S .2 AGRICULTURE - NGS | Tr. Bodyo Judith

SOIL FERTILITY

This is the ability of the soil to supply plant nutrients in adequate amount and right proportion for better plant growth.

FACTORS AFFECTING SOIL FERTILITY.

Soil depth, soil structure, soil drainage, soil PH, soil aeration, water holding capacity, availability of plant nutrients, presence of pests and diseases, soil compaction, living organisms, accumulation of salts, soil capillarity, hard pans, soil capping and presence of polyethene materials in soil.

SOIL DEPTH

Soil depth is associated with the maturity of the soil and it also influences the amount of water retained in it for plant use.

SOIL STRUCTURE

This affects the amount and movement of air and water within the soil and also the transfer of heat. Therefore a good soil structure gives ideal conditions for plant growth.

SOIL DRAINAGE

This refers to the ease with which excess water drains out of the water logged soils. There is poor aeration, low temperature, poor soil structure, and low PH in water logged soils. All the above will interfere with normal crop growth.

SOIL AERATION

Adequate air in the soil particularly oxygen improved water and nutrients uptake and also encourages better root development. The air is also needed by the soil organisms during the decomposition of plant or animal remains.

POLYETHENE MATERIALS IN SOIL

Affects soil aeration, root development and water infiltration which all affect soil fertility

SOIL CAPPING

This affects soil drainage which determines pest attack, soil Ph and root development in crops and hence soil fertility.

HARD PANS

This impedes water infiltration hence affecting soil fertility.

AVAILABILITY OF PLANT NUTRIENTS

Plant nutrients are needed by plants and therefore a soil which contains most of the nutrients and can easily supply them is said to be fertile.

SOIL PH (SOIL REACTION)

This is the acidity or alkalinity of the soil. It influences the (ability) availability of plant nutrients e.g. at lower PH (acidic) phosphorous and molybdenum are not available but iron, Mg, Zn, K and Boron are available yet unavailable again at high PH (alkaline)

IMPORTANCE OF SOIL PH.

- It affects the presence of certain plant pathogens like bacteria and fungi are not common at low PH but fungi are common
- At very low PH the concentration of certain nutrients such as iron and Aluminium in the soil becomes toxic to plants.
- Soil PH has a strong influence on the availability of various plant nutrients.
- Very low or very high PH inhibits the activity of the soil micro-organisms more especially the nitrifying bacteria.

TESTING FOR SOIL PH

Place a sample of soil in a dry test tube

Add barium Sulphate/ ammonium Sulphate to the soil sample

Add distilled water to the mixture and shake gently

Add 3 drops of the universal indicator and allow the contents to settle for about 45 minutes

Use the Ph chart to find the ph of the soil by relating with the colour of the contents in the test tube

ACIDITY IN SOILS.

This is caused by the following:-

Soil formed from acid rocks: Rocks such as granite contain an excess of silica (Quartz) which combine with water to form acids.

Presence of humus: Humus may react with iron and aluminum to form complexes which under go hydrolysis to yield hydrogen ions responsible for acidity.

Presence of soluble salts: These may be acidic, neutral, or basic arising from fertilizers mainly.

Water lodging: This causes hydrolysis of some of cautions in the soil which may release hydrogen ions leading to soil acidity

Rain water: atmospheric carbondioxide combines with rain water to form a weak carbonic acid responsible for soil acidity.

Cultivation of crops: The growing of crops can cause acidity when the plant absorbs **cations that can be replaced by hydrogen ions.**

Fertilizers application: Application of fertilizers increases cations and anions content in the soil. When the nitrates are leached they move along with cations leaving the H+ behind

Biological activities in the soil: Anaerobic decomposition of organic matter leads to formation of weak acids in the soil e.g. lactic acids, ethanoic acids (Organic acids)

The presence of sulphides in the soil: The sulphides in the soil can also cause soil acidity due to the production of H+ ions.

Presence of sulphides : These can cause acidity to the production of H+

SOIL AMMENDMENT

Rising of the soil PH to reaction nearer neutral is done by addition of lime a process called liming.

Liming materials:-

Calcium carbonate (lime)
Calcium Sulphate
Calcium carbonate
Magnesium carbonate.
Wood ash
Sugar factory lime
Calcium hydroxide
Calcium magnesium carbonate

Factors considered before liming

- Soil ph; very high or low ph may require amending
- Buffer capacity of the soil i.e. ability to resist change in ph after addition of lime
- Amount of bases in the exchange complex.
- Type of crops to be grown i.e. each crop requires a different ph
- Fineness of the materials to be used for liming
- Amount of manganese present in the soil

Importance of liming:-

- It increases the use of nutrients by crops leading to increased yields.
- It increases the microbial activity in the soil
- Organic matter decomposition in the soil is accelerated
- It increases the availability of plant nutrient and their supply like phosphates.
- Make soils easy to cultivate more especially clay soil
- Ensures sufficient utilization of soluble acidic manures such as phosphates
- Keeps the soil in good condition for crop growth.

Negative effects of liming

- It can lower the yields of crops in later years if the PH is allowed to increase continuously.
- It is expensive therefore can increase the production.
- It decreases the future supply of plant nutrients
- Accelerated organic matter (OM) decomposition causes a decline in organic matter content of the soil.

Characteristics of a good liming material

- It should have a mild alkanising effect
- It should have a favouable effect on soil
- Should be cheap and readily available
- Should not affect soil microbes
- Should not affect availability of crop nutrients

LOSS OF SOIL FERTILITY

Soil can loose fertility through:-

Soil capping
Change of soil PH
Build up of pests and diseases in the soil
Burning
Formation of hard pans
Soil erosion
Over cultivation
Crop removal during harvesting
Large number of weeds.

Soil Capping

This is the formation of an impervious layer on the surface of soil which prevents water infiltration. This stops the dissolution of plant nutrients and proper root development

Formation of Hard Pans

This is an impervious layer formed just beneath the soil surface and can be caused by continuous ploughing at the same depth. It prevents water percolation and proper crop root development.

Over cultivation

This causes rapid oxidation of organic matter by micro organisms leading to loss of fertility.

Effects of over cultivation of arable land

Destroys Soil structure making the land more prone to erosion
Increases production costs by engaging more labour in cultivation
Can destroy crop roots
Can increase evaporation of moisture from soil by increasing surface area for loss.
Increases oxidation of crop nutrient hence loss of fertility

Crop removal during harvesting

The removal of crops from the garden or their products from the garden carries away all the nutrients concentrated in their tissue and seeds.

Weeds over growth

These use a lot of nutrients and therefore cause loss of nutrients from the soil

Leaching

This is the washing out of soil nutrients in both solution and suspension to the deeper layers of the soil where plants can not utilize it.

Soil erosion

This carries away the more productive top layer of soil leading to loss of fertility

Change of soil PH

Some plants nutrients are available at low PH e.g. iron, Mg, A1, Zn, K and Boron while others are favoured by a high PH e.g. phosphorous and molybdenum

Build up of pests and diseases

This may be caused by mono-cropping and therefore less products expected from such a soil.

MAINTAINANCE OF SOIL FERTILITY

The fertility of the soil can be maintained through the following ways:-

1. **Crop rotation:** Is the growing of different crops on the same piece of land in a particular sequence season after season for proper utilization of nutrients

Follow the guide lines.

- Legumes should alternate with other crops since they increase soil fertility by fixing nitrogen
- Crops with high nutrient requirement should come first on a newly cultivated piece of land to utilize a high content of nutrients present at this stage.
- Deep rooted crops should alternate with the shallow rooted crops since deep rooters bring nutrients to the upper layers of soil for shallow rooters to use
- Cover crops should be included in the rotation to control erosion.

- A fallow period should be included in the rotation to preserve soil structure and restore the lost nutrients.
- Crops that are easy to weed should alternate with those that are difficult to weed.
- Crops attacked by similar pests and diseases should not succeed one another in the rotation to reduce spread

Importance of crop rotation

- There is maximum use of soil nutrients since different crops with different nutrients requirements are involve in the rotation.
- Pests and diseases are easily controlled by breaking their cycle and starvation.
- Parasitic weeds like string spp in sorghum are easily controlled under crop rotation.
- The nitrogen content of the soil can be improved more especially if legumes are included in the rotation.
- Good rotation evens out Labour requirement throughout the year.
- It spreads financial risks over several crops
- Some deep rooted crops in the rotation will recycle nutrients.
- Soil erosion can be controlled during the fallow period when grasses are allowed to grow on the land or by the binding action of the plant roots.

An example of a four year crop rotation

Year	Plot 1	Plot 2	Plot 3	Plot 4
1	Sweet potatoes	Beans	Cassava	Millet
2	Millet	Sweet potatoes	Beans	Cassava
3	Cassava	Millet	Sweet potatoes	Beans
4	Beans	Cassava	Millet	Sweet potatoes
	Fallow	Fallow	Fallow	Fallow

NB After the fourth year the farmer can decide to have a fallow period

Limitations of crop rotation

- Shortage of land due to an increasing human population
- Presence of permanent building that cannot be rotated
- Introduction of perennial crops with a long gestation period
- Merits of the practice cannot be easily recognized by farmers hence difficult to convince them

Proper weed control: weeds compete with crops for soil nutrients. A high population of weeds will extract a lot of nutrients from the soil making it infertile in the long run.

Mulching: Is the covering of top soil with dry plant materials or artificial substances like polythene papers. Apart from conserving the soil moisture and suppressing weeds, mulches also rot and add fertility to the soil.

Minimum tillage: Minimum disturbance of the soil will conserve its organic matter content and moisture hence maintaining fertility.

Soil pH control: At different pH some macro and micro elements are present while others are absent. The soil pH can be maintained through liming and addition of fertilizers.

Addition of manure: The addition of both organic and inorganic manure will increase the amount of soil nutrients therefore maintaining the fertility. However, over use of artificial manure can cause acidic conditions in the soil that may lower soil fertility.

Soil erosion control: The washing away of the most fertile top soil leads to loss of soil fertility as well. Methods of controlling soil erosion like terracing, mulching, contour ploughing etc should be used.

Improving on soil drainage: This will eliminate water logging with all its disadvantages like increased leaching

Improving on the water holding capacity of the soil: Water is needed by plants in the absorption of soil nutrients and in photosynthesis therefore water holding capacity of the soil should be improved to maintain the soil fertility through the addition of organic manures.

