

# GARGARDENER'S GUIDE TO ORGANIC CONTROL OF PESTS PLANT DISEASES & HEALTHY PLANTS



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## **ORGANIC CONTROL OF PESTS**

### **INTRODUCTION**

In our garden we have a large number of Pests which if not controlled can damage the plants resulting in poor flowering and harvest. A few examples of harmful pests:

**Chewers** Most chewers are big enough to see easily. If there are holes in the leaves and fruit, ragged edges or pieces missing, look for caterpillars, beetles, weevils, grasshoppers, slugs and snails. If plants are wilting or falling over, look for root-eating crickets, beetles, millipedes.

### **BENEFICIAL GARDEN CREATURES**

Many beneficial insects are predators or parasites which eat up harmful insects. These are the Pest Police. Some are pollinators which fertilise plants so they can produce fruit.

Without them, there would be no agriculture.

1. Everyone knows the ladybug, or ladybird\*. Some ladybugs eat aphids, others prefer scale insects and mites. They are very effective at getting rid of pests. Ladybug larvae also prey on aphids. They are colourful and look fierce, so people often think they must be harmful to people or plants. Nothing could be less true.



2. The praying mantis, with its folded legs in prayer position, is another well-known insect predator. Both adults and young lie in wait for insects that stray too close, then grab them with their modified front legs.



3. Assassin bugs are found in tropical countries. Most kinds have slender bodies and dull colours so they are not noticed. They have a curved "beak" which they use to pierce beetles, grasshoppers and caterpillars.



4. Ground beetles (e.g. Carab) are often found under logs and rubbish. Both larvae and adults feed on insects, slugs, snails, snail eggs and mites.



5. The Lacewing fly has green filigree wings and metallic eyes. Close up, the larvae are like miniature monsters. Both adults and larvae hunt for scale, aphids, mites, mealy

bug, thrips and whitefly. The larvae eat up aphids at the rate of 60 per hour and sometimes stick the empty bodies on their bristles as camouflage!



6. Soldier beetles or pirate bugs are slender, brownish red or yellowish, with long antennae. They are often seen on flowers, but both adults and larvae are carnivorous. Like their cousins fireflies and glowworms, they secrete a material which liquefies their prey. They have a "piercing-sucking beak" which they use to suck their victims dry. Each adult pirate bug can eat 5 to 20 thrips larvae per day.



7. Hoverflies or robber flies are a large and useful family. Some fat kinds look like bees; others with narrow waists mimic wasps. They hover in mid-air and dart in to get pollen or nectar from flowers. Their larvae prey on aphids - one larva may eat 900 aphids! The adults are more effective predators than ladybugs.



7. Centipedes feed on slugs, snails (and their eggs), mites and insects. Be careful! They can give a painful bite.



8. Spiders and scorpions are also dedicated hunters. Spiders use six eyes, eight legs, poisonous fangs and sticky, transparent webs to hunt on the ground or in the air. If you find their webs in your garden, leave them there!



9. Many small wasps and flies are parasites on other insects. They are valuable allies. Tachinid flies, for example, lay their eggs on caterpillars. When they hatch, the fly maggots burrow through the caterpillar's skin and feed on it.



10. Pollinators Many insects pollinate flowers: wild bees, flower flies, butterflies. The best known is the honey bee, which also gives us honey and beeswax. Without pollinators there

would be no citrus fruit, nuts, berries, coffee, melons, cucumbers, squash, or other fruits and vegetables. Without them, farmers could not grow crops.



### **COMPANION PLANTING - A NATURAL SOLUTION**

Thousands of farmers are planting weeds in their maize fields (Companion Planting). Bizarre as it sounds, their technique is actually raising yields by giving the insect pests something else to chew on besides maize.

It is better than pesticides and a lot cheaper, and has raised farm yields by 60-70 Percents.

Maize fields face two major pests, the solution to both are. The first is an insect called the stem borer. True to its name, it s larvae eat their way through a third of the regions' maize most years. The borer is likes to feed on a local weed, napier grass. By planting napier grass in their fields , farmers can lure the stem borers away from the maize and into a honey trap. For the grass produces a sticky substance that traps and kills stem borer larvae.



The second major pest is Striga, a parasitic plant that wrecks 10 billion dollars worth damage on maize crops every year, threatening the livelihoods of one hundred million farmers.

Weeding Striga is one of the most time consuming activities for millions of farmers.



But he has an antidote: another weed, called Desmodium. It seems to release some sort of chemical that Striga does not like. At any rate, where farmers plant Desmodium between rows of maize, Striga will not grow.



This Sustainable Agriculture just happens to be the biggest movement in Third World Farming today, dwarfing the tentative forays in genetic manipulation. It seems peasant farmers have a long way to go before they exhaust the possibilities of traditional agriculture. Planting particular plants together can attract good insects and drive away pests. In general, mixed crops and strong smells repel garden enemies, while flowers attract beneficial insects. Companion planting is a natural way to protect plants.

Flowers which attract beneficial insects are camomile, carrot, celery, clover, coriander, daisy, dill, canna, carrot, citrus, mint, nasturtiums, parsley, parsnip, rosemary, rue, thyme and yarrow. Let some of your vegetables flower.



Strong-smelling plants which deter pests by “putting them off the scent” are aloe vera, artemisia, basil, calendula, camomile, catnip, chilli, chives, citronella, garlic, ginger, horehound, lantana, lavender, leeks, lemon grass, marigold, mint, onions, tansy, thyme and tobacco.



Plants which repel soil pests Garlic plants kill off some fungi in the soil. Some marigolds kill nematodes in the soil. Get the right kind. Cabbage smell repels soil pests.

Special combinations. Some say these combinations work well. Try them and see!





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1. Basil repels tomato hornworms.
2. Nasturtiums get rid of squash bugs.
3. Marigolds, mint, thyme and camomile drive away cabbage moths.
4. Radishes trap beetles that attack cucumber and squash.
5. Thyme and lavender deter slugs.
6. Tansy and pennyroyal get rid of ants.
7. Tomatoes repel asparagus beetles.
8. Beans and brassicas planted together confuse each other's pests.

## COMPOST

Compost, "brown gold", is the magic ingredient of good gardening. It provides nutrients to make soil rich and fertile, and keeps it moist and airy by opening up the soil, and trapping and draining water.

