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Center for Grassland Studies

E-mail: grassland@unl.edu
www.grassland.unl.edu

Phone: (402) 472-4101
Fax: (402) 472-4104

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University of Nebraska Lincoln

Using Dried Distillers Grains to Substitute for Forage and Nitrogen Fertilizer: Nitrogen Dynamics and Use Efficiency

by Matt Greenquist and Terry Klopfenstein, Department of Animal Science,
and Walter Schacht, Department of Agronomy and Horticulture, UNL

Recent legislation to decrease the dependence of the United States on foreign oil has created a greater demand for renewable energy sources such as ethanol. Production of dried distillers grains with solubles (DDGS), a feed by-product from the ethanol industry, has increased sharply with the expansion of the ethanol industry. As land and fertilizer costs continue to rise, more efficient and productive uses of grazing lands are essential. Supplementing cattle with DDGS in forage-based livestock production systems increases cattle performance, decreases forage intake, increases carrying capacity, and ultimately may increase profitability of the system.

Cattle on experimental brome pastures at the UNL Agricultural Research and Development Center.

Historically, fertilization has been used to increase forage production relative to the cost and/or availability of fertilizer and/or additional acres. Previous research has shown fertilized (80 lb N/ac) cool-season grasses can be stocked at nearly 150% of non-fertilized pastures and still have similar individual animal performance (i.e., ADG). Most often, the amount of nitrogen applied as fertilizer to cool-season grasses is in excess of plant uptake. Apparent nitrogen recovery rates from fertilized grasses such as these can be as low as 17 to 50%. Besides being extremely inefficient, these types of losses can create undesirable nitrogen sinks in the environment from losses through atmospheric volatilization, surface water runoff, and/or leaching to groundwater supplies.

Although difficult to accomplish with pasture cattle, nitrogen excretion can be minimized when both the undegradable intake protein and degradable intake protein fractions of crude protein are fed to meet but not exceed animal requirements. Actively growing forages contain protein that is highly degradable in the rumen, so supplementing energy, such as that found in DDGS, to cattle on high quality forages can improve both nitrogen and energy efficiency. Dried distillers grains are a good source of both energy and undegradable intake protein. Daily gain improvements are not exclusively related to undegradable intake protein or fat, but both appear to contribute to the improved gain when supplemented to yearling cattle in forage-based production systems.

Dried distillers grain supplementation has also been shown to replace forage intake on the order of 0.5 lb per lb of DDGS. Additionally, because cattle retain roughly 5 to 10% of the total amount of nitrogen consumed, nitrogen from the DDGS is distributed over the pasture via urination and defecation. This phenomenon can be extremely beneficial when fertilizer becomes expensive, when the system is in a negative nitrogen balance, or when fertilization logistics are difficult. By increasing performance, increasing carrying capacity from reduced forage use per

(continued on page 4)

The Center for Grassland Studies is a unit within the University of Nebraska–Lincoln Institute of Agriculture and Natural Resources. It receives guidance from a Policy Advisory Committee and a 50-member Citizens Advisory Council. This newsletter is published quarterly.

Note: Opinions expressed in this newsletter are those of the authors and do not necessarily represent the policy of the Center for Grassland Studies, the Institute of Agriculture and Natural Resources or the University of Nebraska.

Martin A. Massengale .....CGS Director
Pam Murray.....CGS Coordinator
Jan Shamburg..... CGS Secretary
Anne Moore ..... Newsletter Layout

From the Director

Periodically, the U.S. Congress writes a new farm bill. The last one was written in 2002 for a five-year period; therefore, Congress will develop a new farm bill this year.

There are many items to be considered as legislation is crafted for the new bill. Commodity support programs, renewable energy, conservation of natural resources, research and education are a few. Secretary Johanns held 52 listening sessions across the country last year to obtain shareholder input as he designed the department's proposal to present to Congress.

