Soil Data and Interpretations for Applications in Food and Water Security

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Introduction
Use of soils information

Soil Interpretations--

• Primary justification for the National Cooperative Soil Survey in the United States
• Early years, soil interpretations were written guides & tables contained in soil survey manuscripts
• Starting in the 1970s, tabular data were transferred into a national database This soils database, now called the National Soil Information System (NASIS) contains measured and estimated soil properties for soils as collected and compiled by the NCSS.
Official Soil Survey Information for the US

• Since 2003, the Soil Survey Geographic (SSURGO) database—(spatial and associated tabular data) has been the source of official soil survey information for the US.

• Since 2010 gSSURGO(gridded raster-based) is available for faster analysis & computing

• 90 national prewritten interpretations and several hundred regional and local interpretations.
National Cooperative Soil Survey
Natural Resource Planning and Management

- available water capacity, pH, EC, flooding frequency;
- yields for cropland, woodland, rangeland, and pastureland;
- soil properties affecting recreational development, building site development, and other engineering uses and applications.
Soil Interpretation Process with National Cooperative Soil Survey Data

• Steps for developing interpretations listed in NSSH Part 617.09
  • Define a soil interpretation and explain its application
  • Understand how soil, landscape, and site characteristics impact land use- Lit review
  • Decide how soil properties might impact the land use proposed
  • Develop a criteria table for an interpretation
# Example---Soil and Site Suitability – Growing Hops Commercially

<table>
<thead>
<tr>
<th>Property</th>
<th>Suited</th>
<th>Somewhat Suited</th>
<th>Not suited</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depth to Water Table</td>
<td>≥ 1 m</td>
<td>0.5 m – 1 m</td>
<td>&lt; .5 m</td>
<td>Disease Control</td>
</tr>
<tr>
<td>Ponding</td>
<td>Rare</td>
<td>Occasional</td>
<td>Frequent</td>
<td>Disease control</td>
</tr>
<tr>
<td>Flooding</td>
<td>Rare</td>
<td>Occasional</td>
<td>Frequent</td>
<td>Disease Control</td>
</tr>
<tr>
<td>Frost Free Days</td>
<td>&gt;120</td>
<td>≥120</td>
<td>&lt;120</td>
<td>A minimum of 120 Frost Free Days is needed for full development of hop flower.</td>
</tr>
<tr>
<td>Depth to Restrictive Feature</td>
<td>≥ 1 m</td>
<td>0.5 m – 1 m</td>
<td>&lt; 0.5 m</td>
<td>Hops have a very deep rooting system. Additionally, the poles used in the trellis system should be buried at least 3’ below soil surface.</td>
</tr>
<tr>
<td>pH</td>
<td>6.0 - 7.0</td>
<td>5.7 - 6.0; 7.0 – 8.2</td>
<td>&gt; 8.2, &lt; 5.7</td>
<td>Prefers slightly acidic soil conditions. Alkaline and saline non-preferable. Soil amendments may be necessary.</td>
</tr>
<tr>
<td>Photo Period (hrs/day)</td>
<td>≥ 12 hrs.</td>
<td>10-12 hrs.</td>
<td>&lt; 10 hrs.</td>
<td>During growing season. April – October (at a latitude 35-55)</td>
</tr>
<tr>
<td>Precipitation (non-irrigated)</td>
<td>&gt;762 mm</td>
<td>508-762 mm</td>
<td>&lt;508 mm</td>
<td>Dry climate discourages many diseases.</td>
</tr>
<tr>
<td>Slope</td>
<td>&lt;5</td>
<td>5-10%</td>
<td>&gt; 10%</td>
<td>Slopes greater than 10% may limit trellis installation and harvest methods.</td>
</tr>
<tr>
<td>% Sand</td>
<td>&gt; 50%</td>
<td>40-50%</td>
<td>&lt; 50%</td>
<td>Fine sandy loam is the optimal soil texture in higher precipitation areas. Silt loam is optimal in lower precipitation areas.</td>
</tr>
<tr>
<td>% Clay</td>
<td>&lt; 20%</td>
<td>&lt; 30%</td>
<td>&gt; 30%</td>
<td>Fine sandy loam is the optimal soil texture in higher precipitation areas. Silt loam is optimal in lower precipitation areas.</td>
</tr>
<tr>
<td>% Rock Fragments</td>
<td>&lt; 15%</td>
<td>15-35%</td>
<td>&gt; 35%</td>
<td>Affects AWC, tillage, post holes for trellis system</td>
</tr>
</tbody>
</table>
Soil Maps Data Mobile apps

NRCS Maps, Data, Mobile Apps

Overview
NRCS has numerous websites and mobile applications that are rich in data on soils, water, air, energy, and other natural resources. View the list on the right for links to those resources, and see more in-depth information on this page about these websites and apps.

