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Center for Grassland Studies Newsletter

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From the Director

Considerable discussion is occurring these days about global warming, climatic change, and the "greenhouse effect." The "greenhouse effect" occurs when gases, predominately carbon dioxide (CO2), are released into the atmosphere, thus keeping radiation from the earth's surface escaping into space and then reflecting it back to earth-causing a warming effect. The "greenhouse effect" is essential for life, but there is concern that increasing amounts of these gases are having a negative environmental impact. The atmospheric concentration of CO2 has increased by about one-third since the beginning of the industrial revolution (around 1850), according to some authorities.

Fossil fuels are heavily laden with carbon derived from a carbon cycle millions of years ago. Today, as coal and oil are extracted from the earth in increasing amounts and burned, greater amounts of CO2 are released than are needed in the carbon cycle. A large percentage of CO2 in the atmosphere comes from auto exhausts and power plants. Although agriculture contributes a small percentage of atmospheric CO2, it also has the potential to be a moderating influence.

Carbon sequestration is the long-term storage of carbon in any living or dead vegetation, and as organic matter in the soil. It offsets the CO2 released into the atmosphere. Removing CO2 from the atmosphere through photosynthesis and storing it in plant tissue or the soil is one way to reduce atmospheric CO2. During photosynthesis, green plants take in carbon dioxide from the atmosphere and release oxygen. The carbon is stored in the plant tissue until the plant dies and decays; carbon is then released back into the atmosphere. Since grasses carry out photosynthesis during all or a large part of the year, depending on location and the kind of grass, and the soil is usually not tilled or disturbed where they are growing, grasses are among our most effective plants for sequestering carbon. Other potential benefits of increasing the acres of grassland include reduced erosion, improved water quality, and better wildlife habitats.

Reducing the use of oil, coal, and other fossil fuels is the long-term solution, but this takes time. Improved management of grasslands and agricultural systems could help provide some of that time. Certain utility companies and other industries emitting greenhouse gases are already buying carbon credits from landowners or are searching for other ways to offset carbon emissions in a cost effective manner. Eventually, people with grasslands and agricultural producers could have additional income by being paid for storing extra carbon in their plants and soils.

There is an increasing interest in research and management systems to sequester more CO2. For instance, this year the Nebraska Legislature passed LB 957 creating the Carbon Sequestration Advisory Committee. That committee is to advise and assist the Director of Natural Resources, recommend policies or programs to enhance the ability of Nebraska agricultural landowners to participate in systems of carbon trading, encourage the production of educational and advisory materials regarding carbon sequestration on agricultural lands, and identify and recommend areas of research needed to better understand and quantify the processes of carbon sequestration on agricultural lands.

There are many good sources of information on this topic on the Web. One is from the international conference "Carbon: Exploring the Benefits to Farmers and Society" held in Iowa this past August; see conference abstracts at http://www.cvrcd.org/carbon.htm.

We will be hearing much more about carbon sequestration in the future.

UNL Research Towards Biological Control of Turfgrass Diseases - Part I

by Gary Yuen, Department of Plant Pathology, UNL

Editor's Note: This is the first in a two-part series summarizing research at UNL on a biological control agent for diseases of
turfgrass. Part I discusses the importance of biological control and presents the investigations that led to the discovery of the
agent. In the next issue, Part II will present some of the findings regarding the ecology of the agent and the mechanisms by
which it inhibits disease.

Why biological control and what is it?

Turfgrass in home and landscape lawns contributes to the beauty of our communities. Turfgrass planted in recreational fields
and golf courses adds to our enjoyment of sports. To attain lush, green turf, however, we apply cultural practices that also
contribute to disease caused by fungi. The most common of these practices, regular watering and fertilization, cause moisture to
be retained in the turfgrass canopy even when conditions outside of the canopy may be dry. Long moisture periods allow fungi
that infect grass foliage to remain active throughout the growing season. Growth of fungi and infection of leaves by pathogenic
fungi intensify when temperatures in the canopy are optimal for the microorganisms, leading to damage and death of the grass.
Planting of disease-resistant grass varieties is one strategy to control disease, but this option is useful only when reseeding or
when establishing new lawns. Furthermore, current turfgrass varieties do not have resistance to all diseases, and a high level of
resistance is not available against some destructive diseases, such as brown patch caused by Rhizoctonia solani. The use of
fungicides, therefore, is the primary method for controlling fungal diseases in turfgrass.

