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South Dakota Farm and Home Research
SDSU Agricultural Experiment Station

Fall 1994

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South Dakota State University

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Ag Experiment Station Director Fred Cholick plans to communicate by doing a
lot of listening. What he hears will help him develop a better understanding of
the needs of farmers and ranchers, scientists, and other South Dakotans.

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All the resources necessary for the production of food and fiber—humans, soil,
air, plants, animals—come under the umbrella of agriculture. All these
resources will affect the course of SDSU ag research.

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Take scientists from a variety of disciplines—each tackling soybean problems
from a different direction—put them together, establish strong ties and easy com­
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South Dakota Agricultural Experiment Station.

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Fred Cholick, newly appointed Agricultural Experiment Station Director
(left), talks with Rodney Foster at his feedlot near Brookings. Dr. Cholick
is visiting with South Dakotans involved with all aspects of agriculture to
ask opinions and gather information that will help shape the future of Ag
Experiment Station research.

photo: Tom Bare
Before preparing my first “comments” as Director of the South Dakota Agricultural Experiment Station, I looked up Ray Moore’s first comments of 20 years ago and then reviewed his last one, “Looking back to the future.” Dr. Moore’s legacy will continue to bear fruit for many years to come.

So it is both a challenge and an opportunity to accept this position and to build on the strong tradition of the Ag Experiment Station. There are three essential elements to this job, and I will try to tell you how I intend to combine agriculture, research, and people.

In my view, agriculture can be compared to an umbrella. It is an encompassing term for production of food and fiber for mankind. It is a way of life. It requires continued harmony with the natural resources of the planet Earth. Agriculture includes all resources—humans, the soil, the air, the plants, and the animals. Agriculture essentially touches the life of everyone everyday.

Research is defined as a careful, systematic, patient study and investigation to find and develop knowledge for the establishment of facts and principles. That’s a useful definition—as far as it goes. It raises some questions, however. The main one is: Is the research relevant to agriculture and to South Dakotans?

As you will find in an article in this Farm & Home Research, I am originally from Oregon. However, my wife and I consider South Dakota to be our home in every way. I have had the opportunity to travel widely, both in the United States and internationally, but I can truly say that we have never felt more at home anywhere than in South Dakota. Primarily because of the people, South Dakota has become our home.

Now, what will be my part in making agriculture, research, and people fit together?

As I view the job today, one of the two primary roles of the director is to encourage and support the research activities of the faculty within the Ag Experiment Station. The second is to communicate.

Naturally, the director communicates with scientists when he monitors research. Equally important is communication with the citizens of South Dakota. And it is also part of the director’s job to see that the needs of South Dakota are represented in the federal scheme.

Fifteen years at wheat breeding have taught me that the better part of communicating is listening. By “listening” to the wheat plant, by learning its needs, I became a better researcher.

So listening is a great part of what I intend to do in this new job. I will be available—at meetings, on the phone, in the labs, at field days and livestock seminars. I will be a stu-
South Dakota Ag Experiment Station Directors

<table>
<thead>
<tr>
<th>Years</th>
<th>Name</th>
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<tbody>
<tr>
<td>1887-1893</td>
<td>Louis McLouth</td>
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<tr>
<td>1894-1901</td>
<td>James H. Shepard</td>
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<tr>
<td></td>
<td>Hall at South Dakota State University is named in honor of Dr. Shepard.</td>
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<tr>
<td>1902-1938</td>
<td>James W. Wilson</td>
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<tr>
<td></td>
<td>Wilson's father, James, Sr., served as Secretary of the U.S. Department of Agriculture in the late 1800s.</td>
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<tr>
<td>1938-1956</td>
<td>Isaac B. Johnson</td>
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<tr>
<td>1957-1958</td>
<td>Max Meyers</td>
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<tr>
<td></td>
<td>Later served as Administrator of the Foreign Agriculture Service, U.S. Department of Agriculture</td>
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<tr>
<td>1958-1965</td>
<td>Orville Bentley</td>
</tr>
<tr>
<td></td>
<td>Later became the first Assistant Secretary for Science and Education, U.S. Department of Agriculture</td>
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<tr>
<td>1966-1973</td>
<td>Duane Acker</td>
</tr>
<tr>
<td></td>
<td>Also served as Dean of South Dakota State University's College of Agriculture and Biological Sciences. Later served as Assistant Secretary for Science and Education, U.S. Department of Agriculture; Administrator for the Office of International Cooperation and Development; and Administrator of the Foreign Agriculture Service.</td>
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<tr>
<td>1967-1973</td>
<td>Al Mussen</td>
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<td>Associate Director, Ag Experiment Station</td>
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<td>1973-1994</td>
<td>Raymond A. Moore</td>
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<tr>
<td>1994-</td>
<td>Fred A. Cholick</td>
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We will continue the research that enhances the quality of life in South Dakota, research that can be turned to beneficial use and development of human, economic, and natural resources. Our focus on biostress is a natural fit in our mission because of the geographic location of our state. The investigation of stress responses, mechanisms, and management affects the daily lives of South Dakotans and therefore should be emphasized in our research.

It is also critical that we develop a holistic approach in our research. Each research project—a piece of a puzzle—is important in itself, but it has far more impact on agriculture when it becomes part of the entire puzzle. You operate holistically too—you probably call it seeing the big picture—when you cull your beef herd in response to price drops or alter your planting intentions because of weather disasters somewhere else. It is our responsibility here at the Ag Experiment Station to bring more of that large puzzle into clearer focus so you on your farm or ranch or in your business and in your community can make informed decisions about how you will live your lives.

A last word now, before I start listening.

I believe it is extremely appropriate, as it was 20 years ago when Dr. Moore prepared his first comments, that my introduction as director appears in the annual report of the Station. This report will provide you a background of the human resources within the Ag Experiment Station and give you an idea of the depth of research activities that continue to benefit the citizens of South Dakota. May we have a pleasant and productive association together.
New director encourages integrated approach to ag research

"Agriculture should be viewed as an umbrella that covers everyone. It's a way of life. It's the production of food and fiber to feed people. It's the foundation of South Dakota's economy. Agriculture and agricultural research touch everyone's lives, not only in South Dakota but across the nation."

That's the philosophy that Dr. Fred Cholick will bring to his new job as Director of the South Dakota Agricultural Experiment Station. He was appointed to the post in September 1994.

