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South Dakota State University Agricultural
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Utilizing and developing our resources to enhance quality of life

Farm & Home RESEARCH

Volume 57 • Number 2

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



118TH ANNUAL REPORT

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On the cover:

SDSU students (l to r) Ryan Beyer, Flandreau, Jacob Schaeffer, Warner, and Clayton Wulf, Lennox, dip for mosquito larvae in a temporary wet spot. This is the seventh year of the project initiated by the South Dakota Department of Health to monitor mosquitoes in South Dakota for the presence of the West Nile virus (WNV). *Culex tarsalis*, the primary carrier of WNV in South Dakota prefers to lay her eggs in "fresh" water created by rainstorms instead of along permanent water body edges.

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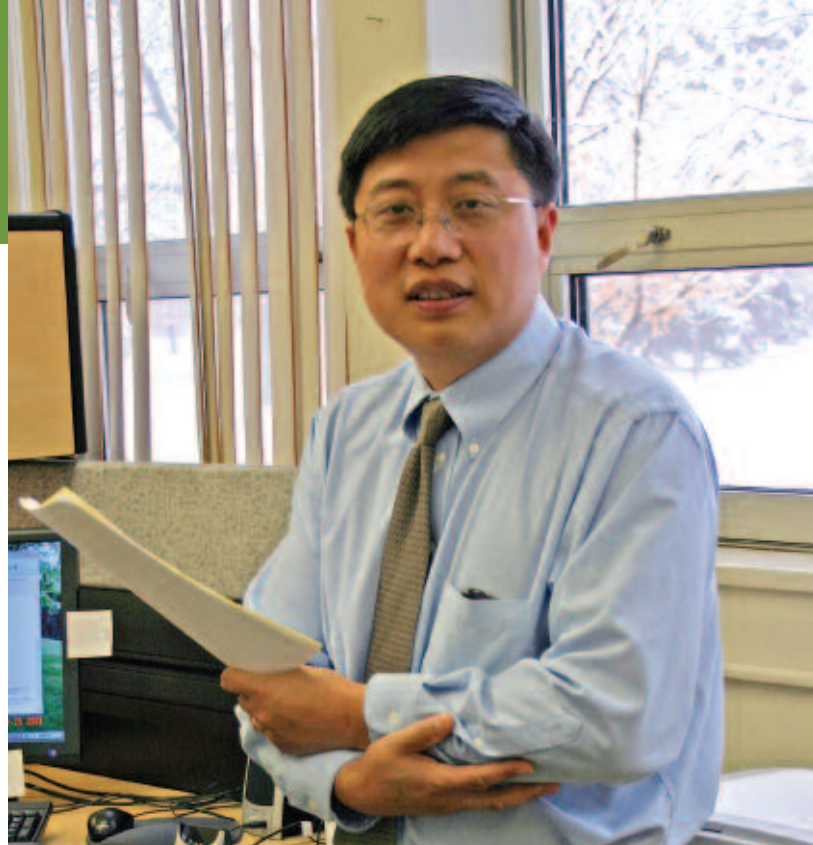
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Director's comments

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

Conducting research to serve you



C.Y. Wang

It is my pleasure to write comments for this annual report issue of Farm and Home Research. The ultimate purpose of any research we conduct at the South Dakota Agricultural Experiment Station is to serve the citizens of this state. This issue offers a few great examples of these research projects.

Many of you might wonder what the young men on the cover are doing. No, they are not scooping up water to drink, although those are indeed long-handled dippers. They are searching for mosquito larvae, being student members of our SDSU mosquito research team. I encourage you to read the mosquito article. It is timely and practical knowledge that will help you stay safe and well. Dr. Mike Hildreth and his team are serving all of us through their dedication to discover more new knowledge about West Nile virus.

Dr. Amir Ibrahim, our SDSU winter wheat breeder, already has a well-deserved reputation of service to our state's wheat growers. This issue contains an article about antioxidant activity studies on some of his wheat white lines. It is also a great example how an agronomist and a chemist, Fathi Halaweish, SDSU associate professor of chemistry, can work together to serve our great state.

The article on the work of Jeff Clapper, SDSU reproductive physiologist, may seem more appropriate for a medical journal. However, this is a great example how a seeming basic research project can benefit the state in the long run. Clapper's work with the regulation of hormones one day will help our livestock pro-

ducers to be more efficient and therefore more competitive. We might not benefit from a basic research project this hour; we can benefit from it tomorrow.

Another livestock related article is about Dick Nicolai, SDSU Extension farm machinery and safety specialist, and his model called the South Dakota Odor Footprint Tool. Given prevailing winds and size of proposed livestock operation and other factors, his model can predict the impact on a community of odor from a livestock site. You can find this program on the Web and try it out for yourself.

Obesity has been in the press a lot lately. What you may not know is that some of the knowledge for obesity prevention is being generated right here at SDSU by Dr. Kendra Kattelman, associate professor of nutrition, food science, and hospitality. She is part of a multi-state research group working to promote healthy lifestyle choices among young adults. This is another way to serve our citizens by providing knowledge and ultimately lowering health care cost from obesity related illness and diseases.

Finally, take a look at the article on the Northeast Farm. This is a historical perspective on how the Farm has tailored our agromomic research "on the ground" for producers in that area.

Call us if you would like to visit about any of the projects listed in the annual report section. It is obvious from the budget pie chart that the Agricultural Experiment Station is a unique partnership among state, federal government, and the agricultural industry. Thank you for your support. ♦



Applying basic research on the farm

SWINE PRODUCERS IN THE FUTURE may be better able to manage reproduction in their herds when research at South Dakota State University finishes up.

Jeff Clapper, SDSU reproductive physiologist, is trying to unravel how a part of the brain called the hypothalamus works with the anterior pituitary gland to sense if an animal is ready to reproduce or not.

The pituitary gland is outside the brain. The hypothalamus is at base of the brain. Clapper explains it is the hypothalamus that sends hormones to the pituitary to cause a release of the two main reproductive hormones necessary for sexual function, the luteinizing hormone (LH) and follicle-stimulating hormone (FSH). Those are the hormones involved in ovulation and they carry out many of the effects of the estrus cycle so that animals can reproduce.

MORE SPECIFICALLY, Clapper's research focuses on what is called the insulin-like growth factor system.

"Insulin-like growth factor-1, or IGF-1, is a protein which is produced by pretty much every cell in the body," Clapper says. "Some people think it is so ubiquitous that it has no effect, but we have seen through different studies that levels of IGF-1 and components of the IGF system—things like IGF receptors and IGF-binding proteins—change throughout the estrous cycle.

"Their concentrations change with changing levels of reproductive hormones, and we also see that they change with nutrient intake. We think there is a logical

connection here between nutrition and reproduction."

That nutrition plays a role in reproduction has been known for years and years, Clapper says. But it's not known exactly what signals to the animal that it is ready to reproduce. Since nutrition doubtless plays a role in that process, one aspect of Clapper's work may help producers to fine-tune the way they feed animals to keep them in shape to reproduce.

"My goal ultimately is to figure out mechanistically how the hypothalamus and the pituitary sense the nutrient load on the animal, and how it responds accordingly," he says. "It's my contention that we sometimes over-feed animals, and

“It’s my contention that we sometimes **over-feed animals, and since 70% of the cost of production is feed costs, anything that we can do to reduce those costs will make the operation more profitable while at the same time maintaining reproduction.”**

—JEFF CLAPPER

SDSU REPRODUCTIVE PHYSIOLOGIST

since 70% of the cost of production is feed costs, anything that we can do to reduce those costs will make the operation more profitable while at the same time maintaining reproduction.”

STRAIGHTFORWARD APPLICATION in the field is the goal of Clapper’s complicated research.

“One of the biggest problems we have in the swine industry right now is that, after a young gilt produces her first litter, she fails to return to estrus to be bred again. That’s one of the main reasons that she’s culled from the herd—she fails to reproduce the second time.

“What’s the problem with her? Have we overfed her? Does she have a pituitary dysfunction that we could overcome by simply giving her a little boost in something?

“We’re working on the answers.”

Clapper estimates it is at least 5 to 10 years before producers can apply such research within their herds.

“Will the producer go in at a certain day, post-farrowing, or post-weaning and give a shot of estrogen to that sow? Is that beneficial or not?

