Biological Diversity and Soil Fertility in organic farming

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The Architects- ecosystem engineers

- Macro fauna (earthworms, beetles, termites are the architects and builders of the soil eco system

  Functions in soil
- Presence of all termites, ants, woodlice, millipedes, centipedes, beetles, caterpillars and scorpions have roles in organic matter decomposition
- Aid in soil structure development enabling other groups to thrive
- Build passages, tunnels and pore networks for transport of materials
- Occurs as diverse group controlling activities of lower organisms
- Form a crucial link in the food web.
- Some are plant pests and parasites, while others activate microflora.

- Helps to fragment organic material, creating more surface area
- Speeds up mineralization process and release of nutrients for plants and microbes
- Earthworm casts and tunnels, termite mounds, ant heaps increase porosity and enhance the nutritional and moisture supply
- Part-time soil residents like moles, snakes, lizards, mice and rabbits perform valuable functions in maintaining soil biodiversity.
- Burrowing activity for food and shelter permits air and water movement

Earth worm – Facts

- Earthworms are master builders of fertile soils
- They reproduce at a rather slow rate.
- Life expectancy is five to eight years and is the most long-lived soil animals
- Play a prominent role in soil. fertility
- Earthworms produce 40 to 100 tonnes of valuable worm casts per hectare per year .
- Worm casts contains on an average five times more nitrogen, seven times more phosphorus,
- and eleven times more potassium than the surrounding soil.
- Mixture of organic substances with mineral soil particles, microorganisms and mucous secretions of earthworms
- Aids in stable crumb structure development preventing the soil from silting up,
- Enhance nutrient and water retaining capabilities of soil
- Loosen up heavy soils and make sandy soils more cohesive
- Earthworm burrows ensure a good aeration of the soil.

Earthworms, are the quiet master builders of soil fertility. Intensive tillage considerably reduces their populations.

Number of cocoons in the soil indicates favourable living conditions

- Stable channels of vertically burrowing earthworms improve the absorption and storage of water significantly
- Soils rich in earthworms absorb four to ten times the quantity of water than soils with fewer worms thus reducing surface runoff and erosion
- Worm burrows extend to over 900 m/sq m to one metre depth in un ploughed soils
- Earthworms break down up to 6 tonnes of dead organic material per hectare in a year Transportation of soil material from the subsoil to the topsoil helps rejuvenation
- Promote colonization and reproduction of useful soil bacteria and fungi in the earthworm passages and faeces.
- Degrades pathogenic organisms from diseased plant residues and plant parts added to the soil
- Over 90 % of worm burrows are inhabited with plant roots permitting deep penetration and nutrient absorption

Earth worm towers', clay–humus complexes and earthworm mucilage work rather visibly ‘towards soil cohesion

Protecting and promoting Earthworms

Tillage and mechanization

- Tillage in any form destroys earthworm activity
- Avoid soil disturbance during peak earthworm activity,
- Tillage of the soil in a dry seasons is considerably less harmful to earthworms, as they will
- remain in the deeper soil layers. Plant residues should be worked in only superficially

Crop rotation

- A long crop rotation with perennial and deep rooting catch crops green manure,varied harvest residues, offer abundant nourishment for earthworms.
- A plant cover, especially during monsoon may promote earthworms considerably.
- Soil-regeneration provided by the use of perennial legumes are most ideal earthworms.

Fertilizer supplements

- A balanced and well cared for soil is beneficial to plants and earthworms.
- Slightly rotted manure or compost is usually more helpful than fresh manure to build soil
- organic matter, to reduce weeds, achieve long term nutrient supply.
- Organic fertilizer and manure should only be worked in superficially.
- Dilution and processing of liquid manure has a positive effect on earthworms.
- Regular liming is important, as most earthworms avoid soils with a pH below 5,5.

Earth worm Towers

- Are devices installed in cultivation plots to build up the population by providing ideal conditions foe growth and multiplication

Materials needed

- Farm waste including kitchen waste
- PVC pipe
- PVC pipe cover or terracotta pot, preferably without holes
- Drill with larger sized drill bit
- Worms – Indigenous or Species used for vermicomposting

Fabrication of a Worm Tower

- First, cut the PVC to the length that you want. Remember worms are surface creatures and prefer surface soils
- On each pipe, drill holes along one end. The drilled end will be buried into the ground.
- Dig your ground deep enough to cover all of the predrilled holes on your pipe,(6-8 inches)
- Worms are surface creatures, so burying the PVC pipes deep is not optimal.
- Place PVC into the hole made in the ground and fix it straight with the surrounding soil.
- Add a layer of old leaves then food scraps and FYM
- Put alternate layer of dried leaves food waste and manure
- Top layer has to be dried leaves.
- Add the worms to the tube
- Place the cover on the top of pipe to protect from outside elements
- Worms multiply and move on to the soil

