Spring 1995

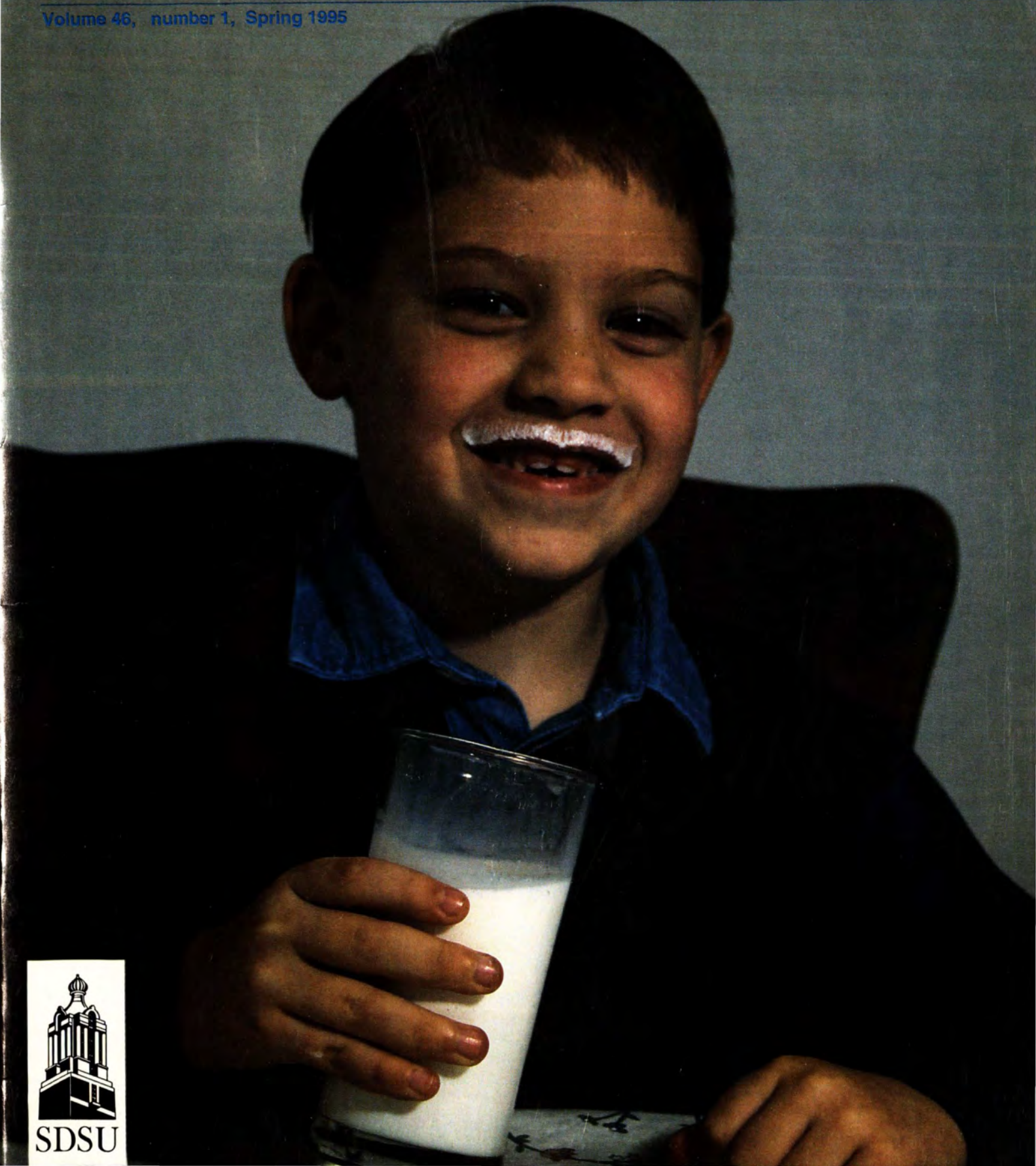
South Dakota Farm and Home Research

South Dakota State University

South Dakota Farm & Home RESEARCH

Agricultural Experiment Station • South Dakota State University • Brookings, South Dakota 57007

Volume 46, number 1, Spring 1995



SDSU

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About the Cover

Daniel Stratton, 7, son of Mark and Jeanne Stratton, Brookings, enjoys a glass of milk. Milk and other dairy products are a nutritional staple in the American diet. Modern facilities recently dedicated at SDSU will benefit both dairy producers and consumers by helping to ensure that high quality, economical dairy products are readily available.

photo: Tom Bare

South Dakota Farm & Home
RESEARCH

Volume 46, number 1, Spring 1995

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Published by the Agricultural Experiment Station, South Dakota State University, Brookings, South Dakota. Sent free to any resident of South Dakota in response to a written request.

South Dakota Farm & Home Research is edited and designed in the Department of Ag Communications, SDSU, and printed on campus at the SDSU Printing Laboratory.

Published in accordance with an act passed in 1881 by the 14th Legislative Assembly, Dakota Territory, establishing the Dakota Agricultural College and with the act of re-organization passed in 1887 by the 17th Legislative Assembly, which established the Agricultural Experiment Station at South Dakota State University. South Dakota State University is an Affirmative Action/Equal Opportunity Employer (Male/Female) and offers all benefits, services, education and employment opportunities without regard for ancestry, age, race, citizenship, color, creed, religion, gender, disability, national origin, sexual preference, or Vietnam Era veteran status.

5,000 printed by the AES at a cost of 71¢ each. AX03 3/95

Printed with AgriTek ink, containing soy, corn and other vegetable oils.

Director's comments

Partnerships spur progress and productivity

by Dr. Fred Cholick

Numerous partnerships have sprung up in the 107 years of the Agricultural Experiment Station in South Dakota.

The two longest lasting have been with the Cooperative Extension Service and with classroom educators at South Dakota State University. As a consequence of these partnerships which have expanded and enhanced the delivery of research results, every South Dakota citizen has benefited either directly or indirectly.

Our partnerships, however, do not end with these traditional linkages. New alliances have been developed to strengthen agricultural research. We must and will continue to seek new partnerships with business, industry, and government.

Two excellent examples of both traditional and new partnerships are highlighted in articles in this issue of *Farm & Home Research*.

The Cattlemen's Satellite Shortcourse sprang from the traditional relationships between research and Extension, and it is completely modern in execution. Farmers and ranchers across the continent have become aware of our research results here in South Dakota and are adapting our recommendations to their own operations.

This shortcourse also highlights the partnerships of several universities and the use of the information superhighway to communicate research results. It is encouraging for us to see that farmers and ranchers in South Dakota and across the nation eagerly accept information sent to them in this manner.

The second example of collaboration is the multi-purpose Dairy Research and Training Facility just north of the SDSU campus.

This new facility strengthens individual research, teaching, and Extension programs and bonds those programs closely together. Classes for SDSU students will be conducted within the facility. Workshops and hands-on training will be offered to dairy herdsmen so they may update their skills.

photo: Jerry Leslie

Without partnerships, the new Dairy Research and Training Facility would not have been possible. The allied dairy industries paid for nearly half the construction costs. Each partner will benefit from the project. SDSU gets a boost to its dairy teaching, research, and Extension programs, and the dairy industry is strengthened by faster research results and greater skill and experience levels in dairy graduates.

The free-stall area is divided equally, with half primarily devoted to research and half to teaching and demonstrations. While the cattle may be restrained by bars and gates, there are no barriers to the free flow of information between areas.

The Dairy Facility would not have been realized, however, without first forming another team. The allied dairy industries contributed $450,000, nearly half of the construction costs, to the facility. This is a partnership that energizes each partner.

The research partnership with commodity organizations in South Dakota is truly a grassroots approach, and I think that description is appropriate. Just as roots exert strength and power as they mingle together to hold the plant upright, the mingling of research and commodity organizations produces superior research. Organizations provide not only funding for research. They also communicate their problems and needs; they provide direction to our research. This is a win/win situation. It enhances researchers' problem-solving capabilities and development of scientific knowledge. It enables producers in South Dakota to become more efficient and competitive.

We seek new and closer ties with other institutions, industries, agencies, and individuals. While the source of creativity is the individual, the source of progress and productivity is an equal partnership of individuals. The beneficiaries are not only the members of the immediate team. They are the citizens of our state, the nation, and the world who receive a continuing and plentiful supply of food and fiber. ❑

Dr. Fred Cholick is Director of the Ag Experiment Station, SDSU.

photo: Jerry Leslie

← In the tradition of christening a ship with champagne, Dr. John Parsons, head of SDSU's Dairy Science Department, marked the dedication of the new Dairy Research and Training Facility by breaking a bottle of milk against an iron gate in the building's free-stall area.

Modern, efficient dairy facility built as model for farmers

by Jerry Leslie

The new Dairy Research and Training Facility at South Dakota State University concentrates the latest dairy production technology in an energy-efficient and labor-saving building.

The cost-effective nature of the building, besides being easy on taxpayers, makes this facility a good and practical example for South Dakota and Midwestern producers planning to build, expand or remodel.

At the same time, the modern facilities should speed relevant research results to South Dakota producers. Through workshops and hands-on practice, dairy managers from the state and region also will find the facility is a place to train and update their skills for working in such an environment.

On November 1, SDSU dedicated the new $1.1 million Dairy Research and Training Facility about a mile and a half north of the Brookings campus. The SDSU dairy herd went into the building November 7.

More than 200 persons, many of them dairy operators, attended the ceremony and open house. They watched as John Parsons, head of the Dairy Science Department, swung a bottle of milk against an iron gate in the free-stall area of the barn.

In the tradition of christening a ship with champagne, Parsons launched SDSU dairy research and training into a new era with a "great white splash." Representatives of SDSU, the South Dakota Board of Regents, and allied industries took part.

The dairy technology is "state of the art," but it is practical technology that can be found in most dairy buildings going up today in the Midwest, according to David Schingoethe, dairy research professor and coordinator of the building project.

The engineer for the project told Schingoethe the firm had 58 or 60 barns on the drawing board for South Dakota, Minnesota, and Wisconsin, and 80 percent of the features in the SDSU building can be found in designs for all of these new buildings.

Don Lee, Arlington dairy farmer, said if he was 20 years younger he would want to build one just like it because "it looks like a great facility." Lee, a dairy production graduate of SDSU in 1956, is chairman of the South Dakota Dairy Promotion Association.

Schingoethe said features of the barn would appeal to almost anyone thinking of expanding a dairy operation. He cited several family operations within an hour's drive of Brookings built on this design or using some of the features.

