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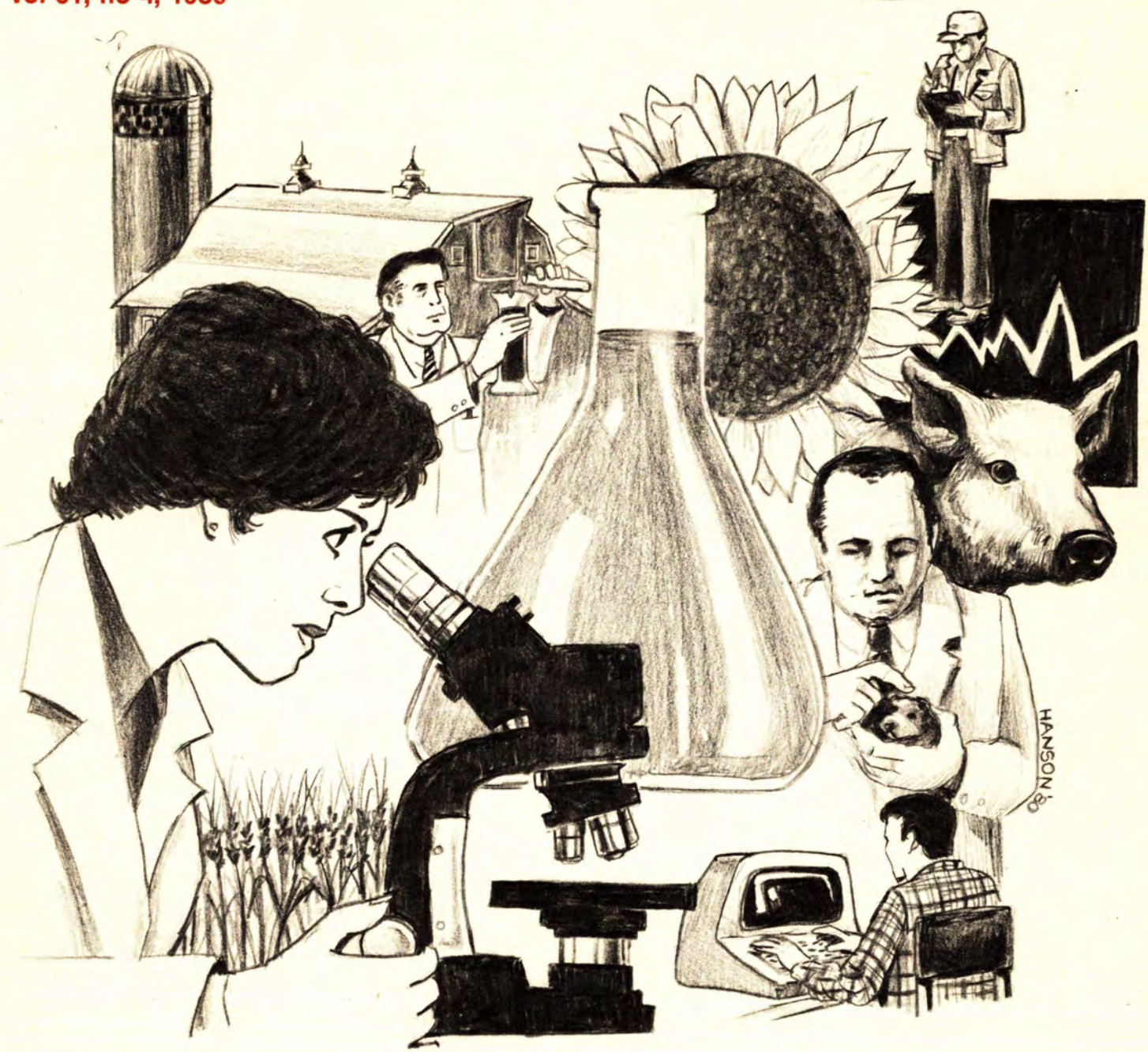

The future of research

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Director's comments

Too often research is a reaction to present needs. It should lead us into future. When do we start?

I wonder how you see research.

You can expect how I'd look at it— as the very foundation of our modern agriculture. We have a higher standard of living today and a greater knowledge about ourselves and our environment because of our predecessors in research. We should do no less in meeting the needs of future generations.

But that's an expected answer from a person who has a "vested interest" in research.

We **all** have vested interests in agricultural research.

We all must eat. A review of any issue of *Farm & Home Research* shows the major efforts of this experiment station are directed toward the production, harvesting, storing, and marketing of a wide variety of food products.

It is also evident that we are concerned about maintaining and improving the quality of our natural resources, developing more effective and efficient community services, better job

opportunities in rural areas, more comfortable and energy saving housing, and providing consumers and local community leaders with training and information that will enable them to make sound community decisions.

In this issue some other people give you their viewpoints on research.

Theodore Schultz, a South Dakotan and this year's Nobel prize winner in economics, warns of a "danger" he sees developing, a danger of non-scientists setting priorities for reseachers, "of requiring scientists to devote ever more time to preparing reports to 'justify' the work they are doing." He maintains that the scientist,who is at the frontier of knowlege in his field, is closer to the problems—and the solutions—than any other person, and that he should be let alone to explore.

One of those persons Schultz describes is Jim Ross, our grass breeder, featured in another story. Jim mentions the "independence" he has enjoyed in his 33 years with the Experiment Station.

That independence has paid off for us all. In the last 2 years alone he has released three new varieties that will help regrass parts of western South Dakota and improve summer grazing in the eastern part. That stabilizes our food supply.

A practical user of research is Matt Sutton, interviewed in another story. Sutton uses neither more nor less research results to improve his operation than many other South Dakotans. He knows what others may not, however: that farm magazines, trade journals, even newspapers and broadcasts are filled with information that originated at an experiment station, even if it is not identified as the source.

That's all right. We do not seek headlines. Our low profile troubles us only when it leads you to a misunderstanding of our purposes and goals.

Where will research take us, and the next generation, in the future?

Legumes use nitrogen fixing bacteria, and our fertilizer investment on these crops is low. Will we someday adapt corn, wheat, oats, and barley to use such bacteria and trim our use of high-energy fertilizer?

We won't know until we allocate resources for the research and try.

Our future energy crises are going to make our present one look like a lamb by comparison. Will we one day have a "fuel crop," as well as food and feed crops?

We won't know if we don't get started.

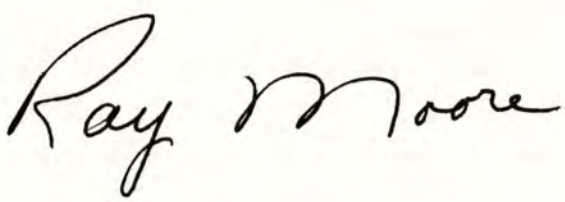
These are basic kinds of research that will not see a payoff in the immediate future. The risk is high and the cost will be great; but the impact of success, be it ever so remote, is so great that we cannot afford not to do the research.

We have very small efforts underway in each of these areas now. A much greater effort is called for.

When shall we start?

Perhaps the greatest challenge of the future will be to set aside the necessary resources for research and recognize our obligation to the future rather than being content with minimal programs to take care of immediate problems.

It seems like the program should sell itself. I'd like to know how you see it.



The human factor

Too much 'accountability' to public destroys research creativity, says South Dakota's Nobel Prize laureate

South Dakota's Nobel Laureate in Economics, Dr. Theodore W. Schultz, was born in Arlington, April 30, 1902, and grew up on the family farm 4 miles northwest of Badger.

He studied economics at SDSU and graduated in 1928. He then took his master's and doctor's degrees at the University of Wisconsin, graduating in 1930 prior to joining the Economics Department at Iowa State. He became head of that department in 1934 and held the post until 1943.

Schultz then headed the Economics Department at the University of Chicago, became Charles L. Hutchinson Distinguished Service Professor in 1952, gaining emeritus status in 1972.

He authored 11 books and edited seven others during his long career, and he gained world-wide recognition for his investigations into investment in human resources as a means toward economic progress.

The much honored South Dakotan won the Francis A. Walker Medal—given only once in each 5 years by the American Economics Association—in 1972. In December 1979, he received the Nobel Prize in Sweden. He has received five honorary doctor's degrees during his career from various universities, including one from SDSU.

Schultz has been quoted as saying that he first became interested in economics because of the economic turbulence in his home state during the late 1920's and early 1930's.

"While I was at State College, there were three banks that closed with some of my money in them," he quipped.

His long and varied career has included serving as adviser and consultant to some of the nation's largest foundations, numerous federal agencies, the White House, and branches of the military.

Mrs. Schultz, the former Esther Werth, is a native of Frankfort and is also a graduate of SDSU.

Schultz is South Dakota's second-ever Nobel Prize winner. In 1939, Canton native Ernest O. Lawrence received the award for physics research.

Theodore W. Schultz

The fundamental dynamic agent of long-term economic growth is the research sector of the economy, and the very essence of research is in the fact that it is a dynamic venture into the unknown or the partially known.

Research, in this context, is inescapably subject to risk and uncertainty. Whereas funds, organization, and competent scientists are necessary, they are not sufficient. An important factor in producing knowlege is the

human ability that I shall define as research entrepreneurship.

