



July 2011

Flaxseed Supplementation to Increase Omega-3 Fatty Acid Concentration in Grass-Finished Beef

Recent research indicates that inadequate intake of omega-3 fatty acids is associated with a significant number of the same health problems some believe are connected to high intake of marbled beef, yet beef could be an important source of omega-3 fatty acids for millions of beef-eating people.

In previous research, higher growth rates of yearling steers grazing northern Great Plains pastures have been observed when supplemented with flaxseed. Feeding flaxseed, an oilseed with high levels of the omega-3 fatty acid α -linolenic acid (ALA), can result in red meat that has higher levels of healthful omega-3 fatty acids.

In 2010, over 90 percent of U.S. flaxseed production was grown in North Dakota, which harvested 388,000 acres.

Cattle grown and fattened on growing perennial grasses can also have higher intramuscular levels of omega-3 fatty acids compared to cattle grown on high-concentrate diets that are typically low in omega-3 fatty acids.

The objective of this trial was to determine if daily supplementation of flaxseed for eighty-five days to steers finished on grasslands of the northern Great Plains would influence growth and carcass characteristics, or fatty acid profile, tenderness, and sensory characteristics of beef steaks.

Eighteen Angus yearling steers were randomly divided into three groups. Treatment 1 steers received a small daily supplement of ground flaxseed. Treatment 2 steers received a small daily supplement of ground corn and soybean meal that had levels of crude protein and total digestible nutrients similar to the supplement for flax. Control steers were not supplemented.

Treatments were fed to each individual steer in side-by-side

stalls for a few minutes, and were fed from mid-August to the day before slaughter in early November. All steers grazed growing forage from early-May through the first week of November.

In an attempt to maximize individual daily weight gain, grazing was managed at all times to achieve no more than moderate forage utilization such that steers were not forced to consume low quality forage. From mid-August to late September, cattle grazed the annual grass proso millet, then from late September through October they grazed immature regrowth (the original stand was cut for hay) of mixed Kentucky bluegrass, smooth brome, blue grama, green needlegrass, Porcupine grass, western wheatgrass, and small amounts of yellow sweet clover. In the first week of November they grazed immature winter rye and mixed pasture grasses species typical of the northern Great Plains.

Growth rate of the group consuming flaxseed was similar to that of corn and soybean meal supplemented group and 25% greater than that of the control group. No differences were observed for carcass

characteristics tenderness or sensory attributes except for a slightly different flavor detected in steaks from flax-fed group than the corn and soybean meal fed and control groups.

The omega-3 fatty acids α -linolenic acid (ALA) and eicosapentaenoic acid (EPA) were 62 and 22% higher, respectively, in beef from flax-fed and control (grass-fed) over corn and soybean meal fed groups. Total omega-3 fatty acid concentration was 39% greater for the flax-fed steers compared to the control group and 71% greater compared to the corn and soybean meal fed steers. The ratio of omega-6 to omega-3 fatty acids was smaller (which is preferable) in beef from the flax-fed group compared to the corn and soybean meal fed and control groups.

Daily supplementation of flaxseed to finishing steers grazing on the northern Great Plains can improve growth rate and enhance the omega-3 fatty acid profile of their steaks.

"The effect of flaxseed supplementation on growth, carcass characteristics, fatty acid profile, retail shelf life, and sensory characteristics of beef from steers finished on grasslands of the northern Great Plains" S. L. Kronberg, E. J. Scholljegerdes, A. N. Lepper and E. P. Berg; J ANIM SCI published online April 8, 2011; <http://jas.fass.org/content/early/2011/04/08/jas.2011-4058>

Dr. Scott Kronberg - scott.kronberg@ars.usda.gov - 701.667.3013



IN THIS ISSUE

Page

- 1 Flaxseed Supplementation to Increase Omega-3 Fatty Acid Concentration in Grass-Finished Beef
- 2 Message from Matt
- 2 Special Guest at NGPRL
- 3 Friends & Neighbors Day
- 4 Personnel News
- 4 SWCS Merit Award
- 5 Infiltration Rates in Integrated Crop-Livestock Systems
- 5 History of Crested Wheatgrass in North America
- 6 Harvesting Corn Stover - What is Removed?
- 7 Economics of Forage Mixtures for Pastures
- 8 Interaction between Morphological Development and Burning Effectiveness in Kentucky Bluegrass and Smooth Bromegrass
- 8 The NRCS Pasture Condition Score (PCS) System

Message from Matt

The past six months since the February issue of the Integrator have indeed been challenging. Winter seemed to never end. When it did, snow melt and spring rains made for extremely wet conditions, which severely hampered field work. On top of that, the historic water levels in the Missouri River basin have caused tremendous hardship for farmers, homeowners, and businesses along the river. The staff at NGPRL has been volunteering with sandbagging and other efforts locally. This is a difficult time for many and we at NGPRL stand ready to help where needed.