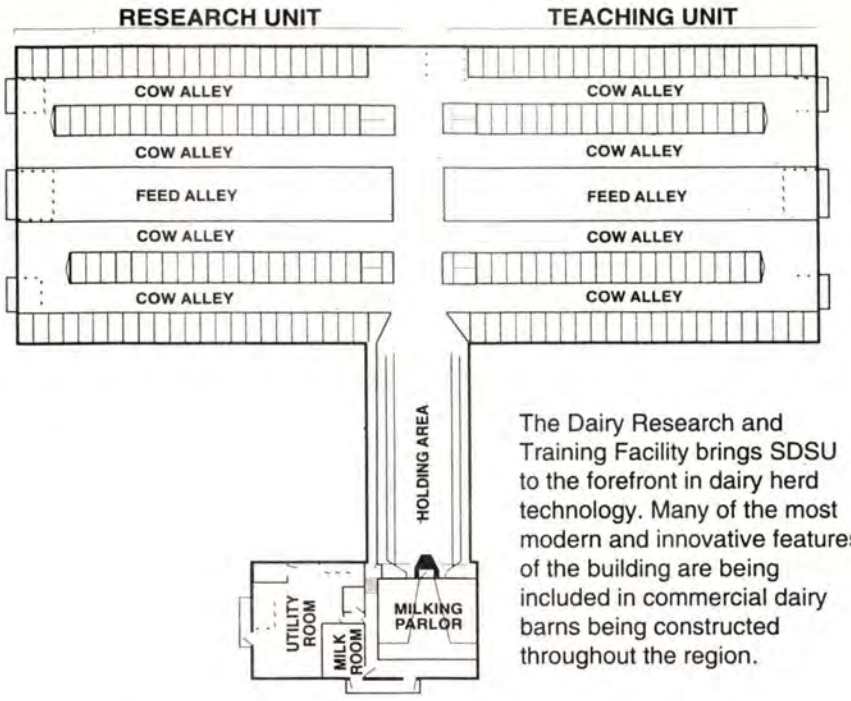
An example of efficiency is the building itself, a trussed, frame structure with open ridges and side-curtained walls for natural ventilation. All but the milking parlor area is unheated.

With the free-stall area under the same roof as the milking parlor, cows never venture outdoors and thus are spared the bitter winter wind and frostbitten teats that often accompany exposure. With curtains closed, inside winter temperature usually is about 20 degrees above outdoors.

Cow body heat and open ridges in the peaked roof create a natural

"...[SDSU] is trying to stay in front or apace of dairy people who are expanding and modernizing... this is a big step forward for us."

—David Schingoethe
SDSU dairy researcher



The Dairy Research and Training Facility brings SDSU to the forefront in dairy herd technology. Many of the most modern and innovative features of the building are being included in commercial dairy barns being constructed throughout the region.

chimney effect for air ventilation, keeping the humidity down and comfort level up. The updraft deflects rain or snow from the open ridge when the barn is full of cattle.

In the summer, side curtains open up and cows enjoy shade and breeze at all times while lying in the free-stall area. Engineers intentionally placed the building away from shelterbelts or other buildings for best air flow and positioned it for best use of prevailing winds in the summer.

The building provides comfort for cows in winter and summer, without expense of heating, cooling, or moving air. Cow comfort translates into better milk production, according to research data of long standing, said Schingoethe.

Energy efficiency also is found in the way milk is cooled. Milk from the parlor goes by pipeline through a double-plate cooling system on its way to bulk tanks. Water flowing through the plates cools the milk from 90-102 degrees as it leaves the cow to about 50 degrees upon entering the tanks where it is cooled further to 36 degrees.

The warmed water from the plate coolers goes to a polyvinyl drinking-water reservoir rather than down the drain. The warmed water again saves energy, since less heat is required to keep the cattle waterers from freezing in the winter.

Labor efficiency, like energy efficiency, is built into the entire operation, from the free-stall barn with bunkline feeding to the double-eight parallel milking parlor with automatic detaching milkers, Schingoethe said.

While SDSU is not apt to reduce its staff in this facility, it is likely to double the size of its herd soon without increasing the work force, said Schingoethe. The building has accommodations for 160 cows in the free-stall area, 80 of them in the research area and 80 in the teaching-demonstration area.

Some of the labor-efficiency features inside the barn include:

- Stanchions in the feeding area that can be set to lock when a cow or cows come to feed. This saves time chasing a cow to put a halter on her for veterinary checks, heat detection, breeding, rumen sampling, or blood sampling. Turning one lever can free all cows at once, or cows can be freed individually.
- Bunkline feeding for the herd as a group allows dispensing the feed mechanically from the mixer wagon to the concrete floor in front of the stanchions.
- A holding pen between the free-stall area and the milking parlor

photo: Jerry Leslie

The Dairy Research and Training Facility features state-of-the-art technology. As each cow enters the milking parlor, a transponder on a cord around her neck automatically sends her ID number to a computer. Meters on the milk line measure the exact amount of milk each cow produces, and record the information on the computer.

South Dakota Dairy Industry Averages

- 1,619,000,000 pounds of milk produced.
- 159,202,000 pounds of cheese manufactured.
- 125,000 milk cows.
- 2,800 dairy operations.
- $210,816,000 cash receipts from dairy products.

SDSU Dairy Science Program Facts

- SDSU is one of the few universities in the U.S. to offer both a dairy production and a dairy manufacturing major.
- SDSU has the largest enrollment of dairy manufacturing majors in the U.S.
- Student curriculum is directed toward business, science, or agricultural education.

employs a "crowd gate" powered by compressed-air driven motors. This advancing gate encourages cows to move as a group toward the milking parlor. Compressed air eliminates risk of electric shock to cows from electric motors.

• Each cow wears a transponder on a cord around her neck. As cows pass through a detection device—similar to an airport security arch—on their way to the milking parlor, a radio signal activates the transponders.

The transponders then emit their own signal, sending the cow's ID number to the parlor display board. When the cow gets to her milking stall, meters on the milk line automatically measure the milk each cow produces and record it on the computer with the ID number beeped earlier from the transponder. This system allows quicker and more accurate recording of research data, according to Schingoethe.

• One person can operate the milking parlor. The double-eight parlor means 16 cows can be milked at once. Milkers detach automatically when volume slows to a preset level, as measured by flow sensors in the line. The automatic detaching feature alone cuts labor in half in the parlor, Schingoethe said. With continuous milking for 20 hours, a parlor this size could handle a herd of 500 to 700 cows, he added.

• Cows treated with antibiotics must have their milk withheld for 72 hours. Treatment, when given, is entered on the computer. As treated cows pass through the "security arch" the digital display lights up red for the treated cow coming to the milking parlor. This safety procedure will require the operator now to unhook the milk line, manually override the milker control, and send this milk to a catch pail rather than the bulk tank.

• While cows are milking and gone from the free-stall area, manure from the free-stall area is scraped with a tractor and blade to a pit for pumping to a lagoon. No forks or shovels are involved.

• In the free-stall area, cows rest on mats containing ground-up rubber tires. Little or no bedding is required. In the summer, open side walls would encourage fine, loose bedding to blow around on a windy day.

Schingoethe said SDSU "is trying to stay in front or apace of dairy people who are expanding and modernizing. We realize the technology is always changing and always will be a step ahead of us. But right now this is a big step forward for us."

On the research side, the new facility will help speed collection of data for new research results and get those results to farmers, Schingoethe said.

One side of the free-stall area is devoted to the research herd. Here, Calan feeders allow individual feeding. Each cow wears an additional transponder that unlocks her individual feeding gate when she gets within an inch or two of it.

The Calan Data Ranger Cart used to feed research cows keeps track of individual cow feed intake on its computer.

Schingoethe expects more research to emerge on effect of nutrition on milk production and milk composition, including effect of increased energy intake, ruminally protected amino acids, and rumen bypass proteins. Also expected is research to alter the fatty acid composition of milk by feeding soybean, sunflower, or safflower seed. Nutritional management schemes also will be examined here.

The facilities also allow examination of overall management schemes for their efficiency in a dairy facility like this one.

Since SDSU also has a dairy manufacturing plant, researchers can evaluate how the composition of dairy products is changed by a change in diet at the dairy research facility.

The information will be presented to producers who come here for training programs, shortcourses, or even 2 weeks of hands-on experience in the facility.

Research results also will be disseminated through Extension meetings and publications, the annual Dairy-Forage Conference, articles in dairy magazines and other farm publications, and through undergraduate classes in dairying.

One side of the free-stall area and half the herd is devoted to graduate and undergraduate teaching plus seminars for dairy managers and workers. SDSU has 85 to 90 dairy science majors, plus 14 graduate students. All will spend some class time in this facility.

Unique to funding a public facility were the contributions from allied dairy industries totalling $450,000, nearly half the construction cost.

Gene Stegeman, a new faculty member with both bachelor's and master's degrees from SDSU's Dairy Science Department, was hired to manage the facility. ❑

Jerry Leslie is ag new and features editor in the Department of Ag Communications, SDSU.

SDSU satellite program serves North American cattle producers

by Emery Tschetter

> *"... this is an excellent way for us to get current information to beef producers in a way they can really use it..."*
>
> —Tim Jergensen, Extension Agent, Wisconsin

A satellite teaching program led by the Cooperative Extension Service at South Dakota State University is bringing some of the top beef production experts in the nation right to the producer, wherever that producer may be in North America.

It's the Cattlemen's Satellite Shortcourse. Every other Tuesday night from September to April, cattle producers from Saskatchewan, Canada, to Canyon, Texas, tune their satellite antennas to watch the program. Many of the participants are watching right in their own homes. Those who don't have satellite systems go to viewing centers like their county Extension office.

More than 100 sites across South Dakota participate in the program, but the number of people involved is higher because 20 to 30 producers may be at each site.

"It fills a real need," according to Dr. J. Toelkes, a veterinarian from Kingsville, Texas. In addition to treating animals, Toelkes offers educational programs on animal health, and one of his clients is the King Ranch, largest ranch in the nation. Toelkes feels the Cattlemen's Shortcourse is an excellent source of new information.

"I think there is a lot of information there that does need to be disseminated, and this is a good way to do it," said Toelkes.

But big ranchers aren't the only ones watching. A survey of participants shows that more than two thirds of the viewers have fewer than 100 head of cattle.

The Cattlemen's Satellite Shortcourse is a 90-minute live program featuring beef specialists discussing grazing management, genetics, marketing, performance evaluation, nutrition, and herd health.

The program grew out of a proposal by SDSU Extension Beef Specialist Don Boggs. He initially designed the program for beef producers in the Midwest.

When U.S. Department of Agriculture officials reviewed his grant proposal, they offered additional money if it would be produced nationally.

As the program concept developed, Boggs involved Extension beef specialists at the University of Nebraska-Lincoln, the University of Kentucky, and Washington State University. The USDA provided a $60,000 grant for production of the program.

Even though it has a national focus, Boggs believes the most important part of the program is that it meets the needs of South Dakota producers.

The South Dakota Cooperative Extension Service is a member of Ag*Sat, a national consortium of land-grant universities that produce and share educational satellite programs. South Dakota Cooperative Extension Service Director Mylo Hellickson was quick to see the potential for delivering timely educational information to Extension clients by satellite.

