

Management-dependent soil properties of cultivated versus non-cultivated SE Coastal Plain Ecosystems



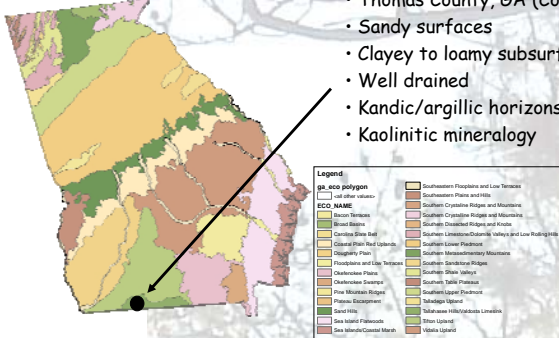
M.R. Levi, J.N. Shaw, C.W. Wood, E.A. Carter, and S.M. Hermann
Auburn University, USDA-Forest Service (Auburn, AL)

Introduction

Heterogeneity of soils is compounded by temporal variability resulting from anthropogenic and natural processes. Comparisons of disturbed soils to reference sites are not extensive in the SE due to scarcity of undisturbed land. Evaluation of relationships between management dependent and inherent soil properties can potentially improve ecosystem management and soil interpretation. An improved understanding of temporal soil variability can be useful for C sequestration and improved soil management, particularly longleaf restoration. Objectives are to evaluate land use effects on dynamic soil properties of some Southeastern Coastal Plain soils and evaluate relationships between management-dependent and inherent soil properties for improving ecosystem management and soil interpretations.

Research Sites

Figure 1. Georgia ecoregions.



- Thomas County, GA (Coastal Plain)
- Sandy surfaces
- Clayey to loamy subsurface textures
- Well drained
- Kandic/argillic horizons
- Kaolinitic mineralogy



Figure 2. Representative soil of study area (Loamy, kaolinitic, thermic Arenic Kandiudults).

Land Management Systems

LL Mature Longleaf Pine (*Pinus palustris* Miller) forest with native groundcover of grass, legume, and composite species [e.g., wiregrass (*Aristida stricta* Michx.)]. The area has been prescribed burned every 1-2 yrs for the last 75 yrs. Pines are replenished by natural regeneration, and the canopy is generally open. Soils have been subjected to minimal surface disturbance (i.e., no plowing).



PP 22 yr planted Slash pine (*Pinus elliottii* Engelm.) stand in the first rotation managed for poles and/or saw timber. The area has been subjected to infrequent fire and mechanical treatment, with the most substantial soil disturbance during site-preparation.



RC Continuous cropping for 30-35 yrs with a rotation of corn-peanuts-soybeans (some fallow). Major annual soil disturbance (e.g., plowing, disking, harvesting).



Measurements

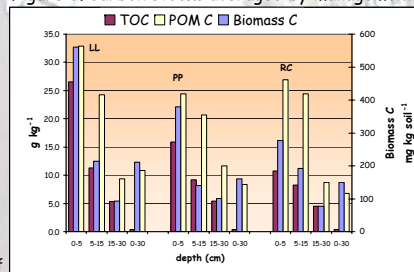
- Site selection by soil map unit and land management system
- Pedons described, sampled, and classified according to National Cooperative Soil Survey Standards
- Near surface soil physical, chemical and biological properties (0-5, 5-15, 15-30, and 0-30 cm) measured as listed in Table 1 and Figures 3 and 4

