Rapid Carbon Accounting In Soil Survey: Effects of Methodology On Estimates of Soil Organic Carbon Stocks

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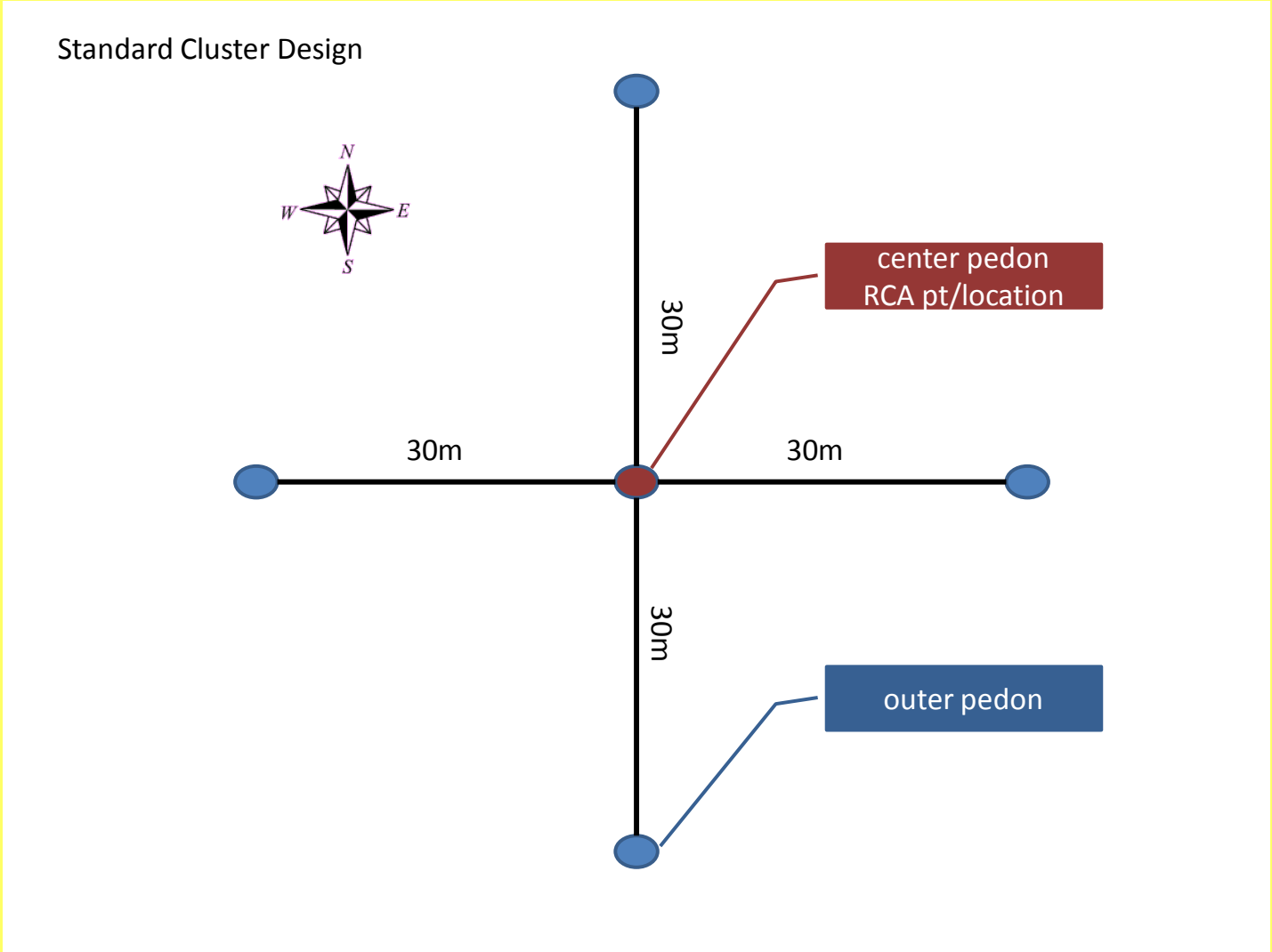
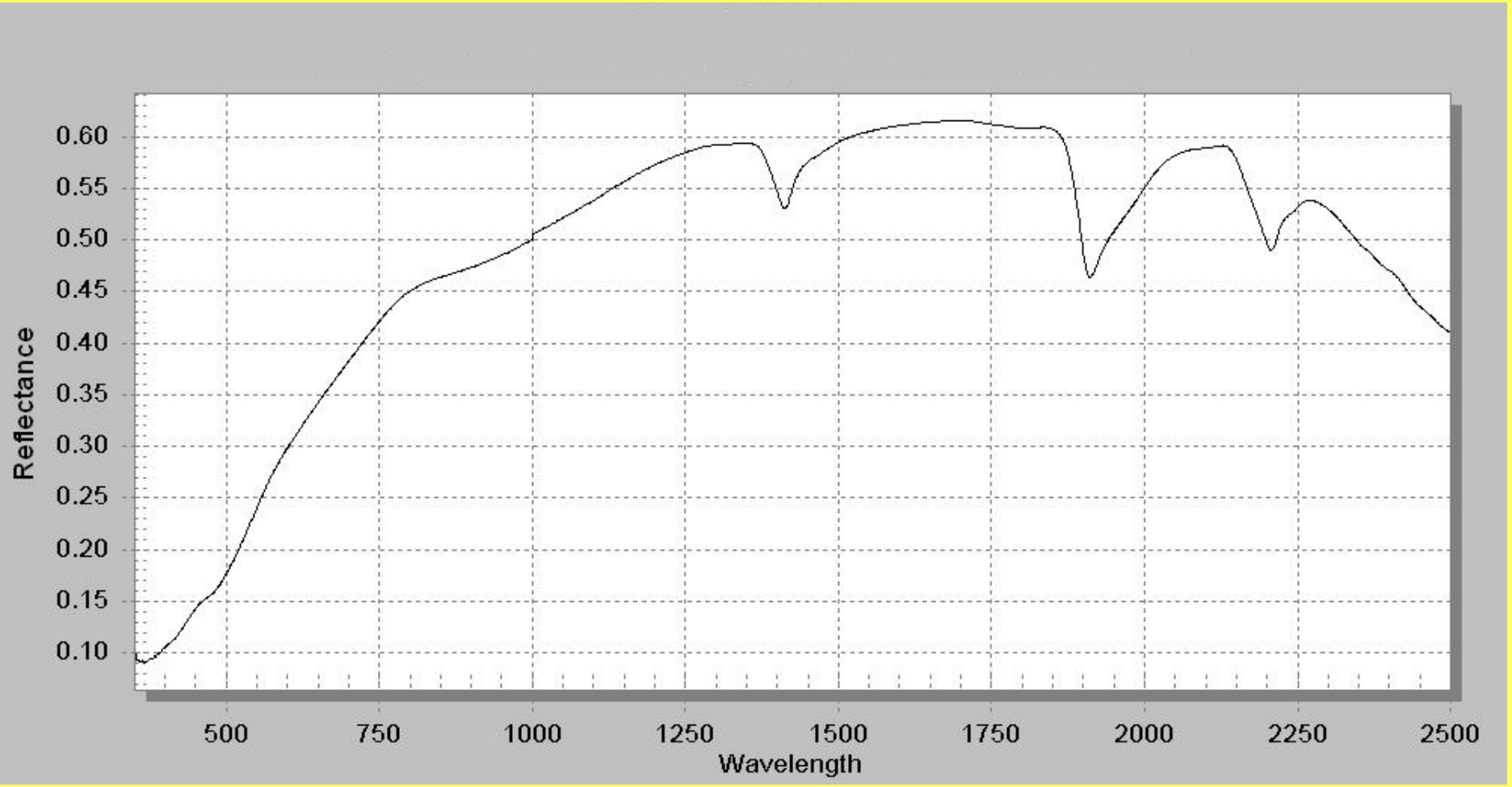
- Soils are the source of the largest pool of organic carbon of any of the terrestrial systems.
- Maintaining such a pool requires significant carbon sequestration suggesting that soils are an essential contributor of carbon sequestration relative to the global carbon cycle.
- Although the majority of the soils within the US have been mapped, accurate measures of the amount of C stored in these soils is far from a reality.
- Making such a measure is a monumental task and essentially unattainable.
- This doesn't mean, however, that SOC metrics of typical soils (benchmark soils) can't be assessed and monitored over time to determine the effects of climate change and land use practices on SOC pools and sequestration.

