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Farm and Home Research: 55-2

Lance Nixon

Marianne Stein

Utilizing and developing our resources to enhance quality of life

Farm & Home RESEARCH

Volume 55 • Number 2

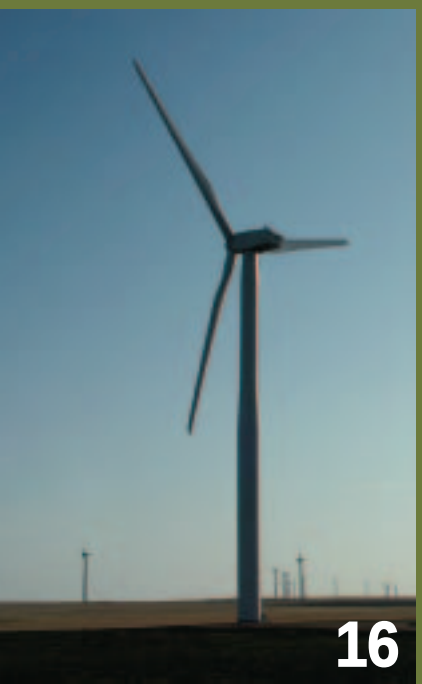
South Dakota State University · College of Agriculture & Biological Sciences · Agricultural Experiment Station

HARVESTING 'GREEN' WIND

BIOSAFETY: PROTECTING OUR FOOD SYSTEMS

116TH ANNUAL REPORT

CONTENTS



On the cover:

Ken Higgings, SDSU Wildlife and Fisheries Sciences Department, and Dennis Todey, Agricultural and Biosystems Engineering Department, return to the first wind farm field at Buffalo Ridge, Minn., where Higgins and an "A Team" compiled the first scientific documentation in the Northern Plains region of bird mortality caused by wind turbines. Todey and Mike Ropp, SDSU Electrical Engineering Department, are now collaborating on finding choice wind farm locations in South Dakota. See stories beginning on page 16.

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Director's comments

BY KEVIN KEPHART
Director, South Dakota Agricultural Experiment Station

LEAVING my comfort zone

Fred A. Cholick

Left to right, Kevin Kephart, Sandy Rusten, and Fred Cholick

When my wife Cathy and I moved to South Dakota 23 years ago, neither of us realized how much we would become attached to SDSU and the state and its people. You have given me opportunities beyond my wildest dreams.

Your warm welcome offset the chilly reception from the weather. We didn't see the mercury rise to zero for 3 weeks after our arrival. That period of cold, the rural isolation, the dry countryside we had traveled through convinced me that here was the perfect place for a new spring wheat breeder to make a difference.

I have enjoyed my time here while I was wheat breeder, head of the Plant Science Department, director of the Agricultural Experiment Station, and dean of the College of Agriculture and Biological Sciences. It's been a blast.

But perhaps it's become too comfortable. Change doesn't happen when a person is "comfortable." And change is a constant; things **will** happen. If nothing else, consider that we all change as we grow older.

So, as much as I'm going to miss the friends I've made in these 23 years, it's time to change, to get out of my comfort zone, to explore new opportunities. This fall I will become dean of the College of Agriculture and director of Research and Extension at Kansas State University. I leave with regret and anticipation of new challenges and new personal growth to come.

Some things don't change, however, and that's the commitment of SDSU and this College to the people of South Dakota. We serve people, agriculture, and science, and you see that you come first on that list. You define the direction we should go in our research, what we should teach in our classrooms and labs, and what information we should bring to you in the field, feedlot, or family home.

And so, in this annual report issue of Farm & Home Research, we again bring you stories that illustrate our goal to improve the quality of life of all South Dakotans, rural and urban. Here are our objectives ; you will see them at the beginning of each story:

- an agricultural system that is highly competitive in the global economy,
- a safe and secure food and fiber system,
- a healthy and well nourished population,
- greater harmony between agriculture and the environment, and
- enhanced economic opportunity and quality of life.

I hope that I have contributed my part to moving South Dakota forward. Putting knowledge to work is what we're about, and it was rewarding to see new wheat varieties growing in South Dakota fields that I had a hand in creating.

It was rewarding as department head to integrate and encourage teams of soil scientists, plant breeders, and plant pathologists to work together, and to watch our graduates go into successful careers and leadership positions around the world.

Again, it was rewarding as director of the Experiment Station to help determine the research base that would become useful knowledge for our producers. A lot of people think it's a drag to read, every year, 150-plus research progress reports, but that was the point where I learned to appreciate the "big picture"—how natural resources, animal health, family issues, and economics, for example, integrate into production agriculture.

Last of all, it was rewarding to be dean for 6 years, to work with central administration of SDSU and to help it expand economic development in South Dakota. I have greatly appreciated the input and counsel from all my colleagues at SDSU and from the citizens across the state of South Dakota. You were excellent teachers.

I am leaving many good things behind as I move on, the best of which are the people of South Dakota. Continue forward into the future, use change to your benefit, and my best wishes to each of you. Thank you.◆

Amir Ibrahim, South Dakota State University winter wheat breeder

A noodle wheat coming up

Most of the hard red winter wheat grown in South Dakota is sold in the U.S.

The first-ever white wheat lines from the South Dakota State University breeding program may be released as early as 2004. Food processors in Asia will be likely markets.

Hard white winter wheat has two main uses, explains Amir Ibrahim, winter wheat breeder at SDSU.

It is used for making whole grain breads because the flour it produces is whiter in color and less bitter in taste than flour made from red wheat. It is ideal for making noodles for the same reasons.

"There is a growing local noodle market in the U.S. And there is a big market dominated by Australia in Southeast Asia," says Ibrahim.

Padmanaban Krishnan of the Department of Nutrition, Food Science and Hospitality adds that white wheat is in demand not only for the nutritional value it possesses but also for what it lacks.

White wheat doesn't have the pigments found in red wheat, which are associated with bitterness as well as color.

"It's a color issue, but it's also a sensory issue, a taste issue," Krishnan says.

Although the bitterness can be dealt with in processing, white wheat has a built-in advantage, says Ibrahim.

"You can add sugar in processing and that will take care of the bitterness associated with the red wheat, to some extent. But whole wheat bread from white wheat would be a healthier choice because there is no sugar added in processing."

White wheat is naturally low in an enzyme called polyphenoloxidase that causes discolored noodles. That's why Asian food processors often prefer white wheat for making some kinds of noodles, Ibrahim adds.

THE SOUTH DAKOTA WHEAT COMMISSION helps fund SDSU's white winter wheat breeding program through wheat checkoff dollars. Randy Englund, executive director, says growers in South Dakota and elsewhere in the U.S. will probably be interested in hard white winter wheat for some time to come.

"If we're going to compete in certain markets, we're going to have to offer white wheats," Englund says. "We do offer some white wheats currently, grown in the Pacific Northwest, but those are soft whites."

In comparison, hard white winter wheat often has higher protein content than soft whites. It also allows for greater flour extraction because of the hardness of the kernel, Englund says.

He adds that Asia would not be the only market for hard white winter wheat.

"There is another export market for hard white winter wheat in the Middle East and North Africa where flatbreads are popular," he says.

A noodle wheat is SDSU's earliest potential release. Another coming up for potential release in 2005 or 2006 has good bread-making qualities. The breeding program began in 1993, when the first crosses of white wheat lines were made. Ibrahim took over the work of his predecessor, Scott Haley, when he arrived in 2000.

"In 4 to 6 years we might have a white wheat that combines excellent noodle and bread-making qualities," Ibrahim says.

WHITE WHEAT OFFERS a unique challenge to plant breeders. Its seeds tend to sprout in the head.

"If it rains continuously for more than 2 or 3 days around harvest time, sprouting can be a problem," Ibrahim says.

It is thought that the gene that controls the kernel color also controls the sprouting mechanism, so that white wheats are more prone to it than red, Ibrahim adds.

Though SDSU has achieved some success in counteracting sprouting, Ibrahim says the first hard white winter wheats released by SDSU will likely be recommended only for West River growers, where drier conditions offer some security against the danger of wet weather at harvest.

That may work to the advantage of some West River growers, says Englund.

The area just west of the Missouri River is often rich in selenium, he says. Wheat is one of the plants that can take selenium out of the soil and store it in the grain. Buyers in southeastern Asia, which is deficient in selenium in many places, may be all the more eager to buy hard white winter wheat if it has high selenium content.

The South Dakota Wheat Commission already is funding a separate study in which James Doolittle, SDSU soil scientist, and a graduate student researcher are looking at how agronomic practices can affect selenium uptake in wheat.

Ibrahim is also monitoring for selenium content in white wheat trials near near Kennebec, Wall, and Winner.

"I don't think there is a difference between white wheat and red wheat in terms of taking up selenium from the soil. It's just that white wheat would be an ideal vehicle, since you are targeting those markets in which the population is deficient in selenium, and where the people also like to eat noodles."◆

—Lance Nixon

David Zeman, South Dakota State University's Animal Disease Research and Diagnostic Lab director

Biosafety:
protecting our food systems

The issue of biosecurity in agriculture took on new importance after the terrorist attacks of Sept. 11, 2001.

"9/11 put an exclamation point behind some things we'd been concerned about for some years," says David Zeman, director of South Dakota State University's Animal Disease Research and Diagnostic Lab (ADRDL).

