



ABOUT THE AUTHOR

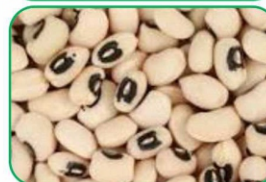
Dr Taiye Femi Olawepo was born on the 14th of October, 1971 in Zaria, Kaduna State, Nigeria. The author is a Chief Lecturer in Kwara State College of Education Ilorin, Kwara State, Nigeria. He attended University of Ilorin for his B. Agric. and M.Sc. (Agronomy) and Ladoke Akintola University for his Ph.D. in Crop Production. The author also holds Post Graduate Diploma in Education from University of Ado-Ekiti (Now Ekiti State University, Ado-Ekiti). He is married to Mrs A. A. Olawepo and blessed with two children Oluwatobiloba and Oluwatomiloba

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INTRODUCTION TO CROP PRODUCTION TAIYE FEMI OLAWEPO, PhD

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INTRODUCTION TO CROP PRODUCTION



OLAWIPO TAIYE FEMI (Ph.D)

**Department of Agricultural Science Education,
Kwara State College of Education, Ilorin.**

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Department of Agricultural Science Education,
Kwara State College of Education, Ilorin.

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DEDICATION

To God be the glory, this book is dedicated to the Almighty God who saw me through the writing of this book and late Mrs. Ruth Bola Olawepo for her financial support, prayer, and encouragement in my career.

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CHAPTER ONE

MEANING OF CROP PRODUCTION

Agriculture has been defined as the preparation of the soil, planting of crops and rearing of livestock for man use, preparation of the matured plants and animals' products and bye-products for both local and international market. It can also be viewed as all the activities involved in the cultivation of the soil and the production of crops and live stock from soil preparation to marketing of the plant and animal products.

Agricultural activities involved in agriculture can be one of the following: crop production, livestock rearing, horticulture, marketing of agricultural products, extension of research output to the farmers, selling of agricultural inputs, forestry, etc.

However, crop production is part of agriculture dealing with land preparation, planting, crop maintenance, harvesting and storage of crops for the benefit of man.

History of cultivation of crops

In the beginning early man depends on wild fruits and seeds and he searches for these fruits and seed for his daily food requirements. With population, the food supplied by the wild fruits and seeds was no longer sufficient to meet his needs, which gave rise to the cultivation of crop production. Crop production began about nine thousand years ago when planting of crop became necessary to argument the plant need supplied from the wild. The practice of crop production is older than modern civilization, with all the essential features has remained unchanged. These main features early crop production were:

1. Gathering and preservation of fruits and seeds from plants
2. Destruction of the biomass in the area settled
3. Tilling the soil to make ridges
4. Planting
5. Remover of unwanted plant
6. Protection of crop from enemies, and finally
7. Processing and storage of crop.

The early husbandman planted few crops, with cereals being the first to be planted. The primitive husbandman is mainly manual and believes in God to drive evil spirits that may affect their crops. With advancing civilization, modern techniques were introduced to crop productions.

The first successful domestication of plants by man occurred in Thailand in Neolithic times. Agriculture in the 1st century A.D. was limited to cultivation of common crops like wheat, clover, barley and alfalfa with similar procedure to those produced today except that they have now been produced using modern crude implements and had undergone several crop improvements.

The ancient practice of crop production still exists particularly in Nigeria and other third world countries of the world. However with increase the understanding of nature and environments, several discoveries have helped to improve the ways to control plant diseases and insect pests effectively, found supplements to improve soil fertilities determine and develop new varieties of crop that is high yielding. Other areas where sciences have helped agriculture include control of weeds with herbicides, improved cultural methods that resulted in better farming system. Modern farmers discovered now that crops yield better when fertilized and weeds were effectively control with close spacing. Empirical studies quickly revealed most appropriate time, where and when to plant crops. These ideas were developed through the generations and eventually, the exchange of ideas and knowledge, through agricultural research institution, agricultural societies and publications in journals and newsletter helped to spread the knowledge of crop productions.

Importance of crop production

Crop production is crucial to human survival, development and civilization for the following reasons:

i. **Food Supply**

- Provides food for man and feed for livestock

ii. **Employment Opportunity**

Provides employment for the citizens, hence it serves as a

means of livelihood for unskilled workers.

- Provides job opportunities for scientist and researchers

iii. **Provision of raw Materials for Industries:**

- Many manufacturing industries use agricultural products as the raw materials.

Agro based industrial transform agric produce into finished goods.

Examples of agro based industries that depend on agricultural products in Nigeria are:

Industry	Product
Flour mills	Wheat, cereal /grains
Fruit canning	Fruits
Breweries:	Cereals
Paper Industry	Pulpwood

iii. **Foreign Exchange Earner**

Agriculture is one of the main sources of the foreign exchange earnings. e.g certain crops, e.g cocoa are produced mainly for export.

iv. **Sources of Income:**

- Selling of agricultural products provides incomer farmers
- Agriculture contributes largely to the national income.

v. **Provision of Shelter**

Modern buildings are built with planks

- Wood products are used as doors, windows, furniture, etc.

vi. **Rural Development**

Rural areas are market centres for agric products.

- This has led to the provision of social amenities such as motorable roads, hospitals, electricity and pipe borne water.

vii. **Afforestation / Forestry**

- Firewood and charcoal (fuel) for cooking and manufacturing of matches are obtained from forest products.
- Woodlands are home of wild animals and are used as tourists centres.

CHAPTER TWO

PRINCIPLES OF CROP

The process involved in raising crops can be outlined as follow:

- i. **What to plant:** This is the beginning of farming activities and very critical as all other activities is hinged on this decision. The decision of what to plan will determine, all other activities carried out by the farmer. Examples of what the farmer will plant are maize, yam, beans, cashew, oil palm etc
- ii. **Where to plant:** After the farmer have decided what to plant, the next decision is where to plant. In Nigeria the right that assigned the ownership of land to an individual or group of person is called land tenure system.

Different types of land tenure system

The major types of land tenure systems in Nigeria are as follows:

1. Community Land Tenure System

The community land tenure system involves the process where the community has the legal right on the land. The approval for land ownership is vested on the authority of the community's ruler. This approach may lead to fragmentation of land.

2. Leasehold Tenure System

A person is having the ownership of land based on the agreement with the owner of the land. The individual may have temporary access to the land during the lease time.

3. Tenants at Government Will

Tenants at Government will is where government have the ownership of the land and distributes land to farmers. The land is usually cheap to purchase as it is a mean of incentives to farmer.

4. Gift Tenure System

The transfer of ownership rights from one person to another is known as the gift tenure system. The new owner has the right to the land and can be used as collateral for a loan.

5. Freehold Tenure System

The individual pays an amount of money in exchange for the land. It may be costly to purchase land. The land can be utilized to

obtain loans from banks and can easily be transferred to another owner.

6. Inheritance Tenure System

The transfer of land ownership to the offspring following the death of the parent is known as an inheritance land tenure system. The next of kin of the landowner is usually the children who assume the role of new landowners under this system.

7. Rent Tenure System

In a rent tenure system, a tenant pays to the land owner to use the land for a length of time. In comparison to leasehold arrangements, the rent period is short.

Advantages of Nigeria's land tenure system

It's a relationship between an individual and their host communities on usage of their land.

It's a system that allows the owner to use the land and its natural resources.

It is governed by "Decrees," which address all matters concerning lands.

Disadvantages of Nigeria's land tenure system

It can lead to different perspectives among people based on their belief and interest.

- iii. Land preparation:** This involves cutting down bushes, trees and shrubs. This can be done manually using a cutlass or mechanically with machines such as root rakers, tree pushers, shear blades etc and this is followed by tillage operations.
- iv. Planting:** Planting is the actual placement of the seed or vegetative materials into the soil. Sowing or planting could be by seed or seedling or planting of vegetative material. Some crops are propagated solely through seeds, e.g. maize, rice, cowpea, some by vegetative means, e.g. cassava, yam, and some by both seeds and vegetative means e.g. onion, cocoa, coffee.
- v. Maintenance of crop:** These are all activities carried on the planted crops after germination to maturity. For farmer to reap the benefits of all what he had invested, he needs to give proper care and attention to the germinated crops so that they can survive and reach maturity.

- vi. **Harvesting and processing:** The act of collecting or gathering matured produce on the farm is called harvesting. The objective of harvesting is to gather all matured crop with little or no harm to the mother plants. Crops are harvested when they are matured for the purpose for which they are produced. The treatment given to harvested product before consumption is called processing. Crop processing includes drying threshing, cleaning, milling, grinding, bagging, etc.

