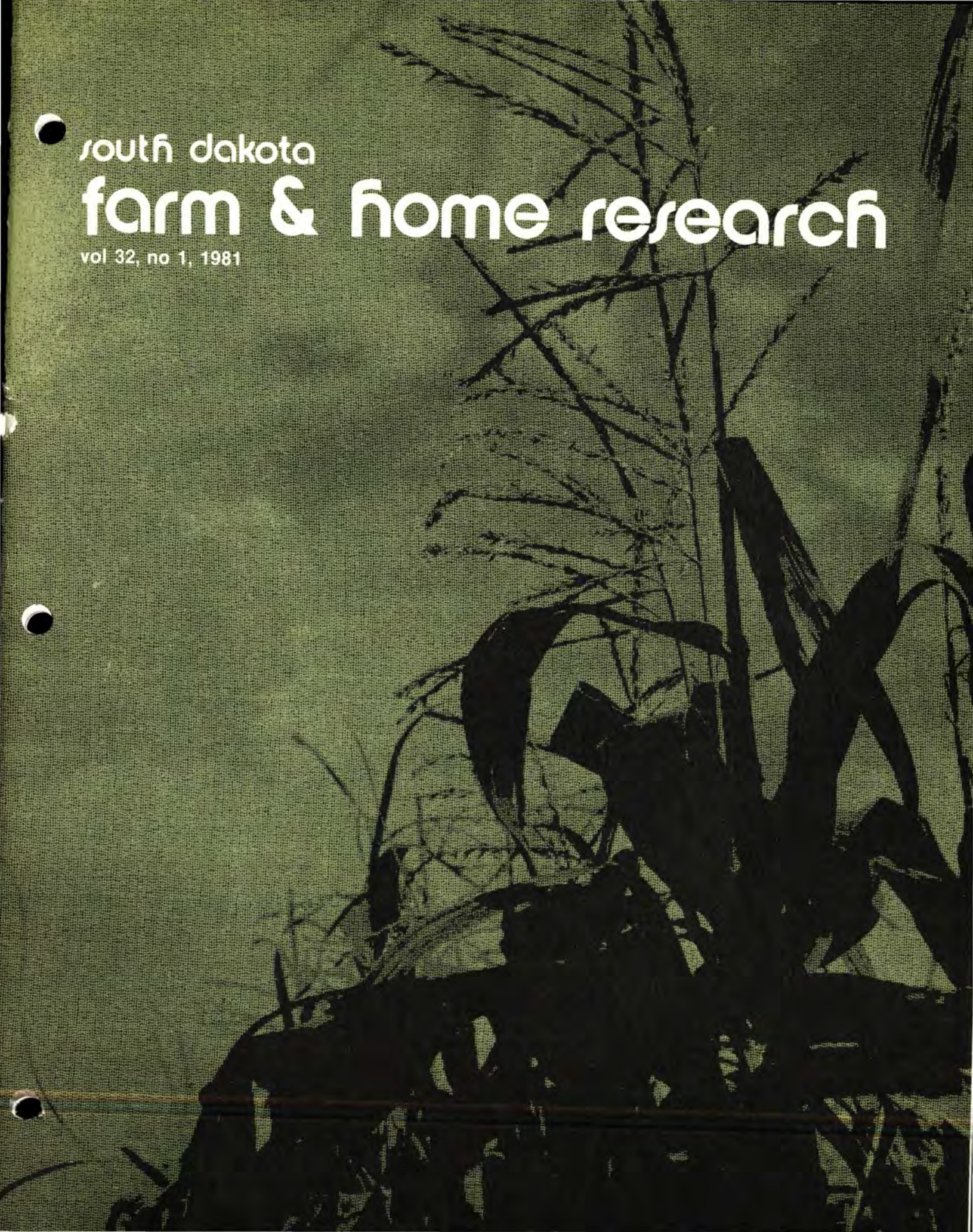
Winter 1981

South Dakota Farm and Home Research

South Dakota State University



south dakota farm & home research

vol 32, no 1, 1981

Publications off the press

The Agricultural Experiment Station and the Cooperative Extension Service distribute a large variety of publications to South Dakota citizens. Your county Extension office has free single copies for you.

These publications list the new subjects off the press between September 1 and December 31, 1980.

FS 757 Selecting Pipe Sizes for Irrigation
FS 766 Wood for the Fireplace or Stove
FS 767 Values
FS 768 Play
EC 734 Fabrics For Today's Consumer
EC 735 Simple Solutions to Sewing Machine Problems
EC 736 South Dakota Range Sites
EC 737 Managing Stress
C 234 Budgets for Major Livestock Enterprises
B 675 Public Impacts of Rural Water Systems

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To simplify terminology, trade names of products or equipment are sometimes used. No endorsements of specific products or equipment named is intended, nor is criticism implied of those not mentioned.

'Money in the bank'

Soil analysis—it's basic. The Soil Lab provides the service for your minimum effort, your maximum profit

You have to spend money to make money.

Putting more fertilizer on your land is like putting money in the bank.

Cliches? Certainly.

Truisms? Maybe. Maybe not.

With fertilizer a major expense when putting in a crop, farmers should base their fertilizer purchase decisions on the facts supplied by a soil analysis. Yet an estimated 80% or more don't, and it's costing them.

Ron Gelderman, manager of the SDSU Soil and Plant Analysis Laboratory, emphasizes the small investment and the high return possible from a soil test.

"Look at the cost of a soil test compared to the possible total fertilizer bill," Gelderman suggests. "A soil test will cost $4 and the sample, if taken commercially, is approximately $25 for a 40-A field. The fertilizer bill for an average crop might come to $12 for nitrogen and $8 for phosphorus per acre or $800 for the entire field. You can see sampling costs are less than 5% of the total bill.

"This small sampling cost can save you an enormous amount of investment. For example, if the test indicated adequate nitrogen, your bill for necessary phosphate might only be $8/A or $320 for the entire field. That's a savings of almost $500.

"On the other hand, just guessing at what you need could cost you in yields. Underestimating nitrogen needs on corn by 20 lb/A could lower production by 15 bu/A or

more. With $3 corn, such a loss would be $1800 for a 40-A field."

The point: a small investment in time for sampling and a few dollars for the sample analysis is well worth the effort.

Program involves more than test tubes and chemicals

A complete soil testing program includes four aspects—sampling, lab analysis, field test data, then the recommendation.

"All of these are vital to any program to produce maximum profit for the South Dakota farmer," Gelderman said. "The sample needs to be representative of the field. The tests—accurate and reliable. The field test data is necessary to coordinate the test with the recommendations."

Experiment Station personnel run extensive field studies to determine how much fertilizer is actually needed for a specific crop, on a specific soil type and with a climate and a tillage method to get a specific yield. And they correlate this information with soil test results, adjusting recommendations to these realities that South Dakota farmers must deal with.

Most soil samples are taken by fertilizer dealers as a part of their service. About 75% of the dealers send these samples to the SDSU lab and the rest go to out-of-state private labs—labs that don't use field data from South Dakota soils.