The NGPRL also faced a severe budget challenge earlier this year. As part of the federal budget cuts enacted in the sixth continuing resolution on March 18, the budget of the NGPRL was cut by \$488,700. This was a permanent reduction. In addition, there was a one-time across the board cut of 1.1% on all USDA-ARS research projects nationwide. For the NGPRL, this amounted to an additional one-time cut of \$38,000 for fiscal year 2011.

To cope with the cut in funds at NGPRL, we eliminated four vacant full-time positions at the lab – two scientist positions and two technician positions. In addition, we eliminated



funding for two cooperative research agreements with North Dakota State University and we cut back on operating expenses to meet the short fall. Our research program in livestock feeding management and our biofuels research program must be reduced because of the loss of the scientist and technician positions. We were able to retain and fill a critical support staff position with Dr. Rebecca Phillips (see “New Faces” on page 3).

We understand the need for economic belt tightening and wise use of our federal resources. We believe that our research is conducted highly efficiently and that we deliver high quality research results that benefit our customers.

We thank our stakeholders and the Customer Focus Group, especially the focus group delegation that went to Washington, D.C. in February, for their continued support. Your input and guidance keep us relevant and engaged with the agricultural community. With your help, we will manage through this budget challenge to maintain the current excellent core of scientists and support staff at NGPRL and continue to deliver high quality research.

Dr. Matt A. Sanderson - matt.sanderson@ars.usda.gov - 701-667-3010

Special Guest at NGPRL

Martin Harries, Grain Legume Research Agronomist with the Western Australian Department of Agriculture and Food will be the featured speaker on the research tour at the July 21st Friends & Neighbors Day. His presentation, “Crop Sequencing for Integrated Weed Management” will be on the tour of the Area 4 SCD Cooperative Research Farm which departs promptly at 3 PM.

In October 2009, Drs. Don Tanaka, John Hendrickson, Mark Liebig, and Dave Archer spent three weeks in Australia (see February 2010 INTEGRATOR) to establish multidisciplinary collaborative research for developing adaptive crop management practices under extended stress conditions. The NGPRL research team provided Mr. Harries significant information on developing crop sequencing research from their decade of sequencing research at Mandan.

Martin specializes in dry land agronomy of legume crops and management of herbicide resistant weeds for the Western Australian Department of Agriculture and Food.

Upon graduation from Tasmania, Harries commenced work with the Weed Science project within the Western Australian Department of Agriculture in 1998. This was a period when herbicide resistant weeds were a major concern over an area

of 13.6 million acres. He was involved in testing a range of novel integrated weed management practices. In 2000 Harries transferred to the Department’s ‘Break Crops Project’. He continued to research weed control in broadleaf crops and also the management of foliar diseases such as ascochyta.



Dr. Don Tanaka and Martin Harries

This involved taking a systems approach to these issues and investigating the role of crop sequence in managing both weeds and diseases in various crop sequences. For both the weed and disease issues of these crops, flexible management regimes have been developed incorporating a much wider set of actions rather than relying so heavily on pesticides. For weeds in particular, growers have adopted many of the integrated solutions developed and are much more confident of successful control than ten years ago, despite increased levels of herbicide resistance.

This work has evolved into an extensive farm paddock monitoring project which is benchmarking the utilization of break crops across the Western Australia wheatbelt. It is also investigating how farmers make decisions around selecting crops or pastures and how we can better inform this decision process.

Harries will be in North Dakota for two weeks.

Friends & Neighbors Day

The public is invited to the campus of the Northern Great Plains Research Lab for Friends & Neighbors Day on July 21st.

Tours of Ag and environmental research will depart promptly at 3 PM.

The highlight of the tour will be Martin Harries of the Western Australia Department of Agriculture and Food talking on "Sequencing Crops for Improved Weed Control" (see page 2).

Major presentations by Mandan scientists on this year's tour are: "Are our Cropping Systems Sustainable?" (Dr. Don Tanaka), "Beef Production with Less Grain" (Dr. Scott Kronberg), "Straw Removal, Soil Degradation?" (Dr. Mark Liebig), "Harvesting Residue – Does It Pay?" (Dr. Dave Archer), "Controlling weeds By Grazing" (Dr. John Hendrickson), and "Soil Moisture, Greenhouse Gases, and NASA" (Dr. Rebecca Phillips). Sonjia Mullally from the National Sunflower Association will also discuss "What's Up With Sunflower?"