Title VII of the 2002 farm bill was the section that dealt with research, education and extension activities, and the component of which we in the Center for Grassland Studies are most interested. The U.S. Department of Agriculture funds research through both its "in-house" agency, the Agricultural Research Service, and the State Agricultural Experiment Stations, often referred to as the "extramural" arm, through the Cooperative State Research, Education and Extension Service (CSREES). Cooperative Extension and Education are also funded through CSREES.

During the last decade or more, there has been a steady erosion of public funding for agricultural science. This decline of resources has reduced the capacity to do needed research and has not provided enough funds to meet the existing and emerging needs of agriculture and agricultural related areas. Now with pressure on agriculture to be a major player in meeting future energy needs, along with food and feed, adequate funding is of even greater importance. Also, evidence now shows that the rate of growth in agricultural productivity is declining when compared to that in previous years. This productivity decline is urgently important in meeting future needs for food, feed and energy production and this country's competitive edge over the long run in a global marketplace.

In the current proposal from the Department of Agriculture for the 2007 farm bill, there has been recommended a significant increase in research funding for two areas: bio-energy and specialty crops. However, there is a great need for funding for all of agriculture, natural resources, and food and nutritional science to support research, education and extension over the entire life of the farm bill.

Basic research receives much of the attention in discussions concerning research, but there is a special need for applied research and extension education relating to grasslands. These lands and their plants underpin our important livestock industry, and are important in our conservation of natural resources and improvement of water quality. To meet the nation's goals in bio-energy production, we must produce more biomass from grass, as well as improve the conversion process of cellulose and/or other complex carbohydrates into alcohol. All of these society needs must be handled in an environmentally sustainable manner.

It is important that we view appropriated funds for research and education as an investment and not a direct cost with no recovery. A recent independent study conducted by the Battelle Institute showed that in the year 2005, every dollar invested in the University of Nebraska's Institute of Agriculture and Natural Resources returned 15 dollars to the state (see report at http://atworkfornebraska.unl.edu/survey.html). Most of us would see that as an excellent return on our investment. Research and education will continue to be important in increasing the productivity and profitability of agriculture and agriculturally related industries.

M. A. Massengale

2007 Nike Golf Camp in Lincoln This July

The third annual five-day Nike Junior Resident Golf Camp will be held in Lincoln July 16-20. Scott Holly, Coordinator of the UNL Professional Golf Management (PGM) program, is camp director. Helping with instruction will be three PGA pros at Wilderness Ridge Golf Club, the home course of the UNL PGM program and host site for the camp. Girls and boys 14 to 18 years of age with some golfing ability are qualified to participate. Cost is $765 for "resident" (campers stay in a dorm on the UNL campus and are supervised by staff) and $665 for "extended day" (morning through evening).

Students learn proper swing techniques from PGA professionals who work with the campers.

PGM Coordinator Scott Holly demonstrates the pendulum motion of putting at summer golf camp.

The daily schedule consists of breakfast, instruction in the morning (putting, chipping, bunker play, full swing), lunch, course play with staff in the afternoon, dinner, and an evening fun activity.

For more information and to register, go to the PGM web site (pgm.unl.edu) and click on the Nike Junior Golf Camp link. If you have questions, contact Holly at sholly2@unl.edu, 402-472-7467.

Did You Know There Is an Environmental Institute for Golf?

Not only does the Institute exist, but the 2007 chairman of the Board of Trustees is Bill Kubly, founder and CEO of Landscapes Unlimited, LLC, a world-renowned golf course construction company headquartered right here in Lincoln, Nebraska. Kubly is a former member of the Center for Grassland Studies Citizens Advisory Council and a current member of our Professional Golf Management External Advisory Committee.

The mission of the Environmental Institute for Golf is "to strengthen the compatibility of the game of golf with our natural environment." It has five focus areas: water management; integrated plant management; wildlife and habitat management; energy and waste management; and golf course siting, design and construction.

As an example, the wildlife and habitat management page of the Institute's web site states: "The golf courses can provide critical elements of habitat for many species including amphibians, fish, small mammals, birds, insects, and larger mammals. The use of best management practices (BMPs) and enhancement of wildlife habitat, buffer strips and wetlands on the golf course help to maximize the protection of natural resources and protect wildlife for future generations. The Institute and GCSAA support research, education, and other programs to enhance wildlife and natural habitat on golf course properties."

