The Influence of Calcitic and Dolomitic Lime and Phosphorus on Species Composition in Tall Fescue Pastures

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FINAL REPORT

INTRODUCTION

This project was initiated during the summer of 2005 with the selection of field plots at the Southwest Research Center (SWC) at Mt. Vernon. An established tall fescue stand with a diverse plant community was selected for this study. The objective of this project was to ascertain the effect of lime and phosphorus (P) on species composition in tall fescue pastures. A large percentage of the tall fescue acreage in Missouri is on acid soils with low to very low available P. The soil resource in the plot area is primarily the Gerald silt loam (fine, mixed, active, mesic Aeric Fragiaqualf) with some inclusions of the Creldon silt loam (fine, mixed, mesic, Oxyaquic Fragiudalf). Soil test samples from the plot area had the following initial values:

Soil Parameter	Value
CEC (meq/100g)	10.1
Neutralizable Acidity (meq/100g)	5.2
pHs	4.6
Bray P-1 (lbs/A)	6
Potassium (lbs/A)	1515
Calcium (lbs/A)	258
Magnesium (lbs/A)	203

Initial botanical composition was assessed in June 2005 for sectors of the plot area for species composition. Plots with 10 ft by 25 ft dimensions were delineated with 5 ft borders. Liming treatments used were calcitic and dolomitic aglime with each material having 0X, 0.5X, 1X, and 2X the amount recommended by the Missouri Soil Testing Laboratory Woodruff Buffer method. Additionally, P treatments for each aglime treatment were 0 and 50 lbs P/A. Maintenance K was added as called for by soil test value and 100 lbs N/A was also applied. Each treatment was replicated 6 times.

The calcitic limestone used possessed an ENM value of 396 and the dolomitic limestone exhibited an ENM of 452. The limestone recommendation (1X) for the limestone was 3.67 T/A and 3.22 T/A for the calcitic and dolomitc materials, respectively. Initial vegetative composition assessments were made in the summer of 2005. Vegetative composition assessments and forage yields after the application of lime and fertilizer inputs were taken in May 2006, August 2006, May 2007, and August 2007. Soil samples from each individual plots were taken in September 2007 for similar soil testing analysis as the initial samples.

ACCOMPLISHMENTS

The data was assessed from three viewpoints: species composition by lime and fertilizer inputs over the 2 years after initiation; yield by lime and fertilizer inputs; and ending soil test values by lime and fertilizer treatments.

Species composition by lime and fertilizer treatments

The plant species identified in the pasture at initiation were: annual lespedeza, Aster, Blackeyed susan, Broomsedge, Buckbrush, Buckhorn plantain, Bull thistle, Canada goldenrod, Carex, Cheat grass, Common ragweed, Common yarrow, Crabgrass, Crown Vetch, Daisy fleabane, Dalis grass, Deptford pink, Dewberry, Eastern Gammagrass, Eastern red cedar, Elm, Germander, Giant foxtail, Goatsbeard, Grape, Hairy Hawkweed, Hop clover, Horse nettle, Indian grass, Ironweed, Juncus, Kentucky bluegrass, Little bluestem, Milkwort, Mustard, Nightshafe, Orchardgrass, Persimon, Poison ivy, Prairie dogbane, Purple top, Quen Anne's lace, Res sorrel, Red top, Rough-fruited cinquefoil, Sassafras, Sececia lespedeza, Smoothbrome, Sourgrass, St. John's Wort, Suma, Tall fescue, Tall green milkweed, tall thistle, Three seeded mercury, Tick, trefoil, Virginia creeper, Western panicgrass, Wild Cherry, Wild lettuce, Wild Onion, Wild Rose, Wild senna, Witch grass, Yellow foxtail. The summary of major species occurrence is summarized in Figures 1 through 6.

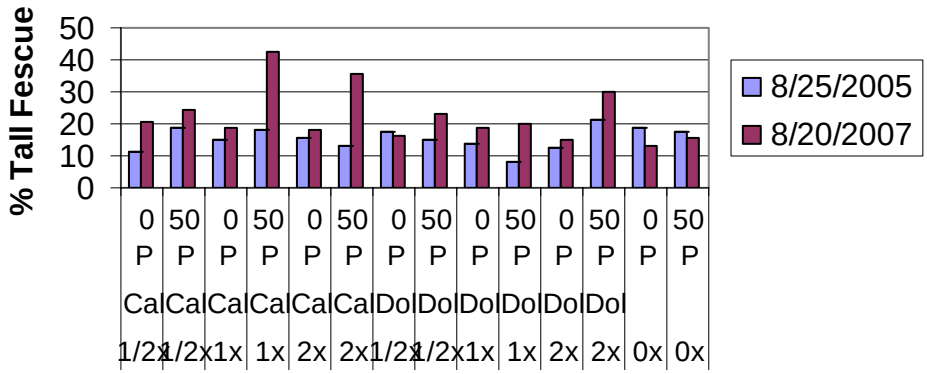

Figure 1. Influence of lime and P on Tall Fescue composition 2005-2007.