Extension Plant Pathologist Marty Draper, SDSU's liaison to the Great Plains Diagnostic Network, says the same is true for scientists monitoring plant diseases.

Plant and animal health scientists have been concerned for decades about new pests or new plant and animal diseases sneaking into the U.S. through natural means—say, windborne spores—or accidental introductions, as when a new insect might arrive in imported wood. But the attacks of Sept. 11 underscored the possibility of malicious introduction as yet another factor to consider.

"What we're really talking about is protecting our food systems. Being vigilant against possible bioterrorism is only a piece of that," Draper says.

ABOUT HALF A MILLION TIMES EACH YEAR, the scientists of the ADRDL perform a diagnostic test to find out what is making a particular animal sick.

"We are the first line of defense, along with the veterinary practitioner and the producer, in identifying any new disease syndrome that comes down the pipeline," says Zeman. The ADRDL serves South Dakota and nearby areas of Minnesota, Iowa, and Nebraska—a region with a very large population of animals and an agricultural economy that leans heavily on livestock.

Zeman points out that South Dakota's experience with West Nile virus in animal populations is a good example of why new animal diseases can be so serious.

"If you get a new disease moving through an area that's never seen it before, it's like dry kindling. It moves like wildfire," Zeman says.

"That's what we saw with West Nile virus as it moved across the country. Our crows and blue jays and several other species of bird were highly susceptible because they were naïve—never before exposed to the virus. We saw a lot of birds dying. We also saw with the first wave that a lot of horses became ill, and many of them died. Now we're starting to see our populations adjust a bit. We're probably seeing some herd and flock immunity developing."

As it has in other parts of the world, West Nile virus will more than likely become endemic, Zeman says. That means that although the disease loses the punch it had during the initial outbreak, it will likely settle down into a low level of activity in the region.

INCREASING WORLDWIDE TRADE of animals and animal products and the ease with which people travel make it all the easier for animal diseases to move from one country to another, Zeman says.

"As if that wasn't enough, since 9/11 we've become acutely aware that we also have to be concerned about people who purposely want to bring in things that will create diseases in our populations of animals for political reasons."

A list of "foreign animal diseases" not found in the U.S. has been drawn up by animal health officials.

"If you get a new disease moving through an area that's never seen it before, it's like dry kindling. It moves like wildfire. That's what we saw with West Nile virus as it moved across the country."

—Dave Zeman,
SDSU Animal Disease Research and Diagnostic Laboratory

"Diseases known to have a high mortality or high morbidity or diseases known to affect trade potential are the ones we're concerned about," says Zeman.

Foot and mouth disease is probably at the top of the list. The family of diseases called transmissible spongiform encephalopathies (TSEs), such as BSE or mad cow disease, also is a concern. Diseases that have been eradicated in the U.S. but persist in other countries, such as hog cholera—still found in Caribbean nations—also remain an issue.

STATE ANIMAL HEALTH LABS, such as the ADRDL, which generate about 95% of all animal health data in the United States each year, already had been forging a better working relationship when the terrorist attacks came.

State labs are accredited by an organization called the American Association of Veterinary Laboratory Diagnosticians (AAVLD).

In year 2001 the AAVLD signed a memorandum of understanding with the USDA Animal and Plant Health Inspection Service (APHIS). One of the first actions under that memorandum was to begin development of the National Animal Health Lab Network.

Extension Plant Pathologist Marty Draper, SDSU's liaison to the Great Plains Diagnostic Network.

"It's basically a mechanism for us to deal with issues that go beyond our state borders and maybe even beyond our region," Zeman says.

The ADRDL is part of a network of prion test labs, for example. The prior theory maintains that prions are infectious protein particles that transmit TSEs.

The network activates when a producer calls his veterinary practitioner to investigate a sick animal. The veterinarian often forwards a specimen or sample to the ADRDL for testing.

If it's a new or emerging disease, the ADRDL typically turns to a Federal Animal Disease Reference Lab to confirm the first diagnosis. The ADRDL also works closely with Lynn Tesar, the federal veterinary medical officer in charge of South Dakota in Pierre.

On the state level, the ADRDL can call on South Dakota State Veterinarian Sam Holland.

Holland has put together what is called the South Dakota Reserve Veterinary Medical Officer Corps, made up of veterinary practitioners across the state.

The corps could respond in times of animal health crisis to help with an emergency testing campaign, for example, if an outbreak of some disease is suspected.

WITH VARIATIONS, THE SAME TYPE of networking is in place for plant and insect diseases.

SDSU is one of the land-grant institutions making up the Great Plains Diagnostic Network (GPDN), a consortium of land-grant institutions that provide services for plant disease diagnosis, plant identification, and insect/pest identification.

The GPDN has set up a software platform to process diagnostic requests and share information among the different diagnostic laboratories.

Draper says the great advantage of the network is that it links scientists throughout area states in responding to new threats to crops. States outside the Great Plains are grouped in four other regions. Together those five regions make up the National Plant Diagnostic Network.

"It's pooling the expertise of everyone in the region, and really everyone in the nation," Draper says.

Draper can examine, via the Internet, what's on a colleague's microscope in another state perhaps a thousand miles away.

"That's a real-time streaming image. If you've got something on the microscope that's moving, it will be moving on the screen in Amarillo, Texas, even if I've got the actual specimen here in Brookings," Draper says.

"I can ask scientists more familiar with this problem what this digital image is showing. They can tell me if I'm on the right track. Or they might say, 'You'd better send me a physical sample.' In any case I've made connection with the expert on that disease."

The system also relies on "first responders." Those include county agronomy educators of the South Dakota Cooperative Extension Service, as well as private crop consultants. All first responders are trained to recognize exotic diseases or pests, and they know the procedures to follow when they find one.

"The first big test of the Great Plains Diagnostic Network is going to be soybean rust. That is the most imminent introduction of an exotic plant pathogen. This is potentially a huge problem since we have 148 million acres of soybeans in the U.S. in 36 states."

—Marty Draper,
SDSU Extension plant pathologist

"The key is that they recognize one of these bad diseases or at least something that they can't identify, then they get it here to our diagnostic lab," Draper says.

"In most cases we will know what it is. But if it is a new exotic pest, individual state labs may not be authorized to provide a confirmatory diagnosis. In a case like that, the sample would be sent to the USDA-Agricultural Research Service lab in Beltsville, Maryland, or some other expert lab."

IT WON'T BE LONG BEFORE the system will face a real-life threat, Draper predicts.

"The first big test of the Great Plains Diagnostic Network is going to be soybean rust. That is the most imminent introduction of an exotic plant pathogen," Draper says.

So-called Asian soybean rust was first detected in the Western Hemisphere in 2001, when it was found in Paraguay in South America. Rust has been working its way north toward North America.

"This is potentially a huge problem since we have 148 million acres of soybeans in the U.S. in 36 states. There's not enough fungicide in the U.S. to treat those acres," Draper says.

"Soybean rust will get here. It could be in 2004. It can get here through intentional release, or bioterrorism. It can get here through accidental introduction, maybe somebody carrying spores back to the United States on their clothes. Or it can get here through natural introduction, which will happen eventually anyway.

"We don't know when it's going to get here, but we have to be out there scouting for it. This is a disease we don't want to get ahead of us. Once it gets established in a field, we won't catch up."

THAT EXPLAINS WHY DRAPER and his colleagues run sample simulations, working through the procedures they'll follow the next time an exotic plant disease does reach the U.S.

"I never know when I might get a FedEx envelope or a U.S. Mail overnight envelope with a note inside that says, 'I am a possible soybean rust sample, kick the process into gear.'

"I will do my preliminary diagnosis and document when I received it, when I made my diagnosis, what I've done with it after that, how I've handled it."

Then, in the simulation, just as in real life, Draper sends the sample on to a regional lab at Kansas State University and also to the federal lab in Beltsville, Md.

"So far there's only one simulation that's taken more than 3 days. It happened for the reasons we'd expect it to happen—people that need to handle the samples weren't in the office for one reason or another and the sample was received late in the week. We're trying to work out potential problems to assure the quickest response time possible."

THERE'S STRONG FEELING among plant pathologists that with some other exotic plant diseases that made recent footholds in the U.S.—citrus canker and Karnal bunt, a wheat disease—there was too much reacting and not enough forethought, says Draper.

Karnal bunt was found in 1996 in Arizona. An Asian strain of citrus canker was found in Florida in 1995, though the U.S. had controlled previous outbreaks of citrus canker in 1986 and 1910 with eradication programs.

By keeping the network on its toes and responding swiftly once a new pest or disease arrives, Draper says plant scientists not only can form ideas of when a pest arrived, but possibly even clues about how it arrived.

"It's hypothesized that soybean aphid was carried in through O'Hare Airport. Whether that was on an airplane or on some person, we don't know. But it looks like Chicago was the entry point."

But Draper adds that even the best network can't answer major questions until an exotic pest or disease arrives.

"We're never going to know for certain how a particular new pest is going to interact with our environment, how fast that thing takes off and how destructive it's going to be," Draper says. "With some diseases out there, we could be called the little boy that cried wolf. Some of them may not be well adapted to South Dakota. But by the same token, there are organisms out there that would be very well suited to the South Dakota environment. We need to be ready."◆

—Lance Nixon

Rajiv Dave, South Dakota State University dairy scientist

Some day whey isn't thrown away

A jolt of calcium in your coffee? One that gives up to 20% of the recommended daily allowance of calcium in just one cup of java?

