VEGETABLE PRODUCTION IN NIGERIA

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INTRODUCTION

The term vegetable in its broadest sense as in Encyclopedia refers to any kind of plant life or plant product. In the Narrower sense, it refers to the fresh edible portion of a herbaceous plant consumed whole in part, raw or cooked as part of a main dish or in salad. Vegetables are all those food crops harvested and eaten in a fresh state as part of the main dish. They are characterizes by high moisture content being of the order of 75% moisture or more and 25% or less, dry matter. To qualify as vegetables, fruits and vegetables when processed must retain their freshness. The edible part may be a root e.g. rutabaga, beet, carrot, sweet potato, tuber e.g. Irish potato, sweet potato, yam, fresh pods e.g. vegetable cowpea immature fruits e.g. egg plant cucumber fresh corn, okra, an immature flower e.g. cauliflower, broccoli, ripe fruits e.g. tomato, mature green fruit e.g. peppers, tender leaves e.g. amaranthus or green, cabbage, lettuce, young shoots of tropical trees e.g. oha, whole shoot e.g. asparagus, spear, bulb e.g. onions & garlic. (Barley, 1935)

The popular distinction between vegetables and fruits is difficult to uphold. In general, those plants or plant parts that are usually consumed with main course of a meal are popularly regarded as vegetables while those mainly used as dressers are considered fruits. Thus cucumber and tomato potentially fruits since they are the portions of the plant containing seeds, are commonly regarded as vegetables.

Summarily, the intensity of production, techniques adopted in cultivation, attention given to individual plants, state of edible portion when used and how used, all determine whether the crop is designated vegetable, fruits or arable crop. Arable crops or field crops are usually harvested in a dry state and are processed before use.

THE ORIGIN OF EDIBLE VEGETABLES

The vegetables eaten by man, originated in eight principal region from which they were eventually dispersed through out the world. Vegetables native to the mountainous regions of central and western China, together with their adjacement lowlands include the, cucumber, eggplants, lettuce, reddish, squash, taro etc. Northern India was another natural habitat of cucumber, eggplant, cowpea or the black-eye bean. Among the native vegetables of central Asia, the area including Northeast, Afghanistan, and soviet socialist republic of Tadzhik & Uzbek, were the carrot, garlic. Muskmelon, onion, pea, radish & spinach. The near Eastern Area encompassing the interior of Asia Minor, Iran included the cabbage, leek, and lettuce onions among its native plants. (Barley, 1935, Cobley, 1956).

Vegetables indigenous to the Mediterranean region were, Asparagus, beet, garlic, Leek, lettuce, onion and pea were native. Southern Mexico and Central America were the habitat of the bean lima bean, pepper, pumpkin and sweet potato, and the native vegetables of the South American area including Bolvia, Chile,

Ecuador and Peru were the lima bean, potato, pumpkin & Tomato. (Perkins et al, 1970).

PROPERTIES AND NUTRITIONAL IMPORTANCE OF VEGETABLES

PROPERTIES:

In fresh vegetables, water content is usually over 70% of total composition, protein content is usually 3.5% or less and fat content 0.5% or less.(Nihort, 1986).

The cell walls determine the structure of the cell, the texture of the plant tissues and other distinguishing characteristics. Outside the cell wall is the middle lamella, composed largely of the colourless carbohydrates materials called peptic-substances binding the primary wall of each cell to that of adjacent cells. Some types of cells have a secondary wall, inside the primary wall, that is nonelastic and provides mechanical support. Some cells produce more fibrous structure because of the high content of the cellulose and lignin forming the cell walls. As they mature many vegetable plants develop an outer protective tissue frequently seen as the rind or peel. (Church et al. 1966)

The colour seen in plants results mainly from such pigments as chlorophyll, producing green colour, the carotenoids producing yellow, or red colour, and the flavonoids including the flavones which are almost colourless or light yellow, and the anthocyanins, resulting in dark-red or purple colour.

NUTRITIONAL IMPORTANCE OF VEGETABLES:

Many elements are required to make up a diet that is nutritionally adequate and no single natural food supplies all. Vegetables supply some elements in which other food materials are deficient, and as such play specific roles in the maintenance of human health. They supply some elements such as magnesium, iron, chlorine and other sources of minerals in which other food materials are deficient **(Table 1).**

TABLE I: THE CHEMICAL COMPOSITION OF VEGETABLE CROPS AS DERTERMINED IN A 100 RAW SAMPLE OF THE COMMON PORTION.

Vegetable	Carbohydrate	Proteins	Fat (g)	Fibre (g)	Ascorbic acid (mg)	Niacin (mg)	Riboflavin (mg)	Thiamine (mcg)	Vitamin A (mg)
Asparagus	5.0	2.5	0.2	0.7	33	1.5	200	180	900
Bean, snap	7.1	1.9	0.2	1.0	19	0.5	110	8-	600
Cabbage	5.4	1.3	0.2	0.8	51	0.3	50	50	130
Carrot	9.7	1.1	0.2	1.0	8	0.6	50	60	1000
Cucumber	3.4	1.0	0.2	0.6	12	0.2	40	30	250
Lettuce	2.5	1.2	0.2	0.5	8	0.3	60	60	970
Muskmelon	7.5	0.7	0.1	0.3	33	0.6	30	40	3400
Onion	8.7	11.5	0.1	0.6	10	0.2	40	30	40
Parsley	8.5	3.6	0.6	1.5	172	1.2	260	120	8500
Pea, green	14.4	6.3	0.4	2.0	27	2.9	140	350	640
Pepper	4.8	1.2	0.2	1.4	128	0.5	80	80	420
Potato	17.1	2.1	0.1	0.5	20	1.5	40	100	

Radish	3.6	1.0	0.1	0.7	26	0.3	30	30	10
Spinach	4.3	3.2	0.3	0.6	51	0.6	200	100	8100
Sweet potato	26.3	1.7	0.4	0.7	21	0.6	60	100	8800
Tomato	4.7	1.1	0.2	0.5	23	0.7	40	60	900
Water melon	6.4	0.5	0.2	0.3	7	0.2	30	30	590

Source Encyclopedia Britania 1935

For instance certain vegetables contain magnesium whose function is to help activate Enzyme reaction and also to build parts of the skeletal tissues. It is important to note that in the absence if magnesium in our diet, tetanus and muscle spasm as deficiency symptoms may occur.

Vegetables are also useful in neutralizing the acid substances produced in the course of digestion of meats, cheese and other foods. Therefore through increased vegetable production we expect that this role should be promoted by eating more of vegetables.

The cellulose and lignin (an indigestible carbohydrate material) vegetable contents absorb water and provide the bulk or roughage that promotes intestinal function.

Various vegetables produce important vitamin for example, both the orange coloured and dark-green vegetables are rich sources of carotene which can be converted by the body to vitamin A. The vitamin A aids in vision and development of epithelial tissues lying the reproductive and digestive tracks. The general deficiency

symptom of vitamin A in our dietary needs is Xerophalmia (Night blindness). All other vitamins such as vitamins C (ascorbic acid), vitamin B, (thiamine), vitamin B2 (riboflavin) vitamin B6 (pyridoxine) in addition to *Niacin* and folic acid, are provided by leafy vegetables (Clutter 1961). In our body the vitamins are not structural part of the body but functions as enzymes or co-factors in metabolic processes.

Increased vegetable production in Nigeria will help us to obtain more of their by-products such as oils, flour, starch, colouring matter and animal feeds. We can obtain vegetable oils from garlic cloves and seeds of asparagus, pumpkin, okra, mungbean, muskmelon etc. the oils which are processed by vegetable oil industries located in various part of the country can be used for the manufacture of soap, margarine. Flour can be extracted from the enlarged roots of sweet potatoes; starch is obtained from potatoes and sweet potatoes. Pigments such as colouring matter for food and cosmetics are extracted from beet, and carrot. Animal feeds include the straw of the bean, mug bean and pea, and the culls of the dry seeds of the bean, cowpea and pea. Whole green plants or their parts used as livestock folder include the bean, cabbage, turnip, sweet potato etc.

Vegetable production can provide self-employment to the jobless young school leavers who are roaming the streets in search of white-collar job. One can start vegetable gardening in his or her home with minimum capital investment or engage himself in commercial vegetable production with good amount of money. Retired or

retrenched workers, government workers of all sectors of life can equally engage themselves in backyard vegetable gardening.

In terms of material gain and income source, vegetable production is very much rewarding. Normally, after harvest, the damaged vegetables are separated from the good ones intended for sale. The bad ones are either consumed or sold at a reduced price while the good ones attract high prices in both our local and distant markets, especially during the dry season. For instance, the estimated gain in producing 35.0kg of tomato (*Lycopersicum esculentum mill.)* with a spacing of 45 x 60cm at the cost of N15.00 per kg from a bed measuring 7.2m x 11.2m is N525.00. In hectare, the estimated return will be N607, 638.89 with minimal production costs. This estimate however depends on the location of the market, tomato variety and the prevailing market price.

Vegetable production has been very much successful in the advancement of scientific research. Especially in the agricultural sector, crop scientists use vegetables mainly for their experiments. This is because vegetables have life span of short duration ranging from 2-4 months which allows scientists to carry out many experiments with them, within a given on or off season. Hence vegetables, with high yield variety, disease resistant varieties, and improved quality and early maturity are produced and recommended to the farmers.

VEGETABLE PRODUCTION SYSTEMS IN NIGERIA

a. HOME VEGETABLE GARDENING

Vegetable production operation in Nigeria, range from small patches of crops, producing a few vegetable for family use or marketing to the great highly organized and mechanized farm (Eijnatten (1969.)

Vegetables production is undertaken in the home- the Home Vegetable Garden, in order to provide choice vegetables to augment the food budget, to provide certain crops which are not available in certain seasons and to ensure that the vegetables are utilized as required and it makes for the retention of vegetable aroma and excellent taste. Whenever practicable a home garden is a necessary part of a compound because it trains the children in the love and care of plants. In Nigeria, today, even undergraduates who did not grow up in the rural area may not identify many vegetables, which they eat. If Nigeria is to be self-sufficient in food, greater emphasis should be placed on the home vegetable garden through a directional extension programme.