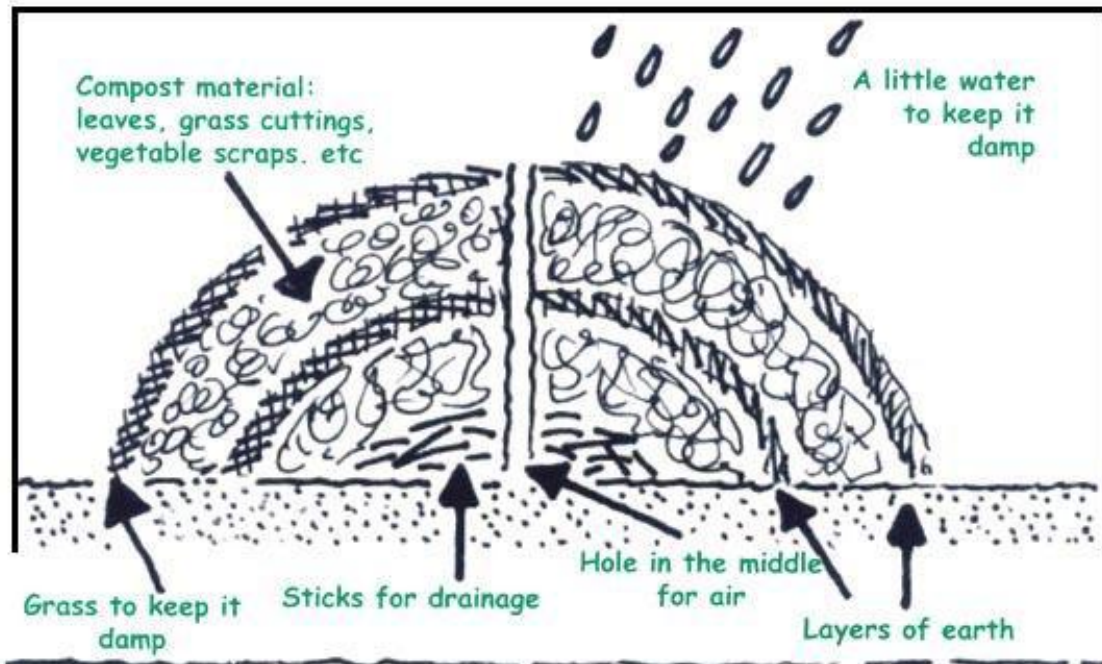


**Compost ingredients** Most organic materials can go into compost: straw, cut grass, organic waste from the kitchen, weeds, plants, leaves, animal manure, wood ash, animal and fish bones, feathers, cotton cloth, bits of leather or paper, soil. Do not use cooked food, large pieces of wood, plastic, metal, glass, crockery, wire, nylon, synthetic fabrics, coal ash, seeding grass or very tough weeds.

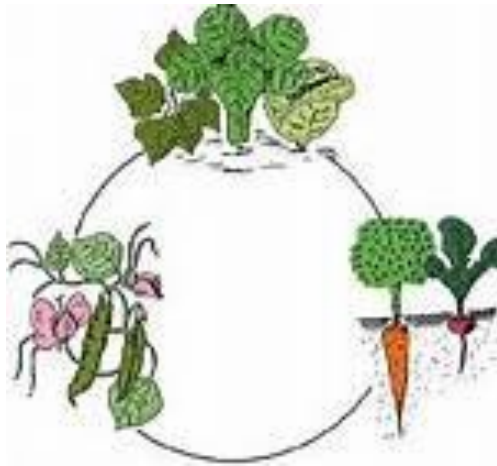
**Compost containers** Compost can be made in a bin with a roof for shelter. Having three bins is best: one to make it in, one to move it to, and one to store it. It can also be made in a pit, in a large cardboard box or in a large strong plastic bag with air holes. The important thing is keep it "cooking" by keeping it damp and giving it air.

Making compost Start with a layer of sticks for drainage, then follow with layers of grass, leaves, manure, soil. Mix wet and dry, and alternate brown and green. Chop up big leaves. Add a final layer of soil, make a hole in the middle to let air in, water the heap and cover with grass or with a cloth to keep it damp. After about five days the heap will heat up as bacteria work to break it down. Keep the compost damp. After about six weeks turn the compost - take it out and put it back, or move it to the next bin, always keeping it damp. Turn it again every few weeks. After three months test it. If it is dark, crumbly, light and moist, it is ready to use.

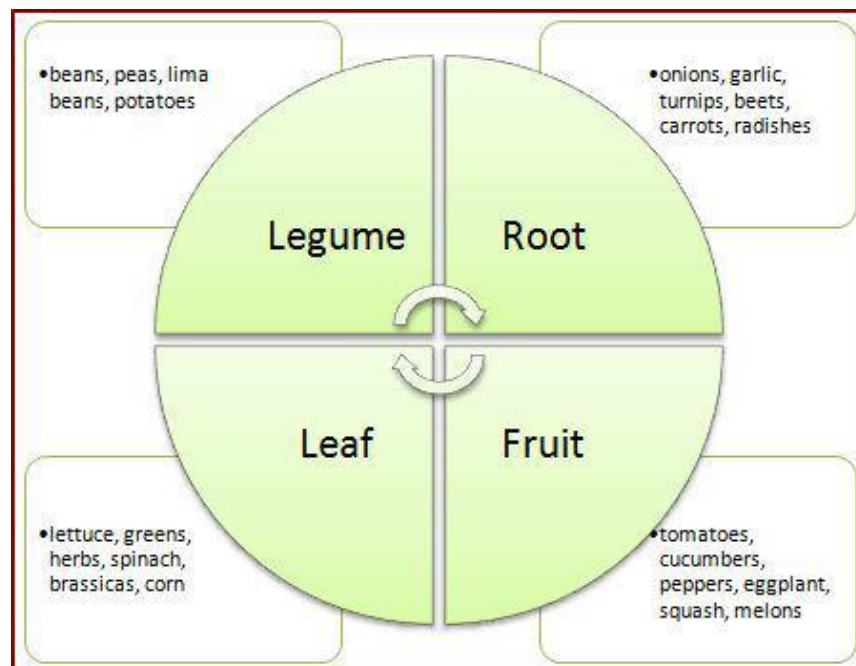
Using compost Use compost as soon as it is ready. Spread it before planting and when potting, and put it around growing plants every two weeks. Do not let it dry out: use it in the early evening, when it is cool, and cover with mulch to keep it damp.



## CROP ROTATION



If you plan to grow the same crops regularly, you will need to rotate them. Each kind of crop needs particular nutrients in the soil and uses these up at a particular level in the ground. At the same time, each kind of plant attracts its own particular pests and diseases, which soon become established around the crop. If you grow the same kind of crop in the same place season after season, the nutrients that the plant needs are quickly exhausted, the plants grow weak and stunted and quickly come under attack from waiting pests and diseases. Crop rotation restores the soil and frustrates the pests and diseases. The main crop families to be rotated are:



Legumes leguminosae e.g. beans, peas

Solanums solanaceae e.g. tomatoes, peppers, potatoes, chilli, eggplants

Cucurbits cucurbitaceae e.g. cucumber, squash, melon, marrow, pumpkin

Brassicas brassicaceae e.g. broccoli, cabbage, cauliflower, kale, radish, rutabaga

Grains gramineae e.g. corn, millet, sorghum, wheat

Bulb crops amaryllidaceae e.g. onions, leeks, garlic, chives

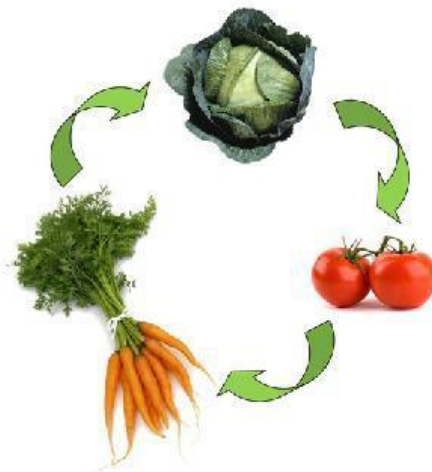
Umbells umbellifereae e.g. carrots, fennel, chicory, parsnip, parsley, sesame