USDA Staff will provide historical tours of the 99 year old research facility from 1:30 to 6 PM. The 15 acre park-like campus will also host presentations throughout the day on cooking with herbs (Jackie Buckley, NDSU Extension), energy needs and conservation (Jackie Miller, Mor-Gran-Sou), ornamental grasses (Alan Zuk, NDSU), sun and skin care (Custer Health District), new tree releases for North Dakota (Todd West, NDSU), severe weather (John-Paul Martin National Weather Service), "Its A Bug's Life" (Dr. Kris Nichols, USDA-ARS Soil Microbiologist), and the new NDSU Biomass Testing Laboratory (Dr. Igathi Cannayen, NDSU) being built in Mandan.

The North Dakota Department of Agriculture will exhibit the "North Dakota Feeds the World" display. The exhibit is under two tents featuring fourteen "grain" commodities and six livestock commodities. The murals have

AREA 4 SCD Cooperative Research Farm USDA

Friends & Neighbors Day

Highway 6 South Mandan ND

Featuring **Martin Harries** Western Australia Dept of Agriculture & Food Sequencing Crops for Improved Weed Control

International Soil & Water Conservation Society 2011 Merit Award Recipient

www.mandan.ars.usda.gov 701 667 3000

Thursday, July 21

USDA-ARS RESEARCH FARM TOUR

- ◆ Are our Cropping Systems Sustainable?
- ◆ Beef Production on Less Grain
- ◆ Soil Moisture, Greenhouse Gases, and NASA
- ◆ Harvesting Crop Residue - Does it Pay?
- ◆ Controlling Weeds by Grazing

CAMPUS ACTIVITIES & PRESENTATIONS

- ◆ Historical Tour
- ◆ Cooking with Herbs
- ◆ Ornamental Grasses
- ◆ New Tree Releases for ND
- ◆ It's a Bug's Life
- ◆ NDSU Biomass Testing Laboratory
- ◆ Sun and Your Skin
- ◆ Severe Weather
- ◆ Energy Needs & Conservation

3-6 PM CDT

1:30-6 PM CDT

NO COST

- ◆ All-Day Children's Activities
- ◆ Evening Barbecue
- ◆ Evening "In the Mix" With Tom O'Neill

SPONSORS

Use of product or corporate name or trademarks does not constitute official endorsement by the Area 4 SCD Cooperative Research Farm, United States Department of Agriculture or the Agricultural Research Service of any product or service. Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at 800 735 6989 (voice) and 711. The United States Department of Agriculture prohibits discrimination in its programs and activities based on race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital and family status. For file a complaint or discrimination write USDA, Director, Office of Equal Opportunity, Room 3206 W. Williams Building, 14700 Independence Ave., Washington, DC 20250-8610. Call 800 735 6989 (voice) or 711. USDA is an equal opportunity provider and recipient.

interesting facts about the commodities plus actual products from the commodities. There is an eight foot map of the world that shows the state's main exports, major trading partners, and the price of food in the U.S. compared to other countries.

Informational exhibits and educational displays from many local organizations, including the Red Cross and Salvation Army, will be found throughout the campus. The public is also invited to contribute to the "Feds, Farmers, and

Friends Feed Families" food drive (see page 8). Crafts, face painting, a balloon man, and horse-drawn wagon rides, and the NDDA exhibit TA free barbecue and entertainment will complete the evening activities.

Over 80 businesses and organizations have joined with the Area 4 SCD Cooperative Research Farm to support this annual event.

Over 1000 visitors joined us last year. Please join us on July 21st.

New Faces



Dr. Jonathan Aguilar is a postdoc Agricultural Scientist funded by USDA-ARS headquarters in Washington, D.C. His current research includes spatial and temporal analysis of crop diversity indices for the contiguous U.S. Prior to coming to Mandan, Jonathan was an Agricultural Engineer with the USDA-ARS in Sidney,

MT exploring the use of remote sensing in quantifying crop residue. His interest includes GIS, remote sensing, database management, soil and water conservation, watershed modeling, and hydrology among others. He earned his PhD in Agricultural and Biological Engineering from Kansas State University and both his MS and BS in Agricultural Engineering from the University of the Philippines Los Baños.

Dr. Jonathan Aguilar - jonathan.aguilar@ars.usda.gov - 701.667-.009



Manlu Yu is an NDSU Agriculture and Biosystems Engineering PhD student and research assistant with Dr. Igathinathane Cannayen and with NGRPL scientists. Her research emphasis is on biomass preprocess engineering. She will be providing technical support and conducting experiments in the “NDSU Biomass Testing Laboratory”

and “NDSU Biomass Processing Laboratory” at NGRPL. She received an MS in Biosystems Engineering from the University of Tennessee and a BS in Mechanical Engineering from the Northeastern University in China. She has engineering and research experiences in China, Sweden and the U.S.

Manlu Yu - manlu.yu@ndsu.edu - 701.667.3033

International SWCS Merit Award



The Northern Great Plains Research Laboratory is being recognized for excellence in technical transfer of USDA-ARS research and public outreach at their annual “Friends & Neighbors Day” event.

