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Utilizing and developing our resources to enhance quality of life

Farm & Home RESEARCH

Volume 57 • Number 1

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



**HIDDEN DRAG
ON GROWTH:
LUNG LESIONS**

**HOW LONG CAN THE
GOOD YEARS LAST?**

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On the cover:

Jay Daniel, SDSU sheep researcher, says that a bad case of lung lesions—more than 50% consolidation in any lobe of the lung—in a lamb can drop its daily gain 10% below average. It's a condition that seems to come on after weaning and is found more often in spring-born than in fall-born lambs. It is nearly impossible to detect just by looking at the lamb; only slaughter will reveal the telltale purple lesions.



Director's comments

B Y C . Y . W A N G
*Interim Associate Director, South Dakota
Agricultural Experiment Station*

Continue the excellence

It has been a joy to work with every one of you—researchers and South Dakota producers—during my time as interim associate director for SDAES. This is the last issue of *Farm & Home Research* in which I will have the opportunity to provide comments on this page.

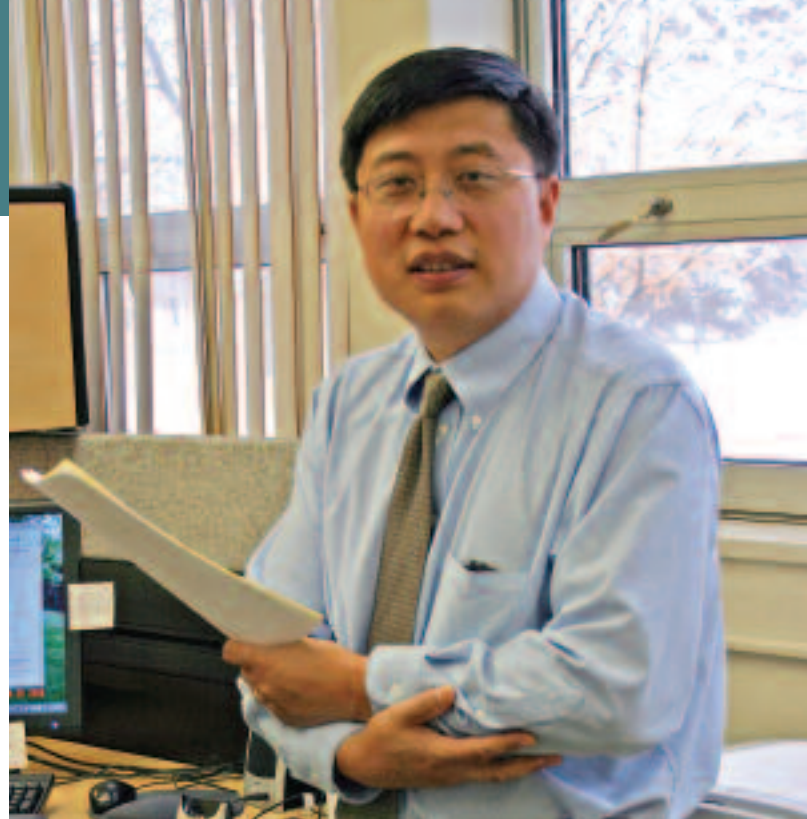
As many of you have heard, Dr. John Kirby will soon begin his duties as director of the South Dakota Agricultural Experiment Station. I have come to know John very well during the past 2 months. He is an outstanding scientist and a visionary leader who is committed to the continued excellence of the SDAES.

I am excited about the future of the SDAES with Dr. Kirby's leadership. Like each of you, I am looking forward to his arrival so that we can begin building a productive work relationship with him.

This is another excellent issue of *Farm & Home Research*. It covers reports from different areas of our research focus: plant/animal systems, natural resources and environment, value added processing, and family and community.

For instance, Dr. Alan Young of the Veterinary Science Department has started an innovative project on prions in cooperation with RTI, a local Brookings company. Abnormal prion proteins can cause scrapie in sheep, mad cow disease, and Creutzfeldt-Jacob disease in humans.

Dr. Jay Daniel's work on lung lesions in lambs has important economic impacts for our sheep producers. A serious case of the disease can remain virtually invisible until slaughter but will retard average daily gain.



C.Y. Wang

The article, "Replacements on range and DDGS equal dry-lot-raised heifers" offers a great example of integration of research and Extension. I congratulate Robin Salverson, Harding County Extension livestock educator, for doing a great job of working with researchers on this important subject.

This issue has an important report on Dr. Ron Gelderman's work with nitrogen applications and protein content in wheat. It also reports his segment of our DDG utilization collaboration project with Iowa State University. Dr. Gelderman's research shows interesting prospects for using residue ash from gasification of processed DDG.

The article on the Antelope Station offers a historical perspective on the work of the SDAES in the northwestern part of the state. It shows how researchers continue to work alongside northwestern ranchers, facing the same environmental challenges while discovering and applying good science to cattle and sheep production in this area of our state.

The article about climate change and its impact on prairie pothole wetlands addresses a common interest area—our environment. Dr. Johnson's work provides insights for this issue; he can answer a lot of "what ifs?" as global warming occurs.

In closing, I would like to thank you, our stakeholders: Your continued support makes our continued excellence possible. I have met some of you in person during community leader meetings last winter. I truly enjoyed our interactions. Stop by when you are in the Brookings area. Our scientists and I will be happy to talk with you. ♦

“... it’s thought that the protein in the kernel is laid down before most of the carbohydrates. Therefore the **nitrogen should be applied early** in kernel development.”

—RON GELDERMAN,
SDSU SOIL TESTING LAB MANAGER



Late N boosts PROTEIN

South Dakota producers hoping to tap into premiums for protein in their 2006 wheat crop can get some help from South Dakota State University.

Ron Gelderman, manager of SDSU's Soil Testing Laboratory, says that while circumstances such as weather can affect the result a grower gets, a growing body of research is demonstrating that late nitrogen applications can bring about higher protein levels.

"We've done a number of studies with both winter and spring wheat looking at the effects of late N applications on wheat grain protein," Gelderman says. "Our data suggest an average of about 0.75% and 1% grain protein increases for spring and winter wheat, respectively, when the N is foliar-applied just after flowering."

But Gelderman adds that accurately predicting when the late-applied nitrogen will boost protein levels is difficult.

SDSU work suggests that if potential wheat yield at late boot to heading stages appears to be better than early season yield goals, the chances of nudging protein levels higher is about 70%.

However, if potential wheat yield appears to be at or below yield goal, there's only about a 23% chance of getting the protein boost.

NITROGEN RATES AND NITROGEN SOURCES and their connection to protein are also being explored by SDSU scientists.

Work with spring wheat suggests that a grower needs to add an average of 30 lb nitrogen per acre beyond what is needed for maximum yield in order to get the maximum protein level. Actual nitrogen needed to raise protein content by 1% is about 6 lb an acre at a 60 bu/acre yield; it increases to about 10 lb an acre at 100 bu/acre yield.

For nitrogen sources, producers can use either urea, a dry nitrogen fertilizer, or liquid 28% nitrogen.

"There are problems and advantages with both sources," Gelderman says. "With 28%, we run the risk of significant burn to the flag leaf, and that has been shown to reduce yield. Its advantage is that some of the nitrogen may be taken up through the leaf and stem."

With dry urea, Gelderman says, producers need rain within 2 weeks to dissolve the granules and move the nitrogen into the soil.

"Four years of comparisons between liquid and dry forms show a distinct advantage for the liquids applied to spring wheat. We would conclude that some of the N is taken into the plant directly through the leaf, stem, or head," Gelderman says.

SIX YEARS OF COMPARISONS SHOW a clear advantage if foliar N is applied at post-pollination instead of at the boot stage.

"How late the producer can apply the nitrogen needs further research," Gelderman says. "But it's thought that the protein in the kernel is laid down before most of the carbohydrates. Therefore the nitrogen should be applied early in kernel development."

To avoid leaf burn, Gelderman advises producers don't apply nitrogen under hot, dry, high light intensity conditions. Instead, he says, they should choose cool, cloudy days or apply the nitrogen toward evening.