The home vegetable garden is planned. It follows a definite rotation of crops. Unless a good crop rotation is followed it will be seen that crop yields will drop. Also manure should be added before each planting. Crop rotation will help to reduce the accumulation of insect pests, fungi, bacteria and eelworm in the soil.

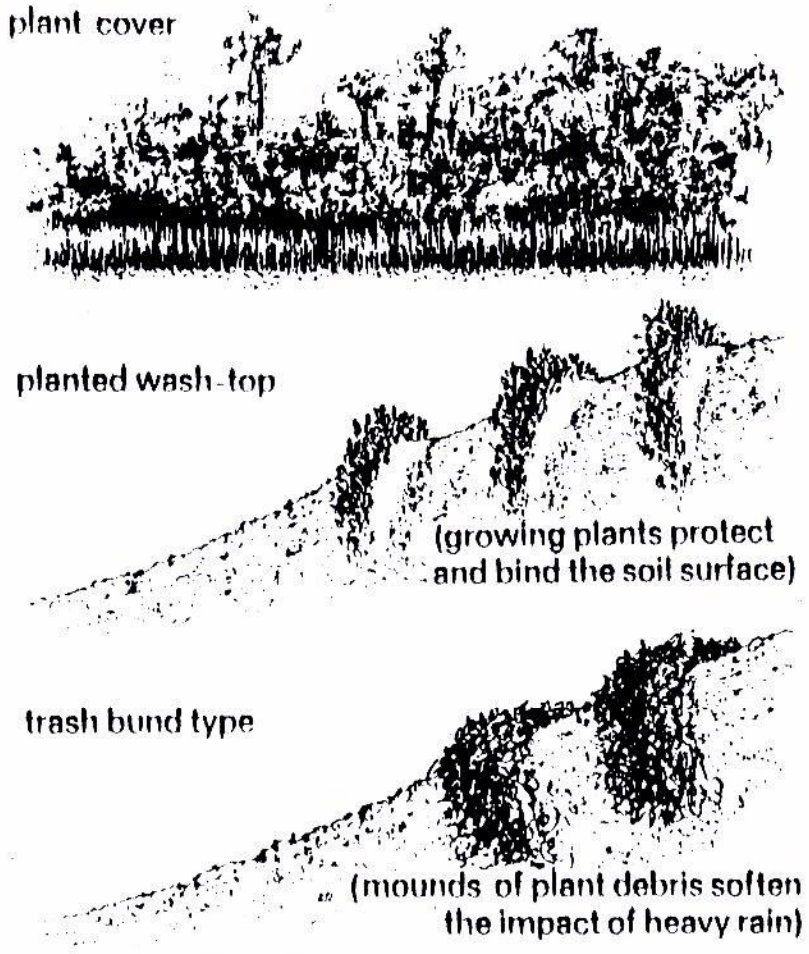
When poultry manure or compost is not applied regularly succession of crops diminishes certain soil nutrients and leads to nutrient deficiency in the garden. Vegetables produced in soils with

nutrient deficiency are of poor quality, and yields are low. Vegetable rotation ensures that another follows one type, the order being based on a sound scientific reasoning.

The home vegetable garden should be protected from soil erosion by using staggered beds, cross bars and by benching the bed against the slope of the land if the site is not level. A ridge is constructed around the garden and an appropriate hedge vegetable like the bitter leaf or oha (Pterocarpus) cuttings may be established for erosion control(figure1),for other forms of erosion control.

The home vegetable garden also provides choice of vegetable out of seasons. A good home vegetable garden rotation includes a legume- e.g. vegetables cowpea, French beans, winged beans, lime beans. The fresh beans are nutritionally desirable for the proteins they contribute and they enrich the garden soil with additional nitrogen. **Intercropping in the Home Garden:**

Because home gardens are cultivated by hand and not by machine, in Nigeria, a certain degree of intercropping is beneficial. (Willey 1971). A guiding principle is that the two crops must harvest different niches of the environment. For example, if one vegetable crop is shallow rooted and the other deeper rooted, they can be grown together. Also if a later maturing vegetable crop does not cover the plot fully for part of the growing season, another short season vegetables may be raised between the rows of the former; example is lettuce and radish. At the beginning of the growing period lettuce stands may not cover the ground fully and a quick crop of



Methods to prevent soil erosion

Fig. I

'Crimson Red' radish which matures in 28 to 32 days may be raised and harvested before the lettuce covers the plot. Another example is fresh maize & pole lima beans. Before the maize tassels, pole lima beans (*Phaseolus lunatus*), a local legume, may be planted between the maize stands. The maize stubble provides stakes for the pole lima bean thereby reducing cost both in manufacturing and in providing stakes.(figure2 and 3).

Oyenuga(1967) defined farming systems as a specific agricultural enterprise that satisfies well-defined objectives and involves plant and /or animal inputs and the practices and operations with which they are managed in a given environmental; setting. In the tropical West Africa, farming systems vary in their objectives, complexity, degree of sophistication and the number of practices and operations involved.

In tradition West Africa, the diet is always rich in starch staples, however; recently some farm families are now appreciating the importance of vegetables in the traditional farming system and the profitability of vegetable crops, an aspect relegated to the farm family's wife.

Traditionally and culturally, stews and soups are taken with various preparations of starchy staples. Hence, housewives have to ensure that fresh vegetables, certain fruits, spices, nuts and oil seeds are available for soups, stews and sauces. Hence they incorporate vegetables into the various farming systems. Within the existing farming systems, therefore, vegetables come from:-

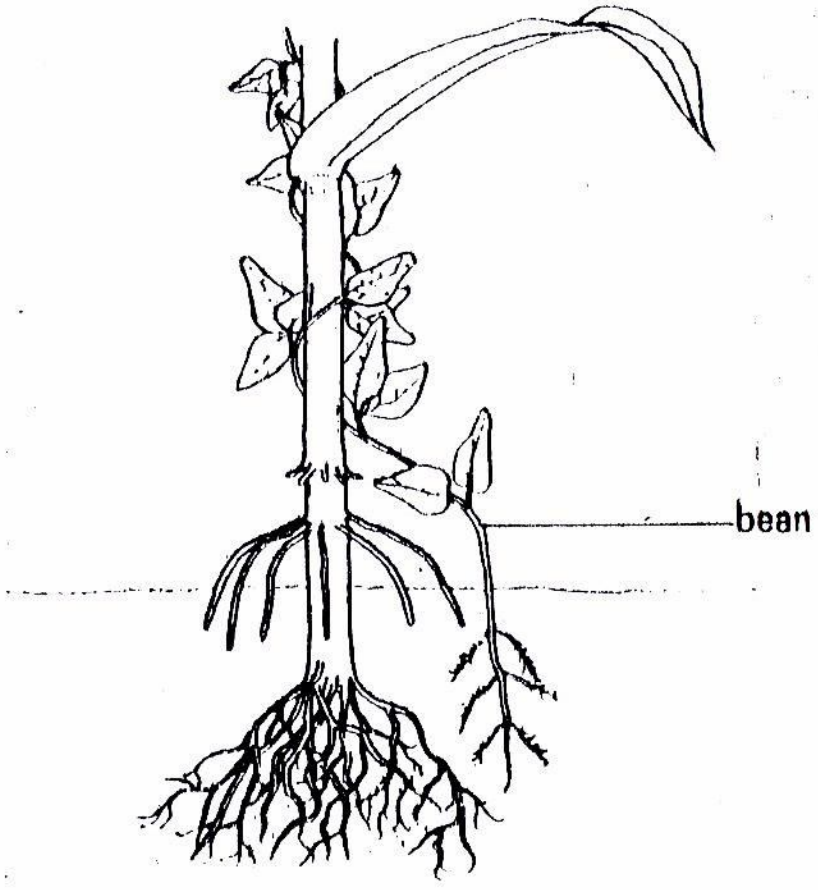


FIG. 2: *Young bean climbing stalk of maize*

FIG. 3: *Maize on high ridges, interplanted with beans*

1. Wild
2. Semi-wild and protected plants;
3. Vegetables intercrops in compound mixed cropping system and home gardens;
4. Importantly, from commercially cultivated vegetables grown as sole crops in market gardens and vegetables farms, for distant market and for processing.

Vegetables gathered from the wild for sale include *Gnetum africanum (Okazi); Gongronema latifolium, (Utazi); Ptercarpus santaliniodes, (Nturukpa).* They are usually found in secondary forest where they are preserved for this reason. The semi-wild and protected vegetables include *Sesamum indicum, Coratotheca sesamoides* – seed and leaves; waterleaf, *Talium triangulare;* African Spinach- *Amaranthus hybridus, Amaranthus cadatum,* vegetable spear of elephant grass spear of elephant grass; *Pennisetum pupureum Pterocarpts soyauxii,* oha; *Adansonia digitata, 'kwuka'*, These plants are protected during land clearing and weeding because of their usefulness. Other vegetables that are regularly cultivated but sometimes unplanted in some compound farms are volunteers and are therefore protected until required: - *bitterleaf, (Vernonia amygdalina) bush okra, (Corchorus olitorius; shokoyokoto, Celosia argentea; utazi, (Gosngronema latifolium).* These plants are now fully cultivated vegetables through the efforts of vegetable crops improvement programmes in the country, (Attfield 1969).

Apart from the vegetables colleted from the wild and sem-wild, many other vegetables are intentionally cultivated in mixed culture with other staples and fruits trees. Chapman 1976; Osato, 1981 observed that the common feature of the African traditional farming system is the growing of several vegetables, starch and staple food crops in haphazard mixed stands near and around the homestead. The vegetables are grown as minor crops, probably to harvest them for preparing soups, stews, and sauces and for port herbs that go with the starchy Staples in the diets. Uzo (1983) noted that the mixed cropping system in compound farms seems to provide a major proportion of fresh vegetables supplied during the rainy season in the areas where it is practiced(figure3). These vegetables include fluted pumpkin (*Telfairia occidentalis*), pumpkin (*Cucurbita pepo*), vegetable cowpea (*Vigna unguiculata*), Okra (*Abelmoschus esculentus*),leaf vegetables such as bush okra for port herbs (*Cochorus olitorius*),African spinach (*Amaranthus hybridus*), fresh peppers (*Capsicum spp*), fresh maize (*Zea mays*), tomato (*Lycopersicon esculentum*), and numerous others.

