  

PROGRAM

8th Eastern Native Grass Symposium

October 1-4, 2012

DoubleTree by Hilton Hotel Charlottesville
Charlottesville, Virginia

VirginiaTech
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8^{th} Eastern Native Grass Symposium

October 1-4, 2012

DoubleTree by Hilton Hotel Charlottesville
Charlottesville, Virginia

Virginia Tech
College of Agriculture

Department of Crop and Soil Environmental Sciences
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Dear Colleagues,

Welcome to the 8th Eastern Native Grass Symposium (ENGS). On behalf of the organizing committee, I would like to thank you all for participating in the conference hosted this year through Virginia Tech.

The 2012 ENGS brings together a diverse group of people with interests in native grasses and plants. This year the ENGS will place special emphasis on the role that native grasses can play in mitigating the effects of climate change. Sessions will feature topics related to biofuels, ecosystem restoration, forage and hay production, and wildlife management related to native grasses in the eastern United States and Canada. We are excited to have Dr. Doug Tallamy from the University of Delaware as our Keynote Speaker. Doug will be talking about the importance of native plants in our landscapes and gardens - "Bringing Nature Home: How to Sustain Wildlife with Native Plants". This topic has been somewhat overlooked in past ENGS meetings, and we look forward to hearing about Doug's perspectives on this important topic. Expect our other plenary speakers to provide interesting talks covering the meeting's main subject themes on biofuels, forage and wildlife. These topics also frame the 28 talks that will be presented in the concurrent break-out sessions Tuesday and Thursday. Remember also to visit the posters (23) and exhibitors. A special poster/exhibitor session is scheduled for Tuesday morning but remember that all posters and exhibits will be available for viewing throughout the meeting.

Lastly, the central location of Charlottesville affords us some interesting field trip opportunities. Field trips this year include a chance to the view the unique beauty of nearby Shenandoah National Park and Fort Pickett, which is home to some of the largest native prairies east of the Mississippi. Also make sure to attend one of our on-site workshops Tuesday evening to gain some hands on experience with native grass identification, seed cleaning or planter operation.

We are excited about this year's program and think you will really enjoy it. Have a great stay in Virginia, and we hope to see you at future meetings!

Sincerely,

Ben Tracy
Associate Professor
Department Crop and Soil Environmental Sciences
Virginia Tech

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Organizing Committee

Ben Tracy – Virginia Tech
Pat Keyser – University of Tennessee
Bob Glennon – Virginia Tech/USDA-NRCS
Martin Van Der Grinten – USDA-NRCS
Howard Skinner – USDA-ARS
Barry Isaacs – USDA-NRCS
Jon Dickerson – USDA-NRCS

Shelly Jobst – Virginia Tech, Continuing and Professional Education
Colleen Bartos – Virginia Tech, Continuing and Professional Education
Nancy Rakes – Virginia Tech, Continuing and Professional Education

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Switchgrass

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USDA Natural Resources Conservation Service (NRCS)

USDA, NRCS, National Plant Materials Center

Virginia Department of Game & Inland Fisheries

Schedule-at-a-Glance

Monday, October 1

6:00 – 8:00 p.m. Registration and Reception *(Promenade Garden/Ballroom)*

Tuesday, October 2

7:00 – 8:00 a.m. **Breakfast**

Plenary Session *(Rotunda Ballroom A&B)*

8:30 – 9:00 a.m. **Welcome** – Ben Tracy, Virginia Tech

Forage and Grazing Systems Plenary Talk
"Sustainable, Low-input Grazing: Native Grasses and Changing Climates"
Pat Keyser, Professor and Director - Center for Native Grasslands Management
University of Tennessee

9:00 – 9:30 a.m. **Biofuels Plenary Talk**
"Forages for Fuel: Building an Industry from the Ground up"
Jon Walton, Feedstock Systems Analyst
Genera Energy

9:30 – 10:00 a.m. **Wildlife Plenary Talk**
"An Ocean of Grass: Wildlife and Native Grasslands"
Marc Puckett, Wildlife Biologist and Small Game Project Leader
Virginia Department Inland Game and Fisheries

10:00 – 11:00 a.m. **Key Note Speaker**
"Bringing Nature Home: How to Sustain Wildlife with Native Plants"
Doug Tallamy, Professor and Chair - Department of Entomology and Wildlife Ecology
University of Delaware

11:00 a.m. – Noon Break – **Posters Session** and **Exhibits** *(Promenade Ballroom)*

Noon – 1:20 p.m. **Lunch** *(Rotunda Ballroom C&D)*

1:20 - 3:00 p.m. **Concurrent Sessions**
Forage *(Rotunda Ballroom A)*
Wildlife *(Rotunda Ballroom B)*

3:00 – 3:30 p.m. Break – **Posters Session** and **Exhibits** *(Promenade Ballroom)*

Tuesday, October 2 *continued*

3:30 – 4:50 p.m. **Concurrent Sessions**
Restoration *(Rotunda Ballroom A)*
Biofuels *(Rotunda Ballroom B)*

4:50 p.m. Adjourn – Dinner on your own

7:00 p.m. **On-Site Workshops** (Pre-registration required)
Small Scale Seed Cleaning *(Rotunda Ballroom A)*
Native Drills—Operation and Calibration *(outside near entrance)*
Native Grass Identification *(Rotunda Ballroom B)*

Wednesday, October 3

7:00 – 8:00 a.m. **Breakfast**

8:00 a.m. – 4:00 p.m. **Field Trips** (Pre-registration required)

4:30 – 6:00 p.m. Visit **Posters Session** and **Exhibits** *(Promenade Ballroom)*

6:00 p.m. **Banquet** *(Rotunda Ballroom C&D)*

Speaker
"Tropical Grasslands of Southeast Asia"
Bill McShea
Smithsonian Conservation Biology Institute

Thursday, October 4

7:00 – 8:00 a.m. **Breakfast**

8:30 – 10:10 a.m. **Concurrent Sessions**
Forage and Restoration *(Rotunda Ballroom A)*
Establishment, Selection, and Wildlife *(Rotunda Ballroom B)*

10:10 a.m. Adjourn meeting

Detailed Program

Monday, October 1

6:00 – 8:00 p.m. Registration and Reception *(Promenade Garden/Ballroom)*

Tuesday, October 2

7:00 – 8:00 a.m. **Breakfast**

Plenary Session *(Rotunda Ballroom A&B)*

8:30 – 9:00 a.m. **Welcome** – Ben Tracy, Virginia Tech

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"Bringing Nature Home: How to Sustain Wildlife with Native Plants"
Doug Tallamy, Professor and Chair - Department of Entomology and Wildlife Ecology
University of Delaware

11:00 a.m. – Noon Break – **Posters Session** and **Exhibits** *(Promenade Ballroom)*

Posters Session *(Promenade Ballroom)*

1. **Ecological Impact of Conversion of Agriculture Lease Lands to Warm Season Grasses at the Merck, Sharp and Dohme Corp. Stonewall Plant in Elkton, VA**

Mr. Verl Emrick[1], Dr. Glen Stevens[2], Mr. Brian King[3]

[1] Virginia Tech Conservation Management Institute
[2] Ferrum College
[3] Merck, Sharp and Dohme, Corp.

Corresponding Author: vemrick@vt.edu

Warm season or C4 grasses (WSG), such as switchgrass, big bluestem, and indian grass are perennial grasses native to the southeast that have been largely supplanted by agricultural and non-native C3, cool season grasses (CSG). As a distinct plant functional group, WSG have advantages over CSG and row crops in providing ecosystem services. Warm season grasses are: 1) drought tolerant; 2) deep rooted with high belowground biomass production, 3) have high tissue C: N ratio and 4) sequester more soil C than annual row crops. The permanent extensive root systems of WSG build soil C stocks and may also increase immobilization of N, P and other soil nutrients. Native WSG also provide conservation benefits by providing habitat for many plants, small mammals, birds, and insects. Merck, Sharp and Dohme, Corp. Stonewall plant in Elkton, VA is in the initial stages of implementing a large scale project to convert row crops and CSG pasture WSG in order to benefit the local ecology and to investigate as a potential energy source. The large scale shift from row crops to WSG at Merck, Sharp and Dohme, Corp. presents a unique opportunity to measure and monitor the establishment, growth, and maturity of WSG stands and quantify the ecological and conservation impacts derived from these stands. Merck, Sharp and Dohme, Corp. has teamed with the Virginia Tech Conservation Management Institute and Ferrum College to quantify the changes in key ecosystem components and processes resulting from the conversion of row crops and CSG pasture to WSG.

2. Evaluation of Midwestern and Southern Switchgrass Cultivars and Germplasm for Biomass Production in the Northeast

Dr. Paul Salon [1], Mr. Martin vander Grinten [1], Mrs. Shawnna Clark [1]

[1] USDA-NRCS Big Flats Plant Materials Center

Corresponding Author: paul.salon@ny.usda.gov

The potential for switchgrass to be used as a lignocellulosic biofuel crop as well as for direct combustion has received much attention and research because of its wide adaptability and high yields. Evaluation of switchgrass cultivars across similar plant hardiness zones and ecoregions has shown the potential to move high productive cultivars developed in the Midwest to the East. To evaluate germplasm and cultivars developed for bioenergy purposes that may be adapted to the Northeast two studies were conducted at the Big Flats Plant Materials Center on a Unadilla silt loam soil at latitude 45º 07‘ 30”. Thirteen elite breeding lines from the USDA-ARS Central –East Regional Biomass Center in Lincoln, Nebraska was established on 5/22/09. The cultivar Kanlow was seeded as a control. These lines represent improvements in Kanlow and the cultivar Summer for yield and chemical compositional attributes useful for ethanol production to be used in a hybrid population breeding system for improving yield. Third year yields were obtained with no fertilizer inputs. Yields for Kanlow and for germplasm selected out of Summer (both used as parent populations for the hybrid system), and the resulting highest hybrid population line was 5.5, 4.5, and 6.4 t/ac respectively. Three lines improved out of Kanlow averaged 6.1 t/ac. An additional line in the trial is a fourth cycle of selection out of the cultivar Cave-in-Rock for improved IVDMD which averaged 5.6 t/ac. An additional study was established on 5/10/10 comparing four lines developed by the USDA-ARS U.S. Dairy and Forage Research Center in Madison, Wisconsin to cultivars Timber, Bomaster, Kanlow, Cave-in-Rock and two lines from University of Oklahoma.

3. Effect of Rust Infection on Ethanol Production Potential of Switchgrass

V.R. Sykes [1], Dr. F.L. Allen [1], Dr. J.R. Mielenz [2], Dr. C.N. Stewart [1], Dr. M.T. Windham [1]

[1] University of Tennessee
[2] Oak Ridge National Laboratory

Corresponding Author: vsykes@utk.edu

Switchgrass (Panicum virgatum) is a native, warm-season, perennial grass used as a forage or biofuel crop. Switchgrass is susceptible to a number of pathogens, including rust (Puccinia emaculata); however, the impact of infection on biomass or ethanol yield is unknown. This study examined the effect of varying degrees of rust infection on switchgrass ethanol yield. Naturally infected leaves from field-grown Alamo and Kanlow in Knoxville, TN were visually categorized as low (LD), medium (MD), or high (HD) disease based on degree of chlorosis, necrosis, and sporulation. Rust was isolated to confirm infection. Vegetative tillers were used for LD and reproductive tillers for MD and HD. Leaves from vegetative and reproductive tillers of a disease-free, greenhouse-grown Alamo clone were used as controls. Leaves were dried, ground to 0.063 mm, acid/heat pretreated, and subjected to simultaneous saccharification and fermentation with Saccharomyces cerevisiae D5A with two runs per material set. HPLC was used to assess ethanol yield. Ethanol yield differed significantly among disease levels within cultivars and between vegetative and reproductive stages. In run 1, vegetative tillers produced 19% less ethanol than reproductive tillers. MD had 33 and 36% less ethanol, and HD had 54 and 57% less ethanol than LD in Alamo and Kanlow respectively. In run 2, reproductive tillers produced 16% less ethanol than vegetative tillers. MD had 13 and 48% less ethanol, and HD had 26 and 60% less ethanol than LD in Alamo and Kanlow respectively. Ethanol yield loss in rust infected switchgrass may contribute to reduced economic value.

4. Using Fertilization, Irrigation, and Harvest Strategies to Maximize 'Alamo' and 'Cave-In-Rock' Switchgrass Biomass Yield in the Southern Ozarks

Alayna Jacobs [1], Randy King [2], Thomas E. Pratt [2], Luther D. Goff [2], Joel Douglas [3]

[1] USDA-NRCS Booneville Plant Materials Center
[2] USDA-NRCS, Booneville Plant Materials Center
[3] USDA-NRCS, Regional Plant Materials Specialist

Corresponding Author: alayna.jacobs@ar.usda.gov

Switchgrass (*Panicum virgatum* L.) is recognized as a model perennial bioenergy feedstock for marginal land where water and nutrient availability prevent the production of conventional row crops. Switchgrass may offer a source of income for producers on these lands in the southern Ozarks, either as forage for livestock or biofuel feedstock. However, information is lacking on the management of switchgrass for these purposes in this region. The objective of this study is to evaluate the effects of harvest frequency, fertility sources, and irrigation management on yield and forage quality of 'Alamo' and 'Cave-in-Rock'. Switchgrass cultivars were established in 40ft x 40ft plots in a randomized complete block with three replications on a Leadvale silt loam in March 2007. Fertility treatments included an annual 2 ton/acre application of poultry litter and nutrient-equivalent commercial fertilizer. Irrigation treatments included no irrigation and 2 inches per week of supplemental irrigation. Half of each plot was harvested twice per year in June and December; the remaining half was harvested once in December. Percent crude protein (CP), acid detergent fiber and neutral detergent fiber were determined for the June harvests. The greatest yields generally occurred for Alamo harvested twice/year, irrigated, and fertilized with either poultry litter or commercial fertilizer. Dry matter yields ranged from 6.5 to 13.7 ton/acre. Forage quality estimates were similar across treatments with Cave-in-Rock providing a slight increase in CP over Alamo. Irrigation provided minimal benefits, which may indicate switchgrass can be productive under climatic condition and rainfall as a low input feedstock for forage and biofuel in the southern Ozarks.

5. Switchgrass Establishment and Yield Affects from Dormant-season Planting, Seeding Rate, and Seed Dormancy Level

Ms. Amanda Ashworth [1], Dr. Pat Keyser [1], Dr. Fred Allen [2], Dr. Gary Bates [2], Dr. Elizabeth Doxon [2]

[1] University of Tennessee, Center for Native Grasslands Managment
[2] University of Tennessee

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Establishment success is arguably the greatest agronomic challenge to wide-scale switchgrass (Panicum virgatum L.) feedstock production on marginal lands in the Southeastern U.S. Stand failures have often been linked to seed dormancy, a common trait in this species; one strategy for breaking dormancy is dormant-season planting. The objective of this study was to evaluate the efficacy of dormant-season planting to enhance switchgrass establishment in the Southeast by: i) evaluating three dormant-season planting dates versus a growing-season control; ii) evaluating two seeding rates for dormant-season planting; and, iii) comparing high and low dormancy seed lots for both rate and date combinations. Four planting dates (1 December, 1 February, 15 March, and 1 May), two seeding (6.7 and 10.1 kg PLS ha-1), and dormancy rates (high, 45 and 75%; low, 2 and 5%, 2009 and 2010, respectively) were assigned in a split-block design with three replications at two locations in Tennessee from 2009-2011. All four seeding rate by dormancy level combinations were the split plots and seeding date was the whole plot. Planting date, seeding rate, or dormancy did not significantly influence yields for two years at one location ($P < 0.05$). Density of March plantings equaled or exceeded those of other dates for all locations and years. However, density was not affected by seeding rate or seed-dormancy level. Therefore, higher seeding rates for dormant-season planting are not necessary or cost-effective. Conversely, our results suggest that March planting offers increased reliability and flexibility for establishment with either high or low dormant seed lots. Dormant-season planting also suggests in-situ stratification is a viable option for high-dormancy seed lots. However, results need to be validated over a broader range of soils and climatic conditions, especially along a winter severity gradient.

6. The Biomass Yield and Nutritive Value of Tall Fescue Versus Native Warm-Season Grasses During the Summer Months

Ms. Amber Hickman [1], Dr. Ozzie Abaye [1], Dr. Benjamin Tracy [1], Dr. Chris Teutsch [1], Mr. David Fiske [1]

[1] Virginia Polytechnic Institute and State University

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Tall fescue (Festuca arundinacea Schreb.) is a cool-season perennial grass that is only productive during cool-moist months. On the other hand, native warm-season grasses are capable of producing forages during the hot summer months through early fall. The objective of this study is to assess the yield and nutritive value of four native warm-season grasses versus three tall fescue types. Three replications of three types of tall fescue (endophyte infected (E+), endophyte-free (E-), and novel endophyte (MaxQ)), and four replications of four native warm-

season grass species (switchgrass (Panicum virgatum L.), big bluestem (Andropogon gerardii Vitman), indiangrass (Sorghastrum nutans (L.) Nash), and little bluestem (Schizachyrium scoparium (Michx.) Nash)) were used. The experiments are conducted at Kentland Farm near Blacksburg, VA during the 2011 and 2012 growing seasons. Tall fescue plots were fertilized in March of both years with nitrogen in the form of urea at a rate of 56.37 kg/ha (51.62 lbs/acre). The native warm-season grasses were never fertilized.

In 2011, the native warm-season grasses produced much higher yields compared to the tall fescue types. Crude protein (CP) was lower for the native warm-season grasses than for the tall fescue types. Neutral detergent fiber (NDF) and acid detergent fiber (ADF) were similar between the tall fescue types and the native warm-season grasses. The same experiments are repeated in 2012 however, the data is not available at this time.

7. Forage Production of Native Warm-Season Grass Varieties in Beltsville, MD

Mr. R. Jay Ugiansky [1], Mr. Lester Vough [2]

[1] USDA, NRCS, Norman A. Berg National Plant Materials Center
[2] University of Maryland Extension

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Many native warm-season grass varieties are available with potential to provide valuable summer forage in rotational grazing systems. To better utilize these grasses, more forage productivity data is needed for specific growing regions. The objective of this study is to determine the total and seasonal yield of warm-season grass species and varieties when grown in Maryland in a simulated rotational grazing system. Forage production information will help farmers to optimize production in a sustainable manner that will conserve natural resources and benefit their profitability. Included in this study are a total of 36 varieties of eastern gamagrass, switchgrass, big bluestem, indiangrass, little bluestem, Florida paspalum, and coastal panicgrass. Varieties were planted in June 2005 at the NRCS, Norman A. Berg National Plant Materials Center located at Beltsville, Maryland. Experimental design was a randomized complete block with four replications. Cuttings were made using a Carter flail-type harvester and cut to a height of 8 inches. Plots were harvested beginning in 2007 and will continue through 2012. The eastern gamagrass varieties 'Meadowcrest', 'Highlander', 'Pete' and 'Verl' and 'Carthage' switchgrass were the varieties with the highest 4-year average yields. 'Carthage' switchgrass, 'Atlantic' coastal panicgrass and 'Kanlow' switchgrass came into production quickly and exhibited consistently high yields even through dry conditions. Florida paspalum exhibited excellent stand establishment and initial yields, especially considering it is an unimproved collection, however it declined sharply after 2009 indicating poor persistence.

8. Warm-Season Grass Management Trials in Maryland

Mr. R. Jay Ugiansky [1], Mr. Steve Strano [2]

1 USDA, NRCS, Norman A. Berg National Plant Materials Center
2 NRCS, Maryland State Office

Corresponding Author: rjay.ugiansky@md.usda.gov

In Maryland, thousands of acres have been planted to native warm-season grasses and wildflowers to protect water quality and provide wildlife habitat. However, existing plantings lack species diversity due to the use of low diversity planting mixes and improper management. To improve stand diversity an appropriate selection of wildflower species and management treatments are required. Trials have been conducted at the Norman A. Berg National Plant Materials Center in Beltsville, Maryland in cooperation with NRCS Maryland to determine the optimal methods for renovating warm-season grass stands to increase plant diversity. Treatments included timing of disking (late summer; late fall; early spring), disking intensity (0%; 25%; 50%; 100%), and wildflower seeding rates (none; ½lb PLS/acre; ½lb PLS/acre + 20lb/acre small grain; 4lb PLS/acre wildflower mix). These treatments were tested with a 'dry' wildflower mix on a stand of predominantly indiangrass in well-drained soil and a 'mesic' wildflower mix on a dense stand of predominantly switchgrass in moderately well-drained soil. Vegetation percent cover and composition were evaluated for three years. The data indicate fall disking more effectively reduced warm-season grass density and better facilitated wildflower establishment and growth. Spring disking appeared ineffective at reducing grass density, which resulted in smaller wildflower plants while having comparable or better germination. Disking reduced indiangrass cover, but not switchgrass and big bluestem, suggesting indiangrass is more susceptible to disking. Some species of wildflower established and persisted better than others. Results have been transferred into technical documents to support conservation planning for USDA Farm Bill programs.

9. An Examination of Forage Composition, Yield, and Quality of Native Warm Season Grasses, and their Potential Value as a Poultry Bedding Material

Prof. Glen Stevens [1], Mr. Verl Emrick [2]

[1] Ferrum College
[2] Virginia Tech Conservation Management Institute

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Warm season or C4 grasses (WSG), such as switchgrass, big bluestem, and indiangrass are perennial grasses native to the southeast that have been largely supplanted by agricultural and non-native C3 or cool season grasses (CSG). Factors that we assume to be limiting to broader establishment of WSG in the Virginia region include information on the stand development, forage quality, and alternative market uses. This study was initiated to track changes in stand composition, yield, and forage quality across a range of newly-established stands within the Chesapeake Bay region of Virginia. In addition, we worked with Virginia Cooperative Extension faculty to assess the potential use of WSG as a poultry bedding material. In recently established stands (three years post-planting with light management), WSG comprised approximately 60% of plant biomass, with significant variability in yield and cover among the different research stands. In our heavily managed, well-established reference stand, WSG made up 80% or more of biomass. Forage quality varied significantly across the growing season at each of the assessed sites, with high protein content observed in stands regenerating from the first cutting. Our assessment of the use of native warm-season grasses as a poultry bedding material showed promising results, with similar rates of mortality and weight gain seen in WSG trials as compared to typical bedding material (pine shavings). Overall, these results support a range of market opportunities for native grasses planted for their economic benefit.

