NATIONAL OPEN UNIVERSITY OF NIGERIA

CRP 304

Principles of Horticultural Crop Production

Module 2

CRP304 (Principles of Horticultural Crop Production) Module 2

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Unit 1 Requirement for Sitting Fruit Orchards and Vegetables farms

1.0 Introduction

The science and art of producing and marketing fruits and nuts is called pomology while the science and art of producing and marketing vegetables is called olericulture. Before any production, there are some certain requirements that you will meet to ensure successful production and marketing fruits and vegetables so as to reduce cost of production and increase profit. This unit deals with the requirement for setting fruit orchard and vegetables farm.

2.0 Objectives

At the end of the unit, you should be able to:

- to explain the requirement for sitting fruit orchards
- to explain the requirement for sitting vegetables farm
- define orchard.

3.0 Main Content

3.1 Requirement for Sitting Orchards and Vegetables Farms

Fruits and vegetables are of great importance in nutrition since they are sources of food. An orchard can be defined as a parcel of land devoted to the cultivation of fruits. Even though fruits and Vegetables may be different in their nature, life cycle and mode of production, what they require for a successful production of the enterprise are the same since they use the same resources (land, labour, environmental factors, market etc). The following are basic requirements for the sitting of fruits and Vegetables farms.

3.1.1 Environmental Factors

These include all the climate factors (rainfall, temperature, light, humidity) affecting crop production. The grower must have knowledge of the crop he want to produce and the climatic requirement of the crop so that he can produce maximally.

a) Rainfall – This is basically a natural means of water supply to plants. Water is very important because 70 – 80% of the fresh weight of herbaceous plant is water. For woody plants, water constitutes about 50% of their fresh weight. Water acts as a medium for uptake of nutrients and also for transportation of substances within the plant body. It is a primary raw material in the process of photosynthesis and it's also required for the maintenance of turgor pressure in plant stomata which controls its opening to permit exchange of gases between plants and the environment. Water is needed by the plants to replace the one lost by transpiration.

The plant losses about 98% of the water absorb through transpiration. The water requirement of plants varies with species and age of the plant. Irrespective of the species, the water needs increases as the plants increase in size. Lack of moisture makes the air less humid, thereby increasing its drying power. The rate of plant processes such as transpiration, diffusion and evaporation are affected directly by lack of moisture. Excessive moisture exposes plants to diseases and causes lodging (falling of plants). Horticultural plants grown indoors are sometimes given a misty spray of water (irrigation) to increase the humidity of the plant environment, especially in winter when the heaters are turned on to warm the building.

b) Temperature – The response of plants to temperature varies among species. For every plant species there is an ultimate temperature range within which it will grow and reproduce. In general, most horticultural crops grow and produce between 15°C. Horticultural crops can be classified according to their response to temperature as follows.

i. Hardy Plants – Plants that withstand low temperature but cannot grow under high temperature. These are basically temperate crops such as carbage, cole flower and apple.

ii. Tender or Tropical Crops – Plants that withstand high temperature but cannot tolerate low temperature. That is, they grow under warm to high temperature. E.g. Banana, Mango, Okra. Response of plants to temperature varies with the stage of growth of the plant. For example, the seedling of crops is more easily damage due to high temperature. Different parts of plant also response differently to temperature. For example the flowers are more susceptible to high temperature than the vegetative parts. Roots are more susceptible to low temperature than the aerial part. The response to temperature also depends on the duration and the degree of temperature extremes. High temperature especially night temperature has an adverse effect on plants because it increases respiration and hence, decreases food reserves. High temperature also prevents tuber initiation in crop such as potatoes and root formation e.g. in carrot.

There is also indirect effect of high temperature on plants. High temperature increases the activities of pest and disease organisms. It also has adverse effect on flowering and fruit formation e.g. in tomatoes, high temperature reduces the number of flowers and fruits formed. It has been shown that maximum fruit formation will require a night temperature of 21°C. Low temperature is undesirable since it reduces germination, slows growth and result in fruit damage.

c. Light – Light for plant growth comes primarily from the sun. The role of light in the growth and development of horticultural plants depends on its quality, quantity and daily duration. When plants are grown indoors, artificial lightening is required. The most readily recognised role of light is in photosynthesis, but it also has other important functions such as seed germination in some horticultural species. The responses to light also vary among plants species. The light factors have three aspects. These are quality, intensity and duration.

i. Quantity – This refers to the wavelength of light. This aspect is affected by cloud cover. When there is continuous cloud cover, the quality of light reduces and this result in poor fruit colour. The visible light range between about 390 – 735 nanometer wavelengths and most of the radiation reaching the earth from the sun falls within this range.

ii. Intensity – This refers to the quality of light or quanta. Some plants grow under full sunlight e.g. maize, and tomato and they are called the sun plants while some plants like asparagus and chrysanthemum do not do well under bright light and are called shade loving plants. Some other plants need shade at certain stages e.g. seedling of cocoa. Sunlight intensity at midday is about 10,000 foot candles of this quantity, many plants can effectively utilize only about 50% of the light for photosynthesis.

iii. Duration – This refers to the number of hours of light received on the basis of light requirement for flowering. Plants can be classified into three groups on the basis of light duration.

a) Longday Plants – These plants flower only under day length longer than 14 hours e.g. onion, peas, lettuce.

b) Short Day Plants – They flower at day length less than 10 hours e.g. citrus.

c) Day Neutral Plants – Many tropical crops are day neutral plants and they flower at day length of 12 hours e.g. tomato, maize.

d) Humidity – The water content of air is called humidity and is measured in units of relative humidity (RH) by using an instrument called a psychrometer. Humidity depends on vapour pressure (concentration of water vapour in the air) and temperature. Relative humidity decreases when temperature increases and water vapour remains constant. The amount of water needed by a plant for normal growth is directly related to the humidity or water content of the air. Relative humidity is a very important factor affecting the growth and development of horticultural plants as it is a products of rainfall and temperature. Some crops requires high humidity e.g. banana. Other plants require high humidity at one time and low humidity at another time e.g. mango requires high humidity for growth but for flowering, low humidity is necessary. Low humidity is required for drying crops like maize. High humidity has the disadvantage of encouraging attach by pests and diseases.

3.1.2 Land

Land is a gift of nature and found in it are the soil, water, minerals etc. To the Grower, soil is an important requirement without which production cannot take place. The soil should have a good texture and deep enough that it poses minimal resistance to root penetration and is easy to till. Sandy loam is ideal for fruit tree and vegetables production since they retain moisture, nutrient and are easy to till and drain freely. Soil pH of 5.5-6.5 is best for fruits and vegetables. Elevation (this is the degree of the slope of land) should encourage both air and water drainage to avoid erosion. Land with gentle slope is best for fruits and vegetables production.

3.1.3 Labour

This is the physical or mental energy required in any production. For a small garden, labour is not a problem. However, for a large operation, labour is needed for fruit harvest and also for various pruning operations. A commercial orchard should be located where seasonal labour is readily available and affordable for vegetables farm operations from weeding to processing require labour which should be readily available to avoid lost of yield or spoilage of the produce.

3.1.4 Inputs

These are materials that are required for a successful production apart from those mentioned above. These include the seed or seedling, fertilisers, herbicide, machines, insecticide etc are used for fruit and vegetables production. Inputs must be readily available at affordable cost for a meaningful fruit orchard and vegetables farm to be achieved. These inputs increase production when properly managed thereby, reducing cost of production while maximising profit of the grower.

3.1.5 Market

Home gardens are designed primarily for home consumption. However, plans should be made to handle surplus produce. The surplus can be preserved by processing it in a variety of ways and offering it to consumer for income. If larger scale farmer wish to serve the general public, then markets and marketing strategies should be carefully considered. Dry fruits can be stored for a long period of time. However, fresh produce is highly perishable and thus markets must be known before production.

3.1.6 Finance

Finance is a critical factor in any production as such it is required to buy inputs and pay for labour and also rent of land. Family labour sometimes is not enough when large production is involved and hired labour has to be engaged. In commercial enterprise, lived labour is the source of labour hence finance is needed to pay for it.

4.0 Conclusion

The success of any enterprise depends on not only the inputs required but the managerial ability of the operator. Good management of resources leads to maximization of profit while reducing production cost. A bad management even, with abundant resources at his disposal, leads to lost in the business.

5.0 Summary

Fruits orchard and Vegetables farm have same requirement for sitting since they use the same resources and the requirement include;

- Climatic factors
- Land
- Labour
- Market
- Finance
- Management

6.0 Tutor- Mark Assignment

1. Explain the requirement for siting a fruit orchard.
2. List the requirement for siting a Vegetables farm.

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Unit 2 Practices Used in the Production of Horticultural Crops

1.0 Introduction

Horticultural crops are usually specialised crops because of the way they are produced and as such they require some specific production practices such as pruning, staking coupled with the conventional practices such as land preparation, watering fertiliser application e.t.c. This unit deals with the conventional and specialised practices carried out on horticultural crop production.

