

# Food, Soil, Agriculture & Pest Management

Lecture 9

ENHL 220

# Outline

1- Food Production

2- The Soil

3- Soil problems

4- Sustainable Agriculture

5- Protecting Food Resources: Pest management

# 1- Food Production

# 1- Food Production (Cont'd)

- Two types of Agriculture for food production exist. These are:

1- Traditional Agriculture or Low Input Agriculture

2- Industrial Agriculture or High Input Agriculture

# 1- Food Production (Cont'd)

- 1- Traditional Agriculture:
  - ✓ “Traditional Agriculture” or “Low Input Agriculture”.
  - ✓ usually polyculture.
  - ✓ provide about one fifth of the world’s food supply.
  - ✓ uses about three forth of the world’s cultivated land.

# 1- Food Production (Cont'd)

- ✓ consist of 2 main types. These are:
  - 1- Traditional Subsistence Agriculture: “production of enough crop or livestock for a farm family’s survival & in good years a surplus to sell or put aside for hard times” (Miller, 2009/7).
  - 2- Traditional Intensive Agriculture: “production of enough food for a farm family’s survival & a surplus that can be sold. This type uses higher inputs of labor, fertilizers and water than the previous type” (Miller, 2009/7).

# 1- Food Production (Cont'd)

- 2- Industrial Agriculture (industrial food production):
  - ✓ “Industrial Agriculture” or “High-Input Agriculture”.
  - ✓ “the use of large amounts of fossil fuel energy, water, commercial fertilizers, & pesticides to produce large quantities of single crops (monocultures) & livestock animals for sale” (Miller, 2009/7).
  - ✓ produces about 80% (4 fifth) of the world’s food supply.
  - ✓ practiced on one forth of croplands, mainly in developed countries.

# 1- Food Production (Cont'd)

- ✓ plantation agriculture → one form of industrialized agriculture  
→ cash crops growing → based on growing specialized crops  
(bananas, coffee...) in developing countries primarily for sale in  
the developed countries → decreasing biodiversity as forests  
are cleared to provide land for plantation (main  
disadvantages).
- ✓ Finally: agricultural sector as a whole → largest industry &  
most environmentally harmful industry.



# 1- Food Production (Cont'd)

- “Interplanting”:
  - ✓ “simultaneously growing a variety of crops on the same plot” (Miller, 2009/7).
  - ✓ some benefits: insecticides & herbicides are less needed - less fertilizers - crop diversity reduces the chance of losing most or all of the year’s food supply.

# 1- Food Production (Cont'd)

- ✓ there are four types of interplanting. These are:
  - 1- Polyvarietal Cultivation: planting a plot with several genetic varieties of the same crop.
  - 2- Intercropping: two or more different crops are grown at the same time on a plot (ex: a carbohydrate rich grain that uses soil nitrogen & a nitrogen-fixing legume plant that puts it back).
  - 3- Alley Cropping or Agroforestry: crops & trees are grown together.
  - Polyculture: many different plants are planted together

# 2- Soil

# 2- Soil

- Soil:
  - ✓ “a complex mixture of eroded rock, nutrients, decaying organic matter, water, air, & billions of living organisms” (Miller, 2009/7) (most are microscopic decomposers).
  - ✓ some main soil characteristics:
    - a slowly renewable resource
    - provides most of the nutrients needed for plants growth
    - helps purify water.
  - ✓ soil formation → begins when bedrock is broken down into rock fragments & particles by physical, chemical & biological processes called “weathering”.
  - ✓ Mature Soil: “soil that have developed over a long period of time” (Miller, 2009/7).