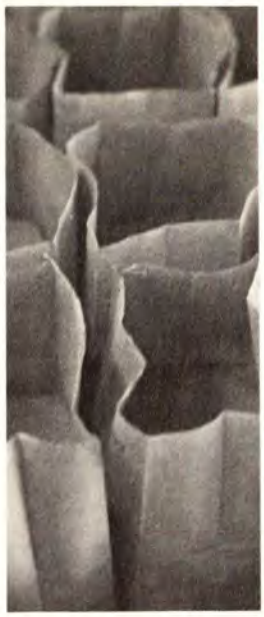
In comparison studies last year on recommendations from private labs and the SDSU lab, Paul Carson, professor of plant science, found costly differences.

Identical soil samples from the agronomy farm at Brookings were sent to four labs with fertilizer recommendations requested for 90-bu corn. The SDSU lab recommended $12.10 of nitrogen per acre. The yield when tested was 100 bu/A. The most costly lab recommendation was for nitrogen, phosphorus, potassium, zinc, sulfur, and lime at $57.75/A. The yield also came to 100 bu/A.

In the second test, identical soil samples from near Gettysburg were sent to four labs requesting recommendations for 200-bushel irrigated corn. The SDSU lab recommended nitrogen, phosphorus, and potassium at $55.50/A; the yield was 196 bu/A. The most costly lab recommendation was for nitrogen, potassium, phosphorus, sulfur, manganese, and boron at $92.40/A; the yield was 184 bu/A.

"Our main service to South Dakota farmers is that soil testing must be based on field calibration research for the most profitable crop response. Excessive plant food recommendations simply reduce profits. Our calibration data, research, and recommendation tables are open to anyone to use, including other labs that operate in South Dakota.

"With computerized recommendations commonly in use, it wouldn't be difficult or costly to program other lab computers for specific South Dakota recommendations."



Between the soldierly ranks of sacks and the entries into the computer in the next photo are an assortment of painstaking treatments and tests. First after drying is grinding (upper right). Nitrate-nitrogen is measured lower left; other samples are filtered prior to a potassium test. Farmers can request separate tests for any nutrient. They should have regular soil analysis at least every 3 years, may want nitrate-nitrogen every year.

Drought can result in high nitrate-nitrogen levels

Two full-time technicians, some part-time personnel, and a secretary process as many as 17,000 soil samples for South Dakota farmers and 5,000 for Experiment Station researchers each year.

Gelderman recommends the regular soil analysis at least every 3 years. But nitrate levels, unlike phosphorus or potassium, can vary widely from year to year. The need for annual nitrate-nitrogen tests is particularly emphasized this year.

"In drought areas we are seeing higher levels of nitrate-nitrogen. Some areas in eastern South Dakota are pretty low, however, because of better growing conditions this past year. There is no way to predict how much nitrogen will be available until we test."

The nitrate-nitrogen test is part of the regular soil test that also includes analysis of organic matter, phosphorus, potassium, pH, soluble salts, and texture.

Phosphorus and nitrate-nitrogen analyses cover two of three elements most likely to be deficient in South Dakota soils. An estimated 10 to 15% of the samples are low in zinc.

Secondary and micronutrient analyses include zinc, iron, manganese, copper, sulfate-sulfur, calcium, and magnesium. These are requested separately.

Plant analysis is useful to determine the cause of problems when a crop is in the active growth stage. The regular plant analysis includes total nitrogen, phosphorus and potassium. The complete test includes total nitrogen, phosphorus, potassium, sulfur, zinc, calcium, magnesium, manganese, and iron. Any test can be requested separately.

For accurate recommendation, the sample is all important

The most crucial step in the process of soil fertility evaluation is getting a representative soil sample. That's basic.

Getting a sample for one area with a hydraulic probe takes about a half hour. "We recommend taking 15 to 20 probes per area. If it's a large enough area to fertilize separately, it's large enough to sample separately," Gelderman said.

"Although the amount that comes into the lab ranges from a couple teaspoons to a 5-gallon bucket, we need about a pint of soil, preferably in a plastic, cloth, or paper container to prevent contamination of the sample from a metal bucket such as zinc or iron."

Each sample should represent a uniform area. Look for variations in texture (sand, silt, clay), color, slope, degree of erosion, drainage, and past management (mowing, fertilizing, or cropping). Avoid or sample separately such areas as dead or back furrows, old straw piles, water ways,

Computer printout has matched field calibrations with test results to program a specific recommendation. You may waste fertilizer money if this match-up of sample and local research data isn't made.

All the research data, sophisticated lab equipment, and exacting methodology won't pay off, Ron Gelderman warns, if the sample wasn't good in the first place. "If it's large enough to fertilize separately it's large enough to sample separately."

terraces, fence rows, fertilized lands, and other unusual spots.

Take 15 to 20 samples to a depth of 6 inches from a uniform area. Mix thoroughly and use about a pint of this mixture for testing.

Nitrate-nitrogen behaves differently in soil, so samples must be taken differently. Since nitrate-nitrogen can move downward as well as upward in the soil, samples must be taken to greater depths in the root zone, at least to a 2-foot depth.

Irrigators may need to take probe samples to 3 or 4 feet, since downward water movement can move nitrates deeper into the root zone where irrigated crops easily reach and use the nitrogen.

A bucket is necessary for each depth increment sampled. Those sampling to 2 feet will need two buckets (0-6 and 7-24 inches); those sampling to 4 feet will need four buckets (0-6, 7-24, 25-36, and 37-48 inches).

You won't need to keep all of the soil from each depth of each probe. It is important to keep a uniform amount from each probe for the final field sample for that depth.

As soon as possible, air dry the sample on paper where no contamination can occur. Heat shouldn't be used for drying because it can break up soil particles, releasing potassium and throwing off the test results.

Air drying is a step some people omit, to their disadvantage. Soil remaining wet for 12 hours or more will cause abnormally high nitrate test levels and nitrogen recommendations will be too low to meet crop needs.

Your county Extension office or the soils lab in Brookings has free soil sampling bags and information sheets necessary for a recommendation.

The information sheet asks the sample's field location, management practices, and cropping history.

It also asks what you plan to plant and the yield you want. You are limited to three variations—any more would create a tremendous stack of paperwork for the lab.

Improvement program works for you and your business

"Hopefully, this winter our recommendations will be available on AGNET, allowing you to plug test results into the computer terminal now at many county Extension offices and get recommendations on more projected crops and yields," Gelderman said.

More information. More accurate information gleaned from studies of the conditions unique to South Dakota farms.

It's a solid base for a management decision. □

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

Cottonwood

Scientists enthusiastic about research with potential to double range carrying capacity

After 73 years, what's happening at Cottonwood Range Field Station?

"Plenty," is the answer.

Any one of several investigations now underway has the potential of doubling the capacity of South Dakota rangeland.

That would be like purchasing twice the rangeland per dollar spent. And, in these times when the cost of rangeland versus its productive capacity in beef cattle or sheep leaves very little margin, the effect could have tremendous economic impact in western South Dakota.

Such an outcome is only "potential" now, but this is what drives researchers like James K. "Tex" Lewis, an associate professor in the Department of Animal Science at SDSU.

Cottonwood Station, located near Highway 14 about 75 miles east of Rapid City, was started on a section of school land provided by the state legislature in 1907. It is one of the oldest "fixtures" in the South Dakota Experiment Station network.

Like the Station itself, Lewis also has given a lot of years to South Dakota agriculture. He's now in his 30th consecutive year of research at Cottonwood.

Lewis explained that the Station was used mostly for work on soils and crops during its first 33 years. Typical research was on soil management, crop variety trials, and crop rotations. After 1940, research began a gradual shift from crops to range and beef cattle.

