# SOIL MANAGEMENT

Soil Management

Like each component of the no-till system, soils are important. They are the foundation of any cropping system. However, they can be very complex, which can make them difficult to manage. It is essential to understand soils to manage them effectively.

Some soil properties are inherent, such as texture, drainage and slope, and are not readily altered by cropping and tillage practices. Poor drainage could limit no-till success on a field. Soil texture will influence planter setup.

Other features are very much affected by cultural practices such as soil structure, organic matter content, soil moisture, and the ecology of soil life. Such features must be considered before getting into no-till. And no-till will usually improve these features over time.

In general, no-till is more easily adapted to some soil conditions than others. However, in challenging soils – rehabilitating soil management practices, equipment modifications or with time – no-till can be made to work. The key, according to most producers, is listening to the experience of no-tillers on similar soil.

**Before converting a field to no-till:**

- **make sure the field is level, i.e., no strikeouts or dead furrows**
- **pick stones, since they will not be moved aside easily by planting equipment.**

**No-till soils become more consolidated in the first few years, by as much as 10-20%. But, over time, if undisturbed by primary tillage and aided by increased earthworm and other faunal activity, the soils will develop better structure and macropores.**

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## PRINCIPLES

Natural soil properties of no-till fields should be known and understood before attempting any fine-tuning of the system.

## NO-TILL EFFECTS ON SOIL PROPERTIES

| SOIL FEATURE | SIGNIFICANCE TO NO-TILL |
|---|---|
| SOIL TEXTURE<br>• the relative coarseness or fineness of soil (e.g., sandy loam, clay, silt loam) | • soils with high silt contents are:<br>◦ slower to dry<br>◦ highly susceptible to soil erosion and moderately susceptible to compaction<br>• can be more difficult to prepare seedbed in clayey soils<br>• sandy and loamy soils can be easier to work within no-till systems |
| SOIL DRAINAGE<br>• the integration of how quickly water naturally moves through soil and water table activity (e.g., well, imperfect or poorly drained) | • soils with poor natural drainage take longer in the spring to dry and warm up – crop residues can compound the problem, delaying operations and slowing seedbed readiness<br>• will improve with time |
| SOIL STRUCTURE<br>• aggregating or binding of soil particles and organic matter | • poor initial structure may cause seedbed problems at first (e.g., crusting, setting up)<br>• generally, overall seedbed structure will improve after 3-5 years, depending on soil conditions when no-till was introduced |

**In no-till, the populations of earthworms, spring tails and mites increase. With the residue removed, numerous earthworm holes are visible.**

**We used to pick stones with a tractor and loader and make three passes. Now I pick with a 4-wheeler, a little box and I'm done in one pass.**

**Jack Fraser, Stormont, Dundas and Glengarry United Counties**

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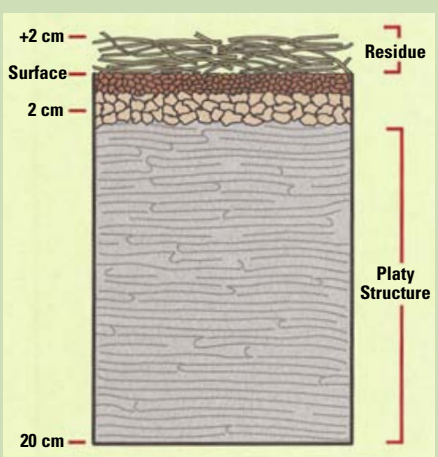
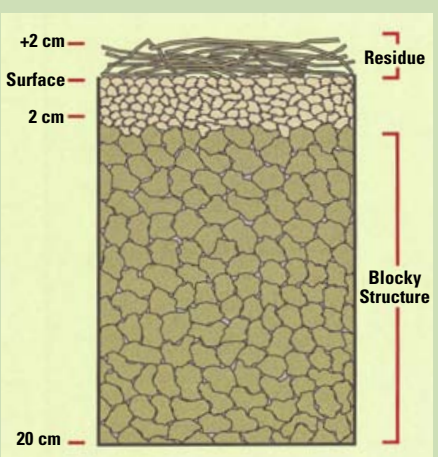
## NO-TILL EFFECTS ON SOIL PROPERTIES, cont'd.