# 2- Soil

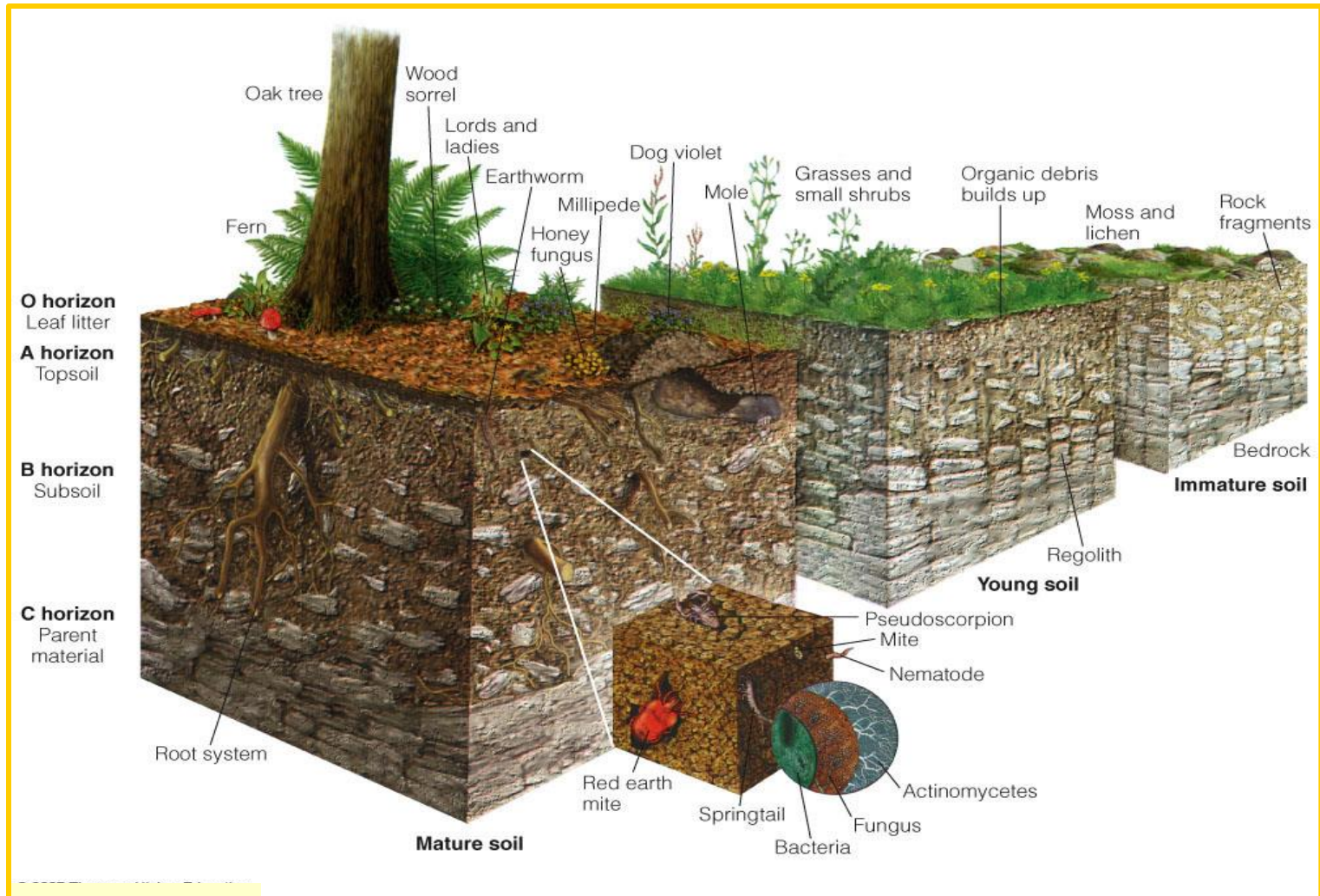


Figure 2: Soil Horizons or Layers (Miller, 2009/7)

## 2- Soil

- Layers in Mature Soil:
  - ✓ 1- O Horizon (surface litter layer):
    - consists mostly of freshly fallen undecomposed or partially decomposed leaves, crop & animal waste as well as bacteria, fungi earthworms and small insects...
  - ✓ 2- A Horizon (topsoil layer):
    - porous mixture of partially decomposed bodies of dead plants & animals called “humus”, inorganic material (clay, sand...) & bacteria, fungi earthworms and small insects.
    - fertile soil → thick topsoil layer with lots of humus.
  - ✓ 3- B Horizon (subsoil) & C Horizon (parent material):
    - contains most of the soil’s inorganic matter (clay, sand...) much of it transported from the A horizon.
    - the C horizon lies on a bed of un-weathered parent material (often bedrock).

