

## **CHAPTER 1- SOIL**

**Give five reasons why soil is an important resource.**

- a. It provides anchorage or support, air, water and nutrients to the plants.
- b. It acts as a home for living organisms such as bacteria, insects, rodents and mammals.
- c. It influences processes of water intake in plant systems
- d. It influences the activities of micro-organisms that help in decomposition and release of plant nutrients.
- e. It is an essential building and construction material.

## **COMPONENTS OF SOIL**

**List the components of soil.**

Soil is made up of five components namely

- 1. Inorganic constituents , that is, namely
- 2. Organic matter (Humus)
- 3. Living organisms
- 4. Soil water (Moisture)
- 5. Soil water
- 6. Soil air(gases)

**State the functions of soil water.**

The functions of water include

- 1. It acts as a major component of the cell protoplasm. It provides support to the plant since in herbaceous plants it helps to the plant cells turgid.
- 2. It acts as a medium in which plant nutrients are dissolved before being transported up the plant.
- 3. It is a raw material of photosynthesis.
- 4. Loss of water by transpiration has a cooling effect on plants.
- 5. Water is necessary for microbial activities in the soil.
- 6. Soil water creates suitable conditions for seed germination

**Give three forms of soil water.**

Soil water exists in three forms. They are

**1. Superfluous water**

This is the soil water found in the large air spaces in the soil particles. It is held together by gravitational force. Once these spaces are situated with water, the soil becomes water-logged. This type of water is available for plant use.

**2. Hygroscopic water**

This type of soil water is found in form of a thin film on the surface of the soil particles. This water is held together by strong forces and so, it is not available for plant use.

**3. Capillary water**

This soil water occupies the micro pores in the soil. It is held by strong adhesive and cohesive forces. It is the soil water that is readily available and beneficial to plants.

**Give the forms of soil water that are available for plant use.**

These

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**2. Capillary water**

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**Describe an experiment that is used to determine the percentage of water in the soil sample.**

**Procedure**

1. Weigh an evaporating dish
2. Put 50g of the soil sample on the evaporating dish.
3. Heat the soil to 105 degree Celsius over a Bunsen burner,
4. Stir the soil as you heat. Ensure that all the water has evaporated.

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5. Remove the evaporating dish from the heat source and let it cool. You may use desiccators for faster cooling.
6. Re-weigh the dish with the soil, and record the mass.

### RESULTS

Working out percentage of soil water.

$$\begin{aligned}\text{Mass of soil sample} &= 50\text{g} \\ \text{Mass of evaporating dish} &= x\text{g} \\ \text{Mass of dish + soil} &= (50+x)\text{g} \\ \text{Mass of dish + heated soil} &= y\text{g} \\ \text{Mass of water lost} &= (50+x)-y \\ &= z \\ \text{Percentage of water lost} &= \frac{z}{50} \times 100\%\end{aligned}$$

### Conclusion

Air is a constituent of soil, that is, soil contains air.

### EXAMPLE

If the weight of the evaporating dish is 20g, and the total weight of the dish and heated soil is 62g, mass of the fresh garden soil is 50g, calculate the percentage of water in the soil.

Working out percentage of soil water.

$$\begin{aligned}\text{Mass of evaporating dish + soil} &= 70\text{g} \\ \text{Mass of evaporating dish + heated soil} &= 62\text{g} \\ \text{Mass of water lost} &= (70- 62)\text{g} \\ &= 8\text{g} \\ \text{Percentage of water lost} &= \frac{8}{50} \times 100\% \\ &= 16\%\end{aligned}$$

### Conclusion

Water is a constituent of soil, that is, soil contains air.

### SOIL AIR

- Soil contains air. Air is the mixture of gases. These gases include carbon dioxide, oxygen, nitrogen and inert gases.

## FORM TWO AGRICULTURE COMPREHENSIVE STUDY NOTES-SYLLABUS BASED

- Air is found in the spaces between the soil particles. The amount of air in the soil is inversely proportional to the amount of water available in that soil. Ploughing increases the amount of air in the soil.

### Give four importance of air in the soil.

- Soil air is necessary for respiration of plant roots and animals in the soil.
- Nitrogen in the soil is used during nitrogen fixation whereby it is converted to nitrates.
- Good aeration increases microbial activities in the soil.
- Good air circulation in the soil is necessary because it removes excess carbon dioxide that may be poisonous to plants.

### List four roles of water in the crop growth.

- Soil air is necessary for respiration of plant roots and animals in the soil.
- Nitrogen in the soil is used during nitrogen fixation whereby it is converted to nitrates.
- Good aeration increases microbial activities in the soil.
- Good air circulation in the soil is necessary because it removes excess carbon dioxide that may be poisonous to plants.

### Describe an experiment that is used to determine the percentage of air in the soil sample.

#### Procedure

- Put  $100\text{cm}^3$  of water into a  $250\text{ cm}^3$  measuring cylinder.
- Using a  $100\text{cm}^3$  beaker, put soil up to the  $100\text{cm}^3$  mark.
- Empty the soil into the measuring cylinder and shake well. Observe the escaping bubbles.
- After all the bubbles have escaped, record the final reading of the mixture.

#### Results

- Note that the final level of water plus soil is below the expected  $200\text{cm}^3$  mark. This is because soil air escaped thus reducing the volume of the mixture.

## FORM TWO AGRICULTURE COMPREHENSIVE STUDY NOTES-SYLLABUS BASED

- Working out percentage of soil air.

$$\begin{aligned}\text{Expected volume} &= 100\text{cm}^3 + 100\text{cm}^3 \\ &= 200\text{cm}^3 \\ \text{Final reading} &= x\text{cm}^3 \\ \text{Volume of air in the soil sample (y)} &= (200 - x)\text{cm}^3 \\ \text{Percentage of soil air} &= \frac{\text{Volume of air}}{\text{Volume of soil}} \times 100 \\ &= \frac{y}{100} \times 100\% \end{aligned}$$

Example

If the level of the mixture was  $195\text{cm}^3$ , the percentage of air is:

$$\begin{aligned}\text{Volume of air} &= (200 - 195)\text{cm}^3 \\ &= 5\text{cm}^3 \\ \text{Percentage of soil air} &= \frac{5}{100} \times 100\% \\ &= 5\% \end{aligned}$$

### Conclusion

Air is a constituent of soil, that is, soil contains air.

## ORGANIC MATTER

- This is an important component of the soil.
- It is derived from the remains of animals and plants.
- Organic matter undergoes decomposition to release nutrients and humus.

### Give two importance of humus.

- Humus binds soil particles together thus improving the soil structure
- It helps to raise the soil temperature.

## LIVING ORGANISMS

- Living organisms in the soil include rodents, worms, insect and microorganisms.
- Examples of micro-organisms found in the soil include
  - bacteria
  - fungi
- All living organisms respire. During respiration, carbon dioxide is produced

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as one of the by-products.

- It is expected that if the soil has micro-organisms, carbon dioxide will be produced. Carbon dioxide is tested using lime water. Carbon dioxide turns milky.

**Describe an experiment that is used to show the presence of micro-organisms in the soil.**

### Procedure

1. Put a sample of the soil in a muslin bag and tie it with a string.
2. Put an equal amount of burnt soil in another muslin bag and tie it with a string.
3. Suspend each muslin bag in separate conical flasks containing lime water and label them A and B as shown in the figure below:
4. Cork the conical flask tightly.
5. Leave the set up for 6-12 hours.

Note: This forms the basis of this experiment. For the control experiment, use burnt soil under similar conditions.

### Results

The lime water in conical flask A turns milky while there is no change in the lime water in flask B. Burning kills the living organisms so there is no production of carbon dioxide in the flask with burnt soil.

### Conclusion

Soil contains micro-organisms.

**Give two methods of separating soil into different sized mineral particles.**

1. Sieve method
2. Sedimentation method

## SOIL PROFILE

**What is a soil profile?**

Soil profile refers to the vertical arrangement of different layers (horizons) of soil from the ground surface to the bedrock.

**Name four layers in a soil profile.**

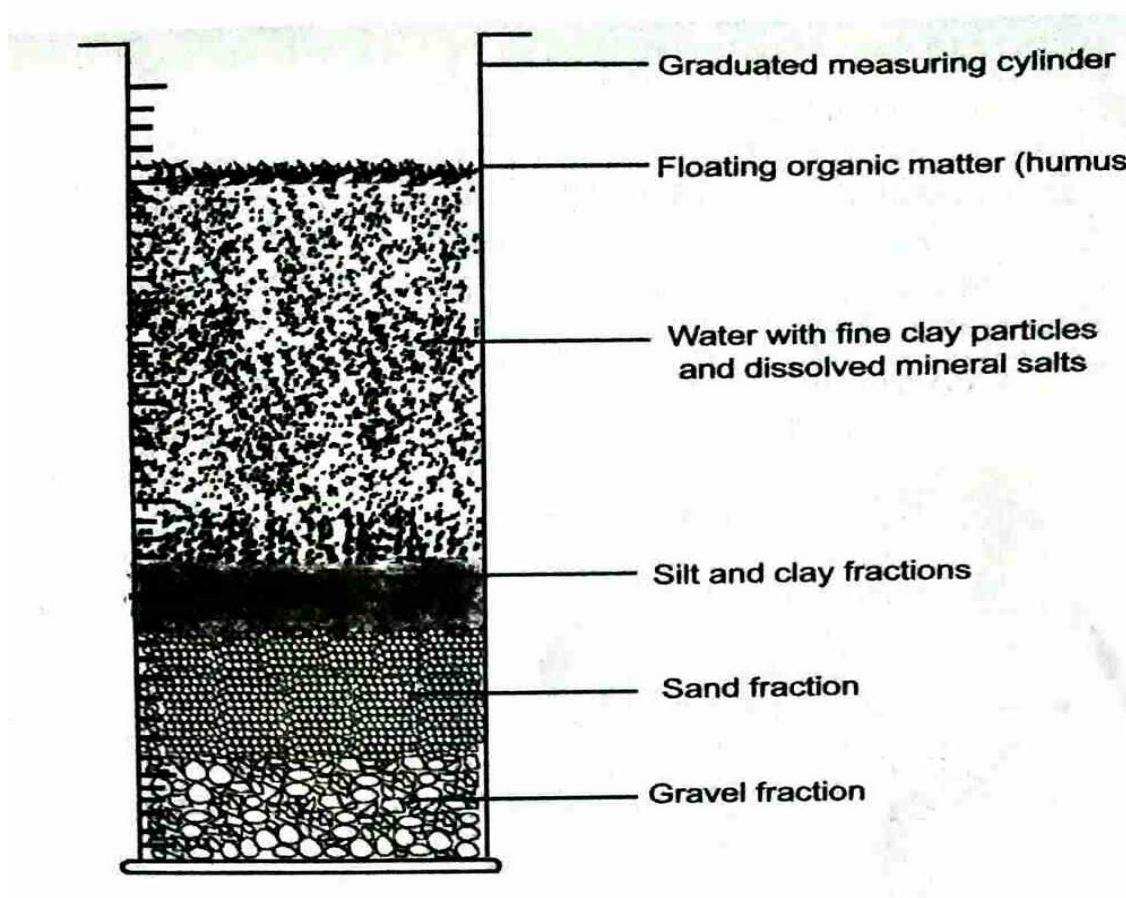
These include

1. Topsoil (Horizon A)
2. Subsoil (Horizon B)
3. Weathered rocks (Horizon C)
4. Parent or Bedrock (Horizon D).

**Draw a well diagram of a soil profile. Explain the four components.**

### **SOIL PROFILE**

Soil profile refers to the vertical arrangement of different layers (horizons) of soil from the ground surface to the bedrock. See the soil profiles and associated soil components below:

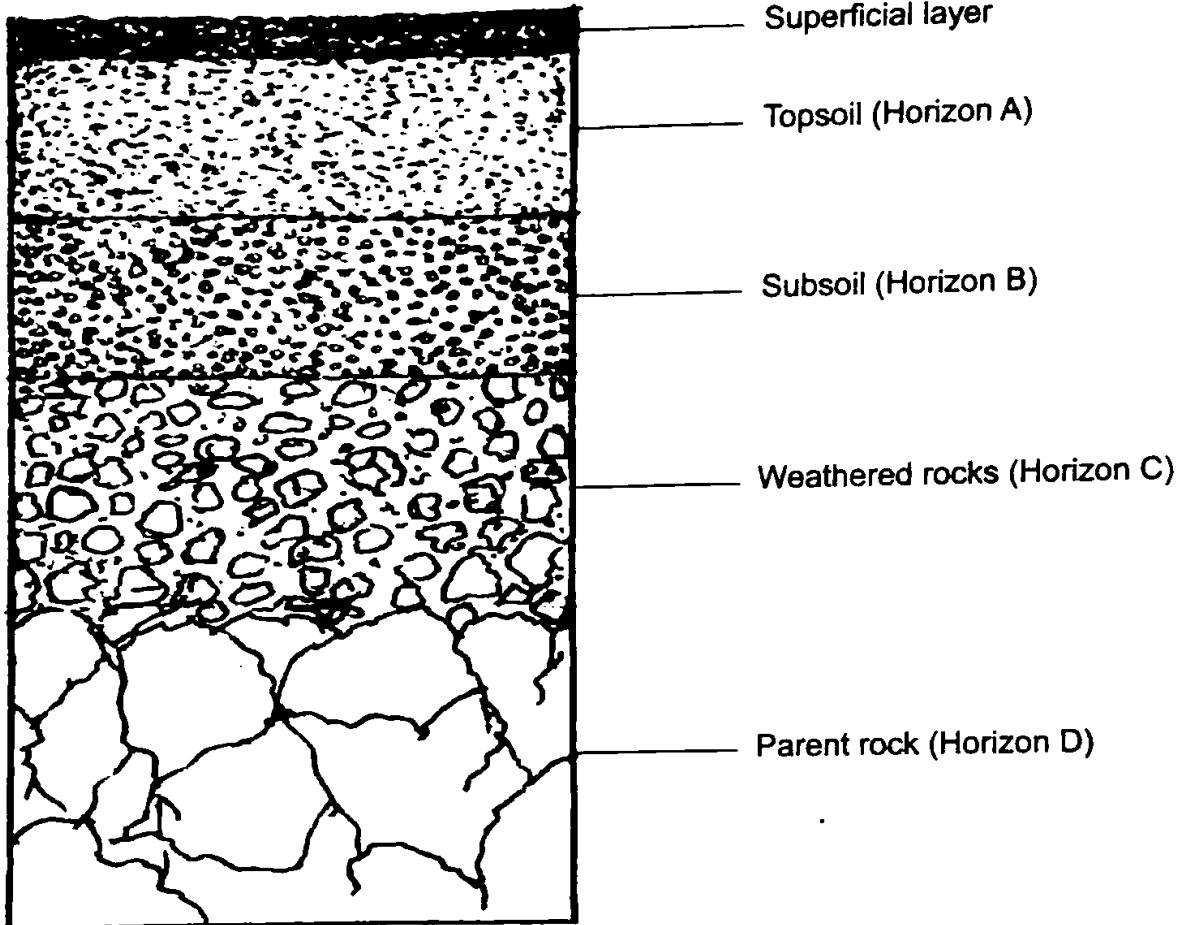


Soil profile is made up of layers

1. Top soil (Horizon A)
2. Sub soil (Horizon B)
3. Weathered rocks (Horizon C)

4. Parent or Bedrock (Horizon D)

These four layers of soil profile are shown below



**O-horizon**

This layer is also known as the superficial layer. This is the thin layer of dry, decaying and partially decomposed layer. It mainly consists of decomposing leaves and roots of plants.

**A. Topsoil**

- This is the first layer of the soil found on the surface.
- The topmost part of the topsoil is made up of decomposed and decomposing organic matter.

- During land preparation, decomposed and decomposing organic matter are ploughed into the soil adding organic matter to the soil.
- The top soil has a dark colour due to the presence of humus.
- The top soil is rich in nutrients.
- It is well aerated
- It contains active micro-organisms
- It contains plant roots.
- The topsoil is subject to leaching. Leaching is the downward movement of dissolved minerals.

#### **B. Subsoil**

- This is the layer beneath the topsoil
- It is compact and less aerated than the topsoil.
- It is called the “layer of accumulation” because mineral salts carried from top soil through leaching are deposited in this layer (Subsoil).
- It contains some roots of some deep rooted crops.
- It contains larger soil particles
- Its soil particles are lighter in colour than the top soil.
- It contains hard pans if it is not cultivated or if it is cultivated when wet using heavy machinery.

Hard pans are hard impermeable layers that cannot be broken down during land preparation unless sub soiling is done.

#### **C. Weathered rocks**

- This is the third layer from the top;
- It is composed of weathered rocks broken down from parent rock material.
- Materials of the weathered rocks originate from the bedrock
- Rock particles become larger in size as one moves down the weathered rock.  
They are less exposed to agents of weathering.

#### **D. Parent rock/Substratum/Bedrock**

- This zone exists a solid mass.

- The rocks is weathered
- It is called parent rock because it is the source of the inorganic matter of the soil.
- The water table is on the parent rock
- The nutrient content of the soil depends on the mineral constituent of the parent rock
- The colour of the soil is determined by the parent rock.

**Explain the effects of soil profile on crop production.**

**1. Soil depth**

- It is the distance from the topsoil to the parent rock.
- The soil depth influences the soil capacity to hold water and mineral salt. Deep soils have more room for water and minerals compared to shallow soils.
- The depth of the soil will determine the crop to be grown. Deep rooted crops can only do well in deep soils but in shallow soils, they may not be well-anchored.
- Deep soils are less prone to soil erosion because they have room for more water hence reducing surface run off as most of the water infiltrates into the soil

**2. Compactness of the soil**

- This influences aeration, drainage and root penetration.
- Compact soils have poor drainage, aeration and they also limit root penetration and tuber enlargement.
- Loosely packed soils will ensure good aeration and packed will ensure good aeration, good drainage, good root penetration and tuber expansion.
- Therefore, Soil texture and soil structure highly influence the absorption of water into the soil and the water holding capacity of the soil.

**3. Composition of the parent rock.**

- This influences the type of minerals present in the soil. If the parent rock was rich in particular minerals, the soil will also be rich in the same

minerals.

- If the parent rock lacked some minerals, they will also be absent in the soil.
- 4. The higher the organic matter available in the soil, the higher the yields from crops.

**Describe the characteristics of each of the following components of soil profile.**

**A. Topsoil**

- It is made up of decomposed and decomposing organic matter.
- The top soil has a dark colour due to the presence of humus.
- The top soil is rich in nutrients.
- It is well aerated
- It contains micro-organisms
- It contains plant roots.
- The topsoil is subject to leaching. Leaching is the downward movement of dissolved minerals.

**B. Subsoil**

- It is compact and less aerated than the topsoil.
- It is where the mineral salts carried from top soil through leaching are deposited in this layer.
- It contains some roots of some deep rooted crops.
- It contains larger soil particles
- Its soil particles are lighter in colour than the top soil.
- It contains hard pans if it is not cultivated or if it is cultivated when wet using heavy machinery.

**C. Weathered rocks**

- It is composed of weathered rocks broken down from parent rock material.
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**Describe the characteristics of each of the following components of soil profile.**

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- It contains micro-organisms
- It contains plant roots.
- The topsoil is subject to leaching. Leaching is the downward movement of dissolved minerals.

**F. Subsoil**

- It is compact and less aerated than the topsoil.
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**G. Weathered rocks**

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**6. Compactness of the soil**

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- Compact soils have poor drainage, aeration and they also limit root penetration and tuber enlargement.

## FORM TWO AGRICULTURE COMPREHENSIVE STUDY NOTES-SYLLABUS BASED

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- Therefore, Soil texture and soil structure highly influence the absorption of water into the soil and the water holding capacity of the soil.

### 7. **Composition of the parent rock.**

- This influences the type of minerals present in the soil. If the parent rock was rich in particular minerals, the soil will also be rich in the same minerals.
  - If the parent rock lacked some minerals, they will also be absent in the soil.
8. The higher the organic matter available in the soil, the higher the yields from crops.

### **What is the difference between soil texture and soil structure.**

**Soil texture** refers to the composition of the soil particles that is, small, medium and large particles while **soil structure** refers to the arrangement of the soil particles to form stable units.

## **UNIT 2: SOIL FERTILITY**

### **Define the term soil fertility.**

Soil fertility is the ability of the soil to provide and sustain high crop yields indefinitely.

In other words, soil fertility is the capacity of the soil to supply plants with sustainable quantities of mineral nutrients such as nitrogen, phosphorous and potassium.

### **State the factors that affect /influences soil fertility.**

These include

- a. the nutrient levels
- b. amount of water and air in the soil
- c. Presence of living organisms in the soil
- d. Absence of pests and diseases in the soil
- e. Topography of the land

The distribution of these factors will determine which soils are more fertile

than others.

**Explain the soil properties which are related to soil fertility.**

**1. Soil colour**

The following colours are indicators of soil fertility

- Black indicates high organic matter
- Bright red and yellow indicate a well drained soil
- Grey shows the soil is poorly drained

**2. Soil structure**

- This is the arrangement of soil particles and includes size, shape and stability of the particles. These affect porosity and water permeability.

**3. Soil porosity and permeability**

- Porosity is the total pore space in the soil. It is the ease with which water and air move through the soil. Soils that have good porosity and permeability tend to be fertile.

**4. Soil texture**

- Soils that have a good balance of sand, silt and clay tend to be fertile.

**5. Moisture holding capacity**

Soils that are of good texture and have good amounts of organic matter are fertile.

**6. Soil depth**

Soils that have rooting depth being reduced by the bed-rock, soil pH and a high water table are generally not fertile.

**Explain the characteristics of a fertile soil.**

A fertile soil have the following characteristics

- a. Sufficient amounts of nutrients available to plants in the correct proportions
- b. Soils should have the ability to retain the right amounts of water and air which should be available to the plants.
- c. An optimum pH range for the desired crop since the soil pH influences the availability of different nutrients to the plants.
- d. Organic matter that improves soil structure and soil moisture retention.

- e. Large amounts of top soil.
- f. A range of micro-organisms that support plant growth.
- g. Enough soil depth which allows plant roots greater space for the extraction of nutrients.
- h. Good soil structure, creating well drained and well aerated soil.