| SOIL FEATURE | SIGNIFICANCE TO NO-TILL |
|---|---|
| ORGANIC MATTER<br>• decomposed and incorporated plant residues, manures and soil fauna | • low initial organic matter levels in some soils may lead to seedbed structure problems<br>• levels near the surface will rise over time as tillage is reduced and crop residue levels are sufficient |
| SOIL ECOLOGY<br>• soil fauna, flora, microbial life and the quality of the soil habitat | • soil habitat improves as organic matter levels increase and physical properties improve – and as habitat improves, so do the diversity and numbers of soil life |
| TILE DRAINAGE<br>• the use of designed subsurface drainage systems to remove excess water from cropland | • soils with standing water or high water tables in the spring (and imperfect or poorly drained rating) are not suited to no-till<br>• tile drainage should be installed or upgraded in wetter fields prior to switching to no-till |
| SOIL MOISTURE<br>• the amount of plant-available water in the soil during the growing season | • initially, soil seedbed moisture levels will increase with the insulation effect of crop residues on the soil surface<br>• as soil porosity and overall soil structure improve, some excess soil moisture will be drained<br>• crop residues will help preserve moisture for crop growth<br>• the continuous macropores allow roots to grow deeper into the soil, allowing access to more moisture |

## NO-TILL SOIL STRUCTURE ON SANDS AND CLAYS




**The top layer is very active biologically and produces relatively stable aggregates. However, these break down easily with coulter action to create a fine seedbed. Take a look under the residue cover and compare the soil surface to exposed soil.**

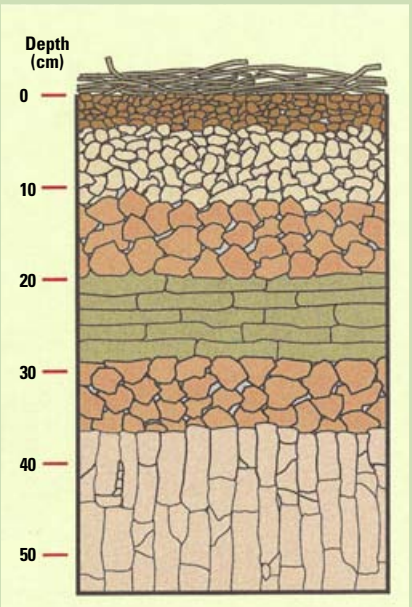
**Below the surface, soils with a coarse to medium texture (left diagram) will take on a platy appearance, while clay soils (right diagram) will have a thin granular layer over small- to medium-sized blocky aggregates. Over time, the clay will develop a definite structure and the aggregates will be easy to break apart with your fingers.**

