

Soil Science – PSC104

# Topic 1: Introduction-Soil Properties and Composition

## Soil importance/influence on plant growth:

### Physical medium for plant growth

- Root depth (anchorage)
- Erosion
  - Surface
  - Sub-surface
- Access to water and nutrients-eg. Acid layer and compaction/hard soil layer limit plant growth

### Supply water

- Water infiltration-getting water into soil
  - Bigger channels/pores (air spaces), less of them, in soil move more water (aggregate=clod)
- Water storage
  - Smaller pores, more of them, hold more water
- Water drainage
  - Larger pores more drainage, faster drainage
  - Bad drainage=waterlogging, no air in soil

### Supply oxygen

- O<sub>2</sub> required for normal respiration in plants
- Soil must be able to allow air to diffuse to roots
- Microbes in soil require oxygen
- Red coloured soil (large amount of iron), large pores=oxygen in soil
- Gley=bluey green colour indicates a lack of oxygen in soil, dead microbes

### Provide stable chemical environment

- Essential elements
- No chemical problems-toxins, deficiencies
- Salinity
- pH

### Provide stable biological environment

- Home for living organisms-only some good

## Summary of soil influence on plant growth:

- Physical: roots, water, aeration
- Chemical: nutrients, pH, salinity
- Biological: function, limitations

## Soil influence on animal production:

- Quantity of pasture
  - Influenced by soil fertility
- Quality of pasture
  - Influenced by soil fertility
  - Soil low [N]=pasture low [N]=low protein content =low growth rate
- Disease/animal health
  - Liver fluke exist on waterlogged land
  - Sandy soil causes increased wear of animal teeth (especially in sheep)
  - Essential elements for animals:
    - Cobalt
    - Selenium
    - Iodine
    - Fluorine

### Soil influence on the environment:

- Soil erosion
  - Dust storms
  - Runoff into rivers (nutrients also runoff causing algae blooms)
  - Soil pollution (algae)

### Composition of soils:

- Determines suitability for growth
- 25% gas, 25% liquid, 50% solid

#### Soil solids (solid phase):

- Comprised of:
  - Inorganic materials
    - Do not contain carbon
    - Residual minerals from rocks
    - Minerals are formed as rocks are broken down
  - Organic materials
    - Has carbon in structure
    - Humus (resistant to breakdown)
    - Fresh (not yet decomposing) and decomposing
    - Living (worms and microbes) make up 1-5% of soil mass
- Properties:
  - Pores-smaller in compressed soil
  - Measure of compaction is bulk density
    - Increase in bulk density occurs after compaction
    - Bulk density ( $\rho_b$ )=mass of oven dry solids/total volume of soil (unit is Mg/m<sup>3</sup>-mega grams per cubic metre). Collect known volume of soil, oven dry it at 105 degrees for 24 hours.
    - Bulk density is the ratio of mass of oven dry solids to the total volume of soil including pores.
    - Oven dry is running oven at 105 degrees for 24 hours.
    - Average soil bulk density = 1.0-1.2 Mg/m<sup>3</sup>
    - Compacted soil bulk density > 1.7 Mg/m<sup>3</sup>
    - Organic soil bulk density = 0.3 Mg/m<sup>3</sup>
  - Compacted soils have less/smaller pores which effect water infiltration, drainage, etc.
  - Particle density (absolute density) is the ratio of mass of solids to the volume of solids (units are Mg/m<sup>3</sup>).
    - Particle density = mass of solids/volume of solids
    - Cannot be changed by management
    - Average soil particle density is 2.65 Mg/m<sup>3</sup>
    - Organic soil particle density may be around 1.3 Mg/m<sup>3</sup>
  - Total porosity is the proportion of the soil volume occupied by pores including those containing air and/or water (units are %).
    - As soil compacts, porosity decreases

#### Soil solution (liquid phase) comprised of:

- Water that is held in soil pores
- Dissolved materials (cations and anions=nutrients)

#### Soil air (gas phase) comprised of:

- Nitrogen gas (N<sub>2</sub>)
- Oxygen gas (O<sub>2</sub>)
- Carbon dioxide (CO<sub>2</sub>)-higher CO<sub>2</sub> concentration in soil than in air (harder for air to escape)