Soil maps, data, & mobile apps
Title: SoilWeb
Description: The SoilWeb app provides GPS based, real-time access to USDA-NRCS soil survey data, formatted for mobile devices. This application retrieves graphical summaries of soil types associated with the user's current geographic location. Images are linked to detailed information on the named soils. The app is available for iPhone and Android users, and Google Maps and Google Earth also interface with this application. This application was developed in partnership with UC Davis California and NRCS.

Quick links - Soils
- Soil Web
- Soil Survey
- Soil Data Access
- Soil and Water Resources Conservation Act (RCA) Data Viewer

Quick links - Water
- SNOWTEL - Water Supply Data & Forecasting
- NRCS National Water & Climate Center Climate Reports
WebSoilSurvey & SoilWeb App

Welcome to Web Soil Survey (WSS)

Web Soil Survey (WSS) provides soil data and information produced by the National Cooperative Soil Survey. It is operated by the USDA Natural Resources Conservation Service (NRCS) and provides access to the largest natural resource information system in the world. NRCS has soil maps and data available online for more than 95 percent of the nation’s counties and anticipates having 100 percent in the near future. The site is updated and maintained online as the single authoritative source of soil survey information.

Soil surveys can be used for general farm, local, and wider area decision making.
Soil Characterization Data

Information on the applications of laboratory data, reference web site: Soil Survey Investigation Report 45, or other listed resources. You are most WELCOME to use the database, but you should be aware that the assessment of the accuracy and applicability is strictly a USER RESPONSIBILITY and the NRCS and NCSS take no responsibility for problems that arise from use of this database.
05DW030-06 Volkmar

Soil Sample locations analyzed by the NRCS Soil Survey Lab and Cooperating University Labs

Sampled as: Volkmar
Correlated as:
MLRA: 229
Data Completeness Index(max 9): 8
Characterization Report: LabReport
Description Report: Description
Rapid Assessment of U.S. Soil Carbon (RaCA)

• The Rapid Assessment of U.S. Soil Carbon (RaCA) was initiated by the USDA-NRCS Soil Science Division in 2010 with the following objectives:
  - To develop statistically reliable quantitative estimates of amounts and distribution of carbon stocks for U.S. soils under various land covers and to the extent possible, differing agricultural management.
  - To provide data to support model simulations of soil carbon change related to land use change, agricultural management, conservation practices, and climate change.
  - To provide a scientifically and statistically defensible inventory of soil carbon stocks for the U.S.
Rapid Assessment of U.S. Soil Carbon (RaCA)

- 144,833 samples were collected from the upper 1 meter of 32,084 soil profiles at 6,017 randomly selected locations.
- Measurement of organic and inorganic carbon by visible and near infrared (VNIR) spectroscopy and bulk density by traditional methods.
- NRI sites were used as the basis for random selection of sample sites stratified by soil group within RaCA Region and land use/land cover (LULC) within soil group.
- Soil morphology and landscape characteristics; limited vegetation and agricultural management information.
- Sample collection and analysis -- 300 soil scientists and assistance from 24 universities.
Rapid Assessment of U.S. Soil Carbon (RaCA)

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National Commodity Crop Potential Index (NCCPI)


The model criteria relate directly to the ability of soils, landscapes, and climate to foster crop productivity. All criteria used in the index affect crop culture and production and are referred to as factors affecting inherent productivity.
National Commodity Crop Productivity Index (NCCPI)

NCCPI Interpretive Results

- Fuzzy Value (Weighted Average):
  - .700 and less
  - 0.781 - 0.800
  - 0.701 - 0.720
  - 0.801 - 0.820
  - 0.721 - 0.740
  - 0.821 - 0.840
  - 0.741 - 0.760
  - 0.841 - 0.860
  - 0.761 - 0.780

Variability in NCCPI fuzzy values between the two Clarion MLRA map units displayed in the map on the right relate directly to differences in depth to saturation, as well as soil physical and chemical properties (substantiated through laboratory data analysis). Additionally, the unique composition of soils in each map unit impacts weighted average values.
Estimating the Impact of Climate Change on Corn Yield Using NCCPI
Valley Fever Soil Habitat Mapping

- surface must be saline and contain some organic matter
- surface must be moist at some time during the year but then become dry and very hot
Applications to Storm water Management

• EPA mandate for localities over 10,000 population to have storm water plans

• National Cooperative Soil Survey Team of University faculty (West Virginia, VA Tech, University of Akron) with ARS and NRCS staff to consider methods of storm water management applicable to the eastern US.

