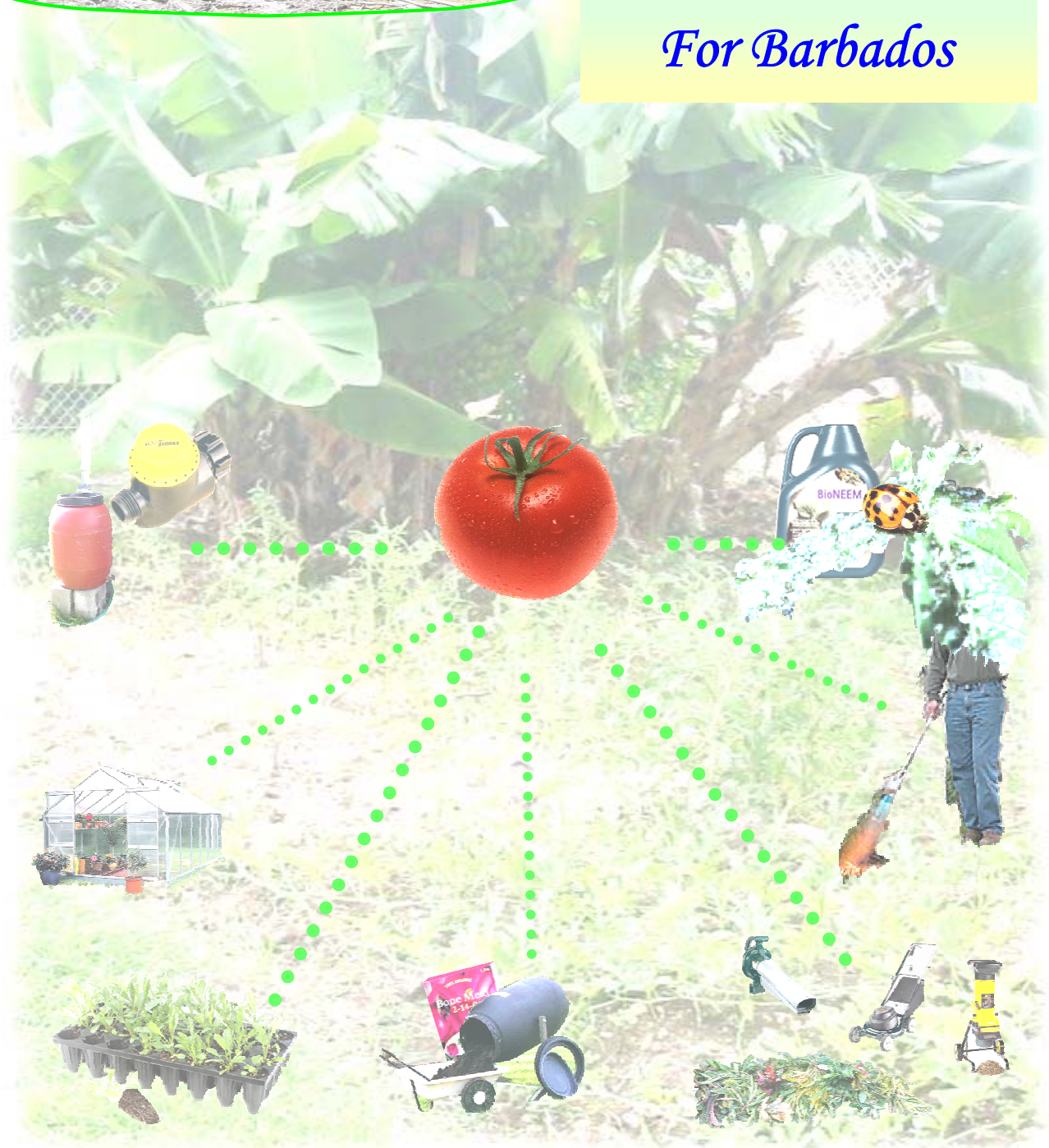


# Organic Gardening Technology



*For Barbados*



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## Foreword

*Organic gardening may be described as traditional gardening with a bit of sophistication added. "Old time" Barbadian gardeners would certainly have practiced the traditional form of organic gardening. The sophistication brought on by new and improved technologies is recent. Though volumes exist on the practice of organic gardening in temperate countries, there is a dearth of literature with a local or regional slant.*

*The National Council for Science and Technology over the past three years has received a number of inquiries and requests for a publication on organic gardening that speaks to things with which Barbadians are familiar.*

*In keeping with one of the requirements of its mandate which is to collect, collate, review and disseminate information on science and technology, the council has collaborated with Mr. Stevenson Skeete (a local agronomist) and Mr. John Hunte in the production of this booklet.*

*The booklet targets, in the main, the household gardener and the small kitchen gardener. However, it may also prove useful to those persons who are producing on a larger scale.*

*The Council trusts that this booklet will prove beneficial to all who use it.*

Lennox Chandler  
Director,  
NCST

# What is Organic Gardening?

Organic farming is not as new to Barbados as it may appear. Any person who grew up in the countryside would remember relatives who grew almost everything that they ate. The “home farm” effort was a carefully woven blend of root crops, vegetables, corn, legumes, fruit trees, groundnuts and various livestock. The only fertilizer used was manure from the animals. This type of gardening is still practiced and exists along with large monocropping farms.

Organic farming by the definition of International Federation of Organic Agriculture Movements (IFOAM) is a farming system which produces food and fibre in a way that respects the environment. Organic farming emphasizes soil condition, and respects the natural capability of plants and animals. Subsistence farms in Central America, Asia and Africa have used organic techniques to their advantage for many years before the dawning of large commercial farms.

Organic farming is not a matter of neglecting the garden as was a practice of some farmers in the early days of organic gardening in some countries. Some conventional growers, under the guise of organic growing, failed to manage the farms properly and fall-off in yields resulted. This mishap almost gave the false impression that yields for organic farming were dramatically lower than for conventional farming.

On the contrary the organic gardener combines crops, animals and techniques in the farm environment to produce wholesome food while looking after the farm ecosystem. This

work requires careful planning and dedicated management. The grower focuses on the use of organic matter to build and maintain the fertility of soil, avoiding synthetic fertilizers. Weeds and pests are kept under control by skillful combination of cultural and biological measures.

Some important principles of organic farming are:

- A farming technique which is compatible with the course of nature;
- Avoids the use of any kinds of artificial and toxic chemicals including pesticide and hormone;
- Improves and maintains soil fertility continuously with organic matters such as animal manure, compost and green manure by trying to use renewable resources on the farm;
- Maintains ecological system on the farm and sustainability of the whole ecology such as growing many different types of plants on the same farm;
- Animals are treated in a humane manner;
- Farmers are satisfied and can generate a reasonable level of income;
- Farmers are self reliant in term of production factors, and use renewable resources in locally organized production systems.

Normally, to export organic produce a farm must be certified to meet certain standards.

### *Why practice organic gardening?*

For some organic gardeners, this approach is part of the lifestyle which seeks to grow healthy food, eat wholesome produce and preserve the richness and diversity of the land for future generations.

In recent times there has been an escalation in the occurrence of cancer and certain chronic diseases. It is felt that food which is grown organically is a first step towards changing conditions which create poor health.

Organic gardeners are fully aware of the need to encourage biodiversity and to enhance the environment. Their ultimate aim is to leave the land and its ecosystems in at least the same state that it was when they started, or better.

## **What is Sustainable Gardening?**

Organic gardening and sustainable gardening are not always one and the same. If, for example, a farmer practices organic gardening on a piece of land but cannot support his family by so doing, the venture may be short-lived.

Twentieth century agriculture emulated industrial production where the farm was vertically integrated into a larger industrial process (e.g. making of orange juice). The farm was no longer treated like a biological environment as large stands of a single crop were planted. The realization later came that such ventures were unfriendly to the environment and were unsustainable.

For farming to be sustainable, besides embracing methods that are friendly to the environment, the venture must be profitable

and the farmers must have a high degree of self-reliance as regards off-farm inputs. Sustainability therefore has three aspects-economic, social and environmental.

The ultimate test of sustainability could perhaps present itself if international shipping was disrupted by events such as war or disease epidemic. A truly sustainable farm in Barbados would be able to continue producing then and for years after.

Sustainable farming is not always seen as purely organic gardening. In some countries a sustainable farm may be one which reduces, as best possible, the use of chemicals by a good integrated pest management (IPM) program.

Sustainable farming seeks to produce abundant food without depleting the earth's resources or polluting its environment. It follows the principles of nature to develop systems for raising crops and livestock that are, like nature, self-sustaining.

For farming to be sustainable it is also important for consumers to appreciate the value of organic produce and allow the organic gardener to make a living.

It is worth noting, also, that true **food security** is hard to achieve in the absence of sustainable agriculture.

Sustainable agriculture should really create vibrant rural communities, with families on the farms living financially rewarding lives, and wholesome food for everyone. This is the dream that lies ahead to be realized.



## Preparation and Planting

### *Finding the right seeds-*

Ideally you should use seeds which are produced for organic gardening. However, where there are no such local suppliers ordinary seeds can be used.

**Preparing the beds-** If plowing is necessary it should be done at least six weeks before. This will allow the stale seedbed technique to be done. Weeds are allowed to germinate and are killed two or three times before organic matter is mixed into the seedbed.

At three weeks before planting, compost or manure is incorporated in the bed.