10. Meat Quality and Consumer Sensory Acceptance of Beef From Cattle that are Fed Native Warm Season Grasses During the Stocker Phase

Mr. Vikram Kurve [1], Dr. Poulson Joseph [1], **Dr. Holly Boland** [1], Dr. Byron Williams [2], Dr. Sam Riffell [1], Dr. Wes Schilling [1]

[1] Mississippi State University
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Native warm season grasses (NWSG) provide excellent wildlife habitat and are well adapted to the Southeastern United States. Our objective was to evaluate the effect of feeding NWSG during the stocker phase of beef on carcass/meat quality and sensory attributes. Seventy-two British cross-bred cattle were randomly allotted to paddocks such that three replications of eight animals were grazed on each pasture plot within a treatment which included Bermuda grass (BER), Indiangrass monoculture (IND), and a mixture of NWSG including Big Bluestem, Little Bluestem, and Indiangrass (MIX). Cattle were grain-finished in commercial feedlots and harvested to determine carcass quality. 94% of carcasses were graded as 'choice', with treatments displaying 100, 95.8, and 87 % for MIX, BER, and IND, respectively. Rib eye steaks (Longissimus muscle) from each animal were vacuum-aged for 2 weeks prior to simulated retail display for meat quality evaluation after 0, 3, 6, and 9 days of storage. BER had greater ($P<0.05$) fat content, and less ($P<0.05$) protein and moisture contents, compared to IND and MIX. Treatments had no effect ($P>0.05$) color (L^*, a^*, b^* values), pH, and aerobic plate count. However, MIX steaks had less ($P<0.05$) lipid oxidation than BER and IND steaks after six days of display storage and MIX steaks were initially juicier than BER steaks after 6 days of storage. At day 0, there was no difference ($P>0.05$) in overall consumer acceptance among treatments. Therefore, NWSG could be utilized for feeding beef cattle during the stocker phase without compromising carcass and meat quality attributes.

11. Two Strategies For Grazing NWSG on the Highland Rim in Middle Tennessee

Mr. Matt Backus [1], Dr. John Waller [1], **Dr. Brian Campbell** [1], Dr. Elizabeth Doxon [1], Dr. Pat Keyser [1], Dr. Gary Bates [1], Dr. Craig Harper [1]

[1] University of Tennessee

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Performance of stocker steers was used to compare two strategies for grazing NWSG at the Highland Rim Research and Education Center near Springfield, TN. Strategy A: early season (ES) where steers grazed NWSG for 28 day when forage was of highest nutritive value and Strategy B: full season (FS) where steers started at the same time as ES but remained on the pastures for about 90 days. Angus and Angus cross steers (~ 600 lb) were used in completely randomized design with 3 to 4 year old stands of two forage treatments: 1) switchgrass (Panicum virgatum); and 2) a combination of big bluestem (Andropogon gerardii Vitman) and indiangrass (Sorghastrum nutans). Before and after grazing NWSG pastures all steers were fed a high fiber filler diet for 4 day to reduce differences in gut fill. Four steers (testers) were allotted to 3-acre paddocks with three replications per treatment. Additional steers were used in a put-and-take manner to keep forage in a vegetative

state. Data were analyzed using the MIXED procedure of SAS. Least square means for ADG of ES steers grazing BB/IG and SG did not differ with ADG of 2.38, 1.90 lb/day respectively. Least square means for ADG of FS steers grazing BB/IG and SG did not differ, with ADG of 2.09 and 1.76 lb/day respectively. Our results demonstrate the ability of NWSG to provide adequate summer performance for cattle grazing early season and full season in the mid-south.

12. Planting Depth and Season Affect the Emergence of Native Warm-season Grasses

Mr. Gordon Jones [1], Dr. Ben Tracy [1]

[1] Virginia Tech

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Native warm-season grasses can play an important role in pasture-based livestock systems in the Mid-Atlantic. With maximum production during the summer, when cool-season grass growth slows, farming systems including native warm-season grasses can help to prevent forage deficits. The establishment of native warm-season pastures can, however, be inconsistent. Field plots of six grass species were planted at 0.64 cm and at 2.54 cm both in November 2011 and May 2012 in a randomized split-split plot design (n=5). Seedlings were counted weekly throughout the spring, and emergence was calculated based on the initial seeding rate. The May planting yielded higher emergence than did the November planting. The 0.64 cm planting depth showed higher emergence than did the 2.54 cm planting depth for the May planting, but planting depth did not show consistent differences for the November planting. Planting season and depth can affect the emergence of native warm-season grasses.

13. The Effect of Sodium Nitroprusside on the Germination of Warm-Season Grasses found in Southern New England

Noah Leclaire-Conway [1], Rebecca Brown [1]

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The demand for native plants is increasing for both commercial and residential landscapes as well as municipal agencies seeking to reduce the use of potentially invasive introduced species. This demand requires the development of protocols for propagating locally sourced plant materials, as well as developing foundation plots for seed production. Native grass seed was harvested from New England roadside populations, including seed from little bluestem (Schizachyrium scoparium), Hairy paspalum (Paspalum setaceum var. setaceum), Roundseed panicgrass (Dichanthelium sphaerocarpon), and Purple lovegrass (Eragrostis spectabilis). These species express low growth habits and are highly acclimated to the poor roadside-soils of this region. Due to the lack of commercially available varieties, seed was collected from southern New England roadsides and germinated in the laboratory. Seed was harvested during the fall, placed in the freezer, and germinated between February and March. The seed was then primed with 250uM and 500uM concentrations of sodium nitroprusside (SNP) and potassium nitrate (KNO_3). Primed seed was placed in a growth chamber with 12 hours of daylight and 90% humidity. The temperature ranged from 20°C to 26°C levels and there were observable increases in germination rates in all species. Another assay was executed using only SNP as the treatment on little bluestem, Rosette grass, and Paspalum seed. Compared to a control using distilled H_2O, seed primed with SNP germinated more rapidly and with higher percentages. More research is needed to determine the safe and practical application of this chemical to break dormancy in seed.

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14. Mowed Roadsides: Ecological Wasteland or Native Grassland?

Rebecca Brown [1], Carl Sawyer [1]

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The mowed roadside is one of the largest and most visible minimally managed grasslands in the eastern United States. Roadsides are deliberately seeded to a mixture of turfgrass and legume species during construction. Both ecologists and highway maintenance specialists have assumed that these species dominated roadside grasslands, to the exclusion of all other species except some invasives. We decided to test the validity of that assumption by conducting detailed vegetation surveys along high speed, limited access highways in Rhode Island.

Seven sites distributed throughout the state were chosen from satellite images, with no information on the species composition except that the sites were not wooded. Sites were surveyed during the summer of 2008. All of the sites had been previously seeded with a mixture of perennial ryegrass, red fescue, Kentucky bluegrass, and birdsfoot trefoil; no native grasses had been intentionally seeded.

A total of 80 graminoid and forb species were identified. Of these 35 species are native to New England, 32 are considered to be introduced, and 13 are of cryptic status. Native species outnumbered introduced species at 6 of the 7 sites. Red fescue and Kentucky bluegrass were abundant but did not dominate. We found 17 native grass species, and 2 naturally-occurring cryptic grasses. We also found 5 native sedges and 2 native rushes. Eighteen of the 26 species occurred at 3 or more sites. Only 4 out of 11 introduced grass species were found at more than two sites. Mowed roadsides may provide valuable habitat for native grasses.

15. Long-term effects of Herbaceous Native and Introduced Species and Trees on Reclaimed Mine Soil Properties

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The selection of plant species is critical for successful establishment and long-term maintenance of vegetation on reclaimed surface mined soils. Over long terms, the plant species present on reclaimed coal mine sites may also influence surface soil properties and, by extension, related site properties such as surface hydrology. We conducted research to compare effects of 4 herbaceous species on reclaimed mine soil properties over 20 years, and to compare these herbaceous species' effects to those produced by planted trees. In summer 1990, an experiment using 16 different plant species and mixtures of species was established on partially reclaimed mine soils. The experimental design was a complete block. Each of the 16 plant-species treatments was replicated 4 times. Prior to revegetation, a 2:1 mixture of wood chips and sewage sludge was mixed into the soil to provide initial nutrients. No other fertilizer was applied after the initial fertilization. The plots have been mowed annually to stimulate re-growth. The plant species with greatest persistence and biomass production over two decades are switchgrass (Panicum virgatum L.), sericea lespedeza (Lespedeza cuneata {Dum. Cours.} G. Don), reed canarygrass (Phalaris arundinacea L.), tall fescue (Festuca arundinacea Schreb.), and crownvetch (Coronilla varia L.) An adjacent area, reclaimed in association with the herbaceous experimental area, was planted with herbaceous species initially and then replanted with trees of various species in the early 1990s. In Summer of 2011, the switchgrass, sericea lespedeza, reed canarygrass, and tall fescue herbaceous vegetation plots, and six locations within the adjacent area planted with trees, were sampled and characterized for soil properties. Soil variables measured include root mass, bulk density, and soil carbon. Soil profiles and horizonation were also observed. Switchgrass produced more above-ground biomass than any other species, and sericea lespedeza had the shallowest rooting depth. However, sericea lespedeza had higher toot mass compared to the other herbaceous species. Vegetation with more intricate root systems gave rise to increased soil development. It was evident that herbaceous species had an effect on mine soil properties over the 20 experimental years.

16. Efficacy of Cool-Season Pasture Renovation to Native Prairie in the Bluegrass Region of Central Kentucky

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Tall fescue (Lolium arundinaceum) is a non-native, cool season grass, currently covering over two million hectares in the eastern U.S. Tall fescue pastures are not high quality wildlife habitat and contain relatively low levels of biodiversity; therefore, land managers are actively restoring such areas to native warm season grasses and wildflowers. However, the success of such pasture renovations has proven variable. In an effort to understand what ecological factors may explain this variability, we designed a study to quantify relationships between renovation success and various environmental parameters, using a spatially explicit approach. At Shaker Village of Pleasant Hill INC, located in central Kentucky, we measured the initial conditions of a 32 ha field slated to be restored (soil depth, soil nutrient concentrations, and vegetative cover), the variability in the renovation techniques employed (maximum fire temperatures and herbicide interception by the plant canopy), and vegetative cover in the first and second growing seasons post-native species planting. We used a spatial statistical approach to elucidate spatial patterns between the aboveground plant community to underlying soil conditions and renovation techniques. Tall fescue cover pre-renovation was greatest on deep soils at mid-slope elevations. During renovation, maximum fire temperatures and herbicide interception by the plant canopy were highly variable across the landscape (12-1200oC; 3-95% interception). Post-renovation, tall fescue has only been observed in two locations, both in areas with deeper soil (75-100cm). Spatial variability in environmental conditions and the deployment of renovation techniques most likely contributes to determining restoration success across this landscape.

17. Long Island Native Plant Initiative-Bridging the Gap, Going to Seed

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The Long Island Native Plant Initiative Inc. (LINPI) is a non-profit organization supported by volunteer collaborations of governmental agencies, non-profit organizations, nursery professionals, and citizens. The organization's mission is to protect the genetic integrity and heritage of Long Island's native plant populations by ensuring commercial production of ecotypic plants for restorations and landscaping.

Restorations, plant propagation and seed production operations are currently reliant on cultivars and varieties of native plants that are not local ecotypes. The ecological and genetic implications of using such non-native genotypes include out-breeding depression, and genetic swamping caused by intra-specific hybridization between local and introduced populations. In an effort to mitigate these deleterious effects, LINPI's progressive vision aims to preserve the genetic integrity of local populations by providing genetically appropriate materials for the regional applications. The long-term benefits include retaining fit individuals, evolutionary potential of subsequent generations and valued ecosystem function of natural and managed landscapes in the face of habitat loss, invasive species encroachment, development, and climate change.

The application of ecotypes in the landscape is gaining momentum but is limited by the constraints imposed by the law of supply and demand. Through surveying and cataloging native plant populations, collecting and archiving seeds, and creating a source of ecotypic seed and plants for distribution to commercial growers, LINPI provides a supply of ecotypic plant materials to facilitate broader commercial production and use. The demand required to facilitate the availability of commercial ecotypic plant materials is driven by LINPI sponsored educational and outreach programs that inform constituencies of the importance and benefits of utilizing ecotypic plants. These complementary activities provide the framework required to catalyze, support and sustain commercial ecotypic seed and plant production by "bridging the gap" between the supply and demand.

As an unexpected but gratifying outcome, organizations in surrounding states that recognize the importance of using ecotypic plant materials are seeking LINPI's assistance in developing regional programs. With increasing nursery industry interest and high public demand for diverse plant materials, LINPI continues to serve as a mechanism to facilitate commercial ecotypic plant production.

18. Use of Wildflowers in Native Grass Seeding to Enhance Pollinator Habitat

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Native grasses and wildflowers provide habitat for very diverse wildlife populations of pollinators. Protecting and enhancing habitat for native pollinators as well as managed honey bee colonies, is important for not only these species but for the plants that depend on them for their survival, and is critical for food production and human livelihoods. The United States Department of Agriculture's Natural Resources Conservation Service (USDA NRCS), Xerces Society of Invertebrate Conservation and other federal and state collaborators, have teamed up to provide outreach on the problems facing pollinator decline such as loss of floral diversity and habitat, increased use of pesticides, climate change, disease, and parasites. Starting in 2009, the USDA NRCS Big Flats Plant Materials Center, established an early, late, and dormant seeding, replicated 3 times, of over 50 native wildflower species and mixes with native grasses. In 2011, multiple seedings were established at 5 different times during the growing season, at 3 different seeding rates, replicated 4 times, June 23, August 8, August 18, September 1, and September 14, respectively. In 2012, a mid-May seeding was established, with 30 species that showed the greatest potential for easy establishment and persistence. Results to date, show that regardless of time of seeding, tall white beardtongue, purple coneflower, wild and purple bergamot, butterfly milkweed, oxeye and ashy sunflower, lance-leaf coreopsis, blue false indigo, black eyed susan, giant sunflower, many aster and goldenrod species, all established easily and have persisted in the field over the past 3 years. Species that were slow to establish in the first 3 years such as cardinal flower, wild lupine, great blue lobelia, wild senna, golden alexanders, and zigzag spiderwort are now abundant. Based on the results to date, there is great potential to enhance pollinator habitat in underdeveloped and natural areas with a diverse array of native wildflowers and grasses. High species diversity of native plants will provide the resources necessary to help ensure a diverse, resilient population of pollinators.

19. Grasses Ability to Mitigate Poultry Farm Emissions

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The Delmarva Peninsula is home to one of this country's highest concentration of poultry farms. Poultry and egg production is the most valued commodity in Maryland, Delaware and second in Pennsylvania. Poultry farms generate significant amounts of ammonia (NH^3), dust (particulate matter (pm) 2.5 microns in size and pm 10 (both regulated by the EPA)), and odors which are all expelled by the ventilation system. Approx. 587 million broilers are produced annually on Delmarva Peninsula (Delmarva Poultry Industry, Inc.). These emissions pose serious health and environmental challenges ultimately contributing to the air and water quality degradation of the Chesapeake Bay. Research has shown a reduction of dust (66% PSU) and odor (66% ARS) by planting buffers opposite fans. There is a limited quantity of plants currently recommended (only 13 different species MD and DE NRCS Standard #422). Grasses allow the accumulation of dust (spring through summer) and then go dormant. This study was initiated to test the survival and growth of grasses and their ability to tolerate the emissions and conditions. In Maryland, Delaware and Pennsylvania plantings, various species of warm and cool season grasses were randomly planted across the width of the tunnel and sidewall fans. Evaluations of switchgrass, coastal switchgrass, giant miscanthus, gama grass, indiangrass, salt meadow cordgrass and giant cane survived, grew and filtered poultry farm emissions. This study shows that grass buffers assist with the mitigation of ammonia, dust and odors emitted by poultry farms.

Key words: Air Quality, Poultry, Ammonia, Particulate Matter (pm), Odor, Biofuel

20. Native Grass Cultivars, Ecotypes, Germplasm, and Their Adaptations for the Eastern United States

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The widespread use of native grasses depends on an inexpensive, reliable supply of seed with dependable growers and known ranges of adaptation. Over the past seventy years, the USDA, Natural Resources Conservation Service, USDA, Agricultural Research Service, State Agricultural Experiment Stations, and private seed companies have developed cultivars of grasses to restore ecosystems and produce forage and wildlife habitat. Each cultivar has a known production capability in the nursery and seed production field as well as the situation into which it is established. Each cultivar has a known range of adaptation to climate, soil characteristics, hydrology, and stress such as grazing within which it will perform. Knowledge of these adaptations has allowed the effective use of these cultivars beyond the area in which they were originally collected. Since the largest market for the tall prairie grasses is in the Midwest, much of the cultivar development has occurred in the states from Texas to North Dakota. Knowledge of the culitvars' adaptations has allowed their use in the eastern part of the United States until more local origins are developed. Recently, ecotypes and germplasm have been released for use in very localized areas. The poster presents a list of the released cultivars, source-identified material, and germplasm, their intended uses, and range of adaptation.

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21. Short-Statured Native Grasses in the Coastal Plain of Virginia and North Carolina

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Herbaceous plant communities in eastern Virginia and North Carolina are dominated by a suite of short-statured native grasses. These communities occur on regenerating forests disturbed by natural phenomena or timber harvest or thinning, or on power line rights-of-way. Landowners maintain these areas by maintaining low stand densities in pine forests and conducting prescribed burns to suppress hardwood species. The local utility companies manage these areas to control the woody species with herbicides without destroying the herbaceous communities. Grass species include velvet panicgrass (*Dichanthelium scoparium*), variable panicgrass (*Dichanthelium commutatum*), needleleaf rosette grass (*Dichanthelium aciculare*), purpletop (*Tridens flavus*), broomsedge bluestem (*Andropogon virginicus*), splitbeard bluestem (*Andropogon ternarius*), bushy bluestem (*Andropogon glomeratus*), slender woodoats (*Chasmanthium laxum*), shortbeard plumegrass (*Saccharum brevibarbe*), sugarcane plumegrass (*Saccharum giganteum*), and Virginia wildrye (*Elymus virginicus*). Forb species found in association with the grasses include partridge pea (*Chamaecrista fasciculata*), lespedeza species (*Lespedeza spp.*), and beggarweed species (*Desmodium spp.*). The poster will present data from transects conducted on a utility right-of-way on a moderately well-drained Slagle fine sandy loam in Isle of Wight County, Virginia.

22. Early Successional Vegetation Communities on Idled Cropland in Southeast Virginia

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The Virginia Department of Game and Inland Fisheries has initiated three best management practices to encourage landowners to develop early successional habitat for wildlife. One of those practices, called the Idle Land practice, provides an incentive payment of $50 per acre per year to landowners who sign a three-year contract to allow their cropland to go idle. In southeastern Virginia, these crop fields go through succession to a plant community dominated by the native annual forbs chickweed (*Stellaria media*), cutleaf evening primrose (*Oenothera laciniata*), annual ragweed (*Ambrosia artemisiifolia*) and the biennial horseweed or marestail (*Conyza Canadensis*). Annual annual hard-seeded legumes germinated from the seedbank: hairy crabgrass (*Digitaria sanguinalis*), rabbitfoot clover (*Trifolium arvense*), common vetch (*Vicia sativa*), and hairy vetch (*Vicia villosa*). A small percentage of the area is occupied by the native perennials broomsedge (*Andropogon virginicus*) and purple lovegrass (*Eragrostic spectabilis*), hairawn muhly (*Muhlenbergia capillaris*), and Canada goldenrod (*Solidago Canadensis*). The poster will summarize the results of transects on an idled soybean field with well-drained Uchee loamy sand in Sussex County, Virginia.

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23. Species Composition in a Native Grass and Forb Seeding for Wildlife in Southeast Virginia

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Conservation agencies and organizations have been seeding mixtures of native grasses and forbs for wildlife for 70 years. Over that time, the number of commercially available species, cultivars, and ecotypes of seed has increased dramatically as has the technology behind the establishment and management of the stands. This poster will summarize the vegetative composition of a stand established with USDA Farm Bill funds as an upland wildlife habitat seeding. These areas are now seeded at a seed density that allow upland wildlife birds and mammals spaces for nesting and travel within the stand as well as forb species that provide seed as a food source. Landowners and conservationists are often disappointed that these stands are not solid stands of the seeded species. The stand that was surveyed was seeded to a mixture of switchgrass (*Panicum virgatum*), Indianrass (*Sorghastrum nutans*), big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), and back-eyed susan (*Rudbeckia hirta*). Eighteen months after seeding, the stand had an average of one 12-inch diameter clump of native warm season grass every 36 inches, a density that wildlife biologists recommend. The spaces between the seeded grass clumps were occupied by broomsedge bluestem (*Andropogon virginicus*), ragweed (*Ambrosia artemisiifolia*), Canada goldenrod (*Solidago Canadensis*), slender goldenrod (*Euthamia tenuifolia*), and horse nettle (*Solanum carolinense*). The volunteer grass and forbs all contribute to wildlife habitat. Ragweed in particular is a critical element of the diet of bobwhite quail. The future management of the stand with prescribed fire and light disking will ensure that it continues to provide the habitat it provides today.

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Noon – 1:20 p.m. **Lunch** *(Rotunda Ballroom C&D)*

Concurrent Sessions • 1:20 – 3:00 p.m.

Forage (Rotunda Ballroom A)

1:20 p.m. Effect of Overseeding Winter Annuals on Switchgrass Biomass Production

Gary Bates [1], **Pat Keyser** [1], David Mcintosh [1], Joe Beeler [1], Fred Allen [1]

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There has been much interest in utilizing switchgrass as a source of biomass for cellulosic ethanol production. If a viable cellulosic ethanol industry were developed, the loss of land available for forage production could be a problem for many potential producers. A study was initiated to determine if switchgrass biomass yield is reduced if overseeded with a winter annual grass in fall and harvested as an early spring forage crop. Rye, wheat and annual ryegrass were drilled into switchgrass that had been harvested for biomass in late fall. Winter annual grasses were fertilized with 60 lb N/acre in early March. The spring forage was removed using one of three harvest treatments (mid-April, late April, or mid-May). The switchgrass was fertilized with 60 lb N/acre in mid-May, after the last forage harvest treatment. Data from the first year of the study showed rye produced the highest yield of the three winter annual species. The early forage harvest produced less forage than the mid-season or late harvest treatments (0.65, 2.30, 2.87 tons DM/acre, respectively). Biomass yield from the switchgrass during the season following early, mid and late season winter annual harvest was statistically similar to yield from switchgrass not overseeded with a winter annual (4.7, 4.4, 4.2 vs 5.6 tons DM/acre). The results indicate there is the potential to double crop switchgrass with a winter annual grass to obtain both a forage and a biomass crop.

