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Using the USDA-ARS Soil Sample Planning Optimizer Tool (SSPOT)

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Soil sampling is the foundation of effective soil fertility and crop management, as accurate fertilizer and soil pH adjustment recommendations rely on high-quality soil samples. The goal of soil sampling is to collect a sample that accurately represents the area of interest, such as a field or management zone within a field.

A representative soil sample is one that accurately represents the area that will be managed — this often requires multiple samples to represent a field or management zone. To ensure samples are as representative as possible, several criteria must be followed. As a rule, each sample should represent no more than 20 acres, taken at a consistent and precise depth, and consist of 15 to 20 soil cores combined into one composite sample. These guidelines help ensure that the multiple types of variability within a field, such as chemical, physical and biological properties of soil, are evenly represented. Other factors, such as temperature, soil moisture and field topography, can also influence soil characteristics. While it is not feasible to account for every possible variation, these criteria are designed to limit the amount of variation allowed per sample.

"Grid" and "zone" sampling are two practices that reduce the size of the area represented in a soil sample, thus increasing the chance of representing areas of variation. Grid sampling involves dividing a field into grids of equal size and shape, usually between one and five acres. Each grid is then sampled and analyzed independently. This process requires more planning to ensure sample points are equally spaced and as much of the field as possible should be sampled. Because of this, grid sampling is often more expensive, especially when using soil sampling services or fee-based laboratory analysis.

Zone sampling, while similar in approach, divides the field into smaller areas, which are then sampled and analyzed separately. Common criteria for zone sampling are soil classification, field topography or management zones within a field. These criteria allow for more scrutiny in their level of representation than grid sampling. While zone sampling

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may reduce costs by sampling larger areas than grid sampling, the level of planning and information required increases, even over grid sampling.

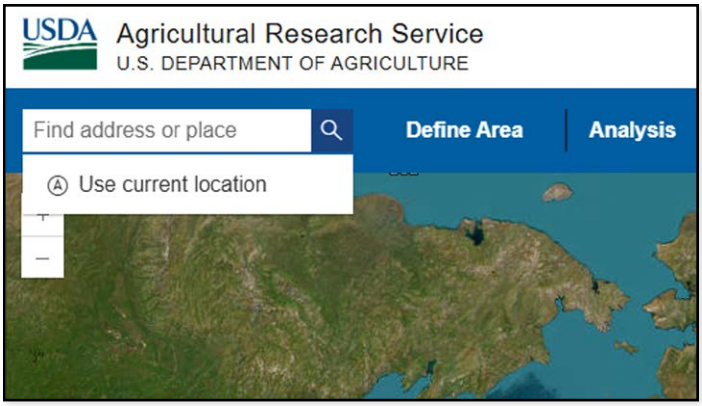
Until recently, tools to assist in the planning of sampling practices have been too cost- and/or knowledge-prohibitive for many producers. In early 2025 the U.S. Department of Agriculture – Agriculture Research Service released a publicly available, user-friendly tool that can ease the planning process for grid or zone sampling. This article is a guide to effectively use the USDA-ARS Soil Sample Planning Optimizer Tool to build maps for field sampling.

The SSPOT can be found at https://sspot.scinet.usda.gov/. Under the pop-up box "About SSPOT," you will find two tabs of information, a disclaimer and instructions. Read the information on both tabs for an understanding of the program. Additional user guidance can be found at https://storymaps.arcgis.com/stories/4e7b83f1fb9d40c084c802088acff814.

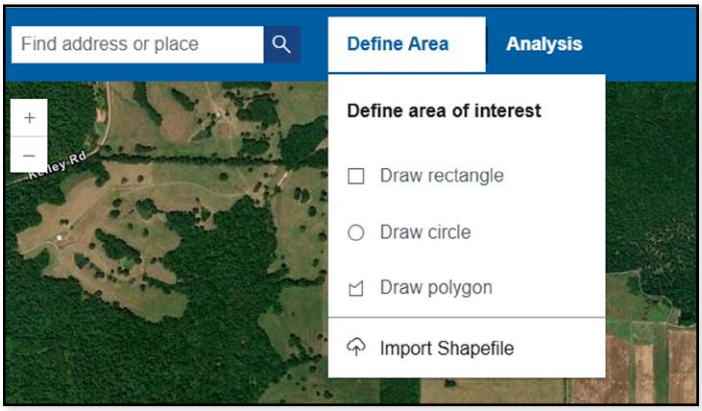
Identifying the AOI

The Area of Interest (AOI) is the area, commonly a field, that you are planning to soil sample. Unlike when using a field composite sampling strategy, there is no limitation to field size. However, the SSPOT program does limit AOI size to 10 square miles. To identify the AOI on the map start by zooming into the area or searching for an address using the search bar in the top left.