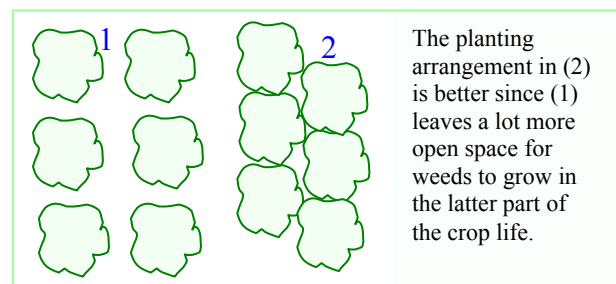
**Sowing-** It is best to transplant rather than to do direct seeding in the garden. Transplanted seedlings start with an advantage over weed seeds which would then have to germinate.

Seeds are sown before-hand in "speedling" trays at such a time that they will be ready for transplanting. Use potting mix that is free of chemical contaminants.



**Layout-** Consider your layout carefully before planting anything. It helps to draw a map showing what will go where and develop a time schedule for crop rotations (i.e the sequence for planting different crops). At this stage, plans are made for companion cropping and various intercrops.

Row spacing does not have to be "by the book" if you are not using a cultivator between rows. It is better to plant in such a way that plants shade out weeds completely when they are fully grown.



If using an inter-row cultivator, then by all means the row spacing should be set in such a way that there is enough space for the implement to pass through.

**Transplanting and Early care-** If available, corn gluten meal may be applied at planting to suppress weeds that have not yet germinated. The good thing about this meal is that it contains 10% Nitrogen which eventually becomes available to the plants. Ask your local agricultural supplier to source this for you.

After planting, pay close attention to watering in the next few days. Often in transplanting, the root system is disturbed and plants need careful watering. Nurture plants well and replace those which fail to respond (have about 5% of the number of seedlings as extra).

The idea is to get your plants growing as vigorously as possible ahead of any weeds that would soon germinate.

Watch out for white flies, aphids, etc which may infest the new young growth.

## Keeping the Garden Fertile

## Building Soil Fertility

Good soil fertility is very important for successful organic gardening. Plants growing on a natural balanced diet tend to be more resistant to pests and diseases and compete better with weeds. Organic growers use this to their advantage to reduce the need for pesticides. Creating a high degree of natural fertility in soil is at the heart of organic gardening strategy.

Building fertility is one of the most time-consuming aspects of organic farming. It is worth the effort, however, since the use of natural fertility is the essence of organic farming.

It may take hundreds of years for an inch of topsoil to form. This same rich soil can be quickly and easily lost from your property if you allow it to be washed away in a single downpour of rain. **Soil fertility is also lost each time grass clippings and other yard waste materials are sent to the landfill.** The first step towards building and maintaining fertility is to think towards **recycling** nutrients.

Conventional farming attempts to achieve good soil fertility by constantly adding large amounts of synthetic fertilizer. The organic gardener, on the other hand, builds fertility and maintains the condition of the soil by

careful recycling of the organic matter (includes returning crop residues to the soil).

After a while there is less need to look outside of the farm for large amounts of fertilizer material. The farming process is therefore more sustainable over time.

### Some tips for building soil fertility:

- Make an “inventory” of the materials that are available on your property that can be used for mulching and/or compost



All of the above will turn into **“Perfect blend” complete fertilizer** (N, P, K, Mg, Ca, S and all trace elements). It contains the “richness” of your soil.

**Don't throw it away at the landfill**

- Keep soil covered with a mulch or plan cropping in such a way that soil is never exposed to heavy rain. This way topsoil will not be eroded. Mulching will encourage earth-worms and other organisms that enrich the soil as well.

- Never push off and throw away topsoil from your property. Shift it away and re-spread it if necessary.

- Incorporate generous amounts of organic matter into the topsoil. Remember that it takes time for some materials (e.g. non-composted bagasse) to break down to a point where plants can use them. Such materials remove nitrogen from the soil before they can add it back. If these are added it would be necessary to add additional manure to supply nitrogen.

## How to Make Compost

### *What is needed for good composting?*

Composting is one of life's most natural and guaranteed processes. Any living thing is destined to return to "dust" once it dies. Any heap of crop residue will eventually decay to compost. To speed up the process we need to understand what to do. Rapid composting requires careful conditions to be set in order to achieve the result in a few weeks.

The most important conditions are:

- 👉 Organic matter of the right type. The material should be shredded or sufficiently succulent to be easily colonized by the decay organisms. Whole leaves may mat into tough layers that prevent intense heating inside the pile. Shredded materials will decompose faster.
- 👉 Moisture
- 👉 Heat
- 👉 Air
- 👉 Nitrogen
- 👉 Bacteria (& other microbes)
- 👉 A pile of the right size (1m x 1m x 1m [3ft x 3ft x 3ft] minimum for good heating)

### What **not** to put in compost heap

- ✗ Cooked food, meat scraps etc. These harbor rodents
- ✗ Troublesome weeds that will propagate from seeds or pieces in the compost (e.g. nutgrass). Compost created at high temperature may destroy the weed seeds but this is not typical.
- ✗ Plants that have stubborn thorns e.g. bougainvillea and rose.
- ✗ Pieces of broken glass, sharp metal or other objects that may injure you later when placed in the garden.
- ✗ Materials that have been sprayed or have been otherwise contaminated with chemicals.
- ✗ Manure from pets (cats, dogs, etc) may contain organisms that are harmful to humans.
- ✗ High gloss color magazines- the inks tend to be toxic.

### *Approaches to composting*

Composting can be very simple or very complex depending in which route you wish to take. In its simplest form and with lots of time to spare it could be a matter of putting materials in a pile or a container and allowing them to decompose.

In our climatic conditions in a few months compost which looks and behaves just like the one from the store will be obtained (except that it will be full of all kinds of creatures).

If time is of essence there are techniques that can be used to speed up the process.

In planning for compost making the questions coming to mind are:

- 🌱 Which container or enclosure to use?
- 🌱 How much time do I have?
- 🌱 How to create a compost heap without spoiling the aesthetic beauty of the surroundings?

Shredding is very important for rapid composting

## Making a Rapid-finish Compost

1. Spread about six inches [15cm] of loose bulky carbon rich material (“browns”) at the bottom of the bin or pile (5ftx5ft [1.6mx1.6m]) (e.g. dry leaves, hay, straw, sawdust, coconut husk).

2. Cover with a two inch [5 cm] layer of fresh nitrogen-rich material (“greens”); e.g. lawn grass clippings, green leaves, kitchen vegetable scraps, fresh manure.

3. Then add up to two inches [5 cm] of soil (activator). If you have not used fresh manure for the nitrogen layer add a handful of compost. You can also purchase an activator to supply micro-organisms. Activators contain the micro-organisms needed to get the composting process going.

4. Water the layers until the materials are evenly moist but not soggy.

5. Repeat the steps until your pile is 3 - 4 feet [1-1.3 m] high.

6. Turn your pile after a week to 10 days, making sure you mix the layers thoroughly.

Continue to invert every week to 10 days until the pile is no longer hot.

Your compost should be ready for use in 3 to 6 weeks.

A few ideas are presented for quick and easy composting. In the end it is all left to the imagination to use what is available and make it blend into the existing landscape.



Four ways to handle a compost pile, including (1) which is designed for composting in the kitchen. (2) allows for easy rotation. (3) and (4) are traditional types which allow for separating new, decomposing and finished materials.

### What happens in a rapid-decay compost pile?

Decay organisms colonize and breakdown the tissues in plant (and animal) material which make up the pile. The organisms use moisture, air, and nitrogen and quite a lot of heat is generated. If the pile is on the ground earthworms, ground beetles and other creatures will also move in and participate. Eventually humus is formed.

The heat can be enough to kill weed seeds and some disease spores. In a few weeks the material looks like soil (brown and small loose particles). Compost has been formed.

**Vermiculture-** earthworms can be used to break down vegetative materials into compost. Worms are multiplied and put in containers with the plant material to convert the material.



## Getting the Materials for Compost

### *Sources of Material*

Almost any plant material on the property can be used in making compost. Uncooked vegetable scraps from the kitchen can also be added. It is best to avoid plants that have sturdy thorns such as bougainvillea or roses and plants that have a lot of seeds on them (especially if the plant is a troublesome weed). Woody stems should be avoided since these will not decompose quickly and may harbor termites on the property. Large woody branches can be burnt and the ashes used in the garden.

During the rainy season when grass and foliage grow in abundance, extra material should be harvested as quickly as it grows and made into compost.

It is useful to make a mental inventory of the material that is available on your property. Material for compost making may be obtained from:

- ✿ Fence clippings e.g. Croton, hibiscus.
- ✿ Lawn grass cuttings.
- ✿ Branches removed from fruit trees.
- ✿ Uncooked vegetable scraps from the kitchen.
- ✿ Bushes and tall grass on your own or adjacent properties (with appropriate permission, of course) e.g. wild tamarind, khus khus grass, guinea grass, sour grass.
- ✿ Animal manure e.g. chicken litter, cow dung.
- ✿ Rinsed seaweed.

### *The “greens” (moist nitrogen-rich)*



The “greens” component includes materials like lawn and hedge clippings, fruit and vegetable scraps and green branches off fruit and other trees.

### *The “browns” (bulky carbon rich)*



The “browns” refer to bulky carbon rich material such as, straw, dry coconut husks and leaves, sawdust, bagasse, etc.

### *Activator*

An activator may be added to the heap to introduce the microbes that will cause the decay.

