The Soils of Iowa

C. Lee Burras
Iowa State University
January 18, 2018
I am honored to be here with PFI today! Thank you for inviting me, Dr. Gailans.

I am a flexible so if you have a burning question while I am speaking, please interrupt me.
Our goal is to understand the formation, distribution and productivity of Iowa’s soils.

1. Overview of Iowa
2. Soil Formation
3. Soil Distribution
4. Soils & plants
5. Summary
<table>
<thead>
<tr>
<th>Key Words</th>
<th>URL</th>
<th>“Value”</th>
</tr>
</thead>
<tbody>
<tr>
<td>California soil resource lab</td>
<td><a href="http://casoilresource.lawr.ucdavis.edu">http://casoilresource.lawr.ucdavis.edu</a></td>
<td>Speedy UC Davis site w/ Apps</td>
</tr>
<tr>
<td>Iowa Geographic Server</td>
<td><a href="http://ortho.gis.iastate.edu">http://ortho.gis.iastate.edu</a> (as an example)</td>
<td>Historical &amp; current information</td>
</tr>
<tr>
<td>GoogleEarth</td>
<td></td>
<td>Satellite images, etc.</td>
</tr>
<tr>
<td>ISPAID Iowa Land</td>
<td><a href="http://www.extension.iastate.edu/soils/">http://www.extension.iastate.edu/soils/</a></td>
<td>Iowa facts, maps, CSR2</td>
</tr>
<tr>
<td>SoilsGrid</td>
<td><a href="https://soilgrids.org">https://soilgrids.org</a></td>
<td>World wide soil maps</td>
</tr>
<tr>
<td>WOSSAC soil maps</td>
<td><a href="http://www.wossac.com">http://www.wossac.com</a></td>
<td>Soil digital data for the world</td>
</tr>
<tr>
<td>NRCS world soil maps</td>
<td><a href="http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/college/?cid=nrcs142p2_054010">http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/edu/college/?cid=nrcs142p2_054010</a></td>
<td>USDA-developed maps of the world</td>
</tr>
<tr>
<td>Iowa Land Use</td>
<td><a href="http://www.extension.iastate.edu/soils/">http://www.extension.iastate.edu/soils/</a></td>
<td>Variety of information</td>
</tr>
</tbody>
</table>
Iowa = North American Central Lowlands, Central Plains, Mississippi River Watershed, Prairie Province, Chernozems, Black Soils, Mollisols.
Iowa – a few facts

Area = 56,000 mi² = 36 million ac.
Population = 3.1 million.
50 people/mi²
55% urban, 45% rural.
40% Iowans live in six counties.
26% urban & 16% rural college degrees.
12% poverty.
Iowa – a few facts

Land area = 90% is farmed.
About 90,000 farms that average 350 ac.
Corn: 14 million ac; mean yield = 12 t/ha.
Soybeans: 10 million ac; mean yield = 4 t/ha.
Pasture, forages & forest: 10 million ac.
Farmland value is $4,000 to $12,000/ac.
Iowa is 90% farmed because of our natural soils & our weather, & our management.

Key soil issues have been and are drainage, fertilization and erosion.
Pedology of Iowa

Iowa has 507 soil series. They differ based upon:

- Parent material
- Time
- Climate
- Biota
- Relief

Hans Jenny (1941)
Parent material regions of Iowa.
Parent materials and pedology starts with glaciers.

Glaciers are HUGE!
They have shaped our world.

Larsen Ice Sheet, Antarctica (NASA photo).
Glaciers = akin to a river with turbulent current

Accumulation zone

Ablation zone

Erosion zone

Sedimentation zone

sediment
Over the past 2 million years...

16 or so major glacial advances
Moved trillion of tons of sediment
Connected/disconnected land masses

http://www.metatech.org/07/ice_age_global_warming.html
“Our” Des Moines Lobe was a tiny bit of ice
But it’s huge from a single human perspective.

Des Moines Lobe in Iowa = 30,000 km² =, >30 m thick in places

Assume average 15 m thick, Iowa part weighs **800 billion tons**
Glacial tills almost outline the USA corn belt.

Why did they stop here?
Off-glacier = What goes on?

