientist and Dairy Science Department head, and others who have developed a novel procedure of using homogenized cream and ultrafiltered milk in the production of processed cheese.

The procedure significantly increases salt retention and recovery in the cheese. That's an economic advantage for the industry, because less salt needs to be used in making the cheese. Smaller amounts of salt also are left in the whey by-product. Currently, "salt-whey" is difficult to dispose of, because it creates problems in the sewer systems or in soil when it is discarded. Less salt makes it not only easier for cheese manufacturers to handle the whey, it is also better for the environment.

FOOD-BORNE ILLNESSES AFFECT AN ESTIMATED 76,000,000 PEOPLE in the U.S. every year, and Agricultural Experiment Station scientists are working on ways to make the food supply safer.

Several scientists are developing and refining methods to sanitize food effectively. Irradiation is a well-established technique for food safety treatment. The method consists of exposing foods to irradiation with gamma rays or high-speed electrons. It is safe for consumers and highly effective in killing harmful microorganisms, says Jim Julson, Agricultural Experiment Station agricultural and biosystems engineer.

Irradiation, however, can affect the color and taste of the food. So Julson is searching for the optimal level of treatment that kills microorganisms but leaves the sensory quality of the food intact.

OZONE ALSO CAN SANITIZE MEAT. Ozone is a gaseous substance generated from oxygen that can be pumped over meat in a closed container where it kills disease-causing microorganisms on the food. The treatment leaves no harmful residues on the food or in the air. Ozone has been used for decades to sanitize water, but its use with food is relatively new.

One problem with the technique at this point is that it only treats the surface; it does not penetrate the meat, says K. Muthukumarappan ("Muthu"), Agricultural Experiment Station engineering professor and lead investigator in the project. Ozonation is more suitable for products such as roasts, steaks, and lunchmeat and less effective for the treatment of ground beef, where bacteria may be found throughout the product, he says.

WHEN A FARM ANIMAL "CATCHES" A DISEASE, there may also be implications for the health of its handlers. Agricultural Experiment Station scientists in the Veterinary Science Department have made a nationally recognized name for themselves for their research on infectious diseases in animals and humans.

The Animal Disease Research and Diagnostics Laboratory (ADRDL) provides a wide range of veterinary diagnostic services for South Dakota and the region, including testing of brain stem tissues of deceased deer and elk for the presence of chronic wasting disease.

Chronic wasting disease belongs to a group of diseases known as transmissible spongiform encephalopathies (TSE), which are caused by abnormal versions of prion proteins. Other forms of TSE diseases are scrapie in sheep, mad cow disease in bovines, and Creutzfeldt-Jacob disease in humans.

Several Agricultural Experiment Station scientists conduct research on TSE diseases. Alan Young studies the interaction between prion proteins, the immune system, and the nervous system, focusing on early detection of prion-related diseases.

One of his goals is to develop a test for live animals. The research could potentially lead to finding a cure for the disease.

A NEW RESEARCH INITIATIVE in veterinary science will focus on technologies to protect both animal and human health. The project is approved under Gov. Mike Rounds' 2010 Research Initiative Centers Program. The state has awarded $780,000 for the first year of a 5-year program to fund a center for infectious disease research and vaccinology at South Dakota State University, with the cooperation and support of University of South Dakota scientists. Contingent on approval from the South Dakota Legislature, the grant will funnel $3.9 million into the project.

The intent is for the initiative to begin paying for itself over the 5-year period by developing marketable ideas and inventions and by increasing the number of federal grants awarded to South Dakota researchers.

David Francis, who is lead investigator for the project, says the initiative will be engaged in partnership with businesses in South Dakota and Iowa working to develop new products that will generate economic activity in the region.

YOUNG MEN AND WOMEN IN TRAINING to become agricultural and biological scientists are an integral part of the mission of the Experiment Station.

In 2005, the College of Agriculture and Biological Sciences awarded Griffith undergraduate research awards to seven students in disciplines ranging from agricultural and biosystems engineering to agronomy, biology, microbiology, and animal science. Each student received a $500 cash stipend and $2,000 in research funds to carry out proposed research under the guidance of veteran Agricultural Experiment Station scientists.

THE PRAIRIE PH.D. PROGRAM IS ONE-OF-A-KIND. Agricultural Experiment Station scientists provide agricultural education to tribal college faculty and tribal professionals in South Dakota, giving them the opportunity to earn a graduate degree in the agricultural and biological sciences while remaining in their local communities.