This is an ability that is scarce; it is hard to identify this talent; it is rewarded haphazardly in the not-for-profit research sector; and it is increasingly misused and impaired by the over-organization of our research enterprises.

What is happening in agricultural research is, on this score, no exception.

Who are these research entrepreneurs? In business enterprises that are profit oriented, the chief executive officers perform the entrepreneurial function, but the skilled factory worker is not an entrepreneur in doing his job. In research, it is otherwise.

Whereas administrators who are in charge of a research organization may be entrepreneurs, much of the actual entrepreneurship is a function of the assessment by scientists of their scientific frontiers of knowlege. Their professional competence is required to determine the research hypotheses that may be worthwhile pursuing.

Briefly and much simplified, my argument is that in the quest for appropriations and research funds, all too little attention is given to that scarce talent which is the source of research entrepreneurship.

The convenient assumption is that a highly organized research institution that is tightly controlled will perform this important function.

But, in fact, a large organization that is tightly controlled is the death of creative research, regardless of whether it be the National Science Foundation, a government agency, a large private foundation, or a large research-oriented university.

No administrator in Washington or in any land-grant university can know the array of research options that the state of scientific knowledge and its frontier afford.

Having served as a member of a research advisory committee to a highly competent experiment station director for some years and having observed the vast array of talent supported by funds that we as a committee had a hand in allocating, I am convinced that most working scientists are research entrepreneurs. But it is exceedingly difficult to devise institutions to utilize this special talent efficiently.

Organization is necessary. It, too, requires entrepreneurs. Agricultural research has benefited from its experiment stations, specialized university laboratories, and from the recently developed international agricultural research centers.

But there is the ever-present danger of over-organization, of directing research from the top, of requiring working scientists to devote ever more time to preparing reports to "justify" the work they are doing, and to treat research as if it were some routine activity. □

Beyond our borders

We carry our full share, and more, of regional research. It pays off: more results for less money spent

Scientists at SDSU and other land-grant institutions are cooperating to resolve common problems, according to Ray Moore, director of the Agricultural Experiment Station.

That stretches hard pressed research money farther and gives a researcher more time to work on problems of high priority in his own state.

Regional research "provides an opportunity for the exchange of knowledge between at least two states, while avoiding unnecessary duplication of work," Moore said.

Federal and state funds are used in the program and "we couldn't avoid regional research even if we wanted to." Each experiment station must use 25% of its federally-appropriated funds on regional research.

South Dakota has a better-than-average record in this area. The SDSU experiment station uses much more than the ear-marked amount on regional research.

"We are very supportive of regional research, because we think we get more from our tax dollars in cooperative endeavors," Moore said. He stressed that everyone (researchers and ultimately, all South Dakotans) stands to benefit from the interchange of ideas and data.

The United States is divided into four regions: Southern, Western, Northeastern, and North-Central. South Dakota is one of 12 states comprising the North-Central Region.

Regional research projects usually originate from scientists within a region. The experiment station directors of the region evaluate the merits of a given research proposal through a regional research committee.

The proposal is then sent to a national committee, consisting of two directors from each region and one person from home economics interests.

Moore is a member of this "Committee of Nine," which decides if the project is worthy of funding by USDA.

A project is typically given 5 years for completion. If that amount of time is not adequate, a short extension may be granted or the format may be revamped and the project renewed an additional 5 years.

Member of the national selection team that reviews the merits of regional research proposals, Ray Moore supports South Dakota's full participation in multi-state studies where scientists divide up the responsibilities, attack a problem as a team, and pool their ideas and findings. "It gives us more value for the tax dollars invested."

Grapes, satellite maps, weather, sheep are samples of N-C research

SDSU participates in 25 regional research projects. Topics cover a wide range of subjects.

Fred Westin, professor of plant science, is using remote sensing data to relate soil and landscape characteristics to land use.

The Remote Sensing Institute at SDSU uses pictures taken by earth circling satellites to map the planet's resources. Westin said a study of pictures comparing soil profiles and climatic patterns reveals the total soil environment of specific areas. This information is used to determine the potential yields of various crops.

Westin's data is compiled in *Soils of South Dakota* and publications of the soil surveys of 26 counties in the state. Soil surveys may be used to identify whether land should be used as cropland, rangeland, a wildlife habitat, a recreational area, a building site, or as a source of sand, gravel, and topsoil.

The information that can be pulled together from Westin's work can be quite specific. It can help determine the most suitable crops for each field under two systems of management—with and without fertilizer, insecticide, and herbicides. The best water drainage systems, even the type of trees that would be most effective in windbreaks and shelterbelts may also be decided.

The publications are available from county Extension agents, local soil conservation services, and the Bulletin Room, Extension Building, SDSU, Brookings, SD 57007.

Research directed by Ron Peterson, head of the horticulture department, has resulted in the development of a new grape variety. The new grape, a cross between Fredonia and an early-maturing wild grape, performs well in South Dakota.

Clusters of the blue grape are attractive, well filled, average four inches in length, and frequently have a shoulder (a branch in the cluster, giving more yield).

The grapes are slightly smaller than Beta, the only grape dependably winter hardy in South Dakota at the present time, but are hardier and mature much sooner. A higher annual yield is common.

The new grape variety will be recommended for planting in this area because of its hardiness, early maturation, pleasant flavor, and high productivity. It will be ready for distribution in 1982.

Lowell Slyter, professor of animal science, is testing the production of crossbred ewes under farm flock and range conditions as his part of regional sheep research. He is interested in the effects of breeding and management.

The animals in his first test group are the offspring of Targhee ewes that were bred with Targhee or Suffolk rams. A group added later consists of Finn-Targhee crossbreds.

Finn breeding increases the incidence of twinning.

"Preliminary data shows that the three-way cross is best if an operator is set up to handle the extra lambs," Slyter said.

The animals are studied at a unit north of Brookings and the Antelope Field Station near Buffalo. The Brookings unit is a farm flock type setup, while the West River facility has range conditions.

Joining in a regional research project allows Lowell Slyter, Animal Science Department, to concentrate in the area in which he is particularly expert—sheep breeding and management. Over 20 other research studies are part of larger regional projects.

Rangeland ranchers generally prefer straightbred sheep over crossbreds that include the black-faced Suffolk. Their decision is based on tradition and management more than any other factors, Slyter said. His research does not show significant problems in the fencing and flocking abilities of the crossbreds.

Bill Lytle, professor of agricultural engineering, is engaged in a cooperative study of climate. His data on South Dakota climate, combined with that of other researchers throughout the North-Central region, help in forecasting weather conditions.

The work encourages an improved weather service with long-range forecasts. Aviators and farmers will benefit greatly from more accurate information about impending weather conditions.

Lytle said that experts may be able to predict the world market so they can raise and lower prices accordingly.

"If we can foresee dry periods in the USSR, we can prevent what happened in 1974 when they surprised us and bought large amounts of grain on a low market," he said.

Research may reveal methods for using wind as a source of energy.

Lytle and others are studying the occurrence of winds and the frequency of their velocities and directions. It is believed that wind generators and windmills may be made practical, he said.

Solar energy for heating and crop-drying is also being explored. The researchers have written a book called *Solar radiation and sunshine duration relationships.* It deals with the North-Central region and Alaska.

These are examples of regional research. There are many more. Even when no specific project is designated as regional, a scientist will most often consult with his colleagues in other states.

"Even a 'rich' state, with much more money and manpower resources than we have, would participate in regional research," Moore concluded. "Sharing with other states enlarges our capabilities. We never forget to direct our research straight at the needs of South Dakotans. But many of our problems don't stop at a state border.

"It only makes good sense to pool our efforts with those of other states. That is careful stewardship of both time and funds." □

The writer is Shary Jost, journalism intern in the Ag Information Office.

Barleys just for us

Present barleys don't meet needs, so breeding is underway to produce better feed and malting varieties

Needs.

Farmers in southwestern South Dakota need a winter barley that would help alleviate feed shortages.

Irrigators need a two-row malting barley to meet growing demand in the malting industry.

Farmers need a six-row malting barley that produces higher extract and low protein under a wider range of growing conditions.

They need a first-rate feed barley with higher oil content and better quality protein that would require less supplements.

Farmers have those needs, so the present barley varieties must not be totally satisfactory. Why, then, do farmers bother with barley?

Because, even though feed barley must be supplemented, its protein is quantitatively

Two-row barleys, like the one on the left, are "promising" but not yet ready for dependable South Dakota production. They have higher malt extract and produce high yields, but need to be crossed with adapted six-row barleys for disease resistance and earlier maturity.

superior to that in corn and sorghum. Because barley is well adapted to different areas and climates. Because it fits rotations, and costs less to produce than some crops.

Barley can be grown in every county in South Dakota—and is—according to Phil Price, USDA funded barley breeder at SDSU.

But to grow well under such a wide range of conditions requires selective plant breeding. Straw strength, low protein, high lysine, high oil, plump, uniform kernels, disease resistance, narrow leaves, proper fall growth habit—each of these characteristics is desirable, depending on the intended use of the variety.

Two-row barley by River would have market in brewing industry

It wasn't until the 1940's that sustained work began on improving barley varieties.

