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Farm and Home Research

South Dakota State University Agricultural  
Experiment Station

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## Farm and Home Research: 51-3

Mary Brashier

Jerry Leslie

Jaimi Lammers

Nancy Grathwohl

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# Farm & Home **RESEARCH**

South Dakota State University • College of Agriculture & Biological Sciences • Agricultural Experiment Station

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## On the cover:

Roy Scott, SDSU soybean geneticist, shows a plant containing a glyphosate-tolerant gene to Bob Pollman, executive director and secretary-treasurer of the South Dakota Crop Improvement Association (SDCIA), and Jack Ingemansen, manager of SDSU's Foundation Seed Stocks. The SDCIA observed its 75th anniversary in 2000; one of the landmark celebrations was the increase and marketing of SD 1091RR, the first South Dakota transgenic public variety of soybean with Roundup Ready® technology. Two stories begin on pages 2 and 8.



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### South Dakota State University

Peggy Gordon Elliott *President*

### College of Agriculture & Biological Sciences

Fred Cholick *Dean*

Kevin Kephart *Associate Dean  
Director, Agricultural  
Experiment Station*

Larry Tidemann *Associate Dean  
Director, Cooperative  
Extension Service*

Charles McMullen *Associate Dean  
Acting Director,  
Academic Programs*

### Farm & Home Research Staff

Barbara Suhr Hartinger *Executive Editor*

Mary Brashier *Writer*

Jerry Leslie *Writer*

Jaimi Lammers *Writer*

Nancy Grathwohl *Writer*

Tom Holmlund *Graphic Designer*

Vergene Clark *Circulation Manager*

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Thanks to our partners, old and new, SDSU's crop breeding program has 'a bright future in South Dakota'

# Director's comments

by Kevin Kephart



**W**e in the Agricultural Experiment Station have a strong tradition of developing crop varieties for South Dakota farmers. From beginnings over 100 years ago our scientists have built today's outstanding breeding programs in small grains, soybeans, oilseeds, forages, and corn. Variety development efforts are also underway in turfgrass and horticultural species.

Plant breeding and variety development are at the heart of our biostress mission. Varieties are developed to better withstand or avoid our heat and droughts, our cold and ice, our diseases and pests. Considerable effort is placed on improving crop quality as well. Baking quality in wheat, hull proportions and beta glucans in oats, and protein concentration in soybeans are only a few examples of crop quality priorities in our breeding programs.

**O**utstanding public breeding programs are not solitary efforts. Teamwork is an essential component. Breeders rely on other scientists — plant pathologists, cereal chemists, plant physiologists, entomologists, weed scientists, agronomists, and many other experts. Team effort goes beyond this key group of scientists, however. The best crop variety is of little value unless adequate supplies of seed can be produced and delivered to producers. That's where other partnerships come in.

Released varieties are provided to the SDSU Foundation Seed Stocks Division for increase. In turn, foundation class seed is sold to members of the South Dakota Crop Improvement Association for production of certified seed.

Reliable availability of high quality certified seed has been a critical component of the state's agriculture. This issue of *Farm & Home Research* joins in the celebration of the 75th anniversary of the South Dakota Crop Improvement Association (SDCIA). Since 1925, the SDCIA has been SDSU's reliable partner in serving farmers throughout South Dakota.

At a recent meeting on economic development, a speaker mentioned that universities can't implement ideas, products, or inventions alone, that an effective coalition with a partner is needed. He described some common traits that such coalitions must have: on-going communication, mutual trust and cooperation, a shared vision, mutual respect. These traits are the foundation of a joint effort to solve problems.

When I measure up our relationship with the SDCIA using these standards, it becomes clear why our crop research programs are successful. We've had unfailing support from a dedicated partner that shares our vision.

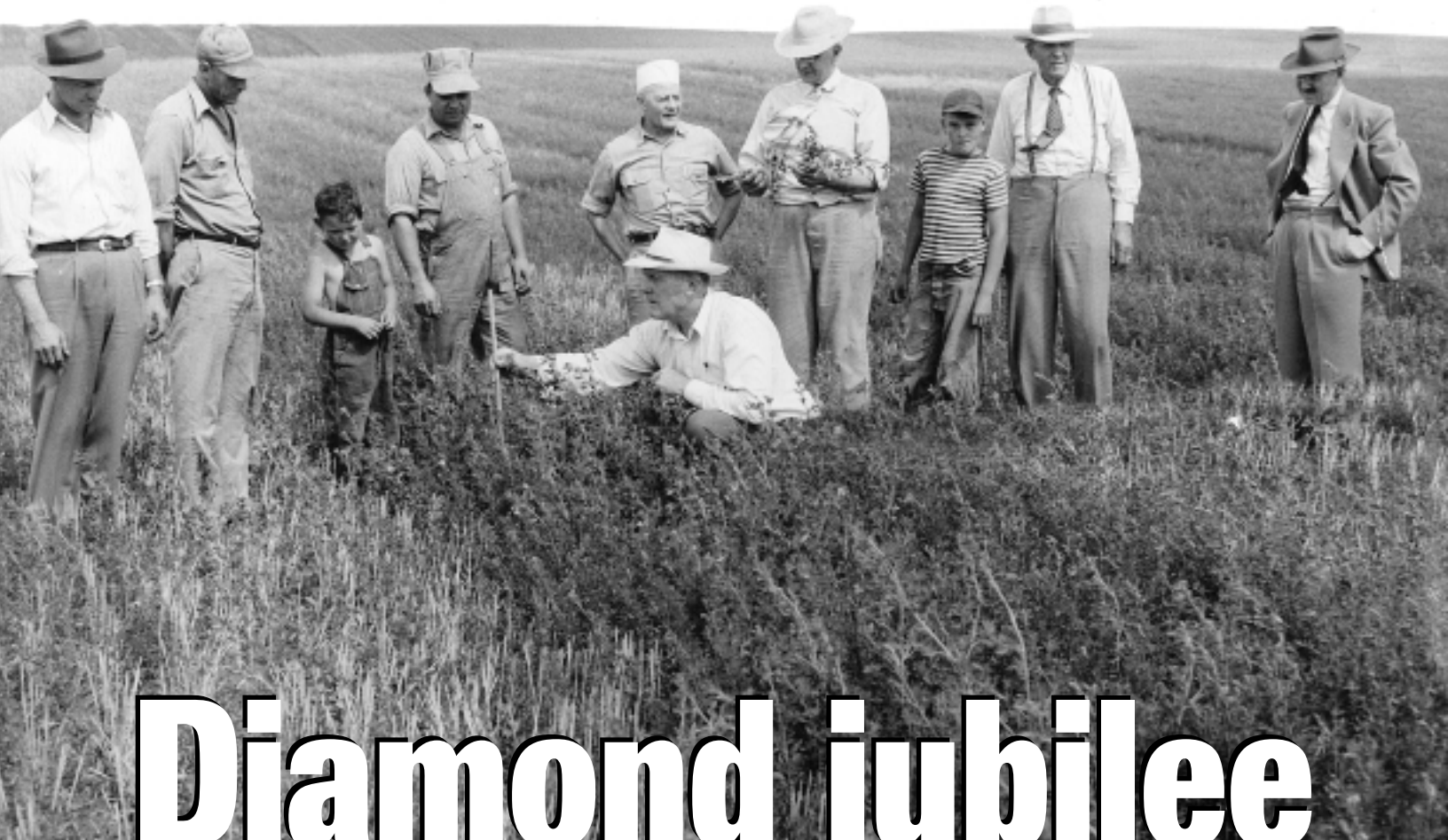
**T**his issue of *Farm and Home Research* announces another ef-

fective coalition. Last summer SDSU became the first public university to jointly develop and market a transgenic crop variety with a major multinational company. Working with Monsanto Co., the South Dakota Agricultural Experiment Station has developed a Roundup Ready® soybean variety specifically for South Dakota growers.

There's a lot happening with soybeans in our state. Acreage has jumped from 2.6 million acres in 1995 to 4.3 million in 2000. Of the 2000 acreage, 68% was planted using Roundup Ready® varieties, few (if any) of which were specifically selected for use in our environments. Roundup Ready® is important to South Dakota producers, so important that they are often willing to use varieties that were not intentionally developed for the western fringe of soybean production.

