Missouri Fertilizer and Lime Board
2009 Project Proposal

Optimum Timing of Nitrogen and Phosphorus Applications for Improved Tall Fescue Seed Production

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Objective and Relevance – **The Problem:** Missouri produces large quantities of tall fescue seed, but average yields are very low. **The Hypothesis:** Optimal timing of nitrogen (N) and phosphorus (P) fertilization, along with the stripkill production method, will greatly increase tall fescue seed yields in Missouri. **The Objective:** to determine the optimum timing of N and P applications for maximum tall fescue seed production in Missouri.

In our most recent tall fescue seed production project, our yields were almost 300 lbs/acre lower with late August N treatments than for 0 N treatments with our stripkill production system (see final report). All plots were treated with 75 lbs N in mid-winter. Evidently, early fall N treatments produced a massive amount of vegetative growth that smothered out plants during the winter, and in other cases, caused lodging in June. However, the high seed yields with stripkill were produced on plots that were treated with P in late August. The experiment proposed is designed to address the appropriate timing of N and P fertilization treatments for tall fescue seed production in Missouri.

Missouri is the number one state in production of uncertified tall fescue seed, while Oregon leads the nation in the production of certified seed (USDA National Agricultural Statistics Service 2007). Another interesting comparison between these two states is in tall fescue seed yields. In Oregon, tall fescue seed is grown in cultivated rows, like wheat, whereas in Missouri tall fescue seed is generally harvested from pastures. In Oregon, seed yields of 1500 lbs/acre are common, while in Missouri the average seed yield is <200 lbs/acre (see ref. above). Last summer our best plot yielded just over 1000 lbs/acre of tall fescue seed when we used stripkill with fall P, but 0 fall N additions. Of course, last summer was a great tall fescue seed yield season and our control plots (no stripkill or P fertilization) averaged over 400 lbs/acre.

Procedures – A tall fescue site will be selected at the Agronomy Research Center near Columbia. Site selection will be based on the tall fescue stand and plot area fertilization history. At this location, untreated plot areas are typically low in Bray I P, and in our past studies, tall fescue seed yields have shown good responses to P treatment. In mid-August 2009, forage will be removed from the plot area and the tall fescue will be allowed to re-grow for about 10 days before 7.5” wide strips are killed with Roundup, leaving 7.5” wide strips of tall fescue. We will use our “homemade” spray rig, built by Will McClain II on his PhD project, and used for the “recently completed” tall fescue seed production grant (see final report). A blue tracking dye will be added to ensure the width and location of the sprayed areas. Plots will be randomly assigned with the following treatments and replications:

N treatment splits: a) 0 lbs N late Aug + 100 lbs N in late Dec
b) 50 lbs N late Aug + 50 lbs N in late Dec
c) 100 lbs N late Aug + 0 lbs N in late Dec
P treatment splits: a) 0 lbs P in late Aug + 50 lbs P in late Dec
b) 25 lbs P in late Aug + 25 lbs P in late Dec
c) 50 lbs P in late Aug + 0 lbs P in late Dec
Production system: Conventional pasture or Stripkill
Replications: Five replications of each treatment
Total plots = 90 (10' x 25') plots with 5' borders
(3 Ntrtmts x 3 Ptrtmts x 2 ProdSystems x 5 reps = 90 plots total)

Ammonium nitrate will be used as the N source and MAP will be used as the P source, unless triple superphosphate can be found. If MAP is used, the equivalent amount of N added as MAP will be applied to all plots. Seed will be harvested with a plot combine around June 18 of each year. A forage harvester will be used on the combined area to cut remaining forage and this forage will be mixed with the combine residue (sometimes called aftermath). This total forage harvest will provide an indication of the biomass produced on each plot in response to the N and P treatments.

Forage will be removed and treatments will be repeated on the same plots during August of the second year. Strips will be re-used (without additional Roundup treatment) for the second year. Treatments and harvests will be identified to those used during year one.