# 2- Soil

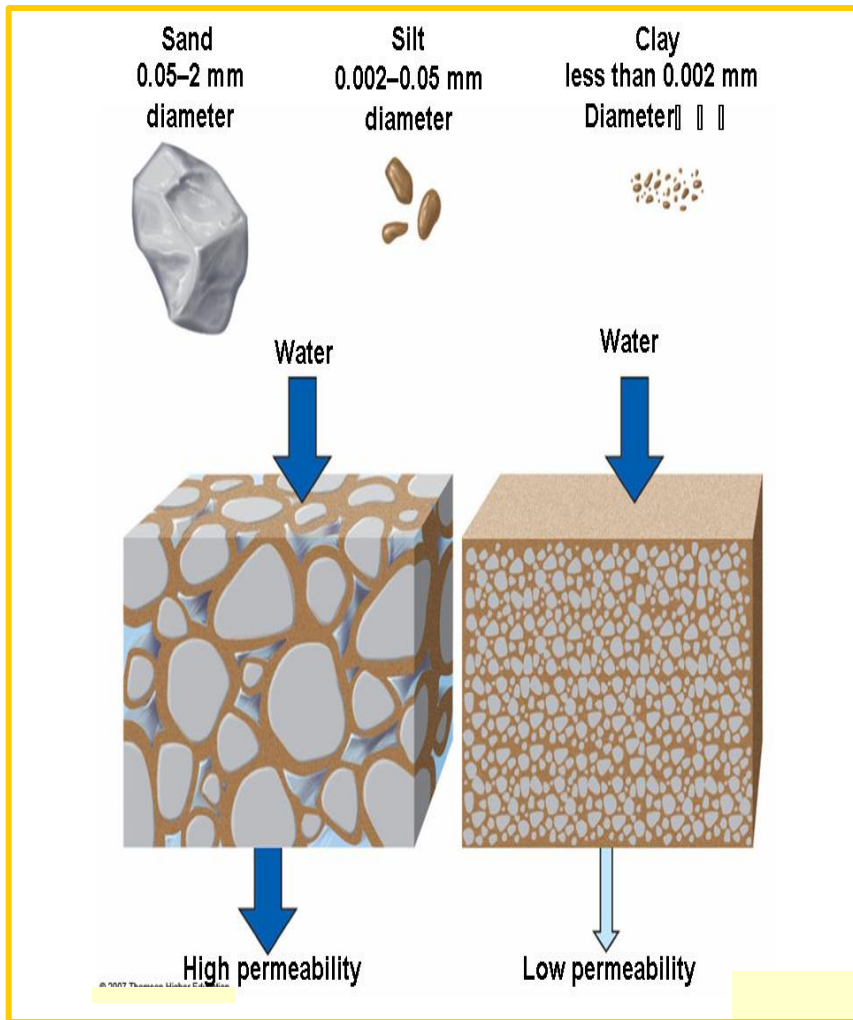


Figure 3: Soil Texture & Permeability (Miller, 2009/7)

- Soil Texture:
  - ✓ determined by the relative amounts of the different sizes & types of the soil particles.
- Infiltration:
  - ✓ “downward movement of water through the soil” (Miller, 2009/7).
- Leaching:
  - ✓ “process in which various chemicals in the upper layers of the soil are dissolved and carried to lower layers and sometimes to groundwater” (Miller, 2009/7).

