Salem Road Grazing Study

Rationale

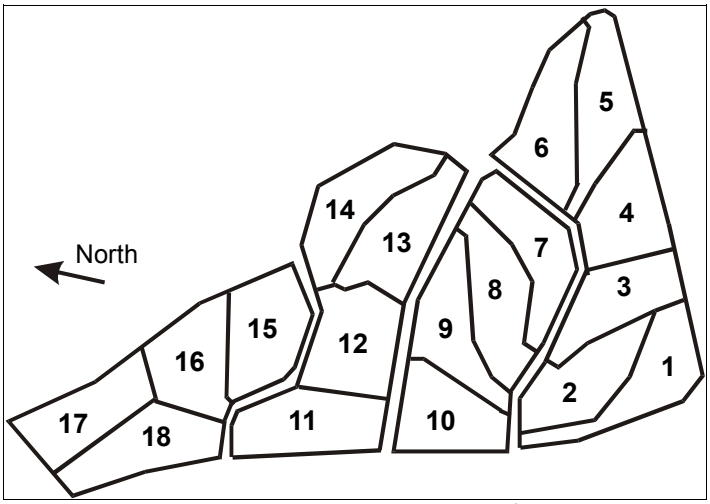
Land productivity lost through erosion from excessive cultivation of annual crops is thought to be best restored by establishment of a perennial sod crop. Accumulation of soil organic matter at the soil surface sequesters nutrients in an organic form, improves soil physical conditions for greater water use, and provides a habitat for soil animals and microorganisms that improve porosity and aggregation. The type of perennial sod management to achieve maximum soil quality is unknown. Grazing of a forage crop compared with haying returns much of the manure directly to the land, but increases traffic that could cause compaction and destabilization of the soil surface. Non-utilization of forage in a conservation reserve has received little attention in its ability to ameliorate degraded land. The type of nutrients applied to forage could affect plant growth and subsequently soil organic matter dynamics. Broiler litter is readily available in the Southern Piedmont for application to grazing land. Overseeding summer perennial forage with a cool-season legume could provide substantial biologically-fixed N to improve soil fertility.

Objectives

1 Characterize the rate of accretion of soil organic C and N, microbial biomass C, and mineralizable C and N as affected by nutrient source and forage harvest management.
2 Characterize various soil physical properties (e.g., bulk density, water-stable aggregate size distribution, steady-state water infiltration) as affected by nutrient source and forage harvest management.
3 Characterize soil phosphorus and minor element concentrations with special emphasis towards the application of broiler litter, which contains appreciable phosphorus and minor elements.
4 Characterize the depth distribution near the soil surface of soil physical, chemical, and biological properties.
5 Characterize the spatial variability of soil physical, chemical, and biological properties within and among pasture management systems.
6 Determine the impact of poultry litter and grazing pressure on animal performance and productivity.
7 Relate animal productivity and performance to soil organic C and N fractions.
8 Characterize plant stand and composition characteristics as affected by nutrient source, forage harvest management, and spatial distribution.
9 Characterize the depth distribution of soil water and inorganic N as affected by nutrient source and forage harvest management.
10 Characterize surface runoff of sediment and inorganic N and P as affected by nutrient source.
11 Characterize the source of soil organic C pools from isotope ratio mass spectrometry.
12 Characterize animal parasite loads and diversity seasonally and in the long-term as affected by nutrient source and harvest management.
13 Ribotype fecal-borne pathogens from cattle grazing the experiment.

Study area

Off of Salem Road near Farmington in the southern part of Oconee County.



Field layout of treatments at Salem Road. One 100 m^2 exclosure is in each paddock (~0.7 ha).

	Low pressure	High pressure
Inorganic	2-10-11	1-9-12
Low broiler litter	3-7-18	4-8-17
High broiler litter	5-14-15	6-13-16

