



VITA Technical Publication

A TROPICAL GUIDE TO YEAR ROUND VEGETABLE GARDENING

By
Harlan H.D. Attfield

a tropical guide to
**Year Round Vegetable
Gardening**

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a **Vita** *publication*

A Tropical Guide to Year Round Vegetable Gardening

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Preface

A Tropical Guide to Year Round Vegetable Gardening was written by Harlan H.D. Attfield, a specialist in tropical vegetable gardening, sustainable, integrated farming programs, smallstock, and beekeeping. Mr. Attfield has traveled widely and has written numerous publications for development organizations.

This concise guide incorporates the author's experiences in Africa, Asia, and the Caribbean. Step-by-step, the author explains in clear, straightforward language how to select and grow vegetables of high nutritional value *year-round*.

Mr. Attfield's guide contains valuable information on tropical leaf vegetables, planning the family's year-round garden with nutrition in mind, and the use of compost as an alternative to costly commercial fertilizers. Included are appendices containing information useful to extensionists promoting home gardening in the tropics and subtropics.

The illustrations of vegetables are by the late Marina Maspero, who worked closely with the author on a number of publications for International Voluntary Services. All other illustrations are by Barbara Libby, an accomplished artist who resides in the San Francisco Bay Area. The design, layout, typesetting and editing of this book were done by Urban Cabin in Oakland, California USA. Joyce Coffland, Artistic Concepts (Oakland), served as publishing advisor.

The author wishes you
the best of luck, and,
Good Farming ☺☺☺

Deciding What To Grow

Generally we grow vegetables we like to eat. But those of us that garden to improve our diet plant vegetables that are tasty **and** high in nutritional value.

Choose plants for the garden that require minimum labor in return for a high production of nutrients. Indigenous (local) plants are usually a safe crop because after centuries in one particular environment they have adapted to its conditions and don't require a great deal of labor or inputs to give a good yield. Local vegetables are extremely valuable for several reasons:

- ⊕ Easy to grow, long yield season
- ⊕ Tolerant to many soil and climatic conditions
- ⊕ Resistant to pests and diseases
- ⊕ High in nutritional value
- ⊕ Tasty and easy to prepare
- ⊕ Produce viable seeds
- ⊕ Can be sold for extra income

Vegetables are a source of vitamins, minerals and protein. They contain many of the minerals such as, calcium and iron, which our bodies use to make bone, teeth and blood. They also provide important vitamins, mainly Vitamin A (provitamin A converted to retinol), the B Vitamins, and Vitamin C.

Vitamin A is needed for healthy eyes and good vision. A lack of this vitamin can cause eye disease and even blindness among children. Dark green, leafy vegetables, yellow fruits and yellow sweet potato are an excellent source of this vitamin.

B Vitamins are needed for healthy skin, eyes, nerves, and good blood. A lack of these vitamins can cause poor blood (anemia), weakness, dry scaly skin, swelling of the body, and even poor

mental health. The best source of these vitamins are green, leafy vegetables, pulses (beans, peas, soybeans, peanuts, etc.), raw, hand-pounded or par-boiled (cooked in the husk) rice, and whole wheat flour.

Vitamin C helps prevent infections, helps cuts and wounds to heal quickly, and keeps the gums around the teeth healthy. Green leafy vegetables, and fruits like guava, papaya, oranges, limes and lemons are an excellent source of vitamin C.

Tables 1 and 2 show which vegetables commonly grown in the tropics are the richest and poorest source of these important vitamins and minerals. Table 3 lists vegetables that are easy to grow **and** rich in vitamins and minerals.

Protein is a very complex group of substances (amino acids) found in all parts of our bodies. Without protein in our diet we would wither and die. "Almost all vegetables, roots, and cereals contain significant quantities of protein. Cassava root and bananas are the only staple foods whose protein content is low, and it is the people who depend heavily on these crops who most frequently suffer serious protein deficiencies. The role of cooked leaf protein as a contributor to good nutrition is often overlooked. Although the quality of leaf protein is usually lower than that of animal protein, this can be corrected either by consuming somewhat more, or by eating leaves in combination with other foods (cereals and legumes) that compliment (actually boost) its protein value.

Even in a diet which contains no animal protein at all, there are four main vegetable sources available: legumes (peas and beans), cereals, leafy green vegetables, and some root crops (sweet potato, Irish potatoes, yams). These four types of food, eaten together, can meet one's needs very well, though each by itself is likely to be inadequate by lacking one or more of the wide variety of amino acids needed to build up the body's protein requirement. Thus, in an area where grain crops are the staple food, beans and green

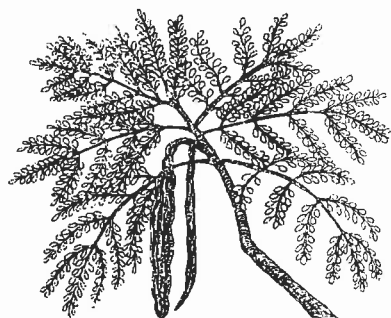
vegetables from the garden should be eaten in the same meal as cereal foods to achieve a desirable protein balance. But where cassava, which contains very little protein, is the staple, it will be important to eat some cereal along with beans and green vegetables. The protein in yams and sweet potatoes will be more useful to the body if eaten with food from other protein sources such as greens or legumes. The benefits of combining different protein sources in this way has been proven in many countries throughout the world. In India, by adding a green leafy vegetable from the amaranth group to a diet consisting mainly of cereals and beans, the quality of protein, and its utilization by the body, was improved so much that it was almost equivalent to the best animal protein, such as that contained in milk (*Arnold Pacey, Gardening for Better Nutrition, Oxfam, IT Publications*)." See Appendices 1 and 2 for more information on nutrition and garden planning.

Table 1
Vegetables of High Nutritional Value

Listed in order of their food value. Items in **bold** show which part of the vegetable contains the most food value.

- | | |
|---|---|
| 1. Black colocasia leaves | 20. Jute leaves |
| 2. Carrot, leaves and root | 21. Spinach |
| 3. Turnip leaves | 22. Mustard, field |
| 4. Beet leaves | 23. Field bean, tender |
| 5. Fenugreek leaves | 24. Sword bean, tender |
| 6. Radish leaves | 25. Bitter gourd, leaves and gourd |
| 7. Pigeon peas, tender | 26. Chinese cabbage, pak-choy |
| 8. Kohlrabi leaves | 27. Okra |
| 9. Sweet potato, leaves and root | 28. Sweet corn, tender |
| 10. Red amaranth | 29. Peas |
| 11. Green amaranth | 30. French beans |
| 12. Mint leaves | 31. Potato, leaves and tuber |
| 13. Celery leaves | 32. Tomato |
| 14. Coriander leaves | 33. Pointed gourd leaves |
| 15. Indian spinach | 34. Onion leaves |
| 16. Cowpea, leaves and pods | 35. Sweet pumpkin leaves |
| 17. Soybean, green beans | 36. Cabbage |
| 18. Cauliflower, leaves and flower | 37. Colocasia root |
| 19. Broccoli | 38. Lettuce, dark leafy |

Field Plants and Trees Used as Vegetables



The leaves of plants, like papaya, cassava and moringa (drumstick) (left, *Courtesy, ECHO*) are often harvested for food. Their nutritional value is often significant. For example, the highly nutritious leaves of moringa can be dried and powdered and then mixed in the food given to malnourished children.

This is one way of treating the problem without having to rely on expensive commercial products: whole milk powder, vegetable oil, and sugar.

Table 2
Vegetables of Low Nutritional Value
Listed in order of their food value.

- | | |
|------------------------|----------------------|
| 1. Eggplant | 9. Ash gourd |
| 2. Onion, small red | 10. Radish root |
| 3. Pumpkin, pale flesh | 11. Snake gourd |
| 4. Beet root | 12. Vegetable marrow |
| 5. Colocasia stem | 13. Bottle gourd |
| 6. Pumpkin flowers | 14. Cucumber |
| 7. Coco yam | 15. Kakrol |
| 8. Turnip root | 16. Ridge gourd |

Table 3
Garden Vegetables Easy to Grow
and Rich in Nutritional Value

- | | |
|--------------------------|---------------------|
| 1. Colocasia, black | 10. Soybean |
| 2. Carrot | 11. Jute |
| 3. Radish (for leaves) | 12. Mustard, garden |
| 4. Pigeon pea | 13. Field bean |
| 5. Sweet potato | 14. Sword bean |
| 6. Amaranth | 15. Bitter gourd |
| 7. Pumpkin, orange flesh | 16. Okra |
| 8. Indian spinach | 17. French bean |
| 9. Cowpea | 18. Pointed gourd |

Learning When To Sow

Many garden vegetables have traditional planting seasons. For example, in Bangladesh most vegetables are grown in the winter, although some vegetables can be grown at almost any time (Table 4). In order to keep a garden producing the year round, proper planting schedules need to be followed.

The Planting Calender on the next page was used in Sylhet, Bangladesh. It's offered only as an example of how the author planned his year round garden. To make a planting calendar you must first be familiar with your local climatic conditions. Appendix 1 provides helpful information on altitude preferences for many commonly grown vegetables in tropical and sub-tropical countries. Experience and experimentation will help you achieve a garden that stays productive throughout the year.

Table 4
Vegetables and Their Season

Summer	Winter		Round the Year
Ash gourd	Beet	Mustard	Red amaranth
Bitter gourd	Broccoli	Onion	Black colocasia
Jute	Carrot	Pea	Eggplant
Kakrol	Cauliflower	Pigeon Pea	Green amaranth
Pointed gourd	Cabbage	Radish	Indian spinach
Ridge gourd	Chinese cabbage	Spinach	Okra
Snake gourd	Field bean	Sword bean	Pepper (hot)
	French bean	Tomato	Cowpea
	Kohlrabi	Turnip	Sweet potato

Sample Planting Calendar (Sylhet, Bangladesh)

January

Amaranth, Spinach, Radish (for leaves), Chinese cabbage

February

Amaranth, Bitter gourd, Eggplant, Indian spinach, Okra, Sweet corn

March

Amaranth, Ash gourd, Bitter gourd, Cowpea, Eggplant, Kakrol, Jute (sweet), Sweet potato (for leaves), Indian spinach, Pepper (hot), Okra, Pointed gourd, Sweet corn (maize)

April

Amaranth, Ash gourd, Bitter gourd, Black colocasia, Cowpea, Cucumber, Okra, Indian spinach, Jute (sweet), Kakrol, Pepper (hot), Pointed gourd, Ridge gourd, Snake gourd, Sweet corn, Sweet potato (for leaves)

May

Amaranth, Ash gourd, Black colocasia, Cowpea, Cucumber, Indian spinach, Jute (sweet), Kakrol, Okra, Pepper, Pigeon pea, Pointed gourd, Ridge gourd, Snake gourd, Sweet corn, Sweet potato (for leaves)

June

Amaranth, Cowpea, Indian spinach, Kakrol, Pigeon pea, Pointed gourd, Sweet corn

July

Amaranth, Cowpea, Field bean, Kakrol, Pointed gourd, Radish, Sword bean

🌿 **August**

Amaranth, Broccoli, Cabbage, Cauliflower, Field bean, Kakrol, Okra, Radish, Pointed gourd, Sweet pumpkin, Sword bean

🌿 **September**

Amaranth, Broccoli, Cabbage, Carrot, Cauliflower, Eggplant, Field corn, Okra, French bean, Kohlrabi, Mustard, Radish, Spinach, Sweet corn, Sword bean, Sweet pumpkin, Tomato, Turnip

🌿 **October**

Amaranth, Beet, Broccoli, Cabbage, Carrot, Cauliflower, Chinese cabbage, Pea, Cucumber, Eggplant, French bean, Garlic, Kohlrabi, Mustard, Okra, Onion, Pepper (hot), Radish, Spinach, Turnip, Sweet corn, Sweet potato, Tomato, Sweet pumpkin

🌿 **November**

Amaranth, Beet, Broccoli, Cabbage, Carrot, Cauliflower, Chinese cabbage, Cucumber, French bean, Garlic, Kohlrabi, Mustard, Pea, Onion, Pepper (hot), Radish, Spinach, Sweet corn, Sweet potato, Sweet pumpkin, Tomato, Turnip

🌿 **December**

Amaranth, Beet, Carrot, Chinese cabbage, French bean, Mustard, Pepper (hot), Radish, Spinach, Tomato, Turnip



Step-by-Step Gardening Guide

Some basic gardening knowledge will be needed to successfully grow food at home.

Garden Location

The garden should be located where it will receive sun most of the day. Its size will depend on what is being grown and how much time is available to work on it. A small, well-cared for garden is more productive than a large, neglected one. Whenever possible, the garden should be located near the home where it will be more convenient to care for, and where vegetables can be picked just before cooking, when they are at the peak of freshness and flavor. As the garden will need watering from time to time, it should be near a source of water, such as a pond, canal, river, ringwell or tubewell (Illustration 1).

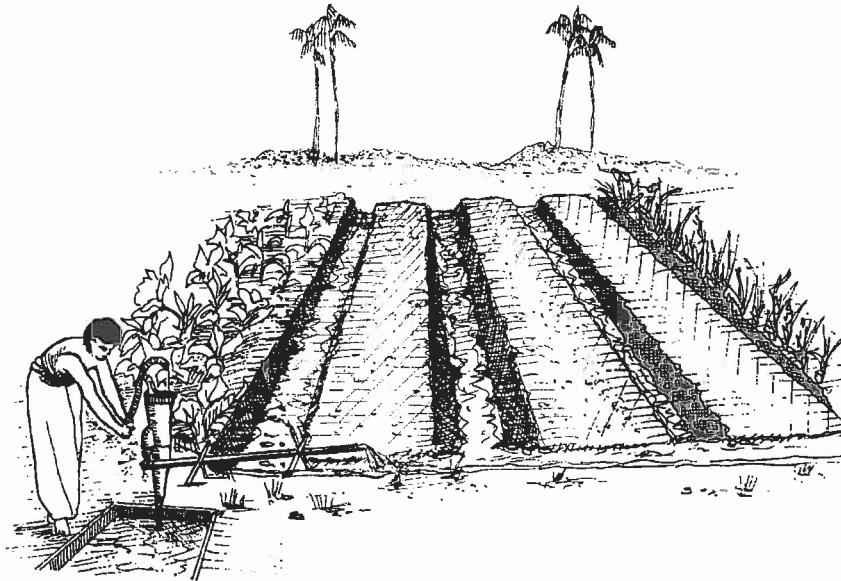


Illustration 1: “Automatic watering” using a tubewell and bamboo pipe.

Some people have been able to raise a few vegetables using only the dirty water from the kitchen. During the rainy season extra water will not be needed. At this time, the garden should be located on land that doesn't become flooded. Soil must breathe air, and land that is under water cannot do so. Plants growing on very wet land will grow slowly and turn yellow. As many homes are built on slightly raised land, enough space can probably be found around the bari for a family garden.

Fencing

Once a good location is found for the garden, the next step is to build a strong fence to keep out chickens, goats and cattle. It is useless to start a garden until this is done (Illustration 2).

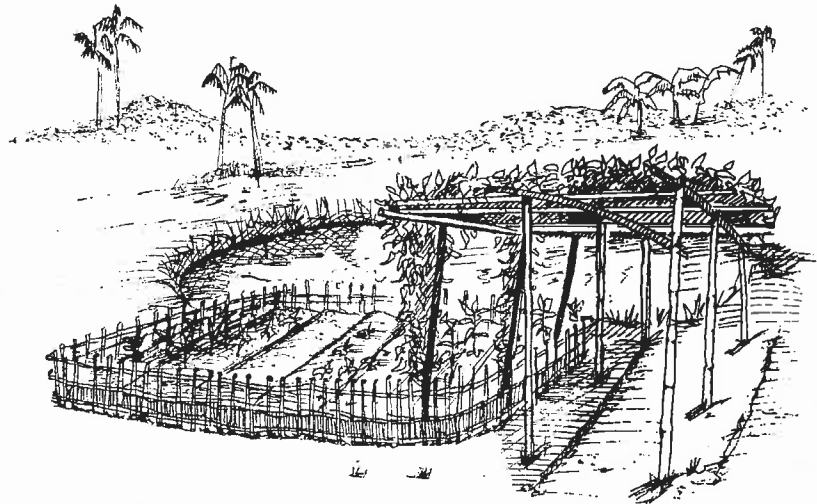


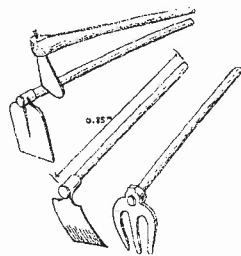
Illustration 2. A garden needs a strong fence.