Greens

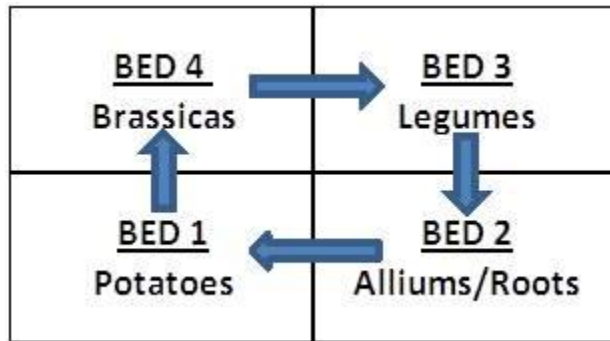
Chenopodiaceae and compositae e.g. beet, chard, spinach, lettuce

Some “rotation tips” are:

1. Rotate over at least three seasons (five or six is better)
2. Change the plant family every time, not just the individual crop.
3. Leave at least a metre distance when planting the same crop again.
4. Grow green manure as part of your rotation - e.g. cereal grains (millet, oats), beans, vetch, sun hemp (*crotalaria juncea*). They put back organic matter and rebuild the soil. Dig them in before they flower, or cut and leave as mulch.
5. Leave one field/bed fallow, with no crops, as part of the rotation. This gives the soil a rest.
6. Grow sunflowers (or alfalfa or safflowers) as part of the rotation. Their roots go deep into the soil for nutrients and water.
7. Some good combinations: - Grow corn after legumes - Grow potatoes after corn - Grow brassicas after onions.



## GARDEN BEDS



## PERMANENT RAISED BEDS

In this Manual we advocate permanent raised beds, which are easy to maintain, highly productive and excellent for improving the soil.



Making raised beds:

Other kinds of beds:

Flat beds are easy to establish but not so productive.

Sunken beds trap water and are good for dry climate or dry seasons.



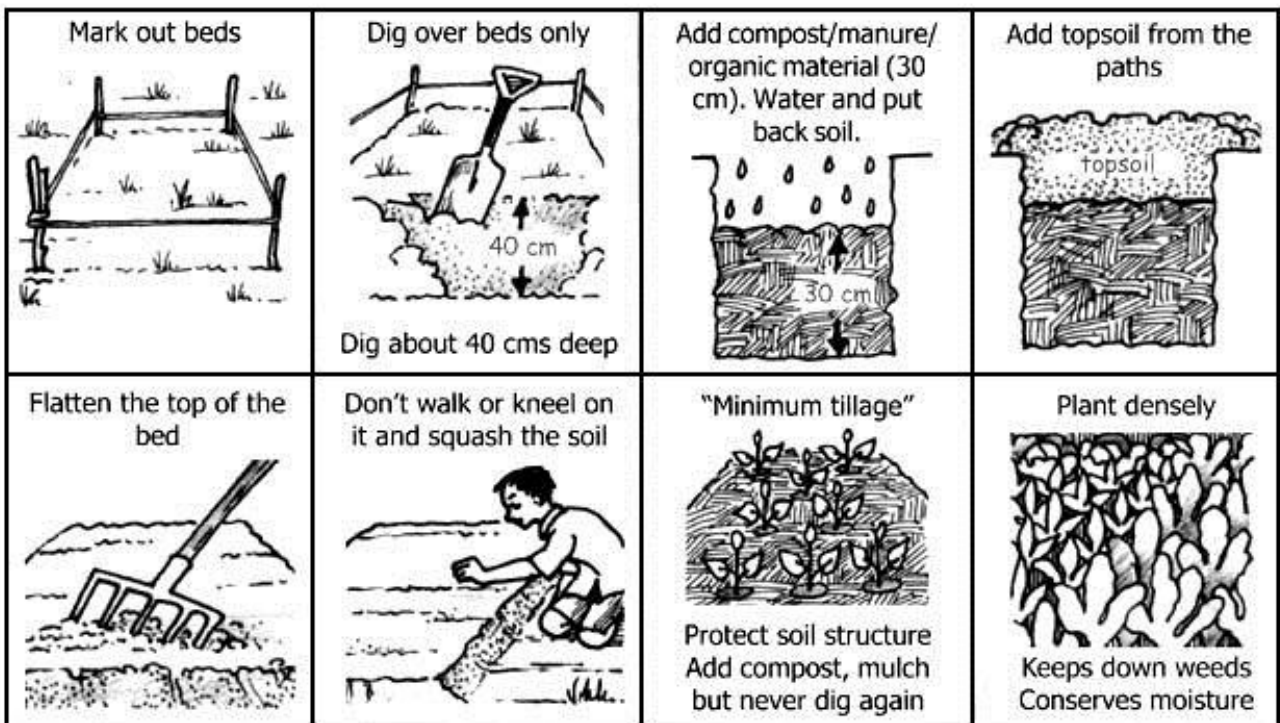
Ridged beds are good for root crops. The ridges help rain drain out of heavy soil.



## PERMACULTURE

Where soil is poor, permaculture beds can be built on top of the ground by filling in a border with organic matter.

Containers (e.g. plant pots, old car tyres) are movable, good for limited space and for display.



## HEALTHY PLANTS

Integrated pest management employs a range of natural methods to reduce and control pests and diseases. Ensuring that plants are healthy is the first strategy. Plants should be monitored regularly and treated immediately. The checklist below covers the main points to be checked.

### Plant Patrol Checklist

#### 1. Growth

Have the plants grown? What stage are they at? Any fruit/seeds?

#### 2. Health

Are they looking well? Are there signs of pests or diseases? Are any plants wilting or stunted? Are there fallen leaves, eaten leaves, yellow leaves, fungus?

#### 3. Garden creatures

What insects/worms/animals are around? Are there plenty of beneficial creatures (e.g. lacewing, ladybug, frogs, lizards)?

#### 4. Soil/water

Is the soil dry? Which plants or beds need water? Is anything too wet?

#### 5. Mulching

Is everything well mulched? Where do we need more mulch?

#### 6. Protection

How good is our protection against predators (e.g. fences, walls, scarecrows)?

#### 7. Wind and sun Is anything getting too much wind, sun or shade?

#### 8. Space

Is anything overcrowded? Does anything need thinning/transplanting?

#### 9. Weeds

Are there a lot of weeds near the plants?

#### 10. Support

Does anything need training up, tying up, spreading out?

#### 11. Hygiene

What needs tidying up? Burning? Cutting back? Cutting down?

#### 12. Compost

How good are our supplies of compost and mulch?

## HOMEMADE SPRAYS



The sprays below are cheap to make and effective against a range of pests, while also relatively safe for children to make and use.

### Chilli pesticide spray



To control aphids and other sucking insects. Slice a handful of dried chillies and some onion or garlic and mix together in a litre of water. Grate in a small handful of hard soap. Leave overnight, then strain through a cloth and add 5 more litres of water. Brush, sprinkle or spray on affected plants, but not in direct sunlight. Don't get it on your skin or in your eyes. If plant leaves burn, make the mixture weaker with more water. Repeat the treatment as often as necessary.



## Simple soapy water spray



### For sucking insects.

Use one teaspoon to two tablespoons of normal liquid detergent soap for every four and half litres of water. Spray as often as needed, especially under the leaves. Increase the amount of soap if necessary.

**Flour or ash** dusted onto leaf vegetables suffocates caterpillars.

Flour is also a stomach poison for them.



### Tea or coffee spray

To deter insects. Soak coffee grounds or tea leaves in water and spray on plants.

### White oil or “summer oil” spray

To suffocate chewing and sucking insects. Make a concentrated mix with half a litre of vegetable oil (e.g. coconut oil) and half a cup of detergent or soap dissolved in water. To spray, mix 1 tablespoon of the mixture in a litre of water. If you store the mixture, shake well before using to mix up the ingredients.