CHAPTER THREE

CLASSIFICATION OF CROPS

Crops can be classified in two major ways:

1. Botanical classification: This is based on the morphology of plants.
2. Agronomic classification: This is based on their uses.

1. Botanical classification

This classification is based on morphological similarity among plant parts. Crop belong to the spermatophyte division and within this group, crop belong to the subgroup called angiosperms. This group is characterized by having their ovules enclosed in an ovary wall. The angiosperm is further divided into the monocotyledon and dicotyledonous. All the grasses are monocotyledonous plants while legumes and other crops are dicotyledonous plants.

i. The grass family

The grass family includes all the cereals crops which are either annuals, or perennials crops. The grasses are majorly herbaceous plants they have hollow cylindrical stems. The stems are consisting of nodes and internodes with the leaves parallel-veined.

ii. The legume family

Legumes are annuals, biennials or perennials with high plant protein. Leaves are usually alternate on the stems, with netted veins and mostly compound. The flowers are always arranged in racemes pattern and the seed poded

iii. Other families

This group contain other botanical families apart from grass and legumes:

Cannabaceae (hemp), Polygonaceae (buckwheat), Chenopodiaceae (sugarbeets,) Cruciferae (mustard), Linaceae (flax), Malvaceae (cotton), Solanaceae (tobacco) and Compositae (sunflower)

2. Agronomic/economic classification

This is the classification of crops is based on their use or usage. We have the following:

i. Cereal or Grain crops

These are manly grasses. They are grown for their seeds which are rich in carbohydrate. They are taken by man to supply the energy requirements in the diets. Examples of cereals include rice, millet, maize, sorghum. etc.

ii. Legumes

They belong to legume family. They are grown for their edible seeds, which are high in protein they are also rich in vitamins and carbohydrate e.g cowpea, soybean, groundnut. They are all enclosed a pod and belong to the family Leguminosa.

iii. Oil crops

The oil crops are crops that contain useful oils examples include soya bean, groundnuts, sunflower, sesame, and cotton seed.

iv. Root and tuber crops

Plant whose edible portions are the underground tuber. The storage organ may be stem (yam) or root (cassava), and it contains high carbohydrate. Examples are carrot, yam, cassava, potatoes and cocoyam.

v. Fiber crops

These crops that are grown mainly for the fibre they produced and not for eating. The fibre could be found in the leaf, seed (cotton) or stem (kenaf), etc. Examples are cotton, jute, kenaf and sisal.

vi. Sugar crops

These are crops that contain sweet juice called sucrose which can be extracted and crystallised. Examples are sugar beet, sugar cane etc.

vii. Forage crops

Forage crops are crops that can be harvested fresh and then utilised as fed to animals as feed. Examples are legumes, grasses etc.

viii. Vegetable crops

They are crops high in vitamins and materials. They can be eaten raw. They are either seed or fruit vegetable. Examples include

tomato, pepper, okra, as fruit vegetable or leafy vegetables like Amaranths, celsia, corcorus, fluted pumpkin, etc).

ix. Latex crops

Latex crop like rubber are grown for the sap they produced.

x. Stimulant of Crops

Stimulant crops eaten by man for their stimulant effect they produced on their body. Examples are kola, coffee and tea.

CHAPTER FOUR

CROP NUTRITION

For plant growth and development there is a need for regular supply of nutrients to plants especially the primary nutrient. During crops, nutrients are absorbed from the soil, through the root system in solution however not all of them are essential. Crop nutrients are in two forms, essential and the non-essential. There are only sixteen elements that have been found to be essential for crop growth and development.

Essential elements for crop growth

The essential elements are required for the formation of plant protein and protoplasm. Examples of essential crop elements are nitrogen, oxygen, hydrogen, sulphur, phosphorus and carbon. The other ten elements are manganese, iron, potassium, boron, molybdenum, copper, magnesium, calcium, chlorine and zinc.

Sources of crop nutrition

The following elements used by crops are derived:

1. From air i.e. carbon from CO_2
2. From water i.e. hydrogen and oxygen as from soil water
3. From the soil, through both organic and inorganic manure:

Micronutrient and Macronutrients

Macronutrients are required by crops in large quantities and must be added to the soil if the soil is deficient in any one or more of these nutrients. The primary nutrients are nitrogen, potassium and phosphorus while calcium, sulphur and magnesium are referred to as secondary nutrients because of their secondary importance in crop nutrition.

Micronutrient elements are required in small amounts for proper crop growth and development. They are not usually of fertilizer much concerned and if not enough in the soil, they are added in very small amount.

Functions of crop nutrients

Nitrogen

1. It require for plant vegetative growth
2. In the crop, it produces amino acids and proteins.
3. It is necessary in all process involved in the development and yield crop.

Phosphorus

1. It plays a great role in the transfer of energy in plant.
2. It is essential for photosynthesis
3. it is important in the chemical-physiological process in the crop.
4. It is important for cell division, , differentiation and development plant of tissues

Potassium

1. It used for enzymes formation.
3. It plays a great role in the synthesis of carbohydrate and protein..
4. It improves the water regime of the crop and increases plant tolerance to drought,
5. It reduces the risk of the crop to be affected by diseases.

Magnesium

1. It is an important constituent of chlorophyll use for photosynthesis.
2. It is use for the formation of enzyme require for the reactions related to the energy transfer.

Sulphur

1. It is important constituent in the formation of protein
2. It is used in the formation of chlorophyll.

Calcium

1. Calcium is essential for growth of root hair.
2. It is an important constituent of cell wall.

Micronutrient elements

Micronutrient elements are iron, copper, molybdenum, zinc, manganese, chlorine and boron. They are required in small quantities for crop growth and development. They are taken up in small amounts through the roots and they are hardly insufficient in plant and hence not a serious concern in fertilizer applications.

Deficiency Symptoms

a. Nitrogen

1. It results in stunted growth in crop.
2. Change in the colour of leaves from green to yellow.
3. Dropping of lower leaves.

b. Phosphorus

1. The plant has stunted growth.
2. The leaves turn dark bluish green from tip backward.
3. The crops ripe slowly,.
4. The fruits and seed do not form properly.

c. Potassium

1. The plant has stunted growth.
2. The leaves show discolouration along the margin.
3. The outer edges of leaves becoming brownish and the leave wilt.
4. There is lodging of stem of the plant.
5. The leaves are become curved.
6. Small fruits and may easily be spost during storage.

d. Magnesium

1. Yellowish of leaves between green leaf veins, which may later develop into necrosis at older leaves.

e. Sulphur

1. The whole plant becomes yellow.
2. There is yellowish of upper leaves
3. There delay in crop maturity.

f. Calcium

1. Young leaves which later turn to black and curved.
2. Wilting of the crop.
3. Rotten of fruits.
4. Roots are deformed and start to malformed.

g. Boron

1. The leaves become crinkled, thick and brittle, with white, irregular spots between veins.
2. The growing tips of buds die.
3. Necrotic patches on the leaves and stem.
4. The fruits not properly formed.

h. Zinc

1. There is stunted growth of leaves.
2. The plant becomes shortened with bushy shoots.
3. The leaves become olive green in colour (very similar to P deficiency).

i. Iron

1. the young leaves have typical chlorosis in the veins, along the entire length of leaves.

CHAPTER FIVE

PRE-PLANTING OPERATIONS

A. **Land Clearing**

It involves cutting down bush on a piece of land. It may be done manually using with cutlass or mechanically with machines such as root rakers, tree pushers, shear blades etc.

The choice of land clearing method depends on the:

- Types of vegetation on the land
- Size of the farm land.
- Nature of the soil slope
- Type of crops to be grown.

Only experts should carry out mechanical land clearing so that the top soil (which is crucial to crop production) is not destroyed.

Effects of land Clearing

- i. There is disturbance /removal of top soil
- ii. It brings about increases evaporation/ reduction in soil water
- iii. Increases in soil temperature
- iv. Exposes soil to erosion
- v. Reduction of soil organisms
- vi. Increases leaching/infiltration
- vii. Possible reduction of organic matter.

Bush burning: This involves setting the plant residues on fire. It may be used as a means of land clearing, or to get rid of excess vegetation on the farm.

Advantages of burning:

- i. It destroys weed seeds in the soil
- ii. It destroys soil borne pathogens
- iii. It adds minerals to the soil in form of ash (potassium and phosphate.
- iv. Sterilization of soil. The heat generated kill pests and destroys their eggs.

- v. It is a cheap means of getting rid of vegetation on the farm.
- vi. It affects soil pH through the addition of ash and volatilization of some nutrients.