“First, we have to know how that shot of estrogen would work and what it’s going to actually do. We can artificially make that animal think that she’s in estrus, but whether she’ll ovulate or not is a different story. And if she doesn’t ovulate, she doesn’t get pregnant.”

ONE PART of Clapper’s research may shed light on why boars grow faster and more efficiently than barrows or gilts. He measured serum concentrations of insulin-like growth factor and hormones in blood samples from sets of similar age of these three groups, and tracked serum concentrations from 70 to 140 days of age.

After 84 days and continuing through 140 days, serum concentrations of IGF-1

were higher in boars than in barrows or gilts. Similarly, relative amounts of several “IGF-binding proteins” that interact with IGF were higher in boars than gilts or barrows as the animals grew; and concentrations of the hormones estradiol and testosterone were higher as the boars grew older.

The boars were also more feed-efficient than barrows or gilts.

“This indicates that increased serum concentrations of IGF-1 may play a role in the increased growth performance seen in boars compared to barrows and gilts,” Clapper says. “This information may lead to ways in which lean growth in barrows and gilts could be enhanced to achieve levels similar to what we see in boars.”

IT MIGHT TAKE another scientist to fully understand what Clapper’s finding in the pituitaries of the pigs.

He removed the pituitaries and searched within their tissues to find out what is actually going on with different components of the IGF system—especially with those components called IGF-binding proteins.

“There are at least six different IGF-binding proteins, with concentrations varying depending upon the tissue they are found in. Some of these IGFBPs, as they are called, can function to inhibit the activity of IGF-1 while others actually enhance IGF-1’s activity. So it is probably the sum total of all the IGFBPs within a particular tissue that determines IGF-1’s function there.”

SDSU studies find that giving the hormone estradiol to pigs results in an increase of IGF-binding proteins 2 and 5 within the anterior pituitary.

“We’re still trying to determine what IGFBP-2 and -5 are doing within the pituitary, but the fact that they are coincident with increases in estradiol leads us to believe that they may have something to



The hypothalamus at the base of the brain, pointed out by Jeff Clapper, controls secretion of the main reproductive hormones necessary for sexual function. His goal is to discover how it and the pituitary gland sense and respond to the nutrient status of the animal.

do with ovulation as well as LH secretion, because estradiol naturally increases at ovulation. We think the IGF system and the IGFBPs, in particular, participate in fine-tuning pituitary function.”

While that sounds too complex to be of much use to the producer, Clapper says reproductive research does bear practical results, in time. Figuring out how the hypothalamus and the anterior pituitary are working, he hopes, will lead the way to optimized reproductive efficiency. ♦

—Lance Nixon



FIFTY YEARS on the Northeast Farm

YIELDS GO UP AS AGRICULTURAL KNOWLEDGE INCREASES. Data from South Dakota State University's 50 years of agricultural experiments at the Northeast Research Farm north of Watertown make that point very clearly.

That's what the South Dakota Legislature had in mind when it appropriated money early in 1955 to begin new research on crops, soils, and crop diseases in northeastern South Dakota. A site of 20 acres on the Otto Korth farm was selected, 15 miles north of Watertown at the junction of U.S. Highway 81 and state Highway 20. The first experiments took place there in 1956.

The station was originally one of several mobile units, and the intent early on was to move the unit to a different location every 6 to 10 years. But for a variety of reasons, that mobile unit sank roots. Tops among other considerations was that

the soils are remarkably uniform across the station, meaning researchers don't have to contend with major differences in soil type when setting up experiments.

An additional 13 acres were acquired for expanded experiments starting in 1957. Eventually the farm grew to its present size of 86 acres.

"The purpose of this farm is to provide research facilities to obtain solutions to local problems in crop production," the 1956 annual progress report for the farm announced. "The committee of farmers and county agents representing the northeastern South Dakota counties will meet before the 1957 planting season begins, to

discuss and select the experiments to be started on the newly acquired land."

Today, the farm's advisory board is made up of a farmer representative from each of the 10 counties in the state's northeast region (Brown, Clark, Codington, Day, Deuel, Grant, Hamlin, Marshall, Roberts, and Spink), along with SDSU Extension's county agronomy/farm management educators in the region.

LOOKING BACK on the farm's first 50 years, Northeast Farm Manager Jim Smolik says that combination of farmers working hand in hand with research scientists of the South Dakota Agricultural

Experiment Station remains in place because it's effective.

It keeps researchers in touch with problems in agriculture at the grassroots level, he adds. Research projects in weed control, insect control, crop variety trials, disease management, and soil fertility management have been standard throughout the years.

"It's a model that works."

The farm also has been a key location for SDSU plant breeders, who continue to use it in breeding work for spring wheat, winter wheat, oats, forages, corn, and soybeans. A major focus of breeders has been to develop varieties resistant to both biotic stress (stress from living sources such as scab or insects) and abiotic stress (stress from non-living sources such as drought or soil conditions).

The herbicide demonstration and testing program, closely followed by area producers, has expanded greatly over the past 15 years and now occupies 45% of the land at the research farm. Crops included in the herbicide programs are corn, soybeans, alfalfa, flax, sunflowers, dry beans, canola, and spring wheat.

Variety testing is another important activity at the farm. Included are varieties of alfalfa, sweet clover, red clover, field peas, warm and cool season grasses, spring wheat, durum, oats, barley, rye, winter wheat, triticale, soybeans, and corn.

In addition, Smolik notes, researchers have tested reduced tillage and no-till systems at the farm. SDSU scientists have been at the forefront in launching innovations such as herbicide-tolerant crops—products of conventional breeding as well as biotechnology—and biotech Bt corn varieties that produce their own insecticides.

Some producers got their first glimpse of those and other innovations at the Northeast Farm field tours. Two field

tours are held in most years. The summer tour emphasizes small grains, and the fall tour focuses more closely on row crops. In addition, results from field trials are published each year in the farm's annual progress report.

FIVE DECADES of data from the Northeast Farm tell the story in black and white: Knowledge gained—and applied—from research equals higher yields.

Corn yields have tripled since SDSU began operating the farm in 1956, from a 5-year average of 42 bushels an acre at the end of the 1950s to an average of nearly 130 bushels from 2001–05. The 2005 average of 174 bushels in that year's crop performance trials was the highest ever.

Small grain yields also have seen large gains.

Oats yielded nearly 63 bushels an acre for the 5-year average in crop trials at the Northeast Farm from 1956–60. For the 5-year period that ended in 2005, the average was 101 bushels.

The 5-year average yield in the farm's barley trials was 31 bushels an acre at the end of the 1950s. The 5-year average from the farm's trials stood at 82 bushels an acre in 2005.

Spring wheat yielded an average of 19 bushels from 1956–60. The farm's 5-year average for 2001–05 was nudging 50 bushels an acre.

Average soybean yields have leveled somewhat in recent years, but overall have substantially improved. The farm's 5-year average was 17.4 bushels from 1956–60. It stood at 37.4 bushels from 2001–05. The best year ever for average soybean yields at the farm was 1998, when the average in the crop trials was 53 bushels.

THESE NUMBERS may help chart a path toward new research at the farm, Smolik says.

"Soybean yields more than doubled over the first 30 years, but have shown little consistent improvement over the past 20 years. Soybean yields the past 5 years were only slightly better than the 1986–1990 period," he says. "The decline in soybean yields and the apparent leveling of oat yields suggest areas where additional research may be required to improve yields."

But he notes that SDSU's commitment at the Northeast Farm still includes work with crops well adapted to the region, though acreages of some of those crops have declined. Small grain and flax trial plots continue each year.


"Part of our responsibility is to stay abreast of developments with the traditional crops, even if the acreage is down," Smolik says.

Smolik adds that some challenges to producers are the same ones their fathers and grandfathers faced when the Northeast Farm began in 1956. For instance, crown rust remains a serious problem for oat growers in northeastern South Dakota, cutting into yields significantly in some years. More recently, scab has cut into spring wheat yields when conditions were right, as they were during the wet cycle from 1991–95.

And there are the new challenges: South Dakota producers didn't have to deal with soybean cyst nematode as a pest before 1995; it's now known to be present in at least 19 counties in the state (though it hasn't been found yet at Northeast Farm). The soybean aphid was first detected in South Dakota in 2001 and at the Northeast Farm in 2005.

