Theme 1: Forage production and pasture management

SOIL FERTILITY MANAGEMENT

Level 2 – Part I

Topic	Training & information Content
1.1	Planning of fodder/feed requirements for the dry season
1.2.1	Integrated soil fertility management I
1.2.2	Integrated soil fertility management II
1.3	Use of natural resources, compost making, farmyard manure, manure storage and use
1.4	Growing maize and sorghum for fodder and estimating time of harvest and yield
1.5	Brachiaria, Panicum, & Napier (cut and carry) grass management
1.6	Growing fodder trees and use of feed
1.7	Estimating of dry matter content, feeding value and yield of various fodder crops
1.8	Guidelines for Tropical pasture management and grazing management
1.9	Scaled mechanization of forage production and pasture management (harvesting practices)
1.10	Operating farm equipment and self-propelled tractors
1.11	Mechanization of feeding management
1.12	Economics of forage and pasture production

Soil Fertility Management (Level 2 – Part I)

Learning Activities - You will learn about:

- Key characteristics of Soil
- Soil organic matter, its benefits and sources
- Soil sample collection for analysis
- Plant nutrients

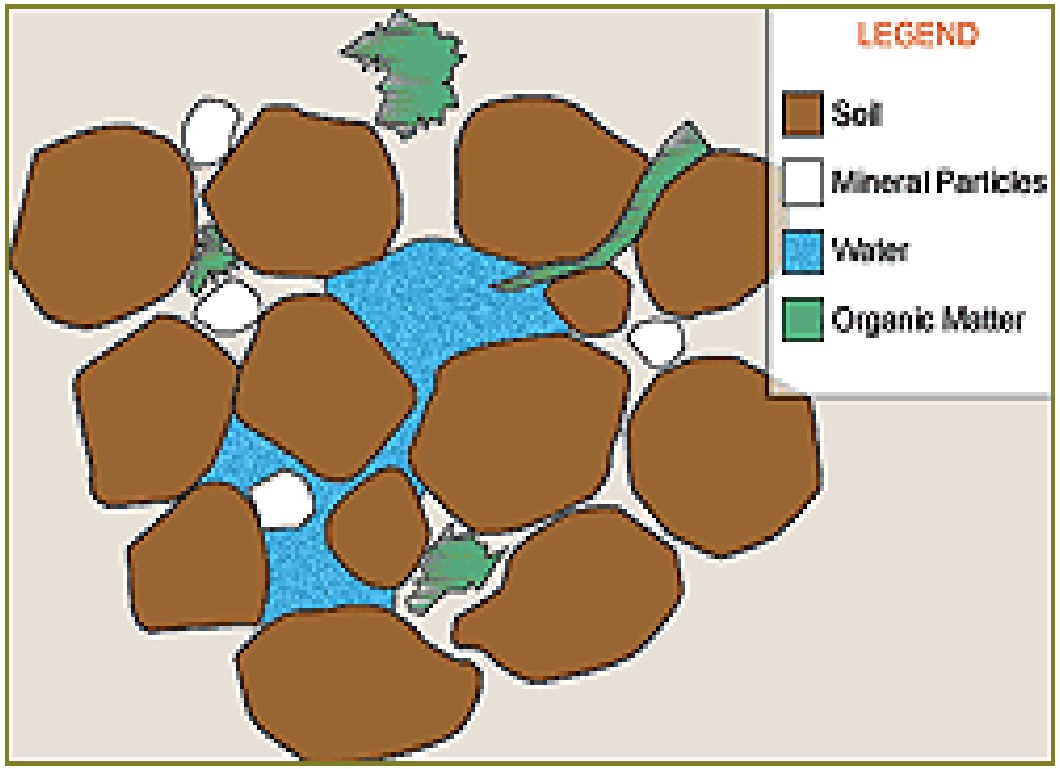
Soil Fertility Management (Level 2 – Part I)

Introduction

What is Soil?

- Soil can be living or dead. A living/healthy soil consists a mixture of:
  - Minerals (Sand, Silt and Clay)
  - Organic matter
  - Water
  - Oxygen

- Such soil is viable for crop farming. A dead/degraded soil cannot support crop production



Soil Fertility Management (Level 2 – Part I)

Characteristics of Soil

- Soil has three characteristics important for plant growth and productivity:
  i. Physical - e.g. Soil texture
  ii. Biological - e.g. Soil (micro-) organisms
  iii. Chemical - e.g. Soil pH, Nutrients.

i. Physical Characteristics

Soil Texture

- Soil texture determines whether soil is Sand, Silt and Clay.