Fred Cholick has worn a number of hats during his 13 years at South Dakota State University. He came to South Dakota State University in 1981 as project leader of the spring wheat breeding and genetics program. During that time, Cholick developed...
six new varieties for South Dakota, including the only two hard red spring wheat varieties in the region with Hessian Fly resistance. Since 1991 he served as head of South Dakota State University's Plant Science Department.

"As our spring wheat breeder and later as Plant Science Department Head, Dr. Cholick has worked with South Dakota farmers for more than a decade. He understands the challenges that farmers and ranchers face, and he has a proven track record of using science to solve South Dakota ag production problems," according to South Dakota State University's Dean of Agriculture and Biological Sciences, Dr. David Bryant.

"His leadership abilities, credibility, and rapport with agricultural commodity groups and his knowledge and commitment to the improvement of agriculture and family life will make him an excellent leader in South Dakota State University's research efforts," Bryant said.

Looking ahead to his new role as South Dakota State University's ag research director, Cholick said, "My goal is to keep doing what we are already doing well. That is to conduct research that enhances the quality of life in South Dakota through the beneficial use and development of human, economic, and natural resources. Our research has been and will continue to be the foundation for South Dakota's economy."

Cholick believes in a holistic approach to research.

"That's more critical today than it's ever been. When we talk about a holistic approach, we have to consider the entire umbrella of agriculture, which is more than just the production of food.

"In addition to considering how their research will impact production, scientists now have to consider the impact of production agriculture on local communities. And they must also consider national and international impacts of their research. It's that whole package that we have to take a look at from the production standpoint all the way through to where it reaches the consumer," Cholick said.

Cholick sees challenges and opportunities in agricultural research, starting with the Northern Plains Biostress Lab in Brookings.

"One of my goals is to continue to build on the biostress concept, which is an integral part of the Ag Experiment Station.

"The Northern Plains Biostress Lab is an outstanding facility on the South Dakota State University campus. But it's more than a building. The concept of using research to address biostress problems provides the central focus for our research efforts.

"South Dakota State University is the logical home for biostress research because South Dakota is a natural laboratory for animal, plant, and human stress research. It's a natural focus point for our efforts in the Agricultural Experiment Station," Cholick said.

Even though Cholick has worked for more than a decade with South Dakota farmers and ranchers, he intends to spend the next few months as a student of agriculture and South Dakota.

"I've had a career of working with a great group of people in Plant Science. I've spent 15 years being a student of the wheat plant. Now, I've got to become more of a student of agriculture, South Dakota, and all research. So I'm going back to school," he said.

As Ag Experiment Station Director, Cholick will be responsible for the research conducted in 11 departments within the South Dakota State University College of Agriculture and Biological Sciences, and for some research in the College of Home Economics. The research is coordinated nationally with the USDA's Cooperative State Research Service, as well as with the North Central States Experiment Stations.

Cholick is looking forward to building on the past accomplishments of the Ag Experiment Station. "I feel very fortunate that I'm following the 20-year tradition of research leadership established by Dr. Ray Moore," he said.

Cholick was born and raised on a diversified family farm in western Oregon. He has agronomy degrees from Oregon State University and Colorado State University. Fred and his wife Cathy have two children.

Prior to his appointment at South Dakota State University, Cholick provided leadership for an international USAID program that developed and distributed winter wheat germ plasm to national breeding programs in developing nations.

Dr. Dale Reeves, Professor of Plant Science and South Dakota State University's oats breeder, has been appointed acting Plant Science Department Head until a nationwide search is completed.

Emery Tschetter is the head of the Department of Ag Communications, South Dakota State University.
A soybean research team at South Dakota State University is unlocking the secrets of the soybean plant. In its fourth year, the team already has delivered payback to soybean producers. The team's first "hold-in-the-hand" kind of success is a new soybean variety named Hendricks. It was released to farmers this year.

If the team's long-term goals are achieved, growers can expect continued production of new varieties with better quality oil, improved protein, better disease resistance, and more yield stability. Growers can also look for improved practices for tillage, weed control, disease control, and soil fertility.

Post-doctoral researchers, graduate students and technicians assist the faculty scientists working on various facets of soybean production. The group is working to improve prof-

New approach unlocks secrets of soybean plant

by Jerry Leslie
individual members of the team are attacking from several different directions. Some are improving the plant itself. Others are working on agronomics and cultural practices. Yet others are trying to improve demand by finding new uses for soybeans.

Research focus includes breeding and genetics, genetic engineering, phytophthora root rot, flower abortion, soil fertility, weed management, and soy oil for feed value and health benefits of soy foods.

The total team embraces a mixture of academic specialties, from traditional plant breeders like Roy Scott, soybean breeder, to molecular biologists Catherine Carter and Tom Cheesbrough. The latter two are probing the nucleus of the cells in hopes of finding genes worthy of transferring to improve oil and protein traits of the soybean plant.

Other members of the team include R. Neil Reese, flower abortion; Tom Chase, disease resistance; Howard Woodard, soil fertility; Paul Johnson and Leon Wrage, weed control; Chunyang Wang, human nutrition; James Doolittle, soil chemistry; and Bob Thaler, swine nutrition.

The development of this interdisciplinary soybean research team was encouraged by Dr. David Bryant, dean of the College of Agriculture and Biological Sciences. He and other administrators put the team together in 1990 and 1991.

Scott immediately began collaboration with the University of Minnesota and North Dakota State University, collecting and screening hitherto unreleased lines from their breeding programs. His motive was to "jump start" the SDSU program.

He formed alliances with these two states because their climates are similar to South Dakota's, and the soybean plant is sensitive to climate, Scott explained. These states also work with the same maturity group soybeans as South Dakotans need, he added.

That joint effort resulted in release of the SDSU team's first new soybean variety, a joint release with the University of Minnesota in February 1994. The variety was named 'Hendricks' for the lake northeast of Brookings that forms the border between South Dakota and Minnesota—symbolic of a cooperative release between the two states.

The new variety is a Group Zero soybean, meaning it is a short-season variety adapted to the northern area of the South Dakota where temperatures normally are cooler and the growing season shorter.

Hope for two more new varieties rests in two lines that have been tested 2 years in the National Uniform Testing Program. "They were tested last year and showed good potential," said Scott, "so they were re-entered this year."

He added, "Those lines, both Group II maturity beans, may be considered for release in another 2 or 3 years if they continue to perform well. We're looking for yield stability, and they also have good resistance to phytophthora root rot and acceptable protein levels."