The Institute's online resource, EDGE, is the golf course management industry's source for BMPs and case studies on environmental topics. Users will find actual case studies and BMPs at golf facilities relating to the five focus areas. Each is a practical topic recommended, managed, and practiced by GCSAA golf course superintendents.

Learn more at www.eifg.org.

Editor's Note: We congratulate Landscapes Unlimited, which was presented the 2007 Golf Course News Builder Excellence Award at the recent Golf Course Builders Association of America's awards dinner. It is one of many awards Bill Kubly's company has received over the years.

Using Dried Distillers Grains to Substitute for Forage and Nitrogen Fertilizer: Nitrogen Dynamics and Use Efficiency (continued from page 1)

animal, and/or increasing nitrogen through the feed, dried distillers supplementation increases overall production of forage-based livestock systems.

An experiment was conducted using yearling steers weighing 767 lb to evaluate animal and pasture performance, nitrogen use efficiency, and the economic impact of supplementation and management strategies on smooth bromegrass pastures. There were three treatments that included yearling steers stocked at 4 AUM/acre and fertilized with 73 lb N/acre, or non-fertilized smooth bromegrass pastures stocked at 69% the rate of the fertilized treatment, or non-fertilized smooth bromegrass pastures stocked at the same rate as the fertilized treatment (4 AUM/acre) with 5 lb (dry matter) of DDGS supplemented daily. Pastures were grazed from April 22 to September 19, 2005 using a management-intensive rotational grazing system. Variable stocking rates were used to maintain grazing pressure throughout the grazing season. Standing crop was estimated immediately before and after each grazing period by a combination of hand clipping quadrats (0.38 m^2) and a calibrated drop disc method. Diet samples were collected with ruminally-fistulated steers.

Nitrogen retention was estimated from measured weight gains using equations from the National Research Council (1996). Economic assumptions for evaluating the grazing management and supplementation strategies were: land costs $32/acre, yardage costs $0.10/hd daily, fertilizer cost $0.3525/lb N ($324.30/ton 46-0-0), fertilizer application $4/acre, DDGS $110/ton delivered to the bunk. Following the experimental period, steers were finished on a high-concentrate diet containing high-moisture corn at 66%, DRC at 16.5%, alfalfa hay at 7.5%, and a meal supplement at 5% of diet. Metabolizable protein, Ca, P, and K requirements were formulated to meet or exceed steer requirements.

Table 1. Pasture performance for grazing management and supplementation strategies of steers grazing smooth bromegrass.

	Treatment [a]			
Item	CONT	FERT	SUPP	SEM
Pasture performance				
Days	153	153	153	
Initial BW, lb [b]	766	767	767	2
End BW, lb [b]	977 [c]	977 [c]	1065 [d]	9
ADG, lb	1.37 [c]	1.37 [c]	1.95 [d]	0.06

[a] CONT = non-fertilized pastures, FERT = fertilized pastures, SUPP = non-fertilized pastures supplemented with 5 lb of DDGS (dry matter) daily, SEM = Standard Error of Mean.
[b] Shrunk weight.
[cd] Means without a common superscript differ (P<0.01).

Steers on fertilized pastures gained the same as steers on non-fertilized pastures stocked at 69% (P=1.0, 1.37 lb/d and 1.37 lb/d; Table 1), but had greater costs of gain ($0.35/lb gain vs $0.28/lb gain; Table 3) because the additional costs of nitrogen were greater than the additional cost of land use. In this experiment, the additional land use at $32/acre resulted in lower cost of gain than the addition of fertilizer at $0.3525/lb of N (application rate 73 lb/acre). Steers supplemented with DDGS gained more (P<0.01) than the steers on fertilized or non-fertilized pastures (1.95 lb/d vs 1.37 lb/d; Table 1). Supplemented steers maintained their body weight advantage during the feedlot phase with significantly (P<0.05; data not shown) greater final weights than the non-supplemented steers. Individual intakes and feed:gain ratios were not available for these steers in the feedlot.