A yogurt even better for you than those now in the grocery store? One higher in calcium for good bone health?

Rajiv Dave, South Dakota State University dairy scientist, envisions a day when some whey products—now considered waste from making cottage cheese—may become more important than the cheese itself to the dairy sector.

ACID WHEY SOLIDS REPLACE about 10 to 12% of the nonfat dry milk in fermented dairy products such as yogurt in a process developed by Dave.

He explains that yogurt typically contains about 4.5% milk protein, usually from sources such as milk and nonfat dry milk. Acid whey is a cheaper source of milk protein than nonfat dry milk.

"It also packs additional consumer health benefits," Dave says.

Acid whey has a high concentration of calcium, an important component of healthy bones. Yogurt made with part acid whey is slightly higher in calcium.

Acid whey also contains predigested nitrogen in the form

"... it would change the world of the coffee shop."

—RAJIV DAVE
SDSU DAIRY SCIENTIST

of peptides and amino acids. Using acid whey in yogurt can improve the growth and viability of helpful bacteria," he explains.

"The yogurt is as good as the control when fortified at a level of 0.5% protein from acid whey, so there is no quality compromise when cottage cheese whey solids are used."

Whey is a collective term referring to the watery part of milk left over in the process of making cheese.

Cottage cheese whey and acid casein whey are both sources of acid whey. Acid whey, with a pH of 4 or less, has had only limited use in food products.

Dave believes only the cottage cheese whey has promise as a component in yogurt because acid casein whey lacks the predigested nitrogen that can add health benefits. Acid casein whey also adds an undesirable taste to yogurt that taste-testers in the SDSU study could detect.

Companies now dispose of acid whey by either providing it to farmers who feed it to livestock or apply it as a nutrient in irrigation systems. But the high levels of acid, phosphate, nitrogen, and mineral salts in acid whey can result in high soil salinity and other environmental problems.

Dave believes the SDSU study could provide the dairy industry with an alternative use for cottage cheese whey, alleviating its disposal impacts. His study was funded in part by Dairy Management Inc., which manages the national dairy checkoff program.

MAKING POWDERED COFFEE CREAMER from mineral-rich whey concentrate is the goal of another project.

That isn't as easy as it sounds, Dave says. Whey concentrate, though it dissolves in acidic beverages such as juice, does not adequately dissolve in beverages such as coffee or tea that are not acidic. Dave is developing processing technologies to improve the solubility and "mouth feel" of whey mineral concentrate in liquids such as coffee and tea that have a neutral pH.

Whey mineral concentrate—created by further processing of the whey that is a byproduct of cheese production—is about 15 to 20 times richer in calcium than milk. But the lack of solubility and a gritty mouth feel in neutral pH beverages prevent the food industry from using whey-derived mineral supplements in such products as coffee creamer.

Dave has been looking at one possible solution with colleagues Ashraf Hassan, an assistant professor of dairy science at SDSU, and Lloyd Metzger, assistant professor of food science at the University of Minnesota. The researchers have used whey mineral supplements as the medium to grow starter cultures producing neutral and phosphorylated exopolysaccharides.

HE ADMITS THAT'S A MOUTHFUL of a word but also says that consumers already are familiar with exopolysaccharides.

"That thick, pudding-like consistency and creaminess in yogurt is because of exopolysaccharides," he says. "Exopolysaccharides absorb free moisture and they are very pleasant in your mouth, giving that rich, creamy, and appealing mouth feel."

The researchers believe that in the proper ratios, the phosphorylated exopolysaccharides will help reduce or eliminate the gritty mouth feel of whey mineral concentrate. The exopolysaccharides can interact with calcium to limit the size of the calcium-phosphate complexes present in whey mineral concentrate. That could allow the concentrate to dissolve better.

The SDSU research, funded by the Midwest Dairy Association, has already shown that the whey mineral concentrate supports the growth of the helpful exopolysaccharide-producing bacteria.

No other research has done that previously, Dave says.

Further SDSU research will standardize the conditions for growing the exopolysaccharides, evaluate how well the product dries, then evaluate how it performs when the dried product is added to neutral beverages such as coffee or tea. The SDSU study proposes testing the supplement at a level that, when added to coffee or tea, would add approximately 20% of the recommended daily allowance of calcium per serving.

If the research is successful and finds commercial applications, it could indirectly boost the use of dairy products while helping consumers build stronger bones, Dave says.

"One or two teaspoons of the product would give the equivalent amount of calcium you find in a glass of milk. It would change the world of the coffee shop."◆

—Lance Nixon

Grilling: a guy thing

Americans love to grill. Eighty-one percent of families own at least one grill, and the typical grill owner cooks outdoors 22 times during the grilling season. More than 14 million grills were sold in 2003, according to data from the Hearth, Patio & Barbecue Association.

"Grilling is very popular for number of reasons," says Duane Wulf, South Dakota State University meat scientist. "It gets you outside, it's a way to spend family time, there's very little clean up, and it gets men involved in cooking."

The popularity of barbecuing was the impetus for a two-part study by Wulf and Robert Maddock, also an SDSU meat scientist, and Brock Streff, graduate student.

Gas grills make up 63% of all grills owned, while most existing research and cooking instructions pertain to charcoal grills.

The SDSU study was conducted in two phases. "The first tested those persistent myths regarding the best way to grill a steak. The second evaluated seven different cuts at two degrees of doneness," Wulf explains.

STREFF GRILLED MORE THAN 1,400 STEAKS and presented them to a taste panel of 12 people trained in sensory testing. The panelists evaluated the steaks for tenderness, juiciness, and beef flavor intensity, as well as salt and pepper flavor (in some of the treatments) and presence of any off flavors. Steaks were also evaluated for tenderness using shear force, which is an objective, mechanical measure.

Results from the taste panel evaluations of steaks from 30 USDA Choice strip loins provided clear answers to many questions about the best grilling techniques and, according to Wulf, "debunked some persistent myths" in the process. Here's what the scientists learned:

- Steaks that were flipped often (every 2-3 minutes) during cooking received higher scores on juiciness than those flipped once.
- Steaks that were started out on high heat and finished on low cooked in a shorter time, but there were no differences in tenderness, juiciness, flavor intensity, or overall desirability between them and steaks cooked at a constant medium heat.
- Steaks at room or refrigerated temperature at the start of grilling had shorter cooking times and higher tenderness and flavor intensity ratings than steaks started frozen.
- Keeping the lid of the grill open resulted in longer cooking times, but palatability ratings were the same as steaks cooked with the lid closed.
- Panelists found the same degree of saltiness in steaks seasoned with salt and pepper either before or after grilling. Some cookbooks say that salting before grilling will draw the moisture out of the meat but, in this research, steak juiciness was not affected by salting before grilling. Pepper flavor ratings were lower when the pepper was applied before cooking, indicating that some of the pepper is burned off during grilling.

THREE CLASSIC MEAT CUTS—ribeye, tenderloin, and top sirloin—and four innovative cuts—flat iron (infraspinatus), ranch cut (triceps brachii), boneless short rib (serratus ventralis), and round tip center (rectus femoris)—were evaluated for cooking time, shear force, tenderness, juiciness, flavor intensity, overall desirability, and off flavors in the second phase of the study.

"The last four muscles currently go into roasts or ground beef, but they could be value-added if marketed as steaks," Wulf says. "Flat iron is especially promising.

"Probably the best steak was the round tip center. The flat iron and the ranch cut also ranked high, while the boneless short rib did not do quite as well."

Overall, the innovative cuts were rated on par with the traditional cuts, and there is no reason not to market them as steaks, Wulf concludes.

All cuts were tested at three grades: USDA Top Choice, USDA Select, and Enhanced Select. Enhanced, also known as deep marinated, is a process by which the meat is pumped with a solution of water, salt, and tripolyphosphate, a routine process with other meats such as chicken, turkey, and pork. Studies have shown that consumers prefer enhancement, because it keeps the meat juicy and tender, especially at high degrees of doneness.

"[Flat iron, ranch cut, boneless short rib, and round tip center] currently go into roasts or ground beef, but they could be value-added if marketed as steaks."

—Duane Wulf,
SDSU Department of Animal and Range Sciences

Duane Wulf, South Dakota State University meat scientist

Improved palatability was also noticed in this study. Top Choice, a more expensive cut, scored higher than Select, but Enhanced Select scored best of all in the palatability ratings.

DEGREE OF DONENESS AFFECTED PALATABILITY, but of some cuts more than others, Wulf says. The scientists tested steaks at two different points, 145 and 175 degrees Fahrenheit internal temperature. Overall, palatability ratings went down as cooking time went up.

This would suggest, Wulf says, that steaks should be grouped at the grocery store meat counter according to recommended degree-of-doneness.

All seven cuts work fine when cooked medium rare, but if medium well is preferred, the best choices are tenderloin, flat iron, or ranch cut, he adds.

"Overcooking interferes with palatability, and it also destroys more vitamins. People may want to cook their meat thoroughly for food safety reasons, but that is unnecessary.

"With steaks you only need to worry about contamination on the outside. Muscle is basically sterile. Any bacteria that are present come from the environment during processing and handling, and the risk that they will enter the inside of the steak is minute.