**Describe an experiment that is used to investigate the differences between fertile and infertile soils.**

**Procedure**

- Collect a soil sample from a garden where crops have been performing well, fertile soil.
- Collect another sample from a garden where crops have been performing poorly, infertile soil.
- Put the fertile soil in the first pot.
- Put an equal amount of the infertile soil in the second pot.
- Plant maize seed in each of the pots at the same depth.
- Water the seeds in the pots.
- Practise regular watering of the seeds with the same quantity of water and same frequency.
- Observe the plants as they grow and note any differences.
- Measure the height of each plant using a ruler on daily basis.

**Results**

- The maize seeds germinated at the same time.
- Seedlings in the fertile soil were observed to have a high growth rate compared to the seedlings in infertile soil.

**Explanation**

A fertile soil provides the crop with all conditions necessary for growth. The soil has the various minerals required for proper growth of the plant. Infertile soil lacks some of these essential minerals and hence the plants do not show proper growth. The plants may show different deficiency symptoms depending on the missing mineral. Such deficiency symptoms that may be observed

include

- Stunted growth
- Chlorosis- yellowing of the leaves
- Rolling or curling of leaves
- Premature leaf fall.

### **Conclusion**

Fertile soil allows proper growth of plants while infertile soil does not.

### **List the differences between fertile soil and infertile soil**

<b>Fertile soil</b>	<b>Infertile Soil</b>
• Contains all the minerals essential for proper growth	• May be lacking one or more of the minerals essential for proper growth
• Has the right depth depending on the crop grown	• May be shallow with respect to the crop grown
• Has the right water holding capacity	• May hold too much or too little water to allow proper growth
• Has good porosity hence well-aerated	• May have poor porosity hence poorly
• Free from excessive soil-borne pests and diseases	• May have excessive soil-borne pests and diseases.

### **Explain five ways of losing soil fertility.**

#### **a. Soil erosion**

Soil erosion is the removal of the rich topsoil by runoff water and wind especially along the slopes and on grounds without adequate vegetation cover. Erosion of soil by water and wind reduces fertility of agricultural land.

#### **b. Poor farming methods and techniques**

The loss of soil fertility from farming mainly occurs through continuous cropping, burning of crop residues, and is accelerated by frequent and intensive tillage.

**c. Leaching**

This is the loss of soluble substances and colloids from the topsoil by infiltrating rainfall. The materials lost are carried downward and are generally re-deposited in a lower layer of soil. In areas of extensive leaching, many plant nutrients are lost, leaving infertile soils.

**d. Volatilisation**

- This is the chemical process whereby nutrients in gaseous form are lost directly from the soil and into the air. Volatilisation mainly occurs from soil surfaces that have been applied nitrogen based fertilizers. In case of urea, hydrolysis converts the urea to ammonia, and if the urea is not incorporated, the ammonia is lost to the air.
- Conditions favouring high volatilization potential are : high soil temperatures, moist conditions-followed by rapid drying conditions, windy conditions, high soil pH that is greater than 7.5, high lime contentment in the surface soil, coarse soil texture(sandy) and low organic content.

**e. Crop removal**

Soil fertility is also lost by plant uptake and removal of nutrients from the field in harvested products. Growing crops make constant use of minerals in the soil which need regular replenishing. In all agricultural systems, nutrients are removed over time in harvested products such as grain.

**f. Denitrification**

This is the conversion of plant available nitrogen in form of nitrates to nitrogen gases that are unavailable to plants and become easily lost from soil.

**g. Immobilisation/assimilation**

This is the uptake of inorganic nitrogen from the soil and incorporation into organic nitrogen compounds in micro-organisms. This nitrogen becomes unavailable to plants and contributes to loss of soil fertility.

**Explain five ways that help in maintaining soil fertility.**

**1. Soil erosion control**

- Planting vegetation since the plant roots will help hold soil in place on the ground thereby protecting soil from water and wind.
- Practising contour farming which will help to reduce soil losses from surface erosion.
- Terracing farming will keep the soil in place while allowing excess water to drain through natural gravity.
- Mulching will help to conserve moisture; improve fertility and healthy of the soil; reduce weed growth and enhances the visual appeal of the area. Mulches decompose and provide organic matter which help to keep the soil loose which in turn assists in improving aeration and water infiltration.

### **2. Soil conservation tillage**

Conservation tillage is any method of soil cultivation that leaves the previous year's crop residue on fields before and after planting the next crop, to reduce soil erosion and run off. Soil conservation tillage enables soil to retain more moisture, reduces soil crusting and allows organic materials such as leaves and plant parts to accumulate over time, helping to restore nutrients to the soil.

### **3. Use of fertilizers**

Fertilizer is a chemical or natural substance that is often added to the soil to increase its fertility. Fertilizers assist in increasing crop yields as well as in promoting healthy growth and development of crop plants. They contain nitrogen which acts as a growth booster, phosphorus which aids in the faster formation of seeds and in root development and potassium which strengthens plant stalks and straws.

### **4. Use of organic manures**

Manures contribute to the fertility of the soil by adding organic matter and nutrients such as nitrogen that are trapped by bacteria in the soil.

### **5. Nitrogen fixation**

Nitrogen fixation is a process by which nitrogen in the atmosphere is

converted by symbiotic and non-symbiotic organisms into compounds usable by plants.

## **6. Liming**

Liming is the application of calcium and magnesium rich materials to soil in various forms including chalk, limestone, marl or hydrated lime. This neutralises soil acidity and increases activity of soil bacteria.

**State the ways by which each of the following helps to maintain soil fertility.**

Soil fertility can be maintained through the following practices

### **1. Application of organic and inorganic fertilizers**

- These will replenish the nutrients lost from the soil.
- Organic manure releases humus that binds the soil particles thus improving soil structure.
- They help to buffer the soil pH thus preventing rapid changes in soil pH.
- Organic manure acts as food and shelter to soil organism's thus increasing microbial activity.

### **2. Practising crop rotation**

- Crop rotation is defined as the practice of growing different types of crops on the same piece of land following a definite succession.
- **Crop rotation improves soil fertility in the following ways:**
  - a. Control specific soil-borne pests and diseases.
  - b. Ensures maximum utilization of soil minerals from all horizons.
  - c. Legumes included in the cycle add nitrates through nitrogen fixation
  - d. Controls specific crop weeds such as witch weeds

### **3. Regulation of soil pH**

Soil pH is defined as the degree of acidity or alkalinity in a soil solution.

#### **pH can be regulated through**

- a. use of organic manures
- b. use of acidic fertilizers
- c. use of agriculture lime

**Benefits of good soil pH**

- a. Ensures availability of crop nutrients
- b. Increases the population and activity of soil organisms
- c. Determines the type of crop to be grown

**4. Controlling soil erosion**

Soil erosion leads to the loss of top fertile soil making the soil less productive.

**Examples of the practices that a farmer can carry out to reduce soil erosion include**

- a. Mulching
- b. Growing cover crops
- c. Strip cropping
- d. Contour farming
- e. Terracing
- f. Use of cut-off drains

**5. Ensuring proper drainage**

Water-logged soils are not suitable for crop production apart from paddy rice and coco yams.

**Ways of dealing with water-logged soils**

- a. Draining excess water
- b. Application of organic manure
- c. Breaking hard pans if presents

**6. Timely weed control**

The effects of weeds are that they compete with cultivated crops for water, air, minerals and space.

**The following are the methods that a farmer can employ to control weeds**

- a. Legislative
- b. Cultural
- c. Mechanical
- d. Biological
- e. Chemical

**7. Practising minimum tillage**

**The following are the ways how minimum tillage improves soil fertility**

- a. Maintains the soil structure
- b. conserves the soil moisture
- c. Reduces root drainage and disturbance
- d. Reduces soil erosion

**8. Practising inter-cropping**

Inter-cropping is the practice of growing different types of crops on the same piece of land at the same time.

**The following are the ways how inter-cropping maintain soil fertility**

- a. Ensuring maximum utilization of the soil minerals
- b. Legumes included among the crops add nitrates through nitrogen fixation**

**CLASSIFICATION OF FERTILISERS**

**State the two types of fertilizers**

- 1. Organic fertilizers
- 2. Inorganic fertilizers

**ORGANIC MANURES**

**What are organic fertilizers/organic manures?**

These are substances that are prepared from animal and plant remains and are added to the soil to supply plant nutrients.

**State five characteristics of organic fertilizers.**

- a. They have low nutrient value per unit volume
- b. They release nutrients very slowly
- c. They are rich in many plant nutrients
- d. They are bulky and hence cumbersome to transport and apply.
- e. They have few negative effects even if used over a long period of time.**

**State three types of organic fertilizers**

These are

- a. Green manure
- b. Farm yard manure

**c. Compost manure**

**GREEN MANURE**

**Define the term green manure.**

This is the type of manure that is made from green plants. Green plants are plants which are grown for the sole purpose of being incorporated into the soil to decompose and improve soil fertility.

Examples of crops used to make green manure are

- a. Maize
- b. Sorghum
- c. Wild sunflower
- d. Beans
- e. Clovers
- f. Luerne

Legumes have an added advantage in that they are able to supply nitrates to the soil.

**Explain how green manure is made.**

Crops are planted in the field and are allowed to grow up to the flowering stage, then ploughed back into the soil and are allowed to decompose. Sufficient time must be allowed for the material to decompose well before planting.

**State the qualities/characteristics of crops to be used as green manure.**

- a. They should be able to grow rapidly.
- b. They should be highly leafy or vegetative,
- c. They should have high nutrient content and preferably leguminous
- d. They should be capable for fast decomposition.
- e. They should be short for ease of ploughing into the soil.
- f. They should have the ability to grow on poor soils.

**State the reasons why green manure is not commonly used.**

- a. Proper timing of the correct stage for ploughing into the soil is necessary
- b. There is inadequate land space to grow the green manure crops.
- c. The release of nutrients by green manure crops is slow.

- d. Most of the green manure crops are food crops therefore farmers are unwilling to destroy them especially where the land is limited.
- e. They absorb available soil moisture and nutrients at the expense of the incoming crops.

### **FARMYARD MANURE**

#### **What is farm yard manure?**

It is a mixture of animal wastes and animal bedding which are completely rotten. Farm yard manure is also called pen manure/muck.

#### **Explain how farmers prepare farmyard manure.**

Animal wastes and bedding are taken from the animals' house/yards and are then heaped under rain -proof sheds where they are left to decompose. Constant turning -over or mixing is done to ensure uniform decomposition. Water may also be sprinkled if dry to speed up decomposition by the micro-organisms. When completely decomposed, the manure becomes dry. If farmyard manure is used when it is not completely decomposed, it may cause fungal disease. For, example, black scurf in Irish potatoes. When the manure is dry and finely broken down, it is then ready for use.

#### **Explain two reasons why it is important to prepare the farmyard manure under the shed.**

- a. To avoid a loss of nutrients due to volatilization of nitrates
- b. To avoid loss of nutrients due to leaching and washing away by rainfall.

#### **Outline the factors that influence the quality of farmyard manure.**

- a. The type of animal producing the manure-** Different types of animals provide varying qualities of farmyard manure depending on their nutrition and nutrient requirements.

Below is the order of nutrient richness of various manure from highest to the lowest

- Poultry manure
- Sheep manure
- Pig manure

- Horses manure
  - Cattle manure
- b. The quality of the feed given to the animal-** Livestock fed on feeds rich in nutrients will result in farm yard manure rich in the same nutrients
- c. Type of litter-** The best type of a litter is that of high urine absorption capacity and which is easy to decompose such as straw. Litter with a high level of nutrients produces high quality manure.
- d. Method of storage-** Proper storage is necessary to prevent volatilization, washing away of nutrients by rain and leaching.
- e. Age of the manure-** Well rotten manure is rich in nutrients and releases them fast into the soil.
- f. Age of the animal-** Young animals produce inferior quality manure while older animals give higher quality manure. This is because young animals use most of the nutrients for growth.

**Explain the advantages and disadvantages of manure.**

#### **Advantages**

- It is cheaper than the commercial fertilizers.
- It does not require high technical skills to make.
- It uses locally available raw materials and therefore minimizes wastage while maximizing utilization of resources.
- It improves the soil structure
- It is cheaper way of maintaining a clean environment

#### **Disadvantages**

- It is bulky hence difficult to prepare, transport and apply.
  - If poorly stored, stored nutrients are easily leached and volatilization can take place.
  - If used before it is completely rotten, it can cause fungal infection or scorch the plants.
- a.** It can introduce weeds in the seedbed through litter infested with weed seeds.

## **COMPOST MANURE**

**What is compost manure? Explain how is it prepared.**

Compost manure is manure that is prepared from organic materials like soft hedge cuttings, grass, and kitchen wastes.

### **Preparation**

Compost manure is prepared by piling plant residues in a heap or a pit. The material should be turned over at regular intervals to facilitate a uniform rate of decay. If the material is of low nitrogen content, ammonium sulphate may be added to improve the nitrogen content of the manure. If the material is dry, it can be moistened by sprinkling water.

**State the advantages and disadvantages of compost manure.**

#### **Advantages**

- One does not have to own livestock in order to prepare it.
- A lot of manure can be produced within a short time.
- A variety of materials can be used in its preparation.
- Use of organic compost manure improves soil aeration.
- Locally available materials can be used making it cheaper than the artificial fertilizers.
- It improves the soil structure.

#### **Disadvantages**

- It releases nutrients slowly into the soil
- Large quantities of compost manure are required to supply enough plant nutrients.
- Its preparation is labour intensive
- It may induce soil-borne pests such as nematodes.

**Explain the advantages and disadvantages of organic fertilizers.**

#### **Advantages**

- They are cheap because they are made from locally available materials.
- They bind the soil particles together thus improving soil structure
- They improve the water holding capacity of the soil

- They supply a variety a long residual effect; they can supply nutrients for a long period after application.
- They encourage activities of soil micro-organisms because they provide food and shelter to the organisms.
- They supply a variety of essential nutrients.
- They help to buffer soil pH.
- They help to moderate soil temperature.
- They do not require special skills to prepare or apply.

### **Disadvantages**

- They are bulky, hence expensive, to apply and transport.
- They have a low level of nutrients per unit weight
- They take long to release the nutrients as they must undergo complete decomposition.
- They can introduce weeds to the field.
- They can cause fungal infections or scorch the plants if not well-decomposed.
- They require a lot labour to prepare.

## **INORGANIC FERTILISERS**

### **Mention two types of inorganic fertilizers.**

1. Nutrient composition
2. Reaction composition

### **Explain two types/classes of nutrient composition of inorganic fertilizers.**

#### **1. Straight fertilizers**

These are fertilizers which contain only one of the three primary macronutrients.

Examples of straight fertilizers

- a. Nitrogen (N)
- b. Phosphorus(P)
- c. Potassium (K).

#### **2. Compound fertilizers**

## FORM TWO AGRICULTURE COMPREHENSIVE STUDY NOTES-SYLLABUS BASED

- These are fertilizers that contain two or three of the primary macronutrients.
- Incomplete compound fertilizers refer to the compound fertilizers that contain only two primary elements.
- Examples of compound fertilizers refer to the compound fertilizers that contain only two primary elements include Diamond Phosphate (DAP) that contains 18-47-0 AND 23;21:0
- Complete compound fertilizers refer to the fertilizer that contains all the three primary elements (N, P, K).
- Examples of Complete compound fertilizers refer to the fertilizer that contains all the three primary elements (N, P, K).
  - a. 20-10-10
  - b. 17-17-17
  - c. 15-15-15
  - d. 2:18:15

### **What is the difference between acidic fertilizers and basic fertilizers?**

- Acidic fertilizers are those fertilizers that increase the acidic (lower the pH) of the soil.
- Example of acidic fertilizer is Sulphate of Ammonia
- Basic fertilizers are fertilizers that reduce the acidic (raise the pH) of the soil.
- Neutral fertilizers are the fertilizers that neither nor lower the soil pH; they do not affect the acidity of the soil.

### **Explain the properties/characteristics of the nitrogenous fertilizer.**

1. They are readily soluble in water.
2. They have short residual effects on the soil
3. They scorch or burn the plant body upon contact.
4. They are highly volatile; change into gaseous form when applied to dry.
5. They are highly leached especially when the rainfall is high.
6. They are hygroscopic. This causes them stick together in lumps easily.
7. The fertilizers are applied as a top dress, band dress, side dress, through

## FORM TWO AGRICULTURE COMPREHENSIVE STUDY NOTES-SYLLABUS BASED

trickle irrigation and in foliar feed.

8. They are applied in splits when the plants are already growing, after weeding and when the soils are moist.
9. They are highly corrosive and thus corrode the epithelial cells.

### **Define the term immobilization.**

It is the process by which a certain quantity of nitrogen is assimilated into the soil micro-organisms tissue during the decomposition of plant residues in the soil.

### **What are the adverse effects of the application of excess nitrogenous fertilizer?**

1. An increased incidence of certain leaf diseases such as in rice blast.
2. Poor malting in barley.
3. Poor combustibility in tobacco.
4. Lodging of cereal crops.
5. Excessive vegetative growth at the expense of tuber formation in root crops.
6. Failure to form tubers in root crops. For example, Irish potatoes.

### **State the examples of nitrogenous fertilizers.**

1. Sulphate of ammonia
2. Ammonium Nitrate
3. Ammonium Sulphate Nitrate
4. Calcium Ammonium Nitrate
5. Urea.

### **Give the characteristics of phosphatic fertilizers.**

Phosphatic fertilizers are processed from the rock phosphates using sulphuric acid which forms the water-soluble mono-calcium compounds.

Phosphatic fertilizers are mainly found in Uganda, the former Soviet Union, United States of America and some regions of North Africa.

### **Phosphatic fertilizers have the following properties/characteristics**

1. They are not readily leached.

2. They are slightly soluble in water.
3. In acidic soils, much of the fertilizer is converted into insoluble compounds and thus becomes fixed. Due to this fixation, phosphate fertilizers must be placed in the root range of growing plants.
4. Phosphatic fertilizers have a long residual effect on the soil and can be available to plants long after its application.
5. Phosphatic fertilizers have a slight scorching effect.

**List the examples of phosphatic fertilizers.**

1. Single Super Phosphate
2. Double and Triple Super Phosphate
3. Soda phosphate
4. Basic slag

**List the characteristics of potassic fertilizers.**

Potassic fertilizers are fertilizers which are manufactured from salts such as soluble potassium and sodium chlorides. They are mainly found in Germany, Spain, Russia, France and Israel.

**Potassic fertilizers have the following properties/characteristics**

1. Most of them are manufactured from sulvinitite salts which are soluble salts of potassium.
2. They have moderate scorching effect.
3. They are readily absorbed by plants once in solution form.
4. They must be incorporated into the soil.
5. They are applied as a top dress fertilizer.
6. They are only applied when the soil has been tested and found to lack potassium.

**List the examples of potassic fertilizers.**

1. Potassium chloride-. Muriate of potash, Potassium sulphate
2. Potassium magnesium sulphate
3. Wood ashes

**What are compound fertilizers?**

## FORM TWO AGRICULTURE COMPREHENSIVE STUDY NOTES-SYLLABUS BASED

These are fertilizers that contain two or three of the primary macronutrients (nitrogen, phosphorous and potassium).

Complete compounds are fertilizers which have all the three primary macronutrients whereas incomplete compound fertilizers are fertilizers that lack one of the primary macronutrients.

In compound fertilizers, the elements are expressed in percentage forms of N,  $P_2O_5$  and  $K_2O$ . For example , 20-20-0 has 20%N, 20% $P_2O_5$  and 0% $K_2O$ .

### **List the examples of compound fertilizers.**

17–17–17	11–54–0
15–50–0	15–45–0
2–18–15 (Compound A) 4–18–15 (compound B)	
8–18–6 (compound D)	

### **Explain the advantages and disadvantages of compound fertilizers.**

#### **Advantages**

- a. They are cheaper and more convenient to apply thereby saving on cost, time and labour.
- b. They are easy to store as they do not form lumps when stored over a long period of time.

#### **Disadvantages**

- a. They are less bulky hence cheap to apply and transport.
- b. They can contain high levels of nutrients per unit weight.
- c. They are readily release nutrients once applied.

### **Give the advantages and disadvantages of inorganic fertilizers.**

#### **Advantages**

- The nutrients are readily available to the plants and therefore the results can be seen in a few days.
- A farmer is able to know the exact nutrient that is being added for plant use.
- The chemicals used in preparing the fertilizers are accurately measured and thus there is a balanced distribution of the essential nutrients in the

fertilizers.

### **Disadvantages**

- a. The fertilizers are expensive and thus most farmers cannot be able to afford purchasing the fertilisers.
- b. Inorganic fertilizers are easily leached from the soil and into water resources thereby making the nutrients unavailable for the plants.
- c. If the fertilizers are used excessively, there is a danger of over fertilization of the soil. This is because the nutrients are readily available.
- d. The chemical fertilizers lead to environmental pollution especially when they are washed into the water.

## **CHAPTER 3 - AGRICULTURAL AND CLIMATE CHANGE**

### **Define the term “climate”.**

Climate refers to all weather elements of an area observed over a long period of time usually over 30 years.

Elements of weather include

Rainfall/precipitation, temperature,, wind , relative humidity and light.

### **Define climate change.**

Climate is the gradual change in the weather elements of particular place.

### **List the causes/of climate change or factors that affect climate change.**

#### **1. Natural factors**

- a. Volcanic eruptions
- b. Changes in earth's orbit around the sun
- c. Changes in solar radiation

#### **2. Human causes**

1. Production of greenhouse gases.
  - These gases raise the global temperature.

**Examples of these gases include**

- **Carbon dioxide**
- It released in large quantities from burning fossil fuels such as

petroleum, coal and natural gases. Carbon dioxide leads **to** significant raising of the global temperature.

### a. Nitrous oxide

This is a very powerful greenhouse gas produced through production and use of organic fertilizer and burning of fossil fuels.

### b. Methane

The most significant source of methane is decomposition of organic matter such as in landfills and in agriculture. Digestion in ruminant animals also produces significant amounts of methane.

### c. Chlorofluorocarbons

These are produced for industrial use as refrigerating and as air conditioning compounds.