What made the shift possible was an agreement that year between USDA and SDSU. A parcel of 2,000 acres that had been purchased under Title III of the Bankhead-Jones Act was set over for use by the Station. Most other lands purchased under that act were to become National Grasslands, Lewis explained.

Lewis, an Abilene, Texas, native, arrived on the scene in 1950, fresh from receiving his MS degree at Montana State. Many of the transitional projects were still being conducted at the time.

"Part of the reason for the transition away from plant science at Cottonwood is that when you use a set of plots over and over again, you can't escape some of the previous effects. Another factor was that the same experiments in other areas of the state would be more applicable to more situations," Lewis recalled.

"Range studies, on the other hand, are so long-term, it's better to keep them in a given location."

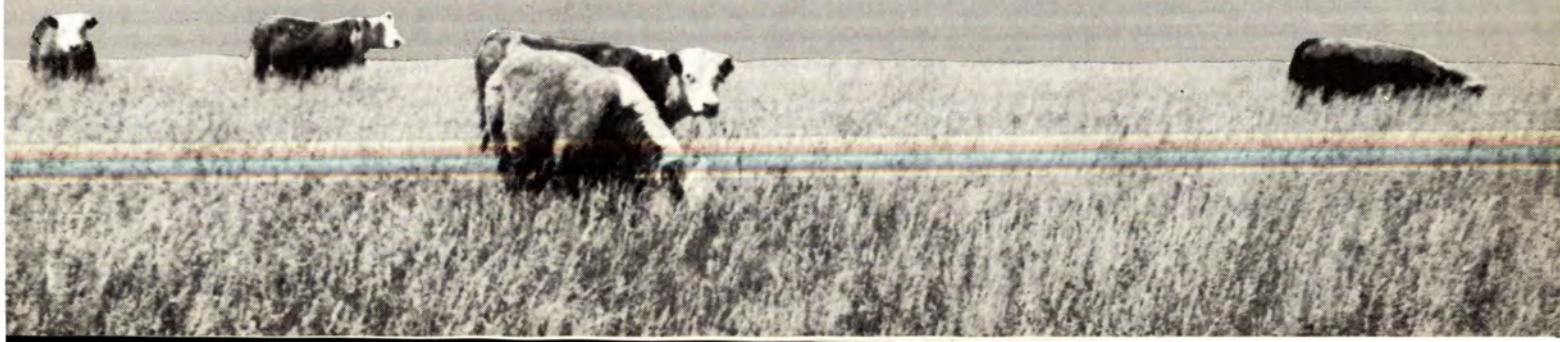
Since the early 1950's, Lewis has worked on several projects. "From 1942 through 1967, we had a study on intensity of grazing on livestock and forage production. These pastures are now being used to study proper utilization of pastures in various range condition classes.

"When I first came here, we began to add various levels of Vitamin A to the winter protein supplement of cows from the intensive grazing studies. That extended through 1958.

"From 1959 and lasting until about 10 years later, we worked with different levels and sources of protein supplementation for wintering steer calves on the range.

"We started our watershed runoff studies in '63, and these are still underway," he continued.

"And about the oldest experimental work there or anywhere around is the weather station that is situated in the yard. That began in 1909 and is one of the relatively few



benchmark stations of the U.S. Weather Bureau. They plan to maintain it and even add new equipment as funds are available."

Underground plant production and consumption more than expected

"But in 1970, we began work that could lead to a real breakthrough," said the senior researcher.

"Then, we became part of the International Biological Program Grassland Biome Project and were one of the comprehensive network sites for that program in 1970, '71, and '72. We collected a lot of data having to do with energy flow in grasslands, and we developed some things that are extremely important.

"We clipped grass samples at 2-week intervals, measuring the amount of biomass production. We also took root samples to measure the production underground.

"We found that a much higher percentage of biomass production was occurring beneath the ground than we'd suspected.

"We then were led into looking at the populations of arthropods and nematodes as consumers of plant growth. Dr. Burruss McDaniel did the arthropod work, and Dr. James Smolik did the nematode work. Both are with the Department of Plant Science at SDSU.

"Here, we got another surprise. We found that consumption of plant growth beneath the ground by nematodes was greater than consumption of plant growth by livestock, insects, and all other consumers above ground.

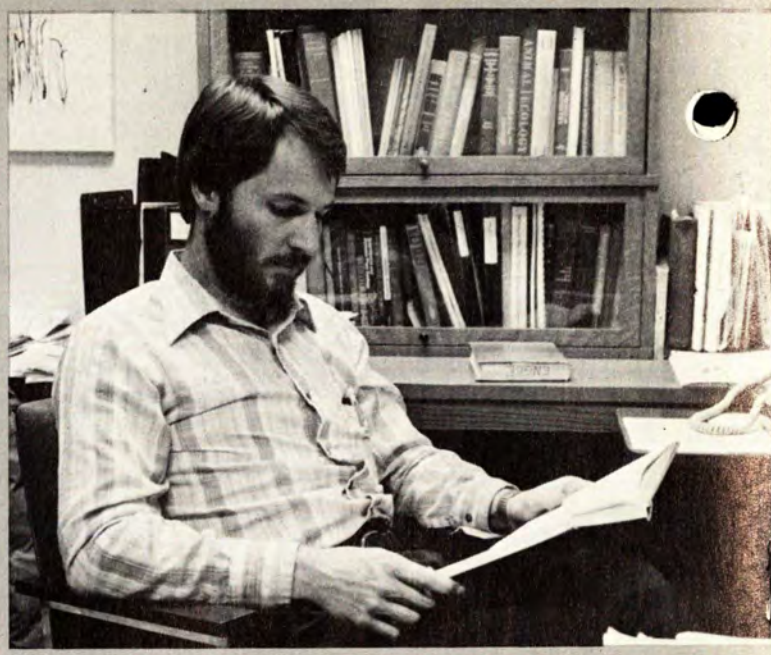
"It also appeared that grasshoppers, except in certain years when they are in plague proportions, have less impact on the range than the sucking insects, which are there at all times."

All this was summarized and presented at the Society of Range Management when it met in Casper, Wyoming, in 1979.

We could double carrying capacity of rangeland

The findings created a whole new set of questions to be answered.

For example, what determines the flow of energy in plant growth? What inhibits it? Can the amount of below-ground growth versus above-ground growth be manipulated? Can grazing management increase plant growth, especially above ground, and make it more nutritious? Can consumption and waste by other herbivores be manipulated so that livestock receive a greater share of plant production? Can below-ground growth not presently being consumed, which now just decomposes, be diverted into livestock production?



Dave Engle, SDSU range scientist, is a co-planner in the Savory system research along with Lewis and Bilger. There has to be a better way to measure energy flow in grassland than with a pair of sheep shears, he thinks (see next story).

The possibilities seem almost endless, Lewis admitted.

