Today's Students, Tomorrow's Land Managers and Policy Makers:

Teaching Sustainable Soil Management

by integrating chemical, physical and biological considerations in theory and practice

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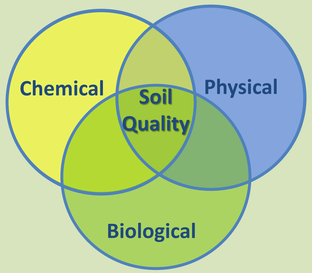


Need for Sustainable Soil Management Education

Human soil management and policy decisions impact soil change, and thus the sustainability of our agroecosystems, significantly. Future decisions will be made by today's college students and young farmers. Universities must prepare these students to grapple with current and future agricultural and environmental challenges.

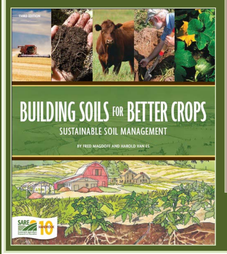
Courses in the broader field of sustainable agriculture and in classical soil fertility abound, but relatively few classes teach the theory and practice of information-driven, holistic, sustainable soil quality management. Training in soil quality assessment and management is essential in fostering new generations to succeed in sustaining our soils through informed on-the-ground management and policy decisions.

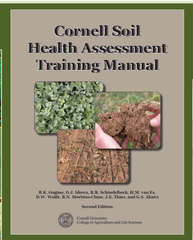
Course Overview

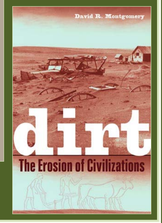
"Soil Management for Sustainability"

- A hands-on course, providing both the theory of important soil processes, and practical real-world applications of these concepts in agriculture.
- Interactions between soil, water, nutrients, organisms and agricultural inputs form the basis of discussions about cropping systems, soil health, water quality and quantity, bioenergy, greenhouse gas emissions, and sustainability.
- Students apply concepts in groups through a semester-long case study project.

Required Reading:







Teaching Theory of Sustainable Soil Management

During the first half of the semester, students explore physical, chemical, and biological soil processes that control crop productivity and environmental quality. They read Montgomery's Dirt, the Erosion of Civilizations, write a book review and conduct a peer-review. Students become laboratory technicians, measuring and interpreting the soil health indicators that make up the Cornell Soil Health Test (CSHT) for a local agricultural soil sample of as-of-yet unknown origin.

Course integrates the recently developed Cornell Soil Health Test

- Available to public since 2006
- Inexpensive indicators of SQ represent agronomically-essential soil processes
- Identifies constraints
- Guides management to alleviate quantified constraints

Student-created Soil Health Report, 2010:

CORNELL SOIL HEALTH TEST

Group Number: 3
Field Location: LeRoy, NY — Soil Texture Scoring Function used: medium
Tillage: no till 5-7 inches till — Crops Grown: SWCCERFBND

	Indicators	Value	Rating	Constraint
PHYSICAL	Aggregate Stability (%)	34.2	49	
	Available Water Capacity (in/in)	0.16	54	
	Surface Hardness (psi)	68	91	
	Subsurface Hardness (psi)	360	25	subsurface pan, deep compaction
BIOLOGICAL	Organic Matter (%)	1.65	7	energy storage, C sequestration, water retention
	Active Carbon (ppm)	327	6	soil biological activity
	Potentially Mineralizable Nitrogen (ppN/gdwsoil/week)	5.53	1	N supply capacity
	Root Health Rating (1-9)	4	64	
CHEMICAL	pH	6.43	100	
	Extractable Phosphorus (lb P/acre soil)	90	20	excessive P
	Extractable Potassium (ppm)	85	100	
	Minor Elements		100	
OVERALL QUALITY SCORE (OUT OF 100):			51	low

Soil Textural Class: loam
SAND (%): 37 — SILT (%): 50 — CLAY (%): 13

Semester Group Project: Part I.