USDA-ARS staff at Mandan, ND and the

North Dakota Area 4 Soil Conservation Districts developed this activity to inform the public of USDA-ARS agricultural and environmental research and enhance awareness of the value of natural resources conservation. The 26-year-old activity has grown into a major day-long community event featuring campus lectures and exhibits, agricultural and environmental research tours, and children’s activities. More than 800-1000 people from the Great Plains region of the U.S. and Canada attend annually. Today, this major event focuses on soil health education and agricultural sustainability research to assist producers develop improved science-based management practices, and also supports public awareness of environmental stewardship.



Dr. Nick Saliendra is an Ecologist working with Dr. Rebecca Phillips. His research includes the study of sustainable rangeland productivity with ground-level biometric/spectral measurements and air-borne hyperspectral imageries or remote sensing. He came to Mandan after working on biophysical research projects

that involve measurements and modeling of carbon, water and energy fluxes at different spatial scales such as ecosystem and landscape levels. His previous research has encompassed a wide range of ecosystems including suburban forests in Maryland, regenerating forests and wetlands in northern Wisconsin, and rangelands in Utah, Idaho at the former Soviet republics of Kazakhstan, Uzbekistan and Turkmenistan. He has studied water relations, hydraulic conductance, carbon isotope discrimination, and leaf/whole plant gas exchange, i.e., water vapor and carbon dioxide, in sugarcane cultivars, coffee varieties and a riparian tree species. He earned his PhD in agronomy and soil science from the University of Hawaii, and MS in agronomy and BS in agriculture from the University of the Philippines.

Dr. Nick Saliendra - nicanor.saliendra@ars.usda.gov - 701.667.3022

North Dakota Top Professional



Dr. Kris Nichols, USDA-ARS Soil Microbiologist, has been selected by *Business Watch* magazine as one of the Top 40 Professionals in North Dakota Under Age 40. She was selected for nationally recognized leadership in her field of science, exhaustive effort in technical transfer of new, innovative USDA-ARS science to

improve family farming and the environment, and support of her community. The profile on Nichols appears in the July 2011 issue of *Business Watch* magazine.

Dr. Kris Nichols - kristine.nichols@ars.usda.gov - 701.667.3008

Rittel Retires



Bruce Rittel, NGRPL Administrative Officer, has retired after 28 years of federal service. Throughout his years, he has contributed to the mission of the lab in the areas of administrative support, safety, EEO and outreach. Bruce was recognized nationally with the ARS Silver Award

for Excellence for making a positive effect on improving efficiency in the administrative support activities and the Federal Civil Servant of the Year Award and Super Supervisor Award for his role in leadership for persons with disabilities.

Infiltration Rates in Integrated Crop-Livestock Systems

Integrated crop-livestock systems have been proposed to have significant agronomic and environmental benefits compared to specialized, single-enterprise production systems. However, concerns exist regarding the potential for livestock in integrated systems to cause soil compaction, thereby decreasing infiltration of water into soil. Such concerns are compounded by projections of more frequent high-intensity rainfall events from anticipated climate change, which would act to increase surface runoff and soil erosion.

To help address this issue, a study was conducted at the USDA-ARS NGPRL southern research station to evaluate the effects of an integrated crop-livestock system on infiltration rate. Measurements of infiltration rate were made in 2001, 2005, and 2008 in duplicate pastures including 1) annual cropping followed by fall/winter swath grazing (integrated crop-livestock), and 2) grazed western wheatgrass (perennial grass).

Infiltration rates were found to be highly variable over time, but not different between the integrated crop-livestock system and perennial grass pasture (Figure 1).

Maintaining key hydrological functions on agricultural land is an essential attribute affecting productivity and

environmental quality. Anticipated changes in climate may favor management systems that can effectively capture and store significant amounts of water in soil following intense precipitation events. Findings from this study indicate integrated annual cropping systems utilizing winter grazing may be able to withstand significant changes in near-surface soil physical properties known to affect water infiltration, and thus may be adapted to a more vigorous hydrological cycle from the standpoint of water capture and storage.

The consistent freeze/thaw and wet/dry cycles characteristic of the northern Great Plains, coupled with the use of no-till management, likely played an important role in the outcome of results. These cycles act to fracture compacted soil zones through the expansion/contraction of soil minerals and water in soil pores, whereas no-till contributes to improved soil structure and pore continuity. Also of note was the contribution

by earthworms to create large macropores in the integrated annual cropping system. Such 'biopores' are effective at facilitating transfer of water into soil.