Most people find that a fence made of local materials is cheap and satisfactory. Many gardeners make their fences with bamboo; others use different kinds of bushes or branches with sharp thorns or spines. Some gardeners make a permanent “living fence” by planting certain types of trees or bushes around the edge of the garden. Pigeon pea makes a good fence, and at the same time

produces food for the family. Some farmers use cassava for the same purpose. Usually, fairly large stems are planted closely together. After they are growing well, the tops are occasionally cut off so the stems grow stronger and thicker. The spaces between the stems are closed with sticks or stakes of bamboo. People who use these fences are able to harvest the cassava roots on each side of the fence for many years. Whatever type of fencing is used, it must protect the garden from all the animals around the home.

Preparing the Land

Almost any type of soil can be made to produce tasty vegetables. If the land around the house is already fertile, the task will be to keep it fertile; if it is very poor, it will probably need some manure and maybe some commercial fertilizer. But in most cases the land will produce enough vegetables without commercial fertilizer. Of course, the garden must be in good order and kept in good condition. When the soil is in good condition, it is loose in texture and easy to work. It must also contain plenty of plant food, the food the roots absorb to feed the entire plant. The best way of producing these two conditions in the soil is to use plenty of organic material, such as animal manure, sewage and sludge, sweepings, bazaar garbage, ground oil cake and fish meal, rotted water hyacinth and compost. Compost is a type of fertilizer made by mixing together leaves, grass, straw, wood ashes, cow dung and other waste materials. Appendix 3 briefly explains how compost can be made using materials easily found around the home.



The hoe is a convenient tool for preparing the garden plot (left, *Courtesy, Oxfam, IT publications, UK*). At least two weeks before planting, the soil should be spaded or plowed to a depth of five to eight inches (13 to 20 cm) or more. After the soil is broken this way, it should be spaded again several days later to make the pieces of earth smaller. If there is grass growing where the garden is to be placed, care must be taken to pull out

all the grass and grass roots before planting. Break the grass and earth into small pieces with the hoe so they can be lifted easily. Then shake all the earth off the grass roots. Any grass roots that fall must be picked up and removed or they will grow again. If there are plenty of pieces of **dead** grass and weeds in the garden, they should be dug into the soil. They will later rot and make the soil richer. Living weeds and grass should be removed and used to make compost.

Some vegetables will not grow well if the soil in the garden is too acidic or sour. Some vegetables, like beet, okra, spinach, onion and lettuce seem to grow better when lime or wood ashes are added to the garden soil. A general recommendation is to spread $\frac{1}{4}$ to $\frac{1}{2}$ pound (112 to 224 g) of lime or wood ashes on every square yard (0.84 m^2) of garden space, and then dig it into the first four to six inches (10 to 15 cm) of soil. It should be remembered that lime does not have to be applied often, usually once every year or two will be enough.

Raise The Soil Into Beds Or Mounds

It is possible to grow vegetables on flat land, but most gardeners find that plants grow better if grown on raised “beds” or “mounds.” Generally, vegetables are planted on beds that are two to three feet (61 to 91 cm) wide. The length can be as short as 10 feet (3.05 m) or as long as 100 feet (30.5 m). If the garden is to be hand-watered using a watering can or earthen pot, then all the beds can be the same size, perhaps three feet wide and ten feet or more in length. If there is a tubewell nearby, the garden can be irrigated by running water down the furrows (ditches) between the beds (Illustration 1). If “furrow irrigation” is to be practiced, the suggested bed sizes given in Table 8 can be followed.

Here is how to make the beds. Start by staking out the four corners of the new bed (Illustration 3). Loosen the soil (Illustration 4) and add some well-rotted manure at the rate of 4 to 6 pounds (1.8 to 2.7 kg) to every three square feet of bed space (0.28 m^2). This is a

good time to add any other organic material available, such as compost, well-rotted water hyacinth, leaves, rice hulls and ashes (Illustration 5). Now, dig the manure and other materials well into the soil (Illustration 6). Next, place the soil from the outside edges of the string into the center of the bed; this will form ditches all along the outside of the bed (Illustration 7). At this point more well-rotted manure or compost can be added to the top of the bed and dug into the top 3 to 4 inches (8 to 10 cm).

Commercial fertilizers may be used if there is a lack of animal manure or compost. If this is the case, $\frac{1}{4}$ pound (112 kg) each of Urea, TSP and MP can be used for every 3 feet by 10 feet bed (91 cm by 3.05 m). The fertilizer should be spread evenly over the top of the bed and dug into the top 4 inches (10 cm) of soil.

Finally, make the top flat by pushing the earth back and forth with the hoe until the bed stands 6 to 8 inches (15 to 20 cm) above the level of the ground (Illustration 8). When the work is finished the beds should be smooth on top with no large pieces of earth to be seen. During the monsoon many gardeners raise the earth in their beds even higher, and sometimes support the sides of the beds with pieces of split bamboo and stakes. This keeps the excess water drained from the beds and allows the plants roots to grow strong and healthy.

Heavy soils often have a compacted sub-soil, and if this is broken up, drainage will be greatly improved. "One technique for loosening the soil to the required depth is "double digging," which is most easily done with a Western-style spade and fork. If the soil has not been touched before it will be a tough job. It is not necessary to break the soil into too small of pieces. Ideally the pieces should be around one inch (2.5 cm) in size. The first step (Illustration 9) is to dig a trench at the end of the bed using a spade as deep as the length of its blade. A fork is then used to loosen the soil in the bottom of this trench to the depth of its prongs, but this bottom layer of soil is not lifted out or turned over. Then the spade is used



Illustration 3. Stake-off the size of the bed.



Illustration 4. Loosen the soil.



Illustration 5. Add well-rotted manure and other organic materials.

Illustration 6. Mix the manure into the soil.



Illustration 7. Make furrows along the edges of the bed.

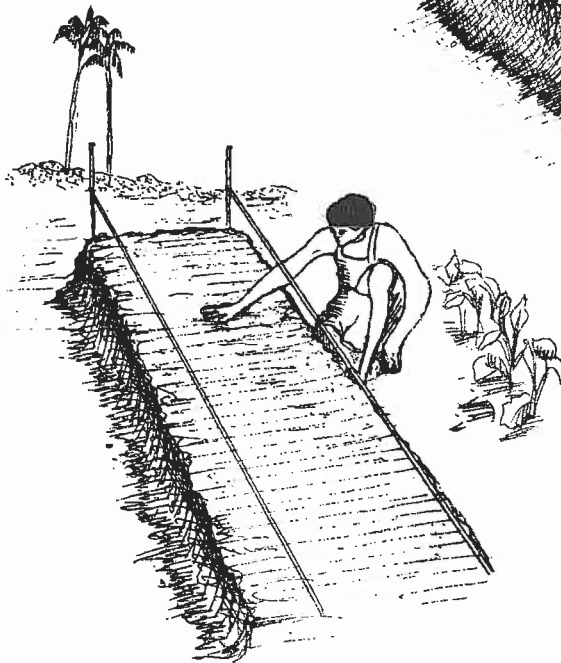


Illustration 8. Smooth and flatten the top of the bed.

to dig a second trench or furrow next to the first, filling in the original trench with the soil removed from the second one. The fork is again used to loosen the soil in the bottom of the trench; then a

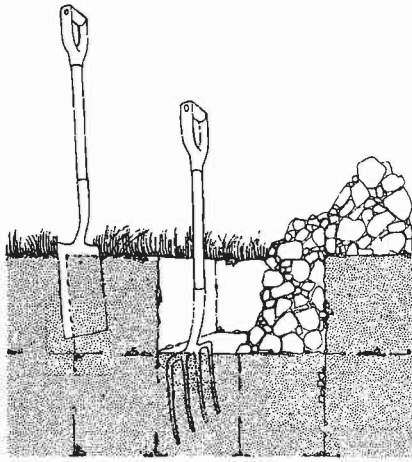


Illustration 9. Double digging.
(Courtesy, Oxfam and Intermediate Technology Publications, UK).

third trench is opened up and the process is repeated. Where compost or manure is available to be dug in, this can be spread along the bottom of each trench before it is filled in with soil from the next one. Remember: when digging deeply, do **not** turn over the soil; the lower layers of tropical soils are often very infertile. The object of the deep digging is to loosen the soil in the zone penetrated by the roots of crops and improve aeration and drainage.

This technique is applicable only on the heavier types of soil;

sandy soils will generally be sufficiently loose and well-drained to begin with, and do not need deep digging at all (Arnold Pacey, *Gardening for Better Nutrition*, Oxfam, Intermediate Technology Publications, UK)."



Illustration 10. Mound.

Some vegetables can be grown on mounds around the edges of the garden or in other places around the house (Illustration 10). Table 5 lists many vegetables commonly grown on mounds. With the exception of black colocasia, pigeon pea and eggplant, these plants are all "climbers" and will need some sticks, bamboo branches, a trellis, or even a house on which to

grow. To make a mound, start by digging a pit 1 ½ feet (45 cm) deep and 1 ½ feet wide. Next, fill the pit with some rotted manure,

compost, or any organic material available. Add soil and mix well. Mound the soil up until a small hill is made. Flatten the top and press down the earth in the middle to make a lip or ridge all around the top edge of the mound.

Table 5
Vegetables Commonly Planted on Mounds

Ash gourd	Cucumber*	Pointed gourd
Bitter gourd	Eggplant*	Pigeon pea*
Black colocasia	Field bean	Snake gourd
Bottle gourd	Indian Spinach*	Sword bean
Cowpea*	Kakrol	Sweet pumpkin

*Denotes vegetables that can be grown on mounds or beds.

Time to Plant

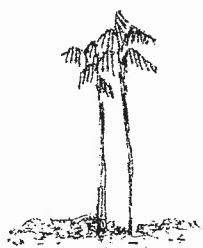
Some vegetables are easy to grow and can be planted directly in the beds. Other vegetables are delicate and should be started in a seed box or seed bed and later moved (transplanted) to permanent beds. Table 6 shows which vegetables are easy to plant and which ones need special care.

Ⓞ **Germination Test** Sometimes gardeners sow too many seeds because they are not sure if all the seeds will sprout. However, a simple “germination test” can determine the quality of the seeds and indicate what percentage of the seeds will grow. Count out ten seeds and put them on a soaked piece of paper or cloth (Illustration 10). Roll up the paper or cloth and put one end into a cup filled with one inch (2.5 cm) of water (Illustration 11). When the seeds have had time to sprout in four to ten days, carefully unwrap the paper and count the number of seeds that have sprouted. If eight out of the ten seeds have small sprouts growing out of them, this indicates that 80% of the seeds are good (Illustration 12).

Table 6

Vegetables that should be transplanted:	Seed to plant directly in the garden:	
Broccoli	Black colocasia (roots)	Pigeon pea
Cabbage	Sweet potato (cuttings)	Okra
Cauliflower	Pointed gourd	Onion
Chinese cabbage	Sweet pumpkin	Beet
Eggplant	Potato (tuber)	Carrot
Indian spinach	Radish	Coriander
Lettuce	Cowpea	Amaranth
Mustard	Cucumber	Soybean
Pepper	Field bean	Sweet corn
Spinach	French bean	Kohlrabi
Tomato	Turnip	Peas
	Jute	Bitter gourd
	Peanut	Sword bean

Table 7
Seed That Can Be Broadcast



Swiss Chard
Peas
Sweet Jute
Coriander
Amaranth

Lettuce
Radish
Carrot
Beet
Turnip

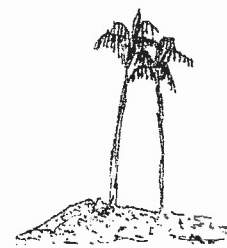


Illustration 10. Place ten seeds on a soaked piece of paper or cloth.

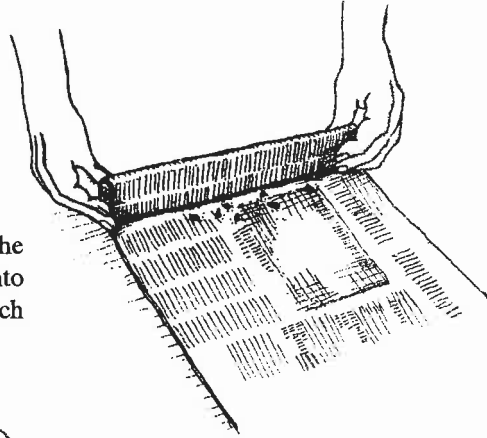


Illustration 11. Roll up the paper and put one end into a cup filled with one inch (2.5 cm) of water.

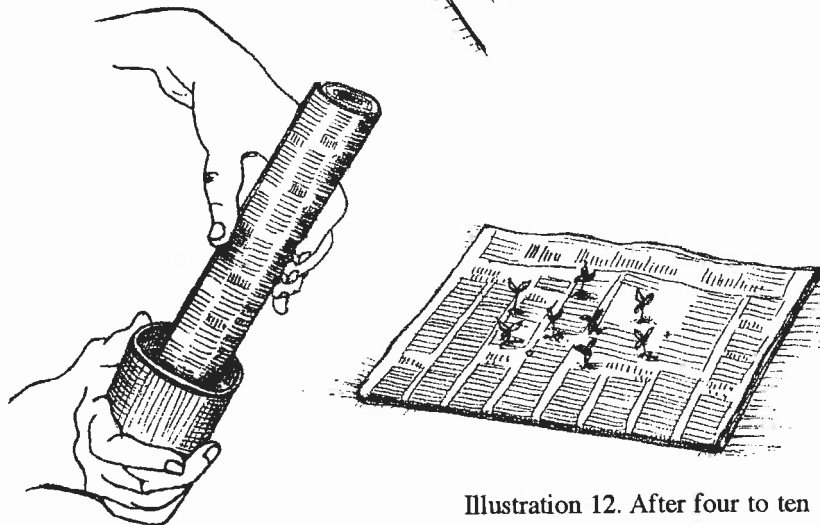


Illustration 12. After four to ten days, unwrap the paper and count the seeds that have sprouted.

① **Direct Sowing** Seeds can be planted directly in the garden by the “drill” method or the “broadcast” method. A “drill” is a very small furrow (narrow groove) made on the top of the bed for planting seeds in a row. It can be made with a pointed piece of bamboo or the corner of a hoe. The drill should only be slightly deeper than the size of the seed. Some gardeners use two stakes and a piece of string stretched between them to keep their rows straight. Once the drills are made, the seeds can be planted and covered with soil.

Remember: a plant will probably grow wherever a seed is placed. If the seeds are too close together, the plants will not have enough room to grow large and healthy. Table 8 shows how much space is needed between each plant in the row, and how many rows of plants can be planted on each bed. If two rows are needed, plant one row near each side of the bed, but no closer than 4 to 5 inches (10 to 13 cm) from each edge. Always start by planting the two sides of the beds; if a third or fourth row is needed, they should be evenly spaced between the two outside rows.

Finger measurements help to make sense of metric units and are convenient to use in the garden (Illustration 13. *Courtesy, Arnold Pacey, Gardening for Better Nutrition, Oxfam, IT Publications*).

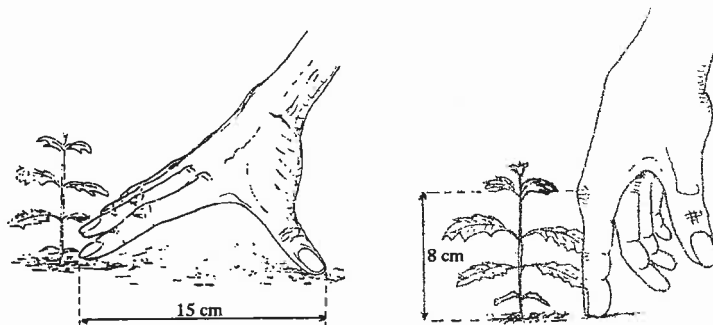


Illustration 13. Measurements shown are based on an “average” woman’s hand. Left: Approximate spacing of chard should be slightly more than the distance shown. Right: Approximate size of tomato plant when ready for transplanting.