There are drawbacks associated with regular fungicide use. These include the selection for fungicide resistance in the pathogen
population, causing the fungicide to be less effective. Fungicides also eliminate beneficial fungi that would otherwise keep
pathogenic fungi in check. As a consequence, some disease problems can be aggravated by regular fungicide use. Lastly, there
is a concern that fungicide residues in turfgrass might be injurious to humans, animals and the environment. Although there is no

good research evidence to substantiate this concern, it must be noted that fungicides used on turfgrass are the same as those
applied in agriculture under strict regulations to minimize exposure to applicators and nearby inhabitants. Turfgrass fungicides,
on the other hand, are typically applied with fewer restrictions and are mostly used in urban areas, so the chances for acute and
long-term exposure to turfgrass fungicides are high.

Because of the need for new strategies to augment disease resistance and fungicides, biological control (or biocontrol) using
microorganisms-bacteria and fungi-has been the subject of research by university and industry scientists in the U.S., Europe and
Asia. One biocontrol tactic is to exploit and enhance naturally occurring communities of microbes. An example is the
application of certain composts that suppress diseases by enriching microbe numbers and diversity in the turf. Another
biocontrol strategy-one that is particularly attractive for commercialization-relies on the isolated microorganisms. The advantage
of this strategy is that products involving isolated microorganisms are defined, and thus, their performance is more predictable.
Currently, there is a commercial biocontrol product for fungal diseases of turfgrass that contains the fungus Trichoderma
harzianum.

Successes at UNL

Research in my laboratory has focused on isolated bacteria as biocontrol agents. We chose bacteria as subjects because most
bacterial species found on plants and in soil can be easily propagated in culture to high cell numbers. Furthermore, bacteria
would be compatible with existing liquid pesticide and fungicide application procedures. We targeted two fungal pathogens: (1)
Rhizoctonia solani, which causes brown patch disease in all cool- and warm-season turfgrass, and (2) Bipolaris sorokiniana,
a cause of leaf spot and "blight" in several cool-season grasses. Although it is less destructive and has a smaller host range than
R. solani, B. sorokiniana is representative of a large group of fungal pathogens formerly known as the "Helminthosporium"
fungi.

Through the efforts of former graduate students Loren Giesler and Zhongge Zhang, a bacterium we coined C3 was found to be
effective in controlling both target fungi. C3, which belongs in the species Stenotrophomonas maltophilia, was discovered on
Kentucky bluegrass leaves. It first attracted our attention because of its aggressive suppression of fungal growth when applied
to grass leaves in the laboratory. When sprayed onto tall fescue turf in a greenhouse, control of the fungal diseases was
dramatic (Fig. 1). The ultimate proof of any control measure, however, is its effectiveness in the field; most biocontrol
organisms, unfortunately, cannot meet this test. To our joy, C3 was effective in repeated field trials against

brown patch and leaf spot. In order to obtain maximum effectiveness, C3 has to be cultured in a broth medium containing chitin, a polymer that makes up the bulk of fungal cell walls, and then the entire contents of a culture is applied in diluted form. The broth fluid is thought to provide nutrients for the growth of the bacterium on grass leaves. It also contains enzymes and other anti-fungal compounds produced by C3 while in culture. In 1999, we found this treatment to reduce damage from brown patch disease in tall fescue and perennial ryegrass and to provide a visible increase in the quality of the turf (Table 1). Disease control provided by C3, however, is not at levels provided by fungicides. Thus, considerable research on C3 is required before it can be a commercially practical system.

Author's Note: I wish to thank the Turfgrass Interdisciplinary Research Group and Lanny Wit, in particular, for providing infrastructure and assistance for my field research. For further information about biological control of plant diseases, please contact me at gyuen@unl.edu, 402-472-3125.

Editor's Note: If you wish to see Table 1, send an e-mail to Pam Murray and she will send it to you in an attached file.

