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South Dakota Farm and Home Research: 100th Annual Report

South Dakota State University

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100th Annual Report

Director's comments

We have begun our second century; the horizons expand ahead of us

Ray Moore
Agricultural Experiment Station

For a year we have been looking toward the horizon.

The drought has been only one reason; our Experiment Station researchers have been hoping for clouds just as anxiously as you have.

Some of our scientists, however, have been able to take advantage of the drought. The data they have gathered will be useful to you in the next set of dry years, just as you are benefiting now from research we conducted back in 1976 and earlier.

It's obviously been far easier to identify drought-hardy wheats to incorporate into our breeding program. We've learned more about some alternative crops: if they grew this year, we're interested in them. We've had plenty of weeds, insects, and diseases to collect data from, and crop residue has proven itself in many of our plots.

But in the Ag Experiment Station this past year, we had another reason to examine our horizons.

We have just finished celebrating the 100th year of the South Dakota Agricultural Experiment Station. Our slogan, appropriate for a state with a far-reaching skyline, was "Horizons."

It meant not only the physical horizon that encompasses all the people of our state—who all benefit, however subtly, from our work. It also meant the "horizons of the mind" that open up our perspective and show how much there is yet to do as we conduct our research.

With our vision of these horizons, we have recommitted ourselves to our mission of "conducting research to enhance the quality of life in South Dakota through the beneficial use and development of economic, human, and natural resources." With the help of the Citizens Review Committee of 1986, we have set our direction as we begin our next century of service.

We provide summaries of the lectures given during our centennial year in this issue of *Farm & Home Research*. Each story relates to the new goals of the Station, and the lecturers were selected on the basis of their national reputation in their fields.

We have also come to be especially proud of three student organizations and their contributions during our Horizons year: the Agronomy and Conservation Club, the Agricultural Education Club, and the Range Management Club.

They established the centennial plots near the Agricultural Heritage Museum

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Another IPM

'Inappropriate political mediation' means others could control farmers' use of water

Agriculture has to control groundwater pollution from farm chemicals or it will face something nobody wants: inappropriate political mediation.

That is the warning of George Hallberg, nationally known geologist who is an adjunct professor at Iowa State University and on the staff of the Iowa Department of Natural Resources.

Hallberg, centennial lecturer for the South Dakota Agricultural Experiment Station, spoke to a convention of irrigators.

The principal investigator of many ag chemical and water quality research projects said that over the past 20 to 30 years there has been a parallel linear increase in nitrates in the groundwater and the amount of fertilizer nitrogen that farmers apply to their fields.

In northwest Iowa, analyses of water quality show that 40 to 70% of the private water supplies sampled exceed the drinking water standard for nitrates.

Statewide, for both Iowa and South Dakota, water analyses results are quite similar, showing that 25 to 30% of all private water supplies exceed the standard for drinking water, Hallberg said.

The more shallow the well, the more serious the contamination, Hallberg said. But it is only a matter of time before the contaminants make their way into the deeper parts of the groundwater flow system. Drilling deeper wells is only a short-term solution to the problem.

Nitrogen in groundwater equals third to half of average year's application

The Big Springs Groundwater Project is a long-term study of chemicals applied and chemicals detected in groundwater of 103 square miles in the Elkader, IA, area. This basin has no industry, no landfills, no metropolis. It is wholly agricultural.

Throughout the 50s and 60s, nitrates maintained a stable concentration of about 12 to 13 parts per million (ppm).

"But since the late 1960s, nitrates have gone up dramatically, so that we now hover around the drinking water standard of 45 ppm."

Cropping records for the basin show a similar increase in nitrogen fertilizer. In the last 25 to 30 years, it has moved from just another input to being "far and away our major input into the system," Hallberg said.

Other studies in other states show the same pattern. Above 50 lb of nitrogen per acre, the losses to shallow groundwater in susceptible areas increase in the same paired fashion.

Yield goes up as more nitrogen is added—to a point. "The line goes up, curves, and begins to flatten off."

What that curve means, according to the geologist, is that for each increment of nitrogen, "we're a little less efficient, and a little less of it goes into grain production."

It's left in the environment. Fertilizer not recovered in the grain is fertilizer that has a chance to leach into groundwater, Hallberg warned.

In the Big Springs basin, the amount of nitrogen lost into the groundwater in a couple of average years is equal to about a third of the fertilizer nitrogen farmers pay for and add to their fields.

In a wet year, it is equal to over 50%.

Pesticides (herbicides and insecticides) are also a growing national concern. Their concentrations are measured in parts per billion (ppb). They are found in many wells, often at about 10 ppb.

These figures are "far below any kind of acute toxic poisonous effects." However, health-related drinking water standards, already in some states and proposed at the federal level, are also measured in parts per billion, Hallberg said.

"When you look at long-term exposure and chronic health impacts, there are some legitimate concerns, even at these concentrations."

Research by the South Dakota Agricultural Experiment Station and the South Dakota Water Resources Institute shows that "some of the pesticides that we did not expect to find can indeed get into the water supply."

In some cases, point-source pollution (such as in back-siphoning in irrigation wells) has produced pesticide concentrations of 600 or more ppb, Hallberg said.

Advice to farmers: act now, or wait and let somebody else do it to you

Because of public-health implications, chemical movement into groundwater "is something agriculture has to deal with. We don't want to overreact, but not to react is not responsible, either.

"We need to develop and implement management practices which will balance our legitimate need for efficient and profitable agricultural production with our equally legitimate need to protect our soil and water resources."

A poll from Iowa shows that over 50% of its residents recognize agricultural chemicals are the biggest threat to water quality.

And 78% of those polled, including 72% of the farmers, said they were willing to accept a limit on use of farm chemicals if that is what it takes to protect water supplies.

A national Harris poll showed that 86% of the people believed there should be no exceptions to water pollution standards, not even for farmers.

"The bottom line is that we need to take some positive action," Hallberg said.

The action he proposes is to direct some of the concern for economic development into research and development in agriculture. "A new car plant would be nice, but it can close up and move away.

"And we need to take some of these steps before we get another type of IPM we really don't want—inappropriate political mediation," Hallberg concluded.

'Not on its deathbed'

'Just' a sickbed, but ag economy will cycle again, because of 'history we haven't read'

Before anyone else would more than speculate that agriculture might be recovering from its 1980s downturn, Earl Butz was prophesying profitability.

Butz, Dean Emeritus of Agriculture at Purdue University and USDA Secretary of Agriculture from 1971 to 1976, told an Agricultural Experiment Station centennial lecture audience in summer 1987 that restoring profitability to agriculture was not exactly the issue.

"The good news is that the bad news is wrong!" In support, he offered the previous year's total agricultural indebtedness: 23% of total assets.

"This is not an industry on its deathbed."

Butz agreed that some farmers were in serious trouble. "Some will make it and some shouldn't make it. That's the American system—a system of risks and rewards."