These, too, would be joint releases, since the lines were started in the Minnesota program.

The SDSU team employs several new approaches intended to shave back the traditional 8 to 10 years required from first-cross to final release of a new variety.

One technique employs winter nurseries, one in the Southern Hemisphere and another in the tropics of the Northern Hemisphere, to supplement a summer's growing season here. While South Dakotans shovel snow and slip on ice, SDSU soybean
plants grow a second generation in Chile. If a third generation is desired within one year, Scott employs another winter nursery in the Central American nation of Belize.

The stepped-up soybean research effort at SDSU has support and encouragement from South Dakota soybean growers. Their checkoff dollars contribute grant support each year to enhance state, federal, and competitive grant dollars. This year, growers, though their South Dakota Soybean Research and Promotion Council, approved $154,300 to assist 10 soybean research projects at SDSU. Similar sums have been provided each year for several years.

Soybean growers also offer considerable input into research directions during a periodic visit to campus referred to as “the soybean roundtable.” During that visit they hear researchers report on their work, and they “brainstorm” on directions in which they would like to see research go.

Improved oil and protein content and Group Zero varieties are a couple of grower priorities that came out of the roundtable.

This year the roundtable met in August at South Dakota State University's Southeast Experiment Farm near Beresford. Members of the Soybean Research and Promotion Council and growers in the South Dakota Soybean Association gathered to hear research updates, then discuss research directions, and finally tour the research plots at the farm.

David Bogue, a soybean farmer from Beresford and member of the Soybean Association, was there. He said, “We must, as producers, stay competitive with the rest of the world in production of soybeans.

“I feel that through the investment of producer checkoff dollars, the projects designed to increase profits take high priority.

“We are seeing a worldwide increase in the demand for soybeans and their processed products, and I want to see this demand met by U.S. soybean producers. This is being done through research at our colleges and universities.”

Bogue said he values SDSU research because it focuses more specifically on South Dakota problems, including work toward a soybean variety that will maintain protein content in northern localities and research on reducing flower abortion to increase pod set. Further research toward solving old and new weed problems is another area he cited.

“We appreciate the progress being done in these areas, and seeing the applied research that has been funded by the checkoff dollars.”

Evolution of a major soybean research effort at SDSU grew out of what was happening with the growers. At one time, South Dakota was not a soybean state, considered too cool and too dry except for the southeastern tip of the state. In the 1980s, the state grew about 500,000 acres. But by 1991, that acreage grew to 2 million, Scott said. It is now the third crop in South Dakota, behind only corn and wheat.

The expansion was brought about by several factors: a decrease in acreage of other oilseed crops, profitability potential in soybeans, and farmer realization that soybeans could be grown farther west and north than originally thought, Scott said.

New drought-tolerant varieties and shorter-season maturity groups came out of past breeding programs, making it possible to grow soybeans west to the Missouri River and north to the border, Scott said. Most of the varieties now grown in South Dakota came out of the University of Minnesota breeding program, he added.

“We're hoping to change that, not to eliminate varieties from other states—because we want as many choices available to farmers as possible—but to have most of the varieties we grow be South Dakota-developed varieties,” Scott said.

Farmer and South Dakota Soybean Association member David Bogue values SDSU research because its focus is on varieties and problems in northern localities. “We are seeing a worldwide increase in the demand for soybeans . . . and I want to see this demand met by U.S. producers,” Bogue said.

The soybean research team members are mostly clustered in the Northern Plains Biostress Laboratory. Working in close proximity aids their communication and they can share equipment and facilities. Some are next door in the Plant Science Research Building, and others are not far away in Ag Hall.

In addition to the traditional plant breeding methods, the team employs advanced molecular techniques. Traditional crossbreeding involves taking pollen from one plant to the flower of another, slowly bringing desirable traits together over generations.

Molecular biologists Tom Cheesbrough and Catherine Carter are developing techniques that will allow them to transfer genes. They now routinely pull the genes out of a cell nucleus, put them in libraries, and then screen for the genes they want.

“Now we think we've found some (desirable genes) and we are checking them out,” said Carter.

They are searching for genes that affect protein levels, oil content, and
types of oil. Cheesbrough is isolating a gene involved in fatty acid synthesis. They will alter the gene, then try to get it back into the soybean and see if it will change the fatty acid type in the soybean.

One of their goals is to reduce the impact of environment on oil and protein content. Since grain elevators can dock for low protein content, growers want a soybean that will maintain its protein levels through tough growing conditions. Another goal is to produce more polyunsaturated oil desired for cooking oils.

Stabilizing oil and protein content is of critical importance in the marketplace to South Dakota growers because of the negative impact of South Dakota's biological stresses on oil and protein content. A variety grown to the south, if moved farther north, will have lower oil and protein content, placing South Dakotans at a competitive disadvantage with growers in other states.

Advanced techniques researchers are using in this molecular kind of work are polymerase chain reaction, electrophoresis, gene transfer with a gene bombarding gun, and finally, regenerating transgenic cells into a total plant through a tissue culture process.

Carter has just hired a postdoctoral research assistant, Charleen Baker, who is expert in transformation and tissue culture regeneration. Her work involves regenerating plants from cotyledons of seedlings or main stems of seeds. A particle gun which was custom-built for the research team will be used to introduce useful DNA into regenerated plants.

Although molecular techniques will speed the process of putting a desirable trait into a line, that line will still have to be field tested before it can be used in the breeding program, Scott said.

Ag Experiment Station Director Emeritus Ray Moore said earlier this year he thought that SDSU's first transgenic plant release would probably be a soybean, simply because so many people are working in that area.

A another team member working in the advanced molecular area is Tom Chase in plant pathology. Chase is project leader on an 11-state north-central regional project funded by American Soybean Association checkoff dollars. He and co-investigators are trying to nail down the precise identity of different races of phytophthora root rot fungus.

Although not normally a serious problem in South Dakota, phytophthora causes more problems as states expand and intensify their soybean production. In 1986, the fungal disease caused problems here during an unusually wet spring.

Using polymerase chain reaction techniques to isolate portions of DNA from the fungus for molecular analysis, Chase is attempting to "fingerprint" different pathogenic races. As many as 26 different races are currently known to exist. Some soybean varieties have resistance to the disease, but this resistance is race specific.

