Soil Quality under Mixed Grassland - Cropland Environments

Soil quality is directly linked to broad societal issues of
* food production;
* food security;
* environmental quality;

through ist effects on more tangible elements of
* energy use in food production;
* global warming; and
* water quality.

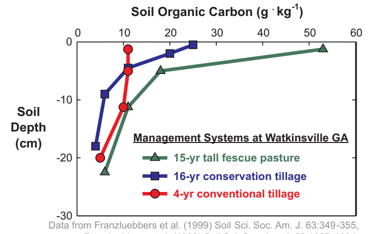
Soil quality is the capacity of soil to function as a provider of key ecosystem services, such as
* supplying and cycling of nutrients for optimum plant growth;
* receiving rainfall and storing water for root utilization;
* filtering water passing through soil to support clean groundwater;
* storing organic carbon for nutrient retention and mitigating greenhouse gas emission; and
* decomposing organic matter and xenobiotics to avoid exposures to plants and the environment.

Soil organic matter is a key attribute of soil quality, because it is a source of energy and substrate for microbial activity and diversity.

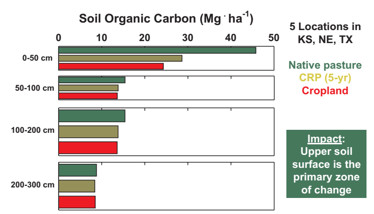
Surface residue is essential to control water runoff and erosion. Along with undisturbed soil, it contributes to surface soil organic carbon (C) accumulation and an increase in soil quality.

Surface soil organic carbon is a key ingredient that links water quality with soil quality through its influence on soil structure, water infiltration, and nutrient cycling.

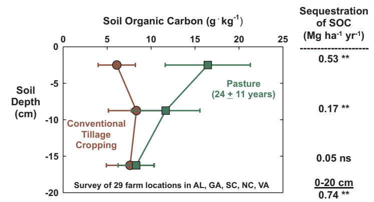
Under grassland systems, soil organic C accumulates primarily at the soil surface.



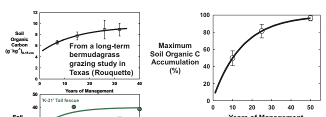
Data from Franzluebbers et al. (1999) Soil Sci. Soc. Am. J. 63:349-355, Franzluebbers et al. (1999) Soil Sci. Soc. Am. J. 63:1687-1694, and Bruce and Langdale (1997) SOM in Temp. Agroecosyst., p. 247-261



Data from Gebhart et al. (1994) J. Soil Water Conserv. 49:488-492



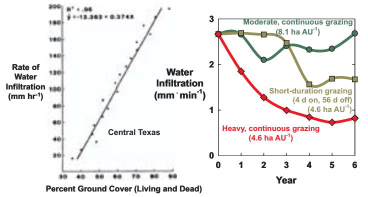
Data from Causarano et al. (2008) Soil Sci. Soc. Am. J. 72:221-230



SOC (Mg ha-1 yr-1)	10 yrs	25 yrs	50 yrs
Hayed BG (GA)	0.29	0.21	0.13
Grazed BG (TX)	0.50	0.33	0.19
Grazed TF (GA)	0.91	0.55	0.31

Data from Wright et al. (2004) Soil Biol. Biochem. 36:1809-1816 and Franzluebbers et al. (2000) Soil Biol. Biochem. 32:469-478

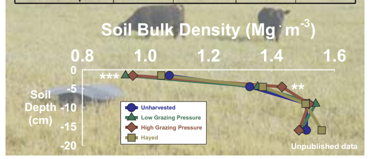
Soil organic C content is highly related to other properties, including water infiltration, soil density, soil structure, and soil biodiversity.

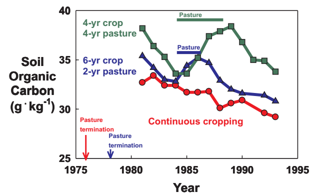


Data from Thurow et al. (1988) J. Range Manage. 41:296-302

End of 12 years of bermudagrass / tall fescue management in Georgia

Soil Bulk Density (Mg m-3) 0-20-cm depth	Unharvested	Low Grazing Pressure	High Grazing Pressure	Hayed
	1.42	1.40	1.41	1.44

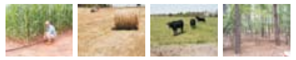




Sod-based crop rotations are needed to maintain fertility and soil quality

Data from Studdert et al. (1997) Soil Sci. Soc. Am. J. 61:1466-1472

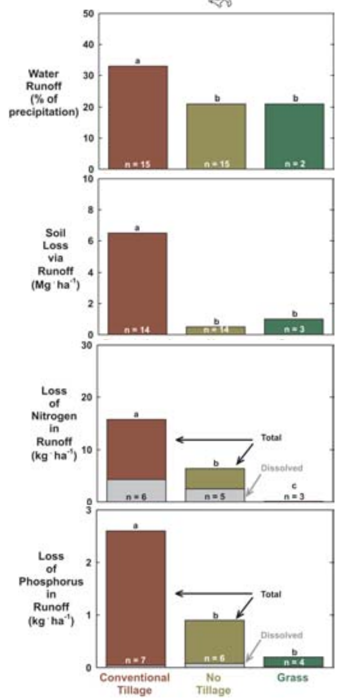
Georgia 1-10-cm depth



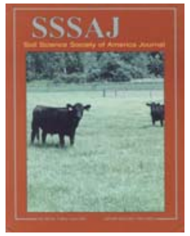
	Tilled Cropland	Hayed Pasture	Grazed Pasture	Natural Forest
Microbial Biomass C	584	598	626	495
PLFA	90	105	108	74
1/Simpson's	128	248	210	79
Chao-1	565	938	862	699

Data from Jangid et al. (2008) Soil Biol. Biochem. (in press)

Location of runoff studies having at least 2 of the 3 land uses
* Conventional tillage cropland
* No tillage cropland
* Grassland



Alan J. Franzluebbers
USDA - Agricultural Research Service
Watkinsville GA 30677
alan.franzluebbers@ars.usda.gov
Telephone: 1-706-769-5631

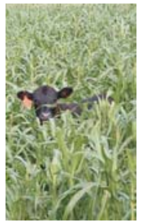













Grasslands have high soil organic matter content, contributing to high soil quality that mitigates greenhouse gas emissions through soil C sequestration and improves water quality by controlling erosion.

Agricultural soils will benefit from the re-introduction of perennial sods into the landscape (i.e., temporally and/or spatially) by:
- ☐ regaining soil organic matter and
- ☐ strengthening their capacity for
  - ❍ long-term productivity and
  - ❍ environmental resiliency