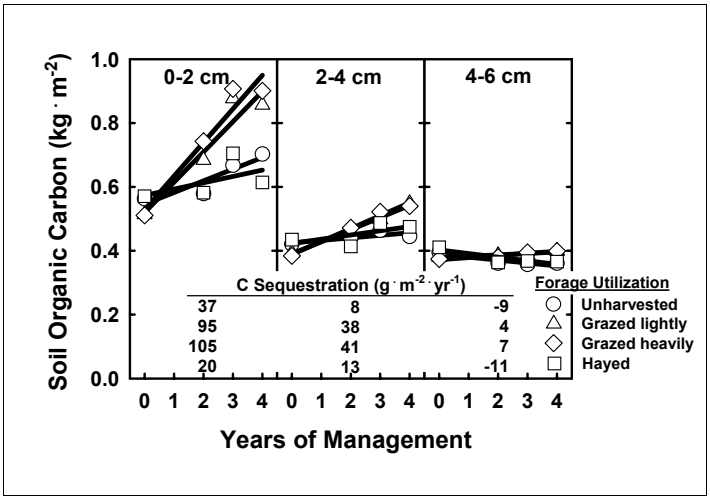
Experimental design

Phase 1 (1994 through 1998):

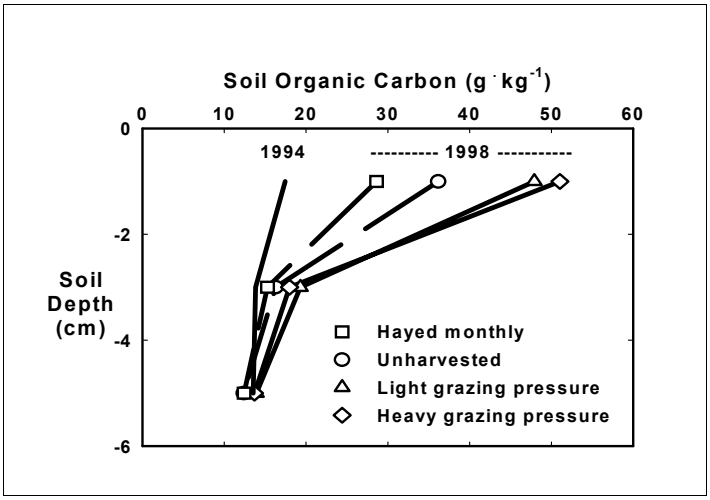
- Site was characterized on a 30 m x 30 m grid layout. Soil profiles to a depth of ~1 m were characterized at each of the grid locations.
- Bermudagrass [*Cynodon dactylon* (L.) Pers. 'Coastal'] was planted from sprigs in 1990.
- Eighteen paddocks (~0.7 ha each) were hydrologically designed to minimize nutrient movement between paddocks.
- The experimental design is a split-plot with N source as the main treatment and grazing intensity as the split-plot. Three replications are blocked according to general degree of previous erosion. The N-source regimes are: (i) all mineral N, (ii) crimson clover interseeded in the fall and cut as surface-mulch in the spring plus mineral N, and (iii) poultry litter. All sources supply equivalent total N. The grazing intensities by steers are: (i) low, leaving 3 Mg · ha^{-1} available forage and (ii) high, leaving 1.5 Mg · ha^{-1} available forage. Exclosures in each paddock are either: (i) hayed monthly or (ii) unharvested conservation reserve.

Phase II (1999 through 2004):

- Georgia 5 tall fescue was interseeded into all paddocks in November 1998 and reseeded into all high-grazing-pressure paddocks in November 1999 and 2000. Clover N-source treatment was replaced with a low rate of broiler litter (90-70 kg N-P · ha^{-1} · yr^{-1}) plus 180 kg N · ha^{-1} · yr^{-1} supplied as inorganic N. The original broiler litter and inorganic N treatments will be slightly modified to supply 270 kg N · ha^{-1} · yr^{-1} in three applications. Grazing season will be extended to take advantage of additional tall fescue forage during autumn and spring.



Rate of soil organic C sequestration under 'Coastal' bermudagrass as affected by harvest management strategy and soil depth. Soil Science Society of America Journal 65:834-841.



Soil organic C depth distribution in 1994 (initiation) and in 1998 as affected by harvest management strategy of 'Coastal' bermudagrass. Soil Science Society of America Journal 65:834-841.

Outputs/technology transfer

Presentation of results have been made at:

1997 Southeastern Sustainable Animal Waste Workshop in Tifton, GA

1997 special meeting of the Soil and Water Conservation Society in Athens, GA

1997 American Society of Animal Scientists meeting in Nashville, TN

1997 and 1999 Annual Meeting of the American Association of Veterinary Parasitologists in Reno, NV and New Orleans, LA

1996, 1997, 1998, 1999, and 2001 Soil Science Society of America meetings in Indianapolis IN, Anaheim CA, Baltimore MD, Salt Lake City UT, and Charlotte NC.