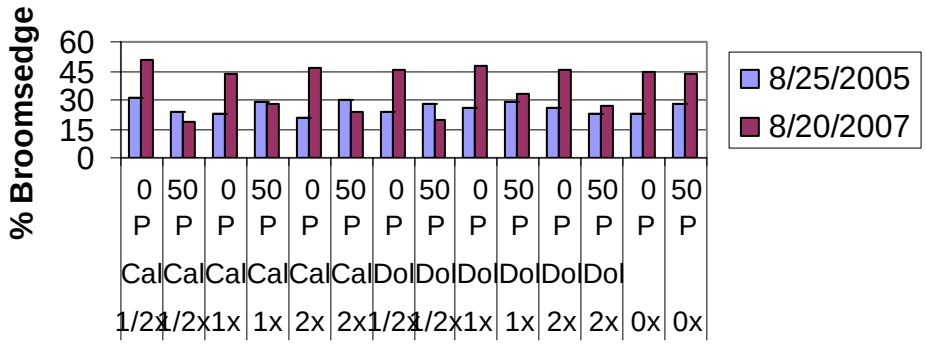

Figure 2. Influence of lime and P on Broomsedge composition 2005-2007.

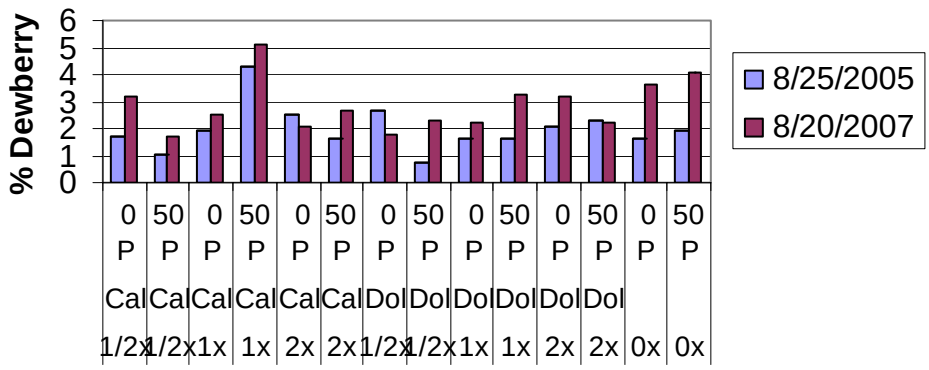

Figure 3. Influence of lime and P on Dewberry composition 2005-2007.

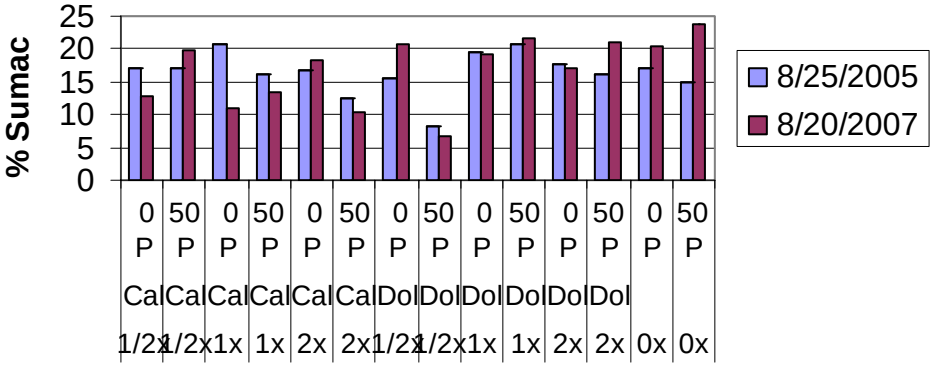

Figure 4. Influence of lime and P on Sumac composition: 2005-2007.