"Our philosophy of regional and national cooperation, along with our cadre of nationally renowned faculty and Extension and research programs were fundamental to SDSU's becoming a charter member of Ag*Sat and in being selected to take the leadership role on the Cattlemen's Satellite Shortcourse," Hellickson said.

South Dakota Ag Experiment Station Director Fred Cholick thinks SDSU will gain greater recognition for the quality of its animal science programs because of the shortcourse.

"I think any time you take the leadership role in a national program, it shows the value and quality of our

photo: Tom Bare

← The master control room at SDSU bustles with activity during the Cattlemen's Shortcourse. Because the program is produced live, careful planning for all technical needs and contingencies is essential to ensure a smooth-running production.

research and Extension programs at SDSU. This gives us an opportunity to showcase our expertise," Cholick said.

The Cattlemen's Shortcourse has taken the beef industry by storm. With more than 800 viewing sites across North America, it has become the largest, longest running, continuing education program on satellite in the nation.

"The outstanding success of the Cattlemen's Satellite Shortcourse is another example of how the South Dakota Cooperative Extension Service uses the information superhighway to quickly and efficiently deliver programs to an ever increasing clientele base," Hellickson said.

Tim Jergensen, Extension agent in Balsam Lake, Wis., believes that local producers in his county have been very pleased with the program.

"We're primarily a dairy county, so we haven't provided a lot of programming here for our beef producers. So this is an excellent way for us to get current information to beef producers in a way they can really use it. This satellite program multiplies the efforts of Extension and university people by helping us deliver information to areas that probably wouldn't get as much support," Jergensen said.

The Extension beef specialist at Pennsylvania State University agrees. "I think it's been done very, very well. I've appreciated the efforts of Don (Boggs) and the others who have put it together. It's a great program," said Dr. John Comerford.

Most people think of horses when they think of Kentucky. But the beef cattle industry is larger, outranking most other beef producing states east of the Mississippi.

The University of Kentucky is one of the cooperating institutions, and will produce four regional shortcourse programs. Carla Craycraft oversees the Kentucky segments. She has heard from local producers who tell her the program has concise, solid information that they can use.

"Traditionally, our beef cattle Extension program has done winter shortcourses," Craycraft said. "We also have demonstration herds throughout the state. We have a program that ships cattle from cow-calf producers to feedlots and follows progress there. So we've got a really wide and diverse Extension program. This shortcourse really fits in. It presents general information and lets our specialists focus on specific programs that help targeted areas.

"I really like the format where we're talking with professionals, talking with producers, and the interaction of the call-in questions," she said.

"The entire idea of the Cattlemen's Shortcourse and distance education really benefits Extension programs. It allows us to deliver the Extension message to a broad and diverse audience. We're reaching clientele groups that we didn't know how to reach in the past. We're also supplementing those who already knew about the Cooperative Extension Service with some good and timely information," according to Craycraft.

"One important component of the program is that it gives beef producers across the country the opportunity to see that there are common problems that go across state lines and segments of the beef industry. It unifies the beef industry," she said.

Cholick agreed. "This program is a classic example of the impact of the land-grant system. We're using some of the new technologies for transferring information. We're using the research base, not only at SDSU, but within our whole network of land-grant universities. By maximizing the strength of our linkage between research and Extension, it becomes a tremendous educational tool, not only for producers, but also for students in the classroom."

Many South Dakota beef producers have been impressed with the quality of the program, according to Jack Duxbury, Lake County Extension agent in Madison, S.D.

"Sometimes when we use new technology, people are hesitant to

Every other Tuesday night, the Cattlemen's Satellite Shortcourse reaches viewers at more than 800 sites across North America. Some producers gather at viewing centers like their county Extension office, others watch in the comfort of their own homes.

"This program is a classic example of the impact of the land-grant system... By maximizing the strength of our linkage between research and Extension, it becomes a tremendous educational tool, not only for producers, but also for students in the classroom."

—Fred Cholick, South Dakota Agricultural Experiment Station Director

photos: Tom Bare

During each live program, a toll-free number is displayed on screen (above), allowing specialists to interact with viewers. Phone volunteers (right) help viewers from across the country get immediate responses to questions.

participate. I think people are surprised the satellite system is that good. People are finding it easy and convenient to use," Duxbury said.

Codington County Extension Agent Chuck Langner agreed. "I think there has been some pride among local participants that South Dakota has taken the lead in this program. It's been very professional, and very well done."

"We have seen an excellent response because of the diverse topics, but most of the program's success comes from the discussion it is generating," said Mel Kloster, Brookings County Extension agent.

"It's evident that people are using the information and thinking about it because of the questions that are coming up," Kloster said.

Those questions indicate the program is meeting its goal. When designing the program, Don Boggs hoped it would provide a reason for producers to get together, exchange ideas and talk about what works. "We hope that continues even after the course is over," Boggs said.

The Cattlemen's Shortcourse has attracted a new audience for the Cooperative Extension Service. Most viewers have participated in fewer than five Extension meetings in the past 12 months and have not participated in any other satellite courses.

Doug Zalesky is an Extension beef specialist based in Rapid City. He participates in the program at the Pennington County Extension office. Zalesky has already seen the results of the program.

"There were a couple producers that indicated they didn't know what they were going to do with their cull cows. They said having that topic discussed on the shortcourse gave them some options to consider, and they were going to look a little closer at how they manage their cull cow herd," said Zalesky.

"I think if producers apply what they hear, they will increase their profits. Especially in the western part of the state in terms of feed costs, if they take the time and do some forage analysis and ration balancing, they can save themselves quite a bit of money," he said.

As beef producers participate in the program, Extension agents are projecting an increased demand for more educational programs.

"I think it opens the minds of producers who want more in-depth information after they see the program. For example, we are putting together a program on calving assistance that is an offshoot from the shortcourse," Langner said.

"I'm seeing questions that are more in-depth as a result of the program," noted Jeff Adrian, Mellette County Extension agent in White River, S.D.

"Instead of just asking what to feed, producers who watch the program are asking how much to feed. People are bringing in ration analyses, feed costs, and cash flow statements. For example, most of the time people didn't look at cull cows being a big income to the ranch. But because of the program, they know it may be 18 percent of their income for the year," Adrian said.

> *"...it gives beef producers across the country the opportunity to see that there are common problems that go across state lines and segments of the beef industry. It unifies the beef industry."*
>
> —Carla Craycraft,
> University of Kentucky

While the Cattlemen's Satellite Shortcourse is one of the most aggressive distance education programs conducted to date, it is really just another step forward on the information superhighway, Hellickson said.

"Technology is changing the way people learn and communicate," he said. "As those changes occur, people can count on South Dakota State University and its land-grant partners to find new ways to make information accessible and convenient." ❑

Emery Tschetter is head of the Department of Ag Communications, SDSU.

photo: Larry Tennyson

Crop by-products find new uses as plastics, food additives, and 'natural chemicals'

by Dr. Larry Tennyson

South Dakota State University is home to the "Bio-materials Utilization Group," a unique team of scientists who are searching for new uses for the crops grown in South Dakota. It's a group that crosses departmental and college lines to further develop new uses for under-utilized biological materials.

Its members may work alone, with other scientists in the same department, or in teams of scientists from two or even three of the SDSU colleges.

Dr. Padmanaban Krishnan, associate professor of Nutrition and Food Science in the College of Home Economics, is one of the 10 members in the group.

Krishnan explained that the name of the group derives in part from their common interest in finding new ways to use South Dakota's renewable agricultural resources, and in part from the fact that a lot of the funding for these efforts has come from the South Dakota Corn Utilization Council. The Council makes these research grants from funds accumulated through the corn checkoff.

The Council makes this sizable investment because of the potential such research has to produce economic benefits to corn growers across the state. When a new use for their product is developed, its demand is enhanced, and so is its price.

Krishnan has a particular research interest in finding new uses for the by-products of the food processing industry, especially in finding food uses for by-products that ordinarily

photo: Jerry Leslie

Distiller's dry grain (DDG) is an underutilized by-product of the ethanol industry. DDG is high in fiber and rich in nutrients, and recent research by the "Bio-materials Utilization Group" at SDSU shows it to be an ideal baking ingredient. Facing page, Dr. Padmanaban Krishnan uses an instrument called a "Retsch Mill" for grinding the DDG in preparation for high-pressure steam sterilization, which also deodorizes the material. Above, Robyn Hansen, executive director of the South Dakota Corn Utilization Council, samples a cookie made from DDG. To date Dr. Krishnan and his associates have given away more than 50,000 cookies at fairs and trade shows.

would go to non-food uses. In the case of corn, much of the by-product now ends up as animal feed.

Converting an under-utilized "feed" by-product into a "food" by-product enhances its value substantially, Krishnan said.

Such a corn by-product is distiller's dry grain (DDG), a by-product of the process for producing corn alcohol, or ethanol. From each 56-pound bushel of corn used in making alcohol, about 17-19 pounds of DDG is left as a by-product. Presently, the U.S. annually produces about 1.25 million tons of DDG.

Ethanol production is a growth industry, and the more it grows, the greater the supply of the DDG by-product. Assuming that about 350 million bushels of corn now goes into ethanol production, about 6 billion pounds of DDG is available.

This by-product has several interesting characteristics. It is rich in fiber and nutrients. It is highly digestible because it has been steam treated in the distilling process. And all of its main qualities such as protein and fiber content have been concentrated threefold over the corn kernel from which it was derived.

It has been well researched as an animal feed supplement, but little work has been done to exploit this tremendous supply as human food.

Research in this area involves Krishnan, Ag Engineer Jim Julson, and Extension Nutrition Specialist Carol Pitts.

"If the corn starch is chemically inserted into that chain, microbes then may be able to 'eat' not only the corn, but also the styrene molecules as well. That means polystyrene then becomes biodegradable in our landfills."

—Jim Julson
Ag Engineering researcher, SDSU

Krishnan, a faculty member here since 1988, is convinced the team has found an ideal use for DDG as a baking ingredient for the manufacture of cookies.

The first task was to make it taste-neutral.

"Neutral taste is not the worst thing in the world. If you have something that is more pronounced in taste, people either like it, or they dislike it," he said. "So, there is a high probability of developing DDG products which have a familiar taste."

Part of the problem was solved in adjusting the processing conditions to assure deodorization and removal of yeasty flavors.

Part also was solved by keeping its concentration to 5 to 7 percent of the cookie. In some recipes developed in Krishnan's lab, this is as little as 2 percent. It doesn't take much DDG to improve a food production nutritionally, given the fact that it is so nutrient-dense.

Another task was in extracting as much of the protein content as possible during processing. Methods developed at SDSU now assure that half of the protein can be recovered.

Yet another challenge was to develop cookies that met consumer expectations for qualities including taste and texture.