Sandy soil

Loam

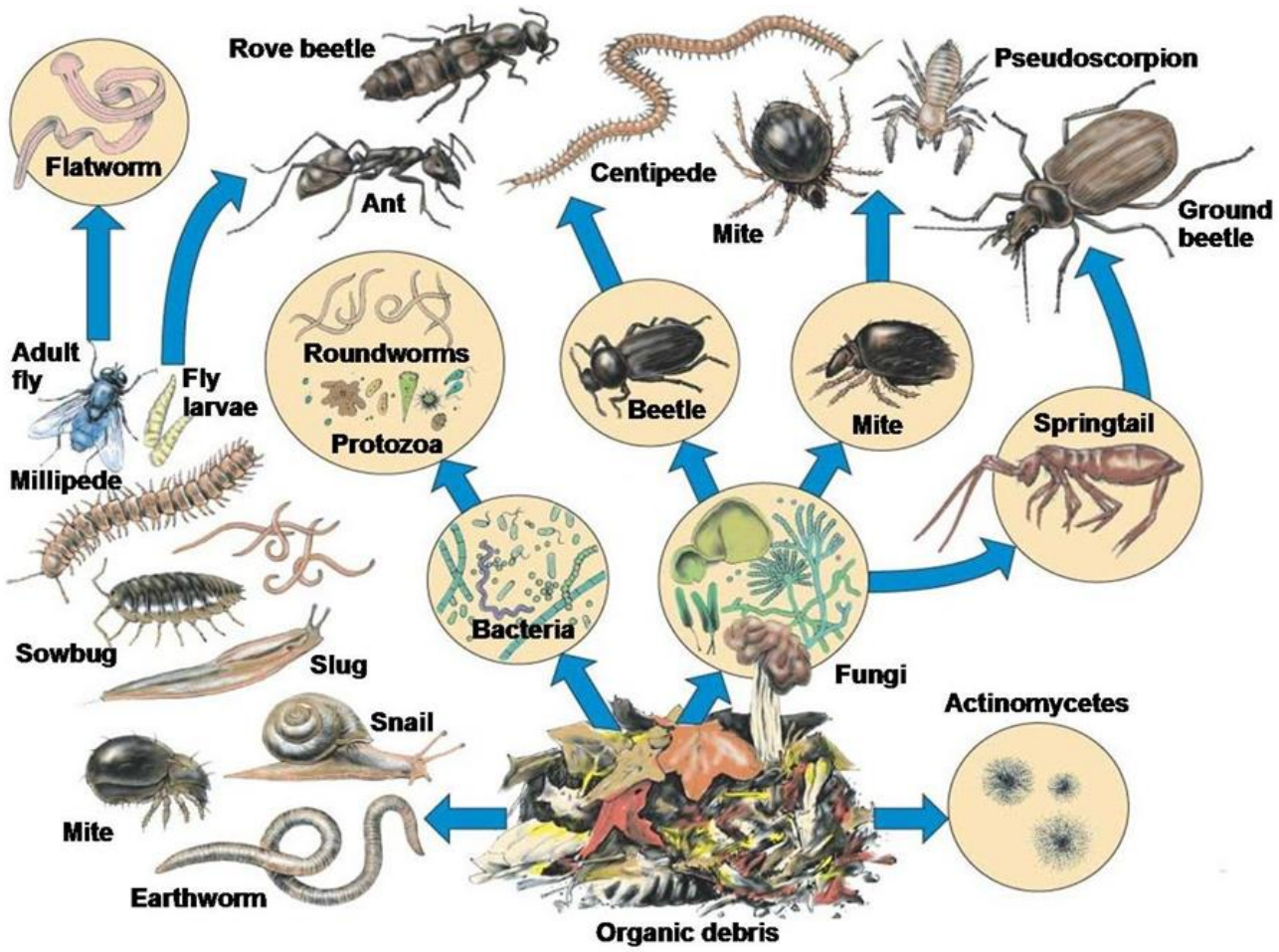
Clay

Soil Fertility Management (Level 2 – Part I)

ii. Biological Characteristics

Soil Organisms

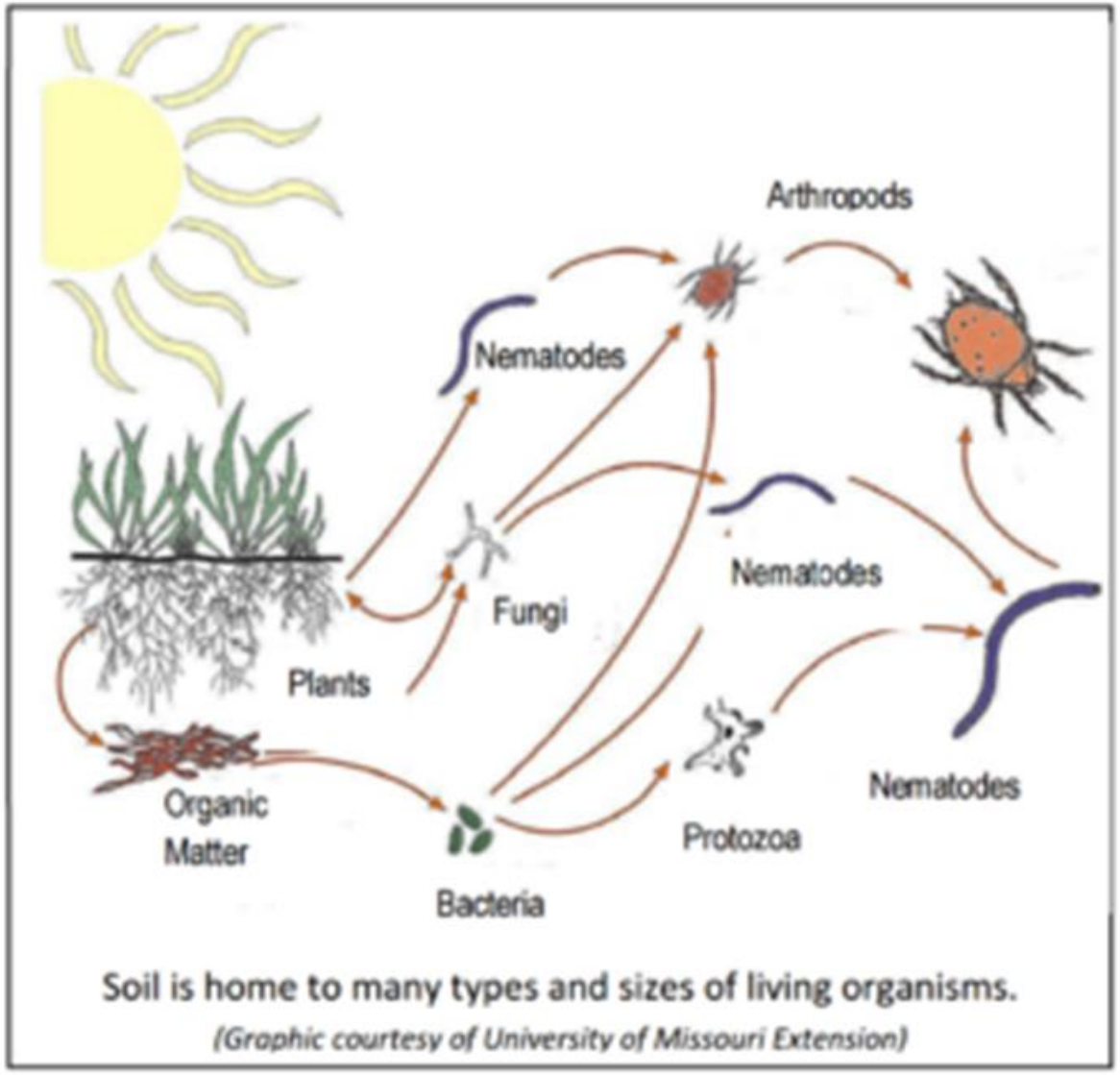
- A soil rich in organic matter is a good environment for living organisms.
- The diverse community of organisms benefits the soil. For example, these organisms protects against major pest outbreaks and soil fertility problems
- Maintain continuous supply of fresh residues to your soil to help build more diverse organisms



Soil Fertility Management (Level 2 – Part I)

Beneficial effects of soil organisms

- Soil organisms keep plants well supplied with nutrients because they break down organic matter.
- Some bacteria fix nitrogen gas from the atmosphere, making it available to plants



Soil is home to many types and sizes of living organisms.

(Graphic courtesy of University of Missouri Extension)

Soil Fertility Management (Level 2 – Part I)

Soil fertility

Plants obtain nutrients from two natural sources namely Organic matter and Minerals.