🕒 **Thinning** If the plants grow too closely together in a row, it will be necessary to remove some of them so that each plant has enough growing room. Spacing plants properly by removing others is called “thinning.” It might not seem right to pull up little plants that are growing well, but sometimes it needs to be done. With large seeds, like peas, beans and corn, it is fairly easy to control how closely together they are planted. Small seeds, like amaranth

Table 8
Suggested Bed Sizes for Furrow Irrigation

Vegetables planted on 24" (60 cm) wide beds:	Rows of plants per bed:	Distance between plants:
Beans, french	two	8" (20 cm)
Beet	three	4" (10 cm)
Carrot	three	3" (8 cm)
Chinese cabbage	two	12" (30 cm)
Garlic	four	3" (8 cm)
Kohlrabi	two	6" (15 cm)
Mustard, leaf	two	6" (15 cm)
Onion	three-four	4" (10 cm)
Peas, bush	two	8"-10" (20-25 cm)
Radish	three	3" (8 cm)
Soybean	two	4"-6" (10-15 cm)
Spinach	three	6" (15 cm)
Sweet corn	two	8"-10" (20-25 cm)
Turnip	three	4" (10 cm)

Vegetables planted on 30" (75 cm) wide beds:	Rows of plants per bed:	Distance between plants:
Broccoli	two	18" (45 cm)
Cabbage, drumhead	two	18" (45 cm)
Cauliflower	two	18" (45 cm)
Eggplant	two	18" (45 cm)
Okra	two	12" (30 cm)
Pepper	two	12" (30 cm)
Tomato	two	18" (45 cm)

and carrot, are harder to space because they roll off the hand as fast as they are planted.

① **Broadcasting** Some seeds can be broadcast (scattered) over the top of the bed, as listed in Table 7. To do this, first make the top of the bed smooth. Then broadcast the seed and firm them into the soil with the back of a hoe. If the seeds are still visible after pressing them in, remove some dirt from the furrows (ditches) between the beds to cover them. As the plants grow, the beds can be thinned several times to provide lots of tender vegetables. This is an excellent method for green leafy vegetables. At the last thinning, be sure to leave enough space between each plant for its proper growth.

① **Seed box** Vegetables to be transplanted are first grown in “seed boxes” or a specially prepared “seed bed.” Later, they are moved as small plants to the garden beds where they will continue to grow until harvest. A seed box is a flat box made of wood or bamboo (Illustration 14). It can be any length or width, but easy to move around. The bottom of the box should have small cracks or holes between the boards to allow excess water to drain away. The soil in the seed box can be a mixture of one-part well-rotted cow dung (manure) and two-parts sand. Some gardeners use a soil mixture of one part soil, one-part rotted manure or compost, and one-part sand.

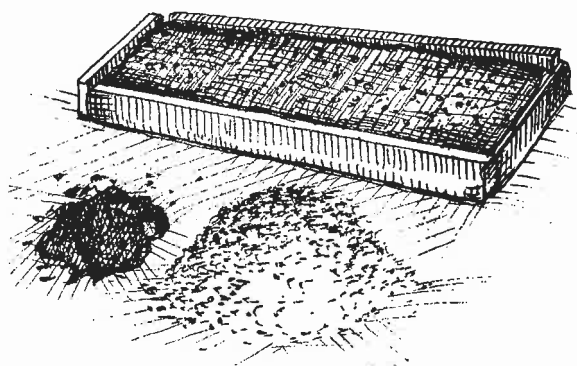


Illustration 14. A seed box prepared with a mixture of one-part well-rotted manure (cow dung) and two-parts sand.

On the bottom of the seed box, place some straw or dry grass to cover the cracks and holes, but not enough to stop drainage. On top

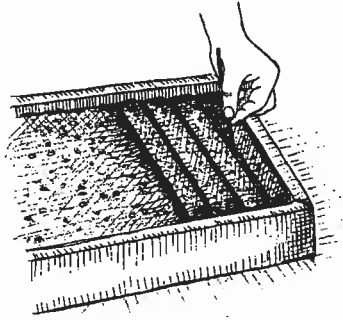


Illustration 15. Using a stick to make neat rows.

of the straw or grass, pour a mixture of seed box soil up to a $\frac{1}{2}$ inch (13 mm) from the top of the box, and press it down with a board or by hand. Before sowing the seeds in the seed box, the soil should be moistened, either by sprinkling, or by letting the seed box stand half its depth in a pool of water until the soil absorbs enough moisture.

Just before the seeds are sown, rows can be made with a thin board or

pointed stick (Illustration 15). Each row should be twice as deep as the size of the seed, and $1\frac{1}{2}$ inches (4 cm) apart. Then the seed can be covered with loose soil and pressed down gently. If many different kinds of seeds are being planted in one seed box, be sure to mark each row or section of the box in such a way that the seedlings can be identified when they sprout. The seed box should be kept in a shady place until the seeds have sprouted. In the dry season, the box can be covered with some banana leaves to keep the soil from drying out too quickly. To keep ants away from the seeds, attach legs to the seed box and set them in cans or pots of water. If only a few seeds are to be planted, use a flower pot or shallow earthen dish and prepare it the same way as a seed box.

④ **Seed bed** Seedlings can also be grown in one corner of a garden bed. It should be located on high land to allow for good drainage of water, and raised 6 to 8 inches (15 to 20 centimeters) above ground level. The soil should be loose for good root growth. If the soil is heavy and sticky, add sand, cowdung and rice hulls to improve it. Some gardeners add 2 ounces (56 grams) TSP for every 15 square feet of bed space (3 feet by 5 feet or 1.4 m^2). Sometimes ants try to remove the seeds. To prevent this the seeds can be dipped in kerosene and then rolled in ashes. When the seeds are planted, a little more ash can be spread over the rows before covering

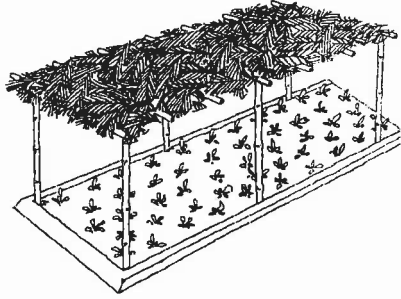


Illustration 16. A seed bed protected against sun and rain.

them with soil. Sometimes it may be necessary to cover the seed bed with mats or palm fronds placed over a bamboo or stick frame (Illustration 16. *Courtesy, Arnold Pacey, Oxfam, Intermediate Technology Publications*). The covering will protect the seedlings from the hot sun and heavy rains.

After the seeds have sprouted and are growing, the seed bed can be left uncovered, except during the hottest part of the day (10:00 A.M. to 3:00 P.M., Bangladesh), or when it starts to rain. This type of seed bed is often used for large community gardens.

① **Care of Seedlings** Water seedlings early in the morning. When seedlings are watered in the evening, the soil remains damp and cold throughout the night. This may cause the tender plants to become sick or even rot. After two weeks the seedlings can be exposed to full sunlight. This will cause the plants to grow more slowly, but they will grow stronger and be better prepared for life in the garden. This practice is called, “hardening off” the seedlings.

① **Transplanting** At about three weeks of age the seedlings are ready for transplanting. Water the seed box or seed bed before the seedlings are pulled out. The soil should be soft so the tender roots are not broken. A small stick or hoe can be used to carefully lift the seedlings while keeping as much soil around the roots as possible. Be sure to lift the seedlings by the leaves, not the stem. If the stem is injured or crushed, the seedling will probably die. Using a stick, dig a shallow hole in the garden bed and carefully place the seedling in the hole at the same depth it was in the seed box. Tomatoes can be planted slightly deeper, so some of their stem is below the surface of the soil. Now the hole can be covered and lightly pressed down by hand. Try to transplant on a cloudy day, or late in the

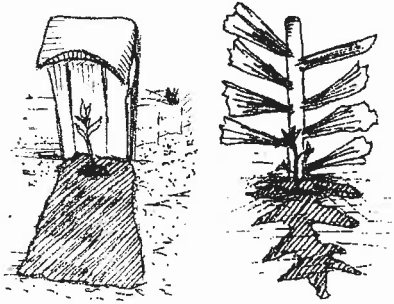


Illustration 17. Simple shading for newly transplanted seedlings.

afternoon when the sun is not very hot. Try not to leave the seedlings in the seed box or seed bed too long. Plants that are long and thin will not grow properly when transplanted to the garden. Some gardeners remove the lower leaves of the seedlings at the time of transplanting. In this way, less water is lost through the leaves, and the plants recover

more quickly. If a seedling falls over, prop it up and pack the soil around the base of the plant. Some gardeners shade their transplanted seedlings for a few days with pieces of banana stem or palm fronds (Illustration 17). This is a very good practice and will help the seedlings recover more quickly from the shock of transplanting. Experienced gardeners do everything they can to ensure their young plants get off to a good start in the garden.

⊕ **Mounds** Growing vegetables on mounds is very easy. The common practice among gardeners is to plant three or four seeds in a small circle evenly spaced. After the plants are up all but the strongest plant is removed.

A Garden Needs Water

After the seeds or seedlings are planted, they must be watered. Water will press the soil gently around the seeds or the roots of the seedlings. There are two basic ways to water a garden. One is with a can or earthen pot that is used to sprinkle or pour water on and around the plants. The other is by putting water into the furrows (ditches) between the beds. If there is a source of water nearby, "furrow irrigation" is possible. Water thrown on top of the beds causes the loose soil to cake and become hard. Some vegetables, like cabbage, tomatoes and cauliflower, are damaged when water is sprinkled on their leaves. In addition, when the top of a bed is wet, it may seem like enough water has been applied; but

later it may be discovered there was not enough water to reach down to the roots. Not only does furrow irrigation ensure water will reach the roots, it also allows water to penetrate to the level of the sub-soil, which in turn protects the upper soil from drying out.

If there is a tubewell near the garden, a “header ditch” can be dug to connect the furrows with the well. A simple way to bring water from the well to the header ditch is to use a bamboo or plastic pipe (Illustration 1).

Every good gardener frequently investigates the condition of the soil under the surface. By digging down to the depth of the plant's roots with a stick or hoe, it is possible to see whether the soil is too wet or dry. Too much water is often as harmful as not enough water. A steady moisture supply should be maintained during the growing season. When the plants are young seedlings, the top two inches (5 cm) should be kept moist. Later, the top two inches can be dry, but the lower ten inches (25 cm) should be kept moist.

In average soils (not too sandy), a one hundred foot (30.5 m) furrow can be filled in ten minutes by continuously pumping with a normal tubewell hand pump. If watering is done properly, it will not have to be repeated for ten days to two week, but this depends on individual garden conditions. Many gardeners prefer to water their gardens in the late afternoon when the sun is low.

Caring for the plants

Gardeners have learned many ways to help their plants grow strong and healthy. Following are a few practices which will improve your garden.

☉ **Weeding** After planting a vegetable crop, careful watch must be kept for weeds. Remove weeds by hand when the plants are small; later this can be done with a hoe. Some gardeners advise against loosening the soil with a hoe, especially during the dry

season. They say this causes the top-soil to dry out more quickly, and sometimes damages the plants roots.

☉ **Mulching** For the gardener who wants to make work easier, weeding can be reduced by “mulching.” Mulching is the old practice of putting loose organic material, such as straw, dry grass, leaves, rotted water hyacinth or rice hulls over the surface of the beds, around the plants and between the rows. Three to four inches (8 to 10 cm) of mulch will keep down the growth of weeds and grass. During the monsoon the mulch will protect the soil from washing away. In the dry season, the mulch will prevent the sun from drying the soil, thus saving irrigation water. Even on the hottest days, if the mulch is lifted, the soil underneath will be moist and cool. Within two or three months the mulch will rot and can be mixed into the beds to make the garden more fertile.

☉ **Staking** Tomato plants are usually tied to bamboo or wooden stakes with soft twine or cloth to prevent the branches and fruit from touching the soil. If tomato plants are allowed to lie on the soil, much of the fruit may rot, or be damaged by insects and snails. Tomato plants can be tied to stakes on the same day as transplanting. Be careful not to cut the buried stem or roots as the stake is pushed into the soil. A strip of cloth is best for tying the stem to the stake. Tie it tightly around the stake, but loosely and gently around the stem. Some gardeners let their tomatoes grow freely over a mulch covering the top of the bed. This keeps the fruit and branches from touching the soil without the use of stakes.



Illustration 17. Sucker.

☉ **Stopping Growth** Another practice with tomatoes is to “prune” (pick off) the “suckers.” Suckers are small stems and leaves that grow from the base of larger stems (Illustration 17). Removing the suckers reduces the amount of leaf growth, and encourages more fruit to be produced. Other vegetables like pumpkin, bottle gourd, ash gourd and cucum-

ber, can be pruned in a similar way. When too much manure is used in the garden, vegetables will grow lots of leaves but very few fruits. To correct this, pick off the fuzzy, green growing tips from the vines. This will stop the plant from taking up too much garden space and force it to produce more fruit.

☉ **Climbing Plants** Cucumber, Indian spinach, cowpea, and bitter gourd will need some kind of climbing support. Most gardeners use poles or bamboo branches. Indian spinach and cucumbers are often tied to their supports with strips of cloth.

A trellis can be built for pumpkin, field bean, sword bean, pointed gourd and bitter gourd. Many of these vegetables will grow nicely over a fence or the roof of a house. A trellis can be made anywhere, but a good location is near the outside edges of the garden. In this way, space inside the garden will be saved for planting other vegetables (Illustration 2).

☉ **Manure Tea** If leafy vegetables grow slowly and have light green or yellow leaves, they probably need fertilizer. “Manure tea” is a good liquid fertilizer made from fresh animal manure (i.e. cow, horse, goat or rabbit). It is easily made by putting two or three handfuls of fresh manure into a bucket, drum, or earthen pot and filling it with water. Stir the mixture occasionally and let it sit for one week. Before using the liquid, dilute it with more water until it is the color of weak tea. After watering the garden, the tea can be poured around the base of each plant. Table 9 lists many leafy vegetables that benefit from feedings of manure tea.

Watching For Insects And Disease

“Most of the insects that plague garden plants can be controlled without the use of commercial insecticides. While most gardeners are aware that toads, spiders, and some birds eat insects, it is not as widely known that an insect’s major natural enemies are other insects. These natural enemies might be called “hunting insects” because they spend most of their time looking for pests

Table 9
Give Manure Tea To Leafy Vegetables

Black colocasia	Mustard, garden
Cabbage	Jute
Chinese cabbage	Radish (for leaves)
Amaranth	Spinach
Indian spinach	Lettuce, dark leafy

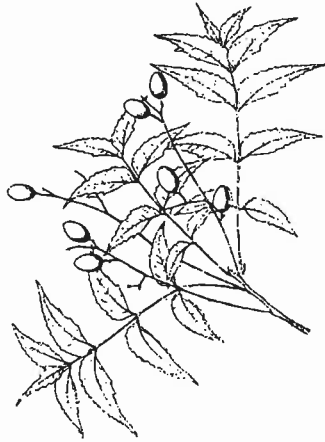
to eat. Some of the hunting insects eat a lot of their prey at one time; others, like the mini-wasps, lay eggs on an insect's body which causes it to die. When a commercial pesticide is used to control a pest, the problem is often made worse by killing the pest's natural enemies—the hunting insects. A plant that is treated with a pesticide may have the same pest back a few weeks later, only this time, in higher numbers than before. Not surprisingly, the pest's natural enemies were accidentally killed off along with the pest. It is rarely possible to kill all of the pests. Without the hunting insects to hold them in check, those that didn't die, or those that flew in from a neighboring yard, were able to breed without restriction. As good gardeners, it is important not to upset the natural balance that exists between pests and “hunters.”

Many pests can be removed by hand. Caterpillars and bugs can be picked off, while aphids and other soft insects can be crushed by sliding your hands along the stems, or dusting them with wood ashes (*Adapted from an article by Helga and Bill Olkowski, Pest Control Experts, California, USA.*)”

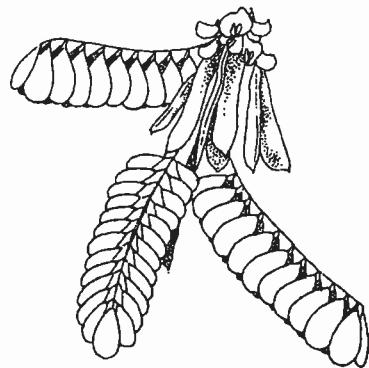
“The U.S. Department of Agriculture recommends the use of a cooking oil spray to control aphids, white flies and spider mites. “Mix one tablespoon (15 mL) of dishwashing detergent to one cup (237 mL) of oil (except palm or coconut oil which will gel within 24 hours), then mix between 1– 2½ teaspoons (5–10.5 mL) of the oil-plus-detergent with one cup (237 mL) water. The detergent causes the oil to emulsify in the water so that it can be sprayed.

Spray directly on plants every 10 days. Eggplants, carrots, lettuce, celery, watermelons, peppers and cucumbers have been successfully protected by the spray, but it burns the leaves of squash, cauliflower and red cabbage. Researchers claim that the oil spray is only about one-third as costly as commercial pesticides with the same effectiveness.