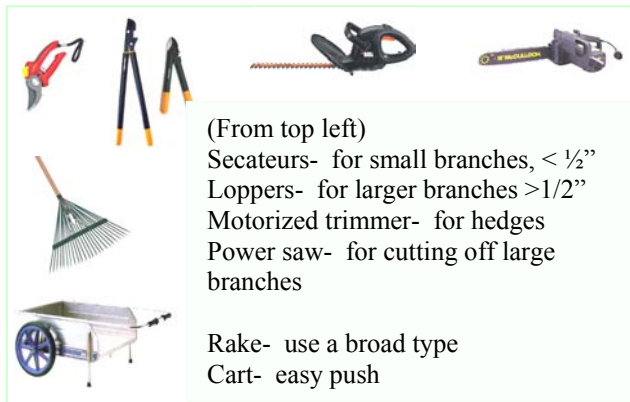
### *How much material can you get from around the house?*

A single **cutting of a lawn** of 500 sq. ft [55 sq m] with 6 inch [15 cm] tall grass can generate one barrel (36 cubic ft [1.2 cub. m]) of grass clippings. Trimming one foot [.3m] off a **croton hedge** 40 ft [13.3 m] long can yield one barrel of shredded material or four barrels of mulch. A household which uses **peeled vegetables** and eat fruit regularly most days can have one 5 gal [18.75 L] bucket of peels and waste each week.

## Collecting Materials

### Useful Tools and equipment

It helps to use modern tools to make the task at hand easier. The vacuum blower and the bag mower are invaluable for collecting and shredding materials for composting. A dedicated shredder is better for chopping green stems, fence and fruit tree branches for composting. The following tools are worth keeping in the tool shed:



*Always follow safety instructions when using any power tool*



The **vacuum/blower** makes it easy to collect and shred fallen leaves from under fruit trees and hedges. The drier the material the better it is shredded.



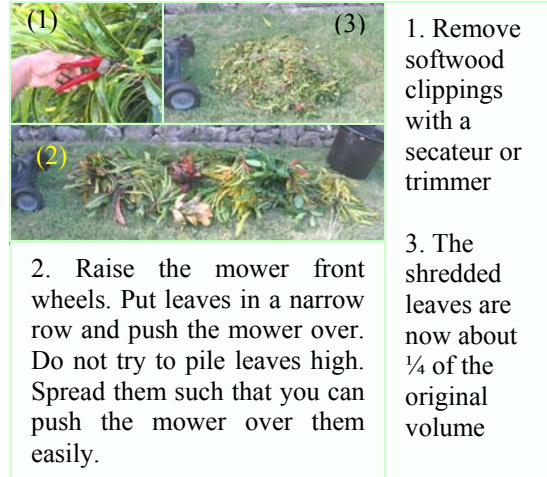
The **bag mower** helps in collecting grass clippings. It can also be used to shred leaves.



A **shredder** is very useful for dealing with bulky materials such as coconut leaves and husks. Prices are falling.

### Shredding using a bag mower

Fence clippings can be obtained by removing the leafy boughs from the plants. It helps then to shred these to a smaller size.

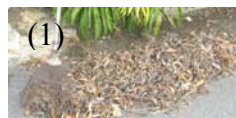


### Grass clippings

Lawn grass clippings are best obtained using a mower which has a bag attached. In the absence of a bag mower the clippings are raked and put in bags or a cart.



### Shredding dry leaves with a vacuum/blower



1. Spread out dry leaves loosely in a row using a rake. Suck up leaves with vacuum/blower.



2 Leaves are shredded/ compressed to about 1/7 the volume. Stones and twigs are usually left on the ground.

## Composting Ideas

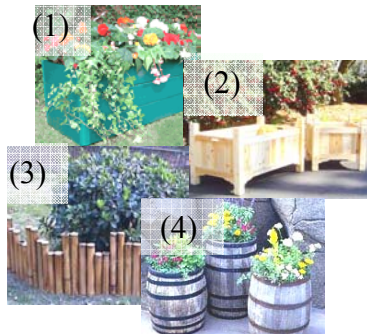
Compost material around the house does not have to be unsightly. There are many ways to maintain the aesthetic beauty of your kitchen and backyard while making precious fertilizer.

### *Handling vegetable scraps in the kitchen*



Try attractive containers like these for hiding away vegetable and fruit peels until you take them outside

### *In the backyard*



Hide compost in a big container and put potted plants on top (1 and 4). You could use an attractive greenheart or purple heart container (2) to hold it (bottom could be plastic-lined with holes punched to allow airflow). Why not just toss it behind a fenced-off area like this bamboo screen (3)?



Four different ways to handle compost material. (1) and (2) are the tumbling types which allow for easy turning of the compost. (3) and (4) could do well for leaf litter composting. Throw the leaves in and leave them to rot.

### *Recreating that “pile of leaves under the breadfruit tree” in the modern home garden*



Remember that old mango tree where “granddad” raked all the leaves and left them and how well it bore fruits? Recycling nutrients really pays off.

That old pile can be recreated on the modern property with the help of fences to maintain the beauty of the property. Plant four fruit trees close together and make a square fence to enclose the area. The fence could be artificial or it could be decorative plants.

Compost material can be placed inside the fenced area and left to decay. The fruit trees will also get some of the nutrients and will perform even better.

## Natural Fertilizers and Manures

### *Cover crops*

Cover crops are not only good for keeping weeds down and protecting soil from erosion, but some crops can manufacture nitrogenous compounds from the nitrogen in air. Cowpea or rounceval (*vigna sp*) and spinach are good local examples of such a crop. When the plants are ploughed in and decay the nutrients add to the soil fertility.

### *Ashes*

Wood ashes are a good source of potassium (about 5%) and trace minerals. Burning of woody branches is a good way to recycle these nutrients and to avoid a buildup of termites on the property.

Ashes tend to increase the alkalinity of soil. It is important to do a soil pH test at least once a year if ashes are incorporated often. This is important because most of our soils already have problems on account of being too alkaline.

### *Bone meal*

Bone meal is a good source of phosphate. It contains about 15% phosphate (and 3% nitrogen) and is often used as a transplanting fertilizer.

### *Seaweed*

Seaweed is a good source of potassium (kelp meal has 5%) and also contains trace elements often in a chelated form which is easily absorbed by plants. Liquefied seaweed makes a very good foliar fertilizer.

### *Animal manures*

Animal manures are the very best all-round fertilizers available to organic gardeners. These manures add humus to the soil; something that no chemical fertilizer does.

### *Rock phosphate*

A natural source containing up to 25-30% phosphate.

#### **What is the difference between humus and organic matter? .... And what is so special about humus?**

Soil **organic matter** refers to all plant and animal material at various stages of decomposition in the soil. **Humus** is the residue left after extensive decomposition of plant and animal materials. It makes up about two thirds of the organic carbon in soils and supplies the cementing substances for good aggregate formation. The presence of humus makes the difference between a flat silty soil with no texture and nice friable soil. Humus plays an important role in making nutrients available to plants (nutrients that would be otherwise locked up in the soil). Humus also allows soil to hold more moisture and deters leaching of nutrients from soil. **The organic gardener seeks to constantly enrich the soil with humus.**

Any of the above materials can be added to compost to improve the nutrient content. Ordinary compost usually has the Nitrogen: Phosphate: Potassium at the ratio of 3:3:1. In order to boost the amount of nitrogen, for example, it would be necessary to add a material such a blood meal or cotton seed meal to the heap. This would raise the proportion of nitrogen in the final compost. It should be worthwhile to boost the level of potassium since plants use it at about three times the rate of nitrogen.

## Composition of Some Organic Fertilizers

In organic gardening jargon animal manures are termed hot or cold. Hot manures such as chicken, rabbit and sheep have a high proportion of nitrogen. Cold manures such as from the cow have a much lower proportion of nitrogen.

The nutrient make-up of animal manure varies depending on how the animals are fed, the age and condition, and whether there is bedding mixed in.

The nutrient value of manure is in effect more than what a lab analysis would show. This is because manures enhance the release of other nutrients that would normally be locked up in the soil. The crop therefore has a much better supply of nutrients beyond what the manure itself contained.

Fresh manures may contain disease causing pathogens e.g. salmonella which are harmful to humans. Never apply fresh manure to crops which are eaten uncooked (e.g. lettuce).

Chicken, sheep and goat manures are usually available at local farms (often for a small price per bag).

There are several organic fertilizers that can be purchased and used in preference to traditional synthetic fertilizers. In Barbados it may not be easy to obtain some of these fertilizers, but they are available on the market in North America.

### *What's in typical organic fertilizers?*

| Material                   | % N<br>(Nitrogen) | % P <sub>2</sub> O <sub>5</sub><br>(Phosphate) | %K <sub>2</sub> O<br>(Potassium) |
|----------------------------|-------------------|--|----------------------------------|
| <b>Cottonseed meal</b>     | 6-7               | 2  | 1                                |
| <b>Blood Meal</b>          | 12-15             | 1  | 1                                |
| <b>Alfalfa</b>             | 2                 | 0.5  | 2                                |
| <b>Bat Guano</b>           | 10                | 3  | 1                                |
| <b>Fish Meal</b>           | 10                | 4  | 0                                |
| <b>Fish emulsion</b>       | 3-5               | 1  | 1                                |
| <b>Bone meal</b>           | 1-4               | 12-14  | 0                                |
| <b>Rock Phosphate</b>      | 0                 | 25-30<br>(only 2-3% available)                 | 0                                |
| <b>Greensand</b>           | 0                 | 0  | 3-7                              |
| <b>Seaweed (kelp meal)</b> | 1                 | 0.1  | 2-5                              |
| <b>Wood Ashes</b>          | 0                 | 1  | 5                                |
| <b>Garden compost</b>      | 3                 | 3  | 1                                |
| <b>Manures</b>             |                   |  |                                  |
| <b>Chicken</b>             | 1.6               | 0.6  | 1.6                              |
| <b>Cow</b>                 | 0.7               | 0.2  | 0.5                              |
| <b>Sheep</b>               | 2                 | 0.5  | 2.3                              |
| <b>Pig</b>                 | 1                 | 0.3  | 0.7                              |
| <b>Horse</b>               | 0.7               | 0.15   | 0.4                              |

You should ask your local suppliers about the possibility of stocking such materials. Few of the products above are on the shelf locally, but there are readily available overseas. It would be advisable to contact the Ministry of Agriculture and enquire about procedures for importing these and other agricultural materials before ordering.