Soil Organic matter (SOM)

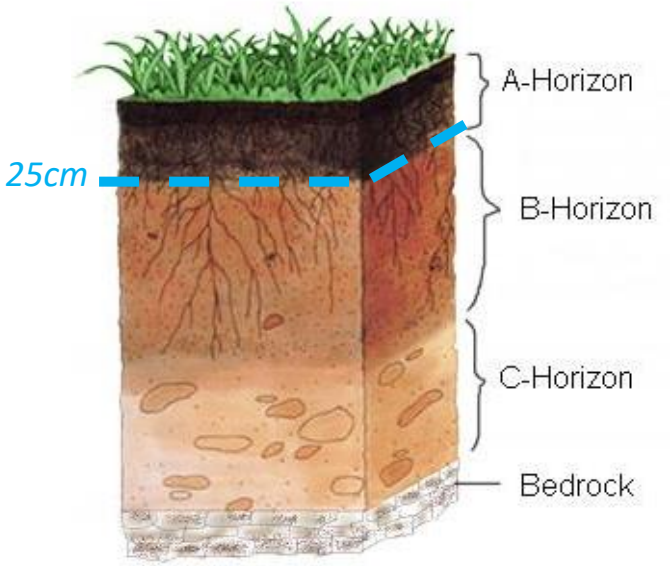
Benefits of Soil Organic Matter (SOM)

- Soil organic matter gives an indication of the measure of a soil's ability to supply nutrients for plant growth

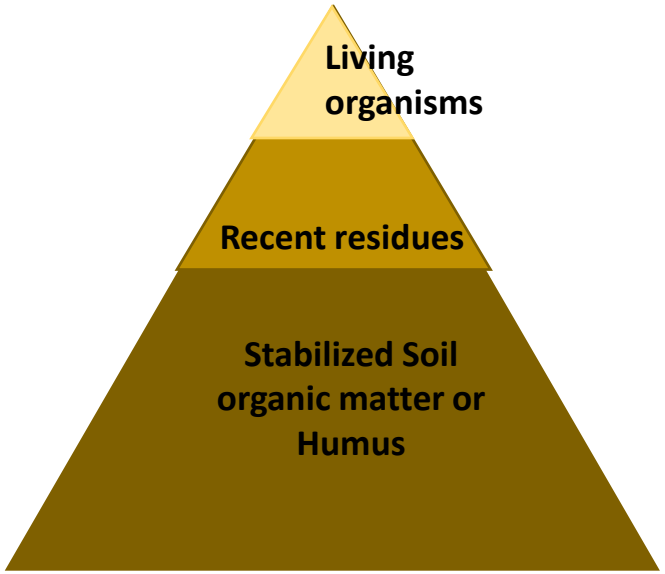
Note: *Enhance soil organic mater and soil organisms.*

Soil Fertility Management (Level 2 – Part I)

- Organic Matter is especially critical for soil functions and quality in horizon A



- A fertile soil has organic matter that: -
  - improves soil structure
  - improves soil moisture retention/holds moisture
  - improves nutrient retention
  - regulates soil pH, which determines the ability of nutrients to being soluble and available to plants.



Source: *Adapted from Magdoff and Weil 2003*

Soil Fertility Management (Level 2 – Part I)

Sources of organic matter

- Includes:
  - Green/Farm yard manure
  - Green (cut) plant material
  - Mulch
  - Planting leguminous trees
  - Dead animals
  - Dead plant material (crop residues)
  - Compost

Farm yard manure

Soil Fertility Management (Level 2 – Part I)

What you need to know about Compost

- Compost is more than a just fertiliser, it helps build the soil

- Compost is made from animal manure and fresh plant materials, including dry materials. Wood ashes and old compost may be added too.

Source: *https://s3.amazonaws.com/newhobbyfarms.com/wp-content/uploads/2019/03/07214702/trench-composting-00-161674781-600x347.jpg*

Sources of organic matter: How to make Compost

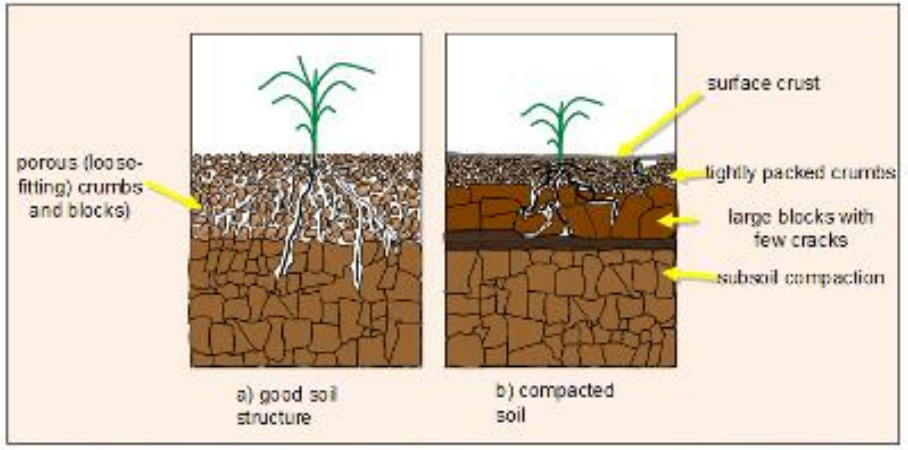
Soil Fertility Management (Level 2 – Part I)

Soil Fertility Management (Level 2 – Part I)

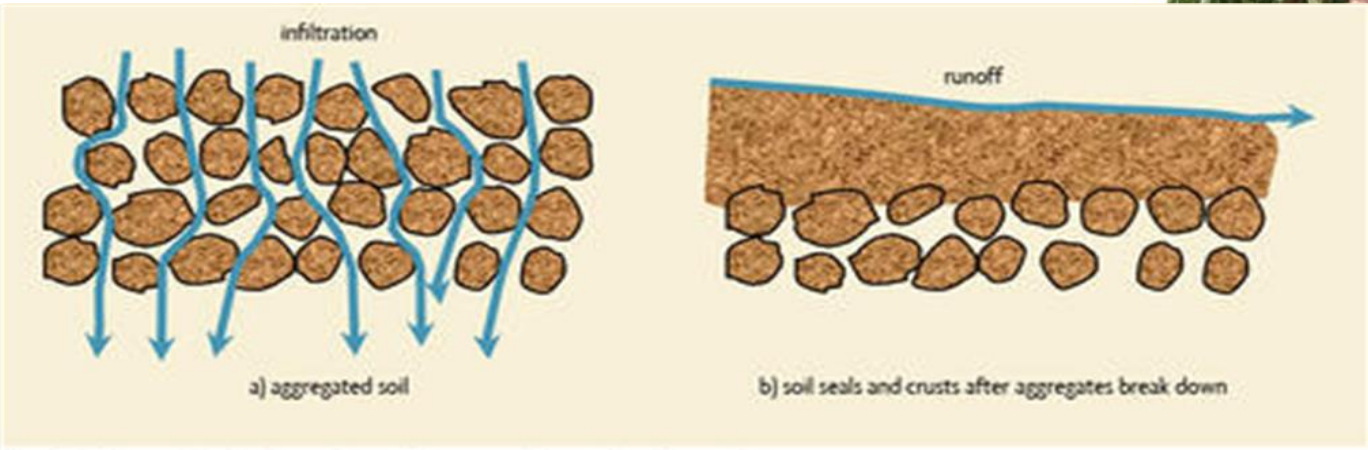
Soil Organic Matter: Compaction

- Soil compaction occurs when soil particles are pressed together, reducing pore space between them
- Organic matter in the soil provides benefits the structure of the soil.

