

COURSE CODE:	HRT 501
COURSE TITLE:	Vegetable crops production
NUMBER OF UNITS:	2 Units
COURSE DURATION:	Two Hours Lecture and Two Hours Practicals per week.

COURSE DETAILS:

Course Coordinator:	Professor F. O. Olasantan
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Office Location:	
Other Lecturers:	Dr. E. A. Makinde and Dr. A. W. Salau.

COURSE CONTENT:

Principles and practices of vegetable crops production. Major classes of vegetables- indigenous, exotic and wild vegetables. Factors influencing site selection – climatic and soil requirements. Field establishment, management, cultural practices. Processing, storage and marketing. Problems of vegetable production.

Practical: Raising vegetable transplants in the nursery. Seed identification. Fresh produce identification. Visit to appropriate establishments fo

COURSE REQUIREMENTS:

This is a **Compulsory** course for students in College of Plant Science and Crop Production (COLPLANT), and **Elective** for students of Home Science and Management (HSM). Students are expected to participate in all the lectures and practical activities and have a minimum of 75% attendance to be able to write the final examination.

READING LIST:

1. Gopalakrishnan T. R. 2007. Vegetable Crops. *Horticultural Science*, Series 4.
2. Premnath 1976. Vegetables for the Tropical Regions. Indian Council for Agric. Research (ICAR)
3. Shanmughabelu. K.G. 1993. Production Technology of Vegetable Crops. Oxford and IBH publishing company, New Delhi.
4. Tindall, H.D. 1983. Vegetables in the Tropics. First Edition, Macmillan Press, London. Pg 146-189

Introduction

Is an arm of Horticulture in which crop plants are intensively cultivated within a protected area called garden

Horticulture is derived from two Latin words: *Hortus* and *Colere*.

Horticulture is a science that deals with the production and utilization of garden crops. Horticulture is divided into four branches.

Floriculture: the science of production and utilization of ornamental plants.

Olericulture: the science of production and utilization of vegetable crops

Pomology: the science of production and utilization of fruit crops

Landscape horticulture: beautification and protection of the environment.

Definition of Vegetable

The term vegetable is used to describe the tender edible shoot, leaves, fruits and root of plants and spices that are consumed whole or in part, raw or cooked as a supplement to starchy foods and meat.

CLASSIFICATION OF VEGETABLES

1. According to the part consumed (disposition)
2. According to season or area of production
3. According to their botanical or taxonomy
4. According to their frequency of cultivation
5. According to their maturity time, harvesting pattern and growth habit

1. According to the part consumed

Leafy vegetables: the leaves and succulent young shoots are picked for consumption. Examples are amaranthus, celosia, pumpkin, lettuce, cabbage, bitter leaf, water leaf, jews mallow and fluted pumpkin.

Fruit vegetables: this comprises of young, immature unripe fruits or mature ripe fruits of plants grown as vegetables. Examples are cucumber, tomato, okra, pumpkin, eggplant, garden egg, water melon, sweet pepper and chilli pepper.

Seed vegetables: this group is important for the seed produced. Examples are Egusi melon and Ito melon.

Root vegetables: such as sweet potato, irish potato, carrot and radish.

Spices: important for their flavor and colour in foods such as chilli pepper, onion, garlic and basil.

2. According to Season/Climatic area/ area of cultivation

Cool season vegetables: such as cabbage, garlic, onion, radish, spinach, lettuce, potato and carrot.

Warm season vegetables: such as tomato, pepper, cucumber, okra, eggplant, garden egg, melon, pumpkin, sweet potato.

3, Botanical or Taxonomic Classification

Vegetables are classified according to family, genera and species. It is the most important and acceptable form of classification.