COMPONENTS OF SOIL

Soil is composed of living organisms (micro and Macro), air, mineral elements, organic matter and water.

Living organisms

These include micro organisms like bacteria, fungi, protozoa, etc. It also includes macro living organisms like earth worms and some insects.

Importance:

- They carry out decomposition of dead plants and animals remains to produce humus which is used by plants.
- Some bacteria like Rhizobia fix nitrogen into the soil
- After their death more especially the macro organisms decompose and add fertility to the soil.
- Other living organisms like earthworms, excrete urea which adds fertility to the soil by providing nitrogen.
- They aerate the soil by making tunnels. The more tunnels, the more the aeration.

AN EXPERIMENT TO SHOW THAT SOIL CONTAINS LIVING ORGANISMS.

Apparatus
2 conical flasks
Lime water
2 muslin bags
2 samples of soil i.e. sample A sterilized soil and sample B fresh top soil.

Procedure

Label the conical flasks i.e. A and B
Pour about 10cm3 of lime water in each of the flasks.
Put fresh top soil in the muslin bag and hung it in the conical flask A and sterilized top soil in another muslin bag in B as shown below.

Observation:

After 8 hours the lime water in flask A will turn milky while in flask B there will be no observable change.

Conclusion

The lime water in flask A turned milky due to the presence of living organism in the soil that respire releasing carbondioxide which turns lime water milky.

SOIL AIR

Soil contains air, the biggest portion being CO_2 and O_2. Soil air is used by living organisms in respiration and also the plant roots.

N.B. Water and air occupy the same position and therefore high level of water in the soil will reduce the amount of air in that particular soil.

Apparatus:

Soil sample
Distilled water
A beaker
Stirring rod

Procedure

Put the dry soil sample in the beaker to cover ¼ of it.
Pour twice the volume of soil water, and stir continuously

Observation

Air bubbles are seen coming out of the water in the beaker

Dry soil contains air.

EXPERIMENT TO DETERMINE THE AMOUNT OF AIR IN SOIL

Apparatus:

Dry soil sample
At least two measuring cylinders
Distilled water
A beaker.

Procedure:

Measure off 50cm^3 of dry soil and transfer to another dry measuring cylinder.

Measure off 50cm^3 of water and add it to the soil in the measuring cylinder.

Observation

Bubbles of air are seen escaping when the two are added and the volume of the mixture is less than the expected 100cm^3.

Conclusion:

The difference between the expected volume of the mixture (100cm^3) and the actual-volume will be that of air e.g. (50 + 50) cm^3 = 100cm3 expected.

Actual = 70cm^3
100 – 70 = 30cm^3 Air = 30cm^3

EXPERIMENT TO DETERMINE WHETHER SOIL CONTAINS WATER

Apparatus

Dry soil sample
Boiling test tube
Heat source
Stirring rod.

Procedure

Pour dry soil up to 1/3 of the test tube.
Put the test tube on a heat source for about 5minutes.

Observation:

As the heating goes on, vapour condenses at the cooler part of the test tube.

Conclusion

Soil contains water.

SOIL PERMEABILITY.

This is extent to which a soil allows water to pass and spread through it. However sometimes soil permeability and soil drainage are considered to be the same.

Soil drainage

Refers to the relative ease by which water passes through the soil.

EXPERIMENT TO SHOW WATER RETENTION (DRAINAGE) IN SOIL

Apparatus

Atleast 3 filter funnels
Filter paper / cotton wool
Three soil samples i.e. clay, sand, and loam
Clean water
Stop clock
Atleast three measuring cylinders
Arrange the practical as below:-

Water should be added to each of the funnels in the same quantities. A stop clock should be used to measure the time taken for a particular quantity of water to pass through each sample.

Observation:

After a specific period of time its observed that clay soil retains a lot of water than loam and sandy soils. Therefore clay soil is poorly drained while sandy soil is well drained.

EXPERIMENT TO FIND OUT THE AMOUNT OF ORGANIC MATTER IN THE SOIL

Apparatus needed

Heat source	evaporating dish	Tippled stand
Weighing balance	Stop Clock	Stirring rod

Soil sample

Procedure

Weigh the evaporating dish and its weight recorded as X g

Weigh a dry sample of soil and call it W g.

Add the two weights and the total should be called "y" i.e. (CX+W) g = Yg.

Place the dish with the soil on heat source for about 30 minutes.

Remove the dish after that time and cool it.

Weigh the dish and the soil and call it Zg

The weight of organic matter in soil = Yg-Zg =P g

Pg is the loss in weight as a result of loss due to organic matter.

SOIL PRODUCTIVITY

This refers to the ability of the soil to produce and sustain high crop yields.

CHARACTERISTICS OF PRODUCTIVE SOIL

- It should be well drained.
- It should be of a sufficient depth for good root penetration and growth.
- It should be well aerated.
- It should have a good water holding capacity.
- It should have enough nutrients which must be the right proportions.
- It should be fee from crop pests and diseases.
- It should have a right PH for the particular crop to be grown on it.
- It should have a good structure and texture.

PLANT NUTRIENTS

Plant nutrients can be divided into two major groups i.e. Macro and Micro nutrients.

Macro nutrients (major elements)

These are nutrients needed by plants in large quantities e.g. carbon, oxygen, hydrogen, nitrogen, phosphorous, potassium, calcium, magnesium and Sulphur.

Micro elements (trace elements)

These are nutrients needed by plants in small quantities though they are very important for plant growth. E.g. iron, manganese, copper, molybdenum, zinc, chlorides and cobalt.

Macro nutrients

Nitrogen:

This is one of the most important elements needed by plants yet its deficient in most areas of East Africa.

Uses of nitrogen to plants

- Its necessary for the formation of chlorophyll
- It improves the quality and quantity of leaf crops such as cabbages, dodo, etc.
- It is a constituent of plant proteins.
- It helps in cell division and therefore responsible for growth
- Controls the use of phosphorus and potassium in the plants.

Deficiency symptoms of Nitrogen in plants.

- There is restricted root development
- Plants become stunted.
- There is even yellowing and loss of leaves
- There is pre-mature ripening of fruits.

Signs of excess nitrogen in plants.

- Excessive leaf production
- Delayed maturity
- Leaf and stem logging
- Scotching of leaves
- Poor crop yields

Fate /loss of nitrogen from the soil

Crop removal during harvesting
Soil erosion.
Through leaching
Burning of crop residues
Volatilization (denitrification; oxidation of nitrates to atmospheric nitrogen)

Sources of nitrogen

Commercial fertilizers e.g. NPK, Urea, CAN, Sulphate of ammonia, Diammonium phosphate (DAP)

Organic fertilizers like farm yard manure, compost manure and green manure.

Lightening.

PHOSPHOROUS

Importance

- Encourages the formation, development and establishment of roots.
- It is necessary in the formation of fruits and seeds.
- It is needed for cell division
- Production of fats and proteins.
- It helps in nitrogen break-down during respiration
- It is a constituent of nucleic acid (DNA, RNA)
- It is important in the synthesis of nucleoprotein
- It is a constituent of phospholipids.
- It gives resistance to certain diseases in crops.
- Its essential part of all the sugar phosphate in photosynthesis and other metabolic processes.
- Improves the quality of crops more especially vegetables.

DEFFICIENCY SYMPTOMS

- Purple colouration of the leaf especially at the margin.
- Low yield of grains, fruit and root crops
- Slow growth rate resulting into late maturity of the crops.
- Red necrotic areas on the leaves, petioles etc.
- Distortion of the leaf shape
- Older leaves become dark brown.
- There is a general overall stunted ness and leaf fall.

POTASSIUM

Importance

- It increases resistance to certain diseases
- It encourages root development and growth
- It is necessary for formation of starch and transport of sugar within the plant.
- It is essential for chlorophyll formation.
- It is needed in nitrogen metabolism and protein synthesis.
- It reduces lodging in plants by strengthening cellulose cell wall.
- It controls stomatal movement hence loss of water.
- Its important to folic metabolism
- It has been linked with carbohydrates metabolism.
- It regulates water in plant cells.

Deficiency symptom

- Retarded root development
- Plants are easily attacked by diseases
- Leaves dry out at the edges
- Premature loss of leaves
- Chlorosis can also be experienced

- In cereals cell at the leaf tip and margin die first.

Factors affecting the availability of potassium in the soil

Soil moisture: Too much moisture interferes with exchangeable moisture.

Soil PH: High soil PH favours potassium fixation

Temperature: High temperature favours the level of exchangeable potassium

Types of colloids: Potassium fixation is usually done in soil containing montimolironite.

CALCIUM

Importance

- Raises soil PH which favours nitrogen fixing bacteria
- Improves root development and growth
- It improves vigor and stiffness of the stem,
- It governs the availability of certain essential minerals like phosphorus and potassium.
- It is an activator of enzymes in plants
- It is associated with cell wall structure
- In increases carbohydrates content in crops like cotton.
- It increases the number of mitochondria in wheat plants.
- It protects plants from injuries due to the effect of hydrogen ions.

Deficiency symptoms

- The roots become stunted
- Death of the leaves occurs
- Formation of weak stem
- Leaves become chlorotic and chlorosis occurs along the margin of younger leaves.
- Terminal buds and tips of roots do not grow well

- There is distortion of the growing shoot tip
- Cell walls become rigid and brittle

Sources:

Crop residues
Manure i.e. organic and inorganic
Weathering of sol minerals
Agricultural lime

MAGNESIUM

Importance

- It is a constituent of chlorophyll hence responsible for the green colour.
- It is important in the formation of oils in plants.
- It encourages the production and transportation of carbohydrates and proteins in growing plants.
- It maintains the integrity of chromatic fiber and ribosomes.
- It is necessary for full activity of two principle carbon dioxide fixing enzymes.

Signs of magnesium deficiency.

- Loss of green colour in leaves
- Development of purple, orange, and red patches in horticulture crops such as cabbages.
- It causes extensive chlorenchyma development and scanty pith formation.