# 3- Soil Problems



# 3- Soil Problems

- Some main soil problem are:
  - 1- Soil erosion: “the movement of the soil components, especially surface litter & top soil, from one place to another, by the action of wind or water” (Miller, 2009/7).
  - 2- Desertification: “occurs when the productive potential of drylands falls by 10% or more because of a combination of natural climate change that causes prolonged drought & human activities that reduce or degrade topsoil” (Miller, 2007).
  - 3- Salinization: “the process of gradual salt accumulation in the upper soil layer as a result of repeated annual application of irrigation water in dry climates resulting in an inability of the soil to support plant growth” (Miller, 2009/7).
  - 4- Waterlogging: “saturation of soil with irrigation water or excessive precipitation so that the water table rise close to the surface” (Miller, 2009/7).

# 4- Sustainable Agriculture

# 4- Sustainable Agriculture (Cont'd)

- Sustainable Agriculture: “Method of growing crops and raising livestock based on organic fertilizers, soil conservation, water conservation, biological (non chemical) pest control and minimum use of fossil fuel” (Miller, 2009/7)
- Soil Conservation → most important aspect for sustainable agriculture :
- ✓ “using a variety of ways to **reduce soil erosion & restore soil fertility**, mostly by keeping the soil covered with vegetation” (Miller, 2009/7).

# 4- Sustainable Agriculture (Cont'd)

- ✓ Reducing soil erosion → 6 main methods to reduce soil erosion.  
These are:

- 1- Conservation-Tillage Farming:
  - definition → crop cultivation (with special tillers & planting machines) in which the soil is disturbed little (minimum-tillage farming) or not at all (no tillage farming).
  - benefit → reduce soil erosion.

# 4- Sustainable Agriculture (Cont'd)

- o 2-Terracing:
  - definition → “a method to grow food on steep slopes without depleting topsoil” (Miller, 2009/7) .
  - done by converting the steeply sloped land into a series of broad, nearly level terraces that run across the land’s contours.
  - benefit → retains water for crops at each level (way for water conservation)& reduces soil erosion by controlling runoff.
  
- o 3- Contour Farming:
  - definition → “plowing & planting crops in rows across the slope of the land rather than up & down” (Miller, 2009/7).
  - benefit → each row acts as a small damn to help hold the soil & slow water runoff.



# 4- Sustainable Agriculture (Cont'd)

- 4- Strip Cropping:
  - definition → “planting alternating strips of a row crop (ex: corn, cotton) & another crop that completely covers the soil” (Miller, 2009/7) (ex: grass, grass-legume mixture).
  - benefit → the crop cover traps the soil that erodes from the row crop & catches & reduces water runoff.
  
- 5- Alley Cropping or Agroforestry:
  - definition → “planting one or more crops together in strips or alleys between trees which provide shade” (Miller, 2009/7).
  - benefit → reduces water loss from evaporation (way of water conservation) & helps retain & slowly release soil moisture
  
- 6- Windbreakers or shelterbelts:
  - definition → planting trees around crop fields.
  - benefit → reduce wind erosion & help retain soil moisture.

# 4- Sustainable Agriculture (Cont'd)

- Restoring soil fertility → Fertilizers can help restore soil nutrients (that have been washed or leached or removed by repeated crop harvesting) → runoff of inorganic fertilizers → can cause water pollution.
- Three practices can help in restoring soil nutrients/fertility. These are:

# 4- Sustainable Agriculture (Cont'd)

- ✓ 1- Adding Organic Fertilizers:
  - three main types exist. These are:
    - 1.1- Animal Manure:
      - \* the dung & urine of cattle, horses, poultry & other farm animals.
      - \* it improves soil structure, adds organic nitrogen & stimulates beneficial soil bacteria & fungi.



# 4- Sustainable Agriculture (Cont'd)

- 1.2- Green Manure:
  - \* freshly cut or grown green vegetation plowed into the soil
  - \* improves soil structure, increases the organic material & humus available to the next crop.
- 1.3- Compost:
  - \* produced when microorganisms in soil break down organic matter such as leaves, food waste...in the presence of oxygen.
  - \* improves soil structure, adds organic material.

