Project Title: The influence of nitrogen rate and pasture composition on the toxicity, quality and yield of stockpiled tall fescue

Investigators: Robert L. Kallenbach and Robert L. McGraw
Plant Sciences Unit, University of Missouri

Accomplishments for Year 1:

- A three-year field trial studying the effects of nitrogen rate and pasture composition on the toxicity, quality, and yield of stockpiled tall fescue began in August, 2002. The study has 10 treatments; five rates (0, 50, 100, 150 and 300 lb/acre) of N applied in August and two pasture types (tall fescue with or without red clover). The study is replicated six times.

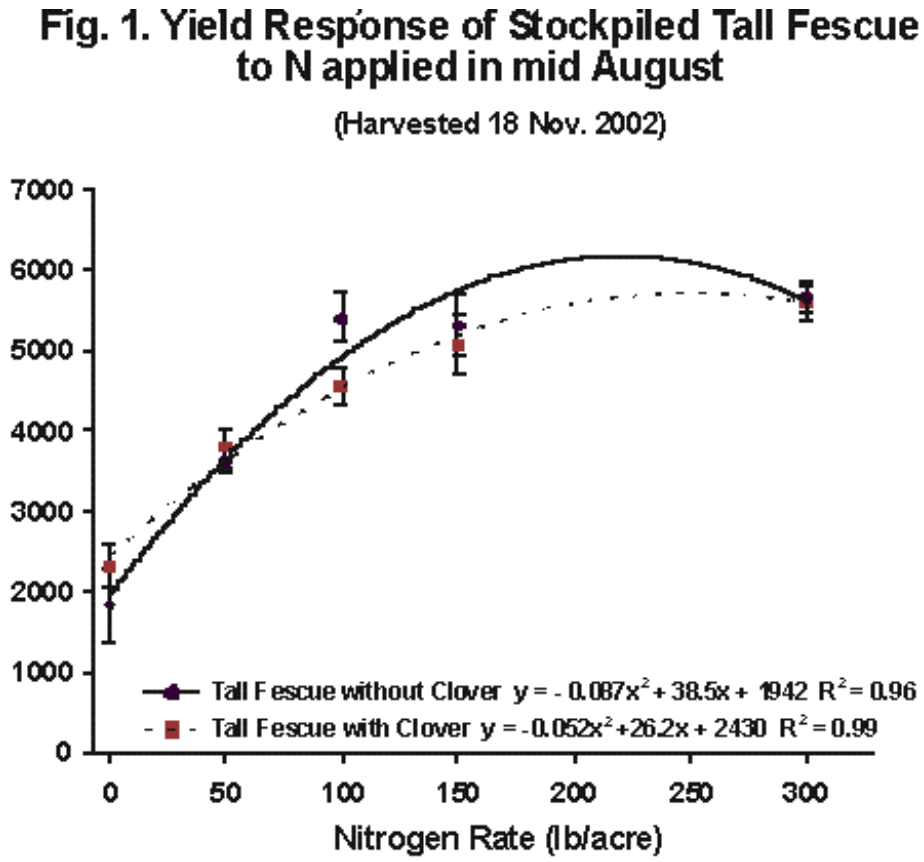
- We established the study in an existing endophyte-infected tall fescue/red clover pasture at the Forage Systems Research Center (FSRC) near Linneus, MO. Before the treatments were applied, the stand was approximately 30% red clover and 70% tall fescue. For the tall fescue treatments without clover, existing red clover plants were killed in the spring of 2002 by spraying 2,4-D and Remedy. The forage in all treatments was clipped to a 3-inch stubble height in early August prior to starting the study.

- Soil samples were taken to a 40-inch depth prior to applying fertilizer treatments using a hydraulically operated soil probe. The probe diameter was 1.5 inches. Samples were split into three depth classes (0-10, 10-20, and 20-40 inches) and then analyzed for NH_4 and NO_3 content. Initial results showed that plots had equal ($P>0.05$) levels of pre-experiment NH_4 and NO_3.

- As planned, we began to harvest forage on a monthly basis starting in mid-November of 2002. Forage harvests will continue monthly from November to March each year.