After you have found the area, use the "Define Area" tab to define the AOI to be



sampled by selecting a field using the draw feature or importing a previously created shapefile. The "Draw Polygon" tool will allow for field boundaries to match that of unique fields. There are also rectangle and circle polygon options for fields that fit these shapes.



To use the "Draw Polygon" option, left-click on the map interface to create an outline of your field boundaries and close the polygon by double-clicking the last point of the shape (note: if the last point does not overlap the first point, a straight line between the two will be created).

Analyzing the AOI

Once the AOI has been created, select the "Analysis" tab, then the algorithm (Grid, Soil Zones) to be used for developing sampling points and the grid size

or the number of sample points. Then click the "Analyze" button to reveal the sample points in the AOI.

Grid

Grid sampling will prompt a "Sample Area" input with a choice of grid size (one, two-point-five or five acres) that will determine how much area each sample point should represent. Additionally, there is a toggle for "Triangle Offset" that will offset the points in every other row.

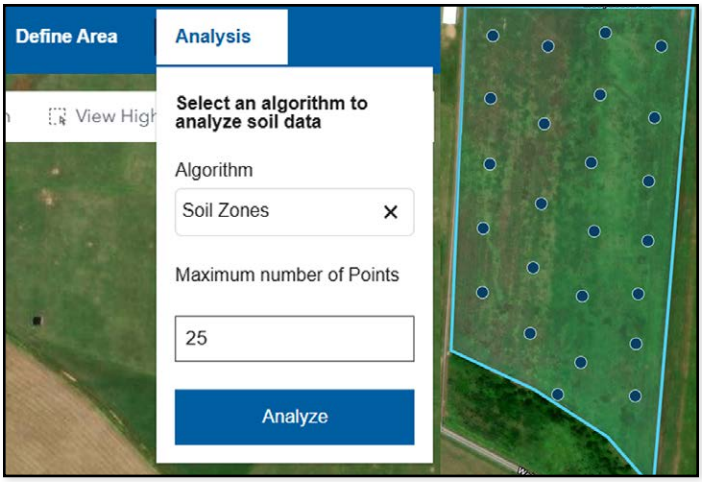
Soil Zones

Selecting "Soil Zones" uses the USDA's Soil Survey Geographic Database to distribute the placement of points within the soil zones present in the AOI. This algorithm aims to create equal representation of points within the zones based on the area's soil texture as defined by the USDA-NRCS Soil Survey Geographic SSURGO database (https://websoilsurvey.nrcs.usda.gov/).

Editing the AOI

The AOI can be edited at any point prior to exporting using the tools in the top left corner near the zoom buttons.

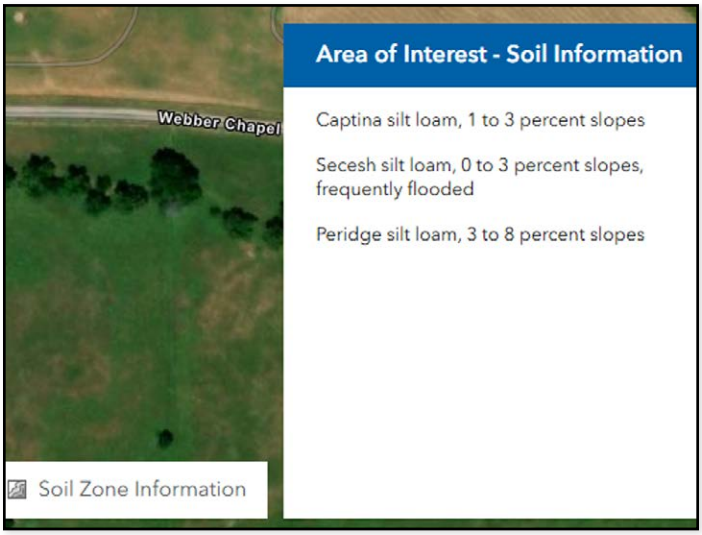
1. Pointer: Left click, hold and drag the map to reposition the map by panning. Double clicking will increase zoom. Use right click to hold, drag and rotate the map.
2. Select Rectangle: Draw a rectangle around the point(s) to be moved, rotated, copied or deleted.
3. Draw Point: Add sample point(s) to the map by clicking on the location(s) on the map.
4. View Path: Creates a path between points, click after each adjustment to realign the path.
5. View Highlighted Area: Recenters the AOI to the middle of the screen.
6. Clear AOI: Deletes the AOI and sample points.