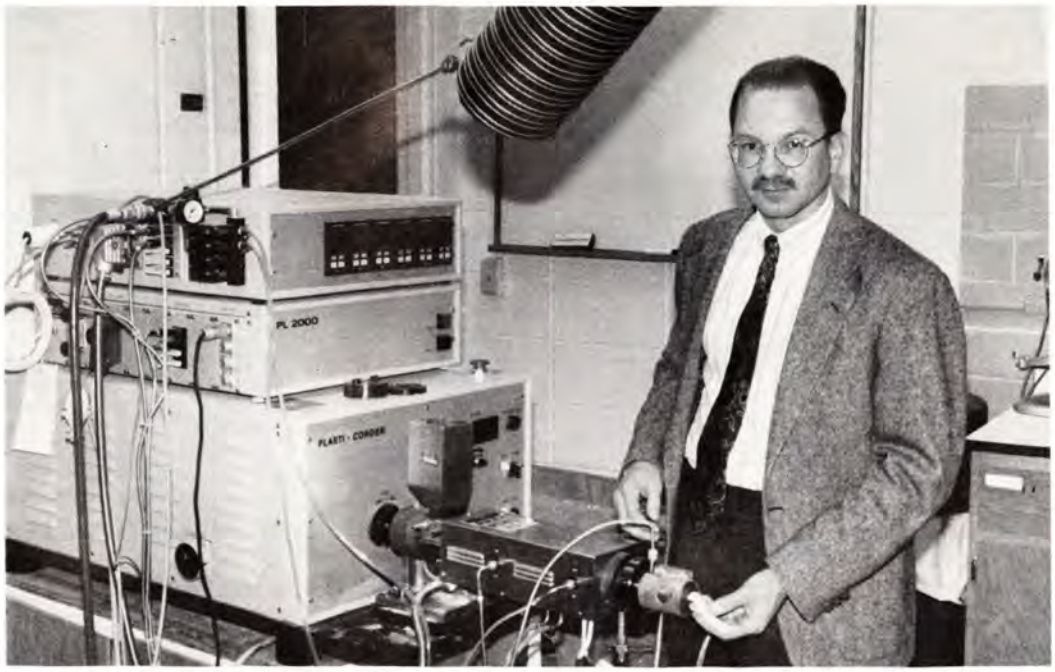
This testing was initially conducted in the Food Science Department's Sensory Evaluation Facility, but it since has been expanded to a greater scale with taste-testing of thousands of cookies by visitors at the South Dakota State Fair and other large events.

This information then is used to re-formulate and improve some of the recipes.

Dozens of cookie recipes have been developed, and something in excess of 50,000 cookies have been baked from these recipes to demonstrate to the public the potential use of the DDG by-product.

This is where Carol Pitts comes into the equation. As a specialist in the Cooperative Extension Service, one of her roles is to serve as an information transfer person, making this information available to the general public, and telling them how this material might be used in food stuffs. She did a lot of work on this at the South Dakota State Fair, and she also is developing several publications based on this work.

Other uses include crackers, breads, and pasta, but its use in cookies has the greatest potential by far, Krishnan said.



Jim Julson of the Ag Engineering Department demonstrates the lab-sized extruder used in SDSU's biodegradable plastics research. Plastic material coming from the extruder resembles corn curls. The extrusion process creates air cells in the material to enhance its shock-absorbing and insulative properties. Now that the team's formulation for the material is close to the optimum, it will be tested further through a commercial-sized extruder at a manufacturing plant in Minneapolis.

photos: Larry Tennyson

Another effort is in researching biodegradable plastics. This work involves putting corn flour into polyethylene and polystyrene plastics. Once these plastics are used and discarded into landfills, bacteria eat the starch. Thus, in the case of a 50-50 mix between starch and plastic, 50 percent of its bulk can be degraded by microorganisms. This cuts the accumulation of plastic in landfills by half in this case.

Jim Julson from the Ag Engineering Department now is working on ways to optimize the use of corn flour in making an extruded water-insoluble foam plastic that acts as a good insulator and shock absorber when used as a packing material.

The new material also is environmentally friendly.

SDSU Biochemist Tom West also has studied the degradation properties of the corn-based plastic. He has found that when buried in the soil, this new formed plastic was unrecoverable within 4 weeks.

This compares with other plastics which are virtually nondegradable and last possibly hundreds of years in a landfill.

The manufacturing economics for the material are attractive too, and for this reason it has a potential market with manufacturers who ship a lot of glassware, computers, scientific instruments, and similarly fragile items.

The cost of ordinary polystyrene plastic "peanuts" could drop from about 70 cents a pound to about 44 cents with the SDSU approach to manufacturing it.

If this new product catches on, it could increase the demand for corn by about 30 million bushels annually, Julson estimates.

"Right now, our formulation is very close to the optimum, so our next step is to extrude it through a commercial-size extruder in Minneapolis. This will provide valuable information for scaling up the process for commercialization," Julson said.

"Our formula calls for about 50 percent corn flour, which is a by-product of the corn dry milling industry. After this industry grinds up the corn and separates off the various size particles for which they have a ready market in the food industry, the part of the corn left over is corn flour," Julson explained.

"This is nearly all starch, and it's really cheap—about 9 cents a pound. Regular corn starch, by comparison, is 15-20 cents a pound. Polystyrene is about 60-80 cents a

pound, so by adding the corn flour to the mixture, we increase its value. We've also reduced the cost of the raw materials in the foamed plastic by about 40 percent."

The process for making the foam plastic is similar to making corn curls—a snack food which is actually extruded corn flour with a little cheese flavoring. The corn flour itself will expand when extruded with the right moisture content, and polystyrene needs a material like this to make it expand.

"Pure polystyrene such as a picnic plate is hard and brittle. Polystyrene used for insulation has had a blowing agent added to it to make it foam up—to create air cells.

"In the past the industry has used a gas to do this which has proven to damage our ozone, so the industry has switched to another blowing agent which is less damaging.

"But what we use for a flowing agent when we use corn flour in the styrene mix is actually water, which does no harm at all.

"That's just one of the several benefits built in to the corn flour based styrene insulation we are developing," he said.

What really interests Julson is whether the corn flour has combined chemically with the styrene.

"If it has, we've created a new molecule. The styrene molecule by itself is a long hydrogen-carbon chain—too long to be assimilated and consumed by microbes. If the corn starch is chemically inserted into that chain, microbes then may be able to 'eat' not only the corn, but also the styrene molecules as well. That means polystyrene then becomes biodegradable in our landfills. Otherwise, polystyrene lasts an extremely long time before it breaks down. Nobody really knows for sure how long."

Dr. Krishnan now is at work to test whether this chemical combination has actually occurred in the material produced in Julson's lab.

"The true test of our work is whether persons in the world of agriculture and commerce can use it to make a profit, and many of these developments definitely have that potential."

—Padmanaban Krishnan
Nutrition and Food Science
researcher, SDSU

The utilization group has also expanded their research into other areas.

Julson says just one of several promising avenues of research is the use of corn starch granules as time-release herbicide carriers—especially for no-till producers. They can use a low-cost preplant-incorporated herbicide but not have to incorporate it. Instead, they would spread the granulated starch material carrying the herbicide on top of the soil and gain the time-release benefits.

Krishnan already has looked at this time-release characteristic in expanded corn starch polystyrene primarily as a pharmaceutical medication delivery material, and he already knows it exhibits such time-release characteristics.

Krishnan says if an economical method could be developed for separating the fiber from the protein, there might be separate markets for each.

Another necessary research project is in finding an economical way to de-water the high-moisture DDG. In its natural state, it is almost 70 percent water, Krishnan said.

Yet another potential avenue of research is in attempting to extract the highly useful nucleic acids and flavoring agents from DDG.

West sees another promising area in biopolymers, which are microbially produced polymers for use in plastics, adhesives, and a multitude of other potential applications. Microbes that produce these biopolymers use corn as their primary food source.

West also forsees the future development of biologically produced organic chemicals that today are derived mainly from petroleum based fuels. This potentially could be achieved through the development of new specialty crops or through microbial bioconversions.

Already among the several interesting spinoffs of the research is the development of a miniaturized sensing device for measuring the thermal conductivity or "R-factor" of the extruded corn plastic. This features a thermocouple embedded in a hypodermic needle that can be inserted into the material.

All this activity actually signifies the emergence of a whole new approach to farming and manufacturing called "natural chemistry," Julson said.

The starches in certain crops are more adaptable to certain uses such as the manufacture of plastics. For instance, it could be that specialized crops will be planted and harvested in the future solely for use in plastics.

Materials now used exclusively for food and feed could also become sources of chemicals used for other applications. The development of new, specialized kinds of corn and other crops could even result in the formation of specific new industries.

"The true test of our work is whether persons in the world of agriculture and commerce can use it to make a profit, and many of these developments definitely have that potential," Krishnan said. ❑

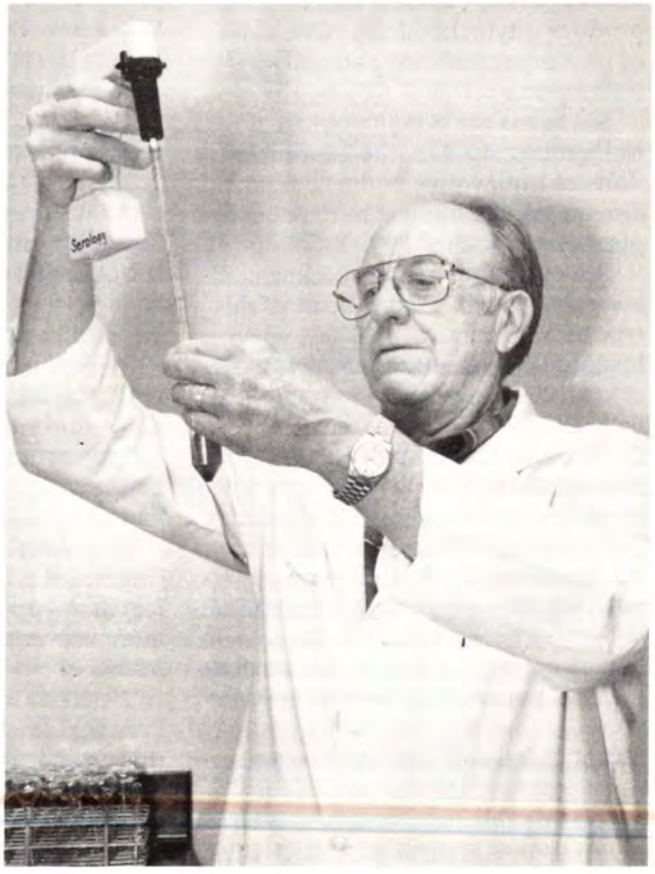
Dr. Larry Tennyson is a communications specialist in the Department of Ag Communications, SDSU.