Table 2. Nitrogen balance for grazing management and supplementation strategies of steers grazing smooth bromegrass [a].

	Treatment [b]			
Item	CONT	FERT	SUPP	SEM
N inputs, lb [c]	---	69.71	31.17	
N intake from forage, lb	52.17	57.79	51.19	6.23
N intake total, lb	52.17 [d]	57.79 [d]	82.36 [e]	8.14
N retention, lb [f]	5.95 [d]	5.93 [d]	8.21 [e]	0.24
N excretion, lb [g]	46.22 [d]	51.86 [d]	74.15 [e]	8.9
N use efficiency, % [h]	---	8.51	26.33	

[a] Items are based on the total lb of N/hd for the entire grazing period.
[b] CONT = non-fertilized pastures, FERT = fertilized pastures, SUPP = non-fertilized pastures supplemented with 5 lb of DDGS (dry matter) daily, SEM = Standard Error of Mean.
[c] Nitrogen inputs include fertilizer and DDGS. Pastures were fertilized with urea at 73 lb/ac of N. Steers were supplemented with 5 lb (dry matter) of DDGS (24.6% CP) daily for the entire gazing period.
[de] Means without a common superscript differ (P<0.05).
[f] Nitrogen retention calculated from NRC (1996) equations.
[g] Difference between nitrogen intake total and nitrogen retention.
[h] System use efficiency, calculated by dividing nitrogen retention by nitrogen system inputs*100.

Table 3. Economic evaluation of grazing management and supplementation strategies for steers grazing smooth bromegrass.

	Treatment [a]			
Item	CONT	FERT	SUPP	SEM
Number of steers	15	15	15	
Total gain, lb/hd [b]	218	217	309	
Acres 21.49	14.88	14.88		
Fertilizer lb/ac		72.78		
Supplement (as-is) lb/hd daily				5.55
Costs, $/hd [c]				
Land	45.84	31.73	31.73	
Yardage	15.84	15.84	15.84	
Fertilizer		25.44		
Fertilizer application		3.97		
DDGS				48.35
Total	61.68	76.98	95.92	
Cost of gain, $/lb [d]	0.28	0.35	0.31	
Cost of gain above CONT, %	---	25.00	10.71	

[a] CONT = non-fertilized pastures, FERT = fertilized pastures, SUPP = non-fertilized pastures supplemented with 5 lb of DDGS (dry matter) daily.
[b] Total weight gain includes additional cattle used for variable stocking rates during peak forage production (27 d total). Cattle were of the same weight and type.
[c] Economic assumptions for evaluation of grazing management and supplementation strategies, land costs $32/acre, yardage costs $0.1/hd daily, fertilizer cost $0.3525/lb N, fertilizer application $4/acre, DDGS $110/T delivered to the bunk.
[d] Calculated by dividing total cost by total gain.

The cost of gain for steers supplemented with DDGS was $0.31/lb gain (DDGS was $0.055/lb, delivered; Table 3). Nitrogen retention for supplemented steers was approximately 38.4%

greater than steers on fertilized and non-fertilized pastures (P<0.01, 8.21 lb/hd vs 5.94 lb/hd; Table 2). These values estimated from the National Research Council (1996) equations show that the increase in nitrogen retention is a function of body weight gain and final carcass composition. Increases in body weight can be attributed to both the energy from fat and undegradable intake protein when cattle are supplemented with DDGS. A portion of this response may be due to correcting a metabolizable protein deficiency.

Nitrogen inputs were highest for the fertilized system, but nitrogen retention was greatest for the supplemented steers. This is mainly due to the inefficiencies between fertilization and plant uptake. Nitrogen use efficiency, based on the amount of N applied as either fertilizer or in DDGS, was 3.2 times greater for supplemented steers than the steers on fertilized pastures (26.38 % vs 8.23%; Table 2), which makes the total amount of potential nitrogen for volatilization or surface water runoff greater in the fertilized livestock system.

