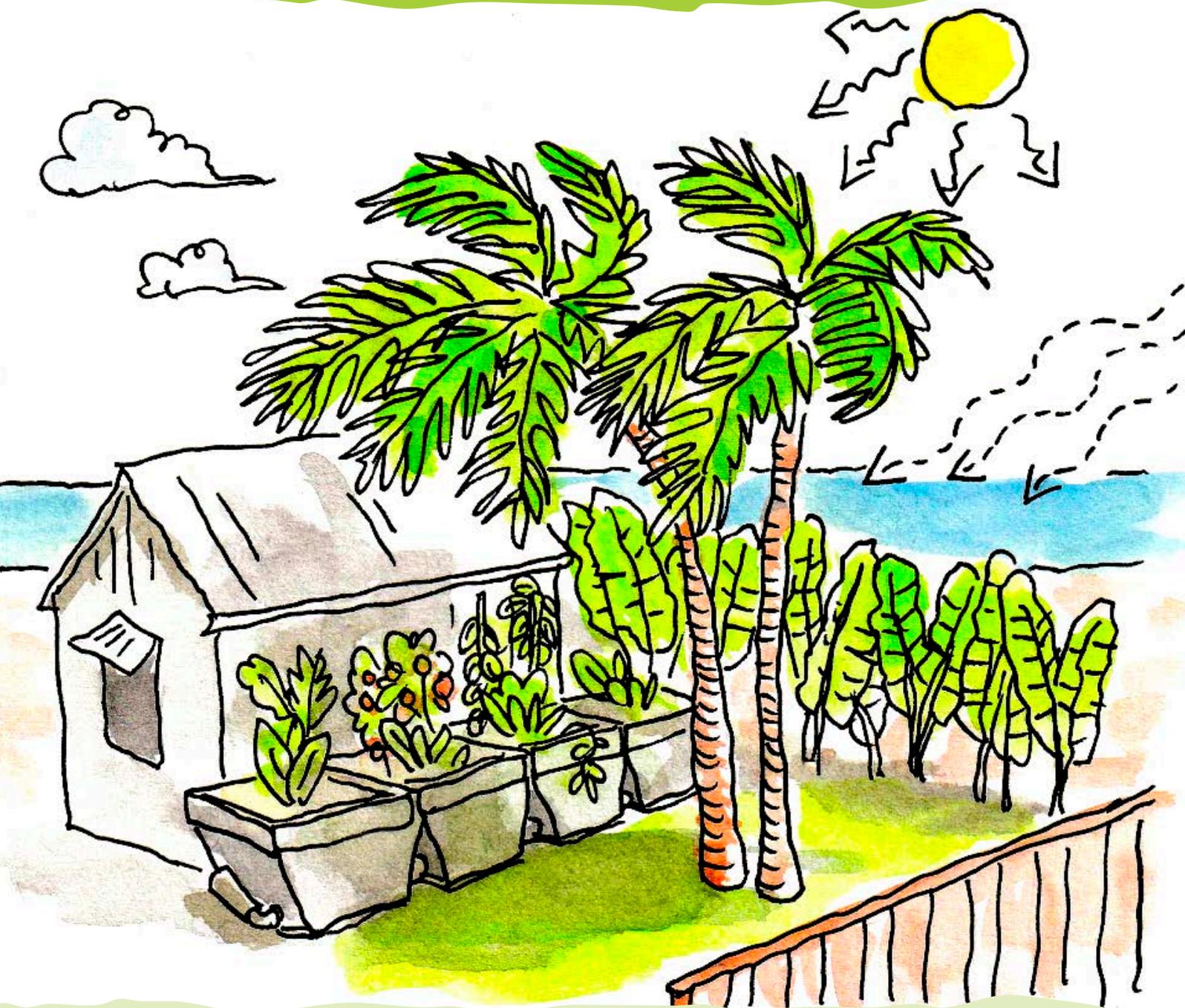


Home Food Cube Gardening

A guide to using Food Cubes to grow vegetables in Tuvalu



LIVE & LEARN
Environmental Education

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The Food Cube is an innovative self-watering wicking garden bed design and manufactured in Melbourne, Australia.
For more information see www.biofilta.com.au

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Introduction

This guide is to help you produce as much healthy food, especially leafy green vegetables, as possible from your Biofilta Food Cube. The guide covers how to set up your Food Cube, the importance of the soil food web and how to feed the soil in your Food Cube so that it feeds the plants, suggestions of what to plant together and when, and how to organically manage any pests or disease.

This guide is designed as an introduction and overview to container gardening at your home. It is complimentary to the many other resources and technical advice available to you from local agricultural organisations and government agriculture advice services. There are many sources of help for you as you get your home garden established.

Successful home container gardening doesn't need you to do a special qualification or course. You just need to understand the basic conditions for vegetables to thrive in container conditions, and then carefully watch and learn through each growing season. You will experience failures and successes, that is normal in any gardening. But by using the information in this guide, watching carefully, and sharing your experience with other families who are also growing vegetables in Food Cubes you will build the knowledge and experience to grow amazing organic vegetables.

PART 1

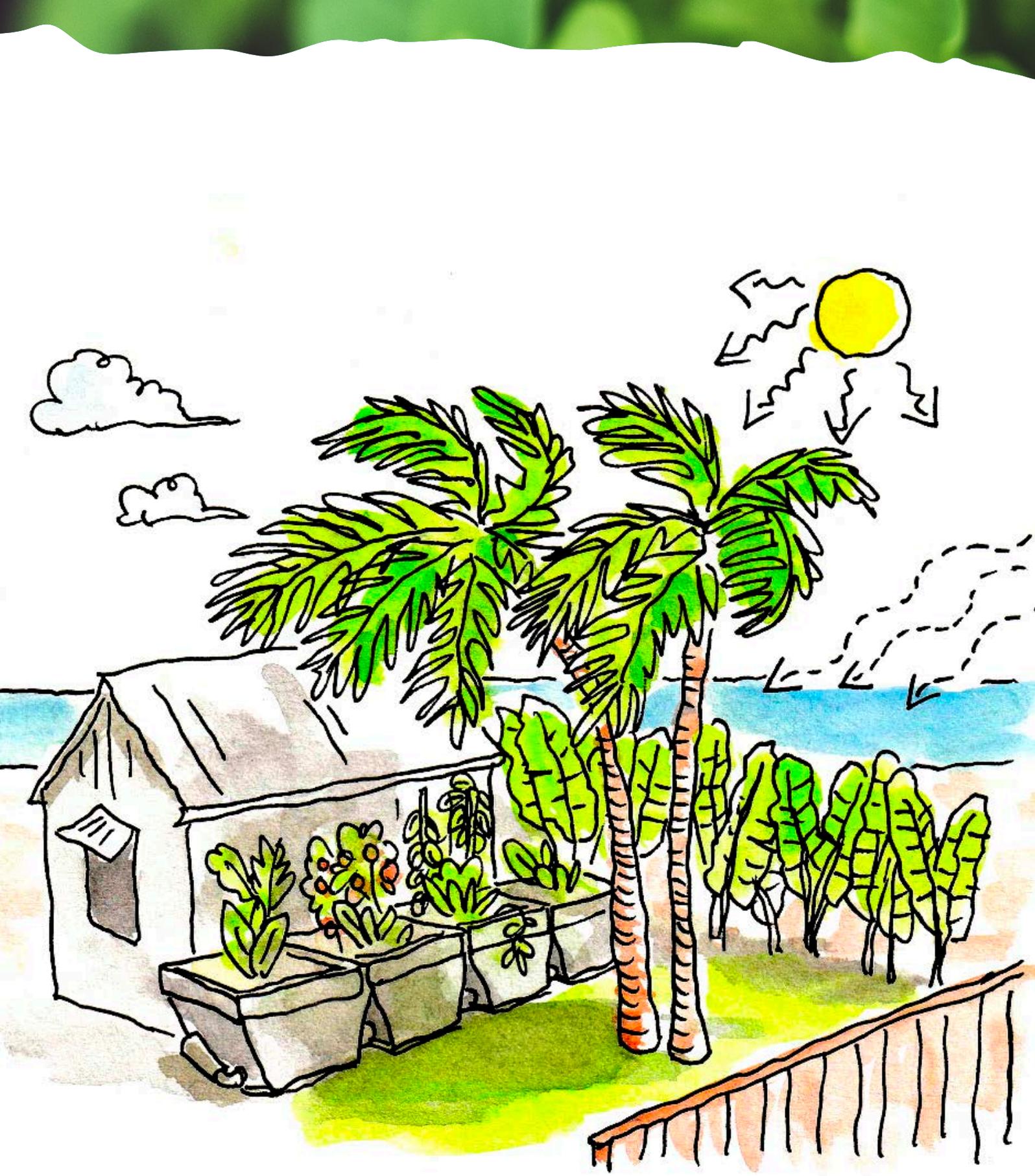


Garden Site & Food Cube Construction

How it works

Your Foodcube uses a wicking process, enabling plants to draw water from a reservoir under the soil via the soil cones. Air circulates through the system via the air towers, aerating the soil.



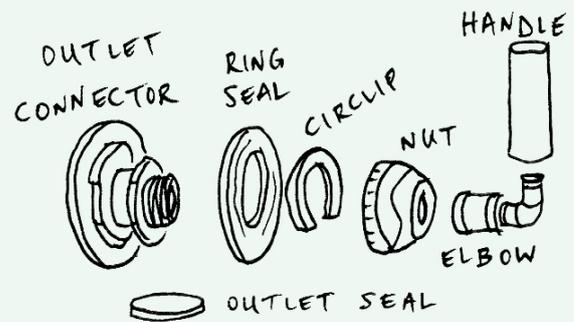


Location

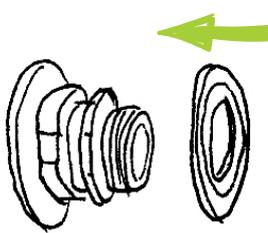
- Position cubes in a sheltered area to reduce direct sunlight and excessive heat (especially between 9am and 3pm), strong winds and heavy rain.
- Place cubes by the side of a building and/or under shade trees. Use plants as a windbreak to shelter from prevailing winds.
- Use plenty of heavy leaf mulch to retain water, cool the soil and add nutrients.



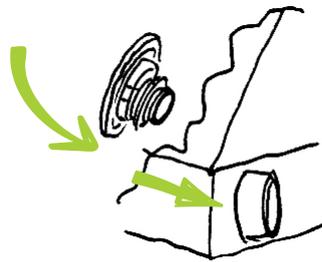
Construction



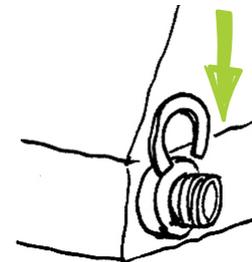
ATTACHMENT OF LEVEL SETTER AND OUTLET CONNECTORS AT TUB OPENINGS:



1 Place ring seal on outlet connector.

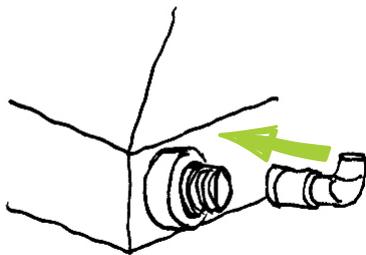


2 Insert outlet connector from inside tub.

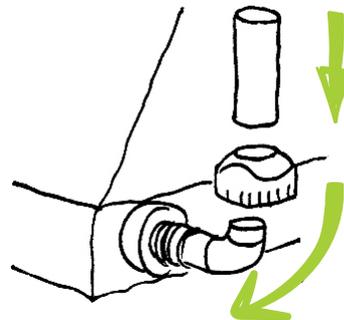


3 Slide circlip onto outlet connector outside tub to secure.

LEVEL SETTER:

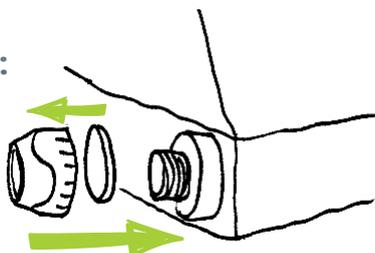


4 Push in elbow firmly. (Lubricate O rings if necessary.)



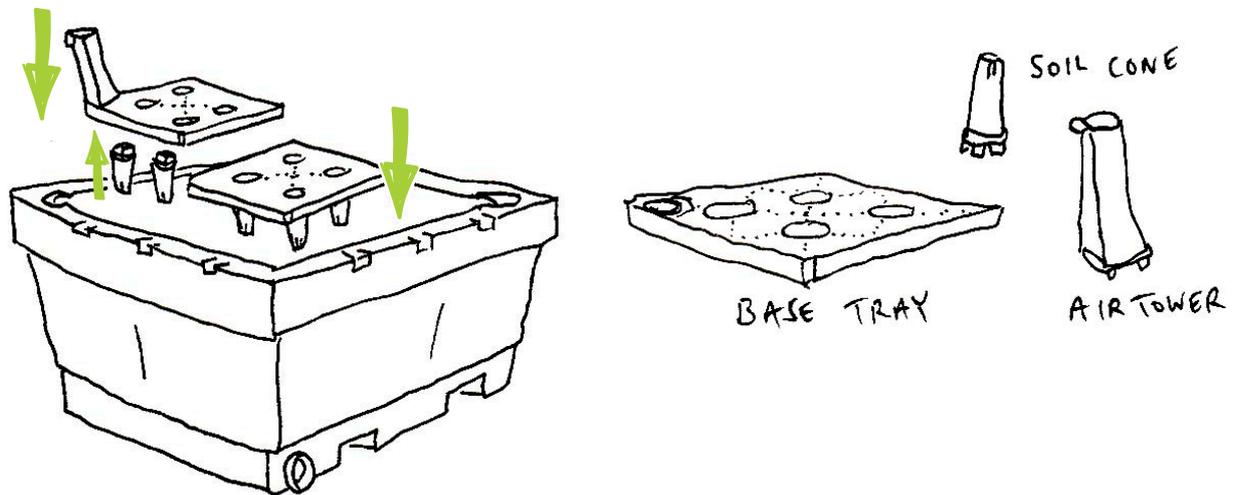
5 Slide nut over elbow and attach tightly to outlet connector. Attach level setter handle to elbow.