SDSU's Animal Disease Research and Diagnostic Laboratory renovation leads to increased efficiency

photos by Tom Bare

Although the dedication of the renovated and remodeled Animal Disease Research and Diagnostic Laboratory (ADRDL) is still months away, scientists and technicians have already moved into the new quarters. The renovation will double the size of the previous facility, and allow for faster and more efficient testing and research activities. Above left, Sharon Franklin of the Dairy Science Department prepares samples for flow cytometry. Dr. Franklin is monitoring changes in white blood cells in dairy cattle. Above right, Dr. Chris Chase is preparing pig cells for the study of Porcine Reproductive and Respiratory Syndrome (PRRS). A few years ago, SDSU's Veterinary Science Department was instrumental in isolating the PRRS virus, which was then known as Mystery Swine Disease. At right, a pass-through window leads from the necropsy area to the tissue prep room. To keep testing operations flowing, related service areas are arranged together.

Most of the specialized equipment and testing procedures at the ADRDL were already in place before the renovation. The additional space allows for more "elbow room" including workstations that maximize use of technology and the skills of the staff. At left, Ivan Stotz uses the electron microscope to scan lab samples for the presence of a virus. Above, Becky Hines operates the flow cytometer. A number of departments share time on the flow cytometer, which uses a computer guided laser to measure cell characteristics at a rate and degree of accuracy impossible with standard light microscopes.



Above, microbiologist Stacey Wessels prepares cells to isolate the Bovine Virus Diarrhea (BVD) virus. Samples from animals suspected to be diseased are sent to the ADRDL for testing to help determine appropriate treatment. Right, microbiologist Rod Ellefson prepares a sample for serology testing. Dr. Ellefson is running a test for anaplasmosis, a parasitic disease of the blood that affects cattle species.

Soybeans—good for your heart and cancer fighters too

by Dr. Larry Tennyson

What vitamin research was to the late 1920s, soybean isoflavone research could be to the late 1990s.

Human consumption of soy protein already is known to help prevent heart disease. According to South Dakota State University researcher Dr. C. Y. Wang, it's entirely possible—even probable—that it also plays a role in the prevention of cancer.

Considering this along with the fact that soybeans have long been recognized for their nutritional value as a highly functional food ingredient. Add that South Dakota is one of the major soybean producing states, and you have a potent area for scientific investigation, according to Wang.

Wang, a member of the SDSU Department of Nutrition and Food Science, explains that all plants produce phytochemicals. One class of phytochemical compounds is isoflavones.

Soybeans are a major source of isoflavones. In fact, the concentrations of isoflavones in the soybean are among the highest in the entire plant world.

Scientists already have documented several of the unique properties of this type of compound. One is that when humans consume soy foods, their risk of heart disease and stroke is substantially lowered because of the isoflavones. This probably happens because the isoflavones help reduce levels of serum cholesterol in the blood.

According to Wang, scientists now are concentrating their efforts to determine whether soy protein offers a similar kind of health benefit in the area of human cancers. If it does, it is because the isoflavones somehow also have the power to interfere with the process of cancer as a natural anti-carcinogen.

The exact mechanism by which isoflavones act as anti-carcinogens isn't known, but there are several leads, Wang said.

First, one type of isoflavone competes with the female sex hormone for estrogen receptors, so they act as anti-estrogens and protect against hormone-related cancers.

Isoflavones also inhibit certain enzymes during the early development of a given cancer. Some also inhibit the early development of tumors.

If science further demonstrates this anti-cancer benefit, the demand for soy food products will rise, Wang believes. Presently, only 3 percent of the entire soy protein supply is used for human consumption.

If demand rises, so will prices. And when prices rise, so will income and the quality of rural life in South Dakota.

That's one of the reasons why the South Dakota Soybean Council contributes substantial research grants each year to support the work of scientists like Wang.

With the Council's help, Wang is now at work exploring the possibility of finding special characteristics in the soy protein isoflavones produced by the unique growing conditions and soils in South Dakota.

The questions are: Do our growing conditions produce a soybean that differs in any special way? Are they more concentrated in isoflavones, for instance?

No conclusions have yet been drawn as to which environmental factors promote which of the six types of isoflavones. South Dakota's soils may produce a soybean that either raises or lowers the isoflavone content.

photo: Larry Tennyson

Dr. C. Y. Wang uses an electronic balance to accurately weigh a sample of soy flour. The material is the basis for soy isolate, which is 90 percent protein.

While it is known that the concentration of isoflavones varies with the genetics of the soybeans, little is known about how the growing conditions could affect isoflavone production.

Such an effort requires cooperation of scientists from other departments. Helping Wang are Dr. Roy Scott, soybean breeder, and Dr. Howard Woodard, soil scientist, both from the SDSU Plant Science Department.

Together, this team is looking at the different varieties of soybeans produced in South Dakota for their isoflavone content and how conditions such as rainfall, fertilizers, concentrations of nitrogen and phosphorus, and even tillage methods might affect it.

Wang brings plant materials representing these various conditions and varieties into his lab to assess the isoflavones. He also conducts preliminary experiments designed to form the basis for additional research studies to study the health benefits of soy foods.

Another area of Wang's soybean research pertains to the development of soy food products that preserve the isoflavones but are still acceptable to the consumer.

"Isoflavones have wonderfully different properties, but when the processes for making soy foods were developed, nobody knew about such things. As a result, the processes themselves can and do destroy much of these beneficial compounds," Wang said.

To date, little is known about what happens to isoflavones when the soybeans are processed.

Wang wants to assess these various processing methods and determine the amount isoflavone loss inherent to each.

The challenge in this area of research is to develop a processing method that not only preserves the isoflavone content and its properties for lowering blood cholesterol and fighting cancer, but that also produces a soy food product that the consumer will buy.

"So, in this project, we will need to look at the effects of the processing and how much isoflavone is destroyed by it. Then we'll have to adjust the process so we have a final soy food product that has good flavor, good texture, good acceptability, and also with maximum retention of the isoflavones," he explained.

"Basically, you have three problems to consider in producing the kind of food that the consumer will buy and use," he observed.

"These problems are: flavor, digestibility, and flatulence. These account for the relatively low consumer acceptance of soy products in the U.S.

"There are two major factors in this: first, few consumers in western culture like the natural taste of soy food; second, soy protein naturally has a low level of digestibility.

"In the U.S., you have three main classes of soy food products: soy flour, soy protein concentrate, and soy protein isolate.

"The soy flour is the product you have left after you take out the oil, and this product is used in many ways. In fact, a lot of people don't even know they are eating it," Wang said.

Hexane solvent, a hydrocarbon compound similar in some respects to gasoline—is used to wash the crushed beans to get the oil out.

"In taking out the oil, one really doesn't lose much of the isoflavones, and most of it stays in the flour—which is what remains after this stage.

"Soy flour, the least refined form, has a protein level of about 55 percent," said Wang.

"Soy concentrate contains about 65 percent protein, because it is produced by washing the soy flakes with aqueous alcohol after the oil is out. This process reduces one of those undesirable characteristics: flatulence. The alcohol takes away much of the sugar that causes it. The alcohol also produces a somewhat bland flavor.

"Soy isolate is the most refined product made from the soy bean. It has a 90 percent level of protein, and its major uses include baby formula and health drinks.

"The problem with preserving the isoflavones, then, is primarily in the processes for producing concentrate and isolate," he said.

Soy isolate actually is already on the market, but Wang is looking at ways to further improve its flavor and minimize its less desirable characteristics so manufacturers will mix more of it into their other food products. He's also looking at ways to improve the yield of isolates from a given volume of soybeans.

"In making an isolate, you tend to lose even more of the flatulence-producing sugars out of the bean. Even common tofu has some reduced capacity for flatulence, but it does contain more of those sugars than are found in an isolate. Actually, it's the raw bean that is most offensive in this characteristic," he said.

> *"in this project, we will ... adjust the process so we have a final soy food product that has good flavor, good texture, good acceptability, and also with maximum retention of the isoflavones."*
>
> —Dr. C. Y. Wang
> SDSU Nutrition Researcher

Wang's experimental approach is with a different cooking method for the soy flour. This process is hydrothermal steam infusion (or "hydrothermal cooking," HTC). It promises to address several of the problems of consumer acceptance.

"Traditionally, soymilk or tofu is made by soaking the beans overnight. However, this produces a food that tastes 'beany' or 'grassy,' and that's not very desirable to a lot of people. Even commercially produced tofu tastes a little 'beany'," he said.

Wang has found that HTC denatures the enzymes responsible for much of the undesirable flavor. It leaves the product with a bland flavor. Tofu generally is consumed as an ingredient in soup—or, even more often—as part of a stir-fry. A bland soy food product then is free to absorb and mimic the taste of other foods in the recipe—such as vegetables and meats.

Wang knows from previous research that the steam infusion process has great potential for solving the other consumer-acceptance problems as well. He already has shown that the process improves the solubility of various soy protein products.

He anticipates that the process, properly applied, can produce soy protein food ingredients with minimal "beany" flavor, high digestibility, and high solubility.

In addition to its use in producing acceptable soy isolate, the HTC process also will be tried in processing soymilk for tofu manufacturing. Wang anticipates HTC may result in a tofu that not only also has greater digestibility, but also has exceptional nutritional and flavor qualities.

"We actually are at the earliest stages of this project, and we are making good progress," he said. ❑

Dr. Larry Tennyson is a communications specialist in the Department of Ag Communications, SDSU.

SDSU scientist heads national team to save range soil

by Mary Brashier

> *"...we all agreed to set aside our traditional, comfortable concepts, methods, and agency manuals, and think only about what is best for the rangeland resource."*
>
> —Dr. Pat Johnson,
> SDSU range researcher

Grass grows and sets seed. Cows bear calves and take them to grass. Soil, that grows the grass that grows the cattle, does not reproduce itself.

Worse yet, the soil we have today is more than we will have tomorrow.

Soil is the basis for all terrestrial life, and range management should, at a minimum, meet one goal: keeping the soil in place, says Dr. Pat Johnson, range scientist for the South Dakota Agricultural Experiment Station at South Dakota State University.

Johnson heads a national group of ecologists, scientists, and livestock producers who are bringing range management back to basics, to saving the soil. As a part of that simpler approach to management, the group is creating the opportunity for people with dissenting opinions to talk plainly and reasonably to each other.

The plan will go a long way toward defusing the current "range war" on whether public and private lands are deteriorating or holding their own. While range managers and scientists think that rangelands in general are in their best condition since the turn of the century, many citizens and environmental groups hotly disagree.

"They point at our own data which indicate that vast tracts of rangelands are in 'fair' or 'poor' condition," Johnson says. "They say that anything less than 'good' range is deteriorating."

photo: Mary Brashier

Pat Johnson believes that when all federal agencies adopt consistent terminology, South Dakota ranchers will see immediate benefits. "...range condition assessments will provide information that is useful and understandable to [ranchers] and the public at large." she said.

The problem, Johnson believes, starts with how we now describe range condition.

When scientists say that a rangeland is in poor, fair, good, or excellent condition, Johnson explains, "we are simply categorizing the land according to its successional status. Succession is a process of all natural ecosystems, in which plant communities change or are replaced by other plant communities. The end of succession is the 'climax' plant community. If the plant community on a particular range site is very similar to 'climax,' this site is designated as in 'excellent' condition. If very dissimilar, it is labeled as in 'poor' condition."