## 2. Aerosols

Some human activities lead to an increase in the amount of aerosols in the atmosphere. These include the following

- a. Aerosols absorb solar and infrared radiations hence raising the global temperature.
- b. Dust released into the atmosphere by tilling land when very dry.
- c. Industrial processes produce a variety of aerosols
- d. Burning of biomass leads to production of soot particles
- e. Exhaust fumes from engines also produce aerosols

## 3. Deforestation

This is the indiscriminate clearing of forest cover which leads to changes of the land surface. Removal of land surface cover leads to changes in the amount of light reflected from the earth's surface back to space.

### In which ways do human beings contribute to climate change?

1. Production of greenhouse gases. These gases raise the global temperature.

#### Examples of these gases include

### d. Carbon dioxide

It released in large quantities from burning fossil fuels such as petroleum, coal

and natural gases. Carbon dioxide leads **to** significant raising of the global temperature.

### e. Nitrous oxide

This is a very powerful greenhouse gas produced through production and use of organic fertilizer and burning of fossil fuels.

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- Industrial processes produce a variety of aerosols
- Burning of biomass leads to production of soot particles
- Exhaust fumes from engines also produce aerosols

### What are the effects of climate change on land?

The following are the effects of climate change on land

1. Erratic rainfall due to indiscriminate deforestation.
2. Seasonal droughts that gradually give way to aridity leading to loss of arable land.
3. Floods which lead to serious land degradation by forming of land gullies and consequently loss of arable land.
4. Changing woodlands
5. Landslides and mudslides degrading the land for agricultural activities.

**What are the effects of climate change on crop production?**

1. Increase in crop pests - When climate increases reproduction and rate of growth of crop pests hence increasing their population.
2. High carbon dioxide concentration stimulates growth of certain crops thereby increasing their yield.
3. Erratic rainfall and drought leads to total crop failure lowering the expected yield.
4. Flooding makes the land water-logged damaging the crops already grown lowering crop yield.
5. Strong winds cause breakages of tree crops and lodging of annual crops affecting the expected yield.
6. Landslides and mudslides may destroy crops already growing in the field such as tea, lowering the out of the crop.
7. Flash and intense rainfall lead to loss of the top of the fertile soil. This reduces the potential of the land to produce high crop yield.
8. Unpredictable weather patterns leave the farmers unable to make appropriate decisions such as for land preparation and time for planting annual crops.

**In which way does climate change impact livestock?**

1. Increased temperature may induce heat stress in animals in areas that were initially cooler.
2. Low rainfall and drought will lead to low quantity fodder for livestock lowering livestock growth and output.
3. Increased temperature leads to faster multiplication and growth of livestock parasites such as ticks and tsetse flies. This leads to increased vector-borne diseases negatively affecting the livestock industry.
4. Low water levels lead to low fish stocks.
5. Temperature changes will influence the distribution of livestock as areas that were previously cool become warmer with time.

**In which way does climate change impact livelihood?**

1. Increased food security which leads to malnutrition and hunger. This results in reduced farm labour and chronic deficits.
2. Floods lead to water pollution lowering the quantity of pure water. This may result in outbreaks of water-borne diseases such as dysentery and cholera.
3. Low water levels in rivers and dams have impacted negatively on hydroelectric power generation such as river Shire.
4. Spread of malaria and other vector-borne diseases in areas previously too cold for the vectors to survive.
5. Floods also lead to siltation of dams and other bodies lowering their capacity for storing water.
6. Low water supply impacts negatively on industries as they do not get adequate water.
7. Floods are responsible for the destruction of fish ponds leading to loss of livestock for the fish farmers.
8. Forest fires are more prevalent during the dry season. Such fires lead to loss of seedlings and biodiversity of a given region.

## **CHAPTER 4: IRRIGATION**

### **Define the term irrigation**

Irrigation is the artificial application of water into the soil so as to provide adequate moisture for plant growth.

### **Explain the importance of irrigation.**

Irrigation has the following importances

1. It enables growing of crops during dry seasons when there is no rain.
2. It is used to supplement inadequate rainfall so as to grow crops.
3. It is a method of land reclamation in arid and semi arid areas.
4. It enables growing of crops in special structures such as green houses.
5. It enables one to grow crops that require high amount of water such as paddy rice.
6. It is a source of employment where it is used intensively.
7. It promotes crop production for export market earning revenue to the

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country.

8. Overhead irrigation helps control some crop pests such as aphids.

**Describe three systems of irrigation.**

**Three systems of irrigation include**

1. **Surface irrigation**- This is a system of irrigation where water reaches fields to be irrigated through canals or furrows
2. **Overhead irrigation** - This is a system of irrigation where water is supplied to growing crops from above in form of fine droplets.
3. **Drip irrigation** - This is a system of irrigation where the water is supplied at the root zone of the crop in of form of drops. The system is also known as trickle irrigation.

### SURFACE IRRIGATION

**Define the term surface irrigation.**

Surface irrigation is a system of irrigation where water reaches fields to be irrigated through canals or furrows

**State three conditions necessary for surface irrigation.**

1. **Topography** - The land must be fairly gentle sloping for the water to flow by gravity.
2. **Amount of water supply**- Plenty of water is required due to high wastage through seepage and evaporation.
3. **Soil type**- The soil must be able to hold water for a long period of time and should preferably by clay soil.

**Describe three types of surface irrigation.**

**1. Flood irrigation**

- This is the type of irrigation where water is allowed to flow into the field through furrows or canals. Water is directed to various parts of the farm by opening of sluice gates in the field.
- It requires that land be as flat as possible.
- This type of irrigation is best used in growing paddy rice which requires flooded fields as shown below.

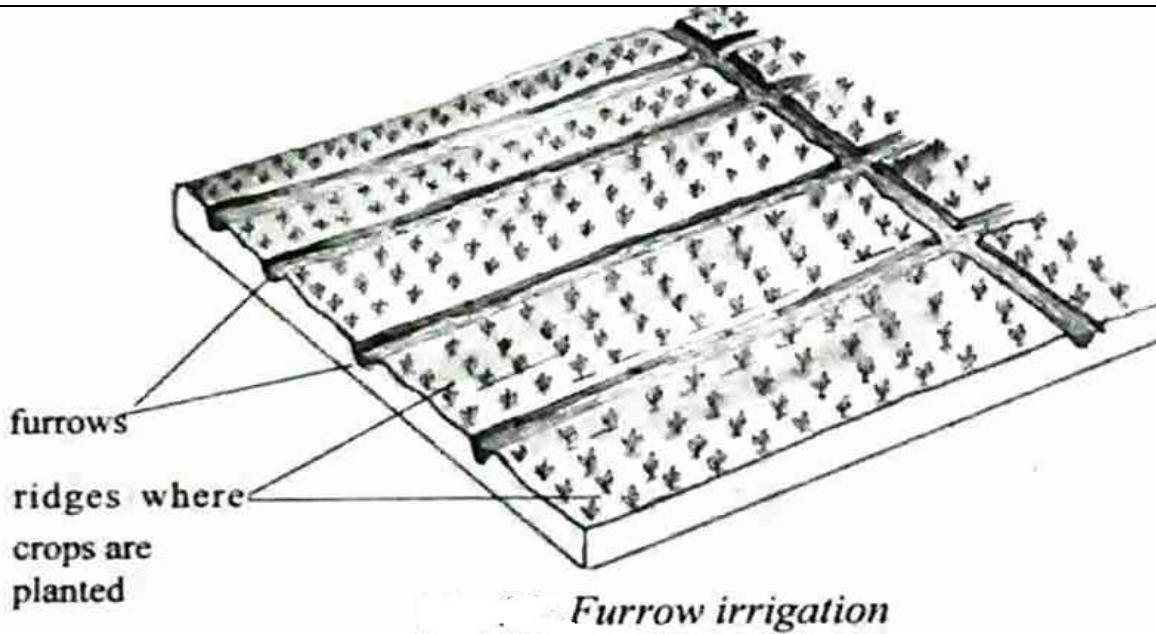


This diagram below also shows flood irrigation



## 2. Furrow irrigation

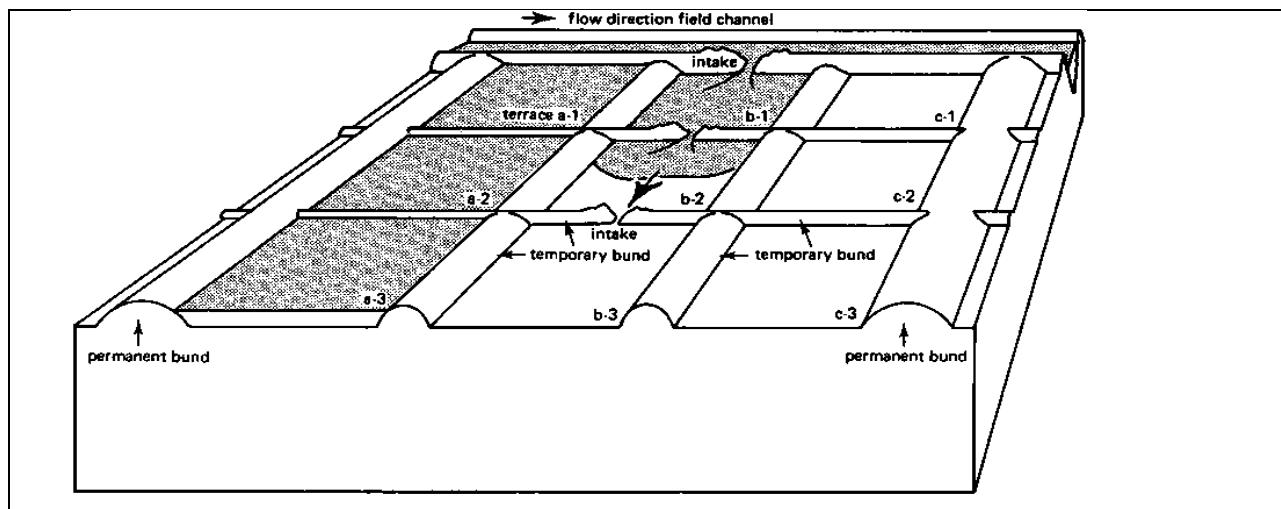
- This is system of irrigation where water flows through open gates and is used on land with gentle slopes of 1% gradient.
- The furrows are dug along the contours to reduce soil erosion. As water flows along the furrows, it wets the soil on the ridge. Crops are planted on the ridges of the furrows.
- The figure below shows furrow irrigation



### 3. Basin irrigation

- It is the flooding of an entire area enclosed by earth embankments known as dykes or levees. Water is allowed into each level basin through an inlet.
- The difference between flood irrigation and basin irrigation is that in flood irrigation the surface is always flooded with water while in basin water is only allowed to flow in when needed.
- The figure below shows basin irrigation





**Explain the advantages and disadvantages of each of the following types of surface irrigation.**

### Flood irrigation

#### Advantages of flood irrigation

- It is relatively cheap to establish
- It requires less skill

#### Disadvantages of flood irrigation

- A lot of water is used
- Water is unevenly distributed causing water-logging in some areas while other parts do not get enough water.
- Siltation of canals is prevalent
- It can only be practiced in soils with high water retention capacity.
- It can only be practiced in flat areas

### Furrow irrigation

#### Advantages of furrow irrigation

- Reduces incidences of fungal diseases such as leaf blight because the leaves do not come into contact with water.
- Relatively cheap to establish and maintain
- Requires less skills

#### Disadvantages of furrow irrigation

- A lot of water is wasted

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- b. Soil erosion may occur if the design is not well done.
- c. If water is saline, it may affect plant roots.
- d. It is not easy to maintain a uniform of water in the furrows from the source to the end.

### **Give three maintenance practices of surface irrigation.**

The following are the maintenance operations which are necessary for surface irrigation

- a. Repair of levees if broken
- b. Removal of weeds in the canals, basin inlet and outlet.
- c. De-silting of canals.
- d. Repair of sluice gates.**

### **Explain the advantages and limitations of surface irrigation.**

#### Advantages of surface irrigation

- 1. It is cheap to establish and maintain
- 2. It does not require a lot of skills
- 3. It is widely used in the country

#### **Disadvantages of surface irrigation**

- 1. It results in accumulation of a lot of salts in the soil.
- 2. It cannot be used in sloppy areas
- 3. Floods may destroy the basins during heavy rains
- 4. A lot of water is wasted
- 5. There may be high incidences of water-borne diseases such as bilharzias and malaria.**

## **OVERHEAD IRRIGATION**

### **Define an overhead irrigation.**

This is an irrigation system where water is supplied to growing crops above in form of fine droplets.

### **Explain three ways in which overhead irrigation is practiced.**

- 1. Use of hose pipe** - This is appropriate for small scale farming.
- 2. Use of sprinklers** -This is where the water is forced through pipes and out

through the sprinklers.



- 3. Use of watering cans.** - This is suitable for watering seedlings in a nursery bed but only at small scale.

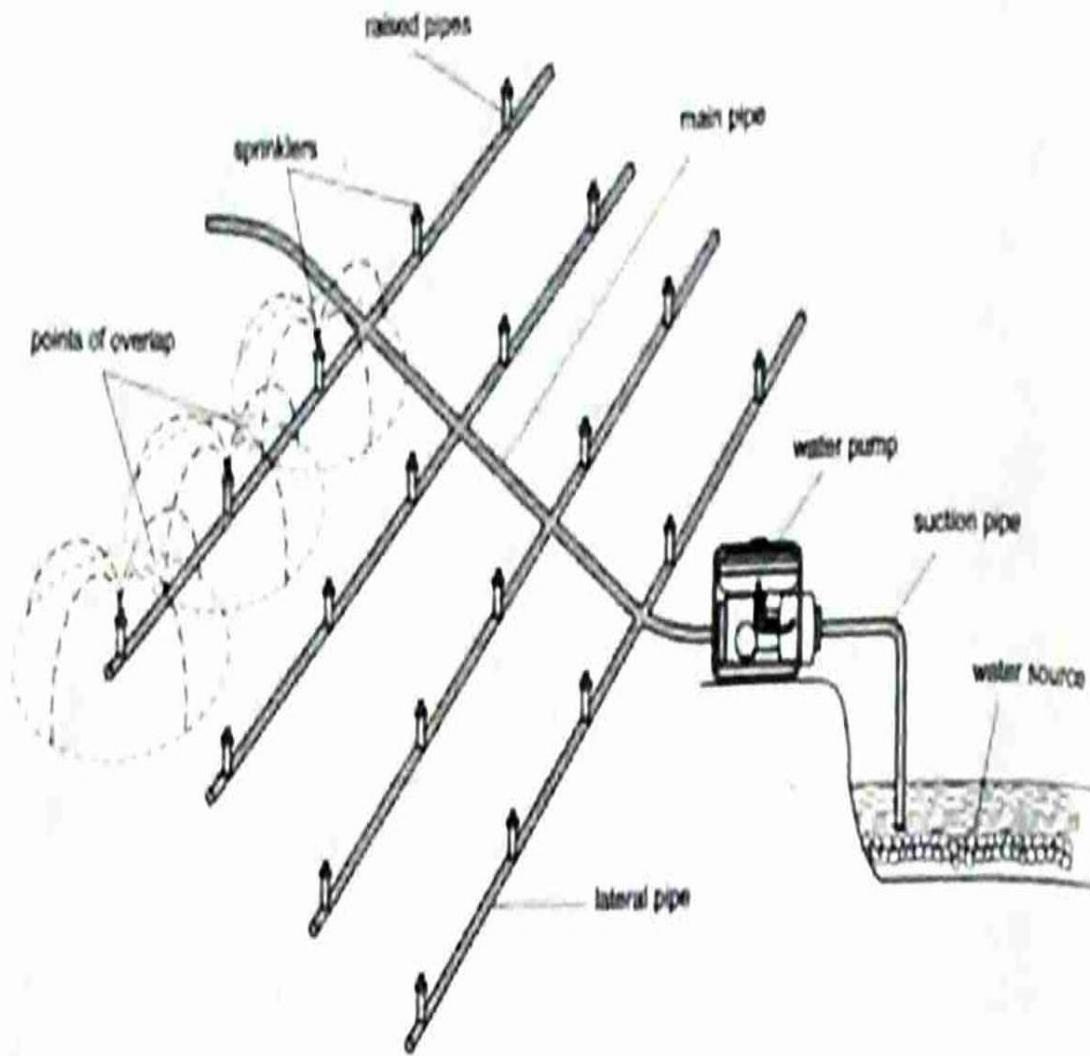


**State four main components of an overhead irrigation.**

1. **Pump**- This provides a mechanical force that pushes water through pipes and out through sprinklers.
2. **Main pipes** - This delivers water from the pump into the field.
3. **Riser pipes**- They hold the sprinklers at the top.
4. **Sprinklers**- They release water under pressure in form of fine droplets.

**Two types of sprinklers**

- a. **Continuous rotating sprinklers** - It is appropriate for small scale farming.
- b. **Spring loaded sprinklers**- Suitable for large scale irrigation.



**Give the advantages and disadvantages of overhead irrigation.**



### **Advantages of overhead irrigation**

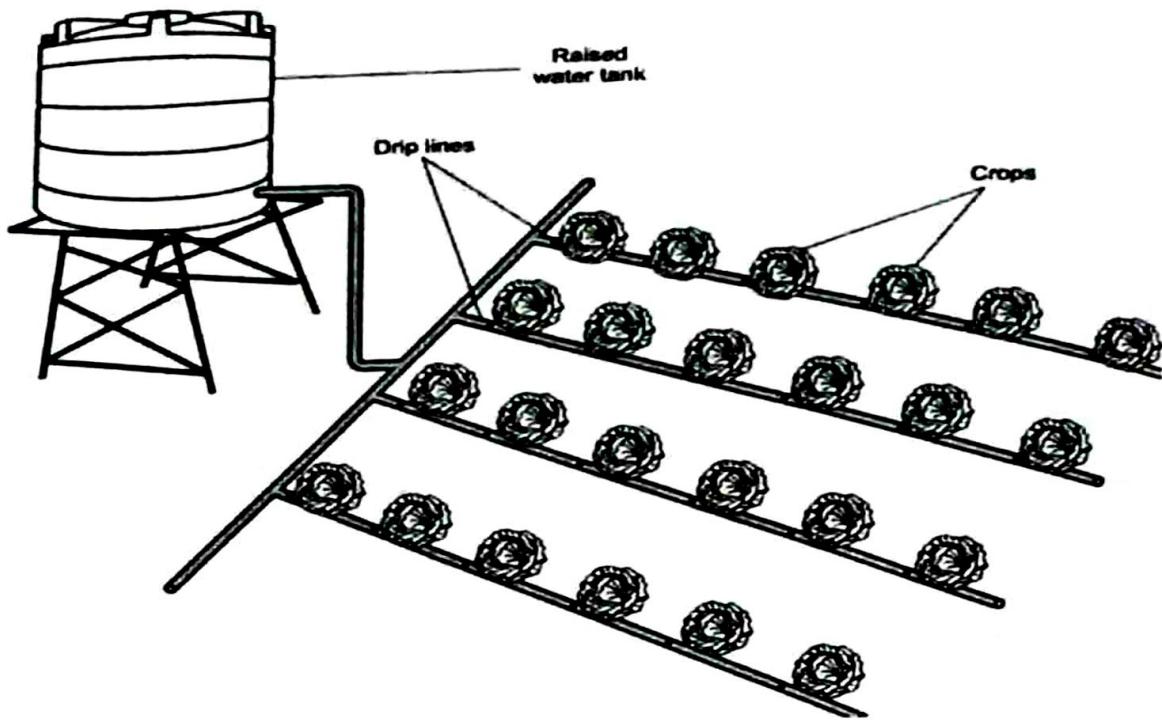
1. Does not require leveling of the land, can be practiced even on sloppy areas.
2. Water is evenly distributed in the required area.
3. Use of water is economical compared to surface irrigation.
4. Soluble fertilizers and herbicides can be mixed with the irrigation water and applied so.
5. It is easy to move the sprinklers from one point to another.
6. Soil erosion is minimized.
7. It does not require special skills.

### **Disadvantages of overhead irrigation**

1. It is expensive to start.
2. May destroy the soil structure due to heavy of water impact.
3. The method may require the establishment of wind breaks.
4. It increases incidences of fungal diseases on the crop.
5. It can lead to soil erosion if not well-controlled.
6. The water must be under pressure.
7. The water must be free from solid impurities otherwise the sprinkler nozzles will be blocked.

## **DRIP IRRIGATION**

**Define the term drip irrigation/trickle irrigation**



This is the system of irrigation where water is applied at the root zone of the crop in form of drops.

**State the advantages and disadvantages of drip irrigation.**

#### **Advantages of drip irrigation**

1. It uses most water economically hence suitable for dry areas.
2. Does not encourage fungal diseases on the crop
3. Does not encourage growth of weeds between the rows.
4. Water even at low pressure can still be used.

Disadvantages of drip irrigation

1. It is quite expensive to install
2. It requires high levels of skills
3. The water must be free from solid impurities to prevent blockage of nozzles.

**State and explain the factors that influence the frequency and time of irrigation.**

#### **1. Type of soil**

Soils with free drainage tend to lose water fast through seepage. Such soils

require to be irrigated more frequent compared to soils with low drainage such as clay soils.

### 2. Type of crop

Some crops require more water than others thus they should be irrigated more frequently and for a longer duration. Such as paddy rice and vegetable crops.

3. **Weather conditions-** During hot and dry weather, the rate of evapo transpiration is high. This makes crops and the soil to lose water faster. This calls for more irrigation water than when it is cool.
4. **Moisture content of the soil** - Small amount of water is required if an area has recently received rainfall.
5. **Presence of mulch**-Mulching conserves soil moisture by reducing its rate of evaporation. This calls for low frequency of watering the crops.
6. **Stage of plant growth** - Some crops requires more water in certain stages of their growth than other stages. Maize requires more water during the silking and filling stage of its growth.

**Explain the factors that are considered by the farmer when selecting irrigation systems.**

1. **Topography-** Surface irrigation requires a relatively flat area where water can flow slowly with little or no soil erosion. Piped irrigation can be practiced in any topography as there is no risk of erosion.
2. **Source of water-** surface irrigation requires large water sources such as a river, dam or a fresh water lake since it requires large amounts of water.
3. **Type of crop-** Paddy rice requires large water sources such as a river, dam or a fresh water lake since it requires large amounts of water.
4. **Value of crop-** Some irrigation systems are very expensive to install, for example drip irrigation. The farmer should only choose drip irrigation in case the crop to be grown has a very high profit margin.
5. **Capital.** Surface irrigation is relatively inexpensive to establish compared to piped irrigation. A farmer with little capital may not afford to install piped

## FORM TWO AGRICULTURE COMPREHENSIVE STUDY NOTES-SYLLABUS BASED

irrigation.

