



## **How do farmers observe the health of their soil and what tools do they use?**

Farmers know that soil health is critical to their success. They thus learn to observe nature keenly and to use their observations for refining their farm management practices. Written records are important tools and the farmer should use them to keep track of all information about individual fields.

It is easy to evaluate the general tilth and physical aspects of the soil even without using precision instruments. It helps to repeat some tests one or more times a year to see the progress of your soil-improvement program.

**Texture** influences water and nutrient-holding ability. Get a handful of moist soil and squeeze it into a ball. If it falls apart when you open your hand, the soil is sandy. If it remains a ball, squeeze some of it between your fingers and form as long a ribbon as possible, and measure it. If making a ribbon is not possible, the soil is loamy sand.

Add some water to the ribbon in your hand until it becomes liquid mud. Feel the mud with the forefinger of the other hand and decide if it is mostly gritty, mostly smooth, or equal parts of both.

Soil that forms a ribbon shorter than 1" is sandy loam if it feels mostly gritty, silty loam if mostly smooth and loam if equally smooth and gritty. A ribbon of soil 1-2" long is sandy clay loam, silty clay loam, and silty clay, respectively.

**Moisture** readings should be taken when the crop is started and several times afterwards. If soil moisture down to a six-inch depth is less than 50%, you will need to add water.

Look at the soil for signs of dryness (crusting, cracking, etc.) and see how far down before soil gets darker, indicating more moisture. Get a few handfuls from various depths and squeeze firmly. If your hand gets wet, the soil is saturated. Moisture is probably 25-50% if light-textured soil does not form a ball, medium-textured soil tends to crumble but holds under pressure, and heavy-textured soil is somewhat pliable and balls with pressure.

**Drainage** problems are easily detected. Fill a 12-inch deep, 6-inch diameter hole with water and let the water drain completely. When the water is gone, fill the hole again and observe how long complete draining takes this time. If it takes more than eight hours, drainage is an immediate problem to address.

Water infiltration rate gives you an idea of soil porosity. Bring one quart of water, a tape measure, and a stopwatch. The test should be done when the soil is equally dry and wet. At soil level, empty the water and count how many seconds it takes to soak into the ground. Measure the diameter of the wet spot and multiply the diameter by the time. Test the soil several times during the growing season, using exactly one quart of water each time. Over the years, subtle changes become apparent. A declining trend indicates an improving capability to absorb water.

**Structure** and size of soil aggregates and how well they hold together are important aspects of tillage. Soil with good structure holds about two times more water than soil of the same texture but with poor structure. Get some soil and observe how it crumbles in your hand. If well structured, heavy soil still crumbles easily whilst light soil keeps some shape without becoming powdery. If poorly structured, heavy soil resists crumbling whilst light soil becomes powdery. Evaluate aggregate stability by placing several large crumbs (up to one-half inch) in a glass filled with water. If many crumbs hold together, the soil has good structure.

The farmer should observe closely the biological activity of farm soil. As in the physical aspects, all information should be written down in the farm's records for use in analysis and decision-making.

**Organic matter content** should normally be measured in laboratory tests, but you can make a visual evaluation. Darker brown soil generally implies higher humus content. Dig up some soil and look for white threads of fungal mycelia and undecomposed organic matter. The absence of crop residues from the previous growing season within a few weeks of the new crop indicates the soil is biologically active. If residues are still present, you need to stimulate more soil organisms.

**Counting earthworms** is a useful indicator of biological activity and overall soil health. Avoid taking the soil from spots that would overstate the worm count, such as under mulch or close to a compost pile. It is advisable to wait until a cool time of day so worms will not be exposed to harmful conditions.

The earthworm census should be taken several times each season; the season average can be used to analyse year-to-year changes in soil health. You can pick any of these alternative methods for estimating earthworm population:

- Dig out everything in a 12-in x 12-in x 6-in (30.5-cm x 30.5-cm x 15.2-cm) plot and place in a pan or bucket. Good healthy soil should contain 10 or more earthworms in a sample this size.
- Dig out a "spade-split" of soil, about 2-in (5-cm) wide and 8-in (20-cm) deep (the spade blade serves as length). There should be several spade-splits taken from each field, and the average for the field is calculated. For each spade-split, one earthworm is roughly equivalent to 100,000 worms per acre (247,000 worms per hectare).
- This is the simplest: just count the number of earthworm holes (marked by the earthworm castings beside them) in a designated area. The same area should be used for subsequent counts during the season, to make the year-to-year numbers comparable.

**Plant root condition** can be considered an ultimate indicator of soil health. Examine the roots of a weed or a growing plant. If you dig up a plant, take care to cut off the least possible portion of its root mass. Select the healthiest-looking specimen in the area and evaluate.

- Are roots well-branched and vigorous? It is desirable for roots to penetrate as much soil area as possible. The estimated volume and depth of the root mass in the area, tracked over the course of the season, indicates changes in the soil biological health.
- Are fine root hairs plentiful? The presence of many fine feeder roots indicates good air circulation in the root zone.
- Are roots spreading out in every direction, or are they growing sideways at some point? A sudden change of direction sideways indicates the presence of an impenetrable hardpan underground.

Legume crops should contain a good number of nodules, which are the living areas of nitrogen-fixing bacteria. Slice open some nodules and check the colour inside. A healthy nodule presents a pink or red colour; green or black indicates lack of bacterial activity (although this may be the temporary normal colour, when the plant is entering its dormant phase). The more and the bigger the nodules, the more nitrogen the plant can fix. Beans and peas normally have fewer nodules than clover and alfalfa.

Close, regular, and accurate observation and recording of information about the soil's physical and biological condition, combined with crop health and yield records, provides a sound basis for evaluating the fertility improvement program.