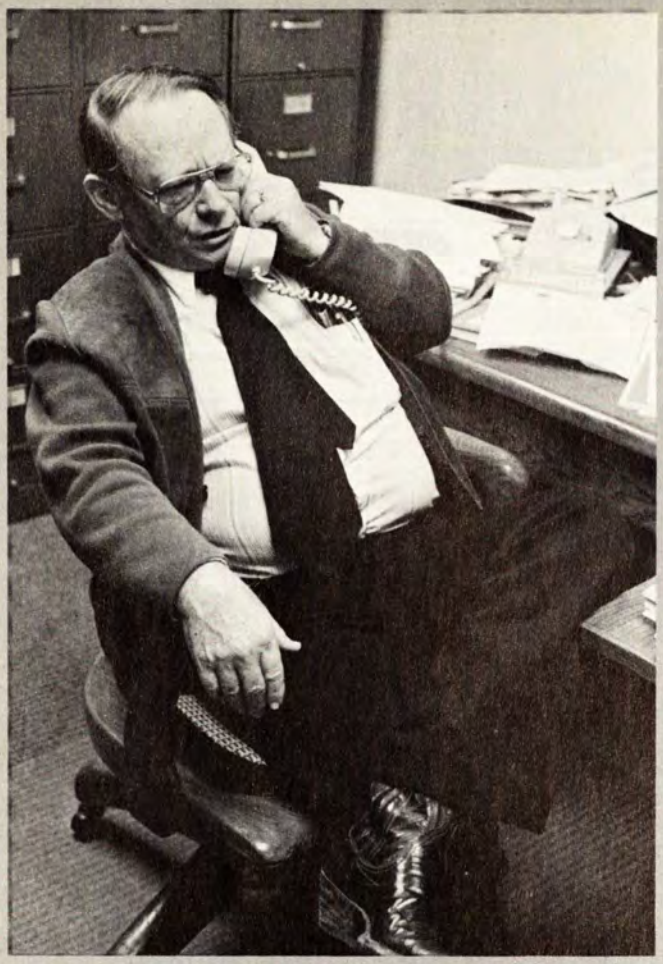
"If funds were available, I'd like most to work out methods of manipulating the energy flow to increase the production of our managed grazing animals.

"Here you have only about 5% of our total plant production in rangeland going to cattle or sheep. About three fourths of it is decomposing below ground and not being consumed by anything. Rabbits, mice, and sucking insects get about 2% of it, but nematodes get a higher share than any other group, including cattle or sheep.

"If we can understand the nature of the system, we should be able to double the amount that is going through our managed grazing animals without damaging the range.

"If we can learn how to manipulate these pathways, we have brought an all new concept to range management.

"Right now, I'd classify the majority of range improvement practices into four major groups. One of these would include practices to increase total plant production. Another would include methods for shifting production from below ground to above ground. A third would include methods for reducing



The team led by "Tex" Lewis has found that more plant growth is eaten by nematodes below ground than by livestock, insects, and all other consumers combined above ground. "Five percent, that's all, of our total plant production gets to cattle or sheep," Tex says.

competing herbivores and a fourth would include making more efficient use of the production.

"But, at this point we don't know what effect many of these practices have on the allocation of primary production above or below ground or the effect of the various competing plant eaters. That's where we need some effort."

One such effort already is underway, others are planned at the prairie outpost.

The current project is a 100-acre Savory system investigation, part of the doctoral work of Lewis Bilger, a SDSU graduate assistant.

Bilger, an East Coast native, received his MS degree in biology at New York University and followed this with 6 years of work in cancer research.

He then joined a team of medical missionaries to work in Swaziland, a southeastern African nation. There he became aware that one of the best ways in which he could help the African people was through improving their ranges and their range livestock production.

Bilger returned to the U.S., looking for a school with both range management and animal science in a single department. This brought him to SDSU and to his present work on the Savory system.

Named for an agricultural consultant from Zimbabwe (formerly Rhodesia), the Savory system essentially is high production, short duration grazing, a variation on rotational deferment in range management. Several ranches had been set up with this system in Angola, Zimbabwe, South Africa, and South America.

Early in 1980 in the Pecos Valley west of Midland, Texas, Lewis had his first opportunity to see a Savory system in action.

"Savory's basic concept is that he has a lot of animals on a small portion of land for a very short time, and that they do not make very heavy use of existing grasses," Lewis explained.

"He does this with a center set of corrals with water and salt, with the pie shaped pastures radiating from them like spokes of a wheel. When animals come in for water and salt, the rancher has an easy time sorting them, working them, and moving them through the corrals and into another pasture.

"Typically, animals remain in a pasture for 1 to 7 days. Pastures can number up to 50, with the optimum somewhere in the 20's, depending on the situation and the vegetation.

"The idea is that you have a very uniform use of small pastures with high animal numbers for a short time. Each pasture is occupied several times during the season.

"Savory says this system improves tillering—or the production of new grass shoots. Some dead material is removed with each grazing and the re-growth is of higher nutritive value. Savory claims that with better distribution provided by the system, stocking rates can be doubled while per-animal gain is equal to, if not better than, what you'd get from continuous grazing."

Until now, Savory system untested by Experiment Station scientists

"The trouble is that the system never has been research tested in this country," continued Lewis.

"We used to think this system had application only in wet country where there is a lot of opportunity for re-growth, but Savory has set it up in areas of 12-inch

Team effort

Not only Lewis and Engle were involved in research work covered in the accompanying articles. They point out that the entire research effort at Cottonwood Station is a team effort.

Permanent staff at the Station includes Superintendent **Lowell Blome,** who holds his degree in animal science from the University of Nebraska, and who has been at Cottonwood since January 1973.

Tim Weber, a native of Philip, is a range technician and a 1976 range science graduate of SDSU.

Field laboratory worker **Paula Erdmann,** also a native of Philip, has been on staff since 1970. Employee **Glenn Bennett,** a third Philip resident, joined the staff in July 1980. Blome also employs some short-term help during peak summer activity.

In addition, beef cattle research is being done by Dr. **Herley Miller** of the SDSU Animal Science Department. Dr. **James Smolik** of the SDSU Plant Science Department is what Lewis terms "a continuing partner" in much of the range research. Evaluation of the grass and legume nursery is by Dr. **Bob Gartner,** professor of Animal Science, who is stationed at the West River Research and Extension Center at Rapid City. Alfalfa demonstration work is by **Jim Johnson,** Extension range management specialist, also stationed in Rapid City.

Advice and counsel on research also comes from Dr. **E.M. White,** SDSU Plant Science Department, on soils; Dr. **Burruss McDaniel,** also with Plant Science, on arthropods; and Dr. **Duane Sander,** SDSU Electrical Engineering Department, on electronic equipment.

annual precipitation quite routinely. Cottonwood averages about 15 inches, which is typical of much of the northern Great Plains, so we thought we should look at the system in terms of why it works—if it works at all.

"It appears that if we are able to double our stocking rates without damaging the delicate prairie grassland system, it would be quite a breakthrough," he said.

Bilger's study calls for measurements of plant production above ground by species, forage intake, botanical composition, and nutritional value of the diet, the grazing distribution, and utilization.

Because of budget restrictions, sheep are used instead of cattle.

"What we're doing is to look at the date of green-up for marked plants of various species in both the Savory system and in adjoining pastures that are being grazed traditionally in continuous use. That way, we'll see if there's a loss of vigor in the Savory system grasses. If so, they won't grow as fast or green up as soon."

Bilger's project probably will be finished in the fall of 1982.

That's just one of the manipulations planned at Cottonwood.

Another is a project Lewis and others hope to initiate this year. Two sets of mini-pastures—one in high range condition, the other low—will be further divided into those grazed in the fall and those grazed similar to a Savory system. Further division will be for treatment with a nematode poison and a nontreatment. All will be replicated six times, for a total of 48 small pastures each measuring 40 by 80 feet. Smolik will be cooperating with Lewis on the work.