He presented the 'Butz principle of economics.'

"If we, in any sector of American industry, guarantee everyone against failure, then we remove the possibility of success beyond mediocrity."

Half of American farms do not have debt, he said, and the net farm cash income in 1988 will be close to a record. "This is not an industry with no future."

State's Station credited for advances 'we take for granted'

In the Soviet Union during his term as Secretary, Butz saw "the arm of government" reaching out and controlling the producers.

"Too much Moscow, too little country."

And after he returned, "I saw the arm reaching out from Washington and from Pierre. I saw farmers seeking permission from the government to grow crops and to set aside acres and following regulations on the use of pesticides. We are faced with a growing maze of regulation."

The problem, he said, "is that half of the population hasn't had the experience of biting into a wormy apple."

American producers use chemical poisons to keep the worms out. "We use so much science, technology, growth regulators, and insecticides that we now feed ourselves with only 15% of our take-home pay.

"We can thank the agricultural experiment stations—like the one here in South Dakota—for many of these changes that we take for granted."

He recalled that, as a 4-Her in a Gold Medal Corn Club, "people used to brag about 50 bu/A corn. The credit for many of the advances we've made goes to the land-grant universities and the agricultural experiment stations."

Number one challenge: feeding the world 'just a little better'

By 1990, Butz predicted, 240 million people will be added to the 5-billion-plus world population. "We will feed them some way.

"If we feed them just a little better than now, it means doubling food production someplace in the world within the next 30 years. This must be mankind's number one challenge."

Butz has seen the cycles of too little and too much. When an educator and dean of agriculture at Purdue, when assistant secretary of ag in the Eisenhower administration from 1954 to 1957, and again when Secretary in the early 70s under Nixon and Ford, he witnessed both cutbacks on production and encouragement to produce more—food glut to food rationing, and back again.

Cycles in productivity are nothing new. "The only thing new in this country is history you haven't read."

He quoted former Secretary of Agriculture James Wilson, a 16-year veteran of the job, as saying, "There are yet many important discoveries to be made in agriculture."

"That was said in 1909. It's more true today." □

The business of research

It's the production of knowledge, 'which will push back the frontiers of ignorance'

The success of America as a worldwide competitor in international trade depends upon its knowledge base.

Continuous production of new knowledge is the business of research.

That is why Congress and the White House must give high priority to agricultural research, said J. Patrick Jordan, Washington, DC, administrator of the U.S. Cooperative State Research Service.

But funding for ag research competes with that for other research—for the $4.4 billion supercollider, the effort to double the National Science Foundation budget by $1.8 billion in 5 years, and NASA's new surge for a space shuttle, space exploration, and a permanent space station.

Jordan, speaking before the centennial banquet of the South Dakota Agricultural Experiment Station, said that if the

nationwide centennial observance of the experiment stations had any meaning at all, "it is to recommit ourselves to this effort and to assure that adequate resources are provided to assure achievement of our national goals in agriculture."

The significance of the centennial did not escape either the Congress or the President, Jordan said.

Congress produced a joint House-Senate resolution recommitting itself to the principles behind the Hatch Act which started state agricultural experiment stations, and the President issued a formal proclamation challenging the nation to use science to resolve world problems, particularly those in agriculture.

Land-grant system's purpose: increase 'intellectual capital'

Jordan briefly traced some of the high points in the history of agricultural research.

Prior to the 1840s, higher education in the U.S. was solely in liberal arts, patterned after schools in England and Germany. Nobody had proposed solving real-world problems by applying scientific principles.

First to do that was Jonathan Baldwin Turner of Illinois in the 1840s. He believed the time had come to build insititutions of higher learning dedicated to agriculture and the mechanic arts.

Although the nation was being torn apart by the Civil War, his idea was converted into an act of Congress by Justin Smith Morrill of Vermont and signed into law by President Abraham Lincoln.

Thus, the land-grant university system was born.

Soon, said Jordan, it became clear this was not enough. The nation was moving westward, leaving worn-out soils for new. The new lands were dry and strange to settlers more familiar with conditions in the East.

So, in the mid 1870s, two states, Connecticut and California, established agricultural experiment stations, again patterned after those in Germany.

By late in that decade, said Jordan, others recognized the the value of a nationwide network of state agricultural experiment stations.

Congressman William Hatch of Missouri proposed the system, to be at least partially funded by federal dollars. The Hatch Act was signed into law by President Grover Cleveland on March 2, 1887.

The South Dakota station opened in 1887.

But only those farmers and ranchers who lived closest to an experiment station derived benefit from its scientific research. The university and its associated experiment station needed to be extended to every corner of every state.

The proposal was that a group of agents go into the field to bring to farmers and ranchers the results of research conducted at the land-grant universities.

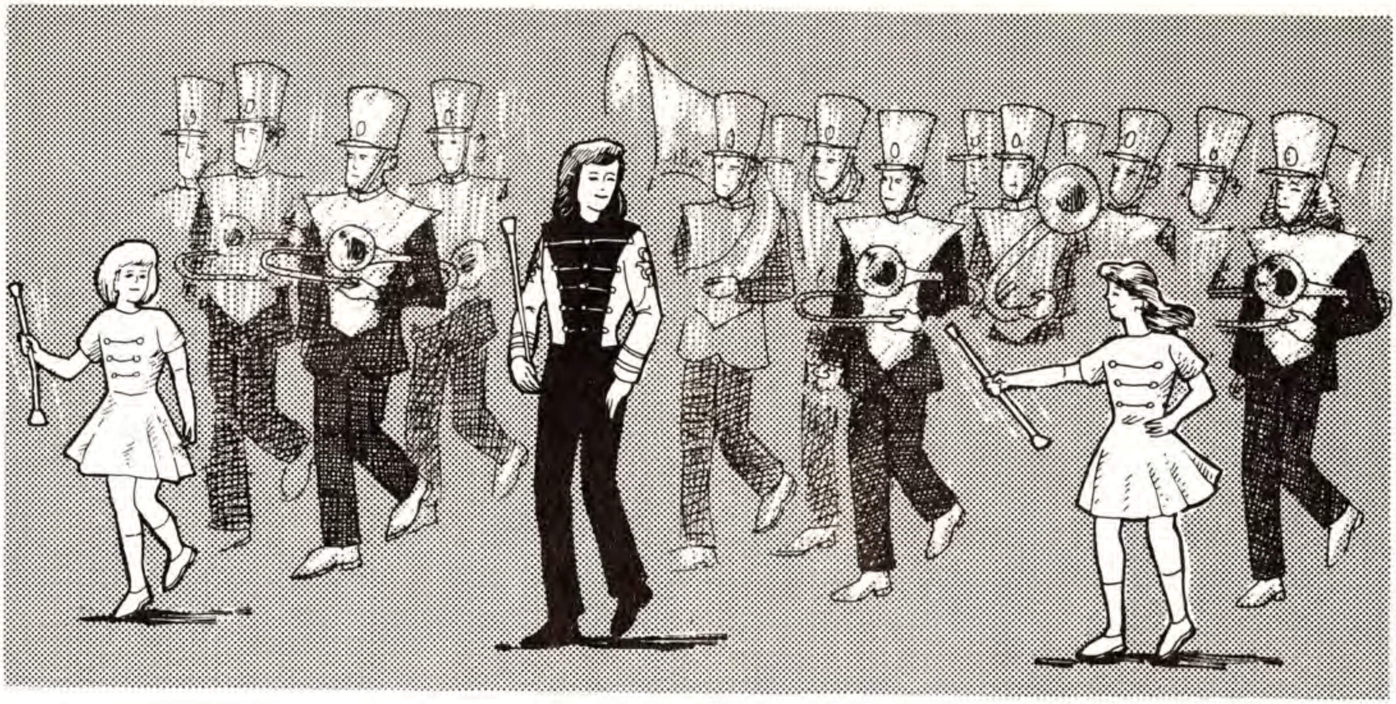
By the turn of the century some states began to dispatch agents, and by 1914 the Smith-Lever Act was passed by Congress establishing the system on a nationwide basis. It is known today as the Extension Service.