SDSU studies have never shown a significant problem with leaf burn when making foliar applications of liquid nitrogen at 30 lb N/acre (10 gallons/acre of 28%) diluted on a 1:1 basis with water to 20 gallons per acre, he adds.

The South Dakota Wheat Commission provided support for the tests.◆

—Lance Nixon



DDG ASH AS FERTILIZER?

Dried distillers grain can produce a nutrient-rich ash that may be used as plant fertilizer, a South Dakota State University research project shows.

Dried distillers grain (DDG) is the co-product from ethanol fermentation via dry-grain milling. DDG is mostly used as livestock feed, but SDSU scientists are studying ways to develop additional value-added products.

One project, conducted by Bill Gibbons, microbiology professor, involves gasification of DDG to produce biopolymers that may be used to manufacture degradable plastics, synthetic fibers, and film.

The gasification process leaves an ash residue that is rich in potassium and phosphorus. Ron Gelderman, professor of plant science, conducted two research projects to investigate if this ash has potential application as a low-cost fertilizer.

“We did a field study and a greenhouse study to investigate the use of the ash as a plant nutrient source. We concluded that the ash had effects comparable to those of traditional fertilizer,” Gelderman says.

Gelderman, Jim Gerwing, Extension soils specialist, and Anthony Bly, research associate, first conducted a study at a cornfield near Flandreau, applying different rates of DDG ash or fertilizer to test plots. They also supplied other nutrients, such as nitrogen and zinc, as needed according to soil tests.

They found that the ash produced results in terms of plant growth and yield comparable to those from regular sources of potassium and phosphorus.

“Ash residue was just as effective as fertilizer phosphorus (P) and potassium (K) for corn production,” Gelderman says.

THEN, IN THE GREENHOUSE, Gelderman and Keri Skroch, graduate student, further tested the ash as a plant nutrient source.

“The objective of this study was to determine the phosphorus and potassium fertility value of DDG ash for corn,” Gelderman says.

They planted corn in pots and added five different rates of fertilizer and DDG ash, studying P and K separately.

“We added fertilizer or ash material to the appropriate soil weight while stirring in a cement mixer. Twelve pounds of the treated soil was placed into 2-gallon pots, which were planted with corn seeds. The plants were harvested after 4 weeks, cut off, and analyzed for growth and nutrient uptake. Soil samples from the pots were taken after harvest and analyzed for P and K,” Gelderman explains.

“Ash residue was just as effective as fertilizer phosphorus and potassium for corn production. ... it needs to be put into a form such as pellets that would allow easier application.”

—RON GELDERMAN,
SDSU SOIL TESTING LAB

“In this study we did not get a response to potassium with either fertilizer or ash, as the selected soil appeared to supply adequate plant potassium,” Gelderman says. “But we did get a good response to phosphorus from both the fertilizer and the ash.

“The DDG ash and the fertilizer phosphorus increased corn growth just about equally,” says Gelderman. Although there were no differences in growth between fertilizer and DDG ash, there was a difference between either of these and the control condition, where no phosphorus was applied, Gelderman adds.

These results indicate that in terms of supplying nutrients, DDG ash may well be used in place of regular fertilizer. But there are still some hurdles to overcome before large-scale application of the ash is practical, Gelderman says.

“The ash is difficult to apply to the field, as it is a fine powder. Spreading this material in the field coats everything with a very fine, abrasive dust. So it needs to be put into a form such as pellets that would allow easier application,” Gelderman says.

Another potential problem is the chemical sodium hydroxide, which is used when protein and fat are extracted from DDG before gasification. “If the sodium residual remains in the ash, it could be detrimental to the soil,” Gelderman says. “So we need to see if that poses a problem or if a different material can be used for the extraction process.”

But if these problems are solved, ash could become another value-added DDG co-product that would give producers a feasible alternative to fertilizer.

At today’s fertilizer prices, the ash contains the equivalent of \$80 of phosphate and \$36 of potash per ton, or a total value of \$116 worth of nutrients. If the material could be pelleted, transported, and spread for less than \$116 per ton, it would be economical for a producer who needed both of these nutrients, Gelderman says.

The field study was funded under a joint grant with Iowa State University from the USDA and the U.S. Department of Energy (see sidebar). The greenhouse study was funded by the South Dakota Corn Utilization Council and the South Dakota Agricultural Experiment Station. ♦ —*Marianne Stein*

VALUE-ADDED PROJECTS AT SDSU

A team of SDSU scientists is putting resources together for a large-scale investigation of value-added products developed from dried distillers grains (DDG), the co-product from ethanol production via the dry-milling process. The group is subcontractor for a \$1 million grant from the USDA and the U.S. Department of Energy. Iowa State University is prime contractor. An ethanol company called Midwest Grain Processors Corp. also participates in the research.

Nine SDSU scientists are involved with the project, each working on a section specific to his expertise and other research activities:

Jim Julson, professor of ag and biosystems engineering. Principal investigator and facilitator of SDSU’s subcontract with Iowa State University.

Doug Raynie, assistant professor of chemistry and biochemistry. Using supercritical carbon dioxide to remove lipid matter from DDG prior to gasification and to isolate polyhydroxyalkanoate (PHA) biopolymers from bacterial cell biomass.

Padmanaban (Padu) Krishnan, professor of nutrition, food science, and hospitality. Separating protein and fiber fractions in DDG and investigating performance characteristics and organoleptic aspects of oils recovered from DDG.

Chunyang (C.Y.) Wang, professor and head of SDSU’s department of nutrition, food science, and hospitality; interim associate dean and director of the South Dakota Agricultural Experiment Station. Extraction of proteins from DDG and characterization of recovered oil products, including nutritional benefits, organoleptic quality, color, and viscosity.

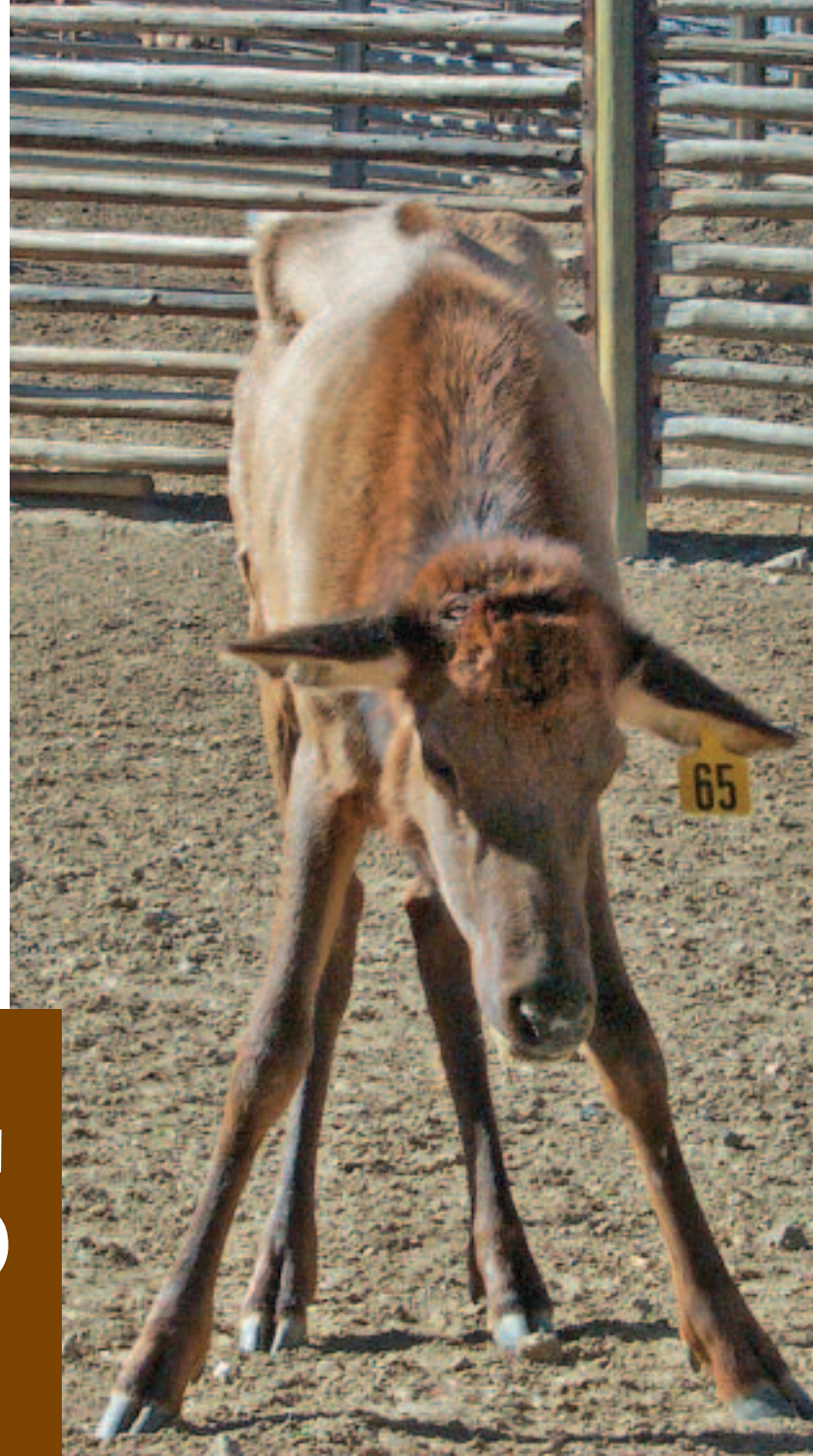
Fathi Halaweish, associate professor of chemistry. Extraction of proteins from DDG by salting out. Chemical characterization and evaluation of the proteins, including foaming and emulsifying properties, solubility, viscosity, adhesiveness, water-holding and oil-holding capabilities.