## How to Apply Organic Fertilisers

### *Before planting*

Manure should be applied at least three weeks before planting.

For **cow or horse manure**, apply at least 25 lbs. per 100 square feet [11.4 Kg per 11 sq. m] of garden soil. This amount may be supplemented with 2-3 lbs [.9-1.4 Kg] of ground rock phosphate. Crops growing in local soils benefit well from the addition of rock phosphate or bone meal.

If using **poultry, sheep, goat or rabbit manure** apply at least 12 lbs. per hundred square feet [5.45 Kg per 11 sq. m] and no more than 100 lbs. per 100 square ft [45.4 Kg per 11 sq. m].

Compost may be broadcast at the rate of at least 25 lbs. per 100 square feet [11.4 Kg per 11 sq. m] and up to 200 lbs. per 100 square feet [90.8 Kg per 11 sq. m].

Broadcast the manure or compost evenly over the plot and then mix it into the topsoil with a stiff rake or roto-till.

### *After planting (as a side dressing) if needed*

Cow or horse manure- up to 5 lbs per 100 square ft [2.3 Kg per 11 sq. m]

Poultry, sheep, goat, rabbit manure- up to 3 lbs per 100 square feet [1.4 Kg per 11 sq. m]

Scatter a band of manure down each side of the row and work it lightly into the soil surface.

Be very careful with handling fresh pig, dog or cat manure. These manures may carry diseases/helminths that are troublesome to humans. If these manures are used they should be well composted and, even then, avoid using with crops such as lettuce or cabbage (which may be eaten raw).

### *Do not overuse organic fertilizers*

Since organic fertilizers tend to have low concentrations of nutrients there may be a temptation to apply excessive amounts. It would be very difficult to burn plants by applying compost. It is all decomposed plant tissue and the levels of nutrients are very close to what exists in the living plants. Some other organic fertilizers are different.

While most manures may not burn the plants when decomposed (fresh chicken or sheep manure may injure plants), it must be remembered that they often contain levels of nutrients similar to synthetic fertilizers (blood meal has 15% nitrogen which can be released very quickly into the soil water; N.B the popular 12:12:17:2 chemical fertilizer has 12% nitrogen).

Just as with chemical fertilizers, these nutrients (especially nitrogen [nitrate]) can end up leaching into groundwater if applied at rates far beyond what plants can utilize in a given time.

The best approach to taking care of your plants is to proactively build the fertility of the soil and to encourage all manner of soil creatures that will help maintain the best level of organic matter in the soil (humus included). In this way there will be little need to add large doses of fertilizer at any one time. If recycling is a standard practice, then the losses of nutrients from the garden will be minimal.

## What do plants need?

### Macronutrients

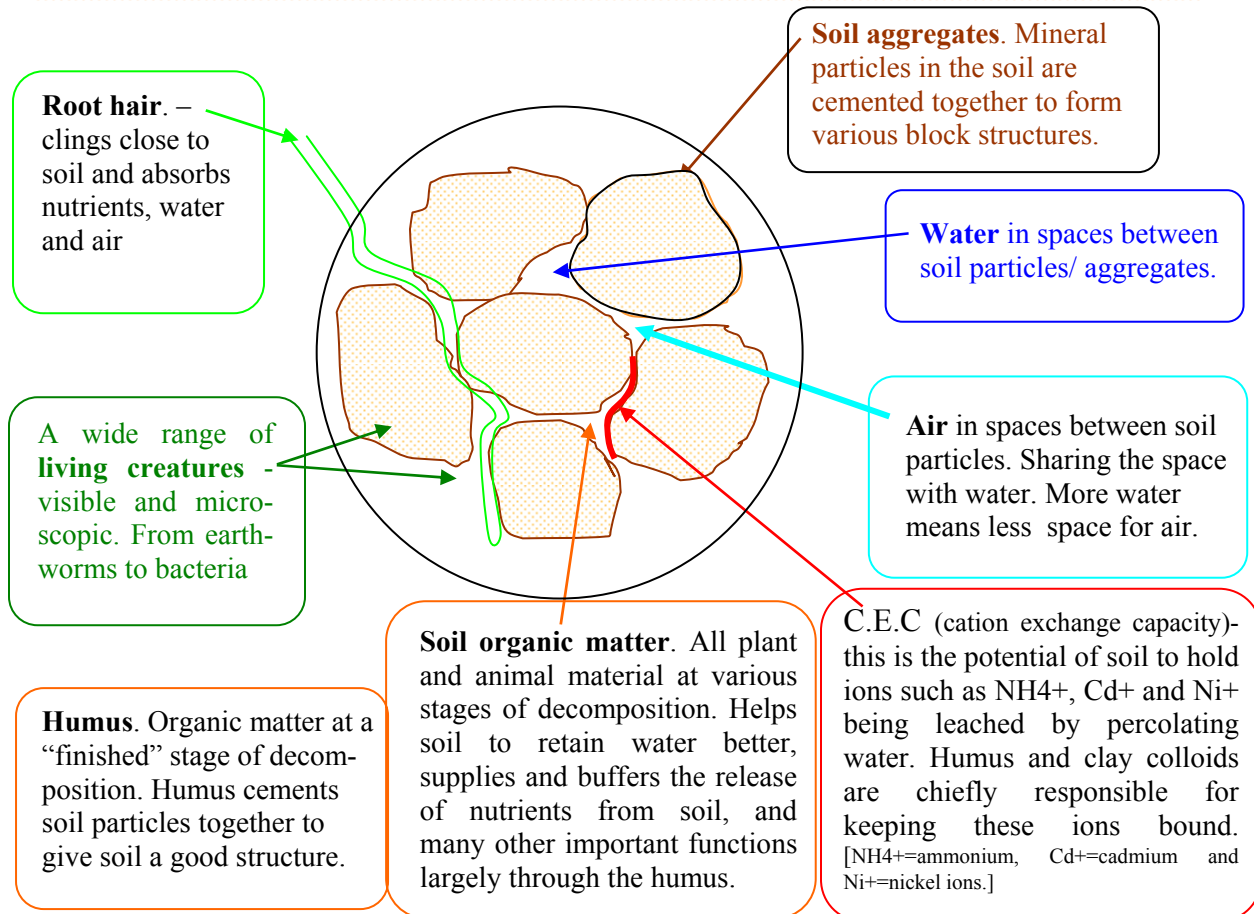
Plants need nitrogen, potassium and phosphate in large amounts. Crops use these nutrients at the rate of many lbs per acre [Kg/Ha]. These nutrients, to a plant, are comparable to what protein and carbohydrate food sources would be to a human.

Sulphur, magnesium and calcium are used in “not so large” amounts.

Plants use carbon, oxygen and hydrogen in large amounts but we do not seek to supply these.

## What's in soil?

Soil is not just mineral particles. It is a complex system of living creatures and organic matter with spaces for air and water. Organic matter, especially humus, has a positive impact on soil structure and how the soil holds and releases water and nutrients.



### Micronutrients

Other essential nutrients that are needed are referred to as micronutrients.

These are:

- Iron
- Manganese
- Zinc
- Copper
- Chlorine
- Boron
- Molybdenum

These are used in small to minute quantities and would be, to the plant, similar to what vitamins are to humans.

Spraying solutions of these nutrients on leaves can make a lot of difference to how well plants develop in local soils.

### “Watering on” the Fertilizer

Applying fertilizer in liquid form to leaves has its benefits. Some nutrients such as calcium, iron and other micronutrients are sometimes better absorbed by the plant when applied directly to the leaves.

It is often better to apply liquid fertilizer through drip irrigation lines. By fertigation (as it is called) the nutrients are applied directly to the root zone so that a plant can better compete with weeds. When fertilizer is broadcast evenly over the bed, both the weeds and crop have equal access to the nutrients.

Fertilizer “tea” can also be watered on to the garden using a watering can. Try to water directly at the roots of the plants.

### Foliar sprays

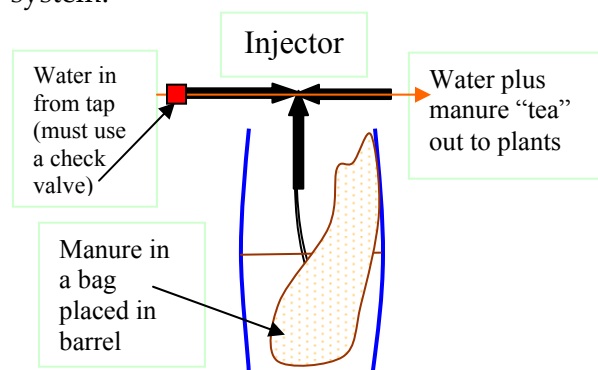
**Liquefied** seaweed is very good as a foliar spray. This fertilizer contains a range of micronutrients, many of which are in a chelated form (i.e. a form that is more easily absorbed). The nutrients are more easily assimilated by the plant.

When plants are sprayed with micronutrients such plants are more robust and tolerant of diseases. Plants that have been boosted with micronutrients are also more tolerant to harsh droughty conditions.

### Fertigation

Some of the substance in manures and compost can be “steeped” into water and applied through the drip line. This process is often called “tea” brewing. The manure or compost is left in a cheesecloth bag soaked and dissolved into water. The resulting “tea” can be watered into the root zone of plants.