Panels will separate all the small pastures, and sheep will graze the grass.

Lewis believes outcomes will advance knowledge of how to manipulate the energy flow pathways.

Whether the breakthroughs occur next year, the year after, or 10 years after that, Lewis believes the effort is worth it.

The total land area of the world is about 34 billion acres, said Lewis in an article co-authored with Dr. Steven Waller. Rangeland is about 43% of that amount. In the United States, about 45% of all land mass is rangeland. And in South Dakota, about 59% of all land is in this category. While agriculture is our state's most important industry, rangeland supplies most of the forage for the livestock industry which accounts for about three-quarters of agriculture's total income.

Livestock grazing probably will always be the most valuable use of the range in our region, and anything we can do to enhance its production is like money in the bank for the economy of South Dakota. □

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

Measuring biomass

Developing new instruments and techniques could speed research results. Answers 'down the road'

Give range science a fast, cheap, and easy method of measuring the amount of biomass produced out there, and that is an accomplishment of major proportions, according to Dr. David Engle, SDSU range specialist who is involved with research at the Cottonwood Station.

A new measurement procedure with new instrumentation would provide scientists and range managers a needed tool not ony for monitoring range conditions, but also for providing feedback on attempts to manipulate the energy flow of rangelands like the Savory system, the use of nematicides, and other possibilities.

"Our present methods of measurement are archaic, labor-intensive, and expensive, but they are the best we have," said Engle, a Roswell, N.M., native and a graduate of Colorado State.

"Now, we have to get down on our hands and knees with a pair of sheep shears and clip grass samples, bag them, and rush back to the lab to evaluate them," he said.

Engle, who is a co-planner for the Savory system project at Cottonwood and who has concentrated on efforts to measure above-ground biomass produced on rangelands, believes the answer lies in a combination of ground instrumentation coupled with low-level aerial photography and possibly satellite imagery.

He and others are already working on two types of instruments.

One is the biometer, a device which has been used in other situations, but which still lacks the latitude and precision Engle believes necessary. Essentially, the biometer—a device with a photometer or reflectance meter transported about on a bicycle-wheeled cart—measures the amount of light reflected by plant chlorophyll. When directed at a sample of rangeland, the machine provides a figure which indicates the amount of green biomass contained in that sample.

Another device, now in early experimental stages in the SDSU range laboratory, measures total biomass—green and dead—in a rangeland herbage sample. It does this by directing a known amount of light at the grass canopy at various heights, then measuring the amount which filters through at the opposite side of the sample.

"These devices, of course, are useful only for small samples of rangeland vegetation at a time, but they may be invaluable as tools for calibrating some form of aerial photography or scanner imagery. This would allow us to interpret imagery made from aircraft and satellites to provide exactly the information we need." he said.

"It's a matter of time, but mostly of money," he continued. "Development and computer time both are very expensive."

Engle credits researchers in Colorado, Texas, and at NASA/Goddard Space Flight Center with "some positive pioneering" in the area. "But the degree of precision and the array of measurement capabilities for our own purposes still has eluded us to this point," he said.

"The Savory system and various other methods of manipulation of the energy flow all have potential for bringing revolutionary economic changes to the livestock industry in South Dakota and other states. Better evaluation techniques could speed up our work in these areas considerably and bring these possible innovations on line much quicker." □

Manageable shelterbelts

Twin row—high density design promises maximum access, height, and ground level density

Norman Baer

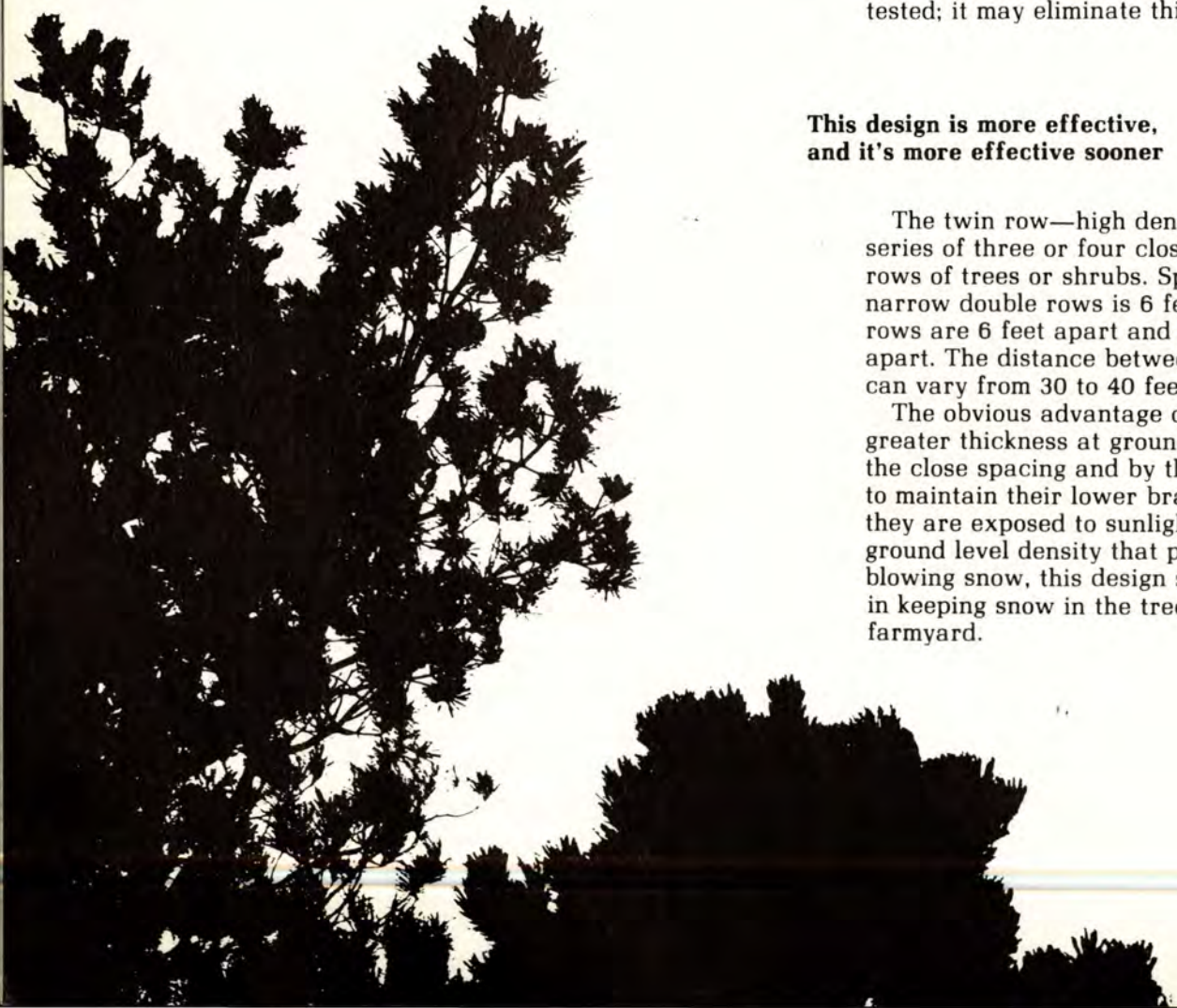
To make shelterbelt management an easier task, a new shelterbelt design called the "twin row—high density design" is being developed at SDSU.