Disadvantages of Burning

- i. It causes loss of soil organic matter.
- ii. It leads to death or destruction of soil microbes
- iii. There is loss of C, N, S and P from the soil through volatilization
- iv. The soil is exposed to agents of erosion
- v. It encourages loss of soil water.
- vi. Burning can lead to destruction of soil structure.

Stumping: It involves the removal of stump (remnant tree bases in the soil after clearing). It can be done manually with axe, mattock or mechanically with machines like root cutter and stump puller.

Purpose of Stumping

- i. To facilitates further operations on the land
- ii. Avoids damage to farm machinery while working on the land
- iii. Prevents them from serving as alternate host
- iv. Allow for maximum use of the available soil space
- v. Prevents re-growths from competing with crops.

After stumping, there may be need for filling of depression or ditches created during stumping. This is done to facilitate adequate working of tractor on the farm. This is termed 'leveling'. In most cases, leveling is done manually though may be mechanized.

B Tillage operation

This involves tilling of land for sowing of crops. It is otherwise called tillage. It involves ploughing, harrowing and ridging.

It may be described as a way of conditioning the soil in order to provide conducive environment favorable for crop growth. It is divided into primary tillage (ploughing) secondary tillage (harrowing, ridging and zero tillage).

Purpose of Tillage

- To produce a suitable soil tilth
- To control soil moisture

- It destroy weeds
- It incorporate crop residues and fertilizers into the soil
- it help to improves the physical condition of the soil.

Types of tillage

Minimum Tillage

This involves at least two tillage operations which include ploughing and harrowing or ploughing and ridging. This carried out with use of tillage implements like plough and harrow which help to tilt the soil before planting. It is also known as reduced tillage.

Advantages of minimum tillage

- i. It helps to reduced soil erosion and run-off
- ii. It is well adapted for well-drained soil
- iii. It is use for mixing of plant residues and the soil.

Conventional tillage

This is when all the three tillage operations which are harrowing, ploughing and ridging are carried out on the farm to make the soil ready for planting of crops. This involves the use of primary tillage implements like plough this is then followed by the use of secondary tillage implements like harrow or ridger.

Conventional tillage has the following advantages:

- I. Efficient means of controlling weeds
- ii. Planting becomes easy
- iii. Allow for proper seed germination
- iv. Seed emergence is faster

Zero Tillage

This is a situation in which the soil is not disturbed at all in the process of producing seedbed. In this case vegetation on the soil is killed using chemicals (herbicides) like gramazine, weed off round up, etc.

Zero tillage has the following advantages:

- i. Excessive water loss and heat can easily be prevented.
- ii. Reduction in rate of water runs off;
- iii. it adds nutrients to the soil when the vegetative materials

- decomposed.
- iv. There is preservation of soil structure; and
- vi. Reduction in cost of production.

TILLAGE EQUIPMENTS



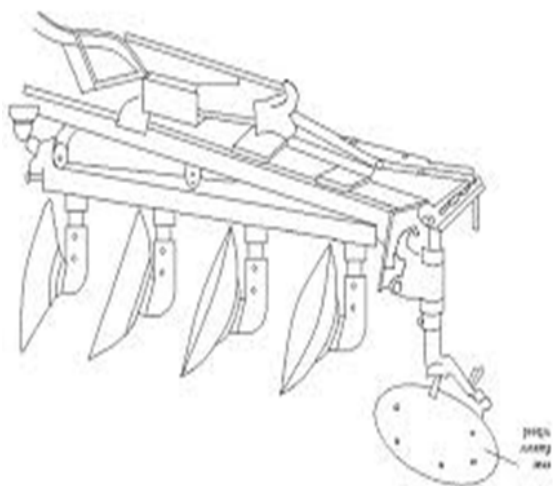
A tractor working on the farm



Disc plough



Ridger



Disc plough

CHAPTER SIX

CROPPING SYSTEMS

Cropping system involves the various methods of production crops on the farm. This term is to describe the pattern in which crops are grown or the various methods of producing crops on the farm in a given locality over specific period of time. It varies from place to place. Cropping systems employed in a place depended on the following:

- a. Level of Technology;
- b. Type of Crop
- c. The amount of resources available to farmers.
- d. The climate influence

The common cropping systems and their characteristics are as describe below:

1. **Monocropping:** This involves growing only one crop season after season on the same piece of land. It is also called sole cropping.

Advantages of monocropping

The practice brings about higher yield. It is easy to handle, fertilizer recommendation and application are easier. Marketing of the product is easy.

Disadvantages of monocropping

It brings about building up of pests and diseases. In case of crop failure, farmers' loss is total; there is rapid depletion of soil nutrients.

2. **Monoculture:** This is defined as growing the same crop on the same piece of land from year to year. For example planting of maize on a given farm land year in year out. It may involve annual, biennial or perennial crops such as maize, sugarcane, cocoa etc.

Advantages of monoculture

The main advantage of monoculture is that it allows maximum concentration of effort on production of one crop which is a permanent crop like cashew as oppose to monocropping which is arable crop.

Disadvantages of monoculture

- a. There is build up of diseases and pests of the crop and these are present year after years.
- b. It encourages rapid depletion of soil nutrients
- c. The risk of crop failure present.

3. **Mixed Cropping:** This involves growing two or more types of crop on a piece of land at the same time. There is no definite spacing. It is common in West Africa where farmer grow yam, maize, melon etc. together at the same time. The system prevents crop failure.

Advantages of mixed cropping

It is an insurance against crop failure; there reduction in pest and disease incident, there is optimum utilization of land and its resources.

Disadvantages of mixed Cropping

Fertilizer and pesticides requirements are difficult to estimate, mechanization of operations is difficult and fertilizer requirement is high.

There are two major types of mixed cropping used by farmers:

- i. **Interplanting:** Is a form of mixed cropping in which the crop planted first is harvested first. For example, when maize and cassava are planted together, maize is harvested before cassava.
- ii. **Intercropping:** It involves planting of two or more crops on the same piece of land and the crop planted first is harvested last. For example, planting of yams and cowpeas together on the same piece of land.

4. **Continuous Cropping:** It involves putting a piece of land under cultivation or cropping from year to year.

Advantages of Continuous Cropping

- a. Maximum and efficient utilization of land is possible. Larger percentage of cultivated land is under cultivation.
- b. Permanent structures can be erected on the farm site.

Disadvantages of Continuous Cropping

- a. May lead to build up of plant disease and pest.
 - b. May lead to soil erosion when the land is cultivated every time
5. **Arable farming:** This involves the cultivation of food crop which are grown and harvest in a year such as maize, rice, yam, cassava etc.
 6. **Plantation Agriculture:** This involves planting of tree crops on large expanse of land, e.g cocoa plantation.
 7. **Crop Rotation:** This is the system that allow for planting different types of crops on a piece of land every year following a definite or sequential order. It also defines as the system of farming whereby different crops are grown on the same piece of land every year in a definite manner so as to allow maximum utilization of soil fertility. The cycle is planned in such a way as to restore nutrients removed from the soil. The number of crops grown varies, where four crops are grown, it is called four-year crop rotation. In this the land is divided into 4 sections, and in each year, different crops like yam, cassava and cowpea are planted.

Principle of crop Rotation: In order to maintain the fertilizer in the soil, certain principles of crop rotation must be observed. These are:

1. Closely related crops should not follow each other. For example yam and cassava should not follow each other in the crop rotation sequence. This is because they will absorb nutrients from the same level in the soil.
2. Shallow- rooted crops like rice and maize should not follow each other because of the same reasons as above.
3. Shallow- rooted crops (e.g maize) should follow deep-rooted crops (e.g yam, cassava).

4. Crop of the same family should not follow one another. This is to prevent the uptake of the same nutrients and also to break the life cycle of pests and diseases that might accompany such crops
5. crops affected by the same pests and disease should not follow each other.
6. There should be fallow period. This is to allow land to rest and the nutrient build up.
7. Cover crops (legumes) should be introduced to increase the fertility of soil.