SULPHUR

Importance

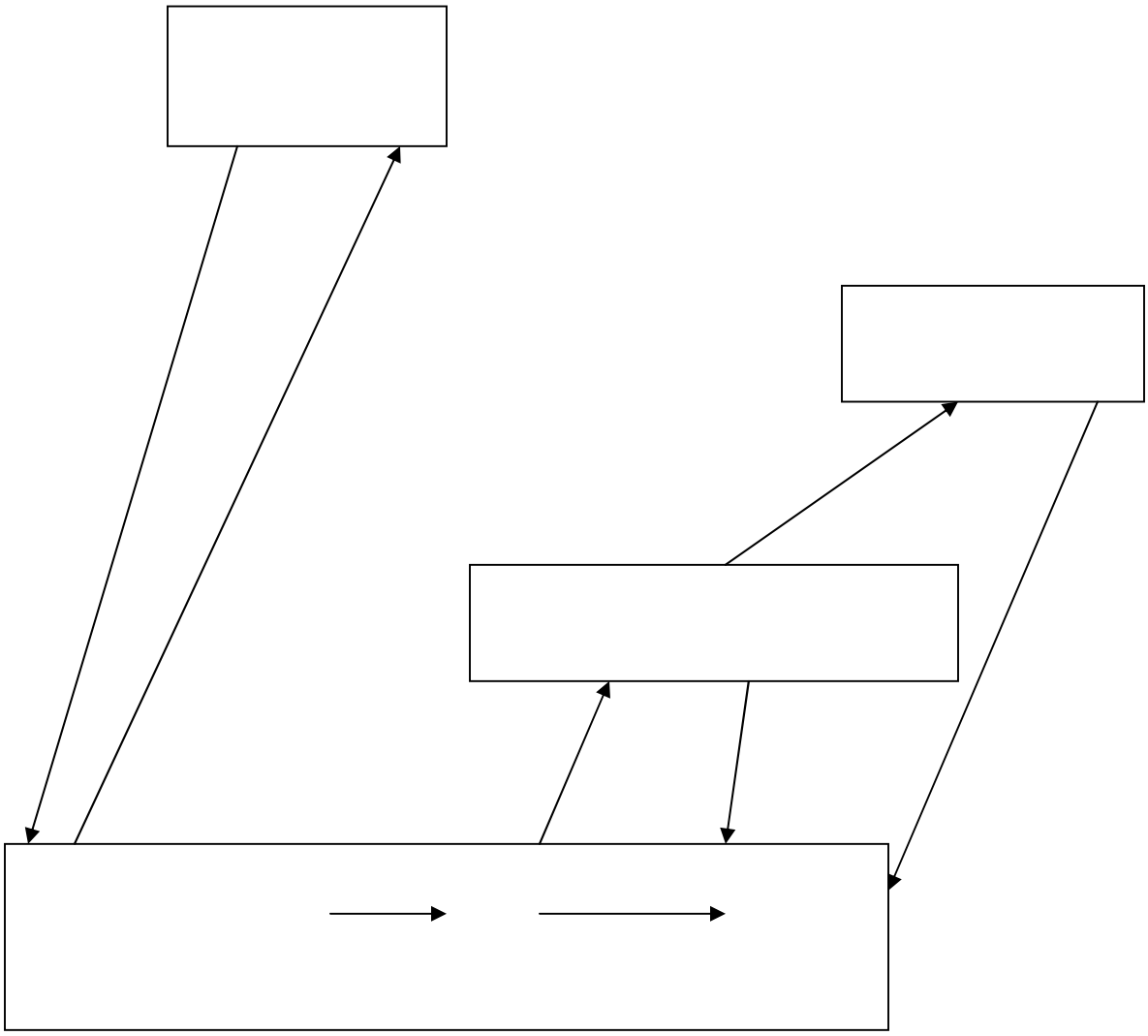
- It is needed in protein synthesis as it's a component of some amino acids.
- It is used in the production and activation of some enzymes.

- It increases the oil content of crops (plants)
- It is essential in the production (formation) of some vitamins like biotine.
- Sulphur together with iron form enzymes important in photosynthesis, respiration, and nitrogen metabolism.

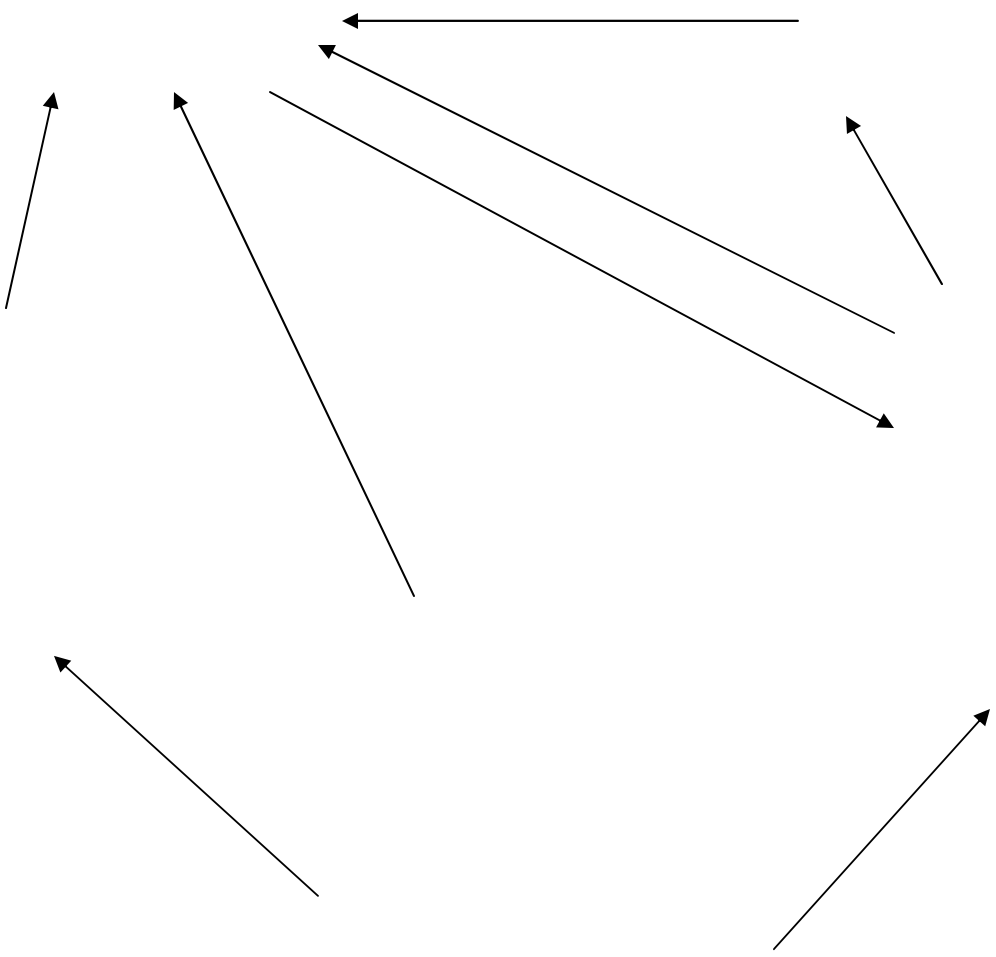
Deficiency symptom

- Lack of root nodules in legumes.
- Stems are thin and plants are extremely small and short.
- There is complete chlorosis
- There is rapid leaf fall
- Leaf tips and margins are rolled inwards.
- Terminal bud growth is inhibited and lateral buds develop pre-maturely.

NITROGEN CYCLE



CARBON CYCLE



MANURES (FERTILIZERS)

These are substances which are either organic or inorganic that add fertility to the soil once applied.

There are two types of manures /fertilizers i.e. organic manures and inorganic manures.

Inorganic manures/fertilizers are chemical substances which are manufactured artificially to supply the chemical elements required for growth and reproduction of the plant.

ORGANIC MANURES

These are substances derived from plants or animals products that will add fertility to the soil once applied.

Examples of organic manures:-

Farm yard manure, livestock manure or muck
Green manure

Compost manure

Importance of organic manures:

- They increase nitrogen content in soils after decomposition
- They increase the availability of plant nutrients like potassium, calcium, magnesium, and phosphorus.
- They increase the humus content in the soil after their decomposition.
- They improve the soil structure more especially in sandy soils.
- It increases the population of microbes in the soil by acting as food for such living organisms.
- Organic manures like muck can rise the soil PH
- They do not have residual effect on the soil.
- Deactivates organic pesticides
- Increases cation exchange capacity of the soil

Characteristics of organic manures

- They are derived from plant and animal materials
- Contain much lower amounts of plant nutrients
- They improve soil structure
- They stimulate the rate of microbial activities
- They are more costly to apply per unit of per unit of plant food
- They are not leached easily due their low solubility in water
- Have no residual effects on crops and soil organisms

COMPOST MANURE:

This is a mixture of decomposed crop remains, vegetable matter, weeds and kitchen refuse.

Advantages of compost manure:

It really releases nutrients for plant growth.

It promotes the conservation of soil moisture by lowering the rate of evaporation of water from the soil.

Fully mature compost manure is black therefore helps in absorbing the sun's heat.

It improves on soil structure more especially in sandy soils.

It promotes the activity of microbes in the soil by providing food for them.

It enhances the creation of neutral reaction in the soil.

Limitations of compost (disadvantages)

If used immediately after making, it can heat up and burn crop roots.

It requires a lot of Labour to prepare it.

Big volumes of compost are needed to be applied in order to obtain the required nutrients.

There should be a good source of composting materials in order for a framer to make enough which is not always easy.

It requires large volumes of water during processing to keep the temperatures at optimum.

METHODS OF COMPOSTING

There are two main methods i.e. Heap method and pit method.

PIT METHOD

This is when composting is done in pits dug in the ground. It is mainly applied in areas with low rainfall.

Procedure of making compost

Pits measuring up to 180cm in length, 120cm width and 60cm in depth varying according to the type of materials being used.

Stones/ maize stalks are placed at the bottom of the pit to form a foundation and promote proper air circulation

Materials for composting should be chopped into small pieces

Composting materials should be arranged in the pit as follows; maize stalks/ elephant grass at the bottom 10 cm height, grass/ leaves/ weeds/ kitchen refuse 10cm height, manure(farm yard) 10cm height, wood ash 10cm height and top soil 10cm height in order.

Repeat the arrangement until the pit is full

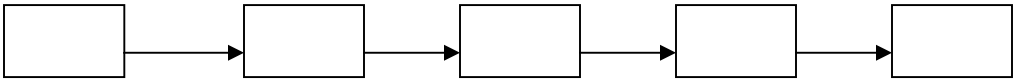
Put plant leaves at the top of the pit to facilitate proper air circulation

Add about 0.5 kg of ammonium Sulphate at any 0.3m height to increase nitrogen content of the compost manure.