We have known for a long time that effective shelterbelts are those that have been properly managed. A well managed shelterbelt is fenced to keep out all classes of livestock, maintained to control competing weeds and grasses, and watched closely for harmful insects and diseases.

Recently we've seen that in many areas of South Dakota, proper shelterbelt management also means the eventual replacement of trees when they begin to lose their effectiveness.

Management of conventional 5 to 9 (or more) row shelterbelts (the "solid block" pattern) is not an easy task because of the restricted area for movement of equipment. This is especially true when it becomes necessary to remove all or part of the trees in a row. In this case, the remaining live trees become obstacles that greatly increase the difficulty of working with dead or dying trees.

The twin row—high density design is being tested; it may eliminate this problem.



This design is more effective, and it's more effective sooner

The twin row—high density design is a series of three or four closely spaced double rows of trees or shrubs. Spacing between the narrow double rows is 6 feet. Trees in the rows are 6 feet apart and shrubs are 4 feet apart. The distance between the double rows can vary from 30 to 40 feet.

The obvious advantage of this design is greater thickness at ground level, caused by the close spacing and by the nature of trees to maintain their lower branches as long as they are exposed to sunlight. Since it is ground level density that primarily stops blowing snow, this design should be effective in keeping snow in the trees and out of the farmyard.

Some days, Norm Baer must wish his "crop" would hurry along and grow as fast as corn or wheat. He's taken his research in twin row-high density shelterbelts into wind tunnels to find what may happen when his trees mature.

This design has several other advantages which are not as obvious as the increased density but are equally important. We know from spacing studies in eastern South Dakota that trees planted 8 feet apart in the row, with rows 12 feet apart, grow taller than trees planted 8 feet apart in the row, with rows 18 or 24 feet apart.

Trees that are somewhat crowded respond by growing up rather than out. With the increased height growth, the shelterbelt becomes effective sooner and influences wind speeds further downwind.

Because the trees are closely spaced, their crowns will overlap much more quickly and can shade out competing vegetation. Consequently, with this design, the number of years of mechanical or chemical weed and grass control is reduced.

If the trees must be sprayed for insects or disease, the wide space between the rows allows easy access. The 30-40 foot area between double rows also makes removal of a tree or, when the time comes, an entire tree row much easier.

During the first 10 to 15 years, the 30 to 40 foot strip can be planted to a crop as long as a 4 to 8 foot area next to the trees is left unplanted. High moisture demanding crops such as alfalfa should not be planted in this area and the crop should not excessively shade the planted trees.

After the first 10 to 15 years, moisture sapping by tree roots will probably reduce crop yields to the point where it is no longer economical to plant a crop in these areas. When this point is reached, the area between the double rows should be kept free of weeds by an occasional cultivation.

Since the twin row—high density design is a new concept, there are no fully mature examples in existence. Several shelterbelts of this design have been planted in eastern South Dakota but the oldest one is only 3 years.

Models tested in a wind tunnel determine effect on wind patterns

To get some idea of the influence that a mature shelterbelt of this design would have on wind patterns, models of a double shrub row, a double deciduous tree row, and a double evergreen tree row were constructed.

Several different arrangements of these rows were then tested in a wind tunnel by scientists from USDA-SEA at Morris, Minnesota. The wind patterns which developed around the models and the effects of the models on wind speeds were measured and recorded. This was fed into a computer which then constructed charts which show areas of turbulence and wind speeds at various heights and distances downwind.

The most effective arrangement of rows tested so far consists of a double shrub row about 250 feet from the area of maximum wind protection, followed by a double row of deciduous trees 40 feet closer in, and then a double row of evergreen trees another 40 feet in. The final row is another double row of evergreens about 50 feet from the area of maximum protection.

It provides an effective snow catch in the double shrub row and also is effective in forcing and keeping the wind up above the level of the trees, decreasing wind speeds at ground level.

Several more twin row—high density design possibilities will be tested in the wind tunnel along with a model of a standard seven-row shelterbelt. We will then be able to compare the data taken from the twin row—high density designs to the standard design. □

The writer is reseach associate in the Horticulture-Forestry Department.

Dawn and Rita

New hard winter wheats show promise for disease resistance and high yield

Two new varieties of winter wheat ought to capture the attention of South Dakota growers.

The Agricultural Experiment Station has released two hard red winter wheats that are high yielding and disease resistant.

Darrell Wells, SDSU winter wheat breeder, named his two new varieties "Rita" and "Dawn."

They will be available for commercial growers in 1981. They were turned over to Foundation Seed Stocks in the fall of 1980 for increasing.

Rita resistant to leaf and stem rusts, top performance

Rita is a brown chaffed, awned hard red winter wheat.

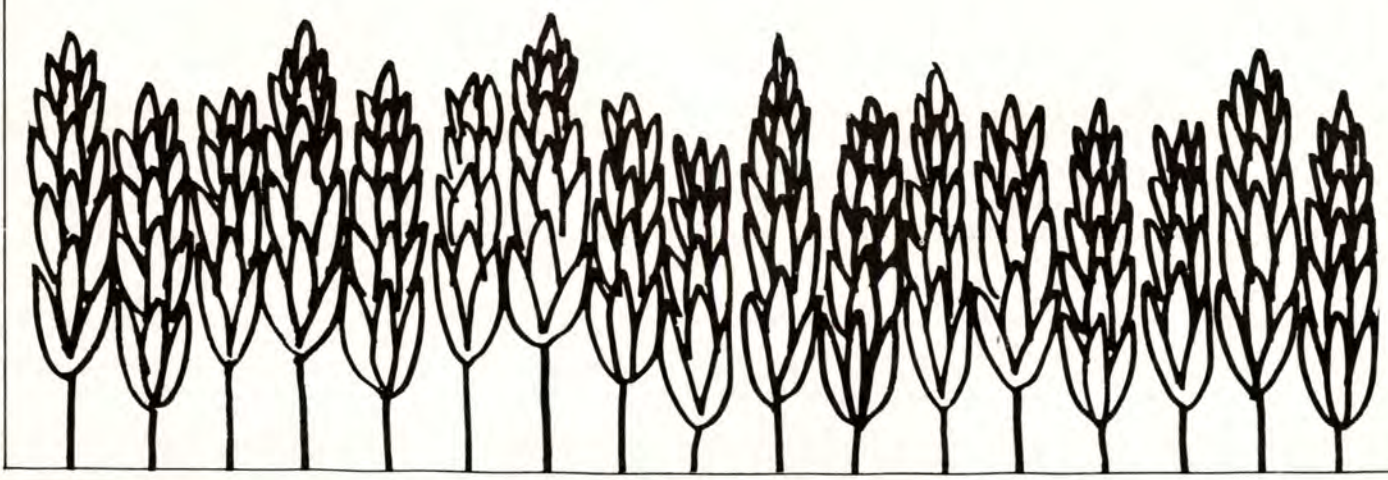
"Rita comes from a cross of a winter hardy semidwarf developed in Montana and a line of our own breeding, SD6689," said Wells. "We first saw it here at Brookings, were impressed with it, saved it, put it in statewide tests, had it checked for milling and baking qualities in Manhattan, KS, and entered it in the regional nursery."