Note: *Prevent Soil compaction*



Source: *https://www.waldeneffect.org/20150226soilcompaction.jpg*



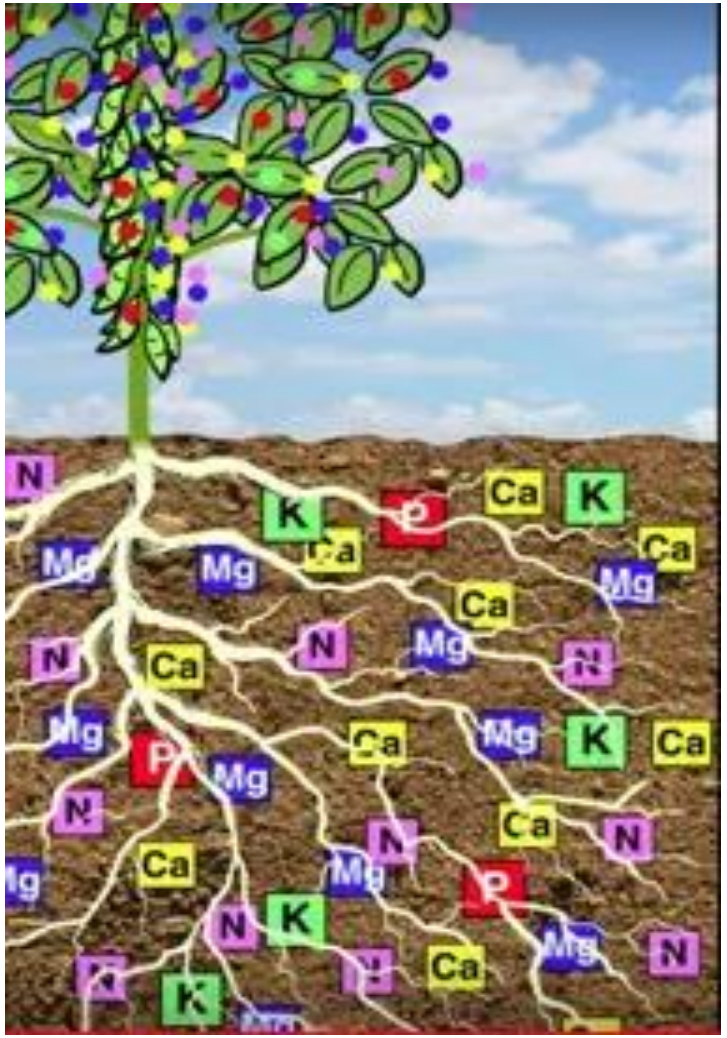
Soil Fertility Management (Level 2 – Part I)

iii. Chemical Characteristics

1. Nutrients

- A fertile soil contains all the major nutrients for basic plant nutrition as well as other nutrients needed in smaller quantities

- Many soils lack all the necessary plant nutrients, in the amounts needed by the plants. Such soils should be identified and rectified through Soil sampling and analysis.



Source: *Plants – and the crops they grow – get their nutrients from the soil they grow in. Crops grown in nutrient-rich soil have higher nutrient content. Illustrator: J. Toomey*

Soil Fertility Management (Level 2 – Part I)

Soil Sampling: How to assess soil fertility

- You will need the following equipment:
  1. Sample bags
  2. Auger or shovel
  3. Bucket
  4. Sample submission forms
  5. Field logbook
  6. Labels or marker pens
  7. Tape measure and;
  8. Mobile testing kit (for soil screening)

Source:
http://t2.gstatic.com/images?q=tbn:ANd9GcQxFNfo5VjNZ7eUukOX0joX9kLlxYKozEMMv9hzXqk3ooK7UazTdyRUAsumQmPLLNREp0GRIw27pplTypRXiAE

Soil Fertility Management (Level 2 – Part I)

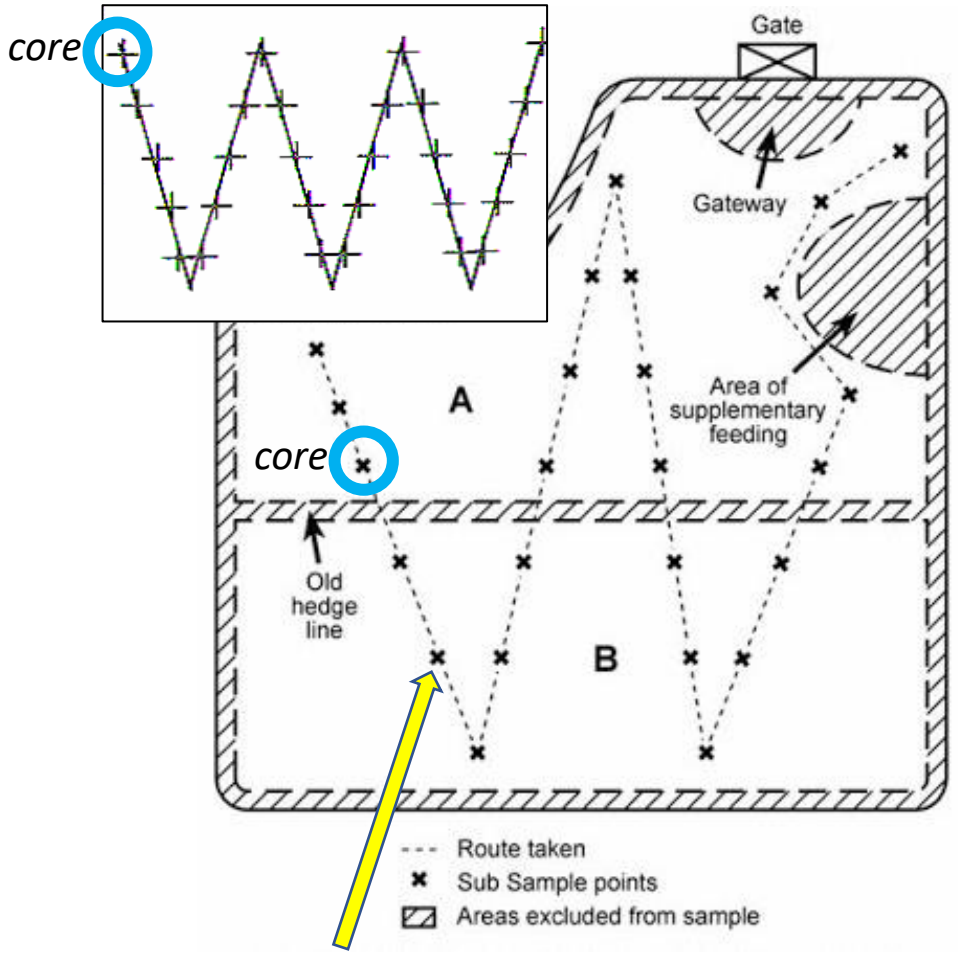
Procedure for Soil sampling

1. One sample should consist of between 20-30 cores taken from the set area of sampling. It is recommended that the cores be taken from the area in a zigzag pattern as shown in the field alongside