Table 1. Management-dependent chemical soil properties averaged by management. †

Management	n	Depth cm	CEC7	ECEC	BS	pH	P	Ca	Mg	K	Al
			cmol kg ⁻¹	cmol kg ⁻¹	%	H ₂ O	mg kg ⁻¹	cmol kg ⁻¹	cmol kg ⁻¹	cmol kg ⁻¹	cmol kg ⁻¹
LL	3	0-5	6.84 (± 1.4)	3.13 (± 0.4)	33.8 (± 14.4)	4.9 (± 0.4)	2.6 (± 0.9)	1.77 (± 0.9)	0.48 (± 0.1)	0.05 (± 0.0)	0.81 (± 0.7)
		5-15	2.79 (± 1.1)	1.24 (± 0.3)	24.0 (± 13.2)	4.9 (± 0.3)	2.0 (± 0.9)	0.44 (± 0.3)	0.17 (± 0.1)	0.02 (± 0.0)	0.60 (± 0.3)
		15-30	2.07 (± 1.0)	0.96 (± 0.4)	19.2 (± 12.8)	4.7 (± 0.4)	1.5 (± 0.4)	0.14 (± 0.1)	0.15 (± 0.0)	0.01 (± 0.0)	0.64 (± 0.4)
		0-30	3.10 (± 1.0)	1.41 (± 0.3)	23.2 (± 13.1)	4.8 (± 0.3)	1.8 (± 0.6)	0.51 (± 0.3)	0.21 (± 0.0)	0.02 (± 0.0)	0.65 (± 0.4)
PP	2	0-5	4.30 (± 0.9)	2.29 (± 0.7)	48.2 (± 9.5)	4.9 (± 0.2)	26.7 (± 19.4)	1.70 (± 0.8)	0.32 (± 0.1)	0.10 (± 0.0)	0.17 (± 0.2)
		5-15	3.44 (± 0.9)	1.67 (± 0.6)	37.3 (± 16.1)	4.9 (± 0.3)	15.1 (± 6.6)	1.07 (± 0.8)	0.22 (± 0.1)	0.05 (± 0.0)	0.32 (± 0.3)
		15-30	3.59 (± 0.4)	1.83 (± 0.6)	29.6 (± 6.9)	4.7 (± 0.4)	5.7 (± 2.8)	0.72 (± 0.2)	0.26 (± 0.1)	0.05 (± 0.0)	0.78 (± 0.7)
		0-30	3.66 (± 0.2)	1.85 (± 0.0)	35.3 (± 10.4)	4.8 (± 0.4)	12.3 (± 6.8)	1.00 (± 0.5)	0.26 (± 0.0)	0.06 (± 0.0)	0.52 (± 0.5)
RC	3	0-5	3.46 (± 1.0)	2.64 (± 0.9)	76.2 (± 16.3)	5.7 (± 0.3)	52.2 (± 27.5)	1.97 (± 0.8)	0.43 (± 0.1)	0.19 (± 0.0)	0.03 (± 0.0)
		5-15	3.19 (± 0.9)	2.06 (± 0.7)	63.2 (± 12.8)	5.5 (± 0.3)	41.0 (± 23.2)	1.52 (± 0.6)	0.30 (± 0.1)	0.18 (± 0.1)	0.06 (± 0.1)
		15-30	3.82 (± 1.3)	1.81 (± 0.4)	47.6 (± 18.3)	5.2 (± 0.4)	17.3 (± 14.1)	1.24 (± 0.1)	0.32 (± 0.1)	0.10 (± 0.0)	0.15 (± 0.2)
		0-30	3.55 (± 1.1)	2.03 (± 0.3)	57.6 (± 12.3)	5.4 (± 0.3)	31.0 (± 17.4)	1.46 (± 0.3)	0.33 (± 0.1)	0.14 (± 0.0)	0.10 (± 0.1)

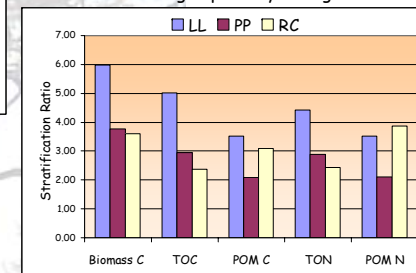
† n= number of reps; CEC7= cation exchange capacity pH7; ECEC= effective cation exchange capacity; BS = base saturation; pH= pH in 1:2 soil:water (v/v); P is Mehlich I extractable; Ca, K, Mg, and Na are NH₄OAc extractable bases; Al is KCl exchangeable Al.

Figure 3. Carbon stocks averaged by management. †



† TOC= total organic carbon; POM C= particulate organic matter carbon; Biomass C=soil microbial biomass carbon.

Figure 4. Stratification ratio (0-5 cm: 15-30 cm) of carbon and nitrogen pools by management. †



† Biomass C=soil microbial biomass carbon; TOC= total organic carbon; POM C=particulate organic matter carbon; TON= total organic nitrogen; POM N=particulate organic matter nitrogen.

Results

- Anthropogenic inputs to cultivated sites were evident based on higher base saturation, pH, exchangeable Ca, Mg, and K, bulk density, and P relative to uncultivated sites.
- Soils in uncultivated sites had higher levels of C (biomass C, TOC, and POM C) compared to cultivated sites.
- On average, Longleaf was 42% higher in biomass C and 59% higher in TOC than row cropping, and row cropping was 20% higher in bulk density and 33% higher in both TON and POM N relative to Longleaf.
- More C and N stratification in Longleaf relative to cultivated sites based on larger stratification ratios of C and N pools.

Conclusions

- More intensive cultivation increased nutrient levels and soil compaction, and decreased C stocks of investigated soils relative to uncultivated sites.