Students are primarily taught through distance learning methods such as the Internet and interactive television, as well as short, intensive courses on the South Dakota State University campus.

The program has a cultural component in which American Indian perspectives are reflected in the curriculum and in the students' research projects, which cover subjects important to the tribes. For example, bison production is the focus of several of the Prairie Ph.D. projects, and the research is often conducted in cooperation with the tribal colleges and agencies that employ the students in the program.

INPUT FROM THE PUBLIC remains one of the most valuable ways to determine research priorities in the Agricultural Experiment Station. That's why the Agricultural Experiment Station's Rural Life & Census Data Center conducts surveys of South Dakotans, asking people for their opinions on a variety of issues.

In 2004, the first-ever comprehensive quality of life survey of South Dakotans was conducted by the Center. The results indicated that South Dakotans generally are very satisfied with their lives, says Donna Hess, Center director, head of the Rural Socioology Department, and lead investigator on the survey.

Respondents to the survey especially valued open spaces, greenery, clean air and water, and family and friends. They mainly had concerns about financial security and economic development in their communities.

Survey results will be used by public and community decision makers to identify core issues and make public policy decisions.

OPINIONS ON BIOTECHNOLOGY were the topics of two other surveys conducted by the Agricultural Experiment Station.

From 2000-2004, SDSU was the lead institution of the Consortium to Address the Social, Ethical, and Economic Aspects of Agricultural Biotechnology, sponsored by a $3.7 million grant from the USDA and encompassing research, education, and outreach at five Midwestern land-grant universities.

Results from South Dakota, North Dakota, Iowa, Minnesota, and Wisconsin indicated that producers choose to grow transgenic crops based on economic consideration and practicality and that they have some concerns about the marketability of such crops.

About half of 860 respondents believed that farmers were not adequately informed about domestic and export market risks of transgenic crops. A majority believed that transgenic crops pose no health risk for consumers, but they felt that consumers were not adequately informed about genetically modified crops.

Educating the public about biotechnology was also part of the consortium grant. Catherine Carter, Agricultural Experiment Station plant scientist, and Stephanie Hansen, research associate, provided a 3-day summer workshop for high school science teachers each year during the grant period. They also gave presentations and workshops to children and adults across the state.

A SOUTH DAKOTA-SPECIFIC SURVEY conducted by Evert van der Sluis, Agricultural Experiment Station economist, and Angella Van Scharrel, graduate student, revealed that adoption rates of transgenic crops were higher on larger farms and by younger farmers.

Respondents said that improved pest or insect control was the main reason for adoption. Nearly two-thirds of respondents believed biotechnology benefits South Dakota agriculture, but many felt that they very not well informed about biotechnological issues.◆

In harmony with the ENVIRONMENT

CONSERVATION "GOES HAND IN HAND WITH AGRICULTURAL RESEARCH," says Director Kevin Kephart of the South Dakota Agricultural Experiment Station "Farmers and ranchers are often the people most concerned about conservation, since they depend on natural resources such as soil and water to raise crops and livestock."

STOCKING RATES AFFECT THE MIX OF PLANT SPECIES FOUND IN THE PASTURE. That's known. What isn't known is the proper balance between livestock and plants and just how the pasture or range can be managed to encourage specific species. At the Cottonwood Research Station in western South Dakota, Sandy Smart, Agricultural Experiment Station range scientist, is finding out.

His work suggests that a light stocking rate—using less than 25% of the grass that's available—will result in an ecosystem dominated by western wheatgrass. A moderate stocking rate that uses 25 to 45% of the available grass will result in a western wheatgrass-shortgrass mix. And a heavy stocking rate—greater than 60% percent utilization—results in range dominated by shortgrasses such as blue grama and buffalograss. A shift from cool-season midgrasses to warm-season shortgrasses can result in soil lost to wind and water erosion; a lower nutrient pool available for plant regrowth; less snow capture, which can significantly reduce spring soil moisture; and little forage reserve if emergency feeding becomes necessary.

Now Smart is puzzling over whether multiple-season grazing—splitting the utilization of a summer pasture so that cattle graze some of it in winter when plants are dormant—can allow producers to maintain or improve range quality.

