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# BETTER VEGETABLES

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and

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AID Mission to Ghana

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## FOREWORD

Dedicated to the Ghanaian farmer who seeks to improve his vegetable production, this handbook is based on the three major climatic zones found in Ghana and other countries on the West Coast of Africa. These zones may be identified as coastal, forest, and savannah. A knowledge of their characteristics is vital in the planning and developing of agricultural potentialities. Thus, the handbook, while primarily serving the needs of Ghana, has applicability in West Africa as a whole, as well as in other tropical areas having similar climatic conditions.

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## INTRODUCTION

Ghanaian agriculture has a geographical specialization, dictated by rainfall, temperature, soil type, and topography. To this end the country has been divided into three zones for this specific publication. They are: (1) the Accra Plains and the Savannah part of the Eastern and Volta Regions Coastal Belt with an annual rainfall of 30-40 inches including a major and a minor season; (2) the forest area with an average rainfall of 60 inches divided into a major and a minor season, and (3) the northern savannahs with an annual rainfall of 40-50 inches representing one general rainy season and a dry season.

Suggested planting dates have been designed to facilitate optimum use of the seasons, whether wet or dry on the basis of normal weather patterns. However, changing trends in the patterns occur at times, but these are not predictable and must be left to chance.

This bulletin is designed to stimulate interest in increased vegetable production for consumption in homes, schools, hospitals, and hotels, and beyond this point to assist prospective gardeners toward growing a quality product for market.

## TOOLS

The hoe and cutlass are the most basic tools needed to develop and maintain a good garden, but it has been found that the following list of improved hand tools makes work easier, more efficient, and more profitable through a reduction in labor requirements. The list includes:

1. Hand Trowel



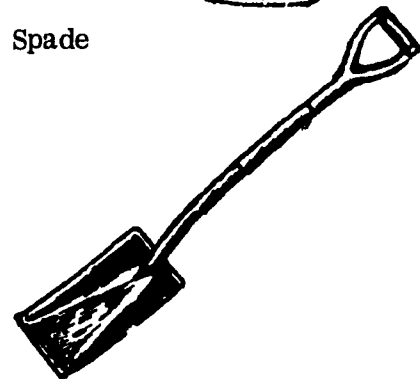
The hand trowel is used for removing seedlings from the nursery, and making holes for transplanting and seedlings.

2. Hand Fork



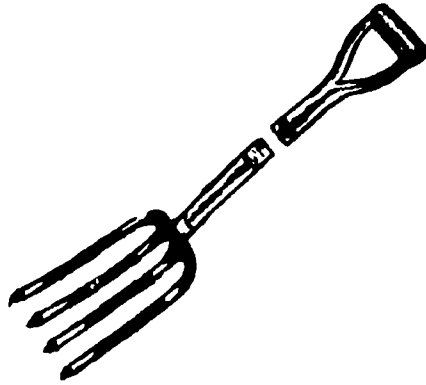
This is a small fork which is used for loosening the soil between plants which are too close to permit the use of bigger tools such as the digging fork or hoe.

3. Spade



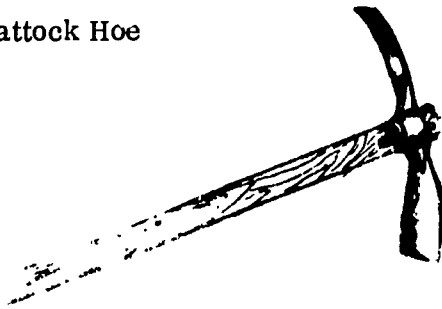
The spade is used for turning over the soil, and for making, and reshaping beds.

4. Digging Fork



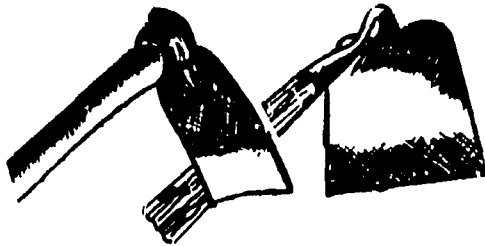
The digging fork is used for loosening the soil and handling manure and garden rubbish.

5. Mattock Hoe



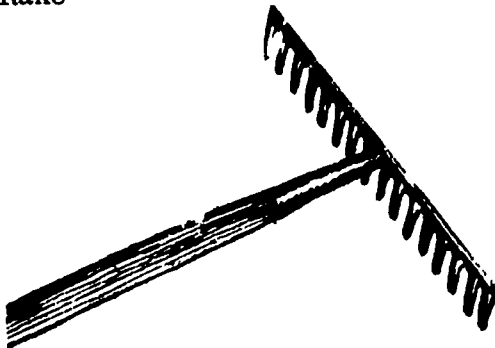
It is used for grubbing roots, stumps, and bush and for digging and making beds.

6. Hoe



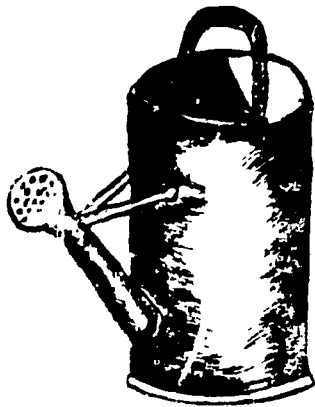
There are many kinds of hoes designed for different purposes. But the most common use of the hoe is for clearing weeds, grass, making mounds and beds, etc.

7. Rake



The rake is used for smoothing the soil in beds, removing stones, roots and hard lumps of soil and for scraping up garden rubbish from the furrows and paths.

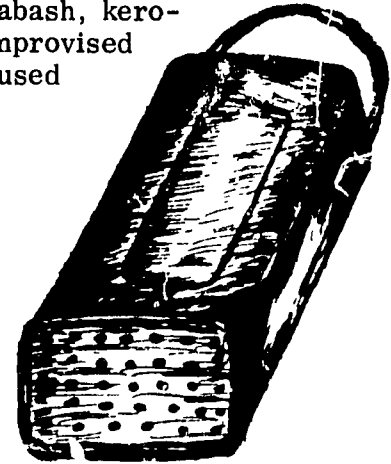
## 8. Watering Can



Watering cans are good to have for watering, but a calabash, kerosene tin or other improvised containers may be used for this purpose.



Calabash



Kerosene tin

## CARE OF TOOLS

Garden tools will last much longer if the following simple rules are observed:

1. Use each tool only for the purpose for which it was designed.
2. Handle the tools with care, and do not throw them down anywhere after use.
3. Always clean tools before putting them away.
4. Store tools in a safe, dry place.

## CHOOSING THE SITE

Consider the following four factors when choosing the site for a vegetable garden:

1. The type of soil
2. The lay of the land
3. Nearness to a permanent source of water supply
4. Nearness to the house

**SOIL TYPE:** A deep rich clay loam is preferable. Avoid shallow eroded soils.

**THE LAY OF THE LAND:** Steep slopes are not preferable, as soil erosion control may present a major problem to the gardener. Very flat lands may favor the incidence of fungus diseases unless they are well drained or the rainfall is mild. Gentle slopes are preferred.

**PERMANENT WATER SUPPLY:** Water should be available throughout the growing season for watering the crops. The garden should be near a stream, a well, a dam, a dugout or other source of water. The nearer the source of water the easier it will be to keep the crops properly watered.

**NEARNESS TO THE HOUSE:** The garden is more conveniently and efficiently managed when it is near the house.



A site is regarded as being ideal when all the above factors prevail. Very often it is difficult to get all of these factors occurring together. When they do not, nearness to a permanent source of water supply and the lay of the land should be given first priority, since a less suitable soil can be improved by manuring. The distance of the garden from the house may have to be sacrificed in the interest of soil and water.

## PREPARING THE SITE

**CLEARING:** The site should first be cleared of bushes and trees. Stumps, roots, and stones, should be dug out to a depth of about 18 inches.

**DIGGING:** The garden should be dug thoroughly all over (ploughing and harrowing) to a depth of not more than 10 inches depending on the depth of the top soil.

**FENCING:** The area may be fenced where necessary to prevent fowls, goats, sheep, cattle, and other animals from destroying the crops to be grown. Wire netting, bamboo or any durable local material may be used.

### NURSERY AND TRANSPLANTING TIME

When to plant the nursery and the garden must be based on locality and season. Dates may be given as a general point of reference, but seasons are more reliable. First, study the pattern of the rainy and dry seasons in your locality — that is, determine periods when the rains are likely to be too heavy for most vegetables. Such periods usually include May to mid-July in the forest area; May to September in the Northern and Upper Regions, and June in the Coastal belt. Most vegetables are grown in the dry season, but require watering or irrigation.

Some vegetables are grown throughout the year despite the above limitations, but more time and effort are required for success during the extreme part of the dry season.

The time to prepare and plant the nursery for the major garden season follows:

#### I. COASTAL BELT

May 22 - June 5. Transplant to the field July 5 - 15, sooner or later depending on a let-up in the rainy season. Repeat on a year round basis as often as your convenience will permit, but it is advisable to avoid having a major crop of vegetables in the field during the month of June when the down pour of the rain is expected to be at its maximum height.

#### II. FOREST AREA

a. May 22 - June 5. Transplant to the field July 5 - 15, sooner or later depending on a let-up in the rainy season.

b. September 5 - 25. Transplant to the field November 10 - 25, sooner or later depending on a let-up in the rainy season. Repeat as often as your convenience will permit, but it is advisable to avoid having a major vegetable crop in the field during the period May - June.

#### III. NORTHERN AND UPPER REGIONS

For vegetable crops, such as cabbage, cauliflower, and tomato, three crops may be obtained in a year.

- 1st Crop: Sow seed in January. Transplant to the field. February 21 - March 31.
- 2nd Crop: Sow seed from May 15 - 31. Transplant to the field June 21 - 30.
- 3rd Crop: Sow seed from August 15 - 31. Transplant to the field September 21 - 30.

For vegetable crops such as eggplant and pepper, only two crops are obtained in a year.

- 1st Crop: Sow seed from February 15 - 28. Transplant to the field in April.
- 2nd Crop: Sow seed from September 15 - 30. Transplant to the field in November.

Tomato, pepper and eggplant find it difficult to set any fruit successfully during the period February 15 - March 31, due to very high day and night temperatures. Therefore, plan your program to avoid this.

Also, mustard green, collard, okra and spinach (including local varieties) grow best in the wet season; therefore April - May is best time plant them in the field.

## NURSERY

It is important to produce healthy seedlings in order to have healthy plants which give a good yield. Great care should, therefore, be taken to establish a good nursery.

Seeds recommended to be sown in the nursery and then transplanted to the garden bed include: tomato, eggplant, sweet or hot pepper, cabbage, lettuce, cauliflower, onion, collards, spinach (*Amaranthus* spp.). Lettuce, however, may be sown direct on field beds in drills and the plants thinned out to one foot apart.

Two methods of establishing a seed nursery are recommended. They are:

### I. SEED BOXES OR TRAYS:

Seed boxes can be made from any available material. Shallow empty wooden cases are ideal or trays can be made from pieces of galvanized or aluminum roofing. Boxes may be of any convenient size but must be 4 to 6 inches deep. They must have drainage holes about 1/4 inch in diameter at the bottom and about 6 inches apart to allow excess water to drain out.

#### A. Preparation of Seed box for Sowing:

1. Cover bottom of box with a thin layer of small stones or gravel to prevent soil particles from blocking the drainage holes.
2. Place over the stones or gravel a thin layer of dried grass or similar organic material to serve as an aid to good drainage.
3. Fill box to within 1/2 inch of the top with top soil or a mixture of good fine loam and vegetable compost in approximately equal proportions. For tomatoes, use sterilized soil as described on pages 19-21. The 1/2 inch space is allowed for watering.
4. The surface of the soil is then reduced to a good tilth, levelled and firmed.

5. Before firming, mix into the top 1/2 inch one teaspoonful of sulphate of ammonia and two teaspoonfuls of single superphosphate per square foot or box measuring 18 inches by 8 inches (better ground to a powder). This has been found to give the seedlings a good start after transplanting. However, it is not an absolute necessity.

6. Firm the surface by pressing with the hands or a piece of board of a suitable size. It is important to have a good level surface to avoid light seeds being washed to one side during watering. To avoid this, place box in a container in which there is an inch of water. Leave the box in the water for the soil to get soaked from below until the surface appears damp.

7. Place boxes on a firm support of the ground to protect them from insects, sheep and goats. Shade from the hot sun as in Figure 1.

#### B. Sowing in the Seed Box:

1. Make grooves not more than 1/2 inch deep and 3 inches or more apart with a blunt stick about the size of a lead pencil.