### Bug juice

Bug juice made with the bugs themselves is effective against caterpillars, slugs, larvae and bugs. Catch and kill a few of the pests which are attacking your crops, cover with water,

grind to a paste and strain through a fine sieve or cloth. Dilute 50 ml in 100 litres of water - then spray their friends and relations!

### **Tomato leaf juice**

Useful in controlling aphids and caterpillars on many plants. Boil 500 grams of tomato leaves in 5 litres of water. Strain and dissolve 30 grams of soap in the mix. For spraying, use one part of the mixture to 4 parts of water. N.B. Do not use this mixture on tomato plants or members of the tomato family (e.g. pepper or Irish potato).

### **Marigold leaf juice**

Marigold leaf juice made the same way as tomato leaf juice, is a powerful, broad spectrum pesticide (it even deters fleas on dogs!). Wild marigold, which comes up in fields, on roadsides or any patch of disturbed soil, is much more effective than the garden variety.

### **Onion Organic Pesticide**



1 Diced Small Onion

1 Chopped Garlic Bulb (make sure you have a whole bulb, not just a clove!)

2 Teaspoons Cayenne Pepper

1 Quart of Water

1 Tablespoon of Dish Detergent

Spray Bottle

Place the onion, garlic, and pepper powder in one 250 ml of water for approximately 2 hours. Then strain the mixture, add the dish detergent, and pour liquid into spray bottle.

Apply to plant leaves liberally including under on the underside of leaves. Reapply every week or following heavy rains.

### **Storage**

This organic bug spray will last up to two weeks if stored in the fridge in a sealed container. If you have a smaller patio garden just cut the recipe in half to keep it from going to waste. Also, make sure you wash your veggies before you eat them and wash your hands after handling the spray - there is a lot of cayenne in this recipe!



### **Homemade Organic Aphid Spray**

Nymph and adult aphids suck liquid from plant stems as well as buds, seed pods & leaves. Although aphids aren't very big (even the largest adults are usually less than a ¼-inch long), they can cause quite a bit of plant damage, particularly if their populations are large. Deformation, stunting and stippling may all result as aphids suck fluid from leaves and buds. Often, leaves with aphid damage appear curled and discolored.

Aphids also suck sap from stems—with less damaging results. And they leave behind honeydew as they feed, a clear liquid that often produces black mold.

The majority of aphid species are general feeders; however, they're particularly drawn to new growth, and some prefer specific species of plants.

At some point in the year, most gardens attract aphids. Their populations are usually kept in check by natural predators like lacewings and ladybird beetles. However, if aphid damage becomes severe, intervention may be necessary. Contemporary wisdom advocates an

environmentally-friendly approach to aphid control, one that eschews harsh poisons. The Garlic spray does work here.

## **8 Safe Ways to Control Aphids**

1. Spray strong bursts of plain water to dislodge aphids.
2. Grow flowering plants to attract aphid-eating beneficials.,
3. Release aphid-eating beneficial insects like ladybird beetles, lacewings & parasitic wasps.
4. Treat aphid-infested plants with homemade garlic spray.
5. Spray plants with insecticidal soap.
6. Scrape aphid eggs and nymphs from leaves, seed pods and stems, and crush them.
7. Handpick adult aphids and crush them.
8. For severe aphid infestations, neem oil may be applied alternately with insecticidal soap.\*

## **Organic Aphid Spray**

When properly combined, garlic cloves, mineral oil, ordinary dishwashing liquid and water create a mild organic pesticide that's effective against aphids. The spray also kills cabbageworms, larval mosquitoes, leafhoppers, squash bugs, whitefly and other garden pests. It can even serve as a mild fungicide and animal repellent.

## **The Drawbacks of Garlic Oil Spray**

The primary environmental drawback of garlic oil spray is that it kills not only aphids, but also other soft-bodied insects, including beneficial ones. Ladybird beetles and other hard-shelled insects, however, are ordinarily unaffected by the spray. It may cause slight leaf burn.

## **Organic Aphid Spray Concentrate**

Adult aphids are small & pear-shaped pests with cornicles that extend from their abdomens. They are usually black, green, orange, red, white or yellow. Pictured: Adult butterfly weed aphids.

### **Ingredients**

3 oz. garlic cloves, minced

2 tsp. mineral oil

1 pint water

1/4 oz. dishwashing liquid

Instructions

Soak garlic in oil for 24 hours or more.

Meanwhile, combine dishwashing liquid and water.

Add soap mixture to garlic mixture, and stir well.

Strain the mixture and store it in a glass container.

Mix about 4 Tbsp. of garlic oil concentrate with a gallon of water to treat aphid-infested houseplants, potted herbs, vegetables & small outdoor ornamentals.

Directions for Use

Add 1-2 Tbsp. of homemade garlic oil concentrate for each pint of water. Then spray affected plants thoroughly.

Because the spray contains oil and soap, it may cause some leaf damage. To ensure that the mixture is not too strong, test it first by spraying a few leaves. Wait 2-3 days for any signs of damage.

### **Make Homemade Pesticide from Neem**

As a household formula to control insects and pests, boil about 100 gm of crushed neem leaves and 20 gm of tobacco leaves with 1 inch cube of any bathing soap and 1 liter of water for 10 minutes. When the mixture gets cooled, apply 5 gm copper sulfate, 5 gm borax and use 100 ml with 1 liter of water to spray in the evening. If you find it difficult, use chemical pesticides but use them sparingly. When required, use for two consecutive days at a gap of 15 days.

**Bordeaux Mixture** - Brown rot, curly leaf, black spot, mildew

Bordeaux is a standard organic fungicide. It can be used when plants are dormant, generally during the winter months. It can be used on all citrus or cool days, when there are no blossoms on the trees. Bordeaux is effective for brown rot, curly leaf, black spot and other bacterial, fungal and mildew problems. Spray grapevines when the shoots are less than 100cm long, for black spot and powdery mildew.

Always make Bordeaux mixture fresh as it doesn't keep and will begin to separate after an hour or so, therefore it must be used soon after preparation.

### Bordeaux Recipe

Mix 90 grams of blue copper sulphate with 4.5 litres (1 gallon) of cold water, in a non-metallic container.

In another non-metallic container, mix 125 grams of slaked lime (not agricultural lime) in 4.5 litres (1 gallon) of cold water. Mix the two together and stir well.

Test the mixture using an old nail. Dip the nail into the mixture for around 30 seconds. If the nail comes out blue, you need to add more lime, or at least, more stirring and mixing in order to dissolve the lime. Do NOT use the mixture until the problem is corrected, otherwise you may burn your plants.

The mixture can be used with any spray equipment. Keep some fresh, clean water on hand to wash out nozzles to keep them clear of clogging.

Spray in early winter or only spray every second row, finishing off the rest ten days later. Take care not to use too much Bordeaux as it will cut down the numbers of natural predators around during Spring time.

### **Chamomile Tea Spray** - Black spot, scab, mildew, brown rot, rust

Chamomile tea can be used as a very mild fungicide. Use it for early mildews and fungal problems, and for brown rot on fruit.

To make, cover a handful of flowers in boiling water, or use a Chamomile teabag, according to the directions on the pack. Allow to cool then transfer to a clean sprayer bottle.