2.0 Objectives

At the end of this unit, you should be able to:
- explain the practices of horticultural crop production
- differentiate the various practices for vegetable and fruit production
- explain the similarity in production practices of vegetables and fruits
- state the advantages and disadvantages of different production practices.

3.0 Main Content

3.1Practices Used in the Production of Horticultural Crops

The practices used in the production of horticultural crops vary with the crops under cultivation. However, the conventional practices of production such as land preparation, weeding, fertiliser are practiced. Horticultural crops have specialised practices such prunning, staking, budding, grafting, and mulching which are carried out on some specific crops.
The general practices of horticultural crops production from establishment to post harvest processing include the following:-

3.1.1 Land Preparation

Land preparation for sowing involves land clearing and tillage. Land clearing may be done manually (using machete, hoe), mechanically (using bulldozers!, stumper) or chemically (using non-selective herbicides in zero or no-tillage system). Bush burning (uncontrolled, controlled) helps to get rid of fallow or excess debris. Except in mechanical land clearing, farmers retain the heavier, bigger and more economically-useful trees such as palms, fruits, exportable timber, nitrogen-fixing trees, some of which also help to preserve the soil environment.

a. Tillage involves the turning of the topsoil either manually (traditionally, minimum tillage) mechanically (conventional tillage), essentially targeted at creating a favourable environment for crop establishment. Primary tillage loosens the soil and mixes in fertiliser and/or plant material, resulting in soil with a rough Contenture. Secondary tillage produces finer soil and

sometimes shapes the rows. It is done by using various combinations of equipment such as mouldboard plough, disc plough, harrow, dibble, hoe, shovel, rotary tillers, subsoiler, ridge- or bed –forming tillers, and rollers. No-till farming involves the growing of crops without tillage through the use of herbicides, genetically-modified (GMO) crops that tolerate packed soil and equipment that can plant seeds or fumigate the soil without really digging it up. Tillage uses hoofed animals, animal–drawn wooden plough, steel plough and tractorised ploughing.

b. Planting/Transplanting

Seeds of many crops can be planted by direct sowing in well-prepared field plots. Direct seed-sowing is achieved by broadcasting (especially for small seeds), drilling and planting in holes. In manual planting, seeds are sown using planting stick or cutlass. Mechanical planters are available and some of them perform combined operations such as seed sowing, fertiliser and pesticide application simultaneously. Vegetative parts are usually manually planted in holes dug in soil with a cutlass and at reasonable depth, or mechanically. For some crops, seeds require pre-nursery (e.g. oil palm) or nursery (e.g. tomato) where seeds and seedlings are hardened for subsequent field establishment. Growth chambers, nursery bags and seedbeds are also required for germinating some crops. Transplanting involves carefully moving seedlings (potted, unpotted 'nursery transplants') at appropriate times from the nursery to the field, during the rainy season or under copious irrigation. Field planting of crop propagules requires adequate spacing to obtain optimum yields.

3.1.2 Watering

In transplanted crops, copious watering is required immediately after transplanting for initial seedling establishment on the field. Irrigation, through controlled application of water over a crop field, is required for dry season planting and production of crops. Proper irrigation leads to increased yields from more plants and higher yields from healthier plants. Over irrigation should be avoided. Poor drainage usually which causes water logging resulting in poor crop establishment, growth and salting of farmland should be avoided. The type of irrigation to be adopted depends on the water source, method of water removal and transportation of water. Techniques of watering include manual system using buckets (bucket irrigation), sub-irrigation (seepage irrigation), lateral move (side roll, wheel line) irrigation, centre-point irrigation, sprinkler (overhead) irrigation, drip/trickle irrigation, localised irrigation, surface irrigation and in ground irrigation.

3.1.3 Fertiliser Application

Fertilisers are chemical (inorganic) or organic materials containing plant nutrients, which are added to the soil to supplement its natural fertility or replenish lost fertility. There are many types of fertilisers, namely nitrogen fertilisers (primarily supply nitrogen; ammonium sulphate (AMS), calcium ammonium nitrate (CAN), urea), phosphorus fertilisers (primarily supply phosphorus; single superphosphate (SSP), triple superphosphate (TSP), basic slag, natural rock phosphate), potassium fertilisers (primarily supply potassium, potassium chloride (KCl), potassium sulphate, (K_2SO_4)potassium-magnesium phosphate, (K_2SO_4- $MgSO_4$), and mixed fertilisers (e.g. NPK 15-15-15, NPK 20-10-10, NPK 23-13-13, mono-ammonium phosphate (MAP), di-ammonium phosphate (DAP), potassium nitrate (KNO_3). Fertilisers may be applied by

broadcasting, row placement by banding and ringing, or topdressing by either method. Micronutrients are also applied as foliar sprays to target crops. Organic fertilisation involves manuring (especially the ageing farm), green manuring (through ploughing of non woody fresh plants) and composting (use of compost consisting of crop residues, straw, manure, kitchen wastes, etc.). Also liming is done which involves the application of lime, steel slag or other materials to the soil to increase its pH level and subsequently, improve conditions for the growth of both crops and micro-organisms. Natural sources of lime are coral, marl, wood ash and steel slag. Artificial sources are lime, ($CaCO_3$) and CaO (unslaked lime). In a closed irrigation system, artificial fertilisers and pesticides are applied through "fertigation" (application of water and fertiliser at the same time).

3.1.4 Mulching

This involves the covering of the ground in a crop field with organic (dead, living) or inorganic materials (stones), especially to protect the soil from degradation and ensure sustainable agriculture. Organic mulch materials include crop residues, straw, leaf-litter, prunings', weed free compost and black soil. Inorganic mulch materials such as paper, biodegradables, stones and plastic films are particularly desirable for physical weed control in high premium Vegetables and greenhouse crops.

3.1.5 Weeding or Weed Management

This involves all aspects of weed control, including prevention of spread and land use practices and modification in the crop's habitat that interfere with the ability of the weeds to adapt to the crop's environment. The three methods of weed management approaches are:

i. Preventive Approach- This involves preventing the incidence of weed infestation through plant quarantine, animal quarantine, fallow management, farm sanitation, rogging isolated stands, preventing weed seeding, re-seeding and propagule regrowth and weed contamination of crop prop gules. Other measures are choice of variety and field, planting rather than sowing, crop sequence, accurate sowing and planting, using certified weed-free plants, seeds, growth media and soil amendments.
ii. Eradication Approach- This involves the complete removal of a weed species from infested land. It is achievable in non agronomic situation but undesirable in agro-ecosystems. The reasons for this are that it is too costly, it disturbs natural ecosystem functioning and the activity of bioagents may lead to crop failure.

iii. Control Approach- This involves the suppression of weeds populations to a tolerable level that renders the cropping situation economically safe for agricultural production. It is the most important and environment-friendly approach to weed management in agro-ecosystems. The different methods of control approach are cultural, mechanical, chemical and biological control.

a. Cultural weed control involves any practice adopted by the farmer in his crop production effort not directly aimed at weed control. The practices help to minimise the number of weeds in the crop, suppress competition by surviving weeds and reduce weed seed production, thereby making the crop more competitive with weeds. The practices includes shifting

cultivation, land preparation (stale seedbed), clean crop propagules, crop rotation, mixed cropping and mulching or soil cover with plant residues or plastic mulch. It is very efficient in controlling weeds in subsistence (peasant) agriculture.

b. Mechanical weed control involves any procedure governing direct physical removal or suppression of weeds on agricultural lands. These include hand weeding, hand hoeing, slashing, mowing, cultivation/tillage, flooding, burning (flaming) and smothering with non-living (in situ) mulch.
c. Chemical weed control involves the use of chemicals (herbicides) at toxic concentrations to kill or suppress (interrupt normal growth and development) of weed growth.
Herbicides may be inorganic (early types) or organic (most herbicides) compounds, which may be primarily selective (benzoic acids, carbamates) or non-selective (bipyridylium salts, glyphosate). They can also be applied pre-plant, pre-emergence, post-emergence or postmaturity to the crop. Herbicides are of diverse formulations, including solutions, emulsifiable concentrates, wettable powders, flowables, granules, liquids, pellets suspensions, dust, paste, micro-encapsulation and micro-granules. A major limitation of chemical weed control is the insufficient specification of chemicals under the mixed farming systems of the humid tropics. The National Advisory Committee on Weed Control (NACWC) has published "Weed Control Recommendations for Nigeria", Series 3, under the sponsorship of the Department of Agriculture, Federal Ministry of Agriculture, Nigeria.
d. Biological weed control is the use of natural enemies (bioagents) of weeds in weed control. The organisms may be predators (fish, insects, snails), parasites (nematodes, plants) and pathogens (fungi, bacteria, viruses). Other methods are live mulching, preferential grasing, cover cropping of food and non-food species, allelopathy, crop manipulation and myco-herbicides (plant pathogens). However, biocontrol enhances shifts in weed species composition and possible allelopathic interaction.
iv. Integrated Weed Management- This is a weed management method that economically combines two or more weed management systems at low inputs to obtain a level of weed suppression superior to that ordinarily achieved with one weed management system. It ensures that weed interference is kept below threshold economic levels, thus preventing economic loss to the farmer. It is aimed at efficient and economic use of resources with minimum hazard to the environment and ultimately, sustained crop production.