This landmark partnership with Monsanto is the first of its kind nationally. We pursued this strategy with guidance from growers and partners. The new variety, SD 1091RR, will be marketed under the brand name **SoDak Genetics®**, and certified seed is available for planting this coming spring.

**W**ith thanks to our partners, old and new, we're able to effectively serve agriculture. Public crop breeding programs have a bright future in South Dakota. □



# Diamond jubilee

Farm organization promotes superior crops for 75 years

by Jerry Leslie

**T**he best crop variety in the world has no value until it is harvested from producers' fields. The South Dakota Crop Improvement Association (SDCIA) provides a critical link between the development of the variety and selection by growers. This year, the SDCIA, an organization of about 1,300 farmer members and about 300 certified seed growers, observes its 75th anniversary.

Their legacy is 75 years of providing better varieties and pure seed to every county in South Dakota through their alliance with the South Dakota Agricultural Experiment Station.

The SDCIA-SDSU seed distribution system is the manifestation

of working farmers who realized they needed more knowledge, better technology, better crop varieties, and better ways of growing them. Those needs brought them to their nearest agricultural college and land-grant university, South Dakota State College, as it was known at the time.

Bob Pollmann, Brookings, has been executive director and secretary-treasurer of the SDCIA for nearly 23 years and serves as an intermediary between farmers and university.

The SDCIA observed its anniversary in a number of ways, he said:

- A 75th recognition at the SDCIA booth at the South Dakota State Fair.

- Special observance during the annual meeting and educational conference, the Ag Horizons Conference, in Pierre.
- Archiving and categorizing of 75 years of SDCIA records and memorabilia in SDSU's Briggs Library, so anyone can access and research the history of the organization. This project was completed this year by Elizabeth Scott, library archivist.
- Commemorative pens and other such items distributed throughout the year.
- Magazine and newspaper articles focusing on the history of the organization.

**S**eventy-five years can easily encompass four generations of farmers. In that time span, mem-

bers, directors, and officers have come and passed on, and so have many of their scientist associates.

But they and the ag research they asked for and then put into practice left legacies all across the South Dakota countryside and on the SDSU campus.

Yields, for example. Soybeans grow all over eastern and into western South Dakota, where none could be found in 1925. Wheat yields have tripled to average 40 bushels an acre today. Hay yields also have tripled.

“Research enables pursuit of complex problems on a small scale without individuals pursuing risky ventures on their own. It’s hard to quantify the economic value of experimentation,” said Pollmann. The SDCIA had a part in evolving a strong and viable system of crop breeding, variety development, seed increase, seed inspection, quality assurance, and seed distribution, he added.

A visitor cannot walk across the campus at SDSU or one of its satellite research stations without seeing landmarks of brick and mortar laid with the help of SDCIA dollars or SDCIA support for legislative appropriations.

The list of buildings with SDCIA connections, either through cash contributions or legislative support includes:

- The Northern Plains Biostress Laboratory, the center of crop breeding laboratories and offices as well as biotechnology research.
- Agricultural Hall, home of administrative offices of the College of Agriculture and Biological Sciences, Plant Science Department, Agricultural Experiment



**2000:** In its 75th year, the SDCIA purchased a plot-sized sprayer/fertilizer spreader for SDSU. Behind the directors, led by Laird Larson, Clark, far right, is the Northern Plains Biostress Lab for which the SDCIA spearheaded the campaign for funds in the early 1990s.

Station, and Cooperative Extension Service, plus college academic programs and Biology-Microbiology. SDCIA executive offices also are housed here.

- Plant Science Building and greenhouses.
- Foundation seed conditioning plant.
- Physiology lab.
- Plant Science seed-house.
- Plant Science greenhouses and head-house.

And:

- West River Agricultural Center in Rapid City.
- Buildings and equipment at the Southeast South Dakota Experiment Farm, Brookings Agronomy Farm, Northeast Research Station near

**Current officers of the SDCIA** are Laird Larson, Clark, president; Max Williams, Brentford, vice president; and Robert J. Pollmann, fulltime executive director and secretary-treasurer.

**The current Board of directors** is Doug Abeln, Groton; Alan Biegler, Timber Lake; Richard Bottolfson, Vermillion; Dave Daniel, Wentworth; Gary Duffy, Oldham; Floyd Hansmeier, Bristol; Charles Howe, McLaughlin; James Kanable Sr., Mound City; Kip Matkins, Sturgis; Clark Moeckly, Britton; Dave Nelson, Miller; Henry Glen Roghair, Okaton; and Steven Van Tassel, Midland.

**Past presidents in the last half-century** include Larson, since 1994; James Suhr, Aurora, 1990-1994; Gerald Moe, Arlington, 1985-1990; Harold Hurlbert, Raymond, 1981-1985; Richard Daly, Columbia, 1971 and 1977-1981; Fred Holscher, Faulkton, 1972-1976; Don Jorgensen, Ideal, 1967-1970; Clarence Dybvig, Baltic, 1960-1966; Raymond P. Johnson, Rapid City, 1959; Frank McHugh, Aberdeen, 1956-1958; and E.G. Sander-son, Aurora, 1950-1956.



1967: Sacks of certified seed continue to bear the familiar logo of the SDCIA. They assure quality seed inside.

South Shore, Dakota Lakes Research Farm near Pierre, Central Research Station at Highmore, and West River Mobile Research Unit out of Boxelder.

*And more:*

A quarter section of land near Aurora with a machine storage building now used for crop variety testing and demonstrations, purchased by SDCIA and turned over to the SDSU Plant Science Department in 1987 when Gerald Moe of Arlington chaired the organization.

SDCIA contributions to SDSU over the last 25 years have totaled nearly \$800,000, Pollmann said. The money came primarily from a check-off on certified seed sold, since an individual membership fee in SDCIA is only \$2.

Minutes from the 1998 membership meeting showed that SDCIA awarded \$85,210 to the Plant Science Department for Fiscal Year 1999.

Those funds were directed to graduate assistantships, hard

white winter wheat breeding, a grain moisture tester, a West River remote weather station, plant disease clinic update, field demonstration trials, walk-behind tractor and attachments, digital cameras, a global positioning system unit, and SDCIA lectureships, among other items.

The Cereal Bowl, a combination of Jackrabbit football and recognition of the contributions of crop growers in this state, provides a chance to tell about SDCIA farmer contributions to SDSU. Last year a combined \$1.25 million was granted to SDSU by corn growers, soybean growers, wheat growers, other oilseed growers, and the SDCIA.

“More important than the dollar contribution,” said Pollmann, “has been the support, aid, and encouragement provided to SDSU scientists.”

In 1925, when the SDCIA organized, South Dakota had 80,000 farms averaging 464 acres.

Farm numbers in South Dakota peaked in 1931 at 84,300. Since then, they have slid to today’s 32,500 farms (in 1999) averaging 1,354 acres.

Similar movements happened to membership in the SDCIA, which peaked in membership about 1953 with 3,500 enrolled.

Pollmann said membership has declined about 2% per year in recent decades as the total number of farmers decline. However, he has seen a steady increase in the acres of seed certified in the last few decades. In 1998, SDCIA members planted more than 128,000 acres of certified seed, a record, Pollmann said.



1987: Gerald Moe, Arlington, president of the SDCIA, center, signs the Aurora Farm to SDSU for crop variety testing. With him are, l to r, former SDSU administrators Ray Moore, Maurice Horton, Robert Wagner, and Richard Battaglia.

The early history of the organization is recorded in a “Half Century of Progress of the South Dakota Crop Improvement Association,” written in 1954 as a master’s thesis by Jason S. Webster, an assistant professor of agronomy.

The SDCIA chartered as a non-profit corporation in 1925, Webster wrote. It had roots in two organizations, the South Dakota Corn Growers and Corn Breeders Association and the South Dakota Experimental Association, both of which had a history of their own.

The Corn Growers formed in 1906 to sponsor a corn school and corn show and in 1910 embraced all crops and changed its name to the South Dakota Corn Growers and Grain Growers Association. The Experimental Association organized in 1912 to assist the Experiment Station in testing and distributing new crops and varieties.

These two associations found they had common ground and combined January 9, 1925, incorporated under the present name, the South Dakota Crop Improvement Association.

This is the anniversary being celebrated this year, although many functions of the SDCIA were carried out by its parent organizations before merger.

The SDCIA letterhead logo — a bushy alfalfa plant, a sheath of wheat, and an ear of corn over a map of South Dakota — remains in use today, much the same as when first used in 1925 and in 1927 when registered with the U.S. Patent and Trademark Office.