6. **Technical.** Drip irrigation requires high technological knowhow compared to surface irrigation.
7. **Soil type-** Surface irrigation requires soil with poor drainage and high water holding capacity; otherwise a lot of water would be lost through infiltration. Pipe irrigation can be practiced on any soil type because the water flows inside pipes.
8. **The technical knowhow.** Drip irrigation requires high technological compared to surface irrigation.

**Outline the maintenance practices of a surface irrigation system.**

- a. Repairing broken components such as pumps.
- b. Removal of weeds in the canals, basin inlet and outlet.
- c. De-silting of canals.
- d. Repairing of sluice gates.

**List the maintenance practices of an overhead irrigation unit.**

- a. Repairing broken components such as pumps.
- b. Replacing broken pipes, sprinklers among others.
- c. Occasionally flush the pipes with phosphoric acid to remove salts especially where saline water is used.
- d. Replacing faulty parts such as emitters or nozzles.
- e. Unblock the sprinkler nozzles in case they are blocked.

## CHAPTER 5

### GENDER AND AGRICULTURAL PRODUCTION

**Explain the meaning of the term ‘gender roles’ in agricultural production.**

It refers to cultural or social duties performed by either male or female members in a given community.

**Describe the roles played by women in Malawi.**

1. Producing agricultural crops. Women do activities like weeding, harvesting, fertilizer application and other related duties.

## FORM TWO AGRICULTURE COMPREHENSIVE STUDY NOTES-SYLLABUS BASED

2. Rearing livestock.
3. Processing and preparing food.
4. Working for wages in agricultural or other rural enterprises.
5. Collecting fuel and water.
6. Engaging in trade and marketing.
7. Caring for family members and maintaining their home

**Explain the factors that limit women involvement in agricultural production.**

- a. **Land ownership**- In customary laws of landownership, land is owned by men and they have the sole rights to decide on the proportions of what is to be produced.
- b. **Land use** - Men make decisions on growing of cash crops while women are involved in production of food crops.
- c. **Access to credit** - Women have no right over land ownership and hence cannot use it as a form of security to get loans.
- d. **Extension and training services** - Women have limited access to extension and training services due to socio-cultural values and low levels of education.
- e. **Use of farm income**- Women do not participate in making decisions on how to use the income upon sale of the produce despite that are involved in cultivation and management of livestock. Decision making is left to men.

**List the factors that limit the involvement of female farmers in decision-making.**

1. Poverty among women
2. High illiteracy amongst women.
3. They are not empowered economically.
4. There is low representation of women in power structures of decision making.

**State seven ways of improving the involvement of female farmers in decision-making for agricultural development.**

## **FORM TWO AGRICULTURE COMPREHENSIVE STUDY NOTES-SYLLABUS BASED**

1. Improving access to education opportunities for both men and women without discrimination against certain gender. This reduces illiteracy levels.
2. Allowing access to land by both men and women in rural and urban areas. This will increase input in terms of labour and use of machinery hence an increase in productivity.
3. Increasing representation of women in power structures and decision-making in their communities will politically empower them.
4. Invest land or capital in women to improve their economic base.
5. Enlighten the community on the contribution women can make in agricultural development and view them as partners and not as subordinates.
6. Review land and property ownership. This will ensure women own land and property.
7. Empowering women culturally. This should include giving equal power to female farmers to contribute to decision-making.

**Explain one reason why women may not access agricultural credit facilities.**

The reason is that women do not have the right over land ownership and hence cannot use it as a form of security to get loans.

**Explain three benefits of equal division of labour in agricultural development.**

Women do more of agricultural activities compared to men. Therefore, it is better when both men and women contribute equally towards agricultural production. This may bring the following benefits:

- a. Men and women will be working as a team hence decisions will be made jointly.
- b. Men and women will cooperate in all farming activities.
- c. Work on the farm will be fairly distributed between men and women hence no overworking of one group.
- d. Men and women will make consultative decisions in income utilization and

## FORM TWO AGRICULTURE COMPREHENSIVE STUDY NOTES-SYLLABUS BASED

investment.

### **Describe the roles of women in making decisions in agricultural development.**

Women are involved in making minor decisions in agricultural production and in consultation with their husbands.

- Women make decisions on when to get credit to increase agricultural production and how the credit borrowed will be repaid.
- They help in the employment of casual labour.
- They get consulted often for selected agricultural decisions such as the amount of grains to be sold, used and that which is to be sold.

Examples of the decisions that are made by women include

- Time of land preparation.
- Time of land planting
- Time of land weeding
- Time of land harvesting
- Time of land applying fertilizer.
- Selling of minor produces such as vegetables, fruits and small stock like chicken and eggs.
- What food crops to produce
- How much crops to produce
- What commercial enterprise to undertake
- Marketing of major produce like tea and cotton.
- How to produce, that is, the technology to use.
- How much to produce; that is the size of each enterprise.

### **Explain the impact of gender roles in agricultural production in Malawi.**

#### **The following are the effects of the existing gender roles**

1. **Inappropriate land preparation-** Over 70% of Malawian households are headed by women. They have less labour available for heavy tasks like land preparation because they have fewer male family members. This leads to

inadequate and late preparation.

- 2. Late planting-** Late land preparation leads to late planting which affects general crop yields.
- 3. Low yields-** As a result of poor land preparation and late planting, crop yields will always be below average.
- 4. Low quality produce.** Farmers do not practice timely pest and disease control measures because the pesticides may not be available at appropriate times.
- 5. Low household income-** Low agricultural output and low quality produce lead to low income to the farmers.
- 6. Low adoption of mechanized agriculture-** Most farmers being of low levels of education, have a hard time understanding modern agricultural technology. This leads to inefficient agricultural production.

### CHAPTER 6: EXPERIMENTAL DESIGN

#### What is experimentation?

It is a type of research design that deliberately imposes the treatment on a group of objects or subjects in the interest of observing their response.

#### Define the term agricultural experimentation.

It is an aspect of research which is performed so as to find out the facts of an act or a happening.

#### What is an experimental design?

An experimental design is a plan that is used to assign the experimental units to treatment conditions.

#### Explain two types of experimental designs.

##### 1. Randomised block design

This is an experimental design where the units to be used when conducting an experiment are arranged in groups known as blocks to ensure greater level of accuracy is achieved.

##### Example

A researcher wanted to find out the effects of three levels of CAN fertilizers

(100kg/ha, 150kg/ha, 200kg/ha) on the yield of four hybrids of maize (A, B and C). Design an experiment using randomized block design.

Variety of maize	Level of CAN application		
A	100kg/ha	150kg/ha	200kg/ha
B	150kg/ha	200kg/ha	100kg/ha
C	200kg/ha	100kg/ha	150kg/ha

The yield of maize, kg/ha, is then filled for each variety of maize in response to each level of CAN application.

## **2. Latin square design**

This is an experimental design used when the experimenter wants to manage the units in an experiment that are related to rows and columns. The treatments are assigned once and at random on each row and columns. There are equal number of rows and columns and the treatment applied.

**An example is shown below**

<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>F</b>
<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>F</b>	<b>A</b>
<b>C</b>	<b>D</b>	<b>E</b>	<b>F</b>	<b>A</b>	<b>B</b>
<b>D</b>	<b>E</b>	<b>F</b>	<b>A</b>	<b>B</b>	<b>C</b>
<b>E</b>	<b>F</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
<b>F</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>

**Describe the factors to consider when laying out experiments.**

### **1. Treatments**

This is what is applied on the experimental units. The person conducting the experiment should choose a variety of suitable treatments to apply on the experimental units so as to monitor its effect on other units.

Treatments are carried out with a view of solving a hypothesis. A farmer can plant hybrid maize at different time intervals in the rainy season so as to determine the most suitable time for planting. In this case, different time intervals are the treatments given to each experimental unit.

### **2. Randomisation**

- Randomisation is the practice of assigning objects of study to an experimental unit by chance.
- Randomization is the true way of creating homogenous treatment units which helps to eliminate any form of potential bias from the researcher.
- The following are methods of randomizing experimental designs

### a. Completely randomized design

This is where all the objects or subjects of study are assigned to groups completely at random.

### b. Randomised block design

This is where the subjects or objects are first divided into homogenous units, known as blocks, before they are randomly assigned to treatment groups.

### The techniques/methods of randomizing treatments

- a. Shuffling of playing cards
- b. Drawing pieces of paper from a bag.
- c. Tossing a coin

### 3. Replication- This involves repetition of the basic experiment.

### The following are benefits of replication in the agricultural experimentation.

- a. Secures more accurate estimates of the experiment error.
- b. Decreases experimental errors thus increasing precision
- c. Obtains a more precise estimate of the mean effect of a treatment.

**Explain the following activities that are involved when conducting an agricultural research.**

### 1. Applying treatments

This involves selecting treatments randomly. **Random assignment** refers to the process of deciding which subject gets which treatment.

The treatment should be the only one practice carried out on the subject different from the rest of the population.

## **2. Collecting data**

- Data is anything given as a fact on which research conclusions will be based.
- Therefore, data collection involves gathering data.
- The techniques/tools which are used in data collection
  - a. Observation,
  - b. Questionnaires
  - c. Interviews
  - d. Document analysis.
- In collecting data ensure the following:
  - a. collect accurate data
  - b. Record the data in a book to serve as reference.
  - c. Use proper tools for carrying out measurements such as weight, height and length.

## **3. Recording data**

- This involves presenting the collected data in forms of tables, graphs and figures.

Therefore the forms of data presentation include

  - a. Graphs
  - b. Tables
  - c. Figures
- **Tables** are used to record precise numerical data.
- A good table should have the following
  - a. Table number
  - b. Title
  - c. Column headings
  - d. Row headings
  - e. Body of the table
  - f. Foot notes
- A table should self-explanatory and clearly show the main points. Units of

measurements should be well indicated such as cm, kg, tones etc and figures should be rounded off to two significant figures such as 8.27 rather than 8.2568cm.

- **Graphs** are used for illustrating trends and relationships among sets of variables. The following are the different types of graphs that are used in presenting data collected during agricultural research
  - a. **Line graphs**- show relationship among data
  - b. **Bars and histograms**- used to compare quantities
  - c. **Pie charts**- show proportions of a whole component as wedges of a circle.  
A percentage must be assigned to the segment or wedge.
  - d. **Flow charts** - shows the process of a complex system.

**Figures** are used to show vivid evidence of research findings and include line drawings and photographs.

### 4. Data analysis

This deals with the organization, interpretation and presentation of collected data.

The two techniques of data analysis include

#### a. Descriptive analysis

This involves analyzing the data using central tendencies such as calculating the mean, median and mode. This describes how close a measure is to the central measure. It also involves dispersions such as calculating range, quartile deviation and standard deviation, to describe a group of subjects. This helps to describe how far a measure is from the central measure.

#### b. Inferential analysis

This is where statistics are used to draw conclusions about the population from which the sample was taken.

### 5. Evaluating data

This is the discussion of the results and describing the implications of the findings. The researcher mainly identifies and interprets the major findings

## FORM TWO AGRICULTURE COMPREHENSIVE STUDY NOTES-SYLLABUS BASED

that relate directly to the study objectives. The researcher states and explains how the study helps to resolve the original problem and suggests improvements.

### **Explain the importance of report writing in agricultural research**

- The reports are meant to communicate the progress of the experiment, the project or the conclusions.
- Reports are based on records which have been kept continually. They tell about success or failures, they motivate the students and keep them informed on what they are doing or let the community know what goes on in the community.
- Reports inform on what other people are doing and motivate others to undertake experiments in the various areas. They help in evaluation.
- It enables students to arrange and organize the information desired from the project or experiment.
- It makes it easier to identify any missing link in the process.
- The report makes analysis of the information easier.
- It is easier to assess the project or the experiment.
- It can lead to changes in the objectives, methods and activities for future participations.
- Outlines the significance of the findings
- Give recommendations
- Allows other scientists to assess work and criticize it.
- Provides a means of presenting ones findings after the research is concluded.
- Allows the sponsor to see what their money was put into.

### **Discuss the following parts of a report of an agricultural experiment.**

#### **1. Title**

- This is the statement that describes what is being investigated. It appears on the first page of the report.

## **FORM TWO AGRICULTURE COMPREHENSIVE STUDY NOTES-SYLLABUS BASED**

- It gives a summary of the main idea of the research in a simplified and clear way.

### **2. Introduction**

- Introduction is usually the first chapter in a report. It provides the basis of the study. It gives an overview of the research, highlighting the background information, statement of the problem being analyses, the significance and scope of the research.

### **3. Aim/purpose of the research**

- This is a broad statement of what the study/research intends to find out or achieve. It elaborates on the information mentioned in the title by giving a quick overview of the study.

### **4. Objectives**

These are the specific aims of the study. They show specific outcomes that specify more directly what the research is going to do.

A good research objective should be:

- a. Specific
- b. Measurable
- c. Attainable
- d. Realistic
- e. Time bound
- f. Clearly indicate the variables to be investigated and their relationship. For example determining the relationship between depth of planting of maize and the yield of maize in Mzimba district in Malawi.

### **5. Materials and methods**

This clearly indicates all the materials and equipments that were used in carrying out the research such as hoes, machines, fertilizers, manure, maize seeds etc.

### **6. Design of the experiment**

This describes the methodology and methods that the study adopted as well as reasons for the choice. There are several designs that can be used

depending on the set objectives of study.

The researcher should:

- a. Identify and name the research design
- b. Briefly and in concise terms, describe the design.
- c. Justify for the use of the design.
- d. Explain how the design will be used.

### 7. Results

This gives a detailed description of the results obtained after data analysis.

The data collected can be presented in form of tables and figures.

There are two kinds of the data that can be collected in a study

- a. **Quantitative data-** It is got from measurable variables. These can be measured using a scale that shows how much of the characteristics is present. These variables include height of the seedlings, size of the cob, yield of maize per unit area,
- b. **Qualitative data-** This indicates the objects under study and individual differences that a researcher can find in a particular way.

When presenting findings, the researcher restates each objective and then includes all the findings related to that objective.

The data collected should be analysed using a suitable technique and presented in an acceptable and conventional manner.

### 8. Discussion of the results

This involves the interpretation of findings in the research objectives. The following procedure should be followed

- a. Give a brief summary of the problem that was being investigated.
- b. Present the major findings under each objective.
- c. Discuss the possible reasons why the results occurred in that way.
- d. Make theoretical interpretations of the findings.

### 9. Conclusion

On completion of the study, the researcher will draw conclusions based on the information presented and analysed with respect to the research

problem and the main research objectives.

#### **10. Recommendations**

These present the possible solutions to the research hypothesis based on the findings of the research. The recommendations should have a target group. This means that what should be done, how and when.

### **CHAPTER 7: FARMING SYSTEMS**

#### **Explain the meaning of the term “farming systems”**

A farming system refers to the way a farmer organizes and carries out farming activities on his or her farm.

#### **Identify two types of farming systems.**

##### **a. Intensive farming systems**

This is a system of farming that is characterized by high capital investment and maximum utilization of available land.

##### **b. Extensive farming systems**

Extensive framing system is a system of farming that is characterized by low capital investment and is usually carried out on large tracts of land.

### **INTENSIVE FARMING SYSTEMS**

#### **Explain the meaning of the intensive farming system**

This is a system of farming that is characterized by high capital investment and maximum utilization of available land.

In other words, it is a system of farming which involves the use of small pieces of land to produce large quantities of goods using a high level of technology, large amounts of capital and labour.

#### **Mention three characteristics of intensive farming system.**

- a. High levels of technology**
- b. High demand for skilled labour and specialization**
- c. High capital input.**

#### **Mention the common examples of intensive farming system.**

- a. Zero grazing**

- b. Battery system of poultry production
- c. Deep litter system of poultry production.
- d. Mixed farming**

**Explain eight methods of farming under intensive farming system.**

**1. Mixed farming**

Mixed farming is a method of farming which involves growing of crops and rearing of livestock on the same piece of land.

**Advantages**

- a. Animals can be used as a source of farm power.
- b. There is mutual benefit between the crops and livestock that is, livestock produce manure for crops and crop remains are used as livestock feed.
- c. There is diversification hence security.
- d. There is maximum utility of land.
- e. Animals waste can be used to produce biogas.

**Disadvantages**

- a. Requires a lot of labour
- b. Requires high level of management skills
- c. Requires high capital investment
- d. Livestock may damage crops if not well confined.

**2. Mixed cropping**

Mixed cropping is the growing of two or more crops on the same field but in different sections of the farm at the same time.

**3. Zero grazing**

This is the method of farming where animals do not directly feed on the pasture in the field but are confined in a shed where they are fed that is feed is cut and brought to them in stall.

**4. Deep litter poultry rearing systems**

Deep litter system is a method of rearing poultry where the birds are confined within a big house. The house usually has no partition and the floor is covered with absorbent litter. It has feeders, winterers, laying nests

and other requirements.

### **5. Battery cage poultry**

Battey cage is a method of farming where birds are confined in wired cages. The cages are normally in rows called tiers and have a slopping floor to allow easy rolling of eggs to the collecting tray.

### **6. No-till cropping/zero tillage**

It is a method of farming where crops are planted season after season without any tillage. The land is usually heavily mulched to prevent weed growth.

#### **Advantages**

- a. Reduces soil erosion
- b. Reduces the cost of crop production
- c. Conserves soil moisture
- d. Maintains soil structure
- e. Promotes timely planting.
- f. Prevents root damage of cultivated crops

#### **Disadvantages**

- a. May encourage build-up of soil borne diseases and pests.
- b. May lead to poor water infiltration
- c. May lead to poor aeration.

### **7. Organic farming**

Organic farming is a method of farming where there is growing of crops and rearing of animals without agricultural chemicals. Crop rotation is used to enhance organic farming.

#### **Advantages**

- a. Environmental friendly and the products do not have any inorganic chemical residues.
- b. It utilizes organic manure to replenish soil nutrients
- c. It also improves food for the soil microbes which help in realizing minerals for crop nutrition.

## FORM TWO AGRICULTURE COMPREHENSIVE STUDY NOTES-SYLLABUS BASED

- d. Naturally occurring materials such as medicinal plants are used instead of chemicals.

### **Explain the advantages of intensive farming systems.**

- a. High crop yields are achieved
- b.** The farmer is able to supervise and monitor **crops** and livestock from being attacked by predators and pests.
- c.** This farming system has made vegetables, fruits and poultry products cheap and affordable therefore most people can have a balanced diet meal.
- d.** Small pieces of land can be used to produce a lot of agricultural products that help to meet the high demand by the population.

### **Explain the disadvantages of intensive farming.**

- 1. There is use of various chemical such as fertilizers, pesticides and insecticides which may lead to contamination of soil and sources of water such as the rivers and lakes.
- 2. Large numbers of livestock are kept in a small area and this may lead to rapid spread of diseases due to overcrowding.
- 3. Excessive use of pesticides may also affect the health of human beings who consume these produce. This usually leads to development of skin allergies.

### **Explain how intensive farming can support the growing population.**

#### **It can support the growing population in the following ways:**

- a. It makes the farmer to have maximum utilization of available land, hence higher output per unit area to support the ever growing population. The available land is properly utilized through good pest and disease management, water conserving irrigation, conservation tillage and use of genetically improved crop varieties.
- b. It leads to high yields of good quality due to the high level of management skills and use of modern technology. This provides enough food for the growing population.
- c. It can be practiced in densely populated areas hence most appropriate in a country where population is growing fast.

- d. It protects the environment because it reduces the amount of land used for agriculture which is in turn exposed to erosive agents. It ensures sustainable agriculture for future generations.

### **EXTENSIVE FARMING SYSTEM**

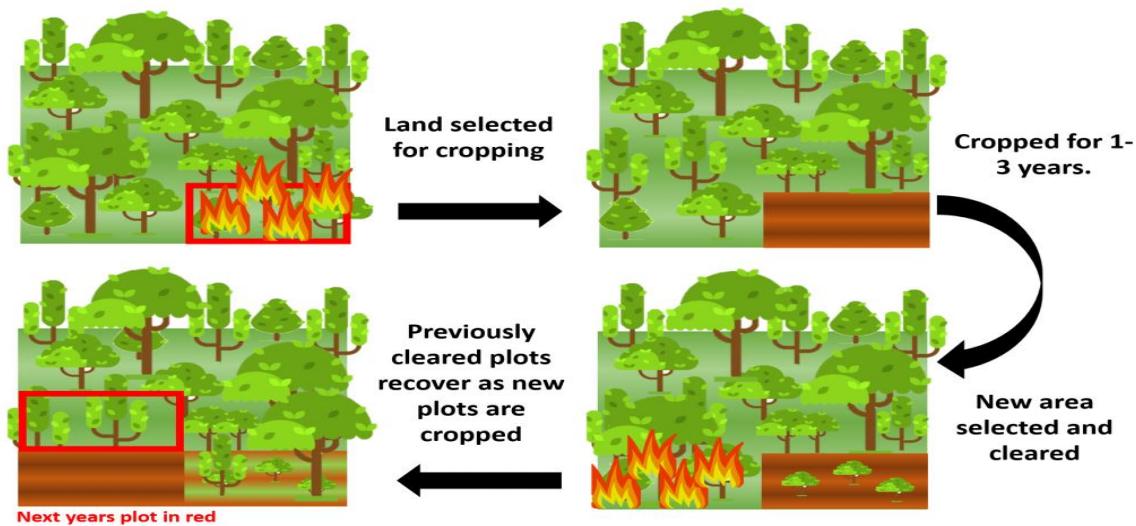
**Explain the meaning of the term “extensive farming system”**

It is a system of farming that is characterized by low capital investment and is usually carried out on large tracts of land.

**Identify four methods of extensive farming systems.**

#### **1. Shifting cultivation**

This is an old method of farming which involves ploughing a piece of land and growing crops on it until the soil exhausted and the farmer then moves to an uncleared land and begins the process once again.



#### **Advantage**

- Land is given time to rest and regain its fertility
- Pests and diseases die upon shifting
- The cost of production is low because no fertilizer is used.

#### **Disadvantages**

- It can be practiced in areas with large tracts of land.
- Its continuous use of the land may lead to soil erosion.
- It can only be used for growing annual crops and not perennial ones.