3.1.6 Pest and Disease Control

Pests and pathogens are among the most serious factors limiting economically-efficient crop production and utilization of natural resources in both tropical and temperate agriculture. Pests, which cause damage to crops, consist of both arthropods (winged and wingless insects, mites, millipedes) and non-arthropods (slugs, snails, nematodes/ eelworms, birds, mammals). Micro-organisms such as viruses, bacteria, fungi and mycoplasma cause crop diseases, such as anthracnose, leaf spots, mosaic virus disease, bacteria wilt, blast and stem and root rot. Approaches to pest and disease control are many and varied, but they are broadly based on the principles of prevention, control/curative and eradication in special situations. The methods include physical, cultural, biological, chemical and legislative measures. These include the use of resistant crop varieties (less effective than in disease control), cultural methods (crop rotation, burning, soil cultivations, soil drainage, crop sowing time, removal of alternative weed hosts and

crop residues and plant quarantine), chemical methods (pesticides) and prophylactic measures for pest control.

In disease control, resistant cultivars of crops have been successfully bred for multiple resistances to diseases, crop rotation (most common), weed control, soil drainage, type of soil cultivation, low nitrogen fertilisation, choice of sowing date and destruction of inoculums sources. Legislative measures include seed certification schemes and preventing the movement of diseased plants within a country.
In pest control, a large number of pesticides is available for the control of soil-borne diseases by the use of sterilants, protectant fungicides, systemic fungicides and air-borne diseases by use of foliar protectant fungicides e.g. maneb; foliar eradicants; foliar systemic fungicides, benomyl. Generally, insecticides and fungicides are most commonly applied to crops during the post-planting period.

3.1.7 Prunning

This is the practice of cutting or removing unwanted or diseased branch of shrubs, hedges, trees to maintain regular shape for the plant and/or prevent disease from spreading to other parts of the plant. Pruning is sometimes done with a view to regenerate old trees. Unskillful pruning may lead to unnecessary injuries to trees with consequent reduction in yield. Light pruning is recommended although; the frequency of pruning depends on the rate of growth of trees. Unwanted vegetative parts (lateral suckers, chupons, branches) should be removed as close as possible to the stem from which they emerge preferably at an early stage, to save the trees from wasting their phosynthates on unwanted growth. A light weight cutlass or pruning saw is the most suitable tool for most pruning operations. A sharp knife or secateur should be used for removing chupons, lateral suckers, young flushes and branches. A heavy bow saw is recommended for removing big branches and stems. Pruned surface should be painted with ordinary paints or any sealing compound.

3.1.8 Staking

This is the process of providing support for plant stems or vines. It is commonly practiced in tomato and yam production. In yam, staking enhances crop leaf exposure to full sunlight for optimum growth and yield. In tomato, staking prevents lodging and fruit rot by infection by soil pathogens.

3.1.9 Harvesting

This is the practice of removing crop produce e.g fruits, seeds, flowers etc when they are ripe for marketing or processing. Harvesting is one of the important operations that decide the quality as well as the storage life of produce and helps in preventing huge losses of fruits and Vegetables. The difficulty or ease of harvesting operation and how it is done depends on factors such as the, the part of economic importance, the growth habit (annual or perennial), the market needs or uses, the maturity pattern and others. Peppers are harvested differently from apples. Potatoes are dug up while oranges are picked. The same crops may be harvested in two different ways for two different target markets e.g mangoes for near market are

harvested when fully ripe while for distant market, they are harvested when they are ripe but still green. Some cultivars of crops are determinate in growth habit and therefore exhibit even maturity and ripening. In other cultivars and certain species, the product (indeterminate) matures at different times and hence requires multiple rounds of harvesting.

3.1.9 Methods of Harvesting

Different kinds of fruits and Vegetables require different methods for harvesting their produces. The methods of harvesting are;

a. Manual or hand harvesting
This is the use of hand to uproot, cut and pick or pluck crop produce. This is done when the produce can be reached with the hand and it is more economical and easy.
b. Mechanical harvesting
This is the use of machines and tools to harvest crop produce. This is done when crop produce cannot be reached with the hand and it is more economical for the crop. Usually, mechanical harvesting is done in commercial farms. Combine harvester machine is the common machine used for this purpose. Mechanized harvesting is generally indiscriminate (good and bad fruits are picked) and it is capital intensive. However, it saves time and large area can be covered within a short time. Mechanized harvesting is adapted to crops that mature uniformly.

3.1.10 Post – Harvest Cultural Practices

These are activities carried out after harvesting till disposal. Major activities include: Preservation, Processing; Storage and Marketing. Affiliated activities include: Transportation and Handling.
Processing:
This is the process of value addition of farm produce to the form that is most acceptable to the consumer. It can be partial or total. Most leafy vegetables are only partially processed for preservation. They can be trimmed, washed, sliced and then dehydrated for preservation. e.g.Amaranthus, Celosia. Some fruit vegetables can also be sliced and dried for preservation. e g. Pepper, Onion. Some leafy vegetables can be blanched in hot water. Fruits may be totally processed into paste or slurry in the factories for canning. Vegetable seeds can be threshed, winnowed and dried for preservation.
Storage:

Vegetables, in the fresh state are not usually stored for a long period. Storage/Preservation is usually done to keep vegetables for only a short period. Vegetables are usually highly perishable in nature, and so, do not store for a long time. Short-term storage can be done, using clay pots or padded materials. Storage should be done under cool, humid conditions. Refridgeration can be used for some vegetables. Freeze – storage is usually not appropriate.
Marketing:
This is the movement of the vegetable from the farm gate to an accessible area for the consumers. The vegetables should still retain their good nature. The means of transportation to achieve the goal should be considered. The time of arrival at the market should also be

considered. The quantity and the quality demanded by the consumers should be considered. Appropriate packaging material and method should be used.

4.0 Conclusion

In this unit, you have learnt that crops have similar cultural practices used in their production. However, horticultural crops require some specialised cultural practices that make them special crop. All a farmer needs is to adopt and adhere strictly to the cultural practices that are peculiar to a specific crop to obtain maximum yield from the crop.

5.0 Summary

You have learnt that cultural practices are all the preparations and cure given to plants before, during growth and harvesting of the plant. This starts from land preparation which includes clearing, tillage and planting/transplanting; watering; fertiliser application; mulching; weeding; pest and disease control to harvesting of the crop. These practices should be carried out carefully and at recommended number of times or at appropriate time to achieve a meaningful crop yield.

6.0 Tutor -Marked Assignment (TMA)

1. List five (5) practices that are carried out on horticultural crops
2. Discuss five (5) conventional practices that are both carried out on horticultural crops
3. Explain the two (2) methods of harvesting crops

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Unit 3 Post Harvest technology and Handling of Horticultural Crops

1.0 Introduction

Horticultural crops are cultivated for their produces which are harvested at the end of a production period. The produce harvested are either marketed for immediate and industrial utilization or stored for future used. What happens to harvested produce of any crop before they are taken by consumer is known as post harvest technology or operation. In this unit, you shall be studying post harvest technology and handling of horticultural crops to marketing of their produce.

2.0 Objectives

At the end of this unit, you should be able to:

- explain the post harvest operation of horticultural crops
- list the post harvest operation of horticultural crops
- state the importance of post harvest operation
  explain the storage of unprocessed horticultural produce
- explain the methods of preservation of horticultural crops
- list the processes of handling horticultural crops.

3.0 Main Text

3.1 Post Harvest Technology

Postharvest technology involves all treatments or processes that occur from time of harvesting until the crop produce finally reaches the consumer. Efficient techniques for harvesting, transportation, handling, storage, processing, packaging, marketing are components of postharvest chain and all this activities are aimed at adding value to the produce and reduce losses. Harvesting is normally included as components of postharvest because the way produces are harvested have a large bearing on the postharvest life of the crop produce. Postharvest treatment largely determines quality, whether a crop is sold for fresh consumption or used as an ingredient in a processed food product. The most important goals of postharvest technology are keeping the product cool, to avoid moisture loss and slow down undesirable chemical changes, and avoid physical damage such as bruising and to delay spoilage.