After combining, seed will be screened to remove any stems and other trash prior to weighing and moisture determination for final seed yield determination. Total forage fresh weight will be determined at harvest time and weights of sub-samples will be determined before and after drying for dry weight determination. This will allow determination of total plant biomass production from each treatment and calculation of % seed vs % biomass for each plot.

Current status/importance of research area – Missouri has over 13 million areas of tall fescue pasture (Missouri Farm Facts 2007). Some of this pasture is used for seed production, but the yield is low compared to drilled stands devoted to seed production. Last summer, producers received $0.45/lb for good quality tall fescue seed making seed production a profitable endeavor. However, we need to improve the productivity of pasture land used for tall fescue seed production. In Missouri, it is recommended that most N be applied in mid-winter for maximum tall fescue seed production, but there is very little information available on optimum timing of P applications (Wheaton, H.N. Seed production of tall fescue and other cool season grasses. MU Extension G4670). As mentioned earlier, last year early fall N application, from three different N sources, produced lower seed yields than plots receiving 0 N on our stripkill plots, and we observed massive vegetative growth and lodging in some of these plots. On the other hand, seed yield responded to early fall P applications. Tall fescue seed production in Missouri usually declines after pastures are three or four years old (Wheaton, see ref.

above). In addition, Wheaton (see above) mentions that solid tall fescue stands are often "skim" plowed to a depth of 3" or 4" to encourage better seed production. Over the last three years, we have harvested (dug) tall fescue root systems in order to study root growth in late fall, winter and early spring. We observed that tall fescue from well-established pastures was "root bound". The massive root systems were thick and intertwined, and this could have major effects on seed production. Opening up the above and below grown "canopies" with our stripkill method would allow new root growth. New root growth increases the number of root tips, the main course of the hormone cytokinin, which plays a major role in seed production (Taiz and Zeiger. 2006. Plant Physiology textbook). Determining the proper timing of N and P fertilization, and using stripkill should provide valuable information for increasing tall fescue seed production on Missouri pastureland.

Expected economic impact of the project – The economic impact for Missouri forage producers could be very important. Using the correct N and P application times and rate, plus stripkill will likely increase seed yields over the 150 lbs/acre current state average. With good weather and management, and we now know that 1000 lbs/acre are possible. At $0.45/lb, this yield level would gross $450/acre. Plus, there is the "aftermath" for hay, then after some re-growth, grazing of the acreage used for seed production is possible.

Timetable for proposed research

2009

June-July - Locate sites, test soil, select site

mid-August - Harvest and remove tall fescue forage from plot area

10 days later - Flag plots, kill strips with Roundup, wait two day, then apply N and P treatments

2010

Mid-June - Start checking plants for seed maturity, combine seed when mature, then immediately harvest aftermath, cut and remove remainder of forage

- Clean and weigh seed, dry and weigh forage samples

July - Calculate seed yield and total forage production for each plot.

- Statistically analyze data and draw graphs of seed and forage production versus N and P treatments, and stripkill versus conventional production systems

Mid-August - Repeat for year two using the same strips and conventional plots, with identical treatments used in year one

Strategy for application/transfer of knowledge - Results from this study will be presented at Southwest Center (Mt. Vernon) and Agronomy Research Center (Columbia) Field Days, and possibly other field days around the state. Regional newspaper and agricultural magazine articles will be prepared in advance of the field days by agricultural journalists. After the second year, a paper will be presented at the American Society of Agronomy meetings, and a refereed journal article will be prepared for publication.

