**Project Title:** Spread it and Forget it: Spoon-feeding Tall Fescue Pastures

**Investigators:** Robert L. Kallenbach and Brett T. Jones

**Objectives and relevance of project:**

Tall fescue is the predominant grass of Missouri’s 11 million acres in pasture and hay. It provides forage for more than 3.5 million beef cattle in Missouri. About one-half of all tall fescue acres receive some nitrogen (N) fertilizer in spring. Most of these applications are made in March or early April. Other times in which tall fescue acres are fertilized with N are in late spring to stimulate summer regrowth and in late-summer for autumn stockpiling.

In past years, ammonium nitrate and urea have been the most popular sources of N for spring and late-summer fertilization. Ammonium nitrate is widely considered the most reliable source of N for forage production as the N in ammonium nitrate is much less likely to be lost to volatilization than that in urea. However, ammonium nitrate is being phased out in many areas due to security concerns.

Given the pricing structure and potential problems with ammonium nitrate, urea is commonly used as a N source for forage production. This is due to urea’s wider availability and lower cost per N unit when compared to ammonium nitrate. In fact, in many rural areas the only source of N available for pastures is urea. While urea is a common source of N fertilizer for row crop applications in spring, its use for fertilization of pastures is problematic due to excessive nitrogen volatilization. Up to 40% of the N applied to pastures as urea can be lost due to volatilization if rainfall does not occur within 48 hours of an application. Given these problems, farmers are looking for a reliable and inexpensive source of N for pastures.

Environmentally Smart Nitrogen (ESN) is a polymer coated urea product from Agrium that offers protection from N volatilization. Additionally, N from ESN is released slowly over time and may provide a steady source of N throughout the growing season. We proposed to test an easy-management (Spread-it-and-Forget-it) protocol where a single application of ESN mixed with urea provides season-long N to the pasture. The ESN product has been an effective source of N for other crops, but research is needed to determine if the Spread-it-and-Forget-it program would be effective for pastures and if so, when is the ideal time(s) to apply it.

The **overall objective** is to test a simple N fertilization program that optimizes seasonal and annual production of tall fescue pasture. Specific objectives are:

**Objective 1:** Determine how the Spread-it-and-Forget-it program compares to fertilizing pasture with urea or ammonium nitrate.

**Objective 2:** Determine the best time to apply ESN/Urea mixture in the Spread-it-and-Forget-it program to optimize the slow-release characteristic of the product.

We propose a three-year experiment to evaluate forage production when N fertilization occurs at one of eight times. Fertilization timings will start in mid-March and continue at 45-d intervals, to end in late January the following year. This spectrum of N fertilization dates encompasses most cultural practices that Missouri producers employ.

**Procedures:**

*Treatments:* Eight N fertilization dates and four N sources (total of 25 treatments per block; Table 1) will be imposed on established tall fescue. The N rate will be 100 lb./acre (annual total). Soil pH, P and K levels will be maintained at those recommended by the University of Missouri Soil Testing Laboratory.
Table 1. Nitrogen fertilizer sources and application timings (45 days apart) to be applied to tall fescue pastures at the Forage Systems Research Center near Linneus, Missouri.

<table>
<thead>
<tr>
<th>N Application Date</th>
<th>N Fertilizer Source</th>
<th>N from ESN</th>
<th>Ammonium nitrate or Urea N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid-Mar</td>
<td>Urea</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>Late Apr</td>
<td>Urea</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>Mid-June</td>
<td>Urea</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>Late July</td>
<td>Urea</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>Mid-Sept</td>
<td>Urea</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>Late Oct</td>
<td>Urea</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>Mid-Dec</td>
<td>Urea</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>Late-Jan</td>
<td>Urea</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>Mid-Mar</td>
<td>Ammonium Nitrate</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>Late Apr</td>
<td>Ammonium Nitrate</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>Mid-June</td>
<td>Ammonium Nitrate</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>Late July</td>
<td>Ammonium Nitrate</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>Mid-Sept</td>
<td>Ammonium Nitrate</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>Late Oct</td>
<td>Ammonium Nitrate</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>Mid-Dec</td>
<td>Ammonium Nitrate</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>Late-Jan</td>
<td>Ammonium Nitrate</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>Mid-Mar</td>
<td>75/25% ESN/Urea</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>Late Apr</td>
<td>75/25% ESN/Urea</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>Mid-June</td>
<td>75/25% ESN/Urea</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>Late July</td>
<td>75/25% ESN/Urea</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>Mid-Sept</td>
<td>75/25% ESN/Urea</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>Late Oct</td>
<td>75/25% ESN/Urea</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>Mid-Dec</td>
<td>75/25% ESN/Urea</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>Late-Jan</td>
<td>75/25% ESN/Urea</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>---</td>
<td>Control</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Location and Design: This study will be conducted on tall fescue at the Forage Systems Research Center near Linneus, MO. Each treatment is replicated six times in a randomized complete block design. Individual plots are 20 ft. x 20 ft. Plots will not be relocated when a new year starts and plots will receive the same N fertilization date and source each year. The repeated measures allow detection of cumulative and residual effects of treatments.