2. Plant the seed in lines or rows not too close together as shown in Figure 2.

3. Scatter fine soil over the seeds and lightly firm.

4. Water the soil lightly by sprinkling. The seed box should be watered often enough so that the soil appears moist but not wet.

5. After the seeds have started to grow, it may be necessary to thin out the seedlings to ensure healthy, sturdy growth.

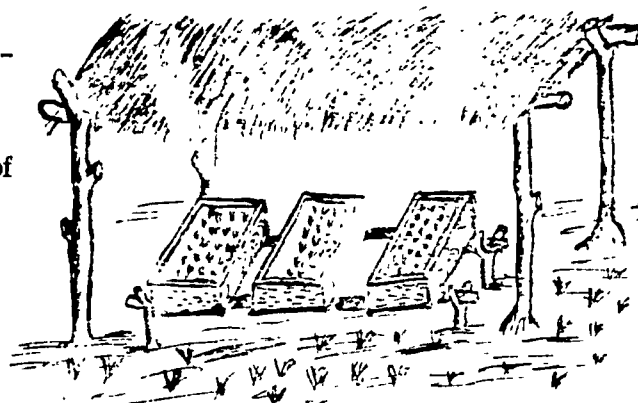


Fig. 1. Seed boxes shaded, off ground

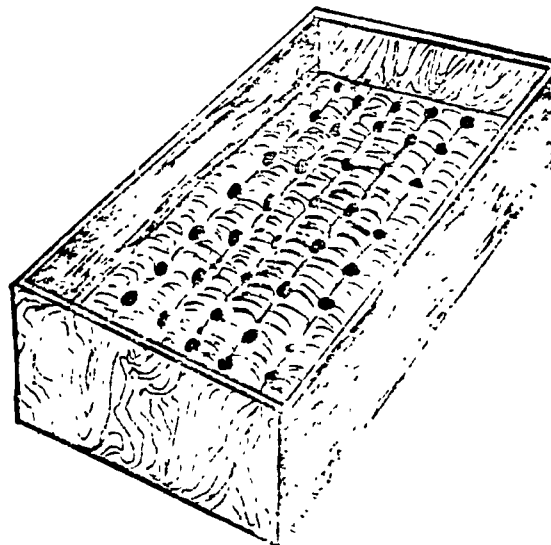


Fig. 2. Plant in lines

## II. NURSERY BEDS

A nursery bed could be 4 - 5 feet wide and of any convenient length. It must be worked to a depth of not more than 10 inches and raised 8 - 10 inches for drainage. All roots, rocks and trash must be removed.

Rake into the top few inches either well rotted compost or sheep, poultry or cattle manure. Settle the bed by soaking it down overnight. One teaspoonful and two teaspoonfuls of sulphate of ammonia and superphosphate respectively per square foot may be added as for the seed boxes. Do not plant tomatoes on these beds unless the soil is sterilized as described on pages 19-21.

#### A. Sowing in Nursery Beds

1. Make rows or drills 1/2 inch deep and 6 inches apart.

2. Put seeds in by hand and cover with fine soil.
3. Firm the soil but do not pack it.
4. Protect the seedlings from sun and rain with 50 - 70 percent shade by building thatch huts over the beds. (See Figures 3 and 4 below for types of protection required.)

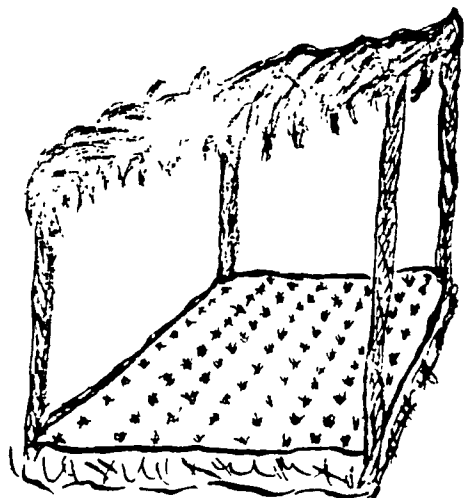


Fig. 3. Nursery bed protected from Sun

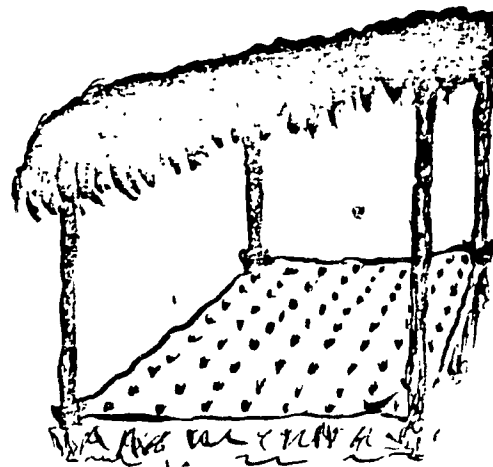


Fig. 4. Nursery bed protected from rain

5. Keep the nursery beds moist and free from weeds. Seedlings, under normal circumstances are ready for transplanting within 3 - 5 weeks.

#### B. Seed Sowing in the Open

The seeds of some vegetable crops can be sown direct in the soil, since they do not require transplanting, e. g., beans (bush and pole), carrots, cucumber, okra, radish, turnip, squash, watermelon and sweet corn. It is advisable to rake over the bed or area to give a level surface before sowing seeds.

Small seed, such as carrot and radish, should be sown in drills. These are best made along a garden line. Drop seeds in the drills at equal intervals. Cover the seeds by using the flat side of a rake to replace the soil ridged up when the drill was first made. Firm the filled-in drill to ensure that the roots obtain a good hold in the soil when germination begins.

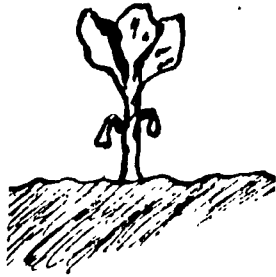
For larger seeds, such as beans, okra and sweet corn, drills are not needed. Make small holes at required distances along the garden line, using a pointed stick or dibbler. Drop seeds into the holes and cover firmly with soil.

As a general rule, seeds should be sown at a depth equal to their diameter. If the soil is dry, watering will be required. To conserve moisture which facilitates germination, mulch of dried grass may be spread on the surface of the bed. This should be moved as soon as germination is noted. Check for this 2 days after sowing and daily thereafter. Such a practice is necessary in the dry weather.

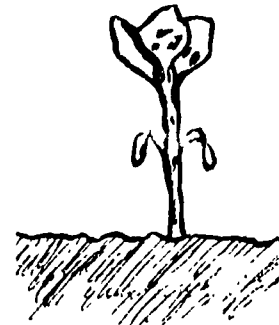


Fig. 5. USAID Advisor watches trainees carry out improved gardening practices.

**TRANSPLANTING:** Raised beds are preferred in areas where the rainfall is heavy, while flat beds may be used in areas where the rainfall is light.



Discard small, spindly plants



Use strong healthy plants

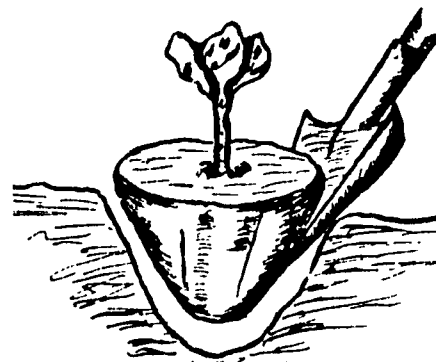
Fig. 6



Fair



Good



Better

Leave as much dirt on the roots as possible

Fig. 7

1. Use only stocky plants with good root systems that are free from disease. Discard small, spindly plants or those with poor root systems.
2. Transplant the plants in late afternoon or during cloudy weather.
3. Take plants from the bed carefully so that the roots will not be damaged. Leave as much dirt on the roots as possible.
4. Don't let plants wilt. Keep them in the shade or in bucket of water after digging from the bed or after buying them. Dip the roots of the plants in a soupy mud paste or clay bath if they are to be carried a long distance before being planted in the garden. The mud paste is made by digging the mud or dirt from a bug-a-bug hill (termite mound) putting it in a bucket, and adding water and working it into a soupy paste.
5. Make the hole with a dibble stick large enough and deep enough to receive the roots without damaging or bending them. Set plants not more than a half inch deeper than they stood in the nursery bed.

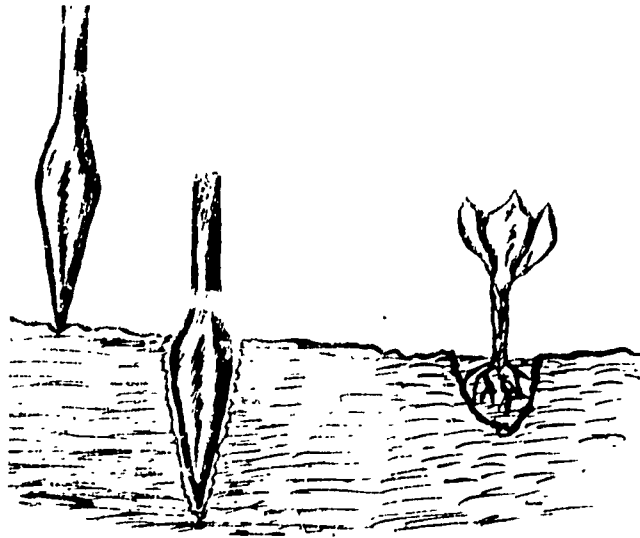


Fig. 8. A dibble stick used in making holes for transplanting

6. Firm the soil around the roots to be sure there are no air pockets.
7. After setting, use one cup of starter solution around each plant. Make this solution by dissolving four tablespoons of 10-10-10, 15-15-15 or any complete fertilizer in one gallon of water. If no commercial fertilizer is available, use one cup of fresh cow manure, and half cup of wood ashes to each gallon of water. Mix well. This will help get the plants off to a quick start.

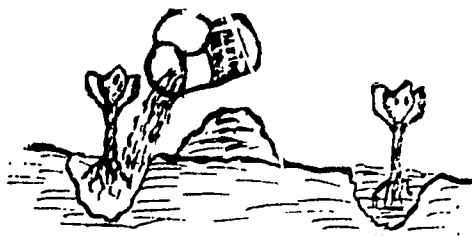


Fig. 9. Use starter solution around each plant



Fig. 10. The slope of the land and the amount of the rainfall determine the size and height of the garden bed. Steep slopes and heavy rainfall require short beds, raised a minimum of 12 inches above the ground level.

8. Cover the damp soil with a little dry soil to prevent rapid drying.

9. In warm weather shade the plants for three to four days with banana, plantain, oil palm, cocoyam or breadfruit leaves. This helps to keep them from wilting until their roots become established in the soil and can take up plenty of water. Water the plants during the dry season. Water before 7:00 a. m. and after 4:00 p. m.



Fig. 11. Protect young plants from direct sunlight first three to four days

10. Dust plants and the ground around them with Toxaphene, DDT, or other contact poisons to prevent cutworms and crickets from cutting off the plants.

#### DRY SEASON GARDENING:

During the dry season plan to have the garden located in low land or a valley, preferably near a dam, dugout, creek, river, well, or water spigot. Almost any vegetable can be grown successfully during the dry season. Plant the nursery four to five weeks before the plants are to be transplanted to the garden, and follow instructions as outlined for general garden activity. It is essential that all water applied to the plants should be directed towards the root system and therefore sunken beds are recommended.

#### MULCH DURING THE DRY SEASON:

Mulching tends to keep the soil damp, cool, and soft around the roots of the vegetable plants, thus making it possible for them to live and grow better during this season. Mulching is done by covering the beds or rows two inches deep between and around the plants with bark scrap from rubber trees, dead plants, cut weeds, leaves and litter from the poultry house. Saw-dust and rice hulls have also been successfully used for this purpose. Avoid using disease or insect infested materials for mulching.

#### SOURCE OF SEEDS:

It is understood that the Ministry of Agriculture is working in cooperation with commercial dealers to get seed distribution points established at convenient locations throughout the country where farmers may purchase their seeds as they need them. See your local Agricultural Extension Officer for further information on this subject.

## THE CULTURE OF VEGETABLES

This chapter is not intended to serve as a full guide to growing the named vegetables comparable with several publications on vegetable growing in Ghana. It gives only the more important facts that the vegetable grower in Ghana should know. A list of tested varieties in the forest region as to their suitability for growing either in the wet or dry season is supplied at the end in Appendix II.



1. BEANS - (Dwarf, bush, French or kidney - *Phaseolus* sp.): Seed may be sown throughout the year but best crops obtained in dry season. Sow in beds, 2 seeds per hole at a depth of one inch. Distance between plants, 12 inches apart in rows 18 inches apart. No stakes are required. Seed takes 4-7 days to germinate. The beans are ready for picking in 6-9 weeks. Harvest pods in the young stage every 2 to 3 days.

