

## 2006-07 Missouri Fertilizer & Lime Proposal

1. **Title: Using Dolomitic Limestone and Timing of Phosphorus Fertilization to Maintain High Leaf Phosphorus and Magnesium Concentrations in Stockpiled Fescue During the Winter**
2. **PI:** Dale G. Blevins, Professor & Kemper Fellow, Division of Plant Sciences
3. **Objectives and relevance to the Missouri fertilizer/lime industry:** The objective of this study is to maintain high phosphorus (P) and magnesium (Mg) concentrations in tall fescue leaves in late winter by using dolomitic limestone (Mg source) and the correct timing of P applications. Results from this research should support the development of a procedure that will keep both P and Mg concentrations in tall fescue leaves high enough in late winter to support the dietary needs of a lactating beef cow. The results produced by this study should provide evidence that will support the use of dolomitic limestone and P fertilization for improving the quality of stockpiled tall fescue for late winter/early spring calving beef herds in Missouri. This project should benefit both the Missouri lime and fertilizer industries by promoting the use of both limestone and P fertilizer on the 13 million acres of tall fescue pastures in the state.
4. **Procedures:** A K31, endophyte-infected, established tall fescue pasture will be selected at the Southwest Center near Mt. Vernon, MO. This area is in the heart of the state's feeder calf industry, which depends on tall fescue pastures. Soil samples will be collected in early June and low soil P (Bray I) and a need for liming based on low soil test pH and N.A. results will be used for final site selection. The plot size will be 10' x 25' with 5' alleys. In late June, dolomitic limestone will be applied to specific plots at a rate of 0 or 1X (X = the amount of lime recommended by the MU Soil Test results). During the third week of August, forage will be harvested and removed from the plot area. At this time, the site will be treated with 100 lbs N/acre and potash will be applied according to soil test recommendations. A total of 25 lbs P/acre will be applied to P treated plots, according to the attached timing chart (Table 1). Specifically, there will be plots receiving 0 lbs/acre P (control), plots with 25 lbs P/acre applied the first week of September, and plots receiving split applications of P. All split P application plots will receive 12.5 lbs P/acre in September, and the remaining 12.5 lbs P/acre will be applied in October, November, December, January, or February. Consequently, there will be 2 lime rates (0 & 1X), 7 P treatment/times and 6 replicates of each treatment = 84 total plots. Starting in October 2007, 20 of the most recently collared leaves will be harvested monthly through April. In late May and late August, hay will be harvested and samples will be weighed for yield determination. Subsamples will be collected for elemental analysis. Hay samples and leaf samples will be dried, ground, digested in nitric acid, filtered, diluted and analyzed for macro- and micronutrient elements using ICP. Data will be analyzed by SAS to determine the effects of liming and specific timing of P application on leaf P and Mg concentrations, as well as the impact of these treatments on leaf concentrations of other elements, as well.

5. **Current status/importance of research area:** This research is designed to support and improve the forage and livestock industry in the state. This is the state's largest agricultural enterprise. The 13 million acres of tall fescue pasture in Missouri are one of the main reasons why the state ranks only second to Texas in the number of feeder calves produced per year. Cattle producers can increase their profit margins by stockpiling tall fescue for winter grazing instead of cutting, baling, hauling, storing and feeding hay. However, there are a few problems with the macronutrient quality of stockpiled tall fescue that we have been addressing. Our recent results show that P and Mg concentrations in leaves of stockpiled tall fescue decline during winter and often drop below levels required by lactating beef cows, even with the application of large quantities of P fertilizer (Fig. 1). It is common for calving to begin in February, and this is the time of lowest P and Mg concentrations in leaves of tall fescue. However, in one of our studies, we found that P applied in December increased leaf P concentrations in January (Fig. 1). This result indicates that by applying P late in the fall or early winter, the drop in leaf P concentrations might be prevented in January and February. In another study, we found that applications of dolomitic limestone significantly increased leaf Mg concentrations of stockpiled tall fescue even in late winter (Fig. 2). In this proposed research, we hope to combine the use of dolomitic limestone and the timing of P fertilization to maintain higher levels of P and Mg in stockpiled tall fescue leaves during late winter. This would be of great value to beef cattle producers who use stockpiled tall fescue.

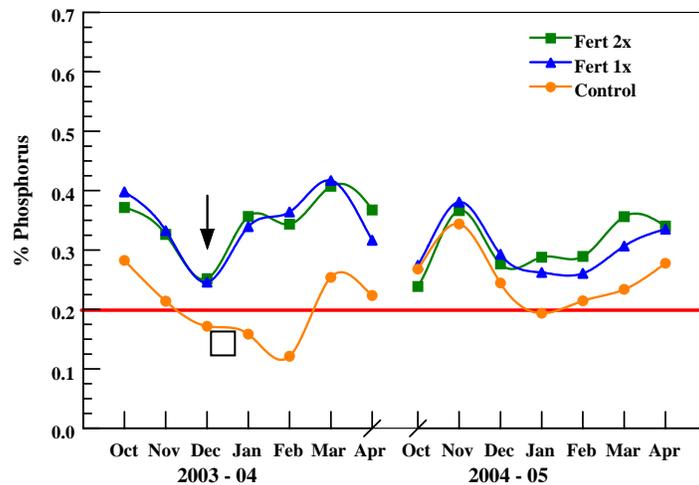


Figure 1. Phosphorus fertilization of tall fescue plots in late August and again in December greatly increased leaf phosphorus concentration in January and February. The top horizontal line indicates the P required for a lactating beef cow and the lower horizontal line indicates the requirement of a dry cow (from: McClain, 2007. PhD Dissertation. MU).