3.2 Handling

This is the practice that is carried out on immediately harvested crop produce before they get to the consumer. Before horticultural crop produce reaches the table or consumer, it undergoes a number of postharvest handling processes which depend on the crop type and the form it will be presented. Handling includes the following.

i. Washing

This is the cleaning/washing of crop produce from soil and dirt particles before packaging or marketing it to consumers. Vegetables are generally not washed before packaging or marketing. They are usually managed such a way that they are clean while growing through close spacing or mulching in the field. However light shaking and sticking with hand is done to remove the particles that stick on the Vegetables. Fruits such as apples may be washed before packaging or marketing. Root Vegetables such as carrot are generally washed to remove the soil before marketing. Onions and other bulbs are not washed but are cured (dried) under the sun to increase their shelf life. Because horticultural products from above-ground plant part are not washed before packaging, the consumer should routinely wash the produce before use.

ii. Sorting and Grading

After harvesting, the produce are hand sorted or separated into different categories (ripe, unripe and discards). Sorting and grading are two postharvest operations designed to group products into quality classes for pricing and use. Hand harvesting allows only a certain quality of products to be picked, and hence sorting and grading may be done in one operation in the field for certain crops. Some products are sorted and graded and are packed as they are picked and transported directly from the field to the intended market or consumers. During the process of sorting, defective and immature products are eliminated and so also diseased products. However, cracked or broken products and those with blemishes are removed but not always discarded. They are placed in a lower quality category or grade and sold at a lower price. The good product or premium quality grade are solid with higher price. Each crop has its own quality standards that are used for sorting and grading. Fruits are frequently graded on the basis of size.

3.3 Storing Unprocessed Produce

This is the act of preserving harvested products to extend their shelf life for future use. Horticultural crops are mostly perishable and they have to be stored properly to avoid postharvest losses. The storage conditions (especially temperature, humidity and light) and the kind of crop affect the duration of storage the crop can withstand before deteriorating. The general goals for storage are to slow the rate of respiration occurring in living tissues and to conserve moisture in the tissue to prevent dehydration. These goals are accomplished by providing the appropriate temperature (usually cold or cool), maintaining good levels of oxygen and carbon dioxide and controlling humidity. As a general rule, cool season crops are stored at low temperature ranging between 0-10°C while warm season crops are stored at warmer temperature (10-12°C). Fruits and Vegetables should be stored at higher relative humidity to retain their succulence and general quality. Lettuce and spinach require 90-95% relative humidity while garlic and dry onion require 70-75% relative humidity. Light may cause produce such as potato tuber to be green and as such require darkness or aim light in the storage areas. There are generally two methods of storing unprocessed products. They are low temperature method and low moisture method.

3.3.1 Low Temperature Method

Temperature is known to affect the rate of respiration which may produce heat and cause rotting in products. Low temperature slows down all biological and enzymatic reactions of stored produce. Temperate or cool-season crops generally tolerate lower temperature than tropical crops, which are readily injured by cold. The mechanism for cooling is by refrigerating using the refrigerator. Refrigerated trucks and containers are used to transport fresh horticultural produce over long distances without spoilage. The temperature required for this type of storage range between 0 -10°C.

3.3.2 Low-Moisture Method

Many crops including grape, date, apples may be preserved for long periods by drying. Solar dehydration (use of sun for drying) is a relatively inexpensive method for drying in areas where the sun shines for a long period. The products are spread in appropriate container and exposed to dry and warm air. For more rapid dehydration of large quantities of produce, the forced hot air method, which involves air heated to 60-70°C is used. The moisture content of produce to be stored using this method should be as low as 8-12% depending on the type of crop and its nature.

3.4 Fumigation

Storage of dry grains and fruits, such as grapes and citrus, require fumigation to rid the environment of rodents, insect pests, and decay-causing organisms. One of the widely used fumigants is methyl bromide, which are effects in storage houses. Sulfur dioxide is used to protect grapes from decay.

3.5 Preservation of Horticultural Produce

3.5.1 Freezing

One of the quickest and most commonly used methods of crop produce preservation is quick freezing, whereby a fresh produce is kept in a freezer. The main disadvantage of this method is the damage it causes to the physical or structural integrity of some products. For example, frozen tomato does not remain firm after thawing but assumes a soft Contexture; consequently, use of the product may be limited by freezing. For best results, freezing should be done rapidly. Slow freezing causes' larger ice crystals to form in the cells of the tissue and ruptures them. These large reservoirs of water in fractured cells give frozen produce a soft Contexture upon thawing. Rapid freezing results in tiny crystals that do not rupture cell. Quick freezing temperatures are around 29-40°C. Stored produce may lose some colour, flavour, and nutrients. To protect against dehydration, produce to be frozen must be packaged (e.g. in plastic wrap). Failure to do so will lead to freezer burn, resulting from sublimation of water to ice, with adverse consequences such as deterioration of flavour, colour, and Contexture.

3.5.2 Canning

Canning is another method used in preservation after placing the produce in air-tight or hermetically sealed containers; they are sterilised in a pressure cooker. Instead of using water, brine (a salt solution) may be used to preserve vegetables such as onion, beet, and pepper. The intense heat used in sterilisation changes some quality traits such as colour, Contenture, and flavour, as well as nutritional value. Low acid produce (pH 4.5 to 7:0) such as Vegetables requires very high temperatures for sterilisation to kill the bacteria that cause food poisoning (Clostridium botulinum). Canned products can stay in good condition for several years. However, because heat treatment does not kill all bacteria, spoilage sets in after some time in storage. The salt in canning corrodes the can and reduces the shelf life. Also, humidity and high temperatures accelerate spoilage.

3.5.3 Fermentation

Fermentation involves bacteria that decompose carbohydrates anaerobic ally. Some of the producers of fermentation prevent the growth of bacteria. The produce differs according to the organism, conditions and duration of the process. Fermentation may produce alcohol and lactic acid, products that affect the flavour of fermented foods. Alcohol may further ferment to produce vinegar. Certain fruit juices are deliberately fermented to produce alcoholic beverages (e.g. grape juice becomes wine). A special fermentation process involving the use of salt is called pickling. Vegetables that are pickled include cucumber, onion, cauliflower and tomato; pickled cabbage is called sauerkraut. Instead of using bacteria in packing, pickles may be produced by placing product directly in citric acid or vinegar.

3.5.4 Processing with Sugar

High concentration of sugar may be used to preserve certain fruits products. The sugar increases the osmotic pressure to a degree that prohibits microbial activity and thereby reduces spoilage opportunities. Different fruit products may be preserved in this way. When fruit juice is used, the products are called jelly. Jam involves concentrated fruit while marmalade is sugar processed citrus fruit and rind. When whole fruits are used, the product is called a preserve.

3.6 Marketing

Marketing in the simplest form entails the supply of satisfactory products by a producer to a consumer at a price acceptable to both. In more advanced market economies (and even in less advanced ones) where division of labour occurs, a host of service providers (called middlemen) operate between the producer and the consumer. The service provider include packaging, storage, transportation, financing, and distribution sometimes the fresh product changes in nature between the farm gate and the consumer's door, as is the case when middlemen add value to the product by processing it into other secondary products. In spite of the activities of middlemen some growers deal directly with consumers.
The characteristics of a horticultural enterprise are:

1. Horticultural products are highly perishable; they lose quality rapidly.
2. Many horticultural products are bulky to transport.
3. Prices for horticultural products are not stable.
4. Some storage may be required in a production enterprise.
5. It is important to identify a market before producing horticultural products.
6. Seasonality of the products.

4.0 Conclusion

From the explanations in this unit, you have learnt that for consumer to get value for their money and producer to get income they deserve, it is the duty of the farmer to present his product in a form the consumer will appreciate and buy and so he needs knowledge of post harvest technology. The farmer or any other processor involved in the marketing chain carry out the task of one or many post harvest technology to add value to the crop before they are finally consumed by the consumer.

5.0 Summary

You will note that postharvest technology involves all treatments or processes that occur from time of harvesting until the crop produce finally reaches the consumer. Post harvest technology start with the harvesting of the crop which determines the success of the post harvest technology practices and add value to the crop or product before it reaches the final consumer. The aim of post harvest technology is to present crop products at a form that the consumer will appreciate at all times. Post harvest technology involves handling after harvest, storage, processing, preservation and finally marketing of the produce or product.

6.0 Tutor-Marked Assignment (TMA)

1. Explain the storage techniques of horticultural crops
2. List the different forms of preservation of horticultural crops
3. State the characteristics of horticultural crops

7.0 References/Further Reading

George, A. (2004*).* *Horticulture- Principles and Practices.* (2nd ed.). Eastern Economy Limited. Pp 3-720.

Unit 4 Pests and Diseases of Vegetables and Fruits

1.0 Introduction

It is estimated that world crop losses due to pests are of the order of about 35 per cent of potential yield, but in most tropical countries of Africa and Asia, the field and store losses are of a higher magnitude and may be as high as 50 per cent in some cases. Fao estimates showed, for example, that nearly 100 million metric tons of cereals grains are destroyed by pests each year. Diseases are estimated to caused about 10 per cent loss of the annual agricultural production in the U.S.A and about 20- 30 per cent in the developing countries. Therefore, it is now widely recognised that the reduction of losses due to pests and diseases is an important element in increasing the efficiency of crop production. Definition of pest and diseases, description of disease causing organisms, symptoms of plant diseases and control and preventive measures are extensively discussed in this unit.