To meet this challenge in a “reasonable” amount of time the NRCS established the Rapid Carbon Assessment initiative to collect carbon data on benchmark and similar soils throughout the US.



In the lab, the samples were prepped and scanned with a near infrared spectrometer (VNIR) to estimate the SOC content. Such an approach was done to speed up the SOC analysis relative to measuring SOC content with a C:N analyzer.



Visible and Near-Infrared (VNIR) Reflectance Spectrum Pattern

In this study we asked two questions:

1) is there too much variability in the SOC content estimates made by the VNIR to make a reliable estimate of the carbon pools of these soils?

2) is there more variability within the 5 sampling stations than with the laboratory analysis to estimate carbon pools?

METHODS AND MATERIALS

- Six forested New England sites were chosen for evaluation.
  Three of the sites were identified as Inceptisols,
  two as Spodosols,
  and one Histosol.

- Bulk samples were collected to measure and estimate SOC content and undisturbed samples were collected to measure bulk density.

- Bulk samples were collected to greater than a meter, but bulk density samples were only collected to 50 cm.

- There were 159 horizons sampled and analyzed.

METHODS AND MATERIALS

- Samples were air-dried and gently ground to pass the fine-earth fraction through a 2 mm (#10) sieve.
- Air dried samples were analyzed with the VNIR and SOC estimates were made based on a nationwide model established at the National Soil Survey Lab.
- The same samples were ground to pass through a #60 sieve and analyzed using a C:N analyzer to determine SOC content.
- Select number of samples (35) were oven-dried, weighed, combusted in a muffle furnace over-night at 550 degrees C, and re-weighed to determine loss-on-ignition (LOI) soil organic matter contents.
- SOC pools were calculated for the upper 50 cm of each soil and station.