YEAR OF CROPPING	PLOTS OF LAND			
	1	2	3	4
1 ST YEAR	YAM	BEANS	CASSAVA	MAIZE
2 ND YEAR	MAIZE	YAM	BEANS	CASSAVA
3 RD YEAR	CASSAVA	MAIZE	YAM	BEANS
4 TH YEAR	BEANS	CASSAVA	MAIZE	YAM

Example of crop rotation with four crops

Advantages of Crop Rotation

- a. It is an effective way of controlling diseases and pests on the farm. The causative organism of a particular disease in a crop is will die off when their host crop is followed by non host crop.
- b. Crop rotation may effective control some weed on the farm. Some weeds are particularly adapted to a particular crop, when not planted for many years due their non inclusion in crop rotation sequence, this can help to control some weeds.
- c. Safe guard against crop failure.
- d. Crop rotation is an effective means of reducing erosion. The different crops planted as an effective of reducing erosion.
- e. Maximum utilization of labour.
- f. High return on the land

Disadvantages of crop rotation

- a. Labour is not evenly spread when more than one crop is planted
- b. The risk of crop failure although low but is still present
- c. Crop specialization does not exist in crop rotation

CHAPTER SEVEN

SOIL AND WATER CONSERVATION

Water is used by plant for the absorbing of nutrient in the soil and is a limiting factor for crop production in Nigeria. It determine the planting season as the beginning of the raining season concise with the beginning of planting season except when irrigation is available. It can be limiting even in humid region of the world where there is a need to dispose of excess water. Dry season occur when there is little or no rain and this will definitely disrupt the planting activities. Over 80% of the agricultural land in Nigeria needs irrigation in the dry season. In rain fed agriculture, the constraint may be either uneven rainfall distribution or the quantities of rainfall the soil received and stored in the root zone. Hence there is the need to apply water to the soil through either rainfall or irrigation so that the crops can grow and develop properly. The following are methods used to conservation of soil

i. Mulching

Mulching may be defined as a covering the soil surface with material either organic or synthetic with the intension to minimize evaporation losses and possibly add organic nutrient to the soil. Plant residues like leaves, straw and saw dust can serve as organic mulch material while nylon and plastic materials are used as synthetic mulch materials.

Importance of mulching

1. Mulch materials intercept sun light and so as to maintain soil temperature.
2. It reduces the speed of wind and air movement.
3. Mulch on the surface of the soil improves the rate of infiltration of water into the soil.
4. Reduces the amount of run-off of water.

ii. Control of run-off

Run-off occurs when the quantity of rainfall exceeds the amount of soil water holding capacity. This is measured by the ability of the soil to absorb water. The pores which exist in the soil as a result of the coarse nature of the soil and activities of soil plants and animals. The rate of run-off is influenced by the amount of rainfall received.

Methods of reducing run-off

1. Fallowing
2. Terraces
3. Contouring
4. Strip cropping

iii. Fallowing

This is an effective water conservation method especially area where rainfall limited. Fallowing is when a piece of land is left uncultivated for two or more years. The moisture conserved is small but it very critical in dry-land farming.

iii. Terrace

These are method of reducing water loss by creating barrier along the flow water thereby reducing the rate water flow down the slope after irrigation or rainfall.

iv. Contouring

This is planting of crop across the slope with the same elevation. The system separated each land by holding water on the soil surface and allowing infiltration of water into the soil. Contour farming reduces soil erosion that would remove the topsoil.

v. Strip cropping

This is the planting vegetations to establish a strip at right angles to the flow of water to gives protection to adjacent strip of crops or fallow land.

CHAPTER EIGHT

PLANTING

Planting is the actual placement of the seed or vegetative materials into the soil. Sowing or planting could be by seed or seedling or planting of vegetative material. Some crops are propagated solely through seeds, e.g maize, rice, cowpea, some by vegetative means, e.g cassava yam, and some by both seeds and vegetative means e.g onion, cocoa, coffee.

Seed propagation

Seed Germination

Seeds face greater dangers before they can germinate into seedling. They are often destroyed by excessive heat or cold, or by animal that feed on them and crush them into useless bits. If seeds that normally grow in rather dry soil should by chance fall into the sea, rivers /ponds, they may not be able to germinate and grow into seedling because of unsuitable conditions. Therefore, plant required favourable conditions for germination.

Methods of sowing/planting

1. **Broadcasting:** The seeds are scattered about on the prepared bed. There is no definite intra-and inter spacing . This method is employed in the sowing of crops like Amaranths, celosia, corchorus, rice, etc. The seeds of these crops are usually very small. To obtain uniform distribution, the seeds is mixed with dry sands at the rate of one stable spoon seeds to one kongo (or 1 kg) fine dry sand soil. After scattering the seeds, cover lightly with soil.
2. **Drilling:** is planting of seeds on ground at the required inter-spacing, no definite spacing between crops on the same row, e.g rice, wheat etc.
3. **Precision planting :** It involves planting of crop with definite intra and inter row spacing . This is observed in crops like maize , cassava, plantain, yam. Etc.

Nursery operation and transplanting

Some crops required nursery operation

Nursery: This is a place where young plants (seedlings) are raised before they are transplanted to the permanent sites. Some seeds are small or required special handling for them to germinate. Their seedlings are raised in the nursery for some times. Examples of crop that required nursery are cocoa, mango orange, oil palm, tomato, pepper, eggplant, garden egg, etc.

Nursery could be carried out in the tray box, wooden box, basket or on the ground. The selected soil for the nursery must be pest and pathogen free. This is achieved by sterilizing the soil with heat or chemicals. The soil also must be of high quality: the soil must be rich in humus and well drained. It could be enriched with fine manure or compost. Depending on the size of the seeds to be planted, sowing can be done by broadcasting or in rows (10-15cm apart). After the emergence of the seedling, the seedling should be protected from direct sun, rainfall and wind by providing a shelter over the seedling..

Transplanting: This involves transfer of young seedling from the nursery to the permanent site or field. For a successful transplanting, the following should be noted:

- a. Do not allow transplant to overgrow to prevent damage to the root system.
- b. Also, avoid transplant too young seedling. As a rule transplant at 5-leaf stage.
- c. Do not transplant when the weather is too hot.
- d. Do not transplant when the weather the soil moisture is low.
- e. Care should be exercised to see that the roots are not damaged or bent during transplanting.
- f. Soil must be pressed firmly round the seedling without disturbing the roots.
- g. Hole must be of the appropriate depth to accommodate seedling roots, and
- h. Transplanting should be done in the morning or evening.

Advantages of nursery /transplanting operations

1. It does not waste seeds
2. Crops can be raised long before favourable planting condition exists in the field.
3. Seed or seedling rate is easily calculated
4. Extra care is given the seedling
5. It reduces problem of thinning, and pest attack of seedling
6. Only health seedlings are transplanted.

Guides to planting

A successful planting operation ensures an optimum germination of the planted seeds or survival of the transplanted seedlings . To achieve this, there is need to follow the following guideline:

- i. Sow viable seeds or transplant strong and vigorous seedlings
- ii. Ensure adequate soil moisture before planting.
- iii. Ensure proper depth of planting.
- iv. Subject seeds to germination test before sowing.
- v. You may need to carry out pre-sowing seed treatments before planting e.g parboiling in corchorus.
- vi. Apply seed dress / chemical e.g Apron plus if need arise. This destroys soil-borne pests and pathogens.
- vii. There may be need for soil irrigation shortly before or after planting.

Methods of seeds scarifications

1. Seeds may be scarified by soaking in concentrated sulphuric acid for few minutes or an hour
2. Soaking in hot water and removing the seeds when the water is cool that is 12-24 hours later.
3. Heating the seed coats of some species.
4. Mechanical object like sand paper may be used to reduce the seed coats.
5. Alternate freezing can stimulate germination of hard seeds like sweet clover.
6. The germination of hard seeds may be enhanced by exposing the seeds for 1 to 1.5 seconds of infrared rays of 1180 mill microns wave length

Seed Quality

Factors affecting seed quality

Maturity

For seeds to germinate when planted, the seed must be physiologically mature at harvest. Immature seed may fail to germinate and may not store properly.

Free from damage

Injury, cracking or breakage of the seed affects the viability of the seed. The extent of damage will determine the ability to germinate to germinate. The market value of broken seed is reduced hence wholesomeness of seeds is important, whether they are to be sown or not.

Diseases and pest

Seed to be planted must be diseases and pests free as the presence of pest and disease will affect the viability and germination of seeds. Diseases seed have unpleasant odour and weak embryo while pest may consume the seed and create hole on the seed.

Foreign matter

The presence of foreign matter reduces its quality. Foreign matter such as stones, stem, leaves, chaff and other remain of dried plant material reduce the quality of seeds either for consumption or planting.

Seed Storage

The following conditions are necessary for storing seeds to enhance its viability:

1. Drying of seed to safe moisture content (5-9%)
2. Storing in a sealed storage in the absence of oxygen
3. Store at a temperature of 8.5° to 18°C.

Cool storage remains the best method of storing seeds so as to preserve the seed viability and to make safe for consumption. However, some seed loses viability rapidly when dry. 10 per cent decrease in seed moisture result in doubling the seed shelf life, likewise the life of the seeds drops with every 10°C drop in

temperatures. However, most seeds can be stored at 18°C or less for considerable length of time.