Students conduct Cornell Soil Health Test (CSHT):

- Analyze indicators in laboratory
- Process raw data for report
- Interpret data using scoring functions
- Write a lab report

Measuring Aggregate Stability Using sprinkle rain simulator

Measuring Active Carbon Using Permanganate Oxidation Assay

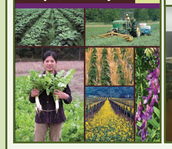
Planting Beans for Root Health Bioassay

"I really liked the soil health project, because we were able to practically apply what we were learning in class." - Student quote from evaluations

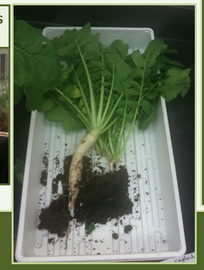
Teaching Practice of Sustainable Soil Management

In the second half of the semester, students explore sustainable soil management options in the broader context of various agroecosystems through hands-on laboratory activities, a field trip and lectures about a variety of management practices. Students then become agricultural consultants, and design a sustainable soil management plan, specific to the constraints they have identified for their field.

Managing Cover Crops Profitably



A classroom full of many options for cover cropping



Field Trip

Students visit an experimental farm and a variety of commercial farms to see equipment, management practices, and effects on soil quality in action.

Successful commercial ridge till operation

Zone till vs. Plow till… residue cover, erosion and soil quality impacts…

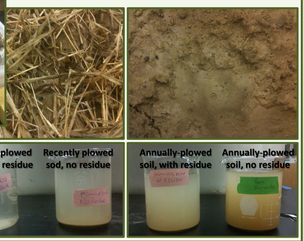
"The field trip was excellent. Actually getting to handle the soil and see the machines in action gave me a better feel for how soil is changed by management -- a feel that didn't come from the classroom or a book." …. "Priceless." - Student quotes from evaluations

Semester Group Project: Part II.

Students use information from 1) their case study's Cornell Soil Health Test results, 2) the grower, situation and current management practices, and 3) management options they have learned about, to:

- Design a short- and long-term soil management plan for their field, that will target identified constraints
- Present findings and plan to group and discuss options
- Write an agricultural consultant report to grower

Measuring Runoff Water Quantity and Quality using Cornell Sprinkle Infiltrometer



Student Feedback

Students state that they will be able to use knowledge and skills gained in this course in their occupations after college, and will manage soils more sustainably as a result of this course.

- *"Coming from a dairy farm and farming more than 3000 acres, I have learned a lot about what the soil needs to be healthy and ways you achieve those needs"*
- *"I have thought a lot about tillage practices and how I may be able to integrate some of them [on my farm]……..I will be farming with reduced tillage in the future."*
- *"I would like to run drag-line manure spreading instead of large spreaders to help eliminate compaction. Other things that I am thinking about are cover crops in corn to corn rotations, no-till, nitrogen and phosphorus levels, and driving lanes."*
- *"Very valuable course. I think over time I am going to be finding it even more valuable than I yet realize." - Student quotes from evaluations*

Selected Resources

Clark, A. 2007. Managing Cover Crops Profitably, Third Edition, Handbook Series Book 9. Sustainable Agriculture Network, Beltsville, MD.

Gugino, B.K., O.J. Idowu, R.R. Schindelbeck, H.M. van Es, B.N. Moebius-Clune, D.W. Wolfe, J.E. Thies, and G.S. Abawi. 2009. Cornell Soil Health Assessment Training Manual, Edition 2.0. Cornell University, Geneva, NY. Available at http://soilhealth.cals.cornell.edu/.

Magdoff, F.R., and H.M. van Es. 2009. Building Soils for Better Crops: Sustainable Soil Management. Handbook Series Book 10. Sustainable Agric. Research and Education, Waldorf, MD.

Mohler, C.L., and S.E. Johnson, (eds.) 2009. Crop Rotation on Organic Farms: A Planning Manual, Vol. 177. Natural Resource, Agriculture and Engineering Service, Ithaca, NY.

Montgomery, D.R. 2007. Dirt - The Erosion of Civilizations. University of California Press, Ltd., Berkeley and Los Angeles, CA.