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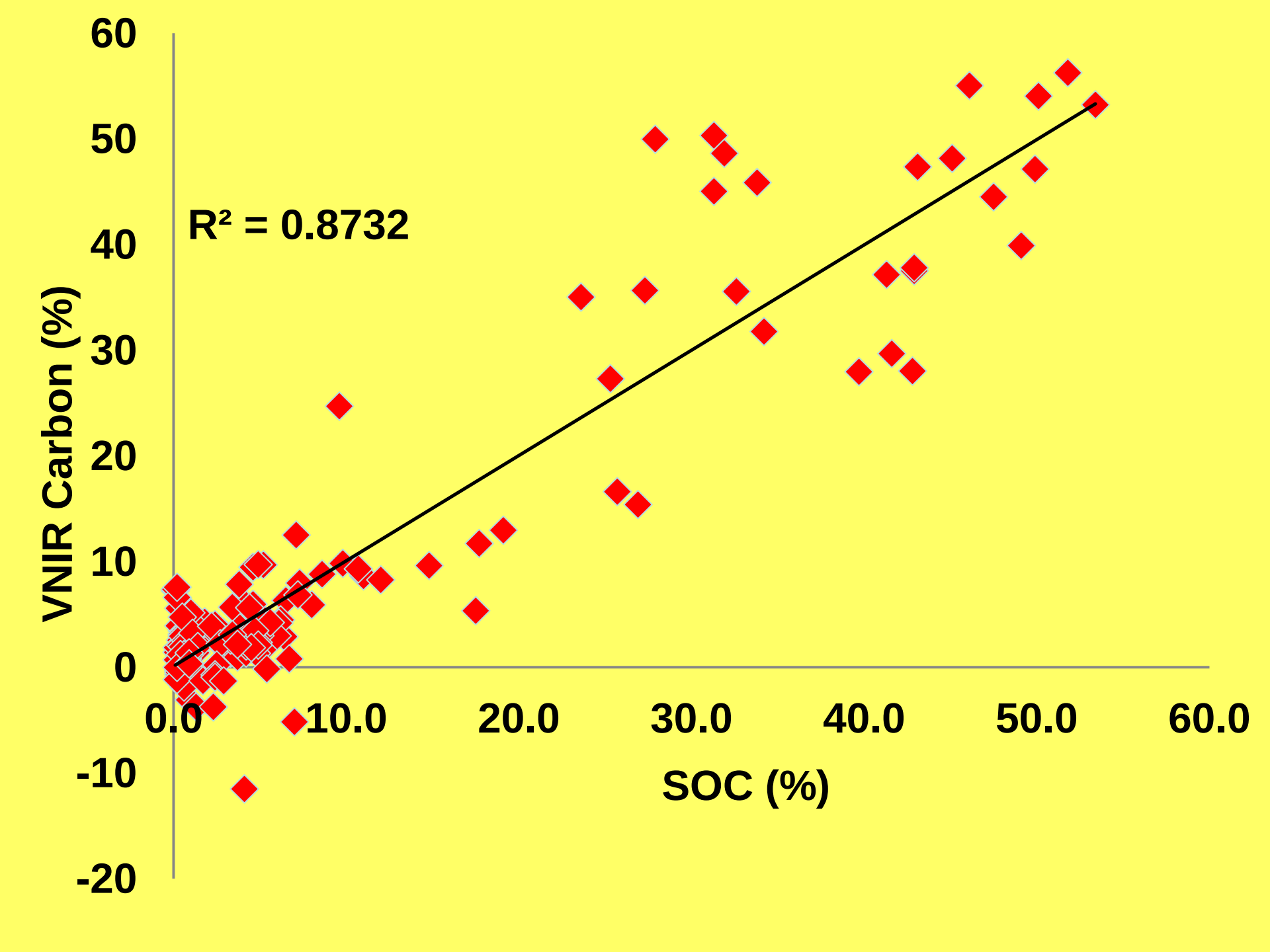
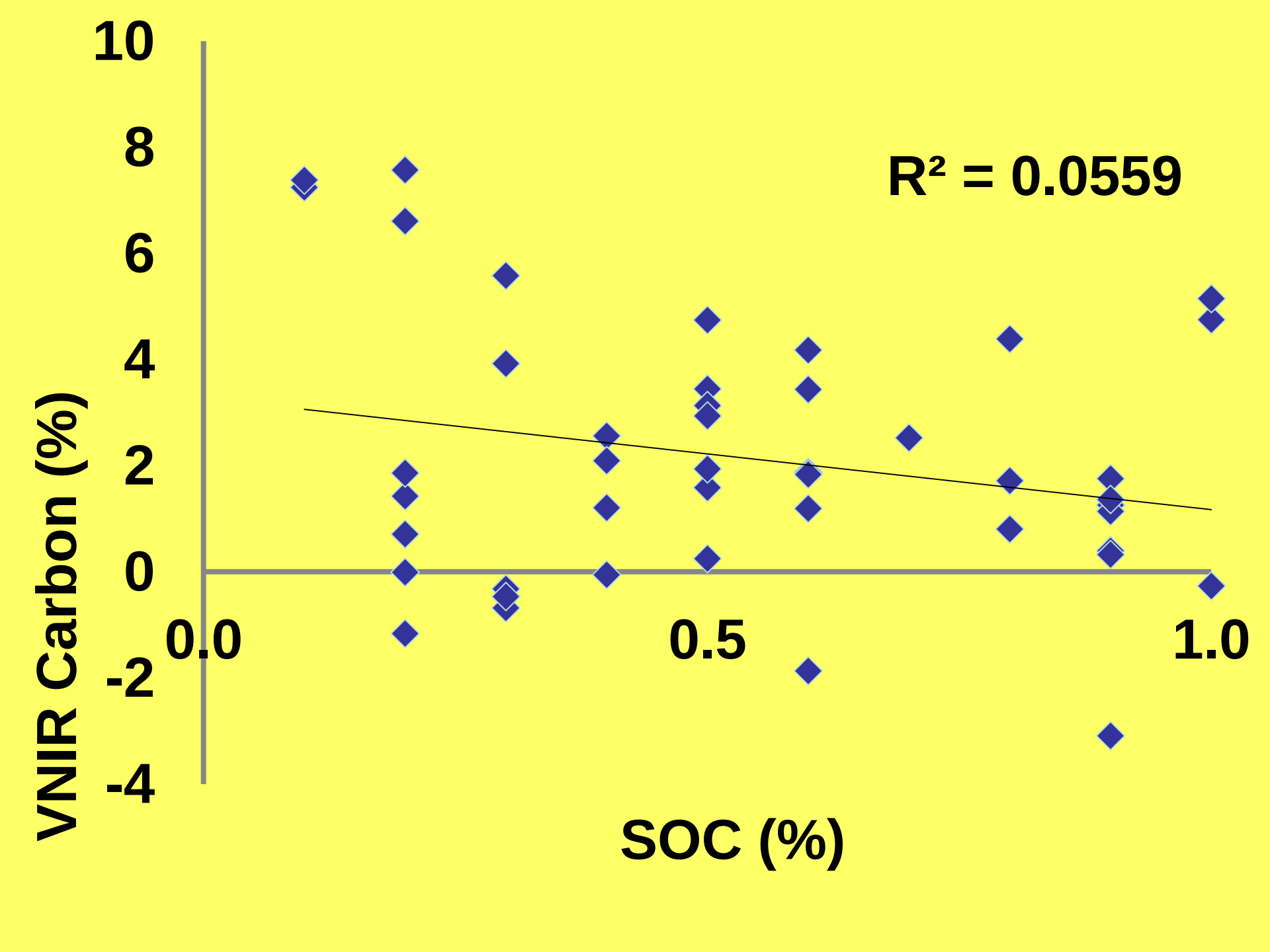
