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South Dakota Farm and Home Research

South Dakota State University

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South Dakota Farm & Home RESEARCH

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About the Cover

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

South Dakota Farm & Home
RESEARCH

Volume 45, number 3, November 1994

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Director's comments

The better part of communication is listening

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.

photo: Tom Bare

Ag Experiment Station Director Fred Cholick.

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

Years	Name
1887-1893	Louis McLouth
1894-1901	James H. Shepard Shepard Hall at South Dakota State University is named in honor of Dr. Shepard.
1902-1938	James W. Wilson Wilson's father, James, Sr., served as Secretary of the U.S. Department of Agriculture in the late 1800s.
1938-1956	Isaac B. Johnson
1957-1958	Max Meyers Later served as Administrator of the Foreign Agriculture Service, U.S. Department of Agriculture
1958-1965	Orville Bentley Later became the first Assistant Secretary for Science and Education, U.S. Department of Agriculture.
1966-1973	Duane Acker 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.
1967-1973	Al Mussen Associate Director, Ag Experiment Station
1973-1994	Raymond A. Moore
1994-	Fred A. Cholick

dent again—listening this time not to a wheat plant but to you, getting a bigger perspective on the needs of farmers and ranchers, scientists, and people in South Dakota.

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

by
Emery Tschetter

"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

photo: Tom Bare

As South Dakota State University's spring wheat breeder, Fred Cholick's lab was in the field. Now as Ag Experiment Station Director, Fred plans to keep coming back to the fields, pastures, and feedlots that form the roots of South Dakota agriculture. He will be traveling the state to discuss research priorities with farmers and ranchers.

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.

photo: Duane Hanson

New approach unlocks secrets of soybean plant

by
Jerry Leslie

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-

itability of soybean production in South Dakota and expand the area of the state that can grow the crop.

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.

photo: Duane Hanson

The soybean team members include (clockwise from left) Catherine Carter, working on gene transfer, Leon Wrage, working on weed control, and team leader Roy Scott, who is breeding soybeans to produce new varieties. Most members of the team have offices and labs clustered together in the Northern Plains Biostress Laboratory. Working in close proximity aids in communication and allows researchers to share facilities and equipment.

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."

photo: Duane Hanson

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.

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.

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

photo: Jerry Leslie

Soybean team leader Roy Scott (left) discusses soybean test plots with South Dakota State University's Northeast Research Farm manager Jim Smolik at a recent field day. Experimental varieties are grown at South Dakota State University research stations, but a second generation of plants is also grown in winter nurseries in Central and South America. This reduces the number of years necessary to develop a new variety.

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.

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.

photo: Larry Tennyson

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."

photo: Larry Tennyson

Plant physiologist Anne Fennell (facing page) explains some of the visual clues in the stems of grape plants. These clues might indicate whether they are daylength responsive or temperature responsive in the way they acclimate themselves to winter conditions. Above, Fennell shows some of the genetic plant materials she uses for testing. These plants display various acclimation characteristics, including the way they respond to daylength.

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. ❑

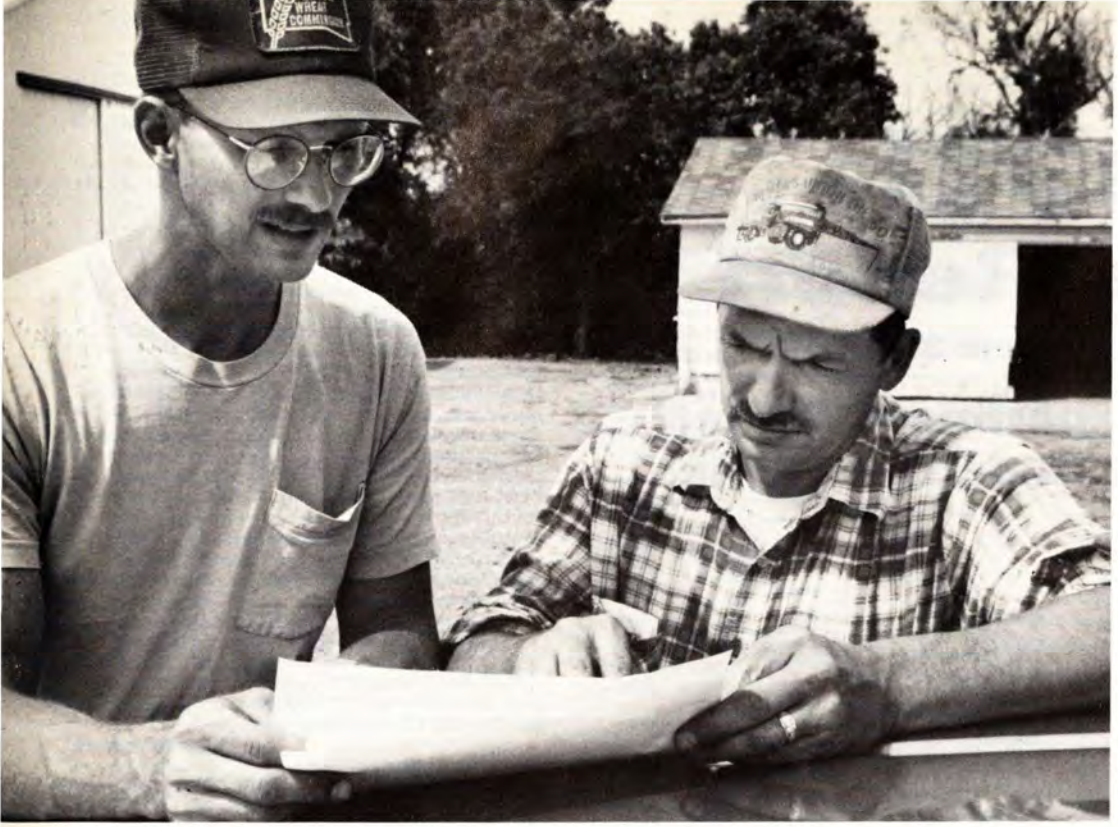
The author is Dr. Larry Tennyson, special projects writer in the Department of Ag Communications, SDSU.