Steers supplemented with DDGS had numerically less forage disappearance with a replacement rate of 0.43 lb of forage per lb of DDGS. Dry matter digestibility of the diets of the smooth bromegrass was not different (P>0.05) among treatments. However, there was a significant linear (P<0.01) decrease in dry matter digestibility over time (data not shown).

Dried distillers grains significantly increased steer performance when grazing smooth bromegrass pastures. Additionally, nitrogen retention and nitrogen use efficiency were greater for the supplemented steers compared to the steers grazing fertilized pastures. Dried distillers grains can be used as a substitute for forage and nitrogen fertilizer by improving performance, reducing cost of gains, and increasing nitrogen retention in yearling steers.

Editor's Note: Additional articles on UNL research with distillers dried grains as well as other areas of beef production can be found in the *2007 Beef Report*, beef.unl.edu/beefreports/200700.shtml.

Program for 2007 Nebraska Grazing Conference

The seventh annual Nebraska Grazing Conference will be held at the Kearney Holiday Inn on Tuesday and Wednesday, August 7 and 8. As this newsletter goes to press, the planning committee is still finalizing the program. However, we can tell you some of the speakers and topics that are confirmed at this time.

Jim Gerrish, formerly with the University of Missouri and now a grazing consultant living in Idaho, will open the conference with a presentation on grazing management. That evening he will conduct a workshop on grassland monitoring.

Opening the second day will be Harlan Hughes, professor emeritus at North Dakota State University, who will also give two presentations – one on stocking/restocking according to weather and cattle cycles, and another on leases to manage financial and animal resources. Hughes, who now lives in Wyoming, is a regular columnist at *BEEF* magazine and maintains a web site titled Market Advisor Online that contains advice and information about the beef industry.

UNL agricultural economist Darrell Mark will address some of the economic issues surrounding the expanding ethanol/biofuels industry.

New Mexico State University range scientist Derek Bailey specializes in large herbivore grazing behavior and livestock-wildlife interactions. His presentation will be on modifying livestock grazing behavior to benefit wildlife and meet land management objectives.

A panel of "emeriti" farmers and ranchers will share their observations and experiences with grazing over several decades. Following them will be a panel of younger producers who will discuss some of their current management issues and challenges for the future.

Concurrent sessions on the first day will include working with goats and a computer program on grazing management, and on the second day, leases and using fire as a management tool.

The two-day pre-registration fee of $75 is due to the Center for Grassland Studies by August 1. The fee covers lunch both days, the evening banquet, break refreshments, and materials (including proceedings). One-day registrations are also available. This year reduced registration fees will be offered for full-time high school or college students. Late fees apply to registrations postmarked after August 1 and to walk-ins. **Checks are to be made out to 2007 Nebraska Grazing Conference** (sorry, credit cards are not accepted). Note the refund policy: cancellations received by August 1, 2007, will receive a copy of the proceedings and a refund of registration fee less $10. Cancellations after August 1 will not receive a refund but will be sent a copy of the proceedings.

Participants of any of the previous Nebraska Grazing Conferences as well as all Nebraska extension educators will receive a brochure in the mail. Others may contact the CGS office to be put on the mailing list. Information and registration form are also on the CGS Web site (www.grassland.unl.edu).

The conference is a collaborative effort with many co-sponsors in the public and private sectors. The Center for Grassland Studies is one of the underwriting sponsors.

Group Studies Great Plains Fire History

by Charles Flowerday, School of Natural Resources, UNL

Federal researchers affiliated with the School of Natural Resources are helping land managers on the Plains piece together a history of fire in the region.

Fire brings many ecological benefits. In forests, it stops build-up of deadwood, preventing more devastating fires. On the prairie, it prevents colonizing woody vegetation and helps reinvigorate growth of grasses. But in most protected areas, fire so rarely occurs that it has to be re-introduced by management decision.

Having some record of how fire once operated means it can be re-introduced in similar ways. In forested areas, tree ring analysis offers evidence of fire's frequency and extent. Fire burns the tree and leaves a scar on the annual growth ring. But in grasslands, where trees are rare, little evidence exists.

