FORM TWO AGRICULTURE NOTES

LIVESTOCK HEALTH II (PARASITES)

Parasite- A living organism that lives in or on another organism and obtains nourishment from that organism without being useful to it in any way.

-This host-parasite relationship is referred to as parasitism.

-Parasitism is an association between two organism one a parasite and the other the host.

Effects of parasites on livestock

(i) Cause Anaemia

-Blood sucking parasites take large volumes of blood from the host animals leading to anaemia.

ii) Deprive the host of nutrients (food)

-Internal parasites compete for food with the host animals this result into loss of weight, emaciation and low production.

iii) Injury and damage to tissue and organs.

-Biting parasites break the skin of the animal exposing it to secondary infection.

-Some internal parasites such as round worms, live fluke etc damage organs and tissues.

-Tissue injury results into Hemorrhage.

Iv) Disease transmission.

-Some parasites act as vectors of some diseases

-They spread disease from sick animals to healthy ones.

v) Cause irritation

-Some external parasites irritate the animals through their biting effects.

-This causes the animal to rub itself against solid objects destroying skin, fur or wool.

vi) Obstruction to internal organs

-Internal parasites may cause mechanical obstruction or blockage of the internal passages.

-This leads to mal-functioning of organs affected.

TYPES OF PARASITES

a. External parasites (ectoparasites)
b. Internal parasites (endoparasites)

a. External parasites

-Found on the outside of the host body.

-They may live on or under the skin.

-Most ectoparasites belong to the phylum arthopoda.

-T here are two main classes of these parasites.

i) Class insecta.
ii) Class arachnida

CLASS INSECTA

These consist of tse tse flies, keds, mosquitoes, flies, lice and fleas.

a. Tsetse fly (Glossina spp)

- This is a true insect undergoing complete metamorphosis i.e.

-Tsetse flies give birth to larvae after the eggs hutch inside the body of the mother.

-Larva forms the pupa, which later changes into an adult.

-Tsetse flies bites mainly during the day.

Harmful effects

-They transmit Trypanosomiasis caused by a protozoan called trypanosome

-Sucks out blood from the animal causing anaemia.

-Cause damage on the skins and hides of animals making wounds which provide routes for secondary infection by pathogenic organisms.

Control

-Bush cleaning to destroy their breeding places.

-Spraying their breeding places with insecticides.

-Use of fly traps with impregnated nets.

-Use of sterilizing agents e.g. radio isotopes on male flies and then releasing them.

b.Keds (melophagus orinus)

-Are sometimes referred to as sheep ticks.

-They are hairy and wingless bloodsucking flies.

Harmful effects

-Cause irritation in heavy infestation.

-Due to irritation, animal scratches itself thus damaging the wool.

-Retarded growth in lambs.

- Anaemia.

Control measures

-Shearing the infected sheep and hand spraying them with appropriate chemicals eg pyrethrum, malathium, dieldrin etc

-Routine sheep dipping.

c. Fleas

They are wingless but have strong legs adapted for leaping over long distances.

-They suck blood as their mouth parts are adapted for penetrating the host's skin and sucking blood.

-They pass through the following stages during development, egg- larvae- pupa- adult.

Harmful effects

-Cause irritation leading to scratching.

-Stick fast in poultry causing wounds on the comb and wattles.

-They cause anaemia.

Control measures

-Animals sleeping places should be kept clean.

-Dusting animal hooks with appropriate insecticides.

-Covering the stick fast fleas with petroleum to suffocate them.

d. lice

They are small wingless insects and can be divided into two groups.

- Biting lice (mallophaga)
- Sucking lice (anoplura)

Biting lice

-They are found on both the birds and mammals.

-They have chewing mouthparts.

-They complete their lifecycle between three to four weeks.

Sucking lice

-Have mouthparts reduced into styles for sucking blood.

-They are found only on mammals.

Harmful effects

-Cause irritation to the animal hence, the animal is seen to rub itself against fixed objects.

-Heavy infestations cause loss of health in animals.
-Since animals under attack do not feed very well, there is emaciation.
-Loss of production in birds.
-Anaemia and restless especially in poultry.

Control measures

-Spraying or dusting animals with appropriate insecticides.
-Keeping animal houses clean.
-Perches in poultry houses should be applied with insecticides eg 40% nicotine sulphate solution.
-Dusting each bird with sodium fluoride for individual treatment.

CLASS ARACHNIDA

-This consists of the ticks, mites and spiders.
-Ticks and mites belong to the order Acarina.
-These do not undergo complete metamorphosis.
-They have two body parts i.e. cephalothorax and the abdomen.
-The adults have 4 pairs of legs.

(a) Ticks.

-Ticks rank as the single most important ectoparasites of livestock.
-They cause injury and spread very dangerous diseases.
-There are over 50 different species of ticks known.

Harmful effects

-Vectors of diseases e.g. ECF, Red water, Anaplasmosis.
-Suck blood-causing anaemia to the host.
-Cause wounds through their bites.
-Cause irritation to the animal.
-Their bites lower value of hides and skins.
-Some ticks produce toxins that may be harmful to the host.

THE LIFE CYCLE OF TICKS

-Ticks usually pass through four main stages in their cycle i.e.

-Egg
-Larva (six legs)
-Nymph (Eight legs)
-Adult (Eight legs)

-Different species of ticks need different number of hosts.
-There are therefore three categories of ticks i.e.
-One host ticks.
-Two host ticks.
-Three host ticks.

ONE HOST TICKS

-These ticks require one host to complete their lifecycle.
-Eggs on the ground hatch into larvae.
-Larvae climb onto the host, suck blood, become engorged and moult into nymphs.
-Nymphs feed on the same host, become engorged and moult into adults.
-Adults feed on the same host, mate and the females drop off to the ground to lay eggs.

Examples of one-host ticks:

-Blue tick (*Boophilus decoloratus)*
-The Texas Fever tick (*Boophilus annalatus)*
-The Cattle tick (*Boophilus microplus)*
-The Tropical Horse tick (*Dermacentor nitens)*

TWO HOST TICKS

-This tick requires two hosts to complete their lifecycle.
-The larvae and nymphs pass through their stages on the first host.
-Eggs on the ground hatch into larvae, which climb on to the first host.

-A larva attaches themselves to the host, feed on blood, become engorged and moult into nymphs.
- Nymphs feed on the same host become engorged and then drop to the ground to moult in adults.
-Adults find a new host on which to feed.
-They feed on the second host and mate.
-Females drop off to the ground to lay eggs.
Examples of two host ticks.

-Red legged tick (*Rhipicephalus evertsi)*
-The Brown tick (*Amblyomma maculatum)*
-The African Bont-legged tick (*Hyalomma truncatum)*
-Large Bont-legged tick (*Hyalomma rufipes)*

THREE HOST TICKS

-These ticks require three different hosts to enable them to complete their lifecycle.
-Eggs hatch on the ground into larvae.
-Larvae attaches itself to the first host, feed on blood, become engorged and drop off to the ground and moults into nymphs.
-The nymphs look for a second host, feed on blood, become engorged and drop off to the ground and moult into adults.
-Adults seek for the third host, climb, feed become engorged and mate.
-Females drop off to the ground to lay eggs.

Lifecycle of a three host tick.

Examples:-

-Brown ear tick (*Rhipicephalus appendiculants)*
-East African Bont tick (*Amblyomma variegatum)*
-Bont tick (*Amblyomma herbraem)*
-Gulf Coast tick (*Amblyomma maculatum)*
-Yellow Dog tick *(Haemaphysalis leachii)*

-Fowl tick (*Heamaphysalis hoodi)*

-Brown Dog Tick (*Rhipicephalus sanguineous)*

TICK CONTROL MEASURES

i) Natural/Biological method.

ii) Mechanical method.

iii) Chemical method.

1. Natural/ Biological method.

-This is the use of the tick's natural enemies which predate on the ticks.

E.g. using predators such as birds to control ticks.

N/B Only a small number of ticks is controlled using this method.

2. Mechanical method

i) Burning the infected pastures.

-Burning destroys eggs, larvae, nymphs and adults.

ii) Interfering with the ticks environment

This is achieved by:-

-Ploughing pasture land .the eggs are exposed to the sun heat or are deeply buried.

iii) By top dressing pasture using lime or dressing using acaricides.

iv) Fencing off the pasture and farm.

v) Hand picking the ticks (deticking)

vi) Starving the ticks to death

-This is achieved by practicing rotational grazing.

-It interrupts the lifecycle of the ticks.

3. Chemical control method.

This is done by application of acaricide.

Properties of an effective acaricide

-Has the ability to kill ticks.

-Be harmless to both human and livestock.

-Be stable.

-Should remain effective after having been fouled with dung, mud or hair.

Methods of acaricide application

-Spraying regularly with the acaricide.

-Dipping animals in plugs dips containing the acaricide.

-Hand dressing using pyegrease.

ENDOPARASITES (INTERNAL PARASITES)

These are parasites which live within the body of the host animal e.g. tapeworms, Round worms, Fluke etc

Categories of Endoparasites

-Endoparasites are generally called helminthes

-They fall under 2 phyla

i)Platyhelminthes (Flat worms)

-class-trematoda (flukes)

-Cestoda (tapeworms)

ii) Nemathelminthes (nematoda)- Round worms.

P LATYHELMINTHES

-Are flatworms.

-Body is symmetrical

-Are hermaphroditic.

a) Tape worm (Taenia spp) -cestodes

-Have two main parts ie

-Has a head (Scolex) and a chain of segments called the strobila

-Each segment is called a proglottis.

-Scolex has suckers or hooks or both.

Animals affected – pigs

- Cattle
- Sheep.
- Goats.
- Donkey.

Symptoms of attack

-General emaciation

-Rough or staring coat.

-Scouring and sometimes constipation due to digestive disturbance.
- Pot-bellies especially in calves.
-Oedematous swelling under the jaw.
-Obstruction/blockage of the intestines when tape worms are present in large nubers.
- Ploglottides present in faeces.
-Anaemia.
-Excessive appetite.
N.B. Lifecycle of tape worm
-Tape worms attack farm animals as intermediate hosts and man as final host.
-There are two common species of tape worm

i) Beef tape worm (*Taenia saginata*)
ii) Pork tape worm (*Taenia solium*)

-Affected human beings drop Ploglottides full of eggs with faeces.
-Eggs are picked by the right intermediate host either cattle or pigs while feeding.
-After ingestion by the host (intermediate), Eggs hutch in the intestines into embryos.
-Embryos penetrate the intestinal wall and enter the blood system.
-They first move to the liver and then to all body muscles of the animal where they become cysts.
-Under cooked beef or pork from infected animals if eaten by man causes an infection.
-In the human intestine cysts wall dissolve and the parasites attack themselves to the wall of the intestine.
-Here they develop into adult tapeworms.
-These are passed out again in faeces.

Control measures and treatment

-Use of prophylactic drugs e.g. antihelminthes (dewormers) to kill parasites in animals.

-Keep animal houses clean and disinfected.
-Practice rotational grazing to starve the larvae (cysts) to death.
-Keep the feeding and watering equipment clean.
-Use of latrines by farm workers ie proper disposal of human faeces.
-Proper meet inspection.
-Proper cooking of meat.
b) Liver fluke (Fascial spp (Trematoda)
There are many species of flukes.
-Two are the most common ones ie

i) Fasciola heptica (sheep)
ii) *Fasciola gigantica* (cattle)

-Heavy infestation of flukes cause a condition called Fascioliasis.

Symptoms

-Emaciation
-Indigestion in the animal.
-Pot bellied condition.
-Damage to liver tissue causing haemorrhage due to movement of flukes in the liver.
-Anaemia due to sucking of blood.
-Animals are dull and depressed.
-Swollen and painful abdomen.
-Recumbence precedes death.
N.B. Fasciola has the following characteristics

-Gray or gray-pink in colour
-Flattened like leaf.
-Have a conical projection at the anterior end.
-Have a tapering body ending.

Lifecycle:

-Liver fluke use the fresh water snail as their intermediate host.
- They have sheep or cattle as their final host.
-Adult flukes are found in the bile duct of the liver of the host animal.

-Here they produce eggs which are passed into the alimentary canal through the bile duct.
-Eggs are passed out through dung.
-A fluke produces about 300-3500 eggs per day.
-I the eggs falls into stagnant water that is warm, they hatch into a ciliated embryos called miracidia (miracidium)
-On coming into contact with the intermediate host snail (*Limnea spp*). It penetrates the snail tissue.
-Once inside the snail tissues, miracidium process masses of cells called sporocysts
-Sporocysts change into Redia.
-Redia produces cercaria more out of snail
-Cercaria change into metacercaria which is the infective stage of the fluke
-The definite/ final host through grazing or drinking infected water takes Metacercaria.
N.B. Metacercaria can survive in wet grass and in shady places or when withstand harsh conditions for a year.
-Once swallowed by the host, cercaria penetrates walls of the intestine and hatch into adults.
-Adults migrate to the liver where they grow, mature, mate and produce eggs.
-The cycle starts all over again.

Control measures

1. Controlling the fresh water snail (intermediate host) though
    a) Physically killing them.
    b) Chemically by use of $CuSo_4$ Sodium pentachlorophenate etc which is added to stagnant water to kill the snails.
    c) Draining swampy areas/leveling any depression that may hold water in the pastures.
2. Burning of the pastures during the dry seasons to kill cercaria
3. Not grazing animals near marshy or waterlogged areas.