1998 conference on novel approaches to the control of helminth parasites of livestock in Baton Rouge, LA

2001 Soil Ecology Society meeting in Pine Mountain, GA

2001 Animal Science meeting in Indianapolis, IN

2002 World Congress of Soil Science in Bangkok, Thailand

A series of publications (animal, water, carbon budget, inorganic N accumulation, phosphorus dynamics, spatial variability, plant productivity) have and will be prepared during 2000-2002, including:

Franzluebbers AJ, Stuedemann JA, Wilkinson SR. 2001. Bermudagrass management in the Southern Piedmont USA. I. Soil and residue carbon and sulfur. *Soil Science Society of America Journal* 65:834-841.

Franzluebbers AJ, Stuedemann JA, Wilkinson SR. 2002. Bermudagrass management in the Southern Piedmont USA. II. Soil phosphorus. *Soil Science Society of America Journal* (Jan-Feb issue).

Franzluebbers AJ, Stuedemann JA. Bermudagrass management in the Southern Piedmont USA. III. Particulate and biologically active soil carbon. *Soil Science Society of America Journal* (in review).

Franzluebbers AJ, Stuedemann JA. 2001. Bermudagrass management in the Southern Piedmont USA. IV. Soil-surface nitrogen pools. *The Scientific World* (in review).

Franzluebbers AJ, Stuedemann JA. 2002. Soil C, N, and P from poultry manure on grazed and ungrazed bermudagrass in the southeastern USA. *Proceedings of the 17th World Congress of Soil Science*, 14-21 August 2002, Bangkok, Thailand.

Investigators / responsibilities

John Stuedemann (Dwight Seman): animal productivity, animal performance, stocking adjustment, available forage, mineral salts

Alan Franzluebbers (Steve Knapp): shallow and deep soil sampling, fertilizer applications, plant composition, water infiltration, laboratory analyses of soils for bulk density, total C and N, microbial biomass C, mineralizable C and N, water-stable aggregation, particulate organic C and N, inorganic N and P

Alan Franzluebbers (Robert Martin): inorganic N analyses (288 shallow soil/year, 432 deep soil/year), inorganic P analysis (288 shallow/year), total CNS (576 shallow soil/year)

Jean Steiner (Debbie Stark): weather station, analysis of soil water data from 1994-1998

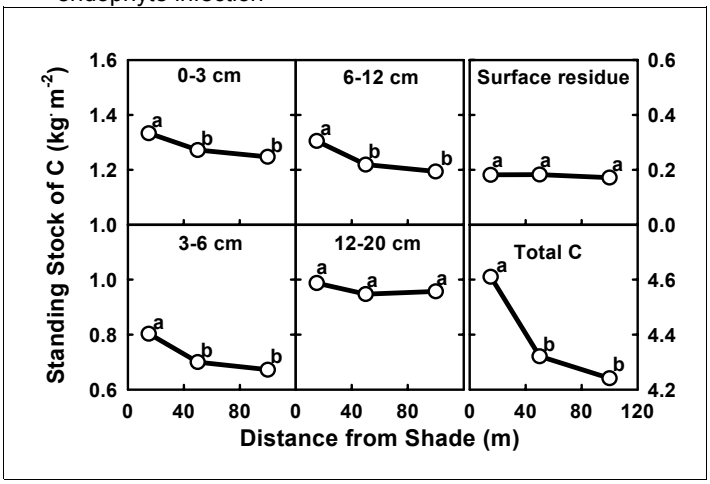
Dory Franklin (Beth Barton): water runoff collection and nutrient analyses, elevation mapping of paddocks

Mike Jenkins (Shaheen Humayoun): collection of fecal samples for ribotyping E. coli

Ray Kaplan (UGA): collection of fecal samples for parasite load and composition

Roger Burke, Keith Kisselle (US-EPA): analyze soil samples for isotopic composition of soil organic matter fractions

Nick Hill (UGA): collect tall fescue samples and analyze for endophyte infection



Standing stock of soil organic C at the end of 5 years of grass management as affected by soil depth and distance from shade and water sources. Unpublished data.