"The idea behind the project is that the Great Plains has been principally overlooked in examining fire history due to a lack of trees. But on the perimeter of the plains, there are trees," said Gary Willson, research coordinator with the SNR-based Great Plains Cooperative Ecosystems Studies Unit.

Willson is coordinating the compilation of a record of fire on the prairie from before European settlement.

In addition to the perimeter, researchers also are interested in fire's history in two other areas: the Niobrara River, crossing Nebraska west to east, and parts of the Missouri River in northeast Nebraska.

"Those two areas might give us some history right in the middle of the Great Plains," Willson said.

The collaborative effort includes the University of Missouri-Columbia's Tree Ring Laboratory, the U.S. Geological Survey's Missouri Cooperative Fish and Wildlife Research Unit and the National Park Service. Researchers will examine tree ring evidence from ponderosa pine and oak trees and feed this data into a fire model that will help fill gaps in fire history where trees are lacking.

During the project's first full field season this past summer, Willson, a fire ecologist, and Richard Guyette, director of the tree ring lab, both worked in the Missouri River valley and Guyette in the Niobrara valley.

"Many resource managers of the national parks in the Great Plains use fire to manage vegetation. And by and large, they don't have information about the occurrence of fire before European settlement. So they may be guessing about when to use it. This information is very valuable as they re-create a fire regime," Willson said.

Parks that can sustain or use fire must have a Fire Management Plan. Such plans help managers assess the state of local and regional ecosystems, make management decisions, create restoration plans and assess national fire plans. The fire histories also can be used by nongovernmental organizations managing grasslands, such as the Nature Conservancy, the Audubon Society and others.

The Great Plains Cooperative Ecosystems Studies Unit includes a dozen university partners and six federal agencies. This project is funded by a $250,000 grant from the U.S. Geological Survey.

Nationwide, the ecosystem studies program secures research, technical assistance and education by universities to support science-based management of federal lands.

SNR is affiliated with the university's Institute of Agriculture and Natural Resources.

Editor's Note: This story first appeared in the December 14, 2006 edition of the *Scarlet,* published by UNL for its employees.

Summer Fire and Post-Fire Grazing Management

by Lance Vermeire, USDA-ARS Fort Keogh Livestock and Range Research Laboratory

Fire is a natural, but more often than not, unplanned event in the Northern Plains. About 75% of wildfires in the region occur in July and August when fuel loads are near their annual peak and the weather is generally hot and dry. The effects of summer fire are not well known since prescribed fires are typically conducted in spring and fall, and studies of wildfires lack replication and specific knowledge of the sites before fire. In a region where livestock grazing dominates rangeland use, a primary concern revolves around the fact that little is known of plant response to summer fire or how that response may be affected by grazing after fire.

Land management agencies typically advise 1 or 2 years of complete rest from grazing following fire. In the absence of data, this may be the ecologically safest option because it is doubtful any harm will come to the plant community from a short period of rest. However, 1 or 2 years of complete rest could add significant economic risk from sudden and often extensive losses in grazing opportunities. Stocking rate has been shown to be the most significant factor affecting plant response to grazing. Therefore, a potential alternative to complete rest is conservative forage use. To address these concerns we designed experiments to determine summer fire and post-fire grazing effects on grassland sites at Fort Keogh.

Four 2-acre plots were burned in August of 2003 and 4 were burned in August 2004 and compared against 8 non-burned plots to determine summer fire effects. Neither burned nor non-burned

sites were grazed. To compare the effects of post-fire grazing, 32 sites burned in August 2003 or August 2004 were not grazed the following growing season or grazed by sheep during June and July to achieve 17, 34, or 50% use by forage weight. The prescribed utilization treatments were achieved by using proportionately fixed densities of sheep (3, 6, and 9 sheep in 2004 and 6, 12, and 18 sheep in 2005) for each treatment and monitoring differences between grazed and caged areas in each plot.