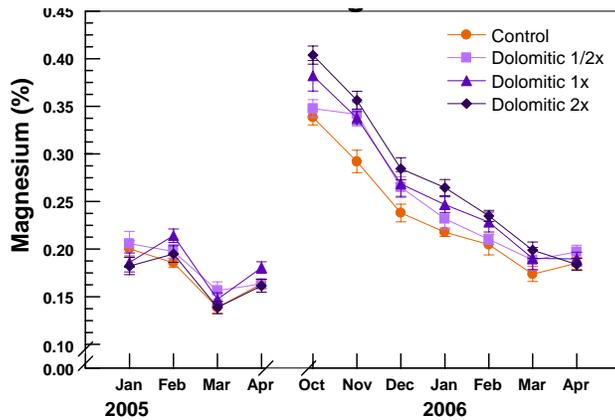


Figure 2. Magnesium concentrations in stockpiled tall fescue leaves harvested monthly from plots treated with 0x, 1/2x, 1x and 2x the recommended dolomitic limestone rate at the Southwest Research Center near Mt Vernon.

- Timetable:** Timing of P fertilization is a key component of this study. Several sites will be examined in early June and soil samples will be collected and analyzed. By late June, soil test results and the quality of the tall fescue stand will be used for final site selection. The plots will be established and dolomitic limestone will be applied to the appropriate plots. During the first week of September, the P fertilization treatments will begin according to Table 1. Leaf samples will be taken each month from October through April of each year, and in late May and August forage will be cut, removed, dried and weighed for yield determinations. Samples from leaf and hay harvests will be prepared and analyzed for macro- and micronutrient content shortly after they arrive in the laboratory. At the end of the two year study, data will be analyzed using SAS and graphs will be prepared for presentations and publications.

Table 1. Schedule for phosphorus fertilization.

	Sep	Oct	Nov	Dec	Jan	Feb
Trtmt #	lbs/acre					
1	0	0	0	0	0	0
2	25	0	0	0	0	0
3	12.5	12.5	0	0	0	0
4	12.5	0	12.5	0	0	0
5	12.5	0	0	12.5	0	0
6	12.5	0	0	0	12.5	0
7	12.5	0	0	0	0	12.5

- Strategy for application and transfer of knowledge:** The results of this study will be presented at Southwest Center Field Days, as well as several meetings of the Missouri

Cattlemen's Association, forage and cattle producer meetings in the state, and at the North Central Extension-Industry Soil Fertility Conference. The final results of this research will be presented at the annual meeting of the American Society of Agronomy and published in refereed journals.

#### 8. Budget:

<u>Category</u>	<u>Year 1</u>	<u>Year 2</u>
Salary		
Research Assistant (50%)	\$16,000	\$17,000
Benefits	4,000	4,250
Supplies (fertilizer, chemicals, DI H <sub>2</sub> O, argon, filter paper, nitric acid)	2,250	2,500
<u>Travel to Mt. Vernon</u>	<u>1,000</u>	<u>1,000</u>
Total	\$23,250	\$24,500

#### Resume:

**Dale G. Blevins** - Professor of Agronomy

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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, Agronomy Department, 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**

- Reinbott, T.M. and D.G. Blevins. 1997. Phosphorus and magnesium fertilization interaction with soil phosphorus level: Tall fescue yield and mineral element content. *J. Production Agriculture* 10:260-265.
- Reinbott, T.M., D.G. Blevins and M.K. Schon. 1997. Content of boron and other elements in main stem and branch leaves and seed of soybean. *J. Plant Nutrition* 20: 831-843.
- Blevins, D.G. and T.M. Reinbott. 1998. Impact of phosphorus nutrition on magnesium, calcium and water status of plants. *Current Topics in Plant Physiology: An American Society of Plant Physiologists Series* 19:197-206.
- Blevins D.G. and K.M. Lukaszewski. 1998. Boron in plant structure and function. *Annual Review of Plant Physiology and Plant Molecular Biology* 49:481-500.
- Markwell, J. and D.G. Blevins. 1999. The Minolta Spad-502 leaf chlorophyll meter: An exciting new tool for education in the plant sciences. *The American Biology Teacher* 61:672-676.
- Reinbott, T. M. and D.G. Blevins. 1999. Phosphorus nutritional effects on root hydraulic conductance, xylem water flow and flux of magnesium and calcium in squash plants. *Plant and Soil* 209:263-273.
- Waters, B.M. and D.G. Blevins. 2000. Ethylene production, cluster root formation and localization of iron (III) reducing capacity in Fe deficient squash roots. *Plant and Soil* 225:21-31.
- Smith, G.J., W.J. Wiebold, T.L. Niblack, P.C. Scharf and D.G. Blevins. 2000. Yield components of soybean plants infected with soybean cyst nematode and sprayed with foliar applications of boron and magnesium. *J. Plant Nutrition* 23:827-834.
- Smith, G.J., W.J. Wiebold, T.L. Niblack, P.C. Scharf and D.G. Blevins. 2001. Macronutrient concentrations of soybean infected with soybean cyst nematode. *Plant and Soil* 235:21-26.
- Lock, T.R., R.L. Kallenbach, D.G. Blevins, T.M. Reinbott, G.J. Bishop-Hurley, R.J. Crawford, Jr. and M.D. Massie. 2001. Soil phosphorus may be important to beef herd health and performance. *Better Crops with Plant Food* 85:4-8.
- 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. Plant Management Network. June 8:1-8.
- 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 Review. *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. 2006. Phosphorus fertilization increased macronutrient concentrations in leaves of stockpiled tall fescue. *Plant Management Network*. accepted and in press.