2.0 Objectives

At the end of this unit, you should be able to:

- define and classify pests according to feeding pattern and economic threshold of destruction
- state the effects of pest on crop production
- analyse and prescribe the best practices of pest control
- analyse the symptoms of plant diseases and identify the kind of diseases that may be affecting a particular crop based on the symptoms
- prescribe the methods of controlling plant diseases.

3.0 Main Content

3.1 Definition and Classification of Pests

Pest is any animal or plant which harms or causes damage to man, his animals, crops, or possessions. On agricultural basis, a pest is that which causes a loss in yield or quality of the crops resulting in loss of profits by the farmer. When a loss in yield reaches certain proportions, then, the pest can be defined as an economic pest. Economic threshold is defined as the population density at which control measures should be started to prevent an increasing pest population from reaching the economic injury level.

3.1.1 Classification of Pests on the Basis of Economic Threshold

i. The Regular Pests
These are pests which perennially damage crops and whose population levels rarely fall below the economic threshold. Examples of these are Maruca testulalis on cowpea, Dysdercus spp. and red boll-worm on cotton, sorghum midge and Quelea birds in most parts of the grain producing Guinea and Sudan savanna of tropical Africa.

ii. The occasional pests
These are pests whose populations levels are normally below the economic threshold but occasionally rise above it. Examples of these include locusts that periodically ravage cereal crops and grasses in Sub-Saharan Africa, the stem borers and armyworms of cereals in western and eastern Africa, the variegated grasshopper, Zonocerus variegates, in West Africa, and many species of snails and lepidopterous larvae attacking deciduous forest trees, and arable and plantation crops.

iii. The potential pests
Those pest whose population levels are usually considered to be far below the economic threshold but which can become highly injurious under changed cultural conditions or as introduced pest. Examples of these include many species of grasshoppers and caterpillars in western and central Africa

3.2 Description of the Important Pests of Crops

The arthropods which comprise the insects, mites, millipedes and woodlice constitute the most dominant group, other organisms include: nematodes, rodents, birds and mollusks.

1. Insects
Insects belong to a group of organism known as arthropods. Insect pests are grouped into three basic classes according to feeding patterns, namely:
- Biting and chewing.
- Sucking.
- Boring insects.

i. Biting and Chewing Insects
These are insects which have biting mouth parts consisting of a pair of toothed horny jaws (mandibles) and a pair of accessory jaws. They tear and bite plant parts in their larval or adult stages. As a result, most of the leaves on the plant are eaten up. The grasshopper or locus, chewing beetle, the larvae of many butterflies and moths, the caterpillars are all examples of chewing insects.

Variegated grasshopper, Zonocerus variegates

ii. Sucking Insects

These insects are made up of a long, powerful, piercing proboscis with which they suck the liquid cell contents from leaves, stems or fruits. Sucking of the liquid cell content has weakening effect on plants but the ability to transmit plant diseases such as viruses is the most serious effect which sucking insects have on crops.

The commonest types of sucking insects are those which have proboscis both at the immature and mature stages of growth. These insects feed on the stems and young fruits of many crops and may also introduce poisonous toxins into the crop tissues. Capsids and aphids are typical example of this group of insects that attack both young and old shoots and pods of cocoa. The cotton stainer is a troublesome sucking insect pest of cotton. It feeds on the young pods, and reduces the commercial value of cotton by staining the lint.

Other types of sucking insects include; scale insects, mealy bugs and aphid. Scale insects have shell that protects them during adverse weather condition and from predators. Fruit piecing moths are sucking insects which feed mainly on citrus fruits.

Citrus mealy bug

iii. Boring Insects

These have mouth parts which are adapted to digging holes through plant and material. The cowpea weevil which infests cowpea is a good example of boring insect.

Bean or cowpea weevil

2. Nematodes

These are small organisms which are normally referred to as eelworms. Nematodes can cause a considerable damage to crops such as yams, cowpea and many Vegetables. A disease known as root-knot disease of cowpea, for example, causes the formation of irregular nodules on the roots and dwarfing of the mature plant.

3. Rodents

These are mammals with teeth which are well adapted to gnaw or grind hard substances. They include mice, squirrels, porcupines, rats and grass cutters. These animals may damage fruits and vegetables and are particularly very injurious to young seedlings of oil palm, rice, sugar cane, and the tubers of root crops such as cassava. The larger rodents such as squirrels and grass cutters can be trapped, and wire netting fences may be erected to protect crops from damage. Small rodents can be prevented from destroying young seedling of palm trees by placing collars of small-mesh wire netting around the base of the trunk.

Rodent (rat)

4. Birds
Birds of various types may do considerable damage to grain crop farms by eating both developing and dry grains. Quelea quelea birds are by far the most populous and destructive birds in Africa. They invade crops like locust and cause heavy damage. Attacking the birds at their nesting and resting sites provides the most effective method of control. Toxic chemicals sprayed at dusk, has been found to be cheap and effective.
5. Mollusks
Garden snails and slugs may damage leaves of many kinds of Vegetables.

3.3 Effects of Pests on Crop Plants

b. Direct Effect of Insect Feeding
i. Leaves eaten, with subsequent reduction in assimilative tissue and hindrance of growth. Examples are grasshoppers, caterpillars, sawfly larvae, leaf-cutting ants, leaf beetle and some weevil.
ii. Leaves rolled and webbed, and eaten. Examples are larvae of skippers, and all Lepidoptera.
iii. Leaves mined with either tunnel or blotch mines, e.g. spinach leaf miner
iv. Buds eaten, destroying either the growing point of young flowers and fruit, e.g Budworms (caterpillars) of rose and Grape Flea Beetle
v. Flowers and young fruit eaten, as by pollen beetle, blister beetles.
vi. Fruits and seeds eaten or bored and destroyed, as by sorghum midge larvae, pea pod borers, maize weevil, coffee berry borer and various fruit flies.
vii. Fruits bored and caused to fall prematurely for example mango fruit fly, and coffee fruit fly.
viii. Stems of both woody and herbaceous plants bored, with subsequent death of the distal part of the stem, for example Earias spp in cotton stem.
ix. Stems of seedlings bored, producing a dead-heart, for example Athergona spp. larvae in cereal seedlings, and Chilo spp. larvae in cereals.
x. Stem of woody plants ring-barked, as done by Anthores spp. on coffee.
xi. Roots eaten, causing a loss of water and nutrient absorbing tissue, for example chafer grubs and some weevil larvae.
xii. Tubers and corms bored, leading to a reduction of stored food material, and impairing both storage properties and next season's growth; examples are Cylas spp. weevils in sweet potato tubers, yam beetles and potato tuber moth larvae.

b. Damage by insects with piercing and chewing mouthparts and mites
i. Loss of plant vigour due to removal of excessive amounts of sap, resulting in extreme cases in wilting, followed by stunting of growth; for example most aphid species, and whiteflies on a range of crop plants.
ii. Cause leaf-curling and deformation, as shown by aphids, thrips, mealybugs, white/black flies and jassids.
iii. Cause premature leaf-fall, as do many diaspidid scales.
iv. Cause leaf and fruit scarification by rupturing epidermal cells and removing sap; as by spider mites and many thrips.
v. Toxic saliva injected by feeding bugs causes premature fruit-fall in coconut and abortion of young cotton bolls etc.
vi. Provides physical entry points for pathogenic fungi and bacteria.

C. Indirect Effect of Insects on Crops
i. Insects can make the crop more difficult to cultivate/ harvest.
ii. They may distort the plant as do Earias spp. larvae on cotton.
iii. They may delay crop maturity, as do the bollworms in cotton, which makes the plant to develop a spreading habit thus making weeding and spraying difficult.
iv. Grain in cereal crops may become dwarfed or distorted.
v. Insect infestation results in contamination and loss of quality in the crop. The loss of quality may be in nutritional value or in marketability.
d. Transmission of Disease Organisms
i. Cassava mosaic, tobacco mosaic and banana bunchy top are typical examples of crop diseases that are transmitted by insect vector.
ii Mechanical or passive transmission takes place through lesions in the cuticle caused by feeding. The pathogen, usually a fungus or bacterium, may be carried on the proboscis of the bug or on the body of a tunneling insect.

Self -Assignment Exercise

i. Define pest
ii. State 5 direct effects of pest
iii. State 3 important pest of Vegetables crops

3.4 Insect Pest Control

The control of the various insect pests affecting crop plants is a major problem for crop production. Insect pests may be controlled by means of various cultural practices, the use of chemicals known as insecticides and, biological methods of insect control.

