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SOIL BIOTA AND BIODIVERSITY

THE "ROOT" OF SUSTAINABLE DEVELOPMENT

Soil organisms contribute a wide range of essential services to the sustainable functioning of all ecosystems by acting as the primary driving agents of nutrient cycling; regulating the dynamics of soil organic matter, soil carbon sequestration and greenhouse gas emission; modifying soil physical structure and water regime; enhancing the amount and efficiency of nutrient acquisition by vegetation; and enhancing plant health. These services are not only essential to the functioning of natural ecosystems but also constitute an important resource for the sustainable management of agricultural systems.



SOIL IS ALIVE

Soils are one of the most poorly researched habitats on earth. Although not generally visible to the naked eye, soils are among the most diverse habitats and contain some of the most diverse assemblages of living organisms. The soil is one of nature's most complex ecosystems: it contains thousands of different organisms, which interact and contribute to the global cycles that make all life possible - the life support systems. Nowhere in nature are species so densely packed as in soil communities. For example, a single gram of soil may contain many millions of individuals and several thousand species of bacteria. Soil biota also includes the roots that grow in the soil and interact with other species above and below ground.



The species numbers, composition and diversity of a given soil depend on many factors, including aeration, temperature, acidity, moisture, nutrient content and organic substrate. However, the number and types of organisms vary from one system and environment to another and this is strongly influenced by land management practices.

Agricultural practices, including forestry, have significant positive and negative impacts on soil biota. An integrated management approach to agriculture should, *inter alia*, enhance the biological efficiency of soil processes with a view to optimizing soil productivity and crop production and protection.

There are many cases in the literature demonstrating beneficial and negative effects of management practices on soil biological activity and its impacts on agricultural productivity and agro-ecosystem sustainability.



For example:

- Earthworms, termites and other burrow-building soil organisms enhance soil productivity by mixing the upper soil layers, which redistributes nutrients, aerates the soil and increases surface water infiltration.
- Worldwide, soil is being lost at a rate 13 to 80 times faster than it is being formed. It takes about 500 years to form 25 mm of soil under agricultural conditions, and about 1000 years to form the same amount in forest habitats. The value of soil biota to soil formation on agricultural land worldwide has been estimated at US\$ 50 000 million per annum.
- Biological nitrogen fixation, the process by which some micro-organisms fix atmospheric nitrogen and make it available to the ecosystem, offers an economically attractive and ecologically sound means of reducing external nitrogen inputs and improving the quality and quantity of internal resources. Recent estimates indicate that global terrestrial biological N₂ fixation ranges between 100 and 290 million tonnes of N per year, of which 40-48 million tonnes per year is estimated to be biologically fixed in agricultural crops and fields.



Improvement in agricultural sustainability will require conservation and management of soil biodiversity.

KEY FACTS

- Soil organisms maintain critical processes such as carbon storage, nutrient cycling and plant species diversity.
- Soil biodiversity plays a role in soil fertility, soil rehabilitation and nutrient uptake by plants, biodegradation processes, reducing hazardous waste and control of pests through natural biocontrol.
- Soil organisms enhance crop productivity through:
 - recycling the basic nutrients required for all ecosystems, including nitrogen, phosphorus, potassium and calcium;
 - breaking down organic matter into humus, hence enhancing soil moisture retention and reducing leaching of nutrients; and
 - increasing soil porosity and hence water infiltration and thereby reducing surface water runoff and decreasing erosion.
- Ecologically, the soil biota is responsible for regulating several critical functions in soil. Excessive reduction in soil biodiversity, especially the loss of keystone species and/or species with unique functions may have cascading ecological effects leading to the long-term deterioration of soil fertility and the loss of agricultural productive capacity.

Learn more:
www.fao.org/ag/AGL/agll/soilbiod/default.htm



Further information about the work of FAO on biodiversity is available at:
www.fao.org/biodiversity