Place a stick long enough to reach to reach the bottom to monitor the temperatures

Sprinkle water to the pit when the temperatures are high to maintain it at optimum

Turning of the material in pits should be done every after 2 to 3 weeks to enhance complete decomposition as follows;



Materials in pit A are put in pit B and pit A filled with fresh materials

After 2 to 3 weeks materials in B is turned to pit C and replaced with that in pit A

Materials are changed every after 2 to 3 weeks in the order until there is complete decomposition

This type of sequence ensures continuous supply of manure to the garden

Heap/ stack method

This is done in areas with high rain fall

Procedure of making compost

Select a flat area with a good drainage

Make stacks/ heaps of about 1.5 to 2 m squared and 1 m away from each other.

Materials for composting should be chopped into small pieces

Composting materials should be arranged in the pit as follows; maize stalks/ elephant grass at the bottom 10 cm height, grass/ leaves/ weeds/ kitchen refuse 10cm height, manure(farm yard) 10cm height, wood ash 10cm height and top soil 10cm height in order.

Repeat the arrangement until the heap/ stack is full

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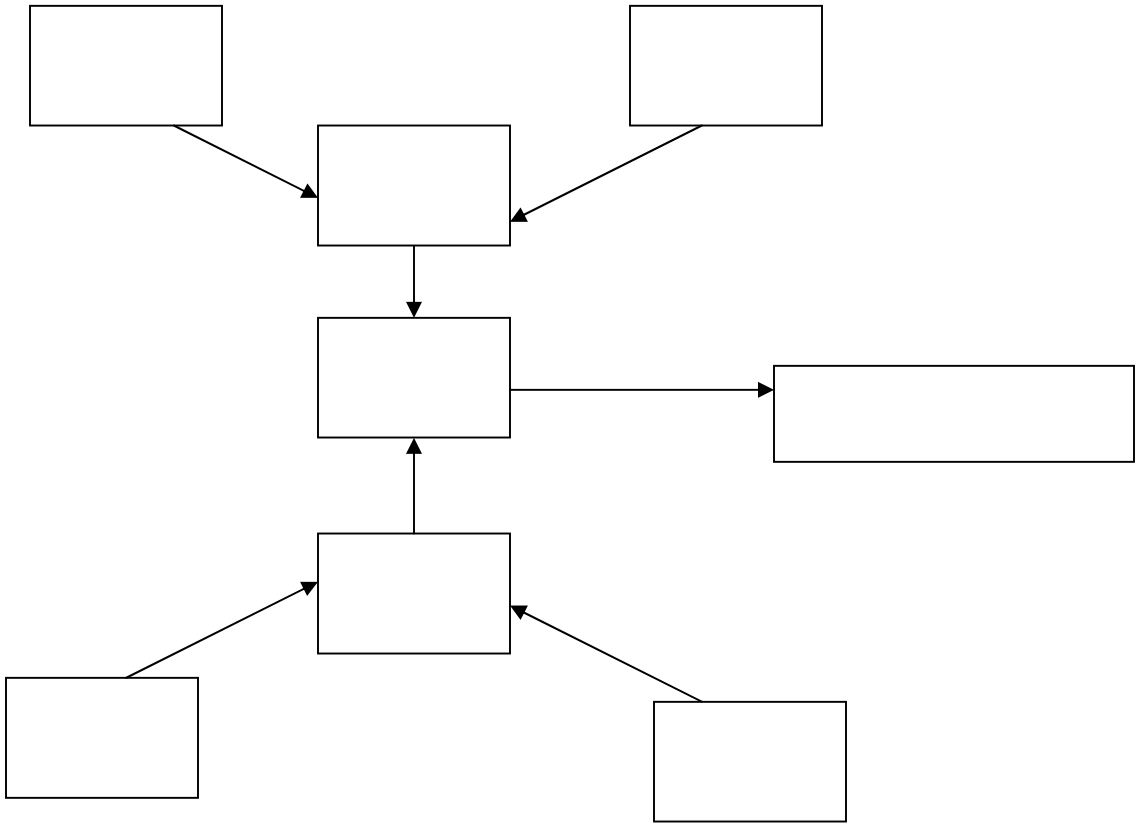

Turn compost material in stack 1 to an empty stack A and that in stack 2 on top of 1 in A after 3 weeks.

Turn compost material in stack 3 to an empty stack C and that in stack 4 on top of 3 in C after 3 weeks.

Empty stacks should be refilled with fresh composting material to ensure continuous supply of compost on the farm.

Turn material in stack A into stack B then followed by that from C after about 7 days

Leave the materials in stack B until decomposition is complete

Precautions to take when preparing compost manure

Make stacks/ heaps that are neither too small nor too big to avoid incomplete decomposition

Ensure free air supply to the compost container for proper decomposition

Avoid putting sticks and plastics in compost materials since they reduce quality

Sprinkle enough water to maintain temperature good for proper decomposition

Occasionally turn the materials to ensure proper decomposition

Add thin layers of farm yard manure to improve the quality of compost manure

Do not trap flies in compost material during composting since it may lower quality

Place compost pit or heaps in areas sheltered from sun's heat and wind.

GREEN MANURE

This is the manure made by incorporating green and vigorously growing plants into the soil.

Characteristics of a good green manure plant:-

- It should be able to grow very fast so as to meet the required purpose in time.
- It should have high nitrogen content.
- It should be leafy or highly vegetative.
- It should be able to rot rapidly and provide manure.
- It should be disease and pest free.
- It should be easy to plough into the soil.

Advantages of green manure:

- It supplies Organic matter to the soil which can improve soil structure.
- It adds nitrogen to the soil especially when legumes are used.
- It stimulates bio-chemical activities in the soil
- It assists in conserving and making available plant nutrients.
- It increases yields more especially in maize, by 20% -70%.

Limitations of using green manure:

- Potential crops for green manure are food crops therefore its difficult to convince farmers to practice it that way.
- Machinery is needed to incorporate the plant into the soil which may not be readily available.
- Old plants with high fiber content are very difficult to plough into the soil.
- If the crops are left to grow until they are hard and fibrous, they may not decompose easily.

FARM YARD MANURE (MUCK, LIVESTOCK MANURE)

This is manure consisting of fermented dung and urine of animals mixed with rotten vegetable matter.

Importance of farm yard manure:

It adds large quantities of organic matter to the soil.
It provides the soil with essential nutrients like NPK (Nitrogen, Phosphorus & Potassium).
It can be used to improve the quality of other organic manures such as compost.

Preparation of farm yard manure

- Place dry litter in the animals' pen to act as bedding
- Turn the litter as animals defecate on urinate on it
- Select a flat place with a concrete floor out side the pen
- Remove the dirty litter from the pen and place it on the concrete floor
- Raise a shade over the litter collected from the pen to protect it from rain and sun shine
- Allow the contents to decompose completely while in the shade
- Coat the content with a thin layer of top soil to reduce loss of nitrogen
- After six weeks the manure is ready for use

N.B Farm yard manure should be prepared under cover to avoid losses of nitrogen and soluble mineral nutrients.

Factors affecting the quality of farm yard manure:-

The type of animals that provides dung; Non ruminants and fattening animals produce dung rich in nutrients than that of lactating animals which extract a lot of phosphorous from the feeds.

Type of food the animal eats; Feeds that are rich proteins and minerals tend to produce better quality dung for manure.

The type of beddings (litter) used by the animals; Cereal straw has a higher capacity of absorbing moisture therefore can make a better raw-material for manure.

Method of storage: Manure heaps should be sheltered from direct sunshine and rain since rain leaches away nutrients.

Length of time given for complete decomposition; The more time given for complete decomposition, the higher the quality of the manure.

INORGANIC MANURES

These are chemical substances which are manufactured artificially to supply the chemical elements required for growth and reproductive ness of plants.

TYPES OF INORGANIC MANURES

There are two main types of inorganic fertilizers

Straight fertilizers

ii. Mixed /Compound fertilizers.

STRAIGHT FERTILIZERS

These supply only one of the primary macro nutrients (nitrogen, phosphorus and potassium) e.g urea, single super phosphate, double super phosphate, Sulphate of ammonia, calcium-ammonium nitrate and ammonium nitrate.

MIXED/ COMPOUND FERTILIZERS

These contain atleast two of the primary macro-nutrients (elements) of Nitrogen, Phosphorous and Potassium (NPK). Examples of such fertilizers are N.P.K., Di-ammonium phosphate, ammonium hydrogen phosphate etc.

Advantages of Compound Fertilizers

The mixture is usually dried into fine and well-mixed granules which can be applied by hand and through fertilizer drill.

The mixture is stable and does not cake up to form lamps

They contain all the major plant nutrients in right proportions.

They save the farmer's Labour of mixing fertilizers during application.

Disadvantages (Limitations)

They are slightly more expensive than straight manures.

They may be unsuitable for most of the soils which lack only one nutrient.

FACTORS INFLUENCING (DETERMINING) THE USE OF MANURES BY FARMERS:

Soil analysis: This is important because it expresses the need and type of fertilizers
The types of fertilizers available; Different crops require specific nutrients and therefore the fertilizers available in shops should meet the above.
Price of a fertilizer, increases use of fertilizers by farmers is determined by the prices and the expected profits after use.
Management; The farmer's follow-up of the right application method and period of application affects the results achieved after use.
Knowledge and skills of the farmer; Farmers more informed about fertilizers can use more of it
Crop value; growing low value crops may not encourage the use of fertilizers since the cost may be higher than the yield expected

FACTORS AFFECTING CROP RESPONSE TO FERTILIZERS

- Nature of fertilizers; Highly soluble fertilizers can be easily absorbed and used by crops
- Soil factors; Some soils have a higher ability of supplying nutrients than others and it varies from place to place and time to time
- Climate; Places with low rainfall have reduced leaching hence most of the fertilizers applied will be used by crops
- The rate of application; Some fertilizers once applied in excess will become toxic and hence not used by the crops or cause death to the crops
- Crop factor; Some crop will fail to respond to a particular fertilizer hence making it useless crops will need a higher quantity of the fertilizers to respond.
- Crop age ; Mature crops may have low fertilizer requirement than the young vigorously growing crops

- Presence of pests and diseases; Crops attacked by such shoe a low response to, fertilizers due to a compromised crop physiology

Weed population; A high population of weed in the garden will use a lot of nutrients leaving little for the crop hence low crop response

Soil structure; Poor structure prevents proper root development hence a reduced nutrient absorptive power for crop roots.