**The structure illustrated here takes time to develop and may be subtle.**

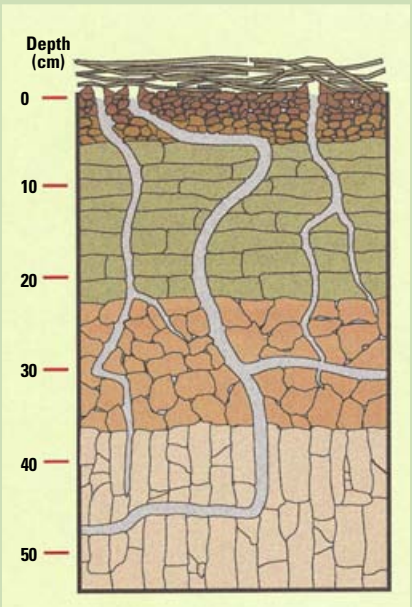
# SOIL MANAGEMENT



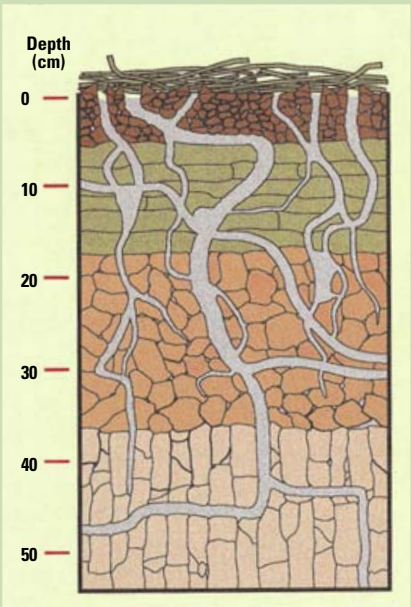
## SOIL CHANGES WITH TIME




In the first few years of no-till, the properties of a somewhat degraded loamy soil don't change much. Eroded soils retain light colours, surface crusting may still occur, and plow pans (if present) remain intact. Conditions aren't yet suitable for an increase in soil animal activity, particularly by earthworms.




After three or more years in no-till, a previously degraded loamy soil will begin to show signs of life. With the absence of tillage and increase in organic matter, earthworm numbers increase dramatically. Surface seedbed changes from a weak, medium blocky structure to a stronger, fine granular structure. Below this layer, soils may form a thicker layer with a platy structure.




After 10 or more years, the soil is nearly rehabilitated. Increases in soil organic matter and earthworm activity help form a thicker and more stable fine-surface seedbed structure. Subsurface platy structures are broken up by combined action of crop root penetration, earthworm channeling and frost action. Long-term no-till soils begin to look like soils found in extensive pastures and woodlands.

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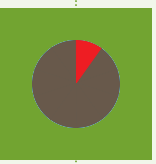



## WHEN TO PLANT

Many problems could be solved and equipment adjustment time reduced if no-tillers planted at the right time.

The land may look dry, but at the depth you want your equipment to operate, it may not be. Here are some tips to check if the land is ready.

1. Use a shovel and the following chart to see if it's ready. Much will depend on your soil type.
2. Try the drill (or planter). Check for trenches, dislodging of soil or seed, or smearing of soil.

   When it's ready, plant no more than 1-3 cm (½ -1") deep into the moisture to reduce distortion of seedbed. Be sure to plant into the moisture, not on top of the moisture – especially with soybeans.

As soil improves over several years, you may be able to plant earlier.

### FEEL TESTING SOIL – IS IT READY TO PLANT, YET?

| MOISTURE | COARSE (sands) | MEDIUM (sandy loams, loams, silt loam) | FINE (clay, clay loams) | SOIL CONDITIONS |
|---|---|---|---|---|
| BONE DRY | dry, loose and single-grained; flows through fingers | hard clods that break into powder | soil surface is hard, baked and cracked | could be too dry to plant, especially in clay soils |
| DRY | appears and feels dry; does not form a ball under pressure | appears to be dry; does not form a ball under pressure | somewhat crumbly; will form a weak ball that will not hold together | suitable for planting |
| MOIST | appears to be dry; does not form a ball under pressure | somewhat crumbly; forms a weak ball that will not hold together | forms a ball but will not form a cigar shape thinner than 1 cm; will not ribbon | suitable for planting, providing the planter does not smear the soil and the furrow closes |
| WET | sticks together slightly; may form a weak ball under pressure | forms a strong ball readily; very pliable | ribbons out between fingers easily; has a slick feeling | do not plant; wait for soil to dry |

**Note: When testing to see if the soil is fit for planting, run the planter at planting or tillage coulter depth and check the soil in the row to that depth.**