Chase's work will help farmers choose soybean seed that carries resistance to whatever phytophthora race or races can be identified in their fields.

Chase is developing techniques so he can screen advanced breeding lines developed by the breeding pro-
gram for race-specific resistance and susceptibility. He also is surveying the soybean production areas for occurrence of phytophthora and other diseases during the growing season.

On another front, R. Neil Reese and his assistants are working to improve soybean yields by reducing flower abortion. Their approach examines the tendency of the soybean plant to abort some of its flowers which, as a result, never set seed. Reese is trying to understand the complex biochemical process involved.

His group is picking up where recently-retired USDA plant physiologist Dean Dybing left off at SDSU. This flower abortion work uses PCR-generated probes or cDNA probes from other plant species. Researchers are screening for other genes that may be involved in regulation of flower abortion or seed set, looking for messenger ribonucleic acid generated from aborting or setting raceme tissues.

Reese’s team has learned that they can apply a hormone called cytokinin to reduce abortion and increase seed set. Now, with a project funded by the South Dakota Soybean Council, they will use a virus to transfer a gene for increased cytokinin production into a soybean cell. They will then regenerate the cell into a soybean plant so they can measure the effect on flower abortion and seed set from the added gene.

On the agronomic front, Leon Wrage and Paul Johnson are working to improve weed control efficiency in soybeans. They are looking at herbicide rate and row spacing, foxtail removal timing, and antagonistic response in some tank mixes for foxtail and volunteer corn. They also are developing a hooded bander they hope will allow farmers to use an inexpensive broad-spectrum herbicide between the rows rather than an expensive selective herbicide over the rows. Wrage and Johnson are demonstrating soybean oil as an adjuvant in herbicide application. And they are expanding their no-till data base.

Soils researcher Howard Woodard is trying to determine the impact of various production practices and phosphorus fertilizer application. He is looking at how row spacing and variety selection affect yield in cultivated and no-till fields. He also plans to determine if phosphorus bands from a previous year in corn are effective for the next year’s soybean crop.

Soil chemist James Doolittle is examining soil-specific management of phosphorus for soybeans. His research will tie in with the global positioning system (GPS) which uses a combination of satellites and farm machinery with on-board computers to manage a field on a small-parcel basis.

On the product-utilization side of research, Extension swine specialist Bob Thaler is working to improve feed value of light test-weight corn by adding soy oil, extruded soybeans, and soybean meal to make up the energy deficit in the corn.

Also working on product utilization is Chunyang Wang in the Department of Nutrition and Food Science. He evaluates the content of natural anti-carcinogens known as “isoflavones” in soybean varieties currently grown in South Dakota by following them through the processing plant. Isoflavones “may become the 21st century vitamins because of their significant roles in prevention of heart diseases and cancers,” Wang said.

Soybean research at SDSU complements work being done in other states, in the USDA Agricultural Research Service, and in private industry.

Roy Scott stays in touch with colleagues in other states and goes to the National Soybean Breeder Workshop every year. He also attended the World Soybean Conference in Thailand in 1994.

Scott particularly is watching efforts at Monsanto, which is working with private companies to develop a soybean tolerant to the herbicide Roundup.

If Monsanto makes the germ plasm available to public institutions, “we certainly would be involved using the gene, if farmers of South Dakota think they need a Roundup-resistant soybean,” Scott said.

Fred Cholick, Director of the Agricultural Experiment Station, extolled the partnership that exists between SDSU, the Soybean Council, and soybean farmers. “If it wasn’t for that partnership, we wouldn’t have the research activity going on in soybeans,” he said.

Soybean farmers and the Soybean Council are part of the team, Cholick said. “It is a very effective team, and it is looking at many aspects of soybeans, targeting many of our problems here in South Dakota,” he added.

The new soybean variety, Hendricks, is the first of many things to come.

The more interesting question is where will the soybean rank in South Dakota 10 or 20 years from now. Will it still be third in acres? And where will South Dakota rank among states as a soybean producer? Will it rank 13th, as it did in 1993, or will it move higher on the ladder as soybean acres continue to push north and west? Will soybeans one day grow and thrive at Winner, Wall, and Mobridge, and Lemmon?

The trends and the expanded research effort are promising for soybean expansion in South Dakota.

Whatever happens, SDSU scientists will be a part of the unfolding future of this ancient hairy legume from China. The people who grow it, sell it, feed it to their livestock, and consume it will be the beneficiaries of this research effort. 

Jerry Leslie is news and features writer in the Department of Ag Communications, SDSU.
Grape genes give clues to winter survival

by Dr. Larry Tennyson

South Dakota produces quality fruit crops, but plant breeders face a continuing challenge in developing varieties that will thrive in the severe climate of the upper midwest.

"Developing those varieties is not one of those things that happens quickly, because of the length of time it takes to get the information we need for selecting better fruit varieties for our state," according to Dr. Anne Fennell, an SDSU plant physiologist.

Fennell's own research will have a major impact in speeding up that process by improving the methods for identifying the important genetic characteristics needed for breeding better varieties.

She uses grape plants to search for "markers" for the genes associated with the processes of acclimation and winter survival of woody, fruit-bearing plants in the climate of the Northern Great Plains.

Cold hardiness or winter survival is a complex problem, she said, and breeders are constantly selecting and breeding new materials to deal with them.

But Fennell's role is to understand the physiology associated with these processes. Specifically, she works to observe cold hardiness characteristics of the plants and to determine the underlying mechanisms that produce them.

This work is part of a stress physiology project financed with a 2-year, $49,220 National Research Initiative Grant from the USDA.

Fennell picked grapes for several reasons. Grapes are a fruit crop, and they are native to South Dakota. Grapes also are easy to propagate and easier to grow in the greenhouse than several other woody, fruit bearing plants, and they don't take up much space. And, because the work can be done in a greenhouse instead of a field, she is able to experimentally control and manipulate their growing environment.

Grapes also have a much simpler genetic structure, or genome, compared to a plant such as an apple tree, but they do have all the complexity she needs in her work.

Yet another reason is that there are several different types of genetic material available: grapes originally imported from Europe, grapes that are native to the Americas, and grapes that were developed by crossing American and European varieties. All this translates to a large variety of material for experimentation and observation.

"I use the grape plant as a model system. Grapes have as wide a range of acclimation and winter survival characteristics as exhibited by other fruit crops, but it doesn't take long to get them from seedling stage to fruiting stage. In fact, grapes can reach fruiting stage in just 2 or 3 years, as compared with apples, which can take from 5 to 8 years.

