OPTIMIZING SOIL & PLANT HEALTH IN AGRI-FOOD PRODUCTION

Module 2

Regenerative Agriculture - its benefits and innovations

Réseau Agroalimentaire de l'Est ontarien
Eastern Ontario Agri-Food Network

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MODULES

1. INTRODUCTION TO SOIL HEALTH
2. SOIL TESTING & ANALYSIS
3. BUILDING HEALTHY SOIL WITH COMPOSTING
4. PREVENTING MOLD & FUNGAL DESEASES
5. NUTRIENT MANAGEMENT & FERTILIZATION
6. ORGANIC SOIL AMENDMENTS & ALTERNATIVES
7. CROP ROTATION & PLANT PAIRING
8. WATER MANAGEMENT & IRRIGATION PRACTICES
9. INTEGRATED PEST MANAGEMENT (IPM)
10. SOIL CONSERVATION & SUSTAINABLE PRACTICES

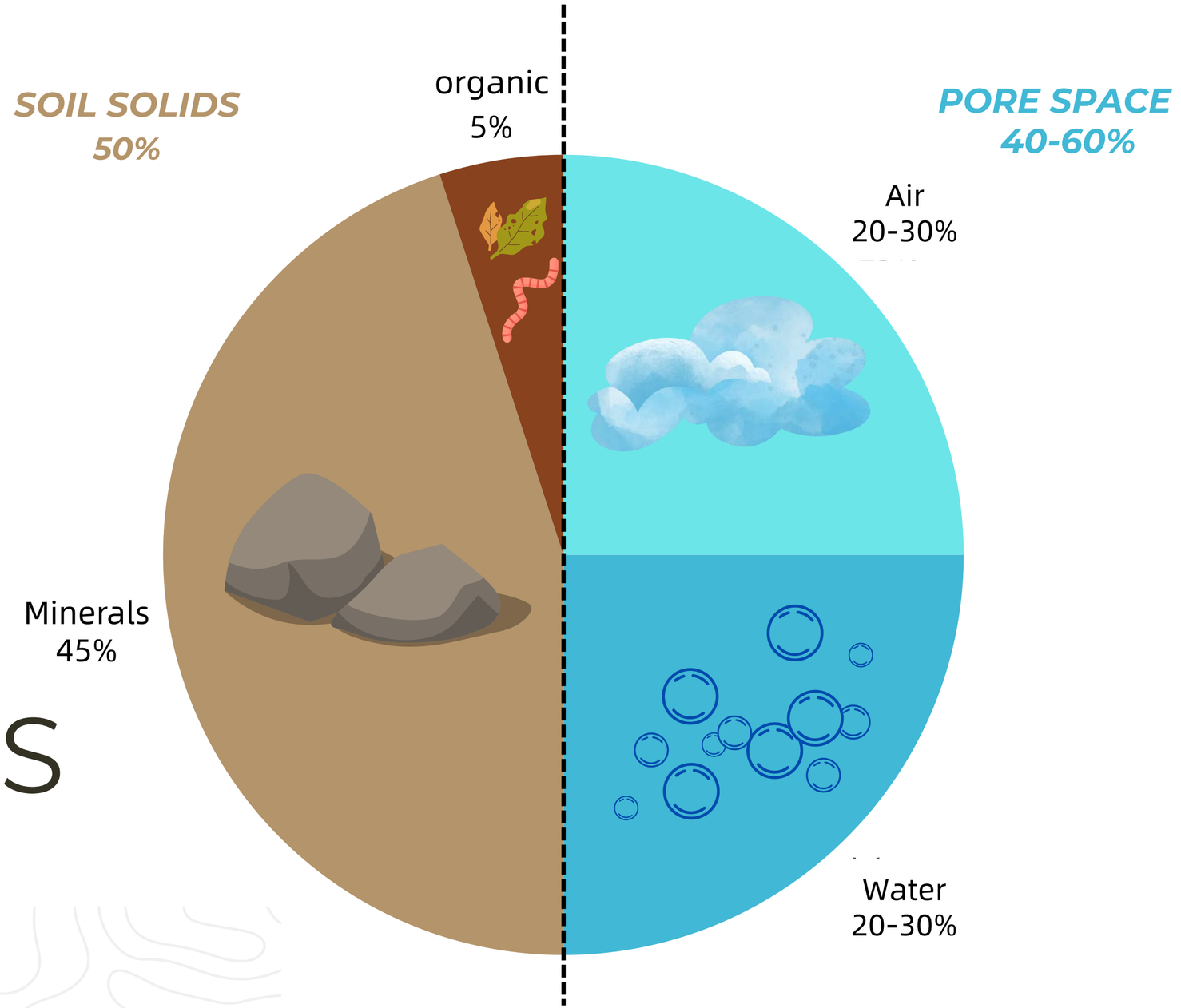
MODULE 2:

SOIL TESTING & ANALYSIS

- Soil Components
- Soil Types
- Understanding Soil Composition
- Informed Decision-making
- Continuous Testing
- Conclusion

1) SOIL COMPONENTS

IDEAL SOIL COMPONENTS



1) SOIL COMPONENTS

Minerals

- break down & chemical alteration of rock through natural elements (*mechanical weathering*: water, wind, frost weathering; *biological weathering*: roots; *chemical weathering*: oxidation, hydrolysis, dissolution)
- rocks degrade > release of essential minerals into the soil
- essential minerals: carbon, nitrogen, potassium, calcium, phosphorus, sulfur, manganese
- soil texture: sand, silt, clay

Organic

- organic matter = dead & decaying material > food for microorganisms
- add nutrients & minerals to soil, main source of essential minerals
- carbon sink
- 3.5 % considered ‘decent soil’; 5% & more can be achieved
- 1 % of soil: microorganisms (fungi, bacteria, nematodes, worms, algae)

Air

- air pockets for roots & soil life > provides oxygen
- soil air high in CO2, less oxygen compared to atmosphere
- ‘room’ for roots to grow deeper

Water

- essential to support breakdown of organic matter
- minerals & nutrients dissolved in water
- roots take up water & minerals
- water essential for soil life

2) SOIL TYPES

Sand

big soil particles

drains quickly
lack of structure
lack of nutrient

slightly granular, rough & abrasive touch, doesn't hold well together

Silt

medium soil particles

drains well & disperses water
lack of structure
contains nutrient

smooth & velvety to the touch, malleable when wet

Clay

small soil particles

drains poorly
contains structure
contains nutrient

hard when dry, muddy when wet, firm sticky ball

2) SOIL TYPES

Loamy Soil - the ’ideal’ soil

- found in nature: river valleys, flood plains, forests, grassland
- balanced mix of sand, silt & clay
- ‘ideal soil’ - ideal structure to retain moisture, allows adequate drainage
- dark color due to high % of organic matter

3) UNDERSTANDING SOIL COMPOSITION

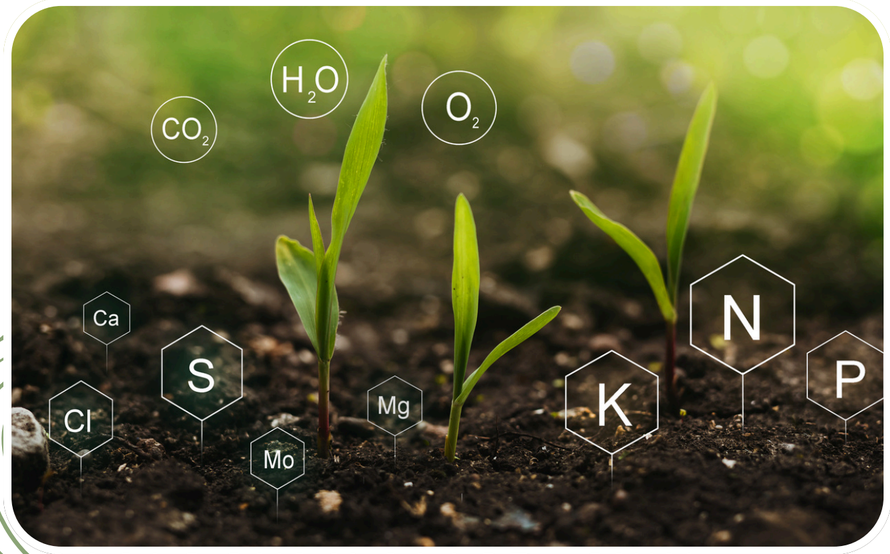
Physical & Chemical Properties of Soil

- pH
- nutrient levels (nitrogen, phosphorus, potassium; NPK)
- organic matter content
- texture
- microbial activity