Smolik says agricultural research must address both the old and the new challenges. Research sites such as the Northeast Farm play a key role in that task, he adds. ♦

—Lance Nixon

A photograph showing a woman with short blonde hair, wearing a grey blazer over a yellow shirt, standing and leaning over a desk. She is looking at a young woman with long dark hair, who is sitting at the desk and using a computer. The computer monitor displays a website with a blue header and some text. The background is a plain wall with a wooden shelf holding some electronic equipment.

Educational intervention to head off obesity is the goal of Kendra Kattelmann (standing) who is participating in a multi-state research program to promote healthy lifestyle choices among young adults.

SDSU picked for national study: OBESITY PREVENTION

OBESITY HAS REACHED EPIDEMIC PROPORTIONS IN THE U.S. One-third of Americans over 20 years of age are obese, according to data from the National Center for Health Statistics. That puts them at risk for heart disease, high blood pressure, diabetes, arthritis, and some forms of cancer.

Obesity is traditionally defined as more than 20% of a person's ideal weight. Ideal weight takes into account the individual's height, age, sex, and build.

The key to preventing obesity is education, says Kendra Kattelmann, associate professor of nutrition, food science, and hospitality at South Dakota State University. She is part of a multi-state research group working to promote healthy lifestyle choices among young adults.

The group has received a \$1 million grant from the National Research Initiative and the USDA to conduct a 4-year research project. Participating are South Dakota State University, the University of Maine, Michigan State University, Penn State University, the University of Rhode Island, Syracuse

University, Tuskegee University, and the University of Wisconsin. The project is entitled "Behavior Change for Obesity Prevention in Young Adults."

Researchers at the eight universities are working together to create a Web-based course for college students between the ages of 18 and 24. After piloting the program through Spring 2007, researchers will recruit approximately 200 students from each school in Fall 2007 and follow participants through Spring 2008 to see if they make and maintain any lifestyle changes.

"We target 18–24-year-olds, because this is the age where they may need nutrition help," Kattelmann says. "These students are maybe living on their own for the first time. They don't have a lot of health problems; however, this is the age

where they are establishing health habits for the rest of their lives."

THE PROGRAM does not focus on dieting but on establishing and maintaining a healthy lifestyle, Kattelmann says. Lessons include topics such as body size and acceptance, adequate exercise, healthy eating, and weight maintenance.

"We have an obesity problem in the U.S., but we also have to realize that there is a small percentage of people who are dealing with eating disorders such as anorexia. Sometimes, trying to achieve a healthy lifestyle goes to the extreme, and people control their eating or their exercise to a point that is not healthy. We don't want to create that, so we're hoping to have a good balance."

"We target 18–24-year-olds, because this is the age where they may need nutrition help. These students are maybe living on their own for the first time. They don't have a lot of health problems; however, this is the age where they are establishing health habits for the rest of their lives."

—KENDRA KATTELMANN,
SDSU REGISTERED DIETITIAN



That's the reason for lessons on body acceptance, Kattelmann says. "This deals with valuing your own body for what it is and also accepting other people for who they are. We're helping people realize that the body size we see in the media is not a healthy body size. We're advocating being comfortable in your own body based on a healthy lifestyle."

Other lessons focus on healthy eating, especially increasing consumption of fruits and vegetables. "One thing we can do to enhance our health is to have adequate intake of fruits and vegetables. MyPyramid—the dietary guidelines that have replaced the food guide pyramid—encourages nine servings of fruits and vegetables per day. Most people don't get that amount."

The course will consist of 10–12 lessons tailored to individual needs. Participants access the weekly lessons online at their own convenience, set their own goals and measure their progress against these goals. When they log onto the Web site, their personal goals will pop up, so they can easily monitor their progress.

Before the course starts, each person will fill out a questionnaire and receive a personalized lesson plan. The researchers

have developed categories for eating habits and weight management issues. For example, in relation to physical activity, people are classified as pre-contemplation, contemplation, preparation, pre-action, or action.

"If you are pre-contemplation, you could care less. So the first step is to get your attention. If you're thinking about doing something about it, you're in the contemplation or preparation stage. If you're ready to do something, you're pre-action. Then you need more specific tools and suggestions. We provide people with information based on where they currently are," Kattelmann explains.

THE RESEARCHERS are conducting online focus groups to help understand how young people view a healthy lifestyle, especially in terms of barriers and facilitators to weight loss and physical exercise.

"We've found in the focus groups and previous studies that students want very specific information. They want to know, for example, what different nutrients provide to the body. They also want recipes," Kattelmann says.

While the lessons are conducted online, each participant is required to attend a session before the class starts to

have his or her height and weight measured. Fitness level will also be measured through a step test. These measurements will be taken again at the end of the class to see if any changes have occurred. There will also be follow-up measurements in the spring to see if the changes are maintained.

When the research project is completed and results compiled, the course can be offered across the U.S. as a college class, or it can be posted on the Internet so people can access it individually.

Kattelmann says the goal of the project is to impact the decision making process of young adults. "This is an educational intervention. As far as nutrition is concerned, we may know a lot about the physiological issues, but when it comes down to actual weight maintenance, that's a human issue.

"When we make choices about obesity prevention, it goes back to what we value. Some of the things we have to do are at the society level. It may be necessary to change the environment to make it easier for us to maintain a healthy lifestyle. That costs money, so there are decisions to be made by humans. ♦

—Marianne Stein



Dick Nicolai has developed an online model that will predict the impact on a community of odor from a livestock site. Then, he says, it is up to the community to pick an acceptable annoyance level and the producer to decide what odor controls will be installed.

SIZING ODOR'S FOOTPRINT

ONE MAN'S ROSE IS ANOTHER MAN'S SKUNK CABBAGE. That difference of opinion makes odor emission one of the major concerns when operating permits are granted to livestock operations.

It can be difficult to estimate odor nuisance levels accurately.

That task has gotten easier now, thanks to the work of Dick Nicolai, SDSU Extension farm machinery and safety specialist. Nicolai has developed a model called the South Dakota Odor Footprint Tool that will predict the impact on a community of odor from a livestock site.

The model, available online, allows the producer, or anyone else in the community, to enter data about the operation—such as size of livestock units and type of odor control measures—and receive information about the potential odor annoyance around the site. It will also help producers determine which odor control

technologies to implement to reduce odor emissions.

The South Dakota Odor Footprint Tool adds in prevailing weather conditions when calculating odor annoyance levels. Results can be used to construct a map that shows odor impact around the site in an easy-to-understand way.

“Odor is a major factor when permits are granted to livestock operations. This model is a science-based tool that clearly shows odor impact and what may be done to reduce it,” Nicolai says.

NICOLAI HAS ALREADY been called upon to use the model several times. In a few cases, the information was requested from

an engineering firm seeking a building permit on behalf of a producer. In another case, a community group opposed to a site expansion contacted him.

“I go into the hearings and make my objective testimony. It is up to the county to pick the annoyance level they can accept. The producer can decide what control technology to adopt in order to comply with the requirements.

“There is now science-based information to help make the decisions. My goal is to take the emotions out of the odor issue and put the science in.”

Nicolai first started working on the odor tool when he was employed as an Extension specialist at the University of

"My goal is to take the emotions out of the odor issue and put the science in."

—DICK NICOLAI

SDSU EXTENSION FARM MACHINERY AND SAFETY SPECIALIST

Minnesota. He and several colleagues developed a model called OFFSET. This model was further developed at the University of Nebraska, and it is this expanded version that Nicolai has used as a basis for his South Dakota tool, developed with financial assistance from the South Dakota Pork Producers.

"The model involves two factors," Nicolai says. "The first is how much odor is being emitted from the source. The second is atmospheric conditions, which indicate how odor is dispersed."

To calculate the first, Nicolai and his colleagues at the University of Minnesota constructed a database of odor emission levels. "We measured emissions from different sources, such as right at the fan, at the outside manure storage system, at free stall barns, dairy barns, dry lots for cattle, and so on. We produced a large database that included species, type of manure system, odor control measures, among other things and calculated average value for each type of information," Nicolai says.

The researchers then worked with the state climatologist in Minnesota to develop a procedure to measure dispersion.

"We drew up a worst-case scenario that described the worst prevailing wind conditions. So we knew that on average, you wouldn't have anything worse than that," he explains.

Nicolai and his colleagues created a measure called "annoyance free value" that indicates the percentage of time there would be no odor annoyance from the site. "Then we'd be able to say, for example, at 1/2 mile you are 98% annoyance free and at 1/4 mile you are 94% annoyance free."

