Evaluating the Effects of Sod Farming on Soil Quality

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Outline

• Brief overview
• Discuss methods
• Initial results
• Upcoming research plans
Introduction

- Sod farming is one of the largest agricultural enterprises in RI

- Most located in So. County on the most productive agricultural soils in RI

- Continuing increase of development pressure on this part of RI

http://www.sodco.net

John S. Allen photo
Open Space Preservation

- In southern RI there is a lot of interest in preserving open space

- Ensures the land is being used sustainably

- Purchasing the development rights of land is one way to protect open spaces

- Funding from land trusts, private & government organizations, etc.
• USDA-NRCS is interested in using funds from the Farm and Ranchland Protection Program (FRPP) for purchasing of development rights of RI sod farms using

• Some criteria of the FRPP are to “protect topsoil from conversion to non-agricultural uses, and ensure that the agricultural capacity of the soils remain viable for future generations”
Soil Loss on Sod Farms

• Each time sod is harvested, a layer of soil is removed

• The amount of soil removed during harvest varies depending on farming practices, soil type, etc.

• A few studies have made attempts to quantify this loss of soil
Is that much soil really being removed?

• RI sod producers feel they are increasing the soil quality of their land, outweighing any soil loss occurring during harvest

• Perhaps methods used to quantify soil loss are inadequate or antiquated for use on modern sod farms - biosolids

• Other factors affect soil quality other than loss
What is soil quality?

“The capacity of a soil to function within ecosystem boundaries to sustain biological productivity, maintain environmental quality, and promote plant and animal health”

- Doran et. al. 1994

• Dynamic Properties
Dynamic Soil Properties

- Describes condition of soil due to relatively recent land use

- Includes soil quality indicators

- Composed of physical, biological, and chemical soil properties
Objectives

• To determine appropriate soil quality indicators to be used for assessing the sustainability of land used for sod production

• To establish reference guidelines to be used for future soil quality assessment on sod farming operations

• To determine the overall effect commercial sod production has on soil quality
Methods

• Sites
  • 5 sod farms, 3 control sites (corn field, turf plot (no harvest), and forest
  • All 8 sites stratified by soil type
    • Agawam, Enfield, Bridgehampton
Soil Types

Bridgehampton A – 29%

Enfield A – 31%
Parent Material for RI sod farm soils

Loess or loamy material – fine, silty material

Outwash – coarse sands and gravels

http://www.nesoil.com/images/enfield.htm
2006 Sampling

• 15 points were randomly selected at all sites using GIS
  • at each point soil cores were taken at depths of 0-10, 10-20, and 20-30 cm
  • these samples were measured for pH, SOM, \( \text{NH}_4^+ \) & \( \text{NO}_3^- \), and microbial biomass C

• 6 points were randomly selected in the field
  • stratified to areas with established turf on sod farms sites, random at control sites
  • used for measuring soil respiration and infiltration rates
SQ Indicators used in this study

Chemical:

- Organic Matter
- $\text{NH}_4^+ \ & \ \text{NO}_3^-$
- pH
Biological:
• Microbial biomass C
• Soil Respiration
SQ Indicators used in this study

Physical:
• Bulk density
• Infiltration rate
• Solum thickness
• Loess thickness
## Sampling harvested sod

- Harvested sod was collected from 4 sites, on the same day
  - in an effort to ensure similar soil moisture conditions during
  - sod strips were collected straight from the harvester to avoid soil loss during handling
  - samples taken from the strips were frozen until ready for analysis
Entire sod piece (grass and soil)

1.4% of the ashed weight of sod piece

Sod sample after initial burning in preparation for LOI analysis

Sod piece with soil washed off (plant biomass only)
• 3 sod strips were collected 50 m apart along a transect at each site

• For each sod strip, 3 1’ x 1’ adjoining squares were traced out

• a 10cm diameter cup cutter was used to take 2 random samples from each 1’ x 1’ square
Results

Mineral Soil Loss per Sod Harvest

<table>
<thead>
<tr>
<th>Sod Farm</th>
<th>Piece 1</th>
<th>Piece 2</th>
<th>Piece 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sod Farm C</td>
<td>32.56-37.68</td>
<td>32.56-37.68</td>
<td>32.56-37.68</td>
</tr>
<tr>
<td>Sod Farm B</td>
<td>30.48-55.28</td>
<td>30.48-55.28</td>
<td>30.48-55.28</td>
</tr>
<tr>
<td>Sod Farm D</td>
<td>49.41-56.80</td>
<td>49.41-56.80</td>
<td>49.41-56.80</td>
</tr>
</tbody>
</table>
Skogley and Hesseltine 1978

- Removal: 27 – 47 tons/acre/harvest

Carr 1996

- Removal: 34 – 45 tons/acre/harvest

NRCS standards

- Tolerable Loss: 3 tons/acre/year

Based on these studies, at least 9-16 times more soil is being removed than allowable by NRCS standards.
2006 Soil Organic Matter Content

n = 15

% Organic Matter

0-10 cm
10-20 cm
20-30 cm

Sod Farm A
Sod Farm B
Sod Farm C
Sod Farm D
Sod Farm E
Silage Corn
Turf Plot
Forest

Legend:
- Blue: 0-10 cm
- Purple: 10-20 cm
- Yellow: 20-30 cm

Note: The data represents the organic matter content in different soil layers from various farms and land uses. The values are averaged over 15 samples.
2006 Soil Organic Matter Content (0-10 cm)

- Sod Farm A
- Sod Farm B
- Sod Farm C
- Sod Farm D
- Sod Farm E
- Silage Corn
- Turf Plot
- Forest

Organic Matter:
- DE
- D
- D
- BC
- E
- CD
- AB
- A
2006 Soil Organic Matter Content (10-20 cm)

- Sod Farm A
- Sod Farm B
- Sod Farm C
- Sod Farm D
- Sod Farm E
- Silage Corn
- Turf Plot
- Forest

% Organic Matter

Values: DE, BCD, CD, AB, E, ABC, A, BCD

Legend:
- DE
- BCD
- CD
- AB
- E
- ABC
- A
- BCD
2006 Soil Organic Matter Content (20-30 cm)

% Organic Matter

Sod Farm A  Sod Farm B  Sod Farm C  Sod Farm D  Sod Farm E  Silage Corn  Turf Plot  Forest

AB  A  A  A  B  A  A  AB
Upcoming research plans

• Run samples for C:N ratios
• Measure δ13C Isotope Signatures
  • Biosolid fertilizer, turf plant tissue, and SOM
• Sample all sod farms within fields ~30 years old
  • SOM, Mineral N
• Finish lab analysis

“Boston Bean” biosolid fertilizer
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Questions?