Technology Transfer
for the
USDA-ARS
Northern Great Plains
Research Laboratory

February 2005

NORTHERN GREAT PLAINS

INTEGRATOR

USDA-ARS Northern Great Plains Research Laboratory

NORTHERN GREAT PLAINS RESEARCH LABORATORY

Our Vision:

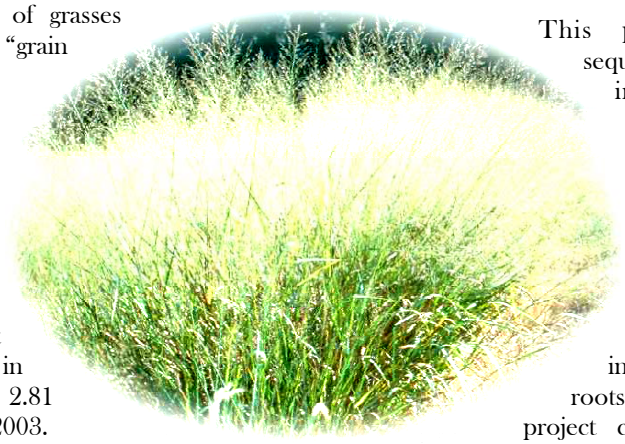
An economically sustainable and environmentally sound agriculture.

Inside this issue:

Grow Grass for Biofuel Production

For over ninety years, Northern Great Plains Research Laboratory (NGPRL) scientists have focused on the development of innovative agricultural systems that offer economically and environmentally sustainable opportunities for farmers and ranchers throughout the region.

An innovative economic opportunity under investigation at Mandan and other research locations is the development of grasses for conversion to "grain alcohol," ethanol.



Ethanol is typically made from corn. According to the Renewable Fuels Association, 81 US ethanol plants produced about 3.4 billion gallons in 2004, up from 2.81 billion gallons in 2003.

As part of a Department of Energy research program **"Developing Switchgrass as a Bioenergy Crop,"** scientists at NGPRL have researched many characteristics of switchgrass to determine its possible use as a biofuel feedstock. NGPRL scientists evaluated eight diverse switchgrass cultivars at three sites across North Dakota. The optimum temperature for germination has been determined to be approximately 77°F. The optimal soil pH is about 6.0. Switchgrass germinates well in a wide range of soil pH values, but germination is significantly reduced beyond a range of pH 5.0 to 8.0. The cultivars Sunburst, Dacotah, and ND3743 exhibited maximum germination rates.

NGPRL research has revealed that yield potential, production consistency, adaptation, persistence, and maturity date favor the cultivar Sunburst for switchgrass biomass production in this region. Although potentially subject to winter injury in some years, the cultivar Trailblazer may also be a good choice.

Switchgrass, and other high-producing perennial grasses, are also important in safeguarding the soil resource of the Northern Plains. Switchgrass, which is a warm - season grass, develops an extensive deep root system that allows for about 50% greater water-use efficiency than cool-season forages.

Switchgrass also demonstrates significant potential for storing soil carbon in the northern Great Plains. Grasses are particularly adept at removing carbon dioxide from the atmosphere and storing it below ground.

This process of carbon sequestration is important in overcoming the effects of increased concentrations of greenhouse gasses in the atmosphere. A study of two switchgrass cultivars showed both stored about 80% of their total mass in plant crowns and roots. Another NGPRL project compared soil carbon stocks within established switchgrass stands and nearby cultivated cropland on farms throughout the northern Great Plains and northern Cornbelt. Switchgrass tended to store more carbon below 12 inches. Carbon stored deeper in soil is significantly less susceptible to mineralization and loss back into the atmosphere, thereby mitigating possible contributions to global warming.

Scientists at NGPRL have determined that several other warm-season grasses may have significant potential use as biofuel feedstocks. When fermented, Big bluestem was found to have about 8% greater capacity for producing methane and carbon dioxide gases, a preliminary indication of the ethanol producing capacity.

According to a study by the Minnesota Department of Agriculture, the ethanol industry directly and indirectly contributes over 2,500 jobs and $600 million to the economy of that state. In addition, the Minneapolis - St. Paul metro area now meets the Environmental Protection Agency's carbon monoxide standard due in large part to the use of ethanol. Agriculturally derived fuels from many sources may substantially help the USA meet many national environmental and economic priorities.

(continued on page 3)

Research Results & Technology Conference

The Northern Great Plains Research Laboratory and North Dakota Area 4 Soil Conservation Districts (SCDs) will be hosting their 21st annual research review conference at the Seven Seas Inn & Conference Center in Mandan, North Dakota on February 22nd from 8 AM to 4 PM (CST). The program will review research results from the field-scale farm developed by the SCDs for use by the NGPRL scientists, and research which could lead to new beef finishing and processing opportunities for cattlemen throughout the region.