"The old varieties were weak strawed, highly disease susceptible, rough awned, not heat and drought resistant," says Price, who began work here in 1957. "You couldn't fertilize those old varieties because they just lodged.

"Then diseases did a 100-yard dash across the field—rust, scab, spot blotch, net blotch—further lowering yields and grain quality."

In South Dakota, acres planted to barley went from 300,000 in 1880 to 2.5 million acres in 1942, then down to 225,000 acres in 1965.

In 1966 Primus was released to growers in South Dakota—the first early barley variety developed at our experiment station. This and other new varieties turned the situation around and acreage increased to about 460,000 acres this last year.

Protein content is an important factor in determining if the barley will receive the malting premium or be sold for feed.

The malting industry requires that barley not exceed 13.5% protein, but prefers 12%. For good livestock nutrition, feed barley should range from 14% to 15.5%.

"The protein content of the developing barley kernel is determined by several factors," explains Price, "varietal genetics, soil type, soil fertility, soil moisture, air and soil temperatures, lodging, and plant diseases.

"The barley grower can control just about everything except soil moisture and air temperature. Consequently, even the best managed farm operation can fail to hit the desired protein level in the harvested grain."

Irrigation could be a partial solution, although little barley is now irrigated in South Dakota.

The potential for irrigation development of the strip along the Missouri River from Ft. Thompson to the North Dakota border has interested the largest brewery in the nation in expanding production of two-row barley in South Dakota.

The two-row barley has an advantage over the six-row barley commonly grown in the midwest in that it has inherently higher malt extract. Also, under irrigation the two-row barley tillers well and produces high yields of uniform kernels.

But a two-row barley must be adapted to South Dakota conditions that will also meet industry requirements—requirements which are, in Price's words, "ever more stringent."

There are problems to overcome. The best two-row barleys now available are relatively new to the midwest and are unadapted.

"They are late to head out and mature, have little or no disease resistance to local diseases, have poor heat and drought tolerance, and are lower yielding than the six-row barleys," Price explains.

"To obtain a good two-row selection, we intercross the unadapted two-row with the

adapted six-row barleys and select the two-row progeny. That gives us some smooth-awned, mid-season, disease resistant two-row selections. Then we can cross these back to the very best, high extract, unadapted two-row selections and gradually move toward a type that has the best characteristics of both."

The malting industry will not give malting barley status to a new variety until the experiment station provides for testing 10,000 bu the first year, 20,000 bu a second year and, if there have been problems with the grain, 20,000 bu again for a third year.

That would tie up more funds than Price has to work with, but he continues to work on a variety that will meet the needs of a potentially lucrative market.

Phil Price, SDSU barley breeder, examines one of 1980's outstanding six-row barleys on a kernel size grading screen. The Elkton sample is 86% plump—many samples couldn't meet the malting industry requirement of at least 65%. In a year that wasn't good for barley, Price attributes this farmer's success to "good management and a little luck."

Poorer quality proteins increase faster when total protein goes up

The six-row spring malting barley breeding project at SDSU has goals common to several states—low protein, high extract, high yield, and high percentage of plump kernels under dryland cultivation.

"Barley breeders are now developing barley selections with a genetically lower protein content, selections that maintain this lower content under a fairly wide range of environmental conditions," Price says.

Protein content is of such concern because 80% is only partially soluble.

"The insoluble protein reduces the water soluble extract, causes problems during the fermentation process, and lowers the appearance, taste, and shelf life of the bottled beer.

"A variety with a large percentage of poor quality proteins is not useful for making beer for two reasons.

"First, the amino acid balance does not provide enough lysine and other essential amino acids necessary for rapid yeast cell multiplication and a proper fermentation rate.

"Second, the insoluble proteins go into suspension during brewing, causing haziness when they combine with substances from the hulls. Eventually, unless removed in the brewing process, these complexes settle on the bottom of the bottle. Over a period of time the beer taste and appearance can be adversely altered."

When a variety is developed that is "programmed" to produce lower protein, the chance of receiving the malting premium will be that much greater.

Feed barley has always been considered second-rate compared to malting varieties because of the lower price it earns.

Work is well under way now to develop a first-rate feed barley, better suited to its use.

Barley needs higher oil content, an efficient source of energy for livestock. Primus II, a variety released in 1968 from SDSU, has 3% oil. The goal is now 5%oil, a 60% increase, and it looks like that is the upper limit for development.

"From 1974 to 1977 we analyzed over 17,000 entries in the USDA World Collection of barleys looking for entries with the higher oil content. We finally settled on five selections which we are now using in a cross breeding program," Price said.

Genetic improvement of protein quality is also part of the project.

"Quality, as well as quantity, of the barley protein affects market value," Price explains. "As total protein content goes up, less digestible classes of protein predominate—the same classes that are insoluble in the malting process. These proteins benefit neither livestock nor the malting industry.

"The quality of the protein is determined by its amino acid constitution. Amino acids are the building blocks in proteins as bricks are in a brick wall. If there are too few bricks (amino acids) of one type, there is a poor balance and the nutritional quality is reduced."

Price is trying to increase lysine, one of the three amino acids that is deficient, yet necessary to meet daily livestock nutrition requirements.

"Several years ago Swedish breeders found a high lysine barley in the USDA World Collection of barleys, but the high lysine character was genetically linked with the

shrunken endosperm character that lowers yields," Price said. "I have been able to get 4.5% lysine from a Danish mutant and we are trying to incorporate this into Primus II."

Our needs in barley research are unique; other states can't help

Winter barley, adapted to the feed-short southwestern part of the state, is another objective of research at SDSU.

With no known single source of hardiness in barley, it is an elusive goal. Testing began when Price first arrived in Brookings, but breeding didn't begin until funds became available in 1968 for seed increase work in Arizona.

Winter hardiness requires a combination of many characteristics.

"We are trying to put together selections from around the world. Progress has to be made in small increments of hardiness," Price explains.

"We look for narrow leaves and a growth habit that is procumbent—that is, the plant grows low to the ground when planted in the fall."

"If there is a warm period in February, winter barley has a bad habit of starting precocious growth, jumping the gun on the calendar, you might say. The roots and crown take up moisture as the soil warms up. Then comes a hard freeze and the crown dies.

"Winter rye and wheat don't respond to that warm-up, normally. They appear to be more day-length sensitive than winter barley. What we need is a winter barley with a different hormonal system that won't be triggered by that warm-up."

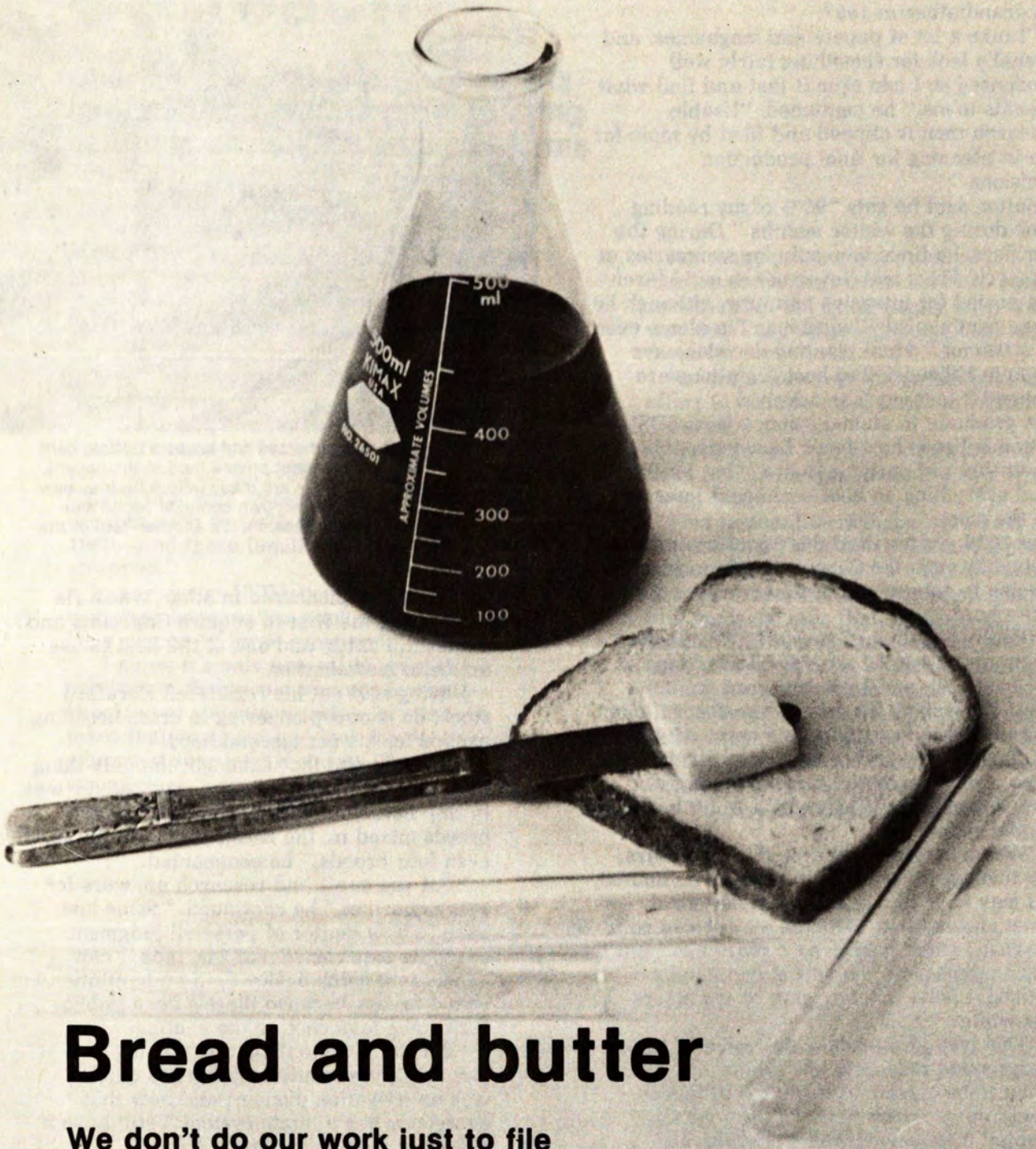
Some of the winter composites have up to 40 parents. This is necessary in order to accumulate the hardiness attributes needed to ensure winter survival.