1. Cultural methods of insect control
i. Hand Picking: For example, fully grown adult grasshoppers and caterpillars of some insects may be partially controlled by hand picking.
ii. Crop Rotation: Since insects are generally selective in the choice of crops they attack a rotation of crops which can result in a reduction of insect number when new crops are planted.
iii. Tillage Practices: Ploughing and harrowing normally reduce the population of soil pest by exposing them to sunlight and desiccation, and to predators and parasites.
iv. Weed Control: some weeds act as host to insect pest, timely control of weeds would deprive them of their host.
v. Adjusting Time of Planting to Avoid Period when Insect's Population is at its Peak. For example sorghum midges can be effectively controlled by planting early so that flowering is complete before the adult midge population reaches damaging levels.
vi. Resistant Varieties: Pest may also be controlled by planting pests resistant varieties. New varieties, resistant to an increasing number of insect pests have been produced in recent years by the research institute.
vii. Timely Harvesting: Prompt harvesting is known to help protect maize and beans from damage by maize weevil and bean bruchid.

viii. Observance of a Closed Season: Some pest cannot survive in the absence of a specific host plant. Observing a closed season for the cultivation of this plant provides effective control. A good example is the pink bollworm (Pectinophora gossypiella), provided no cotton is grown during the closed season, this pest is deprived of a carry-over site for the next season, with the result that its population is kept below the level at which it causes serious economic loss.
ix. Trap Cropping: A trap crop is used to divert the pest from the main crop. The pest usually prefers it to the main crop for feeding or egg laying. The trap crops are grown in strips at appropriate intervals within the field. The pest population concentrates on the trap crop, while the main crop suffers little damage.

x. Optimum Plant Density: The biology of both pest and their natural enemies can be affected by plant density. For example, bean fly infestation in kidney bean is less severe in densely planted crops than in thinly planted ones. Similarly, populations of aphid (Aphid craccivora) are lower and the spread of rosette virus, of which this insect is a vector, is less rapid on more densely sown fields of groundnut.
xi. Crop Sanitation: Clearing crop fields after harvest and burning crop residues to destroy over wintering pest populations are important cultural practices.
xii. Cropping patterns: for example, intercropping controls the spread of pest.

2. Chemical Method of Insect Pest Control
The most effective method of controlling insect pest is by spraying or dusting crops with insecticides. The choice of insecticide will depend on the feeding habits of any particular insect. Biting and chewing insects are usually controlled by the use of stomach poisons. Example of stomach poisons are lead arsenate and Paris green while contact poisons are sprayed to kill the insect upon contact. Examples of contact poison include Gammexane, Lindane, nicotine sulphate, Gammalin 20, Didimac 25, etc. Insect pest of stored products are generally controlled by fumigants (insecticides which kill by poisonous vapours or fumes). Fumigants may either be gaseous, liquid, or powder forms. Examples are carbon disulphide, hydrogen cyanide (gas) sulphur and methyl bromide.

3. Biological Method of Pest Control
Biological control refers to the use of living organisms for the control of pests. The use of predators which feed on harmful insects and reduce their number to a minimum is recommended if there will be no adverse effect. Broadly speaking, biological control also includes the use of pathogens such as bacteria, fungi, viruses, protozoan, and nematodes. Biological control using parasites and predators has been effectively utilised in the control of Kenya mealbug (Planococus kenyae) by Anagyrus spp.

3.5 Plant Diseases

Plant diseases can be defined in the broadest sense as conditions of the plant involving abnormalities of growth or structure. It is this departure from the normal healthy condition, resulting in the appearance of disease symptoms, which enables diseases to be recognised. The most important effect of plant diseases for the farmer is the reduction in crop yield or quality which usually occurs as a result as disease infestation.

3.5.1 Symptoms of Plant Diseases

Many diseases can be recognised immediately by the characteristic symptoms which they produce. Symptoms are usually described according to their appearance. Symptoms of plant diseases include the following:

i. Death of the Tissues or Necrosis: Various terms are used to describe the extent and shape of necrotic lesions, particularly on leaves, stripe for narrow, elongated lesions, scorch, scald, fire and blotch for indefinite areas which often become blanched and then brittle.
ii. An Abnormal Increase in the Tissues: This can result from both an increase in size (hypertrophy) and an increase in number (hyperplasia) of cells. The more common symptoms of this type are witches brooms, galls, canker and scab.
iii. A Failure to Attain Normal Size or Development (hypoplasia): An overall dwarfing or stunting of the plant is common in many diseases.
iv. Change in Colour: Yellowing or chlorosis is a common symptom of disease and is often associated with tissues surrounding a necrotic area.
v. Wilting: Caused by an interference with the normal movement of water within the plant resulting in the drying up of the plant.
vi. Unusual Development or Transformation of Organs: for example maize infected with Ustilago Maydis; The staminate inflorescences may bear pistillate flowers.
vii. Disintegration of Tissues: This is termed as rot. It may be accompanied by a release of cell fluids (wet rot), so much so that there is an exudate from partially disintegrated tissue. Alternatively, the cells may crumble to a powdery mass (dry rot).
viii. Excessive Gum Formation: This is particularly associated with diseases of trees and is known as gummosis or gumming.

3.5.2 Causes of Plant Diseases

Disease can be caused by various agents either acting singly or in combination with another, and the study of these agents is known as etiology of the disease. The agents themselves fall into the following categories:

i. There are the bacteria, fungi and viruses which together probably account for the greatest number of diseases.
ii. Nematodes.
iii. Some insects (excluding those that only serve as vectors for disease agents).
iv. A few flowering plants such as broomrape (Orobanche), dodder (Cuscuta) and witch weed (Striga).
v. Heterogeneous group which includes mineral deficiencies and excesses.
vi. Unfavourable environmental conditions.

Disease-inciting agents that are themselves living organisms are called pathogens. The term parasite and host describes a nutritional relationship between two organisms, but the growth of a parasite in its host usually result in changes which are detrimental to the plant and considered on its ability to induce disease. A parasite can also be a pathogen.

Parasites causing plant disease can be classified according to their dependence upon the host plant as:
- Obligate
- Facultative

i. Obligate Parasites
These organisms can only grow directly on the host plant and cannot generally grow saprophytically on non- living organic matter. Their survival in the absence of a suitable host depends upon dormant resting stages in the life cycle, such as spores. An obligate parasite depends critically upon the existence of the host. They cause only fairly mild symptoms such as growth malformation, stunting and discoloration. They would not kill the host.

ii. Facultative Parasites
These are usually well adapted to a saprophytic existence and can survive long periods in an active stage in the absence of a suitable host. The destruction of the host is of less consequence to the facultative parasites which therefore cause more immediate and drastic damage, such as necrosis and wilting.

1. Causal Agents of Crop Diseases
i. Fungi
The majority of plant diseases are caused by various parasitic fungi. Most parasitic fungi are facultative although some are specialised obligate parasites, such as powdery mildews (erysiphaceae) and rusts (uredinales). Fungal pathogens, although differ in form are characterised by the production of spores which enable them to spread between plants.

Many parasitic fungi disperse their spores through water, in rain splashes or are carried in air. Some fungi attack crops at or below the soil level while others are dispersed by insects or through seeds. The dispersal of spores is aided by the fact that most fungal spores are very small and are also produced in large number. When the spores of these fungi fall on a suitable host plant they grow into its tissue, absorb food and develop reproductive sporangia.

a. Some common diseases caused by the genus phytophthora include:
- Phytophthora palmivora which causes black pod disease of cocoa.
- Phytophthora infestans which causes potato and tomato blights.
- Phytophthora parasitica which causes stem rot of tomato.

Stem rot of tomato

c. Some common diseases caused by the genus Pythium include a number of soil inhibiting fungi which usually enter the host plant through wounds and subsequently cause rotting. Seedlings infected by Pythium spp. turn black and rapidly die; this is often referred to as damping off diseases.

Damping off disease causing dead of seedling

- Many crops are attacked at the seedling stage by Pythium debaryanum which rapidly causes death of the seedlings.
- Watery wounds rot of potato tubers is often caused by Pythium ultimum.

The genus Peronospora includes species which are widely referred to as downy mildew diseases. Examples are:
- Peronospora destructor; which infests crops such as onion.
- Sclerospora graminicola which attack guinea corn.

c. The genus Puccinia, include many different types of rust and smut diseases. They form rust coloured spore patches which develop on the epidermis of the infected host plant. These fungi infect graminaceous crops such as maize, guinea corn and rice, making the grains worthless for both food and planting materials.

ii. Bacteria

These microscopic organisms are generally capable of survival where other living organism cannot exist, such as water, the tissue of plants, dust particles and damp soils. Bacteria usually enter into the tissue of crops through wounds, stomata, flowers or fruits. The symptoms of bacterial infection are varied, but the most common ones are decay, accompanied by an unpleasant odour. Examples of bacterial diseases are: blight diseases of guinea corn and bacterial wilt of tomatoes, tobacco, garden eggs and peppers. Affected plants rapidly wilt, collapse and die. Citrus and mango fruits are liable to infection due to bacteria entering the wounds made by sucking insects or birds.