In some countries certain plants are made into pesticides. Two examples are the neem tree (*Azadirachta indica*) and the fish bean (*Tephrosia vogelii*).



The neem tree (left, *Courtesy, ECHO*) originated in India or Burma, but is widely grown in much of Africa. Large quantities of neem are not needed for insecticidal use. For example, 25g (.9 oz) of ground kernels or 50g (1.8 oz) of ground seeds extracted with 1 liter (1.1 qt) of water by standing overnight then filtered through tissue can be used as a spray. It is most effective against beetles and their larvae, caterpillars, grasshoppers and locusts. It should be noted that the neem spray does **not** usually kill insect pests; its main effect is as a pest repellent.



The fish bean (left, *Courtesy ECHO*) gets its name because for hundreds of years it has been used as a very effective fish poison. To use as an insecticide an extract is first made by pounding fresh leaves and branches in a mortar. The mixture is allowed to soak overnight or is boiled for 30 minutes. A bit of soap is added to help the spray stick to the leaves. The mixture can be used

with garden vegetables to control termites, aphids, beetles, ants, cutworms, weevils, stalk borers, flies and various bugs (*Courtesy, ECHO, North Fort Myers, Florida, USA*).”

Healthy plants can usually outgrow insect damage, and they are more resistant to disease. If rich soil and strong seeds have been used, and proper care is taken, then plants will not often get sick. Sometimes, however, a plant gets very sick. It should be carefully watched and removed from the garden if it looks like the disease is spreading to other plants.

Should a really serious disease attack a crop, ask someone in the local agriculture office for advice. They will usually know what to do, what kind of medicine is needed, and where you can get it.

Time To Harvest

Sometimes vegetables we buy at the market are stale and tasteless. This is because many farmers harvest their crop before it is ripe, and then leave their vegetables sitting around too long before selling them. With a home garden vegetables can be harvested when they are ripe and tasty. Knowing when vegetables are just right for picking is something learned with experience. Vegetables should be picked just before cooking. Remember: taste and food value begin to diminish as soon as the vegetables are harvested.

The secret to getting more food from a garden is to pick everything as soon as it is ready to eat (Table 10). The more that is harvested, the more the garden will produce. Good examples are mustard and spinach. If the outer, bigger leaves are cut continuously as the plants grow, as many as five harvests may be obtained in one season.

In many countries sweet potato leaves are one of the few vegetables that can be harvested every month of the year. The tender vine tips taste good, and they are rich in vitamins and minerals. If


vines are planted near the end of "winter" (dry season), there will be tips and tender stems to harvest throughout the wet season.

Table 10
Harvest These Vegetables Often

Bitter gourd leaves	Okra, tender fruits
Beet leaves	Mustard leaves
Black colocasia leaves	Jute leaves
Cabbage, outer leaves	Pointed gourd leaves
Cauliflower, outer leaves	Radish leaves
Chinese cabbage, outer leaves	Spinach leaves
Cowpea, tips and tender pods	Sweet potato tips (15 cm)
Field bean, tender pods	Sweet pumpkin tips
French bean, tender pods	Sword bean, tender pods
Green amaranth leaves	Red amaranth leaves
Indian spinach leaves	Turnip leaves

Plant Again

In order to provide an abundance of food, a garden should never be left fallow. As soon as one vegetable is harvested, another should be planted. "Succession planting" is the planting of a few vegetables every two or three weeks during the growing season. This way the harvest does not come all at once, but rather over a long period of time. Different planting times should be tried to determine which vegetables grow best and how to extend their planting seasons. The old custom of planting everything at the same time should be avoided. A good example is okra. If it is all planted on the same date, it will all ripen at the same time. After two weeks of feasting we can no longer find tender okra in the garden. With "succession planting," one row of okra is planted one week, another row three weeks later, and so on until four or more rows have been planted. This will provide a good supply of okra for many months.

 **Good Companions** There are many vegetables that grow well when planted side-by-side in the same row or bed. Some vegetables grow faster than others. If grown together, one vegetable can be harvested and out of the way while the other continues to grow. Table 11 lists some combinations that might be tried in the garden. If both vegetables are not planted at the same time, the vegetable listed first should be planted first.




 **Saving Seed** It's often desirable to save seed from the vegetables you've grown. Seeds can be gathered easily from the vegetables listed in Table 12. They should be stored in air-tight containers. Bottles make good seed containers but they need to be dried thoroughly in the sun before filling. Seal the bottles tightly and store them in a dry place.

Table 11
These Vegetables Make Good Companions


Cabbage and Radishes	Radishes and Amaranth
Cabbage and Amaranth	Jute and Amaranth
Cabbage and Lettuce	Onions and Radishes
Carrots and Radishes	Peas and Carrots
Cowpea and Amaranth	Corn and Spinach
Cowpea and Indian spinach	Tomatoes and Amaranth
Corn and Mustard	Tomatoes and Radishes


 **Gourds, cucumbers and pumpkins** Take seeds from a nicely shaped, medium-sized fruit that was picked from a healthy vine. When it is fully ripe, mash the flesh with water and let the mixture stand for several days. Later, the pulp and water is poured off and the seeds dried on a flat surface.


 **Tomatoes** Pick very ripe, well-formed fruit from healthy, strong plants. Mash the tomatoes thoroughly in a small pot or can.


Fill the pot with water and let the mixture stand for a couple of days. The pulp will float to the top and can be poured off with the water, leaving the seeds on the bottom. Wash them in fresh water and spread to dry on a flat surface.

Table 12
Save Seed From These Vegetables

Bitter gourd		Pointed gourd
Chinese cabbage		Peas
Cowpea		Pigeon pea
Cucumber		Okra
Eggplant		Mustard
Beans		Ridge gourd
Tomato		Spinach
Amaranth		Snake gourd
Indian spinach		Sweet corn
Jute		Sweet pumpkin
Kakrol		Sword bean

 **Beans** Simply select the best plants and leave them in the garden until seeds are produced on the top branches of the plant. Before the pods become too dry, harvest the tops and dry them on a tray or piece of paper. To remove the seeds, rub the dry pods between two fingers.

 **Amaranth** Select the healthiest plants and leave them in the garden until seeds are produced on the top branches of the plant. Before the “seed heads” become too dry, harvest the tops and dry them on a tray or piece of paper. To remove the seeds, rub the dry seed heads between your fingers.

 **Corn (maize)** Select the earliest and best ears and let them ripen on the stalk. Later, strip back the husk and hang the full cobs in a dry place. When the kernels have thoroughly dried, shell them out and store them in a dry container.

Popular Vegetables Grown in the Tropics and Subtropics

Many gardeners take simple notes to keep track of their success in the garden. There are certain conditions under which each vegetable grows best, and a certain amount of *experimentation* will be necessary to accommodate local soil and climatic conditions. Focusing on what works well will save you time, labor and money.

Note: planting times will vary from country to country and even district to district. Check with your local agricultural offices for guidelines on preparing a planting calendar.



Amaranth

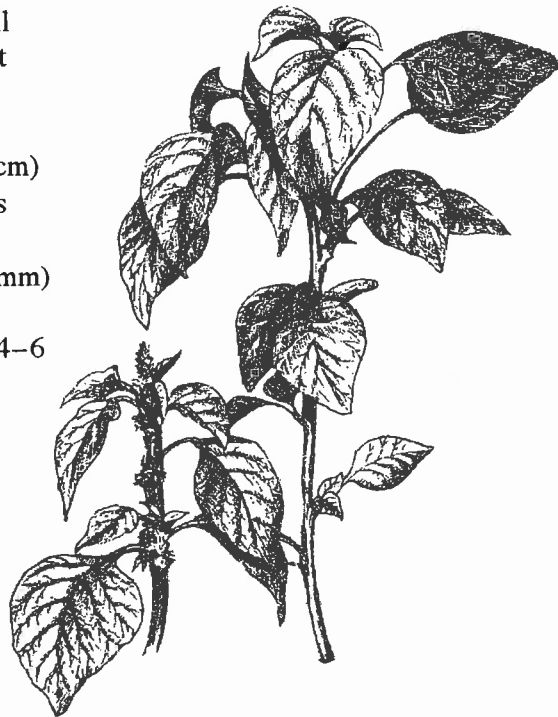
Planting Time: Any month*

Soil Condition: Any soil containing some compost or cow dung.

Spacing: 3"– 5" (8–13 cm)
between plants

Depth to Plant: ¼" (6 mm)

Days to Germination: 4–6



Planting Instructions: Broadcast the seed over well-prepared beds. Cover lightly with soil, then water the bed.

Care: Keep the soil moist until the seeds have germinated. Begin thinning when the plants are 2 to 3 inches (5 to 8 cm) tall. Keep the beds weeded. Give manure tea to promote leaf growth.

Harvesting: Pick the leaves often to prolong the harvest period. The leaves are an excellent source of vitamins and minerals.

Seed Collection: Easy.

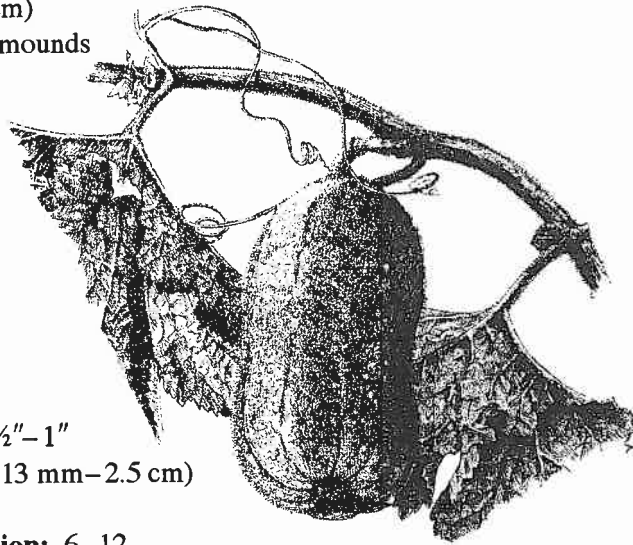
*** All planting times based on Bangladesh.**

Ash Gourd

Planting Time: March, April, May

Soil Condition: Any soil containing generous amounts of organic material (cow dung, compost, etc.).

Spacing: 2–3 seedlings per mound
12" (30 cm)
between mounds



Depth to Plant: $\frac{1}{2}$ "–1"
(13 mm–2.5 cm)

Days to Germination: 6–12

Planting Instructions: Plant 5 to 6 seeds on a mound. When the seedlings are up, remove all but the best two or three plants.

Care: This vegetable is an active climber, so it is best to let it grow over a tree or the roof of a house. Otherwise, it should be tied to some branches or grown on a trellis.

Harvesting: The first gourds will be ready for eating after about 3 months. The green leaves and stem tips make a tasty vegetable, rich in vitamins and minerals.

Seed Collection: Easy.

Beet

Planting Time: October to December

Soil Condition: Loose, sandy soil containing some organic material (rotted manure, compost, etc.).

Spacing: 8"–12" (20–31 cm)
between rows
4"–5" (10–13 cm)
between plants



Depth to Plant: ½" (13 mm)

Days to Germination: 5–7

Planting Instructions: The seed can be planted in rows or broadcasted over the top of the bed.

Care: If the seed is broadcasted, the seedlings should be thinned out until the plants are 4 to 5 inches (10–13 cm) apart. Keep the bed moist.

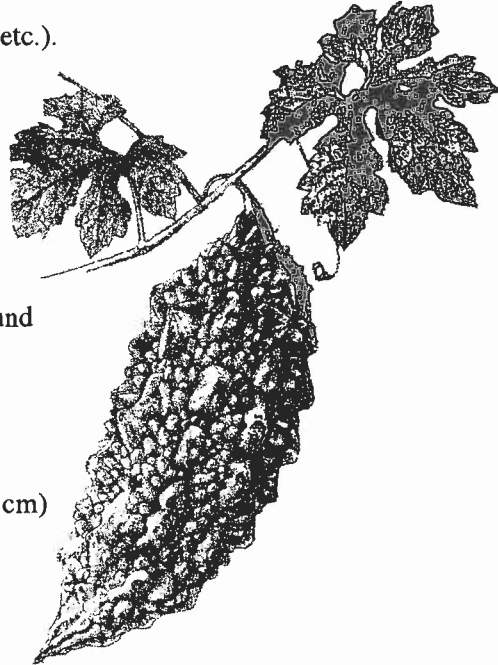
Harvesting: Beet leaves are rich in vitamins and minerals and quite tasty. The root is ready to eat 2 to 3 months after planting.

Seed Collection: Easy

Bitter Gourd

Planting Time: February, March, April

Soil Condition: Any soil containing a generous amount of organic material (cow dung, compost, etc.).



Spacing: 2 seedlings per mound
3' (90 cm)
between mounds

Depth to Plant: $\frac{1}{4}$ "–1"
(6 mm – 2.5 cm)

Days to Germination: 8–12

Planting Instructions: Plant 3 to 4 seeds on a mound. Later remove all but the two strongest plants.

Care: A bamboo trellis can be built for the vines to climb. This is a good vegetable to plant near the edge of the garden, where the vines can grow over the fence.

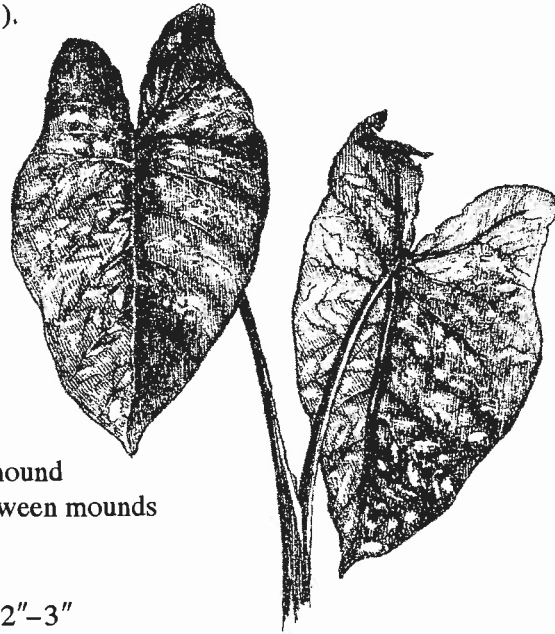
Harvesting: The gourds are ready for harvesting 3 months after planting. The green leaves and stem tips make a tasty vegetable, rich in vitamins and minerals.

Seed Collection: Easy.

Black Colocasia

Planting Time: April and May

Soil Condition: Sandy soil rich in organic materials (compost, well-rotted manure, etc.).



Spacing: 1 plant per mound
1–2 feet between mounds
(30–60 cm)

Depth to Plant Root: 2"–3"
(5–8 cm)

Days To Sprouting: 5–7

Planting Instructions: Plant a piece of root (root-cutting) in each mound. Sometimes young plants with tiny roots are planted.

Care: Keep the soil moist, but not too wet. Good drainage is important. Place earth near the base of the stems 4 to 5 times a year. Remove any rotten stems.

Harvesting: Harvest both the leaves and the stems. The leaves are an excellent source of vitamins and minerals. Plants will continue to produce year after year.

Broccoli

Planting Time: August to November

Soil Condition: Sandy soil containing generous amounts of organic materials (cow dung, compost, etc.).

Spacing: 24" (60 cm) between rows
18" (45 cm) between plants

Depth to Plant: ¼" (6 mm)

Days to Germination: 3–4



Planting Instructions: Plant seed in a seed box or seed bed. Transplant when the seedlings are 2 inches (5 cm) tall, about 4 to 5 weeks after sowing.

Care: Some gardeners shade the seedlings for the first 3 to 4 days after transplanting. Beds can be mulched to keep the soil moist and control the growth of weeds. Give liquid fertilizer (manure tea) several times during the growing season.

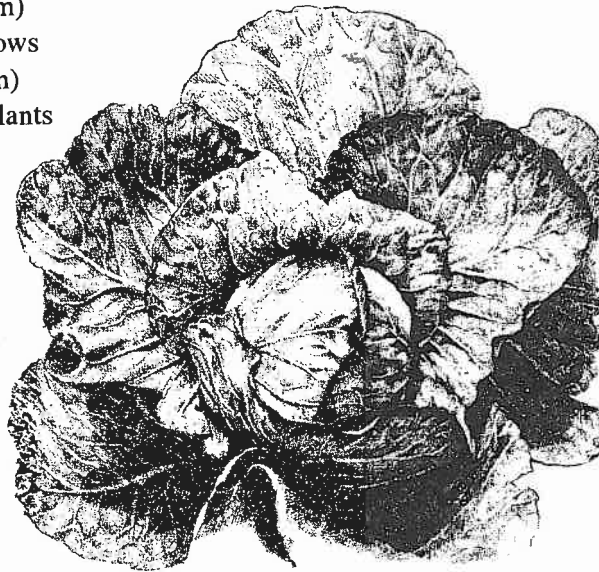
Harvesting: Cut the first head before the tiny yellow flowers begin to open. More heads will be produced. The more heads that are picked, the more the plant will produce.