Jordan noted a few of the many accomplishments of the South Dakota Agricultural Research Station which have been passed on to the state's citizens. He called particular attention to biochemistry, a whole new discipline born at the land-grant universities and one in which SDSU scientists have taken a leading role.

Experiment stations "continue to push back the frontiers of ignorance," he said.

"We will continue to increase the intellectual capital of humankind, because we understand that we start with three resources in addition to financial ones.

"We have natural resources, we have human resources, and we have knowledge resources." □



The driving force

Energy 'to spare' comes from ethusiasm; you can trick yourself into having it

Enthusiasm is like gasoline that fuels the automobile—you don't get very far without it.

That is how Alan Zimmerman, communications consultant, characterized the quality without which nothing great is ever accomplished.

Zimmerman, communications consultant from Prior Lake, MN, and a guest lecturer during the Agricultural Experiment Station's centennial observance, said that the word enthusiasm comes from the Greek "theos," which means full of God, full of life, full of spirit.

"People who have enthusiasm have a driving force that brings about all kinds of success. It is contagious. The energy transfers to other people.

"Negative energy is transferable, too."

After 15 hours of work, Zimmerman finds that he still has energy to spare if he has been working with enthusiastic people, more, in fact, than if he has been with negative people for only 3 to 4 hours.

"The mark of a mature person, a real professional, is to be enthusiastic most of the time, in spite of the circumstances. If you can learn that, you've got one of the great secrets of developing human capital."

But negative people "can zap everyone else's energies and turn off people's success possibilities."

Company managers, committee chairmen, or any other leaders will never get more enthusiasm from their workers than the leaders themselves exhibit, Zimmerman warned.

Odds are against hearing (or saying) a positive comment anytime today

People are conditioned to be negative, Zimmerman said. Social scientists who "eavesdrop" on daily conversations to

analyze them for negative or inspirational bias will find the balance tipped toward the negative.

3-M, a client of Zimmerman's, conducted a 3-year study of companies across the U.S. to find out how people talk around the workplaces of America. The interviewers learned two things.

They found it takes seven compliments to overcome one piece of negative feedback. And they found that people hear nine negative words in the workplace for every positive word.

Zimmerman was not surprised. Workers' number-one complaint, across the country, is that they can do 100 things right and not hear a thing about it. "Do one thing wrong and you get it right in your back. You can work, and work, and work, and work, and do things well, and they don't say anything. But you do one thing wrong and they jump all over you."

Negativism doesn't stop when the workday's over.

People go home from work, he said, and turn on the 5:30 news. The news is mostly negative, even the weather. "They say there is a 20% chance of snow, which really means there is an 80% chance of sunshine."

He quoted a nursing supervisor. "I'm not going to go around complimenting my employees for doing their jobs. That's what I pay them for."

That, says Zimmerman, is another "unenlightened soul."

University of Iowa students studied hundreds of families to learn how many negative and how many positive comments a day the average child hears from Mom and Dad.

They found the average child hears over 400 negative comments a day, and about a dozen positive. "Is it any wonder that enthusiasm is burned out of some people?"

'Just start acting.' Pretend, and soon the real article will follow

How to stay enthusiastic most of the time, in spite of circumstances?

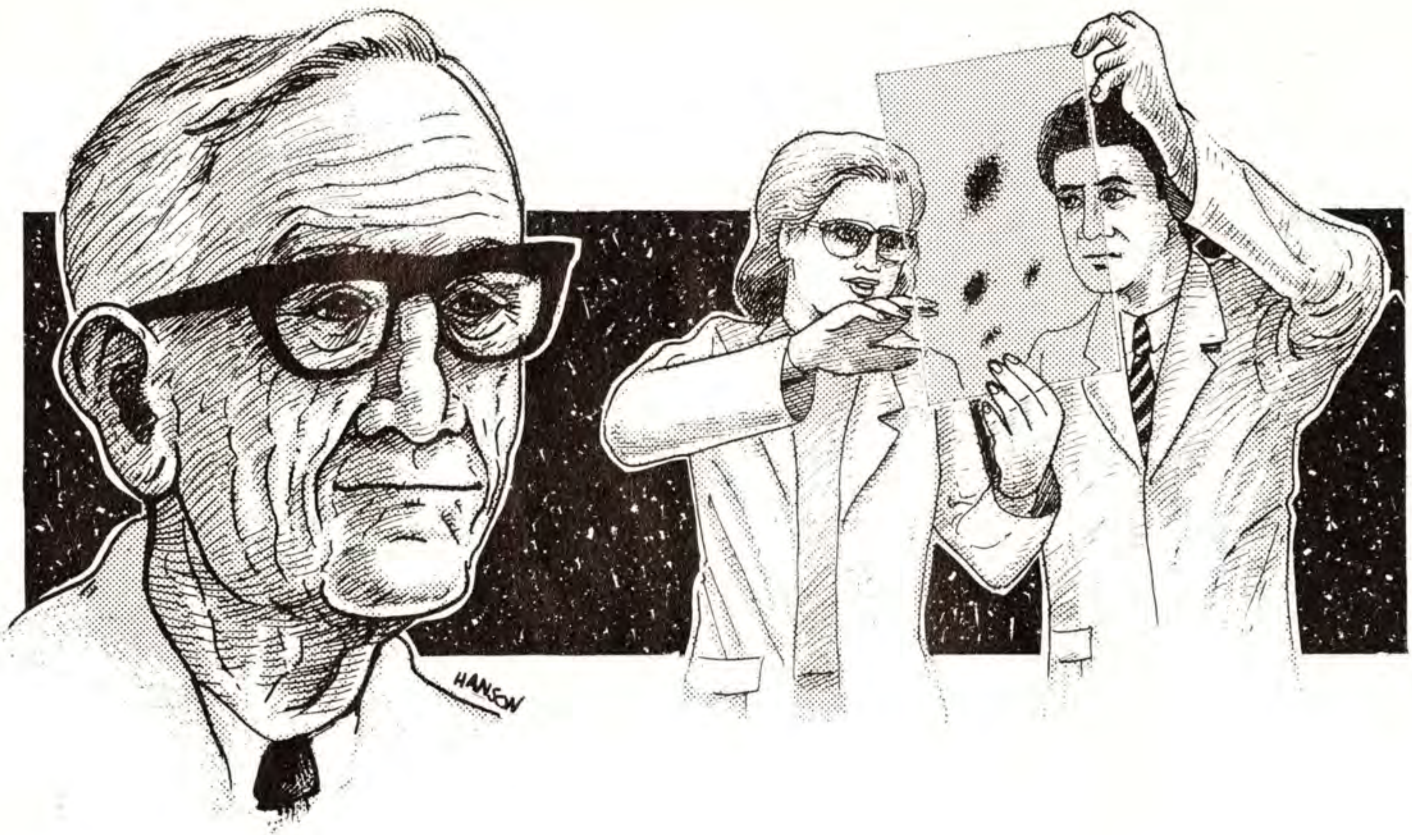
Fake it.