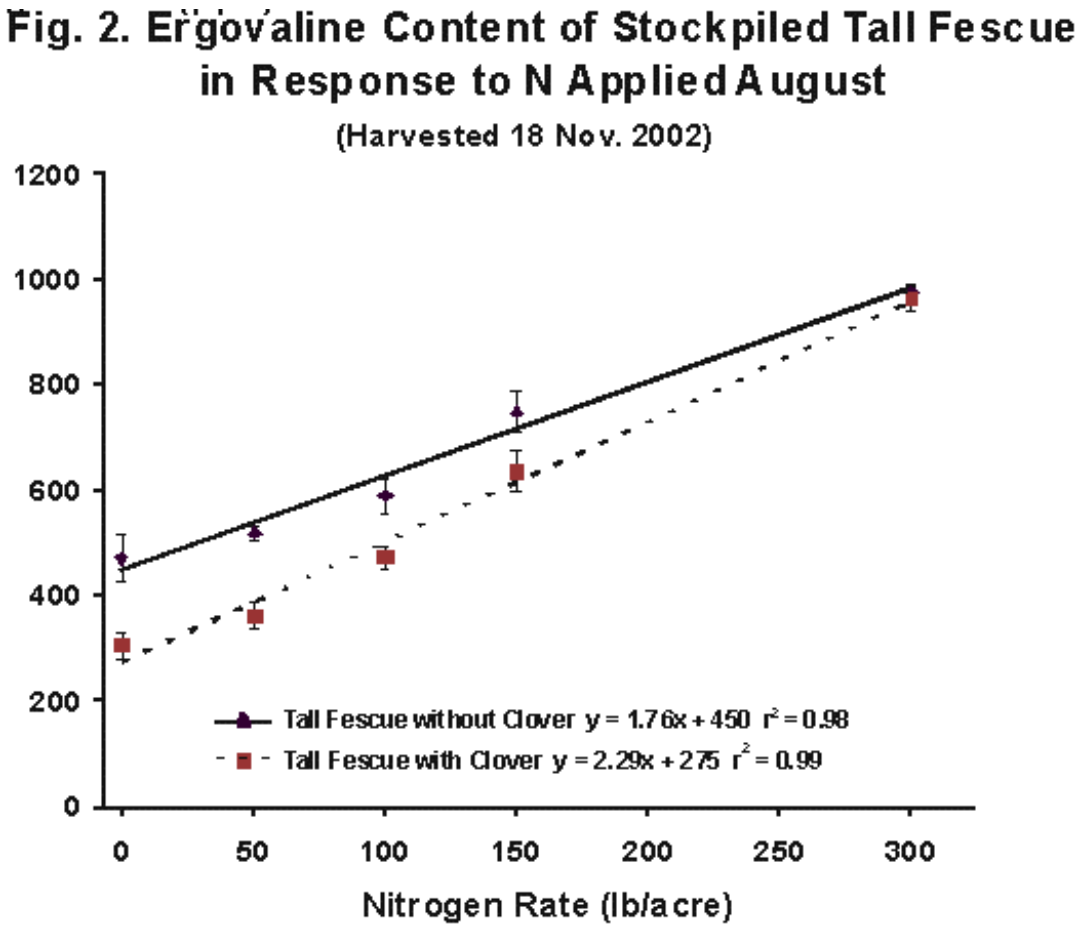
- Because this project examines forage yield, quality and toxicity of stockpiled tall fescue over winter, we are only part-way through the first year. As a result, we have only limited data to report at this time. However, some preliminary results are:

    - Forage yields in November increased substantially when N was applied in August, despite the dry growing conditions in the autumn of 2002. Regardless of whether plots contained red clover, a nearly linear response to N rates up to 100 lb/acre was observed. Rates above 100 lb/acre showed either little or no increase forage yield (Fig. 1). Although many producers limit late-summer or fall applications of N to 50 or 60 lb/acre, our data show that even in dry years rates up to 100 lb/acre give yield responses.



- Our data suggest that when previous moisture conditions cause limited on-farm hay supplies, a late summer N application might be more cost effective than previously thought. Although we have only one year of data, the preliminary results are promising; however, long-term studies are necessary to develop accurate recommendations.

- Ergovaline is the principal toxin in infected tall fescue and this compound causes metabolic problems for almost all classes of livestock. The ergovaline content of stockpiled tall fescue increased linearly with N rate (Fig. 2). When no nitrogen was applied, ergovaline levels were approximately 175 ppb lower in mixed tall fescue/red clover treatments in than treatments where no red clover was present. However, the benefit of red clover declined as N rates increased. Likely this is due to the lower percentage of red clover in the mixed sward as N rates increased.



- The ergovaline concentrations we found are approximately 25 to 50% lower than those reported by Rottinghaus et al. (1991) for spring-grown tall fescue. However, the ergovaline concentration in all treatments was in excess of the 150 ppb threshold for livestock reported by Stamm et al. (1994). This suggests that while stockpiled forage has lower ergovaline levels than tall fescue during the growing season, it still is a potential problem for livestock owners in winter and that N fertilizer management plays an important role.