"If we limit defoliation during the grazing season to less than 45% utilization, we know that we can maintain range condition. If we limit defoliation during the grazing season to less than 25%, we know that we can improve range condition," Smart says. "What would happen if we take an additional 20 to 40% during the dormant season? Changes won't show up next year. I'll have to keep the treatments going 4 or 5 years before we can start drawing conclusions."

A different experiment on grazing tracts reserved as winter pastures showed that ranchers can take some grass off those pastures early in the season and still have about as much winter grazing available by snowfall.

"What we found at Cottonwood is that light clipping in May at 25% utilization

had similar amounts of herbage by the following winter as plots that hadn't been clipped at all."

But Smart says the experiment didn't show as much winter forage available in the clipped plots when the experiment was replicated at the Antelope Research Station near Buffalo, possibly because there may have been lower moisture reserves in the soil in northwestern South Dakota.

WHEN PHOSPHORUS REGULATIONS FOR CONCENTRATED ANIMAL FEEDING OPERATIONS were established by the South Dakota Department of Environment and Natural Resources (DENR), the action was a direct result of ongoing research at the Experiment Station.

Frank Schindler, South Dakota State University chemist working on an Agricultural Experiment Station grant, says agronomic practices in South Dakota have led to an increase in soil test phosphorus (STP) over the past 40 years. From 1985 to 2000, the average STP level from manured fields doubled, with the average being higher than needed for optimal crop growth.

Though not a threat to human health, phosphorus can cause algae blooms in lakes and ponds, depleting oxygen so that fish kills can result. Schindler heads a study to establish a relationship between soil test phosphorus and phosphorus loss in surface runoff. The regulations supported by his work allow for absolutely no further spreading of manure on soils once the level of soil-test phosphorus reaches a level of 100 parts per million. At that level, Schindler said, Vienna soil is 25% saturated with phosphorus. Previous research has indicated that 25% phosphorus saturation is an environmentally critical level for sensitive water resources.

NEW TECHNOLOGIES TO MONITOR WATER BODIES in South Dakota will help natural resource managers better identify problems and work with landowners to improve water quality, says Nels H. Troelstrup, Jr., Agricultural Experiment Station biologist.

Students on his team are measuring the quality of water bodies by the variety

of living organisms—invertebrates, aquatic plants, aquatic insects, algae—they support. Certain species, which require very clean water, serve as indicators of potential problems and may even identify the source of a problem.

Gene Steuven, environmental senior scientist at South Dakota Department of Environment and Natural Resources (DENR) , says this monitoring is very helpful to the state. "We are required to submit water quality reports to the U.S. Environmental Protection Agency, and we contract out the work to SDSU and other institutions."

One Agricultural Experiment Station water quality project, funded by the National Park Service, focuses on developing baseline data for aquatic resources within a network of 13 parks in South Dakota, North Dakota, Wyoming, and Nebraska.

In an Environmental Protection Agency-sponsored project, Troelstrup and his students collaborate with the DENR to identify reference conditions for intermittent (seasonal) stream channels in South Dakota.

An Agricultural Experiment Station-funded study aims to develop tools to measure sedimentation impact. When topsoil erodes and enters stream channels, it may carry contaminants that degrade the quality of the water.

"We're looking at what levels of sediment would pose a threat to the organisms that utilize freshwater lakes. Invertebrate populations play a very important role in these aquatic systems, and they are also recognized as important water quality indicators.

"All these projects focus on generating data and information that is useful to resource managers to monitor and maintain the quality of water resources in the state," Troelstrup says.

AN UNFINISHED EXPERIMENT FROM 1921-22 IS HELPING ANSWER QUESTIONS about the long-term impacts of cultivation on some Great Plains soils.

Douglas Malo, distinguished professor and Agricultural Experiment Station soil scientist, and colleagues Tom Schumacher and Jim Doolittle are using data from the old notebooks to help them answer what happens to soils after more than 80 years of cultivation. The three found the actual locations from the 1920s study in Beadle, McCook, Minnehaha, and Union counties by using soil scientist J.G. Hutton's unpublished field notes.

Big changes in soil properties have shown up. Cultivation has caused significant reductions in extractable phosphorus, extractable potassium, surface pH, total carbon, organic carbon, total nitrogen, and in the organic carbon to total nitrogen ratio in the 15-50 centimeter depth. On the other hand, there have been significant increases in nitrate nitrogen, delta carbon, inorganic carbon, and in the total carbon to nitrogen and inorganic carbon to total nitrogen ratios (15 to 100 centimeter depths).