"Just start acting that way. Don't wait until you feel ready to be enthusiastic, or you might wait a lifetime.

"It is just about impossible to act enthusiastic and be depressed at the same time. The body and mind try to be consistent. Start acting 'up,' and the feeling will follow."

Zimmerman offered the following suggestions to become an "actor" instead of a "reactor" to others' negativism.

1. Make it a habit to say something positive to almost everyone you meet. Find something positive. Have a funny story, a smile, a handshake ready to share.
2. See opportunities in difficulties instead of difficulties in opportunities.
3. Habitually think, "it just might work."
4. Adopt a "why not?" attitude.
5. Practice positive expectations. □



Critical issues

In forefront is need to reduce dependency on chemicals, to avert risk to environment

Agricultural researchers must find ways to reduce agriculture's dependency on chemicals to protect groundwater supply and soil productivity.

That was the charge given by Orville Bentley, Assistant U.S. Secretary of Agriculture for Science and Education, in a centennial lecture at SDSU's Agricultural Experiment Station.

Speaking at ceremonies renaming SDSU's Biochemistry Laboratories for long-time biochemist and selenium researcher Oscar Olson, Bentley praised both Olson for his accomplishments and the Station for its goals for the next 10 years.

Olson, best known as a "bench chemist" who pioneered work on selenium toxicity in livestock, "has set loose on the world of agriculture an outstanding group of eager, intelligent, trained, curious, and competent scientists who had their roots in his laboratory under his tutelage," said Bentley, also a former faculty member at SDSU.

Bentley said that Olson inspired more people to go into biochemistry and microbiology "than anyone I know, and for this we owe him a great debt."

In renaming the biochemistry laboratories for Olson, the University reaffirms the role of agricultural research in the nation's future, celebrates the unique three-part network of University, state agencies, and federal government, and recognizes the career of Oscar Olson, Bentley said.

With new research tools such as biotechnology, SDSU researchers are among those unlocking new secrets to

engineer plants and animals resistant to pests. In doing so, they may be able to reduce the industry's dependence on chemicals, he said.

"We must continue to study non-chemical alternatives which will be safer for humans and the environment.

"Some combination of old, tried-and-true agricultural traditions linked with new and yet-to-come products of biotechnology and biocontrol may yet prove to be the best answer."

In the meantime, Bentley continued, "we need to accelerate our work on applied technology to enable us to make proper, prudent, and safe use of fertilizers and pesticides to minimize both interim and long-term risk to the environment."

Station's goals endorsed; scientists working to save 'dwindling resources'

Bentley applauded the new goals of the South Dakota Station.

They are (1) returning profitability to agriculture, (2) sustaining soil productivity, (3) conserving water and protecting or improving water quality, (4) improving environmental quality, and (5) safeguarding human health and developing human resources.

Bentley said that researchers also are addressing the problem of dwindling natural resources in other ways.

By creating renewable resources to be used as fuels and plastics, they are slowing the depletion of petroleum reserves. USDA scientists can now make plastic from corn starch, for example, thus preserving supplies of non-replaceable natural resources and at the same time providing a biodegradable product.

Biotechnology has also markedly increased forest regeneration. Trees grow in two thirds the time it took in the past, he said. He added that the development of kenaf gives this country a substitute for forest products (pulp) in paper production as well as an alternate crop.

Discovery not enough; it must be translated into practical use

This country must operate from a sound scientific base, Bentley said. That means maintaining the vitality of the federal-state research partnership between USDA and land-grant universities. It means maintaining the National Institutes of Health, the National Science Foundation, and USDA research institutions.

"These institutions provide fundamental knowledge about living organisms, the interaction of the ecosystem, and the conservation of natural and human resources."

Rapid expansion of discoveries in the physical and social sciences increasingly challenges institutions to coordinate the generation of knowledge with the translation of that knowledge into practical applications that enhance all sectors of the economy, Bentley said.

Federal-state research partnership is critical for combining the efforts of diverse agencies and for passing the fruits of basic science on to the state's and nation's citizens, Bentley added.

A "critical issue," Bentley emphasized, is to draw young people into agricultural science.

The current annual demand for college graduates in food and agriculture exceeds the supply by 10%. "There is a critical need to attract outstanding students and to enhance the ability of institutions of higher education to produce highly qualified graduates." □

'The good earth'

South Dakota's conservation record is excellent, but challenges loom in future

Over 20,000 different kinds of soils can be found in the U.S., and the need for soil and water conservation is more acute than ever.

(South Dakota has roughly 500 soil series.)

From those soils come all the crops, livestock, and trees that feed and clothe Americans and a large share of the rest of the world, that provide raw materials for manufacturing, and that supply export demands.

The U.S. land area includes the world's largest regions of productive soils located under temperate and semi-tropical climates.

Those soils (plus some other things), assure Americans of a reliable domestic food and fiber supply "for the foreseeable future," said Norman Berg, Washington, DC, former chief executive of the Soil Conservation Service.

Berg, now senior advisor to the American Farmland Trust, spoke as an

Agricultural Experiment Station centennial lecturer to a meeting of South Dakota conservation district representatives. While the Experiment Station was celebrating its first century, the SCS was marking 50 years of service.

The "other things" are the transportation and marketing systems of this nation, coupled with its agricultural institutions (research, extension, credit, and technical assistance), the private sector, and the managerial capability of its farmers, ranchers, and foresters.