APPLICATION OF FERTILIZERS TO THE SOIL:

The methods for supplying fertilizers efficiently are:-

Broadcasting before planting: Here the fertilizer is spread uniformly over the field and it gives positive results for seeds which are broadcasted.

Row or band placement; In this method, the fertilizers are placed in localized areas along the rows at calculated distance for maximum absorption by plants.

Top dressing; The fertilizers more especially nitrogenous is applied as a second dose by broadcasting on the soil surface close to the plants when the crop is 3-4 weeks old.

Drill placement; The fertilizers is applied by a drill along with the seed during planting. The method gives good results with wheat, maize and other cereals.

Band placement; The fertilizer is placed on one side or both sides of the row about 5cm below the seed and 4cm from the plant. The method is useful for crops which are sensitive to direct contact with fertilizers like cotton and tomatoes,

Application by plough: The fertilizers are placed in a continuous band at the bottom of the plough furrows. Each band is covered as the succeeding furrows are turned over.

Applying liquid fertilizers by irrigation or spraying: The application of fertilizers in solution can be used on high value crops and the fertilizer has to be soluble in water.

SOIL AND WATER CONSERVATION

This is the science and art of looking after the land in such a way that soil is retained in one place and not carried away by erosive agents.

Aims of soil and water conservation:

To reduce soil losses by taking measures against agents that cause soil erosion.
To maintain soil fertility that can be lost through erosion.
To retain water essential for crop growth.

To maintain the physical properties of soil that is ideal for crop production.

SOIL EROSION

This is the removal /washing away of top soil by wind and running water.

Factors predisposing soil to erosion:-

Overgrazing: Keeping a high number of grazing animals on a limited amount of pasture removes vegetation cover exposing land to erosion.

Burning of vegetation: this removes the vegetation from the soil exposing it to erosive agents like water and wind.

Over cultivation: This reduces the organic matter in the soil and also destroys soil structure making the soil more prone to erosion by running water and wind.

Improper farming methods: Like ploughing along the slope, planting annual crops on steep slopes encourages soil erosion.

Man's activities: The major activities here are those involved in construction which can lead to the clearing of vegetation.

Effects of Soil Erosion in Agriculture:

It reduces the quality of soil by washing away soil nutrients and increasing acidity.

There is a reduction of land area available for production more especially where gully erosion occurs.

Erosion increases the costs of production since the farmer will spend money trying to control it.

It destabilizes soil profiles by transferring soil from one place to another.

Erosion leaves the soil surface bare and hard which makes the soil more difficult to work.

Soil productivity is reduced more especially when less productive soil is deposited over the productive soil.

Gully erosion in particular makes mechanization on the affected field very difficult.

Erosion can lead to water pollution more especially where fertilizers from land are washed into water bodies to cause pollution of the water.

Erosion leads to the sedimentation of dams, rivers, and lakes.

Leads to spread of weed seeds.

It may lead to the spread of pests and diseases in gardens

It alters soil structure and texture that affects crop growth

TYPES OF EROSION:

Geological Erosion: This takes place under natural conditions before man's disturbance of soil and vegetation.

Accelerated Erosion: This is the deterioration and loss of soil as a result of human or animal activities which losses soil directly or indirectly.

Splash / rain drop erosion; this as a result of the impact of rain drops on the soil surface. The seriousness of this erosion depends on rain drop size, vegetative cover, soil structure and land gradient.

Sheet erosion; this is a uniform removal of layers of soil from sloping land as a result of sheet flow. It is the most serious erosion since it removes the most productive layer of soil. It gives way to rill erosion.

Rill erosion; soil is removed leading to the formation of small and clearly cut channels. Rills are small and can be removed by normal ploughing or harrowing

Gully erosion; this is where U and V shaped large channels are formed that can carry a lot of water and soil. Gullies cannot be removed by normal cultivation methods due to their size.

Wind erosion; this is where wind carries soil as it blows over the bare soil surface with no vegetation. It is more serious in places with limited vegetation and loose soil structure

Factors influencing soil erosion:

Rainfall intensity: Rain received in small amounts over a long period of time caused less erosion than that received in large amounts for a short time.

Topography: the steeper the slope, the faster the speed of water flowing over it and the greater the soil eroded. A longer slope has more water flowing over it and therefore a greater chance of erosion taking place.

Vegetation:

The density of vegetation cover affects the rate of erosion. Dense vegetation reduces soil erosion by slowing down the speed of rain water and the impact of rain drops on the soil surface.

The plant roots can bind soil particles reducing the chances of erosion

Decomposed plants add organic matter to the soil which improves the water holding capacity and soil structure that can resist erosion

Trees can act as wind brakes hence reducing the effect of wind erosion.

Vegetation increases water infiltration which reduces surface run off

Farming practices: Continuous cultivation of land leads to the break done of the soil structure making the soil more susptible to erosion.

Ploughing down the slope will increase soil erosion since the speed up the speed of water.

Man's activities. Disturbance of soil structure and other properties by man may increase rate of erosion

METHODS OF SOIL AND WATER CONSERVATION

Minimum tillage: this safe guard against disturbance of soil physical properties thus reducing the chances of erosion and moisture loss.

Importance of minimum tillage on soil conservation

Preservers soil structure hence making soil resistant to erosion and water loss.

Reduces loss of water by evaporation.

Conserves organic matter in the soil by reducing oxidation.

Mulching: This reduces the impact of rain drops on the soil surface to cause splash erosion and also controls loss of soil moisture **Mulch** is any material used to cover the soil surface to prevent excess loss of water by evaporation, control of soil erosion and suppressing weeds.

Materials used as mulch include:-

Straws, dry leaves, trash, stalks, coffee husks, dry grass, sisal waste and polythene.

Advantages of Mulching:

- Reduces soil erosion by checking the speed of water and battering effect of rain drops on the soil surface.
- It conserves soil moisture by reducing evaporation of water from the soil surface.
- It increases water infiltration (down ward entry of water into the soil) by reducing surface runoff.
- Organic mulches decompose and add organic matter to the soil hence improving soil fertility and water holding capacity.
- Mulches moderate soil temperatures hence allowing soil microbes to stay in the soil and carry out decomposition so as to improve soil fertility
- Controls weeds by cutting off light supply to them at seedling stage.
- It improves on soil structure when the organic mulches decompose to provide organic matter.

It increases yields in certain crops by providing manure and a weed free environment. Mulches can control certain pests like the banana weevils (***Cosmopolites sordidus***) which are trapped in the mulch.

Disadvantages:

Mulches more especially the organic ones can be it when dry and destroy the crops in the garden.
They can act as breeding grounds for pests like termites.
Some mulches cause deficiency into the soil.
Mulching materials are quite expensive for the farmers to purchase, transport, and lay in the garden.
The vegetable material may be a source of weeds more especially when it is not completely dry.

Crop rotation: This is the system of growing different crops on the same piece of land in a sequence or definite order so as to preserve and maintain soil fertility.
Deep ploughing: This increases water infiltration hence reducing water runoff over the surface of the soil.
Manuring: Manures improve the soil structure thereby allowing water infiltration and binding of the soil particles together.
Afforestation: Trees planted reduce soil erosion by wind and water since they increase water infiltration into the soil and bind soil particles together.
Wind breaks: These are lines of trees planted perpendicular to the direction of the prevailing winds. They reduce the speed of the wind hence controlling erosion by wind.
Planting cover crops: These are crops planted to reduce the rate of water runoff from the soil surface and holds the soil particles.

X-teristics of a good cover crop:

- It should be easy to establish and multiply
- It should grow rapidly and vigorously to suppress weeds
- It should not act as a competitor to the main crop.
- It should not demand too much Labour to control its growth.
- It should be tolerant to pruning and slashing
- It should strive well on a fertile soil
- It should be resistant to pests and diseases.

- It should have good forage which spreads over the soil
- It should be able to withstand sunlight during the early stages of growth.
- It should be able to tolerate shading by the main crop.
- It should be drought resistant so as to be able to survive long drought.
- It should not produce any substance that has toxic effect to the main crop.
- It should be easy to be removed when necessary and incorporated into the soil.

Strip cropping: Here crops and pastures are planted along the contours in alternate strips to reduce soil erosion by slowing down the speed of running water.

Intercropping: When cereals are intercropped with legumes having broad leaves, soil erosion, can be reduced by the broad leaved plant.

Terracing: This is done in places with steep slopes where terrace are constructed to reduce the slope. The terraces can be of various forms like broad based terraces, narrow terraces and bench terraces. These reduce the speed of running water down the slope and encourage water infiltration.

Contour ploughing: This involves ploughing across the hill along the contours to reduce the extent of water run off over the surface of the soil.

LAND RECLAIMATION

This is the practice of regaining or bringing back waste land to use so for cropping, rearing animals or settlement. Such land could be under swamps, rivers, forests, deserts of infested with pests like tsetse flies.

Methods of Reclaiming land:

These include the following:-

Deforestation, irrigation, terracing, draining swampy areas, afforestration, application of fertilizers, land clearing, pest control, leveling and stumping.

Deforestation: Here forests are cleared using bulldozers, motorized saws, axes or panga to release land for agriculture. However this practice has other negative effects on the environment.

Draining swampy areas: Land drainage is a method of rehabilitating land by removing excess water from an area which is water logged.

Advantages of draining land:

- Drainages provide a good environment which encourages optimum root growth by improving aeration.
- Drainage raises soil temperatures since a wet soil is usually cold. This improves the growth of plants since they need warmth around the roots.
- Drainage allows tractors and other machines to move easily over the soil.
- It is important in controlling parasites like the liver flukes
- Drainage improves on the soil structure of a particular place.
- It creates a water table which does not fluctuate much good for citrus fruits.
- It improves root penetration into the soil hence proper growth of the plant.
- Crop losses during harvest which are due to wet conditions are minimized by draining land.