Cabbage

Planting Time: August through
October

Soil Condition: Any soil containing
generous amounts of organic material
(cow dung, compost, etc.).

Spacing: 24" (60 cm)
between rows
18" (45 cm)
between plants



Depth to Plant: $\frac{1}{4}$ " (6 mm)

Days to Germination: 4–9

Planting Instructions: Plant seed in a seed box or seed bed. Transplant the seedlings about 15 to 20 days after sowing.

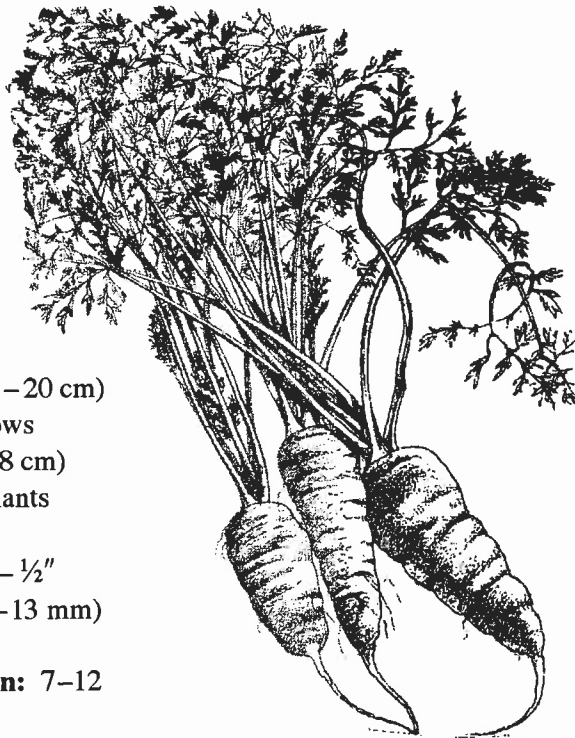
Care: Many gardeners shade their seedlings for the first 3 to 4 days after transplanting. Beds can be mulched to conserve water.

Harvesting: The heads are ready to eat 3 months after planting. Early picking of the outer leaves will prolong the harvest period.

Carrot

Planting Time: September to December

Soil Condition: A loose sandy soil.
Avoid too much cow dung or other manures. Compost can be used.



Spacing: 6"– 8" (15–20 cm)
between rows
2"–3" (5–8 cm)
between plants

Depth to Plant: $\frac{1}{4}$ "– $\frac{1}{2}$ "
(6–13 mm)

Days to Germination: 7–12

Planting Instructions: Seed can be sown in rows or broadcasted over the bed. Seeds can be soaked in water for 12 hours to speed germination.

Care: Thinning should be done 7 to 10 days after germination. A second thinning can be done when the plants are about 4 inches (10 cm) tall. Too much cow dung causes carrots to grow deformed roots.

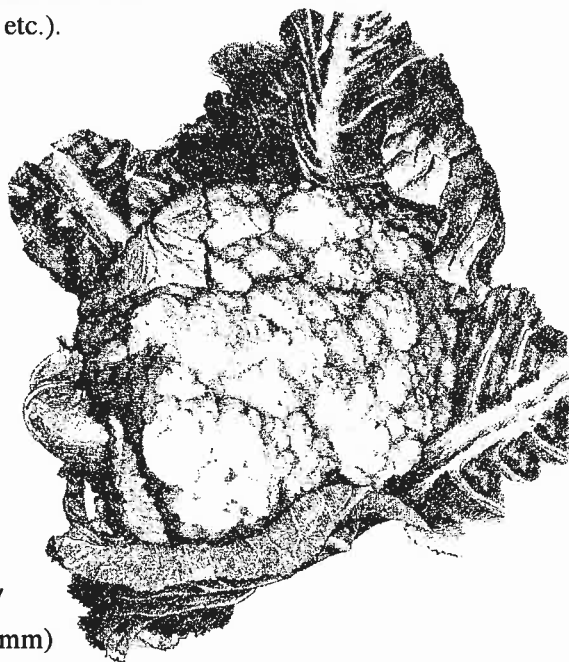
Harvesting: Young carrots can be harvested 2 months after planting. Bigger roots are ready to eat in 3 months.

Cauliflower

Planting Time: August to November

Soil Condition: Any soil containing generous amounts of organic material (compost, rotted manure, etc.).

Spacing: 24" (60 cm)
between rows
18" (45 cm)
between plants



Depth to Plant: $\frac{1}{4}$ " - $\frac{1}{2}$ "
(6 - 13 mm)

Days to Germination: 3 - 6

Planting Instructions: Plant seed in a seed box or seed bed. Transplant the seedlings to permanent beds after 15 days.

Care: When seedlings are set out, press the soil tightly around the roots. Some gardeners shade the seedlings for the first 3 to 4 days after transplanting. Beds can be mulched to keep the soil moist and control the growth of weeds.

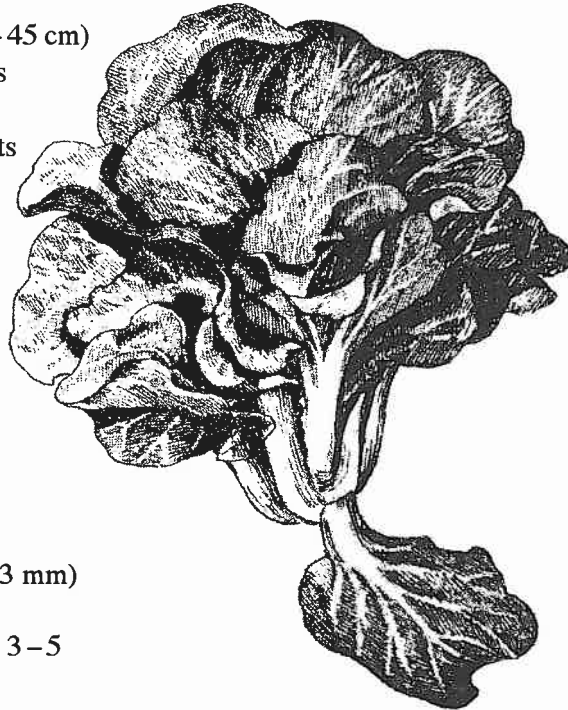
Harvesting: Ready to eat 3 to 4 months after planting. The outer green leaves make a tasty vegetable.

Chinese Cabbage

Planting Time: October to January

Soil Condition: Mix plenty of organic material into the beds.

Spacing: 16"–18" (41–45 cm)
between rows
12" (30 cm)
between plants



Depth to Plant: ½" (13 mm)

Days to Germination: 3–5

Planting Instructions: Plant seeds in a seed box or seed bed. Transplant when seedlings are 15 to 20 days old. Grow on raised beds.

Care: Lots of moisture in the soil is needed for growth. Many gardeners mulch the beds. Give liquid fertilizer (manure tea) several times during the growing season.

Harvesting: The vegetable is ready to eat within 2 months after sowing. Cut and eat the outer leaves to prolong the harvest.

Seed Collection: Easy with the pe-tsai variety.

Cowpea

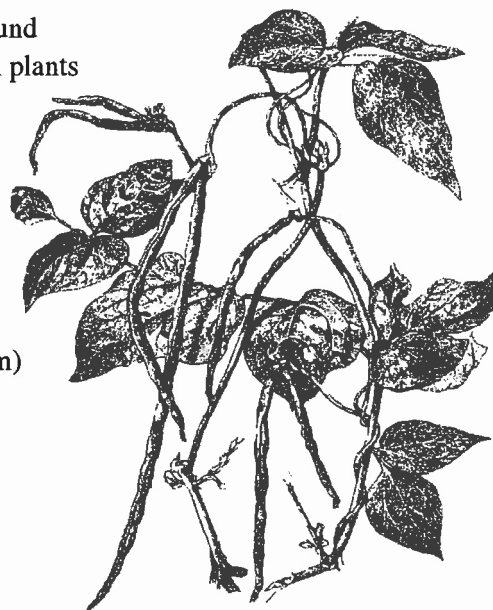
Planting Time: March to July

Soil Condition: Any soil containing generous amounts of organic material (compost, manure, etc.).

Spacing: 2–3 plants per mound
2' (60 cm) between plants
or
2'–3' (60–90 cm)
between rows
6" (15 cm)
between plants

Depth to Plant: ½"–1"
(13–2.5 cm)

Days to Germination: 4–5



Planting Instructions: Plant 4 to 5 seeds on a mound. Later, remove all but the strongest 2 or 3 plants. Seeds can also be planted in rows or broadcasted over the top of the bed.

Care: Provide a large branch or trellis for the plants to climb. Watch for small insects on the tender pods. If necessary, dust with ashes or apply an organic pesticide.

Harvesting: The young pods are ready to eat 5 to 8 weeks after planting. The green leaves and tender stem tips can also be eaten; they are rich in vitamins and minerals.

Seed Collection: Easy.

Cucumber

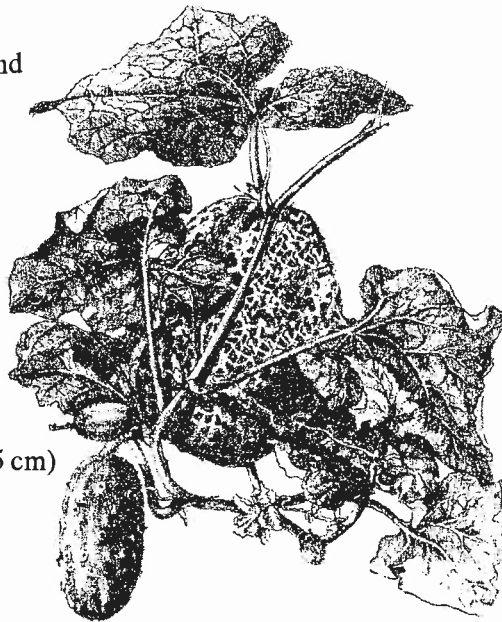
Planting Time: April–May
October–November

Soil Condition: Soil containing a generous amount of organic material (cow dung, compost, etc.).

Spacing: 2–3 plants per mound
2'–3' (60–90 cm)
between mounds

Depth to Plant: $\frac{1}{2}$ "–1"
(13 mm–2.5 cm)

Days to Germination: 4–8



Planting Instructions: Plant 5 to 6 seeds on a mound. When the seedlings are up, remove all but the best 2 or 3 plants.

Care: During the winter season, cucumbers can be allowed to trail over mulched mounds or beds. During the monsoon, tie the vines to a branch or trellis to keep the plants off the ground. Prune excessive side growth from the vines.

Harvesting: Harvest the fruits when 4 to 6 inches (10–15 cm) long, about 3 months after planting.

Seed Collection: Easy.

Eggplant

Planting Time: February, March
September, October

Soil Condition: Grows well on sandy soil containing organic material.

Spacing: 24"–36" (60–90 cm)
between rows
18"–24" (45–60 cm)
between plants



Depth to Plant: ½" (13 mm)

Days to Germination: 6–14

Planting Instructions: Plant seeds in a seed box or seed bed. Transplant when the seedlings are 4 to 5 inches (10–13 cm) tall, about 15 days after sowing. Plants can be grown on beds or mounds.

Care: When the plants are 1 foot (30 cm) tall, they should be supported with a stick. Water every 7 to 10 days and give liquid fertilizer (manure tea) once or twice before the plants flowers.

Harvesting: The young fruits will be ready to eat about 10 weeks after sowing. Pick the fruits often to prolong the harvest.

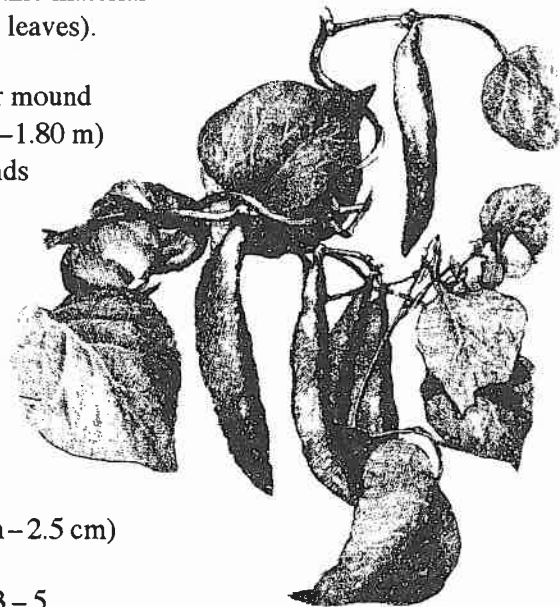
Seed Collection: Easy.

Field Bean

Planting Time: July, August,
September

Soil Condition: Any soil containing generous amounts of organic material (compost, manure, rotted leaves).

Spacing: 1–2 plants per mound
4'–6' (1.20 m–1.80 m)
between mounds



Depth to Plant: $\frac{1}{2}$ "–1"
(13 mm–2.5 cm)

Days to Germination: 3–5

Planting Instructions: Plant 4 to 5 seeds on a mound. Later, remove all but one or two seedlings.

Care: Many gardeners mulch the mounds after the seedlings have germinated. Watch for insect damage on the flowers and tender beans. If necessary, dust with ashes or apply an organic pesticide. Provide a large branch or trellis for plants to climb.

Harvesting: Beans are ready to eat about 10 weeks after planting. Pick the beans often to prolong the harvest.

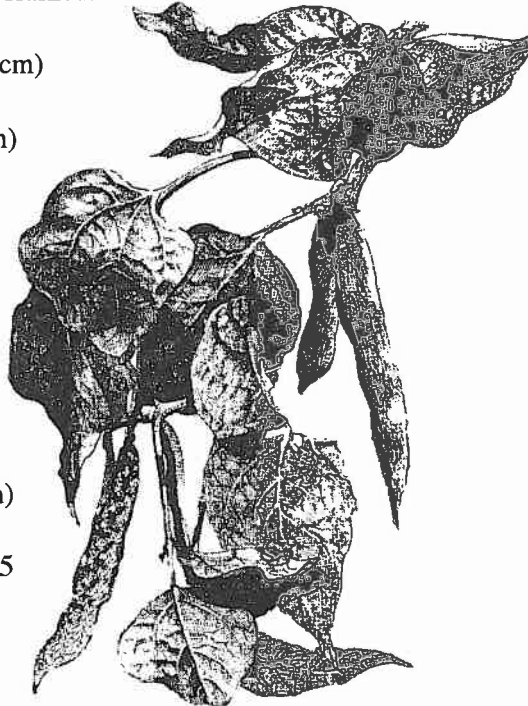
Seed Collection: Easy.

French Bean

Planting Time: September to December

Soil Condition: Mix plenty of organic material (compost, manure, etc.) into the soil. Bed should be well drained.

Spacing: 10"–18" (25–45 cm)
between rows
6"–8" (15–20 cm)
between plants



Depth to Plant: 1" (2.5 cm)

Days to Germination: 3–5

Planting Instructions: Seeds may be planted in rows or broadcasted.

Care: Beans do not like soil that is too wet. Many gardeners mulch the beds to conserve soil moisture and control the growth of weeds. Watch for insect damage on the flowers and tender beans. If necessary, dust with ashes or apply an organic pesticide.

Harvesting: Beans are ready to eat about 10 weeks after planting. Frequent picking will prolong the harvest.

Seed Collection: Easy.

Garlic and Onion

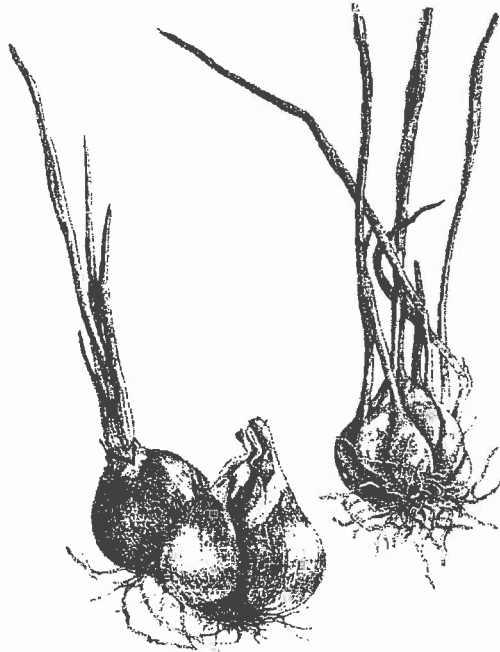
Planting Time: October, November

Soil Condition: Well-drained, sandy soil, containing organic material.