4. Routine drenching using antihelminthes e.g. NaSo4, hexachloroethane drugs.

ROUNDWORMS (NEMATODES)

(Ascaris spp)

There are three common species of round worms

i) *Ascaris lumbricoides* Cattle and sheep.
ii) *A. suum* Pigs.
iii) *A. galli* poultry.

-Heavy infestation of these worms cause a condition called *ascaridiosis*

Symptoms of Attack.

-Anorexia (Loss of appetite in heavy infestation)

-Staring coat (stiff and dry)

-Dehydration and pale mucosa

-Eggs and adults present in faeces.

-Emaciation

-Diarrhoea.

-Anaemia.

-Potbellies especially in young animals.

LIFECYCLE OF A ROUNDWORM

-The common roundworm *Ascaris lumbricoides* does not have intermediate hosts.

-Eggs are laid in the alimentary canal of the host animal.

-Eggs are passed out of the host with faeces.

-Under favorable environmental conditions, eggs hatch into larvae which climb

CROP PRODUCTION III (NURSERY PRACTICES)

Seedbed. This is a piece of land large or small, which has been, prepared to receive seeds at planting or seedlings at transplanting. The crop will establish and grow to maturity here.

Nursery bed. This is a special type of a seedbed prepared for raising seedling before transplanting. It should be 1m wide and of any convenient length.

Seedling bed. This is a special type of a nursery bed used for raising seedlings, which have been removed from the nursery bed due to overcrowding before they are ready for transplanting. This is called **pricking out.**

Importance of a Nursery in Crop Propagation

a) It facilitates the planting of small seeds that develop into strong seedlings that are easily transplanted.
b) Routine management practices are easily and timely carried out in the nursery than in the main seedbed.
c) It is possible to provide the ideal conditions for growth such as watering, fine tilth and shade to the plants.
d) It facilitates the production of many seedlings in a small area.
e) Ensures planting of only the healthy and vigorous growing seedlings.
f) Excess seedlings can be sold earning income to the farmer.
g) Seedlings raised in the nursery bed take a shorter time to mature than ones established directly.
h) It reduces labour on the care of seedlings since the area is small.

Site Selection

The following factors should be considered when selecting a nursery site.

a) *Nearness to water source.* For easy watering.
b) *Type of the soil.* Soil should be well-drained, deep and fertile preferably sandy loam.
c) *Topography.* Should be sited on a gentle slope to prevent flooding and erosion through run-off.
d) *Security.* Should be well protected from theft and destruction by animals.

e) *Previous cropping.* Avoid siting it on an area where the same crop species had been planted to avoid build up of pests and diseases.
f) *Well sheltered.* Windbreaks are necessary to prevent strong winds, which can uproot the seedlings and cause excessive evaporation.

Categories of Nurseries

- Vegetable crop nursery
- Tree nursery
- Vegetative propagation nurseries.

Vegetable crop nurseries

- Most vegetable crops have small seeds and are established through the nursery.
- A suitable nursery site is selected and marked out.
- Vegetation is cleared using slashers, pangas, mowers etc.
- Trash is removed and the site is dug or ploughed to remove all the perennial weeds.
- Various nursery beds are measured and divided leaving paths of 60cm in between the individual beds.
- In dry areas the nurseries are sunken in order to conserve moisture.
- Beds are harrowed to a fine tilth and Phosphatic fertilizer or well rotten manure is broadcasted.
- Leveling is done using garden rakes, which also removes trash.
- Shallow drills, 10-20cm apart are made and the seeds are drilled uniformly And then covered lightly with the soil.

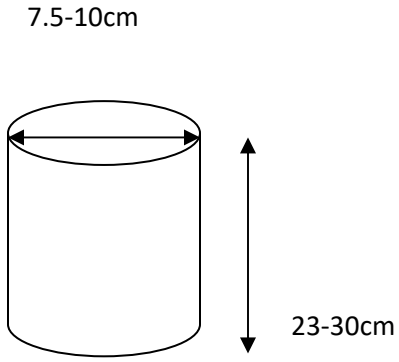
Tree nurseries

- Selected site is prepared the same way as for the vegetables.
- Alternatively, the seeds are pre-germinated by soaking them in water for 24-48 hours. The seeds are then planted in polythene sleeves, which are half filled with soil. The sleeves facilitate transporting of the tree seedlings during transplanting. The polythene sleeves are arranged in rows under shade in the nursery site.

Vegetative propagation nurseries

These are used to raise some cuttings before they are transplanted to the main seedbed e.g. in tea. Correct rooting medium must be provided to facilitate rooting.

- A suitable site is elected, cleared and leveled.
- The nursery unit should measure 3.66m x 1.22m.
- Polythene sleeves measuring 7.5-10cm in diameter and 23-30cm long are filled with the rooting mixture.



- The rooting mixture is made of the subsoil, double super phosphate and Sulphate of potash.
- 1m3 of subsoil is mixed with 450-600gm of DSP.
- The sleeves are then placed in the unit. Each unit holds about 1200 sleeves.

Preparing tea cuttings

Stem cutting are obtained from;

- High yielding mother plants.
- High leaf quality plant
- A plant with the ability to adapt to a wide range of ecological conditions.

- The selected mother plants are pruned and left to grow for six months unchecked.
- The shoots that grow within this period provide cuttings, which are obtained from the middle part.
- The brown hard bottom and the green soft part are discarded.
- The bottom part takes long to root while the upper soft part tends to rot if planted.
- A sharp knife is used to make slanting cuts above the axial bud.
- The cutting should be 2.5-4.0 cm long. Each cutting should have a leaf.
- The cuttings should be placed in water before they are planted to avoid dehydration.

- The sleeves are watered and then the cuttings inserted at the center of each sleeve.
- Leaf of the cutting should not touch the soil to avoid rotting.

The sleeves should then be arranged in the vegetative propagation unit as shown below. Wooden hoops are erected over the sleeved cuttings and a polythene sheet is placed.

The sleeves should be watered once every three weeks. Weeds appearing in the nursery unit should be uprooted.

Nursery management Practices

i. *Mulching.* This prevents excessive evaporation and moderates soil temperatures. It should however be removed on the fourth day or as soon as seedlings start emerging. Dry grass or straw from cereal crops can be used as mulch.

ii. *Watering.* Should be done regularly preferably morning and evening.

iii. *Weed control.* Weeds should be removed by uprooting.

iv. *Pricking out.* Where seedlings are overcrowded some should be removed and planted in a seedling bed. This reduces competition.

v. *Shading.* Should be provided but dark conditions should be avoided to avoid the seedlings becoming etiolated or pale.

vi. *Pest and disease control.* Appropriate chemicals should be applied to control pests and diseases. This should however start during the nursery bed preparation stage where the soil is sterilized through heat treatment or use of chemicals such as *furadan.*

vii. *Hardening off.* This the practice of preparing the seedlings to adapt to the ecological conditions found in the seedbed. This can be done through;

- *Gradual reduction of shade 2-3 weeks before transplanting.*
- *Reduction of watering.*
- *Partial lifting of the seedlings in some cases.*

Grafting

This is the practice of uniting two separate woody stems. The part bearing the roots is called the ***rootstock*** while the part, which is grafted onto the rootstock, is known as the ***scion***. Scion has buds, which develop into the

future plant. The ability of the rootstock and the scion to form a successful union is referred to as ***compatibility***. Only botanically closely related structures are compatible such as lemon and orange or lemon and tangerine.

Methods of Grafting

- *Whip or tongue grafting*. In this case the diameter of the rootstock and the scion are the same. It is carried out when the diameter of the scion and rootstock is pencil thick. A slanting cut is made with a sterilized sharp knife on both the scion and rootstock. They are joined together and wrapped with grafting tape or polythene strip.

- *Side grafting*. It is done where the stock has a larger diameter than the scion. The scion is inserted into the side of the stock.

Other methods of grafting include;

- *Approach grafting*.
- *Bark grafting*.
- *Notch grafting*.

Budding

This is the uniting of a vegetative bud (scion) to a seedling of another plant (rootstock). The scion has only one bud and some bark with or without wood. The bud is inserted in a slit made on the bark of the stock. It is held tightly on the stock by tying with budding tape until it produces roots.

Methods of Budding

- *T – budding.* A T-shaped incision is made onto the bark of the rootstock down to the wood. The incision is made 15-20cm above the ground using the budding knife. The bark is then raised and the bud is inserted by sliding it downwards under the lifted bark. The bud is then firmly tied. Materials such as adhesive tapes, rubber strips and polythene papers can be used for tying.

The wrapping is removed about two weeks after budding to inspect the buds. If they are green they have been accepted by the stock. The stock is then cut a few centimeters above the union. The green bud develops to produce a shoot. When the shoot reaches about 25cm it is tied to a stake to prevent it

from being blown by wind and get broken. The piece of rootstock above the union is now cut 1-2cm above the union.

- *Top budding.* This involves budding of young trees where the buds are inserted at the desired locations. This allows the production of different varieties of fruits on the same rootstock as long as they are of the same species.
- *Patch budding.* The bark with a bud is removed from the scion stem and inserted into a patch where the bark has been removed from the rootstock. The union is tied on top and bottom tightly.

Importance of Grafting and Budding

- Plants with desirable root characteristics such as disease resistance, vigorous root system, and resistance to nematode attack but with undesirable products may be used to produce desirable products. E.g. orange lemon – graft.
- Grafting helps to repair damaged trees.
- They help to shorten the maturing age. Grafted mangoes take 3 ½ years to mature while non-grafted ones may take up to 7 years.
- They facilitate the changing of the top of the tree from being undesirable to desirable.
- They help to propagate clones that cannot be propagated in any other way.
- They make it possible to grow more than one type of fruit or flower on the same plant.

Layering

This is the process by which a part of system is induced to produce roots while still attached to the mother plant. Once the roots have developed the stem is cut off and planted.

Types of layering

- *Marcotting.* Commonly known as aerial layering. It is done on hardwood stems that cannot bend easily to reach the ground. Some moist rooting medium is heaped around a section of the branch whose bark and cambial layer has been removed. The rooting medium is wrapped with a polythene sheet to hold the soil and maintain it moist. *Auxins* (plant hormones)

accumulate at the point where the bark has been removed thereby inducing root development.

- *Tip layering.* The shoot bearing the terminal bud is bent to the ground and then covered with a layer of moist soil. Pegs are used to hold it in position. After roots develop the shoot is cut off from the mother plant and transplanted.
- *Trench layering.* The branch of a stem is bent, laid in trench and is then held in position by pegs. The trench is then covered with moist soil. The buds develop shoots that grow upwards. Roots develop at the base of each shoot. The shoots are then cut off from the mother plant and transplanted.
- *Compound/serpentive layering.* The branch is bent several times and held in position by pegs. This produces several new rooted shoots fro the same branch. However the branch must be highly flexible to achieve this.

Tissue culture for Crop Production

This is the generation of plants from plant tissues (cells). This is a biotechnology, which is used to clone vegetatively propagated materials. Tissue culture produces many propagules or explants. Cells are obtained from the tips and they are provided with certain conditions such as the culture medium, correct light intensity, temperature and relative humidity. The following three stages are involved in tissue culture.

Stage 1

An asceptic culture is established. Cell division and enlargement is enhanced.

Disinfectants such as alcohol, calcium or sodium hypochlorite, mercury chloride and antibiotics are used to eliminate any contamination. All the tools used must be sterilized to establish a clean culture.

The culture medium should include inorganic materials, carbon and energy source (sugar), vitamins, organic supplements and growth regulators (hormones)

Stage 2

This involves a series of sub culturing to rapidly multiply the propagules through somatic development of embryos to produce auxiliary buds and adventitious roots. The culture medium should contain substances that enhance development of plant organs.

Stage 3

This involves the preparation of the propagules for the establishment in the soil. This includes the following.

i) Rooting of the regenerated plantlets. This is promoted by supplementing the medium with auxins
ii) Hardening the plantlets by inducing tolerance to moisture stress and attack by pathogens. Increasing the temperature and light intensity beyond those in the second stage can do this. Plantlets can also be exposed gradually to conditions similar to those in the field.
iii) Converting the plantlets from *heterotropic* mode of nutrition to *autotropic* mode.

Importance of Tissue Culture in Crop Production

i) It is used in the mass production of propagules.
ii) Helps to establish pathogen free plants especially in the control of viral diseases.
iii) It is fast and requires less space than the cultural methods of using cuttings, which require bigger space.

Disadvantages

i) It is expensive, as it requires specials structures.
ii)Requires high skilled manpower.

Transplanting of Vegetable Crop Seedlings

- Seedlings are ready for transplanting when they are a month old or they have 4-6 true leaves or about 10-15cm.
- The nursery is watered 3-4 hours before lifting the seedlings. This ensures that seedlings are lifted easily with a ball of soil around the roots minimizing root damage.
- Healthy and vigorously growing seedlings are selected and lifted using a garden trowel.

- Transplanting is done when the weather is cool preferably in the morning or evening.
- The seedling is planted in the same depth it was in the nursery. The lower leaves should not touch the soil.
- Firming is done to ensure proper root-soil contact.
- Light mulch is applied and the seedlings are watered regularly.
- Shading is done where necessary.