2. BEANS - (Pole, climbing, French - *Phaseolus* sp.): Sow seed in beds, 2-1/2 feet by 1 foot, at a depth of 1 inch. Seed takes 4-7 days to germinate. Provide 10-foot poles to support vines when seedlings are a few inches high. Incline the stakes of two adjacent rows together. Beans are ready for picking 8-12 weeks. Pick every 2-3 days. Pole beans will tolerate heavy rains and give higher yields over a longer period than Dwarf beans.

3. BEETROOT - (*Beta vulgaris*): Sow in drills 12 inches apart and thin later to 6-9 inches apart. Seed takes 5-14 days to germinate. Beetroots are ready for harvesting in 12-16 weeks.

4. CABBAGE - (*Brassica oleracea* var *capitata*): Sow seed thinly in nursery beds or in boxes. Seeds germinate in 4-10 days. Transplant to a bed when seedlings are 3-4 inches high at a distance of 2 feet to 2-1/2 feet each way depending on variety. Cabbages are ready for harvesting in 12-18 weeks when firm hearts form.

5. CABBAGE - CHINESE - (*Brassica campestris* var *chinensis*): Sow and transplant as for cabbage but space at 18 inches by 18 inches each way. Crops ready 8-10 weeks.

6. CARROTS - (*Daucus carota*): Carrots like a light soil which has been manured for the previous crop; fresh manure causes the roots to divide. Sow seed straight on beds in drills 1/2 inch deep and spaced 12-15 inches apart. Seeds germinate in 7-14 days. Thin when seedlings are 2 inches high to 2 - 4 inches apart. Earth up around collars of plants to protect exposed roots from sun. Crop matures 10-14 weeks.

7. CAULIFLOWER - (*Brassica oleracea* var *botrytis*): Sow seed thinly in nursery beds or in boxes. Seed germinate 3-7 days. Transplant 2 feet by 2 feet each way. Bend two leaves over emerging flower head to shade and protect from rain. The heads are ready for harvesting in 10-15 weeks.

8. COLLARDS - (*Brassica oleracea* var *acephala*): Sow seed thinly on a seed bed or in boxes. Transplant into beds 2-2 1/2 feet apart each way. Crop matures in 6-10 weeks. Harvest bottom leaves whilst tender and before they turn coarse.

9. CUCUMBER - (*Cucumis sativus*): Sow seed point downwards directly in the garden bed. Sow 4 seeds per hole 1/2 inch deep and 4 feet apart. The vines should be trained on a fence or trellis such as is used for supporting climbing beans. Artificial pollination of bagged flowers is recommended when fruit-fly attack is severe. Crop matures in 8-14 weeks. Trenches 2 feet deep and 2 feet broad filled with good rich soil and cattle or horse manure form suitable sites for growing cucumbers.

10. EGGPLANT - Garden egg, Aubergine, Brinjal (*Solanum melongena*): Sow seed thinly in nursery bed or in boxes. Necessary to thin out and thinnings pricked out. Space 2-3 feet each way when transplanting into beds. The fruits are ready for harvesting in 12-24 weeks.

11. KALE - (*Brassica oleracea* var *acephala*): Sow and transplant as for cabbage but space at 24 inches by 18 inches. Crop matures in 12-16 weeks. Harvest the young side shoots and leaves when vegetable growth is profuse.

12. **LETTUCE** - (*Lactuca sativa*): Sow seed sparingly in nursery bed or in boxes. Transplant at 12 inches by 9 inches spacing. If sufficient seeds are obtainable, seed may be sown very thinly in 1/4 inch deep drills 12 inches apart. Later thin out to 8-9 inches. Water well to avoid a setback in growth which causes the early production of seed stems. Be generous on nitrogen fertilizer to stimulate growth which produces tender leaves. Crop matures in 6-10 weeks.

13. **MUSTARD GREENS** - (*Brassica juncea* and *B. japonica*): These are kinds of Brassica similar to cabbage but do not form heads. Plant same as cabbage but space at 9-12 inches apart each way.

14. **OKRA** - Okro, Lady's fingers, Gombo (*Hibiscus esculentus*): Sow seeds 1/2 inch deep, 2 or 3 seeds per hole, thinning later to one when seedlings are 2-3 inches high. Space at 18 - 36 inches apart between rows and 18-24 inches between plants depending on variety. Harvesting is done from 8 to 24 weeks. Fruits should be harvested when quite young otherwise they are useless.

15. **ONION** - (*Allium cepa*): Onions are very sensitive to both temperature and length of day and relatively few varieties will form bulbs in tropical temperature and under short day-length conditions, such as 12 to 13 hours of daylight. Care should be taken in using only tested varieties. Sow seed in nursery bed or boxes. The seed germinates in 7-21 days. Transplant onto beds when seedlings are 2-3 inches high and space at 6 inches each way. Bulbs mature in 3 1/2 - 4 months. Crop may be harvested green, 6-8 weeks after transplanting or left till leaves turn brown.

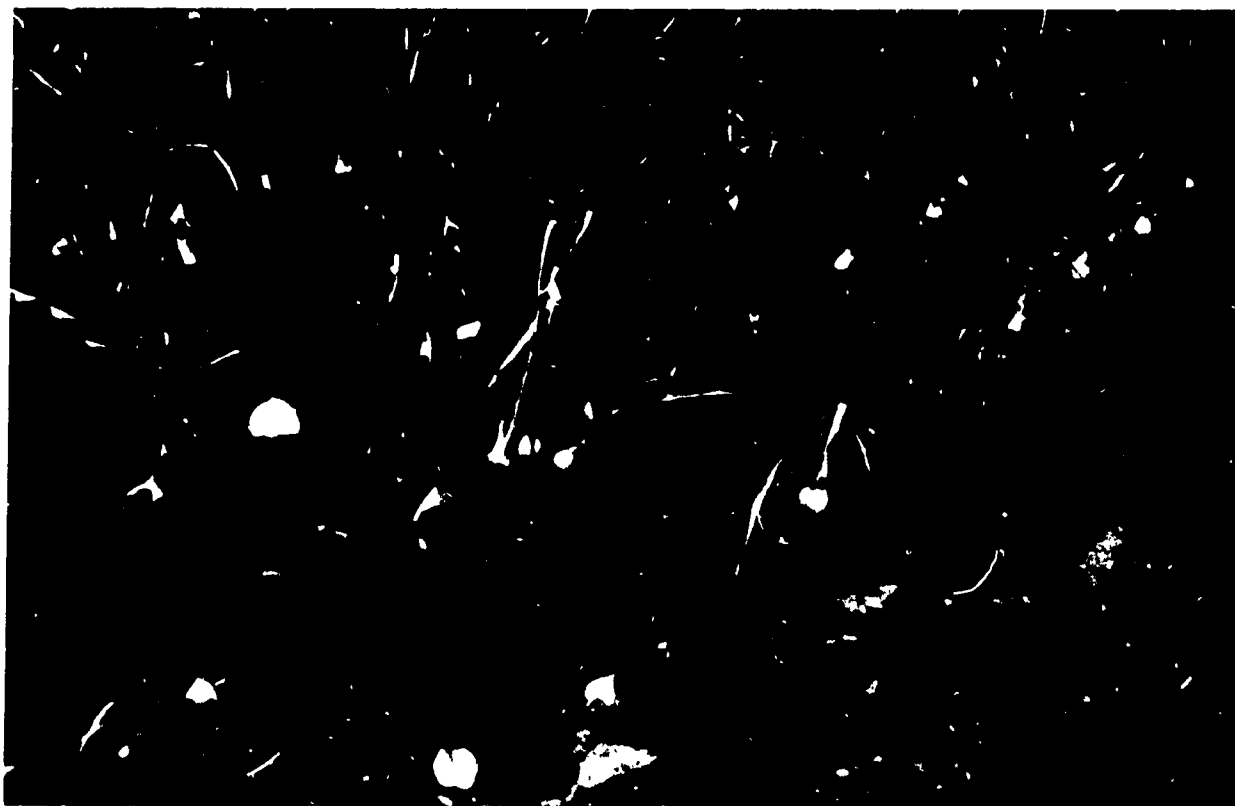


Fig. 12. Onions growing on raised beds. The bulbs develop better when they are exposed as in above picture.



Fig. 13. Select the best varieties to appreciate a good crop such as these sweet peppers.

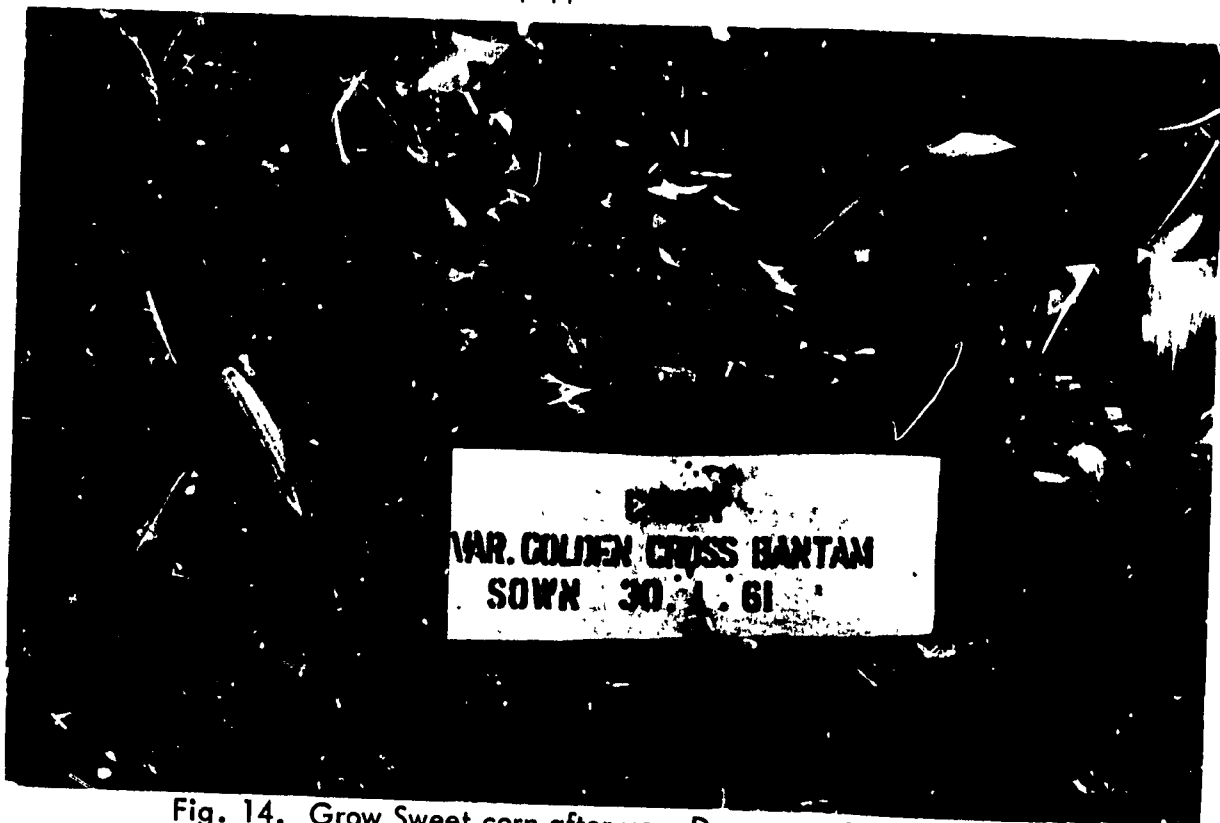


Fig. 14. Grow Sweet corn after your Dry season Tomato crop to reduce nematode population.

16. **PEPPER - Sweet** (*Capsicum annuum*): Sow seed thinly in seed bed or boxes. Thin out and thinnings may be pricked out. Transplant when seedlings are 3-4 inches high. Space at 15-18 inches between rows and 12-15 inches between plants. Crop matures in 8-16 weeks.

17. **PEPPER - Hot, red, cayenne or chilies** (*Capsicum frutescens*): Treat as above. Space at 2 - 2-1/2 feet each way. Harvesting starts 10 weeks onwards.

18. **RADISH -** (*Raphanus sativus*): Sow directly on bed in 1/2 inch deep drills 12 inches apart. Thin to 2 inches apart later. Crop matures in 4 weeks.

19. **SPINACH - Indian spinach** (*Basella alba*): Sow seed in situ in rows at a distance of 2 feet by 1 foot. Train vines on a trellis. Plants can be propagated by soft wood cuttings. Harvest leaves when young.