"This is different from ground beef, where everything has been mixed together, and it is important to cook the meat to 160 degrees throughout. With steak you only need to ensure that the outside is properly cooked."

Wulf, Maddock, and Streff have produced a brochure, Great Steaks From Your Grill, which includes grilling tips and advice based on their research. The brochure is available from the SDSU Animal and Range Sciences Department. The research and the brochure were partially funded by South Dakota Beef Industry Council. ◆ —*Marianne Stein*

How to grill the perfect steak on a gas grill

1. Thaw steak completely before grilling.
2. Start grill, set control(s) to medium, and close lid.
3. Allow grill to warm for 5-10 minutes with lid closed.
4. Before grilling, pat the steak's surface with paper to remove surface water.
5. Season either before or after grilling (some spices such as peppers and herbs may burn off during grilling).
6. Grill steak on medium heat with lid closed, turning every 2 to 3 minutes until desired internal temperature is reached.
7. Let steak stand for 5 to 15 minutes before serving to redistribute the juices.

Any size works

What's the right size for a ribeye steak? Just about any size, according to scientists at South Dakota State University.

The beef industry currently recommends that the ribeye muscle be 12 to 15 square inches, which results in a 10 to 12 oz steak at a thickness of one inch.

But this is based on the needs of the food service industry, says Duane Wulf, meat scientist in the SDSU Animal and Range Sciences Department. "Restaurants cut mostly 10 or 12 oz steaks, so they need a consistent size ribeye. If it's too small, they must cut the steak too thick, and if it's too big, they must cut the steak too thin. So research has shown that a 12 to 15 square inch ribeye is best for restaurants."

But what do consumers want when they buy steak at the grocery store?

Wulf and Kurtis Sweeter, a graduate student in meat science, selected 50 sides of beef with five different ribeye sizes and cut them into 700 steaks. The steaks, all USDA Choice grade, were packaged and labeled, and 35 steaks at a time—seven of each size—were placed in the meat case of the Hy-Vee grocery store in Brookings. The steaks were all priced at $6.99 per pound, resulting in different prices per package due to the size differences.

Sweeter monitored steak sales for 2.5 weeks around the 2003 Memorial Day, checking the meat case every 4 hours during the week and every 2 hours on Friday, Saturday, and Sunday, the busiest grocery shopping days. He recorded how long each steak was in the case before it was sold, as well as the percentage of steaks that did not sell and had to be pulled from the case.

Statistical analysis of the data showed that there were no significant differences between the five steak sizes (Table 1). All sold at equal speed.

"it is not necessary for producers to limit ribeye size, because consumers don't care."

—Duane Wulf,
SDSU Animal and Range Sciences Department

"There are individual differences in what people prefer," Wulf says. "But if you look at people together as a group, they buy all sizes."

CONSUMERS BID ON STEAKS at auction in a second study. The scientists presented 73 consumer volunteers three different types of steaks (all USDA Choice): average size ribeyes, very large ribeyes, and very large ribeyes cut in half.

Each participant was given $15 to purchase steaks in a so-called random Nth auction, a method commonly used by economists to evaluate price differences. Results of this study showed that consumers were willing to pay a higher price per pound (+ 68 cents) for the very large ribeyes, while they would pay much less (- 46 cents) per pound for the large ribeyes cut in half. Sweeter and Wulf found no differences between consumer preferences based on gender, age, income, or household size.

"We conclude from these studies that it is not necessary for producers to limit ribeye size, because consumers don't care," Wulf says.

The size of the ribeye on a beef carcass is widely used in the beef industry to indicate the amount of muscling on a carcass. A large ribeye means more pounds of roasts, ground beef, and other steaks.

When producers try not to exceed 15 square inches for the ribeye (which is mostly done through genetic selection), they lose efficiency because they also produce less of everything else.

Wulf points out that this is especially counterproductive considering that the ribeye, which produces ribeye steaks and strip steaks, represents only 8% of the carcass. "By trying to make a certain portion size of the ribeye, producers are giving up a lot on the other 92% of the carcass," he concludes.

The research was funded by the South Dakota Beef Industry Council. ◆

—Marianne Stein

Table 1: Ribeye size for retail.

Ribeye size (oz)	Price per pound	Price per package	Avg time in case (hrs)	% not sold
10.3	$6.99	$3.79	3.7	9%
11.8	$6.99	$4.52	4.5	17%
13.5	$6.99	$4.91	4.0	10%
15.3	$6.99	$5.33	3.6	14%
17.0	$6.99	$5.47	3.2	7%

Ken Higgins, U.S. Biological Survey and SDSU Wildlife and Fisheries Department, and Dennis Todey, SDSU Agricultural and Biosystems Engineering Department and state climatologist.

Harvesting 'green' wind: Buffalo Ridge

Buffalo Ridge is a far different place these days than when the "A Team" from South Dakota State University patrolled its fields and pastures, setting standards for research that scientists still follow today.

"Back then," 8 to 10 years ago, was generations of wind turbines ago, says Ken Higgins, U.S. Biological Survey and SDSU Department of Wildlife and Fisheries Sciences.

"Buffalo Ridge was the very first wind farm in the upper Great Plains," he says. "Our biologists were in at the beginning because the developers contracted with us to be there. We were the first group in this region of the country to scientifically document bird mortality at wind farms."

There were only 73 wind turbines—toys by today's standards. Today blades are twice as long, towers are higher. There are now about 450 turbines with more planned. That changes the kill statistics, Higgins says.

Buffalo Ridge is a 62-mile long moraine, known as "the longest, highest stretch in Minnesota," says Heather Ulrich, executive director of the Heritage and Windpower Learning Center at Lake Benton, Minn. The ridge runs northwest to southeast in Lincoln and Pipestone counties in the southwestern part of the state and in Brookings County, South Dakota. Cropland, mostly corn and soybeans, accounts for 47 to 60% of land use, depending on year. Pasture is about 20%; wetlands, woodlots, and Conservation Reserve acres together tend to be around 10%.

The newest crop is wind—when it blows at 8 to 65 miles an hour, armies of turbine blades turn lazily; they are idle only about 1 or 2 days a month when the wind is still or when they're down for maintenance.

At present, multiple energy and utility companies own turbines and lease sites from farmers, who receive about 2% of annual generation per turbine as payment. "That averages out at around $1,500 to $2,000 per machine per year," says Ulrich, who adds that a growing number of farmers are now considering owning their own turbines and plugging into the electric grid on their own.

Before the first turbine was erected, a biological reconnaissance showed that, of all possible sites in Minnesota for a wind farm, Buffalo Ridge was the best. Its wind rating was good. It sat on no migratory bird flyway or waterfowl staging area. Migrants that came through usually flew at heights above or below the sweep of the blades, and radar reports had shown that fewer birds migrated at night in the Buffalo Ridge area than in other locations in west-central and southwestern Minnesota.

The turbines went up and the Higgins team of investigators moved in to determine their effects on birds. "It was one of the best projects I've worked on. We had research associates and a graduate student, the 'A Team,' on the study,* and their findings were absolutely solid, still quoted today."

THE TEAM FOUND ON AVERAGE that one bird and one bat were killed per turbine per year from direct collisions with turbine structures in 1994 and 1995.

That kill rate on that part of the energy field continues. But over the years the wind farm at Buffalo Ridge has grown in acreage and turbines. Total mortality rates today are about three birds and two bats per turbine per year, still less than the average at most other wind farms around the country.

"The supplemental income from leasing turbine space could help keep farmers on the land, and wind farms can also give a boost to nearby small rural communities. If carefully sited, wind turbines can co-exist with wildlife."

—KEN HIGGINS,
U.S. BIOLOGICAL SURVEY AND SDSU DEPARTMENT OF WILDLIFE AND FISHERIES SCIENCES

"More obstacles to run into," I guess," Higgins says. "Bigger machines with bigger sweeps. The blades rotate more slowly on the bigger machines, so they probably are more visible to the birds in the daytime, but the blades also take up more air space and may be more lethal to nighttime migrants."

THE METHODS AND PROTOCOLS used by the SDSU team established their research as a benchmark in wind farm studies.

While searching test and control sites for dead birds, the scientists also evaluated their own search efficiency (by hiding bird carcasses from each other and then counting the number of retrievals). They recorded carcass scavenging rates and rates of carcass decomposition. They coaxed technicians to climb the towers and throw bird carcasses off the tops while the machines were running or were still; this determined how far a "kill zone" would extend from the tower if a blade batted a bird and, thus, where searches should be concentrated. They counted densities of breeding birds; they estimated heights of flights. They brought any casualties they found back to SDSU veterinarians in the SDSU Animal Disease Research and Diagnostic Laboratory to verify cause of death.

During 20 months of monitoring they found 79% of the carcasses "planted" by their associates. They estimated that scavengers removed 39% of the carcasses before the scientists got to them.

They found no hawks or owls that died in collisions with wind turbines. The scientists could not rule out, however, that the turbines may have indirectly affected raptor populations if the birds pulled back to a greater distance to nest and hunt.

They found that population densities of seven out of 22 grassland-breeding birds decreased in areas where turbines were located. Although the machines did not directly cause any mortality among these birds, it appears that the presence of the turbines and maintenance activities decreased the suitability of the grassland habitat available to breeding birds.