### **Chive Spray** - Rust, brown rot

Grab a handful of fresh chives and place in a container. Cover with water and allow to steep. When cooled, strain off water, then place in a sprayer bottle. Spray on all plants affected by rust.

### **COMFREY SPRAY** - Rust, brown rot, black spot

Take a handful of Comfrey and cover with fresh water for at least 2 to 3 weeks. Strain and place in a spray bottle.

**EGGSHELLS** - White butterflies

As a decoy for White butterflies (or cabbage moths), place eggshells under and around cabbages and all brassicas.

Broken eggshells can also be used as a deterrent for snails and slugs. Place the crushed eggshells around any plants you wish to keep snails and slugs away from. The slugs/snails find it difficult to cross the broken eggshells.

**GLUE SPRAY** - Aphids, white fly, harlequin bugs, mites, woolly aphids

Mix 1 cup of white flour with 1 cup of boiling water - then mix in cold water. Stir until it is of a thick consistency. Strain out any lumps through a sieve.

Place into a spray bottle for use on small plants, and a larger, pump-action sprayer for high plants and trees. Spray the top of leaves as well as underneath, ensuring that the entire surface is covered.

Either wait for the glue to peel off, or wash off in rain naturally, or hose the plant down after 24 hours. (Ensure that you clean out the sprayer nozzle and bottle, otherwise the glue will set and that will be the end of it)

**MILK SPRAY** - Black spot, mildew, brown rot, mites, apple and pear scab, mould, fungi

Milk spray makes an effective remedy for stopping the spread of downy mildew, mould, fungi and bacterial problems.

Spray full cream milk onto affected areas of the plant.

In hot weather dilute 1 cup of full cream milk to 9 cups of water. This is to ensure that young foliage and flower buds don't burn.

**MILK and BICARBONATE OF SODA** - Brown rot, mildew, scab, black spot

Make up 'Milk Spray' as above, adding 1 teaspoon of Bicarbonate of Soda - and transfer to a spray bottle.

**NETTLE SPRAY** - Brown rot

Take a handful of Nettle and cover with fresh water for at least 2 to 3 weeks. Strain and bottle.

### **PYRETHRUM WSPRAY** - Bugs

Pyrethrum is a broad spectrum spray made from pulverized pyrethrum flowers (*Chrysanthemum cinerariaefolium*). Pyrethrum kills bugs, but has low toxicity for animals and humans. Beware though that Pyrethrum also kills bees, so be sure to only use it in the evenings.

Take 1 tablespoon of Pyrethrum powder or 2 tablespoons of flowers. Cover with oil and leave to steep overnight. Strain fully, then add 1 litre of water and mix well. Use immediately.

### **SEAWEED SPRAY** - Powdery mildew, brown rot

Seaweed strengthens a plant's resistance to a range of infections as well as makes them resistant to frost. It can be also be used as a preventative measure against brown rot.

Seaweed is also said to help fruit set.

Seaweed solutions can be commercially bought, but to make your own Seaweed spray: Wash salt from seaweed and cover with fresh water for at least 3 weeks. Strain off as much water as required, then dilute it until it is the colour of very weak tea. Place in a spray bottle and use when required.

### **SNAIL SOUP** - Repels snails and slugs

To repulse snails and slugs, collect as many as you can, then place in a container and cover with water. Put a lid on the container and put aside for 3 or 4 days, allowing the snails and slugs to ferment. Strain, then spray where you don't want slugs and snails to invade.

### **WASABI** (Indonesian Fish Sauce) - Repels kangaroos, wallabies and possums

Make a spray by using 6 parts water to 1 part Wasabi. Spray thickly, drenching the plant and/or area.

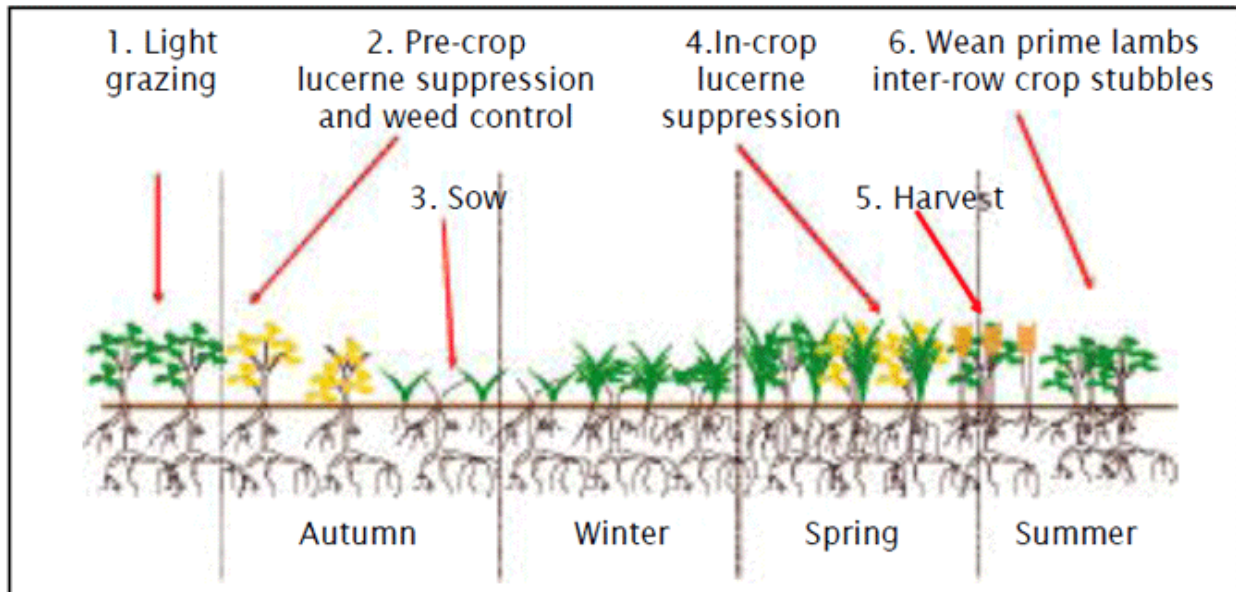
### **WHITE PEPPER** - Aphids, bugs

Sprinkle White Pepper (thickly) to repel bugs and aphids. Sprinkle again after rain or watering. You can also mix the pepper well with soapy water so it is able to stick.



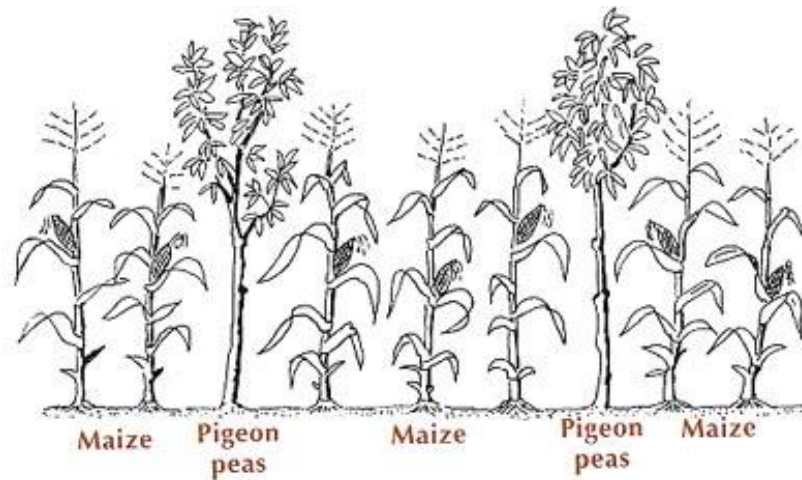
## INTERCROPPING

Intercropping (growing different crops near to one another) helps to utilize and conserve the soil and protect plants. A multi-layered garden, with plants at different heights, is a form of intercropping that makes the most of garden space and sunshine.