PH

- ideal range: 6-7.5 (neutral to slightly acidic)
- testing: electronic pH meters, test strips/paper
- when to test: fall (amendments e.g. cover crops, sulfur, lime)
- indicator plants: acidic soil - heather, daisies, wood sorrel, bracken
  alkaline soil - betony, docks, meadow cranesbill
- DIY: testing with vinegar & baking soda, red cabbage

NUTRIENTS (NPK)



Nitrogen (N)

- N essential to produce proteins, for photosynthesis & reproduction
- indicator plants (N-rich): bramble, nettle, chickweed, dandelion

Phosphorus (P)

- P vital for photosynthesis & plant growth
- P deficiency: stunted growth, dark or purplish leaves, small & fewer leaves

Potassium (K)

- K vital for plant metabolism & development
- K deficiency: yellowing of older leaves, leaves curl under

> home testing kits & laboratories

ORGANIC MATTER

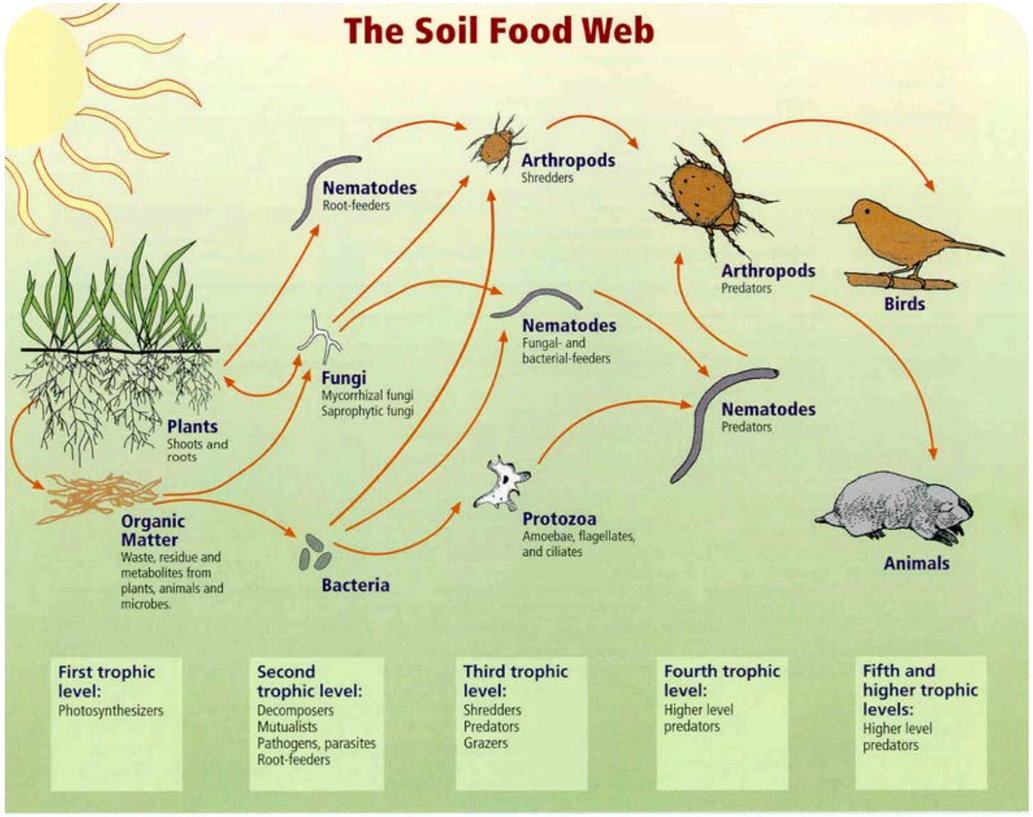
- dead & decaying material > food for soil life
- natural: animal feces, leaves, decaying wood
- soil fertility & water retention
- reservoir for essential nutrients, slow release while decomposing, supporting plant growth
- indicators for high % of organic matter: crumbly structure, rich dark brown color, rich forestry smell, lots of soil life like earthworms & fungi

> Particulate or layer method (DIY mason jar test)
> soil organic matter test (laboratory)

TEXTURE

- **Compaction**: heavy machinery, cattle > limited space between particles, limited water & air flow > flooding, limited plant growth
- **Crusting:** soil separated by heavy rain & following heat, soil surface hardens when rapidly dried > hard to establish seedling
- **Poor drainage**: water logged soil, drowns roots; indicator plants: butterbur, creeping buttercup, marsh marigold
- **Hardpan**: dense cement like layer in soil > below ground 2-4ft > very poor water absorption, poor rooting possibilities for plants; takes long time to form (naturally or man-made)

MICROBIAL ACTIVITY



Relationships between soil food web, plants, organic matter, and birds and mammals
Image courtesy of USDA Natural Resources Conservation Service
http://soils.usda.gov/sqi/soil_quality/soil_biology/soil_food_web.html.