2. Scrape away surface litter and crop residues and sample the whole core from the true soil surface to 25 cm depth

3. Take between 20-30 cores from each uniform soil area. Place each core in a bucket and mix them thoroughly once you have taken all the cores

4. Fill the soil sample bag half full (**500g**) from this mixed representative sample.

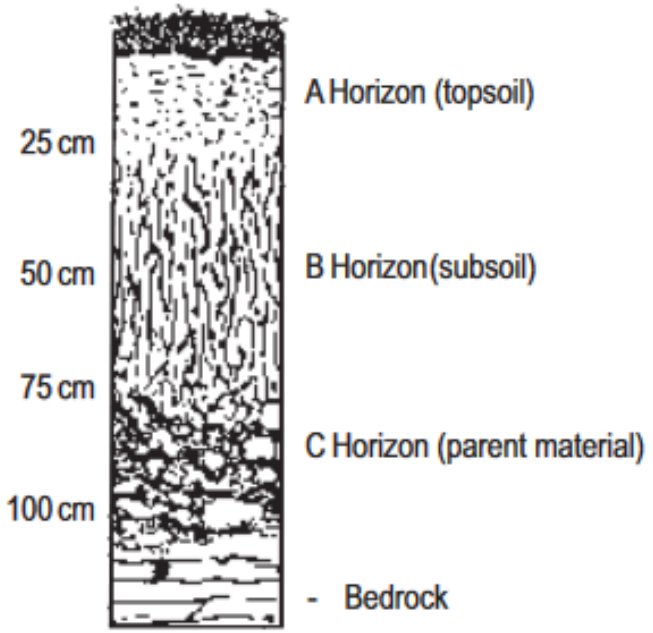


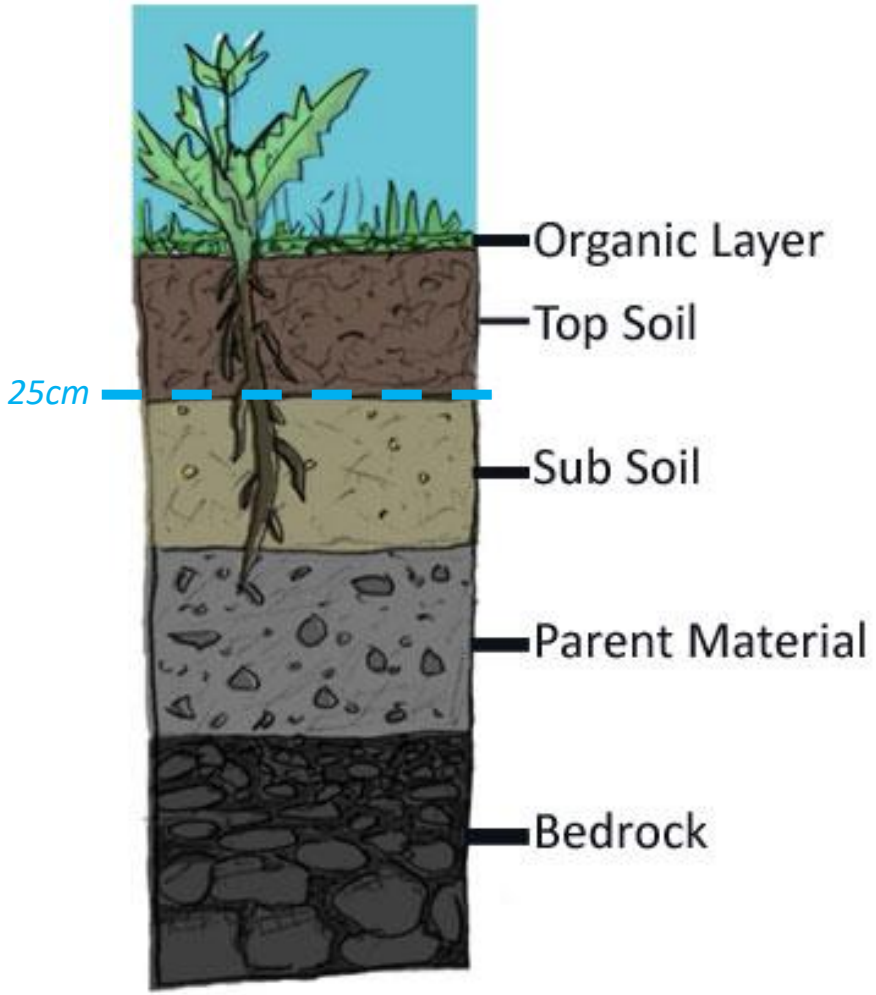
Zig-zag sampling helps sample each soil type equally (ensures homogeneity). X or + shows number of cores

Soil Fertility Management (Level 2 – Part I)