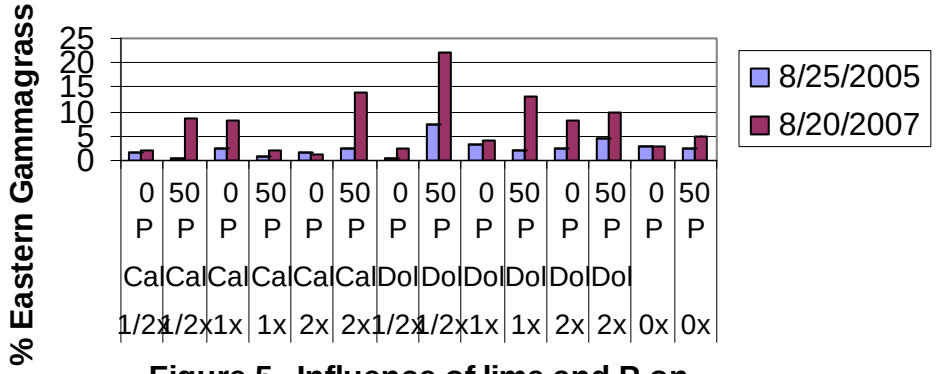

Figure 5. Influence of lime and P on Eastern Gammagrass composition 2005-2007.

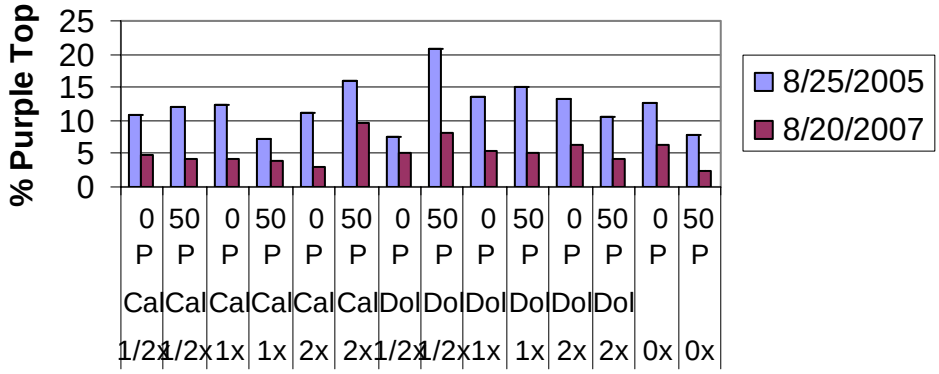

Figure 6. Influence of lime and P on Purple Top composition 2005-2007.

Over the two year period (2005-2007) after liming, if was observed that tall fescue increased in coverage with P treatments when limed (Figure 1). Broomsedge decreased with P applications and lime. The use of calcitic limestone tended to lessen broomsedge percentages more than dolomitic although plant occurrence numbers increased with time after treatment application (Figure 2). Dewberry coverage tended to decrease with calcitic and dolomitic limestone (Figure 3). However, P had little influence of Dewberry. Few consistent trends were observed with sumac relative to liming or P treatments (Figure 4). Calcitic limestone tended to decrease Eastern gamma grass occurrence more than dolomitic limestone (Figure 5). The occurrence of purple top is much less with both calcitic and dolomitic limestone over time regardless of P treatment (Figure 6).

Hay yield with limestone and P treatment

The influences of limestone and P treatments on hay yield over the years after application are presented in Figures 7 through 10.