In a typical compound farm in Nigeria, it is not uncommon to see more than two crops of different species on the same piece of land (figure 4). Vavilov (1969) observed that in addition to the major staples, in compound farms, subsidiary crops are numerous and in a survey of a comparatively limited area of land in Zambi, over one hundred crop varieties were identified He also reported that in several farms in Southern Nigeria, where yam

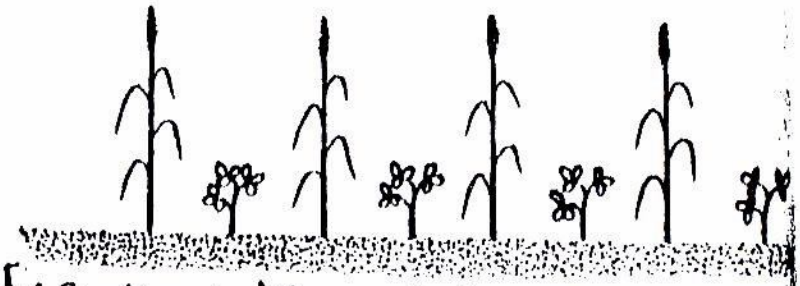


Fig. 4a: Mixed Cropping.

(c) *Mixed farming*

Under this system, both animals and crops are kept.

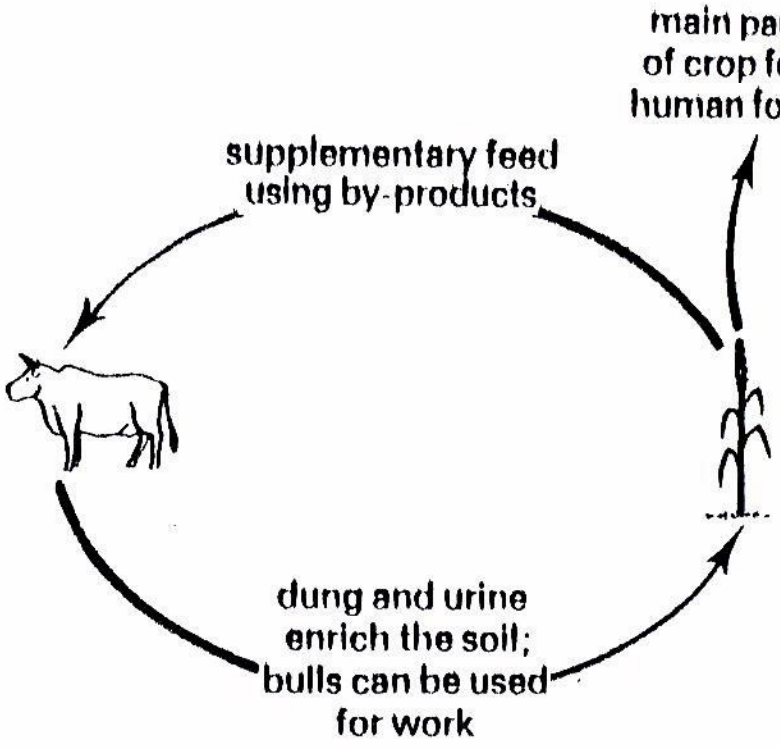


Fig. 4b: Mixed Farming.

(*Dioscorea spp*) and cassava (*Manihot utillisima*) are the major staple crops, it was found that about 93% of them also carried maize, 99% pumpkin, 80% various grain legumes, 92% groundnuts and 90% carry peppers. He noted also that the various varieties of each crop exhibit different characteristics, such as maturing at different times, and adaptation to different ecological situations and cultural practices.

Uzo (1983) stated that Complicity of mixed cropping decreases from the lowland humid tropics to the savannah regions. In the Guinea savannah of Nigeria, which is a transitional zone between the root crop/oil palm/cocoa belt of the south and the Sorghum/Millet/Cotton/groundnut belt of the semi arid north, mixed cropping system begins to decrease in intensity. In the high altitude area, there has sprung up a number of large-scale farms for the production of more temperate and sub-tropical vegetables in sole stands for the urban centers of the country. The vegetables grown in sole stands include tomatoes (*Lycoperaicon esculentum*) Irish potato (*Solanum tuberosum):* carrot (*Daucus carota),* watermelon (*Citrillus vulgaris),* lettuce (*Lactuca sativa),* cabbage (*Brassica oleracea),* cauliflower *Brassica oleracea,* var. Botrytis, and onions *Allium cepa).* Sorghum, millet, groundnuts and cowpeas are also commercially grown in mixed stands. In the far north, latitudes 11 to 13^{0}N, vegetables are also grown in small and large scales along the fadamas and river banks; such vegetables include, tomatoes, onion (Kano) and other exotic vegetables which are transported to the south in trailer

load(figure 5&6),shows distribution of crops in Nigeria and different farming systems.

In the north, except in Kano and other high-density areas of Northern Nigeria, bush fallowing is the common practice with fallow periods ranging from four to eight years in areas of low population density. However, compound farms are as usual, common to all areas and are cropped every year with such crops as maize, okra, peppers, pumpkins and other vegetables. In addition to the compound farms, and bush fallow fields located at varying distances from the homestead, there are fadama fields or hydromorphic areas where bananas and vegetables are grown.

B. COMMERCIAL VEGETABLE PRODUCTION

(Tinadal, 1965), noted that Africans consume substantially less meat and diary products. The main food item is still mostly carbohydrates. An optimum level of good health can hardly be supported with this our present level of feeding. Apart from this, our genius will hardly develop without an excellent level of feeding including adequate protein. At our present level of meat availability, and vegetables offer us a very good chance of developing ourselves in terms of good health, vitality and longevity. It also offers a great opportunity for profitable independent employment through commercial vegetable production.

Basic commercial vegetable production requires certain facilities for all seasons' operation. These are: Sprinkler or drip irrigation.

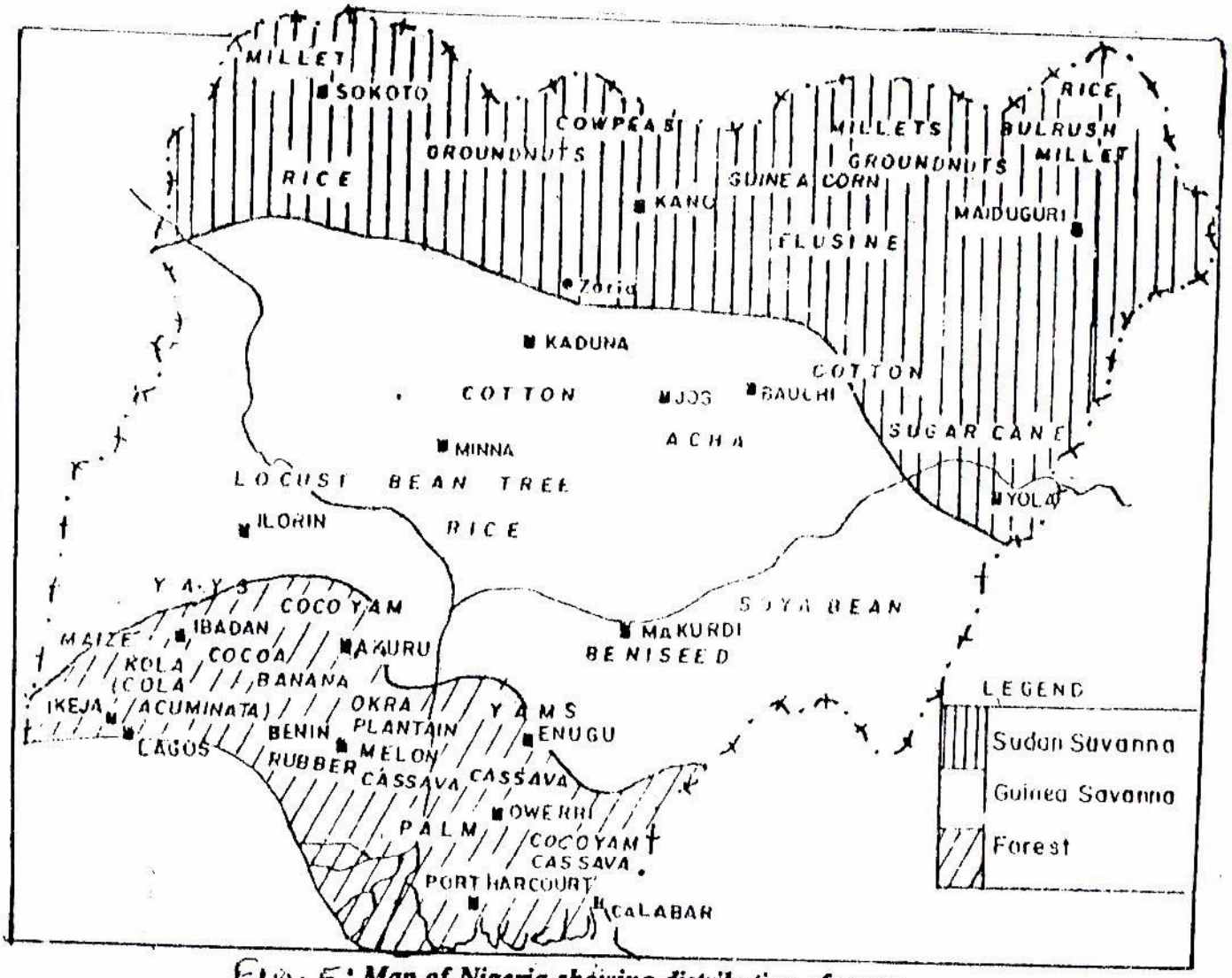
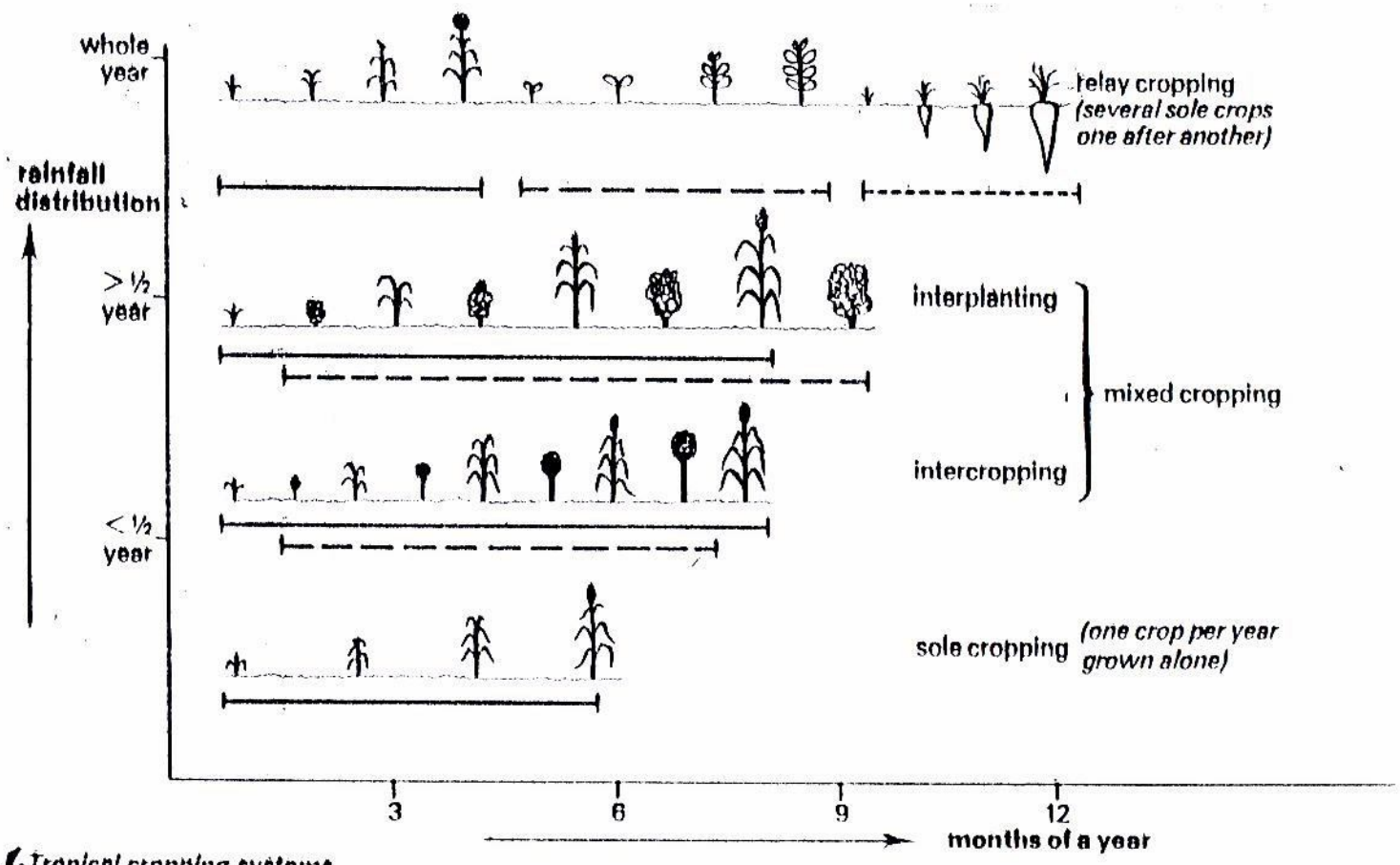