Sampling depth

- 0-25 cm

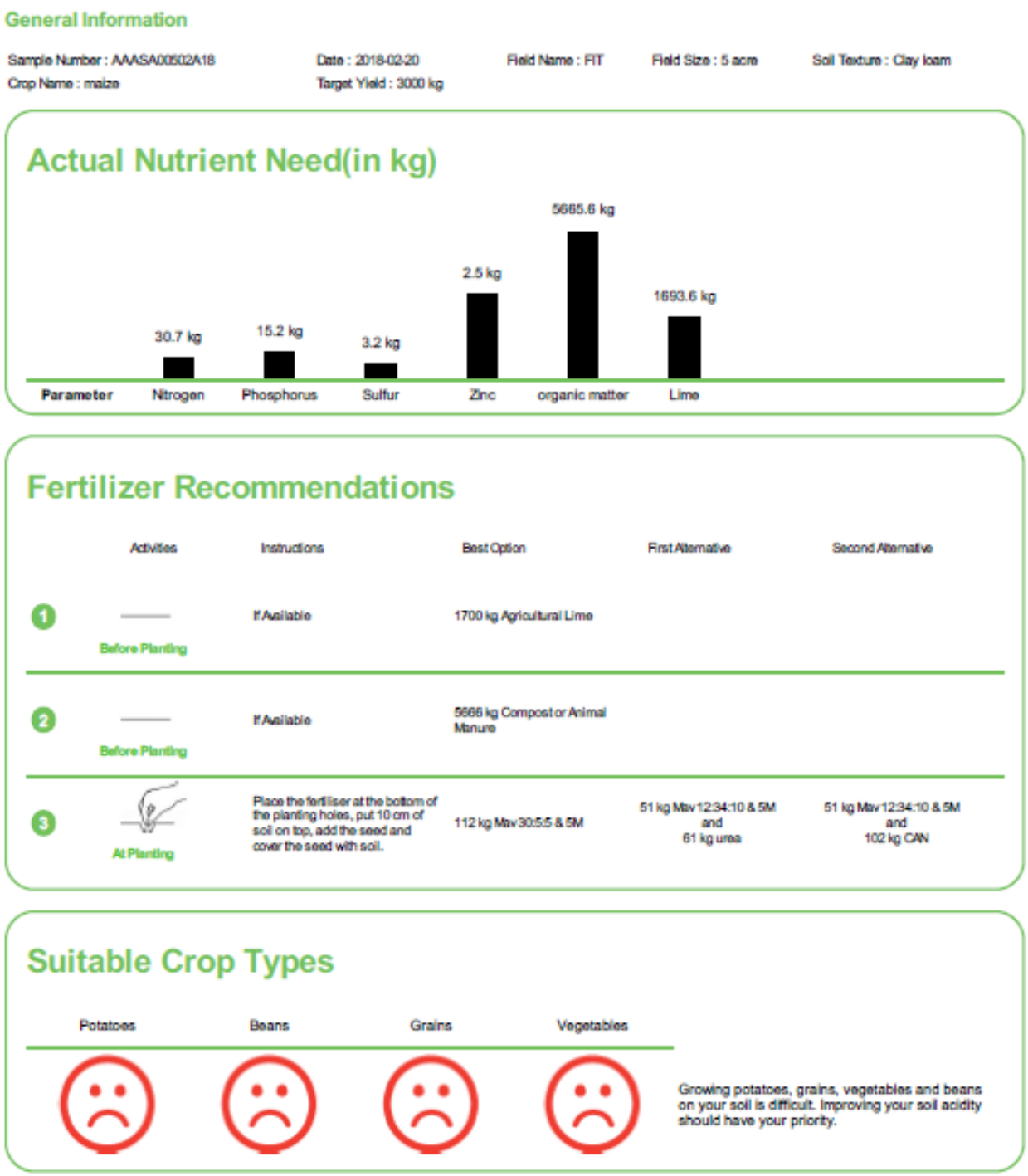




Soil Fertility Management (Level 2 – Part I)

Sample analyses

- Send the collected sample for analyses
- Obtain results and follow the recommendations with the aim to correct those nutrients with status low (meaning deficient). Avoid increasing the nutrients with status high.



General Information

Sample Number : AAASA00502A18 | Date : 2018-02-20 | Field Name : FIT | Field Size : 5 acre | Soil Texture : Clay loam
Crop Name : maize | Target Yield : 3000 kg

Actual Nutrient Need(in kg)

Fertilizer Recommendations

	Activities	Instructions	Best Option	First Alternative	Second Alternative
1	Before Planting	If Available	1700 kg Agricultural Lime		
2	Before Planting	If Available	5666 kg Compost or Animal Manure		
3	At Planting	Place the fertiliser at the bottom of the planting holes, put 10 cm of soil on top, add the seed and cover the seed with soil.	112 kg Mav 30:5:5 & 5M	51 kg Mav 12:34:10 & 5M and 61 kg urea	51 kg Mav 12:34:10 & 5M and 102 kg CAN

Suitable Crop Types

Potatoes	Beans	Grains	Vegetables

Growing potatoes, grains, vegetables and beans on your soil is difficult. Improving your soil acidity should have your priority.

Soil Fertility Management (Level 2 – Part I)

Soil Status

Parameter	Unit	Analysis Result	Range Low	Range High	Low	Adequate	High
pH (KCl)	pH Value	4,4	4,90	6,40	■		
Organic Carbon	g/kg	12,7	20,00	50,00	■		
Total Nitrogen	g/kg	1,1	1,00	2,00		■	
Total Phosphorus	g/kg	0,7	0,20	0,60			■
Total Sulfur	g/kg	0,2	0,30	0,50	■		
Potassium (exch.)	mmol+/kg	8,7	1,50	3,00			■
Calcium (exch.)	mmol+/kg	33,9	15,00	25,00			■
Magnesium (exch.)	mmol+/kg	23,3	4,50	10,00			■
Zinc (M3)	mg/kg	3,9	2,50	4,00		■	
Copper (M3)	mg/kg	4,5	1,00	2,00			■
Cation Exchange Capacity	mmol+/kg	88,7	75,00	200,00		■	
Clay	%	36,8	25,00	50,00		■	
Sand	%	42,5	35,00	55,00		■	
Total Aluminium	g/kg	80,4	56,00	91,00		■	
Total Potassium	g/kg	11,1	9,80	22,00		■	
Total Silicium	g/kg	282,7	250,00	330,00		■	
Total Iron	g/kg	53,4	27,00	72,00		■	
Phosphorus (M3)	mg P/kg	49,1	20,00	40,00			■
Total Manganese	g/kg	689	610,00	2300,00		■	

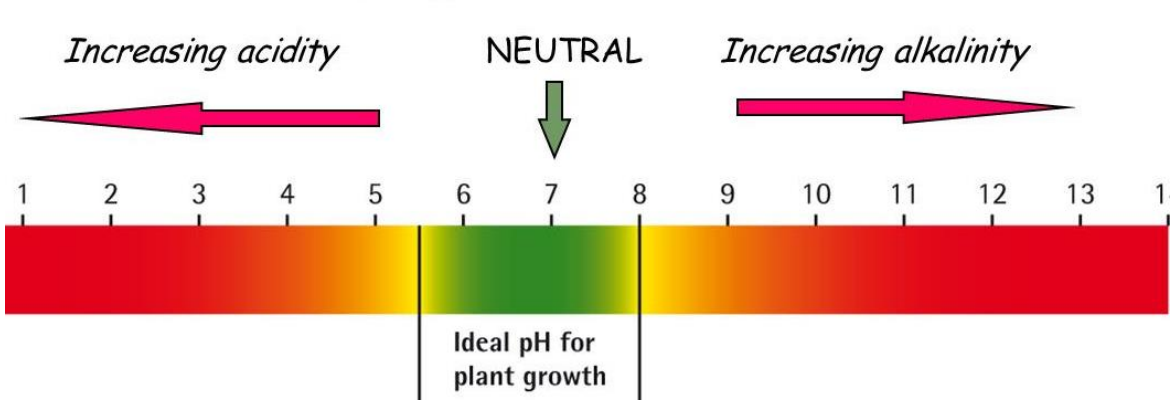
Status Low - *To correct*
Status Adequate - *Just right*
Status High - *Avoid increasing*

- The detailed status of soil sample analysis could be presented as shown alongside, specific to each nutrient.

