Winter 2001

Center for Grassland Studies Newsletter, Winter 2001, Volume 7, No. 1

University of Nebraska

Center for Grassland Studies Newsletter

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From the Director

Many important people, places, structures, plants, animals, events and organizations have been recognized and honored by being placed on postal stamps throughout the years. Because of the widespread use of stamps and the significance they carry in our society, it is considered noteworthy to be honored in this way.

The State of Nebraska, the University and the city of Lincoln are all most fortunate to have two stamp honors in 2001. First, the Nine-Mile Prairie is featured on the new 70-cent international stamp to be released on March 6, 2001. The Nine-Mile Prairie is owned by the University of Nebraska Foundation for research and educational purposes of the University of Nebraska. It is located nine miles from downtown Lincoln, hence the name.

The following month, the U.S. Postal Service will issue another stamp exhibiting the Great Plains Prairie biome. This stamp is one in the Nature in America series depicting the different ecosystems in the U.S. The first-day issue for this stamp will be Thursday, April 19, in Morrill (Elephant) Hall on the UNL city campus. Parking for this event will be at the State Fairgrounds, with bus service to Morrill Hall. That afternoon there will be a symposium on the art, cultural components and natural history of this region. A talk and photographic exhibition on the prairie will be hosted in the evening by the Center for Great Plains Studies at Hewit Place. The following day there will be an outing at Audubon Nebraska's Spring Creek Prairie (15 miles southwest of Lincoln). This activity will include talks and tours of the prairie, as well as a burn--weather permitting. **To make reservations for the tour and lunch, please call Audubon Nebraska at (402) 797-2301.** On Saturday, the University of Nebraska State Museum will have a Great Plains Prairie Day. The public is invited to all of these activities.

The first-day cancellation and associated activities were organized by the co-sponsors: U.S. Postal Service, the Center for Grassland Studies, the Center for Great Plains Studies, the University of Nebraska State Museum, the Regional Humanities Center for the Great Plains, Audubon Nebraska, Nebraska Chapter of the Nature Conservancy, Nebraska Wildlife Federation, Prairie Plains Resource Institute, Conservation Alliance of the Great Plains, and the Lincoln Stamp Club.

We competed with several locations for the opportunity to host the first-day cancellation. Associated activities were organized by the sponsoring groups. The fact that we had so many interested organizations co-sponsoring the event was most helpful in our competition. The stamp artist, who lives in Hawaii, plans to attend, autograph the stamp sheet, and make a presentation. Several other presentations will be made on subjects such as the history of the Postal Service in the Great Plains, and the cultural and natural history of this region.

Also, it is not too early to mention another event for which many of you will want to mark your calendars. The Center for Grassland Studies, along with several other organizations and agencies, will be sponsoring the Nebraska Grazing Conference in Kearney, Nebraska on August 13 and 14, 2001. The planning committee has

been working on this conference, and I know it is going to be very informative, with recognized speakers from the region. Make plans now to attend; we will provide more details in the next newsletter.

Using the Nutritional Balance Analyzer (NUTBAL) Program to Track Crude Protein Values for Rangeland and CRP under Drought Conditions

by Mary Schrader, Natural Resources Conservation Service

Since 1997, the Natural Resources Conservation Service (NRCS) in Nebraska has participated in the Forage Quality and Animal Well Being Project. Through this project NRCS personnel are able to collect fecal samples for analysis and provide a nutritional balance profile to landowners for a variety of landscapes and cattle herd situations. Due to the dry conditions this past spring (2000), I saw an opportunity to collect samples on land enrolled in the Conservation Reserve Program (CRP).