In each experiment, standing crop and species composition were measured in July prior to treatment, one year after fire (immediately after grazing), and 2 years after fire to determine pre-existing differences among plots, immediate treatment effects, and recovery. In the fire experiment, plots were not grazed for the study period. In the grazing experiment, plots were grazed during the first post-fire growing season then released from grazing the next year to assess carryover effects.

We hypothesized that dominant perennial grasses and overall productivity would be resistant to summer fire because the region developed with a history of fire and cool-season perennial grass activity is generally low in summer. For the grazing experiment, our hypotheses were that standing crop would decrease with increasing utilization during the year plots were grazed and utilization would have no effect on production the year after grazing.

Spring precipitation is a strong determining factor for forage production in the Northern Plains and our experiments were conducted under extreme conditions. April-May precipitation was 38% of the long-term average in 2004 and 145% of average in 2005. So, one set of plots was burned in a near-average year and followed by severe drought. The other set of plots was burned during severe drought and followed by a very wet year.

Fire reduced fringed sage 73% the first year following fire. However, fringed sage has well-protected buds in its root crown and standing crop of the sprouting species was similar between burned and non-burned sites by the second year. Fire failed to kill significant numbers of prickly pear cactus, but reduced the number of pads 56%. Prickly pear cactus is generally considered to be sensitive to fire if sufficient fuel is available.

Our results reflect drought-induced reductions in standing crop and the tendency for prickly pear to occur near claypans, both of which reduce the plant's exposure to fire. Forbs were a minor component and were similar between burned and non-burned sites. Grass standing crop was reduced 57% during the drought year, but recovered fully by the second year.

Grass standing crop was unaffected when fire was followed by a wet year. Current-year grass biomass was similar between burned and non-burned sites throughout the study, indicating standing crop differences during drought were completely attributable to old dead material from previous years' growth in non-burned sites and not a reduction in productivity. Sedges, and warm-season grass (primarily blue grama) were similar between burned and non-burned sites. Needle-and-thread standing crop was reduced 47% by fire then recovered fully by the second year. The initial reduction was expected as others have shown needle-and-thread to be sensitive to fire. However, fire had to increase tillering or seedling recruitment to have produced the rapid recovery. Western wheatgrass more than doubled on burned sites after two years. Other cool-season perennial grasses (primarily Sandberg bluegrass and junegrass) increased 60% with fire across years. Annual grass (predominantly Japanese brome) standing crop was reduced 72% by the second year post-fire. Annuals were initially a minor component due to drought, so fire effects were masked until conditions improved in the latter part of the study.

Short-term effects of post-fire grazing were limited. Total grass standing crop decreased with increasing utilization to the prescribed levels (17, 34, and 50%) of forage removal during the year plots were grazed. Individual grass components were not selected strongly enough by sheep to show the same direct relationship, with the exception of warm-season grasses. Because of the timing of grazing, warm-season grasses provided some of the most recently grown forage and appear to have been selectively used by sheep. Warm-season grass standing crop decreased with increasing utilization, regardless of time since fire. Total grass standing crop was similar across treatments the growing season after grazing.

Conclusions

Fire-induced changes in the plant community exceeded those caused by grazing. Summer fire shifted composition toward the described historic community, with western wheatgrass as the dominant species, greater abundance of other cool-season perennials, and less annual grass. Grazing effects were limited and short -lived. Effects of greater utilization or changes in seasonal use are not known. However, grazing at up to 50% use during June and July the first growing season after summer fire was not detrimental to dominant perennial species. The difficulty with post-fire grazing management may be more managerial than biological. Although our research indicates these grasslands can tolerate light to moderate grazing following summer fire, the removal of standing dead material reduces the amount of available forage during the period between the fire and the following growing season. Therefore, accurate stocking decisions are weather-dependent and difficult to make until May or June.

Editor's Note: Reprinted from November 2006 *Fort Keogh Researcher*, a newsletter published by the USDA-ARS Fort Keogh Livestock and Range Research Laboratory, Miles City, MT. Vermeier is a rangeland ecologist at the Lab.