- organic matter > food source for beneficial soil microorganisms
- key role in nutrient cycling & disease suppression
- microbes make nutrients available to plants
- fungi: critical role in global carbon cycle, produce plant hormones, trap harmful nematodes
- loosen soil > increase air & water pockets (e.g. earthworms)
- microbial activity can be raised by increasing of organic matter

4) INFORMED DECISION MAKING

- insights gained from soil tests > data driven decisions regarding soil amendments, fertilizer application & crop selection

Examples:

- Nitrogen deficiency: application of N-rich fertilizer e.g. ammonium-nitrate OR N-fixing crops like peas, beans, clover
- Compacted or Clay soil: cover crop e.g. daikon or tillage radish, add organic matter, mulching

ECONOMIC EFFICIENCY

- growers can optimize *input cost*, *reduce waste* & *enhance profitability*
- can reduce use of fertilizers & amendments > *less expenses & environmental damage*
- *improve yields & plant health*

5) CONTINOUS TESTING

Dynamic Soil Environment

weather patterns, crop rotation, farming practices > change soil properties over time

Nutrient Cycling

nutrient availability

understanding seasonal nutrient cycling > planning effective fertilization strategies

Environmental Stewardship

mitigate environmental impacts of fertilizers & amendments (conventional farming practices)

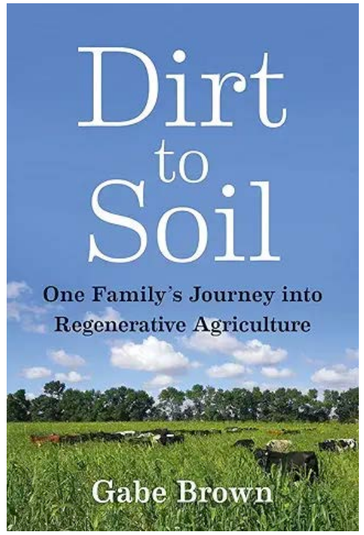
Regulatory Complience

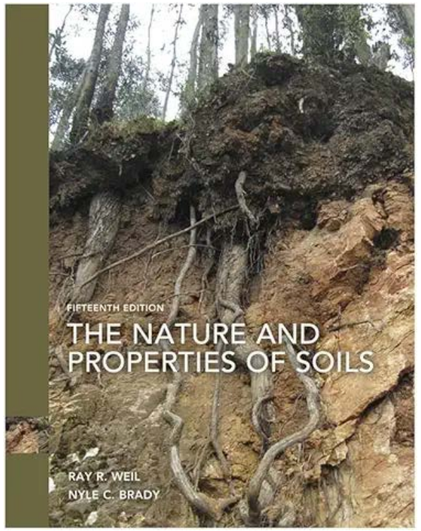
ensures compliance with regulatory bodies

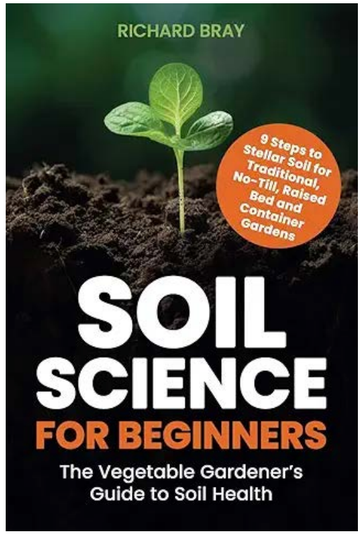
6) CONCLUSION

- Soil testing & analysis vital for establishing a successful agri-food production system
- understanding soil composition > informed decision making . continuously monitoring soil health > optimizing plant growth & ensuring economic efficiency & environmental stewardship
- recognizing importance of organic matter > regenerative agriculture practices

RESOURCES







DIY Soil Testing:

www.thespruce.com/how-to-test-soil-acidity-alkalinity-without-a-test-kit-1388584

MI Gardener Mason Jar Method: https://youtu.be/wX22U3d-nwo

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THANK YOU