Barleys from Russia, Japan, Turkey, Germany, England, Sweden—any place where the winters would suggest that they have a chance to survive moderate stress—have contributed to the gene pool.

It's a research package tailored to our unique and varied needs. Minnesota concentrates breeding efforts on six-row spring barley and, along with North Dakota, on the malting barley profits to be had in the Red River Valley. Nebraska's limited breeding of winter barley is aimed at the southern part of that state.

There is cooperation in feed barley testing between midwestern states in the form of the Great Plains Barley Nursery. But there is little overlap in barley breeding objectives. The best varieties for South Dakota's production needs will have to be developed in South Dakota. □

The writer is Susan Kirkvold-Ivey, assistant information specialist in the Ag Information Office.



Bread and butter

We don't do our work just to file and forget. Here's a man who clips, collects, and then uses research

John E. "Matt" Sutton, Jr., 49, is a man who uses research like a tool.

It undergirds his 4600-acre ranching, farming, and commercial cattle operation near Sutton Bay on the Missouri River west of Agar, showing what can be done in a "bread and butter" sense once research is put into the hands of a capable, thinking, modern agriculturist.

"I glean all the research I can and look for something that I think fits my operation, something I haven't tried before," says

Sutton, who farms and ranches land which is part of the original Sutton spread founded by his grandfather in 1897.

"I take a lot of papers and magazines, and I usually look for something fairly well condensed so I can skim it fast and find what appeals to me," he continued. "Usable research then is clipped and filed by topic for use in planning for final production decisions."

Sutton said he gets "90% of my reading done during the winter months." During the summers, he finds time only for summaries of research. From mid-November to mid-March is a period for intensive planning, although he plans continuously "whenever I'm alone, even on a tractor." Final planting decisions are made in February, but basic rotations are planned 2 to 3 years in advance.

A graduate in animal science from SDSU, Sutton believes he's fairly knowledgeable about the beef cattle industry, "but I still read everything on beef because it interests me the most."

In 1978, Sutton used the Agnet computer system through the Cooperative Extension Service to determine least-cost rations for his cattle herd.

"Really beneficial," he said. "We devised a ration to use what I already had for feed at the least cost, and I got real good gains. What I'm looking for now is the most efficient way to feed oats, alfalfa, and corn. After reading the research, I've concluded these three provide everything cattle need. Even now, if everything goes right, I won't buy any protein supplement.

"We've had two bad droughts in 5 years, and this year my alfalfa is going to be limited, so I may have to buy some soybean meal. Agnet showed that Triticale was priced so low that I could feed it, so 2 years ago I fed it in my supplement and was exceptionally pleased. I got 3 lb a day gain on my steers that winter.

"This just goes to show the value of ration analysis and research," he added.

Just to be certain of results, Sutton also checks on research payback after he's adapted it to his operation. One way of evaluation is test-weighing cattle on his own scales—a practice he's employed for the past 17 years.

Conventions, fairs, exhibits, field days, and tours are excellent settings for current research to spread out to users, Sutton believes. "They motivate you more to try new things. I attended the first sunflower tour and the first irrigation tour in our area, and I had the second irrigation system on the lake (Oahe) and had sunflowers the second year they were in this country."

Matt Sutton raises quarterhorses and keeps a buffalo herd (started in 1909, it is the oldest private herd in the nation). Some hard-headed decisions are made before he tries new ideas—decisions based on his own common sense and research. "I keep up with research; it's another 'tool of the trade.' "

Sutton also pioneered in other areas. He was among the first to acquire Charolais and Simmental cattle and one of the first to use artificial insemination.

Having sold out his registered Hereford stock, he is now pioneering in cross-breeding exotics for his commercial herd.

"It used to be that I thought the only thing to do with a black whiteface cross heifer was to ship her. Now, it seems like the more breeds mixed in, the better the cow—three, even four breeds," he commented.

"But you can't find research answers for every question," he continued. "Some just have to be a matter of personal judgment based on experience. For instance, I can experiment much easier than an institution in mixed breeds because there's been public resistance to accepting the exotic.

"But there's one thing about being a pioneer. You sometimes get in too quick. I was an irrigation pioneer, and now that everybody has a circle system, I still have a 100-acre tow-line system.

"But it's kind of hard to justify spending $40,000 just so I don't have to get my feet muddy."

How would he advise a young rancher interested in building research into his own operation? "In most cases, I'd send him first to his county Extension agent," Sutton answered.

"Also, I'd say, 'Ask me!' " □

The writer is Larry Tennyson, information specialist in the Ag Information Office.

Outreach

Charles Mix won slot in 16-county nationwide 'pilot' program to bring self help assistance to small farms

"While the number of large commercial farms in the state has been increasing, we still have at least two thirds of the farms in South Dakota that fit the national definition of a small family farm," says Laurel Howe, former CRD program leader, Cooperative Extension Service.

"The small farm family is particularly hard pressed because of low commodity prices in relation to ever increasing costs of operation. Couple that with interspersed years of drought such as 1976 and now again in 1980—and these families are really strapped."

In past years USDA programs have been criticized because too much emphasis has been placed on large commercial farms.

"I guess it's only natural to provide services to the people who are always knocking at your door asking for them. It takes time to go out and look for the people who need your help the most. The large commercial farmers tend to be more aggressive," Howe said.

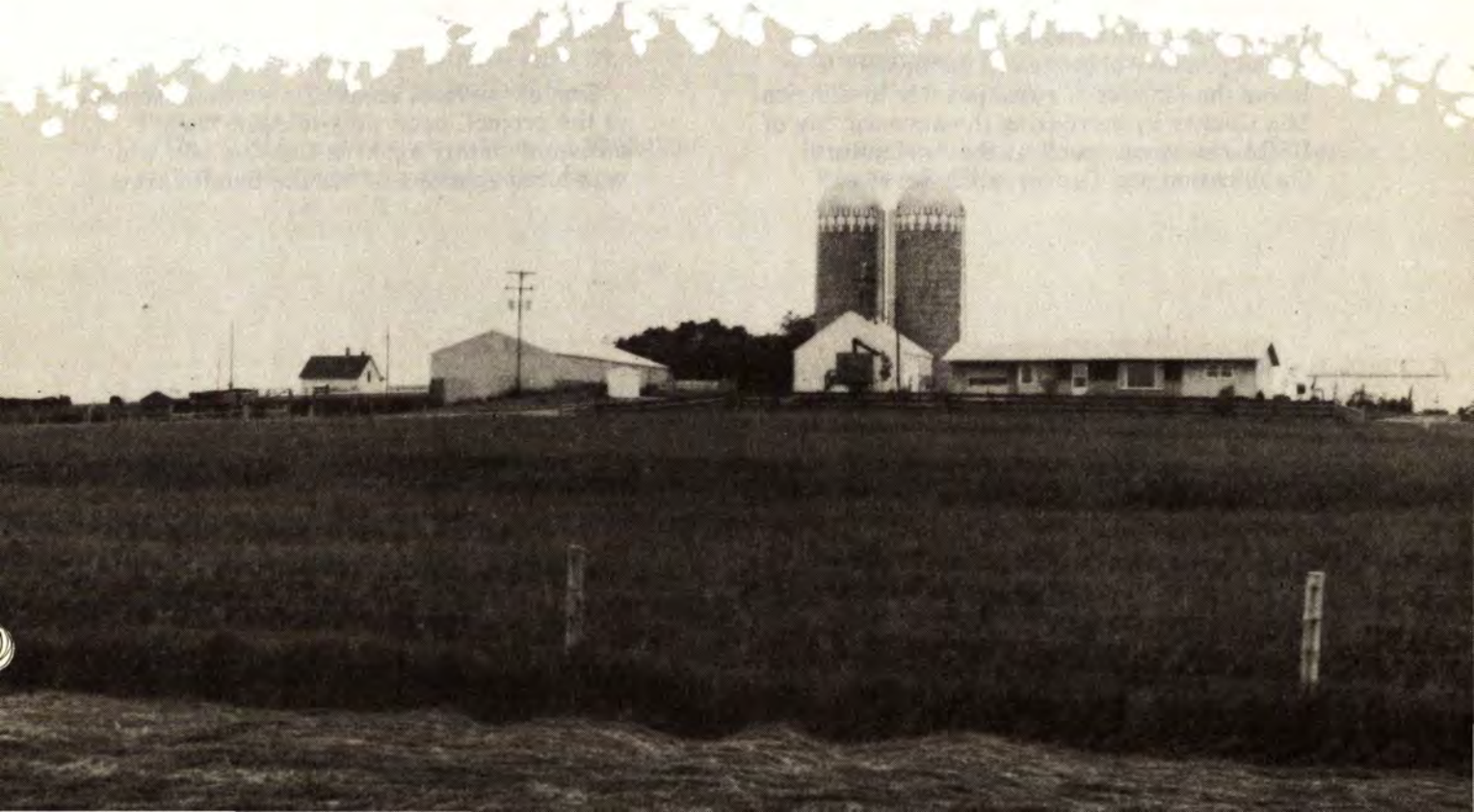
For many years the attitude of policy makers and some researchers has seemed to indicate that the small family farm is on its way out. Very little was being done to slow down its departure.