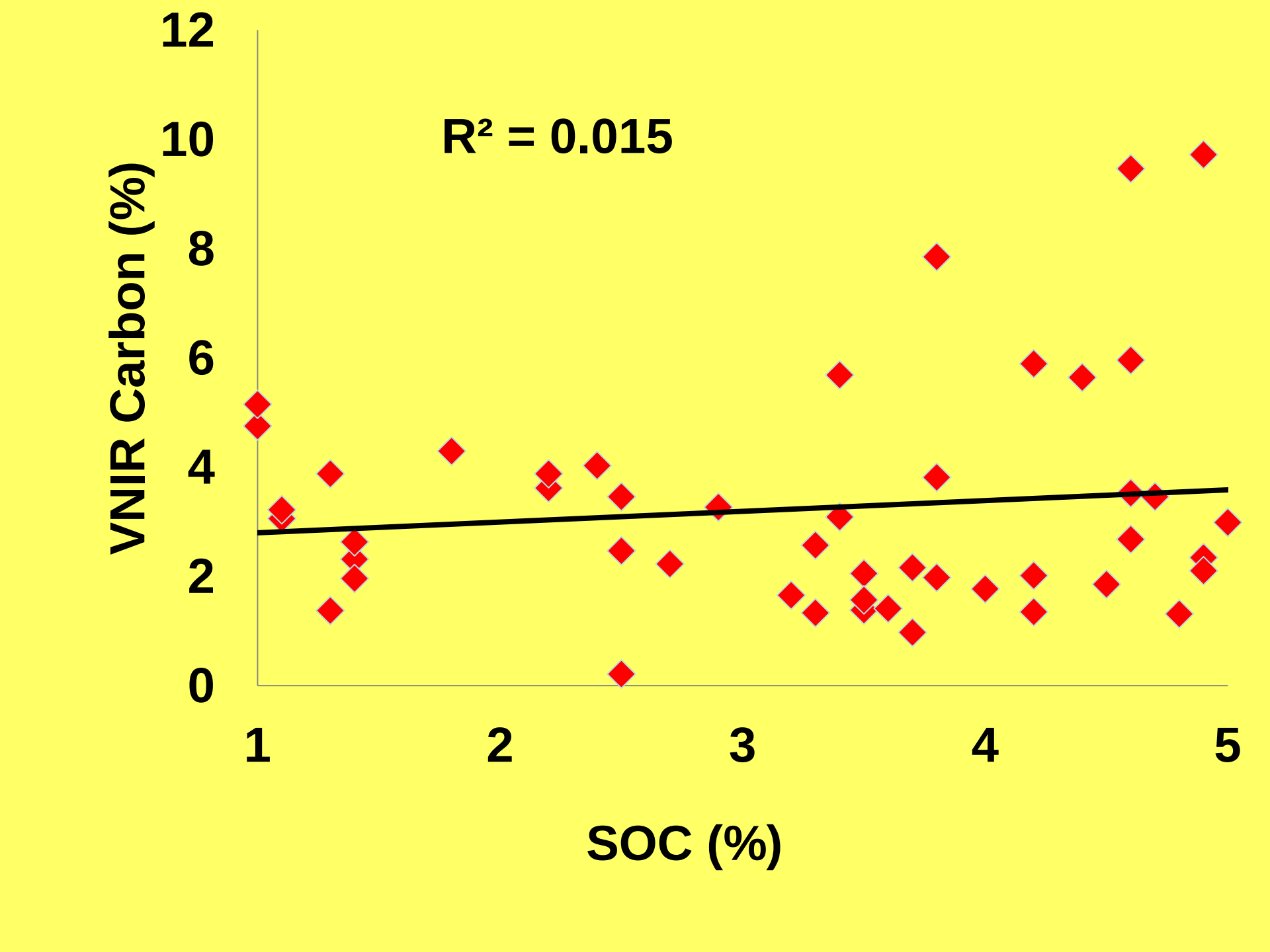