OUTLET:



6 Place outlet seal inside nut and attach nut to outlet connector.

TRAY SET-UP:



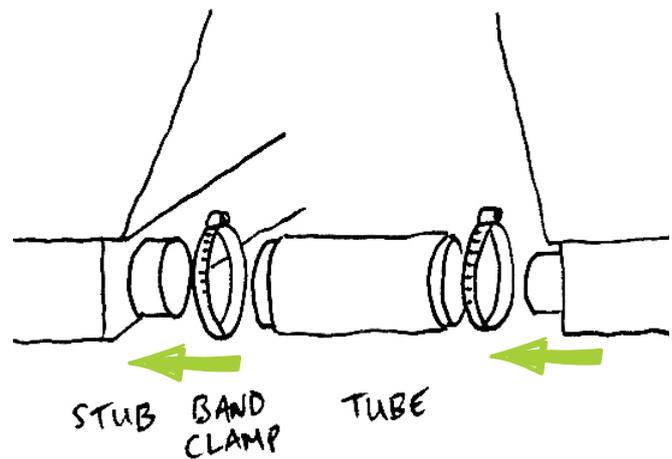
1 Attach each air tower to the two base trays with tower connections.

2 Attach soil cones to bottom of the four trays. Place trays in bottom of tub.

3 Hook tops of air towers into slots at corners of tub.

MULTIPLE TUB CONNECTION:

- 1** Place tubs close together with outlet stubs facing each other. (Level setter must remain on end tub.)
- 2** Place band clamps in grooves of connecting tube (but do not tighten yet).
- 3** Slide connecting tube onto stubs on tubs.
- 4** Tighten band clamps.

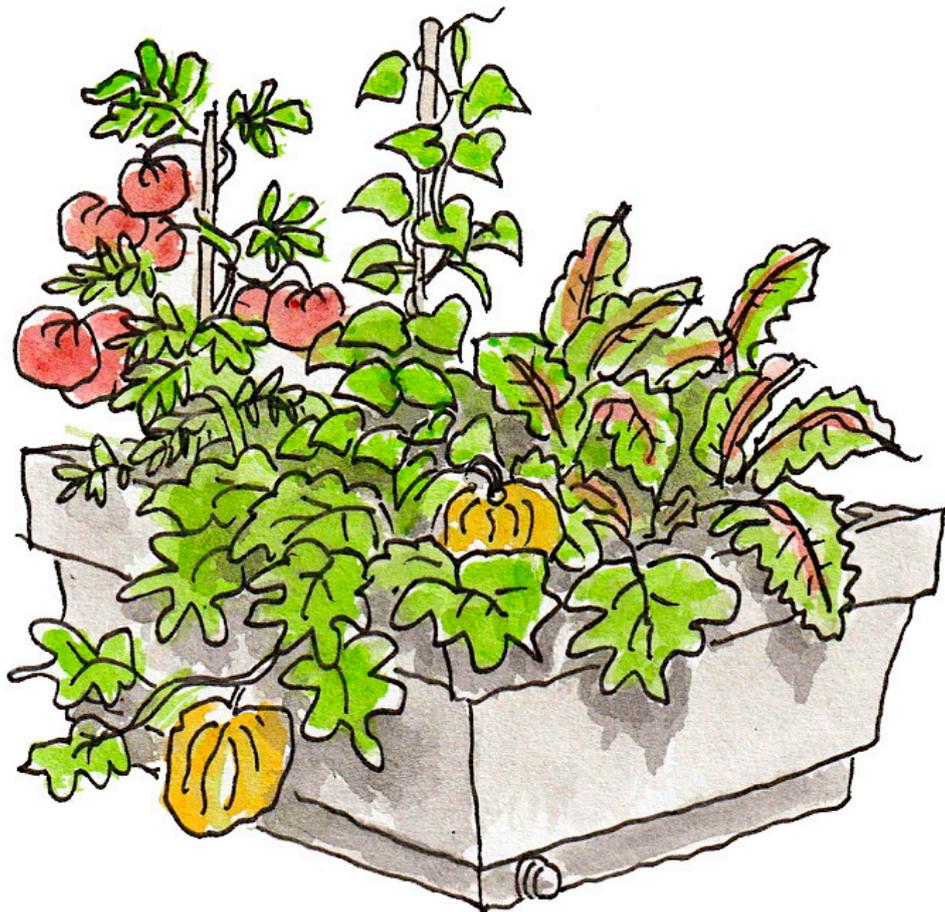


For detailed set-up information and videos please see <https://www.biofilta.com.au/foodcube-setup.html#/>



Using Food Cubes

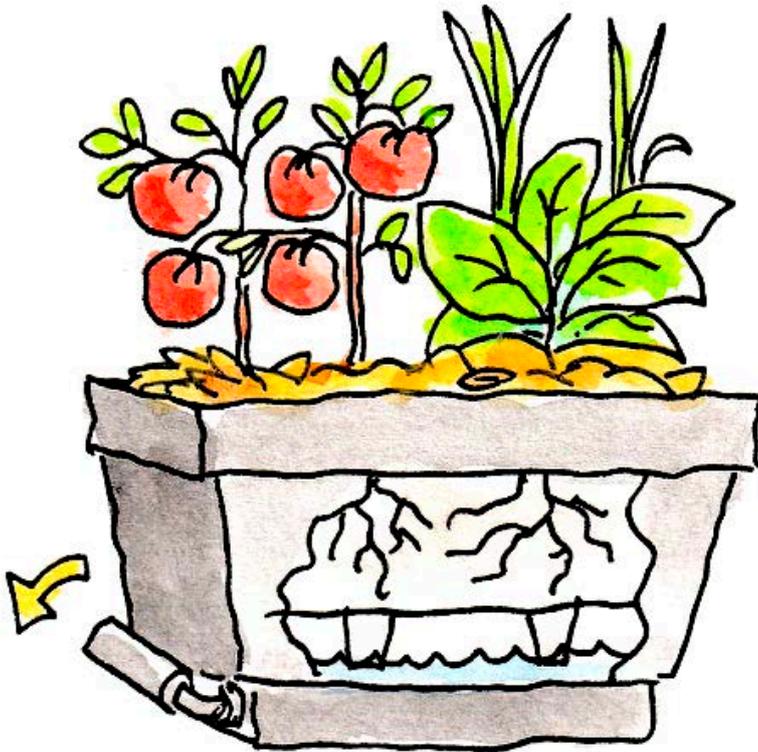
- Ensure cubes are on a firm, level surface.
- Test seals by filling to maximum water level before filling tub with media.
- Use healthy potting soil with plenty of organic matter/compost.
- Cover surface well with thick leaf mulch to minimise water loss.
- When beginning to fill tub with soil, push soil into soil cones to ensure contact with water.
- Add water using the air tower vents at corners of tub.
- Water seedlings directly from above.





Level setter:

- Use level setter to control water height.
- Use maximum setting to saturate soil for seedlings.
- Use normal setting to create air gap between water and soil and to avoid root rot for mature plants.
- Check water level by checking level setter. Water should be visible inside handle when set at appropriate level.
- Tilt level setter downwards below horizontal to drain tub.



Maintenance:

- Every few years between planting you can take out the soil mix so that you can remove the trays and check for root build-up in the cones. When you replace the soil renew it with additional compost and fertilisers.
- Top-up soil after harvesting.

PART 2



Soil / Compost

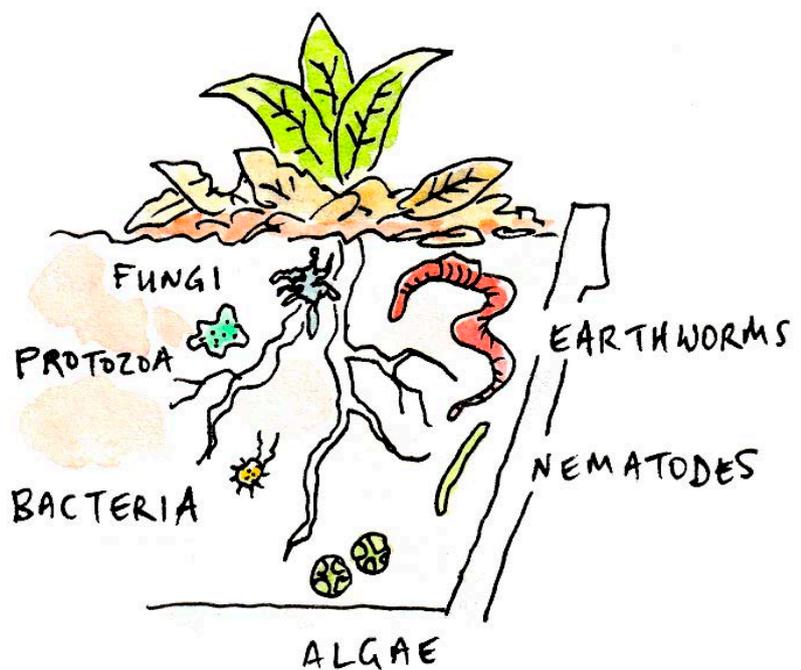
There is more life in the ground than above the ground! Healthy soil flourishes with microorganisms that work together to create a soil food web that results in healthy plants.

Healthy soil contains protozoa, nematodes, mycorrhiza fungi, algae, earthworms, beetles, etc. They mostly cannot be seen by the naked eye, but millions exist in the soil and on the soil surface. For instance, one teaspoonful of soil can contain 6 to 7 million bacteria.

When growing organic vegetables, the idea is that by feeding the soil, the soil will feed the plants.

Organic fertilizers contain decaying matter that act as food for the microorganisms. The soil food web creates fertility by decomposing this organic material so that it is accessible to plants, providing the plants with nourishment. Another part of the organic material is transformed into humus, which helps the soil hold more water and reduces nutrients leaching out in heavy rain.

The microorganisms also improve the overall fertility simply by moving through the soil, creating tunnels and gluing soil particles together. This allows for better aeration and drainage, less compaction, and the movement of nutrients within the soil.



Container gardens have limited space and a smaller diversity of microorganisms compared to regular garden patches, but the same processes are just as important. Keeping the soil food web healthy in container gardening relies almost exclusively on direct feeding of the soil and plants with liquid plant feeds like compost tea and seaweed tea. Use a thick organic mulch of dried leaves on the soil surface in all your containers, as this stops the soil drying out and helps the soil food web. If possible, leave the soil undisturbed except for where you are putting the plant or seeds in. After harvesting, leave some of the old roots in the soil to return nutrients taken from it and provide pathways for new roots. When you do want to use new soil, dump the old stuff in the compost pile and mix it in. The soil-food web in your compost pile will re-mineralize it for future reuse in containers.

Each Food Cube or Food Wall container needs to be filled with 330 litres of potting compost. These initial large amounts of compost can be sourced through local suppliers of compost – contact your agricultural extension officer for more information.

How to feed the soil food web in the Food Cube

You can feed the soil food web in the Food Cubes by topping up with your own home-made compost, and regularly feeding the plants with organic fertilisers. Here are instructions for 18-Day Hot Compost.

Hot Compost Recipe

← RECIPE

You can make smaller batches of your own compost to top up the containers every few months or after harvesting bigger plants.

INGREDIENTS

3 parts brown – 3 parts green – 1 part manure

Brown: Fallen leaves of trees (such as Breadfruit with Premna and Guettarda), rotten coconut logs

Green: Beach Cabbage

Manure: Pig manure, human urine, old compost

EXTRAS

Seaweed, ash, fish waste – to provide essential nutrients lacking in the brown, green and manure ingredients

EQUIPMENT

Only tools needed are a pitchfork, rake and a waterproof cover

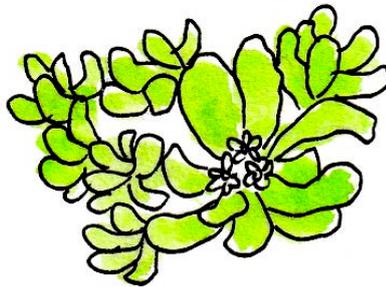


Brown:



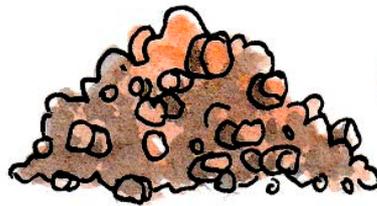
DEAD LEAVES, ROTTING LOGS

Green:



BEACH CABBAGE

Manure:



PIG MANURE

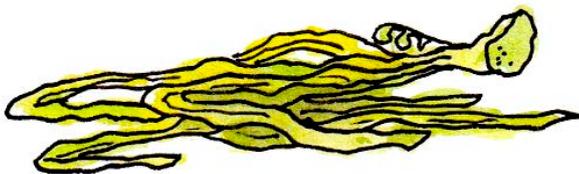


URINE

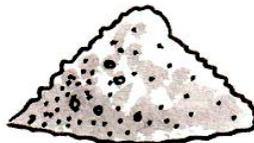


OLD COMPOST

Extras:



SEAWEED



ASH



FISH WASTE

18 Day Compost Method

- 1 Make a base 20cm high with sticks or coconut husks to help air circulation.



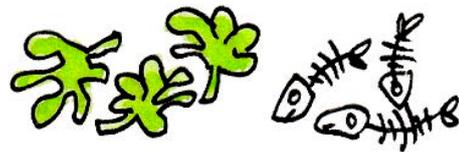
- 2 Add a 25cm layer of brown materials.



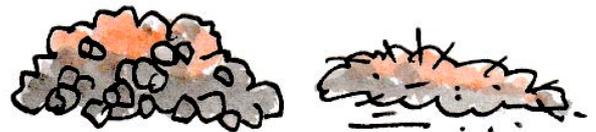
- 3 Sprinkle two shovels of ash over the brown layer.



- 4 Follow with a 15cm layer (width of your hand) of green materials, including fish waste or urine.



- 5 Add some dark soil from the pig run and/or a sprinkling of old compost.



- 6 Sprinkle water over the layers so they are not dusty.



- 7 Repeat the Brown and Green layers, watering lightly after each layer, until the heap is 1 metre high.