Recently, however, there has been a larger effort to include small farms in research and assistance projects.

"A renewed outreach effort toward small farm families began about 3 years ago," Howe said.

Five regional workshops were held around the country. "Nine or 10 South Dakota small farm families attended a 3-day workshop in Oregon. One of the most common complaints that surfaced was that too many of the current USDA programs were of greater benefit to large farm operators than to small farm operators," Howe said.

The South Dakota Small Farms Program Committee, which was formed in 1978, drafted proposals for three different small farms assistance projects. The Charles Mix County project was one of 16 county projects



nationwide that was designated by the federal government as a pilot program.

Plan is to hone management skills and ease access to USDA resources

The project is aimed at helping small farm operators and their families increase their farm management skills.

Charles Mix County, which is located in the south-central portion of South Dakota, has a population of 9,994 (1970 census); 32% of the people live below the federal poverty level. This is more than double the national average and nearly double the state average.

The county has 1,088 farms, approximately 600 of which would be defined as small farms.

Because of the high percentage of low resource families, Charles Mix was selected as a target county for the Small Farms Assistance Program.

An advisory committee was formed soon after it was known the Charles Mix proposal had been accepted. The committee consists of five area farmers—Gary Anderson, Arnold Horner, Richard Slaba, Jack Soulek, and Dean Weber—who have volunteered their time and efforts to help advise the federal, state, and local agencies on the needs of small farmers.

"The farmers in the program were selected on the basis of answers to a questionnaire that was sent out to approximately 250 prospective participants," Howe said.

The advisory committee reviewed all the questionnaires and divided them into low, medium, and high priority groups. Approximately 50 applications were placed in the high priority category.

The primary objective of the project is to lower the amount of rural poverty in Charles Mix County by increasing the accessibility of USDA resources, such as the Agricultural Stabilization and Conservation Service (ASCS), the Cooperative Extension Service (CES), the Farmers Home Administration (FmHA), and the Soil Conservation Service (SCS).

The biggest benefit of the Charles Mix program may be that farmers are now aware of what kinds of assistance—from information to long-term planning and loans—are available. Farmers and agencies also have a better understanding of each other's problems.

"It's an intensification of already existing programs," said Allen Husby, FmHA county supervisor.

Farm visits and classes have paid off, resource use is up

One of the most important accomplishments of the project, according to Alan May, assistant county agent in Charles Mix who was hired specifically for the Small Farms

Alan May's special duties as assistant county agent in Charles Mix are with the Small Farms Assistance Project. He visits farmers to tell them about the program, helps with on-the-spot planning, and conducts farm management classes.

Assistance Project, is increased awareness of USDA services that are available.

May visits farms to explain the programs and available assistance and conducts farm management classes.

These classes, which involve 12 to 15 hours of classroom instruction, were set up to help participants with farm management decision making.

Crop plans are analyzed to determine cost per acre. Livestock budgets are scrutinized to find cost per head. Direct and hidden costs are considered.

"The class gives the farmers an idea of where they're at," May said.

There has been a marked increase in the use of USDA services.

The ASCS has reported that $75,000 in additional ACP funds were allocated to the county specifically for the project. The county has also received approval for a 90% cost-share rate for program participants. The usual cost-share rate in Charles Mix is approximately 75%.

The FmHA provided an additional $500,000 in loan authority to the project for farm ownership loans. Loan activity in the county has increased substantially since the project began.

As of June 26, 22 farm ownership loans had been processed, compared to a statewide average of nine per county. Seventeen operating loans had been made, compared to a statewide average of 10 per county. Most of this increase came as a result of loans to project participants.

A new soil conservationist position was added to the SCS field office staff especially for the small farms project. Assistance is being provided for conservation planning and for application of a number of conservation measures. SCS is encouraging farmers to participate in long-term conservation planning with financial assistance through the Great Plains Conservation Program.

There's a closer tie between local agencies and farmers now

"Although the program did not fulfill all our expectations on increased funding, it did do several things," Arnold Rieckman, county Extension agent, said in a written report.

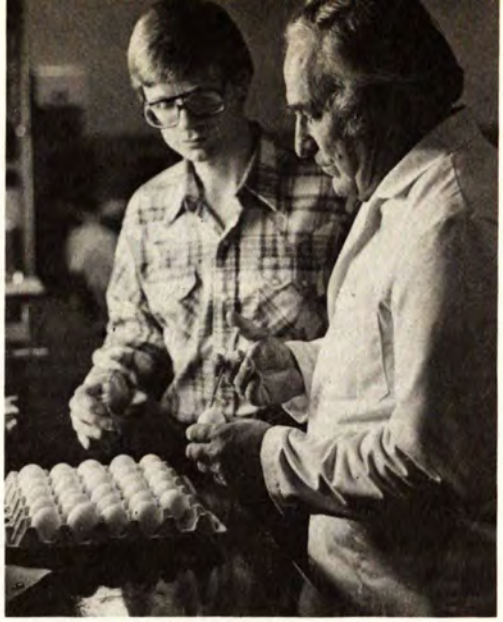
"It made the people of Charles Mix County more aware of the functions of the various USDA agencies and the type of assistance available. And it provided a closer tie between personnel of the local USDA agencies. We now have a closer working relationship and a better understanding of each other's problems and work," he said.

"We plan to conduct several farm management classes this fall and winter and provide additional assistance in commodity futures, cash flow, farm accounting, and enterprise analysis," he added. □

The writer is Michelle Solberg, journalism intern in the Ag Information Office.

A day's work

If it's crammed with conferences and classes, 'catching up,' too little time, coffee grown cold—it's just a usual day



Scientist, educator, adviser, spokesman— a researcher's time isn't entirely spent in the lab. His many duties keep him in touch with your problems, the problems of South Dakota agriculture.

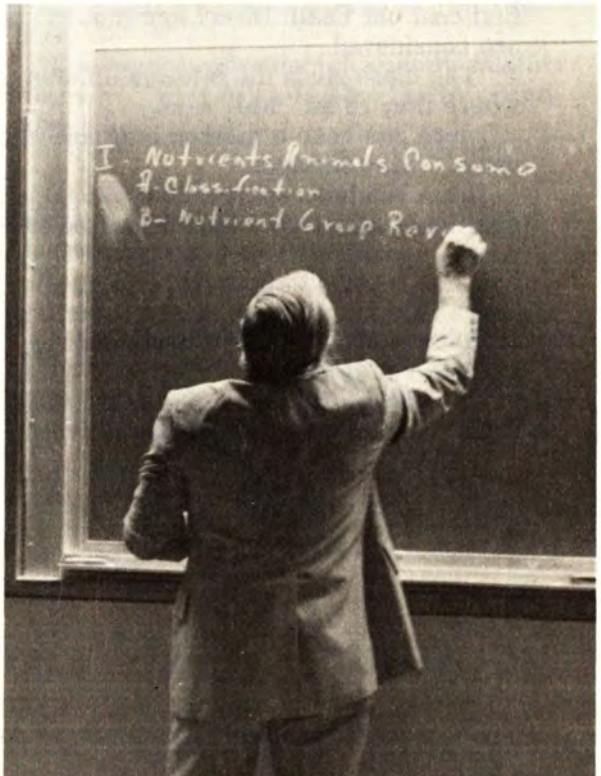
The typical Experiment Station research scientist must devote time to preparing for and teaching classes, work with students as a faculty adviser, and answer dozens of telephone calls and stacks of mail each day. He must keep up with research at other universities and arrange for his own research results to be published in scientific journals and Experiment Station publications.

All this is in addition to developing, initiating, executing, and evaluating research projects that will meet important needs of South Dakotans. Some solutions are found within one year; some solutions won't be discovered in a lifetime.

Researchers like Les Kamstra, a specialist in ruminant nutrition, don't handle all this alone. The secretarial staff, graduate students, technicians, work study students, and colleagues both at SDSU and across the country form the network that helps to find the answers.

They are attentive to your needs. It's a service—it's a necessity.