Bill Gibbons, professor of microbiology. Developing a less expensive medium for cultivation and production of PHA.

Tom West, professor of chemistry and biochemistry. Growing PHA on condensed corn solubles and determining the effect of using this medium.

Ron Gelderman, professor of plant science. Evaluating plant nutrient potential of ash residue from gasification of DDG.

Michael P. Twedt, instructor, Mechanical Engineering Department and director of the Energy Analysis Lab. Cost estimation of upstream recovery of DDG products.



SHORTCUT TO DIAGNOSIS: **PRIONS** IN BLOOD SAMPLES

Photo Credit: Dr. Terry Kreeger, Wyoming Game & Fish Department

Developing a live animal test for Chronic Wasting Disease is one of the first projects underway at South Dakota State University's Center for Infectious Disease Research and Vaccinology (CIDRV).

CIDRV, a multi-university unit headquartered within SDSU's Department of Veterinary Science, was established in Spring 2005 with partial funding from Gov. Rounds' 2010 Research Initiative. One of the center's mandates is to promote economic development in South Dakota by providing research-based assistance to local biotechnology industries.

Alan Young, associate professor of veterinary science and a CIDRV faculty member, is lead investigator for SDSU in a partnership between CIDRV and Rural Technologies, Inc. (RTI), a Brookings-based contract research company.

RTI obtained a \$750,000 grant from the U.S. Department of Defense's Small Business Technology Transfer Program for

“The bottom line is that we think we have the capability of developing a live animal test for CWD and other prion diseases as well.”

—ALAN YOUNG,
SDSU CIDRV

the project. The company contracted with CIDRV and USDA National Animal Disease Center (NADC) in Ames, Iowa, to conduct parts of the research.

“Basically, it’s a cooperative contract that arises from work that we originally started in our lab at SDSU and that has since become translated into a potential new bioassay to look for Chronic Wasting Disease in live animals,” Young explains.

CHRONIC WASTING DISEASE (CWD) IS A DEADLY neurological disease that affects cervids (elk, deer, and moose). It belongs to a category of diseases known as transmissible spongiform encephalopathies (TSE), caused by abnormal prion proteins. Other TSE diseases include scrapie, mad cow disease, and Creutzfeldt-Jacob disease in humans.

Existing tests for CWD are only available for deceased animals, because they are performed on brain tissue. However, Young’s research suggests that it is possible to construct a test on a blood sample from a living animal.

“Most people think of CWD and other prion diseases as being neurological diseases that affect the brain and neurological tissues. Neuronal cells are hard to get at for diagnosis, which is why virtually all of our existing licensed tests for CWD, scrapie, mad cow disease, or Creutzfeldt-Jacob disease are post-mortem tests. Basically, we look at a section of brain tissue to see if it’s positive,” Young says.

However, infectious prions are found in other places as well. “In fact, the earliest place that we see the infectious prion show up is in lymphoid tissue such as lymph nodes or tonsils. They are also found in immune cells, which have the advantage that we find them in the blood.”

Infectious prions appear in the blood and lymph nodes in such small quantities that they are very difficult to detect. But Young’s research gets around this problem by focusing on a specific type of immune cells that appear to proliferate the prions.

“We chose to look at the involvement of a particular type of immune cells called follicular dendritic cells (FDC). They interact with migratory cells in the immune system called B-cells, which make antibodies, and they seem to concentrate the prions in this process.”

The scientists developed a method to cultivate FDCs in a tissue culture dish, and they found that the cells were able to “grow” infectious prions. “The FDCs were actually capable of capturing the infectious prions and replicating them so they would be detectable.

“What we hope to do is to develop a blood test for CWD where we can actually use blood taken from a live animal, place it under our cultures, and then detect the presence of the infectious prion.”

A live animal test would be particularly useful for commercial deer farmers, Young says. “Some deer farmers have been hit very hard by CWD. It’s difficult for them to determine if they have a CWD infection in their herd, because there’s no test to use on live animals.”

While Young’s research is still in its early stages, he says the method is very promising. “We’ve done some preliminary tests and it’s very clear that we are able to detect low levels of the infectious prion molecules, using our cultured follicular dendritic cells. We have data suggesting that we can in fact do this from the blood of sheep. We’re now using the same mechanism with blood from cervids. So we’re fairly confident that the system will work.

“The bottom line is that we think we have the capability of developing a live animal test for CWD and other prion diseases as well,” Young says.

THE GOAL IS TO HAVE A COMMERCIAL TEST available within the next few years, says Christopher Mateo, RTI manager of operations. He adds that while the current research is focused on CWD, potentially the method could be used to develop similar tests for other prion-based diseases.

“RTI’s partnership with SDSU helps us develop technology based on research conducted at the CIDRV. The scientists focus on the basic mechanisms for how the disease works, and RTI translates that research into a marketable product,” Mateo says.

David Francis, CIDRV director and professor of veterinary science at SDSU, says that this is one of the first CIDRV projects that has reached a stage where technology is being developed into a product, and it is a prime example of CIDRV’s goals.

“The center has an economic development mission. One of the reasons that we exist is to help support entrepreneurial activity.

“So of course we’re excited about the opportunity to assist RTI with their grant, and we are encouraging other SDSU scientists to do the same. This is helping to fulfill the obligation that we incurred when we got the funding to establish the center,” Francis says. ♦

—Marianne Stein



DIFFERENCES ARE MORE THAN SKIN DEEP

Brown Swiss cattle are much less common in U.S. dairy herds than America's favorite dairy breed, the Holstein. But milk from Brown Swiss cows has some unique characteristics that may be worth noticing, South Dakota State University dairy scientists say.

"Brown Swiss cows consistently produce milk that is higher in fat and higher in protein than Holsteins do," says Arnold Hippen, SDSU associate professor of dairy science. "Their milk is very well suited for cheese production. The ratio of fat and protein in Brown Swiss milk is close to the ideal ratio for making Cheddar cheese in particular."

One SDSU project, funded by the South Dakota Agricultural Experiment Station, compared milk composition in Holstein and Brown Swiss cows in early lactation. Results showed that the average composition of Holstein milk was 4.06% fat, 3.01% total protein, and 12.23% total solids. Brown Swiss milk was higher for all these components: namely, 4.15% fat, 3.36% protein, and 13.11% total solids.