- d. It may lead to land fragmentation

## **2. Ranching**

It is a method of rearing livestock in vast land where the animals are kept in portioned paddocks.

### **Advantages**

- a. There is maximum use of available pasture
- b. Pasture is given time to regenerate because of paddocking
- c. It allows the farmer to carry out management practices on the pasture such as top-dressing, topping and re-seeding.
- d. Animal droppings are evenly distributed in the fields.

### **Disadvantages**

- a. It requires large tracts of land
- b. It has low output

## **3. Bush fallowing/slash and burn agriculture**

It is the practice of clearing small plots of land to cultivate for a few years generally 2 to 5 years and then leaving the land under natural vegetation for much longer periods usually more than 5 years to restore soil fertility.

## **4. Cut and Carry**

It is the method of farming where crop residues and any forages are cut and carried from communal areas or other farms and taken to the fields to feed tethered animals.

### **Explain the importance /benefits of extensive farming.**

An extensive system of farming has the following benefits

- a. It is cheap due to low capital input.
- b. It requires less labour input.
- c. It ensures proper utilization of marginal areas which could not have otherwise been utilized.
- d. It does not require a high level of management or skills.

## **CHAPTER SEVEN: FINANCING AGRICULTURAL ENTREPRENEURS**

## **SOURCES OF FINANCE FOR FARM BUSINESSES**

**Explain four sources of finance for farm businesses.**

These include

**a. Credit facilities**

This where the farmer borrows capital either in cash or in kind from the financial service providers such as commercial banks, non-bank service providers, micro -finance providers and informal providers.

- **Commercial bank-** The farmer borrows capital from the commercial bank where the credit is payable with interest and also demands security for the loans in the form of buildings or land title deeds.
- **Non-bank formal service providers** are insurance companies, pension companies, Malawi Stock Exchange that offer credit services to the farmers.
- **Micro-finance providers** include the financial cooperatives, SACCOs and micro-finance institutions. These finance providers work under the Malawi Union OF Savings and Credit Cooperative (MUSCO) and Malawi Microfinance Network (MAMN). The MUSCO and MAMN coordinate and organize the exchange of information and farm inputs to farmers.

**b. Personal savings**

This is a source of capital where a farmer set aside part of his or her income to accumulate over a period of time. When enough accumulative savings have been made, the farmer uses it to buy assets needed for the production process.

**c. Inheritance**

This where a farmer can inherit capital from relatives or close friends.

**d. Grants or donations.**

This source of capital which is awarded to the farmers as grants by the sponsors or well wishers to assist them to start agricultural projects.

e. Personal investments

f. The social network which includes friends and relatives

## **TYPES OF CREDITS**

## FORM TWO AGRICULTURE COMPREHENSIVE STUDY NOTES-SYLLABUS BASED

**List and explain three types of credits.**

**These include:**

1. **Short-term credit** which is usually repaid within 1 year.
2. **Medium term credit** which is usually repaid within 2 to 5 years.
3. **Long-term credit** which is repayable within 5 to 15 years.

**Explain the difference between soft loan and hard loan**

**Soft loans** are loans which are offered with little or no security while

**Hard loans** are loans which are offered against immovable assets as security such as land.

### CONDITIONS AND TERMS FOR BORROWING

**Identify six conditions and terms for borrowing capital for farm businesses.**

Some of the general terms and conditions include the following:

- a. Time of repayment- Repayment period must be clearly stated
- b. Default. This specifies what happens in case one fails to pay on time.
- c. Loans are negotiated between applicant and financing institution.
- d. Before receiving the loan the applicant must sign the contract forms.
- e. Some financial institutions give credit against immovable assets.
- f. **Reasons for borrowing**- Farmers are advised to consider specific activities that they want to finance using the loan.
- g. **Cost of borrowing**- This incorporates interest, application fees, processing fees, management fees and insurance premiums. Farmers need to borrow from financial sources whose costs of borrowing are reasonable and affordable. Interest rates have to be specified.
- h. **Surety**- In some cases, loans are only given when the borrower has suitable collateral that will be repossessed if the borrower will have failed to repay the loan.
- i. **Ability to repay**- Clever farmers will first assess their ability to repay the loan before they obtain it. This saves them from embarrassment.
- j. **Grace period**- This is the time allowed before the farmer starts to repay the

loan. Agricultural production is usually seasonal and as such farmers should seek for loans whose grace periods will allow them to start repaying after harvesting and selling their agricultural products.

- k. **Cooling off period-** This is the period of time that is allowed for the borrower to cancel a loan contract without paying a penalty. Good loans must have options for cancellation that will not attract heavy fines or penalties.

### Differentiate between base interest rate and effective interest rate.

- **Base interest rate/prime lending rate** is the minimum interest rate that investors will accept for investing in a non-treasury security and it is set and published by commercial banks. It is also known as **the minimum interest rate or benchmark interest rate**.
- In other words, base lending rate is the rate at which banks or other institutions lend money to risk-free customers. Risk-free customers are those customers that are not likely to default after borrowing. Examples of such customers include the government, large companies and reputable organizations like Press Properties Limited.
- **Effective interest rate** is the interest rate on a loan restated from the nominal interest rate as an interest rate with annual compound interest payable and attempts to describe the full cost of borrowing.
- In other words, effective interest rate is the rate that is arrived upon to suit specific customers depending on their ability to pay back the loan timely. It includes the base lending rate plus the risk of default that the specific customer may carry. A risk of default is the likelihood that a borrower may fail to repay.
- It takes into account the effect of compounding interest which is left out on the nominal or interest rates. For example, a loan may have 10% interest because more interest is accumulated each month. Effective interest rate is also known as effective annual interest, annual percentage rate (APR), annual equivalent rate (AER) or market interest rate).

**How to calculate effective interest rate on borrowing money**

The stated interest rate will be expressed as a percentage. The compound periods will generally be monthly, quarterly, annually or continuously. This refers to how often interest is applied.

The effective interest rate is calculated through the formula

$$r = (1 + i/n)n - 1 \text{ where}$$

r = effective annual rate

i = the nominal interest rate

n = number of compounding periods per year

Effective interest rate will always be greater than the stated rate.

If the interest is compounded continuously, the formula for calculating effective interest rate is:

$$r = e^i - 1 \text{ where}$$

r = effective interest rate

i = the stated interest rate

e = the constant rate = 2.718

**EFFECTIVE INTEREST RATE CALCULATION**

**Example**

**Calculate the effective interest rate on the loan with interest rate 5% compounded monthly.**

$$r = (1 + i/n)n - 1 \text{ where}$$

r = effective annual rate

i = the nominal interest rate

n = number of compounding periods per year

$$r = (1 + 0.05/12)12 - 1$$

$$= 5.12\%$$

**Example**

**Calculate the effective interest rate on the loan with a nominal interest rate of 9% compounded continuously.**

## FORM TWO AGRICULTURE COMPREHENSIVE STUDY NOTES-SYLLABUS BASED

If the interest is compounded continuously, the formula for calculating effective interest rate is:

$$r = e^i - 1 \text{ where}$$

r = effective interest rate

i = the stated interest rate

e = the constant rate = 2.718

$$r = 2.718^{0.09} - 1$$

$$= 9.417\%$$

### EXAMPLE OF CALCULATED EFFECTIVE INTEREST RATES

Nominal rate	semi-annually	Quarterly	Monthly	Daily	Continuously
1%	1.002%	1.004%	1.005%	1.005%	1.005%
5%	5.062%	5.095%	5.116%	5.127%	5.127%
10%	10.250%	10.381%	10.471%	10.516%	10.517%
15%	15.562%	15.562%	16.075%	16.180%	16.183%
20%	21.000%	21.551%	21.939%	22.134%	22.140%
25%	26.563%	27.443%	28.073%	28.392%	28.403%
30%	32.250%	33.547%	34.489%	34.489%	34.986%

Example

**If a farmer borrowed a loan of MK100, 000 at an interest rate to be repaid within one year:**

- a. Calculate the total amount of money the farmer will have paid by the end of the year.**

$$\begin{aligned} r &= (1 + 0.18/12)12 - 1 \\ &= 19.561\% \end{aligned}$$

$$\begin{aligned} \text{The amount of effective interest rate} &= \frac{19.561}{100} \times \text{K}100,000 \\ &= \text{MK}19,561 \end{aligned}$$

$$\begin{aligned} \text{Hence the total amount paid would be} &= \text{Principal} + \text{Interest} \\ &= \text{MK}100,000 + \text{MK}19,561 \\ &= \text{MK}119,561 \end{aligned}$$

## FORM TWO AGRICULTURE COMPREHENSIVE STUDY NOTES-SYLLABUS BASED

### b. Calculate the monthly payment of the loan.

This will be calculate by dividing the total amount to be paid the number of months of replacement

$$= \frac{K119561}{12} \\ = MK9,963.41$$

**A loan of K60, 000 is to be repaid in 5 years at interest rate of 3% per year. The money is to finance a maize production project. The expected maize yield is 9,000kg and the expected selling price is K3, 000 per 50kg bag. Calculate the cost of borrowing using the effective interest rate method.**

$$r = (1 + 0.03/5)^5 - 1 \\ = (1.0304 - 1) \\ = (1.0304) \times 100 \\ = 3.04\%$$

Interest = Principal x rate x time

$$= 60,000 \times 3.04 / 100 \times 5 \\ = K9,120.$$

∴ Cost of borrowing per annum = K9,120

Total cost of borrowing = K9,120 x 5  
= K45,600

The expected cost will be : K45,600 + K 60,000  
= K105,600

Expected income:

The expected maize yield is 9,000kg

One 50 kg bag = K3,000'

$$\text{The number of bags of maize} = \frac{9,000}{50} \\ = 180 \text{ bags}$$

$$\begin{aligned} \text{One bag sells} &= K3,000 \\ ∴ 180 bags &= (180 \times 3,000) \end{aligned}$$

## FORM TWO AGRICULTURE COMPREHENSIVE STUDY NOTES-SYLLABUS BASED

	= K540,000
Profit	= Income - Cost
	= K540,000 – K105,600
	= K434,400

### QUESTION FOR REVIEW

Mrs. Chombo wants to borrow K120, 000 from a Farmers' Bank in order to finance her groundnut enterprise. Use the information below to answer the questions that follow:

Interest rate	5% per month
Expected period of borrowing	8 months
Expected groundnut yield	18,000 kg
Expected selling price of groundnuts	K6,000 per 50kg bag

- Using the effective interest rate method, calculate the total cost of borrowing that Mrs. Chombo will incur.
- By calculation, show whether Mrs Chombo will make a profit or not after borrowing finances from the farmer's bank.

### CHAPTER 9: CROP HUSBANDRY- LAND PREPARATION

- Land preparation involves the practices carried out on a particular piece of land to create a suitable soil tilth in readiness for planting.
- The size of soil clods, the soil depth and the looseness of the soil must be appropriate in order to facilitate the germination and establishment of the crops.
- Timely land preparation and deep ploughing creates favourable conditions for easy management of subsequent field practices such as weeding and pest control.
- Land which has been prepared for the purpose of growing crops is called **Seedbed**.

### IMPORTANCE OF LAND PREPARATION

**Give five reasons why land preparation is important.**

- To remove vegetation cover which may interfere with the subsequent

operations

- To bury organic matter into the soil which later decomposes. This helps in binding soil particles as well as adding soil particles as well as adding nutrients into the soil.
- To kill pests and disease causing micro organisms. This is exposing the soil borne pests and disease causing organisms to harsh environmental conditions on the soil surface thus killing them.
- To kill perennial weeds like couch grass which would otherwise compete with the crops.
- To improve the physical condition of the soil by loosening soil making it suitable for root development that is root penetration.
- To improve infiltration of water into the soil.
- To try to bring up to the surface the nutrients which are present within the subsoil section of the soil for the benefit of crops grown later.

**State and explain four operations which are involved in land preparation.**

These include

**a. Land clearing**

Land clearing can be defined as the removal of vegetation cover from the surface before ploughing. Land clearing can be done:

- **Manually (using hand)** - It involves the use of hand tools like machetes and slashers. It is used by small scale farmers.  
The disadvantage of this method is slow and can also lead to delay in seedbed preparation and may result in late planting and consequently poor crop yield.
- **Using chemicals** - It involves the use of chemicals called herbicides which kill weeds. Examples of these chemicals include Roundup, Gramoxone, and Atrazine etc.
- **Mechanized (using machinery)** - This involves the use of tractor-mounted implements for example tractors with a chain to fell trees in

a forest and bulldozers to remove stumps. It is used by large scale farmers.

### **Advantages**

- It is efficient in land clearing
- It has a labour requirement
- Large areas can be cleared within a short time.

### **Limitation**

- The cost of purchasing and maintaining the machines is high.

Land clearing involves

- Felling of trees and removal tree stumps.
- Slashing or cutting of tall grass or shrubs or bushes.
- Burning of vegetation

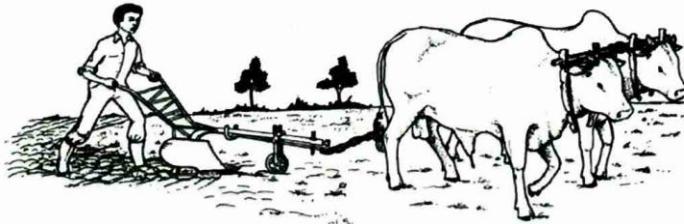
### **Importance of land clearing**

- It makes subsequent land preparation operations such as ploughing easier and efficient.
- It helps in the eradication of pests and diseases.
- It helps open up virgin land to be ready for cultivation.
- It is a land reclamation method especially in warm humid bushy lands.

**b. Primary cultivation** - This is the initial opening of land either after clearing the bush or after a previous season of cropping.

Primary cultivation can be carried out using hand tools or mechanically using various tractor-drawn or ox-drawn ploughs.

The figure below shows a farmer using an ox-plough during primary cultivation.



### **Importance of primary cultivation**

- It makes subsequent operations easier.
- It facilitates aeration and water infiltration in the soil.
- It controls weeds by burying or uprooting them.
- It buries crop residues to decompose and add nutrients into the soil.
- It eases the penetration of the crop roots.
- It controls pests and diseases by exposing them to the scorching sun or to predators.

### **Methods and tools used in primary cultivation**

**Hand method-** Used by small scale farmers who use hoes, fork hoes, ox-ploughs etc.

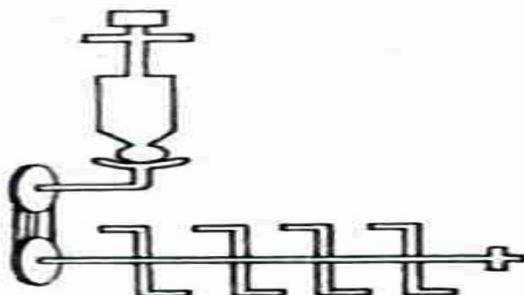
**Mechanical method-** Used by large scale farmers and it involves use of disc-ploughs, chisel ploughs, mould board ploughs, rotary cultivators.

This method has high initial capital and maintenance cost .

The diagram below shows disc-plough



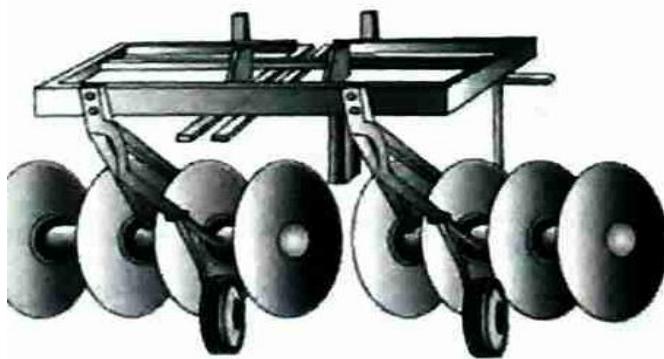
The figure below shows rotary cultivators



### **c. Secondary cultivation**

These are the subsequent land preparation operations which follow primary cultivation. It involves seedbed refinement practices that are breaking large soil clods. It is also referred to as harrowing.

The following are the tools that are used during secondary cultivation disc harrows as shown below.



Other tools include forked hoe, rakes, regular hoe, and ox-ploughs,

**Factors that determine the number of times secondary cultivation is done.**

- 1. Initial condition of the seedbed-** Roughly prepared seedbed may necessitate more secondary cultivations.
- 2. Size of planting materials-** The small seeds requires a finer soil tilth that makes secondary cultivation operations necessary.
- 3. Slope of the land-** It is important to reduce the frequency of harrowing where the land is too steep because it pulverises the soil and makes it more prone to soil erosion.
- 4. Moisture content of the soil**

Wet soils require more secondary operations. Dry soils require fewer operations in order to conserve moisture.

**5. Type of implement used during primary cultivation**

Disc ploughs tend to make clods to be larger and a lot of trash and fresh vegetation to remain unburied. This requires more secondary operations.

**Importance of secondary cultivation**

1. To break large soil clods into finer particles
2. To destroy weeds that may have grown after primary cultivation.
3. To create a suitable tilth ready to receive seeds or other planting materials.
4. To help in mixing organic manure in order to accelerate the release of nutrients into the soil.
5. To further help in exposing the soil-borne pests so that they may be destroyed by desiccation.

### d. **Tertiary operations**

- These are operations that follow secondary operations and are done on the seedbed which are necessitated by the growing of certain crops.
- The tertiary operations are referred to as miscellaneous because they are the extra which may or may not be done depending on a particular crop production need.
- The most common tertiary operation is ridging

### **RIDGING**

Ridging involves digging the soil in a continuous line and heaping on the side to form a ridge. Ridges are good for planting root crops like Irish potatoes, sweet potatoes, cassava as well as groundnuts.

Box ridging can as well be done in groundnut production. This involves establishment of cross tie ridges especially in areas of inadequate rainfall.

### **REASONS FOR RIDGING**

- a. To encourage free expansion of tubers as well as high yielding of groundnuts
- b. To make harvesting easy
- c. The furrows made in between the ridges helps conserve soil and water.
- d. It facilitates drainage in waterlogged soils.

### **COMMON MAIZE VARIETIES GROWN IN MALAWI**

**The following are the common varieties of maize grown in Malawi and are provided by Seed Company:**

<b>Maize varieties</b>	<b>Description</b>
<b>SC 403</b>	<ul style="list-style-type: none"> <li>• It takes 90-110 days to mature. Hence an early maturing variety.</li> <li>• It is drought tolerant</li> <li>• It is resistant to maize streak virus</li> <li>• It does well in dry areas under irrigation</li> <li>• It can yield 3-6 tonnes per hectare under good management.</li> </ul>
<b>SC407</b>	<ul style="list-style-type: none"> <li>• It is an early maturing variety and takes 90-100 days to mature.</li> <li>• It is resistant to maize streak virus and grey leaf spot disease.</li> <li>• It can yield 3-7 tonnes per hectare under good management.</li> </ul>
<b>SC 513</b>	<ul style="list-style-type: none"> <li>• This is a middle maturing variety taking 125-135 days to mature.</li> <li>• It is resistant to grey leaf spot and maize streak virus.</li> <li>• It is a high variety giving 7-10 tonnes per hectare.</li> </ul>
<b>SC 709</b>	<ul style="list-style-type: none"> <li>• This is an extremely late maturing variety taking 130-150 days to mature.</li> <li>• It is resistant to grey leaf spot disease.</li> <li>• It is a high yielding variety giving 11tonnes per hectare.</li> </ul>
<b>SC 715</b>	<ul style="list-style-type: none"> <li>• This is an extremely late maturing variety, taking 130-150 days to mature. It shows resistance to grey leaf spot disease and maize streak virus.</li> </ul>

## FORM TWO AGRICULTURE COMPREHENSIVE STUDY NOTES-SYLLABUS BASED

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	<ul style="list-style-type: none"> <li>• It is a high yielding variety, giving 11 tonnes per hectare.</li> </ul>
<b>SC 17</b>	<ul style="list-style-type: none"> <li>• This is an extremely late maturing variety, also taking 130-150 days to mature. It shows resistance to grey leaf spot disease</li> <li>• It yields long ears averaging 13 tonnes per hectare.</li> </ul>
<b>ZM 309</b>	<ul style="list-style-type: none"> <li>• This is an early maturing variety commonly referred to as Mkawa Sala.</li> <li>• It is drought resistant variety which does well in infertile soils.</li> <li>• It is resistant to maize streak virus, grey leaf spot and other diseases.</li> </ul>
<b>ZM 523</b>	<ul style="list-style-type: none"> <li>• This is a drought tolerant variety which does well in infertile soils.</li> </ul>

**The following are the maize varieties that were developed by DEKALB (US)**

<b>DK 8021</b>	<ul style="list-style-type: none"> <li>• This is an early maturing variety taking 110-115 days to mature.</li> <li>• It has a strong resistance to grey leaf spot disease.</li> <li>• Under good management it can yield 6-8 tonnes per hectare.</li> </ul>
<b>DK 8033</b>	<ul style="list-style-type: none"> <li>• This is middle maturing variety taking 115 -130 days to mature.</li> <li>• It is adaptable to a wide range of areas.</li> <li>• It produces two ears, giving a yield of about 8-9 tonnes per hectare.</li> </ul>
<b>DK 8051</b>	<ul style="list-style-type: none"> <li>• This is a middle maturing variety, taking 130-135 days to mature. It has a high milling suitability.</li> </ul>
<b>DK 8071</b>	<ul style="list-style-type: none"> <li>• This is an extremely late maturing variety, taking</li> </ul>

	140-145 days to mature. <ul style="list-style-type: none"> <li>• It is also resistant to grey leaf spot disease.</li> <li>• It has yield giving 9-11 tonnes per hectare.</li> </ul>
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### **COMMON GROUNDNUT VARIETIES GROWN IN MALAWI**

The following are the common groundnut varieties that are grown in Malawi

<b>CG7 OR Red skins</b>	<ul style="list-style-type: none"> <li>• This is a new variety in Malawi commonly found in Thyolo, Balaka and Mchinji districts.</li> <li>• The nuts have a deep red skin and are very uniform in size and distribution</li> <li>• It is suitable for confectionery, oil extraction and peanut butter manufacture</li> </ul>
<b>Chalimbana</b>	<ul style="list-style-type: none"> <li>• The nuts are light to dark tan in colour.</li> <li>• They have a rich full flavor and are ideal for confectionery and not for cooking oil.</li> </ul>
<b>Manipintar</b>	<p>This is a runner variety with seeds which are variegated red and white, their size and shapes are irregular.</p>
Other varieties include Chalimbana 2005, Baka, RG1 and Nsinjiro.	

