NC STATE UNIVERSITY College of Agriculture and Life Sciences

Department of Crop and Soil Sciences

Soil Health Testing does not Differentiate Long-term Agronomic Systems in North Carolina

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Background

- A current focus in soil research is **'soil health'**, which is the ability of soil to function as a sustainable vital ecosystem.
- Several **physical**, **chemical**, and **biological** soil properties have been referenced as indicators of soil health.
- The utility of these indicators for soil management recommendations in different agronomic systems is not yet clear.
- More research is needed to determine the significance of soil health indicators in quantifying the effects of agronomic practices on soil properties and productivity.

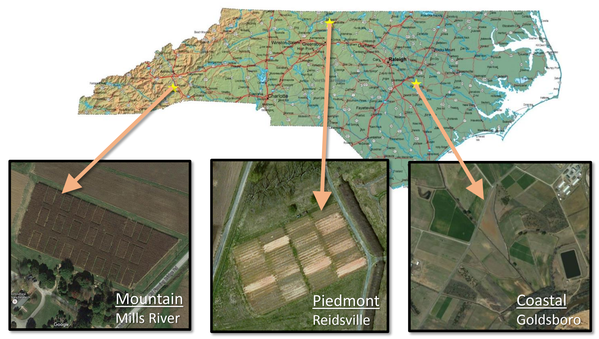
Objectives

1) Determine if soil health indicators can distinguish between cropping and tillage systems in North Carolina.
2) Compare soil test results and their implications for soil management recommendations.
3) Assess relationships between soil health testing and crop yields.

Methods and Materials

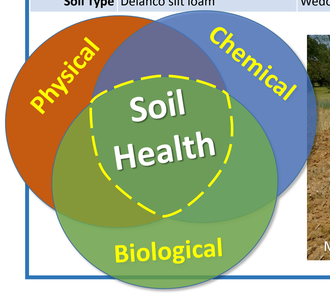
Research Trials

The study consisted of long-term research trials that represented mountain, piedmont, and coastal plain soil types of North Carolina



Management History

	Mountain	Piedmont	Coastal Plain
City	Mills River	Reidsville	Goldsboro
Established	1994	1984	1999
Plot Size and design	12.2 x 24.4 m (40 x 80 ft) 20 plots, CRD	5.8 x 15.2 m (19 x 50 ft) 36 plots, RCBD	Various sizes 12 plots, RCBD
Crops	Vegetables (1994-2006) Corn (2006-2014)	Corn and soybean annual rotation	Various vegetables Corn and soybean annual rotation
Treatments (management)	NTC - No-till chemical NTO - No-till organic CTC - Conventional chemical CTO - Conventional organic CTX - Conventional fallow	NTC - No-till chemical IRS - In-row Subsoil - Spring DS - Disk - Spring CPS - Chisel - Spring CPF - Chisel - Fall CPDS - Chisel/Disk - Spring CPDF - Chisel/Disk - Fall MPDS - Moldboard/Disk - Spring MPDF - Moldboard/Disk – Fall	NTC - No-till chemical RTO - Reduced-till organic CTO - Conventional organic CTC - Conventional chemical
Cover Crop	Annual wheat and crimson clover in all plots	None	Sudangrass, clover, vetch (org) Rye (conventional)
Soil Type	Delanco silt loam	Wedowee sandy loam	Wickham sandy loam; Tarboro



Soil Sampling and Testing

Comprehensive Assessment of Soil Health (CASH)

Cornell's CASH evaluates chemical, physical, and biological soil properties and makes general management recommendations on a 0-100 index scale.

North Carolina Department of Agriculture & Consumer Services (NCDA&CS)

NCDA&CS soil testing extracts essential plant nutrients from soil and uses an index scale conversion to recommend fertility applications for specific crops.

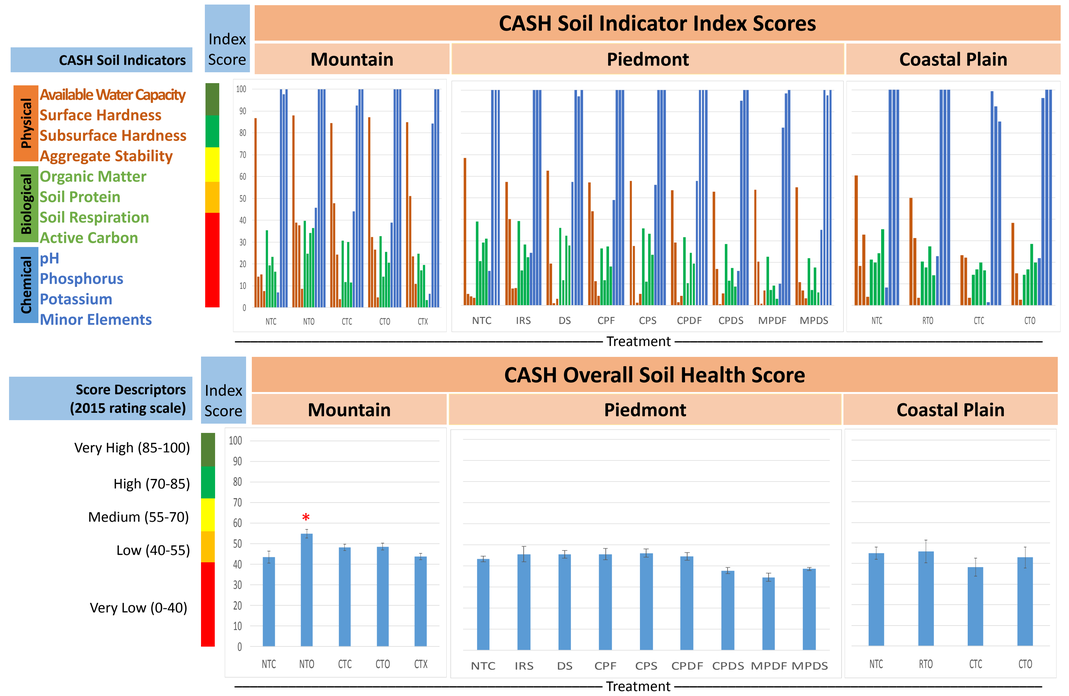
Soil subsamples were collected at random points within a plot and combined to produce a representative plot sample.