Most resident birds seen by the SDSU scientists flew below the blades and most migrants above, or they detoured around the wind fields entirely.

"Birds that we saw flying through the string of towers often adjusted their flight patterns when the blades were rotating and would make no adjustments at all when the machines were still. This would suggest that they could detect blade movement either by sight or sound or both," Higgins summarizes.

THE EXTENT OF THE BAT KILL was unexpected.

"We found as many bats as birds killed by turbines. That brought us national attention, because this was the first evidence of frequent bat collisions with wind turbines," Higgins says. "Not knowing how many bats lived in the Lake Benton area, we couldn't draw any conclusions, however."

A later study by another research team estimated bat collision fatalities under 216 turbines to be just over 2 per turbine per year and that most mortalities were migrants, most of them found after severe weather had passed through the area.

"That would make sense," Higgins says. "During the entire span of our study, we just didn't have any really bad weather—no fog to confuse birds or bats, no great winds or driving rain. When they're familiar with the area and the obstacles, bats turn off their echolocation—which is similar to sonar—to conserve energy. But even with echolocation on, in rough weather they could get scrambled signals back.

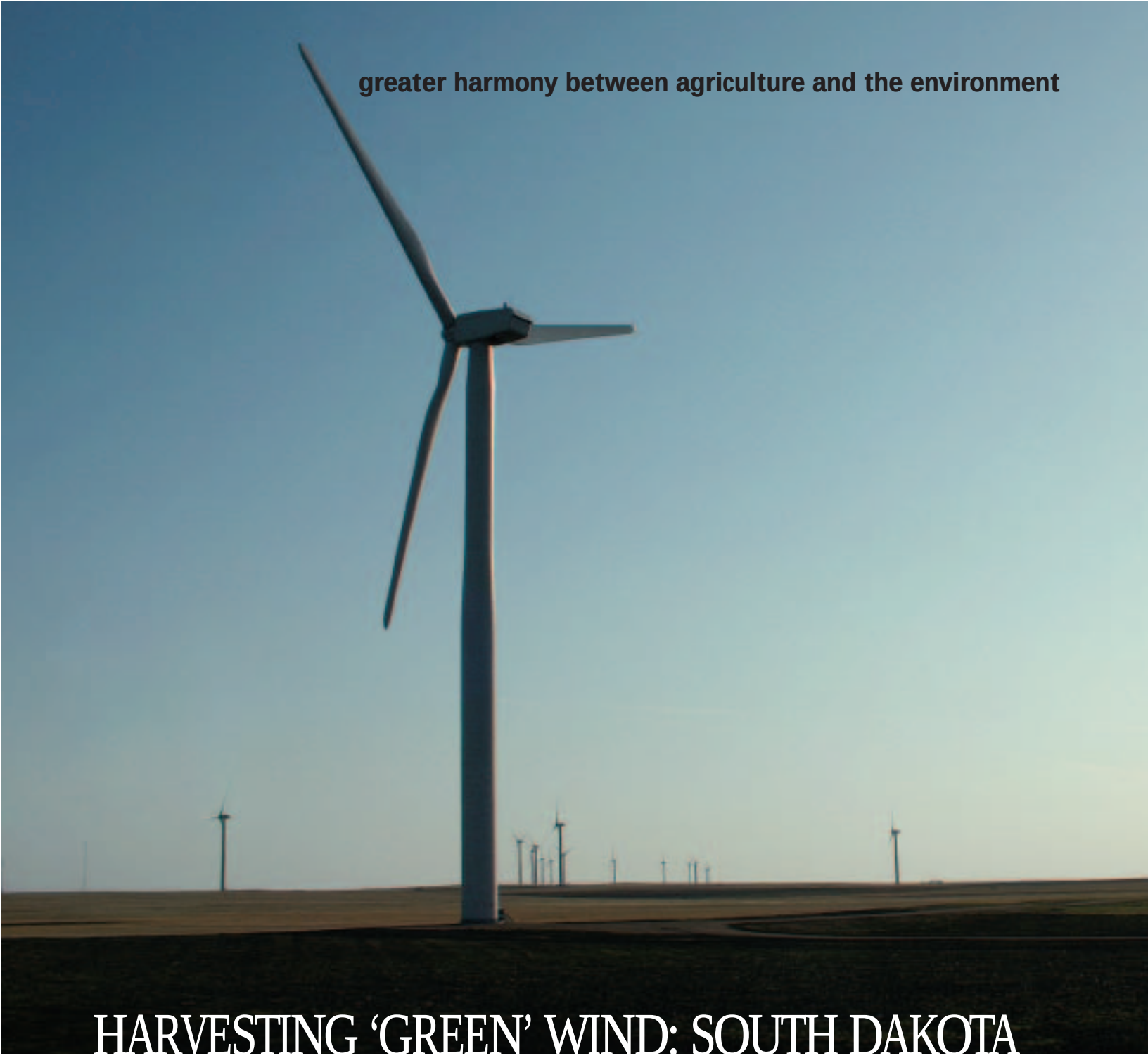
"AT BUFFALO RIDGE, we worked in the best scenario we could have had, so it's no surprise to us that we had lower mortalities than those reported later by other scientists," Higgins says. "The death toll can only go up as more turbines go up.

"As a general recommendation, the best option is to put turbines in cropland habitats that support lower densities of grassland birds. The closer to wetlands, the more birds we will lose. Each potential wind farm site needs its own pre-construction reconnaissance and historical review of wildlife and habitats by professional natural resource scientists, and then a continuing unbiased, objective survey over the years," Higgins says.

"We are losing farmers and small communities. The supplemental income from leasing turbine space could help keep farmers on the land, and wind farms can also give a boost to nearby small rural communities. If carefully sited, wind turbines can co-exist with wildlife," he adds.◆

—Mary Brashier

**Chuck Dieter is now an associate professor in the SDSU Department of Biology/Microbiology. David Naugle is currently assistant professor large-scale wildlife ecology at the University of Montana. The others scattered to the Minnesota winds: Robert Osborn is a big game biologist with the Minnesota Department of natural Resources; Robert Usgaard is with Ducks Unlimited; and Krecia Leddy is with the USDA Natural Resources Conservation Service.*



HARVESTING 'GREEN' WIND: SOUTH DAKOTA

"Wind energy is the fastest growing renewable energy resource in the world," says Ken Higgins, U.S. Geological Survey and Department of Wildlife and Fisheries Sciences at South Dakota State University. "It's clean, getting more cost effective every year, and in South Dakota you could say it's mostly reliable."

South Dakota is rated fourth, behind North Dakota, Texas, and Kansas, in wind energy potential among 15 states.

In thinking about establishing a wind farm, "proceed with the very best information you can get your hands on," Higgins continues. "South Dakota contains over 900,000 wetlands. Tens of millions of birds—songbirds, geese, ducks, shorebirds, cranes, and threatened and endangered species such as whooping cranes, piping plovers, interior least terns, and peregrine falcons—all migrate twice annually through our state.

"But you can achieve compatibility between wildlife and economic development. Do your pre-site assessment before and continue wildlife reconnaissance after the wind farm is built. I can't say that often enough."

"... if wind farms did go in based on our findings, the best new transmission lines should be as short as possible, for efficiency, economy, and lowest impact on wildlife."

—Mike Ropp,
SDSU Electrical Engineering Department

SO FAR, THE MOST PROMINENT WIND FARM on the South Dakota skyline is the Hyde County Wind Energy Center 10 miles south of Highmore. Here, 27 turbines, each 213 feet tall with blades 110 feet long, were built and are owned by FPL Energy of Juno Beach, Fla. Basin Electric, an electricity generator that supplies power to member distribution systems in nine states, purchases the output. The wind energy is transferred to the grid over existing East River Electric Power Cooperative transmission lines.

Jim Edwards, assistant general manager of operations at East River and a 1983 SDSU graduate in electrical engineering, says one of the reasons the site was chosen was because of the availability of transmission lines. "They already ran right by the project" from Ft. Thompson to Highmore. "You can't get better than that."

Mostly, he adds, FPL Energy picked the Highmore site because of its wind resources. "It has turned out to be an excellent site for them.

"The general assumption is that turbines will run at only 35% efficiency on average. However, one month the Highmore turbines were at almost 50%, and for 6 months they've been at 40%."

When considering the site, which is mostly surrounded by pastures and dryland wheat fields, FPL Energy hired a consultant to do an environmental risk assessment, "specifically looking for federally or state-listed threatened or endangered species near the project site," says Steve Stengel, spokesman for FPL Energy. "The conclusion that we drew from the work was that we did not feel the project posed undue risk to any federally or state listed threatened or endangered species."

Continuing reconnaissance by biologists from the U.S. Geological Survey Northern Prairie Wildlife Research Center, Jamestown, N.D., will focus on the effects of wind turbines on grassland bird species. "It's a 5-year project; they inquired if they could survey the site, and we were happy to oblige," Stengel adds.

A twin to the Highmore wind farm is located at Edgeley, N.D. The first two wind turbines in the Dakotas overlook the Missouri River valley near Chamberlain. A single turbine on the Rosebud Sioux Reservation is owned by the tribe.