"Soil hydrological attributes of an integrated crop-livestock agroecosystem: Increased adaptation through resistance to soil change". Liebig, M.A., D.L. Tanaka, S.L. Kronberg, E.J. Scholljegerdes, and J.F. Karn. 2011. Appl. Environ. Soil Sci. doi:10.1155/2011/464827.

Dr. Mark Liebig - mark.liebig@ars.usda.gov - 701.667.3079

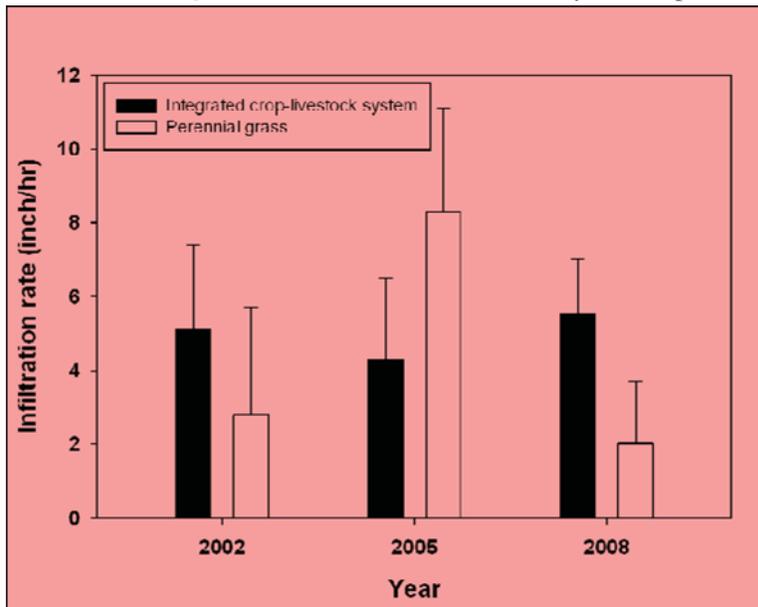


Figure 1.

History of Crested Wheatgrass in North America

Crested wheatgrass is indigenous to the Steppe region of European Russia and southwestern Siberia. It was first introduced into North America in 1892 by N. E. Hansen of the South Dakota Experiment Station. Dr. Hansen obtained five accessions from Valuiki Experiment Station near what is now Volgograd, Russia. Although original seed of these introductions was distributed to agricultural experiment stations, no permanent plantings or seed increases were made.

A second importation, consisting of six seedlots was received by N. E. Hansen in 1906 from the Valuiki Experiment Station. This seed was distributed to fifteen experiment stations. Research initiated with these accessions in 1915 by the USDA-ARS Northern Great Plains Research Laboratory at Mandan, North Dakota led to the initial acceptance of

crested wheatgrass in the northern Great Plains.

The contribution of crested wheatgrass was particularly notable during the early settlement of the northern Great Plains of the United States and Prairie Provinces of Canada and is credited with salvaging vast areas of deteriorated rangelands and abandoned cropland during the depression and "dustbowl" period of the 1930s. Crested wheatgrass rapidly spread from the Great Plains to other semiarid regions and has become one of the most important range grasses in North America where it is an effective biological suppressor of cheatgrass.

Dr. Kevin Jensen, USDA-ARS Forage and Range Research Laboratory, Logan, UT *Abstract of the 64th Annual Meeting of the Society of Range Management - 2011*

Harvesting Corn Stover – What is Removed?

With interest in using crop residue for bioenergy production it is important to understand what is removed when harvest occurs. A corn stover harvest study was conducted in 2007 at eight locations across the U.S. (Figure 1) to identify biomass available at different cutting heights and the nutrient content of the harvested biomass. Corn plants were sampled at two different times for each location: at physiological maturity (“black layer”), and at grain harvest. Plants were harvested in 4-inch segments so the quality and quantity of biomass removed at different cutting heights could be determined. For the Mandan site, samples were collected from corn varieties with two different maturity ratings, a 79-day variety and an 85-day variety. Results for Mandan showed that a one-pass harvest operation removing all material above a height of 20 inches would remove 1.6 to 1.8 tons of dry biomass per acre including the cob but excluding the grain for the 85-day and 79-day varieties, respectively (Figure 2). This would leave about 1 ton of biomass per acre in the field for maintaining the soil resource, such as protecting against soil erosion and maintaining soil organic carbon. Lower cutting heights would remove more biomass and leave less in the field. Results across all sites showed nearly a 1:1 relationship between the proportion of biomass retained in the field and the relative cutting height (proportion of the total plant height). This relationship can help in planning harvest to leave appropriate amounts of residue in the field to meet soil resource needs.