Seed Treatments methods

Surface treatment

This is getting rid of the organisms on the surface of the seed that causes seed-borne diseases treating the seed surface with chemical like copper sulphate, formaldehyde and oxide of copper. Seed treatment can also protect young seedlings from soil borne diseases after germination and emergence seed.

Hot water treatment

Some are treated with hot water for a short period of time enough to destroy the seed borne the disease without affecting the viability of the seeds. This may become necessary if the seed borne pathogen are beneath the seed coat.

Fumigation

When seed is not treated, the some organism like weevils develops within the seeds and affects the viability of the seed. Weevils in beans can be effectively controlled by fumigation it with formaldehyde.

Pelleting of seeds

These when individual seeds are coated with material contain a fungicide or other and chemicals to stimulate growth of seed in spheres of uniform size. The seed that are pelleted seeds are much easier to sown at regular intervals.

Factors affecting time of Sowing or Planting

Rainfall

Rainfall which the main source for the soil to have moisture is a principal factors which determine when the soil is cultivated so that planting can be make possible. The beginning of the raining season marks with the beginning of the planting season. Usually, the crop are planted when there will be enough moisture in the soil to support the germination and the growth of crop.

Temperature

In temperate area, this is crucial, but in the tropics it assumes that the temperature is adequate because of the warm climate. It is important, that planting be done when the soil is warm enough to permit germination

Day length

The crop should be planted bearing in mind that when it flowers the photoperiod that exist is adequate enough for the plant. For example, cowpea requires short days for flowering will remain vegetative for most of the rainy season when long day persist.

Occurrence of diseases and pests

The presence or absence of diseases and pests affects the time of planting. The strategy is to plant of the crop when planted crops are less likely to be affected by diseases and pests.

Marketing

Planting should be timed so when harvesting is done the crop, the crop can command a good market price. This is true especially when the crop is vegetables and other perishable crops which cannot be stored for a long time.

Availability of labour and equipment

Availability of labour and equipments for planting and processing of crop may influence the time of planting of crop.

Factors influencing the choice of planting methods

- i. Size of the seed
- ii. Growth habit of the plant
- iii. Climatic conditions
- iv. Availability of labour
- v. Placement of seed on the field.
- vi. Seedbed preparation

Vegetative propagation

Vegetative propagation involves the use vegetative structures such as leaf, root and stem. The root, stem and leaves all contain buds and some roots develop in to new plant. It is useful in raising several commercial crops. Fruit, vegetable, and ornamental crops can be propagated using vegetative means.

The objectives of vegetative propagation are:

1. In some crops propagated by seeds, off springs plant do not resemble parent plant.
2. Certain plants that produce no seeds can be effectively propagated by vegetative means.
3. Some plants produce seeds which do not germinate easily hence propagated by vegetative means.
4. The plants may be more resistant to diseases and can be used as propagules.
5. Vegetative propagation method is very economical.
6. Valuable varieties can be easily propagated.
7. Some plants do produce seeds but do not germinate easily hence vegetative propagated.
8. Helps to avoid or overcome the long juvenile periods of shrubs and trees.
9. For the maintenance of clones and promotion of combination of desirable clones.
10. Controls unwanted vegetative growth.
11. Use of only limited plant parts.
12. Practiced during any time of the year.
13. Success rate is high.

Types of vegetation propagation

Vegetative propagation can be classified into natural and artificial vegetative propagation.

1. Natural vegetative propagation occurs without human input. It takes place natural in plants that undergo vegetative propagation. Exanples are bulbs, stolons, corms, suckers, rhizomes crowns, tuberous roots etc.
2. Artificial vegetative propagation occurs with human input. It carried out by man using the knowledge of crop physiology to

produce new plant. Examples include budding, division, grafting, layering, cutting, micro propagation etc. It involves reproduction from vegetative parts of the plant and this is possible because most of the vegetative parts have the capacity for regeneration. It also involves mitotic cell division and hence plants propagated vegetatively reproduce by means of DNA replication of all genetic information of parent plant. Progenies produced by this technique are true to type just like their parent.



A planter

TYPES OF VEGETATIVE PROPAGATION

ASEXUAL SEEDS



ROOT CUTTING



SUCKERS



GRAFTING



DIVISION



CHAPTER NINE

POST PLANTING OPERATIONS

These are activities carried out after putting the planting materials into the soil. They are also called post planting operation. They include:

1. **SUPPLY**

It involves re-planting of non-germinated seeds or seedling. This ensures optimum population. It must be carried out as early as possible to ensure uniform crop growth and development.

2. **THINNING**

This involves removal of excess seedling from a crop stand. The weakest seedling(s) are removed to maintain expected number of plant or stand. Thinning arises due to planting of excess seeds per stand. Planting of excess seeds per stand may be to cater for:

- those that will not germinate,
- those that will be eaten up by rodents and other pests,
- those that will germinate and die later.

More often than not, however, most of the seeds planted do germinate, thereby leading to overpopulation.

Thinning is done to:

- prevent or reduce competition for water, light, nutrients, etc.
- Prevent spread of diseases
- Allow for maximum utility of agricultural inputs e.g Fertilizers.

During thinning:

- the weaker seedlings should be removed,
- diseased or abnormal seedlings are removed,
- there must be complete removal of the thinned seedlings,
- soil should be formed about the remaining seedling by replacing the soil around them.

Thinning is best done when the soil is moist.

3. **MULCHING**

It involves covering the soil surface with dry plant materials called mulch. It is carried out for some crops like yam, tree crops and on vegetables beds.

Advantages of Mulching:

- a. It prevents exposing the soil to direct rays of light
- b. The mulch reduced erosion
- c. It reduces evaporation of soil water
- d. It may be used to suppress weeds
- e. It lead to the addition of soil organic matter
- f. It moderates the soil temperature

4. **STAKING**

This involves using plant stem (stake) to support crop plant. It is usually carried out with plant that have weak or creeping stem. Suitable stake are: wooden poles, bamboo, canes, or branches. Millet or guinea corn stems, etc. can also be used for supporting plants. Stakes must be pushed firmly into the ground to prevent them being knocked over by wind or the weight of the staked crops. Care must be taken in selecting stake tree. Live plant such as Gliricidia and Leucaenea will sprout readily, hence should not be used. If allow to survive, they will compete with the planted crop.

Advantages of Staking

- a. It exposes leaves to sunlight thus encourages photosynthesis.
- b. It prevents vines from drying
- c. It reduces humidity; this enhances free flow of air in the plantation.
- d. It increases crop yield.
- e. It makes weeding and other operations easier.
- f. It lift up fruits of crop like tomato, this prevents fruit rot.
- g. It reduces incidence of diseases and pests on the leaves
- h. It reduces effects of rain splash.

5. Moulding

This is gathering of soil around the plant during weeding to avoid loss of soil from the ridges and for proper aeration

6. Pruning

This is the selective removal of branches of certain parts of a plant such as stem. The practice involves targeted removal of dead, damage, diseased, non productive and unwanted tissue from the plant.

The benefits include keeping the people around the plant safe, allowing proper aeration around the plant, avoid wastage of growth resources on dead and unproductive plant parts and to expose the leaves of the plant to sunlight.

There three types of pruning:

- i Deadwooding: This is the removal of dead or dying branches from the plant.
- ii Thinning: This is the removal of excess branches from the plant.
- iii. Raise canopy: this is the removal of the bottom branches to raised the tree canopy.

7. Weeds and Weed Control

Weed is any plant growing in a place that is not wanted. They are grown out of place and thus are unwanted plants.

Economic Importance of Weed

- 1. Some are eaten by man and animals e.g *Talimum triangulare*
- 2. Some are used as pasture to feed farm animals e.g guinea grass.
- 3. Some weeds may be used as medicine e.g lemon grass.

General methods of controlling weeds

The best methods are that which combines efficiency with economy and environmental safety (the soil, air and waters).

- 1. Cultural weed control: This includes all activities of good crop maintenance used to minimize weed interference with crops. Examples are tillage, mulching, burning, flooding,

crop rotation, planting cover crops, etc.