- More than 300 individuals have seen this research as part of various extension education programs conducted at the Forage Systems Research Center. In addition, the research plots have been used as part of Dr. McGraw's *Forages* class at the University of Missouri.

Objectives for Year 2:

- Over the next year we will continue our research on the impact of N on stockpiled tall fescue. As outlined in our original proposal, the tasks in the table below will be conducted over the next year.

Continue to harvest appropriate sub-subplots for forage yield and retain subsamples for forage quality and ergovaline analysis (Year 1)	1/15/03, 2/15/03 and 3/15/03
Seed 5 lb/a of red clover on appropriate plots to maintain grass/legume mix.	3/1/03
Take soil cores from each sub-plot to determine residual soil N.	3/19/03
Harvest all sub-subplots for forage yield and retain subsamples for forage quality and ergovaline analysis. (This should measure the residual effects)	5/19/03 and 7/24/03
Count the legume plants in six, 1.0 $ft.^2$ quadrats in each plot	5/25/03 and 8/12/03
Take soil core samples to a 40-inch depth for soil nitrogen. (Year 2 starts)	8/13/03
Apply N fertilizer for second years of experimentation. Treatments are 0, 50, 100, 150 and 300 lb/acre of actual N. (Year 2)	8/14/03
Analyze samples taken to date for forage quality and ergovaline content	8/30/03
Harvest appropriate sub-subplots for forage yield and retain subsamples for forage quality and ergovaline analysis (Year 2)	11/15/03, 12/15/03, 1/15/04, 2/15/04 and 3/15/04

- In addition, to completing the tasks outlined above, we will be analyzing our field data more fully. Specifically, we are interested in determining the rate and extent of forage degradation over winter, with a special focus on ergovaline concentrations. Based on previous data published by Kallenbach et al. (2003), ergovaline levels are expected to drop over winter in stockpiled tall fescue. Although the influence of N rate on this process is unknown, we would like to develop prediction equations that could guide producers, fertilizer dealers, crop consultants and other about the potential toxicity and use of stockpiled tall fescue in winter.

- We will continue to integrate our findings into the curriculum of the Missouri Grazing Schools and the annual Winter Grazing Workshops at Linneus and Mt. Vernon. These outreach efforts can be expected to reach more than 1,000 producers, agency staff, and agri-business personnel. Additionally, as more comprehensive data are collected, we will start work on a new guidesheet about stockpiling tall fescue as well as prepare articles to be published in statewide and national magazines such as Missouri Ruralist, Graze, Stockman Grass Farmer and scientific journals.

Budget:
As requested last year, our budget for the second year of studies is as follows.

Year 2

Salary and Benefits	
Research Specialist (25% of $31,500)	$ 7,875
Benefits for Research Specialist	$ 1,969
Total Salary and Benefits	$ 9,844
Operating Expenses	
Fertilizer, bags, repair parts for harvester and other field supplies	$ 1,000
NIR charges for forage quality and ergovaline analysis (900 samples @ $1 each)	$ 900
Forage quality wet chemistry for NIR calibration (45 samples @ $11 each)	$ 495
Ergovaline analysis (wet chem. for NIR calibration 45 samples @ $25 each)	$ 1,125
Soil N analysis (366 samples @ $8 each)	$ 2,928
Travel to FSRC (mileage, lodging, and meals for 8 trips per year)	$ 1,100
Total Operating Expenses	$ 7,548
Equipment	
None requested	$ 0
Total Equipment	$ 0

Total Requested for Year #2 ***$17,392***

References

Kallenbach, R.L., G.J. Bishop-Hurley, M.D. Massie, G.E. Rottinghaus, and C.P. West. 2003. Herbage mass, nutritive value, and ergovaline concentration of stockpiled tall fescue. Crop Sci. *In Press*.

Rottinghaus, G.E., G.B. Garner, C.N. Cornell, and J.L. Ellis. 1991. HPLC method for quantitating ergovaline in endophyte-infested tall fescue: Seasonal variation of ergovaline levels in stems with leaf sheaths, leaf blades, and seed heads. J. Agric. Food. Chem. 39:112-115.

Stamm, M.M., T. Delcurto, M.R. Horney, S.D. Brandyberry, and R.K. Barton. 1994. Influence of alkaloid concentration of tall fescue straw on the nutrition, physiology, and subsequent performance of beef steers. J. Ani. Sci. 72:1068-1075.