METHODS OF DRAINING LAND

The methods that can be used include:

Surface drainage: This is the removal of water from the surface of the soil by means of open ditches. Open ditches are used to remove excess (surface) water from low laying areas:-

Advantages of surface drainage

It is easy to notice the blockages and therefore corrected easily.
Open ditches are cheap to construct
There are less chances of leaching in this method
Does not dry out the soil completely hence preserving soil moisture

Disadvantages

They are more prone to gully erosion which may be destructive.
The ditches occupy good land which could have been used for crop growing.
They interfere with mechanical tillage operation and livestock improvement.
They are expensive to maintain
Leveling should be done before water can flow into the drains which may be difficult to achieve

SUB-SURFACE (UNDER GROUND) DRAINAGE / TILE METHOD

This is where water is drained away from water logged areas through tiles or drain pipes laid under ground:-

Advantages of tile method (sub-surface drainage)

It leaves the field free of surface obstruction
It does not encourage gully erosion as observed in surface drainage.
There is no need to level land to facilitate drainage.

Disadvantages of the tile method:

May lead to excessive leaching in areas with heavy rainfall
They dry out the land excessively at times and yet be in adequate during wet weather.
They are expensive and require skilled Labour to install.
They are easily blocked by roots of many perennial crops

Sub-soiling drainage.

This is the removal of surface water logging caused by the build up of an impervious layer using a heavy cultivation with one or more times that can penetrate up to 90cm deep. The operation cracks and loosens sub soil especially under fairly dry conditions.

Use of deep rooted plants

Plants like eucalyptuses which have deep rooted that can penetrate impervious sub soil can be used in draining land.

Terracing:

This conserves water and soil making the field easy to work with machinery. It is mainly done in hilly places.

Afforestration:

This is practice of planting trees in places where they died out or where they have never existed before. Trees are planted in areas such as hilltops or on slopes of mountains and hills, where no crops can grow.

Leveling:

This is done in places with anti-hills which hinder mechanization. The place is leveled to allow machinery use and crop production.

Land clearing:

This is carried out in order to meet the following objectives:

To increase land for crop and animal production

To make mechanization possible
To discourage pests.

It can be done using hand method, mechanical method, chemical method, bush burning or use of explosives.

Fertilizers application:

This is done in order to reclaim poor soil more especially for crops production. Inorganic fertilizers can be added to improve the fertility of such an area.

Pest control:

Since pests are a problem since they are vectors of important diseases like sleeping sickness in humans and nagana in cattle for tsetse flies. Places with such pests should be sprayed to allow human settlement and agricultural production.

Stumping:

This is the removal of tree stumps from an area. It eases mechanization and provides more area for agricultural production.

Irrigation:

This is the process of applying water artificially to the soil in areas where there is no rain or where rain is inadequate or unreliable.

TYPES OF IRRIGATION

1. Surface irrigation

This is the application of water over the surface of land. It may include the following methods:

Flood irrigation	furrow irrigation
Border irrigation	basin irrigation

a. Flood irrigation:

In this method, water is applied by flooding flat areas. It is the most suitable areas in places with abundant and cheap water.

Advantages

Flooding can kill crop pests and diseases

It does not need the leveling of land.

Good for areas with abundant water supply

Disadvantages:

If the water flows fast, it may not infiltrate the soil.
Water logging and leaching of nutrients may occur
Surface runoff may cause soil erosion.
Little control of water supplied leads to wastage.
Excess water causes leaching

b. Furrow irrigation

Here water is supplied to rigid land from a main source through supply canals. The excess water collected from the bottom of the field in drains which lead to a water way.

N.B. Crops are normally grown on ridges which must be carefully panned.

Advantages

Water infiltrates uniformly

This method is suitable for row crops such as cereals since furrows can be made in a row form

Can use poor quality water since there are no pipes to be blocked

Disadvantages

There is a danger of salt accumulation in the furrow more especially if the water contains salts.

It may encourage soil erosion

Excess water may cause leaching

Movement in the garden by machines is impeded

May require grading of land which increases costs of production

Sometimes enough water does not reach the end of the furrows.

c. Border irrigation

In this method water from the supply canal is applied to the top end of strips of land which are divided by low earth bunds. Due to even grading of the land, the water flows in a regular uniform sheet down each strip wetting the soil as it advances.

d.Basin irrigation

This is a system used on leveled land to irrigate orchards mainly. A basin is made either for each tree or group of trees depending on the soil conditions and surface slope.

The advantages of this system are that the Labour cost is low and it uses less water.

2. Over head / sprinkler irrigation:

This involves supplying water just like natural rain. The system consists of a pumping unit which supplies water under pressure and it is sprinkled to the crops and soil.

Advantages

- Water delivery can be matched with crop requirements.
- Movement in the garden by machine is not affected.
- It does not require the leveling of land hence reduce the costs involved in that.
- It does not encourage soil erosion as observed in the surface methods of irrigation
- Agricultural chemicals such as fertilizers pesticides and herbicides can be applied uniformly with the irrigation water.
- Adapts to dry topography.
- The system does not require special skills to operate it as seen in drip irrigation.
- Can be integrated with several agronomic practices in the garden.
- It is an idea method in sandy soils and hilly areas
- Low maintenance costs.
- There is adequate infiltration of water into the soil which is important in crop nutrients absorption.
- Sometimes the high pressures of water from the irrigation system can kill pests.

Disadvantages:

The water droplets may have a hardening effect on the soil which hinders further water infiltration.

The system requires a high initial capital to install which may not afforded by the peasants.

Water does not tend to infiltrate very far into the soil more especially when pumped in small amounts.

There is a risk of salt accumulation around the root zone areas.

If the weather is windy, the application of water becomes uneven.
The system has been known as one way in which pathogens are spread in gardens (pathogens are diseases causing organisms)

3. Drip / Trickle Irrigation

This is relatively new method of irrigating crops and is mainly used in the USA, Australia and Israel. Water is supplied through plastic pipes to each row of crop plants and a small nozzle allows water to trickle out and provides moisture around the plant roots.

Advantages

- Water is delivered near the root area so that the crops can get a good supply of water.
- There is less chances of water evaporation and accumulation of salts as in overhead and surface irrigation.
- The area between the rows is not invaded by weeds since there is no water supplied there.
- It is a very economical way of using water since it involves less wastage.
- Fertilizers can be mixed in the water and supplied to the crops.
- Low pressure is required to pump the water through the system hence saving energy intake.

Disadvantages

- It requires a high initial capital to purchase and install the requirement in this type of irrigation.
- The system requires good quality water which can not block the pipes.
- It is unsuitable for steep and uneven areas

FACTORS THAT DETERMINE THE TYPE OF IRRIGATION TO BE USED IN AN AREA:

1. The source of power

Abundant power supply in an area can encourage some body to use overhead irrigation since there is power to pump the water.

2. Type of soil

Loose sandy soils are not good for the surface methods of irrigation since they are more prone to erosion. But over head irrigation can be good in such places.

3. Topography

An area with hills and valleys can only allow overhead irrigation which doesn't involve the leveling of land.

4. Type of crops grown.

The growing of high value crops can allow the use of costly irrigation methods like drip and sprinkler irrigation methods since a farmer will be able to cover the costs.

5. Methods of planting crops

Crops planted in row can allow the use of drip irrigation method and most of the surface methods which can't be used in broadcasted crops.

6. Availability of water.

Places with limited water supply can efficiently apply drip irrigation method since it is more economical in the use of water.

7. Capital

The availability of enough capital will allow a farmer select any type of irrigation methods since he can afford all the costs involved.

8. Knowledge and skills

Some methods of irrigation like drip require special skills and knowledge which must be readily available during installation and maintaining

9. Climatical records:

These will show the natural water available to the crop in order to determine artificial application needed in a particular period.

CROP PRODUCTION

FACTORS THAT DETERMINE / AFFECT CROPS GROWN IN AN AREA.

The factors are divided into two broad group's i.e.

Abiotic factors - Biotic factors.

ABIOTIC FACTORS

These are factors that are a result of non living part of the environment e.g

Soil fertility *Soil density*

Soil texture *Quality and quantity of light*

Humidity *temperature*

Rainfall *wind*

Day length

1. Soil PH

Different crops require different specific pH for their proper growth e.g. tea require acidic soil, tobacco may require slightly acidic soil.

2. Soil fertility

Crops are nutrients which must be readily available for their proper growth.

3. Soil drainage.

Some crops like rice are able to thrive in poorly drain soil while others like maize cannot withstand poor drainage.

4. Soil structure

This affects the movement of air, transfer of heat and root development.

5. Soil texture

This can also affect the number of physical properties of soil which are very crucial to crop growth.

6. Temperature

Some plants like the cereals and grases can live in area with high temperature. Since they are the mechanism of closing their stomata durig the day.

Availability of water.

Water is used as a raw material for photosynthesis. Absence of water in a particular area can limit the growth of a particular crops more especially these that are not drought resistant in bananas.

Topography

This determines the number of factors like temp, humidity rainfall which all affects crop growth.

Pest and diseases.

Crops in some areas have been eliminated due to the presence pest and diseases. e.g. Tomato growing in most areas of Uganda is limited by bacterial wilt.

Wind.

At high attitudes strong winds are experienced which will affect the growth of crops.

Social factors

Some communities are growing certain crops since historically they have acted as food crop e.g. millet among the Itesot of Uganda.

Economic reasons

Some crops are cash crops therefore they must be grown to provide farms with income e.g coffee, tea, cocoa.

Government policy.

The government has been restricting the growth of certain crops for health reasons and security e.g. Opium / Marijuana.

CLASSIFICATION OF CROPS;

Crops are classified into two main groups

Annual crops

Perennial crops

ANNUAL CROPS

These are crops which complete their life cycle within one year e.g.

Cereal (millet, Sorghum, Rice, Wheat, Barley, Maize, Oats, and Rye)
Legumes (Beans, Soybeans, Cowpeas, Pigeon peg, G-nuts)
Root Crops (Cassava, Sweet potatoes, Irish potatoes, Yams,)
Vegetables (cabbages, tomatoes, onions, egg plants, amaranthus spp, carrots, dodo, spinach, pumpkins, cucumber, water, melon, garlic, pepper.)
Oil crops (Simsim, sunflower, cotton)
Fiber crops ((cotton)
Drug crops (Pyrethrum)

PERRENIAL CROPS

Beverages; coffee, tea, and cocoa

Fruits; pawpaw, guava, avocado, jack fruit, passion fruit, pineapples, bananas,e.t.c

Citrus; oranges, lemons, tangerines, e.t.c.

Sugar crops; sugar cane and sugar beet

Spices; vanilla, ginger, clover, e.t.c.

CEREALS

These are commonly known as grain crops and they have a high content of carbohydrates. They are the most common food crops used all over the world.