Soil carbon changes at the sample sites probably reflect factors such as carbon mineralization and redistribution of carbon due to erosion, Malo says. Changes in soil nutrients are likely due to crop removal, leaching, erosion, and soil-forming processes.

The baseline data from the study, in conjunction with other studies, will give producers better information on managing soil fertility and give scientists another set of benchmarks when they come back to this work 80 or so years from now.◆

THE FUTURE:
commitment to 'a dynamic industry'

IF YOU WANT TO KNOW WHAT THE FUTURE HOLDS for the South Dakota Agricultural Experiment Station, take a look at its history of success.

Kevin Kephart, director of the South Dakota Agricultural Experiment Station, says some of the requirements spelled out in the legislative language authorizing the experiment stations in 1887 still rank high as priorities of the South Dakota Agricultural Experiment Station today, more than a century later.

The Agricultural Experiment Station as it enters the 21st century remains committed to developing new varieties that can help area farmers—small grain varieties made available directly to growers as public releases and inbred corn and sunflower lines for industry breeders to use in developing new hybrids. Congress's original injunction to study crop rotations also continues, Kephart says.

"Disease, insect, and weed pressures are ever-changing and are directly related to production practices such as no-till and biotechnology. For production agriculture you need a diversity of approaches to disease, insect, and weed control. You also need a diversity of approaches to soil conservation and water quality. There's no silver bullet," says Kephart.

"The future of the South Dakota Agricultural Experiment Station is a commitment to South Dakota agriculture. That doesn't mean a stagnant mission. Agriculture is a dynamic industry."

PRODUCERS OF THE FUTURE WILL HAVE NEW TOOLS at their disposal along with traditional tools, Kephart says. So will the scientists of the South Dakota Agricultural Experiment Station.

"Biotechnology will play an enormous role in our future. South Dakota State University was one of the institutions working on Roundup Ready spring wheat—a project that Monsanto Co. has now deferred. The relevance of that to the future is that it was a partnership between private industry and public variety developers."

Though the Roundup Ready wheat project has been set on the shelf, SDSU has had a similar agreement with Monsanto that allows it to include Roundup Ready technology in SDSU-developed soybean varieties. There will likely be more such partnerships in the future, Kephart says, since SDSU varieties —developed specifically for South Dakota's conditions—are the ideal vehicle for delivering transgenic traits.

Kephart adds that the future will see an unfolding of some trends that are already visible. Programs that capture value and deliver a product to a user—the current South Dakota Certified Beef program, for example—are likely to continue.

"South Dakota and other states are trying to create economic diversity, thereby

reducing our reliance on commodity production. Having a vibrant commodity industry is important as well, however. It wouldn't be a good idea to eliminate commodities. But producers want economic diversity. That includes having the choice to provide a product for the commodity market or to provide a product for the specialty market."

Potential products for that specialty market that are already being developed at SDSU include white wheat, Kephart says. Another is high-selenium wheat, perhaps even high-selenium beef from cattle that have been fed selenium-rich feeds. But finding out how to grow or raise such enhanced products is only one step in delivering them to the consumer.

MOVING INTO THE SPECIALITY MARKET will require segregation procedures, Kephart says.

"We're going to need to identity-preserve these products, and we're going to need mechanisms to deliver these products to the consumer. That might include containers. We may need a tracking system to follow some of these products from the point of production to the point of consumption. In some cases we'll probably need a certification program, as we're seeing with South Dakota Certified Beef.

"So some of the challenges are segregation, identity preservation, IP transportation, and certification. All of these things cost money, so we have to be at least getting enough value out of that product to pay for all those steps in the process and on top of that, that provides extra value to the producer as well. If we can't do that, then we'll have great difficulty with these sorts of challenges.

"So if we develop a white wheat variety that is used for an international market, is there enough extra value in white wheat to pay for those extra steps? Or domestically, if a producer wants to sell a variety we developed that is destined for making whole wheat bread here in the United States, there has to be some extra value in there to pay for the system."

CLEAN RENEWABLE ENERGY WILL BE AMONG THE BIGGEST value-added agricultural products of the 21st century, Kephart adds. That's the focus of the Sun Grant Initiative, an idea that began at SDSU. Its intent is to expand the focus of land-grant universities so that their research, teaching and Extension work include energy and other biobased products.