That label can pass on to the person controlling that range site. If it's rated "poor," that operator may be called a "poor manager," becoming a target for persons with other designs for that property.

In retrospect, she says, "the choice of the words—excellent, good, fair, poor—to describe range condition was unfortunate. They are 'hot' words that sound judgmental, even if not intended to be."

Johnson thinks the basic flaw in rangeland classification is more serious than the rating system. It's the whole premise upon which the rankings are built.

"What does 'succession' tell us that is useful," Johnson asks. "Is a climax

plant community better than a lower successional stage? Does a range site in climax stage have greater biodiversity, less soil erosion, cleaner water, better forage production, more recreational opportunities, and better livestock production?

"Turning the question around, are there more noxious weeds, greater soil erosion, reduced carrying capacity, and extinction of species on rangelands in a 'lower' successional stage?"

Her answer is a firm "No."

"Succession and range condition classes don't tell us the things we really need to know. They don't tell ranchers, the public, or Congress whether soil erosion is excessive, whether the variety of plants is best for livestock, or if suitable habitat is available for any number of wildlife species."

Johnson is chair of a national group of scientists, ecologists, and land managers, the Society for Range Management's Task Group on Unity in Concepts and Terminology.

"All of the agencies and groups these people represent have done very good work in the past, and we all agree that rangeland should be managed sustainably so that we can maintain or enhance its productivity for future generations."

But the task group was also well aware of misunderstandings and conflicts with the public brought about by current management concepts and terminology. To complicate matters, agencies had been using different terminology and were having difficulties talking to each other.

"At the first meeting, we all agreed to set aside our traditional, comfortable concepts, methods, and agency manuals, and think only about what is best for the rangeland resource," Johnson recalls.

That "best" was to protect the soil, they decided. While many other attributes of rangelands are desirable to maintain, the most basic requirement of good management is to keep range soil in place. Once lost, it is gone forever.

Using this basis, they developed new concepts and terminology for range condition assessment. Their report and recommendations have been adopted by the Society for Range Management, and an interagency rangeland health steering group is now working to ensure that all agencies will use one concept and the same language to evaluate rangeland sustainability.

"It will be scientifically defensible. There will be less room to misinterpret and, hopefully, fewer arguments," Johnson says.

South Dakota ranchers on the whole will benefit from the new system, she believes.

"Terminology will be consistent between federal agencies, and range condition assessments will provide information that is useful and understandable to them and to the public at large," Johnson says.

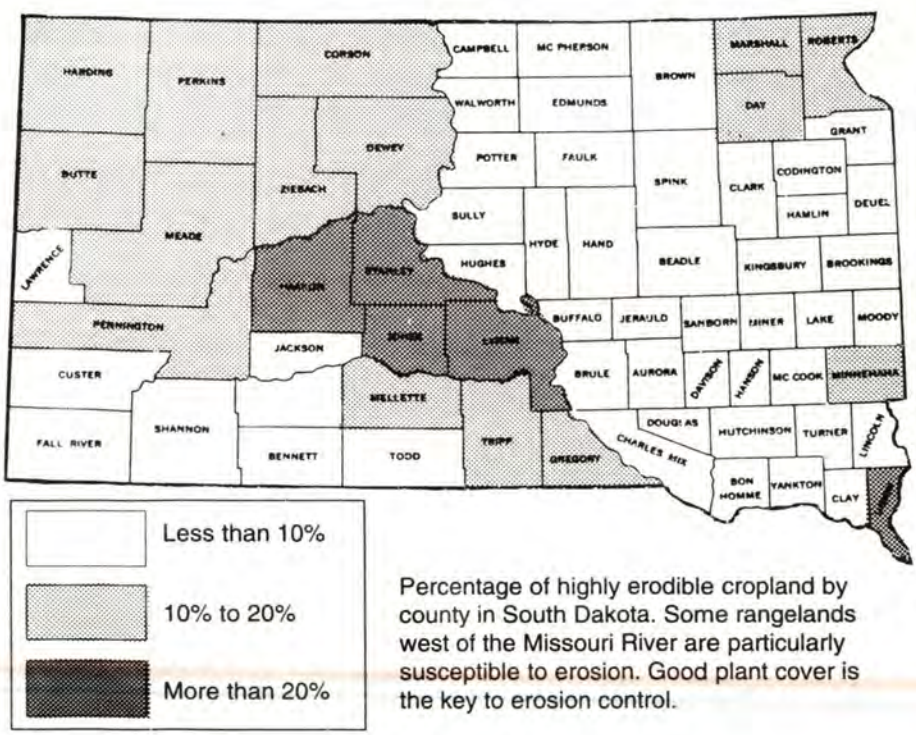
"Our state has lots of highly erodible rangeland, but it's often under good plant cover. That's the key. When rain and wind can't get directly to the soil, there will be less erosion. Our South Dakota rangelands generally recover from disturbances, caused by either nature or humans, relatively quickly, especially as compared to rangelands in more arid regions. Many of our ranchers have been working with the SCS and Forest Service to improve their management and to keep the soil in place."

Range scientists will be mostly concerned about accelerated erosion. Erosion is natural. "We couldn't stop it unless we paved the state with concrete," Johnson says.

Accelerated erosion is a result of management, Johnson says, and is a long-term rate in excess of natural

Rangelands as a percentage of all lands

In the world:	43%
In the United States:	54%
In South Dakota:	52%



Percentage of highly erodible cropland by county in South Dakota. Some rangelands west of the Missouri River are particularly susceptible to erosion. Good plant cover is the key to erosion control.

Society for Range Management (SRM)
Task Group on Unity in Concepts and Terminology

- South Dakota State University and other land-grant universities
- U.S. Department of Agriculture
  - Agricultural Research Service
  - Natural Resources Conservation Service (formerly the SCS)
  - Forest Service
- U.S. Department of the Interior
  - Bureau of Land Management
  - Bureau of Indian Affairs
  - Park Service
  - Fish and Wildlife Service
- Private individuals

photo: Tom Bare

David Fischbach, Faith, applauds the task group headed by Johnson. "As a rancher and past president of the Society for Range Management, I hope the agencies start using their results immediately and to the fullest extent, so they can communicate clearly with each other—and with us on the land." Fischbach says there's been "a lot of frustration and misunderstanding" among agencies, ranchers, and general public because nobody spoke a common language. "It's been long overdue, and I compliment Pat and the task group."

levels. Signs of accelerated erosion are obvious—gullies, changing soil color, sediments building up in the low areas. But erosion cannot be measured directly. Once it is obvious, the damage has already been done.

Johnson suggests that "we should evaluate the vegetation for its ability to protect the range site from accelerated erosion and, with a few exceptions, manage for plant communities that offer that protection. For each site we will have to decide what parameters will best predict the level of protection that plants can provide.

"In many cases, canopy cover will be very useful. If perennial plants are there and are stable and growing, it may not matter what kind of plants they are. And measuring canopy cover is relatively easy to do." All in all, Johnson says, the biggest thing that most South Dakota ranchers would notice under the new system is that "it should make more sense. And there will be a lot more emphasis by agencies to manage for plant communities that fit real management objectives while protecting sites from accelerated erosion rather than an emphasis on trying to achieve climax vegetation."

The new rangeland assessment concepts prepared by the task group create a common and simpler language for all groups, Johnson says. But she adds a warning:

"Whether we're ranchers, scientists, or members of a special interest group, we have to be realistic. The Badlands will never stop eroding."

Another place that conflict could develop is between management for erosion control and management for endangered species. In the Sand Hills of Nebraska and South Dakota are blowouts, bare sand depressions scooped out by wind, the only places where a rare plant, the blowout penstemon, can be found.

"If we stop erosion and those blowouts fill in, the nation may lose an endangered species. At other sites, if we want prairie dogs or black-footed ferrets, we must accept some sparsely vegetated knolls. One size won't fit all.

"On every range site, here in South Dakota and across the world, nature is just a little bit different than anywhere else. That's why we can't set a single standard for level of erosion or amount of plant canopy cover for all sites. That's why the people on the land who are most familiar with it are in the best position to help determine how to evaluate those sites.

"We can reach a consensus that nature in all its variety is good to have around. And the way to keep that variety around, especially on rangeland, is to keep the soil that nurtures all range life," Johnson says. ❑

Mary Brashier is Ag Experiment Station publications editor in the Department of Ag Communications, SDSU.

photo: Philip Pioneer Review

← After graduating from SDSU, nurse practitioner Tonya Matt returned to the area where she grew up to help make a difference in people's lives. Matt provides care for general health needs at Philip Health Services, works at the Rapid City Regional Medical Center, and travels the area speaking about a variety of health care issues.

SDSU graduates make a difference in rural South Dakota communities

by Cindy Price

While growing up in Quinn, near Wall, Tonya Matt wasn't sure what she wanted to do with her life. Now she's back in her hometown, helping meet its health care needs.

Matt is one of several South Dakota State University graduates who are doing their best to keep rural South Dakota strong.

"Because many SDSU students originate from rural and small town South Dakota, they appreciate and understand that environment," said James Pedersen, dean of the College of General Registration. "Many prefer to return to that environment and make professional contributions."

Two and a half days a week, Matt drives from her family's dairy farm near Quinn to work as a nurse practitioner at Philip Health Services. There she provides care for general health needs. She treats illnesses, gives physicals, performs suturing, and tends to women's health, well-baby care and pediatric care. One day a week, she works in the rheumatology unit at Rapid City Regional Medical Center.

"It's been really nice to work in the area where I grew up," Matt said. "It's great to provide care to people I've known all my life. I feel like I'm making a difference in their lives."

Besides her job at the clinic, Matt speaks to people in the area about a variety of health care issues. She said helping people recognize potential health problems is vital.

"Often in rural areas, people don't seek treatment until they're really sick," she said. "I'm telling them to come in earlier so they won't get as sick. We can do more to treat them if we know about the problem sooner."

Matt earned her master of science in nursing and nurse practitioner degrees in 1993 from SDSU.

Another SDSU health care professional is Lynn Johnson, Indian Health Service (IHS) pharmacist at Fort Thompson. An Onaka native, Johnson lives with her family on a farm near Highmore.

Johnson started working for IHS during summer internships. Since graduating from SDSU in 1992, she has worked with IHS full-time, first at Lower Brule and now at Fort Thompson.

"Since this area is so rural, we are the only health care for most people," Johnson said. "Through patient consultations, we tell them about medications and cut down on hospital time by counseling them on what to take and what not to."

In the IHS system, every patient has a chart, begun at birth, that allows health care staff to monitor their condition more closely. This extra care has positively affected people's lives.

"We have a number of state-of-the-art producers here who have high-tech equipment and want to know the latest innovations. Our office is one of the key places they go to get first-hand information."