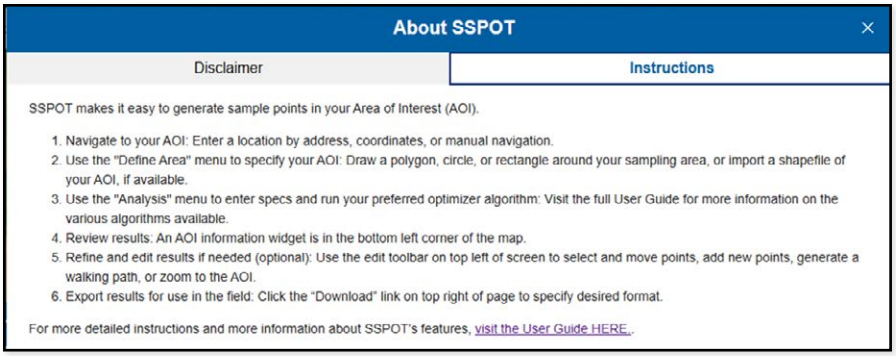


Additional Information:

Soil Zone Information

The "Soil Zone Information" tab, located in the bottom left-hand corner of the screen, shows the basic soil series information for the soils located within the AOI.



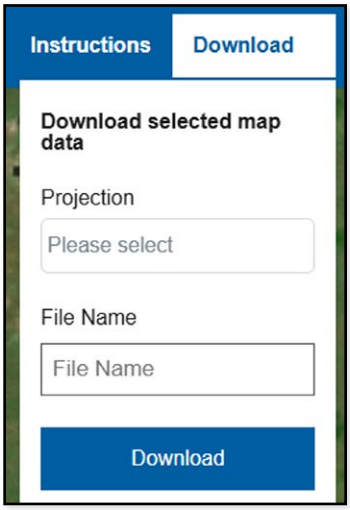


Instructions

The "Instructions" tab, located in the top right-hand corner of the screen, brings up the "About SSPOT" pop-up for a quick reference to simple instructions on using the program, as well as a link to the full User Guide.

Download

The "Download" tab is located in the top right-hand corner of the screen. It features a drop-down menu for sections to download the map with sample points to be exported. See "Exporting the AOI" for details.



Exporting the AOI

Select the "Download" button in the top left-hand corner of the screen, select the projection type, file type, and add a file name. Once these have been selected, click the download button to download the file with the information for each sample point.

Projection Type

LatLong: Latitude and Longitude

A coordinate system that uses latitude and longitude coordinates to define locations on Earth's surface, plotting them as X and Y coordinates on a flat plane. Selecting this option will export the coordinates in degrees of latitude and longitude that are easily interpreted by most GPS or navigation equipment, including mobile devices. Using latitude and longitude for measuring distances often will introduce some percent error because the curvature of the earth is not taken into account. However, for measurements within a field and for soil sampling purposes, latitude and longitude are plenty accurate and are recommended because of ease of use with available equipment.

UTM: Universal Transverse Mercator

A projection system that divides the earth into 60 zones spanning six degrees of longitude, and projects them onto a flat plane. Selecting this will export coordinates in meters measured from the corner of one of these zones. These coordinates are generally more accurate measures of local distances and are commonly used in the land survey industry; however, these measurements are not as easily used by equipment in the field and are not necessarily for soil sampling.

File Type

CSV: Comma Separated Values

A CSV is a plain text file that stores data in a tabular form in which each row represents a record and values within rows are separated by commas. This format is one of the simplest and more commonly compatible software options. Often software will ask you to identify the correct X and Y columns upon importing so that the data is displayed properly. CSV files can be opened and modified without specialized software, but proper mapping software is necessary to view the CSV file as points on a map. Common compatible mapping software includes Google Earth, ArcGIS and QGIS.

Shapefile

A Shapefile is a simple vector data storage format used to store the location, shape and attributes of geographic features such as points, lines and polygons. Shapefiles are one of the most common geospatial data types and are commonly compatible with field equipment

including GPS receivers and field computers on tractors. Shapefiles will be zipped together when downloaded and appear to be four or more identically named — but different file type — files when downloaded (Ex. POINT.dbf, POINT.prj, POINT.shp, POINT.shx). These file types all contribute to the layers of information (metadata, projection system, location information and index information) and are all required if used to import onto a different computer or software package. Inside software that recognizes shapefiles, the file will appear as a single consolidated file with the .shp filetype. Shapefiles require specialized mapping software to view and edit. Common compatible mapping software includes Google Earth, ArcGIS, QGIS, SWMaps, and most tractor field computers and guidance systems.

KML: Keyhole Markup Language

KML is a XML-based file format used to display geographic data in applications such as Google Earth, Google Maps and other GIS Software. KML files are commonly used in Google-based mapping projects but have increasingly been adopted in other software. Common compatible mapping software includes Google Earth, ArcGIS, QGIS and SWMaps.

Summary

The SSPOT is a publicly available tool that allows users to develop soil sampling maps for planned strategic soil sampling. This guide provides a simple stepwise process for using the SSPOT. Decisions for grid or zone sampling should be based on producer information and interest. The information presented here is not intended to promote or deter the use of any sample planning technologies, but is solely intended to educate users in how to use the USDA-ARS SSPOT. For more information on soil sampling strategies, soil testing or nutrient recommendations please contact your local University of Arkansas System Division of Agriculture Cooperative Extension Service or visit https://www.uaex.uada.edu/.

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