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 neccesary 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 Haiwick, 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

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Projects

Agricultural Engineering

G-043, Application of machine vision to the selective mechanical harvest of mushrooms; Humburg
H-053, 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, Extrusion processing as a value enhancing technique for agricultural materials; Julson, Krishnan
H-192, Root growth and soil impedance; Alcock, Myers
R-239, Variables in agricultural weather information systems; DeBoer, Stange, Chu, Werner
H-243, Modeling groundwater recharge from vadose zone to aquifer; Chu
H-261, End effector design for automated handling of biological materials; Humburg
H-271, Machine vision as a sensor for automation in agriculture; 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; Gartner
H-101, Physiological and nutritional interactions that affect growing pigs; Hamilton, Libal

H-141, Low fat meat snack food: procedures, shelf life, and raw materials; Costello, Romans, Crews
H-151, Beef cow production efficiency and the interaction of plane of nutrition and genotype; Birkelo, Marshall, Miller
H-203, Quality grade prediction and implant strategy as marketing tools for feedlot cattle; Wagner
H-213, Effects of melengestrol acetate and prostaglandin on postpartum reproduction in beef cows; Miller
H-223, Patterns of utilization on season-long and spring-deferred pastures; P. Johnson
H-232, Metabolizable protein requirements of cattle during rapid growth; Pritchard
H-251, Improving the composition and location of animal fat to make meat more healthful; Romans
H-253, Nutritional management to minimize costs and improve reproductive performance of beef cows; Pruitt
H-290, Effects of balance and level of indispensable amino acid on daily feed intake by swine; Hamilton, Libal
H-292, Development of a field guide to the vascular plants of the Black Hills; J. Johnson
H-301, Nutrition and management influencing reproductive efficiency of swine; Libal, Hamilton
H-333, Lean gain in pigs: prediction of lean growth and identification of factors affecting lean growth; Libal, Hamilton
H-340, Cattle and sheep grazing alone and in combination on the Northern Great Plains; Kronburg
R-342, Increased efficiency of sheep production; Slyter
R-390, Factors regulating protein synthesis, degradation, and growth in skeletal muscle; McFarland
G-392, Grazing and drought tolerance of grazing ecotypes: establishment; P. Johnson, Boe
H-433, Leafy spurge interactions with livestock and rats; Kronberg, Phelps
SD-9303587, Heterogeneity in growth factor response of myogenic satellite cell populations, McFarland

Biology/Microbiology

H-143, Bioconversion of ethanol production byproducts into acetate (CMA); Gibbons
H-162, Enhanced growth and reproductive efficiency; Granholm
H-221, Rapid fixation and selection for agronomic characters through auther culture of spring wheat hybrids; Chen, Cholick, Bucheneau
H-222, Nitrite reductase gene of *Azospirillum brasilense* and nitrite assimilation; Westby
H-231, Molecular biology of a mammalian gene which regulates carcass size, fertility, and obesity; Westby
G-233, Developmental regulation of soybean fatty acid synthesis; Cheesbrough
H-311, Echinacea: a potentially new oils crop for the Great Plains; Reese
G-402, Interaction of superantigens with lymphocytes from cattle and swine, Hurley

Dairy Science

H-083, Improving quality and microbial safety of dairy products; Henning
H-093, Composition, quality, and consumer acceptance of milk and dairy products; Baer
H-103, Improvement of the quality of lowfat cheese; Mistry
H-113, Analysis of dairy products; Parsons, Northeimer
R-172, Dairy herd management strategies for improved decision making and profitability; Brouk
R-202, Metabolic relationships in nutrients for lactating cows; Schingoethe
H-212, Whey utiliztion by dairy cattle; Schingoethe
H-413, Reduction of reliance on antibiotics in dairy cattle through nutritional immunoenhancement; Franklin