Transplanting Tree Seedlings

- Holes for planting trees are dug long before transplanting day.
- Topsoil is kept separate and is used for refilling the hole halfway.
- Transplanting should be done at the onset of rains.
- Seedlings should be well watered a day before transplanting. This makes the soil stick onto the roots. It also eases the removal of the polythene sleeves for seedlings raised in sleeves.
- Seedlings are placed at the center of the hole.
- A sharp knife is used to cut and remove the polythene sleeve.
- More soil is added and firmed gently around the plant until the hole is completely full.
- Seedlings should be planted at the same depth as they were in the nursery.
- Watering should be done and mulch provided. A temporary shade may be established to conserve moisture.

- Young seedlings should be protected from damage by animals for about one year.
- This can be done for individual trees or for an entire field.

CROP PRODUCTION IV (FIELD PRACTICES)

Field practices are operations carried out in the field to facilitate proper growth and optimum yield of the various crops grown. These operations should be timely for best crop performance.

Crop Rotation

This is the growing of different types of crops or crops of different families on the same piece of land in an orderly sequence. Land is subdivided into plots. Different crops are grown in each plot in a particular season. Crops are rotated in the following season. This is applicable when dealing with annual crops.

Importance of Crop Rotation

1. *Maximum utilization of nutrients.* Different crops vary in terms of type of nutrient and depth of absorption. Maize absorbs a lot of nitrogen from the soil but low amount of potassium. Cassava needs a lot of potassium but little nitrogen. Therefore the two can be alternated for maximum nutrient utilization.

   Deep-rooted crops absorb nutrients from deep layers of the soil as compared to the shallow rooted ones. The two should be alternated.
2. *Control of weeds.* Planting non-grass crops can help to control parasitic weeds such as witch weed (*striga weed*), which are specific to grass family crops.
3. *Control of soil borne pests and disease build up.* Some pests and diseases are crop specific. Alternating different crop families controls them.
4. *Soil fertility improvement.* When leguminous crops are included in a rotational programme, they fix nitrogen thus improving soil fertility.
5. *Soil structure improvement.* At the end of a rotation programme, a grass ley (piece of land planted with grass) is established. During this time there is little soil disturbance and roots bind the soil particles together improving the soil structure.
6. *Soil erosion control.* When cover crops such as sweet potatoes are included, they reduce soil erosion.

Factors Influencing Crop Rotation

The following factors should be considered when designing a crop rotation programme.

i) *Crop root depth.* Deep-rooted crops should be alternated with shallow rooted crops.

ii) *Soil structure.* A grass ley should be included in the rotation programme because the soil becomes loose after continued use.
iii) *Pests and disease control.* Crops from the same family should not follow each other as the same pests and diseases attack them.
iv) *Weed control.* Crops that are associated with certain weeds should be alternated with those that are not. Crops that are not easily weeded should be alternated with those that are easy to weed.
v) *Crop nutrient requirement.* Heavy or gross feeders (crops requiring high amounts of nutrients) should come first in a newly opened land, which is relatively fertile.
vi) *Soil fertility.* Leguminous crops should be included to improve soil fertility.

Rotational Programmes

The order and the sequence in which crops follow each other should be identified. This should be done in consideration of the above factors. If the farm is divided into four or eight fields, then a four-course rotation works very well.

Examples

i) Three course rotation.

First year - beans
2nd year - maize
3rd year - cassava

ii) Four course Rotation - a.

First year - yams
2nd year - groundnuts or beans
3rd year - maize or any cereal crop
4th year - cassava or any root crop.

iii) Four course Rotation - b.

1st year - Irish potatoes.
2nd year - beans
3rd year - maize
4th year - sweet potatoes.

Terms Used in Crop Production

i) ***Mono cropping.*** This is growing one type of crop on the farm.

Disadvantages

- Plant uses only the nutrients it requires leading to their exhaustion while other nutrients are left unused.
- May lead to pest and disease build up if one crop is grown continually.

ii) ***Inter cropping.*** This is growing of two or more crops in the same field at the same time. E.g. maize and beans, beans and potatoes, bananas and coffee etc. This offers better soil coverage thus smothering weeds and also controlling soil erosion.

iii) ***Mulching.*** This is the placement of materials such as banana leaves or polythene sheets on the ground next to the growing crop. The materials should not come into contact with the base of the crop to discourage pest attack.

Importance/advantages of Mulching

- Soil water conservation by reducing evaporation rate.
- Smothers weeds hence suppressing their growth.
- Soil temperature moderation by acting as an insulator. This ensures no much variations in soil temperature both at night and day
- Reduction of runoff speed thus preventing soil erosion.
- Organic materials decompose to release nutrients thus improving soil fertility.
- Organic materials decompose to form humus, which improves soil structure and water holding capacity of the soil.

Disadvantages of Mulching

- It is a fire risk.
- Provides a breeding ground for pests that are harmful to crops.
- Traps light showers of rainfall lowering the chances of the raindrops from reaching soil.
- Expensive to acquire, transport and apply.

Types of Mulching Materials

- Organic materials. They include sawdust, wood shavings, coffee pulp, dry grass, banana leaves, dry maize stalks and any other appropriate vegetation.
- Inorganic/synthetic materials. They can be black, yellow or transparent polythene sheets. They are expensive and therefore used only in the highly profitable crops such as flowers and pineapple production by Del Monte Kenya Limited in Thika.

iv) ***Mixed cropping.*** This is the growing of two or more crops in the same field but in specific sections at the same time.

Routine Field Practices

i) *Thinning.* This is the removal or uprooting of excess seedlings to allow space for the remaining seedlings. Thinning should be done when the soil is wet to avoid destroying roots of the remaining seedlings. Thinning is done to obtain an optimum plant population in a given area.

ii) *Gapping.* This is the refilling or replacement of dead seedlings or empty spaces left by seeds that fail to germinate. This should be timely to avoid excessive shading of the newly planted seedlings. Gapping ensures optimum plant population.

iii) *Rouging.* This is the removal and destruction of the infected crops. This prevents the spread of the disease or pests. Rouging can control pests such as Maize stalk borers and bean fly. Rouging can also control *Armillaria root rot* in tea.

iv) *Training.* This is the practice of manipulating plants to grow in a desired direction and shape. This cane achieved through,

- ***Staking.*** This is supporting plants having weak stems using strong sticks e.g. in tomatoes, garden peas and some bean varieties.
- ***Propping***. This is providing support to tall varieties of bananas and those with heavy bunches using forked (Y- shaped) stakes.
- ***Trellising***. This is providing support of crops with vines using wire or sisal strings. The strings are held by poles at definite spacing e.g. in passion fruits.

v) *Earthing up.* This is the placement of soil in form of a heap around the base of the plant.

Reasons for earthing up

- In Irish and sweet potatoes to promote tuber formation.
- In tobacco it improves drainage around the crop.
- In maize it provides support hence preventing lodging.
- In groundnuts it promotes production of the seeds.

vi) *Pruning.* This is the removal of extra or unwanted parts of a plant. This could be due to overcrowding, breakage, pest and disease attack and unproductivity.

Reasons For Pruning

- *To train the crop to attain the required shape.* Formative pruning in tea is aimed to encourage lateral growth. Capping in coffee is done to encourage growth of suckers which are later allowed to develop as stems.
- *Control of cropping.* Most fruit crops do bear biennially, that is overbearing in one season which is caused by unproportional ratio of vegetative and productive parts. Removal of extra vegetative parts maintains correct ratio. This ensures uniform bearing in all the seasons.
- *To remove the diseased and unwanted plant parts.* This remove extra suckers, leaves, branches, flowers or stems.
- *To facilitate picking.* Tea and coffee bushes are pruned in order to maintain a low plucking table and bearing head respectively.
- *To ease spray penetration.* Pruning opens bush making spray penetration effective.
- *To control pests and diseases.* Pruning destroys the breeding grounds for pests and disease causing organisms. In coffee Antesia bug and CBD are controlled through pruning which opens up the bush to light.

Methods of Pruning

- *Pinching out.* This is the removal of the terminal buds. This is common in tomatoes where the terminal bud is pinched out. This practice is called capping in tea and coffee.

- *Annual pruning.* This is the removal of branches that have borne two crops and have undesirable growth characteristics. Dry, broken, too close or diseased branches are removed.
- *Coppicing or pollarding.* This is carried out in tree crops where branches are cut at specified points in order to achieve a desired shape.

NB/ Care must be taken during pruning. Cut surfaces may act as entry points to disease causing organisms. Cut surface must be protected by application of paint or Stockholm tar to seal the wound and keep off vectors such as aphids.

Tools Used in Pruning

- *Pruning saw.* For cutting hard branches and stems in coffee and citrus.
- *Pruning knife.* For cutting or pruning tea by use of strokes.
- *Pruning shears.* For trimming hedges.
- *Secateurs.* Used for cutting or pruning soft branches in coffee and citrus.

TEA

Plucking Table Formation in Tea

Young tea is encouraged to produce a lot of lateral branches which in turn form the frame to establish a wide plucking table.

Methods of frame formation

- Formative pruning method.
- Pegging method.

Formative Pruning Method

The plant is capped at different height to encourage lateral growth and discourage vertical growth. This method takes a long time to bring tea into bearing hence not commonly used.

Pegging Method

A young tea plant is allowed to grow for one year to attain a height of 25-30cm.

It is then cut back to 15cm above the ground. This encourages development of lateral branches.

These branches are left to grow to 60-75cm high.
They are forced to grow at an angle of 30^0 - 45^0 by use of pegs and the tips are nipped off. This stimulates the dormant buds to grow into shoots. The following ways can be used in pegging.

- *Use of individual pegs.* Each branch is held down by a single peg measuring about 50cm long. Many pegs are required and they are either metallic or wooden.
- *Use of rings of pegs.* A ring of 30cm diameter made out of thin sticks or a thick wire is used. It is placed on branches which are gently forced to bend to the sides of the bush at an angle of 30-45^0. Three pegs are then placed to hold it in position. The tips of the shoots are nipped off to encourage the growth of more shoots.
- *Use of parallel sticks (fitos) pegs.* Two parallel straight light *fitos* are placed on either side of a row of tea bushes. Pegs are used to hold the *fitos* down. Light sticks about 45cm long are placed under the parallel sticks to hold in position any branches that lie between the *fitos.*

Tipping

This is the cutting back of shoots to the desired table height that is 20cm above the pegging height. This involves the removal of three leaves and a bud from each shoot above the required height of the table. The initial height should be 50cm above the ground level.
Two Y-shaped sticks 50cm in height and a long straight stick about 2 m long are used. The straight stick is placed on the Y-shaped sticks.
Tipping is done at 2-3 weeks intervals five times before the plucking table is properly formed. This process encourages formation of a uniform and a flat plucking table.

Maintenance of the Plucking Table

- Maintenance pruning helps to prevent rise in the plucking height. This is done by cutting back the tea bush to 5cm above the previous pruning height after 2-5 years.
- Three months after maintenance pruning, tipping is done just like in the plucking table formation.

- After many such pruning's, the tea bushes are cut down to 45cm above the ground. This is called *Rehabilitation (change of cycle)* and it is done after every 40-50 years.

Pruning Mature Tree

The following points are observed during pruning of tea.

- Side branches growing below the pruning height are not removed because this would reduce the spread of the bush reducing the yield.
- Outside edge of the bush should not be cut at a higher level than the centre to avoid a dish shaped frame.
- Bush should be pruned parallel to the slope using a measuring stick.
- Branches should be cut across in order to minimize the area of the wounds. Long slopping cuts increase die back and disease infection.
- Small branches and twigs on the frame are removed by hand.
- Branches should be placed on top of the frame to offer protection during the dry period. They should be removed at the start of the wet weather after the new shoots start to sprout.
- All the branches should be left to rot in the field as they contain a lot of nutrients and also act as mulch.
- Pruning knife must always be sharp to cut the branches and not to break them.
- After several pruning's, the tea is cut back to the original table. This is called change of cycle (rehabilitation).

COFFEE

Pruning in coffee is to regulate the quality and quantity of coffee berries.

Reasons for pruning in Coffee

- *Regulate bearing. Unpruned coffee tends to bear biennially i.e. it produces a heavy crop one season and a light one in the next season.*
- *To remove old and unproductive branches.*
- *To make harvesting easy by regulating the height of trees.*
- *To open up the bush to allow better air circulation. This removes the microclimate suitable for pest and disease organisms thus controlling them.*
- *Facilitate spray penetration.*

- *There is economic use of chemicals.*

Systems of Pruning in Coffee

- Single stem system.
- Multiple stem system

Single Stem Pruning

- In this case one permanent stem with a strong framework of primary branches is established. The main stem is capped at various heights as the bush grows.
- At each capping the best growing sucker is allowed to continue growing upwards. The first capping is done at 53cm, 2nd at 114cm and the final one at 168cm.
- The height of single stem bushes ranges from between 1.5-1.8m. In young trees, the initial crop is borne on the primary branches but as the bush matures, the crop is borne on secondary and tertiary branches successively.
- Annual pruning is done throughout the year but suckers are removed throughout the year.
- Single stem system allows easy picking and spraying and minimizes breakage of branches.
- It however requires skill in its establishment and takes time to bring bushes to bearing.

Multiple Stem Pruning

Two or three upright stem are maintained. There are two types of the multiple stem system i.e. capped multiple and non-capped multiple system

- In capped system, the main stem is capped at 38cm and 2-3 shoots are allowed to grow to a height 0f 1.5-1.8m. The bushes are thereafter maintained as in single stem system.
- In non-capped system, the main stem is capped at 38cm above the ground. Suckers are then allowed to grow. Two to three suckers are selected and left to grow. When the stems get old after 4-6 years, they are removed. The removal of the old stems is called ***changing of cycle***.