1:40 p.m. Native Warm Season Grasses for Stocker Cattle Production

Dr. Holly Boland [1], Dr. Brian Rude [2], Dr. James Martin [3], Dr. Sam Riffell [3], Dr. L. Wes Burger Jr. [3]

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The drought tolerance, low nitrogen requirement, and nutritive value of native warm-season grasses (NWSG) suggest they could be a viable option for grazing in stocker cattle operations. Incorporation of NWSG in forage systems may maintain, or improve, animal performance while providing vital ecosystem services. These grasses provide superior wildlife habitat compared to non-native forages species such as Bermudagrass (Cynodon dactylon). Three forage treatments were evaluated in Northeast Mississippi: Indiangrass (Sorghastrum nutans) monocultures (IND); mixed pastures of Big Bluestem (Andropogon gerardii), Little Bluestem (Schizachyrium scoparium), and Indiangrass (MIX); and Bermudagrass (BG). Nine pastures were used (3 per treatment) ranging in size from 7 to 11 ha. Pastures were stocked at 2.7 steers per ha in May, 2011. Cattle were weighed every 28 days and remained on pasture for 110 days. Selected cattle wore activity monitors (IceTag, v 2.004) to measure grazing behavior. Data were analyzed using PROC MIXED of SAS (SAS Inst., Cary, NC). Average daily gain (ADG) of steers did not differ between treatments during periods 1-28, 56-84, or 84-110. However, during the peak of the season (days 28-56), ADG was greater ($P < 0.02$) in IND (1.1 kg) and MIX (0.9 kg) than BG (0.64 kg). Overall season ADG tended ($P \leq 0.10$) to be greater for IND (0.6 kg) and MIX (0.6 kg) than BG (0.4 kg). Percent of the day that animals spent grazing did not differ within period or overall during the season (IND 45%, MIX 45%, BG 46%). NWSG show promise for use in beef grazing systems in Mississippi.

2:00 p.m. Two Strategies for Grazing NWSG in Southwest Tennessee

Mr. Matt Backus [1], Dr. John Waller [1], Dr. Brian Campbell [1], Dr. Elizabeth Doxon [1], Dr. Pat Keyser [1], Dr. Gary Bates [1], Dr. Craig Harper [1]

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Performance of stocker steers was used to compare two strategies for grazing NWSG at Ames Plantation Research and Education Center (REC) near Grand Junction, TN. Strategy A: early season (ES) where steers grazed NWSG for 28 day when forage was of highest nutritive value and Strategy B: full season (FS) where steers started at the same time as ES but remained on the pastures for about 90 days. Angus and Angus cross steers (~ 600 lbs) were used in completely randomized design with 3 to 4 year old stands

of three forage treatments: 1) switchgrass (Panicum virgatum); 2) a combination of big bluestem (Andropogon gerardii Vitman) and indiangrass (Sorghastrum nutans); and 3) eastern gamagrass (Tripsacum dactyloides). Before and after grazing NWSG pastures all steers were fed a high fiber filler diet for 4 day to reduce differences in gut fill. Four steers (testers) were allotted to 3-acre paddocks with three replications per treatment. Additional steers were used in a put-and-take manner to keep forage in a vegetative state. Data were analyzed using the MIXED procedure of SAS. Least square means for ADG of ES steers grazing BB/IG and SG differed from EG ($P < 0.05$) with ADG of 2.60, 2.47 and 1.70 lb/day respectively. Least square means for ADG of FS steers grazing BB/IG differed from SG and EG ($P < 0.05$) with ADG of 1.67, 1.12 and 0.88 lb/day respectively. Our results demonstrate the ability of NWSG to provide adequate summer performance for cattle grazing in the mid-south.

2:20 p.m. Evaluation of Wildrye (Elymus spp.) as a Potential Forage and Conservation Planting for the Southeastern USA

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Introduced species account for a majority of forage grasses grown for livestock in the southeastern U.S. Cool-season non-native species include: tall fescue (Festuca arundinacea), annual and perennial ryegrass (Lolium spp.), bluegrass (Poa spp.), and orchardgrass (Dactylis glomerata). Wildrye (Elymus spp.) is a native cool-season perennial grass with forage potential. It may also be planted in prairie restoration and conservation projects. Literature usually cites only two species, E. virginicus and E. canadensis, however there are six main species that are commonly found in the southeastern U.S.: E. canadensis, E. virginicus, E. hystrix, E. riparius, E. villosus, and E. glabriflorus. Information regarding agronomic principles of these species (i.e. germination characteristics, planting depth, weed control, etc.) as well as forage yield and quality is lacking. The goals of this project are to define optimum germination requirements, planting depth, forage yield, and quality. Southeastern wildrye (E. glabriflorus) was the species used for germination experiments. The optimum temperature for germination was 20oC (five accessions; four temperature treatments). There were no significant differences for light treatments (constant dark and light, short day, long day). Removal of physical structures surrounding embryo does not enhance germination (glumeless, beardless, combination of both). Optimal planting depth ranges from 0.6-1.2 cm (five depth treatments). In terms of forage yield and quality, an eighteen entry cool-season variety trial was established in the fall of 2010 including tall fescue, wheatgrass (Agropyron spp.) timothy (Phleum pratense), orchardgrass, and seven accessions of wildrye. Cumulative yield (three spring harvests) resulted in 'Jesup MaxQ' tall fescue as the entry with the greatest yield (11.2 Mg/ha) followed by 'Profit' orchardgrass (10.7 Mg/ha), 'Kentucky 31' tall fescue (10.0 Mg/ha), and Virginia wildrye (9.7 Mg/ha). Forage quality analysis is pending.

2:40 p.m. Responses of Restored Native Warm-season Grasses to Seasonality of Fire in the Southeast

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Current management paradigms in the Southeast largely concentrate on dormant-season fire although fire occurs naturally over multiple seasons. As a result, no long-term study has examined the effects of season of fire in restored grasslands. We examined the response of planted native warm-season grasses (NWSG) to timing of annual (2008 – 2011) burns (March, April, May, September) in Tennessee. NWSG mixtures [grasses varied by site, but included big bluestem (Andropogon gerardii), indiangrass (Sorghastrum nutans), switchgrass (Panicum virgatum), little bluestem (Schizachyrium scoparium), and sideoats grama (Bouteloua curtipendula)] were established prior to 2004 using NRCS-recommended planting rates at 3 locations. We allocated burn treatments and an unburned control in a RBD with four replicates at each location. Since the initiation of burning in 2008, we monitored vegetation response each summer. We analyzed the effect of treatment on each species of NWSG, bare ground, and forbs for each location separately using repeated measures ANOVAs (MIXED procedure). In general, NWSG did not respond to burn treatment, and forb cover was very low (<10%). In general, repeated prescribed fire, regardless of season of burning, over 4 years in dense, planted NWSG stands did not stimulate forbs or promote openness. Individual species of NWSG did not respond strongly to season of burn. Therefore, in high rainfall environments, it may be necessary to disturb the soil via disking or heavy grazing to reduce grass density and stimulate forb cover in dense stands of planted NWSG.

Wildlife *(Rotunda Ballroom B)*

1:20 p.m. Avian Habitat Response to Grazing Native Warm-Season Forages in the Mid-South

Jessie Birckhead [1], **Craig Harper** [2], Patrick Keyser [2], John Waller [2], Gary Bates [2], Elizabeth Doxon [2], Matt Backus [2]

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Declines in grassland birds have been attributed to loss of habitat, habitat degradation, and changes in land management. In the Mid-South, pasture and hayfield management has focused on maintaining dense stands of non-native forages that do not provide suitable vegetative structure for grassland birds or northern bobwhite. We conducted a study of two cattle grazing treatments on native warm-season grass forages to evaluate suitability for nesting and brood-rearing grassland songbirds and northern bobwhite. We evaluated vegetative composition, vegetative structure, and invertebrate availability during a typical nesting period (May – June) and a typical brood-rearing period (July) across 3 sites in Tennessee, 2010 and 2011. Grazing treatments included a full-season treatment, with animals maintaining grass height at approximately 18 inches from May-August, and an early-season treatment, with animals allowed to graze grass down to approximately 10 inches for 30 days initially, and then removed to allow subsequent forage growth to develop for a biofuels harvest the following fall. Native grass coverage was high in most pastures (36-86%), with little to no bare ground. During the nesting period, both grazing treatments maintained similar structure (65-100% coverage at <30cm). Full-season grazing maintained superior structure during the brooding period, with greater openness at the ground level (1.37 m vs. 0.97 m) and better visibility for foraging chicks. Invertebrate biomass was sufficient (0.08 – 1.92 g/m2) in both treatments to support foraging northern bobwhite broods. Full-season grazing created suitable structure for nesting and brood-rearing grassland songbirds and northern bobwhite, whereas early-season grazing only provided suitable nesting structure but marginal brood-rearing cover for northern bobwhite. We recommend full-season grazing in production stands of native warm-season forages to maintain grass height at approximately 18 inches to maximize benefits where grassland birds and northern bobwhite are a management concern.

1:40 p.m. Grassland Bird Response to Production Stands of Native Warm-Season Grasses in the Mid-South

Mr. Andrew West [1], **Dr. Patrick Keyser** [2], John Morgan [3], Dr. David Buehler [4]

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Grassland birds have declined more than any other guild in the US. These declines could be mitigated by agricultural uses of NWSG, which could be extensive due to market-based incentives. Studies examining these production practices and their effect on grassland birds east of the Great Plains are limited. We examined breeding grassland bird use of 102 production fields of NWSG including control (fallow; n = 37), forage (pasture and hay; n = 7 and 22, respectively), seed (n = 21), and biofuel (n = 15) production fields in Kentucky and Tennessee during 2009 – 2010 breeding seasons. A total of 2,145 birds were detected with field sparrows (43%; Spizella pusilla) and red-winged blackbirds (27%; Agelaius phoeniceus) being most abundant. For all species combined, seed production fields had the highest (P <0.05) relative abundance (5.32 birds/visit), richness (2.46 species/visit), and Shannon diversity (0.70). For individual species, most treatments did not differ from the control with respect to relative abundance. Average vegetation height and vertical cover was highest (P <0.05) in biofuel fields (130.7 cm and 14.4 dm, respectively) and lowest in grazed fields (46.8 cm and 5.5 dm, respectively). Control fields (CRP) were highest (P <0.05) in percent cover for litter, forbs, and woody plants. Based on AICc models, forb cover had the most influence on relative abundance, species richness and diversity. Overall, the lack of strong differences of breeding bird among treatment types suggests that production stands could be a viable approach for increasing usable NWSG for native grassland birds.

2:00 p.m.

Response of a Breeding Grassland Bird to Native Warm-Season Grass Pasture Conversion

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Native warm-season grasses (NWSG) are promoted as a viable forage alternative to bermudagrass (Cynodon dactylon) due to lower fertilizer requirements and greater forage availability, but may also provide suitable nesting structure for breeding grassland birds. From 16 May – 14 July, 2011, we monitored 86 Dickcissel (Spiza americana) nests in bermudagrass pastures and pastures recently converted to NWSG at Mississippi State University's Prairie Research Unit. We also characterized vegetation structure and composition at the nest site after nesting attempts were completed. We monitored ungrazed NWSG to test effects of grazing and grazed Indian grass (Sorghastrum nutans) monoculture to test effects of NWSG diversity. We then used logistic-exposure and hierarchical model selection to model daily nest survival rates and test effects of vegetation structure and treatment. Apparent nest success was 11% in bermudagrass, 22% in Indian grass, 33% in grazed NWSG, and 42% in ungrazed NWSG. A similar trend was observed in daily nest survival rates, but treatment effects were not well supported among our models possibly due to limited sample size and large variances. Increasing daily nest survival was best predicted by decreasing nest age and increasing overhead concealment. Dickcissels are tall structure specialists and may benefit from nesting cover of NWSG as they nested disproportionately in bunchgrasses. In bermudagrass, Dickcissels nested more frequently in shrubs, which had greater overhead concealment, and this likely obscured any treatment effects. However, contemporary management typically discourages woody encroachment through mechanical and chemical treatments, which could eliminate nesting opportunities for Dickcissels in bermudagrass pastures.

2:20 p.m.

Virginia Working Landscapes Native Grassland Research: Birds, Pollinators and Plants

Mr. William (Bill) Mcshea [1], Mr. James Barnes [2], Ms. Maria Van Dyke [1]

[1] Smithsonian Conservation Biology Institute
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Virginia Working Landscapes (VWL) was formed in 2010 and is a cooperative program between land management agencies, research institutions and local landowners in a 8-county region of northwestern Virginia. The program works to encourage landowners to restore lands for native biodiversity with the initial focus being grassland restoration. The effort involves education forums for landowners (workshops, lectures, and farm tours), networking landowners with similar plans and aspirations, and providing standardized surveys of major biodiversity indicator species. We are currently surveying 25 sites on public and private lands for the abundance and diversity of birds, plants and pollinators. Each 20-acre site is imbedded within larger grasslands that are composed of either warm or cool season grasses and are either maintained for hay, livestock or wildlife. Each survey is conducted by a trained volunteer crew based around the local naturalist and specialist groups, we have survey coordinators for each taxa that train volunteers, coordinate activities and check data. In addition we have an outreach coordinator who maintains landowner interest and participation. We will present details of the VWL organization and survey protocols and organization, as well as present results from the first 2 survey years. Our future goals include increased activity by landowners, expansion into riparian and woodland restoration, and create demonstration plots on public lands for landowner education and training.

2:40 p.m.

Whole Farm Approach to Native Warm Season Grasses

Dr. Sue Ellen Johnson [1], James Barnes [1]

[1] Piedmont Environmental Council

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For 40 years, the Piedmont Environmental Council has been protecting the rural character and environmental integrity of the Northern Virginia landscape. The "PEC" has helped protect ~200,000 acres of farmland with 360,000 acres in protection overall The PEC interacts with 400 landowners each year. Landowners with permanently conserved land and those with land that is not protected face continuing decisions of how to manage their properties and vegetation into the future. An increasing awareness of the benefits of natural and native plants intrinsically and as habitat for wildlife along with rising maintenance costs and interest in increasing returns to farmland (whether leased or owned) is driving a revisitation of land management strategies. Next generation and new landowners have multiple questions about the "fit" on NWSG in each property's landscape and business plan. Both active farms and "open space" estates with under or overgrazed pastures or early successional fields present opportunities for NWSG utilization – either as hayfields,

warm season pastures or habitat. The PEC is helping landowners fit NWSG into estates, fields, buffers, farmscapes and grazing plans. The PEC's Agriculture and Rural Economy and Sustainable Habitat programs seek to optimize the fit of native grasses into each property and across property boundaries based on the goals of the land manager/owners. This initiative is developing tools to guide land owners and managers in assessing farm/estate operations, soils, economics, wildlife and aesthetics.

3:00 p.m. Break – **Posters Session** and **Exhibits**

Concurrent Sessions • 3:30 – 4:50 p.m.

Restoration *(Rotunda Ballroom A)*

3:30 p.m. Facilitating Resistance and Resilience to Climate Change in the Piedmont Savanna Ecosystem

Dr. Johnny Randall [1]

[1] North Carolina Botanical Garden, UNC-Chapel Hill

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The once extensive and biologically rich Piedmont savanna ecosystem has been severely degraded due to fire suppression, land conversion, and habitat fragmentation. This relictual ecosystem is dominated by herbaceous perennials and grasses that support a vast assemblage of invertebrates, small mammals, and birds. Over 300 plant taxa occur in this ecosystem – many of which are rare and/or state or federally listed. The Mason Farm Biological Reserve and the Penny's Bend Nature Preserve represent remnant Piedmont savanna ecosystems that retain elements of characteristic savanna vegetation (including both state and federally listed taxa), that are positively responding to proper management. I will report on the management of these savanna ecosystems on North Carolina Botanical Garden lands that are being managed for persistence through climate change by: 1) enhancing ecosystem stability and health (increasing resistance), and 2) facilitating genetic diversity within the plant community and therefore increasing the ability of plants to respond to environmental change (providing resilience).

3:50 p.m. Genetic variation within and among remnant big bluestem (Andropogon gerardii) populations in the Carolinas

Dr. Robert Tompkins [1],Dr. Dorset Trapnell [2], Dr. James Hamrick [2], Dr. Bill Stringer [3]

[1] Belmont Abbey College
[2] University of Georgia
[3] Clemson University

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Genetic diversity within and among nine Andropogon gerardii populations from various physiographic regions of North and South Carolina was assessed. Genetic diversity was high at both the species level and at the population level. At the species level, percent polymorphic loci (P) was 96.4% (27 of 28 loci), the number of alleles per polymorphic locus (AP) was 4.07, and genetic diversity (He) was 0.425. Mean within population values were P = 82.6%, AP= 2.68, and He= 0.351. Within population genetic diversity (He) ranged from 0.190 to 0.466. Allelic richness values per population ranged from 37 to 71. The proportion of genetic diversity among populations (Gst) was 0.166. Mean genetic diversity for the three larger populations (He = 0.369) and within the six smaller populations (He = 0.341) did not differ significantly (p = 0.554). Nei's unbiased genetic identity between pairs of populations ranged from 0.652 to 0.975. Mean genetic identity of individual populations with the eight other populations ranged from 0.71 to 0.89. A Mantel test showed no significant genetic isolation by geographic distance (r = 0.065; p = 0.614). While banding patterns for most of the loci were consistent with disomic inheritance, two loci (PGI3; UGPP1) displayed patterns consistent with tetrasomic inheritance. Results of this study suggest that A. gerardii populations in the Carolinas were once more widespread.

4:10 p.m. Herbicide Safening to Aid in the Establishment of Three Native Warm-season Grass Species

Mr. J. Spencer Smith [1], Dr. Brian Baldwin [1]

[1] Department of Plant and Soil Sciences, Mississippi State University

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Field trials were conducted to determine the efficacy of five herbicide safeners (benoxacor, fenclorim, fluxofenin, naphthalic anhydride, and oxabetrinil) in protecting three native warm-season grass species (big bluestem (Andropogon gerardii Vitman), little bluestem (Schizachyrium scoparium (Michx.) Nash), indiangrass (Sorghastrum nutans (L.) Nash)) from herbicidal injury caused by preemergent application of S-metolachlor. A safener effective in protecting big bluestem, indiangrass, and little bluestem from metolachlor injury would allow stand establishment while suppressing annual grassy weeds. In addition to simply reducing weed competition, weed control can further improve stand establishment by allowing first year fertilizer applications. Laboratory studies generated dose response curves for each safener-species combination. Field trials were planted in a randomized complete block design in May, 2012 near Starkville, MS. Seedling emergence counts and weed control ratings were taken every two weeks for ten weeks. Preliminary data shows improved weed control in the plots receiving S-metolachlor application compared to those receiving no herbicide application. For big bluestem, there is no significant difference in rate of seedling emergence between control 1 (no safener treatment, no herbicide application) and seed treated with fluxofenin or benoxacor and exposed to metolachlor. For indiangrass, all safener treatments are significantly lower than control 1 and none are significantly different from control 2 (no safener, with herbicide). For little bluestem, all treatments are significantly lower than control 1 but one treatment, fluxofenin, is greater than control 2. Week 6-10 observations will determine whether these trends hold. End of season crown counts will further correlate seedling emergence with establishment.

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4:30 p.m. Groundcover Response to Canopy Disturbances and Spring/Fall Burns During Oak Woodland and Savanna Restoration

Andrew Vander Yacht [1], Seth Barrioz [2], Dr. Pat Keyser [1], Dr. Craig Harper [1], Dr. David Buckley [1]

[1] University of Tennessee
[2] Missouri Department of Conservation

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Oak woodlands and savannas in the South have declined dramatically as a result of fire suppression and subsequent succession. Restoration of these imperiled ecosystems requires a reduction in tree cover and re-establishment of diverse ground cover. We evaluated groundcover response, including herbaceous species richness and diversity, to 5 treatments allocated in 20-ha experimental units under a CRD: a factorial combination of fall fire (FallF), spring fire (SpgF), light cutting (LC, 14 m2/ha residual basal area), heavy cutting (HC, 7 m2/ha), plus an unmanaged control. Our study area was located on the Cumberland Plateau in Tennessee. We monitored groundcover at 1-m intervals using 50-meter point-intercept transects (n = 15/stand/year) during 2008-2011; timber harvests were completed in September 2008 and prescribed fires on October 11, 2010 (FallF) and March 22, 2011 (SpgF). A total of 127 herbaceous species were recorded. Forb coverage was greatest in HC FallF and graminoid coverage was greatest in HC SpgF. Coverage of woody species did not differ across treatments, but all were greater than control. Fire had less impact on groundcover metrics the first growing-season post-disturbance than cutting. Heavily cut stands had the greatest increase in grass cover (10 fold), forb cover (30 fold), richness (8 fold), and diversity (3 fold) compared to control in 2011. Additional results and project direction will be presented. Our research includes additional sites and is designed to identify the most efficient techniques for restoring healthy oak woodlands and savannas, including robust, native ground-layer vegetation.

