The importance of earthworms for soil structure

By Dave of Darlington

It was in 1881 that Charles Darwin published his influential book 'The Formation of Vegetable Mould through the Action of Worms with Observations in their Habits.' People must have been aware, probably since the dawn of agriculture, of the beneficial effects of earthworms on the soil, but Darwin was the first to study the activity of earthworms in a systematic way and to observe in detail the conversion of dead plant material by worms into soil organic matter.

However, earthworms have another very important effect on soil, which has only been studied in the last 15 years or so. That is, earthworms directly improve the *structure* of the soil and hence its stability. Of course, it has long been known that worms improve the aeration and drainage of soils through their burrows, but they also have a more fundamental effect. Through their activity they directly promote the aggregation or crumb structure of the soil.

To understand this we need to look more closely at the structure of soils. If soils were structureless, that is, if they consisted entirely of separate clay and silt particles, they would be too dense and airless for plants to grow in. The roots of plants could neither penetrate the soil nor breathe in it. It is crucial for plant

growth that the individual mineral particles in the soil clump together into larger pieces called aggregates, which, because they are more irregular in size and shape than the individual mineral particles, have more spaces between them, through which air, water and plant roots can pass. The aggregate structure of soil also stabilises it and makes it resistant to erosion. If the soil had no structure, there would be nothing holding the individual mineral particles in place and they could very easily be washed away by rain or blown away by wind.

These aggregates make another important contribution to the soil properties, apart from leaving spaces between them and stabilising the soil. As well as mineral particles, the aggregates also contain organic matter. In fact, in most cases it is precisely that organic matter that sticks the mineral particles together to make the aggregates. Certain sticky organic materials are particularly important here, for example, mucous-like substances, usually secreted by living organisms in the soil, and sticky solutions of various carbohydrates. (Old-fashioned wallpaper paste, made from mixing cellulose or starch with water, is a familiar example of such a solution.)

More aggregation, less aggravation

Worms don't like it too wet! Picture from Regenwurm

So these sticky substances glue the mineral particles together in the aggregates and, at the same time, in a kind of mutual relationship, the mineral particles protect the organic matter, to some extent, from microbial attack and thus preserve it for a longer time in the soil. However, microbial attack does continue, if only at a much-reduced rate, so eventually the aggregates are liable to break down, as the soil microorganisms consume the sticky substances that are holding them altogether. At the same time aggregates are continually being formed, as a result of various processes in the soil – physical, chemical and biological. It is the relative rates of these two contrary processes – aggregation and disaggregation (or breakdown) – that determine the future nature of the soil.

In order that the soil should not revert entirely to a structureless mass of mineral particles again, it is obvious that new aggregates should be formed at least at as great a rate as the old ones are being broken down. This is where the earthworms come in. They have the capacity to promote the formation of aggregates at a much great rate than they would be formed in worm-free soil.

This is because, as the soil and organic matter pass through the gut of the worm, they are all ground up into an intimate and fairly homogeneous mixture of very small mineral and organic particles. This brings the various materials into close contact and increases the likelihood of the right particles meeting to form aggregates. (The worm's gut also provides mucus to help the aggregation process along.) In ordinary soil, on the other hand, the particles are larger and less homogeneously mixed and therefore the rate of aggregate formation is lower.

The worth of the worms

So worms are triply important – as well as aerating the soil and incorporating dead plant material into the soil organic matter, they also help to maintain or improve soil structure. Since it is the soil structure that determines its resistance to erosion and hence whether future human generations will have any soil at all, it is more apparent than ever that we should do all we can to look after the earthworms and give them what they need.

They need two things more than anything. First of all, they need dead plant material to feed on, so we have to supply that in the form of crop residues and mulches. Secondly, they need to be left alone to do their work. Disturbance of the soil is bad for them. Turning the soil over with spade or plough can halve the earthworm population. Turning the soil and then breaking it up with fork, harrow or rotavator can literally decimate the earthworms – reduce their population to a tenth of what it naturally is. The earthworm population will recover in a few years if the soil is left undisturbed, but, if cultivation is repeated

every year, as it often is, then the earthworm population will have no chance to recover and will remain well below the natural level.

Reference

Darwin, C. 1881. The Formation of Vegetable Mould through the Action of Worms with Observations in their Habits. Murray, London.

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