Family	Botanical name	Common name
Amaranthaceae	<i>Amaranthus dubius</i> <i>Celosia argentea</i>	Amaranth Celosia
Cucurbitaceae	<i>Cucurbita maxima</i> <i>Cucumis sativus</i>	Pumpkin Cucumber
Malvaceae	<i>Abelmoschus esculentus</i> (L.) Moench	Okra
Solanaceae	<i>Solanum tuberosum</i> <i>Solanum melongena</i> L.	Irish potato Eggplant
Tiliaceae	<i>Corchorus olitorius</i> L.	Jews mallow
Compositae	<i>Vernonia colorata</i> <i>Lactuca sativa</i>	Bitter leaf Lettuce

Cruciferae	<i>Brassica oleraceae</i> <i>Raphanus sativus</i>	Cabbage Radish
Portulacaceae	<i>Talinum triangulare</i>	Water leaf
Basellaceae	<i>Basella rubra</i>	Indian spinach

4. Frequency of Cultivation

Regularly cultivated vegetables – Onion, Amaranthus, Celosia, Egusi melon, Okra; Egg plant, Tomato and Pepper

Occasionally/Wild vegetables such as: mushroom (*Agaricus* spp, *Celosia triguna* Ajefawo) *Basella Rubra* (White) – Indian spinach *Basella alba* (Red) *Crassocephallum biafrae* - Bologi, *C. crepidoidis* - Ebolo

5. According to their maturity time, harvesting pattern and growth habit

Vegetables with short growing period and harvested two or three times by topping or young leaf removal: This group consists of leafy vegetables such as *Amaranthus* spp and *Celosia argentea*.

Vegetables which can be harvested over several weeks or months: This group comprises of vegetables such as *Corchorus* spp, *Solanum* spp, *Capsicum* spp, Tomato, Okra, and Cucurbits.

Vegetables with Climbing growth habit: these are vegetables which are trained along a stake and on house walls. Examples are snake gourd, fluted pumpkin, ito melon and basella spp.

Vegetables with Creeping stems: such as melon, cucumber and water melon.

Vegetable Type

1. Indigenous vegetables

These are vegetables that are associated with the hot, humid tropical Africa.

They are adapted to the hot temperatures and heavy rainfalls of the tropics.

In tropical Africa, where starchy root crops are the staple food, they are generally consumed as supplements to the starchy staple foods.

They provide a cheap source of protein, vitamin and minerals.

The indigenous vegetables are usually cultivated under mixed cropping systems as minor crops.

They are more prominent in compound/backyard farms.

They are usually grown with household organic refuse or farm yard manure. They are rarely fertilized with inorganic fertilizers

Women are key players in production, processing and marketing of indigenous vegetables

Cultivation require low capital/cash requirement and relatively small land area
Also, a tangible profit can be realized over time.

2. Exotic-type vegetables

They originate in areas with cool season climate/temperate region.

In Nigeria, they are grown in high altitude areas such as Sahel and tropical uplands of Jos and Adamawa state.

They are very popular especially in the urban areas

Vegetables in this groups are: Beet, lettuce, cabbage, radish, carrot, irish potato etc.

Production of exotic vegetables in the mixed system is often impossible because of the following reasons:

There is poor demand for exotic vegetables

Cultivation of exotic demands special methods which are difficult and expensive

Exotic vegetable has poor seed formation and storage under warm – season tropical conditions.

Exotic vegetables have peculiar taste, texture and special cooking requirements which are not acceptable to most homes in tropical Africa..

IMPORTANCE OF VEGETABLES IN HUMAN DIET

Vegetables supply most of the nutrients that are deficient in other food materials. This includes supply of minerals, especially calcium and iron.

Vegetables are acid neutralizers e.g. okra, *Corchorus* spp neutralizes the acid produced from the some fruits.

Vegetables prevent constipation and promote digestion as a result of fibres/roughages obtained from okra, cucumber, amaranthus, lettuce and cabbage.

Vegetables are rich sources of vitamins A, B, and C which helps to lower susceptibility to infection. e.g.: Carrots, sweet corn, amaranthus and celosia provide Vitamin A; Bitter leaf, water leaf, *solanum* and celosia provide Vitamin B; Tomatoes, carrots, lettuce, cabbage and amaranthus provide Vitamin C.

Also, some vegetables are rich sources of carbohydrate e.g. potatoes, sweet corn, carrot etc. Green beans and peas are cheap sources of protein. Vernonia (Bitter leaf), Amaranthus and *Telfeira* provide some amount of protein in human diet.

Vegetables are generally needed to have balanced diets and overcome nutritional deficiencies.