## PUTTING PLANTS WITH DIFFERENT NEEDS TOGETHER CUTS COMPETITION.

1. In particular, try growing tall plants next to small ones, e.g. maize with cabbage, broccoli with spinach/ lettuce, fruit trees next to vegetables;
2. Deep-rooted plants next to shallow-rooted plants, e.g. maize with sorghum and pigeon pea;
3. Climbing plants next to ground plants, e.g. passionfruit, beans or corn with lettuce, onions, carrots or squash;
4. Broad leaves next to narrow leaves, e.g. cabbage with carrots.



## MULCHING



Mulching means putting dry organic material (grass, straw, leaves) about 6 cm deep around the base of plants. The mulch keeps moisture in the soil, keeps the soil surface cool and soft, prevents weeds, and gradually decays like compost to enrich the soil. It is particularly useful where the soil is poor or there is very little water, in hot climates and hot seasons. The best mulching material is light-coloured and reflects the light. Use grass and weeds before they produce seeds, otherwise you will be providing competition instead of reducing it

## NUTRIENTS AND FERTILISERS

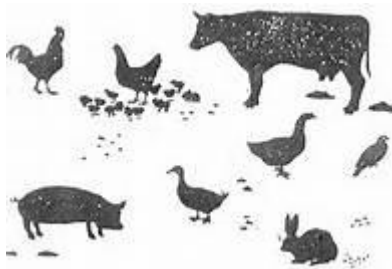
Plants need

1. potassium for health and strength;
2. nitrogen for leaves and growth;
3. phosphorus for roots, flowers and fruit.

Fertilisers can supply these nutrients There are:

1. Inorganic fertilisers (e.g. ammonium nitrate, ammonium sulphate and ammonium phosphate). These are quite expensive. They give quick results but don't help the soil structure in the long term.
2. Organic fertilisers (e.g. bone meal, blood meal, seaweed, manure). These cost a little more than inorganic fertilisers, but they improve the soil structure as well as add nutrients.
3. Homegrown organic fertilisers (e.g. green manure, compost and animal manure). These cost very little, improve the soil structure, and provide nutrients as well.

Animal manure Use manure from plant-eating animals. Fresh animal manure hurts roots: either leave it for six months or add it to compost.



Green manure gives a rich airy soil. Grow legume crops and dig them in or use them for compost. For example:

1. (field crops) beans and peas, sunhemp, groundnuts, water hyacinth
2. (hedgerow crops) leucaena, flemingia sp., gliricidia sp., pigeon pea, guinea grass, setaria sp. Prune and leave the branches on the ground.

**PARTICULAR ORGANIC MATERIALS SUPPLY PARTICULAR NUTRIENTS. PUT THEM IN YOUR COMPOST.**

<b>NUTRIENT</b>	<b>Nitrogen N</b>	<b>Phosphorus P</b>	<b>Potassium</b>
Bonemeal or bones	✓	✓	
Wood ash	✓	✓	✓
Fishmeal	✓	✓	
Green manure	✓		
Banana leaves and stems			✓
Chicken manure	✓	✓	✓
Compost and manure	✓	✓	✓
Shredded castor oil plants	✓	✓	
Coffee grounds	✓	✓	✓

**ORGANIC GARDENING**



Organic gardeners use natural methods to protect and improve the soil, control pests and diseases and increase production. Some ways of gardening organically are rotating crops, using compost and manure, making raised permanent beds, mulching, weeding, using good seeds, growing local varieties, treating plants well, doing companion planting, not using artificial pesticides or insecticides, harvesting rainwater, and using drip irrigation. Most of these are dealt with in detail in these Notes; here we summarize the important points to demonstrate the value of organic approaches.

**Keeping the soil healthy**

The soil is full of nutrients, which go into the food we grow. When we harvest food, we remove these nutrients. If we do not put back into the soil what we take from it, it becomes “exhausted” and cannot produce good crops. Good gardeners have to protect and maintain

the soil. How is this done? Chemical fertilisers put nutrients back into the soil, but they are harmful to worms and good soil fungi and are also expensive. They can burn roots; they dissolve quickly and are washed out of the soil. Organic gardeners protect and maintain the soil in other ways:

1. Crop rotation Each kind of crop takes different nutrients from the soil. Moving the crops around gives the soil time to recover.
2. Compost, manure and mulching Organic materials slowly rot away in the soil, put back the nutrients, improve drainage and keep the soil damp and airy.
3. Permanent raised beds Soil is not just a bagful of nutrients. It is a structure and a system, full of life and activity. Once you have begun to create healthy soil you should not interfere with it.

For example, if you dig it again deeply or walk on it, you squash out the air, make the earth hard, destroy earthworms and other useful life. This is why it is good to have permanent raised beds and let the plants and the soil do the cultivation for you.

Keeping plants healthy A popular way to keep down pests and diseases is with chemical sprays. This is expensive, and creates a lot of problems. Pesticides are poisons: they kill insects which pollinate plants, and also birds and insects which eat pests. They can also poison us if we eat sprayed foods, or breathe the air after crop-spraying.

The natural way to fight pests and diseases is to make plants healthy and resistant to pests and diseases. Choose good seeds and local varieties, add compost, weed and mulch to keep down the competition, control pests and check plants regularly.

Make sure plants have enough water, but not too much. Keep the soil damp and add compost to help it drain well. If water is scarce, harvest rainwater or use grey water, and use every drop - for example, use drip irrigation or mulch plants to stop water from evaporating. Grey water, or waste water from washing hands, clothes, etc, usually contains soap, so has the extra benefit of helping to control pests.

Organic gardeners encourage beneficial insects like bees, butterflies and ladybirds by growing plants that attract them. They keep away harmful pests by companion planting with strong-smelling plants and pick off harmful bugs, worms and beetles before they spread.

They use sprays that do not harm birds and bees, and natural insecticides that disappear after doing their work

### **PLANT PROBLEMS (DISEASES)**

It is not always easy to tell if a plant is suffering from disease, diet/water problems or pests, since a single symptom (e.g. wilting) may be a sign of any of these. But some symptoms are more specific

Disease	Symptoms	Remedy
Mosaic markings	Wilting	Destroy
Soggy rotten flesh	Withering	
Rolled-up leaves	Oozing sap	Burn infected plants and start again
Red and yellow streaks	Spots	- use clean seeds.
Discoloured leaves		- plant in a new place.
Black patches with yellow edges powdery substance on leaves		- let the bed dry out before replanting. Diet
Diet	Lack of nitrogen	FEED
Yellow leaf veins		For all problems, give compost and mulch and rotate crops.
Stunted growth		For nitrogen, give compost, green manure and legumes.
Pale leaves		For potassium, give wood ash or wood bark
Red colour		For phosphorus, add chicken manure or animal bones to compost.
Lack of potassium	Nearby plants have same problems	For phosphorus, add chicken manure or animal bones to compost

Disease	Symptoms	Remedy
	Edges of leaves look scorched. Brown patches in leaves between	For phosphorus, add chicken manure or animal bones to compost
Lack of phosphorus	Purple in stems or leaves veins	
Too little	Wilting	Water regularly or drain the bed
Too much	Wilting	
Leaf tips burnt/crinkled	Yellowing	
Stunted	Root rot	
Yellow leaves	Stem rot	
Pests		
Sucking insects	Insects on buds, leaves, stem (aphids, scale) sticky secretions	PICK, WIPE, TRAP, SPRAY! Pick Hand pick caterpillars, slugs or snails, beetles - look in possible hiding places and you'll find them.
	Sooty mould on leaves	Wipe whitefly, scale, mealybug by hand.
	Pale, brown, speckled, drying leaves or fruit	Trap whitefly with "sticky traps". Smear yellow cardboard with petroleum jelly (Vaseline) Whitefly like yellow things.
Chewing insects	Holes	Trap slugs under citrus or potato skins, in a slug trap (e.g. A half buried can of beer or milk) or with ash or sawdust around plants.
	Jagged edges	Spray with natural pesticides, or dust with wood ash or flour. Spray under leaves too. Pest police Let in ducks and hens, carry in ladybugs and lacewing, encourage frogs and lizards.