"It's clear that agriculture is going to be a significant player in energy production in coming decades."

In addition to developing new products, some SDSU research is likely to find spin-off applications. For example, SDSU's Department of Veterinary Science is home to a new Center for Infectious Disease Research and Vaccinology. Some of the new products it is developing for animals—needle-less vaccines, for example—may also have applications in human health.

Whatever the future holds for the South Dakota Agricultural Experiment Station, Kephart notes that he will not be directly overseeing those developments. On Sept. 1, Kephart begins a new job as vice president for research and dean of the Graduate School at SDSU.

"I feel as though I'm leaving one of the best jobs on campus. I'm fortunate to have served as the Experiment Station director for 7 years. It's the most rewarding work I've ever done.

"Every state and territory has an 1862 land-grant university, and every 1862 land grant has a research mission conducted by their Agricultural Experiment Station. The reward comes from leading the Agricultural Experiment Station in this most rural of states, where the economy is dominated by agriculture and the challenges for the future depend on the decisions we make about production, management of natural resources, and engagement of our rural people and communities.

"My approach to directing the South Dakota Agricultural Experiment Station has been to seek out and develop partnerships that work toward the future described above. As my term ends, my sincere gratitude goes out to those partners I've worked with."◆

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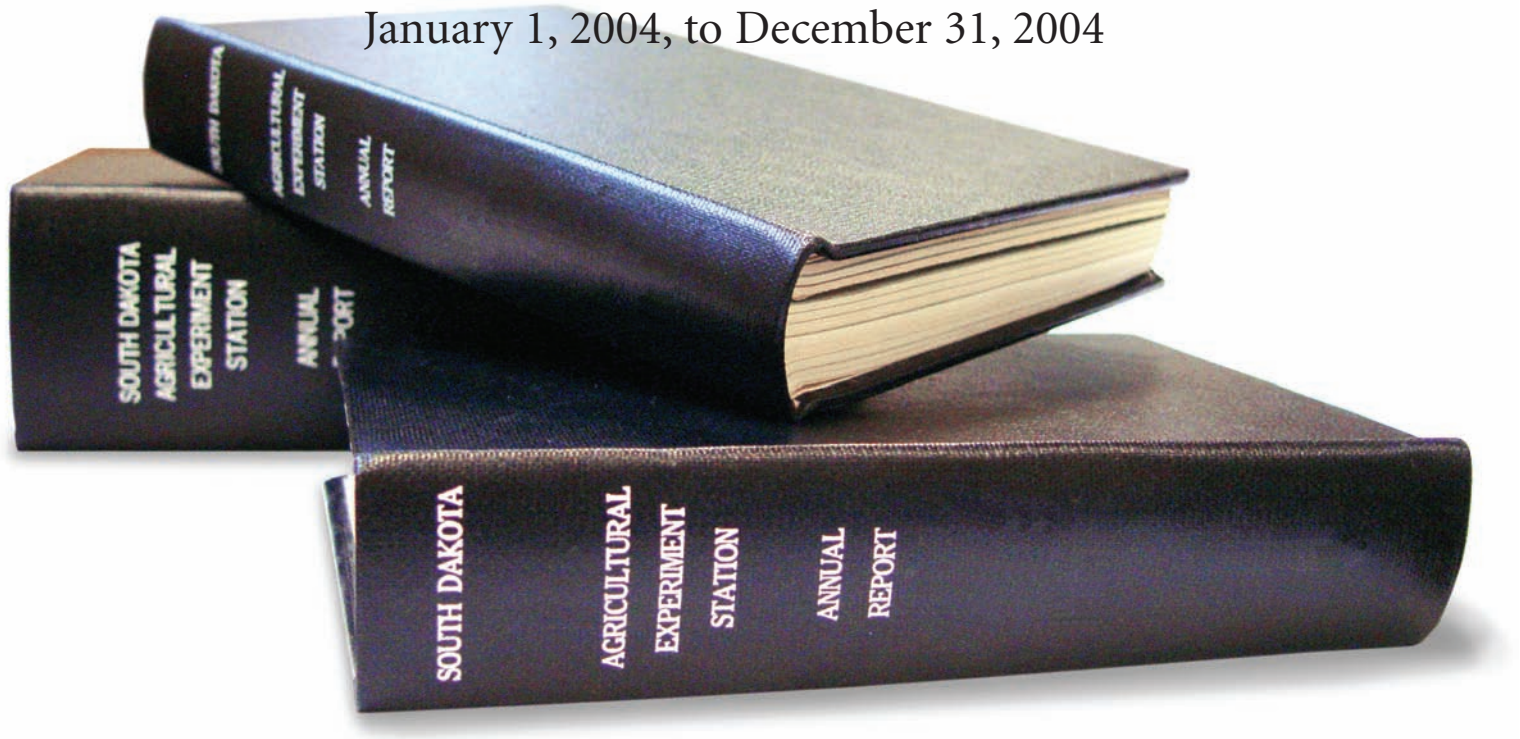