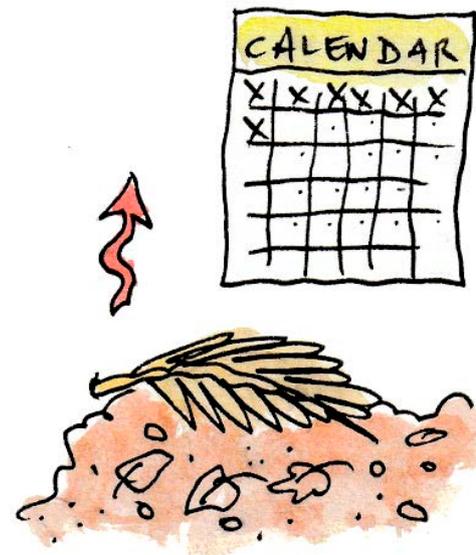


- 8 Cover the heap with a tarpaulin or banana leaves or palm fronds (we want it to get steaming hot inside).



- 9 Wait for 2 or 3 days, then check the temperature by pushing a knife into the centre of the compost pile and testing the temperature of the blade against the back of your hand. The knife blade should be hot to touch when you pull it out.

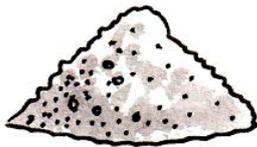
- 10 Leave the pile to heat up for 1 week, then turn the compost every two days. Make sure the pile is not too wet or too dry – you should be able to squeeze a drop of water out of a big handful after 4 days.



- 11 By day 18 the finished compost pile should be the same size as at the beginning, but everything has changed to a dark colour, with fine texture (not too many lumps) and a slightly warm temperature.

Always wash your hands with soap and water after working with compost.

Compost seasoning for added nutrition

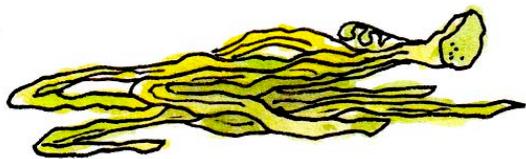


ASH

ASH

> Adds potassium, iron, manganese, copper, phosphorus, zinc and boron

Sprinkle 1 cup of cool ash from burned coconut husks and shells in cooking fires on top of each layer of brown. Or 2 shovels (4–5 kg) sprinkled in a cubic metre compost heap.



SEAWEED

SEAWEED (SARGASSUM POLYCYSTUM)

> Adds potassium, iron, manganese, copper, phosphorus, zinc and sulphur

Must be left to rinse in rainwater (to get the salt off)



FISH WASTE

FISH WASTE OR HUMAN URINE

> Adds nitrogen

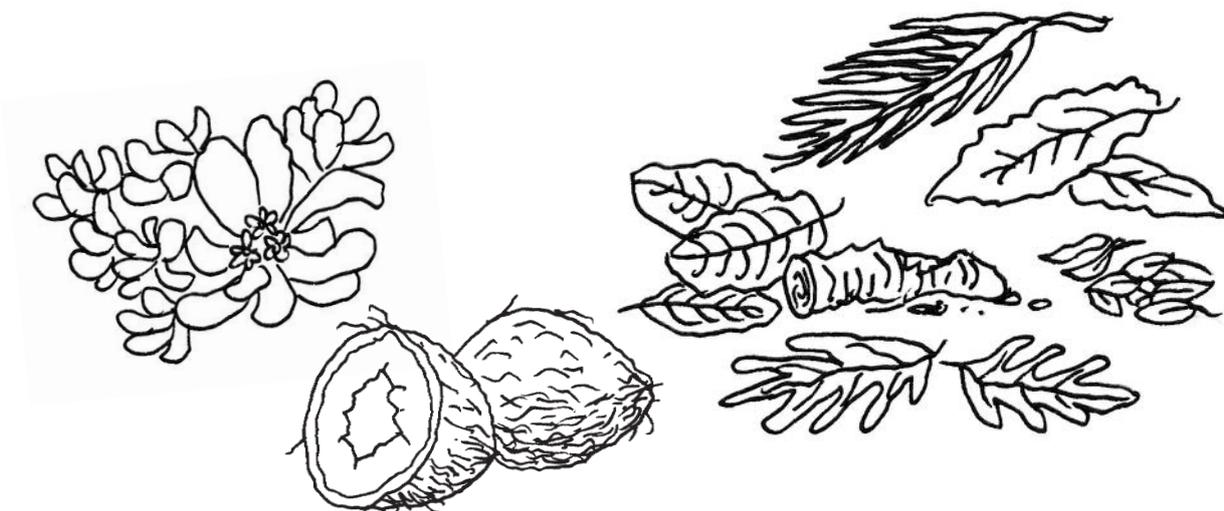
Other sources of nitrogen include chaya, drumstick (moringa), yellow beach pea and pisonia leaves.



Common sources for different micronutrients needed in the soil food web

NUTRIENT	COMPOST INGREDIENTS
Nitrogen (N)	Sea cucumbers, fish meal, green leaves (Chaya, drumstick, purslane, Vigna), manure, vegetable scraps
Phosphorous (P)	Manure, ash (coconut husk shell), green leaves (Sida, chaya, drumstick)
Potassium (K)	Ash (coconut husk shell), seaweed (not seagrass), green leaves (purslane, Pisonia), manure
Copper (Cu)	Ash (coconut husk shell), manure, green leaves (purslane)
Manganese (Mn)	Manure, ash (coconut husk shell), green leaves (Pisonia, Vigna, castor weed)
Iron (Fe)	Manure, fish meal, ash, algae, seaweed, green leaves (purslane, Vigna, Chaya), rusty cans
Zinc (Zn)	Manure, ash (coconut husk shell), fish meal, green leaves (purslane, hedge panax, Sida)
Boron (B)	Ash, algae, seaweed

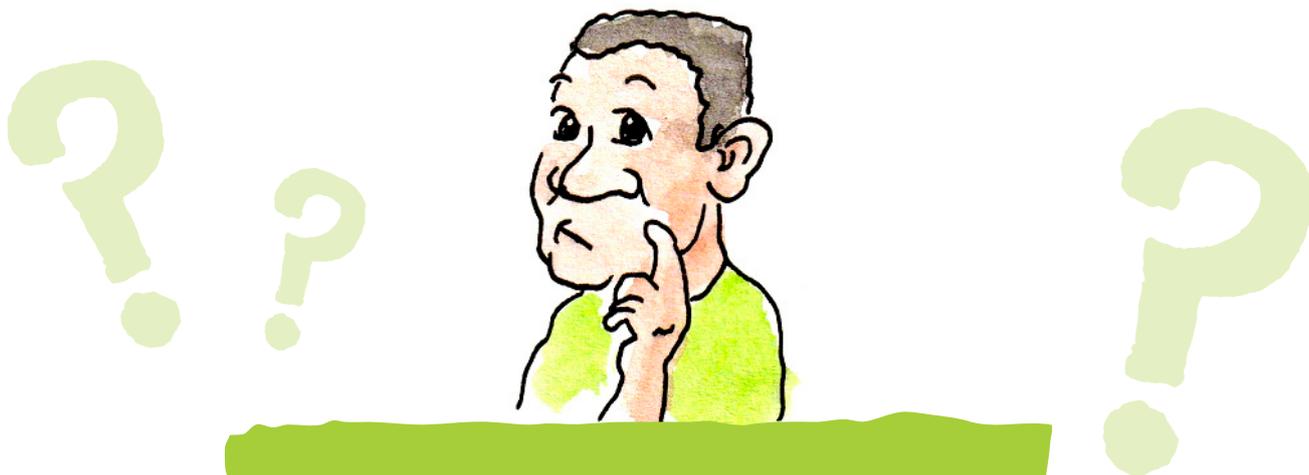
Source: Deans et al. 2018





Tips

- Anything that has lived before can be composted, so all organic materials can be put into the compost pile. Are they brown (dead, dry, like paper) or green (still a bit alive, wet, like green leaves and food scraps from cooking)?
- The soil from around tethered pigs is great to add into compost (for potassium and nitrogen). It is also a good idea to add a layer of chopped brown leaves into the pig run to soak up urine (high in nitrogen) to add to the compost.
- It is better not to put meat into the compost pile (it attracts rats or pests), and only limited amounts of citrus.
- Weeds can be included as part of green material – but not weeds with mature seeds or that grow from bits of roots – we have another use for those (weed tea – described later)!
- No plastic can be composted.
- Animal manure is an important source of nutrients and organic matter. Chicken manure is the best due to the combined urine and waste in the manure, but all animal manure is useful. Make sure the animal manure has been left for some time (3 months for chicken manure) before using it in your gardens. Do not apply fresh animal manure, especially chicken manure, to your plants as this will burn the plants.
- Sun, rain and wind can decrease the quality of the manure. Rain washes out the nutrients in the manure, while wind and sun dry up the manure, killing the micro-organisms and evaporating nutrients like nitrogen. It is important to keep the manure covered under a shelter and to protect it by covering it with mulch after applying it to garden beds.



Troubleshooting

PROBLEM

Not hot enough

- Is it big enough (at least 1.5m high)?
- If it is at least 1.5m high, is it too wet or too dry? (You need to be able to squeeze a drop of water out of a big handful after 4 days.)
- If the size and moisture is ok, check the brown material. Were the leaves cut up fine? If the leaves or paper were cut up into small pieces then it must be a lack of manure (nitrogen).
- Add more manure and wait two more days.

PROBLEM

Gets hot too quickly and shrinks low and smells bad

- There is too much manure, fish waste or other nitrogen material.
- Add more brown dry materials and wait two more days.

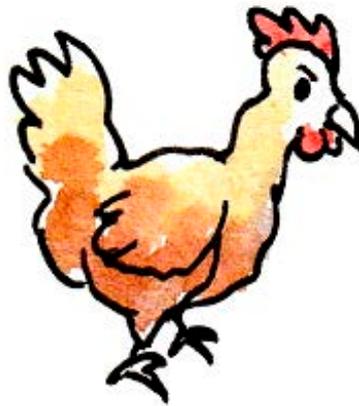
Liquid Fertilisers

How to make Liquid Manure Fertiliser

RECIPE

MATERIALS

- Fresh poultry manure
- Water
- 2 containers



STEPS

1. Fill a quarter of the container with the manure and top up with water.
2. Stir the mixture three times a day for two days, until the mixture turns a pale yellow colour.
3. Pour the liquid into another container until it is a quarter full, then top it up with fresh water. The liquid is now diluted and ready to be applied to the soil and mulch around the plant.

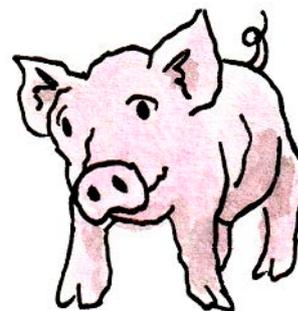
Always dilute liquid manure before applying it to plants to ensure that you don't burn the leaves of your plants.

NOTE:

You can use pig manure, but chicken manure has a higher amount of nitrogen (N), phosphorous (P) and potassium (K).

Chicken Manure: N – 1.8%, P – 2.7%, K – 1.5%

Pig Manure: N – 0.3%, P – 0.4%, K – 0.2%



How to make Liquid Seaweed Fertiliser

This solution controls pests and keeps soil healthy

← RECIPE

MATERIALS

- Large container with lid
- Seaweed (not sea grass)
- Fresh water
- Stick for stirring



STEPS

1. Put seaweed into a bucket.
2. Add 5 litres of water and firmly close the bucket with the lid.
3. Leave in bucket for 2 weeks, stirring every few days.
4. Strain out the liquid.
5. The seaweed left in the bucket can be used in mulching the Food Cubes or included in making more compost.

Take half a cup of seaweed solution and mix it with three quarters of a cup of fresh water to make your pest control and fertiliser solution. It is full of many useful nutrients and minerals that help plants to grow.

NOTE:

This recipe works just as well by replacing the seaweed with banana skins. You don't have to dilute the liquid after soaking the banana skins.

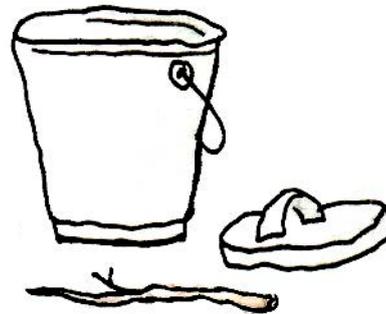
How to make Liquid Weed Fertiliser

Certain weeds are a nightmare in the garden. Some weeds grow around trees and shrubs, and in the vegie garden, where they compete for water and nutrients. Composting is one way to get rid of them. But the problem with some weeds is that even one surviving piece of stem or root can re-sprout and grow into a new plant. But there is a way to kill them and effectively recycle nutrients into the garden. One way to get rid of them is to make a weed tea fertiliser.