## WATER MANAGEMENT

For wet areas or wet seasons:	For dry areas or dry seasons
Dig holes and canals to drain water. Add compost to drain clay soil. Grow plants that love water (e.g. Rice, taro, lotus, water chestnuts). Protect young plants from heavy rain. Grow plants on trellises and use containers. Don't mulch too much.	Use "grey water" from washing. Harvest rainwater with gutters and water tanks. Grow crops near the water. Prevent runoff - put beds across slopes and build up edges. Water conservatively - use a drip system, NOT a sprinkler. Use a lot of compost and mulch. Provide shade for young plants. Remove competitive weeds that steal water. (Grow dry-climate crops (e.g. Mung bean, egg-plant, sweet-potato, mango, groundnut, okra.)

## WATERING PLANTS

### Methods of watering plants

1. Flood the bed - in dry places make a sunken bed to keep the water in.
2. Drip irrigation - use a drip hose or soaker hose.
3. Water by hand with a watering can or a plastic bottle with holes.
4. Make water traps - e.g. keep the water in by digging a shallow trough round the plant.
5. Water plants individually with sunken tins or upended bottles.

### Watering advice

1. Water seeds and seedlings gently.
2. Don't drown plants by over-watering. If they need a lot of water, give it in stages.
3. Water the soil, not the plants. Get the water to the roots. Water on leaves can hurt plants.
4. Don't use a sprinkler - it wastes water.
5. Measure moisture each day with a measuring stick. When the top 3 cm is dry it's time to water.
6. Water in the morning or evening when it is cool so the water doesn't evaporate.
7. Deep roots don't need more water: let plants dry out between waterings to encourage roots to grow.

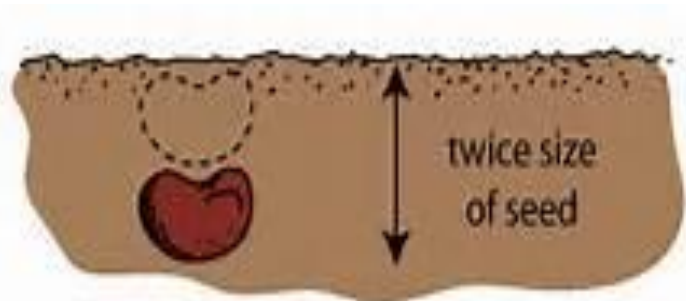


## WEEDS

Weeds are only harmful if they threaten crops. Some weeds attract pests like aphids and can starve crops by taking light, water and food from them, but some attract beneficial insects like bees and butterflies, while others (e.g. clover, vetch) make the soil rich with nitrogen. Here are some elements of a good organic weed policy:

1. Prevent weeds by filling up the space between plants with mulch or ground cover (e.g. pumpkins, sweet potatoes and other vine plants). Create shade with multi-layer cropping to deter weeds.
2. Remove weeds when the ground is damp by digging them, pulling them, or cutting them off under the surface. Try to catch them small, or at least before they go to seed. Avoid weedkiller: it can kill good insects and good plants, poison the soil and harm children.
3. Use weeds for mulch or compost (but not if full of seeds).
4. Leave a patch of flowering weeds to attract beneficial insects.

## PLANTING AND TRANSPLANTING



Sowing big seeds directly in the ground

Soil should be raked finely, removing lumps, roots, stones.

Seeds should be sown at a distance that allows for the size of the mature plant. Use pegs and knotted string to mark out rows, and measuring sticks to measure distance between plants. Make furrows at a depth approximately 3 times the seed's diameter.

Add a little compost, then drop in the seeds.

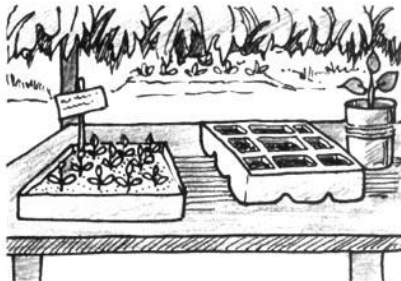
Cover the seeds and press down.

Water gently and keep damp.

Protect seeds/seedlings from sun, rain and predators with canopies (fronds or sacking) and thorns.

Small seeds need to be started in a protected seed bed, thinned out, hardened off and then planted out. Seed beds may be:

1. Boxes, trays, bags, with holes for draining. These are easy to move.
2. A raised garden bed with a shade over it and some protection from predators.
3. Re-usable seed trays with compartments. Transplanting seedlings in their own soil ball protects the roots.



### Preparations

Make a seed bed with fine rich soil, and no lumps, sticks or stones. Weed it well and flatten it neatly with a board. Prepare a canopy of sacking or fronds to protect the bed from sun and rain. Protect the seed bed from predators (e.g. with wall of thorns, or by putting trays on a table).

Sowing Mix seeds with fine soil or sand. Make furrows in the soil a few cm deep and about 15 cm apart. Sprinkle in the seeds and cover lightly. Water well, but don't flood. Label the rows with seed packets on sticks.

Growing Water gently twice a day - morning and evening. When seedlings appear, add mulch to keep them cool and damp and keep down competition.

Hardening off and thinning When seedlings have two leaves, harden them off for about ten days, giving them a little more sun and weather every day. When they are about 8 cm high, thin them out to about 5 cm apart by cutting them close to the ground with scissors.

Transplanting/Planting out Transplant when it's cool into raised beds. Mark lines and holes. Choose good strong seedlings, scoop them up with a little soil to keep their roots intact. Plant them in the holes, fill with soil, water right away and mulch around the plants. Water regularly.

## **PROTECTING THE GARDEN**

Ways of protecting the garden have to take account of the commonest local animal predators, their size and number, what they attack and how they move (flying, burrowing, scratching, crawling, jumping). Local measures are generally the most economical and effective because they make use of widely available materials. Some protective measures are

1. Walls made of brick, concrete, stone or earth are strong but need a lot of work. Deep foundations are necessary if they are to prevent burrowing animals. Dry stone walls need constant maintenance. Rammed earth walls are easy to make, but need tiles on top to keep the water out.



2. Fences made from brushwood, wattle or bamboo are light and easy to move but need to be renewed every year. More permanent wire fences with concrete posts

should start half a metre underground to keep out burrowers. Solar-powered electric fences can keep out big animals.