Economics

H-011, Sustainability of "organic" vs "conventional" beef production in South Dakota; Taylor, Feuz
H-024, Economic implications of current marketing arrangements for slaughter cattle; Fausti
H-081, Analysis of seasonal patterns in grain prices and evaluation of alternative grain marketing strategies; Qasmi
H-152, Crop production functions: economic implications for South Dakota; Franklin
H-181, Economic and environmental implications of conservation reserve program contract expiration in South Dakota; Janssen
H-191, Policy and economic aspects of sustainable cropping systems; Dobbs
H-241, Farm financial management of successful family farms in South Dakota; Janssen
R-291, Regulator, efficiency, and management issues affecting rural financial markets; Lamberton
H-302, Acreage supply response for major crops for South Dakota; Ellingson
R-303, Domestic and international marketing strategies for U.S. beef; Feuz
H-370, Economics of rangeland improvement; Beutler

Home Economics

R-123, Enhancing health and safety through personal protective equipment; Scholten
H-211, Adipose tissue composition and chronic disease patterns; Crews, Simmons
H-273, Near infrared reflectance technology in the measurement of fatty acids and amino acids in oats and soybeans; Krishnan, Kephart

Horticulture, Forestry, Landscape and Parks

MS-022, Strategies of resolving forest production vs forest recreation conflicts in the Black Hills of South Dakota and Wyoming; Stubbles
R-042, Rootstock and interstem effects on pome and stone fruit trees; Fennell
H-052, Environmental stress and fruit production in South Dakota; Fennell
H-069, Vegetable breeding, evaluation, production, and cultural practices to increase yield; Prasher
MS-173, Genetic diversity in native and planted population of *Juniperus virginiana* L.; Schaefer
MS-263, Genetic improvement of agroforestry tree spcies; Schaefer
MS-299, Evaluation and propagation of superior selections of native and introduced trees and shrubs for South Dakota; Evers
H-403, Micropropgation of Echinacea spp. *E. augustifolia, E. pallida*, and *E. pupurea*; Harbage
G-422, Gene expression during photoperiodic induction of bud dormancy in grapes, Fennell

Plant Science

G-013, SDAES particiȍation in NAPIAP; S. Clay
H-014, Elateridae of the Northern Great Plains; P. Johnson
H-021, Soybean breeding and genetics; Scott
H-023, Agricultural management: a systems approach; D. Clay
H-031, Etiology and epidemiology of plant viruses in South Dakota; Langham
R-033, Forage protein characterization and utilization for cattle; Kephart
G-041, Tillage induced microrelief impacts on NO_3 and atrazine movement in soils; D. Clay, T. Schumacher, S. Clay, Bischoff
H-060, Molecular genetics of lipid and protein biosynthesis in oilseed crops; Carter
G-061, Mapping quantitative trait loci (QTL) using molecular markers in cultivated oats; Reeves, Kahler, Butler
H-062, Phosphate buffering capacity in select South Dakota soils; Doolittle, Gelderman
H-073, Water flow through weathered glacial till: description and measurement; Kohl, J. Schumacher, Carlson, DeBoer, Doolittle
R-078, Interaction of nematode-host variability and abiotic factors on crop losses; Smolik
H-091, Soybean in vitro; Carter
H-092, Development and utilization of oats and rye adapted in South Dakota; Reeves
H-102, Correlation, calibration, and interpretation of soil and plant tests; Gelderman
H-111, Agricultural management impacts on wetlands; Rickerl, Bleakley, Hubbard
H-118, Amelioration of claypan or formerly cultivated clay-rich soils to increase range forage production; White
H-132, Management of northern and western corn rootworms in South Dakota; Fuller, Sutter, Boetel
H-153, Metabolic and genetic consequences on inverted solute regulation resulting from freeze selection; Kenefick, Sutton, Haley
R-161, Introduction, multiplication, evaluation, preservation, documentation, enhancement, distribution, and utilization of plant germplasm; Wicks
H-199, Frozen soil effects of herbicide movement and weed ecology in conventional and alternative management systems; S. Clay
H-201, Abscissic acid regulated genes in freeze resistance of barley; Kenefick, Sutton, Cheesbrough
H-229, Expert systems for scheduling fungicide applications for wheat disease control; Buchenau, Gallenberg
H-230, Tillage and crop rotations for eastern South Dakota; Berg
H-250, Root system responses to stress: soil compaction in conservation tillage systems; T. Schumacher
H-269, Alternative farming systems; Smolik
H-280, Environmental and biological stress in wheat; Cholick
H-283, Breeding perennial grasses and legumes for forage, wildlife habitat, and resistance to insect-related stresses; Boe, Kephart
H-293, Technology transfer of applied/basic soils information for agriculture and environment of South Dakota; Malo
H-309, Oilseed breeding and genetics; Grady
R-312, Forage crop genetics and breeding; Boe
H-313, Genetics of fungal pathogens of row crops; Chase
H-323, Corn genetics, physiology, and breeding; Wicks
G-332, Molecular genetic variability within the soilbórne plant pathogen *Macrophomina phaseolina*; Chase
H-341, Isolation and uses of actinomycetes associated with roots of grasses; Bleakley, Rickerl, T. Schumacher
H-343, Spring wheat breeding and genetics; Rudd, Buchenau
G-352, Spatial variability of selenium in potentially irrigable glacial till soils; Doolittle, Kohl, DeBoer
H-353, Soil specific fertilizer, pesticide, salinity, and sediment management; Carlson, J. Schumacher
H-363, Alfalfa forage yield, quality, and establishment; Kephart
R-373, Impact of accelerated erosion on soil properties and productivity; T. Schumacher, Lindstrom
G-382, Application of the barber-cushman model in improving P efficiency in field corn; Woodard, T. Schumacher
H-383, Fertilizer management and nutrient use efficiency in field crops; Woodard
H-388, Biological control of insects affecting seed production of forage legumes and grasses; McDaniel
H-393, Conservation compliance in western South Dakota; Stymiest
R-400, Biological and ecological basis for a weed model to reduce herbicide use in corn; S. Clay
S-401, Foundation Seed Stock; Ingemansen
S-402, Seed certification; Pollmann
S-403, Seed testing; Turnipseed
S-404, Variety testing; Bonnemann
S-406, Survey entomologist; Fuller
R-410, Nutrient management to sustain productivity while protecting surface and ground water quality; Gelderman
R-423, Thifensulfuron-methyl magnitude of residue on flax; S. Clay, Wrage
H-443, Management factors required to urilize cool-season crops as replacements for summer fallow in no-till winter wheat systems; Beck
SD-9304149, Strategy to identify genes linked directly to freeze resistance; Sutton