Although past record is 'excellent,' great challenges loom in the future

However, Berg warned, our highly specialized, capital-intensive agriculture is built on technologies that maximize yields and short-term profits.

"Policies designed to conserve soil and water too often have been afterthoughts."

This country paid a high price for the agricultural expansion of the 1970s, Berg said. "The farming of more acres increased soil erosion and made agriculture one of the major sources of pollution."

Berg quoted John Timmons of Iowa State University. "We were in effect exporting our soil and water quality in the form of food and feed grains."

We have converted good grassland to marginal cropland, increased the drainage of inland wetlands, uprooted shelterbelts, and mined underground aquifers, Berg added.

The depletion of soil and water resources renewed concern and brought active efforts to counteract the losses.

The U.S., through conservation districts and their two million cooperating land users, and with substantial public investments in research, extension, financing, and technical assistance, has "established an excellent conservation record."

The 69 conservation districts in South Dakota have been "most effective, because they, with their cooperating agencies, have demonstrated many innovative ways of solving conservation problems."

Berg sees encouraging signs for land and water conservation with the passage of the Food Security Act of 1985. This initiated the Conservation Reserve Program which, before the drought, put 23 million acres of highly erodible land out of production.

Sodbuster legislation was meant to retain good rangeland, pastureland, or forest land. Wetland conservation (swampbuster) provisions required that to be eligible for USDA program benefits a producer would not raise ag commodities on wetlands converted after 1985.

Conservation compliance requires that all highly erodible cropland planted to an annual crop between 1981 and 1985 have a conservation plan by 1990 which would go into effect by 1995 to qualify for farm programs.

Berg sees a looming challenge in deciding the ultimate long-term use of at least 45 million acres that will eventually go into the Conservation Reserve, once the 10 years are over.

Concluding, Berg said, "Legal niceties aside, we do not own the good earth. It belongs to generations yet unborn.

"Sustaining soil productivity is simply accepting our role in creation." □

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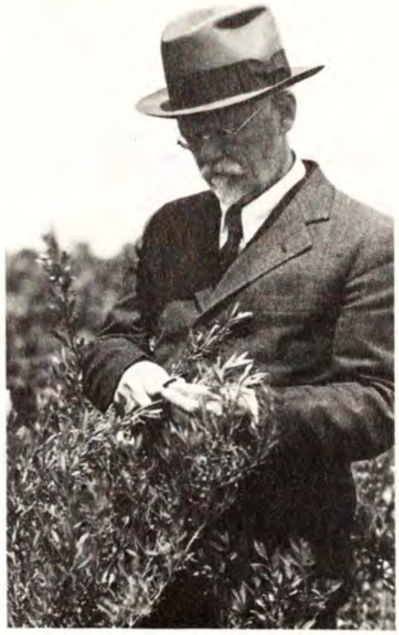

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Agricultural Experiment Station
South Dakota State University

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H.L. Miller, PhD, associate professor
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R.J. Pruitt, PhD, assistant professor
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A.F. Schlundt, PhD, assistant professor
A.L. Slyter, PhD, professor
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J.J. Wagner, PhD, assistant professor
R.C. Wahlstrom, PhD, professor
D.L. Whittington, PhD, assistant professor

Biology

C.R. McMullen, PhD, professor and acting head
C.H. Chen, PhD, professor
N.H. Granholm, PhD, professor (also Animal Science)
D.J. Holden, PhD, professor
G.A. Myers, PhD, professor

Dairy Science

J.G. Parsons, PhD, professor and head
R.J. Baer, PhD, assistant professor
D.P. Casper, MS, Research Assistant
F.C. Ludens, BS, instr/manager, Dairy Farm
V.V. Mistry, PhD, assistant professor
D.J. Schingoethe, PhD, professor
S.W. Seas, MS, professor
J.L. Sommerfeldt, PhD, assistant professor
G.S. Torrey, PhD, assistant professor
H.H. Voelker, PhD, professor

Economics

G.E. Murra, professor and acting head
H.R. Allen, PhD, professor
T.L. Dobbs, PhD, professor
W.D. Ellingson, BS, instructor
L.L. Janssen, PhD, associate professor
C.E. Lamberton, PhD, professor
A.A. Lundeen, PhD, professor
B.H. Schmiesing, PhD, assistant professor
D.C. Taylor, PhD, professor

Home Economics

E.P. Anderson, PhD, professor and dean
M.G. Crews, PhD, associate professor and head
M.N. Rosholt, MS, assistant professor

Horticulture, Forestry, Landscape & Parks

T.D. Warner, PhD, associate professor and head
N.W. Baer, PhD, assistant professor
M.E. Enevoldson, MS, assistant in
N.P. Evers, BS, instructor
R.M. Peterson, PhD, professor
P.D. Prashar, PhD, professor
P.R. Schaefer, PhD, assistant professor
P.L. Spinski, PhD, assistant professor
J.R. Waples, BS, instructor

Microbiology

R.L. Todd, PhD, professor and head
W.K. Gauger, PhD, associate professor
W.R. Gibbons, PhD, research associate
R.P. Hillam, PhD, associate professor
R.M. Pengra, PhD, professor
C.A. Westby, PhD, professor
H. Westfall, PhD, assistant professor

Plant Science

M.L. Horton, PhD, professor and head
W.E. Arnold, PhD, professor
D.L. Beck, PhD, assistant professor, supt., James Valley Research & Extension Center
G.R. Benoit, PhD, adjunct professor (USDA/ARS)
A.A. Boe, PHD, associate professor
J.L. Bonnemann, MS, assistant professor
R.A. Bohls, MS, research associate
T.F. Branson, PhD, adjunct professor (USDA/ARS)
G.W. Buchenau, PhD, professor
C.H. Butterfield, MS, research associate
C.G. Carlson, PhD, assistant professor
M.L. Carson, PhD, assistant professor
W.H. Caskey, PhD, adjunct assistant professor (USDA/ARS)
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P.D. Evenson, MS, associate professor
B.G. Farber, MS, research associate
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G.R. Hoffman, PhD, adjunct professor, Biology, USD, Vermillion
J.A. Ingemansen, MS, research associate
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D.G. Kenefick, PhD, professor
R.W. Keickhefer, PhD, adjunct professor
K.D. Kephart, PhD, assistant professor
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R.A. Kohl, PhD, associate professor
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C.L. Lay, PhD, professor
G.D. Lemme, PhD, associate professor
M.J. Lindstrom, PhD, adjunct associate professor (USDA/ARS)
D.D. Malo, PhD, professor
B. McDaniel, PhD, professor
A.E. Olness, PhD, adjunct associate professor (USDA/ARS)
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M.A. Quinn, PhD, research associate
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D.H. Rickerl, PhD, assistant professor
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D.D. Walgenbach, PhD, professor
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P.D. Weeldreyer, MS, assistant professor
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Rural Sociology