According to the National Weather Service in Goodland, Kansas, Dundy County receives an average of 14.75" rainfall from January to August in a normal year. During the summer of 2000, Dundy County received 9.34" for the same time period. This lack of precipitation was accompanied by several days of 100-degree temperatures and 20-mph south winds during June and July. The most noticeable lack of rainfall came in May and June. In May, the normal rainfall is 3.03" and in June, 2.92". This year, we received 0.12" rainfall in May and 1.92" in June. This lack of rainfall accompanied by high temperatures and strong winds at the start of the growing season slowed the germination and the growth of grass in the warm-season pastures.

Our normal grazing season runs from May 10 to October 15. There are basically two types of plant communities in Dundy County: mixed grass prairie and sand sage prairie. The majority of this county in which I work is in the sand sage prairie plant community.

Fecal samples were collected on native rangeland from May through August. The crude protein values ran from a high of 12.01% in May and gradually decreased to a low of 6.46% in August. There was a steady decrease in crude protein, as expected, due to normal grass growth patterns.

On June 9, 2000, Dundy County was released for Emergency Grazing on land enrolled in the CRP program. Fecal samples were collected from CRP land starting in June and continuing through September. In June, the crude protein was 10.67%. The last sample collected in September had a crude protein of 9.57%. Overall, the crude protein levels for the CRP land did not vary much throughout the summer.

Once the analysis is returned to the field office from the lab, the information is entered into the Nutritional Balance Analyzer program. This program requires data from the herd such as type of animal, breed, weight, age, body condition score, and if bred or lactating. Also entered are environmental data such as temperature, wind speed, slope of area grazed, and if adequate water is available. If supplements are fed, a lab analysis of the feed is required. After the data have been entered, an animal profile is generated. One significant figure is the digestible organic matter to crude protein ratio (DOM/CP). The recommended range is 4-7. This ratio will determine if the available forage is meeting the needs of the animal.

During the past two years, this ratio has risen above 7.5 by mid-August on native rangeland. This is a warning sign to the producer that a protein supplement may be needed to maintain body condition score. This past summer, a ratio above 7.5 was seen at the end of July. A recommendation for a protein supplement was passed on to the landowner. A sample collected one month later showed the consumable crude protein had increased to 7.9%, which lowered the DOM/CP ratio from 7.8 to 7.2, assuming the cattle consume 1.0 lb. per

head per day. The landowner provided a 22% protein tub for the cattle to use free choice.

On CRP land, the crude protein levels from two samples in August were 10.66% and 10.95%. A landowner running cow/calf pairs was concerned that the forage would not allow the cow to maintain a calf. The DOM/CP ratio for his herd was 5.9. According to the information I was given, the forage he was grazing was adequate for the cow to maintain a calf. This particular CRP field had never been grazed or hayed, and had set idle since 1989.

Many times when discussing the option of renting CRP to graze, the landowner indicated it is too expensive. Let's take a look at the cost based on number of cow-calf pairs per month. In this area, native rangeland rents for approximately $18.00 per cow-calf pair per month. For 160 acres, averaging 0.5 AUMs per acre, the stocking rate would be 62 cow-calf pairs. The average rent for CRP in this area is $7.50 per acre per month (based on an average CRP rental rate of $30.00 per acre per month). The stocking rate would be 92 cow-calf pairs, assuming 1.0 AUM per acre (75% of normal stocking rate according to CRP regulations). The cost per cow-calf pair would be $13.04 per month. On CRP, you can run an additional 30 head and the cost per pair per month is less than the cost per pair for native rangeland ($13.04 compared to $18.00). Other costs to consider when grazing CRP are boundary fence and labor to install the fence, the cost and time to haul water each day or the cost for electricity to provide water. An additional cost on native rangeland during dry weather is the protein supplement. When calculated on a per-day basis, the protein cost is approximately $0.26 per head per day, assuming the cattle utilize 1.0 lb. per day.

In summary, I would like to restate three things that caught my attention. First, the crude protein values for the CRP land stayed fairly steady throughout the summer, whereas the values for native rangeland drop off as the plants go through their growth cycle, especially during dry weather. Second, the DOM/CP ratio for CRP stayed within the allowable range, indicating the animal was receiving adequate protein from the forage. Third, on native rangeland, the DOM/CP ratio showed a need for a protein supplement almost three weeks earlier, due to the dry weather, than in past years.