Biofuels *(Rotunda Ballroom B)*

3:30 p.m. **Native Warm Season Grass(NWSG) to Steam at Piedmont Geriatric Hospital(Pgh) 10/2012 Status Report**

Mr. Fred Circle [1]

[1] President/CEO FDC Enterprises Grassland Services/First Soucre Biofuel

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PGH is the first facility in Virginia to successfully burn NWSG/BF to produce steam by direct firing it in an existig 200 HP solid fuel boiler without modifications. During operational test in 2011 and early 2012 FDC/FSB provided through State contract 953 tons of boiler ready NWSG/BF to be burned at PGH. This fuel is a mixture of Switch Grass; Indian Grass and Bib Blue Stem. Mixed native grass biofuel produced 3,943,744 pounds of steam during 44 day in 2011 and 5,846,830 pounds of steam during 50 days in 2012. These successful tests mark the beginning of a new era in Virginia's quest to "Go Green" by burning NWSG as a renewable biofuel. Burning NWSG during the 44 days in 2011 off set and equivlnet of 35,212 gallons of #2 fuel oil plus a cost differential of $43,862 adn during the 50 day test in 2012 an off set of 52,204 gallons of oil with a cost differential of $97,604. This demonstration is having the following impacts in the region: a) Establishment of a cooperative venture with PGH; Nottoway County; FDC Enterprises Grasslands Services/First Source Biofuel; and the Virginia Tobacco Commission to build a permanent NWSG/BF collection, storage, processing and distribution center on County owned land near Blackstone. b) A new 400 HP biomass boiler which burns NWSG/BF is being installed @ PGH. The new equipment more than doubles steam output, biomass use and storage. c) The Commonwealth issued FDC/FSB a contract to deliver to PGH 2,000 tons of boiler ready NWSG/BF annually for the next 5 years. d) FDC/FSB is increasing production of NWSG/BF by contracting with area landowners for 10 years to grow 3-4,000 acres of grass biofuel crops. The PGH Project is: Providing Virginia land owners with a cash crop which provides revenue annually independent of variations in weather; helping to reduce the loss of farmland and family farms; improving local soil, water and wildlife conditions; and reducing green house gases as well as our use of foreign oil. A win win scenario.

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3:50 p.m. **Quantifying the role of Native Warm Season Grasses in Sequestering Soil Organic Carbon**

Mr. Christopher Miller [1], Dr. Curtis Dell [2]

[1] USDA-NRCS
[2] USDA-ARS

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A study was initiated at the USDA-NRCS Cape May Plant Materials Center in 1999 to quantify soil carbon sequestration changes with the conversion from a cool season grass to native warm season grasses in a sandy, coastal plain soil (Downer sandy loam). Five native warm season grasses (switchgrass, coastal panicgrass, big bluestem, indiangrass and eastern gamagrass) were no-till drilled into a spray-killed tall fescue/red fescue sod. The plots are 16' x 20' and replicated 4 times. Soil cores were obtained to 36 inches prior to establishment in 1999 and again in 2003 and 2010. Initial soil organic C concentrations averaged 1.7, 0.9, 0.4, 0.3, and 0.3% in the 0-2, 2-6, 6-12, 12-24, and 24-36 inch depths. The only significant increases in soil C measured between 1999 and 2003 were in the 24-36 in depths under switchgrass and eastern gamagrass and those increases were small (>0.2%). The 2003 data suggests that initial soil C concentrations in the upper 24 in of the soil profile may have already been near the saturation point for our sandy coastal soil with the previous cool season grass, but the deeper rooting of some warm season species creates the potential to increase sequestration at deeper depths where initial C concentration is very low. Evaluation of data from 2010 will also be presented and long-term implications for carbon sequestration will be discussed.

4:10 p.m. **Impacts of Biofuel Feedstocks on Soil Properties and Soil Carbon Stocks**

Catherine Bonin [1], Rattan Lal [1]

[1] Carbon Management and Sequestration Center, The Ohio State University

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Biofuels may serve as a renewable and sustainable source of energy, as well as help sequester atmospheric carbon dioxide to mitigate climate change. The primary feedstock in the US is corn grain, which requires high energy inputs and may conflict with food security. Native perennial grass species may offer a low-input, high-yielding feedstock alternative to corn. Although energy and greenhouse gas balances of various feedstocks have been examined, less research has been done examining changes in soil properties. The objectives of this experiment were to 1) measure feedstock productivity and 2) analyze soil physical properties from 0 to 40 cm under no-till corn,

switchgrass, indiangrass, and willow that had been established for seven years in Ohio. Corn and the two native grasses produced high aboveground yields (9 to 11 Mg ha-1 yr-1), while willow was lower-yielding (2 Mg ha-1 yr-1). However, some soil properties improved under the grasses and willow. Soils under perennial species were more stable, with 50% more large macroaggregates than soils under corn. Soils under perennial species also had lower tensile strength than those under corn. Soil organic carbon (SOC) pools to a 40-cm depth varied by site, ranging from 66 to 131 Mg C ha-1. However, the SOC stocks under the perennial species and corn were similar. Our research suggests that compared to corn, native grasses can produce equivalent biomass yields, store similar amounts of SOC, and improve soil physical properties. It is also possible that further differences may develop as stands continue to establish.

4:30 p.m. **Harvest Opportunities In A Forage-Biomass System Using Native Warm-Season Grasses**

Mr. David Mcintosh [1], Dr. Gary Bates [1], Dr. Pat Keyser [1], Dr. Craig Harper [1], Ms. Jessie Birchhead [1], Dr. John Waller [1], Mr. Matt Backus [1]

[1] University of Tennessee

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Cellulosic ethanol production is forecasted to require millions of acres of crop and pasture in the mid-South to be planted to native warm-season grasses (NWSG), especially switchgrass. Current recommendations are for biomass production with only a single fall harvest. A study was conducted at three locations in Tennessee to investigate the effect of an early season forage harvest on fall biomass yield. Three NWSG mixtures (switchgrass, switchgrass/big bluestem/indiangrass, and big bluestem/indiangrass) were tested under three harvest treatments (early boot plus fall dormancy, early seedhead plus fall dormancy, fall dormancy only). Forage harvest across all species mixtures was higher at early seed-head stage compared to early boot (4.50 and 2.86 tons DM/ac), however, forage quality decreased in the later stage of growth. The addition of big bluestem/indiangrass resulted in a higher quality forage compared to switchgrass alone. Switchgrass and species mixtures including switchgrass produced greater fall biomass yield across all harvest treatments by species compared to big bluestem/indiangrass (5.02 and 3.99, versus 2.52 tons DM/ac; $P<0.05$). Harvesting NWSG at early boot and early seed-head stage decreased total fall biomass yield across all species mixtures compared to the single fall harvest (3.83 and 2.78, versus 4.91 tons DM/ac; $P<0.05$). This suggests that including different NWSG species will allow a portion of the region's forages to remain viable in the agricultural industry and provide the biomass needed for energy production. With increased harvest opportunities, NWSG can potentially be used as a forage crop with minimal impacts on biomass yield.

4:50 p.m. Adjourn – Dinner on your own

On-site Workshops *(Pre-registration required)* • 7:00 p.m.

Small Scale Seed Cleaning *(Rotunda Ballroom A)*

Learn to determine when seed is mature and ready to be harvested, how to document the origin of the seed, and how to clean small samples of seed with kitchen sieves, homemade screens, and manufactured equipment designed to clean small samples.

Workshop Leader: Bob Glennon, retired USDA-NRCS plant materials center manager and plant materials specialist.

Native Drills *(Outside near entrance)*

Operation and Calibration - Learn to convert seeding rates from pounds of pure live seed (PLS) per acre to actual pounds of seed per acre and how to calibrate a seed drill to deliver the correct amount of seed per acre at the proper seeding depth.

Workshop Leader: David Lorenz, Truax Company, Inc.

Collaborators: John Seymour, Roundstone Seed and John Dickerson, retired USDA-NRCS Plant Materials Specialist

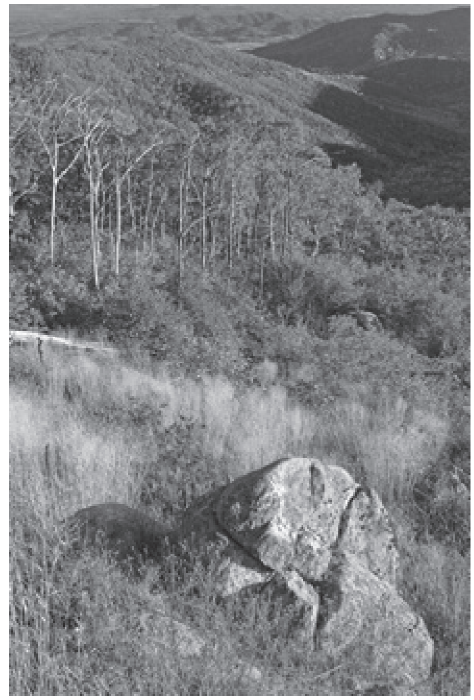
Native Grass Identification *(Rotunda Ballroom B)*

Learn to identify the most common native grasses in the Eastern United States. Participants should bring a hand lens or magnifying glass to assist them with their identification.

Workshop Leader: Christopher Miller, USDA-NRCS Manager/Plant Specialist at Cape May Plant Materials Center

Wednesday, October 3

7:00 – 8:00 a.m. **Breakfast**



Field Trips *(Pre-registration required)*

Trip 1

Shenandoah National Park and Big Meadows. Shenandoah National Park spans 300 square miles of the Blue Ridge Mountains in the southern Appalachians. Big Meadows is situated over 3500 feet above sea level and offers picturesque views of the Virginia piedmont and Shenandoah Valley. Big Meadows has the most visible and studied wetlands within the park and contains two wetlands that support globally rare plant communities believed to be endemic to the park.

Trip 2

Fort Pickett in Blackstone, Va. At this military base, native grasslands and savannas have been maintained by fires ignited from periodic artillery training. This combined with effective natural resource management has created some of largest native grass communities east of Mississippi. In addition to unique grasslands, the habitats support populations of rare grassland birds like the Bachman's sparrow.

Trip 3

Local tour **Charlottesville area and Thomas Jefferson's Monticello**. Monticello is a 5,000-acre plantation that was the home of Thomas Jefferson, author of the Declaration of Independence, third president of the United States, and founder of the University of Virginia. In addition to Jefferson's home, the site has remarkable gardens that are a botanic showpiece with ornamental and useful plants from around the world.

4:30 – 6:00 p.m. Visit **Posters Session** and **Exhibits** *(Promenade Ballroom)*

6:00 p.m. **Banquet** *(Rotunda Ballroom C&D)*

Speaker
"Tropical Grasslands of Southeast Asia"
Bill McShea
Smithsonian Conservation Biology Institute

Thursday, October 4

7:00 – 8:00 a.m. **Breakfast**

Concurrent Sessions • 8:30 – 10:10 a.m.

Forage and Restoration (Rotunda Ballroom A)

8:30 a.m. **Diversity Influences Forage Yield and Stability in Perennial Prairie Plant Mixtures**

Catherine Bonin [1], **Benjamin Tracy** [2]

[1] Ohio State University
[2] Virginia Tech

Corresponding Author: bftracy@vt.edu

Ten prairie plant species were grown in monoculture and mixtures of two, four, six, and all ten species for four years at a study site near Blacksburg, VA (USA) to examine relationships between species richness of perennial prairie plant mixtures and forage yield. Mixtures were highly productive, exceeding 16 Mg ha-1 (1 Mg = 106 g) after four years with no fertilization or irrigation. Forage yield was affected by sown species richness only in years 1 and 4 when most mixture treatments yielded more than monoculture plots. The majority of multi-species plots (71%) exhibited a positive biodiversity effect where mixtures yielded more than respective monocultures. The data also suggested a strengthening of biodiversity effects with time as more multispecies plots exhibited relative yield totals > 1 and a positive net biodiversity effect. Mixtures that were more productive than the best performing species grown in monoculture (transgressive overyielding) increased from 25% in year 1 to 54% by year 4. Plots sown with ten species produced the most consistently high and stable yields and also effectively suppressed weeds. Forage-livestock producers in many temperate regions could improve summer forage productivity with minimal external inputs by adding pastures sown with moderately diverse (n=4-10 species) prairie plant mixtures.

8:50 a.m. **Responses of Replacement Heifers Grazing NWSG**

Dr. Elizabeth Doxon [1], Dr. John Waller [1], Dr. Pat Keyser [1], Dr. Gary Bates [1], Dr. Neil Schrick [1]

[1] University of Tennessee

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This grazing study examined the performance of pregnant dairy heifers grazing switchgrass (Panicum virgatum) or a combination of big bluestem (Andropogon gerardii) and indiangrass (Sorghastrum nutans). Study 1 (5 June to 10 August 2009), Study 2 (14 May to 9 August 2010), and Study 3 (13 May to 22 July 2011) were conducted at the Middle Tennessee Research and Education Center near Spring Hill, TN. Heifers (Study 1, 1067 ± 33 lb; Study 2, 996 ± 106 lb; Study 3, 942 ± 147 lb) were used in a completely randomized design with two forage treatments: 1) switchgrass (SG) and 2) a combination of big bluestem and indiangrass (BB/IG). Stands were two years old at beginning of Study 1. Initial and final body weight of heifers was established using an equilibration ration to adjust for gut fill. A put-and-take system used three heifers in Study 1 and four heifers in Studies 2 and 3 allotted to 3 acre paddocks with eight replications per treatment. Additional heifers were used to keep forage in a vegetative state. Data were analyzed using the MIXED procedure. Least square means for ADG of heifers were different ($P < 0.05$) for heifers grazing SG or BB/IG in all 3 studies. Respectively for SG and BB/IG, the ADG were 1.49, 2.04 lb/d in Study 1; 1.40, 1.69 lb/d in Study 2; and 1.72, 2.09 lb/d in Study 3. Our results demonstrate the ability of native warm-season grasses to provide suitable summer forage and animal performance for dairy heifers.

9:10 a.m. **Evaluating Small Grain Cover Crops Ability to Enhance Switchgrass Establishment in the Southeast**

Ms. Amanda Ashworth [1], Dr. Pat Keyser [1], Dr. Fred Allen [2], Dr. Gary Bates [2], Dr. Elizabeth Doxon [2]

[1] University of Tennessee, Center for Native Grasslands Managment
[2] University of Tennessee

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Switchgrass (Panicum virgatum L.) is anticipated to become a major crop for the emerging cellulosic biofuel industry, as well as provide forage to cattle and hay markets; however, one major obstacle for large-scale production is consistent stand establishment. Use of small grain cover crops prior to planting may off-set lost production, suppress weeds, and conserve soil but possible

allelopathic effects may preclude their use. Dormant-season planting may also be useful in switchgrass establishment to provide in-situ stratification. Therefore, we conducted an experiment to test these establishment strategies. The objective of this study was to determine the effects of winter small grain cover crops (wheat, rye, barley, and oats) and a fallow control on switchgrass establishment and biomass yield when seeded at three dates (March, May, and June). The study was repeated in 2009 and 2010 in a split-block (small grains as whole plots, dates as split plots) design, with three replications at three Tennessee locations. Seedling density at the end of the planting year varied but was generally greatest for March ($P<0.05$). With respect to yield (end of second growing-season), stands planted in May tended to be greatest and those in March the lowest. For the winter annuals, results were less consistent, but oats and wheat tended to have the highest densities, fallow the lowest, and in two cases (barley and rye) divergent results based on one year and location. Winter annuals did not affect yield in any year or location. Therefore, our research indicates that small grain cover crops are not detrimental to switchgrass establishment success or yield and may prove to be a promising management practice in the Southeast, while providing cool-season forage (or grain) during the establishment year. Overall, these strategies need to be tested over more soil types, climates, and years to verify results.

9:30 a.m. Understory Composition in a Restored Longleaf Pine Stand

Mr. Robert Glennon [1]

[1] Virginia Tech

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There were 90 million acres of longleaf pine in the southeastern United States in 1680. By 2000, that area had decreased to 3 million acres as stands were converted to loblolly pine and cropland and developed. The natural range of longleaf pine extends from southeastern Virginia to East Texas. Efforts have been launched to restore the longleaf pine ecosystem, especially on droughty soils to which it is uniquely adapted. Longleaf pine has value as timber, especially as utility poles. However, the motivation for the restoration is the restoration of the ecosystem, which includes an herbaceous understory maintained by prescribed fire and a suite of wildlife species dependent on that herbaceous understory. The typical understory grass throughout the range of the ecosystem is wiregrass (*Aristida stricta*). Southeastern Virginia is north of the range of wiregrass. However, there is a wide variety of grasses, forbs, vines, and shrubs that occur in association with longleaf pine. The grasses include velvet panicgrass (*Dichanthelium scoparium*), variable panicgrass (*Dichanthelium commutatum*), needleleaf rosettegrass (*Dichanthelium aciculare*), broomsedge (*Andropogon virginicus*) and slender woodoats (*Chasmanthium laxum*). The forbs include hairy lespedeza (*Lespedeza hirta*), roundhead lespedeza (*Lespedeza capitata*), and panicleleaf beggarweed (*Desmodium paniculatum*). Vines include Virginia creeper (Parthenocissus quinquefolia). Shrubs include American holly (*Ilex opaca*), wax myrtle (Morella cerifera), blackjack oak (*Quercus marilandica*), and blackberry (*Rubus argutus*). The poster will summarize the results of transects on a forest converted from loblolly pine to longleaf pine with well-drained Uchee loamy sand in Sussex County, Virginia.

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9:50 a.m. A Comparison of a Restored Prairie with Two Remnant Eastern Prairies

Dr. Robert Tompkins [1], Dr. William C. Bridges, Jr. [2]

[1] Belmont Abbey College
[2] Clemson University

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A restoration project was initiated in 2007 to convert a forested section of Crowders Mountain State Park in North Carolina to a prairie ecosystem using regional seed sources. All vascular species were identified over the 2008-11 growing seasons. In addition, the site was sampled in 2011 to assess species richness, diversity, evenness and guild structure. Additional quadrats ($n = 150$) were also sampled at two other remnant prairie sites to compare prairie quality and community structure between the restored and remnant prairies. Seventy-nine species were documented for the restored prairie with 66 (83%) of those being species associated with other Carolina prairie communities. Big bluestem (*Andropogon gerardii*) and velvet witch grass (*Dichanthelium scoparium*) had the highest cover values, while blackberry (*Rubus argutus*) and velvet witch grass had the highest frequency of occurrence in the quadrats for the restored prairie. Both species richness (5.7) and diversity (4.6) were equal or greater in the restored prairie compared to the two remnant sites. The woody, C_3 grasses, and legume guilds for the restored prairie had mean species richness values equal or greater than the remnant sites at the $1m^2$ scale. Mean percent cover for the woody, C_3 grasses, invasive, and legume guilds for the restored prairie were also equal or greater than the remnant sites at the $1m^2$ scale.

Establishment, Selection and Wildlife *(Rotunda Ballroom B)*

8:30 a.m. Grasslands Bird Occupancy of Production Stands of Native Warm-Season Grass in the Mid-South

Mr. Andrew West[1], Dr. Patrick Keyser[2], Dr. David Buehler[3], John Morgan[4]

[1] University of Tennessee
[2] Center for Native Grasslands Management
[3] Department of Forestry, Wildlife, and Fisheries, University of Tennessee
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Grassland birds have declined more than any other guild in the US, primarily due to loss and degradation of native grasslands. Farm Bill programs have restored some native warm-season grasses (NWSG), but populations continue to decline. Other uses for NWSG focused on agricultural production such as hay, pasture and biomass, may have the potential to affect substantially more area due to market-based incentives they provide to landowners. Therefore, we examined breeding grassland bird use of 102 production fields of NWSG including control (fallow; n = 37), forage (grazing and haying; n = 7 and 22, respectively), seed (n = 21), and biofuel (n = 15) in Kentucky and Tennessee during 2009 – 2010 breeding seasons. We used a multi-season, robust design occupancy model in Program Mark to determine occupancy and detection rates for grassland birds. A three-tiered approach that included treatment type, field-level vegetation metrics, and landscape composition at 250-, 500-, and 1000-m scales was used to develop models for field sparrow (Spizella pusilla), red-winged blackbird (Agelaius phoeniceus), eastern meadowlark (Sturnella magna), and northern bobwhite (Colinus virginianus). Important variables included treatment (field sparrow and eastern meadowlark), percent woody cover (field sparrow and northern bobwhite), average vegetation height (red-winged blackbird), and average litter depth and percent NWSG cover (eastern meadowlark). For all four species, forest composition within 250 m had a negative impact (β <-1.97). Our data suggest that NWSG production fields could be an alternative approach for providing habitat for declining grassland bird populations but nesting studies are still needed.

8:50 a.m. Avian Habitat Response to Hay and Biofuels Production in Native Warm-Season Grass Stands in the Mid-South

Jessie Birckhead[1], **Craig Harper**[2], Patrick Keyser[2], Gary Bates[2], John Waller[2], Elizabeth Doxon[2], David Mcintosh[2]

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Changing pasture and hayfield management practices have impacted grassland songbird and northern bobwhite populations in the Mid-South in the past fifty years. Non-native species, such as tall fescue and orchardgrass, are commonly used for hay production in the Mid-South, where they are managed in dense stands that are harvested during peak nesting periods for grassland birds. Native warm-season grasses have been promoted for hay production and are often touted as beneficial for wildlife. Switchgrass is also promoted for biofuels production. The benefits of native warm-season grass hay and biofuels stands for grassland birds and northern bobwhite depend on management. We conducted a study in Tennessee, 2010 & 2011, to evaluate the impact of two hay harvest treatments and a biofuels harvest treatment on vegetative structure for nesting and brood-rearing grassland birds and northern bobwhite in mixtures of switchgrass, big bluestem, and indiangrass. Hay and biofuels stands provided adequate nesting cover for grassland songbirds and northern bobwhite, and hay harvests in May and June created suitable structure for brood-rearing northern bobwhite. However, hay harvests in May or June are likely to impact nesting success for grassland songbirds and northern bobwhite. NWSG planted for biofuels only did not provide suitable structure for northern bobwhite broods because of extremely dense vegetation and limited openness at the ground level. We recommend big bluestem and indiangrass for hay production because these species mature later than switchgrass and eastern gamagrass and and harvest in mid- to late June is less likely to impact bird reproductive success. In areas where grassland birds and northern bobwhite are a management concern, we recommend producers consider grazing in place of hay or biofuels production.

9:10 a.m. Effect of Container Size and Fertilization on Field Establishment of Sweetgrass Plants

Janet Grabowski [1], Dr. Janet Williams [2], Tommy Socha [3], David Findlay [4], Mary Anne Gonter [5]

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Sweetgrass (Muhlenbergia sericea) is a clump-forming grass native to the southern Atlantic and Gulf coasts. Its leaves are the main component of African-coiled basketry produced by the Gullah/Geechee community. The U.S. Army Corps of Engineers is including sweetgrass in their coastal restoration projects in South Carolina to reestablish populations depleted by development and damage from hurricanes. However, plant survival has been disappointing, possibly due to small size of commercial transplants. In 2010, the USDA, NRCS Brooksville PMC began a 6-mo greenhouse production study of the effect of container size (shallow cone tray – 2.375” x 2.375”; deep cone tray – 1.94” x 4.5”; and 4.5” x 3.25” round pot) and fertilization (complete slow release at 100 lb N per acre based on area vs. no fertilizer) on plant growth. After the greenhouse phase, the plants were planted on Daufuskie Island, SC, with and without hydrated polymer gel and/or slow release fertilizer (50 lb N per acre based on area). Plants from the round pots were larger at 6 months compared to the other containers, but root and shoot growth of all treatments declined at around 4 months in the greenhouse. Greenhouse fertilization increased plant weight, but reduced subsequent field survival and is not recommended. Larger size of the plants in the round pot treatment did result in improved field survival. Neither fertilization at transplanting nor polymer gel improved field survival. Using larger transplants or increasing the planting rate will be necessary to improve survival in coastal restoration plantings.