Fig. 5: *Map of Nigeria showing distribution of crops*



9.6 *Tropical cropping systems*

- Machinery and propagation unit with maintenances service; a source of high quality seed
- Availability of farmyard manure
- Suitable insecticide and fungicide at moderate cost. General and special fertilizers
- Service of a well trained extension agent
- Choice of suitable vegetable crops based on market survey

C. **THE MARKET GARDEN:**

As cities become large and congested, residents at the outskirts, or sub urban people use any available land usually not suitable for residential estate and industries or commerce to increase vegetable production for sale in the nearby city. This gives rise to market gardening as a substantial occupation. Market gardeners grow vegetables commercially. The size of a market garden may be 5 hectares or less. It may or may not be mechanized. The land may not be the market Gardener's choice as land is very expensive in sub urban locations. An important consideration, however, is nearness to perennial water and availability of organic manure and irrigation equipment; good transport facility to the markets.

Market gardening involves intensive methods of culture and involves special skills. (Wittwer 1970) Every square meter of market garden land is occupied throughout the season, every year. Companion cropping is popular with market Gardeners. This is growing one crop in a piece of land and sometimes before harvesting, another crop is planted. For example, radish followed by lettuce;

maize followed by pole lima bean. Their combination is for economy. The maize stubble will serve as stake for bean. An illustration of the fact that even tropical soils can be subjected to intensive cultivation using appropriate cultural techniques such as those developed at the market Garden, Enugu where the land has continued to be intensively used for horticultural production, from 1950 to date, without visible degradation.

Management practices adopted there include LIMING every two years, applying manures and fertilizer with each crop; use of good crop rotation including a course of one leguminous cover.

Course 1. Leaf vegetable
2. Beans and bulbs
3. fruit vegetable
4. leguminous cover

Uzo (1983) compared soil fertility parameter of two plots: one under wild grass cover, one under *stylosanthes gracillis*, each for two years, based on sample drawn.

(i) Before Stylo cover crop-wild grass

(ii) Two years of stylo cover followed by four years of vegetable cropping.

The nutrient contents are given below:

TABLE 2:SOIL ANALYSIS OF EXPERIMENTAL BLOCK USED IN MIXED CROPPING STUDY

	Grass fallow (3 yrs. Old)	Fb. Stylo cover (2 yrs.)
P^{H} in $H20$	4.6	6.0
% organic carbon	0.60	0.75
% organic matter	1.09	1.29
%N	0.050	0.073
Pp^{mp}	14.0	188.0
Meq k/100g	0.10	0.21
Meq ^{Ca}/100g	0.4	3.20
Meq mg/100g	0.7	0.3
^{Meq} Na/100g	0.15	0.13
Meq CEC/100g	6.5	4.3

D. TRUCK FARMING:

This involves production of vegetables for transportation to distant markets. The truck gardener specializes in one or two vegetables, which he grows extensively for distant market. The question of availability of cheap labour, climate, soil and transportation facilities largely determine the location of truck vegetable farming. Truck farming has been more developed in United States of America and the European farms and it is still in its infancy in West Africa.

COMMERCIAL VEGETABLE PRODUCTION CONTINUED :

Increased demand for vegetables by the city dwellers throughout the year, rapid transportation and refrigeration facilities for storing vegetables and their product led to the production of special vegetable crops in relatively large quantities for distant markets. It involves greater use of inputs and sole cropping with improved varieties of vegetables. It also involves mechanization of a large area of land. This is applicable to areas of low population pressure with massive hectares of fertile land. Examples are found in savannah areas of Nigeria where there are no forests that impede mechanization. Commercial vegetable farms are set up where major conditions such as good climate, cheap, fertile land with suitable topography, available water (both by rains and irrigation), and good access road are available. It involves location especially where certain crops are grow commercially for fresh market or for processing. Examples are the tomato production and onion production for shipment from the Northern Nigeria to the Southern cities. Around Nsukka there has grown in recent time a commercial cultivation of the yellow aromatic peppers put out by the research efforts of crop Science Department of the University of Nigeria, Nsukka

Producing vegetable commercially to meet the needs of more distant markets and for processing is increasing in importance in Nigeria. This is sustained through the research and development activity of the National Horticultural Institute. Also in Nigeria, tomatoes are grown for processing and canning by Vegfru Nigeria

Limited, Gombe and by Cadbury Limited which process Tomapep for the domestic market. Farmers usually go into contract to grow the crops commercially, for the companies to buy and process.

It is in the light of the need for fruits and vegetables and other grain and carbohydrates in our diet that the Federal Government of Nigeria set up *Eleven* River Basin Authorities to harness our water resources for the production of food throughout the year. In this aspect, vegetable production in Nigeria has made a significant impact on large-scale production and sending the produce to areas of high population density such as from Kano and Jos to Lagos, Ibadan, Enugu and Port Harcourt. Off-season vegetable farms around the fadamas and river banks are of great importance in providing the much needed vegetables year round including during the dry season while some decades ago, there used to be insufficient vegetables in the dry season. Commercial vegetable production is yet to find its place in the traditional farming system of West Africa especially in the tropical rain forest areas, where the land tenure problem and intermingling forest impede mechanization. In Nigeria, leafy vegetables are customarily regarded as a condiment essentially used in order to improve the eye appeal and flavour of foods and are consumed in such small amounts for any nutritional impact. The rate of vegetable production varies from state to state, due to some influences on the vegetable consumption pattern. These include:

(1) Distribution facilities

(2) Buying power (market)

(3) Religious beliefs

(4) Social customs

(5) Knowledge of nutrition.

In purely agricultural communities, fresh vegetables were virtually grown in the kitchen gardens and every household was self-supporting. By this method, the local preferences for particular kinds and varieties of vegetables can be satisfied.

In urban areas the village pattern of life is replaced by a more sophisticated way of life, and many members of the community could not produce their own vegetables because of lack of suitable land for cultivation. In this case, the urban dwellers depend on the supplies from the market garden and from neighboring communities. Market gardens around cities such as Jos, Kano, Kaduna, Zaria, Sokoto and Funtua produce large quantities of vegetables of different types all the year. These are commercial centers of vegetable production from where they are distributed to other areas of the country.

PHYSICAL (ENVIRONMENTAL) FACTORS OF VEGETABLE PRODUCTION

The success in growing vegetable crops is determined by the conditions of the environment. Therefore, a good knowledge of the environmental variables serves as a useful key for production techniques. Some of the factors include temperature, moisture, nutrient supply, light (duration, intensity and quality) carbondioxdide, soil physical state, soil reaction, wind , pest, diseases

and weeds. A trained gardener chooses an area where these conditions/factors are as much as possible fulfilled. Although many of the factors are not controllable by the vegetable grower, a clear understanding of these factors, the extent to which they influence his crop yield and quality will aid him in understanding his crop production problems and adopting suitable agricultural technology.