(1) Lots of ice = sea level change (100 m lower)
(2) Huge discharge every summer = Outwash
Glacial streams have incredible seasonal Q.

Summers lots water ⇒ Outwash = sands & gravels fill valleys.
During winter, little Q; intense winds whip across valleys ⇒ loess on uplands.
Loess in Iowa
75,000 km², 5 m thick = 600 billion tons

Why is loess thickest in western Iowa & eastern Nebraska?

Ruhe, 1969
Is all of the loess in the central USA?

To get loess, need exposed sediment & wind.

http://clasfaculty.ucdenver.edu/callen/1202/Landscapes/Arid/AridLandscapes.htm, reviewed December 04, 2013.
Parent material regions of Iowa

CNW = glacial till
Des Moines Lobe = 600 billion tons

MIH, M = deep loess
Loess hills = 300 billion tons

SSM, AGH, ASE, L, OMT = clayey loess over paleosol

TM, GPS = loess

KFC = pedisediment
Iowan Surface

LOS = alluvium
Missouri River Valley
Pedology of Iowa

Different soils form according to differences in

Parent material
Time
Climate
Biota
Relief

Jenny (1941)
MAP = 33 inches, MAT = 50° F
Ecology & climate

Prairie, Forest, Savannah, Wetlands.

3)
Climate & native biota

SE = 950 mm precipitation
NW = 650 mm precipitation

East = forest
West = prairie

F, FDS, L, C = forest
Alfisol

DT, ASE, AGH = savannah
Alfisol, Mollisol

Rest of Iowa = prairie
Mollisols
**Definition**

**Black Soils = Mollisols**

**Mollisol =**

1. **Mollic Epipedon**
   
   ≥25 cm thick with structure, ≤3/3, ≥0.6% SOC

2. **Solum**
   
   ≥ 50% BS to ≥125 cm.
Mollisols in Iowa = 98,000 km² = 68%

Argiudolls east & south

Hapludolls north & west

Endoaquolls throughout

Alfisols account for another 25% or so of Iowa. The rest are Inceptisols, Entisols, Vertisols and Histisols.
“Forested” Eastern Iowa = Alfisols
Alfisol

Alfisol =

1. Thin Epipedon
   <25 cm thick with structure

2. Solum
   Argillic horizon
   ≥ 35% BS at 125 cm.
Relief = soils differ across landscapes.

Different soils form according to differences in

Parent material
Time
Climate
Biota
Relief

Jenny (1941)
Mollisol catena in north-central Iowa

Late Wisconsinan Till with 20% CCE, 10% feldspars
Hillslope derived sediments high OM

Tallgrass prairie
1.5 m water table depth

Sedges and other hydrophytes
0.0 m water table depth

2018 PFI Revival - Cultivating a Deeper Understanding – Burras – Iowa, a pedologist’s perspective – January 18, 2018
Relief = catena.
Maps showing this detail available.

Please see “web soil survey”
http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm

Or GoogleEarth

Or ISPAID
Pedology and Agronomy – what does the 21st century hold for us?
We are going to farm more intensely.

Average Statewide Yields for Corn and Soybeans, Iowa

With Regression Analysis

\[ y = 1.947x + 68.83 \]

\[ y = 0.456x + 28.40 \]

Source: Iowa Agricultural Statistics
Prepared by: Agronomy Department, Iowa State University
Updated: 3/5/2002
As a result, we will need to better manage root productivity

- Water - infiltrate, store, drain
- Nutrients – 12/17
- Gas Exchange - CO₂ & O₂
- Support/Anchor
- Waste Disposal
- Nursery
- Symbiosis
We will also take into account soil change.
With the biggest payoff coming from improved management for soil quality & health!
Summary 1

1. The pedology of Iowa is straightforward but important.
2. There are 10 major landform regions with the two main parent materials being loess and glacial drift.
3. Prairie-derived Mollisols are the most common soil but in eastern Iowa there are considerable areas of forest-derived Alfisols.
4. There are 500 series in Iowa. Detailed information on their properties and uses is found in Web Soil Survey and/or GoogleEarth.
Iowa is a beautiful place with fascinating history -- both natural hand human.

Iowa’s future will be based upon on continued, intensified use of our soils – and that will require better understanding of soil-root relationships!
Thank you.