• The styles of systems - BMPs
  – deep infiltration, shallow infiltration, and retention systems.

• BMPs in the Soil Survey Database (NASIS)
WV DEP endorsed practices

Infiltration planters or planter boxes

Rain Gardens (bio-infiltration)

Pervious pavement

Vegetated or grassed swales

Intermittent wetlands or pocket wetlands
Soil Interpretation

Lined retention system (retention basin / intermittent wet-land)

Unlined retention system

Shallow infiltration system (permeable pavements/swales)

Deep infiltration system (bio-infiltration)
Soil Rating for Storm Water Management Practices

Criteria

- Ksat
- Unstable fill
- Hard bedrock
- Water table
- Slope (w/o LEP)
- Flooding
- Large surface fragments
- Limestone bedrock – collapse risk
- Limestone bedrock – groundwater contamination

Amir Hass
Agricultural & Environmental Research Station,
Gus R. Douglass Institute, West Virginia State University
Soil Vulnerability Indexes

• Analytical tool to categorize soils into simple groups for analysis of CEAP cropland data.
• Three variables, k-factor, slope, and hydrologic group.
• Losses of sediment via runoff and losses of nitrogen via leaching from our calibrated model runs.
K Factor (Kf and Kw)-Erodibility Factor

- Kf—Erodibility fine earth fraction(<2mm);
  Kw—whole soil

- Nomograph in NSSH Exhibit 618-12 and Ag Hndk no. 537. The nomograph is less accurate for subsoils than for surface soils.

- Minimum Ksat is based on the minimum Ksat within the top 50 cm from the top of the horizon being rated for K; includes bedrock if it is within the 50 cm depth.
K Factor (Kf and Kw)-Erodibility Factor

Data elements

Data elements used in the K factor calculation:
- Structure type
- Structure size
- clay (rv)
- silt (rv)
- very fine sand (rv)
- organic matter (rv)
- Ksat (rv)
- rock fragment volume (rv), Horizon Fragment Table
- rock fragment hardness, Horizon Fragment Table
- restriction kind, Component Restrictions Table (only used for bedrock)
Hydrologic Soil Group

• **Data elements used in the HSG calculation**
  – horizon depth top \((rv)\) in Component Horizon Table
  – horizon depth bottom \((rv)\) in Component Horizon Table
  – \(K_{sat}\) \((rv)\) in Component Horizon Table
  – restriction depth top \((rv)\) in Component Restrictions Table
  – restriction kind in Component Restrictions Table
  – moisture depth top \((rv)\) in Component Soil Moisture Table
  – moisture status in Component Soil Moisture Table
  – month in Component Month Table
T Factor- Soil Loss Tolerance

The GUIDLINES FOR ASSIGNING SOIL LOSS TOLERANCE T are taken from NSSH Exhibit 618-14.

NASIS data elements used in calculating T Factor:

• Component Table-Taxonomic order; Local Phase or Erosion Class (used to identify severely eroded soils)
• Component Restrictions Table; Kind; Hardness; Depth (rv)
• Component Horizon Table-Horizon Depth top, bottom(rv); Horizon name or designation (only used for Fragic properties; looking for "x" in horizon name); Organic matter (rv); Total clay (rv); Total sand (rv)& components(rv); Bulk density at 1/3 bar water content (rv); Ksat (rv); CaCO3 (rv); Gypsum (rv); SAR (rv); Extractable Al (rv) (only used for high aluminum)
• Component Horizon Fragment Table; Fragment volume (rv); Fragment kind (only used if "wood" and "logs and stumps" are present); Fragment hardness (para-fragments are not used)
• Component Horizon Texture Group Table-- Texture modifier and class (rv)
• Component Horizon Texture Table--In lieu of texture (rv)(used for Fragmental)
HEL Soil Erodibility Index

The soil erodibility index (EI) is the measure selected to determine whether a soil map unit is highly erodible.

Determining Potential Erodibility (PE) Sheet and Rill Erosion (using USLE): PE = R x K x LS where:

- R = rainfall and runoff.
- K = susceptibility of the soil to water erosion.
- LS = the combined effects of slope length and steepness.

Wind Erosion (using WEQ): PE = C x I, where:

- C = climatic characterization of windspeed and surface soil moisture expressed as a percentage.
- I = the susceptibility of the soil to wind erosion.

Deriving Alaska Carbon Stocks from SSURGO Data
Susan Burlew Southard, Shawn Nield and Mark H. Clark, NRCS and University of Alaska-Fairbanks
Time for Questions?

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