Measurements: Grass height will be measured weekly in each plot with an ultrasonic sensor mounted to an ATV. Week-over-week measurements will allow us to determine weekly growth rates. At 5 times during the growing season, the ultrasonic sensor heights will be calibrated to dry matter yield by harvesting and weighing forage. This growth monitoring system allows us to determine 1) seasonal and annual forage production, 2) how quickly pastures respond to a fertilizer application, and 3) the dynamics of the best time to apply N fertilizer to optimize forage production.

Cultural practices: Growth will accumulate until grass height reaches approximately 10 inches. At that time, all plots will be grazed at a stocking density great enough to remove accumulated forage in 48 hours. Immediately after the initial or second grazing each spring, all plots will be mowed to 2.5 inches to remove reproductive structures and allow vegetative regrowth in summer and autumn. The residue will remain on the plots. We estimate approximately 4 grazing events per year, each time grass height measured before and after the grazing event to document forage mass.

Current status/importance of research area: Profitability in forage/livestock systems is strongly correlated to stored feed costs. When pastures supply feed, production costs are lower (Poore et al.,
Return on investment for fertilizer continues to be an important factor for forage/livestock managers. Managers like time-saving practices that are dependable and optimize plant growth; the Spread-it-and-Forget it program intends to make pasture fertilization easy and effective.

Previous research from our lab showed ESN had no advantage over urea, but only one fertilizer application date was utilized. However, pasture research from Georgia indicated that blending ESN with untreated urea at 50 to 75% gave optimal results (Payne, 2014). Additionally, forage fertilized with ESN had greater crude protein concentrations than when fertilized with urea and other enhanced efficiency N sources (Connell et al., 2011). Higher N concentration could be valuable to producers matching nutritive requirements of different classes of livestock to pasture resources.

Few unbiased experiments have evaluated the “Spread-it-and-Forget-it” management program. Our experimental design compares seasonal and total plant response to ESN and other N sources. Additionally, the experiment gives insight on the timing of fertilizer for pastures in Missouri.

**Expected economic impact of the project:** Fertilizer records from 2012-2013 indicate that in spring and fall, the top 20 Missouri counties for cattle inventory use 13% of the urea sold in Missouri. In contrast, about 45% of the ammonium nitrate sold in Missouri is used in the same counties in both spring and fall ([http://aes.missouri.edu/pfcs/fert/index.htm](http://aes.missouri.edu/pfcs/fert/index.htm)). From this data, we conclude that if ammonium nitrate becomes unavailable, the equivalent of about 150,000 tons of urea will likely take its place. The question remains if ESN adds enough value to warrant its use on pasture. Our research will help answer questions about the reliability and response of pastures to ESN fertilization and the associated Spread-it-and-Forget-it program.

**Timetable for proposed research:** This study will begin in spring of 2015 and end in December of 2018 (three years of study). The table below gives a brief summary of the project's activities. (* indicates task to be done on an annual basis throughout the three-year study).

