Organics and Soil Carbon

Ameliorating Climate Change and Increasing Farm Profitability through Carbon Management

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CLIMATE CHANGE and CARBON

The world consensus is that atmospheric carbon from human activities is the cause of climate change

Sequestering carbon into the soil will:

- Reduce atmospheric carbon.
- Build farming systems that are more resilient to climate change

COPING WITH CLIMATE CHANGE

Published studies show that organic farming systems are:

- More resilient to the predicted weather extremes.

- Higher yields than conventional systems in weather extremes such as floods and droughts.

Drinkwater, L. E., Wagoner, P. & Sarrantonio, M. (1998), Welsh R. (1999),

A 21-year study published in *Science*

Organic farming is:

- more energy-efficient
- have healthier soils
- greater diversity and number of organisms
- greater efficiency in using nitrogen

Scientific Review by Cornell University into a 22 year-long Field Study

The improved soil allowed the organic land to generate yields equal to or greater than the conventional crops after 5 years

The conventional crops collapsed during drought years.

The organic crops fluctuated only slightly during drought years, due to greater water holding potential in the enriched soil.

The organic crops used 30% less fossil energy inputs than the conventional crops.

Published in the Journal Bioscience

Research shows that organic systems use water more efficiently

Due to better soil structure and higher levels of humus.

Open structure allows rain water to quickly penetrate the soil resulting in less water loss from run off

Humus stores 20 times it weight in water so that rain and irrigation water is not lost through leaching or evaporation.

It is stored in the soil for later use by the plants

Organic Systems Use Water More Efficiently

'Soil water held in the crop root zone was measured and shown to be consistently higher … in the organic plots than the conventional plots, due to the higher organic matter ...' (Lotter 2003)

Organic Systems Use Water More Efficiently

'The exceptional water capture capability of the organic treatments stood out during the torrential downpours during hurricane Floyd in September of 1999.

The organic systems captured about twice as much water as the conventional treatment during that two day event' (Lotter 2003)

Greenhouse Gas Abatement

Organic agriculture reduces greenhouse gases by converting atmospheric carbon dioxide (CO_2) into soil organic matter.

Conventional agriculture has caused a massive decline in soil organic matter, due to:

- oxidizing organic carbon by incorrect tillage
- the overuse of nitrogen fertilizers
- from topsoil loss through wind and water erosion
- biocides killing humus forming microorganisms

Greenhouse Gas Abatement

According to Dr Christine Jones, one of Australia's leading experts on carbon sequestration:
'Every tonne of carbon lost from soil adds 3.67 tonnes of carbon dioxide (CO_2) gas to the atmosphere.

Conversely, every 1 t/ha increase in soil organic carbon represents 3.67 tonnes of CO_2 sequestered from the atmosphere ....'

Greenhouse Gas Abatement

Organic agriculture deliberately builds up soil organic matter

'For example, a 1% increase in organic carbon in the top 20 cm of soil represents a 24 t/ha increase in soil OC which equates to 88 t/ha of CO_2 sequestered." Jones (2006)

A 100 hectare farm that had a 1% increase in organic matter would be removing 8,800 tonnes of CO_2 from the atmosphere.

A million hectares = 88,000,000 tonnes

Rodale Institute

"U.S. agriculture as currently practiced emits a total of 1.5 trillion pounds of CO_2 *annually into the atmosphere.*

Converting all U.S. cropland to organic would not only wipe out agriculture's massive emission problem.

By eliminating energy-costly chemical fertilizers, it would actually give us a net increase in soil carbon of 734 billion pounds."

Rodale (2003)

Organic carbon, particularly humus is critical to successful soil health

Nutrient availability:

- Stores 90 to 95% of the nitrogen in the soil, 15 to 80% of phosphorus and 50 to 20% of sulphur in the soil
- Increases the soils TEC Total ion Exchange Capacity
- Stores cations, such as calcium, magnesium, potassium and all trace elements
- Organic acids (humic and fulvic) make minerals available by dissolving locked up minerals
- Prevents mineral ions from being locked up
- Encourages a range of microbes that make locked up minerals available to plants.
- Helps to neutralise the pH
- Buffers the soil from strong changes in pH

Benefits of Humus

2+

Soil Structure:

Promotes good soil structure which creates soil spaces for air and water by

- Assisting with good/strong ped formation
- Feeding macro organisms (ie earthworms and beetles etc) the form pores in the soil.