Budget:

Category	Year 1	Year 2	Total
Salary			
Research Assistant (25%)	$9,000	$9,500	$18,500
Benefits	2,500	2,625	4,125
Supplies (fertilizer, Roundup, nozzles, gas)	2,000	2,000	4,000
Travel	750	750	1,500
Total	$14,250	$14,875	$29,125

RESUME

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Education

B.S. in Chemistry, Southwest Missouri State University, 1965
M.S. in Soils (Plant Nutrition), University of Missouri, 1967
Ph.D. in Plant Physiology, University of Kentucky, 1972

Experience

1985 - present, Professor, Division of Plant Sciences, U. Missouri, Columbia
1980 – 1985 Associate Professor, Agronomy Department, U. Missouri, Columbia
1978 - 1980 Assistant Professor, Agronomy Department, U. Missouri, Columbia
1974 - 1977 Assistant Professor, Botany Dept., U. Maryland, College Park
1972 - 1974 Postdoctoral Research Associate, Department of Botany and Plant Pathology, Oregon State University, Corvallis

Awards

1982 Gamma Sigma Delta Superior Research Award for Junior Faculty in Agriculture
1983 Amer. Soybean Assoc./ ICI International Soybean Researchers Recognition Award
1983 Gamma Sigma Delta Superior Graduate Teaching Award
1992 Fellow of the American Society of Agronomy
1992 Fellow of the Crop Science of America
1992 Distinguished Faculty Award, UMC Alumni
1993 Kemper Teaching Award, UMC
2006 Outstanding Graduate Advisor, CAFNR, UMC

2006 Teaching Academy, CAFNR, UMC

Selected Publications

Waters, B.M., D.G. Blevins and D.J. Eide. 2002. Characterization of FRO1, a pea (*Pisum sativum*) ferric-chelate reductase involved in root Fe uptake and tissue Fe distribution. Plant Physiol. 129:1-10.

Lock, T.R., R.L. Kallenbach, D.G. Blevins, T.M. Reinbott and G.J. Bishop-Hurley. 2002. Adequate soil phosphorus decreases the grass tetany potential of tall fescue pasture. Online. Crop Management doi:10.1094/CM-2002-0809-01-RS.

Lock, T.R., R.L. Kallenbach, D.G. Blevins, T.M. Reinbott, G.J. Bishop-Hurley, R.J. Crawford, M.D. Massie and J.W. Tyler. 2004. Phosphorus fertilization of tall fescue pastures may protect beef cows from hypomagnesaemia and improve gain of nursing calves. Online. Forages and Grazinglands doi:10.1094/FG-2004-0608-010RS.

Reinbott, T.M., S. P. Conley, and D. G. Blevins. 2004. No-Tillage Corn and Grain Sorghum Response to Cover Crop and Nitrogen Fertilization
Agron. J. 96:1158-1163.

Blevins, D.G., M. Massie and W. McClain. 2004. Phosphorus fertilization improves quality of stockpiled tall fescue. Better Crops with Plant Food 88:7-9.

Bolanos, L., K. Lukaszewski, I. Bonilla and D. Blevins. 2004. Why boron? A Reviw. Plant Physiology and Biochemistry 42:907-912.

Todd, C.D., P.A. Tipton, D.G. Blevins, P. Piedras, M. Pineda and J.C. Polacco. 2006. Update on ureide degradation in legumes. J. Exp. Botany 57:5-12.

McClain II, W.E. and D.G. Blevins. 2007. Phosphorus fertilization increased macronutrient concentrations in leaves of stockpiled tall fescue. Online. Forage and Grazinglands doi:10.1094/FG-2007-0302-01-RS.

Blevins, D.G. and D.J. Barker. 2007. Chapter 5. Water and Nutrients in Forage Crops. In: Forages II, R. Barnes, C.J. Nelson, et al. eds. American Society of Agronomy. pp. 67-80.

Stacey, M.G., A. Patel, W.E. McClain, M. Mathieu, M. Remley, E.E. Rogers, W. Gassmann, D.G. Blevins and G. Stacey. 2008. The Arabidopsis AtOPT3 Protein Functions in Metal Homeostasis and Movement of Iron to Developing Seeds. Plant Physiology 146:589-60.

Kering, M.K., K. Lukaszewska and D.G. Blevins. 2008. Manganese Requirement for Optimum Photosynthesis and Growth in NAD-Malic Enzyme C-4 Species. Plant and Soil. Available online, paper in press.