<table>
<thead>
<tr>
<th>Activity</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locate and layout plot areas; take initial soil samples</td>
<td>2/15/2015</td>
</tr>
<tr>
<td>Apply nitrogen containing fertilizer products</td>
<td>*Eight times per year (45 days apart)</td>
</tr>
<tr>
<td>Measure grass height in plots with ultrasonic sensor</td>
<td>*Weekly all year long</td>
</tr>
<tr>
<td>Calibrate ultrasonic sensor to mechanical harvest</td>
<td>*April, May, June, August, October</td>
</tr>
<tr>
<td>Harvest plots with grazing cattle; determine forage mass and accumulation</td>
<td>*Variable based on plant growth (expect 3 to 5 harvests per year)</td>
</tr>
<tr>
<td>Prepare report to Fertilizer/Ag Lime Advisory Council</td>
<td>*December</td>
</tr>
<tr>
<td>Incorporate results into soil testing reports, hay school materials and forage conferences. Work with press on articles.</td>
<td>October 2015 through December 2018</td>
</tr>
<tr>
<td>Submit manuscript to a peer-reviewed journal</td>
<td>July 2019</td>
</tr>
</tbody>
</table>

**Application/transfer of knowledge:** We will transfer our results in three ways. First, we will incorporate the results and recommendations from this study into the curriculum of the grazing schools and the annual Forage Conferences held across the state. Second, we will work with the Soil Fertility Working Group and the Soil Testing Laboratory to refine the recommendations printed on soil testing results. Finally, we will prepare articles to be published in statewide and national magazines such as Missouri Ruralist, Stockman Grass Farmer and scientific (peer-reviewed) journals.

**References:**
Budget:

**YEAR 1**

**Salary and Benefits**

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Specialist (20% of $58,000)</td>
<td>$11,600</td>
</tr>
<tr>
<td>Benefits for Research Specialist</td>
<td>$3,944</td>
</tr>
<tr>
<td><strong>Total Salary and Benefits</strong></td>
<td>$15,544</td>
</tr>
</tbody>
</table>

**Operating Expenses**

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fertilizer, bags, repair parts for harvester and other field supplies</td>
<td>$3,740</td>
</tr>
<tr>
<td>Travel to research location (mileage, lodging, and meals for 8 trips/yr)</td>
<td>$1,600</td>
</tr>
<tr>
<td><strong>Total Operating Expenses</strong></td>
<td>$5,340</td>
</tr>
</tbody>
</table>

**Equipment**

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>$0</td>
</tr>
<tr>
<td></td>
<td><strong>Total Equipment</strong></td>
</tr>
</tbody>
</table>

*Total Proposal Request for Year #1* $20,884

**YEAR 2**

**Salary and Benefits**

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Specialist (20% of $59,740)</td>
<td>$11,948</td>
</tr>
<tr>
<td>Benefits for Research Specialist</td>
<td>$4,062</td>
</tr>
<tr>
<td><strong>Total Salary and Benefits</strong></td>
<td>$16,010</td>
</tr>
</tbody>
</table>

**Operating Expenses**

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fertilizer, bags, repair parts for harvester and other field supplies</td>
<td>$3,740</td>
</tr>
<tr>
<td>Travel to research location (mileage, lodging, and meals for 8 trips/yr)</td>
<td>$1,600</td>
</tr>
<tr>
<td><strong>Total Operating Expenses</strong></td>
<td>$5,340</td>
</tr>
</tbody>
</table>

**Equipment**

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>$0</td>
</tr>
<tr>
<td></td>
<td><strong>Total Equipment</strong></td>
</tr>
</tbody>
</table>

*Total Proposal Request for Year #2* $21,350
### YEAR 3

**Salary and Benefits**
- Research Specialist (20% of $61,532) $12,306
- Benefits for Research Specialist $4,184
- **Total Salary and Benefits** $16,490

**Operating Expenses**
- Fertilizer, bags, repair parts for harvester and other field supplies $3,740
- Travel to research location (mileage, lodging, and meals for 8 trips/yr) $1,600
- **Total Operating Expenses** $5,340

**Equipment**
- None requested $0
- **Total Equipment** $0

*Total Proposal Request for Year #3* $21,830

**GRAND TOTAL REQUEST** $64,064
Robert L. Kallenbach

Professor and State Extension Specialist  
Division of Plant Sciences – 108 Waters Hall  
University of Missouri  
Columbia, MO 65211

Phone (573) 884-2213  
Fax (573) 882-1467  
email: kallenbachr@missouri.edu

Education:
Ph.D., Agronomy, with an emphasis in statistics. 1994. Texas Tech University, Lubbock TX.  
B.S., Agronomy. 1989. Southwest Missouri State University, Springfield, MO.