RECIPE

MATERIALS

- 20-litre bucket with lid
- Weeds
- Fresh water
- Stick for stirring



STEPS

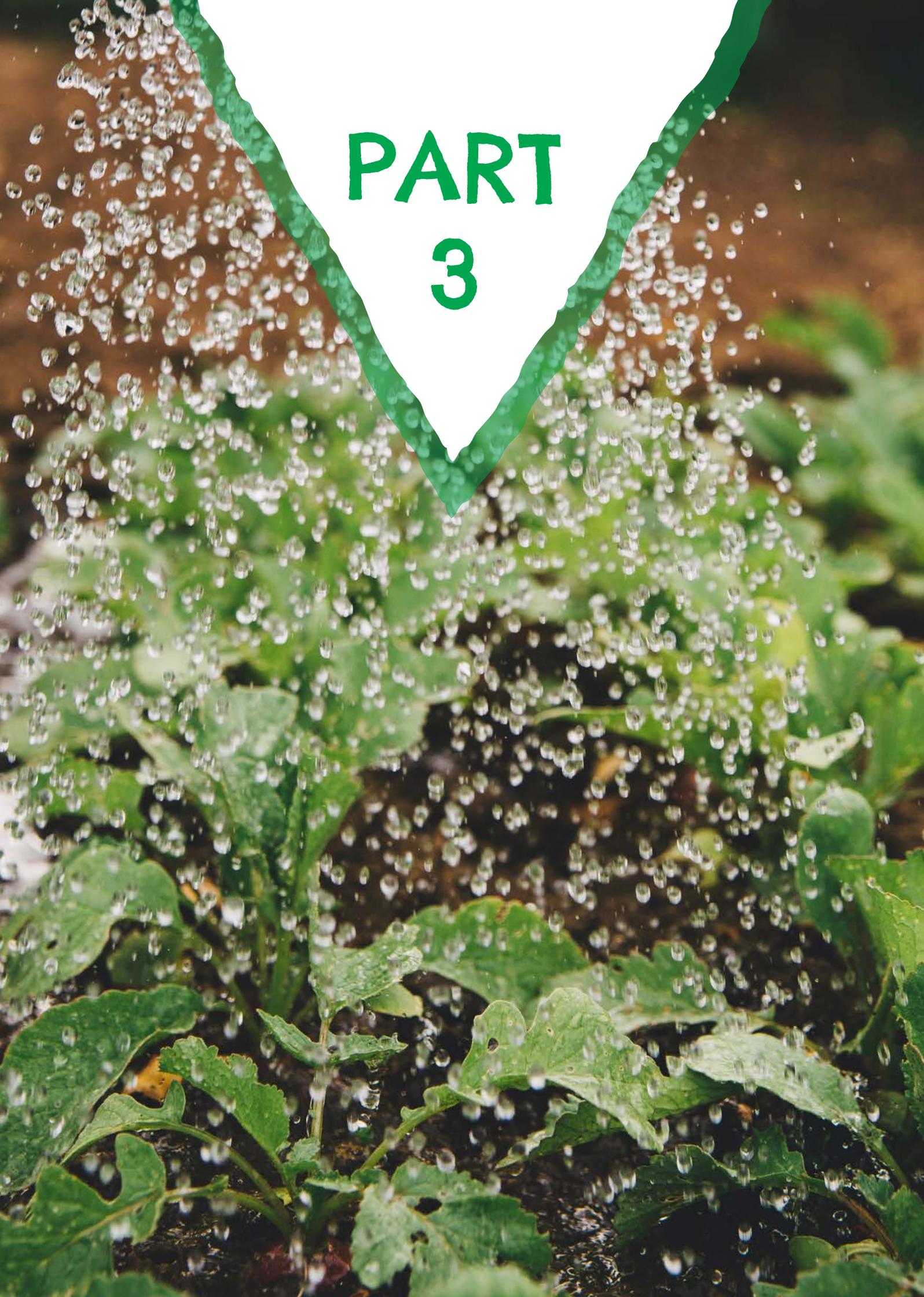
- Put the weeds into a bucket and submerge the weeds in water – ensure they are completely underwater. Put the lid on the bucket. Stir once a week.
- After about six weeks, a beautiful, brown, sludge appears, and the weeds are completely dead.
- Drain the liquid from the weeds into another bucket.
- The structure of the weeds is left, but without the nutrients, which have seeped into the water.
- Put the weed debris into the compost heap so that it continues to break down.
- The remaining liquid makes a wonderful plant fertiliser.

Dilute the mixture to about one part weed tea to ten parts water before you use it. You can also put the weed tea in the compost heap, so the nutrients accelerate the composting process.

Topping up the Food Cubes with rinsed mangrove mud

Mangroves are important for protecting the coastline and providing habitats for fish to breed and many other plants and animals to live in. Farmers in Malaita, Solomon Islands, have also found that they can use rinsed mangrove mud to grow food. If you have access to mangroves you can collect the soil and leave it on a hard surface, like rock or compacted clay, so that the rain will rinse out the salt. Once the salt is rinsed away then it can be mixed with grated rotten coconut husks and added to the compost in the Food Cube or Food Wall.



A close-up photograph of green leaves being watered. Numerous clear water droplets are captured in mid-air, falling from the top of the frame onto the foliage. The leaves are vibrant green and show some signs of being eaten, with small holes visible. The background is a soft, out-of-focus brown, suggesting soil or mulch.

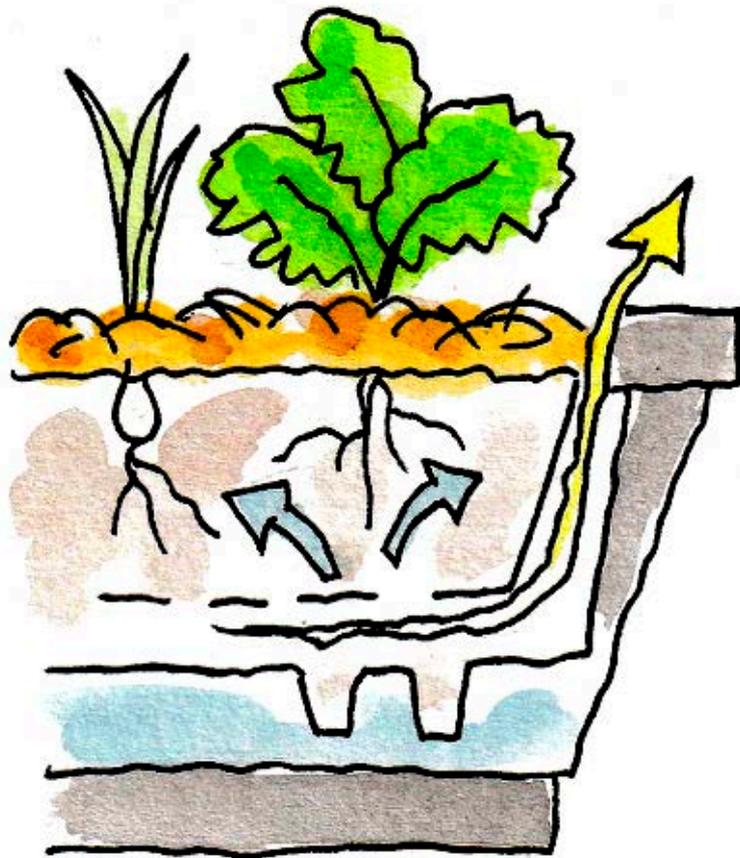
PART 3

Water Conservation

What is the wicking process?

Conserving water is a constant priority in Tuvalu. The Food Cubes use an advanced process called “wicking” to enable vegetable growing with the minimum amount of water. When growing vegetables in regular garden beds or containers watering is done from above the plants, based on a bit of guesswork or estimation on how dry the soil might be or what the plants need.

“Wicking beds” water plants from below, rather than above. They’re basically containers with water reservoirs at the base – like a giant self-watering pot. Moisture is drawn up through the soil via a process called capillary action or wicking. This allows moisture to be more evenly distributed throughout the soil, with the roots accessing the water as they need it.



Wicking beds are probably the most water-efficient way of growing vegetables in areas that have lower rainfall or are affected by water restrictions. Wicking beds also deliver the water right where it is needed – to the plant roots - which minimises water wastage and can also help to reduce the risk of fungal disease on leaves.

The Food Cube has an advantage over a home-made wicking bed – the water level setter. This is a handy way to adjust the amount of water needed in the Food Cube. At first when plants are very small the water level can be set higher to help the soil draw up enough water to reach the small roots of the seedlings. When plants grow bigger their roots will reach further down into the Food Cube, so the water level can be set lower.

A way to avoid having to keep the water level high is to practice interplanting of seedlings with more advanced plants. The roots of the larger plants will bring the moisture up into the soil, to reach the seedlings. The leaves of the larger plants will also provide shade for the smaller ones, reducing water loss.

In Tuvalu it is vital that the Food Cubes and the plants growing in them are shaded from the hot sun every day. This will reduce loss of water through evaporation, and stop the water getting too hot in the plastic reservoirs.





Mulch is Important!

Bare soil is hot soil. Any soil in the Food Cube that is not shaded or covered by plants needs to be covered with leafy mulch.

This reduces the evaporation of water from the soil, and so reduces the amount of water that you will need to put into the Food Cube.

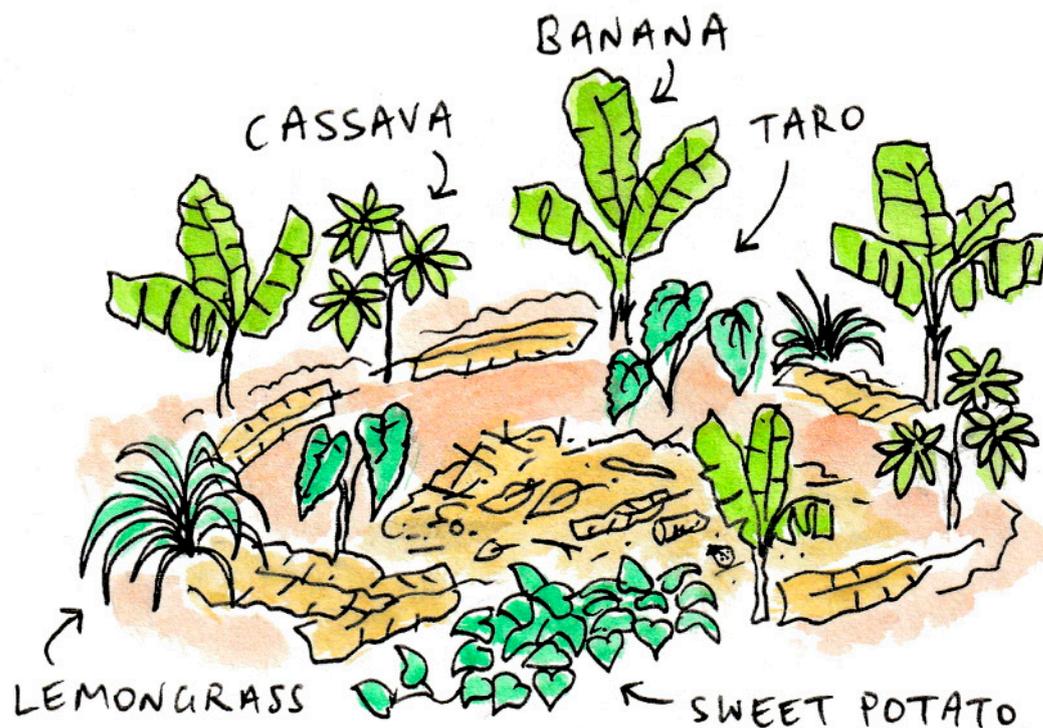
Mulch also helps to feed the soil food web and keep the compost in the Food Cube healthy and productive – as discussed in Topic 2 about soil and compost.

Using every drop of water – grey water

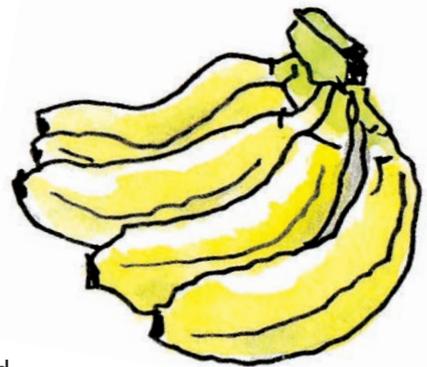
On islands such as Tuvalu no water should be wasted. Cooking water and laundry water is what we call “grey water” because it is no longer suitable for drinking.

It is not good to put grey water in the Food Cubes because it can contain salts and other things in amounts too high for the soil to filter out, and they will damage the plants. But we can use the grey water for growing food in ways that allow it to be filtered safely back into the ground water. One of the easiest ways is to grow banana circles.





Banana circles



A banana circle is a way to grow bananas, produce bio-mass (mulch and compost) and re-use greywater from a sink or shower.

- Pick a location with a small depression or where water gathers in a puddle when it rains, so the bananas can make good use of the water.
- Dig a hole 1 metre deep and 2-3 meters in diameter, piling the soil in a mound around it.
- Depending on location, you can leave a gap for water to flow into the middle, and add a lead-in drain.
- Plant 5-7 banana shoots evenly spaced around the top of the mound.
- Dot in sweet potato cuttings over mound with the intention of covering mound and mulch pit.
- Fill centre of circle [mulch pit] up to 2 meters high with garden prunings/old banana stems/unwanted suckers and growth/straw mulch/leaves, etc. to feed your bananas and tidy up your garden.
- When you have grey water from washing dishes, doing laundry or showering you can bucket it right into the middle of the pit, or you can connect a hose directly from the kitchen sink.
- As you maintain your banana circle, keep a mix of mature fruiting plants, half grown plants and young suckers around the top of the mound so there is a continuous supply of bananas.

Source: <https://treeyopermacultureedu.com/chapter-10-the-humid-tropics/banana-circle/>



**PART
4**

Planning What to Grow When

Plant rotation

Many locations in the tropics have rainy and dry seasons. The timing of growing crops to fit with these seasons depends on the type of crop grown and whether water is available from another source.

It is generally easier to grow crops during the wet season as they will not require extra water, but the rains can bring other problems such as washing nutrients out of the soil, damaging seedlings (this can be avoided by building temporary palm shelters) and increasing fungal diseases.