THE SITING OF OTHER WIND FARMS in South Dakota could depend on what Mike Ropp, SDSU Electrical Engineering Department, discovers from WRAN (Wind Resource Assessment Network). WRAN is a network of five instrument stations near Leola, Crandall, Summit, Fort Thompson, and Crow Lake.

"We picked those locations partly because they were offered to us. We were working with East River Electric, so we were limited to their towers, but of course they've got plenty to pick from. We also needed a certain height—we wanted our instruments at 164 and 230 feet," says Ropp.

"We tried to pick sites that might be potential wind resources. We tried to get as close as feasible to existing substations; if wind farms did go in based on our findings, the best new transmission lines should be as short as possible, for efficiency, economy, and lowest impact on wildlife."

Existing state maps showing wind speeds at various locations "tend to rely on computer-generated models and very little actual hard data, "Ropp says. "Plus, what wind data we do have comes mostly from airports at a height of 10 meters—that's 33 feet. That's just way too low. Turbine heights now are in the 200- to 330-foot range."

Installed at each site are instruments to measure and record wind speed at regular intervals. The project runs for 3 years and data will be on the Internet at http://www.engineering.sdstate.edu/~wran/ The project is funded by grants from the U.S. Department of Energy and the South Dakota Office of Economic Development. Tower space, installation assistance, and communication access were donated by East River Electric of Madison.

"They've all turned out to be viable wind sites," Ropp says. One problem that he has found is that "energy in the wind is proportional to the wind velocity cubed. So a fairly small error in a wind velocity reading can lead to a big error in how much energy we've got. It means we have to have accurate measurements to start with."

Wetlands in the Summit area "are not within eyesite range of our tower," Ropp says. "At the Crandall site there's a big lake south of the tower that's always full of waterfowl. However, I am confident that the developer would make sure there's a pre-site reconnaissance before any installation went in."

Dennis Todey, state climatologist based in the SDSU Agricultural and Biosystems Engineering Department, is working with Ropp on the project. An additional grant has been awarded by FPL Energy to expand the project to other sites. Negotiations for the use of their towers are underway with West Central Electric Cooperative of Murdo and South Dakota Public Broadcasting. Sites near Buffalo, Murdo, Martin, Howard, Lowry, and Faith have been chosen, a seventh is yet to be named.

Stay tuned, say Ropp and Todey.◆ —*Mary Brashier*

The human impacts of BIOTECHNOLOGY

Once again, South Dakota leads the nation—and the world—in adoption of genetically modified crops. In 2003, 91% of soybean acres in the state were planted to herbicide resistant "biotech" varieties, compared to 81% nationwide. Biotech corn accounted for 75% of all corn acreage in South Dakota, compared to 40% nationwide.

Modern biotechnology refers to transgenic techniques that move genetic material from one species to another.

But even as growers choose to plant biotech crops, primarily for their built-in insect and pest control and consequent potential savings in chemical treatment costs, unanswered questions arise among producers and consumers about the real economic costs, the ethics, and the safety of biotechnology.

For the past 4 years, South Dakota State University has been the lead institution of the Consortium to Address the Social, Ethical, and Economic Aspects of Agricultural Biotechnology, sponsored by a $3.7 million dollar grant from the USDA and encompassing research, education, and outreach at five Midwestern land-grant universities—SDSU, Iowa State University, North Dakota State University, University of Minnesota, and University of Wisconsin—and four tribal colleges.

Donna Hess, professor and head of SDSU's Rural Sociology Department, is the overall project coordinator. "The consortium addresses the economic, social, and ethical considerations associated with agricultural plant biotechnology," Hess explains. "There's also a cultural component that involves the four tribal colleges."

Hess and Ron Stover, professor of rural sociology, have been responsible for the sociological part of the grant.

"We have looked at attitudes and perceptions about the use of transgenic methods, economic concerns such as the ease or difficulty of marketing transgenic products, and ethical issues such as the moral acceptance of genetic manipulation of animals and plants," says Hess.

"PRODUCERS WILL GROW TRANSGENIC CROPS based on economic considerations and practicality, but they are worried about their markets," Stover says.

More than 75% of the respondents to a questionnaire mailed to a random sample of 400 producers per state in South Dakota, North Dakota, Iowa, Minnesota, and Wisconsin expressed concern about the acceptance of genetically modified crops by U.S. and foreign consumers.

About half of the 860 respondents also believed that farmers had not been adequately informed about domestic and export market risks of transgenic crops.

A majority of respondents believed that transgenic crops pose no health risks and that consumers are well protected by government safeguards. More than half said that consumers are not adequately informed about genetically modified crops.

Another significant—not unexpected—finding was a difference between organic and non-organic producers. Twelve percent of the respondents described themselves as organic farmers, and they were consistently more critical toward transgenic crops than non-organic respondents.

ONLY SOUTH DAKOTA PRODUCERS were the targets of a survey conducted by Evert Van der Sluis, associate professor of economics, and former graduate student Angella Van Scharrel, now an economist for the State of South Dakota in Pierre.

Surveys were sent to 1,000 randomly selected corn and soybean farmers in South Dakota in 2002, and 367 usable responses were returned.

Van der Sluis says that larger farms had higher transgenic crop adoption rates than smaller farms. Younger respondents (less than 50 years of age) and farmers with higher levels of education also had significantly higher adoption rates of transgenic crops.

Respondents indicated that improved insect or pest control was the major factor for adopting biotechnology. Other important reasons were to reduce the amounts of labor, costs, and herbicides. The main reason some farmers chose not to grow transgenic crops was satisfaction with their current varieties.

Nearly two-thirds of survey respondents said they believed that biotechnology benefits South Dakota farmers.

They were more divided in their opinions about benefits for agriculture in general. About half of surveyed farmers replied that biotechnology could help solve farm surpluses by finding new uses for crops and livestock, while the other half believed that biotechnology could hurt American farmers by increasing farm surpluses.

"Nearly half of the respondents expect biotechnology will enable farmers to become less dependent upon agricultural chemicals," Van der Sluis says. "However, many producers were concerned about a shift in power away from production agriculture and toward agricultural input firms, making farmers more dependent upon large corporations."

Many respondents wanted to know more about biotechnology. Two-thirds felt that farmers in general lacked sufficient knowledge; fewer than half considered themselves to

Selected characteristics of producers and their operations in Van der Sluis survey.

	Bt corn	Herbicide-tolerant corn	Herbicide-tolerant soybeans
	percent adoption		
Age of respondent			
50 or younger	81.3*	45.8	88.8
over 50	68.0*	41.2	89.7
Crop acres			
640 acres or fewer	68.5*	38.2	84.3*
more than 640 acres	80.5*	48.3	93.2*
Farm receipts			
less than $150,000	69.3*	38.6	85.2*
$150,000 or above	81.1*	49.1*	93.4*

* Significant at the 5% level

"If people are wedded to a particular position, we often have them argue on behalf of the opposite position. That teaches them to understand where other people are coming from and to respect their views."

—NELS GRANHOLM,
SDSU DEPARTMENT OF BIOLOGY/MICROBIOLOGY

"Producers will grow transgenic crops based on economic considerations and practicality, but they are worried about their markets."

—Ron Stover,
SDSU Rural Sociology Department

be well informed. Van der Sluis believes that there is a role for land-grant institutions such as SDSU to provide that information.

EDUCATING K-12 STUDENTS AND TEACHERS about biotechnology is, in fact, an integral part of the consortium grant, managed at SDSU by Catherine Carter, professor of plant science, and Stephanie Hansen, research associate.

Every summer during the 4-year consortium period, Carter and Hansen have provided a 3-day workshop for high school science teachers. Each workshop consists of lectures and lab activities and demonstrations, including DNA extraction, a recombinant DNA project, and gel electrophoresis of DNA. The teachers receive a 260-page notebook and a CD.

"We also provide exercises and tool kits they can use in the classroom," Carter says.

Throughout the year, Carter and Hansen give presentations and demonstrations across the state and provide workshops to groups such as Ag in the Classroom teachers, master gardeners, 4-H groups, and scouts.

Carter and Hansen staged a "crime-scene" investigation at the George S. Mickelson middle school in Brookings in October 2003. Students were given a list of "suspects" and were put to work solving the crime through forensic techniques.

"We provided activities such as blood typing, karyotyping, hair/fiber analysis, DNA gel electropheresis, transillumination, and DNA fingerprinting activities for 200 8th grade students," Hansen explains.

Biotechnology education supported by the consortium also takes place through the South Dakota Cooperative Extension Service. Joan Hegerfeld, Extension food safety specialist, works with Extension educators across the state to provide information to the general public.

"Our role is to help producers and consumers make informed decisions," Hegerfeld says.

In November 2002, more than 30 Extension educators came to the SDSU campus to get an overview of biotechnology research at SDSU. "We looked at different areas—crops, livestock, marketing and economics, medical issues, sociology, organic farming, ethics, and careers," Hegerfeld says.

Hegerfeld and Extension educators also bring biotechnology to youth and adults at local fairs and special events. Their displays often include test tubes, pipettes, and a food item.

"They get a chance to 'be scientists' by extracting DNA from bananas or kiwi. Yes, there is DNA in food!"

WHILE CONSUMERS NEED TO UNDERSTAND the science of biotechnology, it is equally important that scientists understand consumer perspectives, believes Nels Granholm, professor of biology. Granholm is in charge of the part of the consortium that addresses the ethical implications of biotechnology.