Vegetables make our staple food more palatable and enhance their intake.

The practice of cultivating vegetables and spices for food, composite seasoning and medicine is referred to as Olericulture. Olericulture is one of the four general and sub-categories of horticulture. Others are Pomology, Floriculture, and Landscape gardening/

Principles and Practice of Vegetable productions

There are some principles required in the production of vegetable crops which are very important and well known to the grower. These principles are:

1. Production of vegetables does not involve a long- time investment as does in the orchard of citrus, mango, or cashew.

2. Vegetable growers/farmers are not bound to produce the same crop each year like his counterparts, who grow fruit crops.
3. Vegetable growing lacks the stability which is methodically developed over a period of years like an orchard thus, getting into vegetable production is a fast process and getting out may even be faster.
4. Vegetables can be grown by people with limited experience. Only skillful farmers sustain their vegetable production
5. The land for production of vegetable crops is flexible and adjustable. It is much easier for vegetable growers/farmers to change production from one crop to another than for fruit crop grower.
6. Cooperative efforts and organizations are somewhat more difficult with vegetable crop producers than fruit growers. Vegetable/grower/farmers have no long period for making plans. Vegetable production is seasonal.
7. Vegetable production requires more intensive production management per unit area and time.

Practices of Vegetable crops Production

The several practices of productions have developed as a result of rapid urbanization and socio-economic and political situations. The practices are highlighted below:

- 1. Home Gardening:** the principal source of fresh local vegetable supplies for most homes. It supplies an important part of the family needs and additional tax-free income.
- 2. Market Gardening:** It takes care of both family needs and market supplies; production goes beyond family taste or needs. It depends on urban market demands.
- 3. Commercial Production:** The principal source of vegetables for big market. It is more extensive and specialized than market gardening. The area of production is determined by climatic and edaphic factors.
- 4. Production for Processing:** The principal source of fresh vegetable for processing industries .The scale of operation is similar to that of commercial production.
- 5. Vegetable Forcing:** The practices of producing vegetables out of their normal production season. It may be accomplished by modifying the growing environment such as heat provision or protection from cold, etc.
- 6. Controlled Environment Agriculture:** The practice of modifying the natural environment for optimum plant growth and production of growth factors such as light, air, temperature, water, relative humidity, etc.
- 7. Vegetable Seed Production:** This is a specialized agricultural industry for seed production and processing. The practice only involves seed production and not fresh vegetables for consumption.

Factors Affecting Vegetable Production

The importance of environment in crop production cannot be over-emphasized. It is a major determinant of crop production; it plays an indispensable role in plant growth and development, determining the extent to which crop plants attain their potential values. It also provides the scientific principles on which production technology is based.

The environment of crop production can be classified into two dimensions, operating separately or dependently:

- i. **Human Environment**
- ii. **Material Environment**

Human Environment: Is made up of Economic, Institutional and Social factors.

i. Economic Element: This includes economic policy, which determines quantities and distributions, as well as absolute and relative prices of inputs and outputs. Policy also influences the availability and distribution of physical infrastructure such as transportation, water supply, health services and facilities for marketing, processing and storage.

ii Institutional Element: These are laws of the land, credit and marketing conditions, contractual agreement, extension services, property right to land and water, as well as distribution and quality of goods, grading and taxation.

iii Social Element: These include culture and customs within a community. They determine access that farmers have to capital, source of credit or money and other production inputs, and the distribution of labour

Material Environment

This is also called technical environment which consists of physical elements of climate (e.g rainfall, relative humidity, temperature and light), topography and soil and the biological elements (vegetation, plants, weeds, insect pests and diseases).

Some of the challenges of material environment are:

1. It is difficult or impossible to manipulate, for example many tropical soils are highly weathered and generally infertile.
2. The rainfall is unpredictable in the time of onset, duration, distribution, reliability and cessation.
3. The temperature and light intensity are generally high and may permit pest development and crop growth throughout the year.
4. There is no fallow or winter period between the end of one cropping season and the beginning of another to help reduce pest infestation. The fallow period has been shortened in the tropics as a result of rapid population growth.