THE SOUTH DAKOTA Odor Footprint Tool is based on the Minnesota model and adapted specifically for South Dakota climate conditions. Using data from local weather stations, Nicolai divided the state into three parts. Each part has a different set of dispersion curves depending on typ-

ical local wind conditions.

The model calculates annoyance level values, and the results can be combined with a site map to graphically illustrate the odor impact at different distances.

"We present a map of the local area, including the proposed site and maybe 3 or 4 miles around it," Nicolai says. "We have an ellipse in contours around the site, showing odor annoyance levels. The first contour indicates 94% annoyance free, the next is 98 or 99%."

"That means everybody can see the proposed site and know the impact it will have on the neighbors. You can see at a glance if you're living in the 98% or the 94% annoyance-free zone."

There are several ways of utilizing this information, Nicolai says. "Regulators can use it when they write zoning regulations. They can say, for example, everyone in this zone should be 94% annoyance free. Or, if you build a site within one mile of a community, it has to be 98% annoyance free."

"A producer can run the numbers before building or expanding and use the information when applying for a permit. It can also help you if you have already built and are getting complaints from your neighbors. You know you have to incorporate some odor-reducing technology. The

model would help you find out which methods would satisfy the conditions. For example, should you put in a biofilter, do oil sprinkling, cover up your outside storage, or use a combination of these methods?"

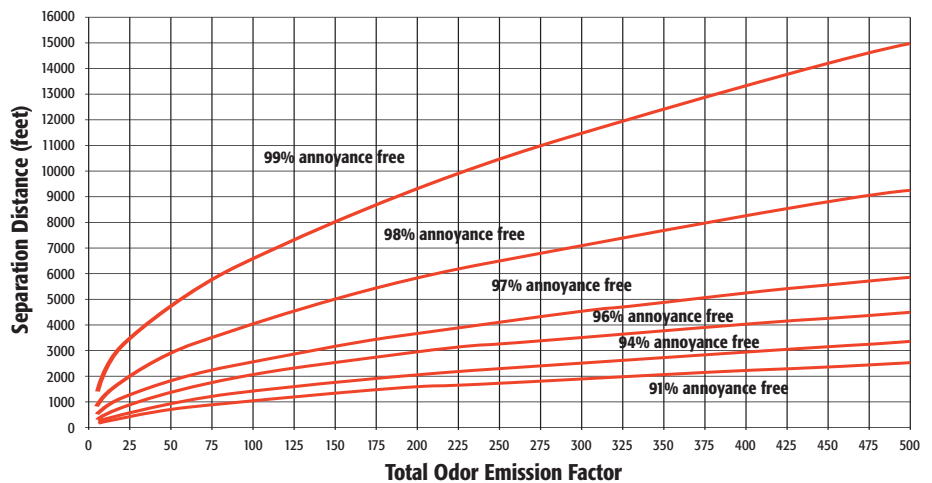
The South Dakota Odor Footprint Tool is available on the Internet at <http://abe.sdstate.edu/wastemgmt/airquality.html> so anyone can calculate odor annoyance levels from a livestock site anywhere in South Dakota. "People can pick the county they live in and put in their conditions, such as species, type of barn, manure storage, odor control technologies, for example."

"They need to enter the size of the system rather than number of animal units, because odor is highly correlated to surface area."

"Each source is added up to get the total emitting factor for that site. The next step calculates the setback distances."

People who use the tool on their own will get the annoyance level results in the form of numbers, Nicolai says. The map generation will not be available online, because it requires specialized software to do the graphing. People who want a map must contact Nicolai for assistance. ♦

—Marianne Stein





Mike Hildreth and his mosquito search team have learned where to find breeding sites of the main WNV carrier. Precisely when she will lay her eggs is now the primary goal.

STEALTH BITER

SHE COMES WINGING IN FROM THE EDGE OF TOWN AFTER DARK.

Nearly silently, she chooses a target, perhaps a blue jay roosting for the night, perhaps a human enjoying a summer evening.

After she scores a hit, she's full of blood. Now she can lay her eggs, for blood stimulates development of mosquito eggs. In a road ditch or other depression normally dry but now full of water from a recent thunderstorm *Culex tarsalis* deposits her eggs—50 to hundreds—as a raft floating on the water. If in her prime and full of blood and eggs, she can make a raft every third night.

It doesn't matter that the water she chooses is only temporary and will dry up in a couple of weeks. Depending on the temperature, her eggs will hatch within 24 hours, going from egg to adult in 14 days at 70°F. In the heat of late summer

in South Dakota that time can be even shorter.

If, in her quest for blood, she bit a bird infected with West Nile virus (WNV), the next human that *C. tarsalis* bites stands a chance of coming down with the disease.

WE HAVE OUR DEFENSES: protective clothing and repellents, community and individual pesticide spraying, and simply staying indoors on late summer evenings. However, more effective than defense is offense. That's beginning to take shape.

"We've learned where to look for her breeding sites," says Mike Hildreth, professor of biology and leader of a South

Dakota State University mosquito research team. "We are intensely interested in where the larvae are so that we can better focus on larvaciding.

"And now we're working on when to look for her," he adds, "so we can give suggestions on what weather patterns seem to be associated with higher numbers of *C. tarsalis*. We assume that higher levels of *tarsalis* should result in higher risks of WNV. This species is the state's most common carrier of WNV."

Such information would give communities in mosquito hotspot areas time to get their spraying equipment ready and warn citizens to take personal precautions.

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—MIKE HILDRETH,
SDSU PROFESSOR OF BIOLOGY

WEATHER PLAYED A BIG PART in a 2004 drop in human cases, Hildreth believes.

In 2003, 1,039 human cases of WNV were reported to the Centers for Disease Control; in 2004, 51 cases; and in 2005, 229 cases.

"It was really cool in the first part of the summer in 2004, and after a warm spell it cooled off really quickly toward the end, and we went into a cool fall.

"Contrast that with 2005, when human cases were up again. There was good moisture in most of the state, which made for puddles in which the females could lay eggs; and the summer was warm and stayed warm into the fall.

"Continuing warm weather allows *Culex tarsalis* to squeeze more generations of mosquitoes into the summer. How fast these mosquitoes develop from egg laying to adults is dependent upon temperature. The warmer it is, the faster the life cycle spins, and the more potential carriers of West Nile virus you have."

THE REAL QUESTION wasn't why the numbers of human cases were up again in 2005, says Hildreth. "It's why weren't they even higher. I hope it's because people were being careful. The *tarsalis* mosquito was out there, and more of her kind were carrying the virus. The number of infected pools was way up."

By "pool," Hildreth doesn't mean the obvious—standing water.

To mosquito scientists a pool is a collection of 50 mosquitoes per tube from a single mosquito trap. The tubes are sent to

the South Dakota Department of Health, where the contents are ground up and tested for WNV-infected mosquitoes.

"If a pool is infected, maybe only one or two mosquitoes in the whole bunch are carriers," Hildreth says. "The highest would probably be four or five mosquitoes."

From one trap last summer 13 different pools collected on different dates showed infected mosquitoes. Transmission potential was "very high."

So why weren't there more human cases? Maybe, Hildreth theorizes, the answer can be attributed to a sister mosquito, *Aedes vexans*.

FOR BEING THE TWO most common mosquitoes in the state, *A. vexans* and *C. tarsalis* are remarkably unlike.

A. vexans is the primary nuisance mosquito in the Hildreth team's search area and is only rarely infected with WNV. She usually arrives at sundown in a swarm of wickedly armed, buzzing females of her kind. By persistent buzzing and strafing, they drives their human victims inside to hunt up the DEET or picaridin products before venturing outside again.

A. vexans lays her eggs at water margins. The eggs seem to need a drying period after the water evaporates, and amazingly, the eggs overwinter. Spring floods reactivate them. If the water stays 7 to 15 days, many thousands of eggs hatch at the same time, causing the swarms that pester humans and livestock alike.

"So, with *vexans*, because eggs overwinter, you get an early increase and early



Stimulated by blood from a bite victim, *Culex* mosquitoes will develop eggs, find temporarily ponded water, and lay a raft of up to hundreds of eggs every third night, if mosquitoes is in good condition.

peak in population," Hildreth says.

"Troublesome as they are, these mosquitoes remind us to wear our repellents."