# SOIL MANAGEMENT



## TROUBLESHOOTING

| PROBLEM | CAUSES | BEST MANAGEMENT PRACTICES & TIPS |
|---|---|---|
| SOIL COMPACTION<br>• water ponds on surface<br>• crops showing nitrogen deficiency<br>• poor root growth | • past tillage practices<br>• planting, spreading manure and harvesting in wet conditions<br>• excessive traffic and axle loads | • avoid field operations when soil is wet<br>• improve soil structure by including forages, cereals and cover crops in the rotation<br>◦ use manure where possible<br>• limit number of passes and axle weight<br><br>**Note:** Sub-soiling can be a temporary remedial measure if conditions are right. The long-term benefit of proper soil management is the best solution. |
| RUTTING<br>• ruts left from crop harvest | • wet harvest conditions | • light tillage the following spring |
| PILES OF SOIL OR UNEVEN SETTLING OF SOIL | • tile line excavation and installation | • light cultivation and levelling of affected areas |
| POOR NO-TILL CORN PERFORMANCE ON CLAY SOILS<br>• poor germination<br>• poor emergence<br>• poor vigour<br>• low yields<br>• shallow root system | • cool, wet soils<br>• coarse seedbed<br>• wet soils combined with heavy cereal residue<br>• soil compaction and poor soil structure | • improve soil structure and improve organic matter levels by including forages and cereals in the rotation, cover crops and manure where possible<br>• bale and remove cereal straw<br>• tile drainage<br>• plant when soil is fit<br>• use 3-coulter system or 2-coulter with row cleaners<br>• crop-row pre-tillage (pre-tillage tool) |

**In the T-2000 program, we used a paraplow for two years and studied the effects for three years. There was no economic benefit from this practice.**

**Wilf Riddell, Middlesex County**

**To make no-till corn work on my clay ground, I now use 3-13 wave ¾" coulters shimmed so they won't run in a straight line. The outside coulters throw soil to the center of the row.**

**Randy Molzan, Lambton County**

**I have used the Trans-till (pre-tillage tool) for corn on clay soil after wheat underseeded to clover. The additional cost is partially offset by reduced costs for planter modifications.**

**Laurence Taylor, Huron County**

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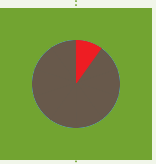
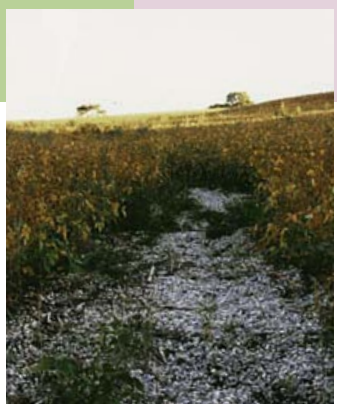


Soil Management

## TROUBLESHOOTING, cont'd.

| PROBLEM | CAUSES | BEST MANAGEMENT PRACTICES & TIPS |
|---|---|---|
| SOIL EROSION<br>• runoff during storm events<br>• light-coloured soils on knolls<br>• crops show drought and nutrient deficiency symptoms<br>• rills and gullies | • low organic matter levels<br>• poor soil structure<br>• compacted soils<br>• erodible soil type<br>• steep slopes<br>• aggressive tillage up and down slopes<br>• knifing-in nitrogen fertilizer<br>• incomplete residue cover | **Preventative Measures**<br>• improve soil structure and organic matter levels by including forages, cover crops, and cereals in the rotation<br>◦ use manure where possible<br><br>**Control Measures**<br>• residue management<br>• erosion control structures, e.g., grassed waterways<br>• crop at right angles to steepest, longest slope<br>• spread straw or hay where more residue is needed to protect the soil |

**Solutions to many soil problems can be found in *Soil Management*, another Best Management Practices book.**



**Murray Lobb has combined no-till with erosion control structures and practices. Stone-filled gullies are providing excellent erosion control on his farm.**

**Remedial Measures for Eroded Knolls**

**A few years back my brother and I worked with Doug Aspinall, Adam Hayes and Peter Johnson of the Ontario Ministry of Agriculture, Food and Rural Affairs to improve soil conditions on our eroded knolls. We moved the topsoil from the draws where it had been since the last time a moldboard plow had been used. Some knolls got soil, others soil and manure – the rest got nothing. Crop yields improved by 30% on knolls where soils were replaced. Now no-till will keep the soil in place.**

**Wilf Riddell, Middlesex County**

**Note: Consult an expert for advice on how much soil to move and where to take it from.**