Rita resists both leaf and stem rusts. It is susceptible to Hessian fly and streak mosaic. It resembles Scout types in winter survival. It is a little shorter than Centurk. Test weight varies from several pounds below standard to standard, but normally is substandard. It heads with Centurk or a day later.

In collaborator tests in 1979 it baked better than Scout 66 and Gage. It was better than Scout 66 in grain and texture, mixing tolerance, and overall baking quality. It appears to be satisfactory in milling.

Rita ranked first in grain yield in the Northern Regional Performance Nursery in 1979 across 14 stations and first for 1978-79 across 13 stations. In standard variety winter wheat comparisons at Wall in 1978, Brookings in 1980, and Presho the past 3 years, Rita has substantially outyielded Scout 66 and Centurk. At Highmore in 1978, Onida in 1980, and Bison in 1979, it yielded less than Scout 66 and Centurk.

Across nine tests and the years 1977, 1979, and 1980, Rita exceeded Scout 66 in South Dakota by 2.7 bu and Centurk by 5.2 bu in standard variety winter wheat tests.



Rita offers better performance and resistance to leaf rust in the main winter wheat area of South Dakota than Scout 66 and Centurk, although it shows no improvement in hardiness.

Rita has strong straw. It has too many white chaffed rogues in it for removal, which detracts from its appearance. Repurification began in 1980.

New prospects are given plenty of opportunities not to measure up, as variety tests go on for years and in many locations in the state. Here Donatus Ekanem, a student from Nigeria, measures height in one of the plots.

Dawn a better choice for the main winter wheat area

Dawn is a white chaffed, awned hard red winter wheat.

"It is a Colorado line which I first became interested in 8 or 10 years ago when I saw it in a winter hardiness nursery that I was growing," said Wells. "I obtained permission for further testing. When we wanted to release this line, we were given permission to do so by Colorado State University, the originator.

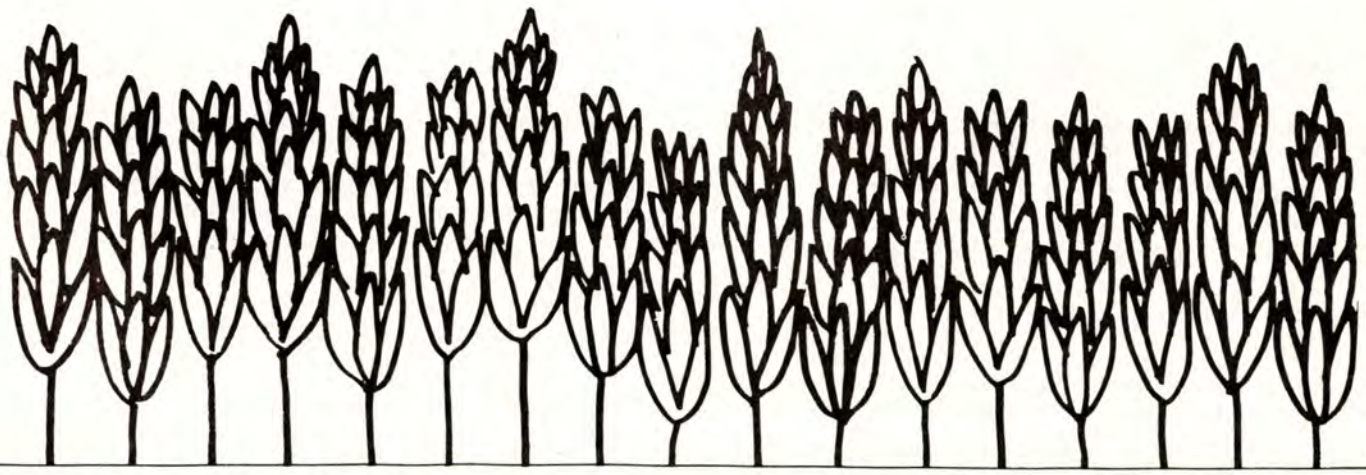
"Colorado made the cross and selected the line as being potentially desirable for them, so it appeared in their tests for a while. However, it wasn't one of their top two or three performers," Wells said.

Dawn resists stem rust and Hessian fly and is moderately resistant to leaf rust and streak mosaic. Dawn resembles Scout types in winter hardiness. Straw strength is good. Test weight is standard. It is about an inch shorter than Centurk. It heads the same time as Scout 66.

"In the collaborator tests in 1979 it baked better than Scout 66 and Gage. Compared with them, it had longer dough mixing time, less absorption of water, greater loaf volume, and better bread grain and texture," said Wells. The collaborators judged Scout 66, the high quality check, however, to be below its past performance in quality.

Dawn has been judged to be of promising milling and baking quality at Manhattan, KS.

In standard variety winter wheat tests in 1974 to 1980, Dawn yielded more than Scout



66 and Centurk at Presho, Brookings, and Redfield, but less at Highmore and Onida. At Wall it has outyielded Scout 66 but not Centurk. At Bison it equalled Scout 66 but not Centurk.

In the Northern Regional Performance Nursery, Dawn ranked number one across 14 stations in 1977 and number one across 13 stations for 1976-1977. In 1966 during a severe drought at Highmore, Dawn was ahead of Warrior by 4.2 bu, Roughrider by 8.6 bu, and Centurk by 2.9 bu/A.

Dawn, says Wells, offers growers a better performing variety in the main winter wheat area than most of them currently use.

Darrell Wells is surrounded by his new varieties, Dawn and Rita, in a SDSU greenhouse. Always on the lookout for disease resistance combined with yield, Wells spotted these two potential releases 10 years ago and has been refining them ever since.

Hatch Act and wheat producers provide breeding program fund

Wells explained how he named his two new varieties.

"There were many choices of names. I wanted short names, preferably four letters, easy to spell. I thought it would be interesting to name a couple after women. I don't know any women whose names are Rita and Dawn, but you'll look almost in vain among varieties of wheat in the United States for any that have been named after women. I thought in this era of women's rights, why don't we do that?"

Wells has been involved in the research on these two varieties 11 years for Dawn and 9 years for Rita.

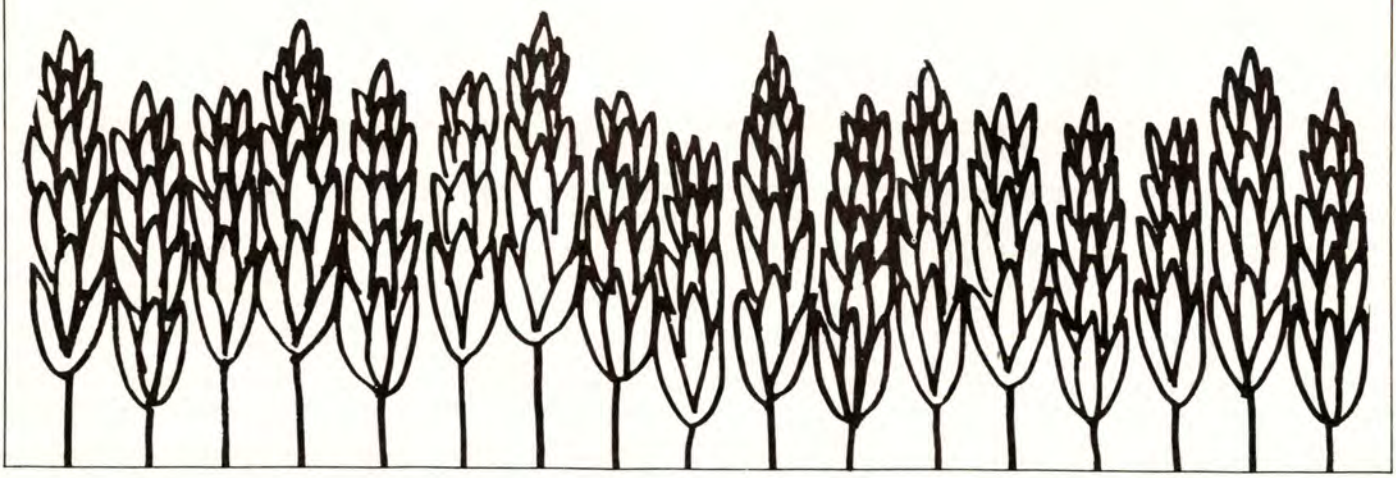
Funds for the research came through the Agricultural Experiment Station from federal Hatch Act money and from the wheat producers through the South Dakota Wheat Commission.