"Grapes and other fruit crops may have a very good winter hardiness and may be able to withstand very low temperatures, providing they receive the right temperature and daylength conditions. But, quite often, they get 'zapped' by the sud-
den onset of freezing temperatures before they are completely acclimated,” Fennell explained.

“The same plant material may be capable of surviving the same amount of cold temperatures if it instead receives the right sequence of environmental conditions, however.”

To survive in the Northern Plains, woody plants need to respond to environmental cues before the onset of freezing temperatures.

One environmental cue is that of decreasing daylength (hours between sunrise and sunset) in the late summer. Another is the lower growing temperatures in the early fall.

The decreasing daylength is constant year after year. Daylength begins decreasing in late June and continues until we reach our shortest daylength in December, she explained.

“Temperature, however, is variable and does not always decrease gradually.”

Plants can acclimate in response to the decreasing daylength, or in response to low temperatures, or in response to both. However, if the grower has a variety that acclimates in response to low temperatures instead of decreasing daylength, it can be damaged when the warm temperatures suddenly drop below freezing like they did in October 1991, Fennell said.

If researchers like Fennell can find ways to identify whether a certain variety has daylength responsive genes, they can then use these materials to cross with varieties that respond to low temperatures to produce a plant capable of continuing its winter acclimation despite warm fall temperatures.

“What I’m trying to do rather than tackling the whole aspect of cold hardiness is to look at early acclimation and dormancy in grapes,” Fennell said.

“I’m using short daylengths to start the acclimation and dormancy processes in these grape plants, so I can observe their physiological and molecular responses and search for genetic characteristics or ‘markers’ that can be used to test new materials.

“These ‘markers’ may be as easy to see as changes in stem color, or they may be identified by enzyme activity, presence of specific proteins, or the actual genes themselves.

“By combining physiological and molecular screening in plants that acclimate in response to decreasing daylength and in those that do not, I can start picking away at the responses and begin to determine what mechanisms are involved.”

She already has some indications of those mechanisms from her collaborations with fruit breeders at the University of Minnesota.

“Right now, we think the response to the decreasing daylength in grapes is not controlled by a large number of genes, but in fact by a fairly small family of genes.”

Fennell also is involved in other fruit crop research projects—one of which features a national effort to find hardy rootstocks, primarily for apple tree propagation.

“As far as South Dakota is concerned, this is a critical project, because existing commercially available dwarfing root stocks are not tremendously winter hardy. They do pretty well here in Brookings, but if you have an open winter, your root stock can be killed.”

Root stocks can impart certain cold-hardiness characteristics to the grafted apple. These characteristics also can include anchorage, size control, and the ability to tolerate heavy clay soil or dry sandy soil, she added.

When a plant breeder thinks he’s found a good root stock, Fennell’s group of 25 to 30 scientists from around the country decide how it should be tested. It usually ends up being planted in at least 10 locations, and all plantings are identical and handled exactly the same.

“This cuts the time required for a normal test. Working alone, the individual breeder might need 20 years to test in all the environmental conditions that this group can provide working cooperatively.

Working cooperatively cuts that time in half, Fennell said. ☐

The author is Dr. Larry Tennyson, special projects writer in the Department of Ag Communications, SDSU.
A day in the life of the Highmore research station

photos by Tom Bare

South Dakota State University's Central Crops and Soils Research Station is almost always called the "Highmore Station". It is located just outside of Highmore, South Dakota, on Highway 14.

Research Technician Mike Volek (photo at right) and his family live at the Highmore Station. This allows Volek to be immediately available for all the day-to-day routines and maintenance necessary at the station.
Station manager Brad Farber (above, left) has an office in Brookings, but spends a lot of time at Highmore. Farber oversees all aspects of operations at Highmore, and works with South Dakota State University researchers to develop plans for future plots and projects. Spring wheat researcher Jackie Rudd (upper right) checks his plots at Highmore regularly.

Visitors are welcome at the Highmore Station. Above, left to right, Volek listens to suggestions from area farmers Jim Faustich, Gary Halwick, and Leroy Scott. Highmore teens work at the station during the hectic summer season. Above right, Wendy Zemlicka and Nicole Faucett walk beans. Lower right, Farber and Volek unload seed with Alex Cermak, another local teen.
107th Annual Report
July 1, 1993, to June 30, 1994
Agricultural Experiment Station
South Dakota State University

Board of Regents

Bob Brancel, Pierre
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Executive

R.A. D.A. Bryant, PhD, Dean
W.L. Tucker, PhD, professor
Station Statistician
Fiscal Officer

W.L. Tucker, PhD, professor
D.G. Longeisier

Advisory Groups

Antelope Livestock & Range Field Station

John Brown, Vermillion
Bill Clinton, Buffalo
Blaine Drageset, Isabel
Dave Flachschluf, Faith
Gary Gilber, Ludlow
Tom Gibson, Sioux Falls
Ray Meyer, Sorum
Leonard Nygaard, Gason, ND
Larry Vroman, Buffalo

Central Crops and Soils Field Station

Brad Bonhorst, Pierre
Pat Fastnacht, * Miller
Kevin Haber, * Huron
Randi Hagge, Higmore
Phil Hamburger, Seneca
Scott Ingel, Caufield
Jerry Johnson, * Higmore
Brandi Kousemchak, * Wessington Springs
Newell Ludwig, Ondria (alternate)
Keith Melius, Miranda (alternate)
Larry Nagel, Gettysburg
Tom Olsen, Wessington Springs

Dakota Lakes Research Farm

Lyle Stewart, Blunt (alternate)
Gerald Syring, Pauliston
Jake Villhauer, Higmore (alternate)
Paul Wellwrenny, * Ondria
Ken Womnenberg, * Pierre
Todd Yackley, Ondria
Greg Yopp, Huron
Mike Volek (ag tech), ** Higmore
Brad Farber (manages), ** Brookings
Fred Cholick (dept head), ** Brookings
Bob Schurrer (acting CES supervisor), ** (retired 6/30/94)
Bob Davis (dist CES supervisor), ** Brookings
Nilo Reber (dist conservationist), ** Higmore