Biotic factors: The elements of biotic factors are important components of tropical farming systems. They occupy several niches and compete with crop plants for space, water, light and nutrients. They may be beneficial, neutral or harmful to plant growth. The biotic factors comprise of micro flora, micro fauna, macro flora and macro fauna. Micro-flora include, bacteria, fungi, actinomycetes, and algae; microfauna include protozoa and nematodes. Micro-fauna include burrowing animals such as moles, rats and rabbit, earthworms, arthropods such as mites, millipedes, insects, ants and termites; and gastropods such as slugs and snails. Micro-flora include roots of herbs, shrubs and big trees.

Light Attributes: Light has three main attributes such as **quality**, which determines tissue differentiation, physiological processes and germination; **Intensity** which determines rate of dry matter accumulation; and **Duration** or **Photoperiod** which affects behaviour and physiological functions of living organism (plants and animals)

Cultivation and Cropping Systems

Cropping system defines the pattern of growing crops in terms of crop combinations and sequences in time and space dimensions in addition to the cultural practices and technologies with which the crops are grown. Crops may be grown in pure stands (monoculture) or mixed cropping (crop mixtures).

Monoculture or Sole Cropping: The practice of growing only one type of crop in a given area of land at a time. There is no competition for growth resources between two different crop types, either in space or time dimension, apart from the one between the crop and weeds.

Mixed Farming: It is the farming practice that combines growing crops and rearing livestock on the same piece of land.

Multiple Cropping: The practice of growing more than one crop on the same piece of land. Multiple cropping consists of mixed cropping or intercropping, sequential cropping and crop rotation.

Intercropping: This is the practice of growing more than one crop plant species, simultaneously, in contiguous stands, on the same piece of land. Intercropping has four general subcategories:

i. Mixed intercropping: It is the practice of growing two or more crops with no distinct row arrangement.

ii. Row intercropping: It is the practice of growing two or more crops simultaneously with at least, one crop planted in the same row or alternate row.

iii. Strip intercropping: It is the practice of growing two or more crops in different strips wide enough to separate them and permit independent cultivation, but narrow enough to allow interactions agronomically between them..

iv. Relay intercropping: It is the practice of growing two or more crops during different part of their life cycle, but with one or more of them planted after the first crop has reached reproductive stage of growth but some time before harvesting..

v. Patch intercropping: It is the practice of growing two or more crops simultaneously in small contiguous patches or mounds,

Sequential cropping: It is the practice of growing two or more crops in sequence on a piece of land in a year. Sequential cropping consists of the following;

i. Double sequential cropping: It is the practice of growing two crops in sequence in a year.

ii. Triple sequential cropping: It is the practice of growing three crops in sequence in a year.

iii. Quadruple sequential cropping: It is the practice of growing four crops in sequence in a year.

iv. Ratoon cropping: It is the practice of cultivating crop regrowth after the first harvest for subsequent production

Crop rotation: It is the practice of growing two or more different crop types in planned sequence on a piece of land for specified number of years. Crop rotation combines features of intercropping and sequential cropping systems

Agro-forestry: It is the practice of integrating the raising of trees into horticultural fruit tree plantation and arable farming by mixed cropping. It can simply be referred to as growing crops under tree canopy.

Alley cropping: It is the practice of growing two or more crops in alleys of hedgerows of young tree crops or multipurpose trees and shrubs, preferably N-fixing leguminous species. It is a modified form of agro-forestry.

Agro-forestry sustains green cover on the land throughout the year and also involves the integration of appropriate fertilizer trees into crop production. The system bolsters nutrient supply through N-fixation and nutrient recycling, and increases direct production of food crops, fodder, food, fibre and income from products produced by the tree.

VEGETABLE NURSERY ESTABLISHMENT TECHNIQUES

Most vegetable species are grown from seeds, but some important ones are propagated by vegetative methods. Among those grown from seeds, a significant number mainly those with small seeds are usually first sown in nursery beds, boxes or containers and are transplanted at a later stage.

Nursery: A nursery is a place where young plants are raised under intensive care before transplanting into the field.