Among the goals of SDCIA, from the original Articles of Incorporation, were:

- to collect and disseminate information concerning the growing, harvesting, storage, and handling of seeds of the staple crops;
- to encourage the breeding and general improvement of farm crops;
- to stimulate the growing and effective economical distribution of pedigreed or improved certified seeds in every section of the state.
- to advance the husbanding, propagating, and maintaining of the purity of adapted new varieties or improved strains produced by the plant breeders;
- to inspect crops grown for seed, to provide for the certification of seed, and to maintain a system of registration of fields and seeds;
- to promote state and national legislation to the end that the purposes of this and similar organizations may become more effective.

The constitution also reveals an advocacy and legislative action role from the very beginning.

SDCIA officers and legislative committees frequently went to the state and even the nation’s capitol to support laws in their interest.



1990: The Board of Directors are, standing, l to r, Kip Matkins, Sturgis; Gordon Brockmueller, Freeman; Ray Schultz, Madison; Donald Giese, Mobridge; Mark Weisbeck, Herreid; James Kanable, Sr, Mound City; Harold Hurlbert, Raymond; Laird Larson, Clark; John Schwab, Andover; Tom Olsen, Wessington Springs; and Charles Howe, McLaughlin. Seated are Gerald Moe, Arlington; Bob Pollmann, Brookings; and James Suhr, Aurora. Not pictured are Cliff Halverson, Kennebec; and Norman Smeenk, Harrisburg.



1927: Aboard the “Alfalfa and Sweet Clover Special,” SDCIA members encourage greater acreage of these crops as “the most reliable ... sources of feed ... under all conditions.” The train made 76 stops in East River and was visited by 49,395 people.





**1950: On the SDCIA 25th anniversary, this exhibit toured scientific meetings in Omaha, Washington, D.C., Pennsylvania, and Colorado and sites in South Dakota. Here at the State Capitol is the late Sen Karl E. Mundt, left.**

They supported a state seed law, a state weed law, and the legalization of their own Seed Certification Service. They lobbied long and hard for an Agricultural Hall at SDSU and for many other buildings.

They pressed for more staff and better wages for a permanent rather than itinerant faculty in State College, as it was known then.

They came out in favor of a deepened Great Lakes-St. Lawrence waterway project back in 1926.

They supported the comprehensive soil survey. They helped establish a soils testing laboratory at SDSU.

SDCIA members and activities were influenced by other major events in U.S. and South Dakota history, like the Depression and the Dirty 30s when they helped the Extension Service maintain lists of available seed.

World War I and World War II disrupted their work as did the in-

fluenza epidemic of 1919 which claimed some of their key people.

**T**he major contributions of SDCIA members, in cooperation with SDSU breeders and other scientists, have changed the face of agriculture in South Dakota.

New varieties have pushed the “soybean belt” north and west. Research efforts have increased yield and stability of all crops through new and im-

proved varieties and farming practices, supported in part by SDCIA members.

The organization developed a lasting system to continue crop improvement for all South Dakota farmers. Continuing efforts by this group to stay on top of emerging technology were demonstrated this summer in the announcement of an agreement with SDSU, its seed distribution partners, and Monsanto to market Monsanto’s Roundup Ready® gene in some of SDSU’s new soybean varieties.

The SDCIA has supported these negotiations from the beginning, and now SDCIA’s Class I growers are selling their first Roundup Ready® soybean variety. (See related story, this issue.)

Seventy-five years of trial and error toward achieving original goals caused the evolution of several spin-off organizations between SDCIA and SDSU. These are now an essential part of the process of new variety production and distribution process. They follow:

- **Foundation Seed Stocks.** Foundation Seed Stocks Division (FSSD) was organized in 1941 and incorporated in 1945 as a non-profit corporation. Its purpose is to increase and distribute superior varieties of seed and propagating materials released by the Agricultural Experiment Station. It also stores a reserve of pure seed stock materials. The operation is financed through the sale of Foundation Seed.
- **Seed Certification Service.** The South Dakota Seed Certification Service is a division of the SDCIA and the official certification agency for seed and propagating materials of all crops, except potatoes, in the state. This service, managed by the SDCIA executive director, hires part-time field inspectors during the inspection season. To qualify as certified seed, these seed increases must be made according to strict growing, harvesting, and conditioning standards to prevent contamination and mixtures.



**1917: A.J. Wimple, Beresford, was recognized as one of the first true corn breeders in the state at the Corn Show.**

- **South Dakota Seed Testing Lab.** Through its State Seed Testing Laboratory, another division of the SDCIA-SDSU alliance, laboratory inspection is done on seed samples intended for certified seed. After meeting all requirements, certification labels are attached to the seed containers or bulk transfer certificates for bulk seed lots. Then SDCIA certified seed growers can market the seed to other farmers. The process insures anyone buying certified seed that it is the variety stated on the label and that it has a high degree of purity.

Duane Colburn, Hendricks, Minn., was secretary of SDCIA and manager of the Seed Certification Service from 1961 until 1978 when he retired.

Colburn had words of praise for the SDCIA for promoting research at the Experiment Station and for increasing new seed and getting it out to South Dakota farmers. Both SDSU and farmers benefited from the relationship, he said. During Colburn's tenure, grower classifications were established so that the best growers would have a better chance of getting new re-

leases than those who had never planted certified seed but were members of SDCIA.

Colburn said of the work, "I enjoyed working with farmers, and they were exceptionally supportive of crop improvement and the college in general."

Laird Larson of Clark, current president of the SDCIA, has been a CIA member 28 years, a board member 11, and chairman for 7 years.

Larson describes the SDCIA "as a link in the chain from the producer to the researchers and breeders to communicate what is needed in South Dakota crops and agriculture. We're also a communication link for new information from research back out to the producer."

The relationship with SDSU produces "new and improved varieties that exhibit better disease resistance and a better quality



2000: Also in 75th year, a new small-plot combine is donated to research and inspected by SDCIA directors. Max Williams, Brentford, vice president, is in center.

product." The consumer benefits from a better product going to the processor and, ultimately, a retail product at an affordable price, Laird said.

Larson believes it is necessary to keep the SDCIA as a voice from producer to researcher and scientist and breeder.

"I've been involved long enough, I can honestly say I've asked for a problem to be researched and have seen solutions come back during my tenure on the board.

"An example is scab resistance. We haven't achieved total fusarium resistant varieties, but we have advanced resistance levels considerably. Among many other examples, we asked for higher oil and protein content in soybeans, and now we are seeing some of that initial research effort start to come out in our new variety, 'Surge.'"

The SDCIA makes South Dakota farmers more competitive with farmers around the country and the world, Larson said.

"Ultimately, the SDCIA is working to benefit all growers in the state, so we have a product we can sell that processor and consumer like. Because we really are all in this together." □



1931: Winners at the State Crop Show are, l to r, Dave Mueller, Freeman, Otto Sundstrom, Beresford, J.T. Sundall, Colton, Henry Preheim, Marion, E.H. Brockmueller, Freeman, and F.A. Fleming, Elkton. Local crop shows and shortcourses were held in cooperation with the Extension Service.

# LANDMARK PARTNERSHIP

## SDSU, Monsanto to produce Roundup Ready® soybean seed

by Jerry Leslie

**M**onsanto's Roundup Ready® gene has been incorporated and will be part of some soybean varieties developed by the Agricultural Experiment Station at SDSU.

Officials of Monsanto Co. and officials of SDSU, its plant breeders, and its partners in seed distribution have signed a commercialization agreement to that effect.

This first-of-its-kind agreement between a land-grant university and a large international company will provide South Dakota farmers with Monsanto's Roundup Ready® technology in public varieties developed by SDSU.

These varieties will have traits already customized for South Dakota's unique conditions by SDSU's breeding program.

The new Roundup Ready® varieties will be increased and marketed via the partnership with Foundation Seed Stocks and cer-

tified seed growers of the South Dakota Crop Improvement Association (SDCIA), both non-profit organizations.

A signing celebration took place this summer on the SDSU campus between Monsanto executives, SDSU administrators and scientists, the manager of Foundation Seed Stocks, the South Dakota Soybean Research and Promotion Council (SDSRPC), and members of the SDCIA.

The event is regarded as a triumph by South Dakota commodity group leaders who from the beginning have supported and assisted these negotiations. They also took part in the signing ceremony.

