Soil Fertility in Organic Agriculture

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Concept of the nature of soil fertility

- Early days soil fertility was conceived merely based on nutrient levels of the surface soil
- Attempts were made to elucidate chemical structure of organic matter and soil fertility
- Focus now is on the availability of nutrients, the C/N ratio, mineralization, recycling /release of nutrients
- Hot water extracted nutrients of the soil is a measure of plant available nutrients
- The microbiological biomass

Concept of soil as an ecosystem

- Soil is comprised of organic matter, minerals, gases, liquids, and organisms that operate together as an ecosystem that supports life
- Soil ecosystem, functions as dynamic interaction of the abiotic and biotic components and is dependent on major key factors like moisture, light etc.
- A change in this balanced system, cause impairments in soil functions which are strictly dependent on soil structure and biodiversity

Soil Quality in relation to soil functions

- Soil quality is the sum total of all socially valued function of soil

Functions associated with soils

- **Production function**:- Yields that suit local conditions.
- **Transformation function**: Nutrients are efficiently turned into yield.
- **Habitat function**: Living space for an active and diverse flora and fauna.
- **Degradation function**: Degradation/transformation of plant and animal residues,
- **Self-regulation function**: No danger of being permanently thrown off its healthy balance e.g. efficiently suppressing soil pathogens which affect crops
- **Filtering, buffering and storage function**: Retaining and breaking down harmful substances/pollutants to non toxic forms which do not affect crops.
- Sequestration of carbon

Soil fertility management in organic farming

- The enhancement of soil fertility was crucial even to the pioneers of organic farming
- Organic Agriculture depends mostly on the natural fertility of the soil
- Decline in fertility by various processes like erosion, or nutrient depletion by crops
- Replenishment of fertility is mostly through ecological means and organic supplements

Attributes of soil fertility

- Fertility is the combined effect of the soil physical, chemical and biological characteristics
- Assessment of soil fertility is very complex
- Cannot be assessed or quantified by a single measurement

Physical properties

- Can be identified by a spade test
- Physically sound soil offers living space and sufficient air for respiration all soil macro, micro fauna and plant roots.
- Soil with good physical condition should have favorable loam to clay loam texture permits stabilization of organic matter and aggregate stability
- Good aggregate stability promotes better water infiltration and air exchange
- Favourable available water storage capacity to meet water needs of the plants and soil fauna
- foraging of plant roots and good water infiltration
- Compaction in the surface and subsurface layers has negative impact on all the above properties
- Germination of seeds is impeded in soils with surface crust (Ref Cornel p. 28)
- Compaction measured in field using a penetrometer
- Expressed as Psi (Pounds per square inch)
- Plant roots cannot penetrate at penetration values greater than 300 psi

Organic matter content and soil properties

- OM has great impacts on the physical, chemical and biological properties of the soil
- Contributes to soil aggregation, water and nutrient holding capacity
- Provides nutrients and energy to the plant and soil microbial communities,
- Increasing the percent organic matter in the soil takes time and patience.
- It is unlikely that a single incorporation of a green manure or compost will noticeably increase the percent organic matter.
- However repeated use of organic amendments in combination with reduced tillage will build soil organic matter levels.
- Active carbon is particulate organic matter that is readily available and serves as an indicator of soil organic matter content
- Serves as a readily available carbon and energy source for the soil microbial community
- Addition of fresh and easily digestible organic matter Improves soil aggregate stability, nutrient cycling/mineralization, increased microbial activity and diversity

- Addition of more stable organic matter such as compost improve water infiltration and retention, nutrient adsorption thus preventing leaching
- Organic matter supplements through crop rotation, cover crops, green manures, and composts have a major impact on the population of microbes and diversity
- Controls soil borne pathogens, plant-parasitic nematodes and other pests.
- Plants differ in their efficiency to produce compoumds that inhibit or suppress pests Stimulates microbial communities that are antagonistic or parasitic to crop pests.
- Produce allelopathic compounds that inhibit or have positive influence on a plant

Chemical qualities

- Should have a favorable pH and sufficient levels of all nutrients (macro, secondary and micro) required for the plant
- Well balanced nutrient levels and organic compounds are a requisite for favorable for growth and nourishment of a complex of plant and soil organism.
- Complex metabolites of different organisms enhance the plant's immune response
- Excreted nutrients by organisms returned to soil contribute to the fertility

Biological qualities

- Life forms of the soil, mainly involved in transforming/recycling activity and release of nutrients
- Cohabitations are robust with a variety of forms which maintain a self-regulating ecological balance,
- All the animals, plants and microorganisms work symbiotically.
- Management of the biological factor involves providing conducive environment for their growth so as to maintain an appropriate balance

Root Health

- Healthy roots most essential for vigorous plant growth and high yield
- Quality and function of the roots indicated by size, color, texture and the absence of symptoms of damage by root pathogens including the fungi Fusarium, Pythium, Rhizoctonia, Thielaviopsis, and plant-parasitic nematodes
- Healthy roots also contribute to the active fraction of soil organic matter, promote rhizosphere microbial communities, contribute to increased aggregation, and reduced bulk density and soil compaction.

Reference

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Thank You