Soil Basics for Field Scouting

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Soil Sampling

The type and depth of soil sampling will be determined by the purpose or use of the sample. Regardless the basic sampling method remains the same.

- Use a stainless steel soil probe or auger for collecting the sample.
- Use a clean plastic pail to contain the sample.
- Use a zig zag pattern across the field to ensure the sample reflects the whole field.
- Take one composite sample for every 25 acres or less.
- If sampling problem areas ensure that the sample represents the problem area and take a sample from the "good" or better area too.
- Ensure that the sample is well mixed
- ***Sample to 6 in (15 cm) for most soil sa***mples i.e. basic fertility, pH etc.
- Sample to 12 in (30 cm) for soil nitrate samples – these samples need to be stored below 4C for transport or can be frozen or air dried if they can not be analyzed within 3 days.

Soil pH

Soil pH is the measurement of the hydrogen ion activity or concentration in the soil solution. This has an impact on the availability of most nutrients. It can cause the concentration of some elements to rise to toxic levels i.e. aluminum. It also affects the activity of soil organisms that build soil structure, cycle organic matter or fix nitrogen in legumes nodules. Soil pH also has a dramatic effect on the performance and breakdown of some pesticides i.e. Pursuit.

pH can be measured with a standard lab test using an electrode and a saturated paste. There are also a number of hand held meters available. They range greatly in cost and accuracy. Generally any meter that is directly inserted into the soil is not adequate (think of the variation that we get with soil moisture over the season – soil moisture carries the hydrogen ions, so pH is very difficult to measure in a dry soil). Usually a reasonably accurate meter costs $100 to $400.

Soil Texture

Soil particles come in three main sizes; sand, silt and clay. Within these, especially the sand there are further breaks in particle size. There is a lab test called a particle size analysis that will give a complete breakdown of soil texture. It is fairly expensive but the information can be used to calculate the water holding capacity of a soil for irrigation scheduling. Soil texture in most fields is highly variable. It can be assessed quickly by hand with a little practice. See the hand texturing flowchart.

Soil Structure

Soil structure refers to the arrangement and organization of soil particles or how soil particles are bound together and the spaces or pores in between. It has a significant impact upon crop growth and productivity through water movement in and through the soil, aeration and crop germination and root growth.
The structure of a soil is influenced through climate, biological activity and soil management practices. In agricultural soils in Ontario, the farming practices are the key influence on soil structure.

Soil structure is formed through the actions of:

- Drying and wetting or shrinking and swelling, this creates cracks and planes of weakness for roots
- Freezing and thawing
- Roots
    - the removal of water
    - root exudates or organic materials that bind soil particles
    - formation of root channels
- soil animals like worms and beetles, moving soils, mixing and releasing organic materials
- microorganisms breaking down plant and animal residues
- tillage - reduces the size of aggregates, this is an artificial way of creating structure in some soils and is generally not long lived.

The larger scale structure of a soil is described with terms like blocky, massive or platy to name a few. Within this structure are ***aggregates*** or soil crumbs, a number of soil particles bound together. Aggregates are a dynamic form within the soil. They form and re form over time. They are a result of microbial activity, organic and mineral components of the soil, plant root growth and the ecosystem over time.

Aggregate stability is the ability of aggregates to resist destructive forces like water. This is influenced by:

- soil organic matter content
- clay content

Stable aggregates do not break down under rain and resist crusting.

Water stable aggregates can be measured and used as a way of evaluating soil quality and measuring the impact of soil management practices.

Compaction

Compacted soils often exhibit:

- **a decrease in porosity, especially the macropores that are involved in air and water movement.** Excess water does not drain easily from compact soil and usually the crop available water holding capacity is reduced which makes the crop more drought prone. Plants can look waterlogged or droughty.

- **increased soil strength, which means more resistance to roots and tillage**. This can result in a restricted root system. Of course this has an impact on nutrient and water uptake. Look for flattened roots or restricted or bunched up root mass.
- **reduced soil stability** which can take the form of crusting or setting up, causing problems with crop emergence

All of this can result in **stunted crop growth and reduced crop yields**, although this is highly dependent upon weather conditions during the growing season. Research has documented yield reductions 0 to 75 per cent due to compaction.

Detecting compaction – for more information on detecting/diagnosing compaction and compacted layers take a look in:
pg 36 Soil Management Best Management Practices booklet

Diagnostic Tools

As you walk into a field there is a lot you can tell about the field even before you look at the crop or take a soil test. Take advantage of all the tools available to you when assessing a problem.

Tool	***What can you assess?***
hands	Texture, soil moisture
knife	Soil density or compaction, crusting
drainage flags	Give a good indication of compaction
soil probe	Gathers a soil sample for chemical testing, soil compaction or density, soil moisture, soil profile, texture, colour, historical drainage at depth
soil auger	Gathers a soil sample for chemical testing, soil moisture, soil profile, texture, colour, historical drainage at depth
tile probe	Soil compaction or resistance
shovel or trowel	Gather a sample, soil moisture, soil structure, soil profile and horizons, soil compaction or density
backhoe	Create a soil pit, observe soil horizons, soil colour, texture and structure etc
pH meter	Soil pH, some are also able to do electrical conductivity EC

For suppliers of these soil tools try:

Halltech Environmental Inc
503 Imperial Road N
Guelph, Ontario
N1H 6T9
1866- 425-5832
www.htex.com