Approximately 470 cm^3 (2 cups) of soil from the top 0-15 cm was collected for soil testing by NCDA&CS.

Approximately 1400 cm^3 (6 cups) of soil from the top 0-15 cm was collected for the CASH.

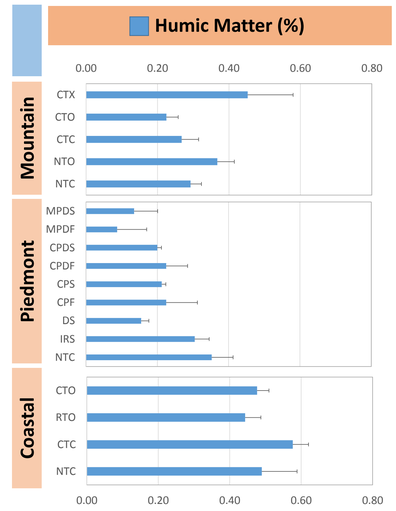
Results

Comprehensive Assessment of Soil Health (CASH)



- **All tillage and cropping systems,** <u>except</u> Mountain NTO were rated low by the CASH regardless of the presence of cover crops or other conservation tillage practices.
- **Essential plant nutrients** were in sufficient quantity for every treatment.
- **Biological** soil indicators were rated low in each system and were the reason why management systems were rated low overall.

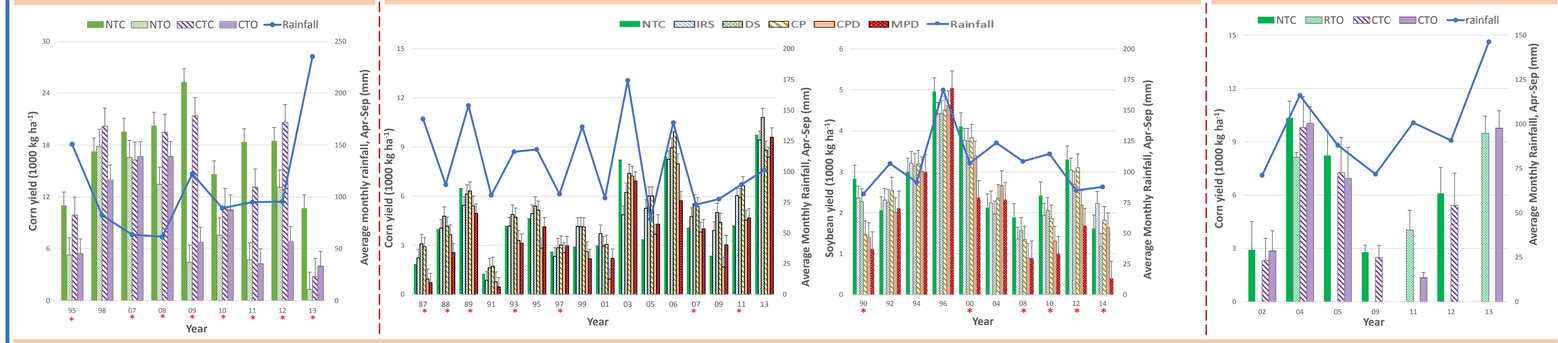
NCDA&CS Soil Testing



Note: Lime and fertilizer was applied to all plots according to NCDA&CS soil test recommendations

- There was no statistical difference in humic matter (representative of organic matter) between agronomic systems with conservation tillage and those with intense tillage.
- Soil test levels of major plant nutrients were adequate (data not shown).

Crop Yields (* indicates years with statistically different yields between treatments in the trial)



- Conventional no-till systems yielded more corn than moldboard plowing, but not more than other tillage systems.
- No-till organic production in the mountains had better soil health scores than conventional production, but yielded less corn because of weed competition (instead of soil constraints).

Conclusions

- CASH soil health indicators lack sensitivity to quantify differences in long-term agronomic systems in southern soils.
- Soil health management recommendations for agronomic systems need to be adjusted to account for differences in intrinsic soil properties and agroecological regions.
- There is no relationship between crop yields and current soil health indicators.

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