

# **Report for 2004AR70B: Vadose-zone losses of soluble heavy metals from pasture soil amended with varying rates of poultry litter**

- Conference Proceedings:
  - Brye, K.R. and A.L. Pirani. 2004. Characterizing solute leaching using equilibrium-tension lysimeters. 2004 Annual Arkansas Water Resources Conference Proceedings, April 20-21, 2004, Fayetteville, Arkansas.
  - Pirani, A.L., and K.R. Brye. 2004. Mass balance of heavy metals applied to pasture soil in poultry litter. Agronomy Abstracts, American Society of Agronomy Annual Meeting, Seattle, Washington.
  - Pirani, A., and K.R. Brye. 2005. Heavy metal leaching from poultry litter amended pasture soil. 2005. Arkansas Water Resources Conference Proceedings. April 19-20, 2005, Fayetteville, Arkansas.
- Articles in Refereed Scientific Journals:
  - Brye, K.R. and A.L. Pirani. Metal Uptake by Tall Fescue as Affected by Poultry Litter Application. Forage & Grazinglands (Submitted/In Review)
- Dissertations:
  - Pirani, A. 2005. Leaching Losses of Plant Nutrients and Heavy Metals from Poultry Litter Amended Pasture Soil (tentative). MS Thesis, Department of Crop, Soil, and Environmental Sciences, College of Agriculture, Food & Life Sciences, University of Arkansas, Fayetteville, AR. (To be completed by August 2005).

Report Follows

## **Problem and Research Objectives:**

Problem: Agriculture and the economies of the Ozark Highlands, (i.e., northwest Arkansas and northeast Oklahoma), and other regions throughout the southern United States, are largely influenced by the poultry industry. Consequently, animal waste disposal and, ultimately, surface and groundwater quality become major issues in areas with a large concentration of confined-animal-feeding operations. Since poultry litter contains notable amounts of heavy metals and despite the cost-effective use of poultry litter as an organic N and P fertilizer, the potential impairment of groundwater drinking supplies from heavy metals contained in poultry litter is an important concern to those requiring clean drinking water supplies. Relatively little information exists on the nature and concentration of these compounds in the soil solution as a result of the addition of poultry litter. The likelihood of heavy metals leaching from pasture soils with a history of repeated poultry litter applications is too great to ignore.

Research Objective: To continuously monitor water movement and heavy metal leaching from the root zone of tall fescue (*Festuca arundinacea* Schreb.) vegetation amended with varying rates of poultry litter using equilibrium-tension lysimeters.

## **Methodology:**

Equilibrium-tension lysimeters were employed to provide continuous, year-round drainage, solute concentration, and solute leaching loss data from the root zone of tall fescue as a function of poultry-litter application rate (0, 2.5 and 5 tons/acre). Equilibrium-tension lysimeters (0.19 m<sup>2</sup>), with a 0.2- $\mu$ m porous-stainless-steel plate, were installed below undisturbed root zones of the tall fescue vegetation, at approximately a 0.9-m depth, in each of six plots with high soil-test P in the top 5 cm. Filtered leachate samples collected from the lysimeters were acidified and analyzed for soluble heavy metals by ICAP. Drainage fluxes were multiplied by solute concentrations to obtain leaching losses (i.e., loads) from the root zone of pasture soil.

## **Principal Findings and Significance:**

Leachate was collected continuously throughout the year for two consecutive years (2003 and 2004), with flow-weighted mean concentrations and mass losses calculated by 3-month season and year. Total annual leachate collected did not differ among treatments. In 2003, there were no significant differences in flow-weighted mean concentrations or mass losses of heavy metals (Fe, Cu, Zn, Mn, As, Se, Cd, and Cr) among treatments. In 2004, several significant differences among treatments were observed in flow-weighted mean concentrations, however they were inconsistent among element, treatment, and season. Treatment differences in mass loss were also inconsistent among elements and seasons in 2004. The data suggest that the addition of poultry litter to pasture soil will influence concentrations and mass losses of heavy metals in areas of concentrated poultry production. Further monitoring is necessary to evaluate the longer-term effects of repeated annual poultry litter applications on soil solution water quality.

The type of data generated in this study will provide credible scientific evidence for soil leachate solution concentrations and loads that may aid regulators in defining new and/or adjusting existing solute concentration and load limits to realistic and achievable thresholds to maintain high quality groundwater resources in the Ozark Highlands region of the mid-South.