Annual pruning involves the removal of lateral branches that have borne two crops, those that are too close, dry or broken and any that are undesirable. Suckers should be removed as they appear.

Advantages of non-capped multiple stem system

- Requires less skill to establish.
- Easy to prune.
- Doesn't allow accumulation of CBD due to frequent removal old stems.

Disadvantages

- Breaking of stems and branches.
- Difficulty in gathering the berries from the top points.
- Difficulty in spraying the tall bushes.
- Rotting of stumps with age.

Capping

- This is cutting the main stem at height of 53cm when the young coffee plant is 69cm tall. One lateral is selected and later capped at 114cm when it grows to 130cm.
- The third capping is done at 168cm when the lateral branch reaches 183cn in height. At each capping only one upright branch is selected and allowed to develop.
- Capping is mainly done in single stem system. The tree is kept capped at 1.5-1.8m.

De-suckering. This is the removal of suckers.

Changing the cycle. It's the replacement of old stem by suckers. This occurs after 4-6 years.

Cutting back in pyrethrum. This is the removal of the old stems down to the level of the top foliage at the end of the cropping year towards the end of the dry season. This increases production in the following season and minimizes incidences of *bud disease*.

Banana Stool Management. This is involves the removal of extra suckers in the stool. 3-6 stem per stool are maintained. The suckers left should be at different stages of development; one sucker bearing, one half grown and the

other one starting to grow. This ensures that they come into bearing at different times. Dry and diseased leaves should be removed using a sickle or *panga* to open up the stool.

vii) Crop protection. This involves the following;

- *Weed control.* Weeds are plants growing where they are not required. Potatoes growing in a wheat field are regarded as weeds. Some plants are however referred to as weeds regardless of where they are found such as black jack, couch grass, Sodom apple, wandering jew etc.
- *Crop pest control.* Pests are harmful to crops. They include insects, nematodes, rodents, thrips and mites. They reduce the quality and quantity of the crop products and should therefore be controlled.
- *Crop disease control.* A crop disease is any alteration in the state of a plant and functions of a plant or its parts. Diseases are caused by;
  - *Fungi.* CBD, maize rust, coffee rust, smut in maize and sorghum etc.
  - *Bacteria.* Tomato wilt, cabbage black rot, black arm of cotton etc.
  - *Virus.* Ratoon stunting disease of sugarcane, rosette disease in groundnuts, cassava mosaic.
  - *Nutritional cause.* Blossom end rot in tomatoes due to calcium deficiency.
  - Physiological disorders. Frost injury in tea, coffee etc.

viii) Harvesting.

This is the final operation in crop production that is carried out in the field. Harvesting should be timely to avoid loss in quality and quantity of the produce.

Stage and Time of Harvesting

Time of Harvesting is determined by the following factors.

- *Market demand.* Consumers' preference is considered before harvesting. Maize is harvested either green or when the grains dry depending on market demand.
- *Concentration of the required chemicals.* In coffee the ripe berries are the ones harvested as they contain the required caffeine. In tea the two youngest leaves and the terminal bud are harvested as they give high quality tea.

- *Purpose/use of the crop.* Maize for silage making should be harvested just before flowering while that for grain production should be harvested when the grains mature.
- *Weather conditions.* Most crops should be harvested during the dry season to avoid losses. Synchronisation of planting and harvesting time should therefore be done
- *Prevailing market price and profit margins.* In some crops harvesting can be deliberately delayed to await better market prices. Carrots and pears can be harvested late to realize higher profit margins.

Methods of Harvesting

This depends on;

- Growth habit of the crop.
- Part being harvested.
- Scale of production.

Crop.	***Method of Harvesting.***
Coffee	Cherry red berries are picked and put in bags ready for pulping.
Tea	Two young leaves and terminal bud are plucked and put in airy baskets without compressing and then taken to factory immediately.
Irish potatoes	Sticks, *panga*, or *forked jembe* are used to lift the potato tubers when the stems have dried.
Beans.	Green pods are picked if the market demands for them. For dry beans the whole plant is uprooted after drying, spread on the mats to dry further, followed by threshing and winnowing.

Precautions During Harvesting

- Timing should be correct.
- Weather should be dry to avoid rotting of the produce.
- Delayed harvesting should be avoided as most crops get spoilt in the farm.
- Store should be ready to receive the produce after it is harvested.

Post Harvest Practices

They are carried out on the crop after harvesting. They include the following.

i.) *Threshing/shelling.* This is the act of removing maize from the cobs, beans from the pods or sorghum from the heads. This is done to facilitate subsequent cleaning and storage. It is normally the first operation done after harvesting.

ii.) *Drying.* Grains are dried up to a moisture content of 12-13%. This prevents rotting and fungal attack of the grains while in store.

iii.) *Cleaning.* This is done by winnowing in cereals to remove the chaff from the grains.

iv.) *Sorting and grading.* The produce is sorted and graded according to quality. In coffee the berries are sorted into grade I and II. Grade I has big and well ripened berries. Grade II berries are under-ripe, overripe, diseased or small. The first grade fetches the highest price.

v.) *Dusting.* This is application of chemical powders on seeds to prevent storage pest attack.

vi.) *Processing.* It is the transformation of the raw material into a final product. This is done in order to;

i.) *Improve the flavour of the produce as in tobacco and tea.*

ii.) *Improve the keeping quality as in fruits when canned or made into juices or sauces.*

iii.) *Reduce bulkiness to lower transportation and storage costs as in sugar cane when crushed into sugar.*

NB/ with vegetables such as kales and spinach, the leaves can be completely dried in the sun and stored in airtight containers for use during scarcity periods.

vii.) *Packaging.* It is the placement of produce into containers for storage, sale or transportation. This reduces damage to the produce and also makes it possible for the farmer to quantify the produce and set prices.

STORAGE

Most agricultural produce are seasonal yet consumers need them throughout the year. Storage is therefore necessary to ensure availability of these products throughout the year.

Types of storage structures

viii.) *Traditional storage structures.* Traditional granaries are elevated from the ground by posts. They are made of wooden twigs woven together and roofed with thatching materials such as grass or reeds.

Disadvantages

i.) Rats and weevils attack.
ii.) Rotting of grains.
iii.) Limited in size.

Others include pots and gourds for putting shelled grains.

ix.) *Modern storage structures.*

This is more improved than the traditional one. It should have the following properties/characteristics.

i.) Vermin or rat proof.
ii.) Well ventilated.
iii.) Easy to load and offload.
iv.) Pest free
v.) Leak proof.
vi.) Well Secured to minimize theft.
vii.) Cool conditions to prevent overheating that would crack the grains.

Preparation of the store

i.) *Cleaning the store.* Previous debris is removed as in may be harbouring storage pests.
ii.) *Maintenance.* Broken, worn out part or leaking roof should be repaired.
iii.) *Dusting.* Appropriate chemicals should be used to control pests.
iv.) *Clearing vegetation around the store to keep off vermin around the store.*

LIVESTOCK HEALTH 1

(Introduction to Livestock Health)

Health. – State in which all the body organs or parts and systems are normal and functioning normally.

Disease - deviation or alteration in state of body of animal or its organs which interrupts the proper performance of its functions.

Importance of Keeping Animals Health

1. Healthy animals maintain high productivity.
2. So as animals to have a longer economic and productive life.
3. To produce good quality products which fetch high market value.
4. Healthy animals grow fast and reach maturity quickly.
5. So as not to spread diseases to animals and humans.
6. Healthy animals are economical and easy to keep as the farmer spends less money on their treatment.

Signs of Good Health in Livestock

They are grouped into the following categories.

- Physical appearance.
- Physiological body functions.
- Morphological conditions of the body.

Physical Appearance.

This can be examined in terms of the following.

i. *Behaviour of the animal* – a healthy animal should not be over excited, aggressive or produce abnormal sound. It should be docile/gentle and produce normal sound.
ii. *Movement of the animal* – healthy animal should have normal walking style/gait and should walk with ease.
iii. *Posture* – healthy animal should have normal posture according to the species while standing or lying down.
iv. *General appearance of the animal* – healthy animal should be alert, bright and responsive to touch.

Physiological Body Functions

This can be examined under the following;

i. *Appetite and feeding.* Lack of or excessive appetite
ii. *Defecation.* Dung containing eggs, larvae of parasites or blood stains indicates ill health. Healthy animals defecate normally and regularly.
iii. *Urination*. Healthy animals should have normal and regular urination. Abnormal colour in urine such as red or heavy yellow indicates ill health.
iv. *Body temperature*. Body temperature of a healthy animal should be within the normal range.

v. *Respiratory rate*. Respiratory rate of a healthy animal should also be within the normal range. Illness. This is measured using the **Respirometer**. Difficult and fast breathing indicates illness. Respiratory rate is influenced by the following factors;
   - Body size of the animal.
   - Amount of exercise done by the animal.
   - Degree of excitement.
   - Ambient or environmental temperature.

vi. *Pulse rate*. A healthy animal should have normal pulse rate. It varies from species to species and is also influenced by factors such as;
   - Degree of excitement.
   - Age of the animal.
   - Sex of the animal.
   - Physiological status of the animal e.g. in pregnancy.

Animal	**Temperature (^{0}C)**	**Pulse rate (Beats per Minute)**	**Respiratory rate (Breaths per Minute)**
Cattle	38.5 – 39.5	50 - 70	10 – 30
Sheep	38.5 – 40.5	70 – 80	10 – 20
Goat	38.5 – 40.5	70 – 80	10 – 20
Chicken	40.4 – 43.0	200 – 400	15 – 30
Pig	38.0 – 39.0	60 – 80	8 – 18
Horse	37.5 – 38.5	28 – 40	8 – 16
Donkey	37.5 – 38.5	28 – 40	8 – 16

vii. *Production level of the animals.* Loss of weight, emaciation and sudden drop in production may signify ill health.

Morphological conditions of the body

The morphological conditions may be observed in the following areas;

i. *The visible mucous membranes*. In normal health, the mucous membranes should be pink in colour, moist, soft, smooth and well lubricated. In ill health they are bright red, pale, yellowish or bluish in colour.
ii. *The skin and animals coat*. Healthy animals have smooth, soft, warm and moist skin especially around the muzzle. Dry and staring coat, loss of hair, swellings on skin etc are signs of ill health.

Predisposing Factors of Livestock Diseases

These are conditions inside or outside the body of an animal which lead to the animal contracting a disease or an injury. They include the following;

i. *Species of the animal.* Some diseases are confined to certain species e.g. Newcastle disease in poultry and swine fever in pigs.
ii. *Breed of the animal.* Some diseases are confined to certain breeds such as Hereford suffer from cancer of the eye and solar erythema affects only the large white pig breeds.
iii. *Age of the animal.* Some diseases are associated with certain age groups e.g. piglet's anaemia affects only piglets, lamb dysentery affect lambs and calf pneumonia affects calves.
iv. *Sex of the animal*. Some diseases affect a particular sex e.g. mastitis affects lactating female animals, orchitis affects males as it affects the testis.
v. *Colour of the animal*. Black animals suffer more to heat stress. Animals with light pigmentation may suffer from disorders such as photosensitization when exposed to high light intensity such as the large white breed of pigs.

CAUSES OF LIVESTOCK DISEASES

(a) Nutritional cause
(b) Physical causes
(c) Chemical cause

d)Living organisms

A) NUTRITIONAL CAUSES:

This may be due to:-

a) Mineral imbalances

- Mineral deficiency problems are more common in rapidly growing animals

- The deficiency of certain minerals in the diet of livestock can cause the following nutritional disorders.

i. Anaemia in piglets due to lack of iron.
i. Curled toe paralysis in poultry due to lack of calcium and phosphorous.
ii. Milk fever (*parturient paresis*) in lactating dairy animals due to lack of calcium.
iii. Development of goiter in young calves due to iodine deficiency.
iv. *Enzootic ataxia* or swayback in lambs due to lack of copper.
v. *Bovine ketosis* or acetonaemia due to impaired metabolism of carbohydrates and volatile fatty acids.
vi. Osteomalacia due to lack of carbohydrates.

b) Amount of food eaten by an animal

-Excess intake of lush pasture will cause bloat or Ruminal tympany

- This is a digestive disorder of ruminating animals caused by production of Excess gas (Methane) in the rumen during fermentation.
- Excess food eaten especially in animals with single stomach (monogastrics) can cause rapture of the stomach, diarrhoea or constipation.
- Low food intake or lack of food results in loss of weight, poor health and in extreme cases result in starvation and even death.
- Animals that lack proteins, carbohydrates, minerals and vitamins become emaciated, unproductive and occasionally suffer from diseases.
- Feeding animals on contaminated feeds cause death e.g. rotting grains may contain aflatoxin, which is very poisonous.

B) PHYSICAL CAUSES

-These include physical injuries to the body organs or parts such as

-Sudden or violent physical force can result into fracture.

C) CHEMICAL CAUSES

- If an animal eats, swallows or inhales chemicals such as acids, insecticides, herbicides etc it can be poisoned.
- Poison is any substance, which interferes with the normal structure or the physical metabolism of an animal's body if it comes into contact with its internal body organs.
- Most chemicals cause irritation, corrosion and burning of tissues or interfere with body systems.
- Other chemicals may interfere with membrane permanently.
- Stings from certain insects in sensitive parts of the body can cause irritation to the animal and may also cause swelling.
- Some weeds in pasture are poisonous if eaten by animals e.g. *Datura stramonium* (Thorn apple)

D) LIVING ORGANISMS

-These are the most common cause of diseases in livestock.