Spectrum Technologies Inc.
23839 W. Andrew Road
Plainfield, Illinois
USA
60544
1-800-248-8873
www.specmeters.com

Gemplers
100 Countryside Drive
P.O. Box 270
Belleville, Wisconsin
USA
53508
1-800-382-8473
www.gemplers.com

Universal Field Supplies
1540 Trinity Dr.
Mississauga, Ontario
L5T 1L6
905-795-1610
1-800-387-4940
www.ufsupplies.ca

BAP Equipment Ltd.
203 Waggoners Lane
Fredericton,N.B. Canada
E3B 2L4
1-800-561-3600
http://www.bapequipment.com/

More Soil Management Information

Cover Crops:

OMAFRA has a cover crop section as part of their website. It includes discussion on a wide variety of cover crop species and a listing of seed suppliers. There is also a Cover Crop Best Management Practices book in the works.
http://www.omafra.gov.on.ca/english/crops/facts/cover_crops01/covercrops.htm

The SARE program in the US has a number of cover crop resources. Probably the best cover crop resource is **Managing Cover Crops Profitably**, 3rd ed, Sustainable Agriculture Network 2007. It is available on line at
http://www.sare.org/publications/covercrops/covercrops.pdf
However, keep in mind as you read through it that it is a national US publication and some of the information is not applicable to Ontario conditions.

The **Midwest Cover Crop Council** hosts a website that has more regional cover crop information
http://www.mccc.msu.edu/

Recently a link has been added to a new interactive cover crop decision making tool for the states of Michigan, Indiana, Minnesota, Wisconsin and Ohio. **Ontario** just recently added a province specific version.
http://www.mccc.msu.edu/SelectorTool/2011CCSelectorTool.pdf

The Cornell site also hosts a lot of cover crop information and a decision making tool at
http://www.nysaes.cornell.edu/hort/faculty/bjorkman/covercrops/decisiontool.php

Soil Biology:

The OMAFRA website has some basic soil biology information available at
http://www.omafra.gov.on.ca/english/crops/facts/livingsoil1.htm

The 2010 and 2012 Southwest Agricultural Conference featured a number of talks on soil management and in particular soil life. Some of these were taped and are available with the slide sets at:
http://www.southwestagconference.ca/presentations2010.cfm
In particular, take a look at two talks by Dr. Mario Tenuta – Session 4 Nematodes – Good, Bad or Ugly? And Session 34 – Build a Healthier Soil
http://www.southwestagconference.ca/presentations2012.cfm
Check out the earthworm talk by Odette Menard from Quebec

For information on the Soil Foodweb and all the soil animals that inhabit it, the USDA has an excellent publication, The Soil Biology Primer available on line at:
http://soils.usda.gov/SQI/concepts/soil_biology/biology.html
Tugel, Arlene, Ann Lewandowski, Deb Happe-vonArb, eds. 2000. *Soil Biology Primer*. Rev. ed. Ankeny, Iowa: Soil and Water Conservation Society.

If you are interested in earthworms in particular:

Earthworm Ecology, 2nd ed. Edwards, Clive, CRC Press c.1994

Worm Watch has identification keys and background information on earthworms at
http://www.naturewatch.ca/english/wormwatch/

A new booklet from Cindy Hale, a researcher at the University of Minnesota has excellent identification keys and pictures of earthworms but is more concerned about invasive earthworms in forest environments.
Earthworms of the Great Lakes, Hale, Cindy,Kollath & Stensaas Publishing. c. 2007
http://greatlakeswormwatch.org/educator/book.html

Soil Health:

Measure to manage – there are a number of techniques for measuring soil health and tracking it for the long term.

OMAFRA Publication 811 Agronomy Guide for Field Crops features a chapter on Soil Management which includes a table to help you complete a soil health check – Table 8 on page 140-143 and can also be found on line at http://www.omafra.gov.on.ca/english/crops/pub811/8soilhealth.htm

Cornell University in New York State has a soil health test that is being evaluated in Ontario - http://soilhealth.cals.cornell.edu/

New Zealand and parts of Europe seem to favour the Visual Soil Assessment (VSA) http://www.landcareresearch.co.nz/research/soil/vsa/

The 2012 Southwest Agricultural Conference featured a number of talks on soil management. Some of these were taped and are available with the slide sets at: http://www.southwestagconference.ca/presentations2012.cfm
There are cover crop, crop residue and soil health talks that were recorded.

Soil Management:

The SARE program in the US has a good general soil Building Soil for Better Crops, 2nd ed, Magdoff, Fred and Harold van Es available on line at http://www.sare.org/publications/bsbc/bsbc.pdf

If you are interested in how roots respond to soil management Roots and Soil Management features a wide variety of topics from the various forms and functions of root system as we understand it now to soil aggregation, mycorrhizal fungi and root effects on organic matter decomposition.

Roots and Soil Management: Interactions between Roots and the Soil, Zobel, Richard and Sara Wright, c. 2005 American Society of Agronomy.

Richard also spoke at the 2011 Southwest Ag Conference in Ridgetown: http://www.southwestagconference.ca/presentations2011.cfm

For more soil references:

- Soil Fertility Handbook Pub 611, OMAFRA
- Agronomy Guide for Field Crops Pub 811 OMAFRA
- Ontario CropIPM – online (ontario.ca/cropIPM) or on CD
- BMP booklet series – Soil Management, Nutrient Management, etc