Prairie Restoration Cooperative

by Gerry Steinauer, Nebraska Game and Parks Commission

Hand collecting seeds from native prairies and wetlands on hot, muggy summer days in Nebraska is hard work. But the weather could not stop employees of the Prairie Plains Resource Institute (PPRI), Nebraska Game and Parks Commission (NGPC), and The Nature Conservancy (TNC) from collecting seeds from over 250 species of native grasses, sedges, and forbs this past summer. The seeds will be used to restore over 100 acres of wet meadows in the Platte and Loup River valleys and 50 acres of tallgrass prairie in Lancaster County. These restorations are being conducted as part of the Prairie Restoration Cooperative.

The Cooperative is a three-year, multi-agency project designed to restore threatened prairie and wetland plant communities in eastern and central Nebraska. Prairie Plains Resource Institute, located in Aurora, is the lead agency in the Cooperative and administrator of a grant from the Nebraska Environmental Trust that provides the majority of the funding for the project. Other project partners include the NGPC, U.S. Fish and Wildlife Service (USFWS), Natural Resources Conservation Service (NRCS), TNC, Pheasants Forever, and the Volunteer Conservation Corp.

During the project's duration, over 450 acres of prairie and wetlands will be restored and monitored. Native plant communities
to be restored in years 2 and 3 of the project include Missouri River wet meadows (100 ac), tallgrass prairie (50 ac), loess
mixedgrass prairie (100 ac), and Lancaster County saline wetland. Most of the land being restored is owned by the NGPC, but
land owned by the USFWS, TNC, and private individuals whose properties are protected by Wetland Reserve Program
easements will also be restored.

Since European settlement, a large majority of eastern and central Nebraska's prairie and wetlands has been destroyed or
degraded through agricultural and urban development. Attempts to restore these plant communities have been few, and the
staffs of conservation agencies have little, if any, experience conducting such restorations. Compounding the problem,
locally-adapted seeds for most of Nebraska's native plants are commercially unavailable, or if available, extremely expensive.

The restorations conducted through the Cooperative will include up to 150 species per planting. Only seeds from local
ecotypes will be used in the restorations, with most of the seed sources being within a 50-mile radius of the restorations. The
seeds of wildlflowers and less abundant grasses and sedges will be hand collected. Seeds of the dominant grasses, such as big
bluestem and Indiangrass, will be machine harvested using a pull-behind brush stripper and a combine.

Prairie Plains Resource Institute has been conducting tallgrass prairie restorations in the central Platte River valley for over 20
years. The knowledge and experience of PPRI will be relied upon heavily by the Cooperative while conducting the restorations.
However, we hope to build upon this knowledge base as we conduct the restorations, in some cases, in previously unrestored
plant community types such as salt marshes, Missouri River wet meadows, and loess mixedgrass prairie. At project's end we
will produce restoration manuals for each restored plant community type detailing: species suitable for planting; seed collecting,
storage and processing methods; planting methods; and post-planting management.

An additional goal of the Prairie Restoration Cooperative is to increase the availability of seeds of locally-adapted native plants
for restorations, wildlife plantings, and landscaping in Nebraska. The Game and Parks Commission intends to harvest seeds off
its restorations for future restorations and wildlife plantings on other NGPC lands and privately-owned lands enrolled in its
wildlife programs. The private landowners with restorations under Wetland Reserve Program easements will be encouraged to
harvest and sell native seeds as an alternative source of farming income. Finally, samples of seeds collected for the restorations
will be provided to the Nebraska Statewide Arboretum. The Arboretum's long-term goal is to make these locally-adapted
native plants available to nurseries and seed farms for use in landscaping and other plantings in Nebraska.

Interest in high-diversity prairie and wetland restorations in Nebraska grows each year among conservation agencies and
private individuals; the days of the five-species, warm-season grass restorations appear to be nearing an end. The Prairie
Restoration Cooperative hopes to provide a stimulus for more restorations, increase our working knowledge of prairie
restoration in Nebraska, and increase the seed availability of locally-adapted plant species.