There is not one set way of planning a rotation, but some general principles should be followed:

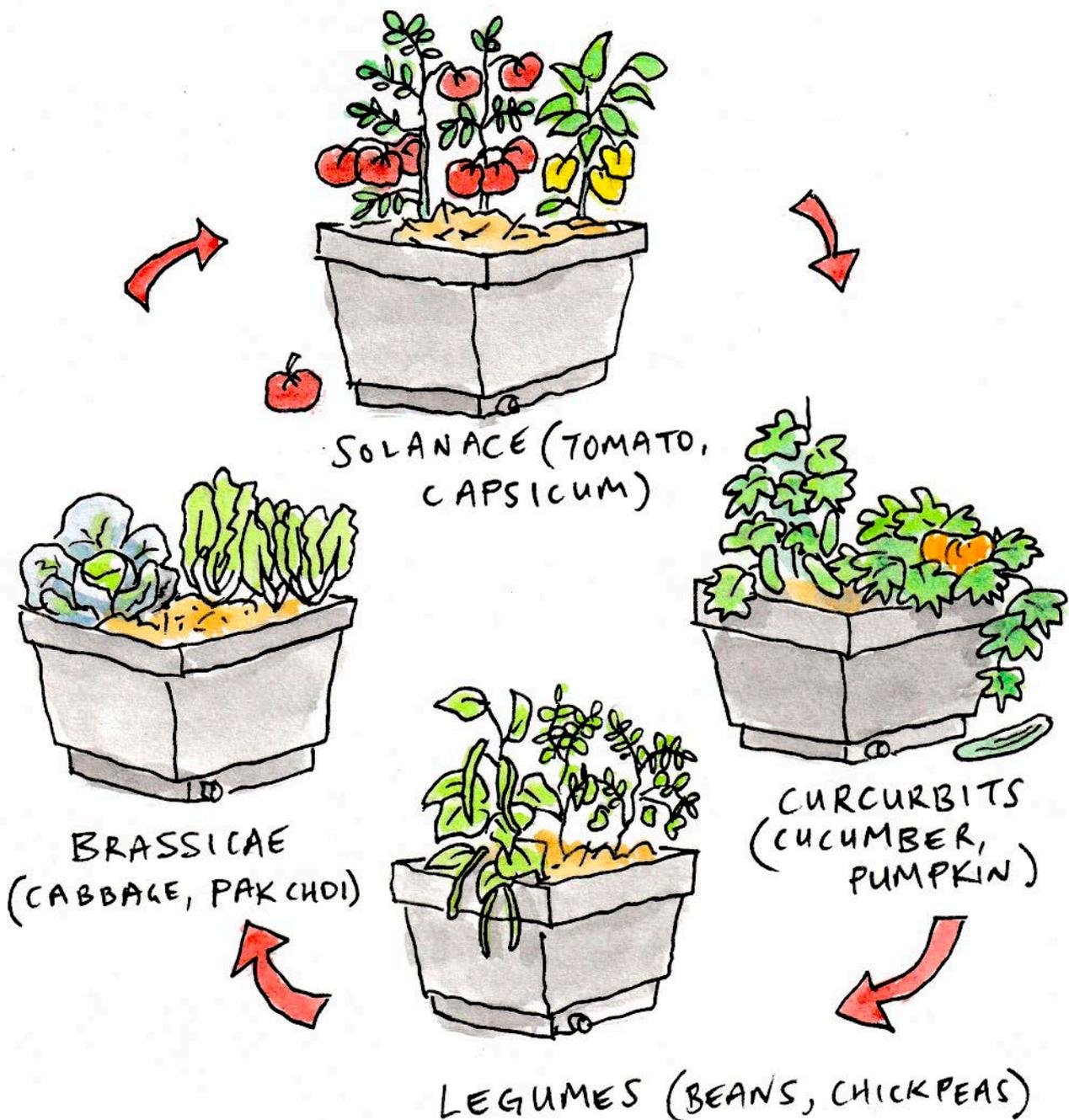
Don't follow one crop with another from the same family.

Don't follow one heavy feeder with another heavy feeder.

Do plant a green manure crop at least once in every four crops to replenish your soil.

By growing the same thing again and again in the same location the diseases and insect pests that affect that crop can build up to levels where you can't grow the crop at all. Crop rotation appears to be complicated, but the more different types of plants, or, more specifically, plant families, you can grow, the better the rotational value you will get. Crop rotation can be done on any scale, from open gardens down to the container garden.

Draw a map of your Food Cubes or Food Walls and label each section. Make a list of all the crops you grow and include all those you would like to grow. This just might be the incentive to get you to plant that never-before-tried vegetable. Then categorize your entries by botanical families. In tropical climates you can grow vegetables all year long. So every time you put a new group of plants into the Food Cube also include dark green leafy vegetables – as we all need to eat these super healthy foods every day.



Planting things together (plant stacking)

Stacking plants is a way of copying how nature does it in our gardens. In nature plants grow up, out, around, any direction they can. Different plants fit into different niches in the overall forest, depending on how their light or temperature needs, and their growth habit.

If you look at forests, rainforests in particular, you can see that there are many layers of plants stacked on top of each other – of course almost all have their roots in the ground. There are the low ground covers and creepers, then the herbs and grasses, then shrubs and smaller trees, and at the top the giants. Vines and climbers are rambling over everything as well. And they all occupy the same space on the ground.

Stacking can be done in the garden container. An example is stacking sweet corn, beans and sweet potato. The tall corn acts as a trellis for the beans, and the sweet potato cover the ground, keeping it moist and suppressing weeds. Three crops can grow in the space of one. Another example is tomatoes, dark green leafy vegetables and garlic chives. The tomatoes are tall, climbing a trellis, the dark green leafy vegetables provide shade for the soil, and the garlic chives assist with preventing pests at the root level of the tomatoes.

The following pages have some tips for thinking about plant stacking in the Food Cubes.





Using different plant growth periods

Every plant has a different growth period and will produce harvest at different times. You can use this knowledge to increase production in each Food Cube, with more crop variety and multiple harvest times.

Green leafy vegetables grow quickly and can be harvested in 1-2 months. Eggplant, chillies, cabbages, capsicums, tomatoes and beans need 3 months or more to be ready for harvesting. When you plant all of these plants at the same time you can continue to plant dark green leafy vegetable seedlings after the first harvest. So you can get two harvests of dark leafy green vegetables while waiting for the tomatoes to ripen. Be careful not to disturb the roots of long-term crops when harvesting the short-term crop.

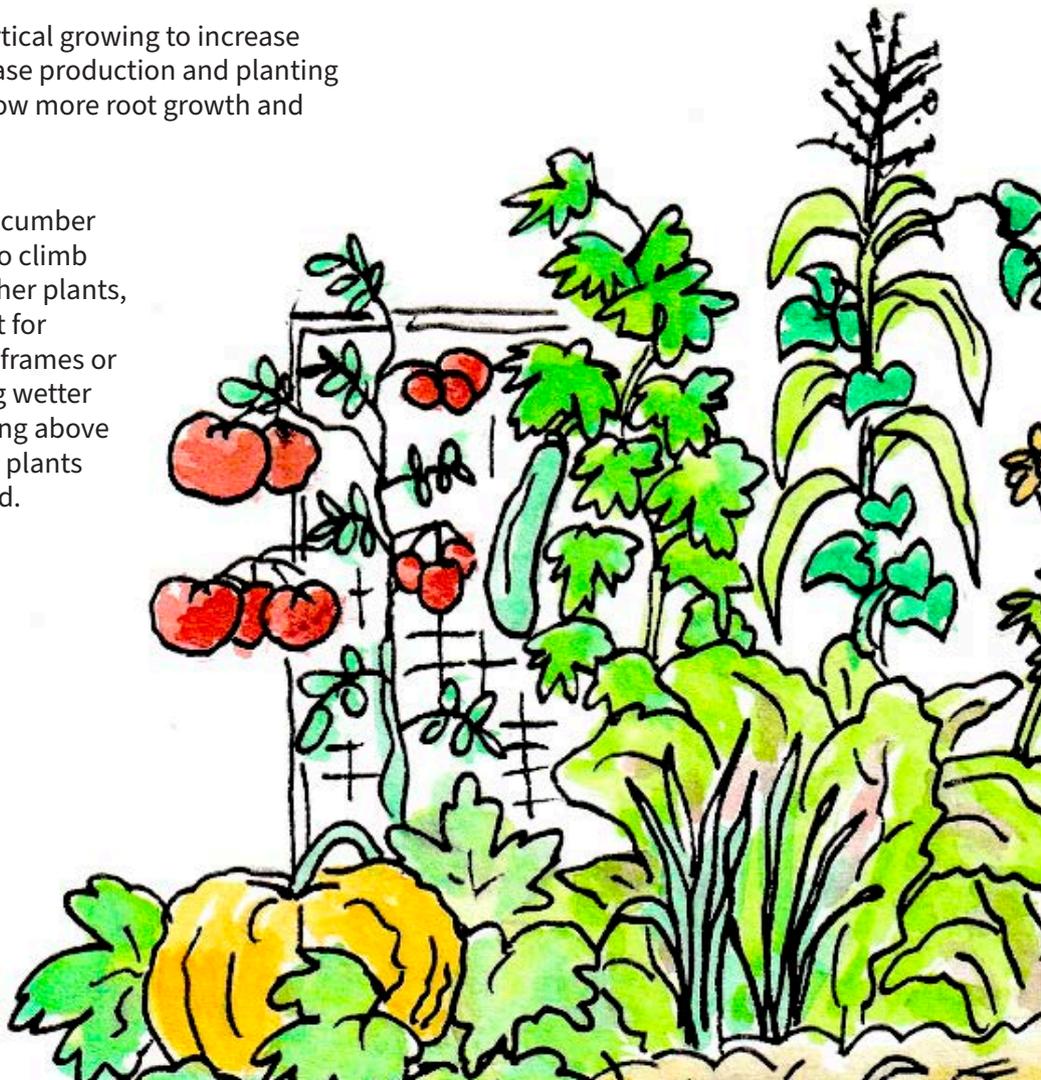


Grow up as well as out



During the wet season use vertical growing to increase the height of the plot to increase production and planting area. Different heights will allow more root growth and better access to sunlight.

Climbing plants like beans, cucumber and pumpkin can be trained to climb frames or fences above the other plants, making more space in the plot for other vegetables. Growing up frames or trellis can only be done during wetter times though, as plants growing above the ground dry out more than plants growing in or along the ground.





Checklist for plant stacking and companion planting

Compatible water needs if everything likes water, no worries. If everything is drought-tolerant, wonderful. Don't mix plants with different water needs.

Different root systems try to vary root systems such that plants aren't competing, and think about including a root crop.

Plant arrangement position plants of different sizes and shapes, envisioning how they might work in close proximity. What's that vine going to grow up? Think of the vertical spacing.

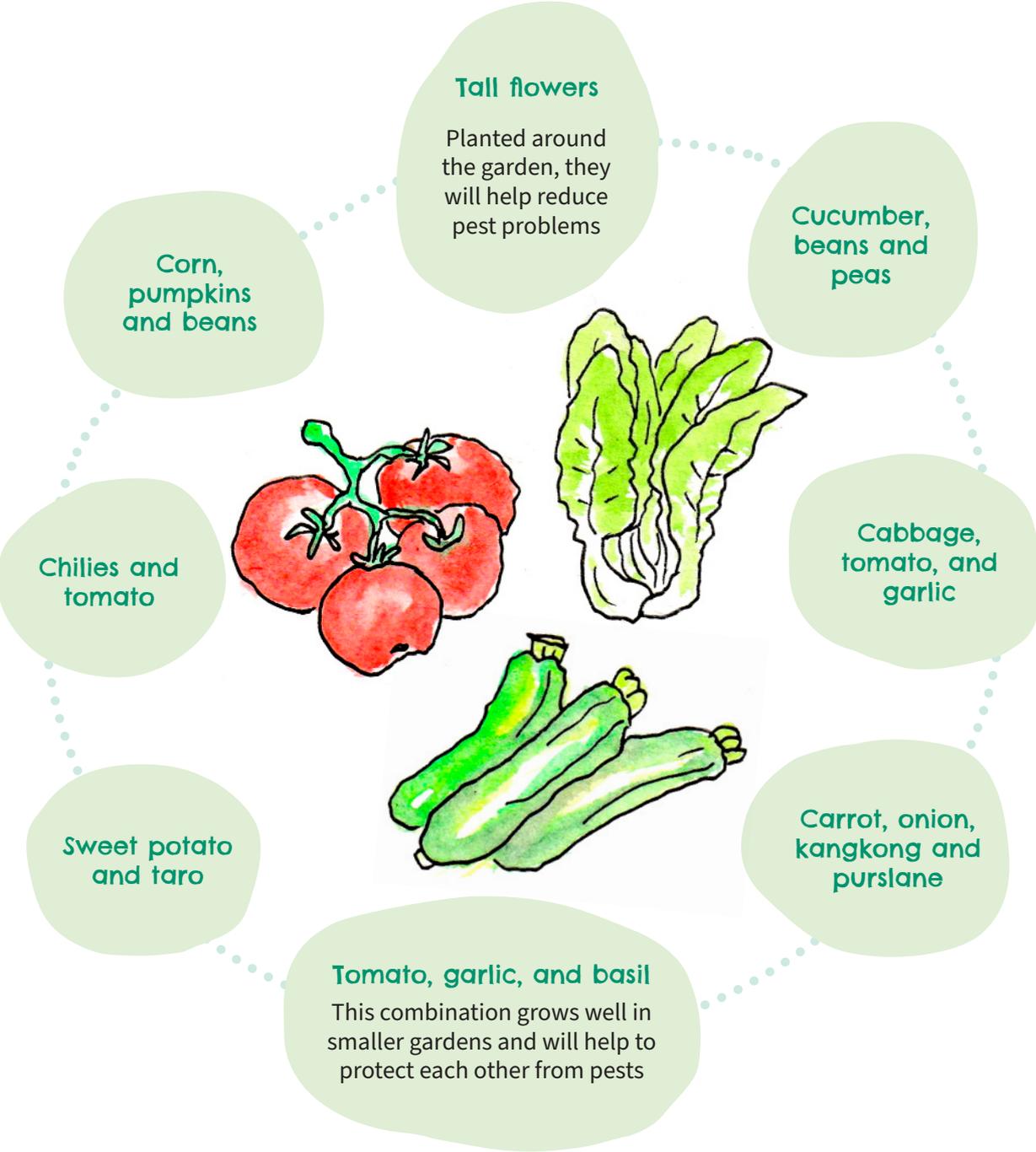
Insects, good and bad which plants attract beneficial insects and deter pests?

The soil something always needs to cover it. Something always needs to feed it new nutrients.

Use the rule of three have at least three reasons for including a plant in the mix – attracting bees, providing food, accumulating trace minerals in the soil, etc.



Examples of common vegetable combinations



(Source: <https://www.permaculturenews.org/2016/08/22/guilds-small-scale-home-garden/>)



What about fruit trees?

Fruit trees are usually too big to grow in containers, even as big as a Food Cube. This is because the soil depth in a Food Cube is only around 30 centimeters, which is too shallow for regular fruit trees.

If there is access to dwarf varieties of fruit trees it might be possible to plant a small fruit tree in the centre of a Food Cube and then surround it with other short season vegetables. It is important to be able to match the soil and water quality needs of the fruit tree with the vegetables planted around it. This can be tricky and needs research and technical advice that is not addressed in this guide. A fruit tree can take many years before providing sufficient crops. This ties up the Food Cube as a food production resource and reduces the amount of vegetables that can be produced from the other Food Cubes.

Organic pest control

The best protection against pests and diseases is keeping the soil food web in the Food Cube and Food Wall in the best condition possible with regular top-up of fresh compost, use of organic fertilisers and implementation of crop rotations. Healthy soil produces strong plants that resist disease and pests. Insects are a vital part of our ecosystem. We never use pesticides, as these will kill soil – all the good microbes along with the few problem ones.