The morning program will focus on soils and agronomy. Presentations on "Building Living Soils" and "Improving the Bottom Line with Carbon Sequestration" will be followed by annual updates from eight major commodity groups. The topic of "Crop Sequencing in Dry Years" will complete the morning program, focusing on crop water use, crop production, and plant diseases.

A complementary lunch will be provided by over 60 program sponsors, many of whom will host commercial exhibits.

The afternoon program focuses on the potential development of value-added commercial beef production. There will be presentations on innovative cattle research at the Mandan facility and NDSU, and also speakers from the North Dakota Stockmen's Association, UND School of Medicine, USDA-ARS Grand Forks Human Nutrition Research Center, and the North Dakota Department of Agriculture.

This event is open to the public free of charge. Certified Crop Advisors can register for 5.5 Continuing Education Units (CEU) for the day.

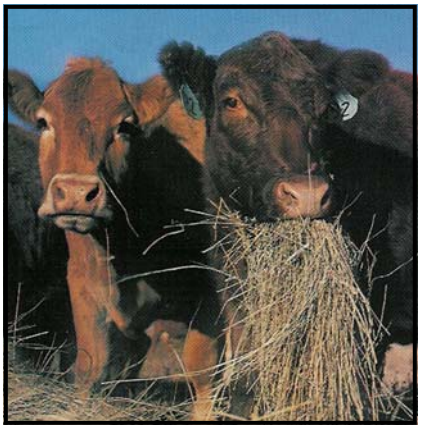
Northern Great Plains Integrator

Northern Great Plains Integrator is published and distributed by the USDA-ARS, Northern Great Plains Research Laboratory, 1701 10th Ave., S.W., Mandan, ND 58554. Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at 202-720-2600 (voice and TDD). The United States Department of Agriculture prohibits discrimination in all its programs and activities on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital and family status. To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326-W, Whitten Building, 14th and Independence, SW, Washington, DC 20250-9410 or call 202-720-5964 (voice or TDD). USDA is an equal opportunity provider and employer. Mention of trade or manufacturer names is provided for information only and does not constitute endorsement by USDA-ARS. **Any material in this publication may be copied and distributed in part or whole if due credit is given to the authors.** Editor: Cal Thorson, Technical Information Specialist, USDA-ARS Northern Great Plains Research Laboratory, 1701 10th Ave., S.W., Mandan, ND 58554 O:701 667-3079 F:701 667-3077 E: thorsonc@mandan.ars.usda.gov

Omega-3 Fatty Acids in Beef Increased with Feeding Flaxseed

Most people on a 'western' diet consume foods with much lower levels of omega-3 polyunsaturated fatty acids than the recommended daily amounts, and much higher levels of omega-6 polyunsaturated fatty acids than is ideal for good health.

Few people routinely eat cold water fish that are excellent sources of the omega-3 fatty acids EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid), and there is concern about contaminants such as mercury and dioxins limiting healthfulness of high fish intake by health-conscious consumers. The average annual per capita fish intake in the USA is merely 16.3 lbs (USDA Economic Research Service, 2004) with only some of this intake of species that contain high levels of omega-3 fatty acids (National Oceanic and Atmospheric Administration, 2004). Per capita US beef consumption is 64.9 lbs/person (USDA Economic Research Service, 2004).



Previous studies have shown that cattle consuming feedstuffs containing higher amounts omega-3 fatty acids before they are slaughtered can produce beef with higher levels of omega-3 fatty acids and lower levels of omega-6 fatty acids. This beef has the potential to help beef-eating Americans increase their omega-3 and decrease their omega-6 fatty acid intake. A person who consumes 8 ounces of omega-3 enhanced beef per day for five days could consume 200 milligrams of omega-3 fatty acid per day. Flaxseed-fed, omega-3 enriched beef, consumed along with other omega-3 sources from plants (e.g., flaxseed and walnuts) and omega-3 enhanced dairy products, chicken and eggs, and pork, could provide a diet with adequate omega-3 intake.

The omega-3 fatty acid level in beef may vary with the particular muscle, breed of cattle, type of feed fed, amount fed, length of time of feeding, and if the feed has some protection from bio-hydrogenation by rumen microbes. Many feedstuffs containing high levels of omega-3 fatty acid are relatively expensive and may be toxic to rumen microbes at relatively low levels. Ninety-two percent of the omega-3 fatty acid in flaxseed (α-linolenic acid; ALA) is hydrogenated by rumen microbes and therefore not available to cattle muscle.

The most effective hydrogenation-prevention process uses formaldehyde, which may be unacceptable to many consumers that might otherwise prefer omega-3 enriched beef. Alternative methods would be beneficial to protect omega-3 fatty acid sources; perhaps improve our ability to enrich beef with omega-3 fatty acids; as well as reduce the amounts of more expensive feeds. There is limited evidence that treating omega-3 sources with lignosulfonate (a byproduct of the pulp industry) can provide some protection for ALA from microbial hydrogenation in the bovine rumen.