I was encouraged by the data I received this past summer. Many times I hear landowners say "my cows won't eat those grasses" or "these grasses won't maintain a cow-calf herd" (when referring to seeded grasses). Although, I have only one growing season of data, I feel this information will be very useful when discussing the use and value of seeded grass with producers.

Editor's Note: Mary Schrader can be contacted at NRCS, PO Box 186, Benkelman, NE 69021, 308-423-2402 ext. 3, mary.schrader@ne.usda.gov.

UNL Research Towards Biological Control of Turfgrass Diseases - Part II

by Gary Yuen, Department of Plant Pathology, UNL

Editor's Note: This is the second in a two-part series summarizing research at UNL on a biological control agent for diseases of turfgrass.

In the previous issue, I presented some of the findings at UNL on the use of a bacterial agent (*Stenotrophomonas maltophilia* C3) for biological control of diseases in turfgrass. In this installment, I summarize what we know about the two mechanisms by which C3 controls disease. I also discuss the implications of these mechanisms for how we might develop and use biological control in the future for controlling diseases of turfgrasses and cereals.

Biocontrol through enzyme action

The bacterial species *Stenotrophomonas maltophilia* is known to have the capacity to produce enzymes that digest complex organic compounds. This ability gives these bacteria a competitive edge in nature by allowing them to use certain organic compounds as a nutrient that cannot be exploited by other microbes. Some of these compounds may be synthetic, such as herbicides and chemicals used in munitions manufacture. Other compounds digested by *S. maltophilia* include complex carbohydrates that are produced in nature in abundance. Strain C3 produces enzymes that digest various structural components of fungi. Dr. Zhongge Zhang, formerly a graduate student in my lab, found that C3 produces chitinases and glucanases, enzymes that break down chitin and glucans, respectively. Chitin is the major cell wall material in most, but not all, fungi, whereas glucans are found in all fungi. In those fungi that lack chitin, e.g., water molds, glucans serve as the primary cell wall material. In Dr. Zhang's experiments, the effectiveness of C3 in inhibiting plant infection by fungi was compared with that of mutant strains lacking the ability to produce chitinase. It was found that the wild type, or natural, form of C3 could arrest germination of fungal spores and cause hyphae, the vegetative body of fungi, to grow abnormally. As a result, the wild type suppressed infection of grasses by the chitin-fungi *Bipolaris sorokiniana* and *Rhizoctonia solani*. In contrast, the chitinase-lacking mutant forms had no effect on spore germination or hyphal growth, and were much less effective in reducing disease severity than the wild type. The mutant forms were equal to the wild type, however, in preventing infection by *Pythium ultimum*, a water mold that lacks chitin. These results suggest that chitinase is important in controlling fungal pathogens that have chitin in their cell wall, and that other mechanisms, perhaps glucanases, might also be involved. My lab is currently exploring the function of glucanases in biocontrol by C3.

Biocontrol through induced resistance

Ozlem Kilic, a graduate student in my lab, recently discovered induced resistance to be another explanation for the effectiveness of C3 in biocontrol. Induced resistance is the phenomenon by which pathogens and certain non-pathogenic microorganisms can activate existing defense processes in plants, rendering the plants more resistant to subsequent infection by pathogens. She found that both live and dead cells of C3, when applied to only a part of a grass leaf, can hinder germination of fungal spores throughout the same leaf. This implies that C3 activates, at its point of contact with the plant, a signal that is transmitted throughout the leaf. The signal causes plant tissues to produce substances that prevent spores from germinating. The fact that dead cells also triggered this response confirms that it is not due to the production of compounds by the bacterium that are toxic to fungi.

Why is this information important?