If *A. vexans* is the early summer mosquito, *C. tarsalis* is the late bloomer and, more often than *vexans*, the carrier of WNV. *C. tarsalis* overwinters, not as eggs, but as adults. "We think they crawl down into animal burrows. If you take a careful look around, you'll find more burrows than you expected."

Low numbers of *C. tarsalis* probably come through the winter, and then the females must find a blood meal and begin egg laying. That takes time.

"A *tarsalis* mosquito lays eggs, they hatch, those females lay eggs, those hatch. It takes a long time for *tarsalis* numbers to increase. That's why they are particularly deadly in late summer, just when we're letting down our guard because those nasty *vexans* aren't bothering us so much any more."

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—MIKE HILDRETH,
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SCIENTISTS NOW HAVE a sense of where *C. tarsalis* lays her eggs.

It's not always where you'd expect, Hildreth says. Ponds and low, wet places that last all summer can harbor predators on *tarsalis* that hunger for mosquito larvae.

"Birds, macroinvertebrates, and dragonflies eat mosquito adults; dragonfly nymphs eat larvae. Hundreds of little crustaceans eat larvae; so do fish. And if predators don't get them, mosquito larvae even have their own diseases."

A depression that only fills after a rain event "is ecological heaven" for *C. tarsalis* larvae, Hildreth says. "there's a lack of enemies and a bloom of bacteria and protozoa and microinvertebrates for quick-hatching larvae to eat."

The bloom can begin just hours after a rain.

Some city control officers have mapped out those likely breeding spots with the assistance of Hildreth and Mike Catangui, SDSU Extension entomologist.

Treating breeding sites in the rain-filled ditches and depressions with Bt (*Bacillus thuringiensis* subsp *israelensis*, a bacterium that releases a protein toxic only to mosquito wrigglers and the larvae of other aquatic flies) helps reduce the number of mosquitoes coming into cities.

"Some *tarsalis* will get through—they can fly for miles, and some are already within the city, but control officers are treating for maximum effect," according to Jim Wilson, SDSU Extension pesticide education coordinator.

But can we be certain that these temporary depressions full of fresh water actually contain *tarsalis*, that there's a connection between a rainstorm and a mosquito laying her eggs?

That leads to the "when."

As storms rolled over large areas of the state every week or two during Summer 2005, Hildreth's team began evaluating the effects of precipitation and temperature on mosquito populations.

As the data collection continues this year, the scientists will be looking for any correlations between *C. tarsalis* population peaks and weather patterns that can be used to predict developing problems even before the mosquitoes appear.

THE STUDENTS WHO HAVE served on the mosquito research crew over the years "have learned a lot of science," according to Hildreth. Originally, they expected to find *C. tarsalis* in some more permanent waters such as shallow ponds. But only a few larvae of the species, not the hundreds they had anticipated, showed up in the dip nets.

"The only way you can be sure is by dipping and then sorting. Ryan can pick out the differences between larval *vexans* and *tarsalis* with the naked eye," says Hildreth of his current crew leader, Ryan Beyer of Flandreau. "When he couldn't find the *tarsalis* we expected in the more permanent sites, we began to change our thinking about where she laid her eggs."

Collections at a farm near Huron this last summer illustrate the point.

"There were about a hundred old tires holding plastic down on silage piles," Beyer recalls. "Two, only two, had mosquito larvae. And there was *Culex tarsalis* in only one tire. It was stagnant water and it was July 21, just starting the peak *tarsalis* season. But that was our entire take of *tarsalis* out of those tires for the whole summer."

"There were plenty of *vexans* around. We pulled 6,200 mosquitoes from a trap at that site that night, most of them were *vexans*, and none of the pools was infected."

"Inside Huron itself later in the summer, we had over a dozen WNV-infected pools, even though we didn't see many mosquitoes about. That's the danger of thinking you're safe after the nuisance mosquitoes stop bothering you," Beyer says.


SO KEEP THAT personal repellent handy this year, say Hildreth and co-scientists Wilson and Catangui, and keep using it even after you think most mosquitoes have gone away. Wear long pants and long sleeves if you're out after dusk or before dawn.

Keep window screens in good repair.

Drain or pour out water that collects in containers around your yard after a rain. There are larval control products labeled for home use.

Be prepared: The stealth biter is zooming in again this summer.◆

—Mary Brashier



South Dakota niche-market wheats may turn out to be ideal vehicles to deliver antioxidants that fight cancer, says Amir Ibrahim, SDSU wheat breeder.



'GOOD NEWS' FOR WHEAT GROWERS

NEW EXPERIMENTAL WINTER WHEAT LINES high in cancer-fighting properties may offer South Dakota growers a way to cash in on a niche market targeting the health-conscious consumer.

New experimental winter wheat lines high in cancer-fighting properties may offer South Dakota growers a way to cash in on a niche market targeting the health-conscious consumer.

Up to now, a soft winter wheat cultivar from Virginia called Madison has had the highest antioxidant activity among several U.S. winter wheat varieties tested. That's a desirable quality; antioxidants have cancer-fighting properties and other health benefits.

The South Dakota State University experiment comparing wheat varieties in terms of antioxidant activity and

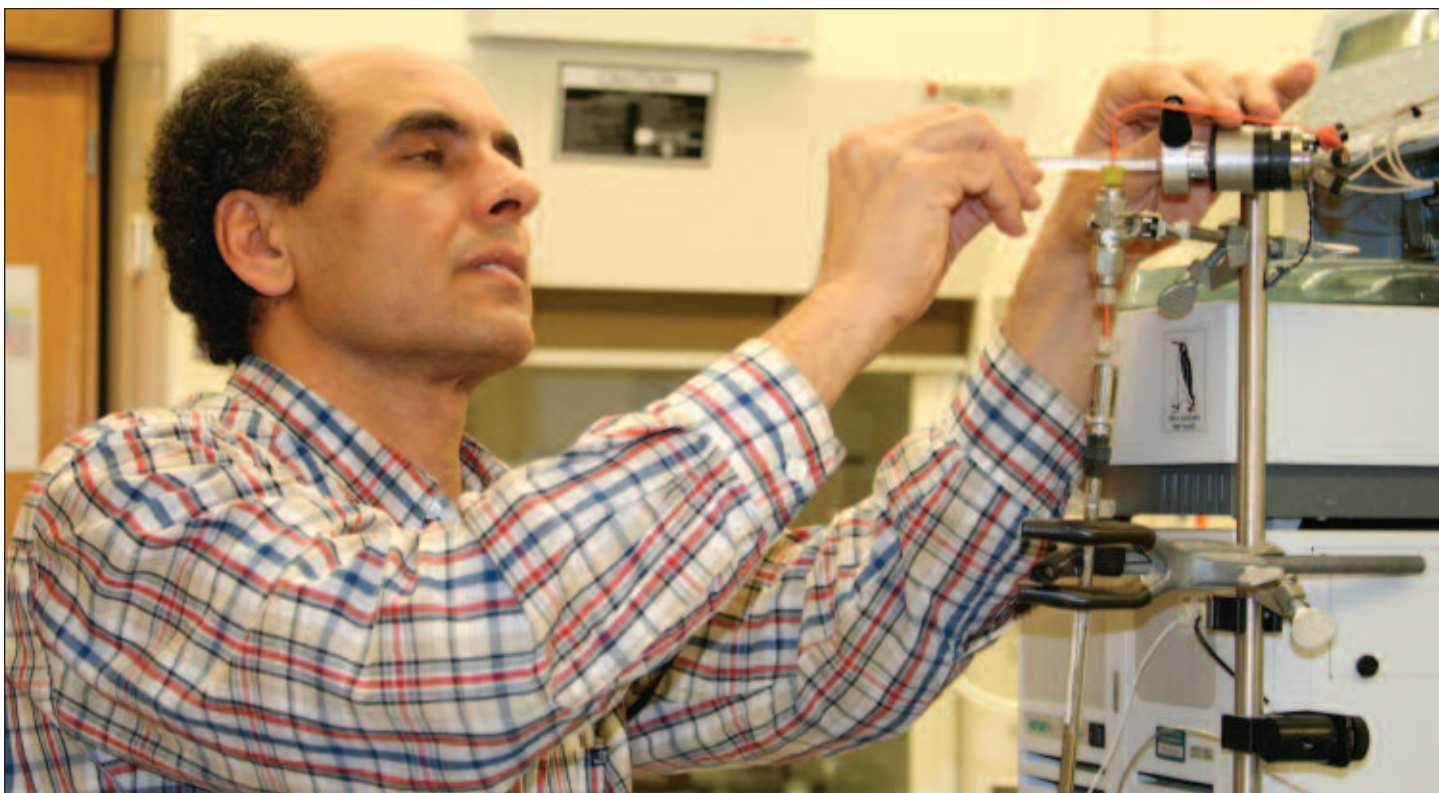
orthophenolic concentration (which is related to antioxidant activity) is generating some surprising results.