* county Extension agent
** nonvoting advisor

Cottonwood Range and Livestock Field Station

Neal Brunskill, Philip
Olmer Cook, Quinn
Ingeborg Fauske, Wall
Clifford Fees, Philip
Larry Gabriel, Cottonwood
J. Tipps Hamilton, Pierre
Bill Headlee, Kadoka
Rick Horton, Wall
Jerry Jasmer, Philip
Scott Kennedy, Philip
Richard Kjerstad, Quinn
Eugene Thomas, Murdo

Dakota Lakes Research Farm

Advisory Board
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Barry Muxen, Doland
Roger Rix, Groton
Roger Schiele, Pierre
LeRoy Smith, Lucas
Mark Stiegelmeier, Selby
Steve Taylor, Prentice
Pat Tracey, Pierre
Tom Trivett, Pierre

Board of Directors
Terry Beattrom, Pierre
Wilbert Blumhardt, Bowdle
Ron Gilman, Kennebec
Ralph Holtworth, Gettysburg
Christ Huse, Ondria
Bryan Jorgensen, Ideal

Northeast Research Farm

Bill Biggard, Waubay
Lynn Eberhart, Britton
Michael Flor, Webster
Sandra Greep, * Sisseton
Donald Gathmiller, Hayti
Orvin Korth, Watertown
Loren Krause, Clear Lake
Lyle Kresel, Summick
Craig Haagaard, * Milbank
Laird Larson, Clark
Paul Leiseth, Hazel
Gordon Ljungquist, Watertown
Warren Rusche, * Clear Lake
Chuck Langner, * Watertown
Arlyn Thompson, Sisseton
Lorne Tilberg, Britton
Chuck Tellerson, Clark

*Loyal Eyer, (ag tech), ** South Shore
James Smolik (manages), ** Brookings
Fred Cholick (dept head), ** Brookings
Bob Davis (dist CES supervisor), Brookings

* county Extension agent
** nonvoting advisor

SESD Research Farm

Dennis Auch, Oliver
Kevin Crisp, Dell Rapids
Darrell E. Edelman, Menno
John Fallberg, Beresford
Neil Hoogestraat, Chancellor
Willie Hubner, Akron, IA
Ron Johnson, Alcester
Dean Kootson, Centerville
LeRoy Larson, Vermillion
John Olbertson, Beresford
Frank Orr, Meckling
Merlin Peterson, Irene
Meryln Smeenk, Harrisburg
Dean Weber, Wagner

Staff

Ag Communications

E.J. Tschetter, MS, department head
M.R. Brashier, MS, assistant professor
J.R. Leslie, MS, assistant professor
L.K. Tennison, Ed.D, professor

Agricultural Engineering

R. Alcock, PhD, professor and head
G.A. Anderson, PhD, associate professor
A.R. Bender, MS, assistant professor
S.T. Chu, PhD, professor
D.W. DeBoer, PhD, professor
D.S. Humburg, PhD, assistant professor
L.J. Juhl, MS, assistant professor
V.C. Kelly, MS, assistant professor
M.A. Schipull, MS, assistant professor
K.W. Stange, MS assistant professor
J. Tang, PhD, assistant professor
H.D. Werner, PhD, professor

Animal and Range Sciences

J.R. Males, PhD, professor and head
C.P. Birkelo, PhD, assistant professor
W.J. Costello, PhD, distinguished professor
R.J. Emerick, PhD, professor (joint appointment with Station Biochemistry)
F.R. Gartner, PhD, professor and director, West River
Agricultural Research and Extension Center, Rapid City
D.H. Gee, PhD, professor
S. Goodfellow, manager, beef breeding unit
R.H. Haigh, BS, superintendent, Range and Livestock Research Station, Philip
C.R. Hamilton, PhD, professor
D.H. Gee, PhD, professor
P.S. Johnson, PhD, associate professor
J.R. Romans, PhD, professor
J.L. Wagner, PhD, associate professor
R.H. Pritchard, PhD, associate professor
R.J. Romans, PhD, professor
A.L. Slyter, PhD, professor
R.H. Swan, BS, superintendent, Antelope Range Livestock Station, Buffalo
R.N. Swanson, PhD, professor (joint appointment with Veterinary Science)
K.E. VanderWal, BS, manager, cow-calf teaching and research unit
J.L. Warner, PhD, associate professor
L. Warborg, manager, meat laboratory
M. Zehms, MS, manager, beef cattle and sheep nutrition research unit

Biology/Microbiology
C.R. McMullen, PhD, professor and head
B.H. Bleakley, PhD, assistant professor
C.H. Chen, PhD, professor
W.R. Gibbons, BS, assistant professor
N.H. Granholm, PhD, professor
M.B. Hildreth, PhD, associate professor
D. Hurley, PhD, assistant professor
R.N. Reece, BS, assistant professor
C.A. Westby, PhD, professor

Dairy Science
J.G. Parsons, PhD, professor and head
R.I. Baer, PhD, professor
K.A. Baldwin, MS, instructor/dairy plant manager
M.J. Brouk, PhD, assistant professor
S.T. Franklin, PhD, assistant professor
D.R. Henning, PhD, associate professor/Alfred Chair
K.M. Kasper, BS, research assistant
F.C. Ludens, BS, instructor/dairy farm
V.V. Misry, PhD, associate professor
D.J. Schingoethe, PhD, professor

Economics
A.A. Lundeen, PhD, professor and head
M.K. Beutler, PhD, associate professor
T.L. Dobbs, PhD, professor
W.D. Ellington, BS, instructor
S.W. Faust, PhD, assistant professor
D.M. Feuz, PhD, associate professor
D.R. Frankle, PhD, associate professor
L.L. Janssen, BS, professor
C.E. Lambertson, PhD, professor
B.A. Quami, PhD, assistant professor
D.C. Taylor, PhD, professor

Home Economics
G.D. Tigidemand, PhD, associate professor and acting dean
M.G. Crews, PhD, professor and head
P.G. Krishnan, PhD, associate professor
L.A. Scholtens, MS, instructor (resigned 6/69)

Horticulture, Forestry, Landscape and Parks
W.C. Johnson, PhD, professor and head
S.E. Boettcher, MS, research assistant
M.E. Enevoldson, MS, research associate
N.P. Evers, BS, instructor
A. Fennell, PhD, assistant professor
D. Gehris, BS, research assistant
J.F. Harbage, PhD, assistant professor
C.A. Hoss, MS, research assistant
P.D. Prathar, PhD, professor
R.P. Schaefer, PhD, associate professor
R.L. Stubbles, PhD, assistant professor