**U**nder the 5-year agreement, Monsanto will continue ownership of their Roundup Ready® technology, and SDSU's Foundation Seed Stocks will be the licensee for all new SDSU varieties that carry the gene. The varieties and their ge-

netic background will continue to be the property of the Agricultural Experiment Station.

Twelve Class I certified seed growers of the SDCIA will increase the seed for commercial production and collect a technology fee for Monsanto.

SDSU's Foundation Seed Stocks used the signing occasion to announce the release of SDSU's first Roundup Ready® soybean variety coming out under a new brand name, SODAK GENETICS®. All future SDSU transgenic plant variety releases will carry that brand.

The new variety will be "SODAK GENETICS®, SD 1091RR." Future SODAK GENETICS® releases also will be numbered varieties.

This, the first Roundup Ready® release from the SDSU soybean breeding program of Dr. Roy Scott, will be a late Group 0 variety adapted to the cooler and shorter growing season in the



SDSU officials and Monsanto executives sign a historic marketing agreement to incorporate Monsanto's Roundup Ready® gene in some of SDSU's soybean varieties. From left are Kevin Kephart, director of the SDSU Agricultural Experiment Station; Peggy Elliott, SDSU president; Brett Begemann, Monsanto's vice president for U.S. business; and Dale Gallenberg, head of SDSU's Plant Science Department and chairman of the board of directors of the Foundation Seed Stocks Division.

north half of the state and to late-planting conditions.

The Roundup Ready® trait allows soybean plants to be unharmed during weed control with treatments of Monsanto's family of non-selective glyphosate herbicides, branded as Roundup®.

The new variety has high yield potential, high protein concentration, coupled with good oil content.

The SDSRPC, through grower check-off dollars, assisted in providing funding to develop this new SDSU variety.

SODAK GENETICS®, SD 1091RR was grown for increase this summer by the seed associates who are Class I certified seed growers. The seed was harvested this fall and will be available to farmers for planting in 2001, said Bob Pollmann, manager of the Seed Certification Service and executive secretary for the SDCIA.

**B**rett Begemann, Monsanto's vice president for U.S. business, said this agreement "marks the first time Monsanto has entered into a commercial agreement pertaining to biotechnology traits for corn or soybeans with any public institution." He added it also is the first agreement between any company and university for joint marketing of biotechnology crops.

"Monsanto believes the upside potential is significant for both parties," Begemann said, "and we stand committed to help SDSU establish a marketing system that will monitor revenue streams necessary to support their breeding programs.

"This will insure continued publicly developed commercial varieties containing Monsanto's Roundup Ready® gene for South Dakota farmers," Begemann said.

"Monsanto is hopeful that the partnership with SDSU can be used as a foundation in our rela-

tionships with other public institutions."

Stephen Joehl, Monsanto's director of technology licensing, said, "From our perspective, if biotechnology and its traits are to be successfully developed by us or anyone else, we need all the scientific community getting behind them and supporting the science around them and the benefits to the public.

"We think SDSU, now, not only in education of students, but also in their own research and working with us and others, will only enhance the scientific review of this technology to make sure it is safe and confers the proper benefits to the consumer."

Kevin Kephart, director of SDSU's Agricultural Experiment Station, said he and Fred Cholick, dean of the College of Agriculture and Biological Sciences, have been working with Monsanto toward this agreement since 1996.

“This came about from a complex multi-partnership developed through years of patience and negotiation,” said Kephart.

Kephart said the agreement never would have been reached without the support of South Dakota commodity groups, especially the SDCIA, SDSRPC, and the Wheat Commission.

Kephart said, “I view this as a fulfillment of our mission, actually an evolution of our mission. Our mission evolves as technology evolves.”

The agreement allows SDSU “to provide better service to our soybean growers,” said Kephart. “They have told me repeatedly they need access to new technologies. This is what we at SDSU are about, service to agriculture and the people.”

Kephart also pointed out that the South Dakota certified seed distribution system has not been eroded. He emphasized that SDSU’s plant breeding programs will continue to develop conventional varieties.

“The relationship between SDSU, the Agricultural Experiment Station, Foundation Seed, the Crop Improvement Association, and their growers remains intact. We have not lost control of the variety.”

Kephart said he hopes that SDSU will be able to expand this partnership as future biotechnologies devel-

op. He added that this agreement doesn’t restrict SDSU from partnering with other companies.

SDSU President Peggy Elliott said, “I believe there are great opportunities for progress when universities and producers work together. The reality of the market and the theory of the university serve each other well as we sharpen the thinking of both.”

Dean Cholick said, “The College of Agriculture and Biological Sciences has a long history as a land-grant university partnering with many groups. We were founded on developing partnerships, such as what we do between research and Extension.

“This new partnership allows us to combine the research invest-

ments in development of new knowledge by both partners, which is critical today given that private industry is investing more into their research efforts than that of the public investment to land-grants.

“From my perspective,” said Cholick, “new partnerships such as this will allow us to make a difference for the people we’re here to serve, South Dakotans.”

Cholick pointed out that SDSU “worked very hard through these negotiations to protect the rights of both of the partners — the investment Monsanto has made in this new knowledge and our traditional integrity that we’re here to serve the people as a public institution. We have to maintain our integrity as the unbiased develop-



Stakeholders, supporters, and well-wishers gather to witness the signing of a technology marketing agreement between SDSU and Monsanto. Signing, front row, are from left, Kevin Kephart, Experiment Station director; SDSU’s President Peggy Elliott; Monsanto’s Brett Bege-mann, vice president of U.S. business; and Dale Gallenberg, chairman of the board of Foundation Seed Stocks; back row, Lewis Bainbridge and Dennis Hardy, president and past president of the South Dakota Soybean Research & Promotion Council; State Sen. Randy Frederick; Roy Scott, SDSU soybean breeder; Laird Larson, Clark, president of the South Dakota Crop Improvement Association; Fred Cholick, dean of the SDSU College of Agriculture and Biological Sciences; Stephen Joehl, director of technology licensing for Monsanto; and Michael Reger, SDSU vice president.

er and deliverer of knowledge and information.”

Laird Larson, a farmer from Clark and president of the SDCIA, has worked in support of the agreement for more than 3 years.

He explained, “If farmers keep growing genetically modified crops, the public varieties must get into that realm.

“In my area (northeast South Dakota), a clear majority of soybeans grown are genetically modified, Roundup Ready®. Acreage of conventional beans has dropped so drastically that sales by SDCIA members, certified seed growers, have dropped with it.”

In fact, a report from the South Dakota Ag Statistics Service said 68% of the record 4.3 million soybean acres planted in South Dakota this year are herbicide-resistant, compared to 54% nationally.

Larson’s contribution through the SDCIA was to provide producer perspective as the agreement developed. This perspective provided a critical viewpoint that helped link the ideas and goals of the partners.

Having Roundup Ready® traits in SDSU-developed soybean varieties will offer real advantages to South Dakota farmers, said Dennis Hardy, a Beresford soybean grower and past president of the SDSRPC.

Hardy said, “We (the SDSRPC) suggested to Cholick 3 or 4 years ago that we go after Roundup Ready® in our soybean variety program.”

Roundup Ready® traits will help farmers on the northern and western fringes of the soybean belt, where private seed companies are not getting involved,

“We think SDSU, now, not only in education of students, but also in their own research and working with us and others, will only enhance the scientific review of this technology to make sure it is safe and confers the proper benefits to the consumer.”

—Stephen Joehl, Monsanto’s director of technology licensing

Hardy said. These beginning soybean growers find it hard starting out with soybeans, knowing herbicides for wheat rather than soybeans. “Roundup Ready® is easy. You just spray with Roundup®.”

Worked into SDSU’s high-protein germplasm, this trait will make it easier for the South Dakota Soybean Processors Plant at Volga, one of three northernmost soybean plants in the country, to find high-protein soybeans, Hardy said.

“Roundup Ready® traits in high-protein lines will allow us to compete with other parts of the country to hit the niche high-protein meal market.”

Worked in with SDSU soybean cyst nematode resistant lines, Roundup Ready® traits also will be helpful in southeast South Dakota, Hardy said.

**M**onsanto provided SDSU a soybean line with the Roundup Ready® gene in it. SDSU then crossed it with South-Dakota-adapted material. The resulting cross then had to be grown and treated with the herbicide to screen out plants that didn’t express the trait, following rules and regulations developed by the USDA.