Spacing: 7"–12" (18–30 cm)
between rows
3"–4" (8–10 cm)
between plants

Depth to Plant: ¼" (6 mm)

Days to Germination: 5–12



Planting Instructions: It takes too long to grow garlic from seed. Break apart an old garlic into cloves (small bulbs). Plant each clove 1½ inches (4 cm) deep in the garden bed. Soak onion seeds in water for 12 hours. Plant the seed in a seed box or seed bed. When the seedlings are 3 to 4 inches (8–10 cm) tall, transplant to garden beds.

Care: Keep the bed free of weeds. Some gardeners loosen the soil once or twice a week.

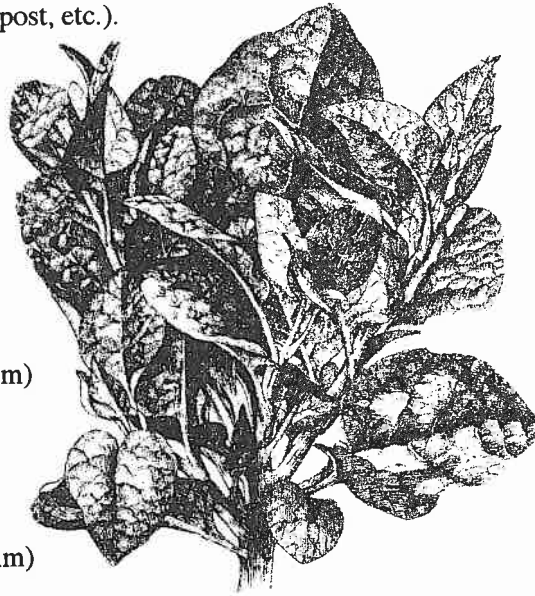
Harvesting: When the leaves turn brown (3 to 4 months), carefully dig up the bulbs and dry them in the sun for a few days. Store them in a cool, dry place.

Indian (Ceylon) Spinach

Planting Time: Any month
Best time: February to June

Soil Condition: Any soil containing generous amounts of organic material (well-rotted cow dung, compost, etc.).

Spacing: 2' (60 cm)
between rows
8"-10" (20-25 cm)
between plants



Depth to Plant: ½" (13 mm)

Days to Germination: 4-6

Planting Instructions: Plant seeds in seed box or seed bed. Transplant when the seedlings are 4 inches (10 cm) tall. Seedlings can be grown on mounds or beds. Plant 3 seedlings per mound.

Care: Keep the soil moist. Tie the plant to a stick. Give liquid fertilizer (manure tea) every week to stimulate leaf growth.

Harvesting: Begin harvesting when the vine is 3 feet (90 cm) long. The more the vine is cut, the more branches will grow.

Seed Collection: Easy.

Jute (sweet)

Planting Time: March to May

Soil Condition: Any soil containing some organic material (compost, well-rotted cow dung, etc.).

Spacing: 3"-4" (8-10 cm)
between each plant

Depth to Plant: ¼" (6 mm)

Days to Germination: 4-6



Planting Instructions: Broadcast the seeds over well-prepared beds. Cover lightly with soil and water the bed.

Care: Keep the soil moist until the seeds have germinated. Begin thinning when the plants are 3 inches (8 cm) tall. Keep the beds weeded. Give liquid fertilizer (manure tea) to promote leaf growth.

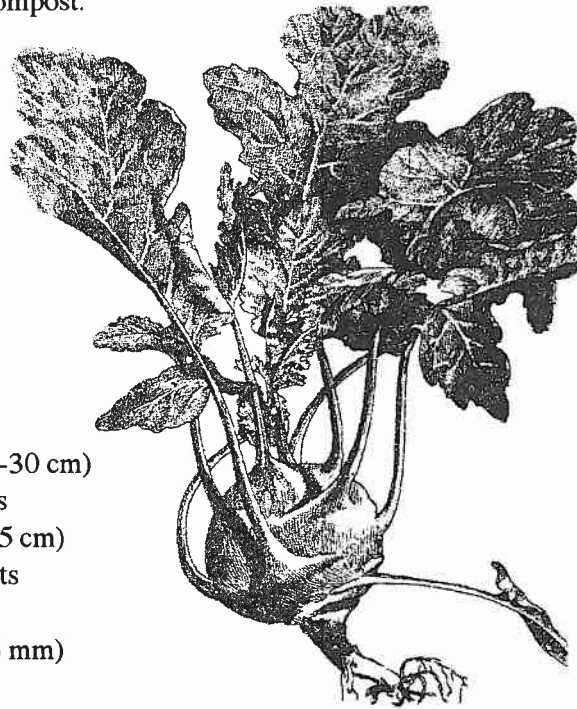
Harvesting: Start picking the leaves 1 month after planting. Stems can be harvested for fiber after 5 months. The leaves are a good source of vitamins and minerals.

Seed Collection: Easy.

Kohlrabi

Planting Time: September, October
November

Soil Condition: Any soil well-prepared
with rotted manure or compost.



Spacing: 10"–12" (25–30 cm)
between rows
4"–6" (10–15 cm)
between plants

Depth to Plant: $\frac{1}{4}$ " (6 mm)

Days to Germination: 4–6

Planting Instructions: Plant seeds in a seed box or directly in the garden. Transplant seedlings from the seed box when the plants are about 2 inches (5 cm) tall.

Care: Mulch the beds to conserve soil moisture and control the growth of weeds.

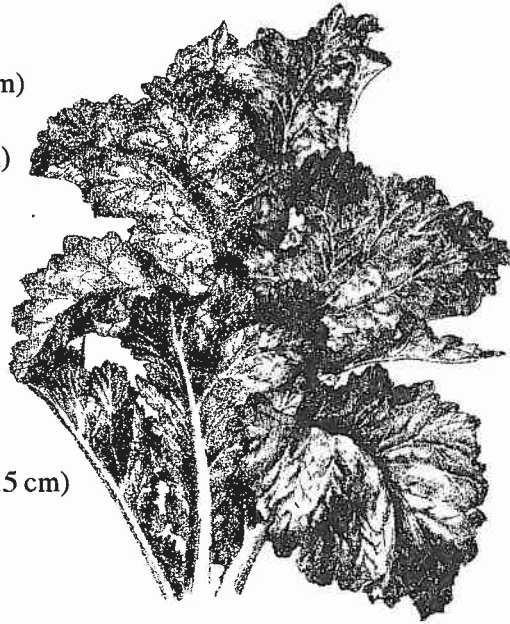
Harvesting: Once the bottom of the stem has reached 2 to 3 inches (5–8 cm) in diameter, it is ready to harvest (2–3 months).

Mustard (garden variety)

Planting Time: September to December

Soil Condition: Any soil rich in organic materials (rotted cow dung, compost, rotted leaves, etc.).

Spacing: 18"–24" (45–60 cm)
between rows
8"–12" (20–30 cm)
between plants



Depth to Plant: ½"–1"
(13 mm–2.5 cm)

Days to Germination: 3–5

Planting Instructions: Plant the seeds in a seed box or directly in the garden (broadcasted or in rows).

Care: If seeds are broadcasted, the seedlings should be thinned out to stand 8 to 12 inches (20–30 cm) between plants. Mulch the beds to conserve soil moisture and control the growth of weeds. Give liquid fertilizer (manure tea) several times during the growing season to promote leaf growth.

Harvesting: The vegetable is ready to eat within 2 months after sowing. Cut and eat the outer leaves often to prolong the harvest.

Seed Collection: Easy.

Okra

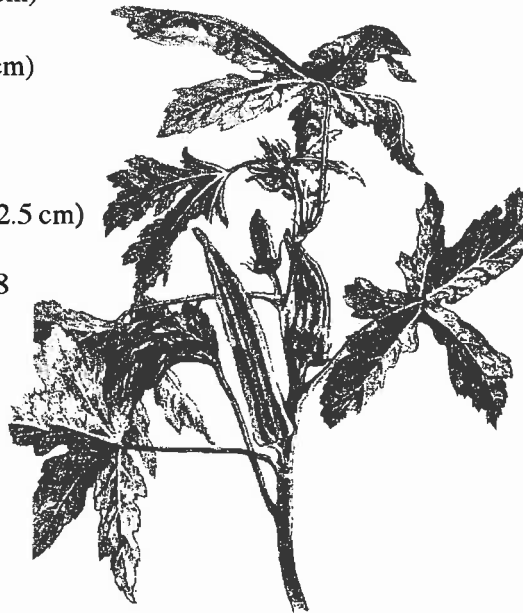
Planting Time: February to May
August to October

Soil Condition: Any soil well-prepared with manure or compost. Some gardeners add lime to the soil two to four weeks before planting.

Spacing: 24"-30" (60-75 cm)
between rows
18"-24" (45-60 cm)
between plants

Depth to Plant: ½"-1"
(13 mm-2.5 cm)

Days to Germination: 5-8



Planting Instructions: Seeds may be planted directly in the garden. Keep the soil moist until the seeds germinate.

Care: Some gardeners mulch the beds to conserve soil moisture and control the growth of weeds.

Harvesting: Pick the fruits before the seeds are too big. Dried okra seeds are good to eat. Prepare them like dry lentils or beans.

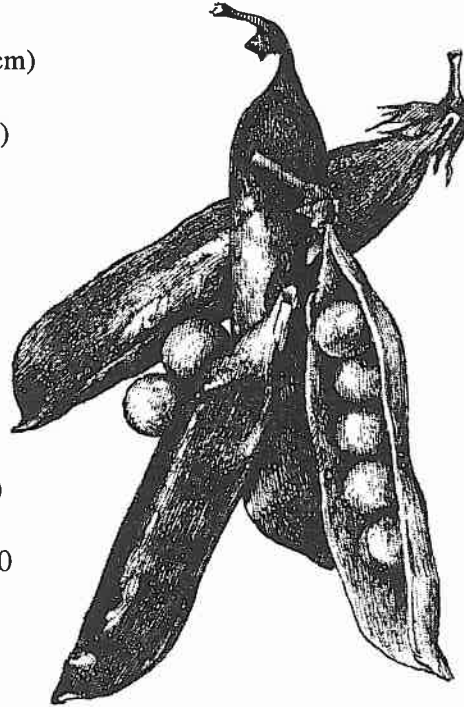
Seed Collection: Easy.

Pea (bush type)

Planting Time: October and November

Soil Condition: Mix plenty of organic material into the beds.

Spacing: 18"–24" (45–60 cm)
between rows
6"–8" (15–20 cm)
between plants



Depth to Plant: 1" (2.5 cm)

Days to Germination: 6–10

Planting Instructions: Plant seeds directly in prepared beds. Seeds can either be broadcasted or planted in rows.

Care: Lots of moisture in the soil is required for good growth. Many gardeners mulch the beds. Provide short sticks to support the plants if needed. Peas are good to grow along the fences of the garden.

Harvesting: The young pods are ready to harvest about 7 to 8 weeks after sowing.

Seed Collection: Save seeds when the pods are dry after 4 months.

Pepper (hot)

Planting Time: March to May
October to December

Soil Condition: Any soil containing organic material (well-rotted manure, compost, rotted leaves, etc.).

Spacing: 2' (60 cm)
between rows
12"–18" (30–45 cm)
between plants



Depth to Plant: ½" (13 mm)

Days to Germination: 5–10

Planting Instructions: Plant seeds in a seed box or seed bed. Some gardeners soak the seeds for 12 hours before sowing. Transplant the seedlings to a permanent bed after 1 month.

Care: Shade the seedlings for the first 3 to 4 days after transplanting. Mulch the beds to conserve soil moisture and control the growth of weeds. Keep the beds moist for the first two weeks after transplanting.

Harvesting: Green peppers are ready 3 to 4 months after planting. Pick the fully ripe peppers for drying.

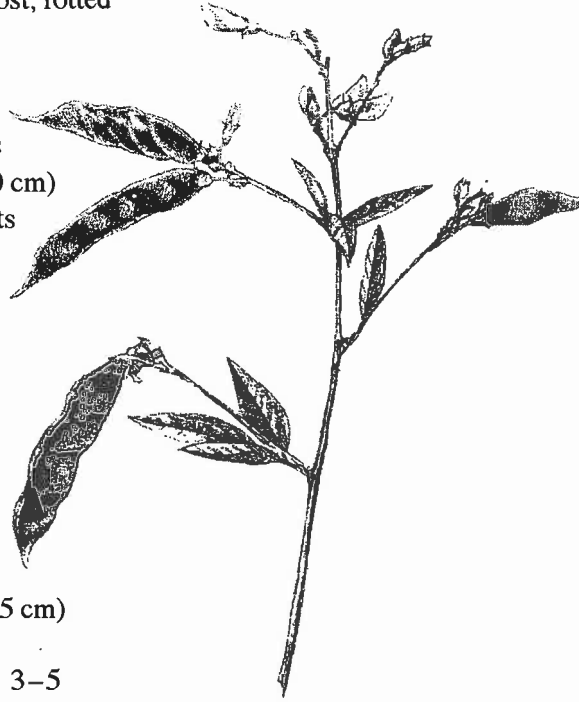
Seed Collection: Easy.

Pigeon Pea

Planting Time: May through June

Soil Condition: Sandy soil rich in organic material (compost, rotted leaves, manure, etc.).

Spacing: 3' (90 cm)
between rows
2'-3' (60-90 cm)
between plants



Depth to Plant: 1" (2.5 cm)

Days to Germination: 3-5

Planting Instructions: Seeds may be planted on beds or mounds. Keep the soil moist until the seeds germinate. Because this vegetable occupies the ground for a long time, it is best to plant it near the edges of the garden, or in other places around the house.

Care: Some gardeners put mulch around the plants to conserve soil moisture and control the growth of weeds.

Harvesting: Plants flower when the weather turns cool. Pods are ready for picking in December and January.

Seed Collection: Easy.

Pointed Gourd

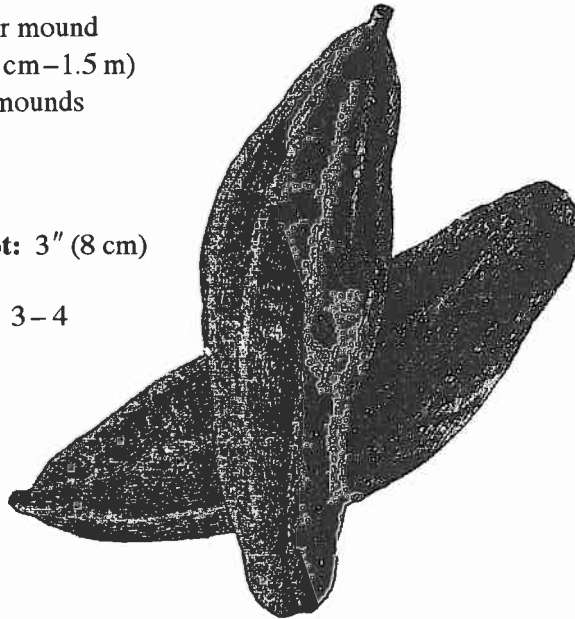
Planting Time: March to August

Soil Condition: Any soil well prepared with manure or compost.

Spacing: 1 plant per mound
3'–5' (90 cm–1.5 m)
between mounds

Depth to Plant Root: 3" (8 cm)

Days to Sprouting: 3–4



Planting Instructions: Plant one root cutting per mound. Select pieces of root from healthy, productive vines. Plants will continue to produce year after year.

Care: Put a large bamboo branch into the ground for the vines to climb. Mulching around the plants holds soil moisture and keeps weeds from growing. Watch for insect damage. If necessary, dust with ashes or apply an organic pesticide.

Harvesting: The young fruits are ready to eat 2 months after planting. Harvest before the seeds become too large.

Radish

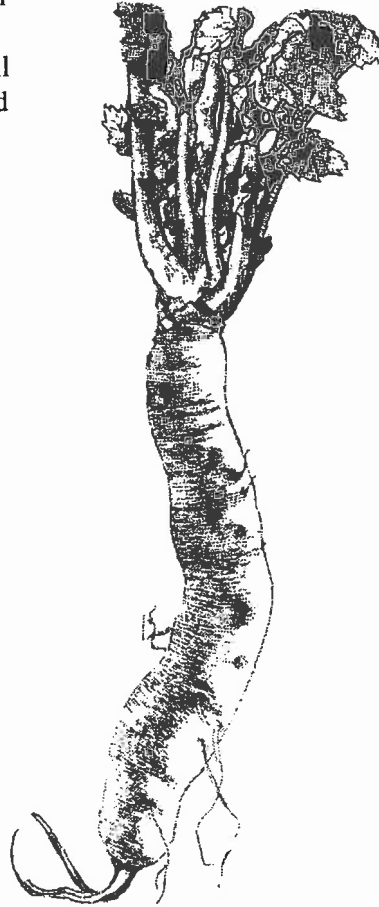
Planting Time: July to December

Soil Condition: Loose, sandy soil containing organic material (rotted cow dung, compost, etc.).