These characteristics are significant for cheese manufacturers, says Vikram Mistry, SDSU dairy science professor and department head. More fat and protein translate into a higher cheese yield. For example, the study also showed a yield increase of 8.8% in Cheddar cheese made from with Brown Swiss milk, compared to Holstein milk.

Higher contents of fat and protein also mean that the milk is more concentrated, Mistry says. Many cheese plants concentrate the milk before making cheese, but because Brown Swiss milk is already pre-concentrated, this step in the production process can be eliminated.

Milk with more fat and protein also produces more concentrated whey, the co-product of cheese production. Whey is used in dried form for a variety of commercial purposes, and it is converted into powder by removing the water. This can be done more efficiently if the whey is already concentrated, Mistry says.

A HERD OF APPROXIMATELY 40 BROWN SWISS cows is kept at the dairy research and training facility. Nutrition and feeding studies show the differences between them and cows in the herd of 100 Holsteins.

Because cows usually need to be at a certain stage of lactation for inclusion in an experiment, typically only four to eight Brown Swiss cows are available for research at any given time.

“Our results are limited, because we have just a few Brown Swiss cows, but our evidence suggests there is a difference. We’re trying to follow up on these findings in other studies.”

—ARNOLD HIPEN,
SDSU DAIRY SCIENCE ASSOCIATE PROFESSOR

That isn't sufficient for large-scale comparisons but is enough to pick up differences in milk composition and metabolism, Hippen says.

Most of Hippen's research deals with feeding co-products from corn, soybean, and milk processing to dairy cattle. In a recent study, funded by the South Dakota Soybean Research and Promotion Council, the researchers fed glycerol, a co-product from soybean diesel production, to the cattle as an energy supplement.

“We were able to increase production efficiency, which was expected, because glycerol is energy dense,” says Hippen. “The results were similar for Holstein and Brown Swiss. That's typical for all our feeding experiments; feed utilization is similar in the two breeds. But we were able to observe the usual differences in milk composition.”

SDSU research supported by the South Dakota Corn Utilization Council also indicated that Brown Swiss milk may contain higher levels of conjugated linoleic acid (CLA) than milk from Holsteins. CLAs are known to have cancer-preventing properties.

“Our results are limited, because we have just a few Brown Swiss cows, but our evidence suggests there is a difference. We're trying to follow up on these findings in other studies,” Hippen says.

Hippen notes that there are other differences between Brown Swiss and Holstein cows, but their significance isn't fully understood. “We consistently find that Brown Swiss cows have more urea nitrogen in the milk than Holsteins, but we're not sure what it means. Urea nitrogen comes either from the rumen breaking down protein or the body changing amino acids to make better protein. It may be related to protein synthesis in the mammary gland.

“Brown Swiss cows produce more protein; yet, they have more excess nitrogen in the milk. That is counterintuitive. You would expect the nitrogen level to be lower, because they are turning more of it into protein, but that's not the case. It could mean that they are more efficient in protein utilization, but we don't know yet.”

Hippen has also observed that Brown Swiss cattle seem to have more resistance to ketosis, a serious metabolic disorder. “Typically, we see higher levels of ketones in the Brown Swiss cows, which would indicate that they are more likely to be ketotic. However, the causes of ketosis, which are body fat mobilization and fatty liver syndrome, seem to be less frequent in Brown Swiss cows. This suggests that they are better able to

metabolize fat into ketones to be used by other tissues and are less susceptible to suffering from severe ketosis.

“We're currently doing a long-term lactation study with support from the USDA Agricultural Research Service, feeding wet distillers grains. We are looking at the whole lactation period and also following the cows into a new lactation. We want to study the transition period between lactations, where the cows are most susceptible to metabolic disorders such as ketosis. We're hoping this will also give us more data to indicate differences between Holstein and Brown Swiss cows.”

AND WHY DON'T BROWN SWISS CALVES like to drink from a bucket?

SDSU researchers support a Brown Swiss Cattle Breeders Association research project conducted at Iowa State University. The project, which is dubbed “Smart Calves,” looks at why Brown Swiss calves do not like to drink milk from a bucket. “They drink well from their mother and fairly well from a bottle, but training them to drink from a bucket is very difficult,” Hippen says.

It is a major concern for Brown Swiss producers. So the Brown Swiss Association is funding research to study physiological differences that may explain this. “Iowa State University has limited numbers of Brown Swiss cows available, so we will supply additional blood samples for that research. Our data are particularly valuable, because we have Brown Swiss and Holstein cows in the same herd.”

The SDSU Dairy Plant produces Brown Swiss Cheddar cheese, butter, and ice cream. Brown Swiss milk is specifically sorted at the farm and transported to the dairy plant for processing. The Brown Swiss product line is sold at the SDSU Dairy Bar.

The Brown Swiss Association (BSA) has also supported SDSU through “Send a cow to college,” a program where BSA members donated cows to SDSU. The program was active from 1994-96, and Mistry and BSA Executive Secretary David Kendall are aiming to revitalize it.

Kendall says the BSA is very supportive of dairy research and product development at SDSU. “Dr Mistry was one of the first to show that there is a distinct difference in some of the characteristics of Brown Swiss milk, and we believe that it definitely adds value not only to our milk, but also to our cattle,” Kendall says. “We're trying to get our members interested in supporting the Brown Swiss research that SDSU can do for us.” ♦

—Marianne Stein

HIDDEN DRAG ON GROWTH LUNG LESIONS





Jeff Held, SDSU Extension
sheep specialist



A condition that impairs lung capacity in lambs is also smothering a percentage of producer profits, South Dakota State University research shows.

Joseph A. “Jay” Daniel, SDSU sheep researcher, and Jeff Held, SDSU Extension sheep specialist, are determining the effect that lung lesions may have on lamb growth. They have also tried to find out when lung lesions begin occurring and have examined possible strategies to lessen the effects of the lesions.

It’s research that can have practical results for producers and processors, one South Dakota feedlot operator says. Bill Aeschlimann of Hurley-based Dakota Lamb says lambs that turn out to have lung lesions clearly don’t perform as well in the feedlot. Furthermore, he adds that a lamb with lung lesions won’t pass the inspection to be certified at higher levels of the kosher market, where Dakota Lamb sells a portion of its meat.

“If there’s any kind of a blemish, the lamb would not pass the kosher requirement,” Aeschlimann explains. “A lung lesion is a blemish.”

Daniel describes a normal lamb’s lung as a pink, bubble-gum color with a spongy feel. Lung lesions are areas of dark purple, consolidated tissue that feel rubbery. Those consolidated areas are associated with past lung infections.

Lung lesions are virtually impossible to detect just by looking at the lambs.

“We know that lambs that are severely affected have significantly reduced performance, though you wouldn’t necessarily be able to identify them visually,” Held says. He adds that there’s a suspicion that condition producers know as “barn cough” may be related; but Daniel says there’s no hard, clear link as yet.

“It might be; we just haven’t been able to document it yet.”

Only by examining the lungs when lambs have gone to slaughter can researchers pinpoint which lambs had lung lesions and to what extent.

THE IMPACT THAT LUNG LESIONS can have on profits came out when the scientists cross-referenced carcass data with records of average daily gains from before the animals went to slaughter.

“Early on in the study we matched up consolidation with growth, and we saw about a 10% decrease in average daily gain for lambs that had what we call ‘severe lung lesions,’

“... we saw about a 10% decrease in average daily gain for lambs that have what we call ‘severe lung lesions.’ We’re trying to figure out what we can do to get rid of these lesions and hopefully recapture that growth.”

—JAY DANIEL,
SDSU SHEEP RESEARCHER



Lung lesions are purple masses in an otherwise pink lung.

Daniel says. “We’re trying to figure out what we can do to get rid of these lesions and hopefully recapture that growth.”

A ‘severe lung lesion’ in the study was defined as more than 50% consolidation of any lobe of the lung. The lung is divided into right and left, Daniel explains. The right has four lobes and the left has three lobes, as defined in the study.

SDSU researchers also slaughtered lambs at different ages to try to find out when lung lesions are forming.

It’s clear that the lung lesions in the SDSU flock occurred after weaning, Daniel says.