2. Manual weed control:- This involves application of physical efforts to kill weeds. Examples are uprooting, hoeing, slashing. It is laborious and tedious and suitable for smallholding.
3. Chemical weed control: This involves use of chemicals called herbicides to kill weeds. Herbicides are of different forms and formulation e.g.
 - a. Contact herbicides: They kill weeds that they are in contact with e.g. glomoxone.
 - b. Systemic herbicides: These herbicides can move within the plant, e.g. round up (glyphosate). They are used in controlling perennial weeds with underground rhizomes.
 - c. Pre emergence herbicides: They are soil active and are applied after planting the crop but before the crop and weed emerge, e.g. primextra, Atrazine, Gesaprim, Roustar, Pursuit plus.
 - d. Post-emergence: They are applied to growing weeds e.g. glomoxone, round up, fusillade, etc.
 - e. Selective herbicides: They are herbicides that kill certain groups of weeds and leave the crop planted undamaged e.g. primextra, Atrazine.
 - f. Non-Selective herbicides: This group kills anything green, e.g. glomoxone, Round up.

8. Pests and their control methods

Pests: These are organisms, which cause damage to crops. They are organisms that significantly reduce the quantity and quality of farm produce. Common crop pests include mammals, birds, insects, weeds and pathogens. Common mammalian pests include rats, squirrels, monkeys and fruit bats. The most serious of agricultural pests are the insects, which inflict damage on crops.

Insect Pests: Insect pests can be classified according to their mode of feeding and the stage of growth when the pest attacks the crop.

Control Measures of insect pests

1. Physical or mechanical method: This includes:
 - a. Hand picking of insects and killing.

- b. Destroy their house e.g termitarium of termites.
- c. Regular cultivation i.e tillage to exposes soil borne pest to desiccation;
- d. Good sanitation, proper dry of grains before storage, Smoking of grains
- e. Use of trips; and
- f. use of scare crow for birds.
2. **Cultural method:** Good cultural practices may enable crops to escape being destroyed pest populations. Such practices include: crop rotation, practices regular pruning; avoidance of over crowdedness, fallowing, timely planting and harvesting, burning, soil sterilization, adequate flooding in case of soil borne disease, destroy crop residues, adequate spacing and correct seed rate per hectare, effective weed control, etc.
3. **Biological method:** This involves the use of natural enemies of the insect pests to kill and destroy them. Examples are trapping cropping, use of lady bird beetle to control cushion scale, etc.
4. **Chemical method:** This is the application of pesticides to prevent pest attack. Pesticides are applied to destroy the pests at various chosen stages of their life cycle. Examples of pesticides are insecticide e.g DDT, Aldrin dust karate, Nuvacron, cymbush, phostoxin table, gamalin 20 and Actellic dust. They may be applied in form of dusts, suspension, emulsion or spray. They may also be used as fumigants.
5. **Preventive method:** This includes planting of resistance varieties.
6. **Quarantine and probation:** This includes planting of resistance varieties, importation of infested materials.

9. Plant disease and their control methods

Plant Diseases: Disease is an unfavourable condition caused either by the pathogen present within a living organism or by nutritional deficiency. A disease is any condition that prevents crop plants from their normal growth and development. It is the deviation

from normal condition. Pathogen and physiological factors generally cause crop diseases. For disease to occur there must be pathogens, a host and favourable environment.

Pathogen: Pathogens are disease causing living organism. Diseases caused by pathogens are called pathological diseases. In pathological diseases, there is always presence of a living organism (pathogen), which can be isolated either from the crop itself or from the soil in which it is grown. In order to control pathological diseases, the causal organisms should be put under control.

Physiological Factors: The physiological factors may be physical chemical or environmental. They caused physiological diseases. Physiological diseases are caused by non-living factors such as deficiencies or excess of mineral elements in the soil, insufficient or excess of soil water, lightening injuries, incorrect pH, and inadequate temperatures.

Method of controlling plant diseases

1. Cultural method: Examples are early planting, correct spacing, flooding regular weeding, mulching, proper drainage, timely harvesting, soil sterilization, destroying infected plants (Rouging) or plant parts (e.g pod), pruning.
2. Biological method: Use of natural enemies (predators) to control disease pathogens, breeding/selection for resistance varieties.
3. Chemical method: Use of insecticides, fungicides and nematicides to kill the insect vectors or the pathogen.
4. Quarantine: Legislation against importation of infected materials
5. Physical method: e.g hand picks and kills the vectors; heat treatment, resistant variety use of uncontaminated farm tools, control of alternate host, control of insect vectors.

10. Irrigation

Irrigation is the artificial application of water to soil for farming purposes. Irrigation can also be defined as the artificial application of water to the soil to supplement insufficient rainfall. Irrigation is practiced in areas where there is insufficient rainfall or

drought. Water is the most importance determinant in the growth of crops.

The choice of irrigation system depends on:

- i. Water availability
- ii. Topography of the land
- iii. Soil type
- iv. Crop type
- v. size of farm land

Purpose of Irrigation

- i. Supply water to the soil to provide moisture for plant growth
- ii. Allow the survival of crops during insufficient rainfall
- iii. Cool the soil and environment, thereby making the environment favourable for farming activities
- iv. Make dry season farming possible

11. Drainage

Drainage is a process of removing excess water in the soil promote good farming activates. Drainage can also be defined as the extraction of excess water from the soil to a point that retaining reserves to carry the crops during the periods of little or no rain.

Importance of drainage

- i. To remove excess water.
- ii. To reclaim waterlogged land and swamps for agriculture;
- iii. To improve soil structure;
- iv. To improve soil aeration for respiration of plant roots;
- v. Drainage supports the germination of seed.
- vi. It provides suitable environment for the growth and development of soil micro organism.

12 Manure application

Manures are materials or substance use to increase soil fertility. The use of manure has becomes of greater importance each year as most soil are deficient in soil nutrients due to continuous cultivation year in year out.

Types/Forms of manure

A. Organic manure

Organic manure are natural materials either from animal or plant,. There are green manures, crop residues, compost, household waste, and litter from chicken. Organic manure is both plant and animal by-products. They act slowly. They supply the three primary nutrients, Organic nitrogen fertilizers include oil cakes, fish manure, etc., where as organic phosphorus fertilizers are from bone meal and organic potassium from cattle dung ash, wood ash and water hyacinth.

The following are the three types of organic manure:

A Farmyard manure

This is basically from animal droppings. It has been used since prehistoric times and will continue to be relevant to farming purposes as long as the farm animal remains on the farm. The value of manure depends on four important factors.

- i. The type of feed consumed by the farm animal. This is because animal fed on concentrates then to produce the rich organic manure.
- ii. Source of the manure i.e type of animal
- iii. The age of the manure. Decomposed manure contains more nutrients and readily available to the plant.
- iv. Manure not stored under roof or not properly piled on the farm, rapidly losses its nutrients after few months hence its important to store manure properly to preserve its nutrient status..

B. Compost manure

Compost is a mixture of waste organic material such as grass, weeds, crop residue and animal droppings like litter to stimulate decomposition so as to produce high quality fertilizer. This is ready within the next two to three months under the tropical conditions.

C. Green Manure

The easiest way to fertilize land when commercial fertilizers are not ready available is green manure. The method involve growing leguminous crop such as *Desmodium trifolium* trifolium and then plough it into the soil.

Advantages of Organic Fertilizers

1. Organic fertilizers mobilize existing soil nutrients. By act, they improve soil physical and biological nutrient storage mechanisms in the soils.
 2. They release nutrients to the plant slowly.
 3. They help to retain soil moisture, thereby reducing the stress during temporary moisture stress.
 4. They improve the soil structure.
 5. They help to prevent soil erosion
- Organic fertilizers also have the following advantage over chemical fertilizers:
6. The necessity of reapplying organic fertilizers is low during the planting period..
 7. Extensive runoff of soluble nitrogen and phosphorus is low in organic manure and this may cause eutrophication of water bodies.
 8. Organic manure costs are lower than that of chemical fertilizer.
 9. Organic fertilizer nutrient are relatively soluble and nutrient release are much lower than mineral fertilizers making it to last longer in the soil.

Disadvantages of Organic Fertilizers

1. They are required in large quantities.
2. Transporting large amount of organic fertilizer incurs higher costs.
3. Their composition tends to be more complex.
4. Improperly-processed processing may harm the plant because of the presence of pathogen in the organic manure especially the farm yard manure.
5. More labor is needed to apply organic fertilizer hence, increasing production cost of farmers.
6. Unavailability of seed for green manures is one of the major problem.

Inorganic fertilizer

These are chemical substances that are added to the soil to increase the soil fertility. They supply high amount of nutrients then

the organic manure. They are usually of two types:

- i. **Mixed or compound fertilizers** are usually manufactured by a company and contain two or three essential elements (N, P and K). Nutrient contents and their concentration are always shown in the order N, P, K on the bag e.g. 10:10:5 means (10% nitrogen, 10% phosphorus and 5% potash).
- ii. **Single fertilizers** contain only one type of nutrient. E.g. urea contains nitrogen, SSP contains and muriate of potash contains potassium.
- iii. **Fertilizer blends or mixed fertilizers:** These are fertilizers formed by blending mineral fertilizers to obtain a desired nutrient ratio. Two or more of the single fertilizer are mixed to obtain the desired nutrient ratios.