Nutrient removal results across all sites at grain harvest showed the above-ear stover contained 14.9 pounds of nitrogen, 2.5 pounds phosphorus, and 17.3 pounds of potassium for every ton of biomass, with lower nitrogen and phosphorus amounts contained in the cob and the below-ear stover (Figure 3). However, the below-ear portion contained more potassium than the above-ear portion. Based on 2005-2009 average fertilizer prices, replacing the nitrogen, phosphorus,

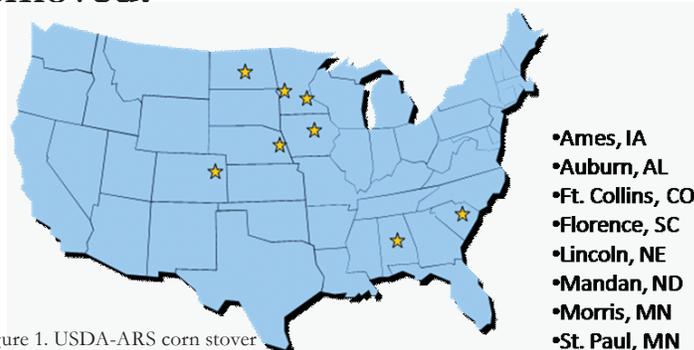


Figure 1. USDA-ARS corn stover harvest study locations.

- Ames, IA
- Auburn, AL
- Ft. Collins, CO
- Florence, SC
- Lincoln, NE
- Mandan, ND
- Morris, MN
- St. Paul, MN

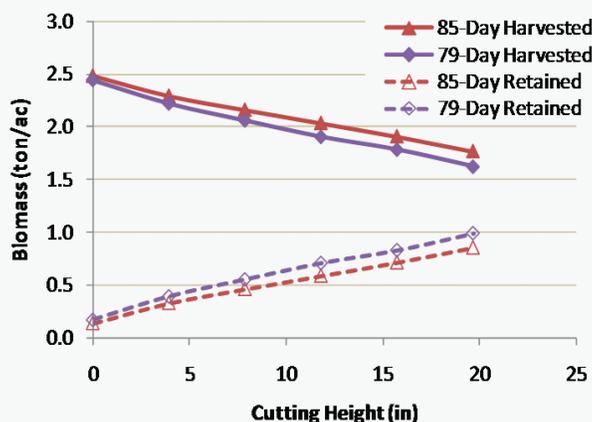


Figure 2. Corn stover harvested and retained on the soil as a function of cutting height for the Mandan, ND site.

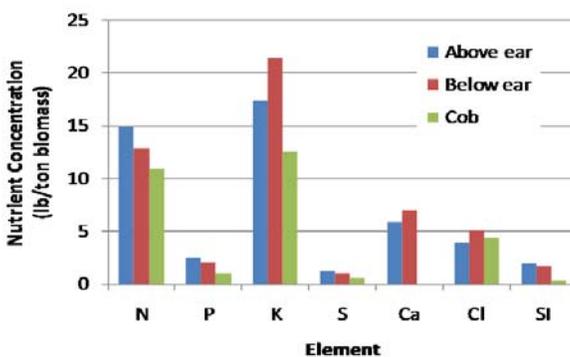


Figure 3. Average nutrient concentration for the above-ear, below-ear, and cob portions of corn stover across eight study sites.

and potassium in the above-ear stover would cost \$15.96 per ton of biomass removed, while replacing the nutrients from the cob and the below-ear portions would cost \$10.56 and \$16.43 per ton, respectively. So, harvesting cobs only or cobs and above-ear stover would reduce nutrient replacement costs. The nitrogen (N), sulfur (S), and calcium (Ca) content of the above-ear biomass decreased 17% for N, 26% for S, and 32% for Ca from physiological maturity to grain harvest. So, waiting for corn to dry down in the field before harvesting could also help reduce the amount of nutrients removed. Because of the relationship between residue removal and nutrient content, producers harvesting cobs and stover should utilize soil tests and monitor crops for signs of nutrient deficiency and adjust fertilizer applications accordingly. Decisions to harvest corn stover should consider short-term and long-term fertility impacts together with the risks of erosion and loss of soil organic carbon.

This work was conducted as part of the USDA Agricultural Research Service, cross-location Renewable Energy Assessment Project (REAP).

Nutrient removal as a function of corn stover cutting height and cob harvest. Johnson, J.M.F., Wilhelm, W.W., Karlen, D.L., Archer, D.W., Wienhold, B.J., Lightle, D.T., Laird, D.A., Baker, J.M., Ochsner, T.E., Novak, J.M., Halvorson, A.D., Arriaga, F.J. and Barbour, N.W. 2010. "Bioenergy Research 3:342-352.