REASONS WHY CEREALS ARE THE MOST FOOD USED IN THE WORLD.

- They are easy to prepare as food for example rice and posho.
- They are adapted to a very wide range of soil and the environmental condition.
- They have fewer pest and disease as compared to other crops.
- Cereals contain a high amount of carbohydrates and vitamin which are highly needed in our diet.
- Because they contain low moisture content they are easy to store and used when needed.
- Cereals have a short life cycle as compared to the crops and other perennials.
- Cereals can be used as food for both man and animals.
- Because they are less bulky hence it is easier to transport cereals from one place to another.
- Management practices like plant, weeding, can be easily done by machines reducing Labour requirements during production.
- They do not require special seed bed before being planted.

MAIZE - ZEA MAYS

Plant characteristics

Maize is an annual cereal crop which can grow up to a height of 4- 6 metres

A mature and a growing maize has a prop root radiating from the main stem outward into the soil providing support. The depth of the root depends on number of factors e.g. soil, rainfall etc.

The tassel i.e. male maize inflorescence emerges at the top of the plant and shed its pollen over a period of about one week.

The silk i.e. female inflorescence emerges from the ear outwards towards the end of pollen shedding and remains conceptive for a period of about three weeks.

In good condition maize leaves are green with parallel vein and long i.e more than 0.5m.

At an early stage of growth it can be plough down as green manure to provide nutrient into the soil.

Young maize can be used for making hay for feeding livestock however it can bring digestive problem if the maize is a mature one due to fibrous content.

Maize flour contain a lot of carbohydrates when eaten it can be metabolized to provide energy to support the organism.

Growth requirements

Maize requires a well drained soil with a good supply at nutrient

It can not tolerate a slightest degree at water logging.

It requires enough rainfall which is equally well distributed but however, during harvesting it should be as compared to during silking where enough water is needed.

Maize thrives very well between temperatures of 20 – 25^0 C. High temperature during the day is accompanied by high rate of transpiration and low temperature at night is accompanied by a high rate of respiration thus limiting yield.

Seed bed preparation

Seed bed preparation is done by hand roughly this in turn advantageous because weeds are killed, encourage water infiltration and resist soil erosion than in fine seed bed.

Secondary cultivation may not be necessary since the crop has big seeds.

Planting and spacing

It should be planted at the beginning of the rain because early planted maize benefit from nitrogen flush that occur when a dry soil are wetted and suffers less from fungal diseases

Planting is done mechanically by planter or by hand. Two seeds are planted in one hole made at 5cm deep in moist soil but in dry soil should be placed 10cm deep to prevent it germinating as a result of only a slight shower.

Spacing should ensure low population Atleast 90 cm X 30 cm between each plant. This is to reduce competition for basic growth requirement. However spacing can be determined by other factors like soil fertility, soil moisture, variety, e.t.c.

In properly spaced maize in area of reliable rainfall weed free condition need only to be maintained until the crop is 45cm high. After this height the crop suppresses weeds by itself.

Weeding and fertilizer application

Maize is weeded when its between 10 - 15cm and before it starts silking

selective herbicides can be used to control weeds like atrazine herbicide

Nitrogen fertilizers should be applied as top dressing when maize is at about 45 cm high.

Phosphates should be incorporated into the soil at the time of sowing.

Farm yard manure can be applied to the soil to increase its fertility owing to maize growth and development.

Pest and disease control

Pests that affect maize include stalk borer and army warm which its larvae may eat all the leaves until only remain midrib.

Few diseases like white leaf blight, maize streak caused by virus and rust caused by fungus attack the crop.

Harvesting and yields

Harvesting maize is done mechanically by combine harvester and manually by hand.

Maize grain is physiologically mature at a moisture content of about 35%. when left in the field to dry it is reduced to 19 – 20% after the husks has been removed.

Maize is dried and stored in the crib i.e. a store with wall of wire netting.

Question.

Describe the agronomic practices carried out in the growing of rice from planting to harvesting.

Plant characteristics.
Ecological requirement of the crop (soil, rainfall, humidity, temp)
Importance
Seed bed preparation
Planting
Weeding (thinning, pruning)
Fertilizers application
Harvesting
Yield
Storage.

VEGETABLES

- They are sources of income when a farmer decides to sell.
- They are very good source of vitamin like vitamin A and C.
- They act as appetizers for food e.g. onions and tomatoes.
- They are a good source of minerals e.g. Iron, magnesium.
- They heap in controlling digestive problem like constipation
- They can be used as animal feeds like cabbages to rabbits.
- Vegetables growing provide employment for people working as attendants in vegetable gardens.
- Vegetables are a good source of manure since they rot fast.
- Leguminous vegetables fix nitrogen into the soil e.g. beans
- They can act as cover crops hence controlling soil erosion.
- Some vegetables have medical value e.g malakwang, red amaranthus.

CLASSIFICATION OF VEGETABLES

Vegetables can be classified into two ways. i.e. according to the part eaten and family

ACCORDING TO PART EATEN.

Leaf vegetables

Cabbages
Amaranthus

Spinach.

Fruit vegetable

Egg plant
Tomatoes
Water melon
Cucumber
Pumpkin.
Okra

Seed vegetables

Cowpeas
G-nuts
Beans
Garden pea
Field pea

Root vegetables

Onions
Sugar beet
Garlic
Carrots
Irish potato
Turnip
Radish

Flower vegetables

Cauliflower

Family classification

Here vegetables are grouped into six families:-

1. **Leguminosae (pulse)**

   This include

Beans
Pigeon pea
G-nuts
Garden peas
Cowpeas

2. **Solanaceae (Tomato family)**

This include

Irish potatoes
Egg plant
Tomatoes
Sweet pepper

3. **Brassicaceae (cabbage family)**

It includes

Cabbage
Cauliflower
Radish
Turnip
Kale

4 **Cucurbitae (gourd family)**

Includes

Pumpkins
Water melon
Cucumber
Gourds.

5. **Alliaceae**

This includes

Onions
Leek
Garlic

6. **Apiaceae**

Carrots

Parsely
Celety
Carriander
Parsely.

7. **Amaranthanceae**

Amaranthus hybridus
A. dubius
A. caudatus

PROCEDURE FOLLOWED IN GROWING VEGETABLES

1. Choosing the site.

The site to be considered for growing vegetable should measure up to the following:-

The soil should be deep and fertile. Incase at low fertility fertilizers should be applied.
Availability of water, the site should have enough water supply hence the site should be close to a water source.
Distance from home. The site shouldn't be far from home for security reasons and easy management.
The area should be free from frost and the farmer to effect this should avoid valley bottom.
The place shouldn't be having shade since some vegetable like tomato and egg plant do not thrive well in shade.
Gentle slope or flat land and require for fair drainage.

2. Preparing a nursery bed.

A nursery bed is an area where seedlings are grown before they are transferred to the actual vegetable field / garden. The seeds can be planted in a seed bed, seed boxes or soil blocks.

Treatment of planting materials

Seed dressing –coating seeds with pesticides e.g. copper Sulphate.
Chitting or encouraging sprouting e.g. in potato seeds.
Inoculation, usually done legumes where seeds are coated with right bacterial for nodule formation.
Hot water treatment against viral diseases e.g in sugarcane and cassava.

Importance of a nursery bed.

When propagating seeds which are too small to be planted directly into the soil.
The crop seedlings are delicate and need great care
Bulking up of planting materials is necessary like in sugarcane
Helps in selecting healthy and strong seedlings.
When cuttings to propagate the crop need special treatment e.g tea.

Procedure of making a nursery bed

Remove all grasses, roots and tree stumps on the area.
The place should be cultivated deeply to encourage proper root development.
All large soil pieces should be broken down to encourage a fine bed.
Incorporate manure containing phosphorous into the soil to improve fertility
Leave the area to settle for Atleast 3 – 4 weeks before planting seeds
Measure off the seed bed to a width of 1 metre and any length that you feel.
Erect a shade on the prepared place to control light and water delivered to the seedlings.
Make ridges across the bed where the seeds are to be planted.
Place the seeds in the ridges and cover it with a thin layer of mulch to facilitate germination.
Place a thin layer of mulch over the seeds to conserve soil moisture and control weeds.

As soon as the seeds germinate the mulch should be removed since it may interfere with germination.
The seeds should be watered twice each day in the morning and evening.
After germination excess seedlings can be removed a practice called pricking out.
At a later stage before transplanting seedlings are exposed to environmental conditions referred to as hardening off
Transplanting should be done in the evening hour or morning to reduce the rate of water loss from the seedlings by transpiration.

3. Preparation of a seed bed.

A seed bed is a well prepared piece of land ready to receive planting materials.

The land should be cleared of large bush, all trees and grasses
All tree roots and stump should be removed in advance.
The whole place should be deeply cultivated and big pieces of soil broken.
The whole place should be measured to establish the size in accordance to the number of seedlings to be planted.
The place should be leveled before planting seedlings.
The whole vegetable should be along the contour of land to reduce erosion.

Nursery bed management

- Seedlings must be watered Atleast twice a day i.e in the morning and evening**.**
- Apply fertilizers to the seedlings to improve growth.
- Apply pesticides to control pests on the seedlings
- Spray fungicides on the seedlings to control fungal infections like dumping off
- Provide a good shade over the nursery bed to control damage to seedling due to harsh environmental conditions
- Remove diseased and excess seedlings from the nursery bed i.e prick out to reduce disease spread and allow proper seedling growth.
- Weed the bed to reduce competition for nutrients and control disease spread

4. Transplanting

Precautions to be taken when transplanting

- Seedlings in the nursery bed should be well watered before lifting to reduce root breaking
- Seedlings should be lifted with soil in their roots to control distorting of roots.
- Care should be taken not to damage roots as it may deter proper crop establishment and development.
- Transplanting holes should be big enough to accommodate seedlings without bending roots since it may affect root development.
- Where fertilizers are used it should be thoroughly mixed with soil for efficient utilization by the seedlings.
- Seedlings should not be planted deeper than they were in the nursery for proper establishment.
- Transplanting should be done during the cool hours to reduce wilting of seedlings through excessive loss of water by transpiration.
- Seedlings should be watered after transplanting if the soil in the field is dry to provide adequate moisture for crop establishment and growth.

Transplanting the seedlings.

Only healthy, strong seedlings should be selected.

Watering of the nursery to soften the soil to ease transplanting and reduce root damage.