Rural Sociology

H-112, Census data center; Satterlee

Station Biochemistry

H-099, Mineral nutrition and metabolism in animals; Emerick, Kayongo-Male, Pritchard
H-110, Flow cytometry; Evenson
H-149, Analysis of selected herbicides and fungal metabolism; Matthees
H-171, Corn-based fungal polysaccharide production; West
H-209, Biochemistry of selenium; Palmer, Olson
S-407, Analytical services; Thiex

Veterinary Science

R-082, Prevention and control of enteric diseases of swine; Francis, Benfield
AH-131, Epidemiology and control of johne's disease in South Dakota livestock; Johnson, Fawcett, Bjordahl
AH-182, *Chlamydia* infection in the intestines of pigs; Nietfeld, Leslie-Steen

H-183, Objective measure of stress and its physiological effects of stress on the immune response of cattle and swine; Hurley, Walker
AH-193, Early events (binding and entry) in the pathogenesis of porcine rotaviruses; Benfield, Erickson
AH-242, Identification of the respiratory epithelial cell receptor for bovine herpesvirus 1; Chase
G-252, Analysis of porcine intestinal receptors in which *Escherichia coli* K88 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 syndrom (SIRS); Yeager, Hennings, Benfield
R-281, Bovine respiratory disease: risk factors, pathogens, diagnosis, and management; Miskimins, Thomson, Leslie-Steen
G-322, Pathogenetic mechanisms of swine infertility and respiratory syndrome (SIRS) virus; Benfield, Collins, Hurley
SD-9304186, Consequences of interaction of bovine herpesviruses with mononuclear leukocytes; C. Chase, Hurley

Wildlife and Fisheries Sciences

H-012, Assessment of movements, density, and depredation patterns of white-tailed deer at Sand Lake National Wildlife Refuge, South Dakota; Jenks
MS-051, Wood ducks and prairie woodlands: artificial nesting structures, brood survival, and habitat in South Dakota; Flake
H-071, Northern pike management in South Dakota ponds and small lakes; Scalet
H-072, Assessment of fisheries management options for South Dakota ponds; Willis
S-492, South Dakota Cooperative Fish and Wildlife Research Unit; Berry, Higgins

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.

Biology/Microbiology

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Other reports:

Baer, R.J. 1993. Milk fat modification: reduced saturated fatty acid dairy products. Conf on Fat and Cholesterol Reduced Foods, Int Business Communications.

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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

College of Agriculture and Biological Sciences
Agricultural Experiment Station
South Dakota State University
Brookings, SD 57007
Fred Cholick, Director

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Address Correction Requested

Calendar of Events

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