Some local growers put bags of chicken manure in a 55 gal. drum and use a venturi injector to send the “tea” through the drip irrigation system. If this is done from a domestic water supply a check valve must be used to prevent backflow into the water system.





## Dealing with Weeds

### Strategy for Handling Weeds

Surveys conducted in the USA have shown that weed management is the most difficult task for organic growers.

Dealing with weeds on the typical small farm where “kill and cure” chemical herbicides are used can still be a real challenge especially in the wet season. Organic farmers do not have the facility of chemical herbicides and, for many, managing weeds is as much an art as a science.

Since the preservation of biodiversity is one of the important principles of organic farming it is not appropriate to kill every non-crop plant on the farm. The organic gardener depends on a very careful blend of approaches and techniques to stay on top of weeds.

Weed management focuses on giving the crop plants a competitive edge over all other plants that may try to come up in the garden beds. The organic grower uses a combination of methods to suppress the weed population. In some situations where it becomes necessary to kill weeds there are commercial organic herbicides that can be used. There are also specialized tools such as flammers that can be used.

#### Approaches

■ **Crop rotations**- Each crop or crop type has its own types of weeds that proliferate when it is grown. It is good to rotate different crops in a

cycle. Rotation introduces diversity to crop ecosystem and could avoid buildup of particular weeds.

- **Soil nutrients and structure**- planting in soil which has a good tilth and is fertile gives the crop plants a much better chance to outgrow weeds. In harsh soil conditions most weeds can grow where the crop would fail.
- **Crop choice**- some crops have a better chance of competing against certain weeds. It may be a futile exercise, for example, to try to grow onions successfully in a bed full of nut grass.
- **Cultivations**- a single deep plough can bring up the seeds of weeds that have not been seen for a long time. Choose cultivation method and depth carefully.
- **Sowing, planting, mulches and cover-plants** can be planted close enough that weeds are shaded out early or planted precisely far enough apart to allow the use of tools. Mulches and solarization [covering with clear plastic to heat up soil] can also be used to control weeds.
- **Crop production techniques**- careful placement of irrigation water by a drip system can limit how much water is available to weed plants and give the crop a “head start”.
- **Machine weeding**- there is a range of equipment and tools available for controlling weeds without use of chemical herbicides.
- **Hand weeding**- if time allows, hand weeding is always an alternative. Hand weeding can be a mentally relaxing exercise.
- Grasses such as khus khus grass, sourgrass and guinea grass are invaluable as mulches. Khus khus grass doubles as a deterrent to slugs. Try using dry leaves from plants such as certain palms, breadfruit, almond, banana, and avocado. These larger leaves stay in place and cover the ground well (but look out for slugs).

## Dealing with Difficult Weeds

Nutgrass and devil grass can be very difficult to control. If you have a heavy infestation the best way to tackle the problem is to “fork out” as many of the tubers/rhizomes as you can. This is tedious work and it may be helpful to pay someone to do it properly. But having had it done your life in the garden will be a lot easier.

Broadleaf weeds that produce a lot of seeds early can also be very difficult to control. These are best weeded out before seeds set. Keep these weeds out of compost. They can be burned and ashes returned to the soil.

## Mulching and Cover Crops

### *Mulching*

In Barbados the easiest way to control weeds is to use fabric mulch or ground cover (full control). This is especially useful for plants such as thyme which will be in the ground for a long period. The material allows water and air to pass through. Dry leaves of plants such as almond tree, breadfruit trees (whole or shredded), khus khus and guinea grass can also be used for mulching.



### *Cover crops*

Cowpea (rounceval), spinach and sweet potato are good for use as a cover crop. Cover crops are useful for keeping weeds down when nothing else is planted. Cover crops also reduce the amount of potential weed seeds since weeds do not get the chance to grow and shed seeds.

## Special tools for Post-Emergent Control



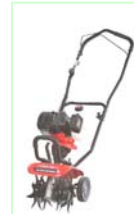
Flame weeder

Uses propane open flame to kill weeds. Not as effective against grasses as broadleaf weeds.



Infra red burner

Uses radiation from a heated element rather than an open flame. Can be directed better towards weeds.



Small Cultivator-

A motorized cultivator can be used between rows. Since the soil in organic gardens are generally loose this equipment will work well. May not be effective on virgin soil.

*Always follow safety instructions  
when using any power tool*

## Organic Herbicides

### *Pre-emergent*

Corn gluten meal can be applied at 20 lbs per 100 square feet [9.1 Kg per 11 sq. m]. prevents weed seeds from germinating



### *Post-emergent examples*

There are nonselective weed killers made from all natural ingredients, including eugenol (clove oil), 2-phenethyl propionate (peanuts), castor oil, thyme oil and winter-green oil.

Another formulation is made from clove oil, vinegar and lemon juices. This weed and grass killer is a broad spectrum natural herbicide.

## Other Hints

- If space allows, create a spot in the garden where a range of weeds and useful plants can grow freely without getting in the way of your garden crops.
- Do not allow persistent weeds to set and disperse seeds in the garden bed. Each plant that gets to set seed may mean tens or hundreds of new weeds to germinate in the garden bed.

- If contact weed killers need to be used, best results are often obtained when weeds are young and actively growing.
- If using cow or sheep manure, try to know the type of grass used for “bedding”. Sometimes troublesome grasses can be introduced into your garden bed as part of the pen manure.
- The designs of hoes have changed considerably over the years. Try different designs and see which work best. There are also new devices that can save you from bending over and allow you to remove weeds that are normally hard to uproot.

Ask your local dealer about stocking such implements.



## Coping with Pests

The key to managing pests in the organic garden

lies in encouraging the natural balance of pests and beneficial insects. In this way the natural predators of the pests will be around to keep the population in check. A good mixture of plant species on the farm encourages a diverse insect population.

There is also increasing evidence that excesses or deficiencies of nutrients encourage quicker buildup of some pests. Aphids, for example, multiply more rapidly when plants are fed excess nitrogen (growing too green). Similarly some diseases have been known to develop when key micronutrients are deficient.

The organic gardener can do a lot to limit pest outbreaks by strategic intercropping and by maintaining good soil fertility.

There are also products that can be purchased and used for safe control when outbreaks occur. Natural pesticides can also be made.

## Some Difficult Pests

In Barbados white flies, mites, thrips and aphids are often very difficult to control. Typically when conditions are right these pests multiply so rapidly that a farmer can be overwhelmed by the high population. Birds, especially the sparrow, can be difficult pests as well. Netting can be useful in a small garden.

Slugs are often the unseen enemy. Where mulches are used (except for khus khus grass) slugs can become a problem. There are a number of safe products on the shelf nowadays for controlling slugs.



*Know your friends (the beneficial creatures)*

Ladybirds, as attractive as they look, are voracious predators of some pests, especially aphids. There are also many parasitic wasps which keep pest numbers in check. Bees, earthworms and many other creatures have important parts to play in keeping the garden productive.

It is important to recognize the beneficial creatures and to avoid killing them or driving them away from the property



*Above: A mini-wasp getting rid of a pest.  
Below: Lacewing larva feeding on immature white fly*

## A note on diseases

Plants which are grown with a good balance of nutrients are less prone to disease. Many diseases also thrive or escalate either in wet or dry conditions. For this reason many diseases that may attack foliage or fruits may be avoided when water is applied only to the roots by drip irrigation. Growers should avoid the urge to wet foliage unnecessarily.

Where disease infection escalates, there are safe products that can be purchased or made to treat the problem.

## Cultural Methods

### *Mixed cropping*

Departure from mono-cropping has its advantages for pest control. Companion cropping, alley cropping, rotation and various planting arrangements help to restrict the rapid establishment of any one insect as a pest.



The art of intercropping was well known by our forefathers and can still be seen in many plots throughout the island. This plot (taken in 2005) had rows of eddoes, corn, sorrel, cassava, yam sweet potato, banana and plantain.

### *Variety selection*

Get to know which varieties stand up better to pests and diseases

## Commonly used Organic Pesticides

Many natural pesticides are sold commercially:

*Neem extract*- In virtually every local community park you will find a neem tree. Neem seeds and leaves contain natural compounds that have insecticidal properties. The compounds have been used in a range of commercial insecticides (e.g. Neemex)



Neem seeds and leaves

*Thuricide*- (e.g. dipel) contains bacteria of the bacillus type. The bacteria attack and kill caterpillars.

*Pepper*- Hot pepper is a repellent for many insects. The ingredient in pepper (capsaicin) is used in many formulations to repel and disrupt insects. Pepper wax contains, additionally, paraffin wax

and plant nutrients to protect from insects while feeding plants.

*Garlic*- Garlic is very useful as a repellent to a range of insect pests.

*Soaps*-Insect soap is a contact insecticide, miticide and fungicide for the control of soft bodied insects, mites and the fungus, powdery mildew. It is based on potassium salts of naturally occurring fatty acids.

*Pyrethrin*- is a natural plant derived substance that comes from the chrysanthemum "painted daisy". It can kill insects rapidly at very low concentrations.

*Rotenone*- is a natural plant derived substance contained in the stems and roots of certain tropical plants, such as the Jewel Vine or Flame tree. It is an insect stomach and contact poison.

*Citrus extract*- These act as repellents. The active ingredient d-Limonene (orange peel extract) destroys the wax coating of the insect's respiratory system. When applied directly, the insect suffocates.

*Sticky traps*- used to attract and trap insects.

There are many other types of organic pesticide such as growth regulators, diatomaceous earth and pheromones which can be used to control pests.

*Baking soda (for diseases)* - This is useful for controlling fungi (usually 5% by volume in water and sometimes mixed with horticultural oil).

