Influence of Soil Texture, Tillage and Management Systems On Soil Quality Indicators

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Introduction

Soil Quality or Soil Health is the capacity of soil to function in supporting important ecosystem services without a negative interaction with the environment[1]. A good soil quality assessment should integrate the biological, physical and chemical aspects of the soil for evaluating directional changes due to management practices.

The recently developed Cornell Soil Health Test (CSHT) is an integrative farmer-oriented soil quality assessment tool consisting of 15 multiple soil indicators that include biological (organic matter, permanganate oxidizable carbon, potentially mineralizable nitrogen and root disease potential), physical (wet aggregate stability, available water capacity, surface hardness and subsurface hardness) and chemical (pH, P, K, Mg, Fe, Mn and Zn) measurements[2]. These measurements are integrated together using scoring curves to develop the CSHT report. The scoring curve for interpreting the wet aggregate stability and a copy of the CSHT report are given in Figures 1 and 2. The general interpretations of the CSHT have been based on the major management practices (dynamic aspect) and the soil texture (inherent aspect).

Recent studies have shown that soil quality indicators can vary in their response to soil/crop management practices and soil texture[3, 4]. There is, therefore, an increasing demand to evaluate how various soil indicators perform under alternative management systems and in contrasting soils[5]. This work evaluates the biological and physical soil measurements which are part of the CSHT, on commercial farms in the Northeastern USA.

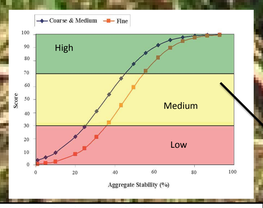


Figure 1. Scoring curve for the wet aggregate stability based on soil texture.

CORNELL SOIL HEALTH TEST REPORT (COMPREHENSIVE)

Name of Farmer: GATES FARM RESEARCH TRIAL — Sample ID:
Location: — Agent:
Field/Treatment: - — Agent's Email:
Tillage: PLOW TILL — Given Soil Texture: SILTY
Crops Grown: SWEET CORN/BEANS/CORN GRAIN — Date Sampled: 06-May-08

	Indicators	Value	Rating	Constraint
PHYSICAL	Aggregate Stability (%)	17	18	aeration, infiltration, rooting
	Available Water Capacity (in/in)	0.21	85	
	Surface Hardness (psi)	48	93	
	Subsurface Hardness (psi)	214	79	
BIOLOGICAL	Organic Matter (%)	2.6	25	energy storage, C sequestration, water retention
	Active Carbon (ppm) [Permanganate Oxidizable]	615	50	
	Potentially Mineralizable Nitrogen [ugN/ g/soil/week]	7.8	9	N Supply Capacity
	Root Health Rating (1-9)	6.6	38	
CHEMICAL	*pH	7.0	100	
	*Extractable Phosphorus (ppm) [Value <3.3 or >21.5 are downscored]	10.0	100	
	*Extractable Potassium (ppm)	58	72	
	*Minor Elements		100	
	OVERALL QUALITY SCORE (OUT OF 100):	64.1		Medium

Measured Soil Textural Class:==> silt loam
SAND (%): 41.4 *SILT (%): 50.6* *CLAY (%): 8.0*
Location (GPS): Latitude=> *Longitude=>*

* See Cornell Nutrient Analysis Laboratory report for recommendations

Figure 2. Specimen copy of the Cornell Soil Health Test Report

Objectives

- ❑ **Assess the effect of management on soil quality indicators**
- ❑ **Assess the effect of soil texture on soil quality indicators under different management systems.**
- ❑ **Assess the effect of tillage on soil quality indicators under different management systems.**

Methods

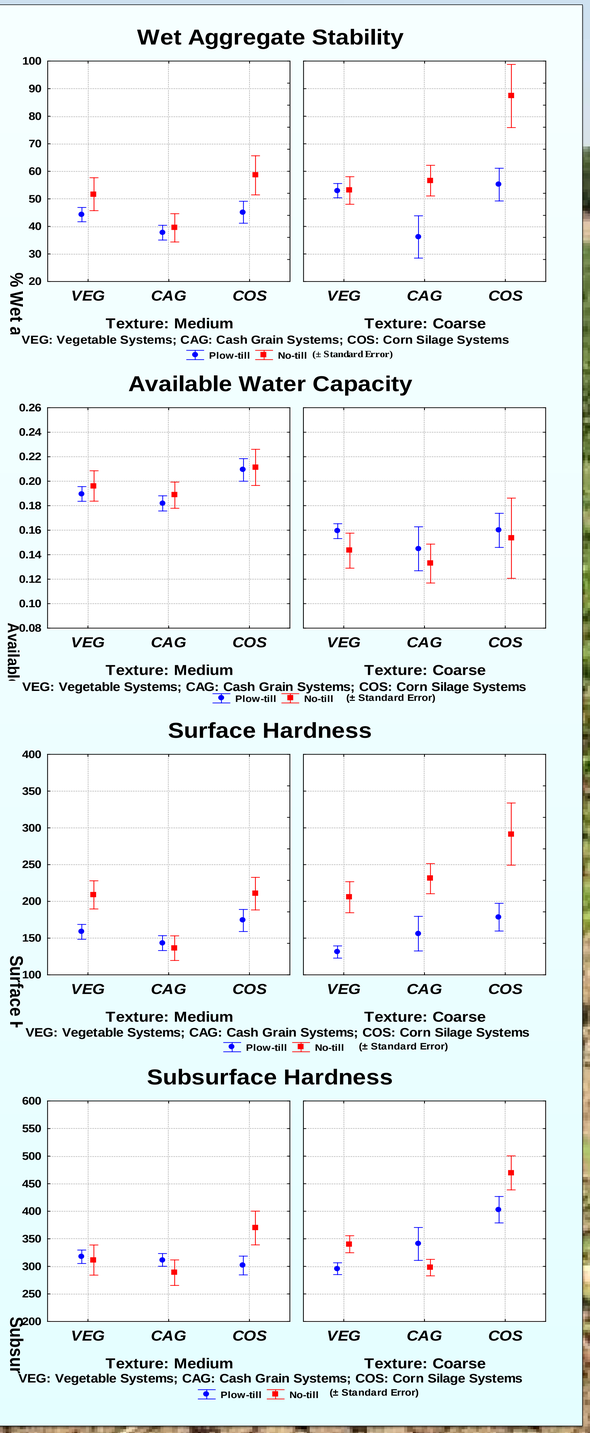
Soil samples were collected from different management systems on commercial farms in the Northeastern USA. Management systems included cash grain, corn silage and vegetable production systems. These systems were further classified based on texture (coarse or medium) and tillage (no till [NT] or plow till [PT]). Soil quality indicators were measured for over 700 samples from different fields.