J.L. Satterlee, PhD, professor and head

Station Biochemistry

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B.E. Ballachey, MS, adjunct assistant in
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R.J. Emerick, PhD, professor
D.P. Evenson, PhD, professor
J.E. Houglum, PhD, associate professor
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W.P. Jensen, PhD, professor
L.K. Jost, MS, assistant in
M.S. Kosco, PhD, research associate
D.P. Matthees, PhD, associate professor
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C.G. Paech, PhD, associate professor
I.S. Palmer, PhD, professor
R.R. Rue, PhD, professor
D.M. Simon, BS, assistant in
N.J. Thiex, MS, assistant professor

Veterinary Science

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D.A. Benfield, PhD, associate professor
B.M. Carlson, BA, assistant in
J.E. Collins, DVM, assistant professor
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D.F. Francis, PhD, associate professor
G.D. Hanson, BS, livestock supervisor
B.H. Janke, DVM, PhD, assistant professor
D.D. Johnson, DVM, PhD, professor
C.A. Kirkbride, DVM, professor
M.C. Libal, DVM, MS, assistant professor
D.T. Nelson, DVM, MS, professor
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Wildlife and Fisheries Sciences

C.G. Scalet, PhD, professor and head
C.R. Berry, PhD, adjunct associate professor
A.J. Bjugstad, PhD, adjunct professor
L.D. Flake, PhD, professor
K.F. Higgins, PhD, adjunct assistant professor
T.R. McCabe, PhD, assistant professor
T.C. Modde, PhD, associate professor
D.W. Uresk, PhD, adjunct associate professor

Projects

Agricultural Engineering

H-04 Heat pumps for livestock building heating and cooling and agricultural processing applications; Julson, Lytle, Froehlich
R-062 Irrigation scheduling methods for efficient water and energy use; DeBoer, Lytle, Evenson
H-085 Innovative approaches to tillage practices and equipment design; Alcock, Froehlich, Arnold
H-124 Catenary trail tube design for low pressure irrigation; Chu, DeBoer
H-134 Improvements of farm chore vehicles and their application; Christianson, Alcock
H-144 Engineering aspects of swine production; Froehlich, Christianson
H-176 Irrigation management practices for efficient crop water use; DeBoer, Chu, Stange, Werner
H-196 Management of shallow water tables under agricultural lands; DeBoer, Chu, Lytle, Stange
R-214 Weather and climate research for agricultural decision-making in the North Central Region; Lytle
H-246 Equipment considerations for agricultural operations as related to soil compaction; Froehlich, Alcock
H-256 Evaluation and design of chemical application equipment for agronomic agriculture; Froehlich, Klosterman
H-303 Compatibility of reduced pressure sprinkler irrigation and conservation tillage practices; DeBoer, Chu, Stange
H-312 Irrigation requirements for South Dakota; DeBoer, Chu, Stange

Animal and Range Sciences

S-043 Range and tame pasture production practices in western South Dakota; Johnson, Stymiest
H-044 Improving reproductive efficiency of commercial beef production; Pruitt
H-073 Improving reproductive performance in the postpartum beef cow; Miller, Pruitt
H-084 In vivo measure of microbial contributions to the net protein requirement of growing bovine; Pritchard
R-093 Improvement of beef cattle through breeding methods; McCarty
H-104 Preconditioning effects on health and performance of feeder calves; Pritchard
H-153 Reproductive efficiency of sheep; Slyter
H-175 Improving the utilization of corn-corn silage diets for feedlot cattle; Wagner
H-185 Amino acid balance in swine diets and effects on pig growth and nitrogen and mineral metabolism; Wahlstrom, Libal

H-195 Nutrient interrelationships affecting performance and body composition of swine; Libal, Wahlstrom
R-221 Increased efficiency of sheep production; Slyter
H-276 Shortening postpartum interval and increasing pregnancy rates in estrous synchronized beef cows; Miller
H-283 Manipulation of tenderness and other functional properties; Jones, Costello
H-314 Rangeland resource improvement; Gartner
H-444 Grazing management strategies to increase net ranch income; Lewis
H-464 Improved grazing management for the mesic mixed-grass prairie of South Dakota; Schlundt
H-911 Mineral requirements and nutrient interrelationships of sows; Wahlstrom, Libal

Biology

R-055 Development of tissue and cell culture techniques for use in breeding monocotyledonous species; Chen, Boe, Wicks
H-065 Plasma progesterone levels of reproductively senescent yellow mice, correlated with obesity; Wilkin
H-095 Cytology of plant regeneration in tissue cultures of monocotyledonous species; McMullen, Chen
H-154 Agricultural potential of the purple coneflower (Echinacea); Holden
H-294 Structure and biology of Echinacae, the purple coneflower; Myers
H-296 Enhanced reproductive efficiency by controlling early embryo mortalities; Granholm

Dairy Science

H-027 Properties and applications of ultrafiltered milk; Mistry
H-206 Whey utilization by dairy cattle; Schingoethe
H-254 Composition, quality, and consumer acceptance of milk and dairy products; Baer
H-262 Improving dairy cattle through breeding with special emphasis on selection; Voelker, Ludens
R-382 Optimizing the nutritional utilization of forages by dairy cattle; Clark
S-384 Analysis of dairy products; Parsons
R-432 Redirecting the nutrient flow in cows for maximum milk production; Schingoethe, Clark
R-442 Improving dairy herd management practices; Clark
H-454 Improving quality, microbiological safety, and profitability of dairy products; Torrey

Economics

H-075 Economic analysis of South Dakota farmer experience with reduced tillage systems; Allen
H-076 Economics of farming systems alternatives in eastern South Dakota; Dobbs, Taylor
H-086 Determinants of farm size and structure in north-central areas of the United States; Janssen
H-096 Impact of the 1986 federal tax reform on South Dakota agriculture; Lundeen
H-106 Grain price and interest rate risk management for South Dakota producers and agribusinesses; Schmiesing
H-115 Economic analyses of farmland values, rental practices, and financing arrangements in South Dakota; Janssen
R-125 Effect of changes in transportation on performance of the U.S. agricultural transportation system; Lamberton
H-163 Economic impact of alternative electric rate structures on energy and water use in South Dakota; Taylor, Lundeen
H-266 Analysis of marketing strategies to reduce price risk for South Dakota livestock producers; Ellingson

Home Economics

H-146 Effects of diet, genetic obesity, and beta-agonist compounds on body composition; Rosholt
H-205 Tissue levels of pesticides in South Dakota residents on normal and calorie-restricted diets; Crews, Shewmake, DeZeeuw

