Trace Elements Leaching under Pastureland in NW Florida

I. Anguelova[1] and G. Anguelov[2]

[1]Biological and Agricultural Systems Engineering , [2]Center for Water and Air Quality

College of Engineering Sciences, Technology and Agriculture, Florida A&M University, Tallahassee, Florida 32307

Abstract

Agricultural production typically has a significant impact on ecosystem components, influencing the quantity and timing of nutrient cycles. The grazing animals have the potential to negatively affect the environment by creating higher level of trace elements in soil. Animal waste products excreted back onto the pasture contain not only most of essential macronutrients but also some heavy metals, e.g. Zn, Cu, etc. Heavy metal input into the grassland from animal wastes (dung and urine) is low but takes place on large areas. While a number of researchers have studied to some extent metal leachibility in agricultural land, fewer studies have been done on pastureland.

Soil solution metal-content and dynamics in a pasture system in North Florida are presented. Soil-water samples were taken from suction cup lysimeters installed beneath pasture plots in three replications by depths at 2, 4, and 6 ft (0.61, 1.22, and 1.83 m). The suction cup lysimeters were randomly assigned to two groups of animals, i.e. cattle and goats. Soil-water samples were taken biweekly, analyzed for metal-content, and the data from each month were averaged as one aggregate observation per plot at each depth. Samples from several rainfall, wells and the nearby stream were also collected during the same period of observation. The samples were analyzed for pH, EC and content of Al, Fe, Zn, Cu, Mn, Ni, Pb, and Cd. The metal content in the water samples are discussed in relation to mobility and leakage possibility.

The preliminary results have shown that the management practices, particularly medicated feed additives, did not affect significantly leaching potential of the observed heavy metals. Further information over an extended period is needed to determine whether there is potential impact on groundwater quality.

Objective

Under the scope of a project funded by USDA's Initiative for Future Agriculture & Food Systems (IFAFFS) the objective of environmental impact task was to assess the influence of natural factors and management practices on nutrient elements cycling, evaluate potential negative impact on water quality and promote sound adaptation options.

Materials and Methods

This study was carried out at Florida A&M University Research and Extension Center, Quincy on Orangeburg loamy fine sand soil (2-5% slope) which has high to moderate moisture holding capacity, medium surface runoff and medium internal drainage with rapid to moderate-rapid permeability in surface layer and moderate in the subsoil.

Soil-water samples were taken from suction cup lysimeters installed beneath pasture plots in three replications by depths at 2, 4 and 6 ft (0.61, 1.22, and 1.83m). The lysimeters were randomly assigned to pastures grazed by beef cattle and goats. The samples were analyzed for pH, EC and content of Al, Fe, Zn, Cu, Mn, Ni, Pb, and Cd. Samples from rainfall, well and surface water were also collected during the same period of observation.

Soil solution sampling procedure:

Vacuum at 55-65 kPa is applied to the suction cups by a suction pump; Soil-water samples are collected after 18-24h

Results

•Zn concentrations varied greatly from not detectable level up to 0.703 mg L^{-1}. However, all analyzed samples had Zn concentrations less than the maximum permissible level of 5 mg L-1 for US drinking water. The highest Zn content were at 2 ft depth with a gradual decrease to 6 ft (Fig. 1). Cu concentrations in the soil-water samples were far below the US drinking water standards. Pb was episodically detected in 24% of the samples with a high value of 0.02 mg L^{-1}.

•Zn and Cu levels in precipitation, surface water, groundwater and tap-water were below the US drinking water standards (Fig. 2 and 3)

•The observed pH values (from 6.01 to 7.75) are not favorable for metals mobilization and transport

Figure 1. Mean trace metals concentrations in soil solution from pasture plots at three depths

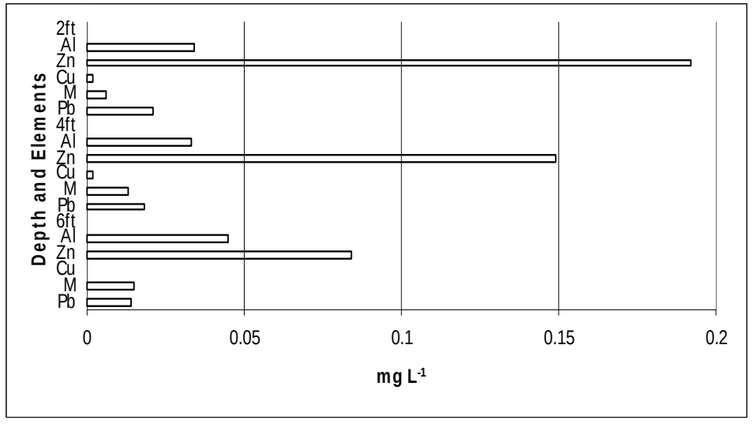


Figure 2. Mean Zn content in water samples from different sources

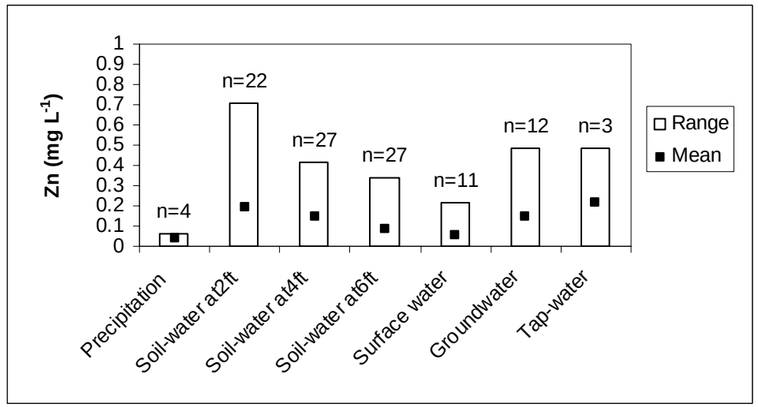
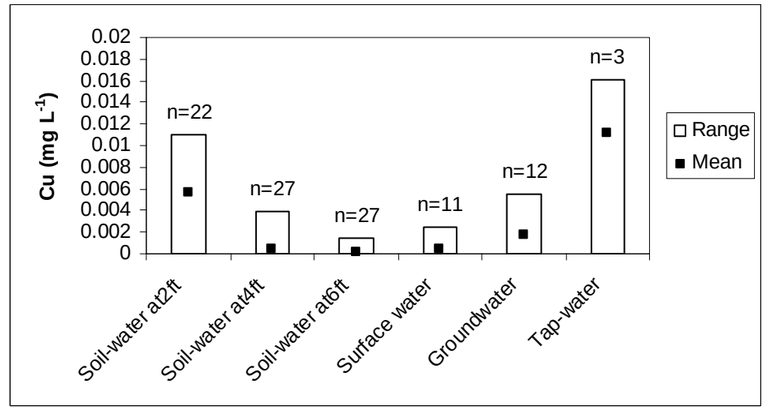


Figure 3. Mean Cu content in water samples from different sources



Conclusion

The preliminary results have shown that grazing management practices, including medicine and feed additives, did not affect potential leaching of the observed heavy metals. Further information over an extended period is needed to determine whether there is possible negative impact on groundwater quality.