Organic Cotton Crop Management: Soil Management

About the Farmer Toolkit

The OE Farmer Toolkit is a compilation of best practices - scientific research and farmers’ experiences - collected to provide crucial information on core organic cotton agricultural practices.

The information was compiled by the OE Farm Development team, and a list of sources and other publications on organic farming are available from Organic Exchange at www.organicexchange.org.

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Soil Fertility in Organic Farming Fact Sheet

What is Soil?
Soil is "the layer of unconsolidated particles derived from weathered rock, organic material (*humus), water and air that...supports plant growth. The formation of soil depends on the parent material (i.e. the original material from which the soil is derived), the climate and topography of the area, the organisms present in the soil, and the time over which the soil has been developing.”

What is soil fertility?
“Soil Fertility is the quality of a soil that enables it to provide essential chemical elements in quantities and proportions for the growth of specified plants.” (Brady and Well, 1999 - The Nature and Properties of Soils)
Soil fertility deals with the nutrient status or ability of soil to supply nutrients for plant growth under favorable environmental conditions such as light, temperature and physical conditions of soil.

Fertile soil contains sufficient nutrients to ensure plant growth and yield and is able to maintain appropriate moisture and components in the soil.

What is Soil Fertility Management?
Soil fertility management in organic farming is a long term strategy aimed at:
1) Reducing the loss of nutrients
2) Building soil fertility through the continuous nourishment of the soil. The aim is to minimize the need to bring in external inputs from outside the farm.

There are a range of tools available to the organic farmer to improve and maintain soil fertility but the main focus in organic farming should be to maintain and improve the organic matter content of the soil.

- A balanced crop rotation – crops with different nutrient demands and rooting depths are grown in the field. Legumes (which help nitrogen fixation) must be included to help.
- Cultivation methods such as minimum tillage chosen carefully to reduce soil erosion and compaction.
- Protecting the soil from strong sunlight and heavy rain by leaving a soil cover of crop residue, a cover crop or mulch.
- A nutrient management regime that supplies the crop with the appropriate nutrients at each growth stage and that does not over supply.
- Feeding the soil organisms by building and maintain the organic matter levels in the soil.
The Importance of Soil Organisms

In an active healthy soil, even a sample the size of a teaspoon will contain millions of soil organisms. These may be of both plant and animal origin, but all are important to the health of the soil and the crops that grow in it. They are classified according to size, the ones visible to the naked eye usually being referred to as soil organisms, and the ones only visible through a microscope being called micro-organisms. Some examples of common soil organisms are shown in the table below.

<table>
<thead>
<tr>
<th>Large Soil Organisms</th>
<th>Soil Micro-organisms</th>
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<tbody>
<tr>
<td>Earthworms</td>
<td>Bacteria</td>
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<tr>
<td>Spiders</td>
<td>Algae</td>
</tr>
<tr>
<td>Ants</td>
<td>Fungus</td>
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<tr>
<td>Termites</td>
<td>Protozoa</td>
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<tr>
<td>Slugs and Snails</td>
<td>Actinomycetes</td>
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<tr>
<td>Millipedes</td>
<td></td>
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<tr>
<td>Beatles and their larvae</td>
<td></td>
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<tr>
<td>Mites</td>
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</tbody>
</table>
Soil Organisms are important for the following reasons:

1. They help decompose organic matter in the soil and produce humus.
2. They mix the organic matter with soil particles and build up stable soil crumbs.
3. They make tunnels in the soil opening up the soil to promote deeper rooting of the crop, and better aeration of the soil.
4. They help to release nutrients from mineral particles in the soil making them available to the crop.
5. They can help to control pest and disease organisms which may affect the roots of the crop.

Soil Fertility Inputs
The various soil fertility inputs used in organic farming worldwide are: Animal manure, humus (vermicompost), manure teas, Green manure, Compost, natural minerals and soil micro-organisms or bio-fertilizers. With the exception of liquid manure all these help increase organic matter in the soil; liquid manures feed the soil organisms and subsequently the crop. Green Manures are crops grown for the purpose of feeding the soil and soil organisms as opposed to being grown for human consumption. They are usually included in the annual rotation system and examples include Sunnhemp, Velvet beans, Cowpeas and Lablab beans.

Compost
Composting is the process of transforming organic material from plants or animals into high-value rich organic compost. Composting can be done in heaps or pits, which break down the organic materials faster because it heats up as part of the decomposition process. This results in a higher quality product with good nutrients and disease fighting micro-organisms. If the compost heap or pit is properly maintained, loss of nutrients (especially nitrogen) can be kept low. Compost provides the crop with well-balanced ‘food’ and helps to increase the soil organic matter content. Compost has both a long-term and a short-term effect on plant nutrition as nutrients are continuously released over a period of time.

Adding organic matter to the soil.
- Providing a balance of nutrients to the soil.
- Improving soil structure.
- Providing nutrients that are slowly released into the soil, so reducing the risk of these nutrients being leached away.
- There is evidence to suggest that micro-organisms in compost can help to suppress soil borne diseases.

Liquid Manures
These include manure teas, leaf teas and compost extract and compost teas these are useful to feed the crop at times of increased nutrient demand such as flowering or fruiting and allow the organic farmer opportunity to tailor a nutrition regime to a particular crop.

Humus (Vermicompost)
Vermicompost (also called Worm Compost, Vermicast, or Worm Manure or VermiCulture) is end product of the breakdown of organic matter by special varieties of earthworms. Vermicompost is a nutrient-rich, natural fertilizer and soil conditioner.

Crop Rotation
The farmer must practice a rotation to mix crops of different rooting depths and nutrient requirements. A legume or green manure crop must be include in the rotation ideally cotton should have two different crops between each cotton crop.
Cultivation Techniques
These should be tailored to the local climatic conditions but the farmer should always try and reduce soil erosion and loss of soil organic matter and nutrients. This means avoiding leaving fields bare and avoiding soil erosion through by cultivating across the slope. If possible minimum cultivation systems should be considered.

Oxford Dictionary of Biology
http://www.ikisan.com/links/ap_soils.shtml#Soil

Additional Resources:
Visit Organic Exchange (www.organicexchange.org) for more information including PowerPoints and Posters for farmer development and education.