Each year, the consortium holds a Bioethics Institute for scientists working with biotechnology in their teaching, research, or outreach. The National Agricultural Biotechnology Council provides part of the funding for the Institute.

"The USDA believes that it is fundamentally important for students and faculty to reach some understanding of the broad issues before us in biotechnology and agriculture," Granholm says. "The Bioethics Institute provides scientists and teachers the background for ethical analysis on issues such as molecular biotechnology, transgenic crops, transgenic animals, animal rights, and cloning.

"We talk about the fundamental underpinnings of life and why people behave the way they do with regard to natural resources and agriculture. We operate from a base of philosophy and attempt to sort out things based on what is ultimately right or wrong. Although it can be difficult to make those decisions, the analysis is very important.

"The Institute is a wonderful medium to explore all the different aspects of a problem in a non-threatening way.

"If people are wedded to a particular position, we often have them argue on behalf of the opposite position. That teaches them to understand where other people are coming from and to respect their views."

Granholm also teaches sections on ethics at some of the workshops offered under the education and Extension parts of the consortium.

The consortium will conclude in Fall 2004, and the grant-funded activities will be ending. But research and educational programs in biotechnology will continue to be a priority at SDSU, Hess says.◆ —*Marianne Stein*

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South Dakota Agricultural Experiment Station

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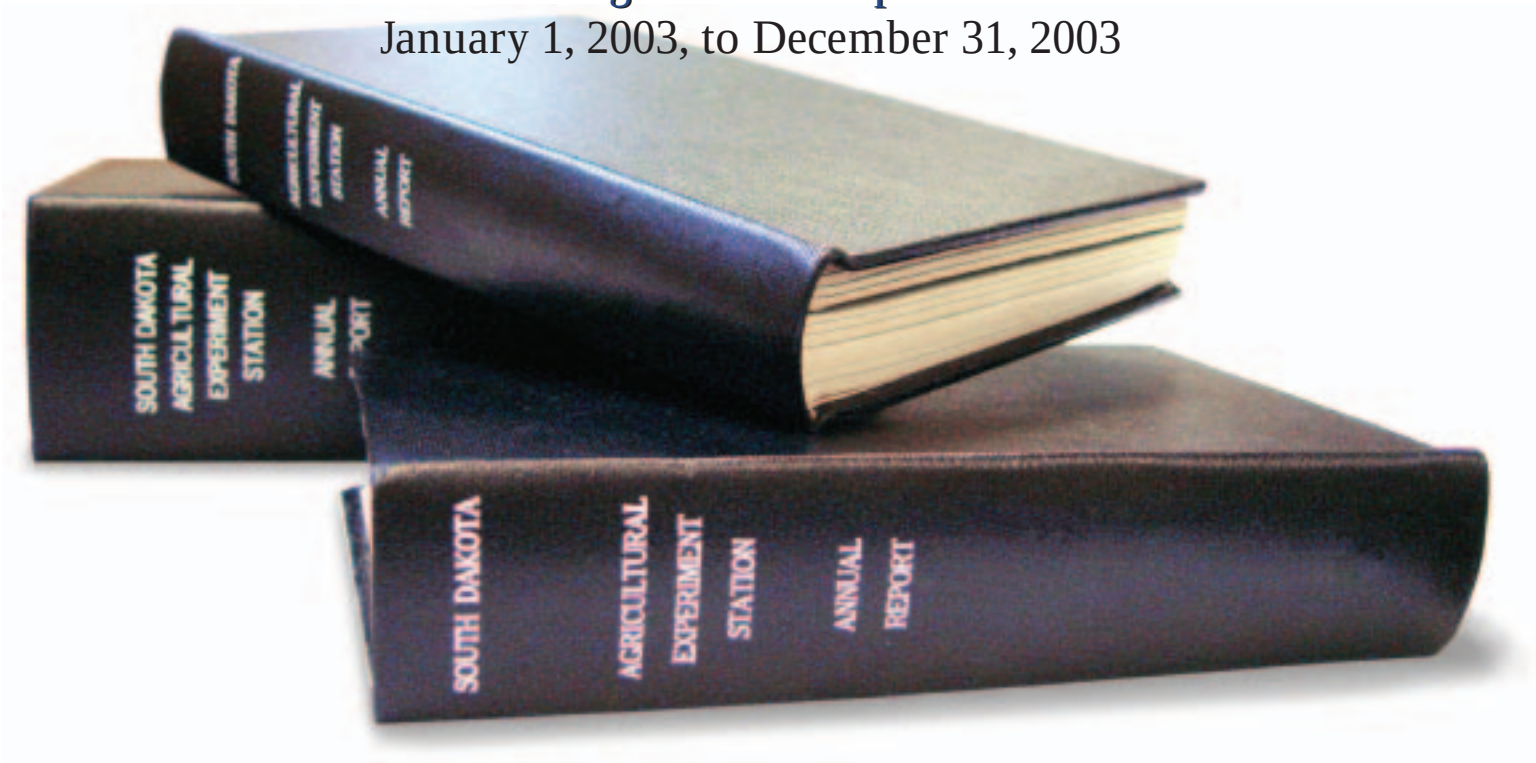

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R.J. Pruitt, Ph.D., professor
A.E. Wertz, Ph.D., assistant professor
A.J. Rosa, Ph.D., assistant professor
A.J. Smart, Ph.D., assistant professor
C.L. Wright, Ph.D., assistant professor
D.M. Wulf, Ph.D., assistant professor
G.A. Perry, Ph.D., assistant professor
H.H. Patterson III, Ph.D., assistant professor
H.H. Stein, Ph.D., assistant professor
J.A. Clapper, Ph.D., assistant professor
J.J. Daniel, Ph.D., assistant professor
K.E. Tjardes, Ph.D., assistant professor
R.J. Maddock, Ph.D., assistant professor
Xu Lan, Ph.D., research associate
D. Thudukurthy, M.S., research assistant
P.J. Schlobohm, B.S., research assistant
R.H. Haigh, B.S., superintendent, Range and Livestock Research Station, Philip
D.B. Young, B.A., superintendent, Antelope Research Station

Biology/Microbiology
T.M. Cheesbrough Ph.D., professor and head
N.H. Granholm Ph.D., professor
R.N. Reese Ph.D., professor
W.R. Gibbons Ph.D., professor
N.H. Troelstrup, Jr., Ph.D., associate professor
V. Brozel, Ph.D., associate professor
Y. Yen, PhD., associate professor
D. Auger, Ph.D., assistant professor
R.S. Kaushik, Ph.D., assistant professor
X. Wang, Ph.D., assistant professor

Chemistry/Biochemistry
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D.P. Evenson, Ph.D., professor
D.P. Matthees, Ph.D., professor
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T.P. West, Ph.D., professor
I.N. Sergeev, Ph.D., associate professor
K.M. Kasperson, B.S., research assistant II
N.A. Anderson, B.A., research assistant II

Dairy Science
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A.R. Hippen, Ph.D., associate professor
R.I. Dave, Ph.D., associate professor
A.N. Hassan, Ph.D., assistant professor
K.F. Kalscheur, Ph.D., assistant professor
H.H. Bonnemann, M.S., instructor/dairy plant manager
D.D. Rennich, B.S., lecturer/manager, dairy research and training facility

Economics
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L.L. Janssen, Ph.D., professor
M.K. Beutler, Ph.D., professor
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D.W. Adamson, Ph.D., associate professor
E. Van der Sluis, Ph.D., associate professor
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G.L. Taylor, Ph.D., assistant professor
W.D. Ellingson, B.S., instructor
J.D. Cole, Ph.D., research assistant
T.J. Hansen, M.S., research associate I

Family and Consumer Sciences
L.S. Nichols, Ph.D., professor and dean
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A.L. Wilson, Ph.D., professor
K.K. Kattelmann, Ph.D., associate professor
N.N. Lyons, Ed.D., associate professor
S. Gardner, Ph.D., associate professor

Horticulture, Forestry, Landscape & Parks
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L.C. Schleicher, Ph.D., associate professor
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N.P. Evers, B.S., instructor
K.L. Mathiason, B.S., research assistant

Plant Science
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E.B. Turnipseed, Ph.D., professor, manager, Seed Testing Lab
F. Sutton, Ph.D., professor
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R.G. Hall, PhD., professor
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Z.W. Wicks, III Ph.D., professor
R.J. Pollmann, M.Ed., associate professor, manager, Seed Certification Service
R.K. Berg, Jr., Ph.D., associate professor, manager, SESD Research Farm
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C. Ren, Ph.D., assistant professor
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D.T. Olson, M.S., assistant manager, Seed Certification Service
J.A. Ingemansen, M.S., manager, Foundation Seed Stocks
J.L. Pikul, Jr., Ph.D., adjunct professor (USDA/ARS)
D.K. Lee, Ph.D., postdoc research associate
J. Chang, Ph.D., postdoc research associate
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J.L. Kleinjan, M.S., research associate I
R.S. Little, M.S., research associate I
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L.C. Zobel, B.S., research assistant

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D.E. Hubbard, Ph.D., professor
J.A. Jenks, Ph.D., professor
M.L. Brown, Ph.D., associate professor
K.C. Jensen, Ph.D., assistant professor
C.R. Berry, Ph.D., adjunct professor
K.F. Higgins, Ph.D., adjunct professor
S.R. Chipps, Ph.D., adjunct assistant professor