### **PLANTING AND TIME OF PLANTING**

- Planting refers to putting seeds or planting materials into the ground to grow.
- Timely planting is essential for optimum crop yield especially when growing annual crops such as maize and groundnuts.

### **Give the importance/benefits of timely planting in maize production.**

Timely planting has the following advantages.

- It ensures that the crop makes maximum use of the seasons' rain.
- The crop is able to escape serious attacks by pests such as aphids and maize stalk borer.
- The crop is able to effectively compete with weeds.

## FORM TWO AGRICULTURE COMPREHENSIVE STUDY NOTES-SYLLABUS BASED

- The crop benefits from nitrogen flush
- It leads to early harvesting enabling farmers to take advantage of high.

### QUALITIES OF GOOD SEEDS FOR PLANTING

**Give four qualities of seed suitable for planting materials.**

Certified seeds are those that have been tested and carefully selected based on the following

1. **Suitability to the ecological conditions.** The selected planting materials should be well adapted to the environmental conditions of the area such as altitude, rainfall, soil type. For example, maize variety SC 403, SC 407, SC 513, ZM 309 and DK 8021 are early maturing and can do well in areas with short rains.
2. **Germination rate.** Select seeds with a high germination percentage.
3. **Purity-** Good seeds should be clean and free from contamination by foreign materials such as weed seeds, husks, hollow seeds and seeds of other plants.
4. **Size-** The seeds should have the usual shape of the variety, an important factor that seeds which will be drilled using planters should have.
5. **Diseases resistance-** Healthy, strong and disease plant resistance plant varieties are highly favoured for certification. The seeds should be free from diseases and pest damage, a desirable quality leading to high quality and quantity yield.
6. **Free from physical damage-** The selected seeds should be free from physical damage
7. **High quality and potentiality for high yields-** The seeds are selected from parent plant crops which are high yielding and of high quality.

**Explain the steps that must be followed when planting maize and groundnuts in a school garden.**

#### 1. Time of planting

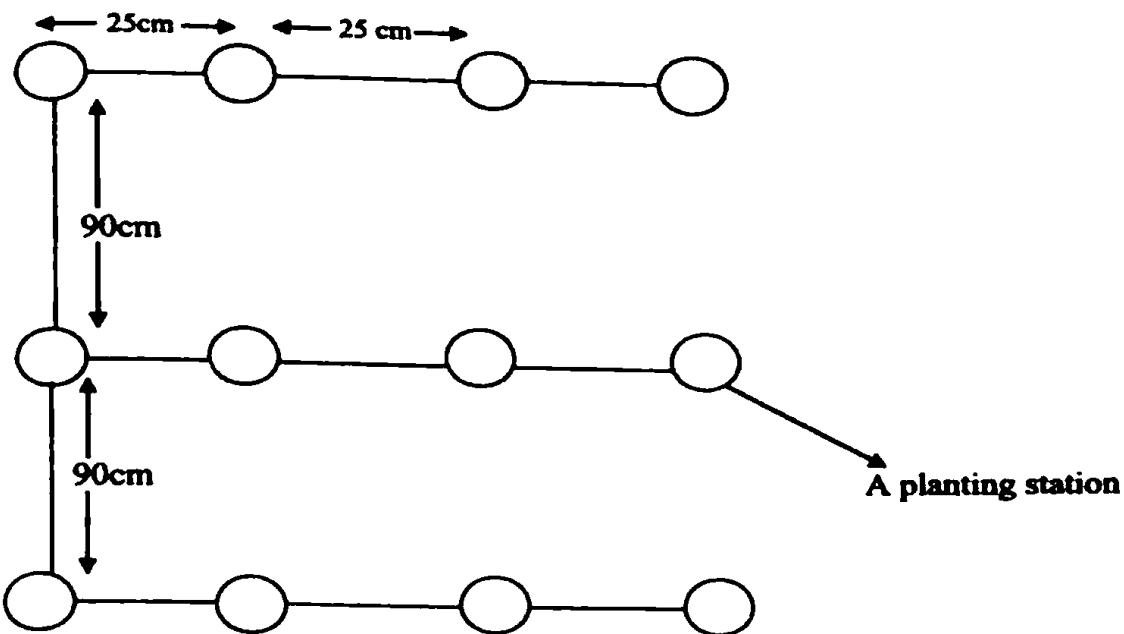
- Maize should be planted when the rains begin to ensure that the yields are not reduced to planting late.

- Groundnuts should be planted before the full rains begin. This is to prevent the seeds from absorbing too much water from the heavy rains which may cause rotting of the seeds. Groundnuts can either be planted together with maize or after the maize has been planted.

## **2. Marking out planting stations**

Planting stations are small pits which are dug using a hoe where the seeds will be planted. In planting maize and groundnuts, the row spaces should be measured carefully. In addition , the planting stations should be evenly measured and marked out so as to produce the best plants.

For example, mark out the planting stations as shown below



The planting station depth should be 2.5cm- 10cm

## **3. Measuring spacing between planting stations**

- In order to achieve high yields, farmers need to carefully determine the spacing between planting stations.
- When planting groundnuts, the planting stations should be closely spaced to prevent diseases such as the rosette virus diseases. This will also help the groundnuts spread out quickly and cover the ground and this will help keep away weeds.

- In maize planting, the spacing between planting stations can be 60cm × 60cm . Two plants thus can be planted per station.

#### **4. Calculating number of seeds per given area.**

- Seed rate refers to the amount of seeds to be used per hectare of land.

$$\text{SEED RATE} = \frac{\text{Average weight of one} \times \text{Number of seeds per hole} \times \text{Number of rows}}{\text{Number of hectares}}$$

#### **Example**

**A farmer wants to plant maize on his 1 ha farm. One grain of healthy maize seed weighs 0.002kg on average. He has prepared 20 rows on his piece of land each having 100 holes. Calculate the seed rate if he plants 2 seeds in each hole.**

$$\begin{aligned}\text{Seed rate} &= \frac{0.002 \times 2 \times 20}{1\text{ha}} \\ &= 2 \times 2 \times 2 \\ &= 0.8\text{ka/ha}\end{aligned}$$

#### **5. Planting seeds at the correct depth**

The correct depth for planting determines the ease of emergence of seedlings and subsequent plant uniformity and stand in the field

#### **6. Calculating germination percentage.**

7. Planting seeds should be tested for germination and purity. After planting, some seeds may fail to germinate due to some factors such as deep placement, inadequate moisture or attack pests and diseases. The number of seeds that germinate can be expressed as a percentage. This percentage is known as the germination percentage.

Germination percentage can be calculated as follows:

$$\text{Germination percentage} = \frac{\text{Number of germinated seeds}}{\text{Number of seeds planted}} \times 100$$

### **PLANTING MAIZE**

- Maize can be planted either manually or mechanically by use of plant seeds planters.
- Manual planting is common with small scale holders.
- Row planting is the most appropriate method of planting maize. The spacing

however depends on:

- a. The number of seeds per hole.
- b. The cultivated variety variety (cultivar) grown.
- c. Soil fertility.
- d. Rainfall amount of the area.
- e. Intended use of the crop.

### CALCULATION OF NUMBER OF SEEDS TO BE PLANTED

The number of seeds to be planted in a given area of land can be calculated as follows:

$$\text{Number of seeds} = \frac{\text{Size of land} \times \text{Number of seeds per hole}}{\text{Spacing of crop}}$$

**Given that maize is planted 2 seeds per hole at a spacing of 100 x 30 cm in a plot of land measuring 40 x 30m, calculate the number of seeds required.**

$$\text{Number of seeds} = \frac{\text{Size of land} \times \text{Number of seeds per hole}}{\text{Spacing of crop}}$$

$$\begin{aligned}\text{Number of seeds} &= \frac{4000\text{cm} \times 3000\text{cm} \times 2}{100\text{cm} \times 30\text{cm}} \\ &= 8000 \text{ maize seeds.}\end{aligned}$$

**State three factors that influence the depth of planting groundnuts.**

The depth of planting is influenced by :

- a. **Size of seed-** The larger the seed the deeper it is planted.
- b. **Soil type-** Seeds are planted deep in light soils than in heavy soils.
- c. **Soil moisture content -** Seeds are planted deeper in dry soils than in moist soils.

### WEED CONTROL

**Define the term weed**

- A weed is any plant whose economic disadvantage outweighs its economic advantages or a plant growing where it is not wanted.
- A non-maize crop or a non-groundnuts crop in the field of maize or groundnuts is a weed.

**Give the reasons of controlling weeds in a maize/groundnuts field.**

## **FORM TWO AGRICULTURE COMPREHENSIVE STUDY NOTES-SYLLABUS BASED**

- To reduce competition for nutrients, water and light with cultivated crops.
- To control pests and diseases which may be harboured by some weeds such as mallow weed which acts as an alternate host of cotton stainer.
- To prevent contamination of farm produce which lowers the quality of maize plant.
- To eliminate parasitic weeds such as a witch weed which are parasites of maize and other cereals.
- To eliminate irritating weeds such as stinging nettle that irritates farmers on the field hence lowering labour output.
- To prevent blockage of irrigation channels by aquatic weed.
- To increase the quality of the produce.
- Early weed control helps reduce the cost of production of the crops
- It will help eliminate pests and disease causing micro-organisms which create their habitats on some weeds.
- Weed control will make movement in the farm easy since there will be no weeds growing in the spaces between the rows of crops.
- Weed control will increase efficiency of work when carrying out farming operations.
- Some weeds found pastures may lead to loss of milk when eaten by livestock just before milking.

**Explain the guidelines that a farmer may consider when controlling weeds.**

1. Control the weeds as soon as they appear.
2. In leguminous crops, weeding should be done before flowering. This is because they are mainly self-pollinated and hence disturbance of the plants during flowering may lead to low yielding.
3. Weeds should be controlled early before they set seeds and fruits.
4. Weeds control should be carried out when soil is moist to reduce incidences of damage on the plants.
5. Use of herbicides in weed control should be done when the weeds are

## FORM TWO AGRICULTURE COMPREHENSIVE STUDY NOTES-SYLLABUS BASED

actively growing.

**State the factors that may affect /influence the frequency of weeding.**

- a. **Type of crop grown-** Some crops are able to smother weeds and hence may require only one weeding.
- b. **Climate of the area-** Some climatic factors favour fast growth weeds hence higher frequency of weeding.
- c. **Type of weeds -** Some weeds are fast growing and require regular weeding.
- d. **Soil fertility-** Soils rich in nutrients support faster growth of weeds.

**Explain the cultural practices of weed control in the crop fields.**

Cultural method involves good husbandry practices which limit the effects of weeds in crops. Some of the cultural control practices include:

1. **Correct spacing or correct plant population.** This will deny the weeds the space to grow and thus allow faster crop establishment enabling crops to overcome the weeds.
2. **Crop rotation-** Crop rotation helps to break the life cycles of wild oats in fields of cereals like wheat and barley
3. **Mulching-** It reduces weeds by suppressing them.
4. **Timely planting-** This allows the crop plants to establish before the weeds germinate and offer stiff competition.
5. **Application of manures and fertilizers.** This practice encourages faster plant growth which helps to suppress.

**Explain the classes of chemicals that are used to control weeds.**

A chemical used for weed control is referred to as a herbicide. The following are the classes of chemicals

<b>1. Contact complete weed killer</b>	These are chemicals which kill all the vegetation they come into contact with
<b>2. Translocated herbicides</b>	They are mainly selective and will kill only certain types of weeds.
<b>3. Pre-emergence herbicides</b>	These are herbicides which are applied either before sowing or immediately after

	sowing but before germination. This will ensure that the seed is protected from herbicide damage by the soil. The herbicides destroy weeds which emerge before the seeds germinate.
<b>4. Post - emergence herbicides</b>	These are herbicides which are applied after germination of crops. It is important to confirm whether the herbicide in this group is selective or a complete weed killer.

**Explain the biological practices and legislative practices of weed control.**

In this method, one organism is used to destroy or suppress the growth of the other.

Legislative control involves the implementation of local, national or international quarantine either on the movements of plants or planting material from an area where a particular weed is growing so that it is curbed or controlled.

### **FERTLISER APPLICATION**

**Explain the following methods of applying fertilizer in a maize field.**

**1. Broadcasting**

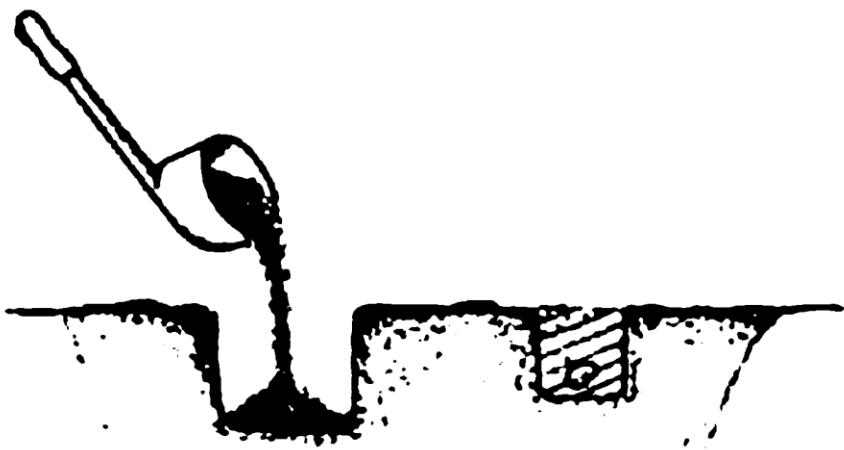
This is the random spreading of the inorganic fertilizer over the seedbed. It is then later incorporated into the soil. The spreading can be done by hand, in small scale farming, or by the use of fertilizer spreaders in large scale farming.

**2. Drilling**

This is the direct placement of fertilizer in the planting hole or furrows. The fertilizer is then thoroughly mixed with the soil before planting.

Drilling is done at the time of planting using the **dibbling method** in small scale farming, and by use of planters in large -scale farming. This method is also known as **hole placement or dollop method**.

The figure below shows drilling method of fertilizer application.

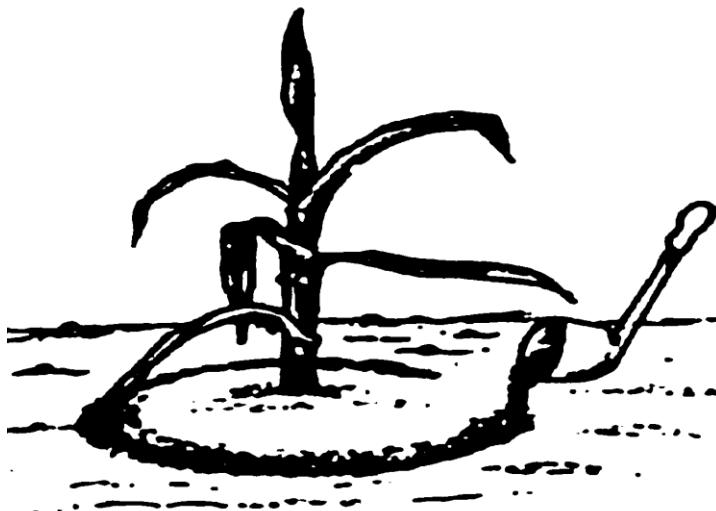


### 3. Side dressing or banding

This is the placement of fertilizer in continuous or discontinuous patterns beside the crop.

The method is also called **side-dressing** when the fertilizer is placed one or two spots beside the crop and **ring application** when the fertilizer is placed in a circle around the plant.

The figure below shows ring application method.



### 4. Foliar application

This is the spraying of fertilizer in solution form on the leaves of the crops. It is used in applying urea and micro-nutrients. The response is usually quick

as the fertilizer is absorbed through the leaf surface.

### 5. Injection into the soil

This is used in specialized cases such as in green houses. In this method, fertilizers, in liquid forms are injected into the soil under pressure.

### 6. Irrigation method

In this method, the fertilizer is mixed and applied with the irrigation water. It is also fertigation.

#### **State the factors that should be considered before applying fertilizer.**

1. Soil analysis should be done to establish the level of nutrients in the soil.
2. The soil pH should be determined to ensure it is appropriate for the type of fertilizer.
3. The availability and amount of soil moisture.
4. The method of application.
5. The quantity and cost of fertilizer required.
6. The time of application.

### **FERTLISER GRADE OR ANALYSIS**

It is important to know the amount of each specific nutrient contained in a fertilizer. This is made possible by calculating the chemical percentage of specific presents.

The analysis or grade is found by determining the chemical percentage of specific nutrients present in a fertilizer.

$$\text{Percentage of nutrient} = \frac{\text{Nutrient content}}{\text{Total weight of fertiliser}} \times 100$$

#### **EXAMPLE**

**How much  $P_2O_5$  is there in 850kg of single Superphosphate (18% $P_2O_5$ )?**

$$\begin{aligned}\text{Weight of } P_2O_5 &= \frac{18}{100} \times 850 \text{ kg} \\ &= 153\text{kg}\end{aligned}$$

#### **EXAMPLE 2**

**A farmer wants to apply 60kg of N per hectare on her Irish potato far., How much Sulphate of Ammonia (20%N) does she require?**

## FORM TWO AGRICULTURE COMPREHENSIVE STUDY NOTES-SYLLABUS BASED

For every 100% Sulphate of Ammonia fertilizer, there is 20% N in it.

Thus in a 100kg SA there is 20Kg N in it.

$$\therefore \text{The amount of SA does } 60 \text{ kg N contain} = \frac{60}{20} \times 100 \\ = 300\text{kg}$$

### THE FERTLIDER RATIO

Fertilizer ratio is the relative percentage expressed as a ration of the NPK present in a fertilizer.

For example, 17 – 17 – 17 can be expressed as a fertilizer of 1 – 1 – 1. To calculate the fertilizer ratio use the smallest figure to divide through the rest.

The fertilizer ratio is only expressed in compound fertilizer

### LIMING OF SOIL

- Liming is the application of agricultural lime to an acidic soil in order to amend it. Lime contains calcium in form of Limestone and hydrated lime.

#### State six importance of liming.

- It removes toxic elements such as aluminum from acidic soils.
- It improves soil structure through flocculation of soil particles.
- It reduces the acidity of soil.
- It hastens the decomposition of organic matter by improving microbial activity.
- It avails nutrients like nitrogen and phosphorous in absorbable forms.
- It improves nodulation in legumes.

### MAJOR DISEASES OF MAIZE

**Mention the causing organism, symptoms and the control measures of each of the following diseases of maize plant.**

1.	<b>Disease</b>	<b>Maize smut</b>
	<b>Causal agent</b>	<ul style="list-style-type: none"><li>Fungus ustilago maydis</li></ul>
	<b>Symptoms</b>	<ul style="list-style-type: none"><li>Plants severely dwarfed</li><li>Abnormal development of tassels</li><li>Black masses of spores on the cob and tassel</li></ul>

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	<b>Control measure</b>	<ul style="list-style-type: none"> <li>• Plant resistant maize varieties</li> <li>• Use certified seeds</li> <li>• Crop rotation</li> <li>• Rogueing</li> </ul>
2.	<b>Disease</b>	Maize rust
	<b>Causal agent</b>	Fungus Puccina Spp
	<b>Symptoms</b>	Red brown powdery pustules on leaves
	<b>Control measure</b>	<ul style="list-style-type: none"> <li>• Practice crop rotation</li> <li>• Plant resistant varieties</li> <li>• Plant early</li> </ul>
3.	<b>Disease</b>	<b>Maize streak</b>
	<b>Causal agent</b>	Virus
	<b>Symptoms</b>	<ul style="list-style-type: none"> <li>• Yellow parallel lines on the leaves which eventually turn yellow with long strips of green patches.</li> <li>• Stunted growth in plants during early periods of growth</li> <li>• Cobs produced half-filled or contain few or no seeds.</li> </ul>
	<b>Control measure</b>	<ul style="list-style-type: none"> <li>• Early planting</li> <li>• Use resistant varieties.</li> <li>• Rogueing</li> <li>• Field hygiene</li> <li>• Crop rotation</li> <li>• Use certified seeds</li> </ul>
4.	<b>Disease</b>	<b>Grey leaf spot</b>
	<b>Causal agent</b>	<ul style="list-style-type: none"> <li>• Leaf lesions</li> <li>• Chlorosis</li> <li>• Leaf bright</li> </ul>

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	<b>Control measure</b>	<ul style="list-style-type: none"> <li>• Plant resistant varieties</li> <li>• Practice crop rotation</li> <li>• Destruction of crop residues</li> <li>• Use of appropriate fungicides</li> <li>• Weed control</li> </ul>
5.	<b>Disease</b>	<b>Rust</b>
	<b>Causal agent</b>	<ul style="list-style-type: none"> <li>• Fungus Puccina arachidis</li> </ul>
	<b>Symptoms</b>	<ul style="list-style-type: none"> <li>• Orange coloured pustules appear on the lower leaf surface and rupture exposing brown spores</li> <li>• Leaves become necrotic</li> </ul>
	<b>Control measure</b>	<ul style="list-style-type: none"> <li>• Observe quarantine</li> <li>• Spray appropriate fungicides</li> </ul>
6.	<b>Disease</b>	<ul style="list-style-type: none"> <li>• Alternaria leaf disease</li> </ul>
	<b>Causal agent</b>	<ul style="list-style-type: none"> <li>• Fungus Alternaria spp</li> </ul>
	<b>Symptoms</b>	<ul style="list-style-type: none"> <li>• Lesions which are brown and irregular shaped with yellowish halos</li> <li>• Leaflets turn light to dark brown colour</li> <li>• Lesions become necrotic.</li> </ul>
	<b>Control measure</b>	<ul style="list-style-type: none"> <li>• Use appropriate fungicides</li> </ul>
7.	<b>Disease</b>	<ul style="list-style-type: none"> <li>• Early and late leaf spot</li> </ul>
	<b>Causal agent</b>	<ul style="list-style-type: none"> <li>• Fungus cercospora</li> </ul>
	<b>Symptoms</b>	<ul style="list-style-type: none"> <li>• Lesions which are dark brown with a yellow halo.</li> <li>• Leaves become chlorotic, then necrotic and later fall.</li> </ul>
	<b>Control measure</b>	<ul style="list-style-type: none"> <li>• Seed treatment with appropriate fungicides</li> </ul>
8.	<b>Disease</b>	<ul style="list-style-type: none"> <li>• <b>Fusarium wilt</b></li> </ul>
	<b>Causal agent</b>	<ul style="list-style-type: none"> <li>• Fungus Fusarium oxysporum</li> </ul>