Knowing how a biocontrol agent inhibits disease from developing enables us to plan how we can use the agent to its maximum effectiveness for disease control under field conditions. For a biocontrol agent that functions solely through antifungal compounds, such as chitinase, the advantage of this mechanism is that the activity of the compounds usually is not affected by the plant, and thus, a biocontrol agent effective by way of antibiosis, i.e., antifungal compounds, is expected to be compatible with all cultivars of a crop species. Numbers of the agent on the plant surface (the dose) will determine its effectiveness (the response), with a higher dose usually providing a greater response. Because the antifungal principals produced on a leaf surface by the biocontrol agent cannot be distributed to any great distance from cells of the biocontrol agent, coverage by the agent of all leaf surfaces subject to infection is also critical. Therefore, the emphasis when applying a biocontrol agent that functions through antibiosis is to establish as high a number as possible over all susceptible leaf areas for as long as possible. The ideal is difficult to achieve because environmental variations or extremes will cause the agent on all or part of the leaf surface to die.

Biocontrol through induced resistance has a different set of advantages and disadvantages. One advantage is that defense responses can be induced throughout the plant or at some distance from the inducing agent, and thus uniform coverage of all susceptible leaf surfaces by the biocontrol agent is not required. Another advantage is that once resistance is induced, the defense mechanisms remain in play for long periods,

sometimes weeks. A third advantage is that only a minimum number, or dose, of the inducing agent is needed to trigger the process; higher numbers are not needed, nor do they provide any additional effect. A disadvantage of induced resistance is that the amount of resistance that can be triggered by an inducing agent is dependent upon the level of "extra" resistance that a plant can potentially express. Generally speaking, induced resistance triggered in disease-susceptible cultivars is more evident than in disease-resistant cultivars because resistance mechanisms are already activated in the resistant cultivars regardless of induction. Each step in the sequence involved in induced resistance - triggering of a signal, production and movement of signaling factors through the plant, and production of defense compounds - requires a period of time for completion. Therefore, another disadvantage of induced resistance is that a relatively lengthy period, usually several days, is required following application of the inducing agent before induced resistance becomes evident. In applying a biocontrol agent that works through induced resistance, the goal would be to apply only the dose needed to trigger the host to respond, but the dose must precede the arrival of pathogens and the onset of environmental conditions that favor disease. Furthermore, the resistance level of the crop cultivar must be considered in deciding whether or not to use that agent.

The two biocontrol mechanisms in C3 appear to come into play in succession after the bacterium is applied to leaves, with direct antifungal activity related to chitinases taking place initially, and then induced resistance being evident days later. This is illustrated in the results from an experiment in which we examined how the dose (C3 numbers)-response (*Bipolaris* spore germination) relationship changes over time. Different numbers of C3 were applied to tall fescue leaves to create a range of "doses," and then spores of *Bipolaris sorokiniana* were applied to the leaves either shortly afterward or 10 days later. In those spores deposited onto treated leaves shortly after C3 application, their ability to germinate (the response) was dependent on the dose, with higher doses allowing less germination. This dose-response relationship reflects direct effects from antifungal compounds. When spores were deposited 10 days after treatment with C3, there was no discernable dose-response relationship, meaning that spore germination was inhibited on leaves treated with C3 regardless of the number of C3 present on the leaf. This is typical of induced resistance. The significance of having dual mechanisms functioning in succession is that, theoretically, C3 would have the advantages of both types of mechanisms while being less subject to the disadvantages inherent to each type. It is conceivable that C3 could be applied in high numbers to any cultivar of grass or cereal, with the chitinase mechanism providing a short-term suppression of pathogens already present in the crop. In cultivars in which resistance can be induced, enhanced resistance can continue to inhibit infection from newly-arriving fungal spores even after C3 numbers have declined.