Encouraging natural pest predators

In a healthy, balanced system, different types of plants have different types of pests that like to attack them, and different pests have different types of predators that like to feed on the pests. Natural predators are very effective at controlling pests in the garden, and include birds, lizards, frogs, bats, dragonflies, wasps, spiders, praying mantis, ladybugs and some types of flies.

Natural pest predators can be encouraged in your garden if you provide:

- small ponds or water containers for birds, frogs, dragonflies, wasps, bees and fish
- trees for birds, bats, wasps, bees and spiders
- rocks and rotting wood for lizards and spiders
- flowers, small trees and vine plants for wasps, bees, spiders, praying mantis and ladybugs.



Traps for snails and slugs

Snail traps can be placed around the garden to attract and kill snails. Place a bowl or container in the ground and fill half way with liquid bait made of milk and water or old beer. A small amount of finely cut lettuce or cabbage can also be added. The snails/slugs will enter the trap, get stuck in the liquid and not be able to leave.

Another method is to place old tin roofing or wet sacks on the ground near your vegetable plots. Snails will like to live underneath this. Check the trap every few days. Coffee husks and sawdust can be placed on paths around vegetable plots to help prevent snails from entering. Snails don't like rough surfaces.

Citrus peel traps: use half peels of citrus fruits, like orange, lemon or lime which still have a small amount of fruit attached to the peel and place on the ground. This fruit will attract insect pests and snails/slugs and they will become trapped underneath the citrus peel.





Natural pesticides

Natural pesticides are a short-term solution for handling immediate pest problems quickly. Natural pesticides should be a part of pest management, but should only be used when necessary. Do not use natural pesticides if there are no pests, or crops are not damaged. In fact, they should not even be used if only small amounts of crops are damaged. Take time to observe if pest predators are eating the pests and if those pests are spreading quickly or slowly. If there are still pest predators, it is best to let them do the work. Hands are an excellent natural pesticide! Many pest problems can be controlled by regular observation and hand removal of pests.

Some natural insecticides are very strong and will kill all insects, both good and bad. Be careful, because most insects are not harmful to your crops and killing them can cause more problems in the future. On the next few pages are a collection of natural pest treatments. Select the one with the most accessible ingredients for you, and use as little as possible. Strong, healthy soil with lots of life, and correct growing conditions (not too much sun to cause heat stress) is the best approach to managing pests.

INSECT SPRAY

- Collect a handful of insects that are eating your plants
- Crush them and mix them into a small bucket of water
- Leave for 2 days
- Strain the liquid and spray onto affected crops

The same type of pests as the ones in the spray will be repelled by the liquid. The remaining insect bodies can be put in containers and placed around crops. The smell of this will continue to repel pests. This spray works well for caterpillars, slugs, snails and various small pests. It is less effective for grasshoppers.

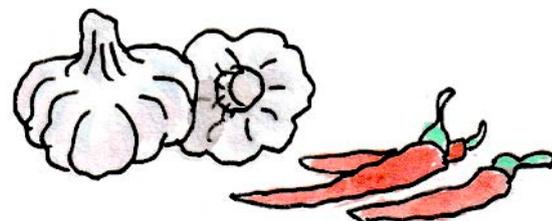
GARLIC AND CHILI SPRAY

- Combine 3 bulbs of peeled garlic with a large handful of chillies and boil in a pot of water
- Add a quarter of a block of grated soap
- Stir and leave for one day
- Strain the liquid and use 2 cups each time you spray

Garlic is an insecticide, fungicide and pest repellent. Chilli is also an insecticide and insect repellent. The soap will help the spray stick to plants and pests. Use this liquid for aphids, caterpillars and moths. Garlic and chilli plants will naturally repel many insects.

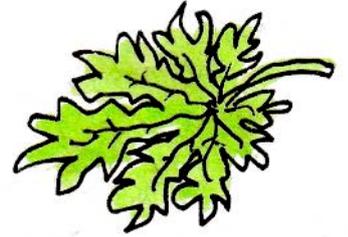


RECIPES



PAPAYA SPRAY

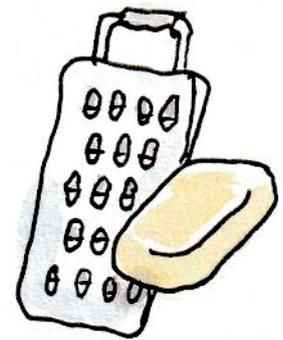
- Collect 1kg of papaya leaves (about 1 large plastic bag)
- Crush into small bits and mix into 1 litre of water
- Leave for an hour
- Strain and add 4 more litres of water and 1 large spoonful of soap power or liquid soap
- Spray onto insect pests



This papaya spray can be used on aphids, termites, bugs and caterpillars. For termites, crush young unripe papaya fruit and collect the juice. Spray this directly onto termites and damaged wood. Papaya spray can also be used as a mild fungicide for powdery mildew.

GINGER JUICE SPRAY

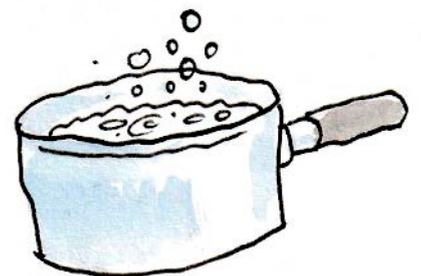
- Grate a handful of ginger and put into a bucket of water
- Leave for one day
- Spray onto damaged plants to control larvae of worms and caterpillars



TARO LEAF SPRAY

- Crush 10 taro leaves
- Place into 3 litres of water and stir well
- Spread onto plants using a palm broom
- Make sure every plant is covered well with this liquid

Taro leaves contain lissolic acid. When insects eat this it feels like eating broken glass!



GLUE SPRAY

Glue spray can be made from left-over water from cooking root vegetables. Small insects will stick to the glue and eventually die of suffocation. This spray is good to use for aphids, caterpillars and white flies and other small insects. Mix left-over cooking water from cassava, taro or potatoes with some more water. A good mixture will leave a thin white coating on plants once it has dried.



Natural fungicide

Fungus lives best in moist conditions and can cause problems for plants because it causes rotting and prevents normal growth. The best way to prevent fungus is through a healthy soil food web and good planting conditions. Due to the sunlight and wind in tropical atolls fungus may not affect your plants. But if it does, here are some natural treatments:

DILUTED URINE SPRAY

- Combine 1 part human urine to 4 parts water
- Spray on plants damaged from fungus like vine mildew, powdery mildew and other similar fungus

MILK POWDER SPRAY

- Combine 1 litre of powdered milk (made up) with 10 litres of water
- Spray every 10 days on vegetables that have fungus or mildew

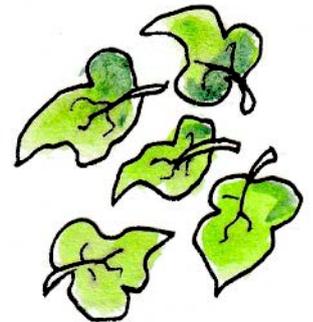
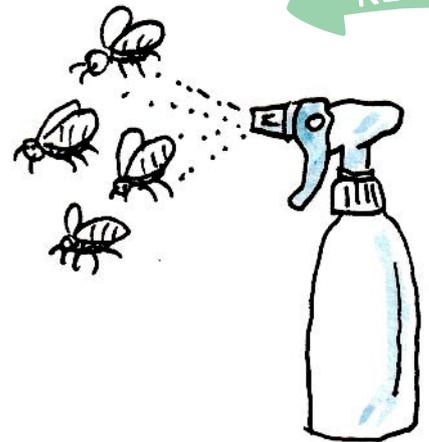
SWEET POTATO LEAF SPRAY

- Cut and soak 3 large handfuls of sweet potato leaf in 1 bucket of water
- Leave for 1 day, then use as a spray for fungus

GARLIC SPRAY

- Dry garlic and crush into a powder
- Combine 1 large spoon of garlic powder with 1 litre of water
- Use as a spray for fungus attacking tomato and bean plants

RECIPES



(Source: *Permaculture – Solutions for Sustainable Lifestyles*, IDEP Foundation)

Saving seeds

Saving your own seeds is the best way to ensure food security and a healthy diet. Locally saved seed is important because:

- the seed is free
- the seed adapts to your local environment each time you plant and replant
- the seed is more resistant to local pests and diseases, and will not require agricultural chemicals, unlike many hybrids bought from the store
- it helps to keep important plant varieties from being lost
- it is easy to share with other gardeners, contributing to their food security
- when you start growing your own food you often have to use seeds that are imported. Try to access open pollinated seeds. This means that the plants grown will produce seeds you can save. These seeds will then be adapted to your growing conditions
- having many varieties of your own seeds will help adaptation to changing climates and conditions



Sources: *Permaculture – Solutions for Sustainable Lifestyles*, IDEP Foundation, and other food security resources published by Live & Learn.

PLANT	WHEN TO HARVEST SEEDS	HOW TO HARVEST SEEDS
Tomato, eggplant	When ripe on the plant, slightly soft, but not rotten	Hand pick the best fruits from the best plants
Cucumber, melon	1 month after you would pick for eating (so the seeds are mature)	Hand pick the best fruits from the best plants
Capsicum, large chilli	When ripe on the plant or when red	Hand pick the best fruits from the best plants
Lettuce, green leaf vegetables	Wait until the seedpods are brown and dry, but not yet open	Cover in a bag, then cut the main stem so that no seeds will fall on the ground during collection
Pigeon pea, cowpea, ground nut, beans	In the dry season, leave seeds to dry on the plant. In the wet season, pick when ripe and dry near a fire	Hand pick when the seeds are ready
Pumpkin	When ripe on the plant, slightly soft, but not rotten	Hand pick the best fruits from the best plants

Producing good seeds

To produce good seeds follow these steps:



STEP 1 HEALTHY PLANTS

To produce quality seeds, the first step is to grow healthy plants. To do this you will need healthy soil and enough compost and mulch.



STEP 2 CHOOSE THE BEST SEEDS

Always collect seeds from the best plants. These plants usually:

- produce healthy and tasty fruits or leaves
- are disease-free and naturally pest resistant
- are able to survive in extreme conditions, such as very dry or hot conditions or rocky soils
- are slow at producing seeds. Collect seeds from plants that produce flowers and seeds last, not first.

Select seeds from many plants. When collecting seeds, remember that you will pass on the plant's characteristics to the next crop. If you choose healthy plants, the next crop will have the same characteristics as the parent plants. Larger seeds will generally last longer than small seeds. When selecting maize seeds tag the head of the plant that you want to use for next season. It will take three to four generations to breed strong organic seed when starting from hybrid seed.



STEP 3 HARVESTING SEEDS

Label the plants that seeds will be collected from, so that these plants won't be harvested for food. Wait until the plants are ripe to pick the seeds. This means leaving the plant until it is past the edible stage. Young fruits have young seeds, which may not germinate. The best time to pick seeds is mid-morning on a clear and sunny day. Even a small amount of moisture can damage seeds. If seeds are harvested during the wet season, pick the fruit, seed or even the whole plant and hang it to dry near a fire.





STEP 4 CLEANING SEEDS

Separate seeds that have a dry pod or shell and remove them by hand. Small seeds with a shell can be kept in a bag, which can be gently rolled and carefully crushed to separate the seeds. Separate any plant materials from the seeds by winnowing or by hand.

Tomato, cucumber, and pumpkin seeds can be removed and placed in a container with water. The seeds must be cleaned well and rinsed, so that all the plant flesh is removed from the seed. The seeds can then be dried.

Tomato and cucumber seeds can be fermented to remove some diseases. Remove seeds and flesh from a ripe fruit. Place in a container with water, leave for a few days. Foam will form on the surface showing that fermentation has happened. The seeds can then be washed with water. All remaining fruit flesh should be removed. Spread the seeds onto a plastic, wood or metal plate, and place in the shade to dry.



STEP 5 DRYING SEEDS

Drying seeds is a very important part of the seed saving process. If the seeds are not dried properly, they will go rotten when stored. Seeds can be dried anyway you choose. However, to achieve the best results, it is very important that you follow these practical guidelines:

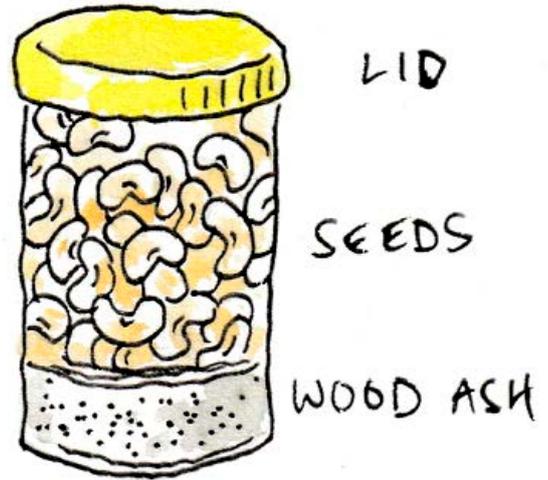
- Spread the seeds and air out. Shallow bowls, woven trays, old paper, woven mats or any other container can be used to hold the seeds. For larger seeds, place in woven bags and hang to dry. Turn them once or twice a day so that all the seeds can dry.
- Protect the seeds from animals, especially mice.
- For small and light seeds, give extra protection from the wind because they can easily be blow away.
- Small seeds generally need about 1 week to dry properly, and larger seeds need about 1-2 weeks.
- Start the drying process for 2 days in shade or indoors. After, move the seeds out into the sun for half of each day. This will help to kill insects and their eggs. Move the seeds inside at night. In the wet season, it is better to dry seeds near a fire.
- Use a bite test to check if the seeds are dry or not. Bite a seed slowly. If the seed is hard and does not have a bite mark, it is ready to be stored. If there is a bite mark, then the seed is not yet completely dry and needs to be dried for longer. If your tooth breaks when biting the seed, next time, don't bite so hard!