Fathi Halaweish, SDSU associate professor of chemistry, has found that Madison lags behind two South Dakota lines when grown in South Dakota soil under identical conditions at Wall and Winner. South Dakota experimental lines SD97059-2 and SD73802 surpass Madison in antioxidant activity and in orthophenolic concentration.

Several other South Dakota experimental winter wheats also are producing impressive results in lab tests.

"We found that most of our winter wheat varieties are comparable to Madison, but we have two or three varieties that are even higher than Madison, which is supposed to be the national standard," Halaweish said. "That means we have some varieties in South Dakota that are much better than any in the nation in terms of antioxidant and total orthophenolic properties."

THAT'S GOOD NEWS for South Dakota wheat growers says Amir Ibrahim, associate professor heading SDSU's winter wheat breeding program. Their crops may



Selenium, common in some West River soils and efficiently stored in the grain by wheat, also has antioxidant properties, says Fathi Halaweish, SDSU associate professor of chemistry. He asks, When selenium combines with other protein compounds in the wheat, does this enhance its antioxidant effectiveness.

command a better price because of potential as nutraceuticals or food supplementation products.

“Antioxidants actually fight cancer. Basically they scavenge and remove free radicals that damage DNA,” Ibrahim said.

Antioxidants include vitamins E, C and A, the mineral selenium, and compounds known as the carotenoids that add color to many fruits and vegetables. Antioxidants are believed to protect cells in the body from the damaging effects of oxidation. Not only do they have a role fighting cancer, it’s thought that they may help prevent heart disease and stroke.

Wheat could be an ideal vehicle for delivering antioxidants, Ibrahim says, because it provides vitamin E and—in soils where selenium is plentiful—the wheat can “mine” selenium from the soil. Wheat also contains, in varying levels depending on variety and location, compounds called orthophenolics which also pack an antioxidant punch.

“You can have this antioxidant activity from selenium, from vitamin E, and from orthophenolics. So if you can combine these three in one product, you have three

means to fight cancer, to fight age-causing processes.”

RESEARCHERS HAVE KNOWN for years that orthophenolic content and antioxidant activity vary among wheat cultivars. Experiments at other universities using mice show wheat bran has greater cancer-fighting properties if it is made from certain varieties of wheat such as Madison, for example.

Ibrahim and Halaweish wondered if the same could be true of South Dakota winter wheats. Their study is one of a number of projects funded by the South Dakota Wheat Commission as part of a wide-ranging look at different issues having to do with selenium in wheat; in the current year SDSU scientists are studying the availability of selenium in the soil, differences in selenium uptake in wheat varieties, distribution of selenium within the kernel, and antioxidant activity of selenium conjugates.

Halaweish examined 10 winter wheat lines, four of them white wheats, six of them red. All but one were South Dakota lines; the outsider was Madison. They

were grown at Winner, Wall, and Brookings.

“I look for pharmaceutically active compounds in plants,” Halaweish explains. “One of these plants just happens to be wheat. We are trying to add value to South Dakota wheat by characterizing the antioxidant activity of the wheat grown in South Dakota and correlating this with what we call the orthophenolic compounds.”

Halaweish also studied several leading spring wheats, including some from SDSU. The spring wheats were grown at Selby, Brookings, and Winner.

INTERESTING TRENDS are emerging in the experiment that will continue for probably 2 more years.

In addition to the evidence that South Dakota varieties compare very favorably with other top varieties in antioxidant activity and orthophenolic content, Halaweish is finding:

- The tested set of winter wheat lines is higher than the spring wheats in orthophenolic content and antioxidant activity.

“We are trying add value to South Dakota wheat by characterizing the antioxidant activity of the wheat grown in South Dakota and correlating this with what we call the orthophenolic compounds.”

—FATHI HALAWEISH,
SDSU ASSOCIATE PROFESSOR OF CHEMISTRY

Halaweish explains that the additional stress on winter wheat, which must overwinter and which is grown sometimes in drier regions, may be a factor. “It is known that when you put a plant under stress, sometimes the phenolic compounds start to increase.”

- There are differences that seem driven partly by geography.

“The wheat grown at Winner seems to have the highest antioxidant properties,” says Jeff Fahey of Pierre, an undergraduate chemistry major assisting Halaweish with lab analysis of the wheat samples.

Halaweish says that holds true for both spring and winter wheats, suggesting that soils in the Winner area may—along with plant genetics—be a deciding factor in how well plants store the compounds that generate antioxidant activity.

- High phenolic concentrations do not automatically guarantee an equally high level of antioxidant activity, or vice versa.

Winter wheat grown in the Winner area shows the highest phenolic concentration and the highest antioxidant activity, but it has a much higher phenolic concentration and only a slightly higher percentage of antioxidant activity when compared to winter wheat grown at the other locations, adding to the complexity of the research and its interpretations.

“Maybe not all the phenolic compounds are contributing to the antioxidant activity. Phenolics are a wide range of compounds; how many of these compounds are available for antioxidant activity? They may be in a form that makes them unavailable for antioxidant activity,” Halaweish said.

In the spring wheat portion of the study, the data from Selby show a similar imbalance. Wheat grown in that area shows a slightly higher phenolic concentration but a considerably higher percentage of antioxidant activity compared to spring wheat grown at the other sites.

That suggests that other factors contribute to the total antioxidant activity in the spring wheat, Halaweish said.

- So far the winter wheat portion of the study is not finding a big difference between red winter wheat and white winter wheat.

“People would think that reds would have more orthophenolics in the bran because of the color, but our findings indicate that there is no difference so far,” Ibrahim says. “We’re not done yet. But based on the antioxidant activity, it seems like there is no difference, and that’s good news.”

It’s good for growers, he adds, because white wheat has greater potential to tap new markets.

White wheat is in demand by the health-conscious consumer because its flour has a white color without bleaching, and because it doesn’t have the red pigment that is often associated with bitterness, which the baking and milling industry often deals with by adding sugar.

“You can make more products out of whole white wheat than you can make out of whole red wheat,” Ibrahim says. “There is a lot of demand domestically and overseas for white wheat. You can use it in a lot of products like whole wheat bread and noodles and steamed buns and dumplings, things like that.”

- In addition to the experimental lines and Madison, several other wheats

performed well. The first round of winter wheat studies showed Arapahoe and Harding had the highest phenolic concentrations and antioxidant activity. Neither Madison nor the South Dakota experimental lines that outpaced Madison were included in that early round of the winter wheat study. In the spring wheat portion of the study, a variety called Reeder had the highest phenolic concentration as well as the highest antioxidant activity.

WHAT’S AHEAD?

In addition to helping tap new markets, the research may bear other practical results for wheat producers.

Halaweish says one outcome may be to give producers a tool that will allow them to know what level of antioxidant activity they have in the wheat they’ve grown. That will help in developing a marketing system that rewards growers for wheat that meets certain thresholds of antioxidant activity or phenolic content.

Halaweish also intends to learn more about the role of selenium, which is known to have antioxidant properties. Selenium is common in some West River soils and wheat can be very efficient at storing up selenium in the grain.

“We know that selenium has an effect by itself. But when the selenium is combined with other protein compounds, the way it normally exists in the wheat, does this contribute to its activity or not? It may be that a particular selenium derivative in a certain form may be more effective than others.”