By identifying the mechanisms through which effective biocontrol agents affect disease, methods can be developed for improving biological control. Microbial traits found important in biocontrol can be added to the selection criteria used in the screening for new and more effective agents. Knowledge of mechanisms of action can also be exploited in improving existing biocontrol systems. Although commercial and societal acceptance of transgenic (genetically-engineered) biocontrol agents is uncertain, it is technically feasible to introduce biocontrol traits (enzyme production, induction of host resistance) into microbes having other beneficial characteristics. It is also conceivable that traits from a biocontrol agent can be used in generating transgenic grasses and cereals with enhanced disease resistance.

Author's Note: For further information about biological control of plant diseases, please contact me at gyuen@unl.edu, 402-472-3125.

Nebraska Grazing Conference August 13-14

The Center for Grassland Studies is helping to organize and sponsor the Nebraska Grazing Conference to be held in Kearney, Nebraska on August 13-14, 2001. The primary audience for the conference is producers, but all are welcome. Watch for details in the next issue of this newsletter.

Natural Landscaping at City Library

Editor's Note: The following article by Justin Evertson is reprinted with permission from the 2000 *Community Landscapes*, an annual publication of the Nebraska Statewide Arboretum. For more information about the Community Landscaping program, see the NSA Web site, arboretum.unl.edu.

In the early 1990s, Gere Library in Lincoln underwent a significant expansion and remodeling. As a part of that effort, the landscape was also redone. In a bold (some might say crazy) stroke of creativity, it was proposed that the landscape showcase native Nebraska prairie, tree and shrub plantings. Such a solution, which was almost unheard of at the time, would require a shift from a high-maintenance turf-dominated landscape that most patrons were comfortable with to one with rough edges and subtle beauty that few people at the time knew how to appreciate.

Tallgrass Prairie

The most notable aspects of the redesigned landscape are the prairie plantings. Planted in the open areas on the east side of the property is tallgrass prairie, complete with all its wildness. Typical species here include: *Andropogon gerardii*, big bluestem; *Sorghastrum nutans*, Indiangrass; and *Panicum virgatum*, switchgrass. Several types of wildflowers are also present including: *Echinacea pallida*, purple coneflower; *Rudbeckia hirta*, black-eyed susan; *Salvia azurea*, pitcher sage; *Ratibida pinnata*, greyhead coneflower; and *Aster novae-angliae*, New England aster. The trees and shrubs used to screen the prairie from adjoining residential properties include tough natives like: *Pinus ponderosa*, ponderosa pine; *Juniperus virginiana* 'Canaertii,' canaerti juniper; and *Cornus racemosa*, gray dogwood.

Shortgrass Prairie Meadow

Circling the building itself is a shortgrass prairie meadow. Here the emphasis was on shorter species that would not be as wild as their tallgrass cousins. Grass species planted here include: *Schizachyrium scoparium*, little bluestem; *Bouteloua curtipendula*, sideoats grama; and *Bouteloua gracilis*, blue grama; along with shorter wildflowers such as *Asclepias tuberosa*, butterfly flower; *Echinacea angustifolia*, purple coneflower; *Achillea millefolium*, yarrow; *Ratibida columnifera*, prairie coneflower; and *Dalea purpurea*, purple prairie clover.

Trees and Shrubs

In key locations throughout the property are several groupings of trees and shrubs. Most of the woody plants are native, and those that aren't, such as *Acer ginnala*, Amur maple, fit well within a prairie setting. The trees and shrubs have several purposes including shade and wind abatement, screening of utility and parking areas, and adding a touch of refinement to the landscape.

The Gere Library project is nothing short of a "slap in the face" that proves that prairie-based landscapes can be done well even in the heart of the city. Although many patrons have not been happy with the landscape's natural appearance, it's hard to argue against the 1.5 million gallons of water saved each year, or the near elimination of fertilizers and pesticides, or the $2,500/yr savings in maintenance (mowing) costs. More importantly, the landscape has been an inspirational and educational example that has helped many people grow to better appreciate Nebraska's natural beauty.