Spacing: 8"–10" (20–25 cm)
between rows
3"–4" (8–10 cm)
between plants

Depth to Plant: $\frac{1}{4}$ "– $\frac{1}{2}$ "
(6–13 mm)

Days to Germination: 3–4



Planting Instructions: The seeds can be broadcasted or planted in rows. Some gardeners broadcast the seeds thickly and harvest the small plants as a leafy vegetable.

Care: Keep the beds moist and free of weeds. Watch for insect damage on the leaves. If necessary, dust with ashes or apply an organic pesticide.

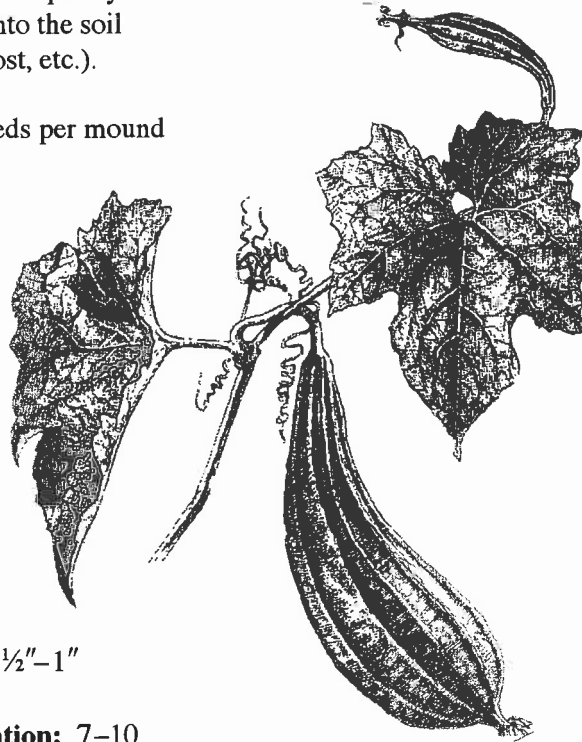
Harvesting: The leaves are ready to harvest 15 to 20 days after planting. The root is ready to eat 2 to 3 months after planting. Grow this vegetable as a “quick crop” for the leaves.

Ridge Gourd

Planting Time: March, April, May

Soil Condition: Mix plenty of organic material into the soil (cow dung, compost, etc.).

Spacing: 2–3 seeds per mound



Depth to Plant: $\frac{1}{2}$ "–1"

Days to Germination: 7–10

Planting Instructions: Plant 4 to 5 seeds on a mound. Later, remove all but the 3 strongest plants.

Care: Grow on a trellis or put a large bamboo branch into the ground for the vines to climb. In the beginning it may be necessary to tie the vines to the support.

Harvesting: The gourds are ready to eat 10 to 12 weeks after planting. Keep gourds picked off the vines to prolong the harvest.

Seed Collection: Easy.

Snake Gourd

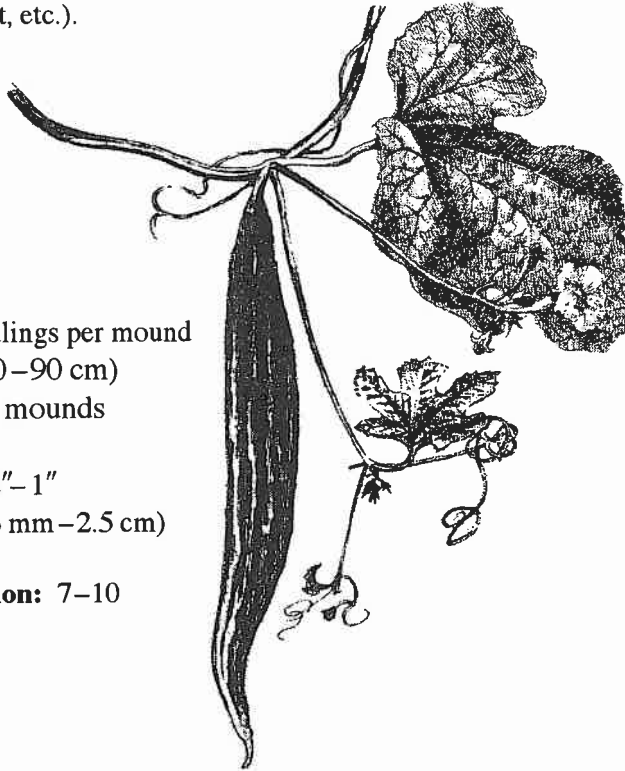
Planting Time: March, April, May

Soil Condition: Mix plenty of organic material into the soil (cow dung, compost, etc.).

Spacing: 2–3 seedlings per mound
2'–3' (60–90 cm)
between mounds

Depth to Plant: ¼"–1"
(6 mm–2.5 cm)

Days to Germination: 7–10



Planting Instructions: Plant 4 to 5 seeds on a mound. Later, remove all but the 3 strongest plants.

Care: Put a large bamboo branch into the ground for the vines to climb. In the beginning it may be necessary to tie the vines to the support.

Harvesting: The gourds are ready to eat 3 to 4 months after planting. Pick the gourds often to prolong the harvest.

Seed Collection: Easy.

Spinach

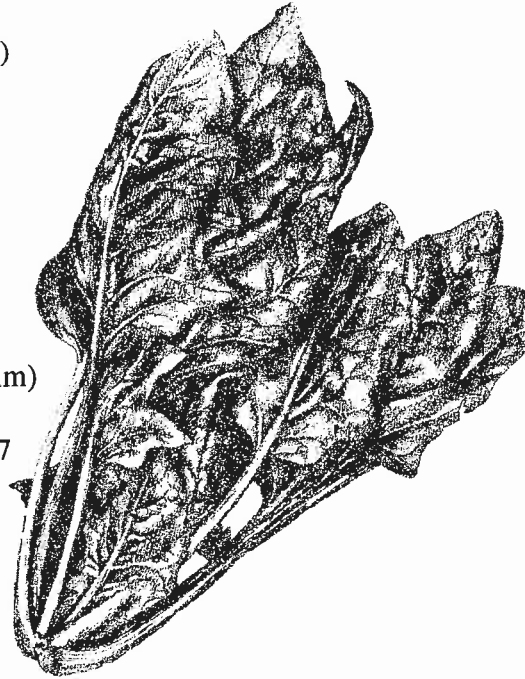
Planting Time: September to December

Soil Condition: Mix plenty of organic material into the beds.

Spacing: 6"-8" (15-20 cm)
between rows
6" (15 cm)
between plants

Depth to Plant: ½" (13 mm)

Days to Germination: 3-7



Planting Instructions: Soak the seeds for 12 hours. Sow in rows or broadcast the seed over the top of the bed. Keep the bed moist until the seeds germinate (sprout).

Care: Many gardeners mulch the beds to preserve moisture and keep weeds from growing. Give liquid fertilizer (manure tea) every week during the growing season.

Harvesting: The first leaves will be ready to harvest 4 to 5 weeks after sowing. Cut the outer leaves often to prolong the harvest.

Seed Collection: Easy.

Sweet Corn (maize)

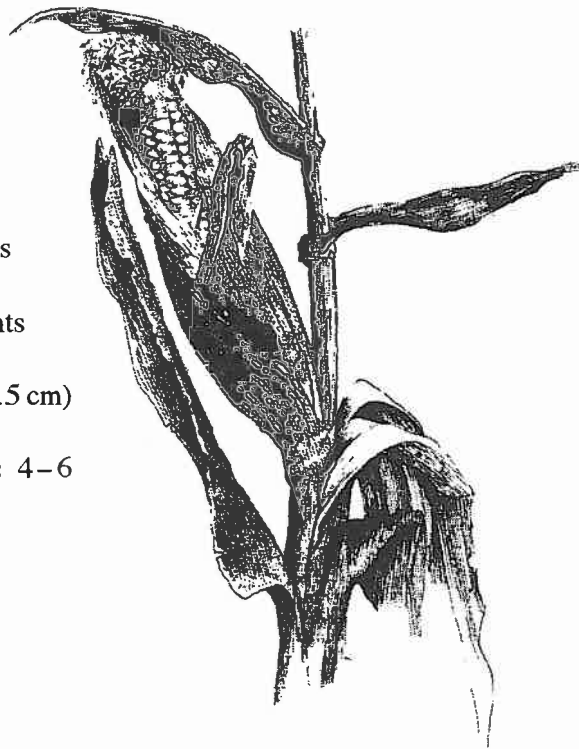
Planting Time: September to November
February to June

Soil Condition: Sandy soil rich in organic material (compost, well-rotted manure, etc.).

Spacing: 2' (60 cm)
between rows
6" (15 cm)
between plants

Depth to Plant: 1" (2.5 cm)

Days to Germination: 4–6



Planting Instructions: Plant seeds directly in the garden. Prepare the beds with plenty of organic material.

Care: Many gardeners mulch the beds to conserve moisture and control weeds. If the corn doesn't grow well, maybe the soil is too acidic; this can be corrected by added powdered lime to the soil.

Harvesting: Harvest the corn when the kernels are still soft and milky.

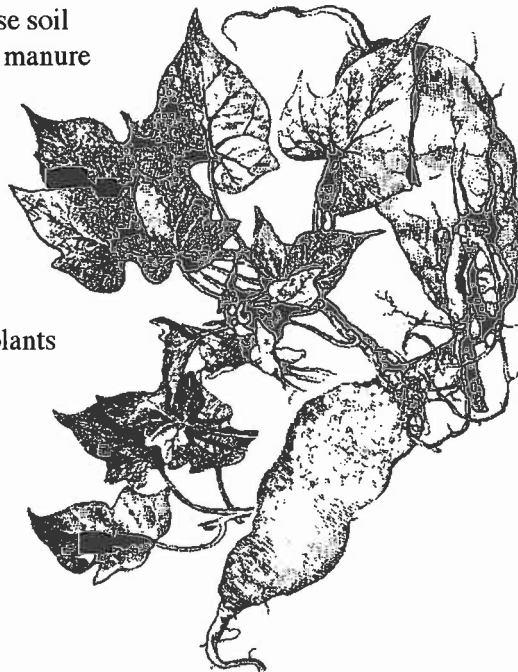
Seed Collection: Easy.

Sweet Potato (vining type)

Planting Time: For Tubers:
October–November
For Leaves:
Year Round

Soil Condition: Sandy, loose soil containing some well-rotted manure or compost.

Spacing: 2' (60 cm)
between rows
8"–10" between plants



Planting Instructions: Plant 18 inch (45 cm) vine cuttings. The cuttings at the tip are the best. Plant the cutting at an angle, so that half (or two-thirds) is buried, leaving the rest of the stem and vine tip above the soil. If vine cuttings are not available, cut a sprouting tuber into sections and plant the pieces leaving the sprouts above the soil.

Care: Remove weeds once or twice until the vines cover the beds.

Harvesting: The 6 inch (15 cm) vine tips make an excellent vegetable, rich in vitamins and minerals. Harvest the tips year round. Tubers are ready to harvest 5 to 6 months after planting. Let them cure (rest) in an open, but covered, place for a week before eating.

Sweet Pumpkin (squash)

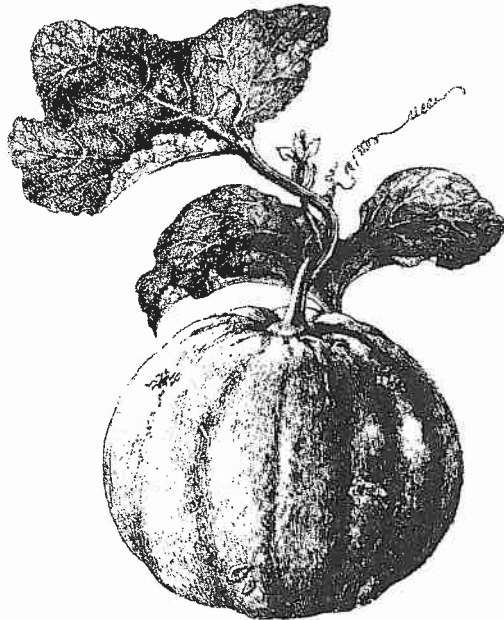
Planting Time: August to November

Soil Condition: Any soil containing generous amounts of organic material (cow dung, compost, rotted leaves).

Spacing: 2 plants per mound
3' (90 cm)
between mounds

Depth to Plant: 1" (2.5 cm)

Days to Germination: 4–10



Planting Instructions: Plant 5 to 6 seeds on a mound. When the seedlings are up, remove all but the best 2 plants.

Care: Sweet pumpkin can be grown on mulched beds, or on a trellis to save space. Over-watering causes excessive leaves and less pumpkins. If the leaves become too many, pinch-off the tips of the vines.

Harvesting: Leaves and stem tips can be harvested after 2 months. Pumpkins are ready in 4 months.

Seed Collection: Easy.

Sword Bean

Planting Time: July, August,
September

Soil Condition: Any soil containing
some organic material (compost,
manure, rotted leaves, etc.).

Spacing: 1–2 plants per mound
4'–6' (1.2–1.8 m)
between mounds



Depth to Plant: 1 ½" (3 cm)

Days to Germination: 3–7

Planting Instructions: Plant 4 to 5 seeds on a mound. Later, remove all but one or two seedlings.

Care: Many gardeners mulch the mounds after the seedlings have germinated (sprouted). Watch for insect damage on the flowers and stem tips. If necessary, dust with ashes or apply an organic pesticide.

Harvesting: Beans are ready to eat 10 weeks after planting. Continuously pick off the tender beans to prolong the harvest.

Seed Collection: Easy.

Tomato

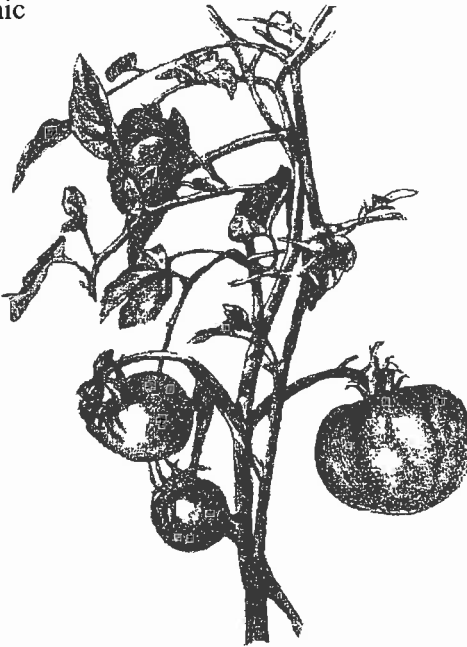
Planting Time: September, October
November, December

Soil Condition: Any soil containing some compost or other organic material. The beds should be well-drained.

Spacing: 24"–36" (60–90 cm)
between rows
18"–24" (45–60 cm)
between plants

Depth to Plant: $\frac{1}{4}$ " – $\frac{1}{2}$ "
(6–13 mm)

Days to Germination: 6–10



Planting Instructions: Plant seeds in a seed box or seed bed. When the seedlings are 3 inches (8 cm) tall, transfer them to another seed box. Plant them deeper than they were growing in the first seed box. When the plants are 10 inches (25 cm) tall, transplant them to permanent beds. Some gardeners transplant only once, while others sow seeds directly in the garden.

Care: Stake the young plants and prune off excess branches (suckers).