-These disease-causing organisms can be divided further into two groups.

- Infectious disease causing organism
- Parasitic organisms.

(i) Infectious disease causing organisms

- These are microscopic organisms they include protozoa, bacteria and viruses.
- These organisms invade the animal, multiply and produce toxins.
- The causal organisms are classified into the following groups.
  - Bacteria
- Bacteria reproduce and multiply very rapidly.
- They are found in the air, food, water and soil.
- Some bacteria are pathogenic and others are non-pathogenic hence beneficial eg a ruminant cannot digest cellulose without the help of bacteria.
- Pathogenic bacteria are harmful and cause some of the most dangerous livestock diseases eg Anthrax.
- Bacteria have different shapes i.e.

Cocci---spherical

Bacilli—cylindrical

Vibros—comma

Spirilla—spiral

- Viruses

- They are very small organisms than the bacteria. They have DNA&RNA in their coat.
- They can only grow and multiply in the living cells of the other organisms.
- Viruses invade the cell, grow, multiply and eventually kill the cell.
- They do not produce toxins like bacteria but reproduce rapidly leading to death of cells.
- Most viral diseases are very contagious and highly infectious.

- Protozoa

- Are microscopic single celled organisms.
- Some protozoa's are pathogenic and parasitic in animals.
- They multiply fast in the host body.
- Arthropod vectors such as ticks, tse tse flies and mosquitoes spread them.
- They can produce toxic substances that are capable of causing disease.

PARASITIC ORGANISMS

- Parasitic organisms harm animals in that they suck blood, transmit other disease causing organisms, can block internal organs in the animal and also cause injuries to the body organs.
- Parasitic organisms are divided into

External –ticks, fleas, keds, tse tse flies.

Internal—Roundworms, tapeworms, fluke etc

GENERAL METHODS OF DISEASE CONTROL

They are generally grouped into 2

i) Routine management practices
ii) Preventive measures

i) Routine management practices

This includes

(a)Proper feeding and Nutrition

- Livestock should be given balanced rations or diets in adequate amounts.
- Adequate amounts of vitamins should also be given to the animals.
- Actively growing animals require huge amounts of proteins.
- A well-balanced ration prevents nutritional and metabolic disorders.
- It also promotes disease resistance in the animals.

(b) Proper Breeding and selection

- During breeding only healthy animals should be selected.
- Such animals should be free from diseases and also resistance to diseases.
- Proper breeding programs should be adopted to avoid disease transmission.

c) Proper housing and hygiene

- Animal houses should be constructed in such a way that they meet the necessary requirement of particular animals.
- Proper housing controls diseases such as mastitis in dairy animals, calf scours etc
- Pests such as mites in poultry can be controlled through proper housing.
- proper hygiene should be observed in animal houses eg
  ©At the entrance of animal houses, a footbath made of 2% $CuSo_4$ should be provided.
  © Diseases like foot rot should be controlled by 5-10% $CuSo_4$ solution or 2-5% formalin solution.
- Proper disposal of carcasses in the farm should also be practiced.
- Animal structures should meet the following conditions.

- Well ventilated and free from draught (cold and wind)
- Have adequate space for the animals housed.
- Have proper drainage.
- Leak proof.
- Well lit.
- Easy to clean.

ii) Preventive measures. These include;

(a)Isolation of sick animals

-Any animals showing clinical symptoms of ill health should be isolated from the rest of the herd to avoid further spread.

-It's usually applied against highly infectious and contagious disease to prevent spread.

(b) Imposition of quarantine

Quarantine-- is restriction of movement of animals and their products from and into the affected areas in the event of an outbreak of a notifiable disease.

Notifiable disease — this is a disease whose outbreak must be reported to a government authority such as veterinary officer.

-During quarantine, affected animals are isolated and their movement is restricted to prevent the spread of the disease causing organisms to the healthy animals.

(c) prophylactic measures and treatment

Prophylactic measures—refer to the control of diseases and parasites using preventive drugs. Such measures include;

i) Use of prophylactic drugs

Eg- Coccidiostats in poultry to control coccidiosis

-Drenching animals using ant helminthes against internal worms in sheep, cows etc

-Use of sulpanomides to control trypanosomiasis.

-Use of antibiotics to control/prevent some diseases.

ii) Carrying out regular vaccination.

-Vaccines contain a dead or weakened disease causing organisms and are injected into the animals' blood stream.

-The animal then produces antibodies eg in the control of viral diseases such as Newcastle, Rinderpest, Rabbies and fowl pox.

-Bacterial diseases controlled by vaccination include anthrax fowl typhoid and black water.

iii) Control of vectors

-A vector is an organism that transmits a disease from an infected animal to a healthy one.eg ticks, tse tse flies, mites etc.

iii) Treatment of sick animals

-Sick animals should be treated to avoid the spread of the disease.

-Antibiotics are used to treat bacterial diseases.

-Viral diseases are however difficult to treat

(d) Slaughtering the affected animals.

Animals suffering from highly infectious and contagious diseases e.g. Rinderpest, foot and mouth, Newcastle etc should be isolated and slaughtered.

-this prevents any further spread of the disease.

(e) Use of antiseptics and disinfectants

-Antiseptics are preparations containing germ killing agents and antibacterial drugs. They are used on the skin or in wounds.

-Disinfectants are very concentrated germinal chemicals used to kill bacteria in buildings and in animal structures.

APPROPRIATE METHODS OF HANDLING LIVESTOCK

Livestock handling should be carried out in the most humane and technical way in order to avoid stress or injury to the animal.

Reasons for handling animals

1. When administering any form of treatment to the animal
2. When spraying or hand dressing the animal with chemicals to control external parasites.

3. When inspecting the animal in case of any sings of ill health.
4. When milking the animal.
5. When performing certain routine management practices eg dehorning, castration, hoof trimming, vaccination etc.

METHODS OF RESTRAINING THE ANIMAL

- ❖ Use of crush.
- ❖ Use of ropes.
- ❖ Use of bullring and lead stick.
- ❖ Use of head yoke

NB: In livestock health, the following activities call for handling of animals.

(a)Drenching

-This is the oral administration of drugs to the animal.

-The drug can be in solid or liquid form.

-A drenching gun is used to administer liquid drugs through the mouth.

-A bolus gun is for solid drugs.

- The animal should be restrained in a crush and the head is held close to the stocks man under the left armpit.
- The mouth is then opened with the left hand and the drugs pushed in with the drenching or bolus gun using the right hand.

(b) Injection

The drugs are injected into the muscles (intramuscularly) or into the veins (intra-veins)

-Care should be taken to select the correct site of injection.

(c) Mastitis control.

-When performing this operation, the animal is restrained in a crush.

-Complete milking is done after which antibiotics are infused into the teats.

(d) Hand spraying.

-The animal is restrained in a crush for this operation.

-A stir-up pump or a knap sack sprayer is used to spray the acaricide onto the animal.

-Proper attention should be given to all the sites preferred by ticks.

LIVESTOCK HEALTH II (PARASITES)

Parasite- A living organism that lives in or on another organism and obtains nourishment from that organism without being useful to it in any way.

-This host-parasite relationship is referred to as parasitism.

Effects of parasites on livestock

(i) Cause Anaemia

-Blood sucking parasites take large volumes of blood from the host animals leading to anaemia.

ii) Deprive the host of nutrients (food)

-Internal parasites compete for food with the host animals this result into loss of weight, emaciation and low production.

iii) Injury and damage to tissue and organs.

-Biting parasites break the skin of the animal exposing it to secondary infection.

-Some internal parasites such as round worms, live fluke etc damage organs and tissues.

-Tissue injury results into Hemorrhage.

iv) Disease transmission.

-Some parasites act as vectors of some diseases

-They spread disease from sick animals to healthy ones.

v) Cause irritation

-Some external parasites irritate the animals through their biting effects.

-This causes the animal to rub itself against solid objects destroying skin, fur or wool.

vi) Obstruction to internal organs

-Internal parasites may cause mechanical obstruction or blockage of the internal passages.

-This leads to mal-functioning of organs affected.

TYPES OF PARASITES

e. External parasites (ectoparasites)

f. Internal parasites (endoparasites)

a. External parasites

-Found on the outside of the host body.

-They may live on or under the skin.

-Most ectoparasites belong to the phylum arthopoda.

-T here are two main classes of these parasites.

iii) Class insecta.

iv) Class arachnida

CLASS INSECTA

These consist of tse tse flies, keds, mosquitoes, flies, lice and fleas.

a). Tsetse fly (Glossina spp)

- This is a true insect undergoing complete metamorphosis i.e.

-Tsetse flies give birth to larvae after the eggs hatch inside the body of the mother.

-Larva forms the pupa, which later changes into an adult.

-Tsetse flies bites mainly during the day.

Harmful effects

-They transmit Trypanosomiasis caused by a protozoan called trypanosome

-Sucks out blood from the animal causing anaemia.

-Cause damage on the skins and hides of animals making wounds, which provide routes for secondary infection by pathogenic organisms.

Control

-Bush clearing to destroy their breeding places.

-Spraying their breeding places with insecticides.

-Use of fly traps with impregnated nets.

-Use of sterilizing agents eg radio isotopes on male flies and then releasing them.

b).Keds (melophagus orinus)

-Are sometimes referred to as sheep ticks.

-They are hairy and wingless bloodsucking flies.

Harmful effects

-Cause irritation in heavy infestation.

-Due to irritation, animal scratches itself thus damaging the wool.

-Retarded growth in lambs.

- Anaemia.

Control measures

-Shearing the infected sheep and hand spraying them with appropriate chemicals eg pyrethrum, malathium, dieldrin etc

-Routine sheep dipping.

c) Fleas

They are wingless but have strong legs adapted for leaping over long distances.

-They suck blood, as their mouthparts are adapted for penetrating the host's skin and sucking blood.

-They pass through the following stages during development, egg- larvae- pupa- adult.

Harmful effects

-Cause irritation leading to scratching.

-Stick fast in poultry causing wounds on the comb and wattles.

-They cause anaemia.

Control measures

-Animals sleeping places should be kept clean.

-Dusting animal hooks with appropriate insecticides.

-Covering the stick fast fleas with petroleum to suffocate them.

d) Lice

They are small wingless insects and can be divided into two groups.

- Biting lice (mallophaga)
- Sucking lice (anoplura)

Biting lice-diagram

-They are found on both the birds and mammals.

-They have chewing mouthparts.
-They complete their lifecycle between three to four weeks.
Sucking lice
-Have mouthparts reduced into styles for sucking blood.
-They are found only on mammals.

Harmful effects
-Cause irritation to the animal hence, the animal is seen to rub itself against fixed objects.
-Heavy infestations cause loss of health in animals.
-Since animals under attack do not feed very well, there is emaciation.
-Loss of production in birds.
-Anaemia and restless especially in poultry.

Control measures
-Spraying or dusting animals with appropriate insecticides.
-Keeping animal houses clean.
-Perches in poultry houses should be applied with insecticides e.g. 40% nicotine sulphate solution.
-Dusting each bird with sodium fluoride for individual treatment.

CLASS ARACHNIDA
-This consists of the ticks, mites and spiders.
-Ticks and mites belong to the order Acarina.
-These do not undergo complete metamorphosis.
-They have two body parts i.e. cephalothorax and the abdomen.
-The adults have 4 pairs of legs.
(a) Ticks.
-Ticks rank as the single most important ectoparasites of livestock.
-They cause injury and spread very dangerous diseases.
-There are over 50 different species of ticks known.
Harmful effects.

-Vectors of diseases e.g. ECF, Red water, Anaplasmosis.
-Suck blood-causing anaemia to the host.
-Cause wounds through their bites.
-Cause irritation to the animal.
-Their bites lower value of hides and skins.
-Some ticks produce toxins that may be harmful to the host.

THE LIFE CYCLE OF TICKS

-Ticks usually pass through four main stages in their cycle i.e.

-Egg
-Larva (six legs)
-Nymph (Eight legs)
-Adult (Eight legs)

-Different species of ticks need different number of hosts.
-There are therefore three categories of ticks i.e.

-One host ticks.
-Two host ticks.
-Three host ticks.

ONE HOST TICKS

-These ticks require one host to complete their lifecycle.
-Eggs on the ground hatch into larvae.
-Larvae climb onto the host, suck blood, become engorged and moult into nymphs.
-Nymphs feed on the same host, become engorged and moult into adults.
-Adults feed on the same host, mate and the females drop off to the ground to lay eggs.

Examples of one-host ticks

-Blue tick (*Boophilus decoloratus)*
-The Texas Fever tick (*Boophilus annalatus)*
-The Cattle tick (*Boophilus microplus)*
-The Tropical Horse tick (*Dermacentor nitens)*

TWO HOST TICKS

-This tick requires two hosts to complete their lifecycle.
-The larvae and nymphs pass through their stages on the first host.
-Eggs on the ground hatch into larvae, which climb on to the first host.
-A larva attaches themselves to the host, feed on blood, become engorged and moult into nymphs.
- Nymphs feed on the same host become engorged and then drop to the ground to moult in adults.
-Adults find a new host on which to feed.
-They feed on the second host and mate.
-Females drop off to the ground to lay eggs.