Plant Science
F.A. Choieck, PhD, professor and head
C.M. Bar, PhD, research associate (postdoc)
D.L. Beck, PhD, associate professor, manager, Dakota Lakes Research Farm
R.K. Berg, Jr., PhD, assistant professor, manager, SESD Research Farm
B.H. Bleakley, PhD, assistant professor
A.G. Bily, MS, research associate
A.A. Boe, PhD, professor
M.A. Bel, PhD, research associate
R.R. Borrmann, MS, research associate
K.A. Brix-Davis, MS, research associate
G.W. Buchenau, PhD, professor (retired 6/30/94)
E.T. Butler III, PhD, assistant professor
C.G. Carlson, PhD, professor
C.D. Currier, PhD, associate professor
M.A. Catangal, PhD, research associate (postdoc)
L.D. Chandler, PhD, assistant professor
T.E. Chase, PhD, assistant professor
D.E. Clay, PhD, assistant professor
S.A. Clay, PhD, associate professor
R.O. Colling, assistant professor
J.J. Doolittle, PhD, assistant professor
C.D. Dybing, PhD, adjunct professor (USDA/ARS)
M.M. Elloury, PhD, adjunct associate professor
P.D. Evenson, PhD, professor
B.G. Farber, MS, research associate, manager, Central Research Station
P.E. Fink, PhD, adjunct associate professor
B.W. Fuller, PhD, assistant professor
R.H. Gelderman, PhD, assistant professor, manager, Soil and Plant Analytical Lab
K.A. Guin, MS, assistant professor
S.D. Haley, PhD, assistant professor
L.A. Hall, MS, research associate
R.G. Hall, PhD, professor
L. Hammad, PhD, assistant professor
S.I. Hanson, BS, research assistant
J.A. Ingemanson, MS, manager, Foundation Seed Stocks
P.J. Johnson, PhD, assistant professor
A.L. Kahl, PhD, adjunct professor
D.G. Kenefick, PhD, professor
R.W. Kleecheffel, PhD, adjunct professor (USDA/ARS)
K.D. Kephart, PhD, assistant professor
J.A. Koepe, BS, research assistant
R.A. Kohl, PhD, professor
M.A. Langham, PhD, assistant professor
G.D. Lemme, PhD, assistant professor
M.J. Lindstrom, PhD, adjunct associate professor (USDA/ARS)
D.D. Malo, PhD, professor
W.C. Moldenhauer, PhD, adjunct professor (USDA/ARS)
A.E. Olness, PhD, adjunct associate professor (USDA/ARS)
R.J. Pollmann, MEd, associate professor, Seed Certification Service
D.L. Reeves, PhD, professor
D.H. Rickert, PhD, assistant professor
J.R. Rickertson, MS, research associate
W.E. Rick, PhD, assistant associate professor (USDA/ARS)
J.C. Rudd, PhD, assistant professor
K.A. Schols, MS, research associate
J.A. Schumacher, MS, research associate
T.E. Schumacher, PhD, professor
R.A. Scott, PhD, assistant professor
J.D. Smolik, PhD, professor, manager, Northeast Research Farm
C.E. Smythe, MS, assistant professor
G.R. Sutter, PhD, adjunct professor (USDA/ARS)
F. Sutton, PhD, associate professor
E.B. Turnspeed, PhD, assistant professor, manager, Seed Testing Lab
M.F. Wettgaste, PhD, adjunct associate professor (USDA/ARS)
Z.W. Wicks II, PhD, professor
H.J. Woodard, PhD, assistant professor

Rural Sociology
J.L. Satterlee, PhD, professor and head

Station Biochemistry
L.L. Peterson, PhD, professor and head (began 7/94)
H.G. Hecht, PhD, professor and acting head (8/93-7/94)
N.A. Anderson, BA, research assistant
R.J. Emerick, PhD, professor
D.P. Evenson, PhD, professor
J.E. Houglin, PhD, professor
W.P. Jensen, PhD, professor
L.K. Jost, MS, technical assistant
H. Kayongo-Male, PhD, associate professor (joint appointment with Biology/Microbiology)
D.G. Kenecki, PhD, professor (joint appointment with Plant Science)
D.P. Matthes, PhD, professor
D.C. McFarland, PhD, adjunct associate professor
L.S. Palmer, PhD, professor
F. Sutt, PhD, associate research assistant
N.J. Thiex, MS, assistant professor
T.P. West, PhD, associate professor

Veterinary Science
J.L. Thorson, DVM, MS, associate professor and head
D.A. Berfield, PhD, professor
C. Chase, DVM, PhD, assistant professor
J. Christopher-Hennings, DVM, MS, research associate
D.H. Francis, PhD, professor
L.D. Holler, DVM, PhD, assistant professor
D.J. Hurley, PhD, associate professor
D.D. Johnson, DVM, PhD, professor
D.W. Miskimine, DVM, MS, assistant professor
D.T. Nelson, DVM, MS, assistant professor
E.A. Nelson, PhD, assistant professor
C.B. Srinivas, DVM, MS, research associate
I.J. Brotz, MS, assistant professor
M.J. Yenger, DVM, PhD, assistant professor
H. Zeman, DVM, PhD, associate professor

Wildlife and Fisheries Sciences
C.R. Scale, PhD, professor and head
C.R. Berry, PhD, adjunct professor
M.L. Brown, PhD, assistant professor
W.G. Duffy, PhD, assistant professor
L.D. Flake, PhD, professor
R.F. Higgins, PhD, associate professor
D.E. Hubbard, PhD, assistant professor
J.A. Jenkins, PhD, assistant professor
D.W. Willis, PhD, associate professor

Projects
Agricultural Engineering
G-043, Application of machine vision to the selective mechanical harvest of mushrooms; Humburg
H-055, Environmental factors that affect pig health; Anderson
H-063, Design and analysis of agricultural structures; Anderson
H-133, Influence of irrigation and drainage design on discharge water quality and corn profitability; DeBoer, Chu
H-163, Explanatory processing as a value enhancing technique for agricultural materials; Julson, Krishnan
H-192, Root growth and soil impedance; Alcock, Myers
H-239, Variables in agricultural weather information systems; DeBoer, Stange, Chu, Werner
H-243, Modeling groundwater recharge from vadose zone to aquifer; Chu, DeBoer
H-261, End effector design for automated handling of biological materials; Humburg
H-271, Machine vision as a sensor for automated handling of biological materials; Humburg