Advantages of nursery are:

Economy of seeds Fewer seeds are needed for raising seedlings in the nursery than for direct sowing in the field

Uniformity of growth

Selection of seedlings: You can select vigorous, pest and disease free seedlings for transplanting.

Better care of seedlings: The seedlings in the nursery receive more intensive care particularly protection from damages by pest, diseases and weeds than when they are seeded directly on the field.

Disadvantage

Cost of labour: Specialized skilled labour, special tools and materials are needed

Factors Determining Nursery location

In selecting site a site for establishment of a nursery, a number of factors must be considered

1. **Water Supply:** Nursery should be located where there is abundant supply of water, particularly from wells, boreholes, streams, rivers or pipe-borne water. Cheap water supply reduces the operating cost in the nursery.
2. **Accessibility:** The nursery should be easily accessible to the field, to the road or market.
3. **Slope or Land gradient.** Level land is ideal for establishment and maintenance of a nursery. It reduces the risk of soil erosion. It also enhances application of irrigation water. However, appropriate conservation methods should be undertaken if a nursery is sited on a sloppy land.
4. **soil;** Nursery soil should be fertile, well drain and non-toxic and free from pests, diseases and weeds.
5. **Labour Supply:** Nursery should be located where experienced and skilled labour are available or where they can be trained.

Nursery Tools and their uses: Some important tools used in nursery are as follows:

1. **Cutlass or Machete:** Cutlass is used for clearing the nursery site. It may also be used for transplanting seedlings and digging holes.
2. **Hoe:** It is mainly used for making heaps, ridges and nursery beds. It is also very effective for turning up the soil, loosening the soil surface and to destroy weeds.
3. **Hand trowel:** It is used for transplanting seedlings from the nursery to the field and for spreading manure and also for digging shallow holes on the beds.
4. **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.
5. **Digging mattock:** It is used for digging and uprooting small stumps
6. **Rake:** A rake is used for leveling 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.
7. **Garden line:** It is used for lining up beds and for making straight line when planting.
8. **Watering can:** It is used for sprinkling water over young seedlings and for irrigation during dry season farming.
9. **Tape:** A tape is used for taking short or detailed measurement on the field.
10. **Ranging pole:** It is used for marking surveyed stations or intermediate stations. It is also useful in marking straight lines

Nursery Duration for specific vegetable types

Vegetable types		Nursery duration (days)
<i>Amaranthus spp</i>	Amaranthus	20
<i>Celosia argentea</i> L	Celosia	21-28
<i>Corchorus olitorius</i>	Jute mallow	21-28
<i>Brassica oleracea</i> L	Cabbage	25-35
<i>Solanum aethiopicum</i> L	Garden egg	30-40
<i>Solanum melongena</i> L	Egg plant	30-50
<i>Capsicum annuum</i> L	Sweet pepper	35-45
<i>Capsicum frutescens</i> L	Hot pepper	35-45
<i>Lycopersicon esculentum</i> Mill	Tomato	25-35
<i>Daucus carota</i> L	Carrot	25-30
<i>Allium cepa</i> L	Onion	45-55

FIELD ESTABLISHMENT

Land Preparation

Vegetables differ widely from field crops in their requirements for land preparation and cultural practices because of their differences in their morphologies, growth habit, and socio-economic values. In preparing land for vegetable production, the following factors are taken into consideration: ecological location, mode of cropping, season, crop disposition, and the type of vegetables to be grown.

Clearing: It is often necessary to remove the vegetation cover when a piece of land is to be used for vegetable production. The land clearing methods may involve removing the remains of previous crops and undergrowth, cutting back the woody shrubs and trees and burning them. Machete is used for clearing in a small scale production, while heavy machine like bulldozer is used in a commercial production.

Levelling: When the site has been cleared, uneven land may have to be leveled. This facilitates the process of ploughing, harrowing ridging and layout of the site.

Tillage: Tillage is the term used for manual or mechanical manipulation of the soil to prepare it for use in crop production. In vegetable production, the main objectives for tillage are to secure increased growth and yields, to obtain suitable seed bed, to eliminate competition with weeds

during early growth, improve the physical condition of the soil and conserve its water and nutrient contents.