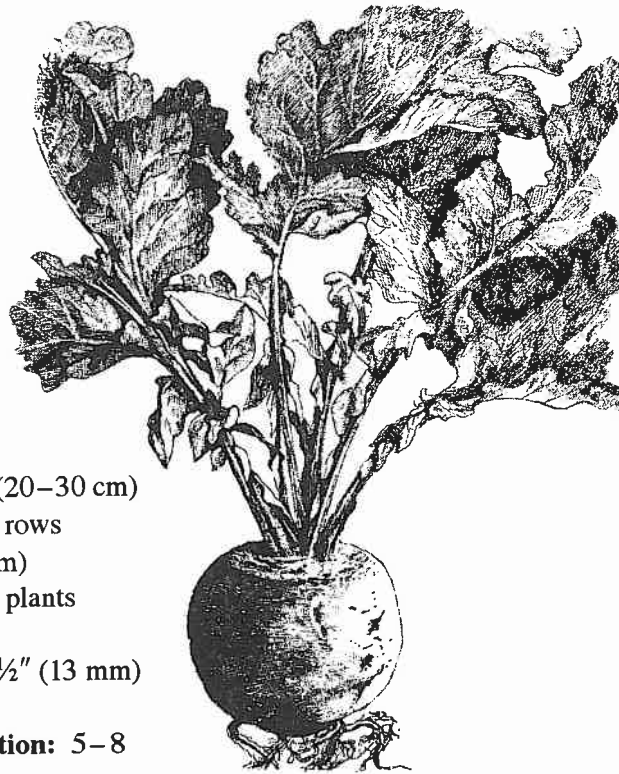
Harvesting: Leave the tomatoes on the the plant until they are fully ripe, about 3 months after planting.

Seed Collection: Easy.

Turnip

Planting Time: September to December

Soil Condition: Loose, sandy soil containing some organic material (rotted manure, compost, etc.).



Spacing: 8"–12" (20–30 cm)
between rows
4" (10 cm)
between plants

Depth to Plant: ½" (13 mm)

Days to Germination: 5–8

Planting Instructions: Seeds can be planted in rows or broadcasted over the top of the bed.

Care: If the seed is broadcasted, the seedlings should be thinned out until the plants are each 4 inches (10 cm) apart.

Harvesting: The turnip leaves make a tasty vegetable. The root is ready to eat 3 months after planting.

Appendix 1

Green leafy vegetables, important mainly for protein, provitamin A, vitamin C, iron, and calcium

Common Name & botanical names	Other names	Growing conditions (altitude and season)
Spinach beet & seakale beet <i>Beta vulgaris</i>	Swiss chard (for seakale beet); Leaf beet	best above 500 m, grow dry season with irrigation.
Amaranth: Chinese spinach <i>Amaranthus gangeticus</i> (<i>A. oleraceus</i>)	Ranga sak (India) Lal sak (India)	the various species and varieties of amaranth are ill-defined; most grow best below 500 m, typically at the start of the rainy season.
African spinach <i>Amaranthus hybridus</i>	Bush greens Spinach greens	
Spineless amaranth <i>Amaranthus gracilis</i>	Kulitis	
Ceylon spinach <i>Basella rubra</i>	Pasali-kiral (Tamil); Put, purai (Assam)	below 500 m; best in rainy season.
Water spinach <i>Ipomoea aquatica</i>	Water convolvulus; .. Kang-kong (Malaysia); Vallai-kirai (Tamil)	below 500 m; requires wet conditions; some varieties do well in rice fields.
*Cassava leaves <i>Manihot esculenta</i>	Manioc; Tapioca	anywhere with temperat- ures regularly above 60°F
*Sweet potato leaves <i>Ipomoea batatas</i>	moist soils below 1000 m.
*Okra leaves <i>Hibiscus esculentus</i>	Lady's fingers; Gombo; Bele	dry and wet seasons below 1000 m.
*Melon leaves <i>Cucumis melo</i>	also leaves of other curcubits: pumpkins, squashes, etc.	
*Papaya leaves <i>Carica papaya</i>		
*Cashew nut leaves <i>Anacardium occidentale</i>		

*Denotes examples of plants grown for other purposes whose leaves are eaten as green vegetables.

(All charts in Appendix 1 courtesy, Arnold Pacey, *Gardening for Better Nutrition*, Oxfam, Intermediate Technology Publications, UK.)

**Legume vegetables, important mainly for protein and
B-vitamins, and sometimes for iron and calcium**

Common Name & botanical names	Other names	Growing conditions (altitude and season)
Cowpeas <i>Vigna unguiculata</i>	Paythenkai (Tamil); Long beans; other names for different varieties	below 1000 m best; dry season or late in rainy season.
Green-gram <i>Vigna mungo</i>	Golden-gram; Mung bean; Tientsin green bean	best in the dry season below 500 m; tolerant of high temperatures but not of high humidity.
French beans <i>Phaseolus vulgaris</i>	Kidney beans; Haricot beans; String beans (names refer to different varieties)	very tolerant of all kinds of conditions, but best above 500 m; climbing varieties do best in high rainfall areas.
Lima beans <i>Phaseolus lunatus</i>	Seemai-motchai (Tamil); Butter beans	best at altitudes between 500 and 1500 m; do badly in very hot weather.
Dhal <i>Cajanus cajan</i>	Dal; Pigeon pea; Red-gram	best below 2000 m, but tolerant of wide variety of conditions.
Groundnuts <i>Arachis hypogaea</i>	Peanuts, Monkey-nuts	varieties differ greatly in requirements. Frequent but light rainfall often crucial; sandy soils preferable.
Soya beans <i>Glycine max</i>	Soybeans	best below 1000 m sensitive to rainfall and humidity in early stages.

Solanaceous crops and root crops; also maize

Common Name & botanical names	Other names	Growing conditions (altitude and season)
Solanaceous crops		
Tomatoes <i>Lycopersicon esculentum</i>		best above 200 m; dry season preferable, with irrigation; high humidity and temperature reduce yields.
Brinjals <i>Solanum melongena</i>	Aubergine, Eggplant, Garden egg; Melongene; Kathiri-kai (Tamil); Baigan (Rindustani)	best below 1000 m; suited to dry or wet season, but avoid high soil temperatures and very wet soil.
Sweet pepper <i>Capsicum annuum cv. grossum</i>	Pimento; Guinea pepper	best below 1500 m; dry or wet season.
Chilli pepper <i>Capsicum annuum cv. longum (or cv. acuminatum)</i>	Cayenne pepper	altitudes up to 1500 m; tolerant of high tempera- tures and a wide range of rainfall.
Irish potatoes <i>Solanum tuberosum</i>	Potatoes; Alu (Hindustani)	best above 1000 m; prone to disease in moist conditions so best in dry season.
Other roots and tubers		
Carrots <i>Daucus carota</i>	Gajar (Hindustani)	best above 500 m; typi- cally do well in a sandy soil at the end of the wet season.
Sweet potatoes <i>Ipomoea batatas</i>		best below 1200 m; can be grown in wet or dry season provided soil is moist.
Cereals		
Maize <i>Zea mays</i>	Mealies (white grain varieties); Sweetcorn; corn (yellow grain)	best in the wet season at altitudes below 2000 m.

Appendix 2

Output from a Home Garden in Hawaii without Nutritional Consideration

Plot	Area sq ft	Estimated Output lb/d	Protein g	Iron mg	Vitamin A Activity IU	Ascorbic acid mg
Lettuce, Manoa	45	0.47	1.76	1.89	2,565	25
Bean, snap	45	0.13	0.99	0.41	315	10
Cucumber	45	0.04	0.15	0.19	430	2
Eggplant	45	0.07	0.31	0.18	20*	1
	180	0.71	3.21	2.67	3,330	38
Fence and space	300 120					

Vegetables:

**Nutritional Contribution
in RDA of family :**

1.4% 3.6% 8.1% 17.3%

*Equivalent to 334 MCG retinol

Output from a Home Garden in Hawaii with Nutritional Consideration

Plot	Area sq ft	Estimated Output lb/d	Protein g	Iron mg	Vitamin A Activity IU	Ascorbic acid mg
Vegetables:						
Water convolv.	45	0.67	7.34	6.12	15,415	79
Pak choy	45	0.75	5.18	2.57	10,035	81
Amaranth	45	0.54	5.40	5.99	9,405	124
Bean, snap	45	0.13	0.99	0.41	315*	10
Fence and space	180	2.09	18.19	15.09	35,170	294
	120					
Nutritional Contribution in RDA of family :			8.5%	18.8%	86.4%	144.5%

*Equivalent to 3, 542 MCG retinol

(Source: University of Hawaii, USA)

Appendix 3

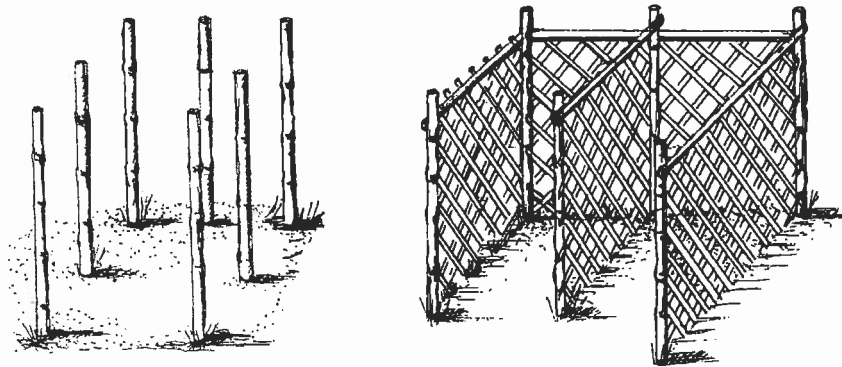
Guide To Making Compost

Your soil is alive! And if you want it to be healthy, fertile and always productive, it must be fed with plenty of natural fertilizer.

Materials That Can Be Used To Make Natural Fertilizer

1. Water hyacinth
2. Ashes (from wood and straw)
3. Banana skins and stalks
4. Egg shells
5. Feathers
6. Fish cleanings
7. Old flowers
8. Grass
9. Hair clippings
10. Animal manures
11. Rice hulls
12. Sawdust (grey, weathered)
13. Wood shavings
14. Ground stones and shells
15. Kelp (seaweed)
16. Coffee wastes and grounds
17. Cotton waste (gin trash)
15. Sludge (processed sewage)
16. Sugarcane residue (bagasse)
17. Rice straw
18. Hedge clippings
19. Felt waste
20. Kitchen scraps (no meat/fat)
21. Leaves
22. Sour milk
23. Vines
24. Peanut hulls
25. Field plants after harvest
26. Silk mill waste
27. Old paper
28. Marsh and swamp mud
29. Brewery waste (hops)
30. Vegetable trimmings
31. Leather waste and dust

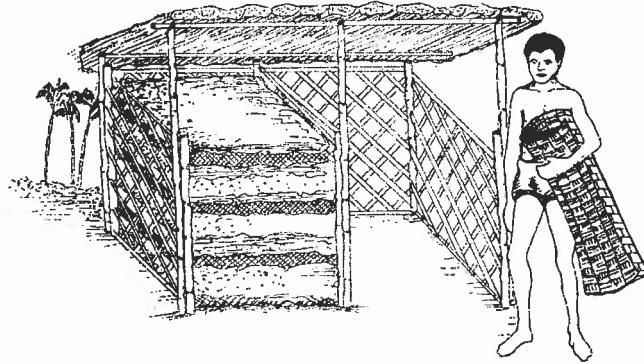
You can make compost in an open pile, but some kind of simple container keeps things better organized. The bamboo container described on the following page is for people who don't have large amounts of garbage, who don't have enough land to have lots of plant waste, and who like to keep their place neat and attractive.



A simple frame and two bin container.



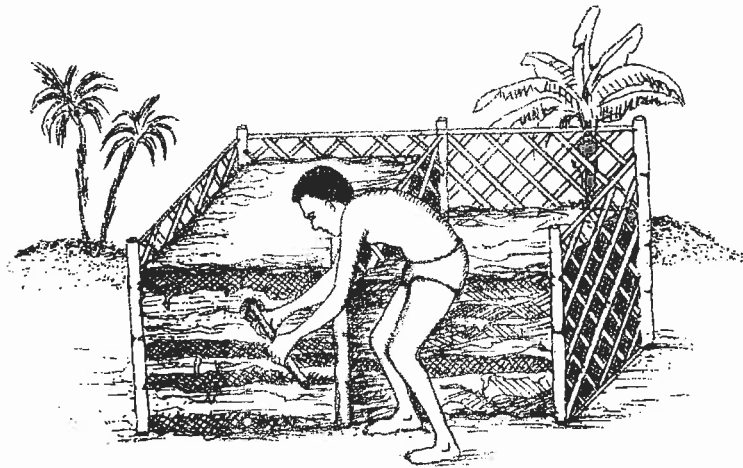
This container was built 8 feet (2.4 m) long, 4 feet (1.2 m) wide, and 4 feet tall. It is separated in the middle by a removable partition. After collecting whatever material you have, begin by putting a 6 inch (15 cm) layer of plant material (possibly, partially rotted water hyacinth or grass and leaves) in one of the bins. On top of this add a layer of some animal manure and a thin layer of soil. A sprinkling of lime or wood ashes can also be added if you have them. If the pile is made with lots of straw or other dry plant materials, you should add a sprinkling of water after each layer of earth. A good pile should always be moist, but never wet.



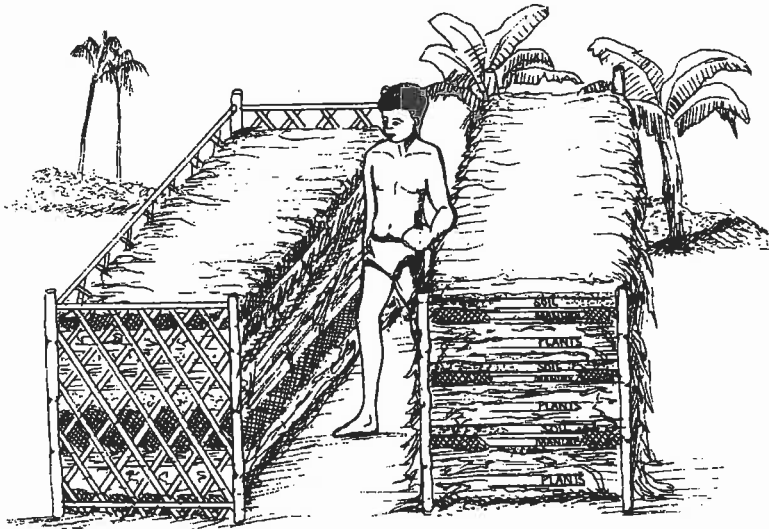
Now a thin layer of rice hulls or rice straw can be added, and the whole process started again by adding another 6 inch (15 cm) layer of plant material, followed by more manure and earth until the pile is finally 4 feet (1.2 m) tall. The top of the pile is then covered with a 1 inch (2.5 cm) layer of earth. A thick layer of straw, woven mats, or even a straw roof can be used to protect the pile during the rainy season.



After 2 weeks, remove the middle partition and place the rotting material into the other bin. Begin making more compost in the emptied bin. Piles made with tender green plants, rice hulls, manure and dirt, are often ready for use after just another 2 or 3 weeks of rotting. Sometimes 2 or 3 months are needed for piles made with straw, leaves, and other dry materials.



If we turn the pile frequently and keep it moist, it will always smell sweet. If the pile smells bad, it's because we didn't turn it soon enough. Test the pile by pushing a bamboo stick into the center and after a few minutes pull it out. If the stick feels dry or smells bad, the pile should be turned.



If lots of materials for making compost are available, you might want to remove the center partition and make one large pile. Or, just build a pile to the same size using a few bamboo stakes to hold the sides in place.

What You Should Know About Fertilizers

- ☼ Compost is easy to make and costs nothing except labor.
- ☼ It takes a long time for some material to rot completely. Don't worry if some of the materials are not completely rotted. Final rotting will take place in the soil. In the meantime, your plants will be getting lots of nourishment. Partially rotted compost is a good fertilizer because it releases its nutrients to the plants slowly.
- ☼ Some people add small amounts of chemical fertilizers, containing nitrogen or phosphate, to their piles when manures are **not** available. Nitrogen, in particular, will help the raw materials rot quickly.
- ☼ Sometimes gardeners use chemical fertilizers in their gardens because they lack animal manures. But we must remember that chemical fertilizers are a **supplement** to organic fertilizers (compost), and that the more organic materials we mix with our chemical fertilizers, the better it will be for our plants and the fertility of the soil.
- ☼ Chemical fertilizers cost money, and much of it may be washed away by rain and evaporate into the air.
- ☼ Experience teaches us that one sack of chemical fertilizer, mixed with compost and applied to our fields, is better than three sacks of chemical fertilizer applied alone. So, to save money on the price of commercial fertilizer, first enrich it with compost.
- ☼ Wise farmers return to the soil all their plant and animal wastes, instead of burning them or throwing them away. ☹

(From, How to Make Fertilizer, H. Attfield, VITA. See, Composting Privy, H. Attfield, VITA, for information on composting human waste.)

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About this book . . .

Emphasis was placed on readability. Sans serif typefaces, small print (under 10 pts.), and justified margins were avoided. Finally, the Flesch-Kincaid and Bormuth tests were applied to verify the book was reader friendly.