“When we slaughter them at weaning, we don’t see this problem at all. But if we slaughter them halfway through finishing, or at the end of the finishing period, the lesions are there.”

Lung lesions could be related partly to the stress of weaning, Daniel says, though that, too, is an unanswered question.

THERE’S A MAJOR DIFFERENCE IN INCIDENCE of lung lesions depending on when lambs were born, the researchers are finding. The SDSU study found 64% of spring-born lambs had lung lesions. In contrast, only 29% of fall-born lambs had lung lesions.

“We’ve looked at lambs from random flocks in Minnesota and eastern South Dakota and have seen the same problem. There’s also been reports of similar problems in lambs from New Zealand, so it seems to be fairly widespread,” Daniel says.

“We’ve looked at some range lambs and they didn’t seem to have the problem as bad. That might be related to the environment in which they were raised.”

Daniel explains that in eastern South Dakota and the eastern U.S., lambs are more often raised in a farm flock. They’re lambled in a barn, usually fed a lot of grain, and finish very quickly. Range lambs, in contrast, may or may not be lambled in a barn, but they’re more likely to be raised on grass, with grain added to the diet at the end of the finishing period. Range lambs are usually older when they go to slaughter than farm flock lambs.

Aeschlimann, who custom feeds lambs for some western producers from the Belle Fourche area as well as Montana, Wyoming, and Colorado, agrees that western range lambs seem healthier.

“We’ve found that lambs from the western regions that are not shed lambs don’t appear to have the respiratory problems of lambs in confinement,” Aeschlimann says.

SDSU tried vaccinating against pathogens associated with lung lesions in lambs. But the vaccinated animals in that experiment didn’t show any statistical difference in incidence of lung lesions—82% vs. 84% incidence of lung lesions in vaccinated vs. unvaccinated lambs. The data also showed that vaccination didn’t alter the incidence of severe lung lesions. It remained at about 63% in vaccinated and unvaccinated lambs.

Daniel and Held conclude that it does not appear that vaccination against the pathogens *Mannheimia (Pasteurella) haemolytica* and *P. multocida* will prevent lung lesions.

One SDSU-NDSU experiment also looked at supplemental feeding of selenium to lambs, since selenium is thought to help the immune system function. Held notes that the selenium did show up in the meat of the lamb.

“That raises the possibility that selenium-enriched lamb may one day be marketed as a natural way of getting selenium into the diet in parts of the world deficient in selenium,” he says. But the selenium did not alter the incidence of lung lesions or their severity.

“We’re trying to find ways to intervene and prevent lung lesions,” Daniel says. “But right now the only thing we know that will lessen the incidence is fall lambing. The problem is that sheep naturally lamb in the spring. It’s harder to get them to lamb in the fall and that doesn’t match a lot of producers’ management systems, either.”

Lung lesion work at SDSU has been funded by the Agricultural Experiment Station and the Four-State Ruminant Consortium.

◆—Lance Nixon

REPLACEMENTS

on range and DDGS equal drylot-raised heifers



Raising replacement heifers on northwestern South Dakota's rangeland may be a cost-effective alternative to using a drylot setting—if producers use a feed supplement to compensate for range forage.

Equally important, reproduction rates don't suffer when those range-raised animals are compared to drylot-raised heifers.

Those are key findings in a South Dakota State University study from the Antelope Range Research Station near Buffalo in the northwestern corner of South Dakota.

Harding County Extension Livestock Educator Robin Salverson evaluated the cost and effectiveness of raising replacement heifers in range and drylot systems in a 2-year study. Assisting in the project were Trey Patterson, former SDSU Extension beef specialist; George Perry, Extension beef reproduction management specialist; Antelope Research

“... range heifers can be developed and achieve the same performance in weight gain, average daily gain, and reproductive performance compared to our more traditionally developed drylot heifers fed ad-lib hay and a protein supplement.”

ROBIN SALVERSON,
SDSU HARDING COUNTY EXTENSION LIVESTOCK EDUCATOR

Station Superintendent Doug Young; and Matt Gibson, executive director of Dakota Gold Research Association. Dakota Gold, a not-for-profit, Sioux Falls-based research group that focuses on distillers products from ethanol plants, also provided financial support for the experiment.

The study used a range setting on which to develop early weaned heifers, who typically must be developed for a longer time and at greater cost than traditionally weaned animals.

Developing heifers on range is not a common practice in northern South Dakota, Salverson says, because of the perception that such a system can't maintain adequate reproduction—partly due to the poor quality of forage available during winter months.

DRIED DISTILLERS GRAIN WITH SOLUBLES (DDGS) were the supplement in the SDSU study. Expectations were that the DDGS would help compensate for the poor quality of winter forage on rangeland, although the animals still would have to graze to meet most of their daily requirements for nutrients.

In the first year, the researchers randomly allocated 65 heifers into one of two heifer development systems. In the range system, heifers were weaned Aug. 12 at an average age of 132 days and 395 pounds, placed in a drylot setting, and fed a weaning ration until Sept. 25.

On that date they were turned out on native range and supplemented with loose meal DDGS fed in bunks at an as-fed rate of 2 lb per head per day in September, increasing by stages to 7 lb in February, then decreasing again. The rate of feeding DDGS was calculated to bring the animals to a target weight of 863 pounds by breeding time in June, or 65% of mature weight.

Hay was fed to the range heifers on only two days when snow prevented grazing.

In the second (normal) system, heifers were weaned on Nov. 6 at an average age of 218 days and an average weight of 565 lb, placed in drylot, and fed the same weaning ration as the range group until Dec. 13.

On that date, though they remained in drylot, they were placed on a diet of ad-libitum access to grass hay and a conventional supplement, fed at an as-fed rate of 3 to 4 lb per head per day (enough to reach the same target weight as the range-raised group).

Both treatments ended May 18, when all the heifers were turned out to native range as a single group.

THE DDGS WORKED BETTER than anticipated, Salverson says. Range-raised heifers consistently outpaced the drylot-raised group in average daily gain.

Heifers on range added an average of 1.34 lb a day from December through February, compared to 1.19 lb for animals in the drylot group; 2.13 lb a day in March compared to 1.30 lb a day for the drylot group; and 2.58 lb a day in April compared to 1.78 lb for the drylot group.

As a result of those greater-than-expected gains, range heifers tended to be larger on average than drylot heifers (859 lb to 830 lb) when the treatments ended in May.

Salverson says DDGS—a co-product of the ethanol industry that is now plentiful in South Dakota and neighboring states—helps supply what is lacking in range forage because it is rich in fat, fiber, and protein. Its low-cost mix of protein and energy also can allow producers to substitute DDGS for more expensive hay in heifer development programs. Research has shown that both fat and nondegradable intake protein, when added to the diets of bred heifers in late gestation, result in higher reproductive rates.

That was the other crucial aspect of the SDSU study. Salverson found no statistically significant difference in reproductive rates: a final pregnancy rate of 91% with the range-raised replacement heifers compared to 88% in the drylot-raised group.

And as to cost, “we were able to feed our heifers at 52 cents per head per day, and this is only including the feedstuffs. For our drylot heifers fed a 29% commercial supplement, the cost was 74 cents per head per day. So we were successful at a lower cost but also achieving the same reproductive success,” Salverson says.

“We are finding that range heifers can be developed and achieve the same performance in weight gain, average daily gain, and reproductive performance compared to our more traditionally developed drylot heifers fed ad-lib hay and a protein supplement.”

The study was done in 2003–04 and repeated in 2004–05 with similar results, Salverson says. But Salverson adds that years with severe winter weather may make it necessary to feed more hay to sustain performance.

A summary of the study is available in SDSU's 2005 Beef Report. Find it online at this link:

http://ars.sdstate.edu/extbeef/2005_Beef_Report.htm.

◆ —Lance Nixon



Ralph Trevillyan

FROM PRONGHORN PENS

It takes an old-timer like Ralph Trevillyan to explain why South Dakota State University's Antelope Range Research Station has its name.

As SDSU marks its 125th year in 2006, Antelope Range Research Station remains a key site of land-grant research activities with cattle, sheep, and range. Trevillyan might know the history of the station better than anyone because he served as the station's manager from 1953 to 1983.