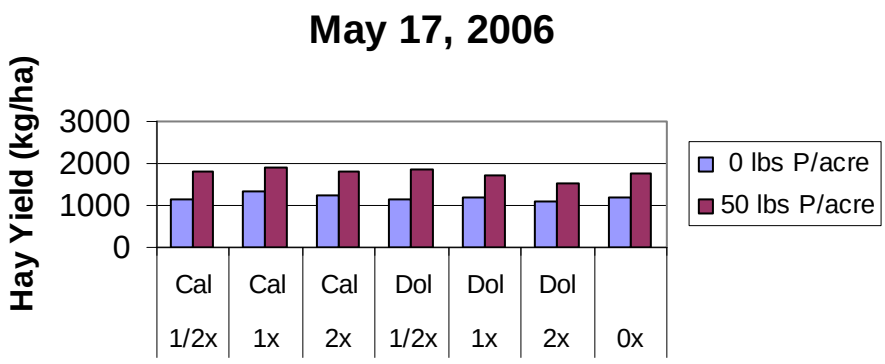

Figure 7. The influence of lime and p on hay yield, May 2006

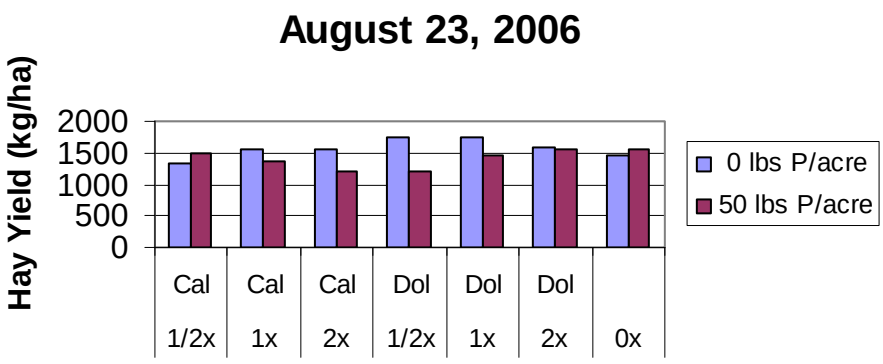

Figure 8. The influence of lime and P on hay yield, August 2006

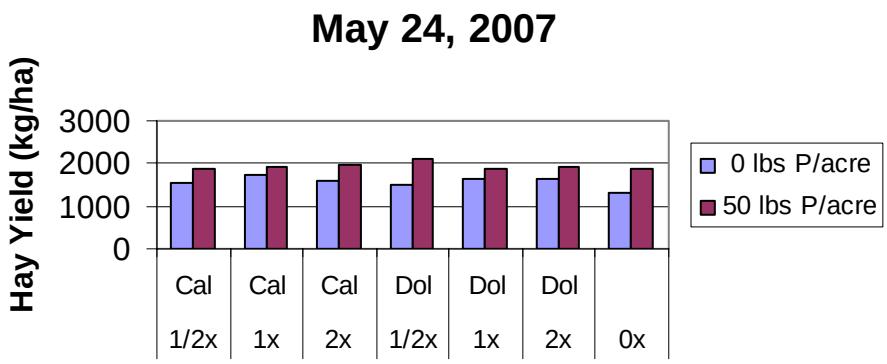

Figure 9. The influence of lime and P on hay yield, May 2007

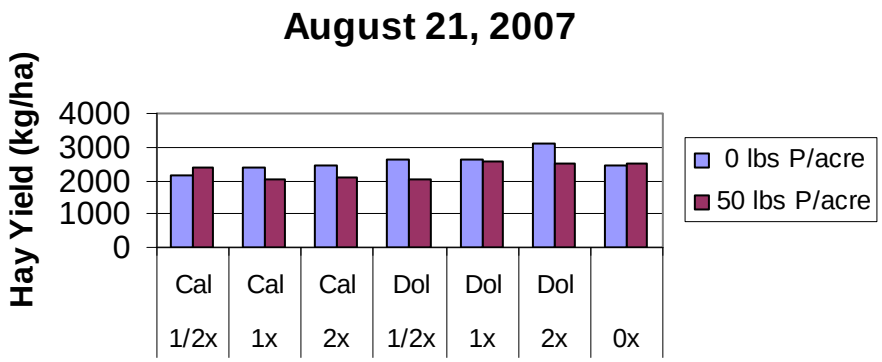

Figure 10. The influence of lime and P on hay yield, August 2007.

In both years the May yields were greater for P applications than the corresponding no P treatment at the comparable limestone quantity and type. This occurrence is best explained by the plant's need for a large portion of its annual P to be in the early part of the growth season. Whereas, both August yields were slightly greater for the no P than the P treatment and dolomitic limestone provided a slighter greater yield at comparable quantities than the calcitic limestone.

Soil test values with lime and P treatments

The 2 years influences of the lime and P treatments on specific soil test values are presented in Figures 11-14.

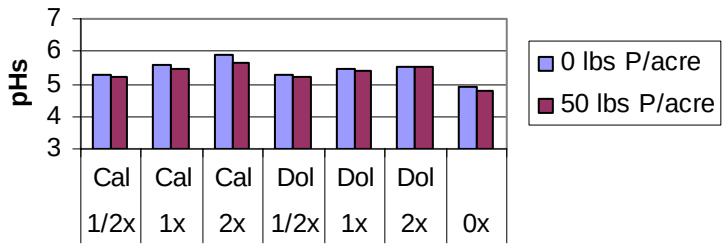

Figure 11. Influence of lime and P on pHs September 2007.