2001-2002 Nebraska Ranch Practicum

The third offering of the Nebraska Ranch Practicum will begin this June. The five-part educational program

emphasizes hands-on monitoring of vegetative and livestock resources to ensure each participant will be able to use knowledge of plant and animal interactions to enhance profitability and sustainability. Participants will monitor body condition score, milk production and cow and calf weight throughout the seven-month period of the course. Forage quality will be assessed with esophageal diet collections and laboratory analysis. Amounts of available forage will also be estimated by several methods and used to calculate stocking rates as the season progresses. Classroom instruction on fundamental principles of monitoring and decision-making processes will precede hands-on training. Sessions will be held primarily at the University of Nebraska's Gudmundsen Sandhills Lab near Whitman. Dates are June 12-13, July 17, September 5, November 13, and January 9-10, 2002.

Applications must be received by May 1 (enrollment is limited to 30). The registration fee is $550, $150 of which must accompany the application. For more information, contact one of the following: Don Adams, North Platte, 308-532-3211, ext. 133, dadams1@unl.edu; Pat Reece, Scottsbluff, 308-632-1242, preece1@unl.edu; Bud Stolzenburg, Cherry County Extension, 402-376-1850, bstolzenburg1@unl.edu; Brent Plugge, Central Sandhills Area Extension, 308-645-2267, bplugge1@unl.edu.

Resources

A Prairie Mosaic: An Atlas of Central Nebraska's Land, Culture, and Nature. 2000. $20 + $3 s&h. Co-edited by Steven Rothenberger and Susanne George-Bloomfield. This 244-page book gives a multidisciplinary overview of the heart of Nebraska and its inhabitants. Consisting of 30 articles, 29 poems, and numerous illustrations (color and b/w photos, maps and drawings), the book combines geology, climate, biology, history, politics, art, and economics of the region into a concise treatment that will appeal to the general reader as well as to the most sophisticated prairie enthusiast. Order from the Office of Graduate Studies, Founder's Hall 2131, University of Nebraska at Kearney, Kearney, NE 68849.

Excellent black/white images of hundreds of grasses are available at www.csdl.tamu.edu/FLORA/image/poacr2ba.htm. They were produced by Texas A&M and the Hunt Botanical Institute.

The UNL Conservation and Survey Division is an excellent source of data and maps for Nebraska. For example, go to csd.unl.edu/csd/gisdata.html and scroll down to Vegetation. You can pull up a beautiful color map titled "Native Vegetation of Nebraska."

In its Livestock Series, ATTRA (Appropriate Technology Transfer for Rural Areas) has several publications on pasture and grazing management, including *Matching Livestock and Forage Resources in Controlled Grazing*. Available free from ATTRA, PO Box 3657, Fayetteville, AR 72702, 1-800-346-9140, and online at http://www.attra.org/attra-pub/livestock.html.

Riparian Grazing Successes on Montana Ranches. Originally printed in 1995 and reprinted in 1998, this publication contains interviews with 14 ranchers and grazing associations on their successful management practices. To request copies, contact the Conservation Districts Bureau, Montana Dept. of Natural Resources and Conservation, PO Box 201601, Helena, MT 59620-1601, 406-444-6667. A copy is available in the CGS office for viewing.

CGS Associates

Citing his role in the development and implementation of the first Nebraska Ranch Practicum, **Richard Clark** was presented the 2000 Chester I. Walters "Extra Mile" award at the Nebraska Cooperative Extension

Association annual meeting.

Kim Stine recently received the Range Management Service Award from the Nebraska Section of the Society for Range Management.

At the Agronomy national meetings in November, **Charles Francis** received the first Seventh Generation Research Award, which is given for innovative work in sustainable food and farming systems that is practical, productive and environmentally sound. The award title is based on the Iroquois people and other North American tribes who planned current activities (agriculture, hunting, fishing) with seven generations in mind. At the same meetings, **Stephen Baenziger** received the Crop Science Research Award for his work with wheat breeding.