Directly assisting plants:

The spaces allow microorganisms to turn the nitrogen in the air into nitrate and ammonia

Soil carbon dioxide contained in these air spaces increases plant growth

Helps plant and microbial growth through growth stimulating compounds

Helps root growth, by making it easy for roots to travel through the soil

Use Plants to Grow Soil Carbon

Between 95 and 98% of plant minerals come from water, carbon dioxide and oxygen.

The remaining 5% come from the soil.

Photosynthesis produces the carbon compounds that plants need to grow and reproduce

The Carbon Gift

30-60% of the carbon and energy used by plants is deposited into the soil

Plant roots put thousand of tonnes per hectare of organic carbon and bio available minerals into the soil every year

Managing Plants to Increase Soil Carbon

Weeds/Plants managed properly:

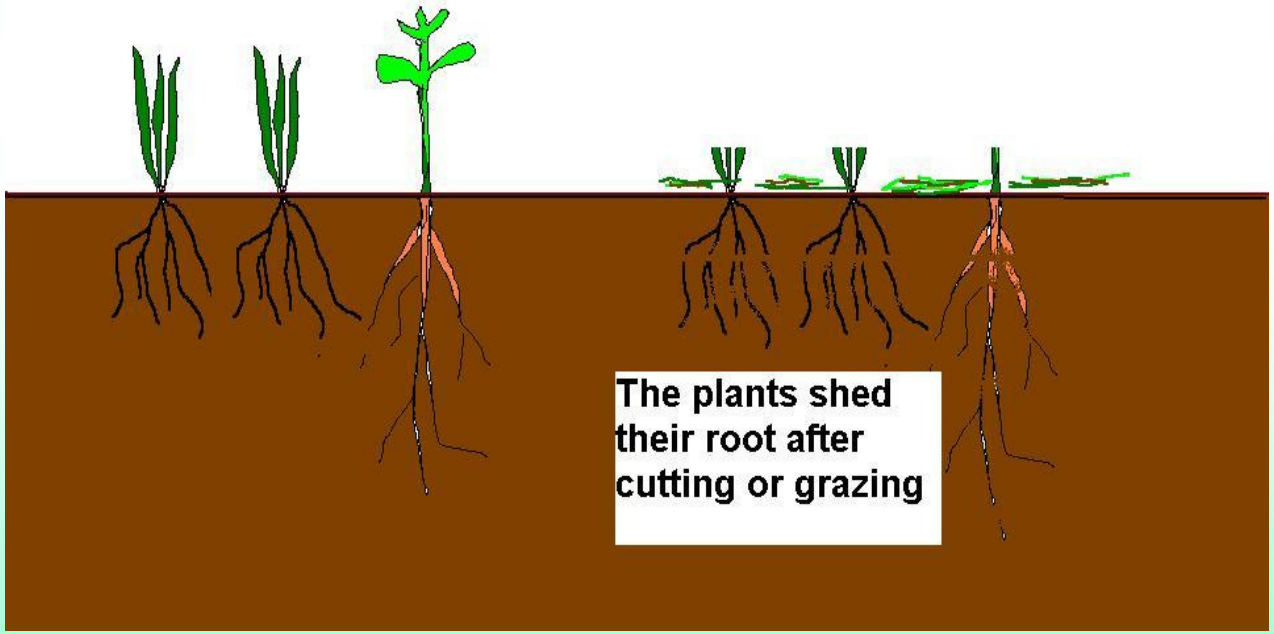
Residues are allowed to return to the soil = their nutrient removal from the soil is zero.

Add 30% to 60% of the organic compounds created through photosynthesis into the soil