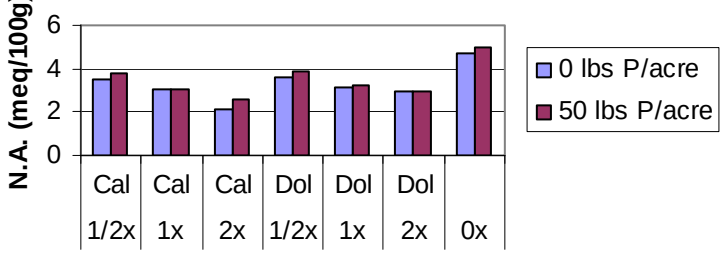

Figure 12. Influence of lime and P on nuetralizable acidity

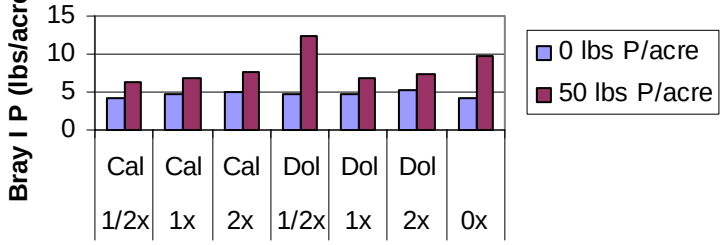

Figure 13. Influence of lime and P on Bray P1 September

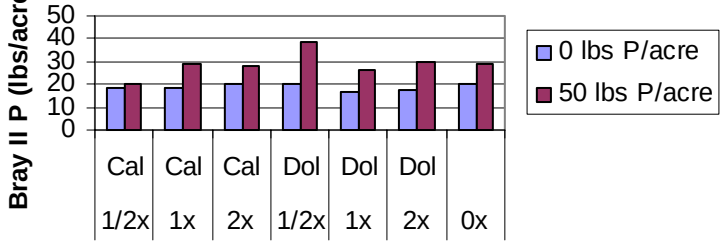

Figure 14. Influence of lime and P on Bray PII September

The various additions of limestone increased the salt pH from the initial 4.6 value to values in the 5 range. The 2X application of calcitic limestone provided the largest salt pH value (Figure 11). However, the values after liming were not near the desired salt pH value range one would target for top management tall fescue production. The salt pH values for tall fescue were much smaller than desired. Perhaps soil test values and liming recommendations for tall fescue production needs to be further researched to provide a greater long-term sustainable production level. All incremental increases of both limestones decreased neutralizable acidity with the calcitic material providing a lesser amount of acidity at the comparable dolomitic material (Figure 12). The addition of 50 lbs of P did increase Bray PI P levels within each liming material and within each incremental increase over the 0 P. However, Bray PI levels were greater for the dolomitic material than the calcitic material (Figure 13). These levels are still too low for consistent tall fescue production levels. Additionally, additions of P increased Bray PII levels with a slightly greater response for dolomitic limestone.

SUMMARY AND CONCLUSIONS

The addition of limestone and P to acid soils which are used for tall fescue production provided the following major observations over a 2 year period after application of the materials

1. With increased limestone and P treatments, the species composition changes gradually. Tall fescue tends to increase with P inputs when it was limed. Additional P drove broomsedge numbers down but only in the limed plots. Dewberry decreased with calcitic and dolomitic limestone. It is apparent that good liming and P management can be an effective weed control management tool. Control of woody species such as Sumac was limited at best. Perhaps grazing practices could assist with partial control of invader species. However, use of limestone and P may be a consistent but slow, evolutionary process in the control of invader species and management for desirable species.

2. Early season yields were greater than later season yields with P treatment. It is apparent that P is critical in the early part of the growing season. In the late-summer, P is not a factor with yield increases while dolomite has a greater positive influence on yield than calcitic limestone.

3. Target salt pH values are not being attained even with twice the Woodruff Buffer soil test recommendation for both calcitic and dolomitic limestone. This consistent finding along with previously funded Fertilizer/Ag Lime research we have preformed catalyzes the consideration that more research in the area of soil test calibration with limestone recommendations is needed to provide a greater long-term sustainability for tall fescue production.

4. Application of 50 lbs P does little to increase the Bray PI values for high yield forage production with very low initial P levels.