—Ken Nelson
SDSU Extension Agent
Harding County

"An 8-year-old was taking a prescription for seizures, but we noticed that her blood levels showed the drug wasn't therapeutic," Johnson said. "After talking to her, we found she couldn't swallow the pills, so she had been hiding them under her pillow. We gave her the chewable kind and she doesn't have seizures anymore."

In another case, a diabetic woman was injecting the incorrect amount of insulin. Johnson sent her to an eye doctor, who prescribed new glasses. Now she can measure her injections accurately.

To travel safely to hospitals and jobs, people need good roads. That's where 1970 SDSU graduate and Fort Pierre native Cliff Reuer comes in.

Reuer is a traffic and safety engineer with the Department of Transportation's (DOT) Office of Local Government Assistance in Pierre. He develops signing plans for townships, counties, and smaller cities and conducts engineering studies to improve problem areas.

"Counties and townships are becoming more aware of the liability problems they have if a road is not properly signed," Reuer said. "They don't have the money or expertise on staff to do this themselves."

At a township board's request, Reuer pays a visit and creates a signing plan. Through a DOT program, 90 percent of the material costs can be reimbursed. At the county level, Reuer hires a consultant to devise a sign inventory and a long-range plan.

DOT statistics show that when signs are properly placed, there is a 14 percent reduction in accidents.

"I think if we can spend a little money to warn someone who may not be familiar with the road, we can prevent an accident, injury or death," Reuer said. "I get a lot of satisfaction in that. This is how we help rural areas."

Harding County roads are well-traveled. SDSU Extension agent Ken Nelson said county residents travel up to 50 miles to bring their problems to his office.

"That bug or weed a person brings in may be from their garden or wheat field," Nelson said. "When they take the time to come in, that's the most important thing to them. They need to stay on top of the problem in order to maintain their livelihood."

Nelson started working for the SDSU Cooperative Extension Service between his junior and senior years at State. The 1982 SDSU graduate and Sisseton native has held his current position since 1984. And he loves it.

"The Extension Service extends the services of SDSU to the corners of the state," he said. "We have a number of

photo: Cindy Price

Barb Cramer started and managed a drapery department for a furniture store in Clear Lake. When her employer moved the store to Watertown, Cramer stayed in Clear Lake and began her own drapery business. "I've really enjoyed it" she said, "I get to be creative with other people's money and meet many nice people."

photo: Cindy Price

Cultural activities in rural areas often revolve around music programs at school. When Richard Woolworth began teaching band at Hamlin High School in Hayti he had 24 band students; now he has 70. Public concerts expose the whole community to a variety of music. "Arts can help a community by creating more reasons for young people to stay there." Woolworth said. "If we can give them another reason to stay, they'll know their children will be given the same opportunities for diversity that they had."

state-of-the-art producers here who have high-tech equipment and want to know the latest innovations. Our office is one of the key places they go to get first-hand information."

Extension agents have a good rapport with each other, Nelson said, and know that if they can't answer a question, they can call another agent or the SDSU main office.

"In this line of work, you can never guess what the next day's going to bring," he said. "It keeps things interesting."

Another aspect that keeps life interesting is culture. In rural areas, cultural activities often revolve around the music programs at school. Brookings native Richard Woolworth has taught band at Hamlin High School in Hayti since graduating from SDSU in 1984.

Of Hamlin High's 200 students, 100 are band or choir members. When he joined the school faculty, Woolworth had 24 band students; now he has 70.

"When kids come to high school from middle school, anything that doesn't experience mass acceptance is weird," he said. "Most are brought up on country or Top 40. When they graduate, they may buy a jazz or classical CD, styles of music they never would have been exposed to without a high school music program."

Public concerts expose the whole community to a variety of music.

"Attendance at concerts has been great," Hamlin School Superintendent Burdell Lund said. "I see people with no kids in school who like them and come to them. If the band plays pieces people don't know, Mr. Woolworth explains a little about the music and its background so people are informed."

"Arts can help a community by creating more reasons for people to stay there," Woolworth said. "If young people feel like they're living in a vacuum or wasteland, they want to leave. If we can give them another reason to stay, they'll know their children will be given the same opportunities for diversity that they had."

Another way to keep people in rural areas is to offer jobs. When no job is available, some people create their own. Barb Cramer owns the drapery business she runs from her home in Clear Lake.

After graduating from SDSU in 1964, Cramer taught home economics for two years, first at Red Oak, Iowa, then in her hometown, De Smet. She was a case worker for the Department of Social Services in Sioux City for a year before she and her husband began a family.

When they moved to Clear Lake in 1976, Cramer decided to stay home with her three boys. In 1980 she began working two afternoons a week at Pletan Furniture in Clear Lake and was asked to start a drapery department.

"When they decided to move the store to Watertown in 1986, I stayed here and did draperies out of my home," Cramer said. "It's nice because I can go with my husband or see my kids' activities when I want."

Cramer shows customers fabric samples, vertical and mini-blinds, valences, and draperies, then travels to their homes to measure, help make selections, and hang the final product. Most of the sewing is done by a friend who has worked for Cramer for 15 years.

"I've really enjoyed it," Cramer said. "I get to be creative with other people's money and meet many nice people. It's kept me as busy as I want to be."

Cramer's customers hear of her through word-of-mouth advertising in the Clear Lake area. She said she prefers it that way so she can be busy, but not too busy.

"South Dakotans respect the many lifestyle benefits that come with entrepreneurship," Dean Pedersen said. "We need to do everything we can to build partnerships among business, industry, and communities that will provide employment opportunities and the chance for our graduates to stay in South Dakota." ❑

Cindy Price works as an information specialist with University Relations at SDSU.

107th Annual Report

July 1, 1993, to June 30, 1994

Agricultural Experiment Station
South Dakota State University

Note: Articles and publications of the Agricultural Engineering and Animal and Range Sciences Departments were inadvertently omitted from the annual report issue of *Farm & Home Research*. We include them here with our sincere apologies to the authors and departments involved.

Articles, publications

If you are interested in any of these articles or publications and cannot reach the author listed, contact the department under which the reference appears. Some of the authors may be graduate students who have completed their studies and left SDSU. The department will be able to assist you.

Agricultural Engineering

Refereed journal articles:

Alcock, R., R. Godbole, and D. Hettiaratchi. 1993. Prediction of tractive performance on soil surfaces. J Terramechanics 30:443.

Chu, S.T. 1994. Green-ampt analysis of wetting patterns for surface emitters. J Irrg and Drang Engr, Am Soc Civil Engrs 120(3):414.

Julson, J.L., S. Narayanan, and T. West. 1993. Environmental effects on the degradation of corn based foam plastics. Proc, Biostress Symposia:107. Brookings: SDAES.

Krishnan, P., J.L. Julson, and Y. Pathak. 1994. Polyethylene-starch extrudates as erodible carriers of bioactive materials. I: erodibility and in vitro dye release studies. J Biomaterials Applications 8:385.

Other reports:

Alcock, R. 1993. Information and agriculture. Keynote paper, Internatl ITS Conf.

Anderson, G.A. 1993. Evaluation of Midwest Plan Service-1 recommended minimum ventilation rates. ASAE Paper RRV93-205.

Chu, S.T. 1994. Green-ampt model for subsurface drip irrigation. ASAE Paper 94-2042.

DeBoer, D.W. and D.L. Beck. 1993. Irrigation surface runoff for tillage systems/crop rotations. Interim report, Dakota Lakes Research Center.

DeBoer, D.W. and R.A. Kohl. 1993. Performance characteristics of reduced pressure sprinklers. Proc, 15th Congress, Internat Commission on Irrigation and Drainage 1C:1033-1044.

DeBoer, D.W. and M.J. Monnens. 1993. Application characteristics of rotating-plate sprinklers. ASAE Paper 932612.

DeBoer, D.W., J.A. Doolittle, A.G. Bly, and R.A. Kohl. 1994. Salinity and selenium distributions in glacial till. ASAE Paper 942109.

Godbole, R. 1993. New approach to traction prediction in agricultural soils. MS thesis. Brookings: SDSU.

Iyyanki, P. and G.A. Anderson. 1993. Large deflection of rectangular orthotropic plates. ASAE Paper 934547.

Julson, J.L., P. Krishnan, and T. West. 1994. Corn flour-polystyrene foam plastic. Proc, Corn Utilization Conference V (abstr).

Kelley, V.C., G.L. Riskowski, and F.A.R. Gesualdo. 1993. Bending performance of spliced, nail-laminated posts with edge reinforcement. ASAE Paper 934533.

Kohl, R.A., S.G. Wangemann, C.G. Carlson, and D.W. DeBoer. 1994. Lateral hydraulic conductivity in glacial till. ASAE Paper 942048.

Li, Y. 1994. Field evaluation of an aquifer recharge model. MS thesis. Brookings: SDSU.

Li, Y.M. 1993. Estimate aquifer recharge with vadose zone composite hydraulic conductivity. ASAE NC Paper 93-404.

Moeller, S., J.L. Julson, and L.F. Brown. 1993. Investigation of the electrical properties of fresh ground beef. ASAE NC Paper RRV93-106.

Shane, R. and J.L. Julson. 1994. On-farm stored wheat management. Regional Stored Grain Integrated Pest Management Workshop, Fargo, N.D.

Sharma, S. 1994. Line heat source technique for determination of thermal conductivity of corn based foamed plastics. MS thesis. Brookings: SDSU.

Stange, K.W. 1994. Analysis of weather station RH sensors. ASAE Paper 942123.

Stange, K.W. 1994. Automating evaporation pan readings using low-cost components. ASAE Paper 942163.

Animal and Range Sciences

Books:

Boggs, D.L. and R.A. Merkel. 1993. Live animal, carcass evaluation and selection manual (4th ed). Dubuque, IA: Kendall-Hunt Publishing Co.

Romans, J.R., W.J. Costello, C.W. Carlson, M.L. Greaser, and K.W. Jones. 1994. The meat we eat (13th ed). Danville, IL: Interstate Printers and Publishers.

Referred journal articles:

Ayree-Bohannon, F.O., D.C. McFarland, N.H. Ferrin, and B. Patzlaff. 1993. Beneficial effect of ground flax seed on insulin receptor binding. Proc, Biostress Symposia:219. Brookings: SDAES.

Crews, M.G., J.R. Romans, and M.J. Marchello. 1994. Dietary effects of feeding omega-3 enriched pork products to healthy young men and women. Proc, 55th Flax Institute:135.

Feuz, D.M., S.W. Fausti, and J.J. Wagner. 1993. Analysis of the efficiency of four marketing methods for slaughter cattle. Agribusiness 9(5):453.

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Gartner, F.R. and K.J. Wrage. 1993. Pine canopy effects on biotic and abiotic parameters in the Black Hills. Proc, Biostress Symposia:154. Brookings: SDAES.

Iman, N.Y. and A.L. Slyter. 1993. Production of yearling Targhee or Finn-Dorset-Targhee ewes managed as a farm or range flock. J Anim Sci 71(12):3206.