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9:30 a.m. Grassland Plant Community Structure and Ecosystem Processes in Response to Disturbance Gradients at Fort Pickett, Virginia

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Many disturbance studies focus on the impact of single events and do not address ecosystem responses to repeated long-term disturbance. Fort Pickett has experienced military training for over 60 years, providing a unique opportunity to assess long-term effects of two specific types of disturbance on plant functional group community structure, and ecosystem processes. Individual species were assigned to the following functional groups: C4 grasses, C3 grasses, forbs, woody species, and legumes. Vehicle disturbance was defined as the frequency of military vehicle passes at each plot. Fire frequency was calculated using historical data. Plant community data were analyzed using CCA and multiple linear regression. The first canonical axis explained 91.9 percent of the relationship between functional group cover and disturbance. There were significant relationships ($P < 0.05$) between functional group cover, richness and both measures of disturbance. Overall species richness increased in response to disturbance with C4 grasses and legumes showing the greatest response. A removal experiment, using a split plot design, was used to investigate the relationship between disturbance, plant functional group and ecosystem processes. The whole plot treatment was disturbance class (Low, Moderate, High and Fire) and the within plot treatments were a full factorial removal experiment using C4, legumes, and woody species. Response measurements were soil CO_2 flux, and mineralizable nitrogen. Soil CO_2 flux was significantly ($P < 0.05$) lower in the high physical disturbance class and highest in the fire class. Mineralizable nitrogen was significantly lower in the fire disturbance class.

9:50 a.m. **Breeding and Selecting Native Grasses for Improved Survival Under A Changing Global Climate**

John Lloyd-Reilley [1], Shelly Maher [1]

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The rate of global warming and other associated climate changes such as increased evapotanspiration rates and drier moisture balances, which are anticipated over the next century, are expected to have significant impacts on south Texas vegetative communities.

To be prepared for these changing conditions, the USDA-NRCS E. "Kika" de la Garza Plant Materials Center in Kingsville, Texas, has been evaluating methods for improving heat and drought tolerance in native grasses. We will discuss our methods and results in changing the location of the crown node in switchgrass to better enhance the seedling survival of this species under dry conditions. We will also discuss our methods and results to select big sacaton seedlings following heat treatments and water deprivations for improving seedling survival under hotter and drier conditions.

10:10 a.m. Adjourn meeting

The Effect of Sodium Nitroprusside on the Germination of Warm-Season Grasses Native to Southern New England

Noah LeClaire-Conway and Rebecca Nelson Brown

Abstract

The demand for native plants is increasing for both commercial and residential landscapes as well as municipal agencies seeking to reduce the use of potentially invasive introduced species. This demand requires the development of protocols for propagating locally sourced plant materials, as well as developing foundation plots for seed production. Native grass seed was harvested from New England roadside populations, including seed from Little bluestem (*Schizachyrium scoparium*), Hairy paspalum (*Paspalum setaceum var. setaceum*), Roundseed panicgrass (*Dichanthelium sphaerocarpon*), and Purple lovegrass (*Eragrostis spectabilis*). These species express low growth habits and are highly acclimated to the poor roadside soils of this region. Seed was harvested during the fall, and stored at -20 C for seven weeks. The seed was then primed with sodium nitroprusside (SNP) or potassium nitrate (KNO_3) at concentrations of 250µM and 500µM. Primed seed was placed in a growth chamber with 12 hours of daylight, 90% humidity, and temperature between 20°C and 26°C. There were observable increases in germination rates in all species, compared to treatment with diH_2O. Another assay was executed using only SNP as the treatment on Little bluestem, Roundseed panicgrass, and Paspalum seed. Compared to a control using distilled H_2O, seed primed with SNP germinated more rapidly and with higher percentages. More research is needed to determine the safe and practical application of this chemical to break dormancy in seed.

Introduction: The demand for the use of native plantings on roadsides in southern New England is increasing and this promotes the need to develop germination protocols for species that are not commercially available. We are looking to facilitate the use of species that are already present, and thriving, in less than optimal soil types and habitats of our roadsides. These grasses include members of the genera *Dichanthelium, Schizachyrium, Eragrostis and Paspalum* (Brown and Sawyer 2012). These warm-season grasses exhibit dormancy mechanisms that prevent germination until favorable environmental conditions occur (Finch-Savage 2006). Research out of the University of Nebraska indicates an accelerated germination response when seed is exposed to sodium nitroprusside (Sarath et al. 2006). However, Sarath et al. only looked at Midwestern species and ecotypes. We sought to examine the effect of certain nitric oxide-donors on the germination of warm-season grasses found in Southern New England, to determine if northern ecotypes of selected grass species respond in a similar way. During the fall of 2011, we collected seed from Little bluestem, Hairy paspalum, Roundseed panicgrass, Purple lovegrass and Switchgrass on the roadsides of Rhode Island highways. Collection sites included US 1 in Washington County, RI 4 in Kent County, RI 138 in Washington County, and I 95 in Washington County. Our intentions for this series of assays were to build upon Sarath's research and to develop a series of protocols for the seed propagation of these New England native grass species

Materials and Methods: In the initial series of assays, seed of *E. spectabilis, D. sphaerocarpon and S. scoparium* that was collected in the fall of 2011 was dried, cleaned and dry-stratified for 7 weeks at 4°C. Seed was then surface sterilized with a 5% bleach solution, and rinsed with diH_2O. Autoclaved Petri-plates were prepared with Whatman no.2 filter paper wetted with treatment solutions. These included 500µM, 250µM and 50µM solutions of SNP and KNO_3, as well as diH_2O. Fifty seeds were placed in each plate, and then the plates were sealed with Para film to prevent desiccation. All plates were placed into a growth chamber with environmental conditions set at 26°C day, and 20°C night; humidity was set to 90%. The plates were observed daily, and germinated seeds were counted for each treatment.

In the second series of assays, the collected seed was dried, cleaned and dry-stratified for 7 weeks at 4° C before any chemical treatments were administered. The seed was weighed out as follows: 0.5g samples for *S. scoparium*, 0.15g samples for *P. setaceum* and 0.6g samples for *D. sphaerocarpon*. Each was surface sterilized with a 5% bleach solution followed by a diH_2O rinse. Following surface sterilization we placed seed samples in 50 mL conical centrifuge tubes, and added 50 mL of imbibition solution. Solutions were 250µM, 500µM SNP or diH_2O. Initial experiments in germination responses to SNP helped to select the concentrations of SNP used for each species. *S. scoparium* and *P. setaceum var. setaceum* was placed in a 250µM SNP solution; *D. sphaerocarpon* was placed in a 500µM SNP solution. Each treatment was replicated three times for each species. We allowed the seed to imbibe the solutions for a 36-hour period at 4° C. After the imbibition period, sand was added to the centrifuge tube, and the remaining solutions were drained off. The sand and seed mixture was then spread across the surface of prepared planting flats containing Metromix 830. This allowed for a more even distribution of seed. The flats were placed into a growth chamber with the

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environmental conditions set at 26°C day, and 20°C night; humidity was set at 90% to prevent desiccation. Each sample was monitored daily for germination responses and the total number of germinated seeds present were counted in each flat.

Results: Data from the first assay using *E. spectabilis* was inconclusive. Excessive fungal growth ended the experiment after only 9 days, at which point only the *E. spectabilis* had germinated seeds in the diH_2O water control. *E. spectabilis* had little to no response to the KNO_3; with 0% germination with 500μM, and 6% germination with 250 and 50 μM solutions after 8 days. This is interesting because compared to diH_2O, which had 12% germination of seed, it appears, suggesting that KNO_3 may have inhibited germination in these treatments. This was not the case with seed treated with the SNP solutions. Seed treated with 50μM SNP had a similar response to diH2O, with 12% germination, however, 250 and 500 μM solutions were much different. Treatment of *E. spectabilis* with 250 uM SNP increased germination to 32%, and treatment with 500 μM SNP resulted in 42% germination.

Data from the next assay showed that treatment with SNP increased germination in all species. The greatest increase was seen in *P. setaceum*, where treatment with 250 μM SNP increased germination by 400%. This increase was statistically significant, with $p = .04$. SNP treatment increased germination in *S. scoparium* and *D. sphaerocarpon* by 260% ($p = .16$) and 280% ($p = .06$), respectively. *D. sphaerocarpon* showed the best germination, with an average of 31 seedlings per flat (6% of total seed) in the SNP treatment 2 weeks after transfer to the growth chamber. *S. scoparium* averaged 18.3 seedlings per flat (6% of total seed), and P. setaceum averaged 12.3 (5% of total seed).

Discussion: While this data shows that germination was increased in the selected warm-season grasses, more research and assays need to be completed to determine the significance of these increases in germination. Initial assays showed positive responses to SNP in several genera including *Eragrostis, Dichanthelium, Panicum, Paspalum,* and certain concentrations affected each species differently. Furthermore, other nitric oxide donors showed some inhibitory effect on germination such as KNO_3 on E. spectabilis.

While we found similar results to Sarath et al. (2006), it is important to mention that our studies differed in methods amongst other aspects as well. Sarath et al carried out germination experiments in Petri plates throughout the study, and focused mostly, but not exclusively, on radicle emergence for germination response. We used soilless planting mix and used coleoptile emergence to denote germination. Another difference between our studies is that we utilized sand as a means to evenly distribute the seed on the planting mixture. This could have impacted overall germination as well. These differences are significant, however, both indicate that SNP contributes to the overall increase in germination.

Sarath et al.,(2006) also reported significantly higher germination percentages than our experiments. Low germination percentages in our study could be the result of numerous factors. One possible explanation could be from fungal growth, as we saw in earlier experiments, though the soilless mix potentially concealed it from view. Furthermore, in the case of *Dichanthelium*, the chasmogamously (spring-primary) produced seed has much higher seed recruitment than that of the cleistogamusly (fall-secondary) produced seed (Vandevender 2010). We harvested the *Dichanthelium* seed after the cleistogamous flowering phase, and reduced seed recruitment could have impacted the overall germination. Lastly, the fact that our seed was harvested from roadside populations, a place where plants are often under nutrient and other physical and environmental stressors, could have impacted seed recruitment and overall viability. This differs from Sarath et al in that their seed was field grown, and those plants presumably received optimal fertility and water. Further experiments may elucidate what caused the lower germination percentages in our study.

Future research plans include a wider species selection within genera, and various concentrations of different nitric oxide donors including SNP and KNO_3, to determine significant effects on the germination of these native, and locally sourced grass seed. Furthermore, we want to look at the practical usage of these chemical treatments for municipal agencies. While KNO_3 is commonly used to prime seed and is extensively used as a plant fertilizer, sodium nitroprusside is not. KNO_3 can be added to hydroseed mixtures or broadcast at planting to increase overall germination during establishment, SNP however is highly toxic and must be treated as hazardous waste¬¬ ––limiting any in situ applications.

We are also currently working with several species of *Dichanthelium* in addition to *D. sphaerocarpon*. These include *D. depauperatum*, *D. acuminatum, D. oligosanthes,* and *D. commutatum*. We are interested in how SNP effects the germination of both the cleistogamous and chasmogamously produced seed, as well as developing a series of protocols for industry professionals and municipal agencies to use in the field.

References

Brown, Rebecca N., Carl D. Sawyer "Plant Species Diversity of Highway Roadsides in Southern New England." Northeast Naturalist 19 (2012): 25-42. Print.

Finch-Savage, William E., Gerhard Leubner-Metzger "Tansley Review: Seed Dormancy and the Control of Germination." New Phytologist 171 (2006): 501-523. Print.

Sarath, Gautam, Paul C. Bethke, Russell Jones, Lisa M. Baird, Guichuan Hou, Robert B. Mitchell. "Nitric Oxide Accelerates Seed Germination in Warm-season Grasses. Planta 223 (2006): 1154-1164. Print.

Vandevender, John 2010. Propagation protocol for production of container Dichanthelium commutatum (Schult.) Gould plants (1+0 container plug); USDA NRCS - Appalachian Plant Materials Center, Alderson, West Virginia. In: Native Plant Network. URL: http://www.nativeplantnetwork.org (accessed 9 September 2012). Moscow (ID): University of Idaho, College of Natural Resources, Forest Research Nursery

Figures

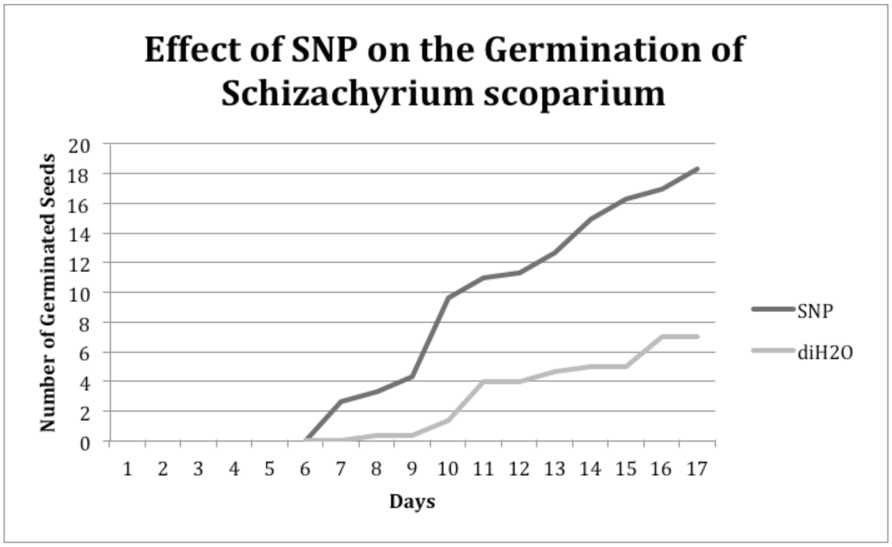

Figure 1 - The germination response of S. scoparium seed primed with 250 µM sodium nitroprusside (SNP) compared to priming with water . Seed treated with SNP began germinating sooner, and significantly more seed germinated. Data presented represents the mean of three replications for each treatment.

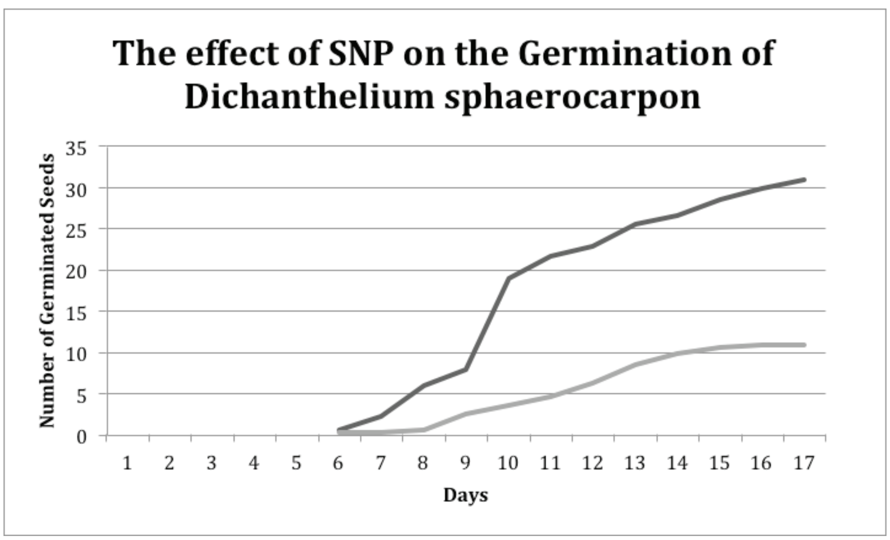

Figure 2 - The germination response of D. sphaerocarpon seed primed with 500µM sodium nitroprusside (SNP) compared to priming with water. Seed treated with SNP began germination sooner, and significantly more seed germinated. Data presented represents the mean of three replications for each treatment.

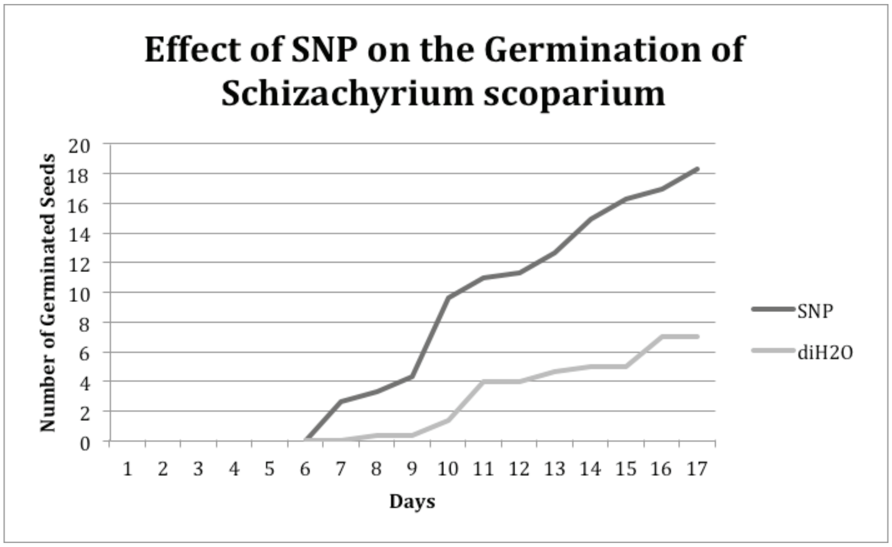

Figure 3 - The germination response of P. setaceum seed primed with 250µM sodium nitroprusside (SNP) compared to priming with water. Seed treated with SNP had more seed germninate than seed treated with water. The data presented represents the mean of three replications for each treatment.

Native Grass Cultivars, Ecotypes, Germplasm, and Their Adaptations for the Eastern United States

Robert. J. Glennon[1]

Abstract

The widespread use of native grasses depends on an inexpensive, reliable supply of seed with dependable growers and known ranges of adaptation. Over the past seventy years, the USDA, Natural Resources Conservation Service, USDA, Agricultural Research Service, State Agricultural Experiment Stations, and private seed companies have developed cultivars of grasses to restore ecosystems and produce forage and wildlife habitat. Each cultivar has a known production capability in the nursery and seed production field as well as the situation into which it is established. Each cultivar has a known range of adaptation to climate, soil characteristics, hydrology, and stress such as grazing within which it will perform. Knowledge of these adaptations has allowed the effective use of these cultivars beyond the area in which they were originally collected. Since the largest market for the tall prairie grasses is in the Midwest, much of the cultivar development has occurred in the states from Texas to North Dakota. Knowledge of the culitvars' adaptations has allowed their use in the eastern part of the United States until more local origins are developed. Recently, ecotypes and germplasm have been released for use in very localized areas. The poster presents a list of the released cultivars, source-identified material, and germplasm, their intended uses, and range of adaptation.