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Wildlife & Fisheries Sciences
C.R. Scalet, Ph.D., professor and head
M.L. Brown, Ph.D., associate professor
K.C. Jensen, Ph.D., assistant professor
J.A. Jenks, Ph.D., professor
D.W. Willis, Ph.D., distinguished professor

AES RESEARCH PROJECT PORTFOLIO

Administration
Sun Grant Initiative; Kephart, Tschetter
Four-State Ruminant Consortium; Kephart, Boggs
Consortium for Alternative Crops; Warmann

Agricultural & Biosystems Engineering
Effect of calcium on functional and structural properties of mozzarella cheese; Muthukumarappan
Effect of cheese calcium and phosphate on functionality and structural characteristics of process cheese; Muthukumarappan, Julson, Metzger
Management of water and biological effluent for crop production in South Dakota; Trooien
Enhancing value of South Dakota agriculturally based materials; Julson, Muthukumarappan, Henning, West
Swine facility design for odor reduction; Hellickson, Pohl, Thaler
Thermal and alternative processes for foods; Muthukumarappan, Julson, Krishnan, Wang
Post-frame building design for reduced environmental impact, increased structural integrity, and energy efficiency; Anderson, Schippull
Engineering technology applied to quality and production issues in Northern Plains agriculture; Humburg, Long, Robert, Kvien, Clay, Carlson, O'Neill, T. Schumacher, L. Schumacher
Impact of climate and soils on crop selection and management; Todey

Animal & Range Sciences
Marbling and fresh meat quality; Maddock
Nutrient utilization and excretion by growing swine; Stein
Minimizing neonatal lamb losses; Daniel, Held, Epperson
Molecular mechanisms regulating skeletal muscle growth and differentiation; McFarland
Hormonal control of growth and reproduction in swine; Clapper
Fertility and reproductive efficiency in cattle; Perry
Production systems to reduce costs and improve reproductive performance of beef cows; Pruitt, Clapper, Epperson, Owens, Patterson, Young
Improving meat quality, Wulf
Nutritional management of health and growth in beef cattle backgrounding programs; Pritchard
Improving economic and environmental sustainability of South Dakota pastures through multiple-season use and stocking rates; Smart
Alternative feeds as energy and protein sources in beef cattle production systems; Tjardes
Grazing patterns and plant responses to grazing on mixed-grass prairie vegetation; P. Johnson, Patterson, Xu, Walker

Biology/Microbiology
Genetic modification to enhance crop quality and insect resistance; Cheesbrough
Nutriceuticals—characterization, evaluation and post-harvest stability—from niche market crops in the Northern Great Plains; Reese
Organic chemicals from biomass; Gibbons, West, Julson
Biotechniques to enhance wheat germplasms; Yen
Bacterial activity at interfaces; Brozel, S. Clay, Bleakley
Analyses of mammalian genes that regulate pigmentation, obesity, fertility, and systemic physiology; Granholm, Marshall, Campbell, Diggins
Biotic integrity in the prairie pothole region and biological responses to priority pollutants, using macroinvertebrates; Troelstrup
Recombinant vaccine development and mechanistic understanding of viral pathogenesis and immunity; Wang
Science and engineering for a biobased industry and economy; Gibbons, Julson

Chemistry/Biochemistry
Calcium signaling during embryonic development in cattle; Sergeev
Characterization of livestock sperm demonstrating susceptibility to DNA denaturation in situ; Evenson
Equipment grant proposal for a freeze dryer system; West
Rigid sorption domains in soil organic matter; Schindler
Microbial biomass conversion into specialty chemicals; West
Analysis of pesticides and related compounds; Matthees
Soy components and cell death in breast cancer; Sergeev
Analytical services; Thiex