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	<b>Symptoms</b>	<ul style="list-style-type: none"> <li>Young seedling become yellow and wilt</li> <li>Plants dry up and die</li> </ul>
	<b>Control measure</b>	<ul style="list-style-type: none"> <li>Seed treatment with appropriate fungicides</li> </ul>
<b>9.</b>	<b>Disease</b>	<ul style="list-style-type: none"> <li><b>Anthracnose</b></li> </ul>
	<b>Causal agent</b>	<ul style="list-style-type: none"> <li>Fungus Collectrium arachidis</li> </ul>
	<b>Symptoms</b>	<ul style="list-style-type: none"> <li>Small water soaked yellowish spots appear on the lower leaves</li> <li>The lesions enlarge and cover entire leaflet</li> </ul>
	<b>Control measure</b>	<ul style="list-style-type: none"> <li>Spray mancozeb</li> </ul>
<b>10.</b>	<b>Disease</b>	<b>Dry root rot/dry wilt</b>
	<b>Causal agent</b>	<ul style="list-style-type: none"> <li>Fungus Macrophomina phaseolina</li> </ul>
	<b>Symptoms</b>	<ul style="list-style-type: none"> <li>Water soaked yellowish on the lower leaves</li> <li>The spots spread upwards to the aerial parts and down into roots</li> <li>Death of plants.</li> </ul>
	<b>Control measure</b>	<ul style="list-style-type: none"> <li>Irrigation</li> <li>Seed treatment</li> </ul>
<b>11.</b>	<b>Disease</b>	<b>Bud necrosis/Bud rot/Bud light</b>
	<b>Causal agent</b>	<ul style="list-style-type: none"> <li>Virus</li> </ul>
	<b>Symptoms</b>	<ul style="list-style-type: none"> <li>Death of terminal buds</li> <li>Chlorotic rings on leaves</li> <li>Stunted growth</li> <li>Small distorted mottled leaves</li> <li>Small and reduced pods in late infections.</li> </ul>
	<b>Control measure</b>	<ul style="list-style-type: none"> <li>Early planting</li> <li>Control vectors</li> <li>Plant resistant varieties</li> <li>Intercropping</li> <li>Seed treatment</li> </ul>

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		<ul style="list-style-type: none"> <li>• Field hygiene</li> </ul>
12.	<b>Disease</b>	Groundnut rosette
	<b>Causal organism</b>	<ul style="list-style-type: none"> <li>• Virus</li> </ul>
	<b>Symptoms</b>	<ul style="list-style-type: none"> <li>• Chlorosis in the whole plant</li> <li>• Stunted growth</li> <li>• Small curled leaflets</li> <li>• Dark green leaflets</li> </ul>
	<b>Control measure</b>	<ul style="list-style-type: none"> <li>• Early planting</li> <li>• Control vectors</li> </ul>
13.	<b>Disease</b>	<b>Groundnut blight</b>
	<b>Causal agent</b>	<ul style="list-style-type: none"> <li>• Fungus : Sclerotium rolfsii</li> </ul>
	<b>Symptoms</b>	<ul style="list-style-type: none"> <li>• Wilt occurs in patches and a white mycelium is found on the roots</li> <li>• Sunk brown is found on the leaves.</li> </ul>
	Control measure	<ul style="list-style-type: none"> <li>• Spray appropriate fungicides</li> </ul>

**State the examples of fungal diseases. What crops does each of the disease attack and their associated symptoms.**

The following are the diseases caused by fungi:

<b>1. Donny mildew</b>	Attack beans, peas, lettuce, kales and onions.
<b>Symptoms</b>	<ul style="list-style-type: none"> <li>• Leaves have a pale green areas all over</li> <li>• Spots later change to yellow angular spots surrounded by leaf veins.</li> <li>• Leaves die quickly.</li> </ul> <p>NB. This is common in rainy season.</p>
<b>2. Damping off</b>	Attack carrots and seedlings of other crops
<b>Symptoms</b>	<ul style="list-style-type: none"> <li>• Stems become soft and narrow at soil level.</li> <li>• Seedlings fall over and die. Small dark brown spots edged with yellow colour along leaf margin.</li> <li>• Crop may appear as if it has been scorched by heat.</li> </ul>

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	NB. This is common in rainy season.
<b>3. Rusts</b>	Attack maize, beans, onions
<b>Symptoms</b>	Small red or reddish brown spots appear on the underside of the leaves and even on the pods.
<b>4. Black root rot</b>	Attack lettuce and beans
<b>Symptoms</b>	Stunted growth in plants and the roots become black. Sometimes the plants may die

**Give the examples of the common bacterial diseases. What crops does each of them attack? State the symptoms of each disease.**

<b>1. Angular leaf spot</b>	<b>Attack beans and peas</b>
<b>Symptoms</b>	<ul style="list-style-type: none"> <li>Pointed dark brown lesions across a vein which later become numerous.</li> <li>Dark grey mould on the leaf underside.</li> <li>Mould may cover petioles and stems</li> </ul>
<b>2. Bacterial canker</b>	<ul style="list-style-type: none"> <li>Attack tomato</li> </ul>
<b>Symptoms</b>	<ul style="list-style-type: none"> <li>Older leaves curl up and their edges start drying.</li> <li>The plant eventually dies</li> <li>Small fruit size and the fruits drop</li> <li>Diseased fruits have circular creamy white spots with a red dot in the centre.</li> </ul>
<b>3. Bacterial wilt</b>	<ul style="list-style-type: none"> <li>Attack potato and tomato</li> </ul>
<b>Symptoms</b>	<ul style="list-style-type: none"> <li>Wilting of plant.</li> <li>The plant tissues become pale to dark brown in colour.</li> </ul>
<b>4. Blight</b>	<ul style="list-style-type: none"> <li>Attack potato and tomato</li> </ul>
<b>Symptoms</b>	<ul style="list-style-type: none"> <li>Dark brown, more or less circular dead areas on leaves and the fruits of the plant.</li> <li>Severe during rainy season.</li> </ul>

**Mention the examples of the viral diseases. What crops does each of the diseases attack? State the symptoms that are associated with each disease.**

<b>1. Leaf roll virus</b>	Attack potatoes
<b>Signs/symptoms</b>	<ul style="list-style-type: none"> <li>• Infected leaves roll up upwards towards the midrib,</li> <li>• Leaves become hard</li> </ul>
<b>2. Mosaic virus</b>	<ul style="list-style-type: none"> <li>• Attack beans and peas</li> </ul>
<b>Symptoms</b>	<ul style="list-style-type: none"> <li>• Diseased leaves have green areas and dark green patches.</li> <li>• Affected leaves develop irregularly- leaf edges are cupped downwards</li> </ul>

**Explain four harmful effects of plant disease**

- a. They decrease crop yield by altering the normal plant physiological processes interfering
- b. Lower crop quality. This affects grading for marketing.
- c. Some diseases may lead to contamination of crops.
- d. Disease control increases the cost of production.

**Explain the losses caused by diseases.**

- Diseases damage leaf tissues thereby reducing the area available for photosynthesis.
- They may cause death to the whole plant when the leaves fall prematurely.
- A disease destroys flowers, fruits, and seeds which are the vital growth points. This leads to stunted growth and failure to produce flowers, fruits and grain.
- In root crops, diseases destroy the tubers and roots thus destroying not only the water supply to the plant but also the expected crop.
- Young seedlings when attacked by diseases either in the field or the nursery may fail to grow and mature.
- Some diseases are easily spread by insect pests thus they are spread quickly to other crops thereby leading to a reduction in the yields.

**Explain the cultural practices of disease control**

These are agronomic practices used to reduce the infestation or spread of plant diseases without the use of chemicals. These include

- Use of disease -free planting materials wil minimizes the occurrences of plant diseases in crop yields.
- Quarantine regulations to help prevent introduction and spread of diseases in new field areas or into the country.
- Crop rotation- This leads to the interference of life cycles of most pests which act as disease vectors such as aphids which transmit the virus causing tobacco mosaic or rosette in groundnuts.
- Practising of field hygiene that is roguei ng and destruction of infested crop residues.
- Proper seedbed preparation- This exposes soil-borne pathogens to the sun thus killing them.
- Proper pruning- Tree diseases can be effectively controlled by proper pruning.
- Hot water treatment of setts helps to control ratoon stunting diseases in sugarcane.
- Proper drying of cereals and pulses helps to prevent occurrence of aflatoxins.
- Proper spacing of crops- In some crops such as groundnuts, wider spacing results in serious infections of groundnut rosette diseases while closer spacing minimizes the diseases.
- Use of resistant varieties of crops is a highly recommended cultural method.
- Crop sanitation should be ensured by destroying diseased materials which might encourage disease build up.
- Eradicate alternate hosts of disease.

**Explain three categories of chemicals which are used for controlling diseases.**

**1. Protective fungicides**

These protect the plants against attack but are ineffective in controlling an established disease. They remain on the plant surface so do not normally enter the plant system

### **2. Systematic fungicides**

These enter the plant system and become distributed within the plant tissues ensuring the tissues are resistant to disease attacks.

### **3. Eradicating fungicides**

They enter the plant system and kill the established diseases infections.

#### **Outline the chemical practices of diseases control.**

These are control measures which involve use of chemicals to eradicate the disease or kill the diseases vectors. These include

- a. Seed dressing of planting materials with the appropriate chemicals- For example **Lindane** and **cerasan** to control seed-borne fungal diseases.
- b. Spraying crops with appropriate chemicals as a preventive or curative measure. For example spraying coffee with **Delan** or **Daconil** for the control of Coffee Berry Diseases.

#### **Explain the biological practices of diseases control.**

These are methods which involve use of living organisms in a bid to control crop diseases. The living organisms are aimed at reducing the population of pests that are vectors to crop diseases.

For example, the lady bird beetle is a predator of aphids thereby reducing their population. Reduced population of aphids consequently lowers the incidence of viral diseases transmitted by aphids such as groundnut rosette disease, maize streak, citrus tristeza and citrus greening.

#### **Explain the legislative practices of diseases control.**

These involve use of laws passed by parliament that prohibit introduction of crop diseases into the country.

The methods of legislative control include

- Quarantine administration
- Seed certification

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- Notification order

It requires inspection and certification of imported plant materials to ascertain they are disease free. It involves sampling of imported materials and hence it is not very effective.

The law also prohibits introduction of plant materials from regions of known disease outbreaks (areas under quarantine)

### CROP PESTS

**Explain two categories of crop pests.**

#### 1. Field pests

These are pests that attack either maize or groundnuts while growing in the fields and they include

- Insect pests such as **aphids** and **maize stalk borer**
- Rodents such as **rats** and **moles**
- Birds such as weaver bird and mouse bird.
- Some mammals such as apes, monkeys, antelopes and buffaloes.

#### 2. Storage pests

These are the pests that attack grains in their places of storage. The common pests include **weevils** and **rats**.

**State the common pests of groundnuts. Explain the symptoms and control measures of each pest.**

#### 1. Red hairy caterpillars ( **Amsacta albistriga,A. Moorei**)

The larva is hairy reddish brown with black bands on either heads or top abdomen. They have long reddish brown hair all over the body.

##### Symptoms

Caterpillars cause loss of leaves of the crop. All the leaves are eaten away leaving the main stem only.

##### Control measures

- Deep ploughing during the dry season
- Early sowing
- Intercrop with castor for every 5 rows of groundnuts

- Use of crop rotation
- Use of trap crops
- Irrigation
- Field hygiene.

## **2. Groundnut leaf miner(*Aproaerema modicella*)**

Shiny white eggs are laid singly on underside of the leaflets. The larva is green with a dark head and prothorax.

### **Symptoms**

- Brown blotches on the leaf
- Leaflets stuck or webbed together.
- Severely attacked fields looked burnt from a distance.

### **Control measures**

- Use cowpeas or soya, beans as trap crops
- Use of crop rotation
- Field hygiene
- Mulching with rice straws causes reduction in leaf miner attacks.
- Intercropping
- Chemical control with appropriate insecticides

## **3. Gram pod borer (*Helivoverpa armigera*)**

Eggs are spherical in shape and creamy white in colour. The colour of the larva could be between green and brown. It has brown grey lines on the body with lateral white lines

### **Symptoms**

- Larva feeds on flowers and buds.
- Symmetrical holes or cutting scion on leaflets.

### **Control measures**

- Deep ploughing during the dry season
- Intercropping
- Use of chemical insecticides

**4. Groundnut aphids (*Aphids craccivora*)**

**Symptoms**

- Wilting of tender shoots during hot weather.
- Stunting and distortion of the foliage and stems
- They excrete honey dew on which mould form a black coating.
- Act as vectors for the groundnut rosette virus.

**Control measures**

- Timely sowing
- Handpicking and destruction
- Use of chemical insecticides

**5. Jassids (*Empoasca kerri*)**

Adults have elongated wedge-shaped bodies, active and green in colour.

**Symptoms**

- Whitening of veins and chlorotic patches
- Heavily attacked crops appear yellow and scorched.

**Control measures**

- Timely sowing
- Use of crop rotation
- Intercropping with millets
- Use of irrigation
- Chemical control with insecticides.

**6. Thrips (*Scirotothrips dorsalis*)**

These are small slender and yellow-black coloured insects. They have piercing and sucking mouth parts.

**Symptoms**

- Tender leaves show yellowish green patches on the upper surface and brown necrotic areas and silvery sheen on the lower surface.
- Stunted plants.

**Control measures**

- Spray insecticides

## **7. Termites (*Odontotermes*)**

### **Symptoms**

- Wilting of plants in patches.
- Termites and hollow pit the tap root and stem thus killing the plant.
- Termites bore holes into pods and damage the seed which weakens the shells making them liable to entry and growth of fungus that produce aflatoxins.

### **Control measures**

- Destroy termite colonies
- Use well decomposed manure
- Timely harvesting
- Chemical control with insecticides
- Irrigate frequently
- Seed treatment.

## **8. White grubs (*Holotrichia serrata*)**

### **Symptoms**

- Feeds on roots and damage pods
- Grubs feed on root hairs, resulting in pale wilted plants drying in patches.

### **Control measures**

- Deep ploughing in dry season
- Use well decomposed organic fertilizer
- Early plan. control with insecticides
- Chemical control using insecticides
- Seed treatment

## **9. Pod borer (*(Anosolabis stalli)*)**

### **Symptoms**

- Young pods showing holes with excreta inside.
- Pods without seeds

### **Control Measures**

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- Chemical control with insecticides
- Soil sterilization.

**Give examples of field pests of groundnuts and state the damages caused by each pest.**

Pest	Damages
<b>Groundnut aphid</b>	The insect injects a toxic substance into the plant while feeding which leads to stunted growth or death of the plants.
<b>Thrips</b>	These are tiny insects that feed in the unfolded developing leaves of the groundnut plants. They suck the juice in the inner parts of the leaves leading to stunted growth.
<b>Leafhoppers</b>	They are tiny insects that move from plant to plant and inject a poisonous substance in the leaves of the plant leading to yellowing of the leaves.
<b>Hairy caterpillars</b>	They eat all the leaves of the groundnut plant leaving the stem only
<b>Leaf miner</b>	They form small brown patches on the leaves of groundnuts
<b>Termites</b>	They get into the roots and stems and feed on them leaving them hollow leading to death of plants.
<b>White grubs</b>	They feed on the shoots and damage the pods of groundnuts making the plant become pale and then it withers.

**State the storage pests of groundnuts and explain the damages caused by each storage pest.**

Pest	Damage caused
<b>Groundnut bruchid</b>	Burrow into the pod and seed leaving holes thereby making the grains hollow
<b>Red flour beetle</b>	They make tunnels into the groundnut grains that have

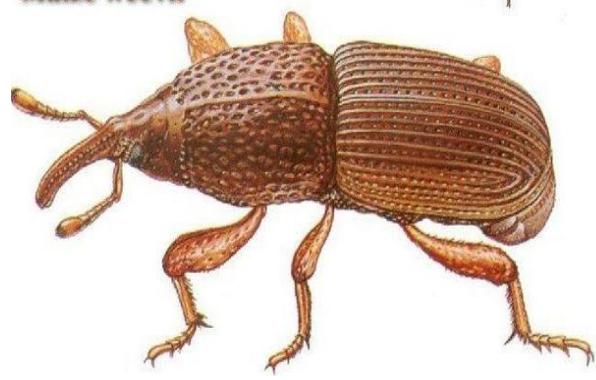
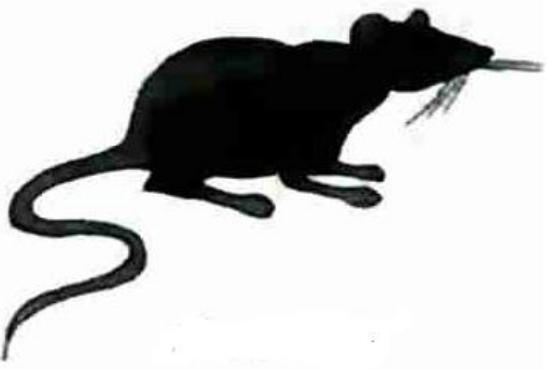
	been stored
<b>Khapra beetle</b>	They scratch the surface of the grains and then feed on the whole grains
<b>Indian meal moth</b>	Feeds on the germ portion of the grain making it unhealthy for use in planting.

### **MAJOR PESTS OF MAIZE**

**State the examples of the pests of maize and how they can be controlled.**

<b>1. Maize stalk borer</b>	
<b>Damages caused</b>	<ul style="list-style-type: none"> <li>• They feed on aerial parts of maize. Their attacks results into death of the central growing points of the crop.</li> <li>• They move through stems tunneling them resulting in weakened stems which later fall off</li> </ul>
<b>Control measures</b>	<ul style="list-style-type: none"> <li>• Remove and destroy all crop residues</li> <li>• Apply Endosulfan or Diazinon granules down the funnel of each plan when the maize is about planting.</li> </ul>
<b>2. Pink stalk borer</b>	
<b>Damages caused</b>	<ul style="list-style-type: none"> <li>• The larvae bore into the stem of maize plants weakening the plants</li> <li>• Early attack results in destruction of the plant's central shoot.</li> </ul>
<b>Control measures</b>	<ul style="list-style-type: none"> <li>• Field hygiene</li> <li>• Use of recommended chemicals insecticides</li> <li>• Destruction of planted alternate host crops</li> </ul>

<b>3. Maize aphids</b>	
<b>Damages caused</b>	<ul style="list-style-type: none"> <li>• These are soft, dark green insects which feed in clusters and are found in the inflorescence especially when there is water shortage in the soil.</li> <li>• They suck sap the green husks of cobs and leaves.</li> <li>• They attacked leaves and husks appear black in colour.</li> </ul>
<b>Control measures</b>	<ul style="list-style-type: none"> <li>• Early planting</li> <li>• Spray with recommended chemical insecticides.</li> </ul>
<b>4. Maize webworm</b>	
<b>Damages caused</b>	<ul style="list-style-type: none"> <li>• The larvae which are long and dark brown in colour form silken webs on cobs. The larvae first feed on the leaves preceding flowers removing the chlorophyll and later on the milky grains</li> </ul>
<b>Control measures</b>	<ul style="list-style-type: none"> <li>• Spray recommended chemical insecticides.</li> </ul>
<b>5. Army worm</b>	 

<b>Damages caused</b>	<ul style="list-style-type: none"> <li>Army worm feed on crop leaves. They move in large swarms and eat up all the vegetation during their invasion.</li> </ul>
<b>Control measures</b>	<ul style="list-style-type: none"> <li>Use of recommended chemical insecticides.</li> </ul>
<b>6. Weevils</b>	
<b>Damages caused</b>	<ul style="list-style-type: none"> <li>The adult which have long curved snouts bore into grains. Damage is caused by their larvae as well as their adults.</li> </ul> <p style="text-align: center;"><b>Maize weevil</b></p> 
<b>Control measures</b>	<ul style="list-style-type: none"> <li>Timely harvesting</li> <li>Use of recommended chemical insecticides.</li> </ul>
<b>Rats</b>	

<b>Damages caused</b>	<ul style="list-style-type: none"> <li>• These rodents have sharp strong teeth capable of gnawing, breaking and chewing grains. They are very destructive in stored grain.</li> </ul>
<b>Control measures</b>	<ul style="list-style-type: none"> <li>• Use of recommended chemicals</li> <li>• Biological control through the of cats</li> <li>• Use of trap rats.</li> </ul>

**Explain the harmful effects of pests**

1. Pests may cause physical destruction to crops by eating leaves, stems, roots or flowers.
2. If not controlled, pests can cause considerable reduction to crop yields.
3. Some pests are diseases vectors sucking pests such as aphids, mealy bugs and cotton strainers which transmit viruses and fungi causing diseases infections in the crops.
4. Some pests lower crop quality.
5. Some pests suck sap depriving the plant of its food leading to low yields.

**PEST CONTROL PRACTICES**

**Outline the cultural practices of pest control.**

- Use of clean planting materials which are free from pests in establishing free crops.
- Proper seedbed preparation that expose soil-borne pests to the adverse conditions or to predatory birds which eat them up.
- Use of resistant crop varieties that have mechanisms of resisting pest attack.
- Weed control that helps avoid pest attack in the crop.
- Observing field hygiene that involves farming practices that ensure little or no plant materials that may harbor pests in the field.
- Mulching which makes the pest to exposed themselves to predatory agent since the pests attach themselves on the mulch.
- Close season. Close season is a period during which a particular crop is

deliberately not grown in a given area in order to control pest build up. Close season makes the pests to starve to death during the absence of that particular crop.

- Trap crops- Trap crops are crops which attract pests diverting them from the main crop. The trap crop is grown together with the main crop. The pests can be killed by use of other means while on the trap crop.
- Proper spacing which makes difficult for the pests to move from one plant to another. However closer spacing reduces aphids in groundnuts.
- Timely harvesting prevents serious attacks by pests such as rats and weevils.
- Crop rotation which helps to break up the life cycles of the pests.
- Proper plant nutrition. Healthy plants are known to be more resistant to pest attack.