The ranch was originally set up in 1924 with antelope in mind, he says. Wildlife managers in the South Dakota Department of Game, Fish & Parks (GFP) were counting pronghorns and didn't like what they saw.

"They were concerned because there weren't too many antelope left in this area at that time. When this part of the country was settled, the settlers hunted the antelope for meat."

Trevillyan says the GFP began to rescue the antelope popu-

lation by paying an incentive to Harding County cowboys to catch antelope the best way they knew how—with ropes.

"They'd rope the small ones and I think the GFP paid them \$5 for each one. They'd bring them in and put them in the Antelope station because they had built high fences around it."

By 1929, local reports placed the number of antelope in the "Antelope Preserve" at 450.

The fence posts, Trevillyan adds, were cut in the Black Hills, transported by train to Newell, and then carried the rest of the way to the station by team and wagon—probably a 3-day journey, he estimates. But the posts were of such good quality that even now, 80 years later, many of them remain in use on the high fences that surround Antelope Range Research Station.

The antelope that were put inside the fences multiplied for more than a decade. But then the snowy winter of 1936 arrived, high drifts covered the fencelines, and the antelope scampered off to repopulate areas outside the station.

WITH THE ANTELOPE POPULATION no longer an issue, ranchers and others in the area started talking about what else the Antelope station could be used for. They settled on SDSU as the ideal operator for the ranch, which covers an area of some 8,300 acres in the rugged country just west of the Slim Buttes in Harding County.

Producers from the Western South Dakota Sheep Growers Association, the Cooperative Wool Growers of South Dakota, the Black Hills Protective Association, the Harding County Livestock Improvement Association, the South Dakota Purebred Sheep Breeders Association, and the South Dakota

of many land-grant research sites in the northern Great Plains where scientists were looking into the problem.

“The whole five-state area was involved, Montana, North Dakota, South Dakota, Nebraska and Wyoming,” Trevillyan recalls. “You don’t hear much about it anymore because they solved it.

“The gene had to come from both sides, both the sire and the dam, or you didn’t have the dwarf. If you cleaned up on one side or the other, you didn’t have to worry about it anymore.”

Chris Dinkel, one of the scientists who studied dwarfism, also used the Antelope station as one site to carry out studies on production systems and efficiency, developing an equation to predict production efficiency to weaning based on calf weaning weight and cow weight. Studies on inbreeding effects and later crossbreeding were also conducted.

TO HIGH-TECH RESEARCH

Stockgrowers Association were involved in the discussion. They helped broker an agreement between GFP and SDSU’s South Dakota Agricultural Experiment Station.

The state of South Dakota continues to own the land, but the Experiment Station operates the ranch for purposes of range and livestock research.

“In 1946 the GFP turned it over to the university,” Trevillyan recalls. “I think it was around 1950 before much of the research really got under way.”

The first thing SDSU and its stakeholders did was come up with a list of 21 problems the Antelope Range Research Station should focus on—topics such as parasitism in sheep, stocking rate and rotational grazing studies with sheep, supplements for wintering pregnant ewes, and beef cattle breeding research. It’s a list that sounds oddly familiar because 60 years after SDSU took over management of the station, researchers are still pursuing very similar topics at Antelope.

Beef genetics research dealing with the problem of dwarfism went forward for years at the Antelope station, one

Don Marshall, now associate dean and director of academic programs in SDSU’s College of Agriculture and Biological Sciences, says the Antelope station also has been a valuable location for students training to become agricultural scientists.

Marshall is one of SDSU researchers who worked at Antelope on several studies with cattle. One of his major projects was to evaluate breed combinations with varying levels of genetic potential for such traits as growth, milk production, and carcass composition. Cows were evaluated both on range conditions at Antelope and under drylot conditions where feed intake could be measured while progeny were evaluated for pre- and post-weaning performance and carcass traits.

According to Marshall, “this work indicated that quite diverse alternative breed combinations could be successful under certain conditions, depending on the cost/benefit factors assigned to such variables as calving ease, supplemental feeding, and yield and quality of meat.”

“One of the main lessons of this research,” Marshall suggests, “is the importance of taking into account multiple inter-

related factors that affect total system efficiency and profitability.

“For example, most producers recognize that if you’re going to increase genetic potential for milk yield in the cow herd, then either stocking rates must be reduced or supplemental feeding increased to account for increased input needs.”

A less-recognized factor, Marshall continues, “is the effect that increased milk may have on post-weaning calf performance. A calf that received more milk during the pre-weaning production phase will often be less efficient in post-weaning performance, but such negative consequences can be countered somewhat by increasing the growth potential of the calf through the use of a terminal sire.”

SOME OF THE STATION’S RESEARCH fit hand-in-glove with beef industry needs. Joe Minyard was one of the scientists who tackled the problem of grass tetany, a disorder in cattle that occurs when the level of magnesium in the cerebrospinal fluid, which surrounds the brain and spinal cord, decreases below a critical point.

“They worked with the chemical companies and found that by adding magnesium to range cake, they could stop that,” Trevillyan says.

“We also used to work with the chemical companies with pour-on treatments for grubs and so on. The university would furnish cattle to test those products on. It was very practical research at the time.”

Other research that had could be taken directly from the research station to the ranch included a 3-year storage study that evaluated round and square hay bales under cover and in the open in different configurations. The study showed there was no advantage, under normal rainfall conditions in the area, to using a hay shed or any particular stacking pattern.

Through the years the research station also tested Great Pyrenees guard dogs and llamas to reduce sheep losses to predators. Both animals were effective in reducing the number of lambs lost to coyotes at Antelope.

Sheep researcher Lowell Slyter used Antelope as a site to compare different breed combinations —research that could be used immediately by ranchers.

MORE PRACTICAL RESEARCH AT ANTELOPE is hidden in the rugged rangeland away from the ranch headquarters: old ruts and furrows in the grass that show the marks of tillage from the early 1970s.

That’s when Trevillyan recalls using heavy equipment to do “pitting” on slopes—more or less gouging a series of pits to retain water—to improve range productivity.

Similarly, he used heavy equipment to rip or break up some of the hard “pans” underlying some parts of the range. The intent was to let rainfall penetrate downward to improve grass production.

Sandy Smart, one of the current generation of range researchers at SDSU, says it’s exciting to see those research sites from the 1970s because even an untrained observer can see the results—the areas where ripping was done produce far more grass than pans that were left untouched.

In fact, Smart says, he has a current project starting up in which a student will quantify how much more productive the areas ripped in the 1970s are than the surrounding range.

Smart said that is research with a practical use for ranchers. Although a banker might be reluctant to loan money on such a project if the front-end costs are high, it’s an easier sell if the producer can point to increased range productivity that continues even more than 30 years later.

Also with an economic impact is a study by Harding County Extension Educator Robin Salverson, who has used the Antelope Station to look at the efficiency and reproductive performance of heifers developed on range instead of in a dry-lot setting. When supplemented with distillers grains, as in Salverson’s study, range-raised heifers perform just as well (see story this issue).

Other ongoing work at the station involves the Four-State Ruminant Consortium—a unified effort to target cattle, sheep, and range research needs of producers in the Dakotas, Montana, and Wyoming. SDSU and the land-grant universities in the other three states are involved.

For instance, SDSU Extension Sheep Specialist Jeff Held and assistant professor Jay Daniel have been studying back-grounding lambs on range; lung lesions in lambs; and alternate feeds such as soy hulls in lamb diets. Some of that work takes place at the Antelope station.