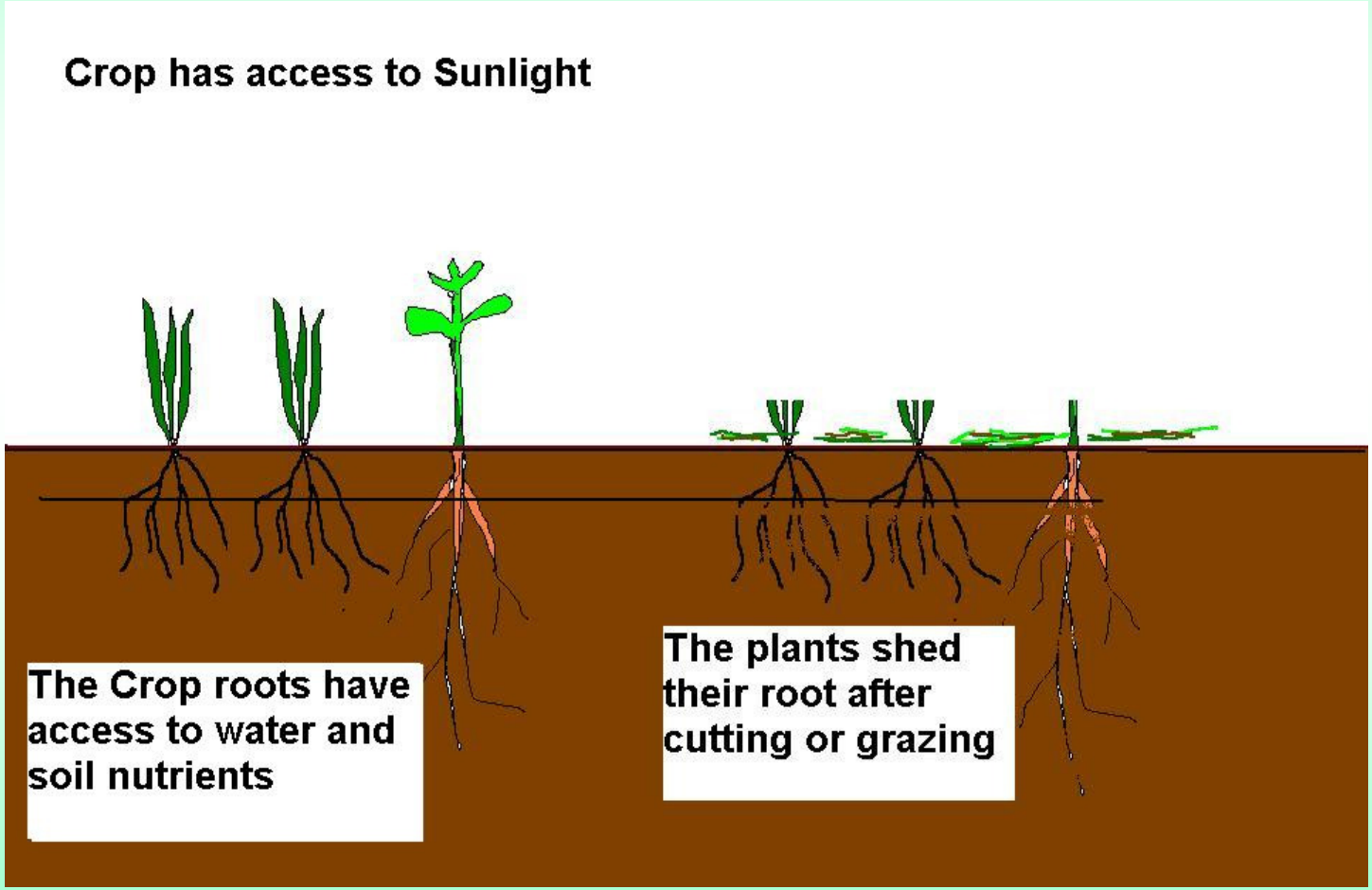
They are increasing soil fertility

MANAGING GROUND COVERS

Cut plants add organic carbon into the soil to feed the microorganisms and the crop



MANAGING GROUND COVERS



No Till without Herbicides

Precision Tillage Systems

- Reduce soil disturbance and erosion
- Precision weed control replaces herbicides

Use microorganisms to Convert Soil Carbon into Stable Forms

- Convert the carbon compounds that are readily oxidised into CO_2 into stable polymers
- The stable forms of soil carbon such as humus and glomalin are manufactured by microorganisms.
- Can last thousands of years in the soil.

Creating stable carbon

Composting uses microbes to build humus and other stable carbons.

Regular applications of compost and/or compost teas inoculate the soil with beneficial organisms that:

- build humus and other long lasting carbon polymers.
- continue working in the soil after compost applications,
- convert the carbon gifted by plants roots into stable forms.

Over time these species will predominate over the species that chew up carbon into CO_2

Conclusion

A large body of published science shows:
Organic agricultural systems can ameliorate Climate Change

- reduce greenhouse gases
- sequester carbon into the soil
- use less water
- more resilient in adverse weather
- achieve good yields of high quality produce.

Thank You