## Managing Difficult Pests

Practice scouting for pests; Look closely at plants especially under the leaves. If you can detect some pests early you may be able to stop a huge buildup before it can happen.

| Pest         | Control (or deterrent) method or approach  |
|--------------|--|
| White flies  | Neem oil, ginger, garlic, combination spray, early detection, try blasting plant with water or using a strong vacuum.                                |
| Mites        | Neem oil, Tumeric, sweet basil, onion spray.   |
| Thrips       | Neem oil & soap, pepper, ginger, insect growth regulator (IGR), traps, mulch, garlic planted at base of the plant, good sanitation, early detection. |
| Aphids       | Tumeric, garlic, ginger, pepper, soursop, onion spray, control the ants.   |
| Scales       | Chive tea, neem oil, control ants.   |
| Leaf miner   | Neem oil, sweet basil.   |
| Caterpillars | Tumeric, pepper, soursop, thuricide.   |

Repellants and deterrents must be applied before the pest or disease arrives

### Photos of common pests



Thrips- these are not easily seen with the naked eye. A hand lens would allow a look at the adult (as seen here).



Whiteflies on the underside of leaf (inset photo of adult). White cottony spots can be seen on the leaf as well



Spider mite- A hand lens would allow the mites to be seen on the leaf under-surface.



Mealy bug on young stem. A fluffy cottony mass surrounds the larva.



Aphids- Aphids cling to the stem in large numbers at the succulent growing tips and young leaves of plants



Leaf miner trail. The actual insect is not visible here. The miner eats a trail through the leaf, leaving the trail of dead tissue shown.



Scales- scales attach firmly to the surface of the leaf, usually the underside (seen in black circle)



Caterpillar (cabbage looper) - an example of a caterpillar.

## Making your own Natural Pesticides

### *Plants with pesticidal properties*

| Plant               | Part used                  |
|---------------------|----------------------------|
| Soursop             | Seeds, leaves, young fruit |
| Basil (Sweet Basil) | Leaves and stem            |
| Hot pepper          | fruit                      |
| Garlic              | bulbs                      |
| Ginger              | rhizome                    |
| Neem                | Seeds and leaves           |
| Papaya              | Seeds,leaves,young fruit   |
| Tobacco             | Leaves and stalk           |
| Tumeric             | rhizome                    |

### *Recipes for natural pesticides/deterrents*

#### **Pepper combination all purpose sprays**

1. Blend 3 hot peppers, 2 onions and a bulb of garlic in 1 litre of water. Boil. Let stand for 2 days. Strain. This may be frozen for future use.
2. 6 cloves of garlic, 1 tbsp dried hot pepper 1 minced onion, 1 tsp pure soap (not detergent) 1 gallon hot water

Blend & let sit for 1 - 2 days. Strain & use as spray. Ground cayenne or red hot pepper can also be sprinkled on the leaves of plants (apply when leaves are slightly damp) to repel chewing insects. Protects plants from cabbage worms, caterpillars, hornworms, aphids, flea beetles and other chewing/sucking insects.

**Onion spray-** Blend one unpeeled onion with 1 litre of water until it is a milky colour. Strain. Helpful with aphids and red spider mites.

**Garlic spray-** Soak 4 garlic cloves in 1 litre of cold water for 3 days. Blend and strain. Helpful with ants, caterpillars and cabbage worms.

**Neem spray-** Crush 500 g of neem seeds. Mix the crushed seeds with 10 L of water and leave to stand for at least 5 hours (preferably overnight). Strain this through heavy cloth or gauze and it is ready for spraying.

**Chive tea-** Pour 600ml of boiling water over 1/4 cup of dried chives. Leave to infuse for one hour. Strain. Dilute 1 part spray to 2 parts water. Helpful for scale and mildew.

**Salt spray-** Mix 125g salt with 9 litre of water and 30g of soft soap. Helpful in controlling white cabbage butterfly.

**Bordeaux spray -** Stir 90g copper sulphate into 4 1/2 litres of hot water. Leave overnight. Mix 125g garden lime with 4 1/2 litres of cold water. Mix a sufficient quantity of spray for immediate use by mixing equal parts. Store the balance of the mixtures separately.

**Spray for powdery mildew-** To remedy this problem, mix 3 tbsp Baking Soda, 2½ tbsp horticultural oil and one gallon of water. Spray the mix onto infected plants. Reapply as often as needed. Powdery mildew is a fungal disease that affects beans, cucumbers, melons, peas, pumpkins, squash as well as many fruit trees and roses.

When using any pest control apply before sunrise and after sunset so that foraging bees are not affected. Use several times a day if pest problem is chronic and after rain.

Homemade sprays should be stored in a glass bottle in a dark place away from children. Most of the sprays can be stored up to a month, with the exception of the Bordeaux spray which should be used immediately. The pulp left after straining the mixtures can be dug into the garden or put in your mulch heap.

## Using a Greenhouse to your Advantage

The tropical greenhouse allows for the ultimate control of pests and diseases. Birds and insects can be excluded by the appropriate mesh on the sides. Since plants are sheltered from direct rain, many moisture dependent diseases are also easier to control. On the other hand the humidity can be controlled by misting if desired.

Greenhouses also present the ideal situation for biological control of pests. When control agents are released they are restricted to staying within the greenhouse. With such limited space the predators/ parasites are usually more effective at seeking and destroying the pests.

In Barbados there is no need for heating and lighting in the greenhouse so all that is required is a transparent roof to keep out rain while letting in sunshine. An the appropriate mesh is used on the sides to keep out birds and/or insects. The structure must be designed to prevent heat from building up inside.

Rainwater can be collected from buildings on the property and from the roof of the greenhouse and stored in a tank. Plants in the greenhouse can then be watered according to their needs.

Small greenhouses are becoming more and more available at typical home and garden stores overseas at affordable prices. A greenhouse with a floor area of 80 square feet



(8'x10') [8.8 sq. m] can be used to grow special crops.

Not all plants are worth the effort in the greenhouse. Generally tomatoes, crucifers, cucumber, squash, sweet peppers and herbs are the first choices. It helps to stake tomato and cucurbits.

### *Inside the greenhouse*

Planting space inside is increased by doing multi-story beds.

If you are not planting directly in the soil you can fill pots (or bags laid flat) with a mixture of soil and compost to use as a medium.

Inside the greenhouse the plants can also be fed organic fertilizers by hydroponics if desired.

When using a greenhouse it is important to keep good sanitation inside. Since the area is enclosed you have to be sure that you do not take in pests and diseases when you enter.

A home made greenhouse can be constructed using thin Perspex or sturdy plastic on the roof and insect mesh on the vertical walls (or bird mesh if you only want to exclude birds). Try chain link post materials and fittings for the frame. It would be best to calculate the total cost and then compare to what it would cost to buy a prefabricated structure.



Sometimes putting loops over the beds and covering with translucent mesh may be a cheaper alternative to the walk-in greenhouse structure. Be sure to allow for good ventilation.



## Keeping Adequate Moisture in the Soil

### Understanding the Local Climate

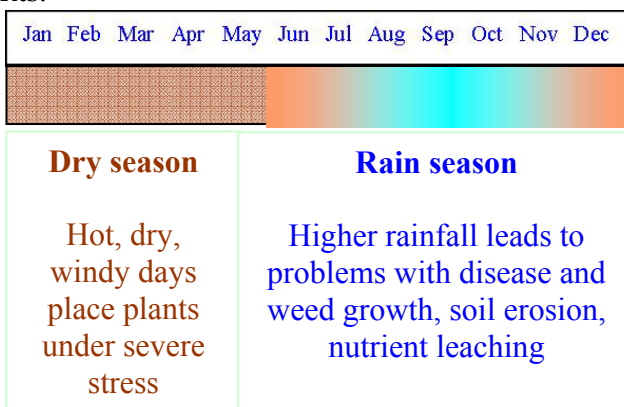
To manage the garden well it helps to understand the local climatic cycle and what it means to the growth of plants.

#### The dry season

The dry season runs from about January to May. This is a period of intensely dry, hot and windy conditions. Plants may undergo severe stress if not well watered during this time. In order to keep cool and to feed, plants transpire water from the roots up to the leaves and out to the atmosphere.

Whenever it is too dry, or plants are losing water too fast plants stop transpiring to avoid desiccation (on hot, windy days).

At this point feeding also stops. On such days the plant may not get enough of nutrients such as calcium, zinc and boron which cannot be moved from old leaves. For this reason micronutrient sprays are very helpful to plants growing under droughty conditions.



A mulched bed next to two exposed beds. Mulching conserves moisture, controls soil erosion, weeds and some pests.

#### The wet season (rain season)

In the wet season (June-December) moisture is abundant in the soil and the environment tends to be more humid. The wet, humid conditions encourage foliar diseases and the proliferation of weeds. Intense rain showers may also cause erosion if the soil is not well protected.

It is worth noting that in some years there is a dry spell in the month of September in the midst of the rain season.

### Conserving Soil Moisture

When it comes to watering crops **the gardener should not only think of applying water, but also conserving moisture in the soil.**

#### Some tips on conserving soil moisture

- Use mulch to reduce evaporation from soil surface and keep soil moist.
- Do not leave soil exposed. Use a cover crop to keep the soil covered in the absence of mulch.
- Use windbreaks to shelter your crops.
- Incorporate organic matter to help the soil hold water better.
- Do not raise beds extra high in the dry season when growing shallow rooted crops (unless the field has impeded drainage).

## Making the Best use of Rain Water

Rainwater can be collected from roof and pavement surfaces and stored in a tank or channeled directly onto garden beds.

During the dry season this is a useful way of harvesting a larger amount of the rain water that falls on the overall property.

