High Intensity Soil Surveys for Precision Agriculture

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Introduction

Soil survey information is highly valuable for land use planning purposes. Soil surveys have been conducted at a variety of scales, though the best known and most readily available product is the county soil survey. These surveys, available for all Ohio counties, are published at a map scale of 1:15, 840 or 1:24,000. Surveys at this scale are considered to be moderately intense and are termed 2nd Order Soil Surveys, by the National Cooperative Soil Survey agencies. While very useful for general purposes, Order 2 surveys necessarily generalize the often highly variable nature of soils at farm field scale. In order to efficiently depict the distribution of soils of entire counties and to make data collection practical, Order 2 surveys map geographic units of soil that are not pure. Soil mapping units shown on county maps can contain a number of contrasting soils; the areas of these are generally too small to show at the published map scale. In addition, the smallest units of land shown on these maps are at least five acres in size.

Order 1 Soil Surveys

For management of variability within farm fields, finer scale maps are necessary. Finer scale soil maps have proven to be very valuable for Precision Agriculture. Fine scale or Order 1 surveys are a valuable data layer for precision management within farm fields, and complement other data sets such as sample-based soil nutrient maps, yield maps and remote sensing images. Order 1 surveys are generally prepared at scales for 1:2,500 to 1:10,000, and are capable of showing soil units as small as an acre or less.

Order 1 surveys are capable of identifying fine-scale soil variability within the field. This variability is frequently strongly related to important attributes determining plant growth and yield, such as nutrient fertility and soil moisture conditions, as well as environmental factors such as nutrient and sediment losses from the field. Fine scale maps have the potential to delineate purer units of soil. Order 1 surveys can provide map units that can potentially serve as an excellent basis for variable rate application planning, and for generating field management zones.

Making Order 1 Surveys

During Order 2 surveys, soil scientists generally rely greatly on soil patterns observed on air photographs, and complement photo interpretation with soil observations on the ground at an average intensity of about one boring for each 10 to 50 acres. To make good Order 1 maps, a trained soil scientist needs to identify soil boundaries on the ground in the field, and the soil profile needs to be observed on average at an intensity

of at least one observation every 2 acres. More observations are needed in most agricultural fields, which can be highly variable.

Rapid high intensity soil survey can be facilitated by the use of accurate GPS equipment, which can be used to trace soil boundaries automatically, for use in a geographic information system.

Order 1 soil surveys are not made as part of the National Cooperative Soil Survey. Consequently, surveys are not usually routinely available. Detailed soil surveys may be a planned activity as part of the information gathering for precision agriculture, to complement zone or smart sampling techniques and other data collection.

Uses for Order 1 Surveys

In many cases, soil units mapped at Order 1 scale are closely related to crop yield, especially where soil morphology is a good indicator of limitations to plant growth such as soil depth, drainage, soil physical condition or soil erodibility. Order 1 maps may identify short-range soil variability, and soil boundaries may show where important transitions of soil properties occur. Fine scale soil maps can be aligned with other data layers in a GIS for comparison purposes. Figure 1 shows a four-year average of crop yield for an experimental site near London Ohio, and also shows Order 1 soil survey boundaries. At this site, the high intensity survey delineated clearly visible soil differences related to soil depth, drainage, and fertility, which consistently determined yield.

However, in other cases, soil map units may not be very closely related to yield, or other influences may override the effect of soil, hence it is important to base within-field management decisions, and to delineate management zones, on the basis of a variety of information sources.

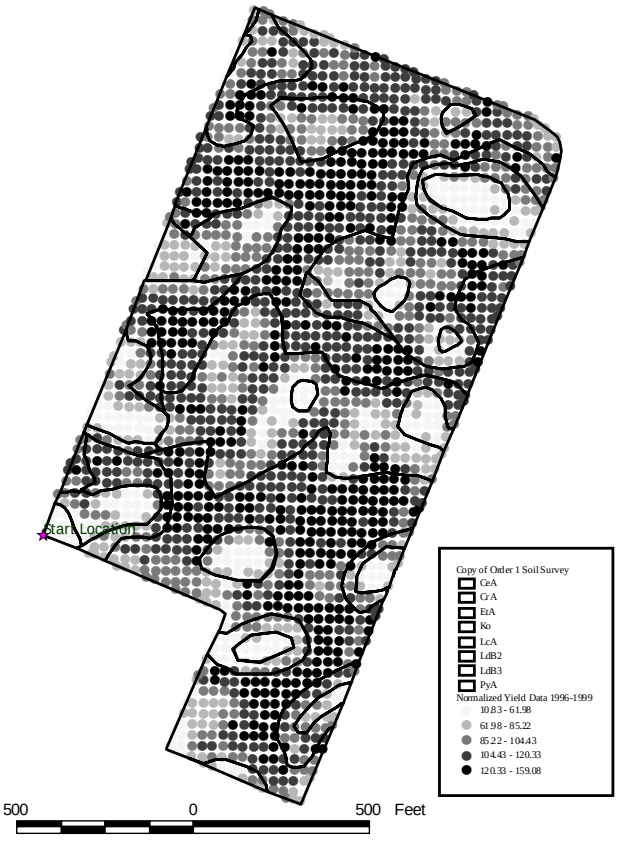

Figure 1. Example order 1 survey and average yield.

Additional resources can be found at: http://geospatial.osu.edu and http://precisionag.osu.edu