Field Lab: Less Toil Better Soil
23rd April 2018, Left Field Market Garden
Notes by Max Johnson

Paul Flynn, the Soil Association's Crops and Soils Advisor, helped us to get to know our soils by examining water content and compaction, soil life and structure, and pH and nutrient availability.

Moisture content and compaction
We learned that soil moisture levels are crucial: damp soils warm up much more slowly than dry ones, thus delaying growth and the ability of seeds to germinate. If fields are worked with machinery while the soil is too damp it can result in compaction, which in turn means even worse drainage, this damages the plants' ability to access nutrients, and can even result in de-nitrification. Of course, this risk is not as severe with no-till/no-dig approaches in which use of compaction-causing machinery is minimal or non-existent. In terms of remedying, Paul cautioned that sub soiling is rather more of an art form than is commonly believed, and can be quite damaging if done incorrectly. Harking back to the previous session, he urged the use of green manures, which reduce the impact of rainwater on the ground and contribute to water loss through transpiration. There is also some interception of water on the leaf that can be lost by evaporation.

The water infiltration rate test:
A short cut method is to dig a hole one spade deep and one spade wide, pouring a bucket of water in, then timing how long it takes to drain. A second fill is normally made before timing, but on clay soils this may take a long time! Typical drainage rates vary from 30mm per hour to 1-5mm/hour. Done properly a cylinder is inserted to eliminate water movement to the side, on farm this can be as simple as a piece of down-pipe. FAO publish a more detailed version if you need more precision. FAO Infiltration test

Soil structure and soil life:
This is key not only to drainage issues but also to plant health and productivity. For a poor soil structure, Paul recommended lime to bring the pH within an acceptable range for most plants and for earthworms, around 6-6.5. The addition of composts to increase organic matter is also a passport to improved structure, though this can take time to effect soil conditions and can also influence the pH of the soil.
Some growers are using gypsum to try to improve clay soils, aiming to bring clay particles together to create a larger particle size (aggregation). However, in the medium- to long-term, Paul outlined how earthworms are vital in creating a good, aerated soil structure. Likewise soil bacteria and fungi are of great benefit for nutrient cycling and availability, as well as soil stabilisation. Ten worms per spade is what farmers should be aiming for and this, alongside healthy soil bacteria and fungi populations. This can be gained by ensuring there is always fresh organic matter available and by minimising rotavator use which can devastate earth worm populations.

Practical tests for soil structure:

1. Soil profile test. If you are buying or renting new land this might be your first test, digging down through the soil profile, taking care at least on one side, not to smear the surface. The act of digging will tell you a lot about your soil. It will also give you a clear idea of your earthworm population – the type of earthworm, their numbers and age range, burrowing depth and potential aeration. Rooting depth can also be seen, with roots gathering above any compacted layers. A pen knife or trowel should help you identify compacted areas and the smell of any anaerobic layers should be obvious. Be aware that soil type can change at depth and may affect the performance of the top soil. Sometimes the test pit will fill with water, indicating a semi-permeable layer of soil, this indicates a good response to any drainage work at this depth, allowing installed drains to draw water from the surrounding area. This is something to celebrate rather than fear.
2. Take a large handful of soil and add water until it can be rolled into a ball. Press down on this ball. If it crumbles easily, you have a sandy soil.
3. Next, form the soil into a ribbon, squeezing it between the thumb and forefinger in an attempt to push it into a flat ribbon that dangles off the side of your forefinger. See how long you can get this ribbon to be before it breaks off. A true clay soil will stay together for several centimetres before breaking.
4. Spreading the soil on to the palm with your thumb or rubbing it between your fingers will indicate a silt soil if it feels soapy.
5. Jar test. Dry your soil sample, process it with a mortar and pestle. Place it a jar add water, non-foaming detergent and stir thoroughly. Leave it for a day, after which the sand, silt, and clay will have separated out, allowing you to see your soil composition. If the layers cannot be distinguished by colour and texture, repeat the test marking the level of the soil after five minutes, two hours and then one day, this should correspond to sand, silt and then clay levels. Measuring these in mm will give the proportion of each.
6. Compaction test. Paul used a penetrometer to measure the amount and depth of compaction. This can be done at much less cost, using a steel rod, approximately 10-15mm diameter, ideally with a T-bar welded across the top, inserting the bar in to the ground to get an immediate sense of compaction.
7. Cigar test. This was Paul's favourite test, attempting to roll a "cigar" of soil from a good handful of soil. If this is possible, the soil may be too wet to work with, where it breaks down to a friable tilth without a cigar forming the soil can be worked with less risk of compaction.

Remember that the soil can be compared to that at the field margins in hedgerows or adjacent woodland as a "reference sample."

<u>pH and Nutrient balances</u>

Here, Paul recommended paying for a full soil test to ensure you know exactly what is going on in your soil. Yearly tests were advised, as pH tends to decrease over time. The key issue here is that pH affects the ability of plants to absorb various nutrients,

and that different crops prefer different pH levels. The pH can normally then be adjusted within a year or two and here Paul proposed the use of lime, especially for those renting land, due to its cheapness and easiness to apply. Rock phosphates and compost were recommended as a nutrient addition and, again, green manures were brought up as a means of resting and re-fertilising fields.