The implications for growers are two varieties with higher yields and better protection against diseases than is afforded by existing varieties, Wells said.

They have a level of hardiness comparable with Centurk and Scout types and so are less hardy than Winoka and Roughrider, the hardiest of adapted varieties in South Dakota. Growers, said Wells, should know that when they choose them. Growers in the northern half of South Dakota probably won't want to pick them, Wells said.

Why did South Dakota need two new varieties of wheat? "We're always after higher yield, and we're always after more protection against diseases," said Wells. "And these two varieties are notable in those two respects. So, they're worth releasing to producers." □

The writer is Jerry Leslie, information specialist in the Ag Information office.



Long-term solutions

Success in corn breeding is hard won. Developing population and inbreds take time, commitment

In the early 1900's, corn seed selection and breeding was as much a part of some farmers' work as hitching the plow and team.

"Throw a bag over your shoulder and go out into your corn field," a 1910 Experiment Station bulletin urged in a description of the seed selection process. The best was to be grown in a corner of the field and then used the following year for seed.

And that is just what many pioneers did with the seed they grew or acquired as they journeyed west. One South Dakota farmer bought a wagonload of odd varieties of corn that a peddler had collected in his travels. From this he developed Wimple's Yellow Dent which was grown in southeast South Dakota for many years. The farmer's name was, of course, Wimple.

Other notables in corn breeding among the settlers were Isaac Lincoln, a banker in Aberdeen who developed Brown County Yellow Dent; H.E. Dawes, originator of Fulton Yellow Dent; and a Mr. Strucka of Reliance who bred a grasshopper resistant strain of Murdock that kept him producing throughout the 1930's.

Experiment Station corn testing began in 1888 when corn was considered a fodder crop for the northern two thirds of the state. SDSU researchers A.N. Hume, Clifford Franzke, Karl Manke, D. Boyd Shank, and C.M. Nagel were instrumental in significantly increasing yields over the years, although many other factors are involved.

"Ten-year average state yields increased from 24.5 bu/A in 1901-1910 to 25.5 in the 1920's, 26.9 in the 1940's, 42.5 in the 1960's, and a high of 74 bu/A in 1979," Shank said.

"The introduction of hybrid corn in the 1940's and 50's was primarily responsible for average yields going from the 20's to the 40 to 50 bu/A level. However, to obtain the average state yield of 74 bu/A we needed good management and favorable weather in addition to continually improved and adapted hybrids," Shank explains.

Inbred production became central to SDSU corn breeding program

Much of the early Experiment Station work with corn was in variety testing to guide farmers in selecting the best seed available for their growing conditions.

It was not "a very good year," says Zeno Wicks III, SDSU's new corn breeder, speaking of 1980. Disease and drought combined to shrink ears and yield in this plot northeast of the campus. You can't always meet yield problems head on, Wicks says. It may be better to treat for drought tolerance, stalk strength, or some other characteristic.

In the late 1920's, Cliff Franzke began developing inbreds; he was testing experimental hybrids by the late 1930's. One of his corn inbreds still has some commercial use, remarkable as the life of most inbreds is very short, Shank said.

A full-time corn breeder didn't join the staff until 1944 when Karl Manke was hired. Two years later D. Boyd Shank became corn breeder. At that time the hybrids still weren't early enough; there was lodging and very low drought and cold tolerance, he explains. Half the state was still planting open pollinated varieties.

Now, after 34 years of research, Shank has to his credit 19 inbred lines released and five inbreds now proposed for release. He also produced 16 varieties of three-way or four-way hybrids that were sold to farmers as certified South Dakota seed.

When hybrid corn production began in the early 1940's, members of the South Dakota Crop Improvement Association were to plant the inbred lines supplied by the state corn breeder, producing seed for double-cross production, Shank said. The attempt failed because most lacked the facilities and technical information for raising, processing and marketing inbred, single-cross, and double-cross seed.

Inbred production involves self-pollinating individual plants for six or more generations until the desired characteristics are consistently repeated with each generation. At that point the plants are very uniform but are usually small, low producing, and often partially sterile—not suitable for crop production.

The inbred is cross-fertilized with another inbred to produce a single-cross hybrid. This single-cross seed can be crossed with another inbred to produce a three-way cross hybrid.

"By 1944 a producer cooperative, the Sokota Hybrid Producers of Brookings, was organized and began producing certified seed of Experiment Station double-cross hybrids," Shank explains.

"The Foundation Seed Stock Division, established in 1943, raised the inbred lines and produced the single-cross seed used by members of Sokota."

In the early 1960's Shank discontinued emphasis on the development of single- or double-cross hybrids for commercial use and concentrated efforts on developing inbreds with specific characteristics the commercial corn seed companies would use in developing their own hybrids. This procedure continues today.

The contributions of corn breeding to the

South Dakota economy are not as visible as those in breeding small grains or grasses. Those releases are sold as certified seed; the pedigree is public knowledge. When seed companies use Experiment Station corn inbreds, they need not acknowledge the fact. But the SDSU inbreds are used in hybrid production throughout the Midwest and around the world.

Solutions require continued effort, time, and cooperation

Boyd Shank retired last year and the new corn breeder, Dr. Zeno Wicks III, began September 1.

The new corn breeding program under Dr. Wicks is still in the formative stages. He is developing a program that will be put into motion this spring.

"I would like to get together with Extension personnel and farmers in the next few months to find out what they consider important problems to work on," Dr. Wicks said. "Maybe we don't always want the highest yielding corn. Maybe we can sometimes accept three-fourths normal yield, but have drought resistance."

Wicks had one year experience in plant breeding for private industry after earning his Ph.D. at North Dakota State University. He considers Experiment Station research an opportunity for greater professional freedom and service.

"With business, the project has to be justified on a short-term basis in terms of profits. Here I have the opportunity to work with insect resistance, drought resistance—solutions for the long term," Wicks said.

"We have to attack the problem of low yields the long way around. Right now you have rootworms, root rots, corn borers, smuts, ear rots, fungi attacking the ears—above and beyond the need for having proper heat and moisture. The key is not a straight on attack every time. By eliminating or reducing these problems, you are increasing yields."

The work requires input from and cooperation among many Experiment Station resources such as plant pathologists, entomologists, and other plant breeders. It requires time—some solutions, more than a lifetime.

The Experiment Station corn breeder works where solutions begin—in population work, with inbred production, producing the material to build on. □

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

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