20. **SQUASH -** (*Cucurbita moschata*): Plant same as cucumbers. Crop matures 8-12 weeks.

21. **SWEET CORN -** (*Zea mays*): This is a kind of maize, except that it is only sweeter (as the name implies) and has a more tender seed testa, and therefore more digestible than the ordinary field corn. It is best eaten in the immature state.

Seeds may be sown at any time of the year but the best time is the beginning of rains when irrigation may not be necessary. Sow seed 2 grains per hole spaced 18 inches by 12 inches. Thin out to one plant per stand after 3 weeks. Apply compost or manure and fertilizer liberally for rapid, vigorous growth. Spray with Didimao 25% missible liquid or Arkotine 25% E.C. against stemborers. First spray is 14 days after sowing at 10-15 gallons per acre. Mix one lidful of one gallon can of Arkotine with a gallon of water.

Crop matures in 6-8 weeks. Sweet corn planted in the garden after a tomato crop helps reduce nematode population in the soil.

22. **SWEET POTATO -** (*Ipomoea batatas*): This can be a very popular and useful vegetable in this country. The tubers provide carbohydrates and some varieties contain vitamins A and C. The leaves, used as spinach, have a very high calcium content, good quantities of vitamins A, B, C, iron and some protein.

Plant Improved Puerto Rican or selected local varieties. Plant any time in the year or best at the beginning of the rains. Plant rooted slips or vine cuttings 10 to 12 inches long. Insert at a depth of 3-4 inches on ridges at 12-15 inches apart. Some local varieties tolerate very wet conditions and may be planted at the edge of swamps during the dry season.

23. **TOMATO -** (*Lycopersicon esculentum*): Sow tomato seed thinly in seed bed or box in sterilized soil. See pages 19-21 for details on soil sterilization. Transplant on to field beds when seedlings are 3-4 inches high. Space at 18-24 inches between the plants in rows. Water well before transplanting. This will ensure that the soil will not fall from the roots of the seedlings. With a small hand fork or table fork remove seedlings carefully in order not to damage the roots as this will put a check on the initial growth. Stake plants of varieties that need support immediately after transplanting. This saves root disturbance later. Starter-solutions at transplanting go a long way with tomatoes. For the tall varieties which are better trained to single stems, carefully remove side shoots as soon as they form in leaf axils to ensure formation of maximum size fruits. In side shoots on the single-stem varieties are not removed, the plants produce a large quantity of small fruits. Spread mulch of dry grass or any organic matter, especially in dry season. Water well during the dry season, at least twice a week and do not water over the plants.

Tomatoes respond well to fertilizers. It is recommended, therefore, to use 2 cwts per acre superphosphate and 3 cwts per acre sulphate of ammonia. Apply all the 2 cwts superphosphate and 1 cwt. of the sulphate of ammonia at planting; 1 cwt. of the sulphate of ammonia at flowering and 1 cwt. sulphate of ammonia one month later. The splitting of the nitrogen helps maintain a uniform fruit size and quality through the fruiting period. Crop matures in 11-18 weeks.

24. TURNIP - (*Brassica rapa*): Follow direction given for carrot but thin to 4-6 inches apart. Crop matures in 7-12 weeks. Harvest the roots before they become stringy.

25. WATER MELON - (*Citrullus vulgaris*): Sow seed point downwards 1 1/2 inches deep at a distance of 4 feet by 4 feet. Seed germinates in 3-10 days. To avoid fruit-fly attacks artificially pollinate bagged female flowers. Place each melon fruit on a hardwood board to protect it from insects and rot. Succeeds very well along the coast especially in Cape Coast and Labadi areas.

## SPECIFIC LOCAL VEGETABLES

Certain vegetables are intensively cultivated in specialized localities in the country and need special mention. These are: Shallots and Tigernuts.

SHALLOTS - (*Allium ascalonicum*): Shallots are rather exacting in their soil requirements, a sandy or sandy loam being best as exists in the South Anlo district. Certain areas of the Kwahu, Mampong-Ashanti, and Mankessim-Saltpond districts are also noted for this crop. Shallots in the South Anlo district are well known for their quality and the industry is an excellent example of intensive market gardening production.

1. WHEN TO PLANT: In the south Anlo district, 3 shallots crops are obtained in a year:

- a. April-June - major season
- b. August-November - minor season
- c. January-March

2. PREPARATION OF BEDS: Permanent beds 6 feet wide and from 25 feet to 50 feet long with shallow ditches between are best used for planting. Open beds at start of season and bury plenty of maize stalks and leaves or dry grass. Level after mixing with top 6-9 inches anything up to 10 tons per acre of cow dung, poultry, bat, sheep or goat manure.

3. PLANTING: Always purchase sets far in advance or save from previous crops. One ton to 1.2 ton of sets is needed per acre. Cut top of set (to induce early production of shoots) and plant on the beds 6-9 inches apart, with the apex of the set just above ground surface.

4. MANURING: An additional bat manure or fish meal hoed in is beneficial. A fertilizer mixture of 2-3 cwts. sulphate of ammonia per acre and 1 - 1 1/2 cwts. Muriate of potash per acre, applied 1/3 few days before planting, 1/3 three weeks after planting and 1/3 six weeks after planting is found to increase yields considerably.

5. WATERING: Shallow wells 6-8 feet deep must be dug to make water available for use when necessary.

6. **HARVESTING:** The maize is normally harvested and sold green and the stalks used for mulching.

The shallots may be harvested and sold green as salad onion, or may be left to mature when tops turn yellow. Lift bulbs with hand. Leave on bed to dry for a week. Further drying is done on racks under shade or on the ceiling.

7. **MARKETING:** Save some for seed. The rest is sold in singles put in baskets, or bags or made into neat bundles weighing 22-25 lbs. per bundle.

8. **SOIL CONSERVATION PRACTICES:** The land is being used practically everyday of the year, therefore, spare no pains to keep it restored.

#### THE KWAHU AND MAMPONG-ASHANTI DISTRICTS

1. **WHEN TO PLANT:** Only 2 crops made - a major season from February to June and a minor season from September to December. The latter season is not very reliable due to uncertainty of rain at this time.

2. **PREPARATION OF LAND AND PLANTING:** Soils cleared of secondary forest are best cropped for 3 consecutive seasons under shallots and put to maize and cassava and then left fallow.

After clearing and burning, small irregular mounds are made and sets planted 6" or 9" apart making 5-6 stands per mound or bed.

Tomato, pepper, eggplant, beans and peas are best used as inter-plants.

3. **MANURING:** No fertilizer recommendation has been worked out for this area but since no organic manure is added a basic NPK mixture will help increase yields.

#### MANKESSIM-SALTPOND DISTRICT

A single crop season from 15th March to May 21st. only is possible. Areas which are not flooded, such as hill sides are suitable. Other operations are the same as in the Kwahu district.

**TIGER-NUTS - Chufas, earth almond, (Cyperus esculentus):** The edible parts of this grass-like plant, the hard round 'nuts', are generally eaten raw but contain many fibers which are indigestible and must be removed from the mouth after chewing. The fresh 'nuts' may be pounded and ground into powder and some kind of porridge (tiger-nut milk) made from it. In the Ada district the nuts are dried and roasted, pounded and ground into powder. Water, salt or sugar may be added and the liquid is drunk.

The tubers are rich in both carbohydrates and in oil. Air-dried tubers contain 43% of carbohydrates, 28% of fatty substances, and 15% of fiber

Cultivation of this crop is restricted to the Kwahu and Ada districts, where the soils are mainly sandy loam. After clearing the vegetation which is usually secondary bush, little mounds are made with the local hoe. The tops are levelled and the seed 'nuts' pushed in at a spacing of 4-6 inches apart.

Preparation of land and planting of seed 'nuts' are advantageously done in February to mid-March. The crop takes about 3 months to mature. In the Kwahu district, maize, cassava and cocoyam are interplanted.

When the tubers are harvested, they still have many tough fibrous roots attached to them. They are, therefore, scrubbed with clean sand and water in baskets to enable them to be clean of their roots. The clean tubers are then dried in the sun and sold in bags.

## SOME IMPORTANT POINTS TO REMEMBER ABOUT GARDENING

1. Grow, eat and sell more and better vegetables. You will feel and live better.
2. A good garden can be grown in all parts of Ghana if carefully planned and managed.
3. Good planning is essential to good gardening. Make a plan.
4. Start on time. Make a nursery. The nursery helps you to get an early start. It should be started five weeks before the plants are to be transplanted to the field or garden.
5. Do not overcrowd plants in the garden or field. Space according to instructions given on pages 11-16.
6. Do not let insects and worms eat up the vegetables in the garden. Early in the morning and late in the afternoons, pick these pests off the vegetables by hand and kill them. Insects and worms can be controlled effectively by this method under ordinary circumstances. Consult Appendix I for further information on this subject.
7. Select and demand disease resistant varieties of seeds for planting from your supplier.
8. Add one good handful of compost, rotted chicken, goat, sheep, cow, and/or horse manure well mixed with wood ash to each plant one week after transplanting to the garden, and work into the soil lightly. Add more of this plant food the third, sixth and eighth week. Work the garden often enough to keep it free of weeds and grass, but do not work the garden when the soil is wet enough to stick to the hoe. Consult your agricultural extension officer for information on sources and use of commercial fertilizers.
9. SOIL CONSERVATION AND COVER CROPS: A good cover crop must be used in rotation with the vegetable crop, if the same land is to be used continuously over a period of several years. An important side benefit from the cover crop is that it helps in weed control by smothering grasses and other weeds. Such crops as velvet beans (*Mucuna* sp), sword beans (*Canavalia ensiformis*), and cow peas (*Vigna unguiculata*) produce excellent foliage in less than three months, can be grown in the rainy season and turned under, thus releasing the land for vegetable production during the dry season. However, in a two to three year rotation scheme, such cover crops as the following may be preferred:
  - a. Calapogonium sp. or Pueraria javanica. They climb or creep and form a dense cover. May be propagated by seed or rhizome cuttings.
  - b. Stylosanthes sp. This crop is new in Ghana, but appears to have a bright future as a cover crop and for pasture.
  - c. Crotalaria. It has a deep root system. The plant grows erect, and may be used in either a one- or two-year rotation system. Some species of eelworms are controlled by growing this crop on the infected soil.
10. The first step toward preparing the garden by hand, following a good cover crop, is to cut and rake the crop into piles. Then dig up the garden to a depth of 12 inches, line off and open up the beds or rows, pack the residue from the cover crop in the beds or rows. Cover with three to four inches of soil, settle the beds or rows by applying water or permit the soil to be settled by a rain, then plant seeds or transplant vegetable plants in the usual manner. If mechanized, run a rotary cutter over the cover crop; cut it into shreds, disc, harrow and plant as usual.

11. Cover crops treated in the above manner become incorporated in the soil, rot, form organic humus, increase the water holding capacity of the soil, and keep it conditioned for better crops.

12. **CROP ROTATION:** Do not plant the same vegetable in the same place every year. Rotate the crops; plant the tomatoes where cabbage or other vegetables were planted before, and do likewise with all of the other vegetables. However, never plant tomatoes following eggplants or peppers or eggplants following tomatoes and peppers. The following rotation system is suggested:

1st Crop: Plant any of the leafy vegetables such as: cabbage, cauliflower, lettuce, spinach, kale or collard greens.

2nd Crop: Follow first crop by a root crop such as: carrots, onions, beetroot, radish or turnip.

3rd Crop: Follow second crop by fruit forming vegetables such as: eggplant, beans, peppers, tomatoes, okra, cucumber, or watermelon.

Rotation helps to control plant diseases, insect pests, and to maintain a balance in the use of soil fertility.

13. **COMPANION CROPPING:** Such crops as cucumber, squash, okra, pumpkin, pepper, eggplant, tomato, watermelon, may be interplanted with upland rice, cassava, and other cash crops.

14. Garden beds that have been harvested and are not being used can be covered with a thick layer of leaves or grass (at least 6 inches deep) until needed. This will protect the soil from the hot sun and from erosion and prevent the growth of weeds. The decomposing mulch enriches the soil and keeps it soft and loose.

## SOIL STERILIZATION

It is now true that the man who uses unsterilized soil for propagation is not only behind the times but sub-standard in his thinking and practice.

When you sterilize your soil you get rid of organisms harmful to plant growth, e.g. bacterial, fungal and virus diseases, eelworm and grub pests, and weed seeds. At the same time you make certain plant nutrients become readily available for plant use.

The methods employed involve the use of (1) Chemicals and (2) Steam.