Bacterial wilt of tomatoes

iii. Viruses

Viruses are a group of extremely minute organisms which are visible only through a powerful electron microscope. They are very highly specialised obligate parasites and can only exist within living plant cells. Most often they cause obscure symptoms easily confused with mineral deficiencies of other environmental effects. Plants infected with diseases due to viruses show varying symptoms such as change in leaf colour, malformation such as swollen shoots, mosaic leaf patterns and distortion. Others are reduced leaf formation, leaf spot, rings and streak on leaves and stunted growth.
Most viruses spread between plants by means of living vector, usually insects or nematodes, which themselves become infected with the virus, after feeding on a diseased plant. Many viruses can be carried by insects, particularly sucking insects such as aphids, mealy bugs and leaf-hoppers. The knives used in budding and grafting may also transmit viruses if used on infected plants. Viruses are rarely disseminated through seeds. Examples of common viruses which affect crops are:

- Cassava mosaic virus (CMV).
- Capsicum leaf curl virus (CLCV).
- Cocoa swollen shoot virus.
- Tristeza virus which affects citrus.


Capsicum or pepper leaf curl virus

Control measures against virus diseases are usually aimed at the vector, but use of resistant crop varieties and clean planting material are also important in the control against virus diseases.

3.5.3 Measures of Controlling Plant Diseases

Plant disease control is concerned with preventing or at least restricting the development of plant disease epidemics. Most control measures for plant diseases are designed to prevent rather than cure the disease. They aim to operate on the pathogen before it has established a parasitic relationship with the host.

3.5.4 Principles of Plant Disease Control

Two of these methods of plant disease control are mainly concerned with the pathogen:

- If the pathogen is not already present in an area then methods are devised to exclude it (exclusion);
- If the pathogen does get in then attempts are made to eradicate it (eradication).

The other two methods of plant disease control concern the host:

- By applying a chemical to the plant surface or by modifying the condition under which the plant is growing it is often possible to protect it from attack (protection).
- By breeding, it is sometimes possible to obtain varieties of the particular plant which resist attack by the pathogen (breeding for disease resistance)

Control measures can be classified into various categories; these include cultural practices, the destruction of insects by chemicals and the development of disease resistant varieties.

A. Cultural Practices

i. Crop Rotation

Important pest and diseases such as cyst nematode and club root, attack specific crops. By the simple method of planting a given crop in a different plot each season, such pests or diseases are excluded from their preferred host for several seasons.

ii. Destruction of Infected Material

An important cultural practiced is the eradication of suspected sources of plant diseases. This includes the uprooting of weed hosts and alternate hosts and the removal, burning or burying of diseased plants, particularly those infected by bacterial or virus diseases. Diseased tree crops should be treated by pruning away diseased portions of individual plants, after which all cut surfaces, should be treated with white lead paint.

iii. Ploughing

This brings about physical improvement of the soil structure as a preparation for growing of crops. Ploughing improves drainage and tilt of the soil. The improved drainage and tilt may reduce damping-off diseases, expose soil pest to the birds.

iv. Soil Fertility
While the correct and balance of major nutrients in the soil are recognised as vitally important for maximum yield and quality, excessive nitrogen levels may encourage the increase of insects such as peach potato aphid, fungi e.g. grey mould. Adequate levels of potassium help control fungal diseases e.g. Fusarium wilt on carnation, and tomato mosaic virus. Club root disease of brassica is less damaging in soil pH greater than 6 and lime may be incorporated before planting these crops to achieve this aim. Dressing with suitable fertilisers may stimulate growth of the host plant so that it will recover from damage caused by disease.

v. General Farm Sanitation
Reasonable sanitary precaution on the farm helps to prevent the introduction of diseases from other fields. Some virus diseases are spread by contact. Therefore, clothing, machinery, and equipment that have been in use on such infested fields should be disinfected before being used on other fields.

vi. Seed Treatment
To avoid seed borne diseases being carried over from one season to the next, seed to be planted is often treated with a fungicide, e.g. Arasan.

vii. Avoidance
Sometimes, a pest or disease is most prevalent at a certain time of the year. The planting may be so timed that the crop grows during the time when the disease or pest incidence is least. For example the deliberate planting of early potato cultivars enables harvesting before the maturation of potato cyst nematode, so that damage to crop and the release of the nematode eggs is avoided.

b. Chemical Method of destruction of Insect Vectors

i. Use Chemicals (Insecticides)
The control of insect vectors which carry disease has been effective in reducing the spread of some diseases such as swollen shoot disease of cocoa and mosaic disease of cassava. Aphids and leaf-hoppers which transmit these diseases can be controlled by the use of insecticides e.g Aldrin dust.
ii. Fungal diseases are controlled by chemicals referred to as fungicides. These chemicals may be sprayed or dusted on to the seeds, young leaves, shoots or flower buds before the arrival of the fungal spores.
iii. Seed treatments are normally effective when the disease is transmitted via seed. Diseases such as smuts or rust may be controlled by soaking the seeds in fungicides before sowing. Certain chemicals (soil fumigants) are effective in controlling nematodes, soil-borne insects and soil borne diseases.
iv. Repellents; Repellents are chemicals which do not actually kill the pests, but they repel them from coming near the plants.
c. Biological Control
A more recent approach to the control of plant pests and diseases is biological control, which emphasises the control of diseases and pest through manipulation of natural and ecological factors.

i. Planting Disease-Resistant Varieties; the use of disease resistant varieties of some crops has proved to be very successful in the control of plant diseases.
ii. Biological control also refers to control of diseases by the use of other organisms to reduce inoculum density or the disease producing activities of the causative agents of diseases.
d. Physical Method
i. Treating seeds of cereals in hot water to kill the loose smut pathogen (Ustilago nuda), and floating of cereal seeds to separate healthy grains from those infected by ergot (Claviceps purpurea) are two examples of physical method of disease control.

ii. Grain smut of sorghum may be controlled by soaking seed in water for 4 hours to initiate germination of the fungal spores. The seed is then spread out to dry, first in the shade and later in the sun, causing the germinating of spores to be killed without harming the seed. Physical methods of this kind may be widely applicable in Africa for certain diseases, and represent one of the more feasible control options available to smallholders.

4.0 Conclusion

This unit concentrated on pest and diseases affecting crops. It explained the nature and characteristics of pest, effects of pests, the control and preventive measures. Diseases, symptoms of plant diseases, causative organisms, control and preventive measures were also treated. It stressed that the effective control of pests and diseases should be based on a sound knowledge and understanding of pests and diseases of a particular crop in a given locality.

5.0 Summary

This unit discussed pest and diseases of crop plants. The characteristics of pests and how they destroy crop produce and how to tackle them were also treated. Diseases, definitions, symptoms and causes of plant diseases were highlighted. The different methods of disease prevention and control were enumerated and discussed.

6.0 Tutor-Marked Assignment (TMA)

1a. Define the term pests.
b. Categorise pests based on pattern of feeding.
c. Enumerate the direct effects of pests.
2a. State the principles of pest control.
b. Describe the cultural methods of pest control.
3a. Distinguish between localised and systemic symptoms of plant diseases.
b. Give the generalised symptoms of plant disease.
4a. Explain the chemical method of disease control.
b. Briefly describe the physical method of disease control.
c. List the cultural practices of diseases control.

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Unit 5 Horticultural Tools and Machineries

1.0 Introduction

Contribution of horticultural and floricultural crops to the total agricultural production in the country is quite significant due to highly favourable and varied agro-ecological diversities. Major field operations for horticultural crops include nursery/seedling preparation, post hole digging for planting, ear thing, irrigation, plant protection, harvesting, handling, packaging transport. The cultivation of horticultural crops is predominantly dependent upon human labour, since commercial cultivation is only on a limited scale. Animal/power tiller or tractor-drawn mould board ploughs, disc ploughs, harrows, cultivators and rotavators, are available and used for land preparation.

2.0 Objectives

At the end of this unit, you should be able to:

- list the different types of horticultural tools
- state the uses of the different types of horticultural tools
- explain the type of machineries used in horticultural fields

3.0 Main Content

3.1 Horticultural Tools and their Uses:

Some important tools used in horticultural farms include the following:
Pick Axe.
The pick axe is made up of a long wooden handle with a double headed thick metal blade that is attached to the handle through a loop. The head of the pick axe is made up of two edges, one part of the end of the blade is pointed, while the other end is flat and sharp edged. They are mainly used for breaking up of hard soil, and digging up of roots and tree stumps.
Axe
The axe is a simple hand tool, which consists of cutting edge and an eye for fixing of a handle. It is multipurpose cutting tool used for felling and delimbing of trees, splitting of logs for firewood and dressing of logs for timber conversion. Small axes are also used for clearing of bushes.

Axe

Cutlass

The cutlass is one of the commonest used farm tools in Nigeria. They come in various shapes and sizes. It is a flat long metal blade with a short wooden or plastic handle with one edge sharp while the other is blunt. They perform many functions. It is used for the clearing of bushes around your homes, for the felling of big trees. It is used in harvesting crops like sugar cane, maize, cassava, yam and palm nut fruits. It is also used in the planting of melon during the planting season, cutlass can also be used for the transplanting of seedlings, weeding of crops, both in the digging of shallow holes and used in the trimming and pruning of flowers.

