Pacific Pests, Pathogens, Weeds & Pesticides - Online edition

Healthy soil (486)

Regenerative agriculture

Regenerative agriculture helps to increase biodiversity in farming systems, improve the cycling of water and its quality, supports capturing and keeping carbon in the soil, and reduces pesticide use, which all help with increasing resilience to climate change. It has important human health and environmental benefits.

Keeping soil healthy (especially the topsoil) is the most important element of regenerative agriculture.

Diagram. A soil texture triangle showing soil textures as determined by the proportion of sand, silt and clay

What is healthy soil?

Healthy topsoil has both inorganic (mineral nutrients) and organic components, and a texture that enables plants to grow well. It provides good anchorage for roots, air spaces where roots can obtain oxygen, holds enough water adequate for plant growth, and has all the minerals plants needs in the form that they can take up. It also contains macro and micro-organisms that make the nutrients available to the plants at the correct rate.

The pH of the soil is important. It is a measure of how acid or alkaline a soil is, and is measured in pH units. Soil is neutral at pH7, more acid from below 7 to 0, and more alkaline from above 7 to 14. Most crops grow best in soil with a pH between 5.5 and 7.0, though some plants require more acid or alkaline conditions.

By enabling healthy growth, soil helps protect plants from insect pests and pathogens. This may be because the micro-organisms in the soil prevent their build-up. For instance, healthy soil contains fungal mycorrhiza that contact the roots and greatly extend the area for the plant to take up minerals and water.

Healthy soil also provides plants with endophytes - bacteria, algae and fungi that live inside the plants cells. They have many functions including supplying nutrients, protection from pests and pathogens and, importantly, increasing plants' ability to withstand stresses, such as drought and salinity.

Endophytic fungi growing inside roots increase contact between plants and the fungi and enable good transfer of nutrients between them.

Bacteria on the roots can also supply nutrients and protect them from harmful pathogens. Nitrogen-fixing bacteria present in leguminous plants are well known to do this.

Note, pesticides destroy these essential soil micro-organisms.

Soil testing

The inorganic components - clay, silt and sand, can be separated out to show the composition and texture of soil. Mix a teaspoon of soil in 500 ml of tap water in a glass or clear plastic container, and allow it to stand for a few hours. Layers will be seen: larger sand particles will settle at the bottom, then the silt, while the fine clay particles will remain in suspension for several hours. Organic matter that has not broken down will float on the top of the water. While different crops might require different soil textures, generally most will grow well in a soil texture known as 'loam'. The triangle (above Diagram) shows the names of different soil textures determined by the proportion of sand, silt and clay.

Soil testing kits or universal indicator (UI) can be used to find out the soil pH. Mix the soil with distilled water and allow it to settle. Add a few drops of UI to the water and check the colour against the chart on the bottle.

Soil improvement

For small areas, adding organic matter in the form of compost and/or worm castings is the best way to improve soil health, as it provides food for soil organisms and also tends to buffer (balance) the pH so the soil is not too acid or alkaline. For larger areas, a green manure or cover crop such as cowpeas, soybeans, annual grasses, clovers, peas, *Vicia faba* (broad beans), *Pueraria, Mucuna,* buckwheat or a mixture of these turned in before they flower, adds organic matter and organic nitrogen to the soil and prevents erosion of exposed soil.

When crops are harvested, leaving their roots in the soil to break down will also add organic matter.

Minimal disruption to soil structure will help protect soil organisms, especially fungal mycorrhiza and macro-organisms such as earthworms. When tilling the soil, use of a chisel or ripper plough instead of a mouldboard plough which lifts and overturns the earth, will help retain the soil structure.

AUTHOR Caroline Smith

Information from Peter Dunne (2021) Regenerative agriculture part 2: A soils-first farming & food policy. (https://www.resilience.org/stories/2021-03-04/regenerative-agriculture-part-2-a-soils-first-farming-food-policy/); and Soil properties. Queensland Government. (https://www.qld.gov.au/environment/land/management/soil/soil-properties); Pacific Farmer Organisations (2019) Organic and regenerative agriculture. (https://pacificfarmers.com/organic-and-regenerative-agriculture/); Improving soil health in support of sustainable development in the Pacific, 2011-2015. Soil and Land Management. ACIAR, Canberra. (https://aciar.gov.au/project/smcn-2009-003). Diagram. Soil texture. Queensland Government. (https://www.qld.gov.au/environment/land/management/soil/soil-properties/texture).

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