Bacteria and fungi – underrated helpers

- One gram of soil contains hundreds of millions of bacteria and hundreds of metres of fungal hyphae.
- Microorganisms capable of breaking down plant and animal material into its basic components.
- They not only regulate nutrient cycles by breaking down organic matter, but are also capable of fixing nitrogen from the air and forming symbiosis with plants.
- Bacteria and fungi are part of almost all mineralization processes in the soil.
- Mycorrhyzae form a symbiotic relationship with plants, infest the plant root, and open
- up an extended soil area for the latter.
- Mycorrhyzal fungi contribute further positive properties for thesoil structure.
- They enable an exchange of substances between plants which are connected by them.
- Cultivation disrupts the fungal network in thesoil but the mycelium regenerates

Mesofauna (collembola, mites)

- Important role in the carbon cycle
- Easily vulnerable to climate change.
- Feed on a wide range of materials including other soil animals, microorganisms,
- Live on decaying plant material, fungi, algae, lichen, spores, and pollen.
- Feaecal matter in the pores add to the fertility of the soil

A Spring tail (Collembola) key agent in Organic matter decomposition

Perceiving Soil fertility in the Organic context

Observing the plants

- The cultivated plant is always the best indicator of the soil fertility
- A healthily plant growth over the years,with out any pest and disesses indicates a fertile soil

Interpreting the soil surface

- The soil surface already is an indicator of the state of the underlying soil.
- Surface vegetation cover, reveals crumb structure due to biological activity
- Also prevents surface sealing,crust formation and erosion
- Crusty and eroded soils are indicative of poor fertility

Observing the soil life

- The activity of earthworms and even smaller species, such as springtails, can be recognized by their exit holes on the soil surface.
- Earthworm faeces on the soil surface, too indicate a high activity
- Observed mainly during monsoon season
- Presence of decomposing organic matter indicates intense microbial activity

Smelling the soil

- Fertile soil smells nice, not repelling can compare the smell of forest soil or field margins.
- If the soil smells of rot, something is wrong.
- Roots also have an inherent odour which derives from root exudates
- Leguminous plants have a pleasant smell.
- Earthworms can often be found in the surrounding area
- Spade test - Manual method for assessing the soil, structure and presence of sub surface hard pan

Soil Probe (Penetrometer)

- The soil probe is an iron bar that sometimes comes with a pressure-measurement display
- Probe measures the penetration resistance of the soil, i.e.bulk density
- Depth of the hard layer also displayed.
- Analysis of chemical parameters
- Estimation of pH and plant nutrient elements has to be carried out
- Deficiencies of major and secondary nutrients to be supplied through organic supplements
- Corrections for acidity has to be done by liming
- Micro nutrient deficiency can be corrected through permissible inorganic supplements

Preserving and improving soil fertility

Soil Organic Matter benefits and management

- Important contributing factor for the improvement of soil problems and crucial for soil fertility
- Organic matter tends to deposit itself as layer on the surfaces of crumbs.
- Bigger lumps tend to break again so that smaller crumbs remain stable
- Organic matter covers the crumbs and protects from further breakdown during rains
- Soil experiences less capping/siltation.
- Organic matter lightens heavy soils, and makes it cultivable and also makes light soils more cohesive with clay-humus-complexes!
- In crumbly soils, there is more of infiltration, lesser erosion more root penetration into deeper layers and has a better water balance
- More organic matter means more nourishment for bacteria, fungi and other organisms in soil

- Green manures decays rapidly releasing nutrients which is nourish soil organisms.
- Lignified plant materials and dead micro organisms,on the other hand, take longer time to decay. and forms clay-humus complex,
- Heavy and humid region soils tend to have more organic matter as compared to light textured arid to semiarid soils
- Replenishment of Organic matter can be through addition of green manures and organic manures

The challenge of soil fatigue

- Continuous cultivation of a species or a group of species of legumes can cause soil fatigue
- Soil fatigue may be caused by an accumulation of pathogenic microbes, or by a one-sided impoverishment of the soils regarding essential nutrients, or toxins exuded by plants (allelopathy),
- Problems are specific to individual farms by a bad soil structure, or by a combination of factors.

Reference

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Thank You