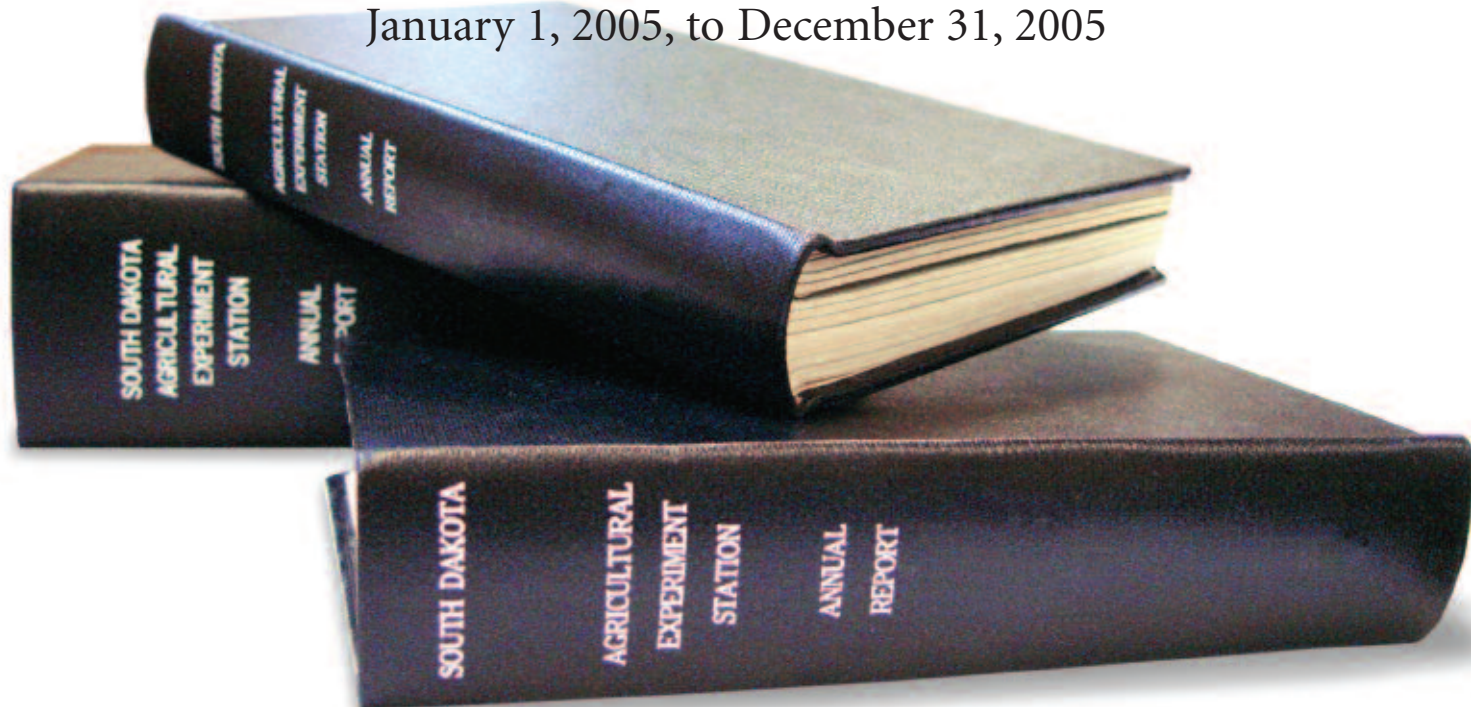
Ibrahim is currently breeding lines for even higher amounts of orthophenolics. ♦

—Lance Nixon

118th Annual Report

South Dakota Agricultural Experiment Station

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F. Sutton, Ph.D., professor
M.E. Thompson, B.S., research assistant II
K.J. Tilmon, Ph.D., assistant professor
E.B. Turnipseed, Ph.D., professor, Seed Testing Lab manager
Z.W. Wicks III, Ph.D., professor
H.J. Woodard, Ph.D., professor

Rural Sociology

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Veterinary Science

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H.S. Kistler, B.S., livestock superintendent
D.E.B. Knudsen, DVM, M.S., associate professor
D.P. Matthees, Ph.D., professor
E.A. Nelson, Ph.D., professor
N.J. Thiex, M.S., professor
A.J. Young, Ph.D., assistant professor
M. Zhao, M.D., research associate II

Wildlife & Fisheries Sciences

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M.L. Brown, Ph.D., professor
S.R. Chipps, Ph.D., adjunct associate professor
K.F. Higgins, Ph.D., adjunct professor
D.E. Hubbard, Ph.D., professor
K.C. Jensen, Ph.D., assistant professor
J.A. Jenks, Ph.D., professor
D.W. Willis, Ph.D., distinguished professor

AES RESEARCH PROJECT PORTFOLIO

Administration

Planning the Sun Grant Initiative; Kephart
Four-State Ruminant Consortium; Wang
Consortium for Alternative Crops; Warmann

Agricultural & Biosystems Engineering

Effect of cheese calcium and phosphate on functionality and structural characteristics of process cheese; Muthukumarappan, Julson, Metzger
Management of water and biological effluent for crop production in South Dakota; Trooien
Enhancing the value of South Dakota agriculturally based materials; Julson, Muthukumarappan, Henning, West
Improvement of thermal and alternative processes for foods; Muthukumarappan, Julson, Wang, Krishnan
Enhancing post-frame building design for reduced environmental impact, increased structural integrity, and energy efficiency; Anderson, Schipull
Biofilter design for reducing swine facility dust and odor problems and airborne diseases; Hellickson, Nicolai, Pohl, Thaler, Daly
Engineering technology applied to quality and production issues in agriculture of the Northern Plains; Humburg, Long, Robert, Kvien, Clay, Carlson, O'Neill, T. Schumacher, L. Schumacher
Impact of climate and soils on crop selection and management; Today

Animal & Range Sciences

Marbling and fresh meat quality; Maddock
Discovery and use of quantitative trait loci associated with growth, carcass traits, and feed efficiency in beef cattle; Rosa
Metabolic mechanism by which the orexigenic peptide ghrelin stimulates feed intake in ruminants; Wertz-Lutz
Molecular mechanisms regulating skeletal muscle growth and differentiation; McFarland
Factors affecting nutrient utilization and excretion by growing swine; Stein
Minimizing neonatal lamb losses; Daniel, Held, Epperson
Ecology and development of yellow-flowered alfalfa; Gates, Boe, Xu, P.S. Johnson
Hormonal control of growth and reproduction in swine; Clapper
Factors influencing fertility and reproductive efficiency in cattle; Perry
Regulation of feed intake, energy balance, and composition of gain in cattle; Wertz-Lutz
Production systems to reduce the cost of production and improve reproductive performance of beef cows; Pruitt, Clapper, Epperson, Owens, Patterson, Young
Methods to improve meat quality; Wulf
Nutritional management of health and growth in beef cattle backgrounding programs; Pritchard
Improving economic and environmental sustainability of South Dakota pastures through multiple-season use and correct stocking rate; Smart
Alternative feeds as energy and protein sources in beef cattle production systems; Tjardes
Grazing patterns and plant responses to grazing on mixed-grass prairie vegetation; P. Johnson, Patterson, Xu, Walker, Beutler

Biology/Microbiology

Role of dendritic cells in PRRSV pathogenesis; Wang
Production of the commercially available polysaccharide gum curdian using a corn-based process; West
Characterization of livestock sperm that demonstrate susceptibility to DNA denaturation in situ; Evenson
Production of organic chemicals from biomass; Gibbons, West, Julson
Utilizing biotechniques to enhance wheat germplasms; Yen
Microbial biomass conversion into specialty chemicals; West
Bacterial activity at interfaces; Brozel, S. Clay, Bleakley
Defining biotic integrity in the prairie pothole region and biological responses to priority pollutants using macroinvertebrates; Troelstrup

Recombinant vaccine development and mechanistic understanding of viral pathogenesis and immunity; Wang
Identification and evaluation of nutraceuticals for potentially new and established crops for the Northern Great Plains; Reese
Science and engineering for a biobased industry and economy; Gibbons, Julson

Chemistry/Biochemistry

Calcium signaling during embryonic development in cattle; Sergeev
Characterization of livestock sperm demonstrating susceptibility to DNA denaturation in situ; Evenson
Equipment grant proposal for a freeze dryer system; West
Rigid sorption domains in soil organic matter; Schindler
Microbial biomass conversion into specialty chemicals; West
Analysis of pesticides and related compounds; Matthees
Soy components and cell death in breast cancer; Sergeev
Analytical services; Thiex