Horticulture, Forestry, Landscape, Parks

M-004 Genetic improvement of tall tree species for South Dakota; Schaefer
M-164 Selection and propagation of superior native and introduced trees and shrubs for South Dakota; Evers
H-166 Micropropagation of herbaceous perennials; Spinski
R-186 Introduction, maintenance, evaluation, and utilization of plant germplasm; Peterson
H-204 Breeding fruit cultivars and developing improved fruit cultural practices for South Dakota; Peterson
MS-236 Physiological characteristics of conifers suitable for windbreaks in South Dakota; Baer
R-336 Strategies and procedures for advanced generation breeding of north-central forest species; Schaefer
H-474 Increasing vegetable yields in South Dakota; Prashar
H-494 Renovation of deteriorating windbreaks in South Dakota; Baer

Microbiology

H-126 Chemotaxonomic characterization of pesticide-degrading bacteria; Gauger
H-155 Mycorrhizae and associated nitrogen fixation; Todd
H-165 Fuel ethanol and feed byproduct production from alternative feedstocks; Westby
H-344 Bovine pulmonary immunoreactivity following localized lung immunization; Hillam
H-364 Denitrification in agricultural soils; Todd
H-374 Nitrogen fixation and guanine metabolism in soil bacteria; Westby

Plant Science

H-003 Weed control for conservation tillage systems; Arnold
R-005 Nutrient management in conservation tillage to improve productivity and environmental quality; White
H-015 Cell adjustments to drought conditioning in winter wheat; Kenefick, Schumacher, Gellner
H-016 Root growth and development of corn with respect to tillage system and landscape position; Schumacher
H-024 Alternative farming systems; Smolik, Fixen, Hall
H-025 Effects of starter fertilization of corn under varying cultural and environmental conditions; Fixen
H-034 Low pressure irrigation: soil crusting, winddrift, and spray evaporation; Kohl, DeBoer, Chu
H-053 Continuing participation in the National Agricultural Pesticide Impact Association Program; Walgenbach, Smolik
H-064 Etiology, epidemiology, and resistance to major sunflower pathogens in South Dakota; Carson
R-094 Bionomics, vector capabilities, and management strategies for face flies; Easton
CG-105 Suppression of stable fly populations in beef cattle through use of sterile insects; Easton
R-162 Relating soil wetness to selected landscape features and to land use decisions; Lemme
H-174 Winter wheat improvement; Gellner
H-184 Use of soil survey information for agrotechnology transfer and soil productivity relationships; Malo
H-193 Breeding and genetics of flax and sunflower; Lay, Grady, Ferguson
H-194 Development and utilization of oats and rye adapted in South Dakota; Reeves
H-203 Corn breeding; Wicks, Carson, Bettendorf
H-213 Spring wheat breeding and genetics; Cholick, Buchenau
H-223 Management of alfalfa insects in South Dakota; Walstrom
R-234 Biological control of soil-borne plant pathogens in integrated crop management systems; Buchenau

H-244 Freeze selection effects on membrane proteins and the cell cycle in winter cereals; Kenefick
H-245 Identification, biology, and control of potato diseases in South Dakota; Gallenberg
H-253 Amelioration of claypan-range-soil properties to increase forage production; White
MS-255 Understory forest production and soil mineralogy in Custer State Park; Lemme
H-265 Evaluation of germination and purity procedures for forage and revegetation species common to South Dakota; Gutormson
R-272 Seed production of breeding lines of insect-pollinated legumes; Boe
H-273 Investigations of Entomorphage grylli, a pathogen of grasshoppers; McDaniel
R-282 Reduction of corn losses caused by nematodes in the North Central Region; Smolik
H-286 Ecology and control of western and northern corn rootworm in South Dakota; Walgenbach, Elliott, Hein
R-304 Arthropod management and economic losses of insects, mites, and ticks on livestock; Easton
H-306 Determination of water stress with isotopic ratios of carbon-12 and carbon-13; Beck
H-316 Cropping systems in western South Dakota; Stymiest, Rickerl, Jacobson, Johnson
H-324 Breeding and evaluation of forage grasses in South Dakota; Boe
R-333 Soil productivity and erosion; Schumacher, Lemme, Lindstrom
H-334 Movement of soil water and soluble salts through till and shale subsoil; Carlson
R-343 Management strategies for leafhoppers, spittlebugs, and aphids on alfalfa; Walstrom
H-346 Economics and ecology of farm systems and conservation tillage; Rickerl, Weeldreyer, Stymiest, Sorensen, Smolik, Beck
H-356 Detection and control of soybean diseases in South Dakota; Ferguson
S-401 Foundation seed stock; Weber
S-402 Seed certification; Pollman
S-403 Seed testing; Gutormson
S-404 Variety testing; Bonnemann
S-406 Survey entomologist; Walgenbach
H-482 Physiological regulation of individual components of seed yield; Dybing
H-484 Establishment and management of forage crops in South Dakota; Holland
H-502 Chemistry of atmospheric deposition—effects on agriculture, forestry, surface waters, and materials; Gardner
H-504 Integrating crop culture, chemicals, and life cycles to control persistent weeds; Arnold

Rural Sociology

H-212 Socio-economic characteristics of South Dakota population; Satterlee

Station Biochemistry

CG-046 Flow cytometic analysis of bull sperm fertility parameters; Evenson, Ballachey
H-116 Extraction methods in trace organic analysis of agricultural samples; Matthees
H-145 Flow cytometry; Evenson
H-156 Ion chromatography and redox in soil solutions; Rue
H-394 Mineral nutrition and metabolism in animals; Emerick
H-404 Biochemistry of selenium; Palmer
S-407 Analytical services; Thiex

Veterinary Science

CG-056 Modified live Escherichia coli vaccine for colibacillosis of pigs; Francis
R-066 Bovine respiratory disease: risk factors, pathogens, diagnosis, and management; Vickers
R-122 Prevention and control of enteric diseases of swine; Bergeland, Benfield, Francis
AH-136 Epidemiology of rotavirus infection in swine; Janke, Benfield
AH-215 Characterization of monoclonal antibodies to enteric viruses of swine and cattle; Benfield
AH-225 Monoclonal antibodies and enzyme-linked immunosorbant assay (elisa) to diagnose bovine viral diarrhea; Vickers
AH-264 Serum and/or tissue levels of antibiotics in swine; Libal
AH-326 Effects of nutrition and management on susceptibility of calves to enteric diseases; Francis, Benfield, Libal, Owens, Sommerfeldt
H-366 Antibody protection of the conceptus from porcine parvovirus-contaminated semen; Kirkbride, Steen, Vickers
CG-544 Role of cellular receptors in the pathogenesis of porcine enteric viral infections; Benfield

Wildlife and Fisheries Sciences

H-026 Development of polyploid fishes for South Dakota waters; Scalet
H-036 Development of management strategies to enhance South Dakota pond fishery resources; Modde
M-514 Relationships of forests and agriculture to management of turkeys in eastern South Dakota; Flake
H-534 Assessment of riparian habitat damage caused by aquatic furbearers; McCabe

Articles, Publications

Agricultural Engineering

Refereed articles:
Alcock, R., and D. Froehlich. 1986. Analysis of rotary atomizers. Trans ASAE 29(6):1514.
Anderson, G.A., R.J. Smith, D.S. Bundy, and E.G. Hammond. 1987. Model to predict gaseous contaminants in swine confinement buildings. J of Agricultural Engineering Research, The British Society for Research in Agricultural Engineering 37.
Christianson, L.L., et al. 1987. United States patent electric tractor. Patent Number: 4,662,472. Washington, DC.
Chu, S.T., C.A. Onstad, and W.J. Rawls. 1986. Field evaluation of layered Green-Ampt model for transient crust conditions. Trans ASAE 29(5):1268.
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Heard, L.R., D.P. Froehlich, et al. 1986. Snout cooling effects on sows and litters. Trans ASAE 29(4):1097.
Thoreson, B.P., R. Alcock, and L.L. Christianson. 1986. Electric choremaster I: Test procedures and results. Trans ASAE 29(5):1259.