Switchgrass (Panicum virgatum)					
	Origin		Adaptation		
Cultivar/Germplasm	State	Plant Hardiness Zone	Plant Hardiness Zones	Major Land Resource Areas	Special Characteristics
Miami	Florida	10b	10b	U	Local Ecotype
Stuart	Florida	9b	9b	U	Local Ecotype
Wabasso	Florida	9b	9b	U	Local Ecotype
Alamo	Texas	9a	7a – 10b	H,I,J,M,N,O,P.T,U	Lowland Type, Stiff-Stemmed
High Tide	Maryland	7a	7a	T	Lowland Ecotype
Kanlow	S. Oklahoma	7a	5a – 8b	H,J,M,N,O,P,S	Lowland Type, Stiff-Stemmed
Carthage	North Carolina	7a	6a – 8b	N,O,P,S,T	Adapted to Eastern Coastal Plain
Durham	North Carolina	7a	6a – 8b	N,P,T	Adapted to Southeastern Piedmont
Blackwell	N. Oklahoma	6b	5a – 7b	D,G,H,J,L,M,N,O,P,R,S	Low Fertility and Water Requirement
Shelter	West Virginia	6a	4a – 7a	L,M,N,O,P,R,S,T	Stiff-Stemmed
Southlow Michigan	Michigan	5b	4a – 5b	K,L,M	Local Ecotype
Cave-in-Rock	Illinois	5b	4b – 6b	H,M,N,O,P,S	Forage Quality, Grazing Persistence
Shawnee	Illinois	5b	4b – 6b	H,M,N,O,P,S	Selection from Cave-in-Rock
Central Iowa	Iowa	4b	4b	M	Local Ecotype

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Big Bluestem (Andropogon gerardii)					
	Origin		Adaptation		
Cultivar/ Germplasm	State	Plant Hardiness Zone	Plant Hardiness Zones	Major Land Resource Areas	Special Characteristics
Suther	North Carolina	7b	7b	P	Local Ecotype
Earl	Texas	7a	7a – 10b	H,I,J,N,O,P.T,U	Long Growing Season
Refuge	Arkansas	6b & 7a	6b - 7a	N	Adapted to Ozarks
OH370	MO, AR, IL, OK	6a & 6b	5a – 7b	N	Adapted to Ozarks
OZ-70	MO, AR, IL, OK	6a & 6b	5a – 7b	N	Adapted to Ozarks
Niagara	New York	6a	4a – 7b	L,M,N,O,P,S	Adapted to Humid East
Hampton	Missouri	6a	6a – 6b	N	Adapted to Ozarks
Southlow Michigan	Michigan	5b	4a – 5b	K,L,M	Local Ecotype
Kaw	Kansas	5b	4a – 6b	H,J,M,N,O,P,S	Lowland Type, Stiff-Stemmed
Prairie View	Indiana	5a&5b	5a - 5b	M	Local Ecotype
Roundtree	Iowa	5a	4b – 6a	M,N,P,S,R	Forage and Seed Production
Pawnee	Nebraska	5a	5a – 6b	D,G,H,J,L,M,N,O,P,R,S	Earlier Seed Maturity then Champ
Northern Missouri	Missouri	5a	5a	M	Local Ecotype
Southern Iowa	Iowa	5a	5a	M	Local Ecotype
Central Iowa	Iowa	4b	4b	M	Local Ecotype
Northern Iowa	Iowa	4b	4b	M	Local Ecotype
Champ	Nebraska	4b	4a – 5b	G,H,L,M,N,R,S	Later Seed Maturity then Pawnee

Indiangrass (Sorghastrum nutans)					
	Origin		Adaptation		
Cultivar/ Germplasm	State	Plant Hardiness Zone	Plant Hardiness Zones	Major Land Resource Areas	Special Characteristics
Americus	Alabama and Georgia	8a	7a – 8b	P,T	Best Cultivar Adapted to Southeast
Lometa	Texas	7b	7a – 10b	H,I,J,M,N,O,P.T,U	Best Forage Production in Texas
Newberry	South Carolina	7b	7b	P	Ecotype Adapted to Southeastern Piedmont
Suther	North Carolina	7b	7b	P	Ecotype Adapted to Southeastern Piedmont
Cheyenne	Oklahoma	6b	5b – 7b	H,M,N,O,P,R,S	Earliest Release
Osage	Oklahoma	6b	4a – 7b	H,M,N,O,P,R,S	Late Maturing
Rumsey	Illinois	6a	4a – 7a	H,M,N,O,P,R,S	Forage Production and Quality
Hampton	Missouri	6a	6a – 6b	N	Ecotype Adapted to Ozarks
Coastal	Connecticut, Rhode Island, Massachusetts	6a	6a – 6b	R	Ecotype Adapted to New England
Southlow Michigan	Michigan	5b	4a – 5b	K,L,M	Local Ecotype
Northern Missouri	Missouri	5a	5a	M	Local Ecotype
Southern Iowa	Iowa	5a	5a	M	Local Ecotype
Central Iowa	Iowa	4b	4b	M	Local Ecotype
Northern Iowa	Iowa	4b	4b	M	Local Ecotype

Little Bluestem (Schizycharium scoparium)					
	Origin		Adaptation		
Cultivar/ Germplasm	State	Plant Hardiness Zone	Plant Hardiness Zones	Major Land Resource Areas	Special Characteristics
Suther	North Carolina	7b	7b	P	Local Ecotype
Cimarron	Oklahoma/ Kansas	6a	4b – 7a	E,G,H,N,O,P,R,S	Most Recent Release
Southlow Michigan	Michigan	5b	4a – 5b	K,L,M,	Local Ecotype
Pastura	New Mexico	5b	4a – 6b	G,H,M,N,O,P,R,S	Excellent Seedling Vigor
Aldous	Kansas	5b	4a – 6b	F,G,H,M,N,O,P,R,S,T	Medium to Late Maturity
Southern Missouri	Missouri	5b	5b	N	Local Ecotype
Prairie View	Indiana	5a & 5b	5a – 5b	M	Local Ecotype
Blaze	Kansas/ Nebraska	5a	4a – 6a	G,H,M,N,R,S	Late Maturing
Camper	Kansas/ Nebraska	5a	4a – 6a	G,H,M,N,R,S	Better Establishment and Forage
Northern Missouri	Missouri	5a	5a	M	Local Ecotype
Southern Iowa	Iowa	5a	5a	M	Local Ecotype
Central Iowa	Iowa	4b	4b	M	Local Ecotype
Northern Iowa	Iowa	4b	4b	M	Local Ecotype

Seacoast Bluestem (Schizycharium littorale)					
	Origin		Adaptation		
Cultivar	State	Plant Hardiness Zone	Plant Hardiness Zones	Major Land Resource Areas	Special Characteristics
Dune Crest	New Jersey and Delaware	7a	7a	T	Local Ecotype

Sideoats Grama (Bouteloua curtipendula)					
	Origin		Adaptation		
Cultivar/Germplasm	State	Plant Hardiness Zone	Plant Hardiness Zones	Major Land Resource Areas	Special Characteristics
Haskell	Texas	7b	7a – 9a	H,I,J,N,O,P	Good Rhizome Production
Niner	New Mexico	7a	4a – 8b	D,G,H,N,O,P	Even Seed Maturity
El Reno	Oklahoma	6b	5a – 7b	D,G,H,J,M,N,O,P	Outstanding Forage
Vaughn	New Mexico	6a	4a – 7a	D,E,G,H,N,O,P	Good Drought Tolerance
Southern Iowa	Iowa	5a	5a	M	Local Ecotype
Central Iowa	Iowa	4b	4b	M	Local Ecotype
Northern Iowa	Iowa	4b	4b	M	Local Ecotype
Butte	Nebraska	4b	4a – 5b	F,G,M,N,R,S	Early Maturing
Trailway	Nebraska	4b	4a – 5b	H,M,N,R,S	Late Maturing

Deertongue (Dichanthelium clandestinum)					
	Origin		Adaptation		
Cultivar	State	Plant Hardiness Zone	Plant Hardiness Zones	Major Land Resource Areas	Special Characteristics
Tioga	Pennsylvania	5a	4a – 7a	L,M,N,R,S	Tolerates ph of 4.0, And Toxic Al and Mn

Velvet Rosettegrass (Dichanthelium scoparium)					
	Origin		Adaptation		
Cultivar	State	Plant Hardiness Zone	Plant Hardiness Zones	Major Land Resource Areas	Special Characteristics
Pilgrim	Texas	7b	7b – 8a	P	Local Ecotype

Eastern Gamagrass (Tripsacum dactyloides)					
	Origin		Adaptation		
Cultivar/ Germplasm	State	Plant Hardiness Zone	Plant Hardiness Zones	Major Land Resource Areas	Special Characteristics
Martin	Florida	9b	9a - 9b	U	Local Ecotype
St. Lucie	Florida	9b	9a - 9b	U	Local Ecotype
Jackson	Texas	9a	8a – 9b	J,N,O,P,T	
Medina	Texas	8b	8a – 9b	J,N,O,P,T	
Hays	Texas	8b	7a – 9b	J,H	Local Ecotype
Iuka	Oklahoma	7a	6a – 8a	H,N,O,P,R,S	
Meadowcrest	Maryland	7a	6a – 8a	P, S	Tetraploid Adapted for Mid-Atlantic
Bumpers	Arkansas	6b	6a – 8a	N	Adapted to Ozarks
Highlander	Tennessee	6b	6a – 8a	N,O,P,R	Adapted to Southeast
Pete	Kansas	6a	5b – 7a	H,M,N,O,P,R,S	First Release
SG4X-1	Synthetic	5b	5a – 7a	N,P,R,S	Tetraploid

Virginia Wildrye (Elymus virginicus)					
	Origin		Adaptation		
Cultivar/Germplasm	State	Plant Hardiness Zone	Plant Hardiness Zones	Major Land Resource Areas	Special Characteristics
Kinchafoonee	Texas	8a	7a – 8b	P	Adapted to Southern Piedmont
Northern Missouri	Missouri	5a	5a	M	Local Ecotype
Cuivre River	Missouri	5b	5b	M	Local Ecotype
Omaha	Nebraska	5b	4b – 6b	H,L,M,N,R,S	Shade Tolerant

American Beachgrass (Ammophila breviligulata)					
	Origin		Adaptation		
Cultivar	State	Plant Hardiness Zone	Plant Hardiness Zones	Major Land Resource Areas	Special Characteristics
Hatteras	North Carolina	8a	7a – 9a	T	Better Adapted To South Atlantic
Cape	Massachusetts	7a	5a – 8b	R,S,T	First Release

Coastal Panicgrass (Panicum amarum var. amarulum)					
	Origin		Adaptation		
Cultivar	State	Plant Hardiness Zone	Plant Hardiness Zones	Major Land Resource Areas	Special Characteristics
Atlantic	Virginia	7b	5a – 8b	R,S,T	Suitable for Inland and Coastal Use

Bitter Panicgrass (Panicum amarum)					
	Origin		Adaptation		
Cultivar	State	Plant Hardiness Zone	Plant Hardiness Zones	Major Land Resource Areas	Special Characteristics
Southpa	Florida	10a	8a – 10a	T,U	Better Adapted To S. Atlantic & Gulf
Fourchon	Louisiana	9a	8a – 10a	T	Better Adapted To Western Gulf Coast
Northpa	North Carolina	7a	6a – 8a	T	Better Adapted To Mid-Atlantic Coast

Seaoats (Uniola paniculata)					
	Origin		Adaptation		
Germplasm	State	Plant Hardiness Zone	Plant Hardiness Zones	Major Land Resource Areas	Special Characteristics
Caminada	Louisiana	9a	9a	T	Local Ecotype

Saltmeadow Cordgrass (Spartina patens)					
	Origin		Adaptation		
Cultivar	State	Plant Hardiness Zone	Plant Hardiness Zones	Major Land Resource Areas	Special Characteristics
Gulf Coast	Louisiana	9a	8a - 10a	T	Better Adapted To Western Gulf Coast
Sharp	Louisiana	9a	8a - 10a	T,U	Better Adapted To S. Atlantic & Gulf
Flageo	North Carolina	8a	7a - 9a	T	Better Adapted To Mid-Atlantic
Avalon	New Jersey	7a	6a - 8a	R,S,T	First Release

Smooth Cordgrass (Spartina alterniflora)					
	Origin		Adaptation		
Cultivar	State	Plant Hardiness Zone	Plant Hardiness Zones	Major Land Resource Areas	Special Characteristics
Vermillion	Louisiana	9a	8a - 10a	T,U	Better Adapted To S. Atlantic & Gulf
Bayshore	Maryland	7a	6a – 9b	T	Better Adapted To N. & Mid-Atlantic

Seashore Paspalum (Paspalum vaginatum)					
	Origin		Adaptation		
Cultivar	State	Plant Hardiness Zone	Plant Hardiness Zones	Major Land Resource Areas	Special Characteristics
Brazoria	Texas	9a	9a	T	Local Ecotype

Maidencane (Panicum hemitomon)					
	Origin		Adaptation		
Cultivar	State	Plant Hardiness Zone	Plant Hardiness Zones	Major Land Resource Areas	Special Characteristics
Citrus	Florida	9a	8b – 9b	T,U	
Halifax	North Carolina	7b	7b – 8a	P,T	First Cultivar

Giant Cutgrass (Zizaniopsis miliacea)					
	Origin		Adaptation		
Cultivar	State	Plant Hardiness Zone	Plant Hardiness Zones	Major Land Resource Areas	Special Characteristics
Wetlander	Louisiana	9a	8b – 9b	P,T,U	First Cultivar

Tall Dropseed (Sporobolus compositus)					
	Origin		Adaptation		
Cultivar	State	Plant Hardiness Zone	Plant Hardiness Zones	Major Land Resource Areas	Special Characteristics
Northern Missouri	Missouri	5a	5a	M	Local Ecotype
Southern Iowa	Iowa	5a	5a	M	Local Ecotype
Central Iowa	Iowa	4b	4b	M	Local Ecotype
Northern Iowa	Iowa	4b	4b	M	Local Ecotype

Florida Paspalum (Paspalum floridanum)					
	Origin		Adaptation		
Cultivar	State	Plant Hardiness Zone	Plant Hardiness Zones	Major Land Resource Areas	Special Characteristics
Harrison	Texas	8a	8a	P	Local Ecotype

Early Successional Vegetation Communities on Idled Cropland in Southeast Virginia

R.J. Glennon[1]

Abstract

The Virginia Department of Game and Inland Fisheries has initiated three best management practices to encourage landowners to develop early successional habitat for wildlife. One of those practices, called the Idle Land practice, provides an incentive payment of $50 per acre per year to landowners who sign a three-year contract to allow their cropland to go idle. In southeastern Virginia, these crop fields go through succession to a plant community dominated by the native annual forbs chickweed (*Stellaria media*), and cutleaf evening primrose (*Oenothera laciniata*) in the spring; and annuals ragweed (*Ambrosia artemisiifolia*), croton (*Croton grandulosa*), and poor joe (*Diodia teres*), and the biennial horseweed or marestail (*Conyza Canadensis*) in the summer and fall. Annual hard-seeded legumes germinated from the seedbank: hairy crabgrass (*Digitaria sanguinalis*) in the summer and rabbitfoot clover (*Trifolium arvense*), common vetch (*Vicia sativa*), and hairy vetch (*Vicia villosa*) in the fall. A small percentage of the area is occupied by the native perennials purple lovegrass (*Eragrostic spectabilis*). The poster will summarize the results of transects on an idled soybean field with well-drained Uchee loamy sand in Sussex County, Virginia.

<u>Introduction</u>: In 2010, the Virginia Department of Game and Inland Fisheries adopted three best management practices to encourage landowners to provide early successional habitat for wildlife. The practices are designed to complement the practices administered by the United States Department of Agriculture that encourage landowners to provide permanent habitat for wildlife.

To be eligible, the land must have been cropped 2 years out of the last 5 years. The landowner must control of all invasive species and control of all woody species throughout the term of the contract. The landowner is compensated $50 per acre per year for a 3-year contract. All $150 per acre is paid in the first year. The landowner is permitted to disc one-third of the area each year to maintain early successional habitat.

<u>Materials and Methods</u>: The site was a field in Sussex County in southeastern Virginia cropped to soybeans in 2010. After the soybeans were harvested in 2010, the field was allowed to go fallow with no other treatment. The landowner signed a contract for the Idle Lands Best Management Practice in the spring of 2011.

The site was inspected visually in the spring and fall of 2010 and the spring of 2011 to document compliance with the contract.

Ten, 100-point transects were evaluated in August of 2012. The transects were established within the area of the field underlain by the well-drained Uchee loamy sand, perpendicular to the direction in which the field had been tilled, and were not within 50 feet of the border of the field near the adjoining forest. The points were set 1 foot apart on a string line suspended 3 feet above the ground. A weighted pin was dropped from each point and the first plant that the pin intercepted was recorded.

<u>Results and Discussion</u>: The stand was dominated by ragweed in the summer of the second year after the field was allowed to go fallow (Table 1). Ragweed is the most prevalent seed in the crops of quail harvested during hunting season. Its succession was a major goal of this best management practice.

Leaf litter and bare ground accounted for 16.2% of the cover. Quail chicks need open space in which the move around and hunt for insects. This habitat element was another of the major goals of this best management practice.

The annuals croton, crabgrass, and poor joe accounted for 12.1% of the ground cover. There three species will complement the ragweed as re-seeding components that produce large quantities of seed for quail and other ground-nesting birds.

Eventually areas such as these will require disking to begin the successional process again.

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Table 1 – Average Groundcover in a Field Left Idle for Two Years in Southeastern Virginia

Common Name	Scientific Name	Average Cover (%)
Ragweed	Ambrosia artemesiifolia	65.9%
Litter		11.7%
Croton	Croton glandulosa	7.1%
Bare Ground		4.5%
Horseweed	Conyza Canadensis	3.3%
Crabgrass	Digitaria sanguinalis	2.8%
Poor Joe	Diodia teres	2.2%
Wild Lettuce	Lactucca virosa	0.7%
Dogfennel	Eupatorium capillifolium	0.7%
Morning Glory	Ipomoea hederacea	0.6%
Purple Lovegrass	Eragrostis superba	0.4%
Rabbit Tobacco	Gnaphalium obtusifolium	0.1%

Species Composition in a Native Grass and Forb Seeding for Wildlife in Southeast Virginia

R.J. Glennon[1]

Abstract

Conservation agencies and organizations have been seeding mixtures of native grasses and forbs for wildlife for 70 years. Over that time, the number of commercially available species, cultivars, and ecotypes of seed has increased dramatically as has the technology behind the establishment and management of the stands. This poster will summarize the vegetative composition of a stand established with USDA Farm Bill funds as an upland wildlife habitat seeding. These areas are now seeded at a seed density that allow upland wildlife birds and mammals spaces for nesting and travel within the stand as well as forb species that provide seed as a food source. Landowners and conservationists are often disappointed that these stands are not solid stands of the seeded species. The stand that was surveyed was seeded to a mixture of little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardii*), and Indianrass (*Sorghastrum nutans*), and 10 native forb species. Eighteen months after seeding, the 40 percent of the area was covered by the seeded grasses and 60 percent of it was covered by volunteer species. The majority of the spaces between the seeded grass clumps were occupied by oldfield aster (*Symphyotrichum pilosum*), ragweed (*Ambrosia artemisiifolia*), and dog fennel (*Eupatorium capillifolium*) No seeded forbs were present. The volunteer grasses and forbs all contribute to wildlife habitat. Ragweed in particular is a critical element of the diet of bobwhite quail. The future management of the stand with prescribed fire and light disking will ensure that it continues to provide the habitat it provides today.

<u>Introduction</u>: The Wildlife Habitat Incentives Program (WHIP) is a program authorized by the Farm Bill and administered by the USDA Natural Resources Conservation Service. WHIP provides incentives to establish and maintain wildlife habitat by compensating landowners for part of the cost of implementing the practices. Establishment practices include seeding of perennial native grasses and forbs, planting of hedgerows, and planting of trees and shrubs with value as wildlife habitat.

<u>Materials and Methods</u>: The site is located in Isle of Wight County in southeastern Virginia on a Slagle fine sandy loam. The site of the seeding was mowed in the winter of 2011 and sprayed with a mixture of imazapic (Plateau) in March, 2011. Seed of three native grasses and ten native forbs was sown with a no-till drill in March of 2011 (Tables 1 and 2).

Ten, 100-point transects were evaluated on August 31, 2012. The transects were established within the area of the field underlain by the well-drained Slagle fine sandy loam, perpendicular to the direction in which the seed was drilled, and were not within 50 feet of the border of the field near the adjoining forest. The points were set 1 foot apart on a string line suspended 3 feet above the ground. A weighted pin was dropped from each point and the first plant that the pin intercepted was recorded.

<u>Results and Discussion</u>: Only 40.2% of the groundcover was comprised of the seeded species (little bluestem - 20.6%, big bluestem – 12.0%, and Indiangrass – 7.6%) and only the native grass species survived (Table 3). None of the seeded forbs are present in the stand; the imazapic probably suppressed their germination. Most of them are tolerant to imazapic, but only at a 4 ounce per acre rate.

Of the volunteer species that occupy the stand, white old field aster blooms late in the year when nectar-producing flowers are scarce and is rated as a high value plant for pollinating insects. Ragweed produces seed late in the year that is a highly desirable food for quail. Dogfennel does not have high value for wildlife or pollinating insects. It may be controlled by the recommended prescribed burning or may be suppressed by the native grasses as they dominate the stand. Crabgrass produces seed throughout the year that is a highly desirable food for quail and songbirds.

The utility of this stands as wildlife habitat requires prescribed burning of the stands of native warm season grasses and forbs at least once every three years to remove the dormant residue and suppress cool season weeds and woody plants. Disking the access trails around the edge of the stand will provide firebreaks for the prescribed burning and accidental fires that may occur.

The prescribed burns must be planned and conducted by a prescribed burn manager certified by the Commonwealth of Virginia. Herbaceous cool season plants that are not controlled by the prescribed fire may be controlled by applications of glyphosate in the fall and spring. Woody plants may be controlled by spot applications of herbicides designed to control woody plants, such as triclopyr or imazapyr.

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Table 1 - Seed Mixture in Pounds of Pure Live Seed per Acre by Species

Common Name	Scientific Name	Pounds of Pure Live Seed per Acre
Little Bluestem	Schizachyrium scoparium	2.40
Big Bluestem	Andropogon gerardii	1.00
Indiangrass	Sorghastrum nutans	1.00
Black-eyed Susan	Rudbeckia hirta	0.05
Crimson Clover	Trifolium incarnatum	0.40
Green-headed Coneflower	Rudbeckia laciniata	0.20
Illinois Bundleflower	Desmanthus illinoensis	0.60
Lanceleaf Coreopsis	Coreopsos lanceolata	0.30
Partridge Pea	Chamaecrista fasciculata	0.40
Purple Coneflower	Echinacea purpurea	0.40
Purple Prairie Clover	Dalea purpurea	0.20
Upright Coneflower	Ratibida columnifera	0.10
Oxeeye Sunflower	Heliopsis helianthoides	0.50
Total		7.85

Table 2- Seed Mixture in Seeds per Square Foot by Species

Common Name	Pounds PLS per Acre	Seeds per Pound	Seeds per Square Foot
Little Bluestem	2.40	260,000	14.32
Big Bluestem	1.00	165,000	3.78
Indiangrass	1.00	175,000	4.01
Black-eyed Susan	0.05	1,575,760	1.81
Crimson Clover	0.40	225,000	2.06
Green-headed Coneflower	0.20	283,760	1.30
Illinois Bundleflower	0.60	85,000	1.17
Lanceleaf Coreopsis	0.30	221,000	1.52
Partridge Pea	0.40	65,000	0.59
Purple Coneflower	0.40	115,664	1.06
Purple Prairie Clover	0.20	317,000	1.45
Upright Coneflower	0.10	737,000	1.69
Oxeye Sunflower	0.50	126,000	1.45
Total			36.21

Table 3 - Groundcover in Native Grass and Forb Wildlife Seeding in August of 2012

Common Name	Scientific Name	Percent Cover
Little Bluestem	Schizachyrium scoparium	20.6%
White Oldfield Aster	Symphyotrichum pilosum	16.6%
Ragweed	Ambrosia artemisiifolia	15.6%
Dog Fennel	Eupatorium capillifolium	15.4%
Big Bluestem	Andropogon gerardii	12.0%
Indiangrass	Sorghastrum nutans	7.6%
Leaf Litter		7.0%
Crabgrass	Digitaris sanguinalis	3.2%
Horseweed	Conyza Canadensis	1.2%
Croton	Croton glandulosus	0.2%
Bare Ground		0.2%
Wild Lettuce	Lactuca virosa	0.2%
Rabbit Tobacco	Pseudognaphalium obtusifolium	0.2%

FDC Enterprises
Grasslands Services

GRASS BIOFUEL TO STEAM AT PIEDMONT GERIATRIC HOSPITAL (PGH)

Fred Circle, President, FDC Enterprises Inc.