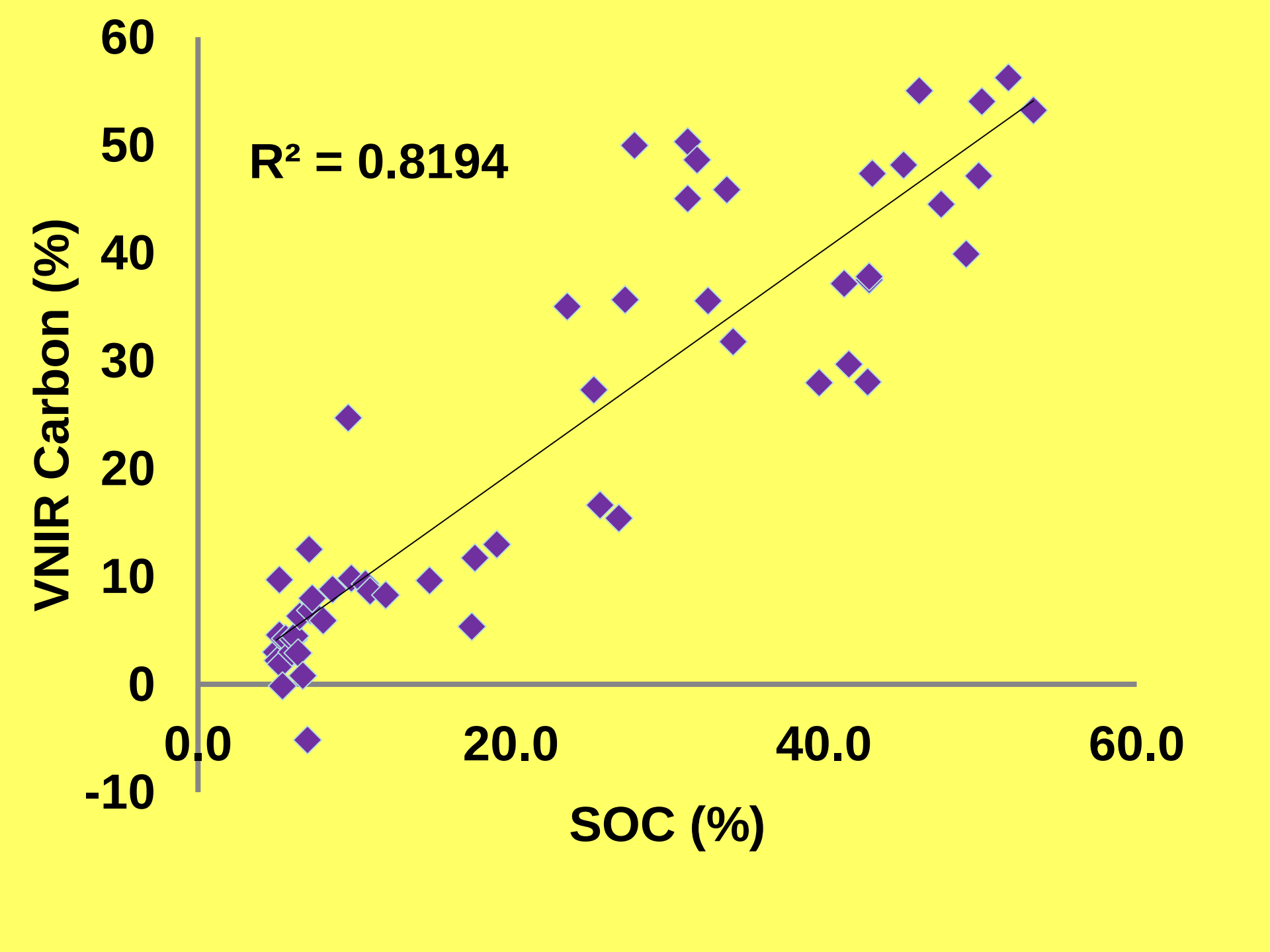
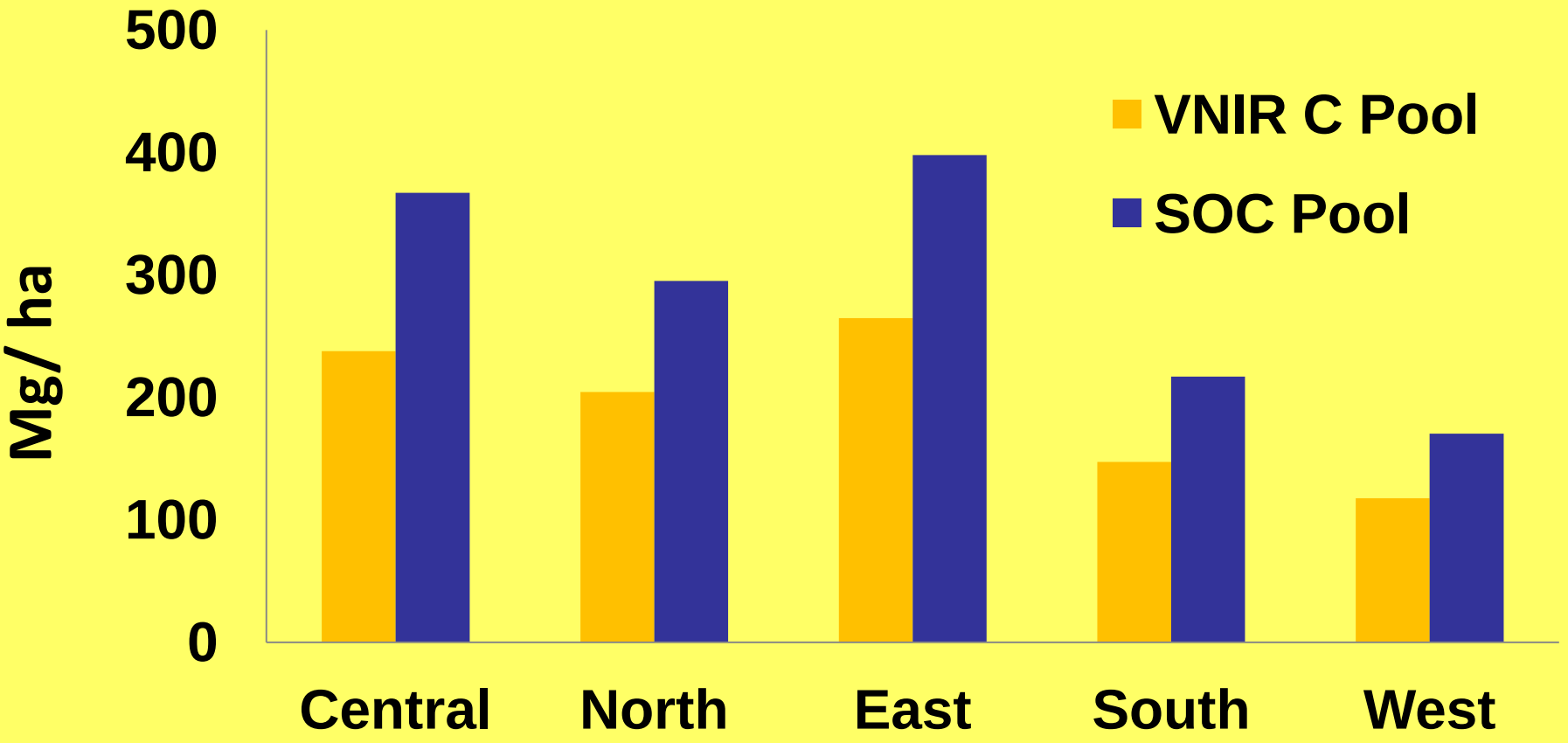