Dr. Dave Archer - david.archer@ars.usda.gov - 701.667.3048

Feel free to pass on this issue of Northern Great Plains Integrator to others interested in agricultural research in the northern Great Plains. Northern Great Plains Integrator is published and distributed by the USDA-ARS, Northern Great Plains Research Laboratory, PO Box 459, 1701 10th Avenue SW, Mandan, ND 58554. Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotope, 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. To be added to our mailing list, request a copy through our website or contact editor: Cal Thorson, Technical Information Specialist, USDA-ARS Northern Great Plains Research Laboratory, 1701 10th Ave., SW, Mandan, ND 58554. Office:701 667-3018 FAX:701 667-3077 Email: calthorson@ars.usda.gov

Economics of Forage Mixtures for Pastures

Establishment of new pastures from seed can be expensive and producers often prioritize stand life of the pasture over herbage yield. Nonetheless, in our research at the USDA-ARS Pasture Systems and Watershed Management Research Unit in Pennsylvania, we have found that some producers in the Northeast U.S. plant complex mixtures of grasses and legumes because they believe that maintaining a highly diverse botanical composition in pastures contributes to increased persistence, yield stability, and productivity. In an informal survey of 86 mixed-species pasture plantings on 56 farms, we found that about 30% of the plantings were to four or more forage species. A major disadvantage of forage mixtures is maintaining each species in the pastures. This might require more frequent re-establishment to maintain the mixture. In this research we examined the whole-farm economic returns from several pasture planting scenarios that varied in stand life. Our research shows that planting grass-legume or grass-legume-chicory mixtures increased net returns per cow compared with a nitrogen-fertilized orchardgrass pasture. The increase in net return ranged from \$57/cow for the two-species mixture to \$191/cow for a six-species mixture with a 3-yr stand life. Corresponding values for a 5-yr stand life were \$107 and \$225, respectively, and for a 10-yr stand life were \$136 and \$246, respectively. The greater forage yields of the mixture compared with orchardgrass+nitrogen reduced purchased feed inputs and in some instances increased the income by providing more forage sold off the farm.

To do the analysis, we used the Integrated Farm System Model to simulate several pasture planting scenarios calibrated to the forage and animal production results from a previous dairy grazing trial. The scenarios included an orchardgrass+nitrogen (150 lb/acre) pasture with a 10-year stand life and two-, three-, six-, and nine-species pastures with a 3, 5, or 10-year stand life.

Planting pastures to grass-legume or grass-legume-chicory mixtures increased net returns per cow compared with the orchardgrass+nitrogen system. Within the four mixtures, the three-, six-, and nine-species mixtures had greater net returns per cow than the two-species mixture. Our simulation results indicate that all forage mixtures were more economical, on a whole-farm basis, than grass+nitrogen pasture. Lower seeding rates would improve the economic advantage of the mixtures compared with orchardgrass+nitrogen. Costs could be reduced further by frost-seeding forages instead of no-till

planting if the forages successfully establish.

Increasing stand life increased net returns from all mixtures but the increase in net return was greatest with the two-species mixture. However, the greater herbage production and resulting greater net returns per cow for the grass-legume-chicory mixtures offset any disadvantage of shorter stand life compared with the orchardgrass+nitrogen or orchardgrass+white clover pastures. For example, the net return per cow from the three- and six-species mixtures with a 3-year stand life was equal or greater compared with the orchardgrass+nitrogen or orchardgrass+white clover pastures with a 10-year stand life. Thus, producers who place a premium on stand life of pastures

without regard to herbage yield may give up potential profit.

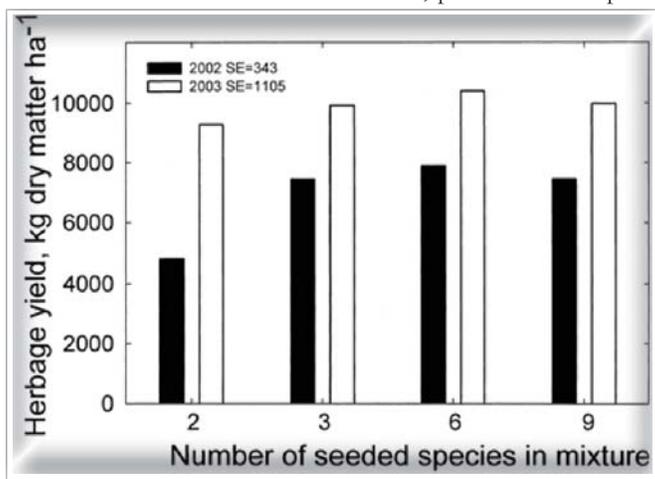
The principal item affected in our simulation analysis was the net purchased feed and bedding cost per cow. The greater forage yields of the mixture compared with orchardgrass+nitrogen reduced purchased feed inputs and in some instances increased the income from forage sold off the farm. The reduction in feed production costs with more efficient forage production on

pastures and the generally lower purchased feed costs are the principal benefits of pasture-based dairy systems.