3. Hedges or living fences keep out big animals. Plants for thorny hedges are thorny vines, brambles, thorny wild apple, sisal, pandanus or *Parkinsonia aculeata*. Other thick hedges are euphorbia, cactus, bamboo and vetiver grass. Some (e.g. pineapple, salak, lemon grass, cassava and yucca) give food as well.



4. Nets are costly and time-consuming but effective for keeping birds, animals and insects away from fruit.
5. Scarecrows and scarers (e.g. shiny metal or plastic strips) are fun for children to make, watch, draw and tell stories about.
6. At the grass roots level, mini-fences of sticks or thorns protect young plants. Coverings (e.g. dry branches or sacks on sticks) keep away chickens and birds from seedlings. Coconut shells or stones can be used as earth blocks around carrots or sweet potatoes to keep diggers away from roots. Chickens are mostly beneficial for the garden, as they seldom destroy vegetables, aerate the soil by scratching and help to control pests. Marigolds planted as mini living fences around seedlings or fruit which chickens like, such as tomatoes, will keep chickens doing good and not harm to the garden.

## HARVESTING

Gardeners should know if the crop must ripen on the plant or can also ripen off the plant. Harvesting should ensure that produce is fresh and undamaged. It should be done in the cool of the day. Produce should be handled carefully to avoid damage. Store only perfect foods; use up damaged foods quickly before they rot. Store foods in cool dry conditions. For transport, fruit should be packed carefully so it will not get hurt. Old plants can be left in the soil as compost.

## CONSERVING AND PRESERVING GARDEN FOODS

General rules for processing foods are:

1. Harvest in the cool of the evening.
2. Choose ripe, undamaged items.
3. Cut out any damaged or rotten pieces.
4. Sterilize equipment and wash hands.

Ten simple food-preserving projects:

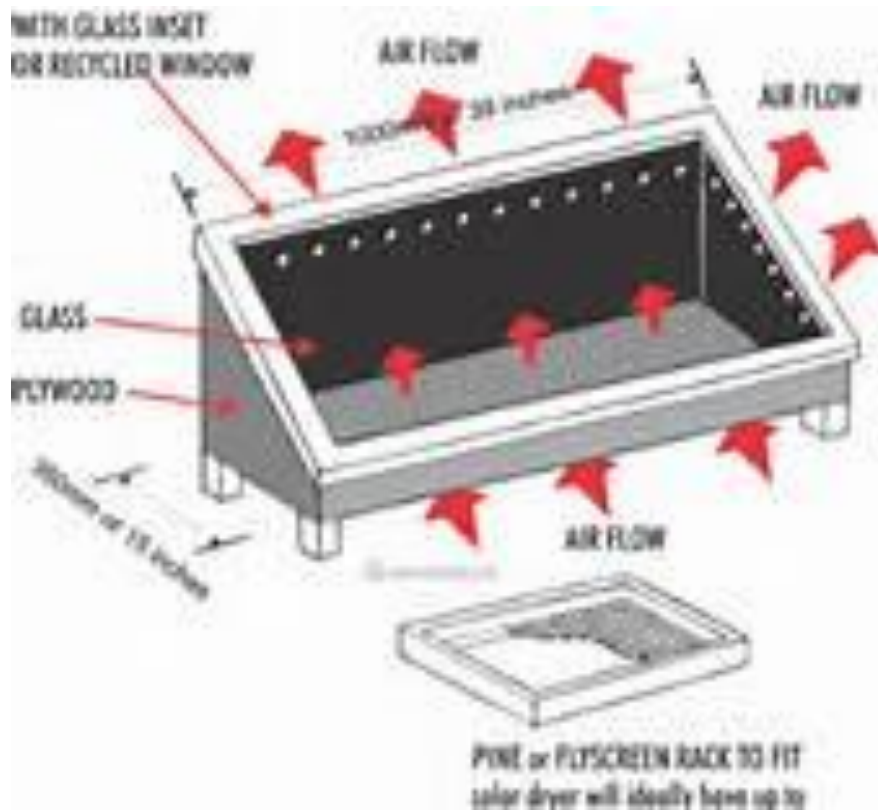
Hang up strings/bunches of onions, garlic, chillies, herbs, cherry tomatoes, in a cool shady airy place.

Cure sweet potatoes, yams, pumpkins by leaving them in a warm shady airy place for a week after harvesting. The skin will thicken and they will keep better. Store in a dark cool dry place.

Dry fruit and vegetables in an airy open-sided shed. Put slices of food on a rack/ mat/ tray well off the ground with its legs in water to prevent climbing insects. Turn every day until dry (vegetables) or leathery (fruit). Thin foods (e.g. green leaves) can be dried whole. Dry legumes and oilseeds on the plant. Store in a cool dry protected place.



Use a solar drier A solar drier is basically a box or frame with a plastic cover. It is not difficult to construct. Solar drying is faster and preserves nutrients better. It takes about three days for fruit/vegetable strips and slices, two days for leaves. Store dried food in airtight containers.



Make flour (e.g. pumpkin, banana, sweet potato, breadfruit, cowpea) and use it in cakes, biscuits, pancakes, weaning foods. Dry the food, then pound, sieve and store in an airtight container. For banana flour, pick bananas when three-quarters ripe. Heat them, peel and slice them, then dry the slices. Pound into flour, then sieve and store.

Make fruit leather by cooking fruit, pulping it, then drying it. For pumpkin leather, wash, peel, cut up and cook the pumpkin, purée, strain, add honey and spices, spread on an oiled tray and dry in a solar drier. Cut the leather into squares and wrap in cellophane.



### Pickle cucumber



Wash 3 kilos of firm, fresh, medium-size cucumbers and put in a deep bowl. Mix salt and water, enough to cover the cucumbers. Let stand for two days. Drain, rinse and slice. Put 10 cups of sugar, 10 cups of white vinegar and some pickling spice in a pot and bring slowly to a boil to dissolve the sugar. Add sliced cucumbers to the hot syrup for a few seconds, then pack into clean hot jars. Fill jars with hot vinegar-sugar solution and seal.



Make Kanji pickled carrot drink, popular in India. Wash a kilo of carrots and grate them into a jar/bottle. Add 7 litres of clean water, 200g salt and some hot spices (e.g. chilli, mustard seed). Close tightly, leaving a tiny hole for gases to escape. Ferment for 7–10 days. Strain. Consume within 3–4 days.

Make guava juice. Choose firm ripe guavas. Wash, cut off ends, slice. Cover with water in a large pot. Boil until very soft (15–20 minutes). Pour into a bag of rough cloth and let it drip

through. Drink it right away. To bottle it, sterilize bottles and lids, boil the juice again, pour into hot bottles and seal.



**Bottle tomatoes** Use plum tomatoes, ripe but hard. Wash well and remove bad bits. Dip in boiling water for 30 seconds, cool in water, then peel. Fill jars with tomatoes. Add a small spoon of lemon juice/vinegar to each. Seal while hot. Cover jars with water in a deep pan, with straw to stop rattling. Boil for 30 minutes (small jars) or 50 minutes (big jars). Let cool and label.





## SNACKS AND DRINKS FROM THE GARDEN



Some snacks Fruit, fruit leather, sugarcane, sweet potato, carrots, celery, maize cob, rice cakes, nuts, sunflower seeds, raw young beans and peas, bean and seed sprouts from alfalfa, barley, wheat, beans, pumpkin, popcorn (with salt or honey) made from maize or sorghum.

Some drinks Fruit and vegetable juices, herb teas and spice drinks, coconut water, bean milk from pulped and sieved black or green gram.