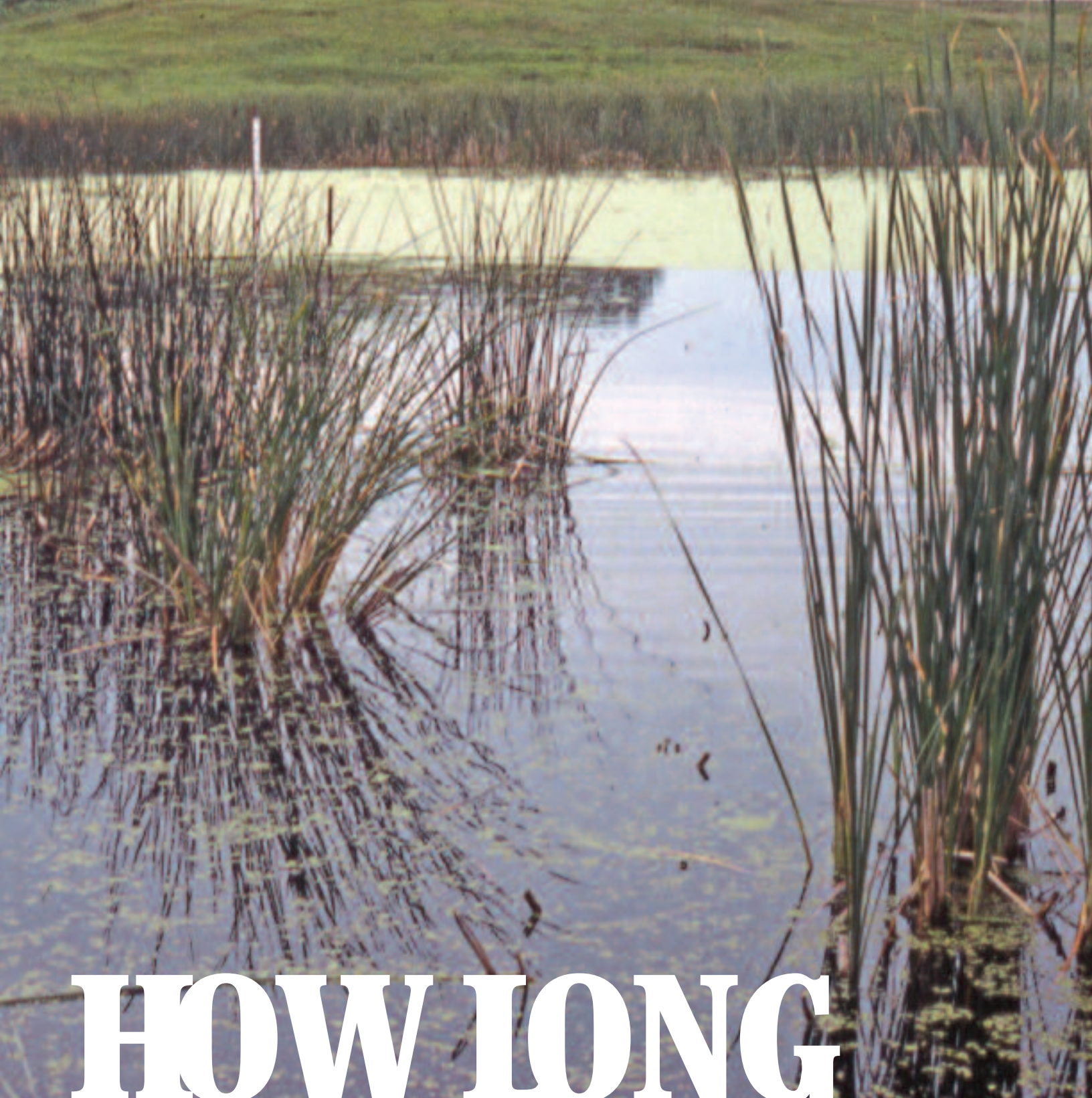
Other studies look at early weaning of calves and the forage savings that result; some of that work also is done at Antelope.

Antelope Range Research Station Superintendent Doug Young says much of the current research at Antelope involves strategies that will help producers adapt to changing demographics that make labor harder to find in rural America.

“With the continued decrease in the number of people working in the agricultural sector and with an aging population and the size of operations increasing, it is important to look at ways to decrease the labor requirements on these operations,” Young says. “The current Four-States Ruminant Consortium project dealing with different management strategies for cattle, calves, and sheep as well as the evaluation of replacement heifer development systems provide information that adds value to the agricultural operations in the region. At the same time ranchers can lower production costs and make efficient use of their available resources.”

Ultimately, Young says, the goal at Antelope remains unchanged despite changes in rural America and changing technologies and production methods: to provide science-based information from the land-grant university researchers that producers can easily incorporate into their own operations. ♦

—Lance Nixon



HOW LONG CAN THE GOOD YEARS LAST?

Global warming created our South Dakota prairie pothole lakes and wetlands.

Now another global warming may dry them up.

When the last glacier retreated some 12,000 or so years ago, it left buried chunks of ice that melted and created the prairie pothole region (PPR) of North America. Over the years it became the most productive wetland habitat for waterfowl in

North America. Fifty to eighty percent of U.S. wild ducks hatch in the pothole region, up to 95% in a good year.

The good years may be coming to an end.

By the year 2050, when ducks return in the spring, they may find few wetlands with water in the central Dakotas.

“Wetlands tend to be very sensitive to climate variability. In the model, it only took a 3 degree rise in temperature for the highly productive ‘duck factory’ to disappear from most of the PPR.”

—CARTER JOHNSON,
SDSU ECOLOGIST

While the future climate farther east in the PPR may be more favorable for duck breeding, nearly all of the wetlands in western Minnesota and in Iowa have been drained, providing no insurance against climate warming, says Carter Johnson, ecologist at South Dakota State University.

“Where we’ve had ducks breeding in the past we may not have them in the future. That might mean we should be thinking ahead, hedging our bets, restoring more wetlands in Iowa and along both sides of the Minnesota-South Dakota border.

THERE’S NO DOUBT THE WESTERN PORTION of pothole country, especially in the Canadian Prairies, is warmer and drier than it was a hundred years ago.

The central part of the PPR, running from Chamberlain and Mitchell up to Jamestown and north, has yet to undergo significant change. The extreme eastern fringe of the PPR region—Brookings—has actually become a little cooler and wetter in the last century, Johnson says.

His evidence is 95-plus years of records—1.9 million of them, in fact—of daily precipitation and minimum and maximum temperatures from 18 weather stations across the PPR.

“Is that climate change? Will the dry-up spread east in the PPR and how soon? Our data are only for 100 years but fit the global pattern of greater warming at higher latitudes, in winter, and at night. Since the glaciers melted, there have been distinct periods of cooling and warming that lasted from decades to centuries. But most experts think that this episode of warming is caused mostly by the burning of fossil fuels.

“Consider that NASA reports that 2005 was the warmest year on record. January 2005 was the warmest January on record around here. Globally, the last 100 years have been the warmest since the ninth century.”

A warmer and effectively drier PPR is forecast by most global climate models. But, says Johnson, no PPR-wide quantitative analyses of the relationships between climate and prairie wetlands had been conducted prior to his team’s studies. Most research was intensive on small wetlands areas rather than extensive.

It was time to build a computer model based on a real wetland and driven by the 1.9 million records of the Johnson

research team that would simulate where the most favorable conditions for waterfowl breeding would be under a warmer climate.

To accomplish this, the model would need to compute various measures of wetland condition, such as hydroperiod (days wet), drought frequency, vegetation cover and its return times (years to complete one cover cycle), and water depth and variability in wetlands across the PPR.

Up and running, WETSIM did what models are good at; it settled some “what ifs.” What if temperatures across the PPR would rise by 3 degrees C (5 to 6 degrees F)? What if the PPR got 20% more precipitation in the future? 20% less?

“Three degrees is actually modest,” Johnson says. “Nobody’s predicting 20% more rain. But most scientists studying global warming do forecast a 3–6 degree C rise in temp.

“Wetlands are like puddles. They’re spread out, are shallow, and are exposed to the wind. It doesn’t take much warmer weather to make them disappear altogether.”