Transplanting should be done in the evening or in cool weather.

Thorough preparation of the seedbed by removing all tree stamps and roots remove any other vegetation Atleast two months before transplanting.

Dig holes before transplanting at the required spacing

Fill the holes with a mixed top soil and double supper phosphate or organic manure Atleast 2 -3 weeks before planting.

Top soil and sub soil should not be mixed but filled to holes separately

Transplant at the beginning of rain for easy crop establishment.

Provide temporary shade to the transplanted plant (seedlings)

Mulch around the seedling

Continue watering until the plant has fully established it's self.

5. Application of fertilizers.

Vegetable require more of N, P and K which should be applied early for vigorous plant growth.

6. Weeding

Effective weed control is needed to ensure proper growth of the vegetable since they are more sensitive to competition.

7. Disease and pest control.

Vegetables are attacked by a number of fungal and bacterial diseases like dumping off, downy mildew, bacterial wilt, mosaic, dry rot, black rot, stem rot, and blight. The common pests are cut worms, termites, grasshoppers, caterpillars, mole crickets, aphids, thrips, nematodes and beetles.

8. Harvesting

Most vegetables are early maturing and are normally harvested manually after harvesting they should be kept in a cool place to that they don't go

bad.

GROWING OF TOMATO SEEDLINGS FROM NURSERY BED PREPARTION TO TRANSPLANTING.

Select a good site for vegetable production
Remove all vegetation from the area where to prepare the seed nursery bed.
Cultivate deeply removing all roots from the bed.
Raise a nursery bed to facilitate good drainage.
Incorporate well rotten F.Y.M / compost or S.S.P fertilizer.
Level the soil by raking and remove any foreign material like stone, polyethene or glasses and break any big clods of soil.

Sow the seed at 0.5cm deep and cover lightly with soil
Spacing should be 15cm between the rows.
Mulch the bed lightly and remove after seeds have germinated
Erect a shade over a nursery bed to protect seedlings from harsh environmental conditions.
Water from the top of the shade twice a day, morning and evening using a watering can.
When the seedlings grow up to about 2.5cm high, prick out to ensure proper spacing and growth.
Weeding should be carried out with a garden trowel or suitable tool
Spraying seedlings with copper fungicides such as ridomil and diethane M45 to control late blight and other pests should be done.
As seedlings near 15cm in height, reduce the shade to ensure hardening off.
A week before transplanting water the seedling to ensure the soil is soft to avoid breaking roots.
A week before transplanting, remove all the shade to ensure full hardening off.
Transplanting should be done in the evening or cloud cast day to reduce water loss from the seedlings.
At transplanting use a trowel to remove seedling with soil around the roots.
At transplanting use a trowel to remove seedling with soil around the roots.
Water immediately after transplanting.

Diseases of tomato.

Tomato Blight-It's a fungal disease, it attacks leaves, stems and fruits causing brown – black sunken lesions

It's very severe in humid weather.
It can be controlled by spraying with copper fungicides such as ridomil and diethane M45.

Bacterial Wilt - Its caused by pseudomonas solanacearum, it causes wilting and death of growing point and upper leaves.

Its airborne and controlling its spread is difficult. However the following control measures are recommended:-
Remove and burn all infected plants.

Crop rotation
Use resistant varieties
Sterilize the soil by burning grass on top or apply formalin or boil
By fallowing

Tomato Mosaic -This is a rival disease, which causes curling and molting of leaves thus reducing the area of photosynthesis.

It may be transmitted from tobacco shred or a smoker's hand

Its controlled by

planting resistant healthy seeds
burning all affected plants and planting healthy seeds
smokers should wash their hands before touching tomato plants.

Pruning tomato

One or two stems are left per plant.
Remove lateral shoot weekly
When 6 – 8 trusses of flowers pinch out the growing it this pruning will encourage the growth of good size marketable tomato.
Remove leaves close to the ground to prevent the entry of blight.

Importance of pruning tomatoes

Improves the quality of fruits by exposing each to enough light.

Improve yields by ensuring big fruits due a reduced competition for nutrients between various branches

Makes spraying against disease more easy

Removes a micro climate that can encourage pests.

Harvesting becomes easier since fruits are properly exposed

Makes movement with in the garden simpler.

Staking tomatoes

There are several methods of staking tomato the common method includes:-

Single staking
Cross staking using a wire cross poles.

Importance of staking tomatoes

Controls fungal diseases that can attack tomato fruits especially soil borne diseases.
Improves the quality of fruits by preventing contact between soil and fruits.
Prevents pest attack of tomatoes by crawling pests
Exposes fruits to adequate air and light which improves quality.
Reduces wastage of pesticides by exposing fruits for easy spraying.
Make movement with in the garden easy.

LEGUMES

These are plants with root nodules which are able to fix nitrogen into the soil.

IMPORTANCE OF LEGUMES.

- They are good sources of protein for human and other animals e.g. soybeans, with a protein content of 38 – 40%
- In pasture they provide protein for grazing animals
- Symbolic bacteria in the root nodules of legumes fix atmospheric nitrogen into the soil.
- Fast growing leafy legumes are good for making green manure.
- Legumes grow and cover the ground very quickly hence can be used as cover crops.
- They are deep rooted hence help in recycling nutrient and opening up the soil thus increasing ration and infiltration.

In any dry area legume shrub provide fodder for animals.
Legumes regenerate faster and produce more nutritious vegetative parts hence can be continually grazed by animals.
Some legumes are used in the manufacture of medicine and dyes
Industrial products made from legumes such as ground nuts cake are fed to livestock.

CHARACTERISTICS OF LEGUMES

They have trifoliate net vein leaves.
Most legumes have root nodules which contain nitrogen fixing bacteria\
They bear pods which contain seeds.
They have a tap root system.

ROOT CROPS

They are crops which have swollen roots or under (ground stems) in which large quantities of starch are stored.

IMPORTANCE OF GROWING ROOT CROPS.

They grow in a variety of soil and can be good source of food for most of the areas.
They require little labour and attention hence cheap to produce
The tuber can lie in the ground until required and therefore available throughout the year.
Most root crops are resistant to drought hence can be produced in area of little rainfall.
Root crops are attacked by few pest and diseases as compared to other crops.
They are able to give high yield even in poor soil hence solving the problem of hunger.
Compared to cereals and legumes, root crops require little processing before they are eaten.

LIMITATION OF ROOT CROPS GROWING.

They are bulky and therefore difficult and expensive to transport
They have a high moisture content hence difficult to store.
They are low in protein, fat, vitamin, and minerals hence needs supplementation.
They are propagated vegetatively therefore the planting material is difficult to transport.

PERENNIAL CROPS

These are crops which complete their life cycle in more than one year coffee, tea, cocoa, sisal, cashew nut, sugar cane, citrus fruits, pawpaw, banana, pineapple.

IMPORTANCE OF GROWING PERENNIAL CROPS IN AN AGRICULTURE SYSTEM.

The cost of establishing is spread over a number of gear hence can lower than that of annual.
Harvesting is continuous after establishment which reduces Labour.
They may be used as security in acquiring loans from the bank.
They increase value of land whenever planted.
The cost of controlling pest and disease is generally lower than that of annual.

LIMITATION OF PERENNIAL CROP PRODUCTION

Require a lot of land to be grown because of their wide spacing.
Perennial take long time to mature therefore waste long which could have been used for short term profitable crop.
Some of the perennial require irrigation so a permanent water source may be necessary.
Some perennial do not have seeds and therefore must be vegetatively propagated which is a bit expensive.
The processing of these crops may have to be done on the farm reducing the land area that could be used for crops.
The average yield for most perennials is low.
Perennials are very difficult to improve because breeding programmes are at along term nature and very expensive.

The perennials are also grouped into families e.g.

1. Rubiaceae - Coffee
2. Theacede - Tea
3. Sterculiaceae - Cocoa
4. Anacardiaceae - Cashew nut -- Mango
5. Agavaceae - Sisal
6. Graminae - Sugar cane
7. Rutaceae - Citrus fruits

8. Caricaceae - Papaw (*Carica papaya*)

9. Musaceae - Banana

10. Bromeliaceae. - Ananas cosmosus (pineapple)

GROWING COFFEE FROM NURSERY BED TO HARVESTING

Choose a suitable site with a good deep, well drained fertile soil from any shade.
Plough the area a depth of 0.6m to a tilth i.e. deep ploughing
Remove all plants roots, stones, weeds and break all big clods then level the soil using a rake.Incorporate manure i.e. compost manure or SSP.
Sow/ plant seeds at a depth of 2.5m in a nursery bed at a spacing of 15cm by 15cm or 20cm x 20xm.
Mulch and water thoroughly using watering can mulches are removed immediately after germination.
Erect a shade to last atleast for one month.
water regularly nursery life last for 1 ½ year
weeding, thinning, pricking out should be done to avoid competition
control pest and disease
Hardening of the seedling before transplanting this is done by reducing water interval, reducing the shade.
Only healthy, strong seedlings should be selected.
Watering of the nursery to soften the soil to ease transplanting and reduce root damage.
Transplanting should be done in the evening or in cool weather to reduce water from the seedlings.
Thorough preparation of the seedbed by removing all tree stamps and roots or any other vegetation atleast two months before transplanting.
Dig a hole two months before transplanting at a spacing of 2.7m x 2.7m and 60cm deep and 60cm wide.
Fill the holes with a mixture of top soil and double supper phosphate or organic manure atleast 2 -3 weeks before planting.
Top soil and sub soil should not be mixed but filled to holes separately
Transplant at the beginning of rain after 1 ½ year when the plant is ready to leave the garden.
Provide temporary shade to the transplanted plant (seedlings)

Mulch around the seedling
Continue watering until the plant has fully emerged.

Examples of coffee diseases.

Coffee berry disease.
Its caused by a fungus, which causes brown sunken spot on the berries making them difficult to pulp.

Antestia bugs
This suck berries and cause zebra strip hey also feed on terminal bud and causes pan braking.

Control is by spraying with parathion and open pruning.

Other pests include:-

Mealy bugs
Coffee thrips
Lace bugs
Scale insect.
The above pest can be controlled by spraying with dieldrin and fenthion.

Advantages of pruning coffee.

It increases quality of berries by controlling over bearing.
Make harvesting easier.
destroys micro-climate for certain pest and disease by reducing over crowding making weeding and spraying easier
It increases the yields.
keeps plants health and more vigorous