The photographer is Duane Hanson, graphic designer in the Ag Information Office.




1989 KOREA

'A great combination'

His definition of a good life is the one he's enjoying—rewarding work with both grasses and his students

Three varieties of grass—Retain, Cottonwood, and Rebound—have been released by the Experiment Station in the last 2 years.

Ask Jim Ross, SDSU grass breeder since 1947, how we got to this point in grass research, and he'll bring out his world maps. He'll tell you of Cossacks, those famous horsemen of Russia, and of railroads luring

settlers onto the plains. Part of their package of promises was free grass seed.

The very names of some of the Station's (and Ross's) past releases—Oahe is the most famous—reflect South Dakota's more recent past. And then there's Summer, a grass that was meant to carry pastures through summer grazing. It was "lost."

Retain, out of Garrison, has Eastern caravans in ancestry

"There was one particular grass growing in the Erzurum Valley of Turkey along the Euphrates River, about 100 miles from the Russian border," Ross begins. "The grass was brought by caravan to the Black Sea, then taken to the Crimean area.

"At the time the Hutterites were escaping persecution in the late 1800's, some of the grass—creeping foxtail—found its way to North Dakota.

"It was discovered by some Soil Conservation people near the Garrison Dam. They saw it had characteristics good for flooded areas and collected samples. It was released as Garrison creeping foxtail in 1960."

From this variety Ross developed Retain which was released this spring.

It does not shatter its seed immediately when it matures as Garrison does, so you can leave Retain until it has ripened, harvest with a sickle bar combine, and still get high yields.

Certified seed will be available from the 1981 or 1982 harvest.

Cottonwood, of mixed parents, recalls state's early history

In 1968 Ross redirected grass research toward extending the growing season of cool-season grasses—those grasses that normally are dormant in July and August. Cool-season grasses are more easily established than the warm-season grasses native to South Dakota.

The efforts of 12 years of selective breeding brought us two varieties of bromegrass this year—Cottonwood and Rebound.

"Smooth bromegrass was grown in South Dakota by 1890. The railroads supported its introduction—just gave it to the farmers. They knew they would profit from increased production along the lines," Ross said.

"On a hillside near Cottonwood in 1968, Bob Gartner, a range researcher at Rapid City, found patches of bromegrass that had been there longer than anyone could remember. We found a 60 by 90-foot patch on this hill where the seed production was extremely high.

"We collected vegetative pieces, put them in a replicated trial at Brookings, and watched for outstanding characteristics that would make a new variety. We crossed these plants with those from other patches so the drought resistance would be preserved.

"The result was Cottonwood, released last fall. It wasn't meant to replace native grasses, but to give cover to areas in western South Dakota that should never have been plowed.

"Smooth bromegrass is from Russia, Hungary, and eastern Europe, but there is a native species. It is debatable whether the selections we made at Cottonwood were smooth or native; we don't know which."

Certified seed of Cottonwood bromegrass will be available in 1981 or 1982.

Rebound bromegrass has the lengthened growing season farmers have been looking for.

This new variety does not go dormant in the hot summer months. So, when moisture is available, Rebound can use it.

The same characteristics that give quick growth and high digestibility can cause lodging as the plants mature. This is not a problem because the grass is used for pasture production, Ross says.

Certified seed was available in the 1980 growing season.

His Oahe has outclassed all other intermediate wheatgrasses

The grass Ross is perhaps best known for is Oahe intermediate wheatgrass. It evolved from Ree, a variety developed by Cliff Franzke, that was released just before Ross arrived at SDSU 33 years ago.

"It was an excellent grass," Ross said, "but didn't have the seed production that enabled a farmer to use it to the extent that its forage production warranted. So I selected for both high forage and seed production and released Oahe intermediate wheatgrass in 1962.

"It has been successful in south central South Dakota, the chief seed growing area for intermediate wheatgrass. Seed from here goes throughout the western states."

In fact, the name Oahe has become synonymous with intermediate wheatgrass throughout the northwestern United States.

Very little is certified seed, according to Ross. "But probably 99% of the seed sold as

Oahe actually is Oahe. Its seed production is so high that other varieties can't compete."

The procedure for releasing new grass varieties when Oahe came out caused problems.

A new variety would be released to the Foundation Seed Stock Division, which increased the seed to sell to seed producers through the South Dakota Crop Improvement Association.

This worked well for small grain varieties. Both farmers who increased the seed and those who ultimately purchased the new varieties were accustomed to working with these crops.

But many forage grasses have smaller seeds; a farmer used to hefting sacks of corn is surprised at the tiny amount of grass seeds he receives. And planting and harvesting equipment must be specialized. Consequently, grass seed production ties up a sizable amount of capital.

"So the farmer who put in 2 or 3 acres as a sideline to his regular operations would never harvest it. We've lost some forage grasses in the past because they never made it down the line to pasture use."

Grass seed from new varieties is now released from the Foundation Seed Stock Division to seed companies who pay the Experiment Station for each bushel they then produce. The companies accept responsibility for increasing and marketing the variety.

"The main objective is to get a new variety into the hands of farmers. It takes a lot of care to do this," Ross said.

Summer, a switchgrass released in 1965, was essentially lost to South Dakotans, according to Ross.

"It was a warm-season grass designed for summer pasture that never got off the ground. It wasn't merchandised.

"When pioneers came to this land, eastern South Dakota was covered with warm-season grasses—big bluestem, Indiangrass, and switchgrass. They don't have the agronomic characteristics that make them easily handled. They don't produce enough seed and are difficult to get established in the spring. Then they must be properly managed, because if they are grazed down to the ground, there isn't enough root reserve for them to survive through the winter."

The students are the best part of a rewarding research career

The current research has two major goals—regrassing areas of western South Dakota and enhancing summer pastures in eastern South Dakota.

A new variety of switchgrass is one warm-season grass nearing release. Ross can't pinpoint the time because that depends on this year's data.

"This switchgrass has large seed that makes it more easily established," Ross said. Normally switchgrass can take 2 to 3 years to get established. The large seeds will shorten this time.

Ross has been cooperating recently with Dr. C.H. Chen of the Biology Department in tissue culture work, a development that could speed release.

"Tissue culture would be a quick method of increase. But it is still in the formative stages. It takes some time to determine the necessary environmental conditions to induce the plantlets from the tissue culture of different species," Ross said.

"We are also selecting and testing big bluestem and Indiangrass. We are making progress.

"There are no totally successful native grasses for pasture even yet. But for a pasture program that will produce all through the season, we need grasses that will grow in the cool months and those that will grow in the heat of the summer."

Jim Ross's work with grass breeding has put him in a variety of challenging situations—a year in Sweden studying cytogenetics under a Guggenheim Fellowship in 1958; 2 years as a visiting professor at the University in Erzurum, Turkey; 10 years of intensive study of colchicine, a chemical that causes mutations which can be incorporated into new varieties.

But his favorite work is with students. He had the first PhD candidate in the Plant Science Department. He has advised 12 students earning MS degrees and 12 students earning PhD degrees—more than any other teacher at SDSU.

"My favorite part of the job is probably working with students—helping them with their research. They need encouragement and understanding. Graduate work is pretty rough and demands a great deal from a person. It also demands discipline. You must know when to encourage and when they should adopt their own self-discipline."

Ross grew up on a farm and enjoyed a lot of independence—independence he says he has in his work here.

"I enjoy my work—serving South Dakota and the field of science. That's a great combination. Just about all I could ask for." □

The writer is Susan Kirkvold-Ivey, assistant information specialist in the Ag Information Office.

IPM

No piecemeal campaign, this all-out war plan employs 'scouts,' cultural, chemical, and biological weapons

Walking, walking, and more walking.

That's what a scout finds to be his lot in life in the Integrated Pest Management Program.

A college student employed for the summer walks a cornfield once a week, he finds an infestation of corn borer, he reports it to the farm operator, the operator asks the county agent what to do, and the farmer treats for the corn borer.

This is one way Integrated Pest Management (IPM), a newcomer to South Dakota, is working in this state.

Sixty-six farmers in six counties are cooperating with IPM, sponsored by the Cooperative Extension Service and USDA. Early identification of threatening economic infestations of insects, weeds, or diseases is accomplished by having paid scouts out in the fields and reporting to farmers on a regular basis.

The goal of the pilot program is a little more lofty, however, than simply saving farmers money by catching insects early.

The goal is to manage the pest by whatever technique is feasible, including chemical, biological, and cultural control, and in the long run to use less pesticide and more management to get at a pest problem.

It's an "early warning system" that heads off pest buildup

So far, IPM in South Dakota has amounted to a lot of walking and a lot of reporting. A scout may walk as much as 8 miles a day through fields of corn, soybeans, sunflowers, or wheat, looking for insects, weeds, and diseases. At the end of the day he turns in a report in triplicate, one copy to the farmer, one to the county agent, and one to the coordinator of IPM.

Scouts, the heart of IPM, are mostly students on summer vacation. One is a small farmer and college graduate, one is a retired farmer.

They get a one-day training session at the beginning of the summer with Extension specialists on the SDSU campus. From there they must learn to identify pests from the literature they're given, the local county Extension agent, their own experiences, and from coaching.