Larson, C.L., H.L. Miller, and T.B. Goehring. 1994. Effect of postpartum bull exposure on calving interval of first-calf heifers bred by natural service. Can J Anim Sci 74:153.

Mahan, D.C., R.A. Easter, G.L. Cromwell, E.R. Miller, and T.L. Veum (NCR-42 Committee on Swine Nutrition). 1993. Effect of dietary lysine levels formulated by altering the ratio of corn:soybean meal with or without dried whey and L-lysine·HCl in diets for weanling pigs. J Anim Sci 71:1848.

Marshall, D.M. and M.B. Long. 1993. Relationship of beef sire expected progeny difference to maternal performance of crossbred daughters. J Anim Sci 71(9):2371.

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Quinn, M.A., P.S. Johnson, C.H. Butterfield, and D.D. Walgenbach. 1993. Effect of grasshopper (Orthoptera:Acrididae) density and plant composition on growth and destruction of grasses. Environ Entom 22(5):993.

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Thaler, R.C. and E.M. Weaver. 1993. Dietary management in pigs. P 278 IN (J.L. Howard, ed) Current Veterinary Therapy 3 Food Animal Practice. Philadelphia: W.B. Saunders Co.

Wagner, J.J. and D.M. Feuz. 1993. Effect of slaughter cattle marketing method on the production signals sent to beef producers. Prof Anim Scientist 9:53.

Wrage, K.J., F.R. Gartner, and J.L. Butler. 1994. Inexpensive rain gauges constructed from recyclable 2-liter plastic soft drink bottles. J Range Manage 47(3):249.

Wulf, D.M., J.R. Romans, and W.J. Costello. 1994. Current merchandising practices and characteristics of beef wholesale rib usage in three U.S. cities. J Anim Sci 72:87.

Wulf, D.M., J.R. Romans, and W.J. Costello. 1994. Composition of the beef wholesale rib. J Anim Sci 72:94.

Other reports:

Alderson, C.L., R.H. Pritchard, and D.L. Boggs. 1993. Effects of growth pattern on muscle growth, nuclei number, and protein accretion in heifers. J Anim Sci 71(Suppl 1):144 (abstr).

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Anderson, G., N. Iman, and A.L. Slyter. 1994. Effect of extended light on growth and reproductive performance of crossbred ewe lambs. J Anim Sci 72(Suppl 1):45 (abstr).

Birkelo, C.P. and R.K. Berg. 1993. Effect of a yeast culture (Yea-Sacc) on feedlot performance of yearling cattle fed a high concentrate finishing diet. SDAES SE Farm Rpt Animal Science 93-19:79.

Birkelo, C.P. and J. Lounsbery. 1993. Conventional versus high energy receiving and step-up diets for feedlot cattle. SDAES CATTLE 93-9:35.

Birkelo, C.P. and J. Lounsbery. 1993. Conventional versus high energy receiving and step-up diets for feedlot cattle. SDAES SE Farm Rpt Animal Science 93-18:74.

Birkelo, C.P. and D. Thomson. 1993. Net energy of soybean mill run for growing cattle. SDAES CATTLE 93-6:19.

Birkelo, C.P., D.U. Thomson, and J. Lounsbery. 1993. Ammoniated oat hulls for growing calves. SDAES CATTLE 93-5:15.

Birkelo, C.P., D.U. Thomson, and J. Lounsbery. 1993. Ammoniated oat hulls for growing calves. SDAES SE Farm Rpt Animal Science 93-20:82.

Birkelo, C.P. T. Van Der Wal, and J. Lounsbery. 1993. Effect of Synovex, Synovex + Finaplix, and Revalor on daily gain of yearling steers. SDAES SE Farm Rpt Animal Science 93-21:86.

Boggs, D.L. 1993. CHAPS summary for South Dakota, 1992. SDAES CATTLE 93-14:58.

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Carlson, M.S. 1994. Role of tryptophan in amino acid imbalanced diets fed to growing swine. MS thesis. Brookings: SDSU.

Carlson, M.S., C.R. Hamilton, and G.W. Libal. 1994. Relationship between dietary tryptophan, serotonin synthesis, and plasma growth hormone in finishing gilts. J Anim Sci 72(Suppl 1):56 (abstr).

Cromwell, G.L. (NRC-42 Committee on Swine Nutrition). 1993. An attempt to counteract growth depression from overcrowding of finishing pigs with a nutrient-dense diet. J. Anim Sci 71(Suppl 1):179 (abstr).

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Feuz, D.M. and J.J. Wagner. 1993. Value based marketing in the beef industry. SDAES Econ Commentator 319.

Gartner, F.R. 1993. The good, the bad, and the ugly of the 1993 growing season. Soc Range Manage SD Section n/l 93-2.

Gartner, F.R. and K.J. Wrage. 1993. Pactola hydrologic unit soil moisture study: summary of soil moisture data collected from the fall of 1990 to the spring of 1993. Tenth Int Seminar on Forest Adm and Mgmt, Univ Michigan and USDA Forest Service, Tour of Pactola Study Area.

Gartner, F.R., K.J. Wrage, and B. Sowell. 1993. Ponderosa pine canopy effects on microclimate and understory vegetation in the Black Hills. Proc, Soc Range Manage Abstr 005.

Gilkerson, K.K., J.E. Pesall, D.C. McFarland, N.H. Ferrin, T.A. Swenning, and W.V. Ye. 1993. Comparison of protein metabolism in turkey satellite cells and embryonic myoblasts. J Anim Sci 71(Suppl 1):126 (abstr).

Gilkerson, K.K., J.E. Pesall, D.C. McFarland, N.H. Ferrin, W.V. Ye, and T.A. Swenning. 1993. Protein metabolism in turkey satellite cells and embryonic myoblasts. Proc, 4th Ann SD EPSCoR Conf.

Hamilton, C.R. and G.W. Libal. 1993. Swine research update. Area Swine Days:71. Brookings SDCES.

Hamilton, C.R., G.W. Libal, and D.N. Peters. 1993. Effects of dietary tryptophan level on the performance of barrows and gilts fed corn-soybean meal based diets. J Anim Sci 71(Suppl 1):169 (abstr).

Hansen, E.L., C.R. Hamilton, D.N. Peters, and G.W. Libal. 1994. Influence of corn density on pig growth and nutrient digestibility. J Anim Sci 72(Suppl 1):57 (abstr).

Iman, N.Y. 1994. Lifetime lamb and wool production of Targhee or Finn-Dorset-Targhee ewes managed as farm or range flock. PhD thesis. Brookings: SDSU.

Johnson, J. 1994. CRM: It settles differences. F&HR 45(1):2.

Johnson, J.R., G.E. Larson, and A.L. Leighton. 1993. Field techniques for successful plant photography. Proc, Soc Range Manage Abstr 307.

Johnson, J.R., G.W. Reeves, D.W. Schmidt, and J.L. Skogberg. 1994. Estimating grass utilization using photographic guides. SDCES EC 900.

Johnson, P.S. 1993. Changing directions in range condition assessment. Proc, Soc Range Manage Abstr 283.

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Larson, C.L., H.L. Miller, D.M. Marshall, and M. B. Long. 1994. Effects of norgestomet or norgestomet and GnRH on age at puberty in beef heifers. J Anim Sci 72(Suppl 1):45 (abstr).

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Marshall, D.M. 1993. Breed differences and genetic parameters for body composition traits in beef cattle. Proc, Breeding Genetics Symp on Genetics of Body Composition in Beef Cattle, Amer Soc Anim Sci.

Marshall, D.M. 1993. Interpreting experimental results. SDAES CATTLE 93-1:1.

Marshall, D.M. 1993. Genetic parameters for carcass traits in beef cattle. SDAES CATTLE 93-8:28.

Marshall, D.M. and M.B. Long. 1993. Maternal performance of first-calf crossbred beef cows in relation to sire expected progeny differences (EPDs). SDAES CATTLE 93-7:23.

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Pruitt, R.J., M.C. Namminga, R.H. Haigh, and D.B. Young. 1993. Level of available forage and supplemental protein and energy for cows grazing winter range. SDAES CATTLE 93-3:4.

Shen, C-L. B.A. Watkins, S.S. Lin, and D.C. McFarland. 1994. Dietary lipid modulation of fatty acid composition of tibiotarsal bone and IGF-1 responses in chicks. FASEB J A929 (abstr).

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Wagner, J.J. 1993. Marketing options for high value calves. Proc, Bovine Connection to Profit.
Wagner, J.J. 1993. Scab-infested wheat or barley for feedlot cattle or sheep. SDCES Extension Extra 2017.
Wagner, J.J. and D.M. Feuz. 1993. Effect of slaughter cattle marketing method on the production signals sent to beef producers. SDAES CATTLE 93-19:92.
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Wagner, J.J. and R.H. Pritchard. 1993. Evaluation of three feed mixing wagons. SDAES CATTLE 93-13:54.
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Wrage, K.J. 1994. Effects of ponderosa pine (*Pinus ponderosa* Laws) on soil moisture, precipitation and understory vegetation in the Black Hills of South Dakota. MA thesis. Vermillion: USD.
Wulf, D.M., J.R. Romans, and W.J. Costello. 1993. Composition of the beef wholesale rib. J Anim Sci 71(Suppl 1):151 (abstr).
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Zalesky, D. 1993. Boost cow-calf profits with better fall management. Dakota Farmer.
Zalesky, D. 1994. Getting heifers ready for breeding. Pasture Performance, Winter/Spring.

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Calendar of Events

Date	Event	Person to Contact
March		
20	National Agriculture Day	
21—22	Community Development Conference, Pierre	Lynette Olson, Home Economics, SDSU
24—25	Little International, SDSU	Brian Sharp, Manager, SDSU
29—30	Nutrition Seminar, SDSU	Carol Pitts, Home Economics, SDSU
April		
2—4	State FFA Convention, Brookings	Bob Bell, Ag Education, SDSU
20—21	Wyo-Mon-Dak Community Development Conference, Belle Fourche	Connie Skinner, Extension Agent, Belle Fourche
29—30	State 4-H Shooting Sports Match, Pierre	Kathy Reeves, 4-H, Rapid City
May		
30—June 2	S.D. Stockgrower/Cattlewomen/Jr. Stockgrower Convention, Chamberlain	Darlene Heuttl, S.D. Stockgrowers, Rapid City
June		
3-7	National 4-H Youth Congress, Orlando, FL	Kathy Reeves, 4-H, Rapid City
23	SDSU Animal Disease Research & Diagnostic Lab Dedication, Brookings	John Thomson, Veterinary Science, SDSU
27	Industry Weed Tour, Southeast Experiment Farm, Beresford	Leon Wrage, Plant Science, SDSU
28	Twilight Tour, Southeast Experiment Farm, Beresford	Bob Berg, Farm Manager, Beresford
29	Dakota Lakes Research Farm Summer Field Day, Pierre	Dwayne Beck, Plant Science, SDSU
July		
11	Northeast Research Farm Tour, Watertown	Jim Smolik, Plant Science, SDSU