1. Chemical sterilization is not thorough because the chemicals used are selective in action, i.e. certain chemicals are more effective against soil pests than soil diseases or vice versa. Examples of chemical sterilizers are (1) Formaldehyde and (2) Chloropicrin for general-purpose sterilization; (3) DD, (4) Ethylene Dibromide, and (5) Methyl Bromide used mainly to control nematodes (eelworms).

2. Sterilization by steam can be thorough because it eliminates equally all pests, diseases and weed seeds.

Various methods are used commercially, e.g. the John Innes Low-rate Sterilizer as used by the University of Science and Technology, Department of Horticulture in Kumasi, and a few other places. There is the high-rate sterilizer which takes in larger quantities of soil.



Precision and modern methods are used in other countries to sterilize glasshouse soils. For the home gardener who wants to raise relatively few plants, say some tomato, the two methods described below can be simple and inexpensive.

1. SAUCEPAN METHOD (6 PINTS): Sieve the soil through a 1/4 or 3/8 inch sieve, spread the soil out thinly, under cover, for several days until it is approaching dust-dry. Take the saucepan and pour into it a measured 1/2 pint of water and heat rapidly on fire; immediately water boils, fill saucepan with soil to within 1/2 inch of the top; put on lid and using a "minute timer" continue boiling for precisely 7 minutes. Remove saucepan (without taking the lid off) and stand for a further 7 minutes. Pour out soil thinly onto a clean surface to cool. When it has cooled mix it into a compost, or alternatively, store in a clean container until required. Do not allow the soil to dry out again and, if necessary, moisten it a little with tap water.

2. TROUGH METHOD (1/2 to 1 bushel): This can be cut out and prepared from a 44 gallon drum (Figure 15) by observing the following points:

a. The trough model consists essentially of a perforated soil container which fits snugly into, or onto, a trough in which water is boiled to produce steam.

b. The soil container should be shallow, say 4 to 8 inches deep, in order to expose as large a soil surface as possible to the steam; and to avoid compaction of the soil by its own weight.

c. The perforated bottom of the container should offer the easiest possible passage to the steam. A 1/8 inch mesh, round sieve or thin perforated metal (e.g. zinc) sheet may be used. Coarse sacking or similar material of 1/8 inch mesh is also satisfactory. Sacking and sheet metal will need supporting on cross bars. A sieve can be supported by its rim.

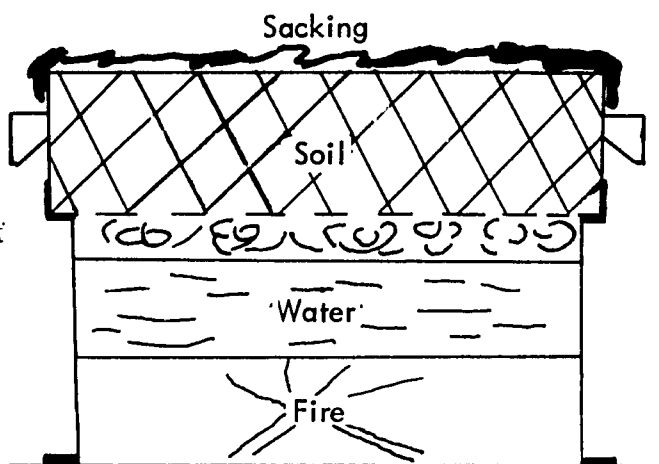


Fig. 15. Home-made "trough" steam sterilizer

4. Whatever the kind of container employed it should fit fairly tightly into or onto the water trough. The aim is to ensure that as much of the steam as possible goes through the soil and as little as possible escapes from the junction of the soil container with the trough. In achieving this, care should be taken to see that steam pressure is not built up in the trough.

5. To ensure sterilization of the surface of the soil it must be covered with thick sacking or a moderately tight-fitting lid (cf. a saucepan lid) through which a hole is made to permit a thermometer to be pushed into the top inch of soil.

**NOTE:**

1. Soil for sterilization must come out of the garden, but must contain no dung, and lime.
2. Medium loam, slightly acid with a pH of 6.0 - 6.5 is preferred.
3. The soil must be dry, sifted and loose.
4. When sterilized soil is not in use, keep away from any contamination.

## SOME SIMPLE RECIPES WITH VEGETABLES

If now, through this booklet, you have learned how to grow better vegetables and think only to make more money, you have derived less than half the benefit of the book. You must now see to it that more vegetables are used in family meals. These added nutrients will promote the health and well-being of all. You will feel stronger to grow more vegetables, and you will see your children grow strong and healthy.

In an attempt to improve the nutritive values of Ghanaian diet through the use of vegetables particularly rich in vitamins, minerals and protein, we have included in this chapter some simple recipes with vegetables, as prepared by the National Food and Nutrition Board, Ghana.

### Recipe 1

#### Palava Sauce

Serving - enough for 2 Persons

1-1/2 cups palmoil  
1 bundle nkontomire<sup>1/</sup> or spinach or efan  
1 medium head cabbage or bunch lettuce  
6 onions  
4 tomatoes  
1 tomato puree tin<sup>2/</sup> ground agusi  
1/2 cigarette tin beans  
1 pint water  
1 lb. meat or fish

#### Method:

1. Pick, wash and soak beans overnight.
2. Wash and cut meat into suitable sizes, add beans, water, chopped onion and salt. Cook till tender.
3. Wash skin and slice onion and tomatoes. Grind tomato skin and seeds and peppers.
4. Heat palmoil, fry onions, tomato, pepper
5. Add meat. Mix agusi with water to form a smooth paste and add. Stir all the time.
6. Remove withered leaves off the nkontomire and cabbage or lettuce or spinach or efan.
7. Wash quickly under running tap or in salt solution (i.e. 1 gallon of water to 1 dessertspoonful salt). Remove leaves from the water. (Do not pour water off the leaves).
8. Shred quickly and add to the stew. Cover and cook quickly for 10-15 minutes till leaves are tender and stew done. Correct seasoning.
9. Serve with Banku, boiled rice, yam, kenkey or boiled plantain or squash.

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<sup>1/</sup> See Glossary page 26 for definition of local terms.

<sup>2/</sup> See Table Equivalentents page 26.

## Recipe 2

### Gari Foto

Serving - enough for 2 Persons

1 medium-size tomatoes	Lima beans
1 cup shrimp	Turnips
3 <u>cigarette tins</u> gari	Cow peas
1 cupful cooking oil	
pepper	
1 onion	
1 head cabbage	
salt	

### Method:

1. Wash, skin, remove seeds and cut the tomatoes into pieces. Grind skin and seeds of tomatoes.
2. Wash, skin and wad and slice onion.
3. Put the oil on the fire.
4. Wet the gari with salt solution.
5. Prepare and shred the cabbage quickly.
6. Fry the onion, pepper, tomatoes and ground shrimps. Add a little water and rest of cooked vegetables.
7. Add the cabbage to the sauce, cover the pan and cook quickly for five minutes.
8. Add the beaten egg. Stir quickly and add the gari. Fry for few minutes and serve.

or

The cabbage can be cooked separately and served along with the Foto.

## Recipe 3

### Joloff Rice

Serving - enough for 2 Persons

1 cigarette tin rice  
1/2 lb. meat  
4 tomatoes  
6 onions  
1/2 cigarette tin beans  
1/2 bunch carrots  
1 turnip  
1 sweet pepper  
1/2 teaspoonful powder curry  
3 tablespoonful cooking oil

### Method:

1. Pick and soak beans overnight after washing. Boil until soft.
2. Wash and cut meat into suitable sizes and fry until golden brown.
3. Wash, scrape, and dice carrots, skin and slice turnip. Boil with carrots and meat till soft.
4. Prepare and slice onions, tomatoes, sweet pepper, removing all seeds.
5. Fry in hot oil all prepared vegetables. Add beans, carrots, turnip, and curry powder to gravy and water. Bring to the boil. Add washed rice. Stir frequently. Simmer till rice and meat are cooked.
6. Serve with boiled cabbage.

## Recipe 4

### Eggplant Stew

Serving - enough for 4 Persons

6 eggplant (garden eggs)	10 okroes
salted fish	1 cup palmoil or cooking oil
6 onions	
4 tomatoes	
3 smoked fish	
1/2 teaspoonful ground pepper	
salt	

### Method:

1. Wash, remove stalk and boil eggplant till tender.
2. Remove and grind skin and seeds.
3. Wash, skin and slice onions. Grind tomatoes.
4. Wash, and cut okro into small thin pieces.
5. Heat the oil and fry onions, tomatoes, okro and pepper till cooked.
6. Add water and fish.
7. Add ground gardeneggs. Simmer until well cooked. Correct seasoning.
8. Serve with Ampesi or Kenkey.

## Recipe 5

### Cooking of Cabbage

1. Remove withered outer leaves.
2. Wash in salt solution quickly.
3. Put a pan on the fire with little liquid to cover the bottom of the pan. Add salt.
4. Shred quickly and finely.
5. Add to the boiling salted water, cover with fitting lid for 10-15 minutes.
6. Serve with Joloff rice or as accompaniment with stew, soup or gravy.

## Recipe 6

### Vegetable Salad

Serving - enough for family

Bunch lettuce	Tomatoes
Cucumber	Eggs
Bunch carrots	Salad cream
Radishes	Salad oil
Beetroot	Vinegar
Turnips	Salmon
Yams	Onion

### Method:

1. Remove withered leaves off the lettuce, wash and put in basket to drain off.
2. Wash, skin and slice onion.
3. Wash, scrape and shred carrots.
4. Wash, boil and skin beetroot.
5. Wash, peel, slice and cook turnips.
6. Wash, peel, dice and cook yams.
7. Wash and shred radishes.
8. Wash, skin and slice cucumber.
9. Wash, skin, remove seeds and slice tomatoes.
10. Boil, shell and slice eggs.
11. Break leaves into suitable sizes or shred finely.

12. Arrange in the serving dish in layers. Cover the bottom with leaves, then onions, tomatoes, cucumber, carrots, turnips, boiled diced yams, radishes and decorate top with best selected slices of egg.
13. Pour over little vinegar, salad oil and cream just before serving.

We have supplemented these by giving some simple ways which most of the popularly grown vegetables mentioned in this booklet could be prepared and eaten in every Ghanaian home. (Taken and adapted from Tropical Cooking Simplified by Marie L. Pickering and Eating Your Way to Health by Ruth Bircher.)

Beans: French and Runner

1. Wash and prepare beans. French beans can be left whole, runner beans should be trimmed then thinly sliced.
2. Plunge them into boiling salted water. Skin. Boil 15-20 minutes.
3. Drain well.
4. Reheat with butter, pepper and salt.
5. Serve with Jollof rice, or as accompaniment with stew, soup or gravy.

Cabbage:

1. Melt fat and saute onion in it.
2. Cut the cabbage into 1/2 in. wide strips and saute with the onion.
3. Add stock gradually and simmer until tender.
4. Add salt, herbs or spices to taste.

Carrot:

1. Wash and scrub the carrots.
2. Cook in boiling salted water, covered with a lid for 15-20 minutes (young carrot); 40-45 minutes (old carrot).
3. Cut in lengths or rings.
4. Add butter and serve as for beans.

Carrot:

1. Melt fat and saute onion in it.
2. Slice carrots and add to the onions.
3. Pour stock on to the vegetables, add rosemary (optional) or spices.
4. Cover and cook for 3/4 hour.

Carrot:

The roots may be eaten raw, cut in slices and boiled until tender. or cut up and cooked in soup with other vegetables.

Cauliflower:

1. Cut off the cauliflower leaves and remove stalk close to the flower.
2. Cut into largish florets, peel stalk and keep tender leaves.
3. Put into cold salt water for one hour. Rinse well.
4. Cook until tender (20-30 minutes) take out and drain well.
5. Pour melted butter over.

### Cucumber:

1. Cut into finger-length strips and eat raw.
2. Slice or dice and mix in salad.

### Garden egg or Eggplant:

1. They may be cut in pieces, or boiled whole, and may be ground and put in soup.
2. They are sliced and fried in a small amount of oil, or first dipped in flour and fried.

### Marrow and Squash:

1. Cut marrow into finger-length strips or 1/2 inch slices (removing pith and seeds).
2. Spread out on a dish and sprinkle with salt.
3. Leave for a few minutes to draw.
4. Dip into flour and fry immediately in deep fat.

### Marrow and Squash:

These are cut in pieces and boiled with a little water. A few slices of onion cooked with the squash or marrow give it a better flavour. Squash or marrow may be added to soup when cooking it.

### Spinach:

1. Wash the spinach in several waters faintly tinted with potassium permanganate.
2. Remove stalks
3. Put the leaves into a saucepan without any extra water.
4. Cover and cook gently 5-10 minutes.
5. Drain and press out all the water.
6. Reheat, adding butter, pepper and salt.