Animal and Range Sciences
R-079, Genetics of body composition in beef cattle; Marshall
H-090, Overstory, understory, and soil water relationships of hydrologic units in the Black Hills; Garner
H-101, Physiological and nutritional interactions that affect growing pigs; Hamilton, Libal
H-183, Early events (binding and entry) in the
pathogenesis of porcine rotavirus; Benfield, Erickson
AH-242, Identifying antibodies to bovine epithelial
receptor for bovine herpesvirus 1; Chace
G-252, Analysis of porcine intestinal receptors in
which Esherichia coli E88 bind; Francis, Bosworth, Erickson
AH-262, Identifying pigs that are inherently resistant
or susceptible to colibacillosis; Francis
H-272, Role of boar semen in the transmission of swine
infertility and respiratory syndromes (SIRS); Yeager,
Hennings, Benfield
R-281, Bovine respiratory disease: risk factors, pathogens,
and glutathione concentrations in regenerating hair
foliage, wheat residue, and corn roots for microbial
tolerance in plants. Proc, Biostress Symposia:46 .
1994. Effect of the Ay allele of the agouti locus on
concentration of alfa-melanocyte stimulating hormone in
lethal yellow (Ay/a) mice. Proc. SD Acad Sci 73: (in
press) (abstr).
colostrom whey preparations inhibit the binding of
enteric viruses and bacterial toxins to HEp-2 cells
in culture. Proc, SDAES. (abstr).


Other reports:


Van Zee, B.E., C.S. Guy, and D.W. Willis. 1994. Electrofishing injury rates for largemouth bass, smallmouth bass, and bluegills collected with pulsed DC and high output, pulsed AC. SD Dept Game Fish Parks, Fish Div Rep 94-1.


Budget

Agricultural Experiment Station
For July 1, 1993, to June 30, 1994

State appropriation $6,145,485

Federal appropriation $2,436,999 *

Federal restricted $2,948,780

Other restricted $5,880,129

Total $17,411,393

* Federal FY 93
## Calendar of Events

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Person to Contact</th>
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<tbody>
<tr>
<td><strong>November</strong></td>
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<tr>
<td>1</td>
<td>Dairy Unit Dedication and Open House</td>
<td>John Parsons, Dairy Science</td>
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<tr>
<td>10-12</td>
<td>National FFA Convention, Kansas City, MO</td>
<td>Robert Bell, Ag Education, SDSU</td>
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<tr>
<td>13-16</td>
<td>National 4-H Livestock Judging Contest, Louisville, KY</td>
<td>Rich Howard, 4-H, SDSU</td>
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<td></td>
<td><strong>DISTRICT WEED MEETINGS</strong></td>
<td>Leon Wrage, Plant Science, SDSU</td>
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<tr>
<td>1</td>
<td>District IV, Faulkton</td>
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<td>District V, Bison</td>
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<td>3</td>
<td>District VI, Philip</td>
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<td>7</td>
<td>District III, Plankinton</td>
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<td>9</td>
<td>District I, Watertown</td>
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<td>10</td>
<td>District II, Madison</td>
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<td></td>
<td><strong>DISTRICT CROP IMPROVEMENT ASSOCIATION MEETINGS</strong></td>
<td>Bob Hall, Plant Science, SDSU</td>
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<tr>
<td>14</td>
<td>NC District, Ipswich</td>
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<td>15</td>
<td>NW District, Bison</td>
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<td>16</td>
<td>SW District, Wall</td>
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<td>SC District, Presho</td>
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<td>C District, Miller</td>
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<td>21</td>
<td>NE District, Webster</td>
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<td>22</td>
<td>SE District, Freeman</td>
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<tr>
<td>23</td>
<td>EC District, Madison</td>
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<tr>
<td><strong>December</strong></td>
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<tr>
<td>3-7</td>
<td>National 4-H Youth Congress, Orlando, FL</td>
<td>Kathy Reeves, 4-H, Rapid City</td>
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<td><strong>January</strong></td>
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<td>7</td>
<td>SDSU Lamb Bonanza</td>
<td>Jeff Held, Animal and Range Sciences, SDSU</td>
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<tr>
<td>11-12</td>
<td>Ag Expo, Sioux Falls</td>
<td>Jim Wilson, Plant Science, SDSU</td>
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<tr>
<td></td>
<td><strong>COMMERCIAL APPLICATOR TRAINING</strong></td>
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<tr>
<td>17</td>
<td>Yankton</td>
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<td>18</td>
<td>Watertown</td>
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<td>19</td>
<td>Sioux Falls</td>
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<td>23</td>
<td>Pierre</td>
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<td>24</td>
<td>Rapid City</td>
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<td>25</td>
<td>Mitchell</td>
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<td>26</td>
<td>Aberdeen</td>
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<td>19-22</td>
<td>Western 4-H Roundup, Denver</td>
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<td>27-Feb 5</td>
<td>Black Hills Stock Show, Rapid City</td>
<td>Kathy Reeves, 4-H, Rapid City</td>
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<tr>
<td>31</td>
<td>Southeast Farm Advisory Board Meeting</td>
<td>Doug Zalesky, Animal and Range Sciences, Rapid City</td>
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<tr>
<td>30-Feb 3</td>
<td>Coordinated Resource Management Community Training</td>
<td>Bob Berg, Southeast Farm, Beresford</td>
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<tr>
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<td><strong>February</strong></td>
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<tr>
<td>1</td>
<td>Dairy/Forage Conference, Sioux Falls</td>
<td>Jim Johnson, Animal and Range Sciences, Rapid City</td>
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<tr>
<td>1-5</td>
<td>Black Hills Stock Show, Rapid City</td>
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<tr>
<td>7</td>
<td>Dakota Lakes Research Center Annual Meeting, Pierre</td>
<td>Dwayne Beck, Plant Science, SDSU</td>
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<tr>
<td>11</td>
<td>4-H Clover Classic, SDSU</td>
<td>Rich Howard, 4-H, SDSU</td>
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<tr>
<td>21-23</td>
<td>AGARAMA, Sioux Falls</td>
<td>Hal Werner, Ag Engineering, SDSU</td>
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<tr>
<td>27-March 1</td>
<td>South Dakota Crop and Pest Conference, Pierre</td>
<td>Bob Pollman, Plant Science, SDSU</td>
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