Dairy Science
Improving quality and consumer acceptance of milk and dairy products; Baer
Expanding use of whey in food products; Dave
Improvement of the nutritional value of process cheese, management and utilization of dairy byproducts; Mistry, Specker, Vukovich
Strategies for health and productivity of early lactation dairy cows; Hippen, Schingoethe, Kalscheur
Exopolysaccharides-producing cultures in dairy; Hassan
Co-product and traditional feeds for lactating cows; Schingoethe, Hippen, Kalscheur, Garcia
Reducing nutrient losses to the environment from dairy cattle; Kalscheur, Hippen, Schingoethe
Metabolic relationships in nutrients for lactating cows; Hippen, Schingoethe, Kalscheur
Management systems to improve economic and environmental sustainability of dairy enterprises; Kalscheur, Hippen
Modifying milk fat composition for improved nutritional and market value; Schingoethe, Baer, Hippen

Economics
Agri-environmental policy options and implementation based on multifunctionality; Dobbs
Agricultural and rural finance markets in transition; Janssen, Diersen
Perceptions of biotechnology, biotech produced agricultural products, and implications for risk management; Franklin
Value-added agriculture in a changing food and fiber system; Van der Sluis
Value added agriculture: opportunities to capture additional value for South Dakota producers; Taylor, Klein
Representative farm and agricultural land market analysis for South Dakota; Janssen
Rural communities and quality of life; Cumber
Globalization and its implications for agriculture in the U.S. and South Dakota; Qasmi
Enhancing competitiveness of U.S. meats; Fausti
Rural labor market behavior, outcomes, and economic development in South Dakota; Adamson

Family & Consumer Sciences
Soy phytochemicals: chemistry, processing, and health impacts; Wang, Krishnan, Matthees, Scott, Woodard, Julson
Value-added cereals, grains and oilseeds; Krishnan, Wang, Scott, Grady, Muthukumarappan, Doehlert
Promoting healthy families and communities through youth relationship education; Gardner
Interventions to increase fruit and vegetable intake in young adults; Kattelmann
Acquisition of high pressure liquid chromatography system for phytochemical research; Wang, Krishnan, Wixon
Crossing paths: fostering informal social support with native arts groups to promote health among pregnant American Indian women; Wilson
Determinants of household savings behavior; Gorham, Enevoldsen

Horticulture, Forestry, Landscape & Parks
Dormancy and early acclimation responses of woody plants; Fennell
Simultaneous economic impact of forest recreation and forest production at the county level; Stubbles
Monitoring restoration of woody vegetation at the Mortenson Ranch; Johnson
Cultural practices optimizing growth of herbaceous horticultural plants in the Northern Great Plains; Burrows, Fennell, Schleicher, Reese
Native and naturalized germplasm for reduced-input turfgrass in the Northern Plains; Schleicher
Integrating biophysical functions of riparian systems with management practices and policies; Schaefer, Johnson, Boettcher
Multi-state evaluation of winegrape cultivars and clones; Fennell

Plant Science
Winter wheat breeding and genetics; Ibrahim, Langham
Seed Technology Center; Gallenberg, Turnipseed
Biological control of fusarium head blight and other wheat diseases; Bleakley
Pedology information transfer for South Dakota; Malo, Doolittle, Schumacher, D. Clay, S. Clay, Carlson, Gelderman, Ellsbury, Lee, Lindstrom
Information support for pesticide use in minor crops; S. Clay
Nematodes associated with soybeans; Smolik
Influence of potassium (K) rate, placement, in-season treatment, hybrid, and tillage on K deficiency in corn; Gelderman
Host-parasite interactions between small grains and their fungal pathogens; Jin
Spring wheat breeding and genetics; Glover
Site specific management using weed interference data across landscapes; S. Clay
Water and soil management for maximizing returns to agriculture; Kohl, Bleakley, Johnson, Schumacher, Carlson
Carbon sequestration and distribution in soils for eroded landscapes; T. Schumacher
Sunflower breeding and alternative oilseed crops for South Dakota; Grady
Tillage and crop rotations for eastern South Dakota; Berg
Linking soil characteristics, remote sensing, simulation models, and enterprise analysis through GIS to improve site specific management; D. Clay
Grain production practices that increase soil organic carbon; Woodard
Characterizing weed population variability for management decisions that reduce herbicide use; S. Clay
Assessing nitrogen mineralization and other diagnostic criteria to refine nitrogen rates for crops and minimize losses; D. Clay
Reducing potential for environmental contamination by pesticides and other organic chemicals; S. Clay
Soybean breeding, genetics, and production; Scott
Breeding perennial grasses and legumes for forage, biomass, wildlife habitat, conservation, and tolerance to stresses; Boe
Molecular markets for soybean; Carter
Drought and freeze survival of winter wheat: a genomics approach; Sutton
Development of management practices for a diversified and sustainable cropping system in western South Dakota; Nleya
Technology to increase agronomic productivity and producer profitability; Carlson
Fungal pathogens of row crops; Chase
Linking ecological and soil property information to improve site specific management; D. Clay, S. Clay, Batchelor, Ellsbury, Carlson, Dierson, Malo, Dalsted
Oat varieties for South Dakota; L. Hall
Bison culture; Rickerl
Plant viruses in South Dakota; Langham
Breeding and genetics of forage crops; Boe
Rootworm management and ecological considerations; Fuller, McManus
Soil management in degraded landscapes; T. Schumacher
Conservation, management, enhancement and utilization of plant genetic resources; Boe
Use of spectral radiance to quantify N status in crops; Beck