Advantages of Inorganic Fertilizers

Works instantly

Leaching may occur beyond root zone

All nutrients are ready for use

Can burn or kill plants if added in excess

Cheap

Advantages of Inorganic Fertilizers

Some are not affordable

Toxic accumulation

Methods of Fertilizer Application

Fertilizers can be applied before planting or while the plants are still growing. Fertilizers can also be added transplanting hole before transplanting. The method of fertilizer application used by farmers is affected by the following factors:

- i) Type of plant
- ii) Soil factor,
- iii) Type of fertilizer to be used
- iv) Size of the farm land.

The following methods are adopted to apply fertilizers-

A) Application of solid fertilizer

1. **Broadcasting:** This is spreading of the fertilizer uniformly

over the entire area. This can be done either manually or mechanically using a spreader.

2. **Band Placement:** This is placing the fertilizer in band about 5 cm to the side of the plant. This is also placing the fertilizer below the soil surface at desired depth to supply plant nutrients to crop before planting.
3. **Drilling:** This is drilling a hole beside the plant at the same time as the seed is planting..
4. **Side Dressing:** This is placing the fertilizer either in a continuous band 4-5 cm deep near the crop or in between the plants in a row.

B) Application of liquid fertilizer

1. **Foliar Application:** This spraying on leaves of growing plants with fertilizer solutions. These solutions are prepared in low concentration to supply any one plant nutrient or a combination of nutrients.
2. **Starter Solutions:** This is when solutions of fertilizers are applied to young vegetable plants at the time of transplanting. This is used in place of the watering the plants to help establish the plant. Only a small amount of fertilizer is applied as a starter solution.
3. **Application through irrigation water:** This is when fertilizers are allowed to dissolve in the irrigation water and the nutrients are supply through the irrigation water. This allows for simultaneous application of water and nutrient together to saves cost.

Major limitations of Inorganic Fertilizers

1. Inorganic fertilizers are powerful and act quickly, this can burn when applied excessively.
2. Excessive application inorganic fertilizers affect soil organism.
3. The inorganic fertilizers can pollute stream and underground water that is used for drinking.
4. Inorganic fertilizers may contain toxic wastes after use. This may lead to accumulation of heavy-metal residues which can

- affect growing plants.
- 5. It is expensive
- 6. Availability is a concern, especially in rural areas

Terms used in Fertilizer

1. **Fertilizer Grade:** This is the numbering system of the element in the mixture of fertilizer. It is written in figures in accordance to the mixed or compound fertilizers. It is expressed in a set of three numbers indicating manufacturer's guarantee of the percentage of N, P_2O_5 and K_2O . e.g. 15-15-15
2. **Fertilizer Ratio:** This is the relative proportion of two or more nutrient elements in the fertilizer grade e.g. NPK 10-10-10 has a ratio of 1:1:1.
3. **Fertilizer Material or Carrier:** This is a material used for fertilizer that contains one or more plant nutrient.
4. **Fillers:** These are material added to a mixed fertilizer to make up weight or to increase the volume or weight of the fertilizer. Examples are sand soil, clay soil, coal, ground lime etc.

Determining fertilizer requirements of a crop

To determine fertilizer requirement of the crops and soils on the farm, two things are important. These are:

- a. Nutrients status of the soil
- b. The quantity of nutrient is needed to give optimum yield

The follow are the ways of determining fertilizer requirement of the crop.

1. Fertilizer recommendations of crop.
2. Deficiency symptoms on the growing crop.
3. Plant and soil analyses to determine the fertilizer requirements.
4. Plant tissue test.
5. Fertilizer experiment on the field and green house

CHAPTER TEN

CROP HARVESTING

This is an act of collecting or gathering matured produce on the farm. The objective of harvesting is to gather all matured crop with little or no harm to the mother plants. Crops are harvested when they are matured for the purpose for which they are produced. Crop must be harvested at the right time to prevent pest and disease infestation. Plant maturity is usually associated with change in colour or senescence (i.e, shedding of leaves).

For examples when fruits of cocoa, orange, guava, tomato and pawpaw are matured, there is change of colour. Harvesting must be done with minimal damage to the mother plant. It may be done using either manual or mechanical (e.g harvester).

Harvesting tools machines are hoes, cutlasses, knives, sickles and harvesters. The choice of tools is dependent on the crop type and the use to which the crop is to be put.

Timing of Harvesting

This varies with respect to crop, season, and method of harvesting, purpose of harvesting or the use to which the harvest will be put. Timing and efficiency of harvesting can make or mar a hitherto promising agricultural output.

To ensure a Successful Harvesting

- There should be adequate understanding of the crop physiology
- Farmlands should not be bushy
- Where mechanization is employed, the machine should be in good conditions
- Harvesting should not be prolonged especially in produce that shatters.

Harvesting Losses may Arise from

- Infestation by field to store pests e.g weevils in crops like maize and cowpea if harvesting is delayed.

- Shattering as in maize and cowpea when harvesting is delayed.
- Prolonged harvesting which more often than not end up in rain
Destroying the produce. Bushy unharvested plots may go up in, flames through indiscriminate bush burning in the dry season.
- Rottening of root and tubers as well as resprouting of some seeds/tubers after delayed harvesting e.g groundnut and yams.
- Unthorough harvesting occasioned by bush state of plots.

When Harvesting

- Ensure that crops that can shatter are harvested early in the day
- Avoid the fruits from getting overripe as apart from loss of fruit quality, the mother plant's productivity is decreased.
- Harvest leafy vegetables in the cool hours of the day and at the age when the leaves are succulent and of high nutrition.
- Always use the right tool/equipment for harvesting to avoid injuries to both harvest and the mother plant.
- Note that injuries on the harvest especially on root and tubers serve as source of infection.

Method of Harvesting

The following methods are used to harvest crop on the farm:

By hand: The mature plants are pulled from the ground by hand and placed in piles for drying. Harvesting by pulling is done early morning when the pods are moist and these will prevent shattering:

Mechanized: This is done with the use of machine called harvester. The machines usually consist of a tractor with front-mounted, horizontal blades with blunt cutting edges or rotating disks operated slightly below the soil surface. Several rows are combined into one window using a side deliver rake, which can be rear-mounted behind the cutters.

Direct Harvesting: this is usually done in the advanced countries like United States and Canada. It involves the harvesting of grain with modifications. For the whole seed market, the quality of seed is important, so proper care must be observed in harvest and post-harvest handling to avoid cracked seed.

Grading

This is the sorting out of harvested produce into different lots according to their various quality specifications.



Combined harvester



CHAPTER ELEVEN

CROP PROCESSING

The treatment given to harvested product before consumption is called processing. Crop processing includes drying threshing, cleaning, milling, grinding, bagging, etc.

This is a process aimed at either separating the chaff from the seeds or presenting the produce in various ways for various uses. It may also be to enhance the shelf life of a product. In general, processing achieve all or part of the following:

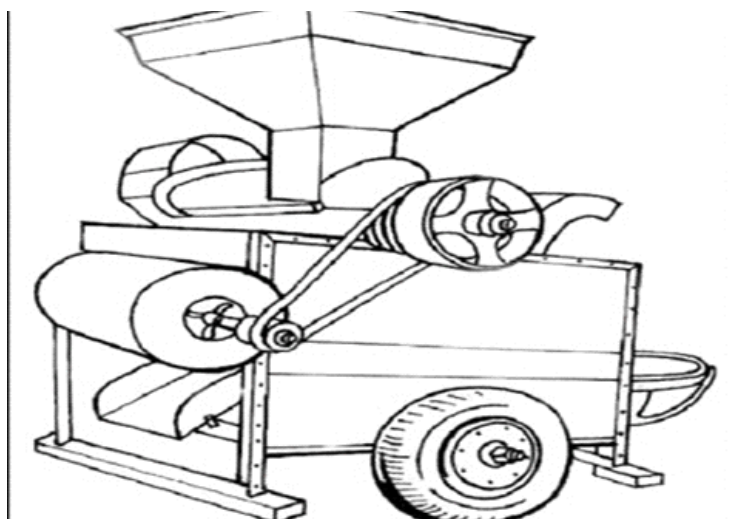
- Purification e.g sorting, sifting etc
- Reduction in bulk, e.g removal of husks, cobs, etc.
- Self life improvement e.g reduction of moisture.
- Increasing the quality i.e dressing, polishing, etc.