Collards may be used in the same way as spinach. Both are very good in soup.

### Sweet Pepper:

Sweet peppers, like onions, are best used to make other dishes taste better.

1. Cut up, remove seeds, and use in raw salad, or in soup, stew, or cook with other vegetables.
2. They may be fried in a small amount of oil, alone or with onions.
3. They may be boiled and eaten alone.

## GLOSSARY

Nkontomire	-	A leafy vegetable
Efan	-	A leafy vegetable
Agusi (or Egusi)	-	Melonseeds which are dried and the shell removed. They are ground and made into a paste before adding to soup
Banku	-	Porridge, or mush
Kenkey	-	Corn dumpling
Okro	-	Okra
Gari	-	A cassava product made by grating cassava and pressing until free of moisture. It is then sieved and roasted.
Ampesi	-	Boiled yam, sweet potato, plantain, cassava or coco-yam

## EQUIVALENTS FOR WEIGHTS AND MEASURES

	<u>Measures</u>	<u>Weight</u>
3 teaspoons	1 tablespoon	1 ounce
2 tablespoons		1 ounce
4 tablespoons	1/4 cup	2 ounces
8 tablespoons	1/2 cup	4 ounces
16 tablespoons	1 cup	8 ounces
2 cups	1 pint	16 ounces (1 pound)
2 pints	1 quart	2 pounds
4 quarts	1 gallon	8 pounds
1 <u>tomato puree tin</u>	1/2 cup	4 ounces
1 <u>cigarette tin</u>	1 cup	8 ounces

## PESTS AND DISEASES OF VEGETABLES

## PESTS OF VEGETABLES

Vegetable	Common name of pest	Scientific name of pest	Nature of Damage	Control Measure
Sweet potato	Sweet potato weavils	<u>Cylas brunneus</u> <u>Cylas formicarius</u>	Larvae and adults bore into the stem and tuber. Infested tubers are quickly decayed.	<ol style="list-style-type: none"> <li>1. Crop residues should be removed from the field to avoid infestation in the following year.</li> <li>2. The field should be well ploughed and the planting of sweet potato should be avoided two years in succession.</li> <li>3. Sevin 5% dust or B.H.C. 5% dust should be applied to the soil before planting.</li> </ol>
	Millipede	<u>Periodontopyge</u> sp.	Larve and adults know tuber in the soil. Damage is generally localized.	<ol style="list-style-type: none"> <li>1. Same as above. The treatment should be limited only to areas known to harbour the pests.</li> </ol>
	Sweet potato hawk moths Cotton leaf worms	<u>Herse convolvali</u> <u>Prodenia litura</u>	Larve cause defoliation of the plants.	<ol style="list-style-type: none"> <li>1. Sevin 5% dust should be applied to the vines at the rate of 25 lbs./acre.</li> <li>2. Larvae collected by hand picking should be killed rightaway.</li> </ol>
Tomato	Tomato fruit-borers	<u>Prodenia litura</u> <u>Heliothis armigera</u>	Larvae bore into the fruit and thus cause fruit decaying.	<ol style="list-style-type: none"> <li>1. Disperse 1/2 oz. of Sevin 85 w.p. in two gallons of water and spray over 30 plants. Repeat at every 10 days interval. A thorough coverage is essential.</li> <li>2. Tomatoes are treated with fungicides</li> </ol>



APPENDIX I (Contd)

Vegetable	Common name of pest	Scientific name of pest	Nature of Damage	Control Measure
Tomato (contd)				prophylactically. It is advisable to mix the insecticide with the fungicide at the time of spraying. 3. Weeds should be exterminated in order to avoid invasion of caterpillar from non-treated plants.
	Grasshoppers Grasshoppers Mole crickets	<u>Atractomorpha gerstaeckeri</u> ) <u>Chrotogomus senegalensis</u> ) <u>Gryllotalpa africana</u> ) <u>Brachytrypus membranaceus</u> )	Nymphs and adults cut tomato seedlings.	1. Disperse 1/2 oz. of DDT 50% w.p. in one gallon of water and spray over 100 seedlings. Repeat after 10 days if necessary.
	Tomato capsids	<u>Nesidiocoris tenuis</u>	Nymphs and adult suck the sap from the delicate part of the blossom and thus cause premature blossom drop. Vector of leaf curl virus.	1. Same as <u>Prodenia</u> and <u>Heliothis</u> .
Eggplant	Shoot and fruit-borers	<u>Leucinodes orbonalis</u>	Larvae bore into the shoots and the fruits. Sometimes the boreholes are not visible from outside.	1. Crop Rotation: Eggplant growing should be avoided two years in succession. 2. Proper field sanitation is necessary. 3. Spray 1 oz. Sevin 85 w.p. 3 gallon of water over 50 plants at 10 days interval. Start spraying when the plants are about one foot in height. A thorough coverage is essential.

## APPENDIX I (Contd)

Vegetable	Common name of pest	Scientific name of pest	Nature of Damage	Control Measure
Eggplant (contd)				4. Do not harvest fruits within 14 days of applying the pesticide.
	Eggplant stem borers	<u>Euzophera villora</u>	Larvae bore into the basal part of the stem. The damage cannot be seen clearly unless the plant is uprooted. Attacked plants wither. Attack is usually at the base of the stem.	1. Same as for <u>Leucinodes</u> . 2. Turn over the soil immediately after the plants have been uprooted (or after harvest). 3. The larvae pupate inside the stem. It is therefore advisable to remove all the uprooted stalks from the field and burn them.
	Leaf skeletonizers	<u>Selepa docilis</u>	Larvae skeletonize the leaves.	1. Same as for <u>Leucinodes</u> .
Okra	Flea beetles	<u>Podagrica sjostedti</u> <u>Podagrica uniformis</u>	Adult beetles perforate the leaves.	1. Dust 5% DDT over the leaves <u>before the fruiting begins</u> . Apply at the rate of 20 lbs/acre. One application.
	Cotton stainers	<u>Dysdercus supersticiosus</u>	Nymphs and adults produce dark lesions on the fruits. Stems of young plants become distorted.	1. Spray 1/2 oz. Sevin 85 w.p./2 gallons of water and spray over 30 plants at weekly interval.
	Cotton leaf rollers	<u>Syllepta derogata</u>	Larvae eat away the leaves leaving the upper epidermis intact. Lower surface of leaves are covered with webbing.	1. Same as for <u>Dysdercus</u>
	Bugs	<u>Calidea dregii</u>	Nymphs and adults pierce the flower buds, stems or leaf stalks and feed on the sap of the plant.	1. Same as for <u>Dysdercus</u>

## APPENDIX I (Contd)

Vegetable	Common name of pest	Scientific name of pest	Nature of Damage	Control Measure
Cabbage and Cauliflower	Diamond Black Moth	<u>Plutella maculipennis</u>	Larvae bore into the main veins of leaves or feed on the underside tissue. Leaves become withered.	<ol style="list-style-type: none"> <li>1. Crop Rotation.</li> <li>2. Dust 5% Malathion at the rate of 25 lbs/acre every week when first signs of damage are seen or disperse 1 oz. of Diazinon 50% w.p. in 1 gallon of water and spray over 20 plants at weekly interval or mix one gallon of Malathion 20% E.C. in 90 gallons of water and spray over an acre plot at weekly interval.</li> </ol>
	Green semiloopers	<u>Plusia signata</u>	Larvae feed on leaves and defoliate the plant completely.	<ol style="list-style-type: none"> <li>1. Same as for <u>Plutella</u>. Apply to both sides of leaves when cabbage is small. May not control under all conditions.</li> </ol>
	Cotton leafworms	<u>Prodenia litura</u>	Larvae attack leaves.	<ol style="list-style-type: none"> <li>1. Same as for <u>Plutella</u>.</li> </ol>
	Tiger moths	<u>Diacrisia investigatorum</u>	Larvae feed on leaves.	<ol style="list-style-type: none"> <li>1. Same as for <u>Plutella</u>.</li> </ol>
	Oriental Cabbage/ Cauliflower web worms	<u>Hellula undalis</u>	Larvae bore into the centre of the stem. Small and young seedlings are killed by the attack.	<ol style="list-style-type: none"> <li>1. Dust the young seedlings prophylactically with 5% Malathion dust.</li> </ol>
	Cabbage fly	<u>Melangromyza Tambi</u>	Maggots bore into the stem. Leaves become yellow and wilted and the plant as a whole does not form a head. Seedlings are also attacked.	<ol style="list-style-type: none"> <li>1. Spray around the plant with 0.1% Mercuric chloride solution at the rate of one litre per 3 meters.</li> </ol>
Beans	Bean aphid	<u>Aphis sp.</u>	Shoots become infested with colonies of black aphids. Leaves are curled downwards. Vector	<ol style="list-style-type: none"> <li>1. Add 1/2 gallon of Nicotine sulphate 40% solution to 90 gallons of water and spray over 1 acre</li> </ol>

## APPENDIX I (Contd)

Vegetable	Common name of pest	Scientific name of pest	Nature of Damage	Control Measure
Beans (contd)			of various virus diseases of beans.	plot when aphids appear or add 15 cc. of Malathion 20% E.C. to a gallon of water and spray 15 plants.
	Bean Bug	<u>Riptortus tenuicornis</u>	Adult and nymphs cause large feeding marks (Lesion) on pods.	1. Dust 5% Sevin at the rate of 25 lbs/acre or Spray 21 lbs. of Sevin 85 w.p/100 gals. of water per acre.
	Dwarf bean pod borers	<u>Etiella zinckella</u>	Larvae bore into the pods and destroy the seeds.	1. Same as for <u>Riptortus</u> .
	Leaf folders	<u>Lamprosema indicata</u>	Larvae web foliage. Soybeans are generally attacked.	1. Same as for <u>Riptortus</u> .
	Mung moths	<u>Maruca testualalis</u>	Larvae bore into the pods and destroy the seeds.	1. Same as for <u>Riptortus</u> .
	Cotton leaf worms	<u>Prodenia litura</u>	Larvae eat the leaves and thus cause defoliation.	1. Same as for <u>Riptortus</u> . 2. Collect larvae by hand picking and destroy them. <u>N.B.</u> Do not apply the insecticide during the early blossom or early pod period.
Pepper, hot	Leaf hoppers	<u>Empoasca</u> sp.	Leaves turn yellow and shrivelled. This bug may be vector of pepper rosette disease.	1. Spray 1-1/2 lbs. of Sevin 85/100 gallons of water per acre plot.
	Pepper bugs	<u>Acanthocoris</u> sp.	Adults and nymphs suck sap from the stem and leaves. Stems become blackened.	1. Same as for <u>Empoasca</u> .

APPENDIX I (Contd)

Vegetable	Common name of pest	Scientific name of pest	Nature of Damage	Control Measure
Pepper, hot (contd.)	Pod borers	- -	Presence of creamy white caterpillars inside the pod.	1. Same as above.
	Pepper maggots	- -	Maggots bore into the pods.	1. Same as for <u>Empoasca</u> . 2. Judicial (early) harvesting may prevent infestation.
Pepper, sweet	Cotton leaf-worms	<u>Prodenia litura</u>	Larvae gnaw the fruit skin and make a round bore hole.	1. Spray 1-1/2 lbs. of sevin in 85/100 gallons of water per acre plot.
Lettuce	Green semiloopers	<u>Plusia signata</u>	Larvae feed on the foliage	1. Same as for <u>Plusia</u> . 2. In small vegetable gardens it may be more advisable to collect larvae by hand and destroy them rather than to apply insecticides.
	Cotton leaf-worms	<u>Prodenia litura</u>		
Cucumber	Beetles Flea beetles	<u>Asbeaesta eyanipennis</u> <u>Prodagrica uniformis</u>	Adult beetles cause perforation of leaves	1. Disperse 2 lbs. of Malathion 50% w.p. in 100 gallons of water and spray one acre plot. N.B. Never use DDT and BHC.

In addition to all the pests mentioned above, vegetables are often attacked by snails. To control them, use the following poisonous bait: be careful at the time of handling. Mix 100 gms. of Metaldehyde with 10 lbs. of dry maize bran and then add 1-1/2 gallons of water to make a crumbly mash. Spread the poisonous bait where snails appear.

In small vegetable gardens it is advisable to collect the snails by hand picking and destroy them rather than to apply the bait.