SITE ELECTION:

A vegetable garden poorly sited may produce inferior crops despite the use of recommended method of cultivation. Land which slopes steeply is difficult to cultivate and erosion of the topsoil can become a serious problem in regions with heavy rainfall { figure 7}. A level site is generally suitable, although a gentle slope can be so advatangous because it assists drainage and ensures that surface water does not collect during heavy rains.

Fully exposed sites are suitable for vegetable cropping because plants are well exposed to sunlight. The most productive sites are often those, which are protected from wind by hills or by trees, and this requirement is often met by selecting site near the streams or rivers. The altitude of the site selected will also influence the type of vegetable which can be grown profitably provided other factors are not limiting.

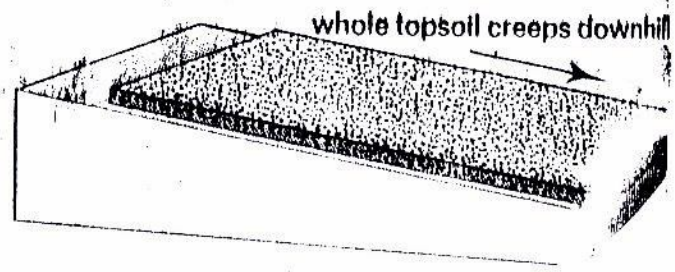
SOIL.

Before acquiring land for vegetable production, it is essential that the soil should be inspected in order to estimate its suitability for crop growing. Chemical methods can be used to estimate the fertility

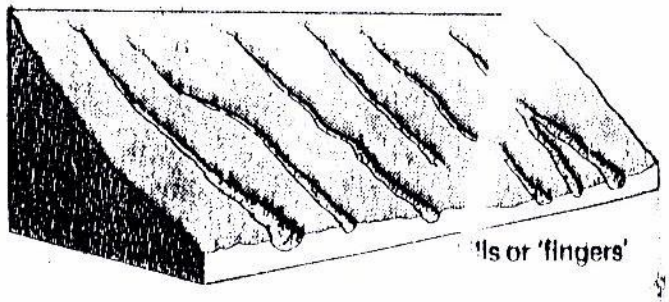
Types of erosion

A. *Water erosion*

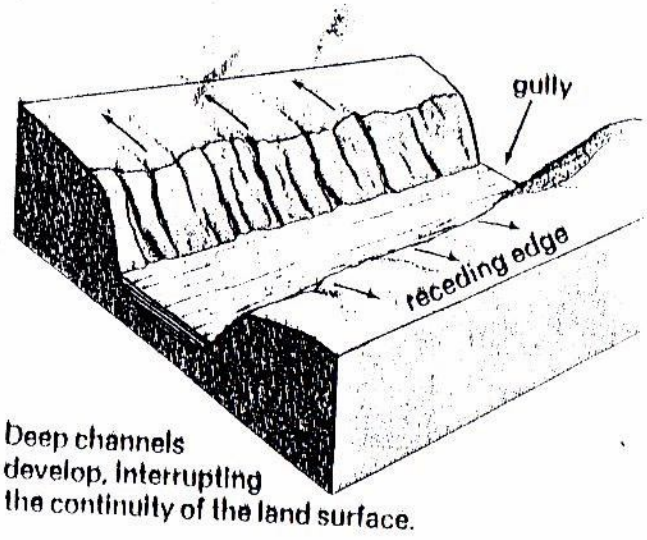
(a) Sheet erosion



(b) Rill or finger erosion



(c) Gully erosion



B. *Wind erosion*

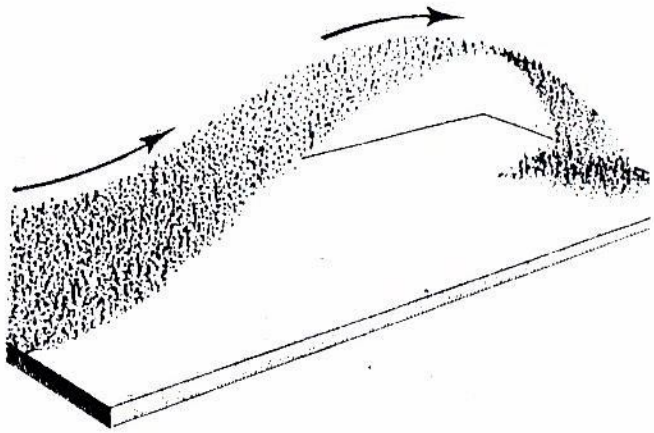


Fig. 7

of the soil, but these are most efficiently undertaken by soil specialists who have the equipment necessary for soil analysis. Usually fadama or alluvial soils high in organic manure are the best. Texture and colour of the soil are often indicative of its potential usefulness for growing vegetables. Dark soils are usually the most fertile since they often have a reasonable content of organic matter. Good vegetable soil should have a fair proportion of clay to assist in the retention of soil water(figure 8a &b) shows a tomato crop and flower truss growing in a fertile soil.

Generally, fertile, deep, friable, well friable, soil is one of the first essentials for successful vegetables cultivation.Also (Figure 9) Shows a maize plant in a fertile soil. The exact type of soil is not so important as that it is wall drained, adequately supplied with organic matter, retentive of moisture and reasonably free from trouble some soil micro-organisms. An infertile soil with favourable physical properties may be upgraded into high productivity by incorporating organic matter, accompanied by the liberal use of soil amendment materials and commercial fertilizers. Other routine cultural practices such as mulching, irrigation, disease and pest control will contribute to an increase in vegetable production.

Valley soils which have been enriched by materials washed down from higher ground are also suitable for vegetable cultivation in the dry season.

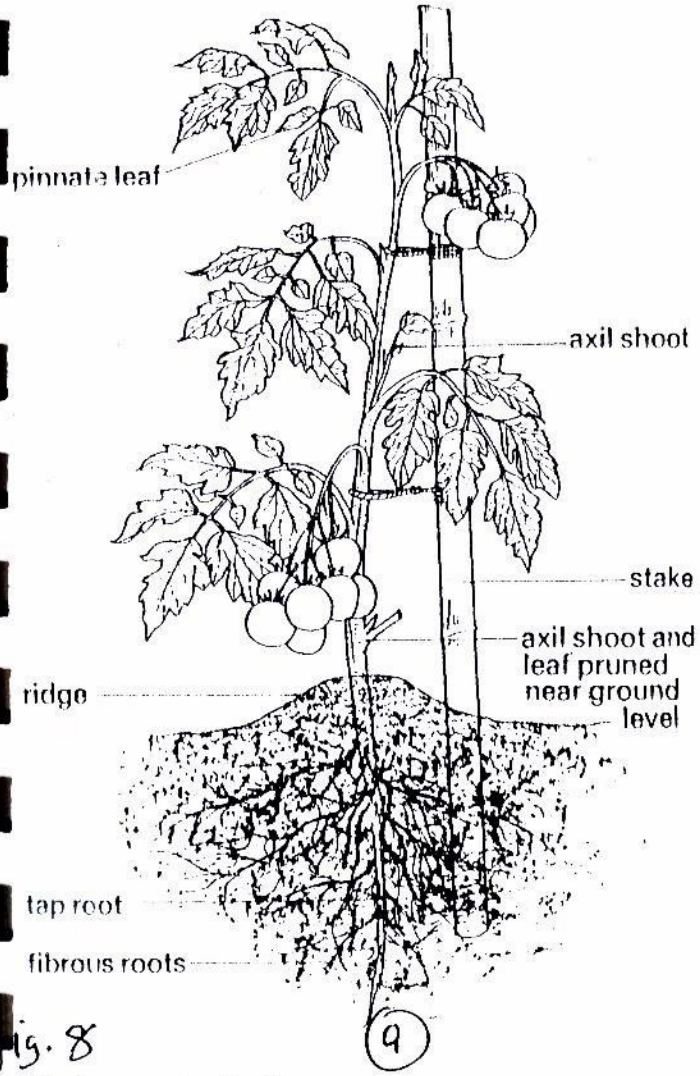
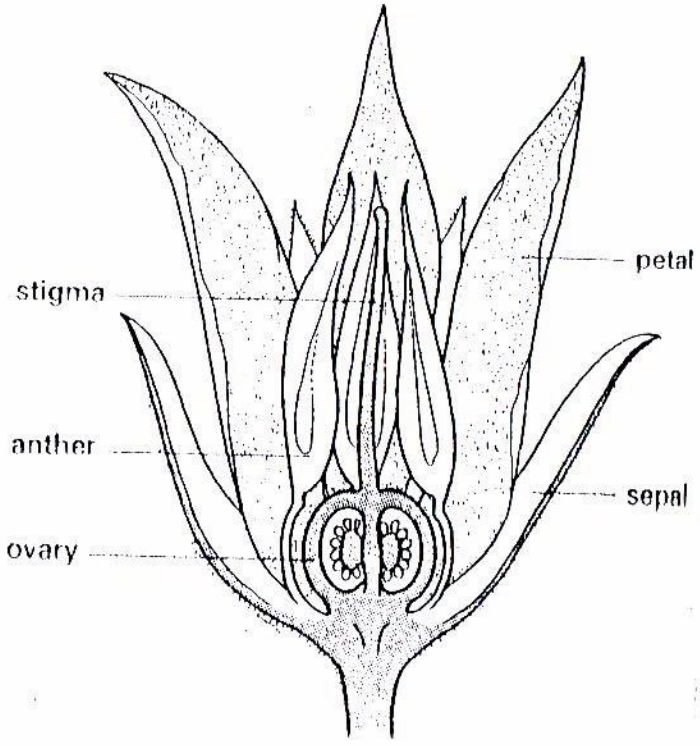


Fig. 8

Whole tomato plant

(a)



Longitudinal section of a tomato flower

(b)