Coach of the scouts is Floyd Wiedmeier of Brookings, a faculty member at SDSU and coordinator of IPM. He was a county agent for 30 years in Pennington, Bennett, and Fall River counties.

Wiedmeier said one thing that attracted him to the program was something that happened repeatedly when he was an agent. A farmer would come in and ask him to go out and look at an insect problem. But by then the problem was already out of hand and the farmer had serious economic damage or had already lost the entire field.

That's not the case for alert IPM cooperators.

Wiedmeier quotes one farmer as saying, "One thing IPM did for me: For the first time I sprayed my weeds at the right time, not too early, not too late."

High-investment crops are best candidates for IPM

IPM and Extension's involvement in this system began in 1971 for the control of insects on tobacco in North Carolina and on cotton in Arizona. One South Dakota county (McPherson) cooperated in a pilot program with North Dakota on wild oats during the 1977 crop year.

South Dakota Extension began planning its own pilot program in 1978, and work started during the 1979 crop year.

The pilot started with Brown, McPherson, and Walworth counties. In 1980 Turner, Union, and Hand were added. Each county has one scout hired by the Extension Service and 10 to 12 farmers in the program.

Cooperators in the first three counties are paying a slight fee in their second year, in an attempt to wean them from Extension's leadership and induce them to undertake the program themselves. First-year counties generally pay no fee.

David Plooster, an IPM scout from Parker, gives an insect and disease scouting report to farmer cooperator Jim Davis of Parker. Regular reports like this let Davis catch problems before they get out of hand.

"We're working toward a private or grower organization type of IPM. We're trying to get it started and help farmers make the decision about how much they can pay for the service," said Wiedmeier.

He predicts that soon there will be permanent IPM in certain parts of the state under certain cropping patterns. "Sunflowers may be a crop that will respond to IPM. And irrigated corn. I think it would have value in alfalfa seed production.

"IPM will be useful in the higher investment crops."

South Dakota already has at least one private consulting firm, Ag Tech in Pierre, working with fertility and water management plus pests with irrigators up and down the Missouri River.

In just about all north-central states Extension Service works with cooperatives or private firms, helping train scouts and using the expertise of the Extension Service to further the program.

IPM gives farmers a choice of weapons to combat pest problems

The ultimate goal, says Wiedmeier, "is not just to identify the pests for control, but to enable farmers to use information gathered by the scouts throughout the season to make decisions for future cropping, varietal changes, rotations, and type of land preparation that may help them cope with the pest problem. It is not just chemical, but biological, cultural, and mechanical control we're after."

Wiedmeier compares South Dakota with the fruit growing country of the west and south.

Those fruit growers in the past years have had regular schedules of spraying for pest problems. But now they can recognize when a pest system is starting to build. They can reduce the number of times they have to spray.

In South Dakota most of the crops that require spraying need it only once or twice a season, so this region's reduction in chemicals occurs by getting the pest problem identified earlier and having to spray less acres and use less chemicals per acre, said Wiedmeier.

"I know there are people who do chemical control of pests automatically because it is the season. They did it last year and will do it next year.

"But you have to look at the cost as well as the environmental impact. If we overuse chemicals we may lose them more quickly to environmental pressure groups."

South Dakota's IPM has not yet expanded into animal pest control. IPM scouts in Nebraska check flies in feedlots. Some states even have programs in cities to check lawn and garden pests and for mosquito control, Wiedmeier said.

IPM's pilot program is administered by the Extension Service (Leon Wrage, weed specialist, Ben Kantack, entomologist, Leon Wood, plant pathologist, Hollis Hall, director, and Lloyd Hansen, ANR program leader) with assistance from an advisory committee made up of cooperators from each county, the Animal and Plant Health Inspection Service of USDA, the SD Department of Agriculture, and USDA insect lab personnel.

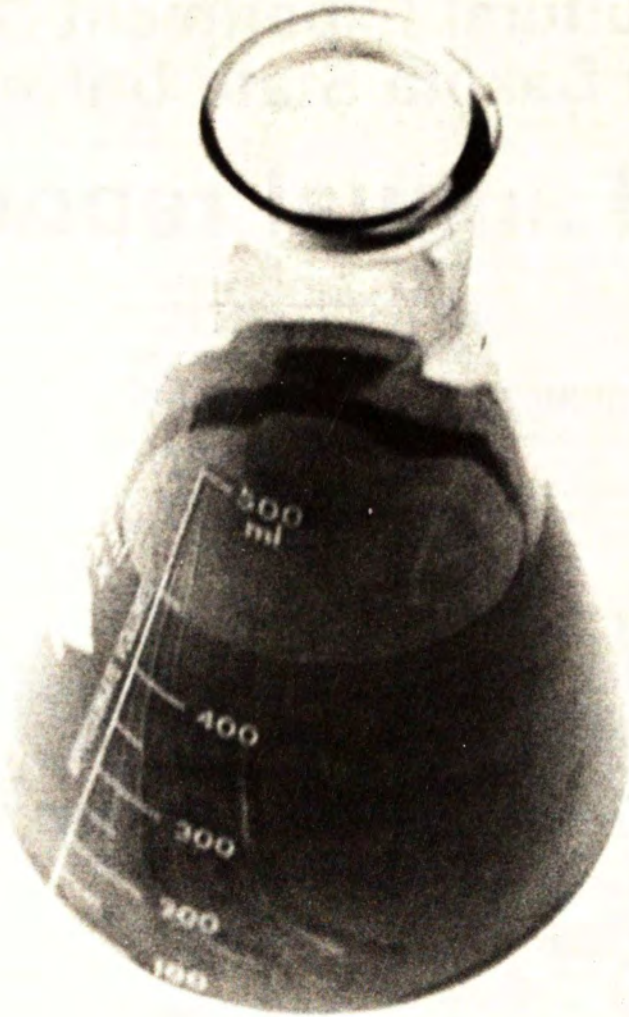
Wiedmeier said the intent of this pilot study, as well as of those in 49 other states and two U.S. possessions, is to learn what crops and livestock areas can benefit from the IPM system, which of these areas can profit economically, and whether the program can be done commercially as a business venture. The program will also settle the question of whether Extension needs to continue training operators themselves to do a more complete job of monitoring.

IPM has changed things for its cooperators.

Spraying used to be the best or only answer to pest problems. And it was often done by the calendar, or when the weeds overtopped the crop or plants were lodged or sickly. Then it was often too late.

But cooperators have a weekly progress report in hand to consult. They can chart the pest's moves, get at it early, and maybe not spray at all. The tools they have to combat pests have expanded to a total management program, and that's good farm business. □

The writer is Jerry Leslie, information specialist, Ag Information Office.



93rd annual report

Agricultural Experiment Station
South Dakota State University

93rd annual report

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R.A. Kohl, PhD, Associate Professor
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A.O. Lunden, PhD, Associate Professor
D.D. Malo, PhD, Assistant Professor
B. McDaniel, PhD, Professor
C.J. Mankin, PhD, Professor
T.J. Martin, BS, Assistant In (R3-80)
G.A. Nelson, BS, Assistant In
J.D. Otta, PhD, Associate Professor (R3-80)
R. Pollmann, MEd, Assistant Professor
P.B. Price, PhD, USDA-C, Professor
J.K. Purdie, BS, Assistant In
D.J. Reeves, PhD, Associate Professor
J.G. Ross, PhD, Professor
D.B. Shank, PhD, Professor
F.E. Shubeck, PhD, Professor
J.D. Smolik, PhD, Assistant Professor
D.K. Steiger, BS, Assistant In
G.R. Sutter, PhD, USDA-C, Associate Professor
C.E. Stymiest, MS, Assistant Professor
J.R. Thysell, MS, USDA-C, Assistant Professor (R9-79)
R.R. Vigil, PhD, Assistant Professor
J.B. Weber, MS, Manager, Foundation Seed Stocks
D.D. Walgenbach, PhD, Associate Professor
D.G. Wells, PhD, Professor
F.C. Westin, PhD, Professor
E.M. White, PhD, Professor
C.W. Wirth, BS, Assistant In
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Rural Sociology

J. Satterlee, PhD, Professor and Head
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R.M. Dimit, PhD, Professor
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G.W. Grant, MA, Instructor
L.A. Hannus, MA, Assistant Professor
D.J. Hess, PhD, Associate Professor
R. Mendelsohn, PhD, Associate Professor
M.P. Riley, PhD, Professor
R.T. Wagner, PhD, Associate Professor

Station Biochemistry

H.G. Hecht, PhD, Professor and Head
R.J. Emerick, PhD, Professor
P.L. Guss, PhD, USDA-C, Associate Professor
A.W. Halverson, PhD, Professor
A.A. Herr, BS, Assistant In
D.C. Hilderbrand, PhD, Associate Professor
D.P. Matthees, PhD, Assistant Professor
T.L. McMahon, BS, Assistant In
L.C. Novotny, BS, Assistant In
O.E. Olson, PhD, Professor Emeritus
I.S. Palmer, PhD, Professor
N. Thiex, MS, Instructor
E.I. Whitehead, MS, Professor