A status report on the cooperative efforts of PGH; FDC ENTERPRISES & GRASSLAND SERVICES (FDC) AND NOTTOWAY COUNTY (NC) as of June 2012

I. BACKGROUND

PGH started testing grass biofuel (Native Warm Season Grasses--NWSG) in 2006 by direct firing small quantities of it into their Kewanee 200 HP fire tube boiler. This boiler (#3) was installed in 1985 and has a 6,900 pound per hour steam rating and has been burning sawdust for the past 25 years. PGH historically used a combination of boilers and fuels to meet their annual steam demands including sawdust in boiler #3 and #2 fuel oil in boilers #1 and #2. As the price of #2 fuel oil increased and the quality and availability of sawdust during winter months decreased, PGH was interested in finding an alternative biofuel that was available during winter and cheaper than #2 fuel oil. Therefore in the Fall of 2006 PGH in cooperation with other State, University and private interest started testing the use of Native Warm Season Grasses biofuel (NWSG/BF) by direct firing it in boiler #3.

2006-2010 was a period of budget ups and downs as well as trials and errors in direct firing NWSG/BF to produce steam. There was no operation manual available to guide the grass biofuel to steam effort. Therefore lots of adjustments in fuel size were made in an effort to get grass biofuel to feed throughout the entire fuel feed system. The objectives of the trials were to determine; a) if NWSG/BF could be harvested during the dormant growing season and processed using standard hay making equipment; b) if processed NWSG/BF could be burned to produce steam by direct firing it in boiler #3 without modification to the boiler or the fuel feed system and c) if NWSG would be more cost effective than #2 fuel oil during the winter months. After 3 years of trials/errors PGH processed and burned 17 tons of NWSG/BF to meet the steam needs of the hospital for 96 hours. This successful test resulted in 3 conclusions: 1) NWSG/BF can be harvested and processed using standard hay making equipment; 2) Processed NWSG/BF can be directly fired into boiler #3 through its fuel feed system without modification; and 3) NWSG/BF was a viable option to generate steam during the winter months. However there remain two major unanswered questions about NWSG/BF---could/would local landowners plant NWSG for biofuel and the cost effectiveness of this grass biofuel compared with #2 fuel oil. The answer to both questions came through FDC Enterprises Grassland Services and its partner company "First Source Biofuel (FSB)." FDC has been planting NWSG in Virginia since 2007. To date approximately 1,200 acres have been planted in Virginia. Some of the older stands have been harvested by FDC/FSB for biofuel. To meet the increasing demand for NWSG/BF FDC/FSB plans to increase supply to meet the projected demand.

II. 2011 A NEW ERA AT PGH

FDC/FSB was successful, through the procurement process, in getting the first state contract to provide "boiler ready" NWSG/BF to PGH starting in January 2011. This is the first grass biofuel contract to be issued by the State of Virginia.

On January 5, 2011 PGH started direct firing processed NWSG/BF in boiler #3 to produce steam. During the next 44 consecutive days PGH burned 401 tons of NWSG/BF and produced 3,943,744 pounds of steam. NWSG/BF provided 9,835 pounds of steam per ton and 11,329,920 BTU/ton or 5,665 BTU/pound of NWSG/BF. NWSG/BF boiler ready was delivered to PGH for $140.00/ton or $56,140.00 to produce 3,943,774 pounds of steam.

This event truly marks the beginning of a new era in Virginia's quest to "go green" by using renewable energy. The 401 tons of NWSG/BF burned during 44 days to produce 3,943,774 pounds of steam off set an equivalent of 35,212 gallons of #2 fuel oil at a cost of $2.84/gallon or $100,002.00---a cost differential of $43,862.00 in 44 days. A win-win resulted by offsetting 35,203 gallons of #2 fuel oil at a cost difference of $997.00/day of burning NWSG/BF.

III. CONTINUED PROGRESS IN BURNING GRASS BIOFUEL @ PGH

FDC/FSB was again successful through the State competitive bidding process, in getting the second contract to provide "boiler ready" NWSG/BF to PGH starting in January 2012.

On January 4, 2012 PGH started to direct fire processed NWSG/BF in boiler #3 to produce steam. From January 4 through February 29, 2012 PGH burned 552 tons of NWSG/BF during 50 days to produce 5,846,870 pounds of steam. NWSG/BF provided 10,592 pounds of steam per ton---or 12,202,163 BTU/ton or 6,101 BTU/pound. As in 2011 FDC/FSB was able to deliver boiler ready NWSG/BF for $140.00/ton or $77,280.00 to produce 5,846,870 pounds of steam.

As in the 2011 NWSG/BF test burn PGH continued to help the State "go green" by burning renewable energy. The 552 tons of NWSG/BF burned during 50 days to produce 5,846,870 pounds of steam off set an equivalent of 52,204 gallons of #2 fuel oil at a cost of $3.35/gallon, or $174,884.00, a cost savings differential of $97,604.00 during the 50 day test.

Another win-win resulted by offsetting 52,204 gallons of #2 fuel oil at a cost difference of $1,952.00 per day by burning NWSG/BF.

IV. NEW DEVELOPMENTS SPRING 2012

1. A cooperative venture with PGH; FDC/FSB and Nottoway County was established; this group selected a site to build a permanent NWSG/BF collection, storage, processing and distribution center on County owned land near Blackstone. These partners were also successful in getting a grant from the Virginia Tobacco Commission to help pay for construction. The Center is scheduled to be completed by Fall 2012.

2. PGH has a Performance Contract with Trane to install a new 400 HP biomass boiler and double the onsite biomass storage capacity. This project is estimated to be completed by Fall of 2013.

3. FDC/FSB has been issued a 5-year contact by the State to provide PGH with up to 2,000 tons of “boiler ready” NWSG/BF annually for the next 5 years starting delivery late Fall of 2012.

4. FDC/FSB plans to start long term (10 yr) contracting with local landowner for acreages to grow dedicated grass biofuel crops including NWSG and Miscanthus.

V. ACKNOWLEDGEMENTS

PGH is the first demonstration in Virginia that NWSG/BF can be direct fired into an existing solid fuel boiler to produce steam. This was achieved through the collaborative efforts of many individuals, agencies and businesses. A sincere THANKS!!! to each for your patience and tenacity during the past 6 years.

VI. CONTACTS FOR ADDITIONAL INFORMATION

PIEDMONT HOSPITAL ---	LARRY W. WILSON 434-767-4565 STEVE BOWEN 434-767-4577
NOTTOWAY COUNTY ---	JOHN PROSISE 434-645-8195
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Herbicide Safening to Aid in the Establishment of Three Native Warm-Season Grass Species

J.S. Smith, J.B. Rushing and B.S. Baldwin[1]

Abstract

Field trials were conducted to determine the efficacy of five herbicide safeners (benoxacor, fenclorim, fluxofenin, naphthalic anhydride, and oxabetrinil) in protecting three native warm-season grass species (big bluestem (Andropogon gerardii Vitman), little bluestem (Schizachyrium scoparium (Michx.) Nash), indiangrass (Sorghastrum nutans (L.) Nash)) from herbicidal injury caused by preemergent application of S- metolachlor. A safener effective in protecting big bluestem, indiangrass, and little bluestem from metolachlor injury would enhance stand establishment by suppressing annual grassy weeds. Laboratory studies generated dose response curves for each safener-species combination in order to determine optimal application rates. Field trials were planted in a randomized complete block design in May, 2012 near Starkville, MS.

Seedling emergence and weed control ratings were taken every two weeks for 10 weeks. Weed control ratings indicated a substantial weed seed bank was present. Seedling emergence indicated, all safeners protected big bluestem. Two treatments, fluxofenin and benoxacor, provided sufficient protection of big bluestem so that there was no difference in seedling emergence when compared to control plots (no herbicide and no safener). No safener treatment protected indiangrass. One safener treatment, fluxofenin, protected little bluestem. End of season harvest and Spring crown counts will further correlate seedling emergence with establishment.

<u>Introduction</u>: Native warm season grasses (NWSG) are of agronomic interest as forages, biofuel feedstock, and aids in soil and water conservation. In addition to these agronomic roles, NWSG are also important plant materials in ecological restoration projects. However, difficulties with stand establishment are significant obstacles to their wider agronomic use and can imperil restoration efforts. Competition with weed species is one major cause of stand failure, since most NWSG do not compete well with weeds at the establishment stage (Mitchell and Britton, 2000). Toward this end, selective herbicides can play an important role in stand establishment, but suppression of grass in grass at the seedling stage is nearly impossible. Use of herbicide safeners, compounds that protect crops from herbicide injury, as seed treatments offers a potential strategy to achieving that goal. However, a single safener does not protect a single crop against all herbicides or all crops against a single herbicide. Empirical studies are therefore necessary to determine a proper crop-herbicide-safener relationship. A safener effective in protecting big bluestem, indiangrass, and little bluestem from metolachlor injury would allow stands to be established with the use of this broad spectrum preemergent herbicide. The greatest benefit would be the suppression of annual grassy weeds while the perennial NWSG are establishing. Reducing competition from annual grassy weeds would aid on-site establishment, whether pasture, field margins, or restored prairie.

<u>Metolachlor:</u> Metolachlor [2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1- methylethyl) acetamide] is an extensively used, pre-emergent herbicide in the chloroacetamide class. Although applied pre-emergence, it does not prevent germination, but instead distorts seedling growth to such an extent as to prevent their establishment (Fuerst, 1987). Metloachlor's primary mode of action is inhibition of very-long-chain- fatty-acid synthesis (Boger et al., 2000).

<u>Herbicide Safeners:</u> Herbicide safeners act through three general mechanisms: competition between the herbicide and the safener at the active site of the target enzyme, reductions in herbicide uptake and translocation, and safener-enhanced metabolism of herbicides to detoxified forms (Abu-Quare and Duncan, 2002). The safeners included in this study have had their safening action correlated with increases in the detoxifying enzyme activity of the glutathione-GST system (Gronwald et al., 1987; DeRidder and Goldsbrough., 2006). Safeners are 'botanically specific,' with results varying between crops (Abu-Quare and Duncan, 2002). This botanical specificity is demonstrated by the safeners included in the present study. Oxabetrinil and fluxofenin protect sorghum (Fuerst and Gronwald 1986; Syngenta, 2008) and benoxacor, maize (Kreuz et al, 1989) from metolachlor injury. Fenclorim safens rice from pretilachlor, also a chloroacetamide herbicide (Wu et al, 1996). Naphthalic anhydride (NA) shows less botanical specificity than the others, protecting a range of grasses from several herbicides of different classes (Hatzios, 1989).

<u>Prospects for Safeners in NWSG:</u> Studies on the efficacy of safeners toward native grasses are limited compared to domesticated crops. However, the studies that have been conducted reported successful protection from metolachlor, but also botanical specificity as to which safeners were effective on which NWSG. Big bluestem was protected from metolachlor by oxabetrinil (Roder et al., 1987) and R-29148 (Griffin et al., 1988).

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Indiangrass was protected by R-29148 and NA (Griffin et al., 1988). Little bluestem was only protected by cyometrinil (Roder et al., 1987). Cyometrinil and R-29148 are no longer commercially available. Unfortunately the botanical specificity of safeners is not well understood. Therefore, we lack the information necessary to make predictions as to which safeners will work in which grasses, meaning specific crop-safener relationships must be determined empirically.

Materials and Methods: Field and lab tests were both performed on the cultivars; Kaw (big bluestem), Aldous (little bluestem), and Holt (indiangrass). Seed was treated with five safeners: oxabetrinil (Sigma-Aldrich; Allentown, PA), fluxofenin (Concep III®; Syngenta; Greensboro, NC), benoxacor (Sigma-Aldrich), fenclorim (VWR; Secaucus, NJ), and NA (Sigma-Aldrich). Field trials were conducted using S-metolachlor (Dual Magnum®; Syngenta; Greensboro, NC).

Dose response curves were generated for each species x safener combination (5 safeners x 3 species = 15 combinations) to determine the optimal application rate. Seed of each species was treated with five concentrations (25%, 50%, 100%, 150%, and 200%) of a published rate of each of five safeners and a control (0%). Oxabetrinil and NA were applied to seed at the 100% rate according to the ratios given in Table 1a, fenclorim and benoxacor according to Table 1b, and fluxofenin according to Table 1c. The compound/solution were added to enough water to thoroughly wet and coat the seed without excess liquid. Safener solution was applied using a Vortex-Genie 2 Mixer (Scientific Industries). Seed was dried in an open box under continuous air flow for 48 hrs. One-hundred seed of each treatment were spaced in a Petri dish lined with water moistened (5 mL) filter paper. Each species was treated with five safeners at five concentrations plus a control for a total of 26 treatments/species. Seed with no safener application served as the control. Each treatment was replicated six times. Petri dishes containing seed were placed in a growth chamber (Percival Scientific® GR-36VL; Perry, IA) set on alternating day and night temperatures (30/25oC) with 16 hr day lengths under cool white fluorescent tubes (50-60 µmol/m2/s illumination) (AOSA, 1992). Germinated seed in each dish were counted and recorded every other day for 22 days. Mean separation of each treatment was obtained using Proc GLM SAS (SAS, 2012). Optimal rates of safener were defined to be the largest dose of the safener that could be applied while causing either no significant decline in total mean germination compared to the control, or the largest concentration in the class below the control. Optimal rates were relative to both species and safener. Within a species there were differences between safeners. Within a safener there were differences between species. Optimal rates are given in Table 2.

Seed of each species were treated with the optimal rates of each safener prior to an in-field safening trial. The amount of seed to treat was determined by a planting rate of 11 lbs/acre PLS (Harper et al., 2007). Germination rates for calculating PLS were determined by the total mean germination of the species when treated with the optimal rate of the safener as defined by the lab study. Field trials were conducted at the H.H. Leveck Animal Research Unit near Starkville, MS on a Catalpa silty clay loam. Safened seed lots were tested in a randomized complete block design with four replications. Each rep consisted of seven treatments (five safeners and two controls) x three species. The two controls were no safener with no herbicide (NSNH) and no safener with herbicide (NS+H). Individual plots were 6' x 11' with eight rows per plot set on 10" centers. Seed was drilled (Almaco® 8-row planter) ¼" deep (Harper et al., 2007). After seeding, the NSNH plots were covered with 4 mil polyethylene plastic. The entire test field was then sprayed with S-metolachlor (Dual Magnum®; Syngenta) at a rate of 0.9525lb a.i./acre, and irrigated 24 hours later. Data collected on the field trial were seedling emergence counts and weed control ratings. Weed control ratings were based on a visual rating on a scale of one to five; one describing very poor weed control and five describing excellent weed control. Emergence counts were based on the mean number of seedlings per 12'' section of 4 rows. Emergence counts were repeated every other week for ten weeks. Mean separation of each treatment within a species was obtained using Proc GLM SAS(SAS, 2012).

Results and Discussion: Mean weed control ratings at week 10 were 1.33 for NSNH plots. Plots receiving metolachlor application had a significantly greater mean weed control rating (4.71). This indicated a substantial weed seed bank was present, but controlled by S-metolachlor. The mean seedling emergence for the three species under the five treatments and two controls are given in Table 2. For big bluestem all treatments are significantly greater than NS+H, meaning all treatments protected big bluestem. Two treatments (fluxofenin and benoxacor) were no different from NSNH, meaning they provided complete protection of big bluestem. Only fluxofenin was effective for little bluestem resulting in significantly greater emergence than NS+H, but it was significantly less than NSNH. Fluxofenin, therefore, provides only partial protection of little bluestem. No safener tested protected indiangrass.

Enhanced establishment through weed suppression provides benefits beyond the establishment year. Weed control allows for first year fertilizer application not possible when weeds are present. Improved performance in the establishment year allows perennial plants to more quickly develop root systems and crowns that will be used for subsequent years' growth. Long term yield lags can result from slow establishment. Safeners also allow for the protection of specific seed lots, even when planted into a seed bank of the same species. This is especially useful in a nursery setting where seed lots need to turned over to different varieties of the same species.

Conclusions: Significant differences in weed control ratings between NSNH plots and all others suggests the importance of herbicides in limiting weed competition during the establishment of NWSG. S-metolachlor can provide the needed weed control when effective herbicide safeners are identified. All safeners tested protected big bluestem as compared to NS+H, with fluxofenin and benoxacor providing sufficient protection so as to show no significant difference from NSNH. Only fluxofenin protected little bluestem, but there was a significant reduction in seedling emergence compared to NSNH. No safener tested here protected indiangrass. End of season harvest and crown counts remain to further correlate seedling emergence with establishment.

Literature Cited:

Abu-Quare, A.W., and H.J. Duncan. 2002. Herbicide safeners: uses, limitations, metabolism, and mechanisms of action. Chemosphere 48:965-974.

Boger, P., B. Matthes, and J. Schmalfub. 2000. Towards the primary target of chloroacetamides: new findings pave the way. Pest Manage. Sci. 56:497-508.

DeRidder, B.P. and P.B. Goldsbrough. 2006. Organ specific expression of gluthione-S- transferase and the efficacy of herbicide safeners in Arabidopsis. Plant Physiol. 140:167-175.

Fuerst, E.P. 1987. Understanding the mode of action of the chloroacetamide and thiocarbonate herbicides. Weed Tech. 1:270-277.

Fuerst, E.P. and J.W. Gronwald. 1986. Induction of rapid metabolism in sorghum (Sorghum bicolor) shoots by CGA-92194 and other antidotes. Weed Sci. 34:354-361.

Griffin, T.S., L.E. Moser, and A.R. Martin. 1988. Influence of antidotes on forage grass seedlingresponse to metolachlor and butylate. Weed Sci. 36:202-206.

Gronwald, J.W., E.P. Fuerst, C.V. Eberlein, and M.A. Egli. 1987. Effect of herbicide antidotes on glutathione content and glutathione-S-transferase activity in sorghum shoots. Pestic. Biochem. Physiol. 29:66-76.

Harper, C.A., G.E. Bates, M.P. Hansbrough, M.J. Gudlin, J.P. Gruchy, and P.D. Keyser. 2007. Native Warm Season Grasses: Identification, Establishment, and Management for Wildlife and Forage Production in the Mid-South. Univ. Tennessee Extension Inst. of Agric., Knoxville, TN.

Hatzios, K.K. 1989. Development of herbicide safeners: industrial and university perspectives. p 3-46. In: Hatzios, K.K. and R.E. Hoagland (ed.) Crop Safeners for Herbicides: Development, Uses, and Mechanisms of Action. Academic Press, New York, NY.

Kreuz, K., J. Gaudin, and E. Ebert. 1989. Effects of the safeners CGA-154281, oxabetrinil and fenclorim on uptake and degradation of metolachlor in corn (Zea mays L.) seedlings. Weed Res. 29:399-405.

Mitchell, R.B., and C.M. Britton. 2000. Managing weeds to establish and maintain warm season grasses. p 159-176. In: Moore, K.J., and B.E. Anderson (ed.) Native Warm Season Grasses: Research Trends and Issues. Spec. Publ. No. 30. CSSA, Madison, WI.

Roder, W., S.S. Waller, J.L. Stubbendieck, E.L. Moser, and A. Martin. 1987. Effects of herbicide safeners on sand and little bluestems. J. Range Manage. 40:144-147. Seedling Evaluation Committee of the Association of Official Seed Analysts. 1992.

Seedling Evaluation Handbook: Contribution No. 35 to the Handbook on Seed Testing. Assoc. Off. Seed Analysts.

Smith, A.P., B.P. DeRidder, W. Guo, E.H. Seeley, F.E. Regnier, and P.B. Goldsbrough. 2004. Proteomic analysis of Arabidopsis gluthione-S-transferase from benoxacor- and copper-treated seedlings. J. Biol. Chem. 279:26098-26104.

Syngenta. 2008. Concep III for use as a seed dressing to protect grain or forage sorghum from phytotoxic effects of S-metolachlor herbicide, SCP 101-L5F. Greensboro, NC.

Wu, J., H. Omokawa, and K.K. Hatzios. 1996. Glutathione S-transferase activity in unsafened and fenclorim-safened rice (Oryza sativa). Pestic. Biochem. Physiol. 54:220-229.

Table 1a: Applied rate (100%) of oxabetrinil and NA.

Safener	Published Safener Rate	a.i. / g seed	Water
Oxabetrinil	1.5 g a.i. / kg seed (Griffin et al., 1988)	1.5 mg / g seed	15 ml H20 / g seed
NA	5.0 g a.i. / kg seed (Griffin et al., 1988)	5 mg / g seed	15 ml H20 / g seed

Table 1b: Applied rate (100%) of fenclorim and benoxacor.

Safener	Published Safener Rate	Stock Solution (100,000x)	Dilution (100%)	Solution
Fenclorim	100 µM (Smith et al., 2004)	22.5 mg a.i. / ml methanol	1µL:1 ml H_20	15 ml / g seed
Benoxacor	100 µM (Wu et al., 2000)	26 mg a.i. / ml methanol	1µL:1 ml H_20	15 ml / g seed

Table 1c: Applied rate (100%) of fluxofenin.

Safener	Published Safener Rate	Emulsion	Final Ratio
Fluxofenin	0.4 g a.i. / kg seed (Syngenta, 2008)	200 µL Concep III® : 5 ml H20	10.85 µL emulsion : 15 ml H_20 : 1 gram of seed

Table 2: Optimal/applied safener rates and mean seedling emergence/12'' row at 10 weeks for big bluestem (Andropogon gerardii Vitman), little bluestem (Schizachyrium scoparium (Michx.) Nash), and indiangrass (Sorghastrum nutans (L.) Nash).

	Big Bluestem		Little Bluestem		Indiangrass	
Treatment	Mean	Rate	Mean	Rate	Mean	Rate
NSNH*	9.0625a	–	6.8125a	–	6.2500a	–
Fluxofenin	7.8125ab	50%	2.9375b	50%	0.3250b	200%
Benoxacor	7.3750abc	200%	1.0000c	200%	0.0000b	200%
Oxabetrinil	6.5625bc	200%	0.8125c	50%	0.3750b	100%
NA**	6.4375bc	100%	2.3125bc	50%	0.1875b	200%
Fenclorim	5.6875b	200%	1.0000c	50%	0.1250b	200%
NS+H***	3.6875d	–	0.6875c	–	0.1205b	–
LSD	1.8143		1.7164		1.2646	

*NSNH = control plots with no safener treatment and no herbicide application
** NA = naphthalic anhydride
*** NS+H = control plots with no safener treatment receiving herbicide application

Effect of Container Size and Fertilization on Field Establishment of Sweetgrass Plants

J.M. Grabowski, M.J. Williams, T. Socha, D. Findlay, M.A. Gonter[1]

Abstract

Sweetgrass [*Muhlenbergia sericea* (Michx.) P.M Peterson] is a clump-forming grass native to the southern Atlantic and Gulf coasts. Its leaves are the main component of African-coiled basketry produced by the Gullah/Geechee community. The U.S. Army Corps of Engineers is including sweetgrass in their coastal restoration projects in South Carolina to reestablish populations depleted by development and damage from hurricanes. However, plant survival has been disappointing, possibly due to small size of commercial transplants. In 2010, the USDA, NRCS Brooksville PMC began a 6-mo greenhouse production study of the effect of container size (shallow cone tray – 5.6 x 6.0 (cm); deep cone tray – 4.7 x 11.4; and 11.0 x 8.3 round pot) and fertilization (complete slow release at 100 lb N per acre based on area vs. no fertilizer) on plant growth. After the greenhouse phase, the plants were planted on Daufuskie Island, SC, with and without hydrated polymer gel and/or slow release fertilizer (50 lb N per acre based on area). Plants from the round pots were larger at 6 months compared to the other containers, but root and shoot growth of all treatments declined at around 4 months in the greenhouse. Greenhouse fertilization increased plant weight, but reduced subsequent field survival and is not recommended. Larger size of the plants in the round pot treatment did result in improved field survival. Neither fertilization at transplanting nor polymer gel improved field survival. Using larger transplants or increasing the planting rate will be necessary to improve survival in coastal restoration plantings.