Maurice Foresman, regional business director for Monsanto, said,

“At first, Monsanto gave the gene to public universities for research, to experiment with and to study, but we didn’t give them to any institution to commercialize.

“We have been trying to understand the role of public institutions in seed development beyond a research base to educate and prepare students,” Begemann continued.

“In working with South Dakota, we realized their programs are critical to developing varieties and hybrids and other crops for the ag community.

“Private companies are not targeting the releases of soybean lines for South Dakota and don’t have breeding stations here. They are going for bigger markets in other states such as Iowa, Illinois, Indiana, and Nebraska,” Begemann said.

“We believe South Dakota could use our help, and we know we needed their help in developing these lines. We hope to do more things with South Dakota. We find our new partners very comfortable to work with, and we appreciate the institutional support for biotechnology within state government.”

Roundup Ready® and Roundup® are registered to Monsanto. □

**Should you  
pick another  
calving date?**



# Big part of the answer depends on the grasses your pasture contains

by Jaimi Lammers

Calving when forage quality is at its highest can increase producer profit and decrease time spent on cow maintenance.

This could mean calving at another time of year than the usual March or April period, says Don Boggs, SDSU Animal and Range Sciences Department head.

If producers focus more of their attention on timing cow production and breeding to when forage quality is high, they will be better able to meet the cow's protein demands, says Boggs. He names two times during the year when it is favorable for producers to schedule calving to match their forage needs.

March and April are the typical calving months for most ranchers. By calving in these months, the producer can breed the cows when lush green grass is available. Weaning in this calving system also occurs after an early fall grass regrowth, thereby raising the condition score of both the calves and the cows, Boggs says.

However, during the two most critical time periods (60 days before and 60 days after calving),

producers may have to drylot or supplement the diets of their cattle to meet their nutrient needs. "Not only do we have to have harvested feeds or excellent dormant grazing at that time, but it's got to be high quality, because animal requirements are high," he said.

If the calving season is changed to early May, the quality of feed needed during drylot or winter grazing is reduced. Early lactation is better matched with peak lush forage production.

"What we're looking at here is timing high milk production with the availability of high quality forages," said Boggs.

The trade-off for a May calving system is that the producer will need higher quality supplementation on native range or a supply of harvested forage to feed during late gestation that will meet the protein needs of the cow. Pasture and range forages in this growth stage will not provide enough nutrition to meet the cow's requirements.

"We don't often get a flush of brome grass in late July, August, and September. Because of the systems we're working with, most

of our cool-season grasses are dormant."

Boggs said the key for May and June calving is a source of warm-season forage through grazing management of native range.

Adds Arvid Boe, SDSU forage breeder, "depending on where you are in the state, you can establish warm-season pastures of the bluestems, switchgrass, Indiangrass, sideoats grama, and blue grama."

Central to success of any cow/calf system is knowing the grasses in your pastures and then matching cow cycle and optimum forage cycle, Boe says.

"Cool-season grasses have a bimodal growth curve. This is two growth flushes, one at the start and another at the end of the growing season. In between, these grasses tend to go dormant in the high summer. Warm-season grasses will be flourishing during this period, although they have a shorter growth period overall."

Charting his prospective calving dates against the pasture calendar in the chart may assist the producer in determining his most successful system, Boe says.



Dick Pruitt, cow-calf management scientist at SDSU, said producers must also take costs into consideration when determining the best calving time. Some figures to consider are cost of facilities, calf prices, and labor.

Pruitt initiated a research project in 1996 at the Cottonwood Research Station west of Philip by dividing 126 cows into three groups. One group was bred to start calving March 15 with calves weaned in late October. The second group also was bred to start calving March 15 but with calves weaned in mid-September. The third group was bred to start calving approximately May 1 with the calves weaned in late October.

After the first calf crop was weaned, 9% more calves survived to weaning from the March calving groups compared to the May calving group. The 1996-97 winter was one of the most severe in recent years. With milder winters, calf survival was not affected by calving season, Pruitt said.

He noted the time of calving or time of weaning did not influence pregnancy rates or calving intervals.

In 1997, pounds of calf weaned per cow exposed to breeding was virtually the same for the March and May calving groups weaned in late October — 443 lb vs. 440 lb, respectively. However, in 1998, the March calving group weaned in late October weighed 57 lb more per cow exposed to breeding compared to the May calving group weaned at the same time.

When calculated as income per cow exposed and based on South Dakota calf prices at that time, the March calving group produced about \$30 more income per cow during 1998.

“Another way to think of that is if we can reduce costs by \$30 per cow or more, then the May calving group would be just as profitable as the March calving group,” said Pruitt. “In some situations, it could be easy to reduce costs by more than \$30 by scheduling the calving season in May instead of March.”

Research at other universities has shown an increase in quality grade and marbling scores for cattle weaned as early as 90 days of age and then fed a high grain diet to harvest, he said.

Scientists at SDSU are evaluating the influence of weaning age on carcass. Following weaning, steer calves were fed at the Southeast South Dakota Experiment Farm near Beresford.

The research will continue to determine the longer-term effect of calving and weaning times on reproductive performance of the cows and the performance of their calves. A more thorough economic analysis will be possible with more information.

To help producers analyze which calving system — winter or spring — works best for them, Boggs used a model comparing how cows in both periods survive in winter if they are fed only average hay.

He used February as the average winter month because of the weather variability during that time.

A winter calving season will put cows in early lactation during February — one of the cow's highest nutrient requirement periods, said Boggs.

“If it gets cold, she's going to lose about 2.25 lb per day,” he said.

“You're going to have to come in with some energy supplements as well as better quality hay.”

Cows in the spring calving period are in late gestation during February. If an average 1,250-lb cow is being fed 30 lb of brome hay and the outside temperature is 20 F, she will maintain her weight. At 5 F, with a little added wind, she will lose about 1/3 lb per day or about 10 lb during that month, he figured.

“Both of these we can live with. We'd prefer not to have this come right into calving, but if you've got the cow in shape, we're in good shape,” he says.

The May 1 calver is in mid-gestation during February. At that point in the reproductive cycle, the cow is primarily maintaining her weight.

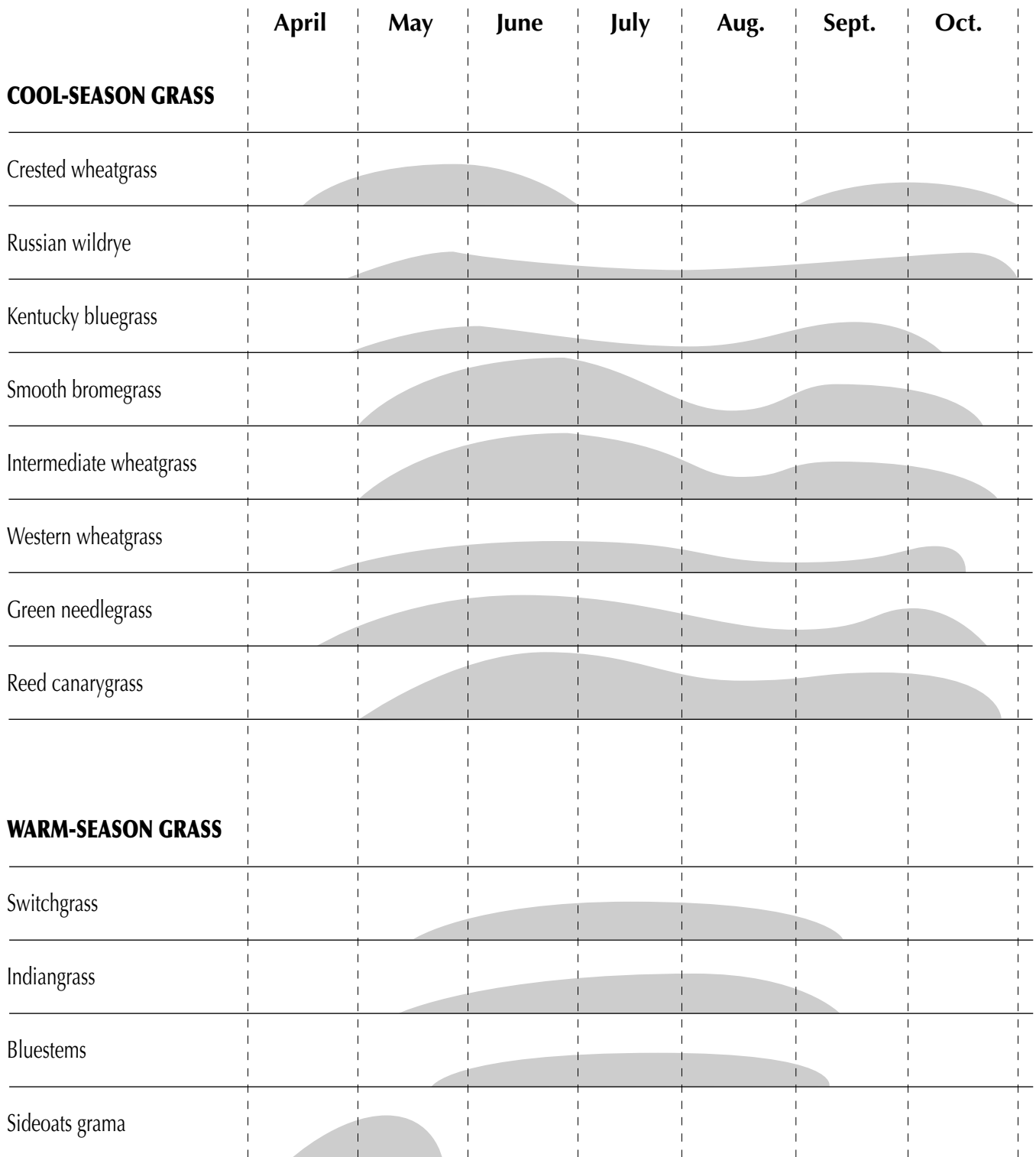
“In the nice weather, she's going to be gaining weight; and even when it gets cold, that calf is still going to maintain or gain weight on that level of feed.”