Veterinary Science

M.W. Vorhies, DVM, MS, Professor and Head
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D.A. Benfield, PhD, Assistant Professor
M.E. Bergeland, DVM, PhD, Professor
S.L. Eustis, DVM, MS, Assistant Professor
D. Francis, PhD, Assistant Professor
D.D. Johnson, DVm, PhD, Associate Professor
C.A. Kirkbride, DVM, MS, Associate Professor
T. Langpap, MS, Instructor
J.P. McAdaragh, MS, Associate Professor
M.D. McDonald, DVM, Instructor
D.T. Nelson, DVM, MS, Assistant Professor
H.J. Shave, MS, Assistant Professor
P.L. Steen, MS, Instructor
I. Stotz, MS, Instructor
M. Roller, DVM, PhD, Professor
R. Swanson, DVM, PhD, Professor
T. Toth, DVM, Associate Professor

Wildlife & Fisheries Sciences

C.G. Scalet, PhD, Associate Professor and Head
R.L. Applegate, PhD, USDI-C, Associate Professor
R.S. Benda, PhD, USDI-C, Associate Professor
L.D. Flake, PhD, Associate Professor
R.L. Linder, PhD, USDI-C, Professor
T.C. Modde, PhD, Assistant Professor
J.T. Ratti, PhD, Assistant Professor
F. Schitoskey, PhD, USDI-C, Associate Professor

*date of retirement or resignation

Projects

Administration

National agriculture pesticide impact program, Wood.

Agricultural Engineering

Climate and its impact on agriculture and other renewable resources, Lytle.
Drip (trickle) and sprinkler irrigation of raspberries, DeBoer.
Weather variables and agricultural production, Lytle.
Livestock confinement and environmental control systems, Hellickson.
Equipment for reduced tillage, Chisholm.
Wind energy, Verma.
Irrigation system performance and pumping plant capacity, DeBoer.
Energy utilization in agriculture, Christianson.
Soil-crop-water management techniques, DeBoer.
Energy efficiency in agriculture, Hellickson, Verma.
Infiltration during rainfall on layered soils, Chu, DeBoer.
Forage production systems, Chisholm.

Animal Science

Energy management systems for growing and finishing cattle, Kuhl.
Fatty liver hemorrhagic syndrome, Carlson.
Meat technology, Seideman.
Diet, rumen fermentation, and performance, Embry.
Beef cattle breeding, Dinkel.
Mercury and selenium in poultry, Carlson.
Cellulosic wastes, Kamstra.
Operation research methods (livestock enterprises), Brown, Dinkel.
Control of livestock insects, Kohler.
Nitrogen suplementation for ruminants, Embry.
Mating and management systems for commercial beef production, Miller.
Range improvement, Gartner.
Mineral metabolism, calculi, and buffers, Embry.
Summer range condition and winter supplementation, Lewis.
Poultry meat and egg products, Carlson.
Livestock feed storage, Luther.
Nutrient management of sows, Wahlstrom.
Lamb production, Slyter.
Livestock reproductivity, Slyter.
Fabricated meats, Costello, Seideman.
Dietary stimulants in poultry production, Carlson.
Amino acid requirements of laying hens, Carlson, Nelson.
Protein and amino acid nutrition for swine, Wahlstrom.
Swine management and housing systems, Wahlstrom.
Wintering cows fed according to environmental variations, McCone.
Management of feedlot heifers, Embry.
Enhanced livestock reproduction, Granholm.

Biology

Tissue culture, Chen.
Wheat mosaic virus, McMullen.
Endangered plant species, Holden.
Sediment control dams and water quality, Haertel.
Sarcocystis in big game and livestock, Hugghins.

Dairy Science

Dairy product improvement, Spurgeon.
Dairy product analysis, Parsons.
Comparative feed values, Voelker.
Whey utilization, Schingoethe.
Dairy cattle breeding, Voelker.
Nutrition of high producing cows, Schingoethe.
Large herd management, McGuffey.
Forage nutrition evaluation, McGuffey.
Consumer acceptance of dairy foods, Gilmore.

Economics

Microcomputer technology in farm and ranch accounting, Allen.
Alternative rural freight transportation, storage, and distribution, Lamberton.
Marketing strategies for grain producers, Sogn.
Water for domestic use, Lundeen.
Farm ownership, tenancy, and size problems of family farms, Berry.
Water for agricultural purposes in eastern South Dakota, Shane.
Tax impacts on farmers and ranchers, Kamps.
Management characteristics of low resource farms and ranches, Allen.
Alternative strategies in transportation, Vollmers.
Employment in rural industries, Dobbs.
Guidelines for municipal school organization: Recreation and park systems, Bateman.
Decision frameworks for water allocation and development, Daves.

Home Economics

Microbial flora and quality of beef, Donelly, Quenzer.
Nutrition improvement, Johnson.
Spring wheat and oat cultivars of high nutritive value, Johnson.
Blanket laundering, Sivers.
Absorbent finishes, Hurlocker.
Burn injury, Hurlocker.

Horticulture-Forestry

State trails system, Nordstrom.
Conifers suitable for South Dakota, Baer.
Tomatoes, Prashar.
Fruit varieties and cultural practices, Peterson.
Annuals and woody ornamentals, Klett.
New plants, Peterson.
Vegetables, Prashar.
Trees and shrubs, Collins.
Effect of water quality and nitrogen on cold hardiness, Klett.

Plant Science

Inheritance in relation to freeze survival and yield of winter barley, Kenefick, Whitehead, Lay.
Alfalfa insect management, Walstrom.
Soil testing and fertility, Carson.
Local soil geography, soil interpretations, and land use relationships, Malo.
Superior field corn hybrids, Shank.
Alternative dryland cropping in western South Dakota, Stymiest.
Insects and mites in grasslands, McDaniel.
Foundation Seed Stock Division, Weber.
Seed certification, Pollmann.
Seed testing, Lunden.
Variety testing, Bonnemann.
Survey entomologist, Walgenbach.
Crop and soil management with and without supplemental water, Fine.
Corn insects, Walgenbach.
Blood sucking flies, Easton.
Production systems controlling movement of N,P, and other nutrients, White.
Root disease control with emphasis on biological control in corn and soybeans, Buchenau.
Nematodes associated with field crops, Smolik.
Plant pathogenic bacteria on seeds and propagative materials, Otta.
Winter wheat improvement, Wells.
Cultural practices for improving efficiency and stability of crop production, Shubeck.
Shelterbelt and ornamental tree diseases, Otta.
Plant growth and control, Arnold.
Physiological factors which may limit flax and soybean yield, Dybing, Lay.

Relating soil and landscape characteristics to land use, Westin.
Sunflower management, Kingsley, Walstrom.
Diagnostic services for identifying plant diseases, Mankin.
Breeding cool-season forages, Ross.
Relationship of corn and four annual grasses to WSMV, Gardner.
Flax, Lay, Franks, Mankin.
Oats and rye, Reeves, Mankin.
Spring wheat breeding, Buchenau, Keim.
Soil water holding capacity, Kohl.
Forage management systems for cow-calf production, Vigil, Embry, Shane.
Seed production of insect pollinated legumes, Holborn.
Cellular photosynthetic processes and photosynthesis, Kenefick, Dybing, Lay, Wells.
Evapotranspiration and irrigation scheduling, Evenson.
Reduction of corn losses due to nematodes, Smolik.
Soil factors limiting production from forage plants, White.
Barley improvement, Price.
Superior grasses, Ross.

Rural Sociology

Population change, Wagner.
Career interests and aspirations of Native American youth on reservations, Hess.
Impact of multi-county planning district activities Dimit.
Population redistribution, pre/post 1970, Riley.

Station Biochemistry

Selenium, Olson.
Nutrition and metabolism in livestock, Emerick.
Selenium metabolism, Palmer.
Analytical services, Thiex.
Manganese oxide deposition in water lines, Gehrke.
PCP toxicosis in young pigs, Hilderbrand.
Barley winter survival and yield, Whitehead.

Veterinary Science

Pseudorabies infection, McAdaragh.
Erythorpoietin and nutrients, Swanson.
Ammonia loads in mammalian tissues, Roller.
Bovine abortions, Kirkbride.
Swine enteric disease, Bergeland.

Wildlife-Fisheries Sciences

Small mammal damage, Schitoskey.
Habitat relationships of wood ducks and great blue herons in northern floodplain forests, Flake.
Hungarian partridge in eastern South Dakota, Ratti.
Fish production in farm and ranch waters, Scalet.

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Budget

South Dakota Agricultural Experiment Station
Fiscal Year 1980

Source of Funds	6-30-79	6-30-80
State appropriations (general funds)	3,509,880	3,624,467
Continuing federal appropriations (Hatch and RRF)	1,440,219	1,551,612
Continuing federal appropriations (M/S)	62,325	72,648
Federal grants & contracts (USDA)	339,250	246,471
Federal grants & contracts (not USDA)	97,817	202,420
State agencies grants	132,250	138,327
Private grants & contracts	314,178	214,811
Internal, statewide, and industry services	423,589	495,043
Replacement livestock and feed purchases	924,971	1,171,623
TOTAL	7,244,479	7,717,422
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Net support from General Fund	3,509,880	3,624,467

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