## DISEASES OF VEGETABLES

Vegetable	Common Name of Disease	Scientific Name of Cause	Nature of Damage or Disease Symptoms	Treatment
<p>General diseases affecting several vegetable crops:</p> <p>E.g. Beans, Cabbage, and Cauliflower</p>	Seedrot or damping-off or wirestem	<u>Pythium</u> sp., <u>Pellicularia</u> , sp. <u>Phytophthora</u> , sp. <u>Botrytis</u> sp. <u>Fusarium</u> , sp. and other soil fungi	Rotting of germinating seed before reaching the soil surface; after breaking through the ground, base of seedling discoloured, shrivelled, seedling falls over and dies; after the plant reaches a certain height the outer layer of the stem base is destroyed, gray to black discoloured, partly girdled.	<ol style="list-style-type: none"> <li>1. Sterilization of the soil for seed boxes or in the seed bed.</li> <li>2. Drainage of wet soil.</li> <li>3. Use of healthy seeds.</li> <li>4. Seed dressing with mercuric or other chemical fungicides for seed treatment.</li> <li>5. Spraying the seedling and the soil at frequent intervals with copper or organic fungicides.</li> </ol>
E.g. Eggplant, Tomato	Bacterial wilt	<u>Pseudomonas solanacearum</u> E.F.S.	Wilting of some younger leaves or slight yellowing of the oldest, lower foliage. Then suddenly a total wilting of the whole plant and dying of the foliage until the plant is killed. The vascular system is discoloured and filled with bacterial slime.	<ol style="list-style-type: none"> <li>1. Long rotation with nonsusceptible crops.</li> <li>2. Eradication of weeds and infected plants.</li> <li>3. Good drainage of the soil.</li> <li>4. Sterilization of the soil for seed boxes or of the seed bed by steam or chemicals.</li> <li>5. Use of resistant varieties.</li> </ol>

## APPENDIX I (Contd)

Vegetable	Common Name of Disease	Scientific Name of Cause	Nature of Damage or Disease Symptoms	Treatment
.g. Beans, Carrot, Onion and Tomato	Southern sclerotium wilt	<u>Sclerotium rolfsii</u> sacc. (perfect stage) <u>Pellicularia rolfsii</u> (Cur.) West.	At first dark brown lesions just below the soil surface on succulent stems. Progressive yellowing or wilting of the foliage beginning on the lowest leaves. The stem may fall over or stand upright and become defoliated. The stem lesion is covered with a white weft mycelium.	<ol style="list-style-type: none"> <li>1. Long rotation with nonsusceptible crops like maize or other cereals.</li> <li>2. Liming of the soil to get a pH of about 7.5.</li> <li>3. Eradication of infected plants.</li> <li>4. In seed beds soil disinfection with steam or chemicals.</li> <li>5. Avoid mulching close to the plants in rainy season.</li> </ol>
.g. Beans, Carrot, Cabbage, Cauliflower, Cucumber, Lettuce, Okra, Onion, Pepper and Tomato	Root knot disease	Several Nematode species of the genus <i>Meloidogyne</i>	Galls are produced on roots, leaves become pale in colour, the stem becomes spindly and dwarfed. Swellings on roots vary from spheroid galls to elongated spindles. Affected plants form only a few fruits, sometimes the whole plant dies.	<ol style="list-style-type: none"> <li>1. Long term rotation with non-susceptible crops such as <i>Crotalaria</i>, corn, cassava and grasses.</li> <li>2. Use of non-affected seedlings for planting.</li> <li>3. Use of resistant varieties if available.</li> <li>4. Seed bed fumigation with methyl bromide.</li> <li>5. Field fumigation with nematicides such as DDT and nemagor.</li> </ol>

## APPENDIX I (Contd)

Vegetable	Common Name of Disease	Scientific Name of Cause	Nature of Damage or Disease Symptoms	Treatment
E.g. Carrot, Cabbage, and Cauliflower	Bacterial soft rot	<u>Erwinia carotovora</u> (Jones) Hol. and other bacteria of genus <u>Erwinia</u> .	On fruits, tubers, fleshy roots or succulent stems at first a water soaked area appears and enlarges rapidly. Affected plant part may collapse. An offensive odour is present.	<ol style="list-style-type: none"> <li>1. Avoid wet soils.</li> <li>2. Prevent damaging of roots, tubers, and fruits by cultivation.</li> <li>3. Eradicate infected plant.</li> <li>4. Harvest carefully and store well.</li> </ol>
Beans	Bean rust	<u>Uromyces phaseoli typica</u> Arth. (syn. <u>U. appendiculatus</u> (Pers.). F <sub>1</sub> )	Minute spots appear on the leaves. They enlarge to reddish-brown powdery pustules (uredia sori). Pods may also become infected.	<ol style="list-style-type: none"> <li>1. Use resistant varieties.</li> <li>2. Eradicate infected plants.</li> <li>3. Application of sulphuric fungicides at early stages should be effective.</li> </ol>
	Angular leaf spot disease	<u>Isariopsis griseola</u> sacc	Angular, reddish-brown lesions on leaves which later turn dark brown. When the disease reaches severity, lesions occur also on pods and branches.	<ol style="list-style-type: none"> <li>1. Long rotation (2 years and more), with nonsusceptible crops (other than beans).</li> <li>2. Use of healthy seed, planting in well drained soil.</li> <li>3. Spraying with maneb, ferbam, captan, ziram, zineb or other organic fungicides before infection starts, at weekly intervals.</li> </ol>



APPENDIX I (Contd)

Vegetable	Common Name of Disease	Scientific Name of Cause	Nature of Damage or Disease Symptoms	Treatment
Beans (contd)	Ashy grey-stem disease	<u>Macrophoma phaseoli</u> (Maub) Ashby	Sunken, ashy-grey lesions appear on the stem of young plants near the base. Root infection results in blackening (charcoal rot). Infected plants are either killed prematurely or stunted with reduction in yield.	<ol style="list-style-type: none"> <li>1. Use disease free seed.</li> <li>2. Crop rotation with nonsusceptible crops like maize and other cereals.</li> <li>3. Remove affected plants when spotted early.</li> <li>4. Bruising of crops should be avoided and storage must be at the correct temperature.</li> <li>5. Seed treatment with mercuric compounds.</li> </ol>
	Web-blight disease	<u>Pellicularia filamentosa</u> (Pat) Rog. (imperfect stage) <u>Rhizoctonia solani</u> Kuhn	Small circular brown spots on leaves which enlarge. The whole leaf turns greyish brown and dies. Sunken brown spots on petioles, stem and pods, later covered with web-like mat of white-brown mycelium, minute brown sclerotia develop.	<ol style="list-style-type: none"> <li>1. Sterilizing the soil in seed beds with steam or chemicals.</li> <li>2. Crop rotation with nonsusceptible plants.</li> <li>3. Avoid excessive overhead watering.</li> <li>4. Removal of affected plants in the field.</li> <li>5. Spraying with copper fungicides at 7-10 day intervals.</li> </ol>
	Bean mosaic disease	Bean virus	Mottling of the leaves and distortion, pods may show chlorotic spots. Whole plant stunted, pods are reduced in size,	<ol style="list-style-type: none"> <li>1. Use resistant varieties.</li> <li>2. Use seeds from healthy plants.</li> <li>3. Eradicate in-</li> </ol>

APPENDIX I (Contd)

Vegetable	Common Name of Disease	Scientific Name of Cause	Nature of Damage or Disease Symptoms	Treatment
Beans (contd)			blossoms drop premature, yield reduced.	<p>ected plants as they appear in the field.</p> <p>4. Avoid transmission by cultural practice.</p> <p>5. Control of the aphid vector by systemic insecticides.</p>
Carrots	Alternaria blight	<u>Alternaria dauci</u>	Irregularly shaped dark brown to black necrotic lesions on older leaves with a pronounced chlorotic area surround the necrotic tissue.	<p>1. Rotation and sanitation practices.</p> <p>2. Seed treatment with mercuric fungicides.</p> <p>3. Spray with copper or organic fungicides at 10-day intervals.</p>
	Leaf blight disease	<u>Pellicularia filamentosa</u> (Pat.) Rog.	Look under web-blight disease of beans.	Look under web-blight diseases of beans.
Crucifers (Cabbage, cauliflower etc.)	Blackrot or blight disease	<u>Xanthomonas campestris</u> (Pann.) Dows	Chlorotic discolorations on the leaves which turn to dark-brown or black. Black discoloration of the vascular bundles and internal break down.	<p>1. Seed-bed rotation (3 years or more) with crops other than crucifers.</p> <p>2. Sanitation practices, removal of diseased plants.</p> <p>3. Use seeds from healthy plants.</p> <p>4. Seed treatment with mercuric fungicides.</p>
	Club-root disease	<u>Plasmodiophora brassicae</u> Worr.	Appearance of yellowish, sickly leaves, roots are enlarged and malformed. Malforma-	1. Eradication of weeds belonging to the mustard family.

APPENDIX I (Contd)

Vegetable	Common Name of Disease	Scientific Name of Cause	Nature of Damage or Disease Symptoms	Treatment
Crucifers (Cabbage, cauliflower etc.) (contd.)			tion vary in size from very small swellings to large club masses. Do not confuse with root-knot disease.	<ol style="list-style-type: none"> <li>2. Elimination of seed beds that show club-root infection.</li> <li>3. Use only healthy seedlings for field planting.</li> <li>4. Long crop rotation with crops not belonging to the mustard family.</li> </ol>
Cucumber	Downy mildew	<u>Pseudoperonospora cubensis</u> (Berk et Curt) Rost	Pale-green areas on the leaves are separated by islands of darker green, soon they change to yellow angular spots. The lower surface is covered with greyish conidiophores of the fungus.	<ol style="list-style-type: none"> <li>1. Eradication of diseased plants.</li> <li>2. Use of resistant varieties.</li> <li>3. Reducing the humidity on the field by cultivation practice.</li> <li>4. Repeated spraying with copper on organic fungicides.</li> </ol>
	Powdery mildew	<u>Erysiphe cichoracearum</u> , de Cand. (imperfect stage <u>oidium spec.</u> ) and <u>Sphaerotheca fuliginea</u> (schlecht.) Poll.	Powdery white cover on the leaves especially the upper side. Brown spots appear and the tissue dries.	<ol style="list-style-type: none"> <li>1. Weed control, especially wild Cucurbitaceae.</li> <li>2. Repeated spraying with sulphuric fungicides or karathane.</li> </ol>
	Angular leaf spot disease	<u>Pseudomonas Lachrymans</u> (E.F.S. et Bry) Cars.	Irregular shaped, angular, water soaked spots on the leaves which turn grey and die, similar spots appear on stems and fruits.	<ol style="list-style-type: none"> <li>1. Eradication of affected plants.</li> <li>2. Rotation and sanitation measures.</li> <li>3. Seed treatment with mercuric fungicides, but this does not give full protection.</li> </ol>

APPENDIX I (Contd)

Vegetable	Common Name of Disease	Scientific Name of Cause	Name of Damage or Disease Symptoms	Treatment
Cucumber (contd.)	Mosaic disease	Cucumber virus	Leaves become mottled, distorted, wrinkled, stunted, and the edges curl downward. Fruits with pale-green areas interspersed with dark-green spots and wart-like projections.	<ol style="list-style-type: none"> <li>1. Eradication of infected plants.</li> <li>2. Use of resistant varieties.</li> <li>3. Avoid transmission by tools and cultivation practice.</li> <li>4. Control of aphid vectors with insecticides.</li> </ol>
Eggplant	Phomopsis blight and fruit rot	<u>Phomopsis</u> <u>rexans</u> (Sacc: et syd) Hart	Damping-off symptoms (look above) Circular grey to brown spots on the leaves, grey dry-rot on the stem base together with canker formation. Pale sunken spots on the fruits leading to a dry-rot which transforms the fruits into a black mummy.	<ol style="list-style-type: none"> <li>1. Long rotation (3 years or longer).</li> <li>2. Use of seed from uninfected plants.</li> <li>3. Seed treatment by hot water (30 minutes at 122°F.)</li> <li>4. Seed-bed spraying with Ziram or Captan.</li> <li>5. Field spraying with Maneb.</li> </ol>
	Mosaic disease	Presumably tobacco ring-spot-virus	Affected plants become conspicuously yellowed, beginning near the tip and progressing downward, remain stunted in growth, and yield poorly.	<ol style="list-style-type: none"> <li>1. Eradication of infected plants.</li> <li>2. Control of the thripvectors by insecticides.</li> <li>3. Avoid transmission by tools and cultivation practice.</li> </ol>
Lettuce	Septoria leaf spot disease	<u>Septoria</u> <u>lactucae</u> Pass.	Small yellow spots on the leaves which enlarge conspicuously. The dead tissue may drop out, leaving holes.	<ol style="list-style-type: none"> <li>1. Long rotation (4 years and longer).</li> <li>2. Using uninfected seed.</li> </ol>