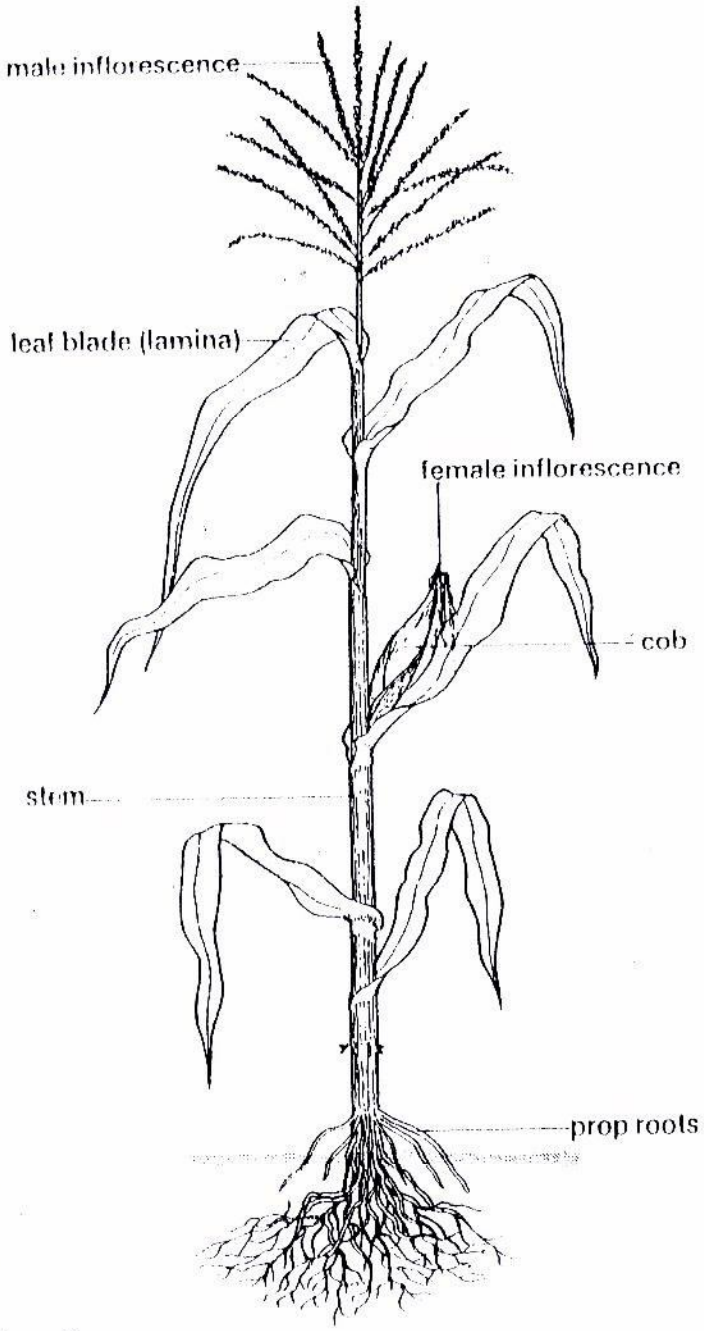
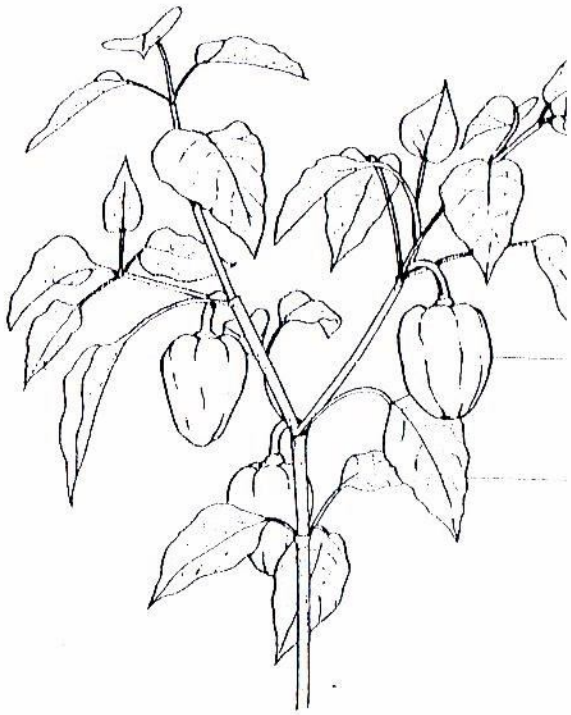
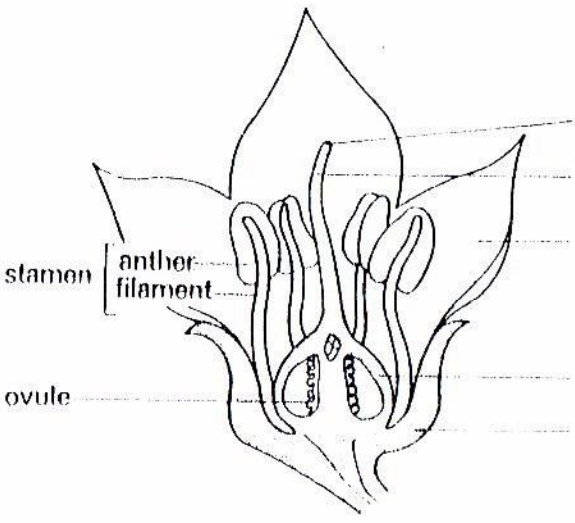


Fig. 9

Whole plant of maize



Whole plant of Capsicum annuum *with fruit*



Longitudinal section of a Capsicum flower

SOIL IMPROVEMENT (FERTILIZERS AND MANURES).

The fertility of tropical soils is difficult to maintain, particularly in the humid zones where plant foods are rapidly washed out of the soil during the wet season. The potential capacity of a soil to support plant growth is controlled by the following factors.

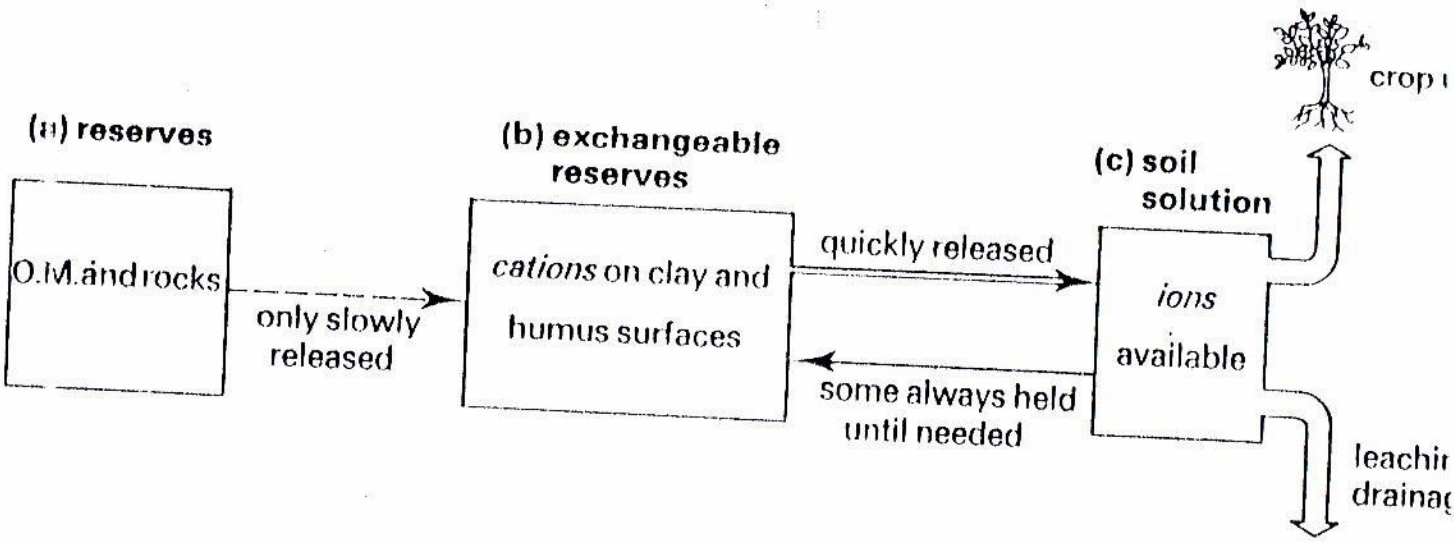
1. The availability of minerals required for plant growth.
2. The presence of useful bacteria and other micro-organisms.
3. A suitable soil temperature
4. Adequate soil oxygen
5. Adequate moisture
6. A favourable pH range

A farmyard manure and chemical fertilizers can provide enough of the plant foods depleted by crops.(Mohammed et al (1986). But their application in excess can cause as much damage to the root systems of plants as a shortage or deficiency of essential elements(figure 10) explains that nutrients occur in plants in three ways. Symbiotic bacteria are essential for the improvement of soil fertility. They provide nitrates in a form available to the plant roots. They equally break down organic compounds from compost or manure applied to the soil. Harmful bacteria occur in badly drained soils and can reduce the amount of nitrate in the soil. This is why a period of leguminous cover crop is included in any good vegetable crop rotation.

A suitable temperature is essential for optimum plant growth. Low night temperatures are necessary for high yields. This

Principles of crop nutrition

1. Nutrients occur in three phases:



N.B.: Ions are produced when a dissolves in water, e.g. common salt:

$NaCl$	⟶	Na^+	+	Cl^-
sodium chloride		sodium cations (positively charged)		chlorid (negati charge

Strong negative electric charges such found in clay and humus will attract cations them.

fig. 10.

Principles of Crop Nutrition.

encourages good accumulation of edible portion and also increases reproductive development. (Wien et al 1987). The amount of water present between particles of the soil not only determines the supply to the crop but also affect the availability of minerals to the root system. Many vegetable crops have a wide range of tolerance and can thrive favourably under relatively dry conditions.

The amount of air in the soil directly affects the fertility of the soil. Plant roots require an adequate supply of oxygen for respiration and optimum root growth. Badly drained soils are often deficit in this respect and accordingly unsuitable for many vegetable crops.

Most tropical vegetables grow well in slightly acidic soils, although some prefer neutral soils. Soil acidity or alkalinity is expressed in terms of pH value where pH 7.0 is neutral. Lower pH values indicate an increasingly acid soil, and very few vegetable can grow in soil of pH value lower than 4.0. Soils with pH value above 7.0 indicates increasingly alkaline soils and are difficult to manage under vegetable crops. lime is applied whenever soil pH is less than 5.5(figure11) shows PH range of soils.