Examples of two host ticks

-Red legged tick (*Rhipicephalus evertsi)*
-The Brown tick (*Amblyomma maculatum)*
-The African Bont-legged tick (*Hyalomma truncatum)*
-Large Bont-legged tick (*Hyalomma rufipes)*

THREE HOST TICKS

-These ticks require three different hosts to enable them to complete their lifecycle.
-Eggs hatch on the ground into larvae.
-Larvae attaches itself to the first host, feed on blood, become engorged and drop off to the ground and moults into nymphs.
-The nymphs look for a second host, feed on blood, become engorged and drop off to the ground and moult into adults.
-Adults seek for the third host, climb, feed become engorged and mate.
-Females drop off to the ground to lay eggs.

Lifecycle of a three-host tick

Examples:-

-Brown ear tick (*Rhipicephalus appendiculatus)*

-East African Bont tick (*Amblyomma variegatum)*

-Bont tick (*Amblyomma herbraeum)*

-Gulf Coast tick (*Amblyomma maculatum)*

-Yellow Dog tick *(Haemaphysalis leachii)*

-Fowl tick (*Haemaphysalis hoodi)*

-Brown Dog Tick (*Rhipicephalus sanguineous)*

TICK CONTROL MEASURES

i) Natural/Biological method.

ii) Mechanical method.

iii) Chemical method.

1.Natural/ Biological method.

-This is the use of the tick's natural enemies, which predate on the ticks.

E.g. using predators such as birds to control ticks.

N/B Only a small number of ticks is controlled using this method.

2.Mechanical method

i) *Burning the infected pastures.*

-Burning destroys eggs, larvae, nymphs and adults.

ii) *Interfering with the ticks environment*

This is achieved by:-

-Ploughing pasture land .the eggs are exposed to the sun heat or are deeply buried.

iii)*By top dressing pasture using lime or dressing using acaricides.*

iv) *Fencing off the pasture and farm.*

v) Hand picking the ticks (deticking)

vi) Starving the ticks to death

-This is achieved by practicing rotational grazing.

-It interrupts the lifecycle of the ticks.

3. Chemical control method.

This is done by application of acaricide.

Properties of an effective acaricide

-Has the ability to kill ticks.
-Be harmless to both human and livestock.
-Be stable.
-Should remain effective after having been fouled with dung, mud or hair.
Methods of acaricide application
-Spraying regularly with the acaricide.
-Dipping animals in plugs dips containing the acaricide.
-Hand dressing using pyegrease.

ENDOPARASITES (INTERNAL PARASITES)

These are parasites which live within the body of the host animal e.g. tapeworms, Round worms, Fluke etc

Categories of Endoparasites

-Endoparasites are generally called helminthes

-They fall under 2 phyla

i)Platyhelminthes (Flat worms)

-class-trematoda (flukes)

-Cestoda (tapeworms)

ii) Nemathelminthes (nematoda)- Round worms.

PLATYHELMINTHES

-Are flatworms.

-Body is symmetrical

-Are hermaphroditic.

a) Tape worm (Taenia spp) -cestodes

-Have two main parts ie

-Has a head (Scolex) and a chain of segments called the strobila

-Each segment is called a proglottis.

-Scolex has suckers or hooks or both.

Animals affected – pigs

- Cattle
- Sheep.
- Goats.
- Donkey.

Symptoms of attack

-General emaciation

-Rough or staring coat.

-Scouring and sometimes constipation due to digestive disturbance.

- Pot-bellies especially in calves.

-Oedematous swelling under the jaw.

-Obstruction/blockage of the intestines when tapeworms are present in large nubers.

- Ploglottides present in faeces.

-Anaemia.

-Excessive appetite.

NB Lifecycle of tapeworm

-Tape worms attack farm animals as intermediate hosts and man as final host.

-There are two common species of tapeworm

iii) Beef tape worm (*Taenia saginata*)

iv) Pork tape worm (*Taenia solium*)

- Affected human beings drop Ploglottides full of eggs with faeces.
- Eggs are picked by the right intermediate host either cattle or pigs while feeding.
- After ingestion by the host (intermediate), Eggs hutch in the intestines into embryos.
- Embryos penetrate the intestinal wall and enter the blood system.
- They first move to the liver and then to all body muscles of the animal where they become cysts.
- Under cooked beef or pork from infected animals if eaten by man causes an infection.

- In the human intestine cysts wall dissolve and the parasites attack themselves to the wall of the intestine.
- Here they develop into adult tapeworms.
- These are passed out again in faeces.

Control measures and treatment

- Use of prophylactic drugs e.g. antihelminthes (dewormers) to kill parasites in animals.
- Keep animal houses clean and disinfected.
- Practice rotational grazing to starve the larvae (cysts) to death.
- Keep the feeding and watering equipment clean.
- Use of latrines by farm workers ie proper disposal of human faeces.
- Proper meet inspection.
- Proper cooking of meat.

b) Liver fluke (Fascial spp (Trematoda)

There are many species of flukes.

-Two are the most common ones ie

iii) Fasciola heptica (sheep)

iv) *Fasciola gigantica* (cattle)

-Heavy infestation of flukes causes a condition called Fascioliasis.

Symptoms

- -Emaciation
- -Indigestion in the animal.
- -Pot bellied condition.
- -Damage to liver tissue causing haemorrhage due to movement of flukes in the liver.
- -Anaemia due to sucking of blood.
- -Animals are dull and depressed.
- -Swollen and painful abdomen.
- -Recumbence precedes death.

NB Fasciola has the following characteristics

-Gray or gray-pink in colour

-Flattened like leaf.

-Have a conical projection at the anterior end.

-Have a tapering body ending.

Lifecycle:

-Liver fluke use the fresh water snail as their intermediate host.

- They have sheep or cattle as their final host.

-Adult flukes are found in the bile duct of the liver of the host animal.

-Here they produce eggs, which are passed into the alimentary canal through the bile duct.

-Eggs are passed out through dung.

-A fluke produces about 300-3500 eggs per day.

-I the eggs falls into stagnant water that is warm, they hatch into a ciliated embryos called miracidia (miracidium)

-On coming into contact with the intermediate host snail (*Limnea spp*). It penetrates the snail tissue.

-Once inside the snail tissues, miracidium process masses of cells called sporocysts

-Sporocysts change into Redia.

-Redia produces cercaria more out of snail

-Cercaria change into metacercaria which is the infective stage of the fluke

-The definite/ final host through grazing or drinking infected water takes Metacercaria.

NB Metacercaria can survive in wet grass and in shady places or when withstand harsh conditions for a year.

-Once swallowed by the host, cercaria penetrates walls of the intestine and hatch into adults.

-Adults migrate to the liver where they grow, mature, mate and produce eggs.

-The cycle starts all over again.

Control measures

1. Controlling the fresh water snail (intermediate host) though

d) Physically killing them.

e) Chemically by use of $CuSo_4$ Sodium pentachlorophenate etc which is added to stagnant water to kill the snails.
f) Draining swampy areas/leveling any depression that may hold water in the pastures.

2. Burning of the pastures during the dry seasons to kill cercaria
3. Not grazing animals near marshy or waterlogged areas.
4. Routine drenching using antihelminthes e.g. NaSo4, hexachloroethane drugs.

ROUNDWORMS (NEMATODES)

(Ascaris spp)

There are three common species of round worms

iv) *Ascaris lumbricoides* Cattle and sheep.
v) *A. suum* Pigs.
vi) *A. galli* poultry.

-Heavy infestation of these worms cause a condition called *ascaridiosis*

Symptoms of Attack

-Anorexia (Loss of appetite in heavy infestation)
-Staring coat (stiff and dry)
-Dehydration and pale mucosa
-Eggs and adults present in faeces.
-Emaciation
-Diarrhoea.
-Anaemia.
-Potbellies especially in young animals.

LIFECYCLE OF A ROUNDWORM

-The common roundworm *Ascaris lumbricoides* does not have intermediate hosts.
-Eggs are laid in the alimentary canal of the host animal.
-Eggs are passed out of the host with faeces.

-Under favorable environmental conditions, eggs hatch into larvae, which climb onto grass and are eaten by host animals.

-Once ingested eggs hatch into young worms called juveniles, which migrate to the liver and lungs. They move up the trachea where they are coughed and swallowed with sputum to the intestines. Here they mature, mate and lay eggs. Eggs are passed out in faeces.

-Some species such as hookworms penetrate the animal's skin directly.

Control Measures.

- Rotational grazing.
- Drenching using appropriate antihelminths.
- Proper use of latrines by farm workers.
- Hygiene in the herd such removal of infected dung.
- Taking care not to contaminate any feed and forage.

Principles of Controlling Endoparasites

Factors to Consider When Controlling Endoparasites.

i.) *The flock and its environment.* Control measures should be directed at the whole group together with their pastures and housing.

ii.) *Nutritional status of the animal.* Good nutritional status of the animals increases the resistance of the animals to internal parasite infection.

iii.) *Pasture management and rotational grazing.* Pastures should be given a resting period after grazing.

iv.) *Housing management.* There should be adequate spacing of the animal. Clean bedding should be provided and manure should be removed frequently. Hygiene should be maintained on feeding and water troughs.

v.) *Protection of the young.* Since young animals are more susceptible than adults to worm infestation, they should be dewormed regularly. They should also graze ahead of the old stock.

vi.) *Prediction of an outbreak.* The life cycle of each parasite should be known to make their control possible.

vii.) *Treatment.* The following rules should be observed;

- *Parasites or causal agents should be identified correctly.*
- *Best available drug should be used at the right dosage.*

- *Treatment should be done when the parasite is most susceptible to the drug.*
- *Ecological requirement of the parasite must be known.*

Methods of Drug Administration

1. *Strategic Treatment.*
   - Administration is regularly at the same time each year. All animals are treated to reduce pasture contamination.
2. *Tactical Treatment*.
   - When rainfall is irregular, rapid multiplication of worms may occur calling for an additional tactical treatment. This is done when climatic and nutritional conditions are abnormal.

SOIL FERTILITY II (INORGANIC FERTILIZERS)

ESSENTIAL ELEMENTS

Plant nutrients occur in the soil in the form of soluble substances. The plants take these substances in different quantities depending on their roles in plant tissues.

Essential Elements

These are nutrients needed by plants for various uses. They are divided into two categories;

- **Macro-nutrients** – are also referred to as major nutrients and are needed in large quantities.
- **Micro-nutrients** – are also referred to as trace as trace or minor nutrients. They are needed by plants in small quantities but must be present.

Macro-nutrients

They include carbon, hydrogen, oxygen, nitrogen, phosphorous, potassium, sulphur, calcium and magnesium.

N, P and K are referred to as *fertilizer elements.*

Ca, Mg and S are referred to as *liming elements*.

Role of macro-nutrients and their deficiency symptoms.

1. Nitrogen.(**$N0_3^-$, $NH4^+$)**

Its sources are; artificial fertilizers, organic matter and atmospheric fixation by lightning and nitrogen fixing bacteria.

Role of nitrogen in plants

1. Chlorophyll formation making the plant succulent deep green in colour.
2. Encourages vegetative growth especially in crops where leaves are harvested e.g. kales, Cabbages and pasture grasses.
3. Protein formation and protoplasm of all living cells.
4. Regulates the availability of phosphorous and potassium in plants.
5. Increases the size of grain cereals and their protein content.

Deficiency symptoms

1. Chlorosis or yellowing of the leaves.
2. Production of anthocyanin pigment instead of chlorophyll in tomatoes causing purplish colour.
3. Stunted growth where plants become dwarfed with extremely short roots.
4. Premature leaf fall.
5. Premature ripening of fruits.
6. Production of light seeds.

Effects of excess nitrogen

1. Scorching of the leaves.
2. Delayed maturity.
3. Excessive succulence in stems hence fall/lodging.

Loss of nitrogen from the soil

1. Soil erosion
2. Leaching
3. Volatilization
4. Crop uptake
5. Used by microorganisms.

2. Phosphorous. (H_2PO_4, P_2O_5)

It occurs in the soil either in organic or in inorganic forms. It is converted into phosphates by microorganisms, which can be absorbed by plants. Since phosphates are relatively soluble in water they are not easily leached.

Source

- Organic manures
- Commercial fertilizers
- Phosphate rocks

Role of Phosphorous

1. Root development and nodules formation
2. Influences cell division.
3. Strengthens plant stems preventing lodging.
4. Hastens maturity of the crop, flowering, and fruit and seed formation.
5. Plays an important role in metabolic processes such as respiration, protein, fat and carbohydrate formation

Deficiency symptoms

1. Stunted growth.
2. Delayed maturity.
3. Increased production of anthocyanin pigment hence purple colour.
4. Yield of grains, fruits and seed is lowered.

Effects of excess Phosphorous

It leads to unavailability of iron, which is converted, into insoluble compounds, which cannot be absorbed by plants.

Loss of phosphorous from the soil

- Soil erosion
- Leaching
- Crop removal
- Fixation by iron and aluminium oxide.

3. Potassium. (K^+, K_2O)

Sources

- Crop residue and organic manures
- Commercial fertilizers
- Potassium bearing rocks e.g. mica and feldspar.

Role of potassium

1. Component of chlorophyll molecule.
2. Plays important role in carbohydrate formation and translocation. Assists in the uptake of nitrates from the soil and balances the effect on phosphorous and nitrogen uptake by plants.
3. Neutralizes organic acids in plants.
4. Strengthens plant stalks increasing plant vigour and disease resistance.

Symptoms of potassium deficiency

1. Leaf curling
2. Chlorosis
3. Premature leaf fall
4. Stunted growth.
5. Leaves develop a burnt/scorched appearance on the margin.

Loss of potassium from the soil

- Crop removal
- Leaching
- Soil erosion
- Fixation in the soil.