Barker and Collins to Give Leu Distinguished Lectures in November

As part of the 2000 Center for Grassland Studies Fall Seminar Series, Dr. Dave Barker from The Ohio State University will
present "Biodiversity in New Zealand Grasslands" on November 13, 3:30-4:30 pm in the East Campus Union. While he is
here, Barker will present an additional seminar titled "More Grass, More Beef, More $$?" on November 14, 9:00-10:00 am in
A211 Animal Science Building.

Dr. Scott Collins with the Division of Environmental Biology at the National Science Foundation will present "Spatial and
Temporal Dynamics in Tallgrass Prairie" on November 29, 3:30-4:30 in the East Campus Union. He will also meet with faculty
to discuss trends in ecological research. Collins' visit is co-arranged by the Center for Grassland Studies and the Initiative in
Ecological and Evolutionary Analysis.

The Barker and Collins seminars are free and open to the public. The Leu Distinguished Lectureship is made possible by an
endowment from the Frank and Margaret Leu Foundation.

CGS Seminars Available on Video

Since 1996, selected presentations in the CGS Seminar Series have been videotaped by CGS staff and are available for
check-out from the CGS reference center, 221 Keim Hall on the East Campus. To see a listing of all seminars and which are
on video, see www.grassland.unl.edu/seminars.htm. This site also shows seminars remaining this year.

Annual Forage Production and Quality Trials

by Burt Weichenthal (Department of Animal Science) and David Baltensperger (Department of Agronomy) at Panhandle
Research & Extension Center, and Kenneth Vogel, USDA-ARS and Department of Agronomy, UNL

Editor's Note: This article appears in the 2001 Beef Report (see Resources) and is reprinted here with permission.

Summary

Two-year forage trials showed higher dry matter yields for winter triticale than for winter wheat while forage qualities were
similar. Likewise, a spring triticale cultivar had higher dry matter yields than spring barley or oat cultivars when harvested for
forage after heading, and forage qualities were similar. In summer trials, dryland forage sorghum and sorghum x sudangrass
hybrids had higher crude protein, digestibility, and energy values than irrigated forages because they were not as mature. Lower
lignin content and higher digestibility resulted when the brown midrib trait was present in forage sorghum or sorghum x
sudangrass hybrids.

Introduction

Data are limited on the forage production and quality potential for currently available annual forages. Changes in production
potential and feed quality have occurred, such as lower lignin content and higher digestibility associated with the brown midrib
(BMR) trait that has been crossed into some forage sorghum, sudangrass, sorghum x sudangrass and corn hybrids. Forage
trials were conducted over two years to compare some of the newer forage cultivars with some that have been around long
enough to be considered standards. Forage production and quality were evaluated for cereal forages grown under dryland
management and for sorghum, sorghum x sudangrass, and pearl millet forages grown under dryland or irrigated management
systems.

Procedure

Dryland winter wheat and triticale cultivars were harvested for forage at Mead, McCook, and Sidney in 1997 and 1998 after
producing a seed head. Ten wheat cultivars were planted, including Arapahoe, Lamar, Longhorn, Pronghorn, and 6
experimental cultivars. Five triticale cultivars were planted, including Trical, Newcale, and 3 experimental cultivars. There were
4 replications of each cultivar at each location.

Dryland spring-seeded cereal crops were harvested as forage at Sidney in 1998 and 1999 after most of the cultivars had
produced a seed head. There were 2 triticale, 2 barley, and 3 oat cultivars, with 4 replications of each cultivar. All annual
forages were planted in 6-row plots with a double-disc grain drill with 12 inches between rows. All forage plots were harvested
with a plot swather that cut the center 4 rows. Mechanical chopping of the forages allowed subsampling for dry matter and
forage quality analyses. Quality results were available from 1998 trials only at the time this paper was prepared.

Summer dryland forages were planted at Sidney and included 1 sudangrass, 6 sorghum x sudangrass, and 8 forage sorghum
cultivars. Forages were harvested after the majority of cultivars had headed in growing seasons of 78 and 75 days in 1998 and
1999, respectively. The plots were fertilized with 60 lb of N and 40 lb of P2O5 in 1998 and 45 lb of N in 1999.

Summer irrigated forages planted at Scottsbluff included 1 sudangrass, 5 sorghum x sudangrass, 9 forage sorghum, and 3 pearl
millet cultivars. The plots were harvested after the majority of cultivars had produced a seed head in growing seasons of 82 and
88 days in 1998 and 1999, respectively. They were fertilized with 120 of N and 80 lb of P2O5 as a side dress in both years.