Introduction: Sweetgrass is found in coastal dune land and at the margins of the marsh and woods from North Carolina south to Florida and west to Texas. In dune areas, it generally occurs on back dune sites (Tackett and Craft, 2010). It is the main component used for African-coiled basketry produced by the Gullah/Geechee community around Mt. Pleasant and Charleston, SC (Grabowski, 2009).

Sweetgrass is being recommended by the U.S. Army Corps of Engineers (USACE), Charleston District for use in coastal restoration plantings in South Carolina to reduce erosion and to reestablish populations that have been depleted by development and damage from hurricanes and tropical storms in areas. Survival of sweetgrass plants in a 2009 USACE planned restoration planting was much lower than the 89% found in field plantings installed by Brooksville PMC staff in 2008 (Williams et al., 2009). One suspected cause of this poor survival may be smaller plant size of commercially produced transplants. The objective of this study was: 1) to determine the effect of pot size and fertilizer on the development of sweetgrass transplants and 2) to determine what effect the different greenhouse propagation methods combined with treatments applied in the field at transplanting have on the subsequent survival of sweetgrass plants.

Materials and Methods: *Greenhouse Study* – On 4 May 2010, pre-divided sweetgrass ramets (approx. 1.5 cm diameter) were planted into three container size treatments (Shallow – 5.6 x 6.0 (cm) , 38 per tray; Deep – 4.7 x 11.4, 50 per tray; and Round – 11.0 x 8.3 round pot, 15 pots per tray). Half of the trays of each container treatment were fertilized with slow release fertilizer (14-14-14, Osmocote® 3-4 mo, The Scott Company, LLC., Marysville, OH) at 100 lb N per acre based on surface area. Trays were arranged in the greenhouse at the USDA, NRCS Brooksville Plant Materials Center in a RCB design with six replicates.

One randomly selected ramet in each treatment/rep was harvested for destructive sampling beginning 4 wk after planting and every 4 wk afterward throughout the 6 mo greenhouse growing period. The ramets were washed to remove the growing medium and each ramet was laid on a ruled board to measure maximum root length and maximum leaf length. After measurement, the shoots and roots were severed at the crown, dried for 7 d and weighed. After the 5 mo evaluation was completed, the tops of all plants were trimmed to approx. 15 cm leaf length because of lodging.

Field Study - Treatments consisted of one plant from each of the six greenhouse propagation treatments planted with and without polymer gel (9 oz hydrated gel; Terra-Sorb® Medium, Plant Health Care, Inc., Pittsburg, PA) and/or fertilizer (Osmocote 14-14-14 slow release fertilizer, 3-4 mo, 50 lb N per acre) at three locations on Daufuskie Island, SC. In total, there were 24 establishment combinations (6 greenhouse treatments X 4 field planting treatments). For the two seaside planting sites, [Haig Point (HP) and Oak Ridge (OR)], each of the 24 treatments were planted parallel to the water line at three landscape positions relative to the water. At the interior planting site (INT), there was no landscape position variable. The sites were planted on 2 Nov. 2010. All treatments were replicated five times at all three locations.

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Plant survival was rated quarterly (Feb, May, and August) in 2011 and plants were considered alive if any green leaves were present. Additionally, at the final rating date, plant height (cm, to the top of the tallest leaf or culm) and plant crown diameter (cm, average of two measurements taken at 90o from each other) were determined. At the HP site, a large number of plants were pulled out of the ground, apparently by deer. Plants that were uprooted or could not be found were recorded as missing plots.

Greenhouse data were analyzed using Statistix, version 8.2 (Analytical Software, 2005) as a factorial experiment with time, pot size, and fertilizer as factors. The field data for the two coastal planting sites (HP and OR) were analyzed as a split plot with landscape position (Water, Middle, and Upper) as the main plot and the 24 treatments (greenhouse treatments X field planting treatments) as the subplot. The interior site (INT) was analyzed as a RCB.

Results and Discussion: *Greenhouse Study* – Maximum leaf length was significantly affected by both fertilizer application and pot size (Table 1). Fertilization increased leaf length throughout the greenhouse period until the tops in all treatments began to lodge and were trimmed at 5 mo. However, leaf growth appeared to plateau at 4 mo in the production cycle. Leaves of plants in the Deep treatment were significantly shorter than those from the Shallow or Round treatments. Increased shoot growth of the fertilized plants may negatively affect root production as indicated by the significantly lower root:shoot ratios in these treatments (Table 2). A criticism of traditional horticultural containers used to produce transplants for coastal restoration is that shallow profile containers produce plants with shallow root systems that limit access to water deeper in the soil profile (Thetford et al., 2005). However, in this study, unlike what Thetford et al. (2005) found for transplants of gulf bluestem [*Schizachyrium maritimum* (Chapm.) Nash], RSR did not increase with decreasing pot size, possibly due to higher growing densities in this study or overall slower growth of sweetgrass plants.

Initial transplant size has been shown to affect survival after outplanting (Davies et al., 2002; Leskovar and Vavrina, 1998). In general, larger sized transplants have at least better initial survival (Davies et al., 2002; Leskovar and Vavrina, 1998). But pot size also affects production costs, as smaller pot sizes mean more plants can be produced per unit of greenhouse space (Vavrina, 2011). Declines in growth parameters at 4 mo suggests that the production system used in this study was starting to interfere with plant growth. Perhaps changes to this system, such as the addition of supplemental lighting, would allow the use of longer production periods to maximize root growth.

Field Study - Plant survival declined over time at all planting locations and landscape positions (Table 3). Survival at the INT location was higher than the two coastal locations. The effect of landscape position on survival differed for the two coastal plantings, with survival generally better at the Upper landscape position at HP but not at OR. Salt deposition may account for the survival difference at these locations. The HP site is at the northeastern end of the island and protected from storm events by Hilton Head Island. However, plant height and average diameter were not affected by landscape position for the coastal plantings. The plants at the INT location were taller (53 cm) than at the coastal sites (39 cm HP; 44 cm OR), but they did not have a larger diameter (3.3 cm, 4.1 cm, and 3.7 cm for HP, OR, and INT, respectively). The greater height for the INT plants was probably due to a combination of shade and presence of flower culms on some of the INT site plants that were not observed on plants in the coastal plantings.

There was no consistent effect of greenhouse pot size on plant height within or across landscape position and/or locations (data not presented). Plant diameter was consistently larger for the Round treatment at the coastal sites (HP - 3.2, 3.2, and 3.7 cm for Shallow, Deep, and Round, respectively; OR – 3.2, 3.6, and 4.9 cm for Shallow, Deep, and Round, respectively), but not at the INT site (3.3, 4.2, and 4.4 cm for Shallow, Deep, and Round, respectively).

Until the plants were trimmed in the greenhouse, fertilized plants were larger than the non-fertilized plants regardless of pot size (Table 2). This larger size did not translate to better survival or growth in the field. Survival of plants produced with fertilizer applied in the greenhouse was similar to the non-fertilized plants for the INT planting, but 12 to 14% lower at more stressful coastal sites. In tomato transplants, Liptay and Nicholls (1993) found an inverse relationship between N fertilization during transplant production and field survival.

Sweetgrass survival and plant height was essentially the same regardless of site planting treatment and position and/or location combination (data not presented). Specific planting treatments, such as fertilizer and hydrophilic polymers (i.e., gel) are often used with coastal plantings. Little information exists on the benefit of using gel when planting coastal plants, but the practice is recommended (Williams, 2007). This is the first controlled study looking at the use of gel or gel+ fertilizer with coastal planting and neither proved beneficial in this case.

Literature Cited:

Analytical Software. 2005. Statistix for windows, version 8.2. Analytical Software, Tallahassee FL.

Davies, A., N.P. Dunnett, and T. Kendle. 2002. The importance of transplant size and gap width in the botanical enrichment of species poor grasslands in Britain. Restor. Ecol. 7:271-280.

Grabowski, J. 2009. Plant guide for gulf hairawn muhly. USDA, NRCS. http://plants.usda.gov/plantguide/pdf/pg_mufi3.pdf (accessed 29 Feb. 2012, verified 1 Sep. 2012).

Leskovar, D.I., and C.S. Vavrina. 1999. Onion growth and yield are influenced by transplant cell size. Scientia Horticulturae 80:133-143. Elsevier Science B.V.

Liptay, A., and S. Nicholls. 1993. Nitrogen supply during greenhouse transplant plant production affects subsequent tomato root growth in the field. J. Amer. Soc. Hort. Sci. 118:339-342.

Tackette, N.W., and C.B. Craft. 2010. Ecosystem development on a coastal barrier island dune chronosequence. J. Coastal Res. 26:736-742.

Thetford, M., D. Miller, K. Smith, M. Schneider. 2005. Container size and planting zone influence on transplant survival and growth of two coastal plants. HortTech. 15:554-559.

Vavrina, C.S. 2011. Bigger is actually better: a study of transplant container cell size. HS814. Hort Sci. Dep., Univ. Florida, IFAS, Fla. Coop. Ext. Ser. http://edis.ifas.ufl.edu/pdffiles/HS/HS10700.pdf (accessed 28 Feb. 28 2012, verified 4 Sep. 2012).

Williams, M.J. 2007. Native plants for coastal restoration: what, when, and how for Florida. USDA, NRCS, Brooksville Plant Materials Center, FL. http://www.plant-materials.nrcs.usda.gov/pubs/flpmspu7474.pdf (accessed 1 Mar. 2012, verified 4 Sep 2012).

Williams, M.J., C.A. Gresham, and J.M. Whetstone. 2008. Evaluation of sweetgrass for dune restoration in coastal South Carolina. p. 159. In Proc. of the Sixth Eastern Native Grass Symposium, Columbia, SC, 7-10 Oct. 2008, Clemson, Univ., Agric, Forestry and Life Sci., Clemson, SC.

Table 1. Effect of fertilization and pot size on mean maximum leaf length of sweetgrass plants during the greenhouse growing period at the USDA, NRCS Brooksville PMC.

Treatments	1 Mo	2 Mo	3 Mo	4 Mo	5 Mo*	6 Mo	Mean
				cm			
Non-fertilized	48	58	72	78	76	33	61a1
Fertilized	57	70	83	91	93	36	72b
Shallow	53	62	77	92	95	34	69a1
Deep	50	53	67	76	79	32	59b
Round	56	76	88	85	80	36	70a

*Tops trimmed to 15 cm after this evaluation date.

[1] Means with different letters are significantly different at P<0.05 according to Tukey's HSD.

Table 2. Effect of fertilization and pot size on mean root:shoot ratio of sweetgrass plants during the greenhouse growing period at the USDA, NRCS Brooksville PMC.

Treatments	1 Mo	2 Mo	3 Mo	4 Mo	5 Mo*	6 Mo	Mean
				g/g			
Non-fertilized	0.30	0.20	0.16	0.12	0.19	0.41	0.23a1
Fertilized	0.25	0.16	0.12	0.11	0.16	0.32	0.19b
Shallow	0.29	0.19	0.14	0.12	0.16	0.40	0.22
Deep	0.27	0.18	0.12	0.13	0.22	0.30	0.20
Round	0.27	0.17	0.16	0.10	0.14	0.40	0.21NS2

*Tops trimmed to 15 cm after this evaluation date.

[1] Means with different letters are significantly different at P<0.05 according to Tukey's HSD.

[2] NS indicates that means are not significantly different according to ANOVA at P<0.05.

Table 3. Mean plant survival at three planting sites and three landscape positions (coastal sites only) on Daufuskie Island, SC recorded at three post-planting evaluation dates.

	Haig Point			Oak Ridge			
No. Days	Water	Middle	Upper	Water	Middle	Upper	Interior
		%			%		%
89	70b1	71b	89a	89	81	83NS	96
190	70	52	71NS2	80	75	74NS	89
274	57ab	39b	73a	59	70	58NS	87

[1] Planting position means within planting site are different at P<0.05 for each evaluation date according to Tukey's HSD.

[2] NS indicates that planting position means are not significantly different within a planting site according to ANOVA at P<0.05 for each evaluation date.

Understory Composition in a Restored Longleaf Pine Stand

R.J. Glennon[1]

Abstract

There were 90 million acres of longleaf pine in the southeastern United States in 1680. By 2000, that area had decreased to 3 million acres as stands were converted to loblolly pine and cropland and developed. The natural range of longleaf pine extends from southeastern Virginia to East Texas. Efforts have been launched to restore the longleaf pine ecosystem, especially on droughty soils to which it is uniquely adapted. Longleaf pine has value as timber, especially as utility poles. However, the motivation for the restoration is the restoration of the ecosystem, which includes an herbaceous understory maintained by prescribed fire and a suite of wildlife species dependent on that herbaceous understory. The typical understory grass throughout the range of the ecosystem is wiregrass (*Aristida stricta*). Southeastern Virginia is north of the range of wiregrass. However, there is a wide variety of grasses, forbs, vines, and shrubs that occur in association with longleaf pine. The grasses include velvet panicgrass (*Dichanthelium scoparium*), variable panicgrass (*Dichanthelium commutatum*), needleleaf rosettegrass (*Dichanthelium aciculare*), broomsedge (*Andropogon virginicus*) and slender woodoats (*Chasmanthium laxum*). The forbs include hairy lespedeza (*Lespedeza hirta*), roundhead lespedeza (*Lespedeza capitata*), and panicleleaf beggarweed (*Desmodium paniculatum*). Vines include Virginia creeper (Parthenocissus quinquefolia). Shrubs include American holly (*Ilex opaca*), wax myrtle (Morella cerifera), blackjack oak (*Quercus marilandica*), and blackberry (*Rubus argutus*). The poster will summarize the results of transects on a forest converted from loblolly pine to longleaf pine with well-drained Uchee loamy sand in Sussex County, Virginia.

Introduction: The longleaf pine ecosystem is characterized by its pine trees, but the effective function of the ecosystem relies on the understory composition. From North Carolina south, understories are dominated by wiregrass (*Aristida stricta*). Virginia is out of the range of wiregrass and other species occur in the herbaceous understory. The longleaf pine ecosystem is home to 30 threatened and endangered species whose occurrence relies on the herbaceous understory.

The longleaf pine ecosystem occurs from southeastern Virginia to eastern Texas. Longleaf pine will occur in mixed stands with other pines and hardwoods on soils from droughty to poorly-drained. The ecosystem reaches optimum function in pure stands on droughty soils with an herbaceous understory and frequent fire.

There has been a deliberate effort by conservation agencies and organizations in the Southeastern United States to restore longleaf pine ecosystems. In southeastern Virginia, The Nature Conservancy has established the Raccoon Creek Pinelands Conservation Area to protect longleaf pine areas with conservation easements and the USDA, Natural Resources Conservation Service has implemented its Longleaf Pine Initiative to share the cost of implementing conservation practices to establish and manage longleaf pine stands utilizing funds from the Wildlife Habitat Incentive Program.

The Virginia Department of Forestry, the Virginia Department of Game and Inland Fisheries, and the Virginia Department of Conservation and Recreation all provide technical assistance with longleaf pine establishment and management.

Materials and Methods: The study site is a clearcut loblolly pine stand located in southern Sussex County in southeastern Virginia. The soils are a Uchee loamy sand, a well-drained soil with a seasonally high water table more than 4 feet below the surface of the soil and rated as a hydrologic soil group A (high infiltration rate) on a scale of A to D.

The site was prepared by conducting a commercial clearcut of the loblolly pine on the site and treating it with the herbicides imazapyr (Arsenal), metsulfuron methyl (Escort), and Glyphosate (Accord). Imazapyr is both a contact and residual herbicide and has an activity in the soil for 6 months after being applied. Metsulfuron methyl is a contact herbicide for hard-to-control hardwood trees and shrubs. Glyphosate is a nonselective contact herbicide. The site was not burned before planting because the prescribed conditions for a burn did not exist before planting.

The longleaf pine was established by planting seedlings that had been grown in containers and had soil around the roots in January of 2009 at a stand density of 620 trees per acre.

Longleaf pine survival was evaluated on August 3, 2012. The average spacing of the surviving trees was 9 feet by 9 feet and the estimated stand population of 537 trees per acre. The average height was 5 feet; the range of heights was 3 to 7 feet.

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Herbaceous groundcover was evaluated on August 3, 2012. It was evaluated along 10, 100-point transects located midway between the rows of planted longleaf pine trees. The points were spaced 1 foot apart along a line suspended 3 feet above the ground. Points were determined by dropping a weighted pin from the line and recording the first thing that the pin intersected.

Results and Discussion: The groundcover was predominantly woody debris, leaf and needle litter, and dormant herbaceous stems (53.8%). There was no cover on 9.2% of the soil. Broomsedge (*Andropogon virginicus*) was the most prevalent plant species present with 9.6% cover. Needleleaf rosettegrass (*Dichanthelium aciculare*) had 4.7% cover and the annual forb poor joe (*Diodia teres*) had 4.1% cover. A total of 26 species comprised the 37.0% of the plant cover on the site. Five grass species account for 19.0% of the total cover. The data is presented in Table 1 and summarized in Table 2.

The significance of species present is discussed below: Broomsedge (*Andropogon virginicus*) is a native perennial warm season grass with erect, persistent foliage for wildlife cover. The seed is of little value as wildlife food (800,000 seeds per pound).

Panicgrass or Rosettegrass (*Dichanthelium spp.*) are native perennial warm season grasses with winter rosettes that flower in spring. The seed matures in early summer and is readily eaten by wildlife (380,000 seeds per pound).

Slender Woodoats (*Chasmanthium laxum*) is a native perennial warm season grass with non- persistent foliage. The seed heads resemble the seed heads of the coastal dune plant seaoats (85,000 seeds per pound).

Hairy Lespedeza (*Lespedeza hirta*) is a native perennial warm season legume with persistent stems. The seeds are readily eaten by wildlife (175,000 seeds per pound).

Roundhead Lespedeza (*Lespedeza capitata*) is a native perennial warm season legume with persistent stems. The seeds are readily eaten by wildlife (174,000 seeds per pound).

Partridge Pea (*Chamaecrista fasciculata*) is a native re-seeding annual warm season legume. The seeds are readily eaten by wildlife (65,000 seeds per pound).

Spurred Butterfly Pea (*Centrosema virginianum*) is a native perennial warm season legume with persistent stems. The seeds are readily eaten by wildlife (34,000 seeds per pound).

Panicleleaf Ticktrefoil (*Desmodium paniculatum*) is a native perennial warm season legume. The seeds are readily eaten by wildlife (200,000 seeds per pound).

Pineweed (*Hypericum gentianoides*) is a native perennial warm season forb with thin leaves and fine stems.

Poor Joe or Buttonweed (*Diodia teres*) is a native re-seeding annual warm season legume. The seeds are readily eaten by wildlife.

The succession on clearcut pine stands resembles the type of succession that occurs on power line rights-of-way maintained with spot spraying of herbicides to control woody species. The species composition within the vegetated component is similar to power line right-of-way succession, but there is a larger representation of forbs on the restored longleaf pine site.

To maintain the herbaceous understory, the landowner will manage the stand with prescribed burning once every three years after the longleaf pine is beyond the bottlebrush stage and can tolerate fire. He will control the hardwood trees and shrubs by spot spraying them with herbicides.

Table 1 – Groundcover Data in a Restored Longleaf Pine Site

Cover Type	Scientific Name	Average Cover (%)
Woody Debris		28.1
Leaf and Needle Litter		12.9
Dormant Herbaceous Stems		12.8
Bare Ground		9.2
Broomsedge	Andropogon virginicus	9.6
Needleleaf Rosettegrass	Dichanthelium aciculare	4.7
Poor Joe	Diodia teres	4.1
Horseweed	Conyza Canadensis	3.6
Pineweed	Hypericum gentianoides	2.4
Slender Woodoats	Chasmanthium laxum	1.8
Hairy Lespedeza	Lespedeza hirta	1.7
Velvet Panicgrass	Dichanthelium scoparium	1.6
Pokeweed	Phytolacca americana	1.4
Variable Panicgrass	Dichanthelium commutatum	1.3
Longleaf Pine	Pinus palustris	1.3
Partridge Pea	Chamaecrista fasciculata	0.8
Panicledleaf Ticktrefoil	Desmodium paniculatum	0.3
American Holly	Ilex opaca	0.3
Loblolly Pine	Pinus taeda	0.3
Blackjack Oak	Quercus marilandica	0.3
Path Rush	Juncus effusus	0.3
Devil's Walking Stick	Aralia spinosa	0.2
Ragweed	Ambrosia artemisiifolia	0.2
Virginia Creeper	Parthenocissus quinquefolia	0.1
Lichen		0.1
Sassafras	Sassafras albidum	0.1
Straw-colored Flatsedge	Cyperus strigosus	0.1
Roundhead Lespedeza	Lespedeza capitata	0.1
Croton	Croton glangulosa	0.1
Wax Myrtle	Morella cerifera	0.1
Blackberry	Rubus argutus	0.1

Table 2 – Summary of Groundcover Data in a Restored Longleaf Pine Site

Cover Type	Average Cover (%)
Non-Plant Cover	63.0
Grasses	19.0
Non-Legume Forbs	11.8
Legumes	2.9
Pines	1.6
Hardwoods	0.8
Other Evergreens	0.4
Grasslike Plants	0.4
Lichen	0.1

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