STEP 6 STORING SEEDS

After the seeds are dry, they need to be stored well. If the climate is not ideal, seeds may easily rot if not stored correctly. When in storage, seeds must be protected from:

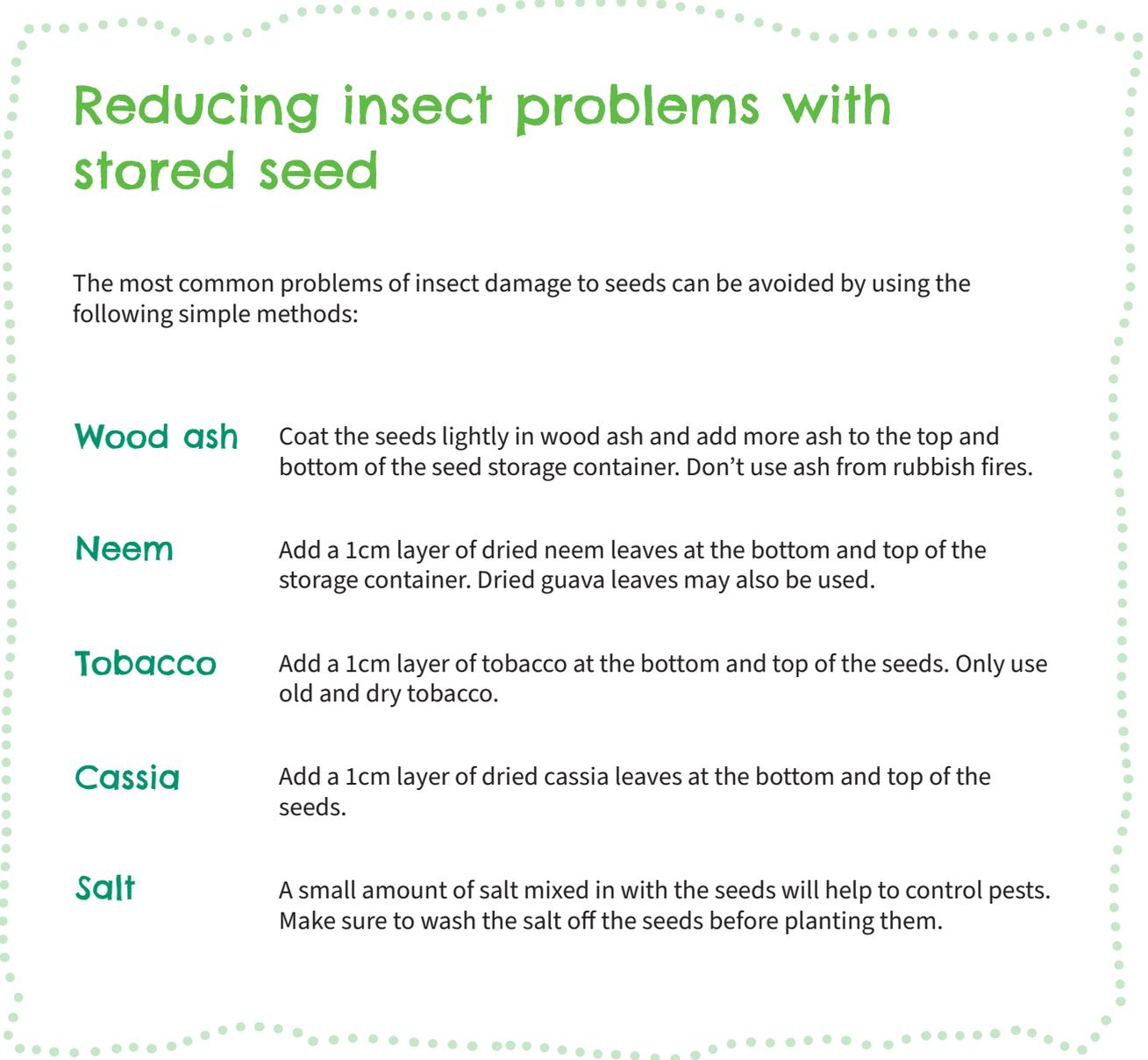
- air, which reduces the seeds' lifetime
- moisture, which can make seeds rot
- heat, which can reduce the number of seeds that will grow when planted
- animals, which can damage seeds
- insects, which can eat or damage seeds (If insect eggs are laid inside the seed storage container, they will hatch, and young insects will eat the seeds.)
- light, which can also damage seeds



To avoid these problems, make sure the seeds are really dry and clean. Then, on a dry and sunny day, place the seeds in an air-proof container.

To reduce moisture problems, add wood ash to the bottom of the container (of course, wood ash which has already cooled). Milk powder or other very dry seeds can be used as a substitute to absorb excess moisture. Or you can use pounded-up cassia leaf.

The air-proof container could be a “seed safe” made on the ground with local clay, and sealed with a simple lid. Then the “seed safe” can be opened when it is time to plant the saved seed.



Reducing insect problems with stored seed

The most common problems of insect damage to seeds can be avoided by using the following simple methods:

Wood ash Coat the seeds lightly in wood ash and add more ash to the top and bottom of the seed storage container. Don't use ash from rubbish fires.

Neem Add a 1cm layer of dried neem leaves at the bottom and top of the storage container. Dried guava leaves may also be used.

Tobacco Add a 1cm layer of tobacco at the bottom and top of the seeds. Only use old and dry tobacco.

Cassia Add a 1cm layer of dried cassia leaves at the bottom and top of the seeds.

Salt A small amount of salt mixed in with the seeds will help to control pests. Make sure to wash the salt off the seeds before planting them.

PART 5



Plant List

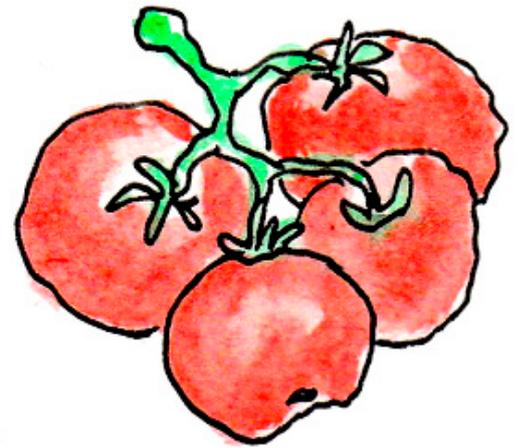
Arranging rotation by plant family

Plants from the same family should not be grown too often in the same place. Below is a list of the main families of vegetable crops and their requirements. Different plants take up nutrients from different soil depths, and some plants grow taller than others. So it is good to have plants that root at different depths within the rotation, and planning this well allows you to grow more plants through stacking them.

- ▶ Solanaceae (Tomato family)
- ▶ Brassicaceae or Cruciferae (Cabbage family)
- ▶ Cucurbits (Cucumber family)
- ▶ Alliums or Liliaceae (Onion family)
- ▶ Apiaceae or Umbeliferae (Carrot family)
- ▶ Legumes (Bean family)
- ▶ Root and tuber crops
- ▶ Dark leafy green vegetables

Solanaceae

(Tomato family)



Solanaceae (Tomato family)	Root depth	Spacing (per plant)	Plant when	Direct seed or seedling?
Chilli	Medium	H: 20-40cm W: 30cm	July to March	Seeds or seedlings
Capsicum	Medium	H: 40-50cm W: 20-50cm between plants	July to March	Start in seed trays and plant out when seedlings
Eggplant	Medium	H: 30-50cm W: 60-75cm between plants	Sep to March	Start in seed trays and plant out when seedlings
Tomatoes	Deep	Short bush H: 60-120cm W: 60-90cm Climbing bush H: 200cm plus W: 60-90cm	All year	Start in seed trays and plant out when seedlings





Solanaceae covers a wide range of crops that are popular to grow in the tropics. Once the plants are established, weed control is fairly easy. Regular watering after transplanting is more important than with some crops, so they are generally easier to grow in the rainy season, unless there is a reliable water supply. They also have the advantage that seed can be saved from open pollinated varieties.

Weeks from seed to harvest	Harvesting, processing, storage	Growing conditions
12-16 weeks	Harvest the fruit. 1-4 kg per plant. Eat fresh. Can be dried or stored in olive oil for longer storage	Need high levels of nitrogen and potassium for fruit formation and should be grown after a legume crop or applying compost. Animal manures, especially poultry, are high in nitrogen. Levels of potassium can be boosted by adding well-rotted compost or small amounts of ash from burning coconut husks.
12-16 weeks	Harvest the fruit. 2-4kg per plant. Eat fresh or cooked. Can be cooked and placed in olive oil for longer storage.	
10-12 weeks	Harvest the fruit. 5-20kg per plant. Needs to be cooked before eating. Can be cooked and placed in olive oil for longer storage	
12-16 weeks	Harvest the fruit. 5-20kg per plant. Eat fresh or cooked. Can be dried or bottled for longer storage. Grow up a trellis in the Food Cube and grow other greens or herbs underneath. Cherry tomato varieties are easier.	



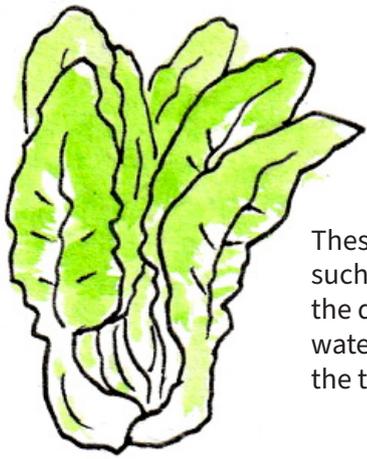
Brassicae or Cruciferae

(Cabbage family)



	Root depth	Spacing (per plant)	Plant when	Direct seed or seedling?
Cabbage (heat tolerant varieties)	Shallow	H: 25-35cm W: Single plants 50cm apart	All year	Start in seed trays and plant out when seedlings
Mustard	Shallow	H: 15-60cm W: 20-40cm between plants	All year	Seeds
Radish	Shallow	H: 10-40cm W: Thin seedlings to 2-4cm apart	All year	Plant seeds close together, thinning after germination





These are a more recently introduced ‘exotic’ crop to many regions. Crops such as pak choi and cabbage have cultivars that can be grown in either the dry or the rainy season, although they will require some additional water if grown in the dry season. Many brassicas do not flower readily in the tropics, so seed has to be imported.

Weeks from seed to harvest

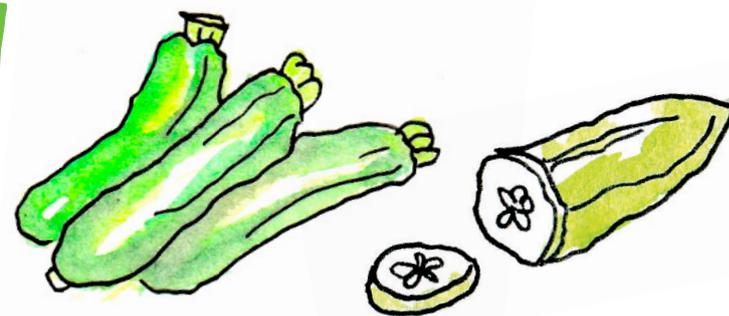
Harvesting, processing, storage

Growing conditions

Weeks from seed to harvest	Harvesting, processing, storage	Growing conditions
12-16 weeks	1.5 – 3kg per plant. Eat fresh or cooked. Preserve by pickling for longer storage.	These need high levels of nitrogen and should be grown directly after a legume crop. Levels of nitrogen can also be boosted by poultry manure. They grow best on heavier soils and need high levels of organic matter. They don't mind growing under the shade of taller plants.
5-8 weeks	Leaves can be cut after 4 weeks and then continued to be cut until the plant sends up tall branching seed stems with yellow flowers. Eat fresh in salads or cooked in stir-fries, soups or stews.	
4-6 weeks	Harvest the root as soon as it can be seen at ground level and is at least 2cm wide. Yield is 30–40 per metre. Eat fresh, or cook large radishes in soups/stews or preserve by pickling.	

Cucurbits

(Cucumber family)



	Root depth	Spacing (per plant)	Plant when	Direct seed or seedling?
Courgette/ Zucchini	Medium	H: 60cm W: 60cm	July - Feb	Seeds
Cucumber	Medium	H: 200cm W: 60cm	July - Mar	Seeds
Melon	Medium	H: 90cm W: 90cm	July - Feb	Seeds
Pumpkin (Tropical)	Deep	H: 100cm W: 100cm	July - Feb	Seeds
Squash	Deep	H: 100cm W: 100cm	July - Feb	Seeds



Cucurbits are generally easy to grow and with their rapid height they can be grown up trellis in the Food Cube or hang over the edge of the Food Wall. They have varying degrees of heat tolerance. Seed saving from open pollinated varieties is easy.

Weeks from seed to harvest	Harvesting, processing, storage	Growing conditions
8-12 weeks	Harvest the fruit. 6-18 per plant. Eat cooked. Zucchini's can be large plants, so plant so that they extend out over the edge of the food cube as they grow. Harvesting every 2-3 days keeps the plant in production longer. Leaves and flowers are also edible and very nutritious.	These will generally grow with more moderate levels of nutrients (although cucumbers may need slightly higher levels). They need well drained soils with high organic matter content.
8-12 weeks	Harvest the fruit. 5-10kg per plant. Eat fresh. Can be pickled for longer storage. Cucumbers should be grown up a trellis. Lettuce or other leafy greens can be grown underneath. Harvesting every 2-3 days keeps the plant in production longer.	
14-16 weeks	Harvest the fruit. 6-8 melons per vine. Small varieties mature more quickly and take up less space. Can be grown to trail over the edge of the Food Cube. Or can be grown up a strong trellis.	
16-20 weeks	Harvest the fruit. 10-20kg per plant. Eat fruit cooked. Young fruits can be pickled. Seeds can be eaten raw or roasted. Flowers, leaves and young stems are eaten as a green vegetable. Can be grown on trellis or support, or spill out over the edge of the Food Cube.	
8-12 weeks	Harvest the fruit. 12-24kg per plant. Harvesting every 2-3 days keeps the plant in production. Leaves and flowers are also edible and very nutritious.	