Soil Fertility Management (Level 2 – Part I)

2. Soil pH

- Soil pH is a measure of the acidity and alkalinity in soils

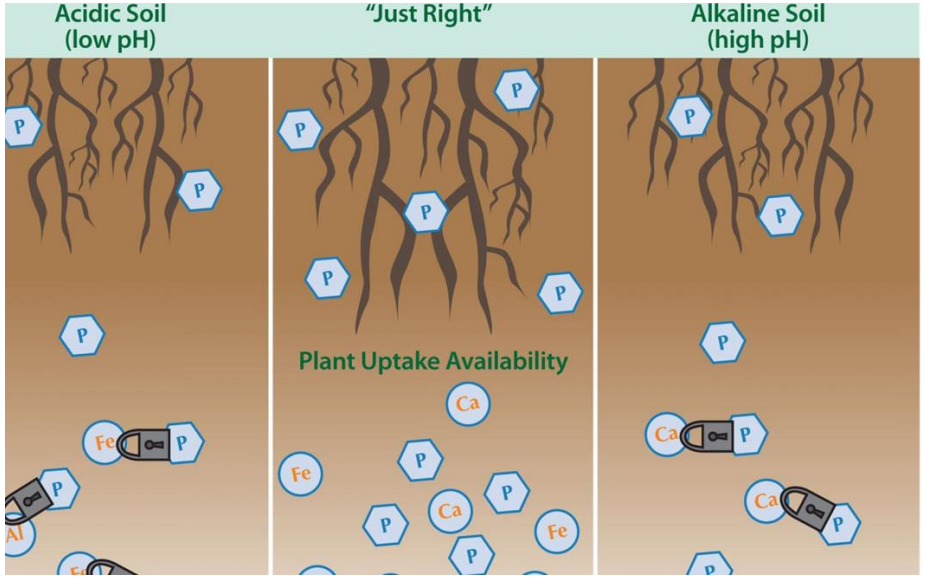


Effect of Soil pH on Nutrient availability to plants

Soil pH affects availability of plant nutrients:

i. Phosphorus availability

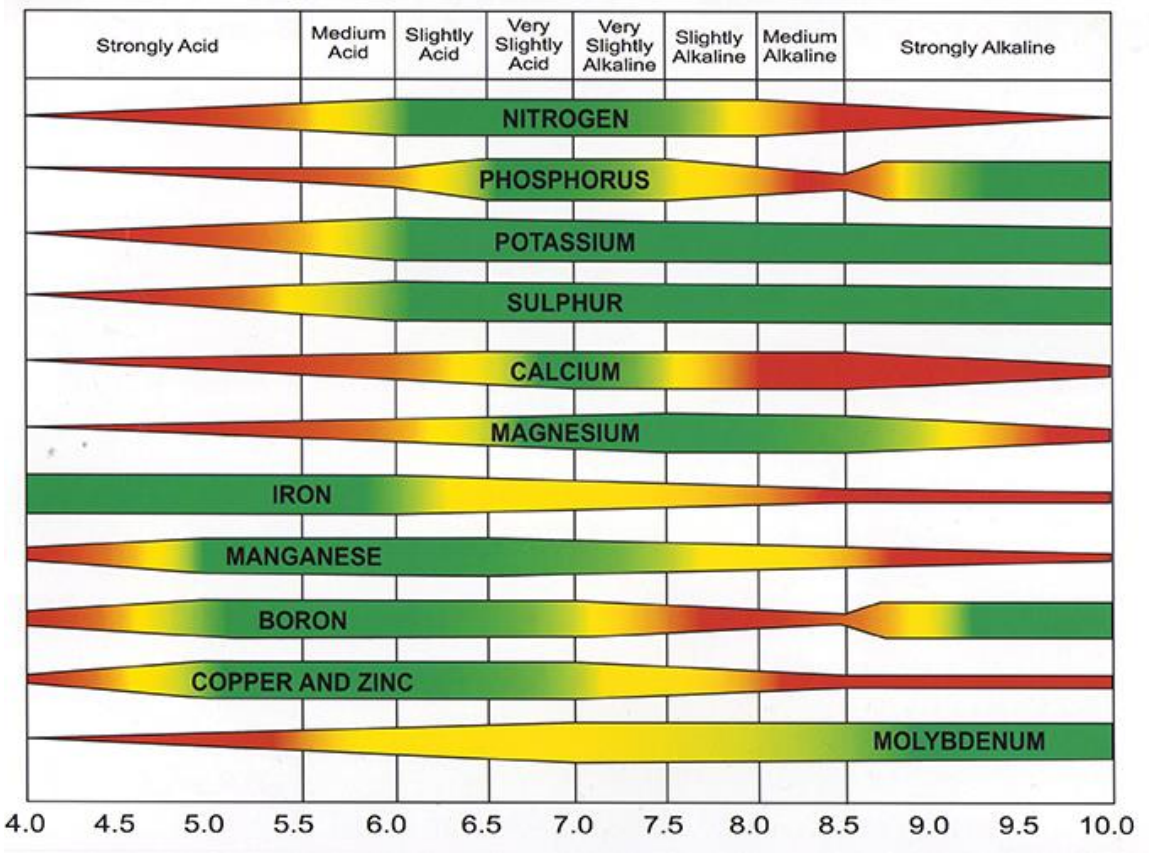
- Phosphorus (P) is freely available for Ph 5.5 and 7 (just right).
- In acidic soils (low pH) Phosphor is “locked in” with Iron (Fe)
- In alkaline soils (high pH) Phosphor is “locked in” with Calcium (Ca)



Soil Fertility Management (Level 2 – Part I)

ii. Other nutrients availability

- Green means the range in which a nutrient is easily absorbed
- Yellow implies the range that absorption is compromised
- Orange indicates that absorption is difficult; while
- Red denotes that absorption is extremely difficult