Importance of Tillage

1. **Seed bed preparation:** A seed bed provides an environment in which a seed can germinate and grow. It is loose, well drained, deep enough, makes good contact with the seed, retains adequate moisture and is free of weeds.
2. **Level land:** land leveling may be required to make it amenable to a chosen method of irrigation.
3. **Weed Control:** Weeds are menace to crop production. They compete with crops for plant environmental factors. They must be controlled before planting and during growth of the crops by appropriate tillage methods.
4. **Incorporation of Organic matter and soil amendment:** Green manures, crop residues, fertilizers and other chemicals may be added to soil by ploughing them under, or mixing at the time of soil preparation.
5. **Improved Physical properties of the soil:** Compaction of the fields impede drainage, rooting and crop growth. A hard pan also be caused by traffic may be broken up by tillage method.

Erosion control: The soil surface after tillage may be such that it impedes run off. Stubble may be incorporated or ridges constructed to curb erosion. **Tillage Tools:** Hoe, cutlass, Garden fork, Hand fork, disc plough, disc harrow

Conservation measure: Most suitable land for vegetable growing in the humid tropics is usually sloppy. When such site has to be used for growing vegetables, soil conservation measure must be carried to prevent top soil from being washed away. After clearing, ploughing and ridging, the surface of the soil is in a very unstable condition unless efficient conservation measures are adopted. The most frequently used methods include the following:

Terracing: This is the most traditional methods used in the prevention of erosion and is effective on land which has a fairly steep slope. It is obtained by constructing flat areas along the main contours of the land.

Cover Crops: These are planted to prevent exposure of the soil from direct solar radiation and falling rain when any part of the farmland is not used for planting. The most suitable cover crops are the forage legumes such as *Calopogonium mucunoides*, *Pueraria phaseoloides*, and *Stylosanthes gracilis*, the leaves of which will provide cover over the land. These crops also improve the fertility of the soil.

Strip cropping: The cultivation of different types of crops in narrow strips usually on steep slope or hill side to maintain

Planting

Vegetables can be propagated either by direct sowing and transplanting methods.

Direct sowing: Vegetables are sowed either by broadcasting or by seed drilling methods.

Broadcasting method: In broadcasting, seeds are spread over the prepared land by throwing small quantities of the seeds into the air close to the surface of the prepared land. Broadcasting is the normal practice in sowing seeds of most leafy vegetables such as *Celosia*, *Amaranthus Corchorus*.

Seed drilling method: This is a method for planting small seeded vegetables in rows. Shallow furrows are made at the spacing recommended for the crop and the seed drilled along the furrows. This method can also be used for some leafy vegetables such as *Celosia*, *Amaranthus*, *Corchorus*.

Transplanting method: Vegetable seedlings are first raised in the nursery for a required period of time before they are transplanted on the field. Seedlings are transplanted in the morning or in the evening to avoid transplanting shock. Vegetables like tomato, pepper, cabbage, egg plant, garden egg are planted by using transplanting method.

Transplanting Techniques:

- i. Clearing of site
- ii. Removal of trash by burning
- iii. Preparation of bed
- iv. Seedling sowing
- v. Watering
- vi. Erecting of permanent supports for shading.

Routine Operations

Thinning: Thinning of vegetable is done to reduce the number of seedlings per stand when planted in situ. It is also used to obtain regular spacing and plant population when sowing is done in drills by removing the weakest seedlings or those infected by diseases or damaged by insect pests.

Supplying: This is the practice of providing missing stands of vegetables planted by direct sowing as a result of poor emergence or when seedlings are damaged by pests. The essence of seed supply is to maintain correct plant population. Supplying of seeds has to be carried out as early as possible after emergence.

Staking: This is usually required for vegetables with climbing growth habit such as fluted pumpkin, ito-melon or those with weak stems such as tomato. Staking is done to provide support for the plant to climb and display the leaves for photosynthesis to take place.. The support allows the plant to carry more load without touching the soil thus enhancing the quality of the fruit.. Stake can be made from bamboo or other available wood.

