Utilization of Conservation Tillage Practices to Rebuild Organic Carbon Levels in a Sandy, Coastal Plain Soil

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Soils are sands to loamy sands and are extensively weathered.

**Norfolk series**
(Typic Kandudult)

**Lakeland series**
(Typic Quartzipsamment)
Past conventional tillage research efforts have shown:

**Mean SOC contents (%) under conventional tillage at PDREC after 2 years**

<table>
<thead>
<tr>
<th>Depth (cm)</th>
<th>time (yrs)</th>
<th>0</th>
<th>1</th>
<th>2</th>
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<td>0 to 3</td>
<td>0.80</td>
<td>0.65</td>
<td>0.92</td>
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<tr>
<td>3 to 15</td>
<td>0.65</td>
<td>0.65</td>
<td>0.67</td>
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**Soil CO₂ flux measurements**
Can conservation tillage rebuild SOC contents in the Coastal Plain region?

Courtesy of Mr. Bobby Brock

A Soil Scientist
Long-term tillage & crop management research plots

▲ Started in 1979 by Dr. Doug Karlen

▲ 20 plots equally divided between conservation and conventional tillage management

▲ each plot is 0.14 ha and contains the Norfolk soil series

▲ crop rotations consisted:
  1980s -- corn + wheat
  1990s – corn + wheat + cotton/beans
  2000s – corn + wheat + beans + rye

▲ crop yields, crop residue and soil samples are collected & examined
Soil sampling at the long-term tillage plots

Soil cores collected annually to 90-cm

Cores are divided by depth and SOC content measured.

Crop biomass collected

Mr. Bobby Fisher, USDA-ARS
Data and units

- Work in the 1980s and 1990s determined SOC on a mg/kg basis.

- Starting in 2001, soil bulk densities are collected annually.

- SOC contents are now expressed on a wt/ha basis.
Grouped mean %SOC in Norfolk soil after 23 years under conservation and conventional tillage
Annual Norfolk mean SOC contents in 0 to 5 cm depth

From: Hunt et al. (1996)
Annual Norfolk mean SOC contents in the 0 to 5 cm depth

SOC (g/kg)

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**Conventional**

\[ y = 54.24 - 0.031x \]
\[ r^2 = 0.015, \ P = 0.76 \]

**Conservation**

\[ y = 97.24 - 0.013x \]
\[ r^2 = 0.013, \ P = 0.75 \]
Mean Norfolk SOC contents (using 2002 data) in the three surface soil depths

Error bar = 1 SD

** **
Annual mean residue C input vs. mean SOC contents in Norfolk soil under conservation tillage (0 to 5 cm)

Assumes that 1 kg residue contains 0.45 kg C and soil bulk densities were 1.34 g/cc.
Conclusions

♦ After 25 years of tillage and crop management, the mean %SOC contents in the Norfolk topsoil (0 to 5 cm deep) under:
  ■ conservation tillage increased from 5.3 to 15.9 g/kg (+300%)
  ■ conventional tillage increased from 6.3 to 9.3 g/kg (+150%)

♦ The Norfolk soil is in the “C saturated phase of maturity”.

♦ Under conservation tillage, the SOC contents (wt/ha) were:
  ■ significantly higher (0 to 10 cm)
  ■ and linear related (0 to 5 cm) with residue C input than in soil under conventional tillage.
Thank you for your attention