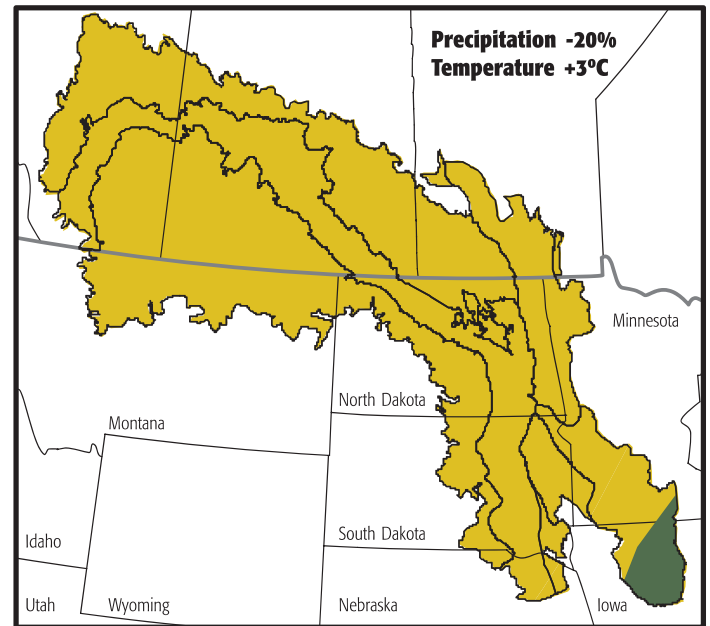
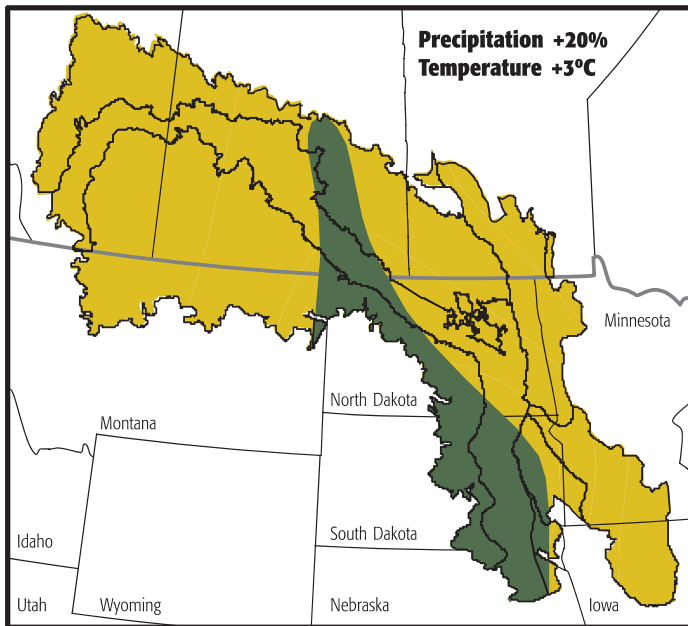
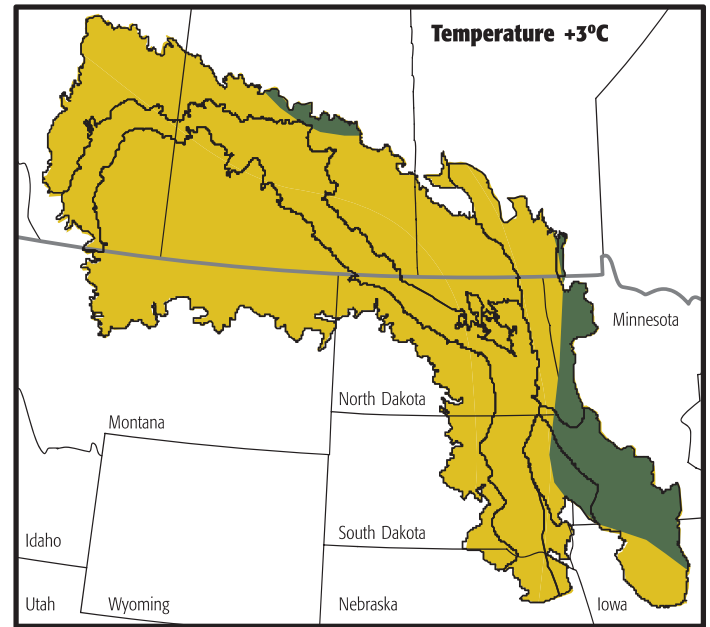
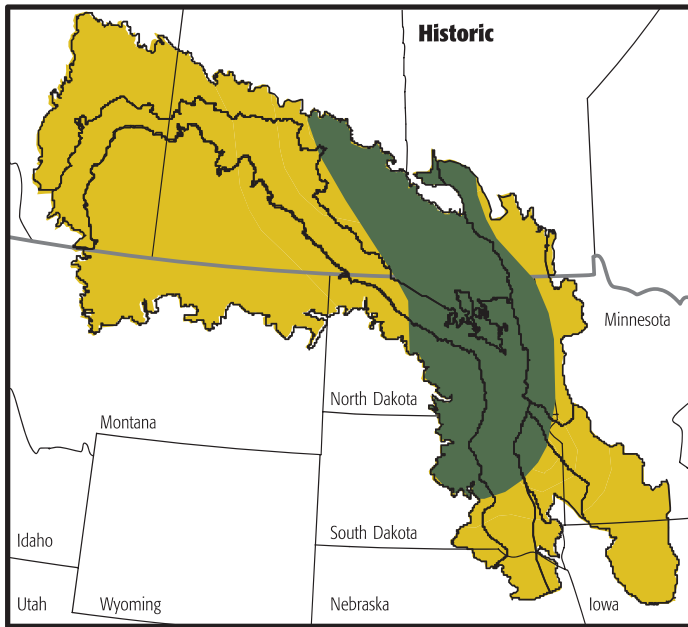
By simulating hydrology and vegetation conditions during the 20th century, WETSIM clearly identified a broad north-west-southeast running band in the middle of the PPR of highly favorable climatic conditions for waterfowl breeding.

“That middle band shows why the east-central Dakotas and southeastern Saskatchewan are the heart of the PPR ‘duck factory,’” Johnson says. “For now.

“We believe the most productive habitat for breeding waterfowl will shift under a warmer and drier climate from the center of the PPR—the Dakotas and southeastern Saskatchewan—to the wetter eastern and northern fringes. Unfortunately for the birds and for us, over 90% of those wetlands in Minnesota and western Iowa have been drained.”

Johnson admits he shouldn’t just focus on ducks. “Many other species of birds, amphibians, and plants, and the farmers who own most of our wetlands will be affected. And hunters, who have such large impacts on our rural economy. The whole ecosystem is inter-dependent.

“Wetlands tend to be very sensitive to climate variability. In the model, it only took a 3 degree rise in temperature for the highly productive ‘duck factory’ to disappear from most of the PPR.”



Under different temperature and moisture conditions, the computer model WETSIM predicts that the historic prime duck breeding area of the Dakotas (dark green) and Canada would shrink and shift.

IN BRIEF, WETLANDS IN THE DRIER PORTIONS of the PPR are especially vulnerable to climate warming, even if precipitation continues at historic levels.

The most productive wetlands, currently in the east-central part of the PPR, would become marginally productive in a warmer, drier climate.

Wetlands in the extreme eastern part of the PPR would contain better water and cover conditions. But without extensive restoration it is doubtful that they can compensate for habitat losses in the western and central regions.

Johnson says that less than 1 percent of the drained wetlands in Minnesota and Iowa have been restored through programs in existence since the 1980s. “There is a long way to go.”

WETSIM’s prediction that the PPR’s duck factory may shift in the future is a new finding that should stimulate discussion among wetland managers, says Johnson, adding that he and

colleagues are refining the model to make its output even more meaningful to decision makers.

A next-generation model is already being tested. It would identify farming practices that could potentially mitigate for the effects of climate change.

The WETSIM project was supported by grants from the EPA and the U.S. Geological Survey. Johnson is a professor in the SDSU Horticulture, Forestry, Landscape, and Parks Department. Co-workers on the WETSIM project were Bruce Millett, instructor in the SDSU Geography Department; Tagir Gilmonov, professor in the SDSU Biology/Microbiology Department; Richard Voldseth, research ecologist with the USDA Forest Service; Glenn Guntenspergen, research ecologist with the U.S. Geological Survey, and David Naugle, professor of wildlife at the University of Montana. ♦

—Mary Brashier



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