CHEMICAL FERTILIZERS

Use of fertilizer is absolutely essential in modern crop production. Application of phosphate fertilizer is made before sowing or planting the crop with N & K applied later during the early vegetable crop-growing period. The greatest response is usually obtained when fertilizer is applied during the early life of the vegetable. After a certain stage in development is reached, fertilizers

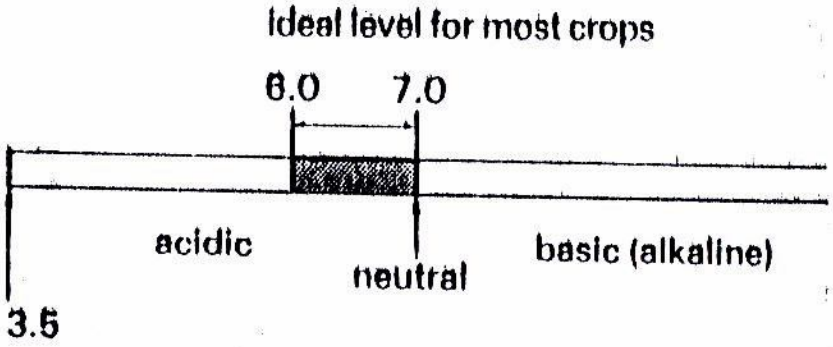


FIG. 11: **Soil pH scale**
(showing maximum range found in soils)

are not helpful for high yield. In sandy soils with poor retention power, fertilizers may be applied more than once. There is a residual effect of applied fertilizer, which should be considered in fertilizing a succeeding crop.

Fertilizer recommendation can only be made of a particular soil, climate, culture and type of crop. The types of fertilizer in common use are as follows:

1. Nitrogenous fertilizers.
2. Potash fertilizers.
3. Phosphoric fertilizers.

Side dressing with sulphate of ammonia, or ammonium nitrate may stimulate leaf vegetables such as spinach, cabbage, and lettuce, which require more nitrogen than other garden crops.

Root vegetables including carrots, sweet potatoes, Irish potatoes, beet root, turnips, etc. need higher percentage of phosphate than other vegetables. Potash helps in strengthening tissue development so that the crop does not lodge excessively.

The quantity of fertilizer to use depends on the natural fertility of the soil, the amounts of manure and the form of the fertilizer, available. Beans for example, require only moderate amounts of fertilizer, especially nitrogen, whereas onions, celery, lettuce and potatoes respond profitably to large applications of fertilizer. At high soil PH less amounts of fertilizers are required.

Chemical fertilizer could be beneficial or detrimental depending on quantity, method and proportions of other fertilizers.

Heavy yield of top-quality vegetables cannot be obtained without an abundance of available plant food in the soil. Failure to bear fruit and even injury to the plant may result from the use of too much plant nutrient, particularly chemical fertilizer, or from unbalanced nutrient condition in the soil. Therefore, it is advisable to follow recommended rates for a particular locality, soil, and crops to be grow.

ANIMAL MANURE:

Goat, sheep, cattle or chicken manure are all valuable sources of organic material, and vegetable growers often keep livestock to produce/supply their own requirements of manure. For a new plot, an application of 20 to 30 tons of decomposed cattle manure per hectare is recommendable. Poultry manure is usually higher in nutrient constituents, hence the rate of application should be from one-fourth to one-third that of the amount of cattle manure. This should be applied a few weeks before planting.

Decayed compost should be applied to the soil before planting at the rate of about 50 tons/ha and should be worked into the soil.

CROP ROTATION:

Gardens are generally grown on fixed site and crop rotation helps in keeping pest, disease, nematode and nutrient imbalance under control. Usually a five or six course rotation is adopted in which leafy vegetables, legumes, root vegetables and fruit vegetables are grown in sequence. An example of a suitable rotation which has been successfully used for growing vegetables at Enugu market

garden with the inclusion of a course of stylo cover crop ley is given below:

The entire field is planted to a leguminous ley for two years thereafter a four course-cropping plan follows:

Course I: Leaf vegetables and bulb crops.

Course II: Fruit vegetables.

Course III: Leguminous vegetables.

Course IV: Root vegetables and tubes.

The crops of each course are rotated within the beds during each year and between course from year to year. Courses I – IV are rotation from year to year or as crops are cleared. The whole block is then put to leguminous ley for two years before returning to vegetable crops. A ridge protects the vegetable field from erosion and soft fruits such as paw-paw and pineapples are grown round the block.

PREPARATION OF VEGETABLE BEDS:

The time, method of preparing the garden bed and the type of bed for planting depend on the type of soil and the location. Two types of bed are used for intensive vegetable growing. These include:

(a) Raised bed

(b) Flat or ridges.

RAISED BEDS:- These are commonly used in the humid tropics because it protects the plants from excess water, at the roots by encouraging rapid run - off into the pathways on both sides of the beds. The use of beds implies that at least 1/5 of the land is devoted

to paths. This is a big disadvantage over ridges where the furrow services as path. Also seedlings may be transplanted not on the crest but on both sides of the ridge, one-third down from top, in a staggered pattern. This further increases the plant density per hectare. A vegetable bed may be of any convenient length for ease of management, it is preferable to use 1.2 meter wide beds. The most convenient size is 7.63m x 1.22m with 30 cm -50cm paths between adjacent beds.

Bed preparation involves digging to incorporate manure into a layer of the sub-soil. After digging up the area of the bed, topsoil from the paths is placed on the bed; and later fertilizer is incorporated.

Flats:- The preparation of flat differs from raised bed. Flats involve loosening the soils in - situ with the addition of manure. A small ridge is made around the edge. The flat bed is preferable during the dry season because it retains soil moisture at the root zone and this makes better use of the limited quantity of water. Adequate mulching increases the effectiveness of flat beds by further conserving water.

To check erosion, beds should be laid out in a staggered arrangement by starting the first row of beds at full length and the second row at half length.

Beds could be made manually using garden fork and spades, and mechanically by using rotary cultivator(figure12) . ;maize planted on flat surfaces .

Fig·12: Drilled maize on the flat

STERILIZATION OF NURSERY SOIL:

Nursery soil should always be sterilized before use in formulating propagation media. This is to destroy weed seeds, pathogens, nematodes, etc. Very small plots can be treated by placing the moist soil in a cut drum and raising the soil temperature from 98°c to 103°c for 45 minutes. This treatment not only controls most diseases that might be present, but also kills insect eggs and many weed seeds. Another possible way to accomplish the same task is to place the soil in an electric soil sterilizer. After sterilization the material should be allowed to stand for 2 weeks before being used in formulation of seed box mixture.

Chemical sterilization using formaldehyde or chloropicrin (tear gass) is extensively practiced in temperate countries.

OTHER NURSERY PRACTICES:

Vegetable seeds vary in size; some are large seeded while others are small seeded. Because of the small size of many vegetable seeds, it is usual to germinate and start the small seeded types in nurseries and the seedlings obtained are transplanted on to the field usually at 21 days old. Celery, onion, lettuce belong to this group, large seeded vegetables such as okra, maize, cucumber, beans and artichoke are planted directly. Root vegetables such as carrot, beet root and radish have small seeds but are seeded directly because transplanting adversely affects the quality of the roots.

The vegetable nursery can be a seed-box, propagation frame, nursery basket or any form of container

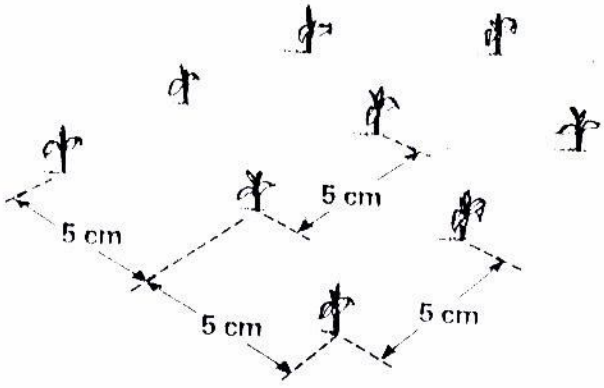
A special mixture of 3 parts top soil, 2 parts well rotted manure and 1 part river sand is used in filling vegetable nursery containers. The topsoil must be sterilized by heating for 30 to 45 minutes, and the mixture should be sieved to remove large clods and stones.

The seed of some species like tomato and cabbage are planted at 5cm and 10 cm intervals and about 10mm deep covered with fine soil and firmed with a pressing board(figure 13)young seedlings in a nursery bed. The nursery is watered regularly and the seedlings of most species can be transplanted 3-4 weeks after sowing in the nursery. At the time of transplanting the nursery should be watered as necessary during the nursery period. The nursery is watered before lifting of the seedlings in order to reduce transplanting loss.

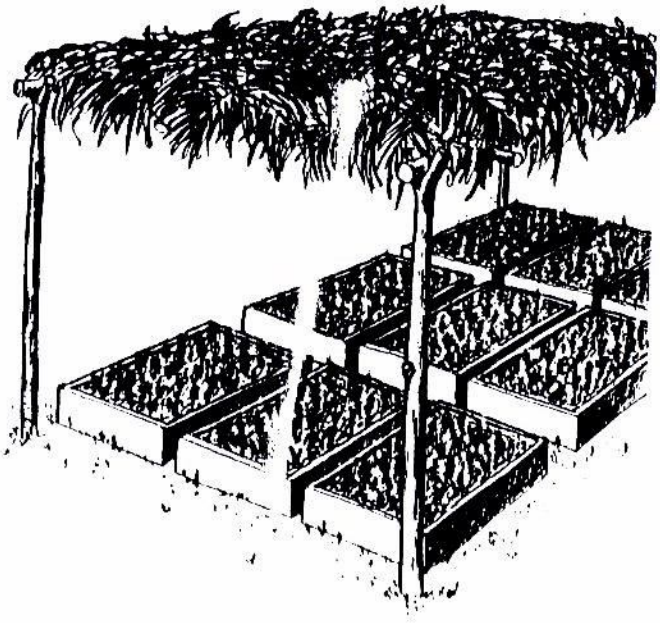
TRANSPLANTING:

This means moving a plant from one soil or culture medium to the field. It may refer to the shifting of small seedlings from the seed box to other containers where the plants will have more space for further nursery growth. This latter is referred to as pricking. Every effort should be made not to damage the roots hence the plants are lifted with ball of earth using a trowel or old spoon.