Other reports:
Anderson, G.A., and D.S. Bundy. 1987. Comparison of methods to adjust light-gage metal diaphragm shear stiffness for different diaphragm lengths. Paper No. MCR 87-141. ASAE, St. Joseph, MI.
Bischoff, J.H., S.W. Schaefer, and D.P. Froehlich. 1986. Field evaluation of deep tillage and soil amendments on sodium-affected soils. ASAE Paper No. 86-2147. ASAE, St. Joseph, MI.
DeBoer, D.W., A. Moshref-Javadi, and S.T. Chu. 1986. Sprinkler irrigation management for surface runoff control. ASAE Paper No. NCR 86-402. ASAE, St. Joseph, MI.
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______, B.M. Ketelhut, and D.L. Beck. 1987. Corn water use requirements for central South Dakota. ASAE Paper No. 87-2017. ASAE, St. Joseph, MI.
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Gerhard, J., K.J. Forester, and M.A. Hellickson. 1987. Mathematical description of diesel engine performance. ASAE Paper No. 87-1026. ASAE, St. Joseph, MI.

Hanson, G.A. 1987. Test procedures and results for skidtric. MS thesis. SDSU Library, Brookings, SD.

Humburg, D.S., B.L. Reynolds, R. Alcock, and D.P. Froehlich. 1986. Assemblies and cost analyses of a battery powered skid-steer. ASAE Paper No. 86-1065. ASAE, St. Joseph, MI.

______, J.L. Julson, and R. Alcock. 1986. Mechanized system for the production and harvesting of green asparagus. ASAE Paper No. NCR 86-503. ASAE, St. Joseph, MI

______. 1987. Field evaluation of an electrically powered spiral mechanization system. MS thesis. SDSU Library, Brookings, SD.

Ketelhut, B.M. 1987. Water balance and economic analysis of reduced pressure/conservation tillage systems for irrigated corn production. MS thesis. SDSU Library, Brookings, SD.

Schaefer, S.W., J.H. Bischoff, and D.P. Froehlich. 1986. Sodium ion effect on the physical parameters of a sodic soil. ASAE Paper No. 86-1537. ASAE, St. Joseph, MI.

Stange, K.W., and D.W. DeBoer. 1987. Distribution patterns for reduced pressure sprinklers. ASAE Paper No. 87-2016. ASAE, St. Joseph, MI.

Toghiani-Pozueh, A., and S.T. Chu. 1986. Laboratory study of catenary trail tube irrigation. ASAE Paper No. NCR 86-401. ASAE, St. Joseph, MI.

Van Zee, R.J. 1986. Irrigation requirements and crop yields for east-central South Dakota. MS thesis. SDSU Library, Brookings, SD.

Animal and Range Sciences

Refereed articles:

Ballachey, B.E., H.L. Miller, L.K. Jost, and D.P. Evenson. 1986. Flow cytometry evaluation of testicular and sperm cells obtained from bulls implanted with zeranol. J Anim Sci 63(3):995.

Borg, B.S., G.W. Libal, and R.C. Wahlstrom. 1987. Tryptophan and threonine requirements of young pigs and their effects on serum calcium, phosphorus and zinc concentrations. J Anim Sci 64(4):1070.

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Thaler, R.C., G.W. Libal, and R.C. Wahlstrom. 1986. Effect of lysine levels in pig starter diets on performance to 20 kg and on subsequent performance and carcass characteristics. J Anim Sci 63(1):139.

Wahlstrom, R.C., B.S. Borg, and G.W. Libal. 1986. Protein level and amino acid supplementation of sunflower meal diets fed to young pigs. Nutr Rep Int 34:351.

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Ballachey, B.E., H.L. Miller, L.K. Jost, and D.P. Evenson. 1986. Flow cytometry evaluation of testis and sperm cells and growth performance of bulls implanted with zeranol. SDAES Beef Report CATTLE 86-25:113.

Baumberger, R.D., K.R. Peterson, and F.R. Gartner. 1987. Comparison of habitat type and range site methods for range condition classification in northwestern South Dakota. Proc Soc Range Mgmt Abstr 305.

Borg, B.S., G.W. Libal, and R.C. Wahlstrom. 1987. Effect of protein level and inorganic phosphorus on performance and serum parameters of young pigs fed corn-sunflower meal diets. J Anim Sci 65(Suppl 1):88.

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Hamilton, C.R., B.S. Borg, M.K. Hoppe, G.W. Libal, R.C. Wahlstrom, and R. Hanson. 1986. Effects of lysine and energy concentration on the performance of growing and finishing pigs fed diets containing barley. SDAES SWINE 86-10:32.

_____, _____, D. Jensen, M.K. Hoppe, R.C. Wahlstrom, and G.W. Libal. 1986. Effects of method used to formulate barley-soybean meal diets on the growth and carcass traits of pigs. SDAES SWINE 86-8:24.

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Budget

Agricultural Experiment Station

For period ending June 30, 1987

State appropriation	$ 4,709,574
Federal appropriation	2,601,573
Federal restricted	889,853
Other restricted	4,327,503
Total	$12,528,503

Director's comments

continued from page 2.

on the SDSU campus. The plots show the differences, sometimes considerable, between older varieties and species of crops and our newer releases. The plantings will be continued.

We accepted numerous invitations to present programs across the state during our centennial year, and we would be pleased to continue this. Several of our staff assisted and met many of you during these vists. The traveling exhibit, telling the story of our Station in pictures, went around the state several times.

What the Citizens Review Committee said is most certainly true: not enough people of our state know what the Agricultural Experiment Station is, what it does, or how it affects the lives of all South Dakotans. We intend to bring new vitality to our effort to serve you and to tell you our story.

Centennial years end, but horizons keep on going. We intend to go a far distance toward the horizon in the century ahead.

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south dakota
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Serving the People of South Dakota through Teaching, Research, Extension

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College of Agriculture and Biological Sciences
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