Forage quality tests included percentages of dry matter for total and nitrate nitrogen, neutral detergent fiber, acid detergent
fiber, acid detergent lignin, and in vitro dry matter digestibility (IVDMD). The acid detergent fiber (ADF) values were used to
calculate energy values as TDN, net energy, and metabolizable energy by using equations listed by the National Forage Testing
Association. Least significant differences at the 5% probability level of incorrectly stating a difference were determined for each
trait by using the general linear model in the Statistical Analysis Services computer program.

Results

Fall- and spring-seeded cereal forage results are shown in Table 1. Averages are shown for the 10 winter wheat and 5 triticale
cultivars harvested at each location in 1997 and 1998. Although differences in dry matter forage yields were not large, the top
yielding winter wheat cultivar at all three locations was Pronghorn, and the top yielding winter triticale cultivar at McCook and
Sidney was Newcale. Both of these cultivars were developed by plant breeders in the University of Nebraska system. Forage
crude protein (CP) and ADF levels were similar among the wheat and triticale cultivars at each location, making energy levels
calculated from ADF similar also.

The top yielding spring cereal forage was triticale cultivar 2700. The barley cultivars ranked second and third in dry matter
yields. Forage CP levels were similar with an average of 8.7% of dry matter. Energy levels were also similar with an average of
65% TDN, which was the same as in the winter forages.

Dry matter yields for dryland summer forages in Table 2 are an average of trials in 1998 and 1999. Dry matter percentages,
plant heights and maturity scores are not shown, but were similar between years. Crude protein levels for 1998 ranged from 13
to 9.4% of dry matter, which was consistent with the maturity stages that ranged from boot to headed. Producers who want
summer forage high in crude protein and digestibility should harvest crops more than once a season when the

crops have
regrowth capability. Other producers may want more dry matter yield with a single cut system when the crude protein and
TDN contents are adequate for the animals that will consume the forage.

Dry matter yields for irrigated summer forages are shown in Table 3 as an average of 1998 and 1999 trials. In Tables 2 and 3,
cultivars with an X before or after numbers or a name were experimental cultivars in the years of these trials. High-yielding
cultivars included both forage sorghum and sorghum x sudangrass hybrids. Some brown midrib hybrids had good yields but
showed some lodging in the single harvest system that allowed them to grow 6 to 7 ft tall, but this was also true for some
non-BMR hybrids.

Forage quality results shown for 1998 indicate variation in CP and IVDMD, which is often due to maturity differences when
harvested. However, the emergence of summer forages with increased digestibility, such as the brown midrib cultivars in forage
sorghum, sorghum x sudangrass, pearl millet and corn hybrids, brings new opportunities for improved animal performance
through grazing or feeding of these forages. Reduced lignin fiber content of these forages allows for greater digestibility, but
multiple harvest or grazing systems may be needed to minimize lodging problems that can occur if they get too tall. In both the
irrigated and dryland trials in 1998, the highest IVDMD values were associated with the lowest acid detergent lignin
percentages which are typical for many BMR hybrids.

Nitrate nitrogen levels in Tables 2 and 3 were generally below the 2000 ppm level often listed for initial toxicity concern for
ruminants. However, previous research with similar forages in western Nebraska showed some potentially toxic nitrate levels in
irrigated forage in the first of two harvests during the summer, especially with high nitrogen fertility in the soil. Thus, nitrogen
application rates will need to be managed carefully along with maturity stage at harvest to achieve satisfactory levels of CP
without increasing nitrates to toxic levels.

The choice of an annual forage crop and cultivar may depend more on the time forage is needed in the grazing or harvested
forage system rather than on differences in yield potential. Fitting a forage crop into a cropping system would be an important
consideration. Also, equipment requirements for the shorter annuals, like small grain or foxtail millet forages, may already be in
an operation for other hay crops, whereas equipment needed to easily harvest and feed the taller forages may be unique.
Getting the thicker stemmed forages to dry down in a reasonable time period for making hay will usually require a crimping
action of the forage during cutting. The emergence of hybrids with higher digestibility may enhance grazing of standing or
windrowed summer annual forages during the winter.