This is where forage quality becomes a consideration. The March calver requires a higher quality feed as she is in late gestation. The May calver has a lower protein requirement during mid-gestation and can get by on a lower quality feed.

“For those of us who aren't getting the hay made quite as well, this is going to be an advantage,” said Boggs.

Whatever time of the year the producer decides to calve, SDSU scientists advise looking into not only weather risks or benefits of certain seasons but also quality and quantity of forage available and the various costs associated with those issues. □

**Pasture calendar showing periods of high and low forage production.**  
**Note that cool-season grass growth is bimodal.**





# *Friends*

*and*

# *Foes*

## **in the seed pod**

Survival of native legumes  
depends on tiny wasps

by Mary Brashier

**M**urder and mayhem aren't unique to humans.  
They happen just about every day in the natural world.

And no one bats an eye at the carnage. Scientists working at SDSU's Oak Lake field station are especially pleased about it, in fact. Meat-eating insects, tiny wasps, keep young beetles and midges who like to eat the seeds in native legume pods under some control. This gives the plants a chance to set seed and propagate themselves, thus preserving the natural diversity of plant — and insect — life on the northern prairie.

Native legumes like those at Oak Lake, a 570-acre outdoor classroom and research location roughly 30 miles northeast of Brookings, will play a valuable role in our future, says Arvid Boe, forage geneticist at SDSU.

If they get the chance, he adds.

“Native legumes offer a tremendous potential to increase the productivity of pastures and rangelands,” he says. “It’s often the case that introduced legumes are not adapted or desirable in native grass areas.”

In addition to being critical forage-producing and nitrogen-fixing species in rangelands, native legumes are also components in seed mixtures for beautification of roadside areas and parks, revegetation of disturbed soils, and establishment of wildlife habitats, he added.

“Down the road there’s going to be a demand and need for these native legumes,” Boe says. “I’m getting calls already for ‘Sunrise’ Canada milkvetch, and I just don’t have the seed. We can’t produce enough to keep up with the demand.”

Sunrise Canada milkvetch was developed by Boe as part of the “Sun series,” modern versions of native grasses and legumes now found only in prairie remnants such as at the Oak Lake station.

“These legumes survived drought, extreme winters, wildfires, grazing and trampling by buffalo. They are soil builders, just like alfalfa.”

Sunrise, in particular, “is exactly what we want in conservation plantings, on roadsides, or for wildlife habitat. We used to think

we had to come up with a late-flowering alfalfa for these kinds of uses. Canada milkvetch was already here and waiting.”

But seed production in the native species is extremely low.

“You wouldn’t think so,” Boe says. “The plants produce a lot of flowers and sometimes lots of pods.”

But often, there are no seeds in the pods. Sometimes the weather is responsible. But too many times, beetles and midges have gotten there first.

“I can’t grow Canada milkvetch anymore at Brookings. The beetles, at least two species of them, empty out all the seed pods.”

Legume seeds are a concentrated source of high protein in a normally low-protein environment, and this attracts beetles and midges to the plant. The female insect lays a single egg on the surface of the pod. The first instar larva to hatch is designed to tunnel and bores into the pod and seed. Later instars (stages) of the larva in the seed “eat so much they have to molt several times so they can eat more,” Boe says. Depending on species, a larval insect may even overwinter inside the pod.

“This isn’t unique to South Dakota legumes,” Boe explains. “Al-



Lab technician Chinatsu Kojima sorts out insects she and entomologist Paul Johnson want to keep from collections made at Oak Lake field station, opposite, before sending samples to other scientists across the country.

most every pea and bean or other legume seed has its own species-specific beetle. Or beetles. In other parts of the world, it’s hard to keep legume seeds in storage. The bugs eat them up. We have in this country the relative of the cowpea beetle that is so notorious in India and Pakistan, for example. It’s the black bruchid beetle in prairie clover.”

Since commercial production of native legumes concentrates many plants in a small area for hungry beetles to munch on, Boe and fellow scientist Paul Johnson, entomologist at SDSU, wondered if legumes spread out in a natural setting would be as attractive and as accessible to the beetles.



**Paul Johnson, entomologist, above, studies the overall biodiversity exhibited in a prairie community by its legumes, beetles, wasps, and other inhabitants. Fellow scientist Arvid Boe narrows the study to specific plants and insects. "Our common goals," says Johnson, "are knowledge gain and economic development."**

If they weren't, scientists interested in seed production for future revegetation might have better luck collecting from wild sources.

And just maybe they'd find another insect, one that exerted a "check and balance" system on the beetle population. Natural communities work that way.

They found what they were looking for — a group of tiny wasps.

**T**hese wasps, often little bigger than the period at the end of this sentence, are carnivorous. Their meal of choice is the larvae of the beetles and midges that destroy legume seeds.

Boe and Johnson are only beginning to learn which wasp parasitizes which beetle; they are only a year into the project at Oak Lake and there's not much in the scientific literature that is helpful.

Some past work has implicated one kind of bruchid beetle as re-

sponsible for up to a 71% loss of viable American licorice seed. Pod collections in bulk from 37 different sites carried immature beetles in every sample.

For its own purposes, the carnivorous wasp has a great sense of timing, Boe found at Oak Lake. And it's probably okay that the wasp's schedule doesn't perfectly fit the needs of the legume plant.

"When the female wasp bores a hole through the pod and into the beetle larva and deposits an egg, it's all over for the beetle, but unfortunately for the plant, the wasp tends to wait until the larva has grown some and gotten enough meat on it to make the wasp's effort worthwhile. By that time, beetles have destroyed most of the seeds in the legume pod."

Sorting out friend and foe also would be easier if there were just one of each.

On purple prairie clover, for example, Boe has found two kinds of beetles and two different

midges feeding on the seeds and five different wasps with apparently specific tastes for specific beetle or midge prey.

Purple prairie clover, Boe says, is of particular interest because of its reputation as an important forage for wildlife and domestic livestock. Plants in his study sites at Oak Lake produced very few viable seeds in 1999, about four per flower on average. False indigo seed loss ranges from 30% to 70%; for Canada milkvetch loss is about 50%.

**I**n work sponsored by a small SDSU research incentive program that mostly covered their weekly visits to Oak Lake during the summer, Boe collected legumes to bring back to the lab where he would identify and count insects from the seed pods.

Johnson set out insect traps. He expected to collect representatives of the general insect community associated with the legumes, and he expected to learn when and at what height the insects were flying.

He got more than he had bargained for. "This is an extremely diverse and complex prairie insect community."