Dairy Science

Improving the quality and consumer acceptance of milk and dairy products; Baer
Expanding use of whey in food products; Dave
Improvement of the nutritional value of process cheese and methods of management and utilization of dairy byproducts; Mistry, Specker, Vukovich
Strategies for improved health and productivity of early lactation dairy cows; Hippen, Schingoethe, Kalscheur
Applications of exopolysaccharides-producing cultures in dairy; Hassan
Strategies to increase the utilization of co-product and traditional feeds for lactating cows; Schingoethe, Hippen, Kalscheur, Garcia
Strategies to reduce nutrient losses to the environment from dairy cattle; Kalscheur, Hippen, Schingoethe
Metabolic relationships in supply of nutrients for lactating cows; Hippen, Schingoethe, Kalscheur
Management systems to improve the economic and environmental sustainability of dairy enterprises; Kalscheur, Hippen
Modifying milk fat composition for improved nutritional and market value; Schingoethe, Baer, Hippen

Economics

Agri-environmental policy options and implementation based on multifunctionality; Dobbs
Agricultural and rural finance markets in transition; Janssen, Diersen
Perception of biotechnology, biotech produced agricultural products, and implications for risk management; Franklin
Value-added agriculture activities in a changing food and fiber system; Van der Sluis
Value added agriculture in South Dakota: opportunities to capture additional value for South Dakota producers; Taylor, Klein
Representative farm and agricultural land market analysis for South Dakota; Janssen
Rural communities and quality of life; Cumber
Emerging globalization and its implications for agriculture in the U. S. and South Dakota; Qasmi
Enhancing the competitiveness of U.S. meats; Fausti
Rural labor market behavior, outcomes, and economic development in South Dakota; Adamson

Family & Consumer Sciences

Soy phytochemicals: chemistry, analysis, processing and health impacts; Wang, Krishnan, Matthees, Scott, Woodward, Julson
Value addition of cereal, grains and oilseeds — an investigation of bioactive compounds of economic, health, and food value; Krishnan, Wang, Scott, Grady, Muthukumarappan, Doehlert
Promoting healthy families and communities through youth relationship education; Gardner
Soy components and cell death in breast cancer; Sergeev

Using stage based interventions to increase fruit and vegetable intake in young adults; Kattelmann
Crossing paths: fostering informal social support with native arts groups to promote health among pregnant American Indian women; Wilson
Economic and psychological determinants of household savings behavior; Gorham, Enevoldsen

Horticulture, Forestry, Landscape & Parks

Dormancy and early acclimation responses of woody plants; Fennell
Simultaneous economic impact of forest recreation and forest production at the county level; Stubbles
Monitoring restoration progress of woody vegetation along streams and in woody draws at the Mortenson ranch; Johnson
Cultural practices optimizing growth of herbaceous horticultural plants in the Northern Great Plains; Burrows, Fennell, Schleicher, Reese
Evaluation of native and naturalized germplasm for reduced-input turfgrass in the Northern Plains; Schleicher
Multi-state evaluation of winegrape cultivars and clones; Fennell

Plant Science

Information age technology for integrated agricultural systems analysis curricula; D. Clay, Carlson, S. Clay
Seed Technology Center; Gallenberg, Turnipseed
Biological control of fusarium head blight and other wheat diseases; Bleakley
Pedology information transfer for South Dakota; Malo, Doolittle, Schumacher, D. Clay, S. Clay, Carlson, Gelderman, Ellsbury, Lee, Lindstrom
Winter wheat breeding and genetics; Ibrahim, J. Stein, Yen, Langham
Precision in-furrow fertilizer placement for corn; Gelderman, Humburg, Gerwing, Haub
Biology and management of nematodes associated with soybeans; Smolik
Studies of host-parasite interactions between small grains and their fungal pathogens; Jin
Spring wheat breeding and genetics; Glover
Improving site specific management using weed interference data across landscapes; S. Clay
Water and soil management for maximizing returns to agriculture; Kohl, Bleakley, Johnson, Schumacher, Carlson
Carbon sequestration and distribution in soils for eroded landscapes; T. Schumacher
Sunflower breeding and testing alternative oilseed crops for South Dakota; Grady
Identifying grain production practices that increase soil organic carbon; Woodard
Assessing nitrogen mineralization and other diagnostic criteria to refine nitrogen rates for crops and minimize losses; D. Clay
Soybean breeding, genetics and production; Scott
Breeding perennial grasses and legumes for forage, biomass, wildlife habitat, conservation, and tolerance to stresses; Boe
Molecular markers for soybean; Carter
Drought and freeze survival of winter wheat: a genomics approach; Sutton
Development of management practices for a diversified and sustainable cropping system in western South Dakota; Nleya
Using emerging technology to increase agronomic productivity and producer profitability; Carlson
Fungal pathogens of row crops; Chase
Development of oat varieties for South Dakota; L. Hall
Bison culture; Rickerl
Etymology and epidemiology of plant viruses in South Dakota; Langham
Breeding and genetics of forage crops to improve productivity, quality, and industrial uses; Boe
Rootworm management and ecological consideration; Fuller, McManus

Soil management for improved soil structure in degraded landscapes; T. Schumacher
 Conservation, management, enhancement, and utilization of plant genetic resources; Boe
 Use of spectral radiance as a means of quantifying N status in crops; Beck
 Corn breeding and sustainability; Wicks
 Systematics of click beetles and wireworms in North America; Johnson
 Soil quality and bioavailability of excess constituents in ecosystems of South Dakota; Doolittle
 Management and persistence of forages used for animal feed and as renewable resources; Owens, Boe, Catangui, Doolittle, Albrecht, Sheaffer, Cuomo, Berdahl, Hanson
 Plant Science farm; Kohl
 Plant Science greenhouse and seedhouse maintenance; Gallenberg
 Seed certification; Pollmann
 Seed testing; Turnipseed
 Variety testing; Hall
 Survey entomologist; Fuller
 Foundation Seed Stock; Ingemansen

Rural Sociology

Rural low-income families: tracking their well-being and function in an era of welfare reform; Hess
 North-central regional center for rural development; Hess
 Generational transfer of alternative farms as rural development in the Northern Great Plains region; Redlin

Rural Life Census Data Center; Hess
 Consortium to address social, economic, and ethical aspects of biotechnology; Hess

Veterinary Science

Unique mechanisms of B cell subset development and function in domestic animals; Young, Nelson, Daniel
 Role of intestinal epithelial cells in mucosal immunity of domestic animals; Kaushik
 Genetic marker development in the NSP2 region of a European-like PRRSV: implications for future recombinant marker vaccine development; Fang
 Third International Rushmore Conference: strategies in the prevention of enteric disease and dissemination of food-borne pathogens; Francis
 Evolving pathogens, targeted sequences, and strategies for control of bovine respiratory disease; Chase, Epperson
 Porcine reproductive and respiratory disease; methods for the integrated control, prevention, and elimination of PRRS in U.S. swine herds; Christopher-Hennings, Nelson
 Parasite issues in South Dakota beef production; Hildreth
 Development of a vaccine for protecting weaned pigs from enterotoxigenic E. coli; Francis, Young
 Domestic surveillance, diagnosis, and therapy of transmissible spongiform encephalopathies; Young, Graham
 Antimicrobial sensitivity and characterization of Campylobacter spp isolates from ovine abortions and comparison to other Campylobacter; Epperson, Holler
 Analysis of pesticides and related compounds; Matthees

Description, impact, and risk factors associated with lung lesions in lambs; Epperson, Holler, Held
 Evaluation of anti-diarrhea substances in pigs; Francis
 Controlling bovine viral diarrhea virus: improving methods for diagnosis and understanding mechanisms of pathogenesis; Chase, Lemire
 Enteric diseases of swine and cattle: prevention, control and food safety; Francis, Nelson, Young
 Analytical services; Thiex

Wildlife & Fisheries Sciences

Yellow perch fingerling production and harvest methods for ponds and small glacial lakes in eastern South Dakota; Brown, Scalet
 Merriam's wild turkey in the southern Black Hills of South Dakota, survival, recruitment, movements, habitat use, and farmstead dependence; Jensen
 Landscape ecology of white-tailed deer in agro-forest ecosystems: a cooperative approach to support management; Jenks
 Prey fish dynamics in South Dakota waters; Willis
 Intrasexual variation in digestive efficiency of white-tailed deer; Jenks
 South Dakota Cooperative Fish and Wildlife Research Unit; Berry, Higgins

Operating Budget

South Dakota Agricultural Experiment Station

Fiscal Year 2006





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