Editor's Note: If you wish to see the tables accompanying this article, send an e-mail to Pam Murray and she will send them to you in an attached file.

CGS Associate News

In September **Martin Massengale**, CGS Director, received the 2000 Exemplary Service to Agriculture Award from the
Nebraska Ag Relations Council.

Steven Rothenberger is co-editor of a new book titled A Prairie Mosaic: An Atlas of Central Nebraska's Land, Culture,
and Nature (see Resources).

Info Tuft

Scientists at the U.S. Meat Animal Research Center (MARC), Clay Center, Nebraska, have developed methods that detect
even a few E. coli O157:H7 in manure. The method was used in research that showed that feeding hay rather than a finishing
ration to market-ready cattle for 7 days reduced the bacteria's prevalence from 52 to 18%. To see the complete article
published by USDA-ARS, see www.ars.usda.gov/is/AR/archive/oct00/ecoli1000.htm.

On October 11 President Clinton signed a major conservation bill that will double spending next year for federal land
acquisition and preservation. The bill earmarks $12 billion over six years for purchasing fragile lands, maintaining parks,
preserving wildlife and other initiatives.

The Nature Conservancy has bought the 27,000-acre Camp Creek Ranch, which represents 20% of the Zumwalt prairie in the
Northwest. The bunchgrass prairie covers 146,000 acres overall and is home to one of the nation's densest concentrations of
nesting birds of prey.

Resources

The 2000 Nebraska Beef Report is in press and should be available shortly. This annual report contains many research articles
on a variety of topics related to beef production, including several on forage and grazing. Summaries of all the reports may be
obtained from Nebraska Extension Educators. Summaries as well as the full reports are at
www.ianr.unl.edu/ianr/anisci/beef/beef.htm. For a printed copy of the report, contact the Center for Grasslands Studies.

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.

Developed in accordance with Executive Order 13112 on Invasive Species issued by President Clinton in February 1999, the Invasive Species Information System site (www.invasivespecies.gov) facilitates access to and exchange of invasive species data and resources by researchers, scientists, land and resource managers, public and private sector agencies, and concerned citizens. The site is guided by the Invasive Species Council, a federal, inter-agency, executive committee that is coordinating efforts to minimize the economic, ecological, and human impacts of invasive plant and animal species in the U.S. As a side note, the only production agriculture representative on a 32-member advisory committee to the Invasive Species Council is Nebraska rancher Barb Cooksley from Anselmo. If you wish to have input in this process, you can contact Barb through the CGS office.

World Resources 2000-2001: People and Ecosystems, The Fraying Web of Life. Examines grassland, coastal, forest, freshwater, and agricultural ecosystems. Grades their health on the basis of their ability to produce the goods and services that the world currently relies on. These include production of food, provision of pure and sufficient water, storage of atmospheric carbon, maintenance of biodiversity, and provision of recreation and tourism opportunities. To access the online version or to order hard copy, see www.wri.org/wr2000.

Growing Carbon: A New Crop that Helps Agricultural Producers and the Climate Too. Free. New brochure sponsored by USDA (NRCS and National Agroforestry Center), Environmental Defense, and Soil and Water Conservation Society. Discusses opportunities producers have to help efforts to slow climate change, to build a cushion against its harmful effects, and perhaps to grow a new crop-carbon. Available online at www.swcs.org (Publications-Educational Resources), or call 1-888-526-3227, or e-mail landcare@swcs.org.

NatureServe is the name of a Web site (www.natureserve.org) that states it is a source for authoritative conservation information on more than 50,000 plants, animals, and ecological communities of the U.S. and Canada. It provides in-depth

information on rare and endangered species, but includes common plants and animals, too. NatureServe is a product of the
Association for Biodiversity Information in collaboration with the Natural Heritage Network.

Calendar

Contact the CGS for more information on these upcoming events:

2000

Dec. 5-8: National Conference on Grazing Lands, Las Vegas, NV, http://www.glci.org/Call.htm

2001

Jan. 8-10: Turfgrass Conference and Equipment Show, Omaha, NE

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.