4. Calcium (Ca^{+}).

Sources

1. Crop residues and organic matter.
2. Commercial fertilizers.
3. Weathering of soil minerals.
4. Agricultural lime such as dolomite and limestone.

Role of Calcium in plants

1. Protein synthesis.
2. Corrects soil PH increasing soil Cation Exchange Capacity (CEC) making more nutrients such as phosphorous and potassium more available.
3. Improves the vigour and strength of straw.
4. Helps in grain and seed formation.
5. Improves the soil structure.

6. Promotes bacteria activity in the soil.

Deficiency symptoms

- Blossom end rot in tomatoes
- Stunted growth
- Dying back of plant tips.
- Young leaves remain closed.

Loss of calcium

- Crop removal
- Leaching
- Soil erosion.

5. Magnesium (Mg^{2+}).

Sources

- Crop residues and organic manures
- Commercial fertilizers
- Agricultural lime
- Weathering of soil minerals.

Role of magnesium

- Synthesis of oil in crops such as Soya beans and groundnuts.
- Forms part of the chlorophyll.
- Promotes the growth of soil bacteria and enhances the nitrogen fixation power of the legumes.
- Activates the production and transport of carbohydrates and proteins in the growing plant.

Deficiency symptoms

- Inter-venial Chlorosis of the leaves where the parts between the veins become yellow.
- Leaves turn purple then brown and eventually die.
- Leaves curve upwards along the margin.
- Stalks become weak and the plant develops long branched roots.

6. Sulphur (SO_4^{2-}).

Sources

- Commercial fertilizers.

- Soil minerals containing Sulphide such as gypsum and pyrites.
- Atmospheric sulphur from industries through rainwater.

Role of sulphur

- Formation of proteins and plant hormones.
- Formation and activation of certain Co-enzymes such as coenzyme A.
- Influences plant physiological processes such as protein synthesis, chlorophyll formation, carbohydrate metabolism and nitrogen fixation.

Deficiency symptoms

- Stunted growth
- Poor nodulation in legumes
- Leaf Chlorosis hence anthocyanin pigment production.
- Thin stems and delayed maturity.

Carbon, Oxygen and Hydrogen

They are derived from the atmosphere and soil water. The three are raw material for photosynthesis in the presence of sunlight and chlorophyll. Oxygen is also needed for respiration to produce energy.

Micro Nutrients

They are also referred to as trace or minor elements. They are required in small quantities but they are essential for proper growth and development of plants. They include iron, manganese, copper boron, molybdenum and chlorine.

Role of micronutrients and their deficiency symptoms

1. Copper, iron and molybdenum help enzymes that are involved in oxidation and reduction processes in plants.
2. Copper is involved in the utilization of iron and in respiration.
3. Iron is needed in the synthesis of proteins in the chloroplasts.
4. Molybdenum is necessary for nitrogen fixation to take place by the help of symbiotic and non-biotic bacteria. It is also necessary for the synthesis of amino acids and proteins in plants.
5. Boron is involved in the translocation of sugars in plants and in the absorption of water.

6. Zinc is involved in the formation of some growth hormones and is also involved in the reproduction process of some plants.

Inorganic Fertilizers.

These are artificially processed compounds, which are added to the soil to improve its fertility.

A. Classification of inorganic fertilizers

They are classified according to;

- *Nutrients contained*.
  -Straight containing only one macro-nutrient
  -Compound containing more than one macro-nutrient.
- *Mode of application*.
- *Time of application*.
  -Soil applied when planting
  -Top dressing after crop emergence
- *Effects on the soil pH.*
  -Acidic
  -Neutral
  -Basic.

i) Straight fertilizer

They contain only one macro-nutrient which could be N, P or K. they are named according to the element contained.

- *Nitrogenous fertilizers.* They contain nitrogen as the primary macronutrient. They include Calcium Ammonium Nitrate (CAN), Ammonium Sulphate Nitrate (ASN) Sulphate of Ammonia (SA) and Urea.
- *Phosphatic fertilizers.* Contain phosphorous. They include Single Super Phosphate (SSP), DSP, and TSP.
- *Potassic fertilizers.* Contain potassium. They include Potassium Chloride or Murate of Potash (KCl) and Potassium Sulphate or Sulphate of Potash (K_2SO_4)

ii) Compound or Mixed or Complex fertilizers

They contain two or more primary macronutrients.

If it contains two of the primary macronutrients it is referred to as an incomplete compound fertilizer. Examples DAP (18:46:0) 20-20-0 etc.
If it contains the three (N<P<K) it is referred to as a complete compound fertilizer. Examples are 20-10-10, 25-5-5+5s, 17-17-17 and 15-15-15.

B. Properties and Identification of Fertilizers

i) Nitrogenous Fertilizers

They have the following properties.

- Highly soluble in water.
- Most are highly corrosive and therefore should not be handled with bare hands. They also corrode metal surfaces such as iron and tin.
- Are highly volatile. Under hot conditions they change into gaseous form and escape into the atmosphere. They should therefore be applied to moist soils to avoid volatilization.
- They are hygroscopic and therefore absorb water from the atmosphere causing the granules to stick together or cake. They should therefore be stored under dry conditions.
- They are easily leached and should therefore be applied to already established crops.
- They have a scorching effect and should therefore not be brought into contact with any part of the plant.
- They have a short residual effect and should therefore be applied frequently.

Properties of Individual Nitrogenous Fertilizers

- *Sulphate of Ammonia* $(NH4)_2SO_4$. Physical appearance, white crystals, has acidic effect, contains 20-21% N. its highly volatile and slow acting.
- *Ammonium Sulphate Nitrate (ASN)* $NH_4NO_3+(NH_4)_2SO_4$. Its less acidic, granules appear yellow orange or brownish in colour, contains 26% N. its both quick and slow acting and highly corrosive.

- *Calcium Ammonium Nitrate (CAN)* $NH_4NO_3+CaCO_3$. It's neutral in nature and highly hygroscopic. It has grayish granules and not corrosive. It contains 21% N.
- *Urea* $CO(NH_2)_2$. Has 45-46% N. occurs as small whitish granules. It is easily leached or volatilized. It is rarely used except in crops with a high absorption capacity such as sugarcane.

ii) Phosphatic Fertilizers

They have the following properties.

- Has low solubility and immobile. However they may combine with ions of aluminium fixing phosphorous into unavailable forms to the plants. They should therefore be place next to the roots so that plants can utilize them before phosphorous becomes fixed.
- Have a slight scorching effect and should be mixed thoroughly with the soil to minimize the scorching effect.
- Are not easily leached and therefore are applied during planting time.
- They have a residual effect and hence benefit subsequent crops.
- They are not very hygroscopic and therefore easy to store.

Properties of Individual Phosphatic Fertilizers

- *Single Super Phosphate (SSP).* It has 20-21% Phosphorous penta-oxide (P_2O_5). Induces negligible acidity and its water-soluble. It's in the form of white creamy granules.
- *Double and Triple Super Phosphate (DSP and TSP).* They contain 43-52% P_2O_5 and occur in form of grayish granules smaller than those of CAN. It induces negligible acidity in the soil.

iii) Potassic Fertilizers

Characteristics

- Moderate scorching effect
- More soluble in water than Phosphatic ones but less than nitrogenous ones. Most East African soils have adequate potassium and should therefore be applied only where soil test show its deficient.

Properties of Individual Potassic Fertilizers

- *Potassium Chloride (KCL).* It is also referred to as Muriate of potash. It contains 50% K_2O. It induces negligible acidity to the soil. It is

hygroscopic. It occurs in the form of creamish or light coloured granules.

- *Potassium Sulphate (K_2SO_4).* It has 50% K_2O. Reacting Muriate of potash with sulphuric acid makes it. It induces negligible acidity to the soil. It is also referred to as Sulphate of potash.

iv) Compound or Mixed Fertilizers

-Are made by mixing two or more straight fertilizers. Their nutrient content is expressed in two ways.

- *Fertilizer grade.* This indicates the guarantee of minimum content as a % of N:P_2O_5:K_2O in the fertilizer for example 10-20-0, 17-17-17 etc.
- *Fertilizer ratio.* This is the relative % expressed as a ratio of the NPK present. For example, 10-20-0 will be 1:2:1 and 17:17:17 will be 1:1:1.

Properties of Individual Compound Fertilizers

- *Diammonium Phosphate (DAP) $(NH4)_2PO_4$ – 18; 46;0.* It is moderately acidic because of the ammonium content. It is applied at planting time and contains both phosphorus and nitrogen.
- *Nitrophos* – 20;20;0. Moderately acidic and contains both N and P.
- *Monoammonium Phosphate (MAP)* – 11;48;0. Its moderately acidic and has same properties as DAP.
- *Others 23;*23;0, 17;17;17, 20;10;10 and 25-5-5+5S

Fertilizer Application

- Phosphatic fertilizers are applied during planting time while nitrogenous ones are applied after crop emergence.
- In maize nitrogenous fertilizers are applied when the crop is 45-60cm or knee high. This application of fertilizers after the emergence of crops is referred to as top dressing.

Methods of fertilizer application

1. *Broadcasting.* This is the random scattering of fertilizers on the ground for plant use. This is applicable with the Potassic and nitrogenous fertilizers. Broadcasting should be done when the soil is moist. This is done manually or by the use of broadcasting machines. Shallow cultivation should be done after broadcasting to prevent loss through volatilization.

2. *Placement method.* This is the application of the fertilizer in the planting holes or drills. The fertilizer should be thoroughly mixed with the soil before placing the seeds. This method is recommended when applying Phosphatic fertilizers.
3. *Side Dressing.* This is the placement of nitrogenous fertilizer at the side of the crop being top-dressed. Side dressing can be done in two ways;

- *Band application.* Placement of fertilizer along a band in between the rows of growing crops.
- *Ring application.* This is the placement of fertilizer around the individual crop just beneath the edge of the canopy.

4. *Drip.* The fertilizer is dissolved and applied to individual plants through perforated pipes or bottles. This is common in horticultural crop fields and flower farms.
5. *Foliar spraying.* This is the application of specially formulated fertilizer solutions onto the foliage of the crop. The leaves directly absorb the fertilizer. This method is recommended when the conditions don't allow the use of the soil applied fertilizers e.g. during the dry season or when top-dressing very closely spaced crops such as wheat.

Determination of Fertilizer Rates

The amount of fertilizer applied in the field is determined by the amount of plant nutrients available.

Calculations Involving Fertiliser Application

- *Fertiliser grade or Analysis.* This indicates the amount of each nutrient contained in a fertiliser. It is calculated by determining chemically the % of each nutrient present in a fertiliser. That is,

$$\% \text{ Nutrient} = \frac{\text{Nutrient Content} \times 100}{\text{Total weight of fertiliser.}}$$

This is usually calculated in terms of the amount of the three primary macronutrient NPK. Usually it is indicated on the bag of the fertiliser.

A bag of 100kg of a fertiliser of a 10-10-10 grade contains 10kg of N, 10kg of P_2O_5 and 10kg of K_2O. This shows that only 30kgs are active, the remaining 70kg is made up of filler material or carrier.

Fertiliser grade helps to determine the amount of fertiliser required per hectare and therefore the amount of fertiliser that one should buy.

- *Fertiliser ratio.* This refers to the relative proportions of the three primary macronutrients (NPK) in a fertiliser.
- *The amount of fertiliser or nutrient required per unit area (per hectare).* The amount of fertiliser to apply per hectares depends on the amount of nutrient needed and the fertiliser grade available.

The Carbon Cycle

This is the series of changes which carbon undergoes in the atmosphere, water, and soil and in living organisms. Carbon is an essential constituent of all living things. Carbon occurs in the atmosphere as carbon dioxide and constitutes 0.03% of air by volume.

Ways in which carbon is removed from the atmosphere

1. *Photosynthesis.* Green plants use CO2 from the atmosphere during photosynthesis.

Carbon Dioxide + water ---------- Glucose + Oxygen

The glucose formed is used by plants to provide energy and the excess is stored in storage structures such as grains and tubers.

2. *As rainwater passes through the atmosphere, it reacts with carbon dioxide to from weak carbonic acid. This reduces the amount of CO_2 in the atmosphere.*

Ways in which Carbon is returned to the Atmosphere

1. *Decomposition.* Once living organisms die, they decay releasing CO_2 into the atmosphere.
2. *Respiration.* During aerobic respiration oxygen is used to oxidize carbohydrates releasing energy, carbon dioxide and water. The Carbon dioxide is released to the atmosphere.

   Glucose + Oxygen --------- Energy+carbon Dioxide +water
3. *Combustion.* When carbon-containing materials such as wood and petroleum burn, carbon dioxide is released into the atmosphere.

Importance of the carbon Cycle

- Maintains the volume of carbon dioxide in the atmosphere.
- Ensures constant supply of CO_2 for plant use.
- Ensures a balance between CO_2 and O_2 to prevent the buildup of CO_2 to toxic levels.

The Nitrogen Cycle

These are the series of changes which nitrogen undergoes between the atmosphere, water, soil and living organisms.

Nitrogen gas makes up to 78% of atmospheric air by volume; however it is not available to plants in this free gas form.

Ways in which Nitrogen is removed from the atmosphere

1. *Nitrogen fixation by lightning.* Atmospheric nitrogen combines with oxygen to form nitric oxide during lightning. Nitric oxide is easily oxidized to form nitrogen dioxide as shown below.