He picks the species of interest out of the many thousands of insects caught in his traps, and then starts the rest of the collection on a trip around the U.S. and Canada. Each scientist on the mailing list selects out his special interests and then sends the collection on to the next person on the list. "Our Oak Lake insects are being studied by expert entomologists all around the country.

“We have found a number of flies, wasps, and beetles at Oak Lake that have never before been reported from the state,” Johnson says. “One particular wasp in the oak-savannah community is about 2,000 miles south of its normal range, specialists in Ottawa tell us.”

Johnson is still counting the insects he collected last summer. Yet, “I would guess at this point, with several thousand vials of insects collected, that we’re looking at on the order of about a dozen families of parasitic wasps representing something like three dozen genera and three to four dozen species of parasitic wasps that live out there associated with native legumes.”

Which means, he says, “we have a parasitic wasp complex out there that is much larger than anybody expected.”

And that’s fortunate, he adds. If the wasps weren’t there, the population of plant feeders would explode.

“Say the plant loses 90% of its annual seed crop per flower to beetles and midges. And remember that is a low estimate, many plants lose much more reproductive potential. Common sense and ecological theory tell us that’s okay, that the plant is producing more seeds than it needs to, not to grow more plants but so the appetites of its seed-feeding insects will be satiated and there will still be enough seeds left over to propagate the species.

“If the plant is producing a thousand seeds per plant and loses 90% of them, there still are a hundred seeds out there per plant.”



**Leadplant, left, and purple prairie clover are two legumes which act as “nurseries” for beetle larvae. Take away the “biological brakes” that the natural enemies of the beetles provide, and numbers of both plants would drop.**

But if a catastrophe happened to the wasps — and they are highly sensitive to insecticides, even low-concentration drift from an application miles away — the restraint on the legume seed feeders would be removed.

“Take the parasites away, and the weevils and bruchids feeding on the legumes have no biological brakes. You could lose the entire seed crop. There’s an old phrase called ‘balance of nature.’ It applies.”

**P**urple prairie clover, leadplant, and other native legumes and bruchid beetles and weevils and their predator wasps and flies are not exactly production agriculture, the scientists admit.

But the final judgment isn’t in, they add. While the value of each species in the natural landscape can be seen, there may be other hidden benefits from maintaining a check-and-balance ecosystem.

Such as the contributions to science by the common housefly, Johnson says. “The work with housefly physiology in the 1930s and ’40s led to antigravity boots

and other things for military use and eventually helped contribute to the development of Velcro, which is based on the interaction of hooked hairs in plants and insects.

“And geckos. How do they stick to ceilings? They don’t have sticky feet; instead, they have hairs upon hairs upon hairs that do the sticking. The engineer that designed Mecho-gecko, a robot that works on this principle, said that without diverse biological communities out there where we can investigate bizarre quirks of nature, he would have had no idea of inventing such a piece of machinery.”

Boe has different reasons for studying the legume community at Oak Lake.

“These plants are nitrogen fixers. They make nutritious forage. They are soil holders and fantastic contributors to prairie and roadside beauty. They contribute to biodiversity. And I’m sure they have values we haven’t discovered yet.

“We need them. It’s that simple.” □

# Math. English Lit. Marriage Prep?

A proposal, a ring, and wedding vows —  
with high school classmates looking on

by Jaimi Lammers



If it's up to one SDSU professor, marriage preparation classes will soon be as common as taking Lamaze classes before having a baby.

According to a 1996 national study, marital distress results in workplace financial losses in excess of \$6.8 billion per year.

But a 1998 study suggested that figure was too low and estimated that up to 30% of sick time is marriage and family related, said Scott Gardner, assistant professor of human development, family, and consumer sciences at SDSU.

"Marital stress and divorce take a toll on physical, mental, and emotional health for children as well as adults. To strengthen children and adults in our communities and in turn to strengthen families, we must start to strengthen marriages," he added.

According to 1998 South Dakota Department of Health statistics, 3.7 of every 1,000 marriages in the state ended in divorce. The Center for Disease Control and Prevention vital statistics report, dated July 2000, said 4.1 of every 1,000 marriages across the country end in divorce.

"Even if you look beyond the moral obligation, we have an economic interest in preventing divorce," Gardner pointed out.

An Australian study found that 10% of the nation's budget was somehow related to divorce. Many U.S. state officials also report a connection between divorce and the state of the economy, Gardner said. Oklahoma officials felt this issue was so important that they are using \$10 million from their Temporary Assistance for Needy Families fund to alleviate the problems of divorce, he added.

Gardner believes prevention is the key. And the best place to catch people — because they're not getting this kind of education at home — is in the schools, he said.

"As a society, we have a mentality that if there's a problem, we fix the individual. That can be helpful, but if you don't fix the people around him or her, they're going to go back to that behavior," he said.

A new type of class offered at many high schools across the nation focuses on family and intimate relationships. These classes more or less teach conflict management. Their effectiveness in South Dakota is the object of Gardner's research.

In our state the class is completely voluntary. Florida laws, in contrast, require marriage education

skills courses for all ninth- and tenth-grade high school students.

Gardner is analyzing the Connections: Relationships and Marriage curriculum, currently in use in 35 states. It includes four units: personality, relationships, communication and conflict resolution, and marriage. South Dakota officials purchased the program for the state's high schools through vocational education funds.

Students are put in real-life situations and taught how to deal with conflict. One such situation is a mock wedding. Students go through all the steps of marriage preparation from pre-proposal (budgeting for the engagement ring) to post-wedding (housing, vehicles, children) and everything in between.

Students at Chamberlain High School draw from a hat to determine their "jobs" and "salaries," said Suzi Geppart, CHS family and consumer sciences teacher.

"At that age, budgeting is a whole new concept," she commented.

In the study's pilot year, 1998-99, over 400 students answered a pre- and post-class questionnaire. Half of those students, the control group, did not take the class.



The teenage years are ones of tremendous growth and development, Gardner said. A control group allows one to see if the changes over a year are related to the class or to the students' natural maturation.

One example question is, "In the last semester in school, when you got in an argument with your best friend, how many times did you: a) talk it out, b) yell at the person, c) beat them up."

"It gives you scores on how often they use reasoning as a tactic for conflict, how often they use a verbally aggressive tactic, and how often they use the violent tactic," he explained.

Preliminary results show three major findings:

- the Connections group improved more than the control in terms of using reasoning,
- the Connections group was more likely to discuss information about close personal relationship with their parents, and
- the Connections group had a less positive view of divorce.

Ideally, Gardner will follow the students through the first 7 years of their marriages, as during that time period is when most divorces occur, he said.

"Realistically, I don't think we'll have enough students in the pool. The return rate [from the questionnaires] is about 50%. So we'll only be able to follow them for a couple of years," he estimated.



Chamberlain High student Kyle Wasserman "proposes" to Danielle Rogers, left, and presents the ring (for which he had to budget!). After more planning and preparation, they "wed" with Matt Tostenson as the minister, Eric Jones as best man, and Jenny Arpan as maid of honor.

Gardner is also evaluating the Connections curriculum on a national level. Through the curriculum's sponsor, the Dibble Fund, Gardner will question 1,000 high school students in California, Michigan, and New Jersey about the usefulness of the curriculum to them.

He is currently working on another study involving SDSU undergraduate students, determining what they like and dislike about their parents' marriage and how they want their own marriage to be different.

Another aspect he would like to pursue is interviewing couples who have been married 30, 40, and 50 years to see what makes their marriages last.

"By combining all this information, I think that would give us a good picture of what marriage looks like in South Dakota and what societal arrangements we might need to adjust to encourage longer-lasting and happier marriages," he said. □



In any 10-year stretch of farming, there are 2 great, 2 rotten, and 6 so-so years. Which tillage/rotation system gives best chance for steady income?

# In for the long haul

by Mary Brashier

**A**sks farm manager Bob Berg what the Southeast South Dakota Experiment Farm's long-term tillage and crop rotation study is showing, and he reminds you that he needs at least 4 straight years to complete the longest of the rotations and collect all yield data. At Beresford, as elsewhere, 4 good years in a row are hard to come by.

The first couple years of the study seemed to be promising for the reduced tillage systems. But 1993 was wet — an understatement — and nothing got planted. “About all we could do was control weeds.”

In 1995 only the spring was wet; all crops were eventually planted; only late soybeans went in at about their normal planting date; income from them “couldn't carry the farm.”

In 1996 everything clicked: Planting was early, prices were great, and every crop was profitable. In 1999, hail damage, a very wet spring, and then no rain during summer and fall killed any hopes for profit from any system.