Plants differ greatly in the way they recover from the shock of transplanting. Transplants are capped with twigs. Seedlings of tomatoes, lettuce, beets, cabbage and related vegetables are easy to transplant if done in the evening or after a rain. It is necessary to



Young seedlings set out in the second nursery bed



FIG·13: *Tomato seedlings growin under shade*

irrigate immediately after transplanting unless there was a rain soon after the operation(figure14)

IRRIGATION OF VEGETABLE CROPS:

Vegetable crops are composed of 75 to 90% of water. Water is one of the raw materials of photosynthesis and a considerable proportion of the plants dry weight is manufactured from water. Apart from being an essential part of the crop composition, water also serves as a means of moving essential nutrients and foods to various parts of the crop. Water maintains plant turgidity.

In applying water to growing crops the soil should be filled close to field capacity, to the depth of the root zone. During the dry season, vegetable beds should be watered regularly. Where irrigation facilities are used to grow vegetables the irrigation should be done during the cooler hours of the morning and evening.

The frequency of irrigation will depend on the total supply of available moisture reaching the roots and the rate of water use. Total available water is affected by soil type, depth of wetted soil, the depth and spread of roots. Amount of water used is influenced by weather condition and the age of the crop.

CARE OF VEGETABLE CROPS:

1. CULTIVATING:

Weeds rob cultivated vegetables of water, nutrient, space $C0_2$ and light. As soon as the soil can be properly worked after each rain or irrigation, it should be hoed or cultivated to kill weeds that have sprouted and to keep the surface in a loose, friable condition to admit

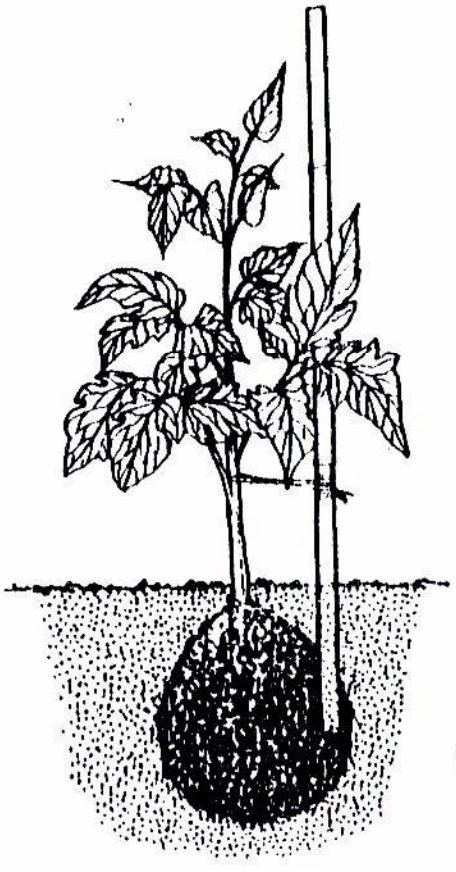


FIG. 14: *Newly transplanted tomato seedlings*

oxygen. The primary aim of hoeing or cultivating is to control weed. This cultivation should be shallow to avoid injuring the vegetable plant roots that lie near the surface.

2. MULCHING:

In non-irrigated areas that have frequent periods of insufficient soil moisture, a mulch of dry grass, dried lawn chipping, half rotted leaves, or similar materials help conserve moisture and keep down weeds. To be effective, the mulch must be applied between the rows and around the plants, early, before the soil dries out. Such a mulch also keeps the fruits of vegetables from contact with the soil. This keeps the fruits clean and reduces losses caused by certain rot organisms that are present on the soil.

3. WATERING:

In most areas the vegetable farm requires a reasonable moisture supply equivalent to about three centimeter of rain a week during the growing season for best result. During the dry season when rains cease, regular watering of the crops will be required for good yield.

4. CONTROLLING DISEASE AND INSECT:

Garden crop are subject to attack by a number of disease and insects. Preventive measures are best, but if an attack occur and the grower is not familiar with the insect or disease and the proper treatment to protect this crop, he is advised to consult the plant protection unit of the ministry of Agriculture.

However, the most important disease-control measures are the use of disease resistant varieties and clones, seed treatment with

fungicide and insecticides and spraying of growing crops(figure 15) shows equipment for spaying pesticides in the farm.

MARKETING:

1. PREPARING VEGETABLES FOR MARKET:

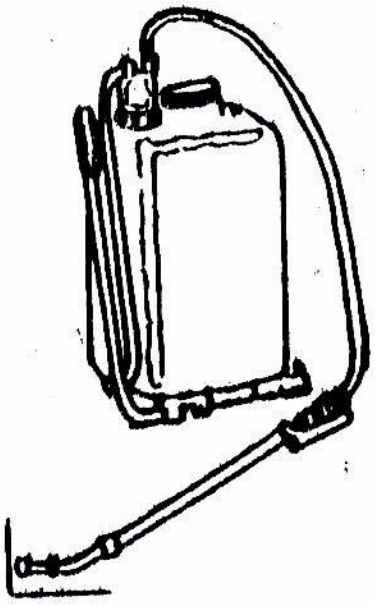
This involves the following procedures;

(A) WASHING: Some vegetable are washed and trimmed before being sent to the market, particularly roots and leafy vegetables in fresh condition. Washing removes soils from the roots and leaves. It also helps to keep the vegetables in fresh condition. as stated by Desrosier (1964). Since leafy vegetable may wilt after a short exposure to the sun if not sprinkled lightly with water before sale they are harvested in the cool evening or early morning and taken to market in cool weather

(B) PLASTIC CONTAINERS: The use of plastic packaging materials prevents water loss, and so the content of the plastic container will remain fresh for sometime if kept cool. Vegetable in plastic bags should not be sealed.

(C) COOL STORAGE: This is an essential factor for large scale vegetable crops under all conditions. A fairly moist atmosphere is also a great advantage, and produce can be kept in a fresh state, by lightly sprinkling it with water at regular intervals.

(D) GRADING: selection of produce is usually by size or quality, and this is often repaid by higher prices received. This is not widely practiced in the tropics, but growers who sell their produce



Knapsack sprayer

Fig. 15

through a co-operative society may e required to select it to a definite standard or grade, before it can be accepted.

2. **HANDLING AND STORAGE OF PERISHABLE PRODUCE:**

Product that remains after sales may be wasted unless it can be kept in cool storage. Cool storage is particularly valuable during the periods of over-production which occur at certain time of the year. One of the main benefits to the grower is the stabilization of prizes and a reduction in the amount of wastage.

Vegetables can be kept for quite long periods at temperatures between 45_of and 45_of without lowering the quality.

Co-operation societies should be able to provide cool storage facilities for their members.

3. **METHODS OF SELLING VEGETABLES:**

There are several channels through which produce can be sold:

(a) DIRECT SALES: A grower often sells his produce direct to the public. By this grower will be familiar with the volume of element for his produce and will be able to present at a time, the quantities of each item likely to be required by the public.

(b) SELLING AGENTS: the growers here for obvious reasons may be unable to sell their produce directly to the consumer and then obliged to sell to an intermediary, such as the market agent or wholesale buyer. This means that the grower will receive fairly low rate of payment for his produce.

CO-OPERATIVE MARKETING:

Many of the grower's marketing problems are reduced if he belongs to a co-operative society formed for purpose of retailing vegetables to the public.

The societies usually adopt some form of grading, and market the produce of its members under a label of brand name. They should also be responsible for supplying containers, and for handling and retailing any produce supplied by members.

Other functions of the society may include the supply of inputs, to members.

Efficiency and effective marketing is very rewarding since a grower justifies his efforts through high returns from sales.

A good knowledge of the physical environment in conjunction with timely operation, and efficient and effective production techniques are rewarded by very high yield.

A well-managed vegetable farm undoubtedly is self-sustaining and very profitable.

VEGETABLE CROPS

A BOTANTANCAL LISTING OF VEGETABLE CROP

Gymnospermae	Edible portion
FAMILY: Gnetaceae	
Gentum africanum	*Leaves*

G. buchalzianum	Leaves
G. gremon	Leaves
Angiopermea	
Monocotyledonae	
a. Family: Graminae	
mays Zea	tender seed (kernels)
Pennisetum purpureum	tender spear
Bambusa spp.	tender shoot tip
Panicum palmifolium	tender shoot tip
Setaria palmifolia	tender shoot tip
(B) Family: *Araceae*	
Colocasia antiquorum	corm, leaves, spear
Xanthosoma sagitifolia	corm leaves
(c) Family: liliaceae	
Asparagus officinalis	tender spear
(D) **Family:** Amarvllidaceae	
Allium cepa	bulb,young wholes
A. porrum	branches leaf fold
A.*choenopasum*	leaves
A staivum	corm
(E) **Family**: Amaranthaceae	
Amaranthus blitum	leaves and tender s
A.caudatus, A. paniculatus	" " "
A Cacorostachys, A. tricolor	" " "
A cruentus, A. viridis	" " "

A. gangeticus, celosia laxa " " "

A. hybridus,C trigyna " " "

A.lividus, Deringia amaranthoides " " "

A oleraceus, C. bonnivaric " " "

Celosia argentia, C. cristata " " "

Pandiaka hendelotii,

Edible portion

Sericostachya scandense leaves and tender

(F) **Family:** Acanthaceae

Justicia insularis " " "

J. p rotolaris " " "

(G) **Family** :Basellaceae

Basella alba, B. rubra

(H) **Family:** Bombacaceae

Adansonia digitata tender leaves

A.madagasariense " " "

B.unguliceryum " " "

Ceiba guineesis " " "

C. pentandra " " "

(J) **Family:** combertceae

Combrstum micranthum

(J) **Family:** Compositae

lactvca capensis tender whole leaves

L. indica " " "

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