Assessing Soil Fertility in the South Fork Watershed of the Iowa River

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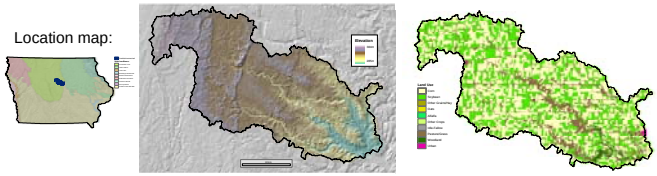
Objective: To determine current soil fertility and soil quality within the Iowa River's South Fork watershed. With this information, soil management issues and program delivery can be prioritized to achieve environmental benefits.

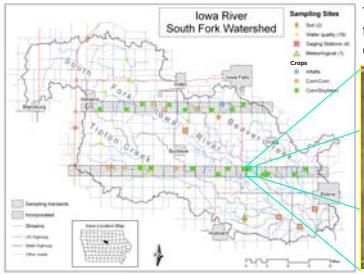
Setting: North-central Iowa
Glacial terrain Corn and soybean rotations

Location map:



Methods

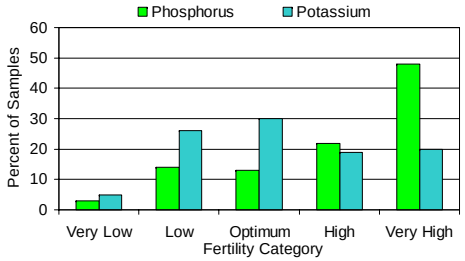
- Two transects, each one mile in width, were established across the watershed covering major soil associations, landforms, and sub-watersheds (see below).
- One 80-acre tract was randomly selected from each section within the transects. Landowners and tenants were contacted for permission to collect soil samples and summarize cropping and management history
- Soil samples were collected by soil map unit from each tract where permission was granted. Individual samples were composites of 15 - 30 soil cores taken to a six-inch soil depth across a nine-acre area.
- Samples were analyzed for soil pH, EC, phosphorus, organic carbon, potassium, and total nitrogen. A soil quality index (SQI) was determined according to the Soil Management Assessment Framework of Andrews et al. (2004), based on the first four of these analyzed soil properties.
- Statistical analyses to identify differences in soil properties and indices among sub-basins, soil map units, crop rotations, and manure-application histories.



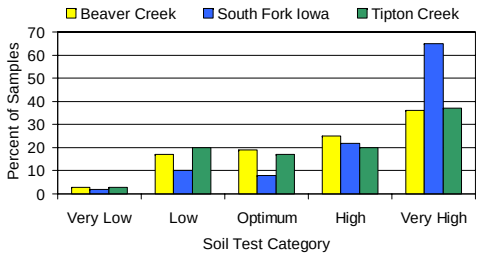
Two sampling transects across basin; 80 acre tracts were selected from each section; the cropped areas were sampled by soil map unit.

Results: nutrient levels

Phosphorus and potassium fertility levels



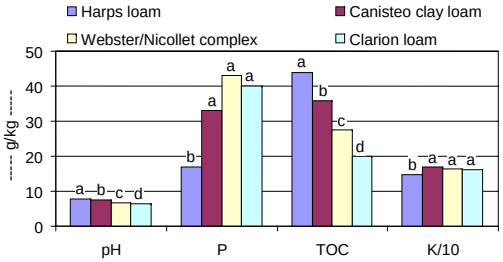
Phosphorus distributions by soil test category, for each sub-watershed



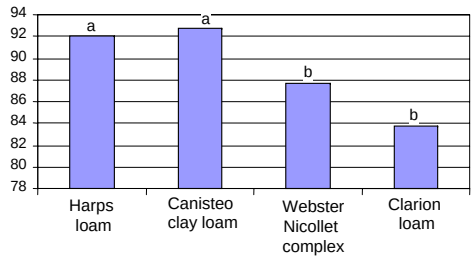
- Soil P levels were typically high, but not to excessive levels. Manured soils had greater P levels ($p < 0.05$)
- Low K levels were frequent enough to be of agronomic concern.

Results: soil quality

Differences in soil properties among dominant soil map units



Differences in SQI among dominant soil map units

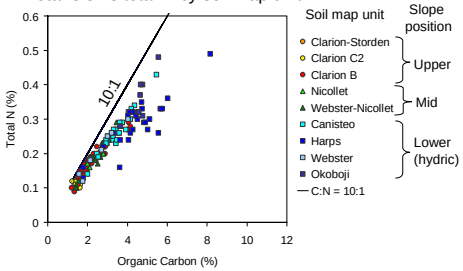


- Significant differences among dominant soil map units were found for measured data (far left), SQI scoring functions for properties (not shown), and overall SQI values (left).

Also:

- Sites with a history of manure application had higher soil-test P, but SQI scoring functions indicated no differences in environmental impact
- Lower SQI values for CRP and alfalfa sites presumably reflected forages being planted on more degraded sites

Total OC vs total N by soil map unit



Soils at upper landscape positions have smaller contents of organic carbon, and most closely approach C:N ratios of 10:1, where risk of N saturation and NO_3 leaching may be increased (Schipper et al., 2004).

Conclusions

- Soils in the watershed have a high frequency of high and very high P levels, but not to the point where SQI scoring functions would indicate environmental risk. Low potassium fertility is an issue of agronomic concern that warrants more attention.
- Soils in upper landscape positions (dominantly Clarion series) have lower organic carbon contents, which is associated with diminished soil quality and with low C:N ratios that may lead to increased risk of nitrate leaching.

References:

Andrews, S.S., D.L. Karlen, and C.A. Cambardella. 2004. The soil management assessment framework: A quantitative soil quality evaluation method. Soil Sci. Soc Am J. 68(6):1945-1962.

Schipper, L.A., H.J. Percival, and G.P. Sparling. 2004. An approach for estimating when soils will reach maximum nitrogen storage. Soil Use & Mgmt. 20(3):281-286.

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