“That's farming for you.”



Ask Doug Franklin, SDSU economist on the multi-year project, about results in the study, and he asks, “which year?”

In any 10 years of a typical farm operation — “any 10 years,” he stresses — “you have 2 very good years, 2 extremely rotten years, and 6 so-so. You can feed the family those 6 years, that’s about all.

“What we want to answer is this: What are the rotations and tillage systems that give us the best chance for a steady income, the least variability in income over those years? Which ones level out the peaks and valleys? Maybe they’re not the highest income in one year, but they’re ones that won’t lose us the most money the next year.”

Those goals mean “farming for the long haul” and gearing up for a third 5-year phase when the project scientists will add work with nutrients in residues, insects, water use efficiency, and perhaps carbon credits.

Farmers in southeastern South Dakota commonly run a 2-year corn-soybean rotation.

They may be missing a bet.

Year after year, an alfalfa stand has made the cropping systems at the Southeast Farm profitable, says Franklin. “Sure, you spend a lot the first year getting it established and fertilized, but after that there are few expenses except for the baler and labor.”

In good years, three cuttings yield 5 tons/acre. A “poor” year gives 3 tons.

“At roughly a \$70/ton selling price, if you subtract \$4 or \$5 per acre for labor and about \$60 for each year’s portion of establishment costs, and then add alfalfa to the losses in corn and soybeans — you could stay in farming another year.”

Berg also likes the forage. “All told, with low prices and crop stress from the weather in 1999, even if we had factored in typical loan deficiency payments, only alfalfa was profitable. It can go a long way in helping stabilize overall income. If the farmer raises livestock, feed costs go down.”

The proximity of the experiment farm to the Sioux City-Yankton area where many serious alfalfa producers are located raises the stakes for the alfalfa research, Berg feels. “Our results are really applicable to this region.”

Usually, the scientists leave out government program benefits, use land values from the first year of the study, and do not “buy” any new machinery over the course of the project. This is for easier comparisons over the years.

However, they make what changes they can to better reflect common farming practices in the area. They use current crop prices and input costs. Crop insurance premiums are a yearly cost. Only in 1999 and only on hauled-out soybeans in one of the seven systems did the crop insurance pay off, Berg says.

What to do with wheat has puzzled Berg and Franklin.

“Farmers around here would like to include small grains in their rotations — for the sake of diversity and to spread out the workload,” Berg says. “But it just isn’t economical because of our higher land costs. We get more moisture, too, than in the primary wheat growing areas, so we can usually do better with corn and soybeans.”

It’s not just that the row crops return a higher unit profit.

“Rains can come at flowering and then the crop becomes susceptible to wheat scab. Then we won’t get even average yields,” Berg says. “That has happened often enough to get our attention.

“If we could get 60 and 80 bushel wheat consistently or better prices, then it would be profitable. But the best we’ve measured is 55 bushels, and some years it’s 20 to 30.”

Other modifications have crept into the project. One system was intended to be chemical free.

“Basically, if you can crop without herbicides for 4 years, you can certify as organic,” Berg says. “Then you can qualify for premiums.”

But over the years, yields dropped. Despite their best efforts at cultivation, the weeds took over. And then the entire study — every crop, every tillage option — had to be treated in 1993 to control weeds.

“That kicked us out of any organic program,” Berg says.

That part of the study has been modified. The tillages and crops

are intact, but fertilizers and herbicides are used as needed.

The project had been set up in 1990 with alfalfa as an annual crop.

“It didn’t take long to realize that rotating alfalfa like any other crop was impractical,” Berg says. “As a result, when we rewrote the study in the second phase, we returned alfalfa to perennial status. It stays in longer and we use best management practices for fertilizer and herbicides.

“That keeps all systems in synch and our comparisons between systems more balanced. It makes our results more helpful to our neighbors.”

The size of the 80 different plots in the project appeals to producers, Berg says. Each plot is 60 feet wide and 300 feet long.

“Of course these aren’t whole fields, but our plots are larger than the typical ones in other research projects. We can use the big tractor and our bigger combine. Our practices are more like those of producers, and consequently our results mean more to them.”

On this farm in this area, a conventional corn and soybean rotation seems to be the way to go. Most farmers in the area already farm this way, Berg adds. Any one year, the soybeans usually have the edge over the corn.

In the long term, however, conventional soybeans and perennial alfalfa tend to be the most profitable crops.

But Franklin would say that crop yields vary so much from year to year that price plays a bigger part than rotation and tillage in the economics of an operation.

Franklin’s economic analysis of the profitabilities of the different rotation and tillage systems includes a consideration of the human element — the willingness to

take on risk or the desire to “play it safe.”

His survey of farmers in the area shows that in a typical year most of the diversified producers plant corn on 41% of their crop acreage, soybeans on 39%, alfalfa on 15%, and small grains on 5%.

If they use a three-crop rotation, the numbers change to corn, 48%; soybeans, 46%; and small grains 6%. Two-crop producers divide acreage nearly evenly, 51% to corn and 49% to soybeans. A few producers put their land into all corn or all soybeans in any one year. “Those are the ones who look strictly at prices and profits.”

For the farmer with a two-crop rotation, “recovering all costs, including paying yourself a wage



Southeast Farm manager Bob Berg, preceding photo, remarks that the size of the tillage/rotation plots “works” for both him and farmers who come to tour. “Our practices are more like those of producers, and consequently our results mean more to them.” This is a beans into corn rotation.

and management cost — the gravy most farmers go without, it looks like a no-till corn-soybeans rotation pays out roughly \$2,900 average over the long run on a farm of 497 acres.

“On the same farm, ridge-till loses about \$440 year after year. Conventional tillage loses about \$1,000.”

If a farmer wants the system that makes the most money, he’ll use no-till, “but he better have a nest egg to carry him through because this is the system that has the largest fluctuation in income from year to year within each rotation system.”

If the farmer has a three- or four-crop rotation, says Franklin, “he likely has other enterprises, like cattle or hogs. He is more diversified and can ride out some low crop prices and crop failures.”

**W**hen Dale Sorensen, former Southeast Farm manager, set up the study back in 1990, the moldboard plow was already on its way out as the standard implement of conventional tillage.

“There was a lot of talk about no-till,” Berg says.

And which works better?

“There seemed to be an advantage to no-till in the first few years. But lately it seems that some conventionally tilled — which is a sort of minimal till — crops are gaining. The weather is just not consistent enough from year to year to say that one system is going to work for a particular crop. As we go on, we

### Tillage and crop rotation systems, Southeast Research Farm, Beresford, S.D.

System	Tillage	Crop rotation
1	No-Till	Corn-Soybeans
7	Ridge-Till	
2	Conventional	
3	No-Till	Corn-Soybeans-Wheat
4	Conventional	
5	No-Till	Corn-Soybeans-Wheat-Alfalfa
6	Conventional	

may be better able to sort out any advantages.”

Theoretically, no-till is more profitable when moisture is limiting, Berg says, and the first years of the study were dry.

The no-till systems attracted perennial weeds, Canada thistle and perennial grasses in particular, Berg says. He keeps them at bay with glyphosate and has been using glyphosate-tolerant crops for several years. “That simplifies the herbicide program.”

**F**armers who drill soybeans can generally count on about a 10% increase in yields over using rows, Berg says. He’d drill, too, if the practice fit the study. “But I have to keep the playing board even. Drilling would obviously mess up the ridge-till part of the study.

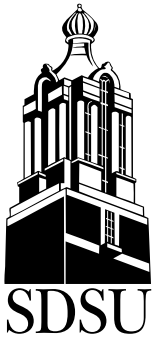
“A few folks around here ridge-till. It has its advantages in wet years when the ridges dry out

faster. It also reduces herbicide costs, because you can band over the rows and cultivate weeds between the rows. But if it’s a wet year and too soft to cultivate, you’re out of luck.

“We use the same row spacings in all systems — ridge-till, no-till, and conventional — to more accurately measure the effect of tillage. If one system has to be in rows, all have to be in rows.”

**B**erg says this research is important to farmers in the area. “For some of them, this research validates what they are doing. It also shows them what could happen if they decide to try different rotations or tillage practices.

“The project is a popular topic at field days and winter meetings. So we’ll keep it going, and we’re planning to add some work to see how or if these practices cause changes in water use and soil quality.” □



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