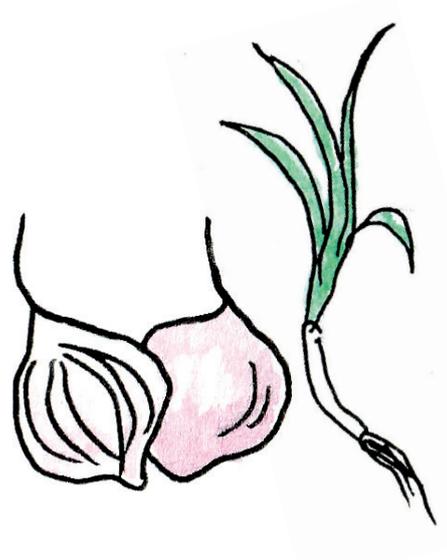
Alliums or Liliaceae

(Onion family)



	Root depth	Spacing (per plant)	Plant when	Direct seed or seedling?
Spring Onion	Shallow	H: 10cm W: 10cm		Seeds or seedlings
Chive	Shallow	H: 20cm W: 40cm	All year	Seeds or seedlings
Garlic	Shallow	H: 15cm W: 15cm	April - July	Cloves





Weeks from seed to harvest

Harvesting, processing, storage

Growing conditions

8-12 weeks

Harvest the entire bulb, or cut off at ground level and allow to reshoot. 50-150g per plant. Eat fresh or cooked.

These need more moderate levels of nutrients and too much manure can cause thick or double necks. They are best grown as a second or third crop in the rotation. Good drainage is essential. Soil-borne diseases are also less of a problem in alliums in the lowland tropics where the soil temperature remains above 20°C.

8-12 weeks

Harvest by cutting the amount needed at ground level. Chives are excellent at helping reduce pests, so can be permanently planted in the Food Cubes as a perennial, and divided as needed when harvested.

16-20 weeks

Eat the roots. 20-30 bulbs per square metre. The immature green stems can be used in stir-fries. Cure and dry for storage.





Apiacae or Umbeliferae

(Carrot family)



	Root depth	Spacing (per plant)	Plant when	Direct seed or seedling?
Celery (leaves)	Medium	H: 20cm W: 20cm	Nov-April	Seedlings
Parsley	Medium	H: 40cm W: 40cm	All year	Seeds
Coriander	Medium	H: 30cm W: 60cm	All year	Seeds
Fennel	Medium	H: 200cm W: 60cm	All year	Seeds





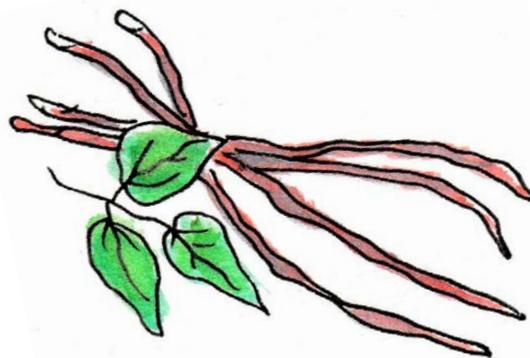
As most of these crops are sown directly into the soil and have fine feathery leaves, a large amount of hand labour for weeding is required, especially in the early stage of the crop.

Weeks from seed to harvest	Harvesting, processing, storage	Growing conditions
20-22 weeks	Harvest the green stems and leaves. 15-20 stems/leaves per plant. Use the green leaves as flavour and green vegetable in soups, stews, stir-fries.	They are best grown as a second or third crop in the rotation.
10-12 weeks	Harvest the green leaves and stems. One plant will go to seed after two years. Can either harvest the seed to plant elsewhere, or allow the seeds to fall and new plants to grow.	
3-4 weeks	Harvest the green leaves, stems and seeds (a spice used in curries) Goes to seed in one season. Can either harvest the seed to plant elsewhere, or allow the seeds to fall and new plants to grow.	
12-14 weeks	Harvest bulb, green leaves and seeds. Fennel is a perennial plant (will continue to grow). Harvest by cutting a bulb at ground level. Can be eaten fresh in salads or cooked. Leaves are a good garnish and seasoning for fish.	



Legumes

(Bean family)



	Root Depth	Spacing (per plant)	Plant When	Direct seed or seedling?
Cowpea (Yard long bean, asparagus bean)	Medium	H: 100cm W: 15cm	All year	Seeds
Pigeon pea	Medium	H: 300cm W: 30 cm	All year	Seeds
Groundnut	Medium	H: 20cm W: 15cm	All year	Seed





There are wide range of legumes available for growing in the tropics, both adapted to the wet season and the dry season (eg cowpea). Seed can be readily saved from open pollinated varieties. Legumes are essential to grow in the garden because they are good for the soil and good for us to eat. Legumes are one of the few vegetable sources of protein. Legumes also improve nitrogen in the soil, which improves soil fertility. Leaves of many legume plants are also edible and very nutritious.

Weeks from seed to harvest

Harvesting, processing, storage

Growing conditions

8-12 weeks

Harvest the beans regularly to keep the plant producing. Can be eaten fresh or cooked. For saving seeds or to harvest dry seeds, allow the beans to dry out on the plant. Can be grown up a trellis or over the edge of the Food Cube.

Legumes fix their own nitrogen so it is not necessary to add animal manures as this will just suppress the bacteria that fix nitrogen. The plants still require adequate potassium and phosphate which can be added through composted plant material or small amounts of wood ash. Growing beans does not increase the fertility of the soil if you let the beans grow to harvest, as the nitrogen put into the soil is removed when the beans are pulled out. A way to avoid this is to grow some bean crops as “green manure” and cut them up and dig them into the soil before they flower. They are therefore a good crop to have at the end of a rotation when soil fertility is not so high.

12-20 weeks, then lives for 5 years

Harvest the beans regularly to keep the plant producing. Can be eaten fresh or cooked. Leaves and young shoots also edible. For saving seeds or to harvest dry seeds, allow the beans to dry out on the plant. Can be used as a living trellis for growing tomatoes or cucumbers. Can also be used as a productive hedge or windbreak, and leaves provide mulch.

12-20 weeks

Remove the entire plant to harvest. Dry the roots in the sun. Can be eaten fresh, or stored in shells.

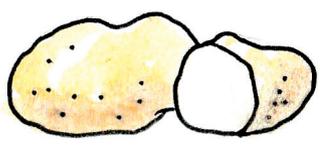


Root and tuber crops



	Root depth	Spacing (per plant)	Plant when	How to plant
Yams	Medium	H: 100cm W: 100cm	July – October	Prepare 5cm hole. Place one sett/ tuber per hole. Soil should then be mounded over the hole.
Sweet potato	Medium	H: 100cm W: 40cm	All year - when there is rain	Normally vine or stem cuttings, but tubers can be used. Cuttings should be 20–40 cm long with 5–8 nodes.
Cassava	Deep	H: 80cm W: 100cm	Plant when the soil is wet, after the beginning of the rainy season	Cuttings are planted on mounds by placing them either straight or slanting, leaving 2 or 3 buds above ground, or burying them horizontally and pressing the soil around them.
Taro	Medium - Deep	H: 20cm W: 10cm	Plant when soil is moist	Plant suckers or top. Dig hole, insert planting material and lightly press soil around the hole





There are wide range of roots and tubers available for growing in the tropics, both adapted to the wet season and the dry season. It is important to grow shallow rooted varieties, as plants such as giant swamp taro are too big for the Food Cubes. Many root and tuber vegetables also have highly nutritious edible leaves, such as sweet potato, that are important in daily diets.

Weeks from planting to harvest

Harvesting, processing, storage

Growing conditions

9 - 10 months

After the vines have been removed, the tubers are lifted, with care taken to do as little damage as possible. They should be stored in a cool storage shed to cure well. The tubers can be stored for several months if no injuries are incurred during harvesting and storage conditions are adequate. Storage techniques include laying the tubers on raised beds in storage sheds or the open. Tubers used for planting should be selected from the previous crop. They should be between 400-500g, healthy and disease free. The tuber can be divided into three (head, middle and tail) for planting. Yams must be staked to expose the leaf canopy to sun.

Most of these require moderate levels of nutrients – too much nitrogen will usually encourage excessive leaf growth at the expense of root growth. These crops remove a reasonably large amount of potash from the soil when harvested.

90 and 120 days

Sweet potato tubers may be harvested all at once or in stages. Growers take larger tubers, leaving the small ones to grow further, or take only enough tubers to meet household needs. Crops planted at different intervals may be harvested in sequence to provide a regular supply of tubers for marketing over a longer time. Allow to grow over the edge of the Food Cube, or along under taller plants.

A free draining soil with good levels of organic matter is normally required.

Between 6–12 months, (depending on variety)

Mature cassava tubers weigh from 1 to 2 kg. Cassava roots begin to spoil as soon as they are pulled out. They keep longer when left in the ground as long as the soil is not too wet. Harvested cassava can be peeled and frozen. Cassava leaves can also be eaten cooked.

Take stem cuttings from strong, healthy plants that have already produced tubers. After harvest, selected stems should be stored in bundles in a cool dry area for at least 10 days before planting. Cuttings are only made at the time of planting. Each cutting should be 20 to 30 cm long with 4 to 6 growth buds.

Between 6–12 months

Suckers at 3-4 leaves is ideal for planting. Harvest tuber when visible at the ground surface. Leaves edible from growing suckers as well from mother plant at harvest.

Tuber is cooked, processed as dessert.

Grow all year round but preferable during wet season. Require moist soil all the time.

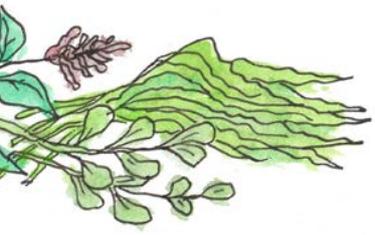


Dark leafy green vegetables



	Root depth	Spacing (per plant)	Plant when	How to plant
Amarant	Medium	H: 100cm W: 60cm	All year	Thinly sprinkle seed on the soil and cover. Keep moist for germination. Grow several plants and let one go to seed to have seed for the next crop.
Aibika (bele)	Medium	H: 200cm W: 60cm	All year - when there is rain	It is easily propagated from cuttings 10 - 20 cm long, half buried in potting mix and kept moist.
Kangkong	Medium	H: 30cm W: 100cm	All year - when there is rain - the soil must be kept moist	The plant can be grown in water or moist soil. When using soil seeds are broadcast, sown in rows or into raised beds. Cuttings can also be used.





Dark leafy green vegetables are very important part of a healthy diet. We need to eat them every day. They're packed with vitamins, minerals and fibre, but low in calories. Eating a diet rich in leafy greens can offer numerous health benefits including reduced risk of obesity, heart disease, and high blood pressure. There are many varieties of dark leafy green vegetables, and most are very easy to grow. The list below is just some of those that are suitable for growing in a Foodcube.

Weeks from planting to harvest

Harvesting, processing, storage

Growing conditions

Harvest leaves when plant is large enough, 3-4 months for seeds.

Amaranth leaves contain three times more calcium and three times more niacin (vitamin B3) than spinach leaves. Or twenty times more calcium and seven times more iron than lettuce. Harvest the younger leaves and stems to use in salads. Harvest the older leaves to cook. The seeds are also edible.

All fast growing leafy greens love rich soil with steady moisture and a good supply of nutrients, especially nitrogen. A free draining soil with good levels of organic matter is normally required. Some need more water than others, so check the notes for each plant.

Harvest year around, within 80 days of planting.

Aibika needs water and rich, fertile soil that is kept mulched. It is a very nutritious vegetable; the leaves are high in vitamins A and C, and iron, and have 2% protein. Pick from stem during cool part of day. The young leaves and young shoots may be eaten raw, steamed, boiled, stir-fried or added to soups. The large soft leaves can be used to wrap food. As the leaves cook quickly, add them last to steamed vegetables or stir-fry. It is great with coconut milk and fish.

About 20-30 days after planting

Harvest when the stems are big and tender but crisp. The whole plant can be uprooted, or you can cut the leaves and stems and more shoots will grow. Stems are tied in bundles and should be used as soon as possible (it will only store in a fridge for about a day). The young leaves and stems can be steamed, boiled, or lightly fried in oil and used in a stir-fry. Also eaten raw in salads.

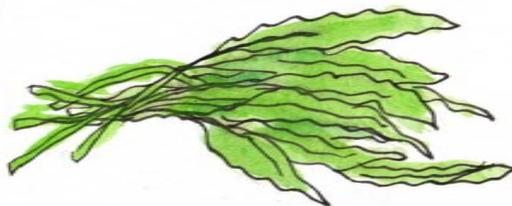


Dark leafy green vegetables



	Root depth	Spacing (per plant)	Plant when	How to plant
Birds Nest Fern (Lulu)	Medium	H: 150cm W: 150cm	All year	Need to plant a mature plant from a nursery. The plant will then remain permanently in the Foodcube.
Cabbage Tree (Pisonia alba)	Deep	H: 400cm	All year	Propagated by cuttings, and likes sandy soil. An evergreen shrub that if grown in a Foodcube will fill it up.
Courgette/ Zucchini	Medium	H: 60cm W: 60cm	July - Feb	Seeds
Pumpkin and Squash (Tropical)	Deep	H: 60cm W: 60cm	July - Feb	Seeds





Weeks from planting to harvest

Harvesting, processing, storage

Growing conditions

Harvest at any time once the plant is established.

The plant can tolerate dryer soil, but needs humidity around the leaves. Don't use too much fertiliser. Check that the leaves are perfectly green and have not been burnt by too much sunlight. The edible part is the younger leaves. Check the leaves carefully, wiping off dirt and bugs that may adhere to the leaves – which will not be removed by a simple wash of water. Cut away some of the thicker veins at the center of the leaf.

All fast growing leafy greens love rich soil with steady moisture and a good supply of nutrients, especially nitrogen. A free draining soil with good levels of organic matter is normally required. Some need more water than others, so check the notes for each plant.

Cook for a short time in salted water, and then add to salads or stir-fries.

Harvest leaves any time once the plant is established.

The younger leaves are used as a green vegetable. Pick them regularly to keep the shrub grow more leaves. The leaves are very nutritious and high in calcium. Use them steamed, boiled or in a stir-fry.

8 - 12 weeks

The leaves and flowers can be eaten and are very nutritious. Zucchini's can be large plants, so plant so that they extend out over the edge of the food cube as they grow. Harvesting the fruit every 2-3 days keeps the plant in production longer.

16 - 20 weeks

Flowers, leaves and young stems are eaten as a green vegetable. Can be grown on trellis or support, or spill out over the edge of the Food Cube.





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