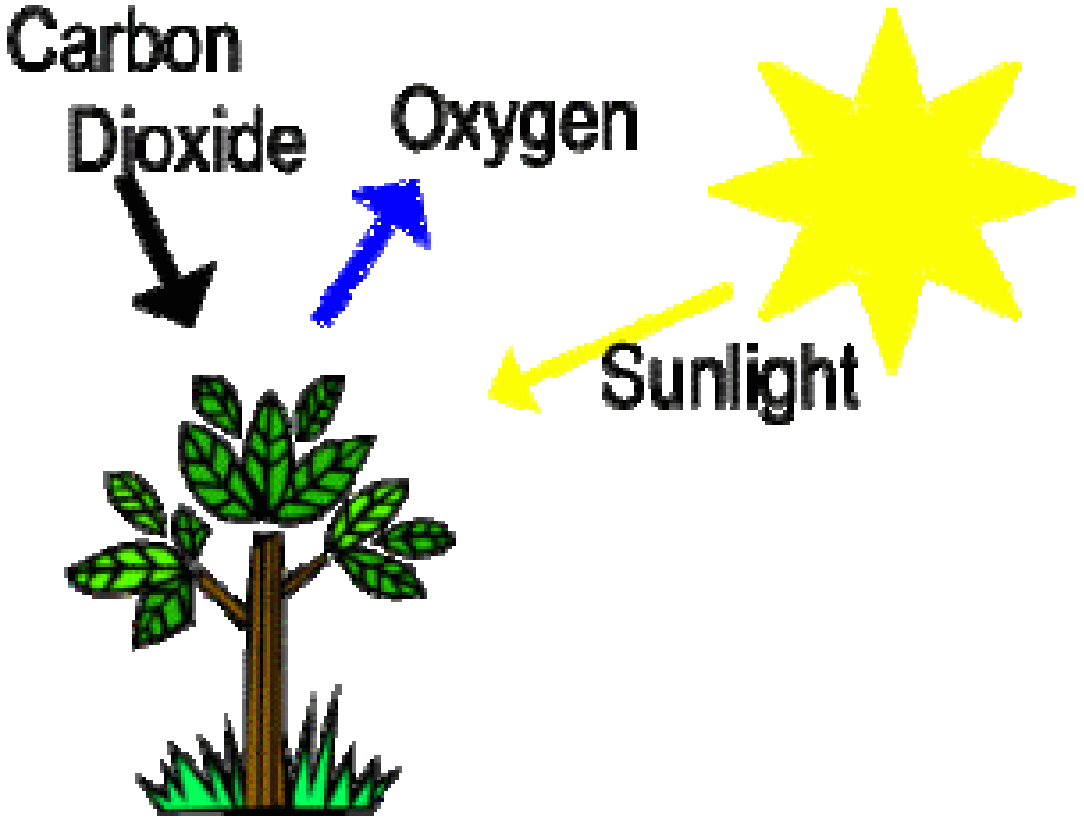


Soil Fertility Management (Level 2 – Part I)

Plant Nutrients

1. Plants can obtain Nutrients from the Air

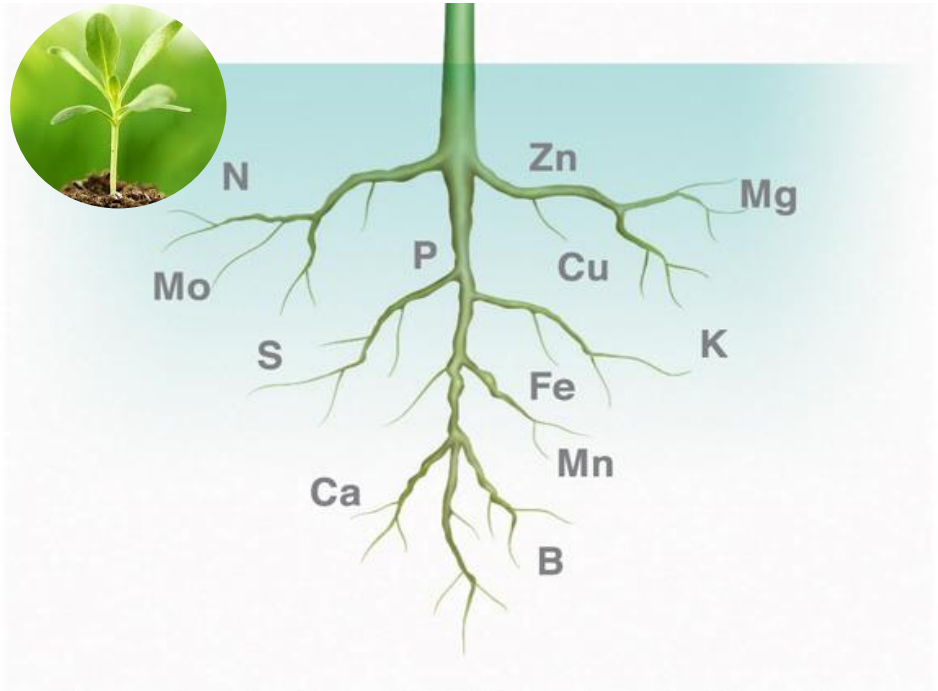
- Plants obtain carbon as carbon dioxide (CO_2) and oxygen partially as oxygen gas (O_2) from the air
- The remaining essential elements are obtained mainly from the soil.



Soil Fertility Management (Level 2 – Part I)

2. Plants also obtain Nutrients from the Soil

- **Macro Elements** are nutrients in the soil that are required by plants in large quantities
- **Micro Elements** are nutrients found in the soil that are required by plants in tiny quantities. When they are supplied in large quantities it might be detrimental to the plants



Macro Elements	Secondary Elements	Micro Elements
N - Nitrogen	**Ca -** Calcium	**Fe -** Iron
P - Phosphorous	**Mg -** Magnesium	**B -** Boron
K - Potassium	**S -** Sulphur	**Zn -** Zinc
		Cu - Copper
		Mn - Manganese
		Mo - Molybdenum

Soil Fertility Management (Level 2 – Part I)

Let's have a quick look at the Macronutrients:

1. The role of Nitrogen (N)

Plants absorb nitrogen in the form of nitrates. It is needed critically for proper growth and development of plants.

Nitrogen deficiency symptoms

- It produces small, yellow leaves and results in stunted growth. Plants grow poorly.

Soil Fertility Management (Level 2 – Part I)

2. The role of Phosphorus (P)

Phosphorus is available to plants in the soil in the form of phosphate. It is needed for establishment of roots and proper growth of plant nob.

Phosphorus deficiency symptoms

- Poor growth and development of plant nob. Poor growth or stunted growth of plants and grass plants tend to have slender/ slim stems

Purple leaf discoloration

Soil Fertility Management (Level 2 – Part I)

3. The role of Potassium (K)

Potassium is available to plants in the form of potassium ions. Potassium is used in the transport of nutrients and water from the soil.

Potassium deficiency symptoms

- Plants die prematurely. Leaf margin or edges of plants tend to be yellowish in colour

Soil Fertility Management (Level 2 – Part I)

The role of Magnesium (Mg)

Magnesium deficiency symptoms

Leaf of plants tend to be yellowish in colour along the plant nerves.

Soil Fertility Management (Level 2 – Part I)

Economic effects of nutrient deficiency in crop production

- Low yield of crops
- Poor quality of harvested crops
- Crops are susceptible to diseases and decay
- Loss of market value of crops
- Harvested crops may lack nutrients required for healthy growth when eaten
- Crops may not grow well and may die early without any harvest.

Soil Fertility Management (Level 2 – Part I)

Take Home Messages

1. A Healthy soil is the foundation of the food system; maintaining a healthy soil demands care and effort from farmers

2. Soil organic matter affects the overall health of soils. Farmers should embrace sustainable soil use and management practices that enhance Soil organic matter!

Healthy soils support growth of crops

- END-