Terry Klopfenstein was chosen president-elect of the Federation of Animal Science Societies Board of Directors. The term begins in September 2001.

Al Steuter was featured in the January/February 2001 *Nature Conservancy*. In this issue, titled "50 Years of Saving Great Places," Al discusses the role of bison on the western landscape and his involvement in "Bringing Back the Bison." As a side note, the magazine also briefly describes The Nature Conservancy's largest (and only ecosystem) restoration effort to establish the Tallgrass Prairie Preserve in Oklahoma, begun in 1989.

Patricia Freeman was the guest on the "Roger Welsch &" show that aired December 29 on the statewide Nebraska ETV Network. Freeman discussed the causes (especially lack of prairie fires) of wildlife redistribution in the state.

At the annual meeting of the Nebraska chapter of Gamma Sigma Delta (honorary agricultural fraternity), **Robert Shearman** received an award of merit, **Chris Calkins** received an award of excellence, and **Walter Schacht** became a new inductee.

Former doctoral student under **Robert Shearman**, Kimberly Erusha, was one of the honored alumni during UNL Master's Week in November. Erusha is the director of education for the U.S. Golf Association's Green Section.

In March **Steve Rodie** will be presented a Senior Faculty Holling Family Award for Teaching Excellence for 2001.

Don Steinegger received the Nebraska Turfgrass Foundation Presidential Award for his significant contributions to the turfgrass industry in Nebraska and the nation.

Info Tufts

Funding opportunity: The National Science Foundation has a competitive grants program titled Biocomplexity in the Environment (BE): Integrated Research and Education in Environmental Systems. Upcoming deadlines are in March. See http://www.nsf.gov/pubs/2001/nsf0134/nsf0134.htm.

Researchers found that dairy cows will eat about 8% more of a total mixed ration containing 40% afternoon-cut alfalfa hay than one containing morning-cut alfalfa hay and will produce about 8% more milk. Adjusting schedules to cut hay in the afternoon and early evening can increase feed value of hay by 15%. For details, see kimberly.ars.usda.gov/mayshew/clues.shtmltails (scroll down to the article titled "Diurnal Cycling in Forage Quality"). For contacts on lactation studies done in the late 1990s on morning versus afternoon haying, contact Pam Murray in the CGS office.

Due in large part to the efforts of CGS Associates David Baltensperger and Robert Shearman, the number of acres of grass seed harvested in the Nebraska Panhandle has significantly increased in recent years -- 1,500 acres in 1999 compared to 300 acres in 1996. It is estimated that grass seed production now contributes about $1 million annually to the region's economy.

Calendar

Contact the CGS for more information on these upcoming events:

2001

Mar. 3: Festival of Color Lawn Care Management Workshop, Lincoln, NE, http://hort.unl.edu/FALLFEST/Index.htm

Mar. 24: Festival of Color Landscape Design Workshops, Lincoln, NE

Feb. 17-23: Society for Range Management Annual Meeting, Kailua Kani, HI

Apr. 22-25: American Forage and Grassland Conference, Springdale, AR

June 23: Festival of Color Landscape Design Workshops, Lincoln or Mead, NE

July 24-28: American Society of Animal Science Annual Meeting, Indianapolis, IN

Aug. 6: Turf Field Day, Mead, NE

Aug. 13-14: Nebraska Grazing Conference, Kearney, NE

Oct. 13: Festival of Color Landscape Design Workshops, Lincoln or Mead, NE

Oct. 21-25: ASA-CSSA-SSSA Annual Meetings, Charlotte, NC

Nov. 6-7: Fourth National Conference on *The Practice of Restoring Native Ecosystems,* in Nebraska City, NE, www.arborday.org/programs/callRneNatConf.html

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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.

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