Other aims of processing are:

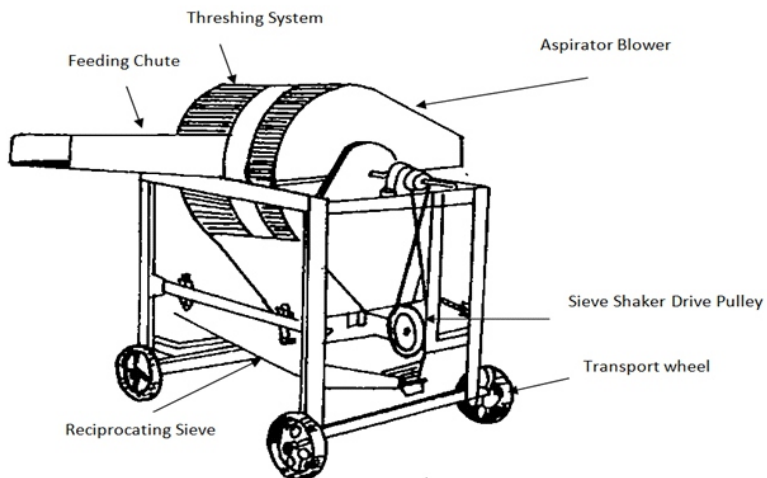
1. To facilities better storage and preservation
2. To improve the quality of the finished product.
3. To remove unwanted materials e.g through sorting
4. To increase crop shelf life.
5. Reduction in bulkiness of produce e.g through removal of husks, cobs, etc
6. Detoxification as in cassava and soybean.

Examples of processing machines are:

- i. Thresher used to detach grain from ear head
- ii. Winnowing used to separate chaff, etc from threshed grain.
- iii. Dehusker used to remove sheath covering cobs or remove outer layer of paddy grain (to give rice)
- iv. Sheller used to break and seeds from cobs or pods.
- v. Decorticator used to break and remove shell from crops like groundnut.



Maize Sheller



Threshing machine

CHAPTER TWELVE

CROP STORAGE

Crop Storage

This is the preservation of harvested produces for future use. It is the art of keeping harvest in a way that will ensure their usefulness at a later date.

Importance of Crop Storage

- To bridge the gap between surpluses and scarcity
- To stabilize market price
- To spread availability for longer period.
- To improve the quality of produce e.g kola nut
- To provide materials for future planting through maintenance of viability.
- The prolong crop usefulness and shelf life

Storage Losses Range from:

- Loss in produce bulkiness (weight/due to perforations from insects, rodents etc.
- Deterioration through fungus growth and rotting e.g groundnut and tubers
- Loss of quality resulting from produces adulterations with pests' excrements
- Loss of viability in seeds
- Injection of aflatoxin into the produce e.g Aspergillus flavus in groundnut causing Aspergillus in livestock animals, Damage to sacks which causes losses as a result of produce spillage.

Common Storage Pests include

- Insects e.g weevils, stophillus zea on maize. Insects eat up the produce.
- Fungi cause discoloration and bad flavor in produce.
- Bacteria cause chemical changes and sometimes produce toxic substances in the infested produce.

- Rodents consume part or all of the produce just as they contaminate with their excrements.

Storage Methods for Some Agricultural Produce

The most important aspect of storage is that of moisture content (M.C). Hence m.c. of 12.5 14% is recommended for most cereals. Pulses should be stored at -15% m.c. cereals and pulses kept at these damaged and are protected from insects.

Methods of Storage

This depends on:

- (i) Type of crops to be stored
- (ii) Available storage materials
- (iii) Weather conditions of the place
- (iv) Moisture content
- (v) Length of storage desired.

Storage could be:

- (i) Dry storage
- (ii) Cold dry storage
- (iii) Cold moist storage

Storage Equipment Agricultural produce are stored in:

1. Silos: This is an airtight bin for storing grains e.g maize grain, cowpea , rice, etc.
2. Basket for preservation kolanut
3. Barn and ventilated hut for storing yam.
4. Drum/bags: this may be of plastic or metallic in nature for storing grains.
5. Cribs/rhombus: To store maize on cobs.
6. Earthen pots and gourd store small quantities of produce for few months.
7. Jute sacks; to store grains, nuts, cocoa beans, etc these should be stacked on a platform in a well ventilated store.

STORAGE STRUCTURES

The facilities where crop are stored for later use to preserve their qualities and in some cases improve it is called storage structures. The choice of storage structures depend on the following cultural practice, custom, environment, type of crop, duration of storage and the financial strength of the farmers. There two main types of storage structures:

1. **Traditional Structures:** This is used by pleasant farmer. The structures are crude and low level of technology.
2. **Modern Structures:** This is used mostly by commercial farmers. It is also fund in research station and some universities. They are better storage structures than the traditional structure. They are made of improved materials and high level of technology.

Traditional Storage Structures

Traditional storage structures include:

1. Aerial storage
2. Ground storage
3. Barn
4. Domestic structures
5. Pit
6. Tradition crib
7. Rhombus

Modern Storage Structures are:

1. Improved crib
2. Ware house
3. Cold storage
4. Silo

Improved Crib

This is an improvement on the traditional crib in term of the size and material. The materials used for the conventional crib storage like bamboo are replaced with durable material like galvanized metal to ensure durability and strength.

Warehouse

This is use for large scale storage of grains stored in bags. The bags are piled on top of each other. To ensures efficiency material handling and ventilation equipments are very essential so also is the prevention of leaking roof.

Silo

This is a cylindrically shaped structure used for storage of grains in large scale. There is the need for accessories such as drying facilities to prevent moisture from migrating and condensation of moisture. It is very useful when storing grains for long period of time.

Cold storage

Cold storage is keeping the stored products at a temperature below freezing point for a long time. It is like the refrigerator but more bulky, expensive and could store for relatively longer time. It is use to store perishable goods like fish, dairy, vegetable, meat. It can also be used to store grain especially those use for planting material it has the following advantages:

- (i) It reduces respiration and metabolic activities of pathogen.
- (ii) It reduces moisture loss.
- (iii) Preservation of colour and texture of the products
- (iv) It controls ripening and softening fruits
- (v) It reduces microbial activities and spoilage.



Structures fitted into the crib to prevent rodents from getting into the crib

Maize crib



Silo



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Ware house



Improved Crib



Cool storage

For Crops to be properly stored:

- i. Dry the grains properly
- ii. Harvest the crop promptly to prevent pest disease attack on

the field e.g bean

- iii. Fumigate the storage facilities
- iv. Store the produce with insecticide
- v. Let the storage facilities be air tight
- vi. Store grains in a cool and dry place
- vii. Fumigate the storage facilities
- viii. Store the produce with insecticide
- ix. Let the storage facilities be air tight
- x. Store grains in a cool and dry place.

Storage Chemical: They may be fumigants or insecticides, Examples of fumigants are: Quickphos and phostoxin; insecticides may be powder protective e.g actellic powder, or liquid preservatives e.g. actellic solution. These are used to eliminate the already existing pest/insects on the produce and make the environment non-conductive for new infestation.

Storage of Root and Tuber Crops

These will store well provided:

- There is no desiccation and the humidity is not too high.
- The tubers are not wounded.
- The store is secured against rodents



Yam storage

REVISION QUESTIONS 1

1.
 - a. What is crop production?
 - b. List and explain five branches of crop production.
 - c. Enumerate five importance of crop production.
 - d. Enumerate the six basic principles of crop production
 - e. Mention ten cultivated plants in Nigeria.
2.
 - a. Mention six effects of land clearing
 - bi. What is bush burning?
 - ii. Mention five advantages of bush burning
 - iii. Mention five disadvantages of bush burning .
 - c i. What is stumping?
 - ii. Mention five purpose of stumping.
3.
 - a. What is tillage operation?
 - b. List and describe the three types of tillage operations.
 - c. Mention three equipment used in tillage operation.
 - d. Mention five purposes of tillage operation.

REVISION QUESTIONS 2

1.
 - a. What is crop system?
 - b. Mention four factors that determine the type of cropping system adopted by farmers.
 - c. Explain the following cropping systems
 - i. Mono cropping
 - ii. Mixed cropping
 - iii. Inter planting
 - iv. Inter cropping
 - v. Monoculture
 - vi. Continuous cropping.
2.
 - a. What is transplanting?
 - b. Mention six criteria for successful transplanting operation.
 - c. Mention five advantages of nursery operation
 - di. What is seed germination?
 - ii. Differentiate between seed emergence and germination.
3.
 - a. List and explain any eight post –planting operations
 - bi. What is crop storage?
 - ii. Mention five importance of crop storage.