Mulching: A mulch is a layer of plant residue or other materials which is applied to the surface of the soil in order to reduce evaporation, run-off or to prevent weed growth. The purpose of mulching is to conserve soil moisture. Mulching also ensure clean fruit, hasten maturity and increase yields. Most vegetables grown in the humid or semi-arid region, particularly those with fairly long duration such as pepper, egg plant and tomatoes, benefit from mulching.

Watering: One of the most critical inputs to vegetable production in semi-arid areas, dry season farming and nursery establishment is water. During the dry season or off season, the source of water for vegetable growing is from irrigation while in the wet season, rainfall is the source of water. Young vegetable seedlings in the nursery or in the field should be watered in the early morning or in the evening. Watering should be done before transplanting particularly in the evening. Over-watering can be very harmful and can encourage the development of pathogenic diseases and also cause mechanical damage to the seedlings.

Fertilizer application: This is an important variable cost in vegetable production, As all vegetables, particularly the leafy grow quickly, they must be provided with ample supplies of nutrients such as nitrogen. Application of N fertilizer has been shown to increase yield and to enhance the content of mineral elements such as Ca, P, Na, Zn and Mg. In some tropical leafy vegetables, fertilizers such as FYM and other sources of P and K can be applied as pre-plant basal dressing or after the plants have become established as post planting application.

Weeding: Weed is any plant that grows where it is not wanted. Weed can reduce yield up to 40-60% if not controlled. Weeds can be controlled using cultural, physical, chemical and biological methods. Weed seeds and rhizomes can be killed using physical method during land preparation by burning. Mulching of soil can also be used to smother weeds. Intercropping of spreading vegetables like melon with some erect and broad leaf crop like okra can provide ecological protection against weed development. Hoeing, pulling and roguing are carried out during the early stages of growth. Chemical weed control is applied in commercially grown vegetable crops.

Pest and diseases Control: Attack by pest and disease is one of the major factors militating against increased vegetable production in the tropics. Insects and disease infestation in vegetable crops bring about heavy losses through yield reduction, lowered quality of produce, increased costs of production and harvests. Control measures include:

- i. planting of high quality, disease-free seed
- ii. use of disease resistant varieties.
- iii. use of vegetables best suited to climate and soil.
- iv. weed control
- v. destroy the remains of annual crop after harvest to prevent pest build-up.

HARVESTING OF VEGETABLES:

- Harvesting is the separation of the portion of need from the mother plant.
- May be carried out once or over time or repeatedly.
- Leafy vegetables may be harvested by total removal or by ratooning.
- The seed and the fruit vegetables may be harvested once, or by topping or digging or lifting.
- Fruit vegetables may be harvested over a period of time by picking.

Maturity Indices:

- Optimum vegetative growth for the leafy vegetables.
 - Fruit/ seed maturity, for the fruit vegetables.
 - Onset of fruit ripening.
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- Harvesting should be done on clear, dry days, for the fruit vegetables.
 - Individual, manual harvesting is preferable.
 - Readiness for harvesting is affected by the species and climatic factors.

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:

- 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.
- Refrigeration can be used for some vegetables.
- Freeze – storage is usually not appropriate.
- Vegetable seeds may require a storage temperature of about 10 – 15°C.

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.

PROBLEMS OF VEGETABLE PRODUCTION:

- Diverse problems face the vegetable production enterprise.
- Problems can be:
 - Biological
 - Agronomic
 - Climatic
 - Economic
 - Sociological
 - Environmental
- **Biological Problems:**
 - Perishable nature of vegetables.
 - Pests and diseases problems.
 - The fertility and acidity of soil.
- **Agronomic Problems:**
 - Need for seed treatment
 - Seed viability maintenance
 - Lack of technology for large scale production.
 - Use of herbicides and pesticides.
- **Climatic Problems:**
 - Inappropriate temperature.
 - High relative humidity.
 - Inadequate/Excessive rainfall and distribution.
- Economic Problems:
 - Marketing and distribution.
 - Unavailability of finance.
 - Unfavourable Government policies.
- Sociological Problems:
 - Lack of Extension services.

- Taste and preference of consumers.
- Environmental Problems:
 - Land Tenure/ inavailability of land.
 - Lack of high- technology production packages.
 - Lack of Research and Development.