60
50
40
30
20
10
0
-10
-20
VNIR Carbon (%)
R² = 0.8732
0.0
10.0
20.0
30.0
40.0
50.0
60.0
SOC (%)


10
8
6
4
2
0
-2
-4
0.0
0.5
1.0
VNIR Carbon (%)
SOC (%)
R² = 0.0559


R² = 0.015
VNIR Carbon (%)
SOC (%)
0
2
4
6
8
10
12
1
2
3
4
5

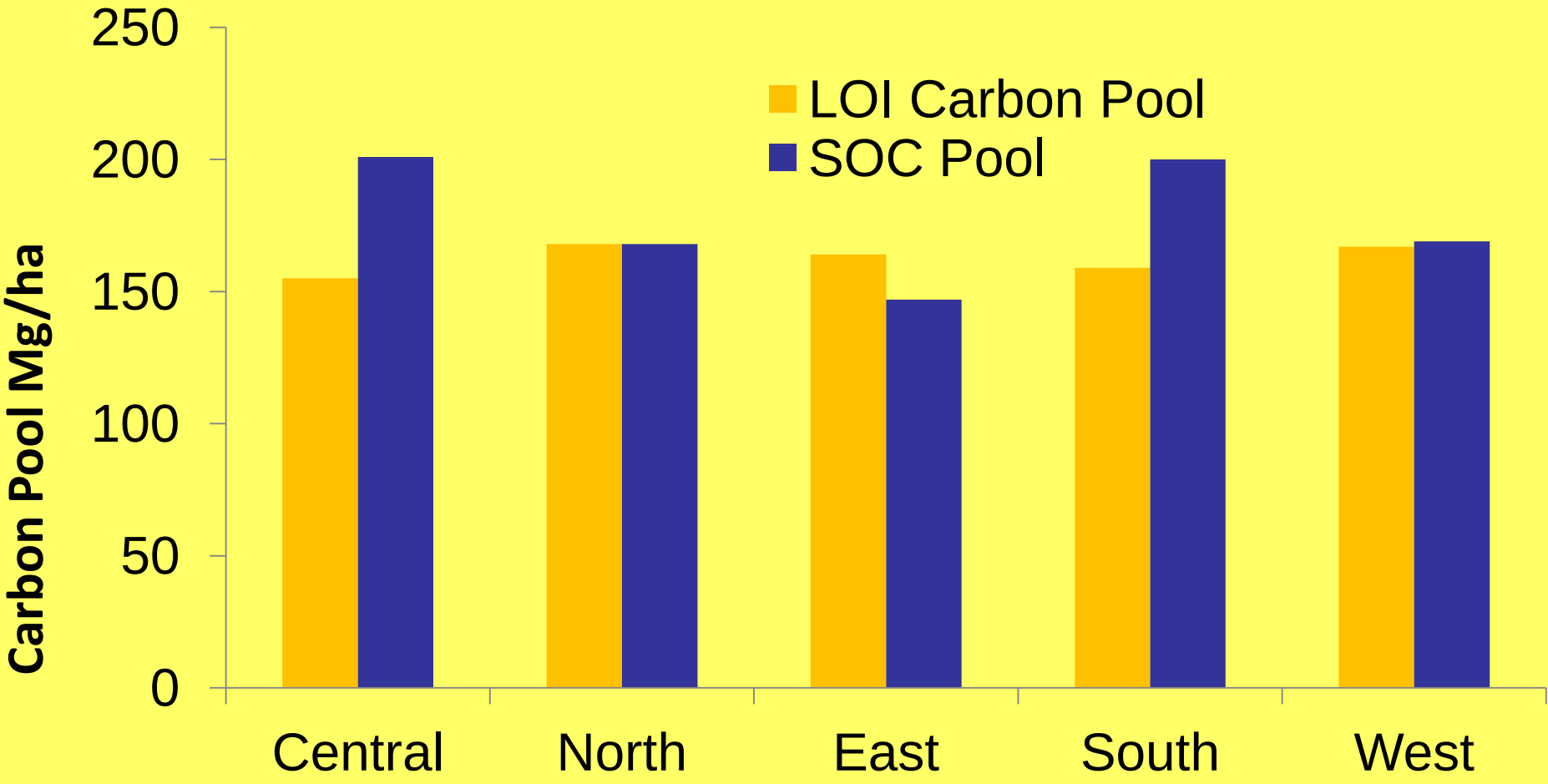

R² = 0.8194
VNIR Carbon (%)
SOC (%)
60
50
40
30
20
10
0
-10
0.0
20.0
40.0
60.0

Carbon pools for upper 50 cm of Histosols



* Means were significantly different

Carbon pools for Spodosols



*Means were not significantly different

CONCLUSIONS

- SOC predictions from VNIR scans are influenced by a number of factors such as mineralogy and parent material. Results from this study suggest that updated models for predicting SOC levels from VNIR scans will be needed in the northeast region to insure accuracy in the VNIR predictions.

- VNIR scans are stored in the NASIS database so that they are available to easily apply updated models for more accurate predictions.

- LOI appears to be an effective rapid carbon analysis substitute.