**Outline the mechanical/physical practices of pest control.**

Mechanical control involves using mechanical means to kill the pests and creating physical barriers to prevent pests from getting into contact with their target crops.

The following are the mechanical control of pests

- Irrigation/flooding- Irrigation drowns pests such as leaf miners and aphids while flooding suffocates moles in the soil.
- use of lethal temperatures -For example of hot water is used to control the pink bollworm
- Hand picking, trapping and killing- This involves catching the pest and killing.
- Creation of physical barriers such as metal plates fixed on posts for raised granaries to prevent rants
- Proper drying which ensures that the produce is hard enough to limit pest damage on the grains.
- Scare crows which are human figure-like objects which are used to scare away birds and other large animals from a field of crops.

## FORM TWO AGRICULTURE COMPREHENSIVE STUDY NOTES-SYLLABUS BASED

- Distress calls that is sound of a captured pest or that of its predator that is replayed from a loud speaker scaring away pests.

### Outline the biological practices of pest control.

These are methods which employ the use of living organisms which are natural predators of the pests.

Predator	Target pest
Parasitic wasp	White fly in citrus fruits
Lady bird beetle	Aphids , cotton cushion scale
Praying mantis	Giant hopper
Cats	Moles, rats and mice
Chicken	Cotton strainers and termites

### Advantages of biological pest control practices

- a. Self-perpetuating
- b. Cause no environmental pollution
- c. Save labour costs

### Disadvantage

It takes too long to research for the correct biological agent.

### Define chemical pest control practices.

This is the use of chemicals to control pests. The chemicals are known as pesticides.

The application of pesticides is done through the following ways

- a. Dusting
- b. Spraying
- c. Fumigation of the soil and the produce
- d. Sterilisation of implements.

### Explain two types of pesticides.

#### 1. Mode of entry

**These are pesticides that kill pests through how they enter the body of the pests. These include**

- a. **Stomach poisons-** these enter the pest through the mouth during

feeding and poison the pest.

- b. **Contact poisons-** These kill the pest when it comes into contact with the chemicals as they get absorbed through the skin.
- c. **Fumigants-** These chemicals enter the respiratory system in form of fumes suffocating the pest to death.
- d. **Systems-** These chemicals may be applied into the soil or directly onto the plant. When pests feed on such plants they get killed.

### 2. Types of target pests

These are chemicals that are killing the target pests. Classes of the chemicals include:

- a. **Insecticides-** These are chemicals that kill insects. They include diazinon, dimethoane, fenthion etc
- b. **Rodenticides-** These kill rodents such as rats, mice and squirrels. Examples of these chemicals include nomui and red cat
- c. **Nematicides-** These are chemicals that kill nematodes. Examples are nemacur, nemagon and temic.

**State the factors that affect the efficiency of applying pesticides.**

- 1. **Concentration of the pesticides-** a pesticide has a higher efficacy when applied in its correct concentration.
- 2. **Weather conditions at the time of application-** avoid applying chemicals on rainy days
- 3. **Timing of applications.** The chemicals are efficient when applied at a time when the pest is most susceptible.
- 4. **Persistence of the pesticides-** Apply the pesticides which have long residual effect to be effective.
- 5. **Pest resistance-** When the pests become resistant to pesticides, this reduces their efficiency.

**State the advantages and disadvantages of pest control.**

#### **Advantages**

- a. It is relatively fast method of pest control

- b. It has low labour requirements.

### **Disadvantages**

- a. Chemicals are expensive to purchase
- b. Chemicals may cause pollution if they have long residual effects
- c. use of chemicals require skills especially in mixing and application
- d. Some target pests may develop resistance.

**Explain the following ways of controlling pests.**

- a. Legislative pest control-** This involves enactment of laws by the parliament that prohibit entry of crop pests from other countries.  
In other words, it is the imposition of quarantine to restrict the introduction of a disease or pest infested planting material or crop produce.  
All crop produce imported to Malawi must be inspected and certified as free before it can be released for use.
- b. Integrated pest management (IPM)-** This is a strategy of pest control which combines various pest control methods such as cultural, physical, biological and use of pesticides in a bid to reduce pest population..

### **CROP HARVESTING PROCEDURES**

Crops should be harvested on time to reduce crop losses through destruction by rain, birds, and rodents, to avoid spoilage of cereal crops due to rotting or mould attack.

**List the factors that determine the stage of harvesting a given crop.**

- 1. Intended use of the crop-** Maize for silage is harvested wholly when it is at the silking stage; green maize is harvested when the cobs are not yet dry; maize for shelling is harvested when it has dried properly.
- 2. Prevailing weather conditions-** Crop must not be harvested late such as in pulses which shatter and throw their seeds when completely to avoid loss of produce.
- 3. Market demand-** A crop can be harvested earlier when the market demand is high. This allows the farmer to benefit from the high market prices.
- 4. Pest and disease outbreaks-** Pests and disease attacks can influence the

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stage of harvesting crops, such as weevil or rodent attacks on maize can be prevented by early harvesting.

### HARVESTING OF GROUNDNUTS

**Give two signs that may show a groundnut crop is ready for harvesting.**

- a. When the crop is mature
- b. The veins on the inner surface of shells will darken
- c. Leaves will turn yellow and begin to shed.

**State the stages of harvesting groundnuts.**

- a. **Lifting-** Groundnuts should be lifted when most of them are mature. Maturity is indicated by darkening of the veins on the inner surface of the shells and yellowing of most of the leaves.
- b. **Drying-After lifting the plants,** turn them upside down and leave them to dry in the field for a few days. The nuts are then removed by hands.
- c. **Shelling-** Hand shelling or hand operated machines can be used in shelling nuts.

### METHODS OF HARVESTING GROUNDNUTS

- a. Groundnuts can be harvested through hand pulling
- b. Groundnuts can be harvested by digging using a hoe.
- c. Groundnuts can be shelled by hand or mechanized groundnut shellers on a large scale.

### HARVESTING MAIZE

**You have visited a maize field, outline the signs of readiness that will determine whether the plants should be harvested or not,**

- Maize is ready for harvesting when the cob-sheath turn brownish.
- Maize is ready for harvesting when the plant starts yellowing and drying.

**State the methods of harvesting maize crop.**

1. Plucking of cobs from the stalk by use of hand
2. Cutting the stalks and stacking them in the fields. Stacking helps to reduce damage by termites, ants, fungi and animals. The maize is shelled and packed in bags of 90kg.

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### 3. Using combine harvesters

NB- The remains of the harvested crop should be burned or buried deep into the soil to reduce the incidences of the stem borers.

## CHAPTER 10: PIG PRODUCTION

### Reasons why pig farming is more profitable compared to keeping other livestock

- a. They have a high prolificacy since a sow gives birth to several piglets at one farrowing.
- b. The gestation period in pigs is shorter than it is in cattle, sheep and goats averaging 115 days.

### Factors that make pig farming not to be exploited to the maximum

- a. Religion- Islamic communities neither rear pigs nor eat their products.
- b. Culture- Some communities do not accept pig rearing and their products.

### Reasons why pigs are reared in Malawi

- a. For pork production
- b. To provide bristles used for making synthetic leather fabrics

## BREEDS OF PIGS

### 1. Local breeds-

- They are mostly kept for pork and are bred using free range system.
- They look for their own food
- They are allowed to mature and grow in natural environment.
- They are predominately black, but some

### 2. Exotic breeds

The exotic breed kept by farmers in Malawi includes Large White (Yorkshire), Landrace, Wessex saddleback (Hamshire) and Berkshire.

## MANAGEMENT SYSTEMS FOR PIG PRODUCTION

### Three systems of rearing pigs include

#### 1. Extensive system

This is a system of pig rearing where they are allowed to move and forage freely in an enclosed piece of land. A simple structure is constructed to

provide shelter at night and bad weather. Foraging is provided.



### **Advantages**

- It is cheap due to lower costs and low capital costs
- Has marketing benefits since most people prefer pork from local pigs.
- Has improved welfare of pigs since they are not kept under hot conditions
- low capital investment
- Does not require a lot of skills
- Droppings are evenly spread in the field

### **Disadvantages**

- low productivity
- Lack of the use of qualified labour
- Poor healthy pigs are kept
- High likelihood of theft/predation
- Cannot be practiced where the land is small
- Has low profit per unit area
- Pigs take long to reach market weight.

## **2. Semi-intensive System**

This is a system of pig production whereby the pigs are restricted to a limited area and are then fed by the farmer.

### **Advantages**

1. Low cost of investment

2. High productivity
3. High quality of pork is produced
4. It requires lesser land than the extensive system
5. Improved feeding and disease control.
6. Pigs are allowed to do exercise to prevent build up of fats.

**Disadvantages**

- a. It requires a lot of technical knowledge- Skilled labour
- b. It requires extra time and effort to ensure maximum productivity.

**3. Intensive system**

This is a system where the pigs are permanently kept indoors in a structure known as piggery. They are provided with adequate feeds and water all the time. It is for commercial purpose.



**Advantages**

1. Can be practiced even on a small piece of land
2. Allows a higher stocking rate
3. Pigs reach market weight early
4. Pigs are secure against predation or theft
5. Piglets are protected from adverse weather conditions
6. Has high profit per unit area
7. Manure accumulates faster.

**Disadvantages**

1. Diseases and parasites may spread fast
2. Requires high capital investment
3. Requires a lot of skills
4. Requires a lot of labour

### **BREEDING IN PIGS**

- Breeding refers to the mating of animals that have certain desirable qualities in order to produce animals that meet the desirable characters.
- A sow should be served 4 days after weaning her piglets. The sow on heat is taken to the boar to ensure successful mating which it is returned to her pen.
- The farmer should observe return of heat on the mated sow or gilt after 21 days and repeat mating. Natural mating is the most common method in serving pigs.

#### **Define the term flushing**

Flushing is the practice of putting the sow/gilt on high level of quality of feeds 2-3 weeks before and after mating.

#### **State the signs of heat in a sow**

The sow on heat shows the following signs

1. Restlessness
2. There is clear slimy mucous discharge from the vulva.
3. Swelling and reddening of the vulva.
4. Frequent urination
5. Occasional grunting
6. Loss of appetite
7. It amounts other pigs in the pen
8. It stands motionless when others mount it.

#### **Define the term gestation and steaming up in livestock production.**

Gestation is the period in which a foetus develops in the uterus of a female mammal to the time it gives birth. In other words, gestation is the period of time from conception to farrowing (parturition). The gestation period of gilt or a sow is 114 days.

Steaming up is the practice of feeding the sow/gilt with adequate high quality feeds during the last three 3 weeks of farrowing.

#### **Explain three importance of steaming up in livestock production.**

**Steaming up is important for the following reasons**

- a. It ensures strong and healthy piglets.
- b. It stimulates growth of alveolar tissue of the udder hence more milk production upon farrowing.
- c. Ensures a strong and healthy sow hence less likelihood of complications during farrowing.

**Define the term parturition.**

Farrowing is the term used when a sow is giving birth

**Explain the signs of parturition in pigs.**

- a. It becomes restless and begins to collect bedding materials at one corner to make a nest.
- b. Loss of appetite
- c. The udder and teats become enlarged and filled with milk.
- d. The vulva becomes enlarged and red.
- e. The vulva muscles on either side of the slacken.

**Explain the things that should be done when preparing sows for farrowing.**

- Deworm the sow
- Wash and spray the sow against ectoparasites using appropriate chemicals.
- Clean and disinfect the farrowing pen at least 5-7 days before the expected date of farrowing to familiarise it with the environment.
- Provide clean water adlibitum
- Create a creep area with infra-red light.

**What are the practices that should be undertaken by the farmer after farrowing in pigs?**

After farrowing carry out the following practices

- a. Ensure the piglets are breathing properly.
- b. Ensure the piglets are safe by moving them away from the sow as each is born.
- c. Tie, cut and disinfect the navel cords of each piglet.
- d. Weigh each piglet and record the birth weight.

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- e. Remove and discard the after-births and any still borns.
- f. Count and record the number of piglets
- g. Place the piglets under infra-red light.

**Give three factors which can cause high mortality rates of the piglets within first 3 days after parturition.**

Piglets are very delicate and high mortality rates can be experienced within the first 3 days due to

- a. **Being crushed by the mother**- crushing of the piglets can be prevented by providing a farrowing crate and guard rails in the farrowing pen.
- b. **Chilling**- Chilling is prevented by providing an infra-red bulb or any other source of heat in the creep area.
- c. **Piglet anaemia**- It is controlled by providing iron supplements to the piglets.

**Define the term teeth clipping.**

Teeth clipping refers to cutting of the sharp canines at gum level using a teeth cutter in pigs.

**Explain the importance of teeth clipping in pigs production**

- a. Avoid injury of the sow's teats or udder hence reduces incidences of mastitis.
- b. It reduces the likelihood of piglets injuring one another when playing or fighting.
- c. It reduces incidence of piglets injuring the farmer during handling of piglets.
- d. It makes the piglets docile hence easy to handle.

**Define the term castration.**

Castration is the practice carried out on male piglets not selected for breeding.

**Describe the procedure for castrating a piglet.**

- Gather the tools and materials that is scalpel, disinfectant and cotton wool.
- Restrain the piglet appropriately.
- Using one hand, squeeze the testes and hold.
- Disinfect the scrotal surface.

- Using a scalpel make an incision on the scrotum.
- Squeeze out the testis through the incision until the spermatic cord is extended.
- Cut the spermatic cord using a scalpel.
- Repeat the above for the other testis
- Disinfect the wound.
- Release the piglet.

### **State five advantages of castration.**

1. It controls breeding
2. It controls breeding diseases.
3. It prevents inbreeding
4. It enhances growth rate of piglets
5. It makes the piglets docile hence easy to handle.

### **Define the term piggery.**

Piggery is the term given to the housing structure of the pigs. It is also known as pig sty.

### **What are the essential features of a piggery?**

1. **Farrowing owing pen-** It is used for farrowing and ensuring the safety of the piglets. The pen is provided with a farrowing crate to prevent the sow from lying on the piglets and a heat source to protect the piglets against chilliness. It contains a creep area where only the piglets can access creep feed.
2. **Weaners pen-** It is where weaned pigs are kept. It should have a feeding, watering and resting section.
3. **Boar pen-** This is where breeding boars are kept. It gives room for sows to be served during the breeding season.
4. **Gilts pen-** It is used for keeping young female pigs up to the age of service usually 12 months.
5. **Feed store-** This is used for storing feed.
6. **Records room-** This is used for keeping feed and weight records.

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**7. Running yard-** This is an extension of the pens. The yards are used for dunging and sunbathing.

**8. Water troughs or drinking nipples-** These are used as watering points for the pigs.

### What are the qualities/requirements of a good piggery?

- Easy to clean
- Draught free especially the farrowing pen.
- Well lit
- Well ventilated.
- Floor should drain away urine and water. The floor should be free to drain to avoid accumulation of water which can result in disease infection.
- Leak-proof.
- Farrowing pens should have guard rails.
- It must be strong otherwise the pigs can destroy the structure.
- The floor should be made of concrete for easy cleaning.

### Maintenance of a piggery unit

- Clean the unit regularly
- Change the bedding regularly
- Repair any broken parts
- Avoid dampness by repairing leaking roofs.

## FEEDING PIGS

### Define the term creep feeding.

Creep feeding is the practice of giving young animals additional quality feeds in form of pellet to supplement mother's milk.

### State four importance of creep feeding

1. It leads to higher weaning weight.
2. It promotes fast growth because the young do not rely on the mother's milk only.
3. It helps in the full development of the digestive system as the young get

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accustomed to digesting solid feed in addition to the milk.

4. It prevents over-suckling of the mother thus promoting good body condition at weaning.

### State the qualities of a good creep.

- Highly digestible
- High in energy content.
- Highly palatable
- Rich in digestible crude protein between 20-24% DCP.
- Rich in minerals such as iron and calcium among others.
- Rich in vitamins A, B and D.

### Name the type of feed given to the following stages of growth of pigs.

- a. **10-8weeks-** The piglets should be given milk from the mother sow and the **creep feed**.
- b. **8 weeks-50 kg** - The weaners are fed on sow and cleaner meal (**Weaners mash**).
- c. **50kg-market-** The pigs are fed on **pig finisher or fattener meal** which has lowest digestible crude protein level with 12%.

## WEANING

### Define the term weaning.

Weaning is the gradual introduction of solid feeds and gradual reduction of milk consumption in piglets. The piglets are separated from the mother sow at 8 weeks of age.

### Explain two systems that are used in the weaning process in pigs.

Piglets can be weaned through the following systems

1. **Old weaning system at 8 weeks-** Weaning piglets at this stage is a natural process. By this time the sow's milk production is declining substantially and solid feed consumption by piglets is sufficient to meet about 70-80% nutritional requirements.
2. **Recent system at 4-6 weeks-** This involves separating the mother sow and piglets at 4-6 weeks of age. The piglets' old feed consumption accounts for

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50-60% of the nutrients requirements and therefore no serious problems should be encountered with weaning at this stage.

### **Explain five factors that a farmer should consider when weaning piglets.**

1. Piglet immunity- Passive immunity from colostrums is transient and declining to very low concentrations by 14 days of age.
  - Piglets do not start building its own active immunity until about 21 days of age.
  - Acquiring active immunity is a slow process even if they are exposed to antigens as part of the disease control program. So piglets have little protection for mother 2-3 weeks.
2. Post weaning fertility- Early weaning does not necessarily lead to fast return of the sow into oestrus.
3. Availability of skilled attendants to take care of the piglets
4. Availability of proper facilities
5. Feed costs

### **State the advantages and disadvantages of very early weaning in pigs.**

#### **Advantages**

1. Better disease control. Piglets are separated from mother sow when their passive immunity is still high, hence cannot get infected by pathogens in the mother's body.
2. Uniform piglet growth is achieved.
3. There is better sow productivity.

#### **Disadvantages**

1. There is potential delayed fertility in sows especially gilts.
2. Very early weaning requires very special facilities such as isolated, precisely controlled environments adjusted as piglets grow.
3. Very early weaning relies on competent and dedicated attendants.

### **Describe three basic essentials for satisfactory weaning in pigs.**

1. **Minimise distress-** Piglets should be properly pre-conditioned and kept with some members of the same litter.

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**2. Physical environment-** Maintain piglets within the pen and have adequate sizes such as 10-20 per pen

**3. Feeding-** Provide palatable rations that meet all nutritional requirements of the piglets.

### Define the term wallowing as used in pig production.

It is a unique behavior of pigs whereby they roll on and spread their bodies with mud.

### State three importance of wallowing in pigs

1. It has cooling effects especially in hot weather.
2. It helps to control sun burns especially those with low pigmentation.
3. It helps to control external parasites.

### COMMON PARASITES IN PIGS

Parasites	Symptoms	Control measures
<b>Roundworms</b>	<ul style="list-style-type: none"><li>• Retarded growth</li><li>• Scours</li><li>• Anaemia</li><li>• Pot belly appearance</li><li>• Diarrhoea</li><li>• Constipation</li></ul>	<ul style="list-style-type: none"><li>• Avoid rearing pigs in muddy grounds</li><li>• Avoid grazing pigs in wet grass in the morning when the larvae is active.</li><li>• De-worm pigs using appropriate dewormers regularly</li></ul>
<b>Whipworms</b>	<ul style="list-style-type: none"><li>• loss of appetite</li><li>• Diarrhoea with mucus and blood stains</li><li>• Dehydration</li><li>• Death</li></ul>	<ul style="list-style-type: none"><li>• Raising pigs in confinement</li><li>• Deworming with appropriate dewormers</li></ul>
<b>Mange</b>	<ul style="list-style-type: none"><li>• Thickened and reddened skin around the ears, shoulders, stomach and between</li></ul>	By washing the animals clean Spray with appropriate acaricides.

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	<p>the legs.</p> <ul style="list-style-type: none"> <li>Animals will scratch themselves until they damage their skins.</li> </ul>	
<b>Mites</b>	They burrow into the skins causing great irritation	
<b>Lice</b>	They suck blood	

### COMMON DISEASES OF PIGS

Disease	Symptoms	Control measures
<b>African swine fever</b>  (caused by iridovirus) transmitted by ticks	<ul style="list-style-type: none"> <li>High fever</li> <li>Difficulty in breathing</li> <li>Constipation followed by blood stained diarrhea</li> <li>Coughing and vomiting</li> <li>Lacrimation-watery discharges from the eyes</li> </ul>	<ul style="list-style-type: none"> <li>Keep off wild pigs</li> <li>Do not feeds on cabbage</li> <li>Quarantine</li> <li>Slaughter and properly dispose of the affected pigs</li> </ul>
<b>Pneumonia</b>  caused by bacterium Mycoplasma mycoides	<ul style="list-style-type: none"> <li>Severe respiratory problems</li> <li>Abundant mucoid nasal discharge.</li> <li>Fever</li> <li>Piglets appears dull</li> <li>Loss of appetite</li> <li>Abnormal lung sounds</li> <li>Coughing</li> </ul>	<ul style="list-style-type: none"> <li>Keep piglets in warm pens</li> <li>Treat with antibiotics</li> <li>Avoid of overcrowding in animal pens</li> <li>Provide adequate ventilation.</li> </ul>
<b>Piglet scours/white scours</b>  Caused by bacterium Escherichia coli	<ul style="list-style-type: none"> <li>White/yellow diarrhoea</li> <li>Rapid dehydration</li> <li>Extremely cold to touch</li> <li>Dullness'</li> <li>Undigested milk curd</li> </ul>	<ul style="list-style-type: none"> <li>Cleanliness of the house</li> <li>Proper feeding</li> <li>Observe hygiene during parturition</li> </ul>

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	<ul style="list-style-type: none"> <li>• Loss of appetite</li> <li>• Blood and mucus stains in the faeces.</li> </ul>	
<b>Piglet anaemia</b> (disease of the piglet because they are born with limited supply of iron)	<ul style="list-style-type: none"> <li>• Pale skin</li> <li>• Rapid breathing</li> <li>• General weakness</li> <li>• Signs of haemorrhage</li> <li>• Scours, sloppy diarrhoea</li> </ul>	<ul style="list-style-type: none"> <li>• Administer iron injection within the first week after birth.</li> <li>• Give iron paste to piglets.</li> </ul>