For every inch of rain that falls on 1000 square feet\* [110 sq. m] of roof about 560 gallons [2100 L] of water can be collected. This means for the average house which is 50ft [16.7 m] by 40 ft [13.3] well over 1100 gallons [4125 L] of water can be collected off the roof for storage.

(\* rates sourced from [www.skyjuice.us](http://www.skyjuice.us))

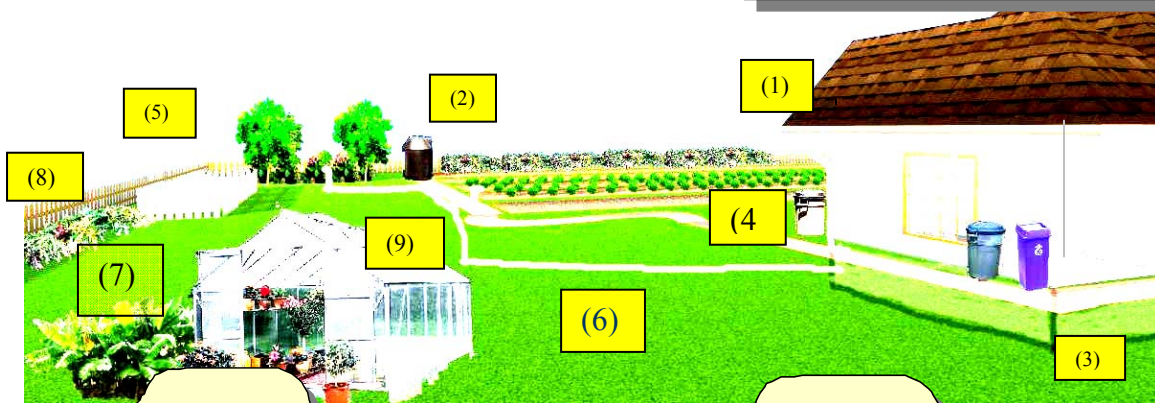
The “rain barrel”  
...water collection  
at its simplest



## Creating Oases on your Property

Create an oasis by focusing water and all the vegetative material on your property into the garden area.

Rainwater is collected from the roof (1) and channeled into a plastic tank (2) or a built-in tank (3) under the house. This is used to water the garden. Pavements can also be designed to bring water into an underground tank.



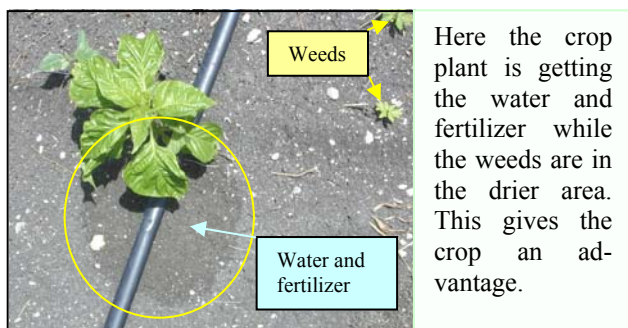
The oasis can be created inside a greenhouse (9) [by focusing water and compost inside]. The greenhouse offers better control over pests and climate.

Kitchen scraps are put in a separate bin (4) to add to the compost heap (5). Grass clippings (6) from the lawn, old leaves and branches from fruit trees (7) and hedges (8) (and crop residue) are put in the compost heap and then the compost added to the garden

## Watering

A drip irrigation system should be used so that water is used efficiently and with careful direction. The drip lines place the water exactly where plants can use it. Careful placement by drip irrigation reduces the water available to weeds, giving crop plants an advantage.

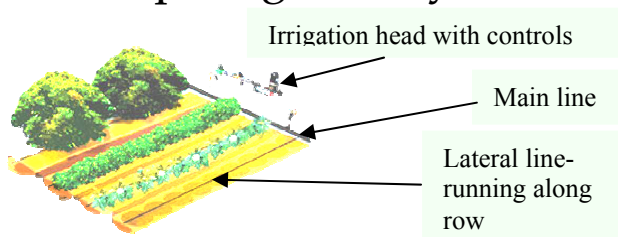
It is important to remember that plants need water in order to take in fertilizer. If you are using a drip system, the fertilizer should be applied in the water or otherwise placed in the wet area close to the plant.



## Sources of water:

- Well water
- Water collected from the roof and pavements
- Domestic water supply (can use chlorine filter)

## The drip irrigation system



## Important parts of a typical drip irrigation system



**Metering valve** – this valve allows you to deliver a preset amount of water to your garden and then turns off automatically. (Helps to save water).



**Pressure regulating valve**- if water pressure is very high this valve is used to prevent emitters and connections from being blown out.



**Check valve** - **extremely important** valve for preventing the back-flow of water into domestic supply when doing fertigation.



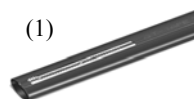
**Fertilizer Injectors**- (a) is a tank where the soluble material is placed inside. (b) is a venturi type injector for sucking soluble fertilizer up through a tube and into the drip line. Useful for applying “tea” but tend to be expensive.



**Filter**- very important for filtering particles that would clog emitters or inline drippers.



**Drip tubing**- used to take water to and along the garden beds. There would be a larger main feeding into the smaller laterals which run along the plant rows. The lateral may be plain tubing or it may have built in emitters at a set distance along the length



**Drippers**- (1) a close-up of tubing with drippers built in at intervals along the tube. (2) is a discrete emitter that has to be plugged into the drip tubing at intervals.



Drip irrigation kits can be bought off the shelf and assembled by householders.

## Tips on Watering

- ◆ Plants need water but the roots also need to get air. Give plants a good soaking and then allow the water to drain off over the next two or three days before wetting again.
- ◆ Most plants need good drainage. Only a few such as bananas, plantains and eddoes will tolerate flooded conditions in the soil. Make a note of areas on your property which are depressions and reserve these areas for flood tolerant crops.
- ◆ Practice pushing your finger in the soil in the root area to see how moist soil is before wetting. If there's a mulch on the soil the mulch surface may be dry but the soil may still be wet underneath.
- ◆ If you use a hose avoid wetting the foliage and fruits on the plants. That way some diseases will be minimized.
- ◆ Use trace element fertilizers (e.g. liquefied seaweed) to help plants to cope better in droughty conditions. Spray plants weekly.
- ◆ Use mulch to save water. It prevents soil from drying out fast in droughty weather (also from being washed away by torrential rain).



Khus khus and guinea grass cut and spread as mulch on beds.

- ◆ Remember that there is often a drought in September (midst of the rainy season) and be prepared to water at this time. Fast-growing crops such as lettuce are most sensitive to this unexpected drought.
- ◆ Watch plants closely and look for signs of drought stress. Simple things such as premature dropping of fruits, flowers and/or leaves may be an indication that plants are not getting enough water.

### Signs of drought stress

Slow growth, leaves fail to expand, fruit fail to set.

Older leaves may turn yellow, dry and fall off prematurely.

Flowers and fruits may fall prematurely.

Flowers are often smaller than usual and detach more easily than normal.

Some plants droop at midday when there is not enough water. If you know the plant well you will notice when the leaves droop. Fast growing crops like lettuce suffer when they have to stop transpiring (when they droop) since they are no longer feeding.

- ◆ The first month in the life of vegetable crops, such as tomato, is the time when the foundation is set for fruit bearing. Pay careful attention to watering during these weeks. Flower buds are produced in the early life of the plant and if water is scarce at this point less buds are produced. The fewer flower buds you get means your chances for getting fruits are less.

## Strategy for Watering Selected Crops

| <b>Crop</b>             | <b>Approach to watering</b>   |
|-------------------------|---|
| Beans (String)          | Water steady after planting during flowering, fruit set and early pod filling   |
| Beets                   | Soak field for good germination; water steadily during root enlargement   |
| Carrot                  | Soak field for good germination; water steadily during root enlargement   |
| Corn                    | Water closely before and during silking, tasseling and ear development  |
| Broccoli                | Water well at transplanting and at flower bud production  |
| Cabbage                 | Water well at transplanting and at head development   |
| Cauliflower             | Water well at transplanting and at curd development   |
| Celery                  | Water frequently  |
| Cucumber                | Water well just before and when flowers are on vine and during fruit growth   |
| Pumpkin                 | Water well just before and when flowers are on vine and during fruit growth   |
| Squash                  | Water well just before and when flowers are on vine and during fruit growth   |
| Watermelon              | Water well just before and when flowers are on vine and during fruit growth   |
| Lettuce                 | Water well throughout growth especially for large heading types   |
| Okra                    | Water well during flowering, fruit set, and fruit growth  |
| Onion                   | Soak field for good germination; water steadily during bulb enlargement   |
| Pepper (hot)            | Water well in first month after planting, during flowering, fruit set, and fruit growth   |
| Pepper (sweet)          | Water well in first month after planting, during flowering, fruit set, and fruit growth   |
| Chives                  | Water to support steady foliage growth  |
| Cassava                 | Water at planting, cassava will do well rain-fed  |
| Sweet potato            | Water at planting, potato will do well rain-fed; irrigation can be used for dry season crop   |
| Yam                     | Water at planting; yams will do well rain-fed   |
| Tomato                  | Water well in first month after planting, during flowering and fruit set, and fruit growth  |
| Avocado pear            | Water young plant well in first 2 yrs; for mature trees do not wet in the dry season before flowering; do not over-soak the roots (prone to root rot)   |
| Banana, figs, plantains | The more water available (as long as it is not stagnant) the better they will grow and bear fruit. Will also bear small bunches under droughty conditions.  |
| Barbados cherry         | Allow soil to dry out for 2 weeks then soak for 1 week to make trees bear fruit (needs a wet/dry cycle; if it gets water continuously the tree will grow well but will not bear well).                            |
| Citrus                  | Water young plant well in first 2 yrs (otherwise grafted trees may die); for mature trees do not wet tree in the dry season before flowering; do not over-soak the roots (prone to root rot)                      |
| Jamaica plum            | Do not water the trees when leaves fall off in the dry season (getting ready to bear fruit)   |
| Passion fruit           | Water steady and vine will continue bearing with each new shoot   |
| Pawpaw                  | Needs weekly watering from planting onwards. Do not over-soak the roots (prone to root rot)   |
| Mango                   | Water young plant well in first 2 yrs (otherwise grafted trees may die); for mature trees do not wet in the dry season before flowering; usually no need to water mature mango trees unless in very shallow soil. |