# 4- Sustainable Agriculture (Cont'd)

- ✓ 2- Adding Commercial Inorganic Fertilizers:
  - the active ingredients are inorganic compounds.
  - without adequate control → they may runoff the land and pollute the nearby water bodies.

# 4- Sustainable Agriculture (Cont'd)

## ✓ 3- Practicing Crop Rotation:

- planting a field or an area of a field with different crops from year to year → to reduce soil nutrient depletion.
- ex: a plant such as corn, tobacco & cotton → which removes large amounts of nitrogen from the soil is planted one year. The next year, a legume such as soybeans → which adds nitrogen to the soil is planted.
- this methods adds nutrients to the soil & reduces erosion by keeping the soil covered with vegetation.

# 4- Sustainable Agriculture

- Example of Sustainable Agriculture → Organic Farming → represents or is an important example of sustainable agriculture.
- Organic food → the food must be produced without using pesticides, synthetic fertilizers, antibiotics, growth hormones or genetic modifications.

# 4- Sustainable Agriculture (Cont'd)

Organic Farming: Is an ecological production management system which:

Some Important Organic Farming Principles:

- 1- Promotes ecological harmony, biodiversity & soil fertility.
- 2- Avoids the use of synthetic pesticides, herbicides, chemical fertilizers, growth hormones & gene manipulation → to protect health and the environment.
- 3- Uses clean irrigation water.

# 4- Sustainable Agriculture (Cont'd)

- 4- Tries to make use of *preventive* measures and the *environment's own system* to control disease, weed and insects through:
  - ✓ building up healthy soil → in healthy soil plants would resist more to diseases & insects.
  - ✓ selecting species that are well adapted to the climate → reduction of disease occurrence.
  - ✓ using mechanical ways to get rid of pests, if they exponentially increased (insect predators, traps...).
  - ✓ using certified non persistent pest controllers under very restricted conditions.

# 5- Protecting Food Resources: Pest Management

# 5- Protecting Food Resources: Pest Management

- Pest:
  - ✓ “any species that competes with us on food, invades gardens, destroys wood in houses, spread diseases, invades ecosystems or is simply a nuisance” (Miller, 2007).
- Controlling pests → 3 main ways:
  - ✓ 1- organisms found in nature control populations of most pest species as part of the earth’s free ecological services (ex: natural enemies - predators)



# 5- Protecting Food Resources: Pest Management

- ✓ 2- Pesticides:
  - “chemicals to kill or control populations of organisms we consider undesirable” (Miller, 2009/7) (natural or synthetic).
  - Vary in their persistence (the length of time they remain deadly in the environment).
  - common types include:
    - insecticides
    - herbicides
    - fungicides
    - rodenticides
  - pesticides can be:
    - Broad-Spectrum Agents → toxic to many species
    - Narrow-Spectrum Agents or Selective → toxic to one or a narrow group of organisms.

# 5- Protecting Food Resources: Pest Management (Cont'd)

- Conventional chemical pesticides have advantages & disadvantages. These are:
  - Advantages:  
save lives – increase food supply – profitable – work fast – usually safe if used properly.
  - Disadvantages:  
promotes genetic resistance – kill natural pest enemies – pollute the environment – harm wildlife and people.....

# 5- Protecting Food Resources: Pest Management (Cont'd)

- ✓ 3- Some more natural sustainable alternatives to chemical pesticides could be (cultivation, biological & ecological alternatives): Integrated pest management
  - fool the pest → not same crop yearly
  - use of insect perfumes → sex attractants → then trap
  - implant genetic resistance.
  - scald the pest → hot water spraying
  - introduce natural enemies

# Reference Book

## Reference Book:

Miller, T. & Spoolman, S (2009). *Living in the Environment* (16th ed.) Canada:  
Cengage Learning – Brooks/Cole

Co- reference: Same Book – Editions 15 & 17 & 18

**n.b: The material in this class presentation is mainly taken from the  
previously mentioned reference book.**

**(for educational purposes)**