Effect of Grazing Management on Soil Solution Composition and Water Quality

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Abstract

Agricultural production typically has a significant impact on ecosystem components, influencing the quantity and timing of nutrient cycles. The lack of soil disturbance, which is suggested to be accountable for most of the perceived management activities associated with pasture/range livestock farms, includes improvements such as less erosion, good soil quality and more plant-available water. However, the grazing animals have the potential to negatively affect the environment by creating higher level of trace elements in soil and in surface and ground waters. Under the scope of a project aimed at improving small livestock farms through integrated grazing/supplemental feed management and cost effective animal health care, the objective of the environmental impact task was to assess the influence of grazing livestock on trace elements cycling, evaluate environmental impact, and promote adaptation options for sustainable and environmentally sound production systems.

Soil liquid phase is considered as an early environmental indicator of potential leaching of nutrients through soil profile. Soil solution samples were taken from suction cup lysimeters installed beneath pasture plots in 3 replications by depths at 0.61, 1.22, and 1.83m. The samples were analyzed for volume, pH, EC and content of P, K, NO_3-N, Ca, Na, and Si. Samples from rainfall, well and surface water were also collected during the same period of observation. The results are discussed in relation to possibility of leakage of the observed elements.

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

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 samples were analyzed for volume, pH, EC and content of P, K, NO_3-N, Ca, Na, and Si. 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 cup lysimeters; and soil solution samples are collected after 18-24 hours

Water sampling objects: rainfall, soil solution well and surface water

Results

Climate characteristics and meteorological data of the study period had shown low risk for leaching potential in the North Florida region; precipitations are evenly distributed with mean monthly evapotranspiration exceeding precipitation most of the time under consideration. The precipitations are characterized with low nutrient concentrations; near detectable level for P and K, and NO_3-N content in rainfall far below maximum permissible level (MPL) of 11 mg L^{-1} (Fig. 1).

The analysis of soil solution (Fig. 2) data showed very low mean P and K concentration and significant variation in nitrate nitrogen content. Top soil layer (2 ft) yielded considerable quantities of NO_3-N but nitrate content is below the MPL and is further decreasing with the depth. Almost the same depth distribution can be seen for Ca.

Comparing data for nutrients in the different water samples had showed that P content in soil solution is higher, especially from the 2 and 6 ft depths (Fig. 3 A). Similar tendency is seen for the K content (Fig. 3 B) while NO_3-N content in soil solution at 2 ft exceeded MPL from time to time. However, the obtained data for the dynamic of nitrates content in the observed water sources at Quincy site had showed that throughout all study period NO_3-N content is far below the MPL.

Figure 1. Rain deposition (mean from 53-69 events Apr 02- Sep 03) Florida A&M University R&E Center Quincy

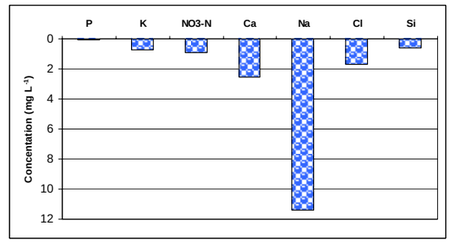


Figure 2. Mean nutrients concentration in soil solution from pastureland Florida A&M University R&E Center Quincy (114 events Mar02-Sep03)

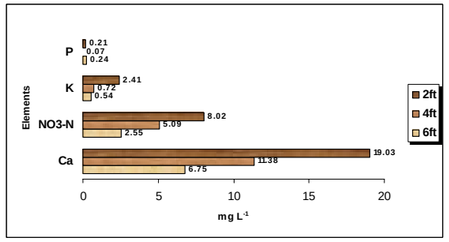
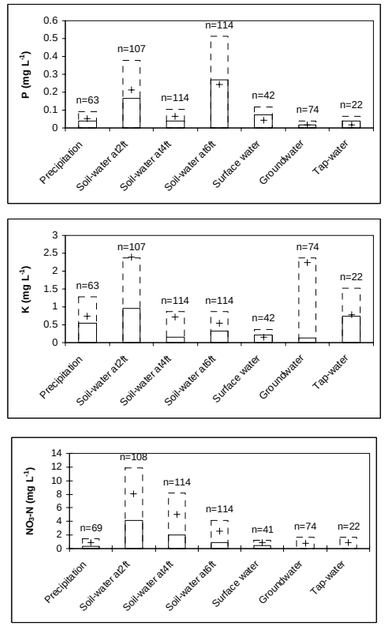


Figure 3. Nutrient content in water samples from different sources Florida A&M University R&E Center Quincy
(+Mean values; --95%confidence; n=samples)



Conclusion

A methodology for assessing the impact of natural factors and pasture management is established. Tension (suction cup) lysimetry technique can be used in monitoring program of livestock production. There is significant difference in nitrogen content comparing soil solution data with natural water sources; NO_3-N content in soil solution at 2 ft exceeded MPL from time to time while in the other observed water sources at Quincy site is far below the MPL.