## How Well are your Plants Growing?

The table below gives an idea of when to expect crops to bear and how much can be harvested from along 18 ft [6 m] of a 5'6" [1.8m] bed (extrapolated from Ministry of Agriculture recommendations,2001). For fruit trees the number of fruits per tree are given (for trees this may vary widely depending on age and variety of tree). (m=month)

| Crop                   | Duration (months)/yrs | Harvest starts at : | What yield to aim for (100 sq ft or 18 ft of a 5' 6" bed) (and yields for fruit trees)                            |
|------------------------|-----------------------|---------------------|---|
| Beans (String)         | 2.5                   | 1.5-1.6 m           | 18 lbs [8.2 Kg]   |
| Beets                  | 2 - 2.5               | 2-2.5 m             | 32 lbs [14.5 Kg]  |
| Carrot                 | 3 - 4                 | Any stage           | 35 lbs [15.9 Kg]  |
| Corn                   | 3 +                   | 3 m                 | 18 lbs [8.2 Kg] (rain-fed); 46 lbs [20.8 Kg] (irrigated)  |
| Broccoli               | 1.6 - 2               | 1.6 – 2 m           | 23 lbs [10.4 Kg]  |
| Cabbage                | 2 - 2.5               | 2 – 2.5 m           | 69 lbs [31.4 Kg]  |
| Cauliflower            | 2                     | 2 m                 | 23 lbs [10.4 Kg]  |
| Celery                 | 5                     | 5 m                 | 80 lbs [36.4 Kg]  |
| Cucumber               | 2 +                   | 1.25 -1.75m         | 57 lbs [25.9 Kg]  |
| Pumpkin                | 4 +                   | 3-4 m               | 18 lbs [8.2 Kg]   |
| Squash                 | 2.25 +                | 1.25 – 2.25         | 23 lbs [10.4 Kg]  |
| Watermelon             | 3 +                   | 2.5 – 3 m           | 46 lbs [20.8 Kg]  |
| Lettuce                | 1.5                   | 1.5 m               | 70 lbs [31.8 Kg] (for dense headed type)  |
| Okra                   | 4.5 - 6               | 1.5 – 2 m           | 23 lbs [10.4 Kg]  |
| Onion                  | 3.5 - 5               | 3.5 - 5             | 115 lb [52.3 Kg]  |
| Pepper (hot)           | 6 - 8                 | 3 m                 | 28 lbs [12.7 Kg] [rain-fed; 69 lbs [31.4 Kg] irrigated  |
| Pepper (sweet)         | 6+                    | 3 m                 | 60 lbs [27.3 Kg]  |
| Tomato                 | 4+                    | 2.5 – 3 m           | 5-18 [2.3- 8.2 Kg] lbs in wet season, 37-55 lbs [16.8-25 Kg] in cool, dry season                                  |
| Sweet potato           | 3.5 – 4.5             | 3.5 – 4.5 m         | 46 lbs [20.8 Kg]  |
| Yam                    | 7 - 9                 | 7 – 9 m             | 27 lbs [12.3 Kg]  |
| Cassava                | 6 - 8                 | 6 – 8 m             | 50-92 lbs [22.7- 41.8 Kg]   |
| Avocado pear           | years                 | 2-3 yrs             | 250-300 fruits/tree for medium size fruit (5 yr old tree)   |
| Banana, figs plantains | years                 | 10-15 m             | Banana: at least 45lbs/tree (150 fruits) 6 oz per fruit is a good fruit size                                      |
| Barbados cherry        | years                 | 8-12 m              | About 1500 fruits per bearing, 3 to 6 times per year (4 year old tree)  |
| Citrus                 | years                 | 2-3 yrs             | Yields vary considerably depending on type.   |
| Jamaica plum           | years                 | 8-12 m              | 20 to 40 plums per bough (1000 to 2000 frt/tree; 4 yr old tree)   |
| Passion fruit          | 2-3 yrs               |                     | The vine should keep setting fruits as it extends.  |
| Pawpaw                 | 1-3 yrs               | 7.5 -9 m            | 40 -60 fruits per tree (trees bearing more fruit than this may not survive long)                                  |
| Mango                  | years                 | 2-3 yrs             | 250-300 fruits/tree for larger fruit (5 yr old tree); small fruits on large old trees may be as much as 3000-5000 |

## Harvesting and Preservation Tips

After going through the effort to produce healthy and wholesome fruit and vegetables, it would be a shame to spoil the produce by improper harvesting or handling.



- Harvest fruit and vegetables at a correct stage of maturity. Learn to recognize when different types of fruit are just ready for harvesting.
- Remember that fruits are “alive” even after you pick them from the plant and every effort should be made to prolong the shelf life.
- Remove produce from the sun as quickly as possible or keep them in shade after picking. This will prevent them from building up “field” heat. The more heat the fruit picks up in the field, the less is the shelf life .
- Do not toss and drop produce around roughly. Bruising causes produce to spoil prematurely.
- Use trays rather than bags to carry soft fruit after harvesting. Bags tend to squeeze the produce and the damage is worst when they are stacked.
- To pick fruits from tall trees (e.g. mango) use harvesting aids that will prevent

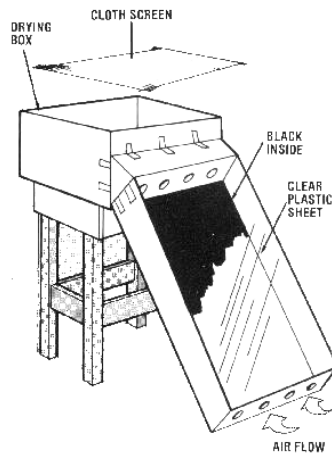
the fruits from falling and being bruised on the ground.

### *“Waste not want not”*

In the true spirit of organic gardening, one should aim to make good use of excess produce.

Extra produce can be preserved by methods such a solar drying and bottling.

There are no chemicals or preservatives added in the drying process and subsequent storage. Dried fruit retain most of the vitamins A and C, as well as thiamine and riboflavin. This makes them more nutritious than canned counterparts where up to 65 percent of vitamins and minerals may be lost.



Above: Photo of a simple solar drier from cartons

Left: Diagram of the same drier.

Source:[www.pathtofreedom.com/pathproject/offthegrid/solarfooddryer.shtml](http://www.pathtofreedom.com/pathproject/offthegrid/solarfooddryer.shtml)

Some non-acid fruit and vegetables may need to be blanched beforehand to prevent spoilage during drying.

Fruit and vegetables that are unfit for eating can be placed in the compost heap.

## Further Reading

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[Http://www.nal.usda.gov/afsic/AFSIC\\_pubs/org\\_gar.htm#toc2a](http://www.nal.usda.gov/afsic/AFSIC_pubs/org_gar.htm#toc2a) National Agricultural Library, Agricultural Research Service, U.S. Department of Agriculture. USA (wide listing of organic gardening resources; mainly books, but the list includes useful web pages )

Chandler, L. 2004 *Presentation on composting*. National Council for Science and Technology. Bridgetown. Barbados

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Panwar F. *Organic farming in Pakistan*. <http://www.cityfarmer.org/pakistanOrgFarming.html> (Canada office of Urban Agriculture)

Sullivan. P. 2004 *Sustainable soil management*. . <http://www.attra.org/attra-pub/> ATTRA-National Sustainable Agriculture Information Service, USA

[Http://www.ghorganics.com](http://www.ghorganics.com) (useful information about natural insect control in the garden and home)

[http://www.permacult.com.au/research/natural\\_pest\\_control.html](http://www.permacult.com.au/research/natural_pest_control.html) (how to make natural pest control sprays)

<http://www.planetnatural.com/> (Commercial site showing the range of products available), USA

<http://www.compostguide.com> (commercial site providing wide range of technical information on composting and showing a range of compost makers)

DISCLAIMER: The information given herein is for educational purposes only. Reference to commercial products or trade names is made with the understanding that no discrimination is intended and no endorsement by the National Council for Science and Technology. Use all pesticides safely. Read and follow labels and safety instructions.



Organic gardening is an art that had been almost lost in an era of “industry-led” farming. Concerns over the environment and the rising occurrence of cancer and other “lifestyle” created diseases have prompted a new interest in fresh, wholesome food...the type that is grown in the organic garden.

The organic gardener cherishes the natural richness of soil and uses this fertility to produce healthy vigorous plants that can flourish in the presence of pests.

Preservation of the environment and its biodiversity are of utmost importance in organiculture. The gardener embarks on a quest for sustainability so that the next generation receives the land in as good a state or better. By recycling nutrients and utilizing cultural and natural methods for growing crops, the grower achieves that level of sustainability.

We may not all be interested in growing organic foods for sale or export, but we can all enjoy the freshness and natural goodness of fruit and vegetables grown in the home garden by pure natural techniques. This booklet is written as a guide for all those who would wish to take control of the quality of the produce they eat.



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