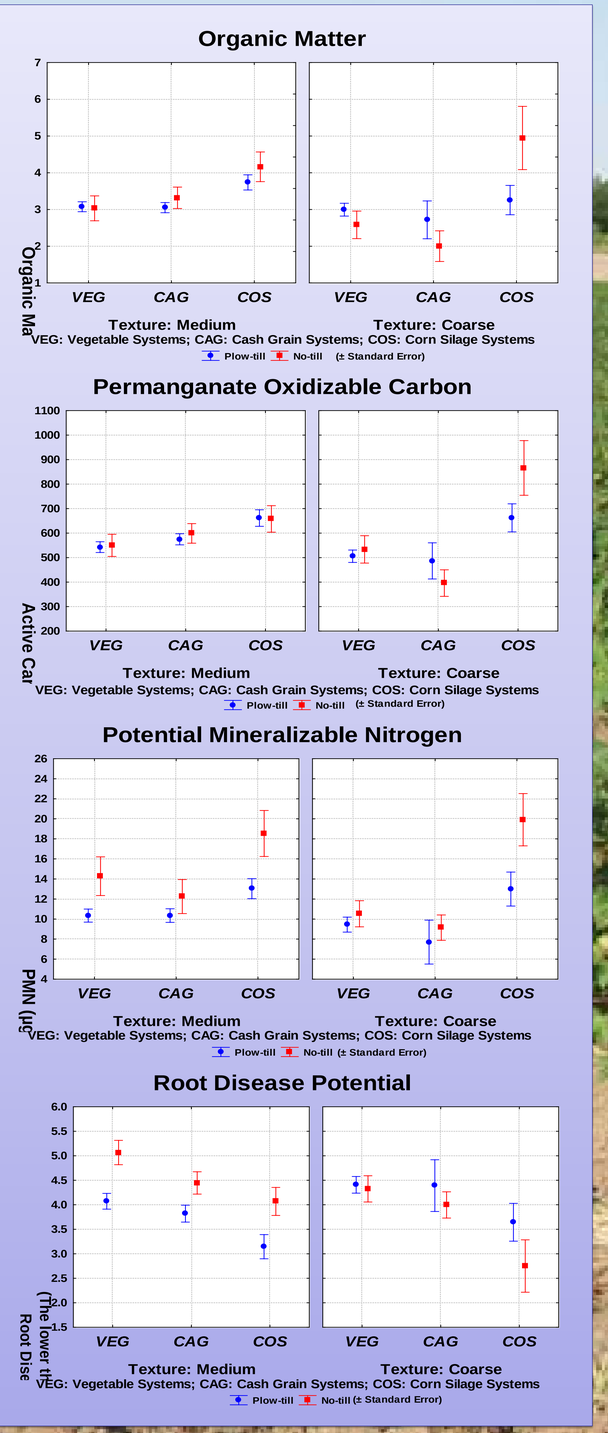
Soil quality indicators that were studied included wet aggregate stability (WAS), available water capacity, surface and subsurface hardness, organic matter, permanganate oxidizable carbon (POC), potential mineralizable nitrogen (PMN) and root disease potential (bean bioassay method). Sampling protocol and specific field and laboratory methods are given in the Cornell Soil Health Training Manual[6].

Conclusions

- ❑ Generally, the response of soil quality indicators to different management systems was dependent on soil texture and tillage.
- ❑ WAS, OM, POC and PMN tended to be higher in corn silage system under NT compared to the vegetable and cash grain systems. This may be related to the high levels of organic manure inputs into the corn silage system.
- ❑ Surface and subsurface hardness were higher in corn silage system especially under NT. This may be a reflection of heavy farm equipment being used for harvesting and manure spreading.
- ❑ Coarse textured soils generally had higher levels of surface and subsurface compaction than the medium textured soils especially in the corn silage system.
- ❑ Root disease potential was generally higher in the vegetable system. NT in medium texture soil also tended to have more disease pressure than the PT.

Results





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