Organic Update No. 9 August 2005

SOIL HEALTH AND FERTILITY

1. physical, chemical and biological fertility

Key points

- Soil fertility includes biological, physical and chemical fertility, which are interrelated.
- Chemical fertility includes nutrient levels and pH.
- Biological fertility includes earthworms and soil microorganisms. Earthworms are an important key to soil fertility.
- Biological fertility can be improved by liming to reach a pH of 6.0 – 6.4; the strategic use of fine lime; applying compost; growing green manure/cover crops or growing pasture.
- Biofertilisers such as the microbial inoculant EM (effective microorganisms) can improve soil biological activity (see Organic Update 1).
- Physical fertility or soil structure is the way the soil is held together – the ideal is small particles joined together into crumbs (or aggregates) which give good aeration and drainage.
- Good structure also provides better conditions for microbial activity and earthworms and prevents erosion.
- Cultivation is the worst thing for structure and for earthworms!

Dr Tim Jenkins presented a seminar on soil health and fertility. Good fertility ensures a more resilient farm system with more efficient nutrient utilisation, healthier crops and lower susceptibility to pests and diseases (especially soil borne ones).

Soil fertility includes biological, physical and chemical fertility, which are interrelated. In organic systems especially, biological and physical fertility are crucial factors as readily available nutrients cannot be added out of a bag if availability is limited through poor soil biology or structure.

Aspects of chemical fertility

1. Nutrient levels, of both macro and micro elements, contribute significantly to the health and productivity of pasture and crops. Low nutrient levels can be the limiting factor for crop and pasture growth. Nitrogen is often limiting in organic systems. Soil tests can give an indication of nutrient levels and pH but there can be variability in the soil and other factors may be affecting productivity, such as the availability of other major and trace elements.

2. pH, a measure of the acidity or alkalinity of the soil – the lower the pH the more acid the soil. The pH of pasture should be in the range 6 – 6.2 to maximise clover growth and productivity. If pH is high (say above 6.5), trace elements may become unavailable. If too low, soil biological activity is reduced which can slow the turnover of organic matter and reduce the release of nutrients.

Aspects of biological fertility

1. Earthworms are an important key to soil fertility. Earthworms break down soil and organic matter. By the time the casts come out of the earthworm the organic matter is smaller and more available for microbial action and there is a 6-10 times increase in the availability of nutrients. The mix of soil and organic matter leads to a good aggregate (soil crumb) and the mucus aids in holding the soil together. Earthworm activity improves the soil's aeration and structure.

2. Microbial activity. Soil microorganisms include bacteria, fungi and yeasts. They help bind soil particles together, release nutrients from the organic matter and some microbial species living in association with legumes (rhizobia) fix nitrogen from the air.

If there is good soil biological activity, then there will be good mycorrhizal activity (the fungi that grow in association with plant roots). This fungi is able to draw phosphorus from up to 7 cm away, so it improves the efficiency of the whole soil system. A benefit of not putting on readily soluble fertilisers is an improvement in mycorrhizal activity (as well as trace element and water uptake).

How to improve biological fertility

Firstly lime the soil to a pH level of 6.0 to 6.4; thereafter regularly apply very fine lime flour at a rate of 30 – 200 kg/ha/year (several strategic applications could be made, which boosts nitrogen availability from enhanced microbial activity).

Canterbury Organic Growers acknowledge the support of the MAF Sustainable Farming Fund, Heinz Wattie's and the Foundation for Arable Research (FAR). Summary prepared by Mary Ralston (mary.ralston@xtra.co.nz).

Aim for good organic matter levels by adding compost, growing green manure/cover crops or growing pasture. Good growth of pasture is achieved through a regular fertiliser strategy, paying particular attention to the needs of clover to maximise levels of nitrogen fixation.

Biofertilisers can improve soil biological activity, e.g., the microbial inoculant EM (effective microorganisms).

Physical fertility (or soil structure)
The ideal soil structure is small particles joined together into crumbs (or aggregates). Crumbs give good aeration and drainage and allow the plant roots to grow into the aggregate to take advantage of the moisture within. Good structure also provides better conditions for microbial activity and earthworms and prevents erosion.

Minimise cultivation
Organic farmers often rely on cultivation for weed control as well as ground preparation. Unfortunately cultivation is the worst thing for structure and for earthworms. Try to minimise cultivation. Reduce the number of tractor passes by combining operations and only cultivate to the tilth (fineness) required for that crop. If possible keep cultivation shallow, especially for weed management. Rotate crops of different rooting depth and include deep rooting crops or pasture species in the rotation. Before cultivating check soil moisture – cultivating when the soil is too wet or too dry can seriously damage structure.

Assessing physical fertility: the Visual Soil Assessment (VSA) method

VSA is a farm based assessment method. Visual soil properties are indicative of soil quality, and provide an effective and immediate way to assess soil quality in the field.

One simple VSA method assesses soil structure and consistence under cropping. Remove a 20 cm cube of topsoil with a spade; drop the sample a maximum number of 3 times from waist height onto the base of a plastic box or a sheet on the ground. If large clods break away after the first or second drop, drop them individually again once or twice. If a clod shatters into small units after the first or second drop, don't drop again. Move the coarsest fractions to one end and the finest to the other to get a measure of the aggregate size distribution.

If there is no significant clodding and a good distribution of friable finer aggregates the soil is in **good** condition. If the soil contains significant proportions of both coarse firm clods and friable, fine aggregates, it is in **moderate** condition. If the soil is dominated by extremely coarse, very firm clods with very few finer aggregates the soil is in **poor** condition.

See Organic Updates Nos. 10, 11, 12 and 13 which cover the pasture phase, soil testing, and cover crops.

Tim Jenkins can be contacted at tje@donaghys.co.nz