CGS Associates

Among those receiving a "Certificate of Recognition for Contributions to Students" from the UNL Parents Association this year were **Garald Horst, Terrance Riordan, Steven Rodie, James Stubbendieck**, and **Kim Todd**.

Tiffany Heng-Moss was selected as one of six regional teaching award recipients by the U. S. Department of Agriculture and the National Association of State Universities and Land-Grant Colleges.

Resources

Forages: The Science of Grassland Agriculture, 6th Edition. The publisher's web site for this 808-page book says it is the "...long-awaited revision of the classic reference that serves as a comprehensive supplement to An Introduction to Grassland Agriculture. The new edition has broadened its scope and is newly re-organized.... Chapter authors are leading researchers and authorities in grassland agriculture who emphasize quantifiable information that lends itself to comparative analysis. An extensive list of references, suggested further reading, glossary, and a thorough index complete the book's value as a single-source reference." Section titles are: Forage Plants, Forage Ecology, Forage Species, Forage Systems, Forage Production and Management, Forage Improvement, Forage Quality, Forage Harvesting and Utilization, Pasture Management. From Blackwell Publishing, store.blackwell-professional.com/9780813802329.html. Also available from the same publisher and authors is the 2003 *Forages: An Introduction to Grassland Agriculture, 6th Edition.* Its 576 pages highlight plant adaptation and the complexity of forage management by integrating soil, climate, and herbivory factors with production goals. This edition was reconfigured to address the needs of today's undergraduate students and provide a foundation for problem solving and decision making in forage management.

Targeted Grazing: A Natural Approach to Vegetation Management and Landscape Enhancement. This new (December 2006) 200-page handbook and companion CD were produced through a grant from the National Sheep Industry Improvement Center (NSIIC) in cooperation with and support from the American Sheep Industry Association (ASI). The Reader's Guide says: "Employing livestock to manipulate vegetation is as old as grazing itself. Promoting grazing to manage vegetation as a paid service – typically called prescribed or targeted grazing – is a more recent phenomenon. As targeted grazing has gained a foothold in the land management arena, both research and experience have evolved to provide land managers and grazing service providers with more definitive tools for managing vegetation. This handbook represents a compilation of the latest research on harnessing livestock to graze targeted vegetation in ways that improve the function and appearance of a wide variety of landscapes. The handbook is organized both as an introduction to targeted grazing for the novice and as a useful reference for those already familiar with the topic." The publication is available online at www.cnr.uidaho.edu/rx-grazing/Handbook.htm, and in print through American Sheep Industry Association, 9785 Maroon Circle, Suite 360, Englewood, CO 80112, 303-771-3500 extension 32, info@sheepusa.org.

Grazing Management Processes and Strategies for Riparian-Wetland Areas. Experts from federal agencies, universities and the private sector assisted with this 2006 publication, which builds on two previous publications 1989 and 1997. The 105-page technical reference (TR 1737-20), issued by the U.S. Department of Interior and U.S. Department of Agriculture, "provides the most current information to further assist livestock operators and land managers in developing successful riparian-wetland grazing management strategies across a wide array of land types." Online at http://www.blm.gov/or/programs/nrst/files/Final%20TR%201737-20.pdf. Hard copies are available from: Bureau of Land Management, National Business Center, Printed Materials Distribution Service (BC-652), P.O. Box 25047, Denver, Colorado 80225-0047, BLM_NCS_PMDS@blm.gov.

Two articles in the April issue of *Agricultural Research Magazine* published by USDA-ARS might be of particular interest to some of our readers: 1) Forum–America's Farms: Growing Food, Fiber, Fuel–and More , and 2) Genetic Snapshots Help Brighten Switchgrass's Future. Online at www.ars.usda.gov/is/AR/archive/apr07.

Info Tufts

On February 14, 2007, in recognition of the important role windmills played in the settlement of Nebraska, Governor Dave Heineman proclaimed 2007 the Year of the Windmill.

University of Nebraska Lincoln | CENTER FOR GRASSLAND STUDIES
222 Keim Hall
P.O. Box 830953
Lincoln, NE 68583-0953

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