Cutlass

Hand Fork

When it is viewed, the hand fork, looks like the kitchen fork we eat with, just that it is a little bit bigger; it has a short wooden or metal handle with four prongs. It is used in mixing manure into the soil, for breaking the surface of the soil, so that air and water, can pass easily and it is also used for the removal of weeds on the seed bed.

Hand fork

Hand Trowel

It is boat shaped or it is either curved sloop metal blade that is attached to a short wooden or metal handle. When using it, you hold it with one hand. It helps in the transplanting of seedlings, for the application of fertiliser and also for the application of manure to the soil, it helps in loosening vegetable beds, it can also be used for light weeding, sampling or mixing up of soil and digging holes for the planting of seeds.

Hand trowel

Sickle
The sickle has a curved metal blade that is fitted into a short wooden handle. The inner part of the curved metal blade is very sharp while the other part, has a blunt edge.

To recognise a sickle when been viewed, it has a structure like that of a question mark (?). It used in the plucking of fruits. This can only be possible, when it is tied to a long handle, it can also be used to harvest cereals like rice, wheat barley because they possess thin stems. It can also be used in the harvest of grasses.

Hammer
It is made up of a thick heavy metal head that is fitted into a straight wooden or metal handle. At the end of the thick heavy metal there is a prong which is used for the removal of nails. The hammer can be used for driving nails into wooden structures whether in the farm or at home, it can also be used to straighten damaged or bent components of either farm implements or our home furniture. It can also be used in the removal of nails from wood.

Mallet
It is made up of a large head with a wooden handle that is similar to that of a hammer. The entire body is made up of wood. It is solely used for the hitting of woods like pegs, so that they would not be damaged in the process, when they are been hit into the ground.

Hoe
Hoe comes in different types, which are used in Nigeria today. There is the West African hoe and the Indian hoe. They both have metal blades with wooden or metal blades. The West African hoe is made of short curve handle while the Indian hoe has a long handle. Hoes are used in tilling the soil, harvesting of crops like cassava, sweet potato and cocoyam, weeding between the rows of crops, digging of drains, making trenches and foundation of farm houses, and the making of ridges and mounds.

Hoe

Spade

The spade is made up of a long rectangular flat blade which is attached to a fairly long cylindrical handle that widens at the posterior end to form a triangular block with a D-shaped whole for hand when used. Spade is used for different proposes. It can be used for digging of holes and trenches around us, for leveling the ground, for making seedbeds, ridges, mounds and heaps, transplanting of seedlings like palm oil seedlings, turning the soil and the mixing of manures, light weeding in the farm and at home, mixing of cement and concrete for farm and home structures and the digging of foundations when constructing farm and home buildings

Spade

Watering Can

It is made up of galvanised iron which prevents it from rusting. Some are also made of very synthetic rubber. The water watering can is made up of a tank, a handle and a spout. This spout is long with a perforated metal sheet over its mouth which is referred to as the ROSE, but in case of the rubber made watering can the mouth is covered by a rubber. It is used to apply water to crops like seedlings in a nursery and vegetables. Sometimes it is used in applying liquid fertilisers to crops as well as the watering of cement blocks used for the constructions of structures and buildings.

Watering cans

Garden Fork
It is used for turning manure during compost making and for spreading manure in the open field. It is also used for loosening the soil before transplanting.

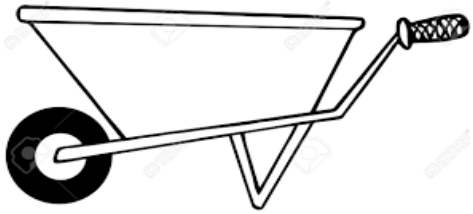
Digging mattock: It is used for digging and uprooting small stumps

Rake
A rake is used for levelling soil surface and breaking large soil crumbs into small ones. It is also used for removing stones and weeds from seedbeds and for covering vegetable seeds when they are broadcast.

Rake

Garden Line
It is used for lining up beds and for making straight line when planting.

Wheel Barrow
It is used for conveying materials (tools, seedlings, manure etc) to and fro the farm



Wheel barrow

Tape
A tape is used for taking short or detailed measurement on the field.

Ranging Pole
It is used for marking surveyed stations or intermediate stations. It is also useful in marking straight lines

Budding and Grafting Knife
The budding knife is an important hand tool of a gardener, which consists of a folding blade and a handle. The blade has two edges. One of the edges is sharpened all along its length; whereas the blunt or the other edge is sharpened on the tip and is slightly curved. It is use for budding and grafting in vegetables, nurseries and fruit gardens. The knife is also used for cutting of thin unwanted twigs, defoliation of leaves and general cutting works in nurseries and orchards.

Budding knife

Secateurs
The secateurs are made up of two metal blades of which one has a concave curve while the other has a convex curve that are joined together at a point. It has two short metal handles with a spring in between them when handling it; you handle with one hand, while the plant branch to be cut is held with the other free hand. To recognise the secateurs it looks like a pair of scissors. It is used for trimming flowers and the pruning of the branches of shrubs and trees. They are also used for pruning vines.

Secateurs

Chain Saw

It is also called power saw and is a light and portable machine. Cutting is done by an endless chain fitted with cutters, which runs around a flat piece called the bar. The chain saw is used to trim dead or diseased wood from trees, to remove inconveniently placed branches or fell trees.

Chain saw

Shears

It is seen as a pair of an enlarged pair of scissors with two long blades, connected at a point by a bolt and a nut of which the blades are sharpened at one edge not the two sides in other not to injure someone. The handle of the shears may be made of wood, metal, plastic or rubber. It is usually handled with both hands. Shears are used to prune down trees or branches of shrubs, trimming of hedges and trimming of ornamental plants used in house decoration. It is also used for cutting of shrubs and removing of haphazard growth in gardens and lawns.

Shears

Lopping Shear

The lopping shear is used for pruning and cutting of branches and twigs of the orchard trees in standing position, which are beyond the reach, and capacity of pruning secateur.

Lopping shear

Grass Shear

The grass shear is simple hand tool used in maintenance of lawns The grass shear is used for trimming of the grass in the lawn. It is also used for side dressing of the lawn and cutting of the soft vegetative material. The shear with 'U' spring steel handle having sharp edges can also be used for shearing of sheep wool.

Grass shear

Crowbar

The crow bar is made either from the structural steel or from medium carbon steel. It is used for digging holes or pits for planting and fencing

Crowbar

3.2 Horticultural Machinery and Implement

The machines are elements that are used to direct the action of forces based energy work, for his part in the agricultural, motor mechanisms used in this work lighten the production and improve farming techniques. Most widely used horticultural machines include:
Tractor: Is a very useful agricultural machine, with wheels or designed to move easily on the ground and pulling power enabling successful agricultural work, even in flooded fields. It has two brake pedals and is preparing to pull sledges. There are two types of tractors: the track of stability and strength, and wheels, able to travel to by road, has a higher speed than the track.

tractor

Walking Tractor: Agricultural machine is a single axle and is operated by handles, have median motor power and strength led to horticultural and ornamental work, can work in strong fields, but is preferably used in construction of gardens.

Walking Tractor

Sprayer: It is a farm equipment designed to spray, is composed of a liquid tank, pressure pump, cap, mouth, tank and pressure valve, belts, hose, faucet and nozzle where the liquid to spray out, is insecticide, fungicide or herbicide. The hand sprayer is placed in the back of the sprayer

and this has placed in the mouth and nose a special mask to prevent strong odours dismissed by the substance that expels the sprayer will harm.

Sprayer

Knapsack Sprayer

This is equipment that is used for spraying chemical on the farm.

Knapsack sprayer

Mower

Mower is a machine that is used for cutting lawn and grasses in the field, farm and homes.

Mower

Farm equipment is a group of devices designed to open furrows in the ground, shredding, spraying and fertilising the soil.

Plough

Agricultural equipment is designed to open furrows in the earth consists of a blade, fence, plough, bead, bed, wheel and handlebar, which serve to cut and level the land, hold parts of the plough, set shot and to serve as handle. There are various types of ploughs but the best known are:

- mould board plough, formed by the grating blade and mould board
- disc plough, disc concave formed by deep grooves to open
- shallow ploughing to remove the topsoil
- Subsoil plough to remove the soil depth.

Plough attached to tractor

4.0 Conclusion

For ease of farm operation in horticultural fields, there is need for the farmer to use farm tools and machineries. This help to make his work easier, faster and enable the farmer cover a larger area within a short time. Commercial farmers used machineries in most of their farm operation while subsistence farmers used local farm tools.

5.0 Summary

In this unit, you have learnt about farm tools that can be used in horticultural farms such as hoe, rake, spade, cutlass, hand trowel, watering can, budding and grafting knife etc and there uses on the farm. You also learnt about farm machineries that can be used in horticultural field for ease of farm operation. These machineries include:

i. Tractor
ii. Mower
iii. Sprayer
iv. Walking tractor

6.0 Tutor -Marked Assignment (TMA)

1. List ten (10) farm tools and state there uses
2. Attempt the drawing of a knapsack sprayer

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