Cource: Rhizosphere Fauna (selective course)

Level one – Program Biotechnology

Title of Lecture number six 25/3/2020

Introduction to soil macrofauna (1)

By
Prof. Dr. Gad Hamada Hassan Rady

Plant Protection Department

Introduction to soil macrofauna

Soil macrofauna consists of a large number of different organisms that live on the soil surface, in the soil spaces (pores) and in the soil area near roots. Their way of living, their feedings habits, their movements into the soil, their excretions and their death have direct and indirect impacts on their habitat. The biological activities of soil macrofauna regulate soil processes and soil fertility to a significant extent.

The effects of soil macrofauna on soil can be divided into three classes: physical, chemical and biological effects. These effects are determined by the functional group involved in the process.

PHYSICAL ROLE OF SOIL MACROFAUNA

Five main physical effects of soil macrofauna can be highlighted:

- **macromixing**
- **micromixing**
- **gallery construction**
- **fragmentation**
- **aggregate formation.**

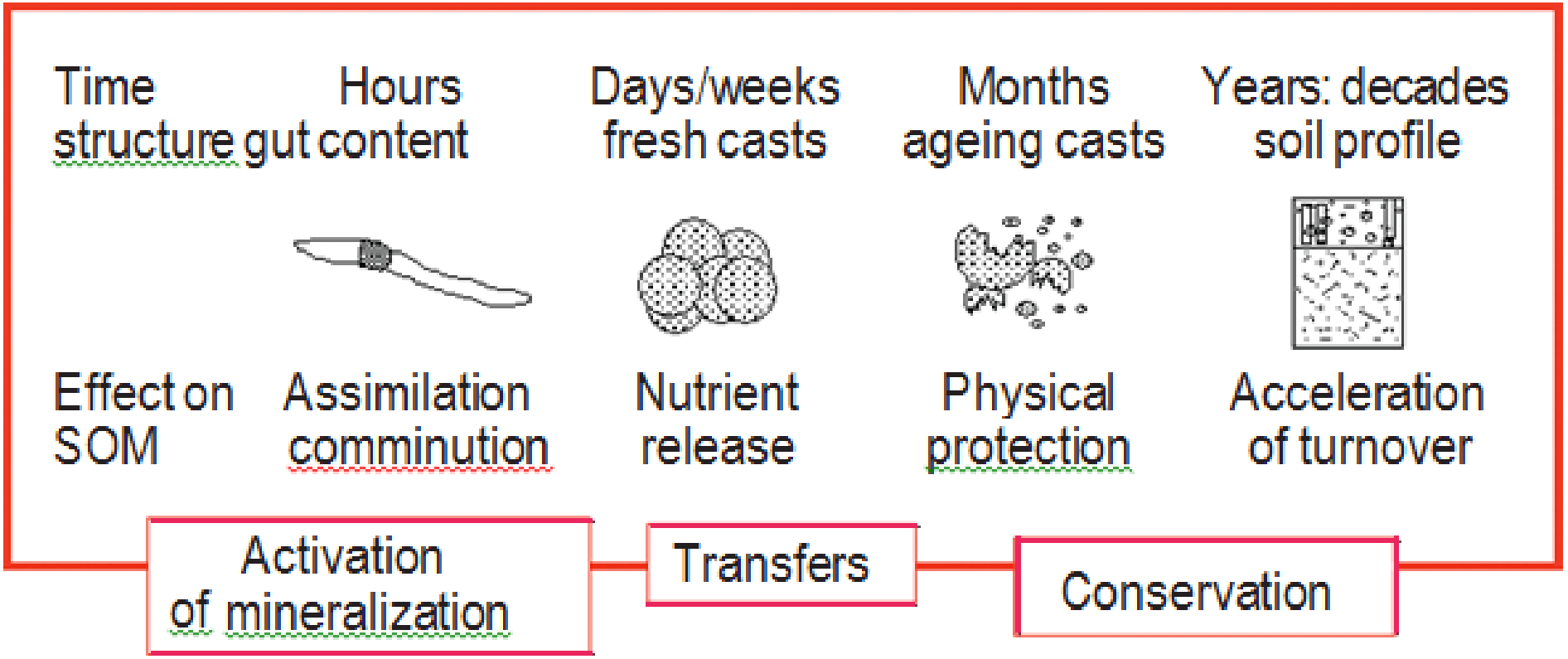
Ants, termites, earthworms and ground beetles can move an important quantity of soil, bringing back to the surface mineral matters from deeper horizons and burying the organic matter from the surface horizons, from litter and from excrements.

The macromixing activity of earthworms is of major importance to soils. It can be measured by the quantity of casts found on the soil surface. Earthworms can produce 40–250 tonnes of casts per hectare per year .

Some beetles (especially those of the subfamily Scarabeidae) are coprophagous – they are very efficient at incorporating and removing excrements that are on the soil surface.

FIGURE 3

Organic matter decomposition process regulated by earthworms



Micromixing

Other groups of soil macrofauna influence soil structure in a less spectacular way, but the micromixing that they realize is as important as macromixing. These organisms, mainly represented by Diptera larvae, have a more limited capacity to dig the soil. They stay on the soil surface where they realize a fundamental task for the incorporation of organic matter to soil. However, they can be carried into soil by leaching to a depth of up to 60 cm.

Gallery construction

Gallery (burrow) formation is very important for soil aeration and water flux. For example, earthworms and termites develop networks of galleries that improve large spaces in the soil macro-porosity by 20–100 percent .

Earthworms can burrow an estimated 400–500 m of galleries per square metre in grasslands. These galleries are denser in the top 40 cm and can represent up to 3 percent of the total soil volume. In these conditions, the waterholding capacity of soil can increase by 80 percent and water flux can be from four to ten times faster.

Earthworm activity is very important in agricultural soils with a high degree of compaction and a ploughing pan that prevents water flux. This situation decreases water infiltration and increases surface runoff and erosion. Earthworms pierce the ploughing pan, so improving water infiltration and offering new paths for root penetration. Termite excavation activity has a similar effect on soils (Gullan and Cranston, 1994), and in some cases can reduce the compaction of surface layers.

Where organic matter is present in the soil, the bioturbating and decomposing activities of termites can reduce soil compaction, increase its porosity and improve its water infiltration and retention capabilities. Such conditions encourage root penetration, vegetative diversity and the restoration of primary productivity .

Thus, galleries make up a draining system that collects rainwater and facilitates its flow. Water drags small material into these tunnels, which become the preferential paths for soil penetration for roots and leached clays. Galleries are also the soil penetration paths for other surface invertebrates with more limited burrowing capacities, e.g. very small earthworms, slugs, insect larvae, and mesofauna.

Litter fragmentation

The fragmentation of dead wood (lignin material), carcass and litter is one of the most important activities of soil fauna. It has a major effect on organic matter evolution in soil, conditioning the activity of bacteria, fungi and microfauna populations. Fragmentation is performed by phytosaprophagous animals (i.e. animals feeding on decayed plant material and dead animals).

Aggregate formation

After litter has been fragmented, it is easier for organic matter to be broken down into the stable form known as “humus”, and then to form soil aggregates

the clumping together of soil particles forming a crumbly healthy structure. Earthworms, termites, millipedes, centipedes and woodlice ingest soil particles with their food and contribute to aggregate formation by mixing organic and mineral matter in their gut.