Corn breeding and sustainability; Wicks
Systematics of click beetles and wireworm in North America; Johnson
Soil quality and bioavailability of excess constituents in South Dakota ecosystems; Doolittle
Management and persistence of forages for animal feed and as renewable resources; Owens, Boe, Catangui, Doolittle, Albrecht, Sheaffer, Cuomo, Berdahl, Hanson
Plant Science farm; Kohl
Plant Science greenhouse and seedhouse maintenance; Gallenberg
Seed certification; Pollmann
Seed testing; Turnipseed
Variety testing; Hall
Survey entomologist; Fuller
Foundation Seed Stock; Ingemansen

Rural Sociology

Rural low-income families: tracking their well-being and function in an era of welfare reform; Hess
Generational transfer of alternative farms in the Northern Great Plains; Redlin
Rural Life Census Data Center; Hess
Consortium to address social, economic, and ethical aspects of biotechnology; Hess

Veterinary Science

B cell subset development and function in domestic animals; Young, Nelson, Daniel
Role of intestinal epithelial cells in mucosal immunity of domestic animals; Kaushik
Biochemical basis for genetic resistance to K88 E. coli; Erickson
Maternal regulation of neonatal immunity; Young, Daniel
Surveillance, diagnosis, and therapy of transmissible spongiform encephalopathies; Young, Graham
Genomic quasispecies associated with the persistence and pathogenesis of porcine reproductive and respiratory syndrome virus (PRRSV); Benfield
Evolving pathogens, targeted sequences, and strategies for control of bovine respiratory disease; Chase, Epperson
Porcine reproductive and respiratory disease control, prevention, and elimination in U.S. swine herds; Christopher-Hennings, Nelson
Parasite issues in South Dakota beef production; Hildreth
Antimicrobial sensitivity and characterization of Campylobacter isolates from ovine abortions; Epperson, Holler
Lung lesions in lambs; Epperson, Holler, Held
Anti-diarrhea substances in pigs; Francis
Genetic analysis of PRRSV attenuation; Ropp
Bovine viral diarrhea virus: diagnosis and mechanisms of pathogenesis; Chase, Lemire
Enteric diseases of swine and cattle: prevention, control, and food safety; Francis, Nelson, Young

Wildlife & Fisheries Sciences

Yellow perch fingerling production and harvest methods for ponds and small glacial lakes in eastern South Dakota; Brown, Scalet
Merriam's wild turkey in the southern Black Hills of South Dakota: survival, recruitment, movements, habitat use, and farmstead dependence; Jensen
Landscape ecology of white-tailed deer in agro-forest ecosystems; Jenks
Prey fish dynamics in South Dakota waters; Willis
Intrasexual variation in digestive efficiency of white-tailed deer, Jenks
South Dakota Cooperative Fish and Wildlife Research Unit; Berry, Higgins

Operating Budget

South Dakota Agricultural Experiment Station

Fiscal Year 2005

Salary & benefits	$11,134,480	88.3%
Operating	$1,479,008	11.7%
Total	**$12,613,488**	

SOUTH DAKOTA STATE UNIVERSITY
College of Agriculture and Biological Sciences
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Brookings, SD 57007
Kevin Kephart, Director

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