Correlation of Crop Yields and Soil Organic Carbon in Midwestern Region

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INTRODUCTION

- Soil organic matter is an integral component of the soil (making soil alive).
- Soil organic matter improve soil quality, crop yields, and the environment by
  - Increasing water retention/release, reducing bulk density, and penetration resistance (Bot & Benites, 2005),
  - Enhancing nutrient retention (CEC)/release, buffering pH changes, reducing toxicity of contaminants (Barber, 1984),
  - Supporting soil microbes (e.g., N-fixing bacteria) and other biota (Six et al., 2002),
  - Protecting surface and ground water, and
  - Sequestration of atmospheric CO_2 (Lal, 2004).
- However, lack of research on quantitatively correlating crop yields to soil organic matter or soil organic carbon (SOC) contents for
  - Field data, and
  - US Midwestern region.

METHODS

- Uses of CS-CAP data base (**www.sustaiablecorn.com**):
  - Available agronomic data ,
  - Available soil data,
  - Corn grain yield at 15.5% MB and soybean grain yield at 13.0% MB,
  - SOC average from two depth (0-10 and 10-20 cm) at the same plot and in the same year,
  - Data from all participating states included (but not from all the sites due to data unavailable),
  - All treatments have not been considered in this presentation .
- Regression method used for assessing correlations between crop yields and soil organic carbon (SOC) .

RESULTS

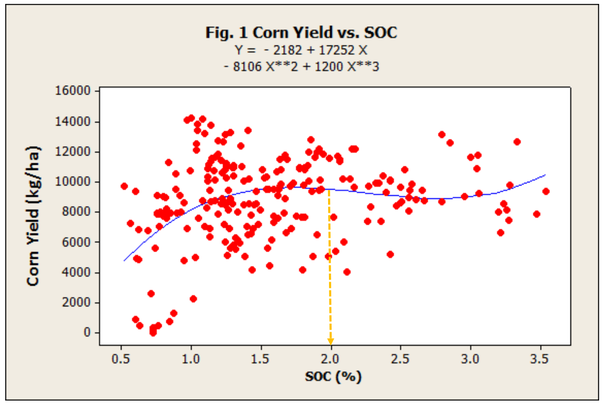
- The average SOC content was **1.56 % ± 0.59 %** in top 10- cm layer,
- The highest SOC found in Minnesota soil (**3.53%**),
- The lowest SOC found in Michigan soil (**0.50%**),

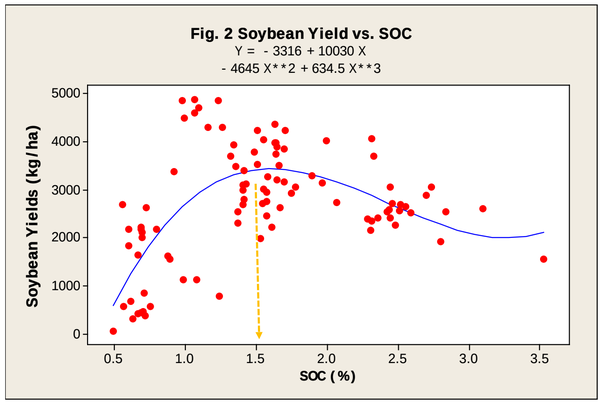
RESULTS (continued)

- Soils contained similar SOC under corns (**1.57 % ± 0.68%)** or soybeans (**1.54 % ± 0.69%**),
- The average yield was **8769.7 ± 2837.1** kg/ha for corns and **2726.1 ± 1167.4** kg/ha for soybeans,
- Crop yields are positively correlated with soil organic matter or SOC contents (**Figs. 1** & **2**),
- The critical value of SOC for the highest yield is ~**2.0%** for corns (**Fig. 1**) and **1.5%** for soybeans (**Fig. 2**),
- Yields do not significantly increase with further increase of SOC beyond these critical values,
- Polynomial models best fitted the field data (Yield vs. SOC, **Table 1**; **Figs. 1** & **2**).

Table 1 Regression of Crop Yields Versus Soil Organic Carbon Using Different Models

Regression type	Corn yields (Y) vs. SOC (X)	Soybean yields (Y) vs. SOC (X)
linear	$Y = 971X+7243.2$ $R^2 = 0.0535$	$Y = 426.55x + 2067.3$ $R^2 = 0.0636$
Exponential	$Y = 4711.7e(0.3079X)$ $R^2 = 0.0699$	$Y = 1247.6e(0.3988x)$ $R^2 = 0.1458$
Logarithmic	$Y = 19571\ln(X)+8058.8$ $R^2 = 0.0861$	$Y = 945.96\ln(X) + 2416.6$ $R^2 = 0.1525$
Polynomial (n=2)	$Y = -1193X^2+5417.6X+3743.4$ $R^2 = 0.1065$	$Y= -1169.6X^2 + 4421X - 760.84$ $R^2 = 0.3608$
Polynomial (n=3)	$Y = 1200\ X^3-8106X^2+17252X-2182$ $R2 = 0.138$	$Y= 634.5X^3-4645X^2 + 10030X - 3316$ $R^2 = 0.424$
Power	$Y = 6102.8X^{0.6203}$ $R^2 = 0.1126$	$y = 1798.2x^{0.7654}$ $R^2 = 0.2619$





CONCLUSIONS

- Increasing soil organic matter content not only stores more C in the soil, but benefits crop yields,
- Highest crop yields found at 1.5-2% SOC in Midwestern soils,
- Polynomial function (n=3) best fits the field data.

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