N_2 + O_2 -------- 2NO

Nitrogen Oxygen Nitric Oxide

2NO + O_2 ---------- $2NO_2$

Nitric oxide Oxygen Nitrogen Dioxide

The nitrogen dioxide formed dissolves in water to form two acids, nitrous acid and nitric acid.

$2NO_2$ + H_2O ---------- HNO_2 + HNO_3

Nitrogen Dioxide water Nitrous acid Nitric acid

Nitrous acid is a weak acid and is quickly oxidized to form nitric acid.

$2HNO_2$ + O_2 -------- $2HNO_3$

Nitrous acid Oxygen Nitric acid.

In the soil nitric acid is ionized to form nitrate ions (NO3), which is now available to the plants.

2. *Nitrogen fixation by Nitrogen Fixing Bacteria.* This is divided into symbiotic and non-symbiotic nitrogen fixation.

- *Symbiotic fixation is carried out by Rhizobium bacteria found in the root nodules of legumes such as beans, peas, Lucerne, groundnuts etc.*
- *Free-living bacteria found in the soil carry out non-symbiotic nitrogen fixation. These bacteria convert atmospheric nitrogen into nitrates into the soil. Azotobacter and clostridium are good examples.*

Clostridium/
Azotobacter

N_2 ----------NO_3 (absorbed by plants).

3. *Nitrification.* This is the process by which ammonium compounds are converted into nitrites and nitrates by the action of *Nitrobacter and Nitrosomonas* bacteria.
4. *The Harber-Bosch Process.* This results in the formation of ammonia.
   N_2 + $3H_2$ ---------- $2NH_3$
   Nitrogen Hydrogen Ammonia

The ammonia produced is reacted with sulphuric acid or nitric acid to produce Sulphate of ammonia and ammonium nitrate fertilizers respectively. Ammonium nitrate can then be mixed with calcium carbonate to produce CAN.

Ways in which Nitrogen is returned to the Atmosphere

1. *Denitrification.* This is the conversion of nitrate ions (NO_3^-) to nitrogen gas (N_2) and ammonium ions (NH_4^-) into ammonia gas (NH_3), which escapes into the atmosphere. This is common in waterlogged soils and in very compacted soils. Denitrifying bacteria does this.
2. *Combustion.* Burning vegetation causes the conversion of nitrogenous compounds into nitrogen dioxide and ammonia, which escapes into the atmosphere.
3. *Volatilisation.* Sometimes ammonium compounds in the soil sublime to form ammonia gas, which escapes to the atmosphere.

Importance of the Nitrogen cycle

- Ensures the availability of nitrogenous compounds in the soil for plant use.
- Ensures the survival of the anaerobic microorganisms such as *clostridium,* which use nitrogen gas.

Soil sampling

This refers to obtaining a small quantity of soil that is representative in all aspects of the entire farm.

Soil sampling methods

- Traverse method. Four corners of the field are identified and sampling is done diagonally.
- Zigzag method. Locations are arranged in such a way that they are in a zigzag form

Soil sampling Procedure

- Clear the vegetation over the site.
- Dig out the soil at depths of 15-25cm for crop-land and 5cm for pasture land.
- Place the dug out soil in clean container.
- Repeat the above steps in different parts of the field, preferably 15-20 spots.
- Mix thoroughly soil from all the spots. The soil is crushed and dried.
- Take a sub-sample (composite sample) from the mixture and send to National Agricultural Laboratory for analysis.

The composite sample should have the following details before being taken to the laboratory;

- Name and address of the farmer.
- Field number
- Date of sampling.

Sites to avoid during the sampling

- Dead furrows and ditches
- Near manure heaps
- Swamps
- Recently fertilized soils
- Ant hills
- Under big trees
- Near fence lines or footpaths
- Between slopes and bottom-land.

Soil Testing

This is the analyzing of the soil samples to determine the ability of the soil to supply the essential elements.

Importance of soil testing

i. To determine the value of the soil hence determine the crop to grow.
ii. To determine the nutrient content hence find out the type of fertiliser to apply.
iii. To determine whether it is necessary to modify the soil pH for a crop.

Soil pH (potential hydrogen)

- This refers to hydrogen ion (H^+) concentration in the soil. It is also referred to as the soil reaction. Soil pH measures the acidity or alkalinity of the soil solution. Soil acidity is caused by the H^+ ions while soil alkalinity is caused by the hydroxyl ions (OH^-).
- The pH scale ranges from 1-14 with 7 being neutral; pH below 7 is acidic and pH above 7 is termed as basic or alkaline. These numbers are negative logarithms or powers. For example at pH 5 the amount of H^+ concentration is $10^{-5.}$
- Most nutrients are available at neutral pH e.g. phosphates are available at pH 6.5-7.5.
- Low soil pH lowers the availability of phosphorous as phosphates become fixed by iron and aluminium. Molybdenum is also unavailable at low pH.
- Too high pH makes manganese, potassium, boron, iron and zinc less available.

Testing Soil pH

- Use of the pH meter.
- Use of colour indicator dyes.

Importance of Soil pH to Crops

1. Determines the type of crop to be grown in an area. For example, tea prefers acidic soils while barley is affected by low pH.
2. Influences the incidences of soil borne pests. E.g. Pests such as nematodes are more serious in acidic soils than in neutral soils.
3. It determines the availability or absence of nutrients.
4. Influences the activity of soil microorganisms. E.g. low soil pH favours fungi and discourages bacteria. Therefore bacterial diseases such as potato scab caused by *Aceptomyces scabies* are common in high pH soils while fungal diseases such as club root caused by *Plasmodiaphora brassicae* are common in low pH soils.
5. Influences the physical and chemical characteristics of the soil.

REVISION QUESTIONS

1. a) Describe the production of tomatoes under the following sub headings.

i) Ecological requirements (3mks)

ii) Nursery establishment (4mks)
iii) Planting (3mks)
iv) Pest control (3mks)
v) Disease control (3mks)

vi) Marketing. 4 mks

2. Mention **four** categories of vegetables based on the part used as food. (4mks)

3. a) Describe the field production of Onions (**Aleum Cepa**) under the following sub topics;

i) Ecological requirements (3mks)
ii) Varieties (2mks)
iii) planting (4mks)
iv) Field management practices (4mks)
v) Harvesting (4mks)
b) Name **Three** diseases of cabbages (3mks)

4 Name any 4 management practices done in carrot production.(4 mks)

5. Describe the establishment of cabbage seedlings under the following sub-heading:-

(a) Establishment of the nursery (7mks)
(b) Management of seedlings in the nursery (6mks)
(c) Transplanting of seedlings (7mks)

6. Give **four** reasons for staking tomatoes (4mks)
7. Give 4 effects of excess nitrogen in tomatoes. (4 mks)
8. State 3 causes of blossom end rot in tomatoes. (3 mks)
9. Give 4 reasons for staking in tomatoes. (4 mks)
10 Name 3 fresh market and 3 processing tomato varieties. (3 mks)
11 Name the early maturing cabbage varieties. (3mks)
12. Why is it not advisable to apply manure in carrot production? (1 mk)
13. Name the two main categories of carrots and give an example in each case. (2 mks)

MARKING SCHEMES

1. a) Production of tomatoes

i) Ecological requirements

-Warm climate with a temp ranging (15 – 25^{0}C), 20^{0}C- 25^{0}C during day and 15^{0}C – 17^{0}C at night. Altitude 0 – 2100m above sea level- Soil should be deep- Well drained- PH 5 – 7.5- Rainfall 760 – 1300 mm/ year / p.a- Well distributed throughout the growing period ***(½mk for each correct answer ½ x 6 = 3mks)***

ii) Nursery establishment and management.

-The nursery should be sited on a gently sloping land.

-A nursery of width 1m is prepared and soil raised to 15cm.

-The bed should be prepared to a fine tilth

-Planting furrows or drills are made at 10 – 15cm apart using a stick of pencil thickness.

-Seeds are planted thinly along the furrows and covered lightly with the soil and firmed.

-A light mulch cover is placed on the bed and watering done. ***(1mk each for any 4 points)***

iii) **Planting**

-Planted at well prepared seedbed with deep soils free from weeds

-Spacing 60cm x 60cm (single row) or 60cm x 60cm x 90 cm (double row planting)

-200kg of DAP per hectare is used for planting

-10 tons of farm yard/ compost manure per hectare

-Nematocide should be applied on planting time to control nematodes.

-Seedlings should be watered before transplanting

-Transplant in the evening or during a cloudy day

-Mulch the seedlings after transplanting ***(½ mk for any 6 correct points)***

iv) **Pest control.**

-cut worm

American bollworm (1mk)

-The adult moth lay eggs on young tomato fruits

-When they hatch the larvae bore into the fruits and feed on them

Control

-Routine spraying of tomatoes with recommended pesticide eg. Karate, Ambush

Nematodes (1mk)

-Can be controlled by crop rotation

-Fumigation of the soil using furadan

v) **Disease control**

i) Bacterial wilt (1mk for mention)

Control

- Crop rotation

-Uprooting and burning the affected plants ***(1mk each for any 2 correct points)***

-Blossom end rot . ***(1mk for mention of any one disease)***

Cause

-Too much Nitrogen in the early stages of growth

- Irregular watering

- Calcium deficiency

Control

- Regular watering
- Apply sufficient amount of calcium (add CAN)
- Top dressing with the right amount of Nitrogen***(1mk each for any 2)***

e) **Marketing**

- Sort and grade them- Pack in wooden boxes- Sold to consumers directly- Sold to green grocers - Sold to canning factories- Fresh market tomatoes should have a reddish colour- For canning should be left to ripen

2. Categories of vegetables based on the part used as flood.

- Leaf vegetables- Root vegetables - Stem vegetables- Pod vegetables- Flower vegetables- Fruit vegetables

3. a) i) Altitude – 2,100m above the sea level ✓
Rainfall – 1,000mm per year ✓
- fairly long period for ripening✓
- irrigated during dry spell ✓

Soil – fertile and well drained ✓ - Ph – 6.0 – 7.0 ✓

(3mks)

ii) Varieties – red creole ✓
- Tropicana hybrid ✓
- White creole ✓

(2mks)

iii) Planting – Can be sown directly or started off in a nursery bed. ✓
- 250kg Dsp used during planting ✓
- Rows for direct planting should be 30cm apart. ✓
- Seeds drilled and covered with light soil or transplanted at 8cm apart within the row.✓
- Deep planting should be avoided as it inhibits bulb expansion. ✓

(1x4=4mks)

iv) - Thinning
- Weeding ✓
- Top dressing ✓
- Pest and disease control ✓

(1x4=4mks)

v) Harvesting ✓

- ready for harvesting after 5 months from planting. ✓
- tops broken or bent at the neck when leaves start drying. This hastens withering of the stem ✓
- bulbs are dug and left to dry in a shade of a few days. Turning should be done daily during drying

- dry onions should be stored in slatted wooden crates ✓
- regular inspection to discard spoilt ones should be done ✓ ***(1x4=4mks)***

b) - Damping off ✓
- black rot ✓
- downy mildew ✓

(1x3=3mks)

4 Thinning, weeding, topdressing and pest control.

5. (a) Choose a suitable nursery site, considering accessibility and source of water

- Dig and prepare the chosen site to a desirable tilth
- Remove roots of previous plants and stones from the site
- Make raised or sunken nursery beds (depending on soil moisture0 measuring 1m wide and any convenient length
- Plant seeds by drilling at a spacing of 15cm by 3cm deep
- Apply fertilizer (phosphatic) or manure
- Cover the seeds to a depth of about 1 cm
- Erect a shade or apply some mulch on the nursery
- Water the nursery thoroughly. ***(7 well described pts = 7mks)***

(b)

- Remove the mulch (if it was applied) and erect shade (if it wasn't erected) above the nursery
- Water the nursery at least twice a day preferably early mornings and late evenings
- Remove weeds that may have come up
- Thin young seedlings if they are overcrowded. Plant them in a seedling bed
- Control pests and diseases when the symptoms of attack are noticed
- Harden off the seedlings by removing shade gradually and reducing frequency of watering ***(6 pts well described = 6mks)***

(c)

- Water the nursery thoroughly before transplanting
- Prepare the field/ seedbed to a suitable tilth before transplanting is due
- Transplant seedlings when 6 10cm high; selecting the healthy and discarding the weak ones
- Transplant during cloudy day or during late afternoon
- Plant seedlings in the field to the same depth (10cm)they were in the nursery space at 60cm x 60cm or 60cm x 90cm
- Lift each seedling from nursery with a ball (lump) of soil to avoid damage to the roots
- Water the field well before it receives the seedlings
- Apply a handful of FYM mixed with some phosphatic fertilizer in each hole

(Well described 7 pts scores 7mks)

6.

- Prevent attack by soil borne pests
- Facilitate spraying and harvesting
- Control soil borne diseases
- For the production of clean fruits

(1x4=4mks)

7. Prolonged maturity; cracking of fruits b4 maturity; blossom end rot; excess vegetative growth.

8. Too much nitrogen in early stage; irregular watering; calcium deficiency in young fruits.

9 Production of clean fruits; facilitate spraying and harvesting; avoid infestation by soil borne pests; control disease incidences such as blight.

10 Fresh market – money maker, hot set, super marmande, ponde rosa, marglobe.

Processing – primabel, cal J, seinz, Kenya beauty.

11. Brunswick, sugar loaf, early jersey, mukuki, Copenhagen market, golden acres, Gloria etc.

12. Encourages forking.
13. -Fresh market – chantenary
    -Canning - Nantes