AES RESEARCH PROJECT PORTFOLIO

Administration
Planning the Sun Grant Initiative; Kephart, Tidemann, Cassel, Tschetter
Four-State Ruminant Consortium; Kephart, Boggs
Consortium for alternative crops; Tidemann

Agricultural & Biosystems Engineering
Assessing potential transport of antibacterial chemicals in the landscape; Trooien, S. Clay, Thaler, Werner
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; Trooien
Enhancing the value of South Dakota agriculturally based materials; Julson, Muthukumarappan, Henning, West
Swine facility design for odor reduction; Hellickson, Pohl, Thaler
Improvement of 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, Schipull
Impact of climate and soils on crop selection and management; Todey
Engineering technology applied to agricultural quality and production issues in the Northern Plains; Humburg, Long, Robert, Kvien, Clay, Carlson, O'Neill, T. Schumacher, L. Schumacher

Animal & Range Sciences
Marbling and fresh meat quality; Maddock
Effects of water quality on cow/calf production; Johnson, Patterson, Gates, Walker, Beutler, Epperson
Adding value to South Dakota and Great Plains lambs by reducing incidence of lung lesions; Daniel, Burns, Held, Epperson, Holler
Factors affecting nutrient utilization and excretion by growing swine; Stein
Minimizing neonatal lamb losses; Daniel, Held, Epperson
Genetic and environmental factors affecting meat quality; Wulf
Molecular mechanisms regulating skeletal muscle growth and differentiation; McFarland
Hormonal control of growth and reproduction in swine; Clapper
Production systems to reduce cost of production and improve reproductive performance of beef cows; Pruitt, Clapper, Epperson, Owens, Patterson, Young
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 correct stocking rate; 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
Use of native plants and a permacultural approach for development of niche-market crops for the Northern Great Plains; Reese
Genetic modification to enhance crop quality and insect resistance; Cheesbrough
Production of organic chemicals from biomass; Gibbons, West, Julson
Utilizing biotechniques to enhance wheat germplasms; Yen
Analyses of mammalian genes (agouti, mahogany, POMC) that regulate pigmentation, obesity, fertility, and systemic physiology; Granholm, Marshall, Campbell, Diggins
Defining biotic integrity in the prairie pothole region and biological responses to priority pollutants by 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
Analysis of pesticides and related substances; Matthees
Calcium signaling during embryonic development in cattle; Sergeev
Characterization of livestock sperm that demonstrate susceptibility to DNA denaturation in situ; Evenson
Equipment grant proposal for a freeze dryer system; West
Characterization and plasticization of rigid sorption domains in soil organic matter; Schindler
Calcium and vitamin D regulation of cellular processes in domestic livestock and poultry species; Sergeev
Microbial biomass conversion into specialty chemicals; West
Acquisition of a differential refractometer; Rice
Analytical services; Thiex

Dairy Science
Improving the 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 and methods of management and utilization of dairy byproducts; Mistry, Specker, Vukovich
Strategies for improved health and productivity of early lactation dairy cows; Hippen, Schingoethe, Kalscheur
Modifying milk fat composition for enhanced manufacturing qualities and consumer acceptability; Schingoethe, Baer, Hippen
Strategies to increase the utilization of co-product and traditional feeds for lactating cows; Schingoethe, Hippen, Kalscheur, Garcia
Strategies to reduce nutrient losses to the environment from dairy cattle; Kalscheur, Hippen, Schingoethe
Metabolic relationships in the supply of nutrients for lactating cows; Hippen, Schingoethe, Kalscheur
Management systems to improve economic and environmental sustainability of dairy enterprises; Kalscheur, Hippen

Economics
Case profile of profitability determinants in the South Dakota beef cow-calf enterprise; Cumber, Dunn, Hamilton
Changes in global patterns of food products trade: implication for the U.S. and South Dakota; Qasmi
Agri-environmental policy options and implementation based on multifunctionality; Dobbs
Value-added agriculture in South Dakota: its impact on structure, efficiency, prices, and agricultural policy; Taylor, Klein
Perception of biotechnology, biotech produced agricultural products, and implications for risk management; Franklin
Value-added agriculture activities in a changing food and fiber system; Van der Sluis
Representative farm and agricultural land market analysis for South Dakota; Janssen
Enhancing the competitiveness of U.S. meats; Fausti
Rural labor market behavior, outcomes, and economic development in South Dakota; Adamson

Family & Consumer Sciences
Soy phytochemicals: chemistry, analysis, processing, and health impacts; Wang, Krishnan, Matthees, Scott, Woodard, Julson
Value addition of cereal, grains, and oilseeds—an investigation of bioactive compounds of economic, health and food value; Krishnan, Wang, Scott, Grady, Muthukumarappan, Doehlert
Promoting healthy families and communities through youth relationship education; Gardner
Impact technology on rural consumer access to food and fiber products; Lyons
Using stage-based interventions to increase fruit and vegetable intake in young adults; Kattelmann
Acquisition of a 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
Economic and psychological 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
Evaluation of native and introduced trees and shrubs for their growth on varied soils in South Dakota urban landscapes; Evers
Restoration progress of woody vegetation along streams and in woody draws at the Mortenson Ranch, S.D.; Johnson
Cultural practices optimizing growth of herbaceous horticultural plants in the Northern Great Plains; Burrows, Fennell, Schleicher, Reese
Evaluation of 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

Plant Science
Winter wheat breeding and genetics; Ibrahim, Langham
Estimating phosphorus release from South Dakota soils; Gelderman, German, Schindler
South Dakota plant physiology/plant biochemistry symposium: from plants to genes and back again; Sutton, Schumacher
Sunflower breeding and testing alternative oilseed crops; Grady
Biological control of fusarium head blight and other wheat diseases; Bleakley
Soybean breeding, genetics, and production; Scott
Pedology information transfer for South Dakota; Malo, Doolittle, Schumacher, D. Clay, S. Clay, Carlson, Gelderman, Ellsbury, Lee, Lindstrom
Supplemental information support for pesticide use in minor crops; S. Clay
Influence of potassium (K) rate, placement, in-season treatment and hybrid, and tillage on K deficiency in corn; Gelderman
Soil management for improved soil quality and reduced biostress; T. Schumacher
Host-parasite interactions between small grains and their fungal pathogens; Jin
Spring wheat breeding and genetics; Glover
Etiology and epidemiology of plant viruses in South Dakota; Langham
Improving site specific management using weed interference data across landscapes; S. Clay
Plant biotechnology methods and applications in agriculture; Carter
Water and soil management for maximizing returns to agriculture; Kohl, Bleakley, Johnson, Schumacher, Carlson
Persistence of *Heterodera glycines* and other regionally important nematodes; Smolik
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
Identifying grain production practices which increase soil organic carbon; Woodard
Characterizing weed population variability to reduce herbicide use; S. Clay
Assessing nitrogen mineralization and other diagnostic criteria to refine nitrogen rates for crops and minimize losses; D. Clay
Diversifying crop rotations; Beck
Reducing the potential for environmental contamination by pesticides and other organic chemicals; S. Clay

Breeding perennial grasses and legumes for forage, biomass, wildlife habitat, conservation, and tolerance to stresses; Boe
Drought and freeze survival of winter wheat: a genomics approach; Sutton
Using emerging 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
Breeding and genetics of forage crops to improve productivity, quality, and industrial uses; Boe
Rootworm management and ecology; Fuller, McManus
Conservation, management, enhancement, and utilization of plant genetic resources; Boe
Corn breeding and sustainability; Wicks
Systematics of click beetles and wireworms in North America; Johnson
Soil quality and bioavailability of excess constituents in ecosystems of South Dakota; Doolittle
Management and persistence of forages used 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; R. 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 Region, Redlin
Rural Life Census Data Center; Hess
Consortium to address social, economic, and ethical aspects of biotechnology; Hess

Veterinary Science

Receptor binding specificity of the K88 fimbriae of *E. coli;* Francis,
Biochemical basis for genetic resistance to K88 *E. coli;* Erickson
Maternal regulation of neonatal immunity; Young, Daniel
Genomic quasispecies associated with the persistence and pathogenesis or porcine reproductive and respiratory syndrome virus (PRRSV); Benfield
Evolving pathogens, targeted sequences, and strategies for control of bovine respiratory disease; Chase, Epperson
Understanding the role of transferred maternal immunity in development of the neonatal immune system; Young
Parasite issues in South Dakota beef production; Hildreth
Porcine reproductive and respiratory syndrome: mechanisms of disease and methods for the detection, protection, and elimination of the PRRS virus; Benfield, Christopher-Hennings
Antimicrobial sensitivity and characterization of Campylobacter spp. isolates from ovine abortions and comparison to other campylobacter; Epperson, Holler
Description, impact, and risk factors associated with lung lesions in lambs; Epperson, Holler, Held
Evaluation of anti-diarrhea substances in pigs; Francis
Genetic analysis of PRRSV attenuation; Ropp
Controlling bovine viral diarrhea virus: diagnosis and understanding 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: a cooperative approach to support management; 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 2004

Salary & benefits	$10,833,818	87.99%
Operating	$1,479,008	12.01%
Total	**$12,312,826**	

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