Dr. Scott Kronberg at the USDA-ARS Northern Great Plains Research Laboratory and his scientific collaborators at the University of North Dakota School of Medicine and Health Sciences, recently conducted feeding trials with lignosulfonate-treated flaxseed to determine if this protection method would increase omega-3 fatty acid deposition in beef. Omega-3 fatty acid levels in beef were clearly enhanced by feeding the treated flaxseed for 71 days, but not to the extent desired for health food labeling.

An improved method for protecting flaxseed ALA from bio-hydrogenation in the bovine rumen and/or more days of feeding lignosulfonate-treated flaxseed is needed to obtain higher levels of ALA, EPA, and DPA (omega-3 fatty acids) in beef.

Dr. Kronberg and colleagues also found that if these steaks are grilled to an internal temperature of 150°F or less, little or no loss of omega-3 fatty acids will occur in the beef. *They tasted delicious!*

Omega-3 Fatty Acid History

Research began in 1970's

Danish scientists studying traditional Eskimos of Greenland discovered what was considered a medical impossibility. The Eskimos were eating a diet containing a massive amount of fat (40%) and extreme amounts of cholesterol, yet were nearly heart attack free. Eskimos living in Denmark and eating a modern diet had the same heart disease rates as the Danes. The traditional Eskimo diet was of fish, seal, walrus, and whale. Marine animal fat differs significantly from land animals. The oceanic food chain begins with sea plants rich in omega-3 fatty acids, which is concentrated up the food chain. Marine animals eat fish rich in omega-3 fatty acids, which we now know have many health benefits.

Land animals are the primary source of fat in modern diets. In modern beef production, animals consume cereal grains or grain by-products for rapid growth and maximum profit. This diet produces fats that are largely saturated fat or omega-6 unsaturated fat, the types that tend to raise blood cholesterol levels and increase production of inflammatory compounds in our bodies.

Before the agricultural revolution 10,000 years ago, humans are believed to consume equal amounts of omega-6 and omega-3 fatty acids. Over the past 150 years, this balance has been significantly upset. Current estimates of the average American diet are approximately 20:1 to 30:1 omega-6 to omega-3.

Biofuel Production (continued from page 1)

Results from NGPRL research are significant. It has been verified that: (A) switchgrass cultivars are available for sustainable biofuel development in this region; (B) an exceptional capacity to preserve the soil resource can be provided by switchgrass; (C) switchgrass has the capacity to store carbon deep in the soil profile; and (D) big bluestem may have an even higher potential ethanol producing capacity.

Ninety years of continuous NGPRL research show that the area's tall and short-grass prairies can sustain family farming. Agricultural producers could derive significant new income opportunities with development of forage-based ethanol bio-processing capacity near local raw material production areas in the region.

Mandan Soil Scientist Honored

Dr. Mark Liebig, Soil Scientist at the USDA-ARS Northern Great Plains Research Laboratory, received the 2004 Soil and Water Management and Conservation Young Scientist Award at the Soil Science Society of America annual meeting in Seattle, Washington. The award is given for excellence in research, teaching, and extension in the area of soil and water management, and is limited to scientists within seven years of receiving their Ph.D. While at the meeting, Dr. Liebig presented two papers: "Greenhouse Gas Contributions and Mitigation Potential of Agricultural Practices in Northwestern USA and Western Canada" and "Soil Carbon Under Switchgrass Stands and Cultivated Cropland."

New NGPRL Research Animal Scientist

Welcome to Dr. Eric Scholljegerdes (pronounced shol-a-ger-dis), the newest member of the scientific research team at NGPRL. Dr. Scholljegerdes arrived on January 24th and is eager to join the team researching and developing "Dakota Healthy Beef". Specifically, Eric's research will focus on integrated management practices that will incorporate supplementation and grazing strategies that not only improve the value of the beef but are sustainable. Dr. Scholljegerdes believes that NGPRL has a great deal to offer in regards to research. "The facilities and resources at NGPRL are excellent and the opportunities to conduct high-quality research are endless." according to Scholljegerdes. Eric, a Missouri native, recently completed his Ph.D. in Animal Science with an emphasis in Ruminant Nutrition at the University of Wyoming. His dissertation was entitled, "Amino acid and fatty acid nutrition of beef cattle consuming high-forage diets". He may be contacted at 701-667-3056 or schollje@mandan.ars.usda.gov.

NGPRL Purchasing Agent Retires

Ms. Linda Dvorak accepted medical retirement from USDA-ARS on January 15th. Linda has been a member of the support team at NGPRL the past fifteen years. Her significant effort to manage the procurement function effectively and efficiently in light of her worsening disability has been an inspiration to the entire staff. She will be missed by all at the laboratory.

USDA ARS

NORTHERN GREAT PLAINS

Technology Transfer Product of the Northern
Great Plains Research Laboratory
United States Department of Agriculture
Agricultural Research Service

USDA-ARS-NGPRL
1701 10th Avenue SW PO Box 459
Mandan, ND 58554-0459
Phone: 701 667-3018 Fax: 701 667-3077