Production risk (measured as the standard deviation of net returns across years) decreased by as much as 24% for the forage mixtures compared with the orchardgrass+nitrogen scenario. This was because forage production was more consistent year-to-year with the mixtures and because excess forage harvested as baleage or hay was available to supplement forage shortages during drought years. Production risk for the two-species mixture was higher than for the other mixtures, which accurately reflects the greater fluctuations in actual yields observed among mixtures in dry vs. wet years. Increased stand life reduced production risk as well.

In the northeastern U.S., using grass-legume or grass-legume-chicory mixtures for grazing dairy cattle was more economical on a whole-farm basis and less risky than grass+nitrogen pastures. The increased forage production from the mixtures reduced purchased feed inputs and sometimes increased income from forage sold off the farm. In all of the pasture scenarios modeled, increasing stand life of the pastures increased economic returns. Even with a shorter stand life, the grass-legume-chicory mixture was more profitable compared with a long-lived and lower yielding orchardgrass+nitrogen pasture.

Dr. Matt A. Sanderson - matt.sanderson@ars.usda.gov - 701.667.3010



Interaction between Morphological Development and Burning Effectiveness in Kentucky Bluegrass and Smooth Bromegrass

Kentucky bluegrass and smooth bromegrass are two perennial cool-season invasive grasses in the northern Great Plains and fire may be used to manage them. Fire intensity is an important management issue in burning but less attention has been given to the morphological development of the target species when burned. A population based growth staging system (Nebraska System) was used to track the morphological development of Kentucky bluegrass and smooth bromegrass prior to conducting weekly spring burns between the last week of April and the end of May in 2004 and 2005. Prior to burning, the Nebraska growth staging system was used to develop a morphological index of Kentucky bluegrass and smooth bromegrass. In late July or early August, ten point frames were used to estimate relative species composition. Burning in late May in both years reduced the amount of Kentucky bluegrass in the species composition by 15 to 20 percent compared to the unburned control. However, this same burning treatment increased the amount of smooth bromegrass by approximately the same amount when compared with early burns. Kentucky bluegrass did not progress from the early vegetative stage during the monitoring period in either year.



Smooth bromegrass appeared to be most susceptible to fire at the 1 to 2 leaf stage. Understanding the interaction between fire and morphological development can provide a tool for enhancing burning effectiveness.

Dr. John Hendrickson - john.hendrickson@ars.usda.gov - 701.667.3015

The NRCS Pasture Condition Score (PCS) System

The Pasture Condition Score (PCS) system, developed by the USDA Natural Resources Conservation Service, is a monitoring and assessment tool for pastureland enrolled in conservation programs (e.g., CSP, EQIP).

Ten indicators of vegetation and soils status are rated on a 1 to 5 scale and summed to give an aggregate score, which is interpreted for management recommendations.

The original version of the PCS system has been modified in several states to address specific variations in vegetation and soils. One common modification of the original PCS system has been to assign weights to the individual indicators to emphasize or de-emphasize particular attributes in specific U.S. regions.

Information was lacking, however, on how PCS results vary within and among environments and farms. An existing data set on pasture condition scores was used to compare the effects of different weighting systems on the aggregate scores and their distributions. Five regional weighting systems (California central valley, irrigated areas and Southeast U.S., Northwest U.S., Midwest U.S., and Northeast U.S.) were used to compute aggregate pasture condition scores from a data set of > 1200 observations of pasture condition indicators measured on five farms: two farms in Pennsylvania (one dairy, one beef), two dairy farms in New York, and an organic dairy in Maryland. All pastures (25 to 63 per farm) on each

farm were evaluated according to PCS methodology in spring, summer, and autumn of 2004, 2005, and 2006. Aggregate PCS scores ranged from 30 to 40 (indicating some improvements were needed to pasture management) and were relatively stable within management recommendation categories across seasons in 2004 and 2006. The PCS scores in 2005, however, plummeted (below 25 to 30 - indicating major management changes to prevent degradation) on the Pennsylvania and Maryland farms because of drought. Pastures used for heifers and dry cows or as wintering areas often had lower scores than other pastures. Typically, these pastures were on less productive soils, steep slopes, and were stocked intensively.

There was much overlap among individual score categories for some indicators, which suggests that fewer but broader score categories (e.g., low, medium, high) would simplify the system. The monitoring workload could be reduced by assessing representative subsets of pastures managed similarly or similar landscape positions instead of all pastures on a farm.

Distributions of pasture condition scores from the five systems were compared with those obtained from using the original system. The various weighting methods tended to shift aggregate PCS scores higher compared with nonweighted scores. In all modifications of the original PCS system, plant vigor was the most heavily weighted indicator, whereas plant residue was the least weighted.

Dr. Matt A. Sanderson - matt.sanderson@ars.usda.gov - 701.667.3010