Professional Employment and Experience (Since 1994):  

Professional Service, Honors and Awards (Since 2004):  
2014: National Excellence in Extension Award. (National award given to one person annually by the American Association of Public and Land Grant Universities and the National Institute of Food and Agriculture)  
2011: C. Brice Ratchford Fellow. (Fellowship given to one person in the MU-system annually)  
2010: Missouri Grasslander - Agency. (Statewide award given by the Missouri Forage and Grassland Council to one agency person each year)  
2009: University of Missouri "Teamwork Extension Award". (System wide award given to a group of faculty and regional specialists working together on innovative outreach programming.)  
2007: Donald W. Fancher Provost Award for Outstanding Achievement in Extension and Continuing Education. (Campus-wide award given to one faculty member at the University of Missouri each year.)  
2004: Young Crop Scientist award presented by the Crop Science Society of America (International award given to one scientist under 37 years of age annually)  
2004: J.W. Burch State Specialist Award for Outstanding Statewide Program Leadership  
2004: Gamma Sigma Delta Honor Society award for Excellence in Extension Education

Membership in Professional Societies:  
American Society of Agronomy, 1990 to present  
Crop Science Society of America, 1990 to present  
American Forage and Grassland Council, 1990 to present  
Missouri Forage and Grassland Council, 1998 to present  
Gamma Sigma Delta Honor Society of Agriculture, initiated in 1988

Research Activities:
Refereed Journal Articles  
Book Chapters  
Proceedings and Abstracts  
Grants Dollars Awarded (last 5 years)  

64  
2  
121  
$4,625,299

Extension Education:
Extension Manuals and Guides  
Workshops and Short Courses taught  
Extension education meetings and classes taught  

34  
148  
452
Refereed Journal Articles (Since 2010):
Brett T. Jones

200A Waters Hall
Columbia, MO 65211
bj2mb@mail.missouri.edu

(417) 366-1148

Education

PhD 2017 (IP)  Plant, Insect, and Microbial Sciences
University of Missouri
Dissertation: Response of beef cattle selected for tolerance to tall fescue
toxicosis
Advisor: Dr. Robert Kallenbach

BS 2012  Plant Science, Crop Management emphasis
University of Missouri
Minors: Agriculture Economics and Animal Sciences
GPA: 3.71

Employment

2012 to Present  Graduate Research Assistant
Division of Plant Sciences, University of Missouri
Supervisor: Dr. Robert Kallenbach

2012  Lab Assistant
Division of Plant Sciences, University of Missouri
Supervisor: Dr. Robert Kallenbach

2011  Maize Product Development Intern
Pioneer Hi-Bred International, Inc., Miami, Missouri
Supervisor: Tiffany Thorton

2009 to 2012  Undergraduate Research Assistant
Division of Plant Sciences, University of Missouri
Supervisor: Dr. Robert Kallenbach
Presentations


August 24, 2013  GrowSafe Research presented to the Southwest Research Center Beef Field Day in Mt. Vernon, MO.

September 11, 2014  Tall Fescue Toxicosis presented to the Southwest Research Center Ag Education Field Day in Mt. Vernon, MO.

September 12, 2014  Influence of Cattle Genetics on Tall Fescue Toxicosis presented to the Southwest Research Center Field Day in Mt. Vernon, MO.

November 3, 2014  Polymorphisms at DRD2 Gene Affect the Gains of Cow-Calf Pairs on Tall Fescue Pasture presented at the 2014 ASA, CSSA, SSSA Annual Meeting in Long Beach, CA.

January 12, 2015  Polymorphisms at DRD2 Gene Affect the Gain and Intake of Heifers fed Tall Fescue Silage presented at the 2015 American Forage and Grasslands Council Annual Conference in St. Louis, MO

Grants & Gifts

Fall 2014  Division of Plant Sciences Travel Fund – Graduate Student Travel Grant $750

Teaching

Fall 2013  Forage Crops – Plant Sciences 3270
Instructor: Dr. Jeanne Mihail and Dr. Michael Collins

Publications