APPENDIX I (Contd)

Vegetable	Common Name of Disease	Scientific Name of Cause	Nature of Damage or Disease Symptoms	Treatment
Lettuce (contd)				<ol style="list-style-type: none"> <li>3. Good drainage of the soil.</li> <li>4. Control of weeds.</li> </ol>
Okra	Leaf curl disease	Virus	Appearance of cup-shaped leaves and enations on the under side of the veins, stunting.	<ol style="list-style-type: none"> <li>1. Eradication of affected plants.</li> <li>2. Avoid transmission by cultivation practice.</li> </ol>
	Mosaic disease	Virus	Yellow mosaic pattern on the leaves, little stunting.	<ol style="list-style-type: none"> <li>1. Eradication of affected plants.</li> <li>2. Avoid transmission by cultivation practice.</li> </ol>
Onion	Purple blotch disease	<u>Alternaria porri</u> (Ell.) Cif.	Small, white sunken areas with purple centers on the leaves. The lesions enlarge and girdle the leaves. Leaf tips dry out and collapse.	<ol style="list-style-type: none"> <li>1. Seed treatment with mercuric or organic fungicides.</li> <li>2. Long rotation with unrelated crops (other than <i>Allium</i> sp).</li> <li>3. Use of resistant varieties.</li> </ol>
Pepper	Fruit rot	<u>Collectotrichum piperatum</u> (Ell. et. Wal. et.) Ell. et Wal. and <u>C. capsici</u> (Syd) Butl. et. Bis.	Depressed lesions varying in size from mere dots to those covering much of the fruit surface, older spots usually are black.	<ol style="list-style-type: none"> <li>1. Crop rotation.</li> <li>2. Eradication of related plants.</li> <li>3. Drainage of soil.</li> <li>4. Spraying with Ziram, Captan, Zineb, Maneb or other organic fungicides.</li> </ol>

APPENDIX I (Contd)

Vegetable	Common Name of Disease	Scientific Name of Cause	Nature of Damage or Disease Symptoms	Treatment
Pepper (contd)	Mosaic disease	Virus	Yellow mosaic pattern on the leaves.	<ol style="list-style-type: none"> <li>1. Eradication of affected plants.</li> <li>2. Avoid transmission by cultivation practice.</li> <li>3. Control of insect vectors by insecticides.</li> </ol>
	Rosette disease	Virus	Leaf curl, stunted growth, malformation of leaves and fruits.	
Sweet Potato	Black Rot	<u>Ceratocystis fimbriata</u> Ell. et. Hal	Dark circular areas on the roots, which extend inward the tuber. Diseased tissue is darkened and bitter in taste.	<ol style="list-style-type: none"> <li>1. Long rotation (at least more than 2 years).</li> <li>2. Eradication of weak and infected plants.</li> <li>3. Selection of healthy stock for seed.</li> </ol>
	Storage rot	<u>Botryodiplodia theobromae</u> , Path.	The rind of harvested tuber collapses and internal rot may be dry or wet depending upon associated organisms.	
Tomato	Early blight disease	<u>Alternaria solani</u> (Ell. et. Marl.)	Dark brown to black spots with concentric zones on the leaflets; on fruits black or brown sunken lesions, tissue leathery.	<ol style="list-style-type: none"> <li>1. Crop rotation.</li> <li>2. Seed treatment with mercuric or organic fungicides.</li> <li>3. Repeated spraying with Zineb, Ziram, Maneb or other organic fungicides.</li> </ol>
	Septoria leaf spot disease	<u>Septoria lycopersici</u> , sp. nov.	Small water-soaked, circular spots on the under surface at first of the lower leaves. Spots enlarge, margins become dark brown with sunken	

## APPENDIX I (Contd)

Vegetable	Common Name of Disease	Scientific Name of Cause	Nature of Damage or Disease Symptoms	Treatment
Tomato (contd)			white or gray center; defoliation	3. Repeated spraying with copper compounds (at 7 to 10 days) or organic fungicides like zineb (at 5 to 7 days).
	Leaf mould	<u>Cladosporium fulvum</u> , Cook.	Irregular chlorotic spots at first on the lower leaves, which turn greyish-black. On green fruits infected areas appear as black, leathery while on ripening fruits they are yellow sunken.	1. Use of resistant varieties. 2. Control of humidity. 3. Repeated spraying with Ziram, Ferbam, Maneb, Captan or other organic fungicides.
	Leaf mottling	Virus	Leaves mottled, distorted, reduced in size; Flowers fail to set fruits.	1. Eradication of affected plants. 2. Eradication of solanaceous weeds.
	Bronze leaf spot disease	Virus	First, brown spots on the leaves which enlarge, distortion of leaves and stem, dropping of flowers.	
	Blossom-end rot	Nutritional disorder	Sunken dark brown lesions at the blossom-end, internal discoloration of the core.	1. Bring the soil to a good fertility. 2. Regular water watering. 3. Application of calcium. 4. Mulch in dry season.
	Root-knot disease	<u>Meloidogyne</u> spp.	Look under general diseases.	Look under general diseases.

## LIST OF TESTED VEGETABLE VARIETIES

CROP	VARIETY	PLANTING SEASON		SOURCE
		WET	DRY	
BEANS, BUSH	Tendergreen	N	SS	Asgrow
	Tenderlong	N	SS	Asgrow
	Refuge	N	SS	Suttons
	Canadian Wonder	N	SSS	Suttons
BEANS, POLE	Florigreen	S	SSS	Burpee
	Kentucky Wonder	SS	SSS	Burpee and Suttons
BEANS, LIMA+ BUSH	Burpee	N	SS	+Asgrow
	Henderson	N	SS	Reuter
BEANS, LIMA POLE+	Florida Red Speckle	N	SS	Reuter
BEETROOT	Detroit	S	SS	OE and Corneli
	Crosby Egyptian	SS	SSS	OE and Corneli
	Spangsbjerg	S	SS	OE
CABBAGE	Badger Market	N	SS	Reuter
	Charleston Wakefield	S	SS	Reuter and all USA Cos.
	Copenhagen Market	SS	SSS	Reuter and all USA Cos.
	Steins Early Flat Dutch	N	SSS	Reuter and all USA Cos.
	Jersey Wakefield	S	SS	Reuter and all USA Cos.
	Best of All	SS	SSS	Suttons and Corneli
	Drumhead	S	SS	OE
	Early Vienna	S	SS	OE
	Ironhead	S	SS	OE
CABBAGE, CHINESE	Granat	SS	SSS	OE
	Michihili	S	SS	OE and All USA Cos.
	Petasi	S	SS	OE and All USA Cos.
CARROT	Amsterdam Special			
	Stock 378	SS	SSS	OE
	Amsterdam Forcing	SS	SSS	Suttons
	Nantes, Improved 38	S	SSS	OE
	Touchon 407	S	SSS	OE and Corneli
CAULIFLOWER	Tropical	SS	SSS	Suttons
COLLARDS	Georgia	SS	SS	Reuter and other USA Cos.

Note: +Don't plant in rain forest area. N: not successful; S: moderately successful, not really worth growing; SS: Successful, worth growing, and SSS: very successful, the variety most worth growing.



## APPENDIX II (Contd)

CROP	VARIETY	PLANTING SEASON		SOURCE
		WET	DRY	
CUCUMBER	Palmetto	SS	SSS	OE, Reuter
	Puerto Rico 39	S	SS	Burpee
	Singapore	SS	SSS	Malaya
	Straight Eight	N	SS	Burpee and other USA Cos.
EGG PLANT (GARDEN EGGS)	Black Beauty	SS	SSS	Suttons, Reuter, Dam.
	Florida High Bush	SS	SSS	Reuters
	Florida Market	SS	SSS	Burpee and Asgrow
	Long Black	SS	SSS	DAM
	Long Green	SS	SSS	DAM
	Round Purple	SSS	SSS	DAM and IG
	Wynad Giant	SSS	SSS	IG
KALE	Blue Scotch	S	SS	OE and Corneli
	Extra Curled Scotch	SSS	SSS	Suttons
	Dwarf Blue Scotch	S	SS	OE and Corneli
LETTUCE	AI	SSS	SSS	Suttons
	Big Boston	S	SS	OE, Reuters
	Continuity (Mig-xnonette)	SSS	SSS	Suttons
	Imperial	S	SS	Reuters
	Great Lakes	S	SS	Kirchhoff and Reuters
	Salad Bowl	S	SS	Reuters
OKRA	Gold Coast	S	SS	Corneli
ONIONS	Crystal White Wax	S	SS	Reuter
	Lisbon White	S	SS	OE
	Queen	S	SS	OE
	Red Creole	S	SS	OE
	Red Creole C-5 Strain	S	SSS	Reuter
	Texas Early Grano	N	SSS	Reuter, Kirchhoff
	Tropical	S	SSS	Suttons
	Bawku	SS	SSS	Ministry of Agriculture
PEPPER, SWEET	California Wonder	SSS	SSS	Asgrow, Reuter, Yates and DAM
	World Beater	SSS	SSS	Asgrow, Reuter, Yates and DAM
	Florida Giant	S	SSS	Asgrow, Reuter, Corneli
	Yolo Wonder	S	SS	Asgrow, Reuter, Yates
PEPPER, HOT	Long Red Cayenne	SSS	SSS	Corneli, Yates
RADISH	Early Scarlet Globe	SSS	SSS	Burpee/other USA Cos.
	White Icicle	SSS	SSS	Burpee/other USA Cos.
	French Breakfast	SSS	SSS	Suttons

## APPENDIX II (Contd)

CROP	VARIETY	PLANTING SEASON		SOURCE
		WET	DRY	
SQUASH	Cocozelle	N	SS	Corneli/other USA Cos.
	Early Prolific	N	SS	Corneli/other USA Cos.
	Straightneck	N	SS	Corneli/other USA Cos.
	Early Yellow Summer			
	Crookneck	N	SS	Comeli/other USA Cos.
TOMATO <sup>+</sup>	Amateur	S	SS	Suttons
	Anahu	N	SS	GAS
	Dwarf Gem	SS	SSS	Suttons
	Early Dwarf	SS	SSS	I. G.
	Leader	S	SS	Suttons
	Local Type	SS	SSS	Kumasi Market
	Pearl Harbor	S	SS	Burpee
	Ponderosa	S	SS	Kirchoff
	Red Plum	S	SS	I. G.
	Ruby	S	SS	I. G.
	Turrialba	S	SS	CR
	Zuarungu	S	SS	GAS
	Zuarungu Improved	SS	SSS	GAS
	Marglobe	SS	SSS	Burpee
Oxheart	S	SS	Reuter	
MUSTARD GREENS <sup>+</sup>	Florida Broadleaf	SSS	SSS	Corneli
	Tendergreen	SSS	SSS	Corneli
	Southern Giant			
	Curled Long Standing	SSS	SSS	Corneli
TURNIP	Purple top	SS	SS	Corneli
WATERMELON	Charleston Gray	N	SS	Reuter
	Darlington	N	SSS	Reuter
	Dixie Queen	N	SSS	Reuter
	Florida Giant	N	SSS	Reuter
	New Hampshire Midget	N	SS	Reuter
	Tom Watson	N	SSS	Reuter, Kirchoff

Sources and varieties are those in use in Ghanaian experiments.  
Endorsement is not implied. There are many others equally good.

Abbreviations

- (a) Source: Asgrow . . . . . Kilgore Seed Co., Plant City, Florida, U.S.A.  
 Burpee . . . . . W. A. Burpee Co., Philadelphia, U.S.A.  
 GAS. . . . . Plant Breeder, Crop Research, Ghana Academy  
 of Sciences.  
 CR . . . . . Agric. Research Institute, Turrialba, Costa Rica.  
 Dam. . . . . D. J. Damani, Poona, India.  
 IG . . . . . Indian Council of Agric. Research, New Delhi.  
 Kirchhoff . . . . .Kirchhoffs E. Africa, Ltd., Nairobi, Kenya.  
 Malaya . . . . .Dept. of Agric., Kuala Lumpur, Malaya.  
 OE. . . . . Ohlsen Enke, Copenhagen, Denmark.  
 Reuter . . . . .Reuter Seed Co., New Orleans, U.S.A.  
 Suttons . . . . .Suttons & Sons, Reading, England.  
 Yates . . . . .A. Yates & Co. Brisbane, Australia.

- (b) Rating: N: Not successful.  
 S: Moderately successful, not really worth growing.  
 SS: Successful, worth growing.  
 SSS: Very successful, the variety most worth growing.

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Fig. 15. Plan to grow enough vegetables to meet family health needs first, then sell surplus.