Starting a Backyard Microfarm

www.underthechokotree.com
Sustainable Living in the Suburbs

By Nev Sweeney

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1.0 Introduction

There are many benefits to growing your own food, see the information below, whether it is a tomato in a pot, or a …… microfarm. So what is a microfarm?

Wiktionary imaginatively enough, defines it as: ”a very small scale farm” (Who’d have thought it?) (https://en.wiktionary.org/wiki/microfarm)

Hello Homestead website describes it as “Micro farming is small-scale, high-yield, sustainably-minded farming, generally conducted by hand in urban or suburban areas.” (https://hellohomestead.com/what-is-micro-farming/)

The definition on the Landgate website is a bit more loquacious: “A micro farm, also referred to as an urban farm, refers to an agricultural property that operates on five acres of land or less. The exact acreage is not as important as the principles of efficiency, sustainability, and productivity. Micro farms are common in urban and suburban areas. The overall focus is on sustainability and a commitment to being eco-friendly through intensive planting methods, crop rotation, companion planting, and more. Overall, micro farming is based on maximizing productivity using a limited amount of space.” (https://www.landgate.com/news/what-is-micro-farming)

When I look at those definitions it seems to me that what we do here at Underthechokotree.com is microfarming! Obviously we enjoy it and find it to be rewarding as well as productive. It keeps us active, keeps us fed and we do produce some surplus that can be given to friends, family or placed in our street pantry.

So the question I ask myself is – if it is so great, why am I not helping others start their own microfarm? Hence, this eBook.

Following is a summary of the process around starting your own microfarm, that may help you use this eBook more efficiently, wherever you are on your microfarm journey. Good luck!

1.1 Advantages to starting your own Microfarm

1. **It will save you money** – you can actually save money by growing your own produce and the more of the process you do yourself, the more you save. Growing from seed (rather than buying in seedlings), saving and using your own seed, making and using your own compost and making your own seed raising mix can all help keep your costs down. Fruit trees are a larger investment but can pay back for many years once they are established and with the right care.

2. **Growing your own provides fresher produce, improving your family's nutrition** – Once a fruit or vegetable has been picked the vitamin content starts to decrease so that the older, they are the poorer nutrition they provide. While we like to think that we buy only the freshest produce, there is no real way to tell how old it is at the time of sale. If you pick it from your backyard or balcony and cook it straight away or even eat it raw, you are giving yourself and your family the best nutrition available.

3. **Taste** - Also, there is nothing that beats the taste of fresh, home grown produce! Fresher fruit equals sweeter fruit - it has not been harvested unripe then stored for months before getting to the retailer.

4. **Lower food miles** – it has been calculated that a typical Australian food basket, including fruit and veg, has travelled 70,000 miles to get to you. Each of those miles consumes fossil fuels and pumps greenhouse gases into the atmosphere (and travel by air generates 177 times more greenhouse gases than shipping). If you only have to step into your backyard or onto your balcony to gather the ingredients for a feed, the travel is measured in food feet not food miles, and no fossil fuels are consumed at all!

5. **No chemical residues**: you know where your food comes from and that it is not contaminated by pesticides – If you grow your food organically you can be sure

that there are no residual nasties waiting for you. You know what has and what hasn't been using to grow your produce so you can eat it with confidence.

6. **It shows kids where their food comes from** – If you have kids it can be a real eye opener for them to see that carrots, onions and potatoes actually come out of the ground and lemons come from a tree, not a supermarket. Also, getting them involved with growing the food they are going to eat is a great motivator for them to develop healthy eating choices. Years ago my kids would love it when I brought carrots in with the foliage still attached, that they could eat raw (we used to call them Bugs Bunny carrots).

7. **It enables you to eat a greater variety of foods** – If you source your fruit and veg from retailers, you can only buy the types and varieties of fruit and veg that they are prepared to sell you. Take tomatoes for instance, if you are lucky you may find 3 - 4 varieties in the supermarket, but there are over 200 different varieties available from heritage seed companies which you can grow. Think of all the taste treats awaiting you out there that you don't even know about, growing your own can open up a world of taste!

8. **The satisfaction which comes from growing and eating your own produce** is amazing. It may be only one of two ingredients but it can transform a whole meal, and it really is special when you make a meal mainly from ingredients you have produced yourself.

9. **No packaging to try and recycle or send to landfill** – Even organic produce can come packed in layers of plastic film, on a polystyrene foam tray, in a plastic bag and all of that packaging will wind up polluting the environment sooner or later. A big difference I noted when we started to get serious about producing our own food was that the amount of garbage we generated reduced significantly and the amount in our worm food/compostable bucket increased significantly.

10. **Reduced environmental impact of fertiliser and pesticide use** – The chemicals used in industrial agriculture have a detrimental effect on the soil, ground and surface water, biodiversity and the environment in general. By opting out of that system and growing your own (as well as buying organically grown what you can't produce yourself) you don't encourage the continued use of these damaging chemicals.

11. **Resilience** – When things go wrong in the world, like pandemics, wars and high cost of living, being able to produce some of our own food means we are more resilient when bad things happen.

12. **Food security** – The shorter the supply chain, the more secure your food supply is likely to be, and you don't get much shorter supply chain than walking into your back yard to be able to eat!

So you can see there are lots of good reasons for starting a microfarm and you can use the information in this eBook to set about starting one today!

1.2 Process Summary for this eBook

The first thing to do one you have decided you want a microfarm is to check out the land where you are thinking putting it in and then look through the criteria and decide the best place for it (Selecting your site, page 11).

To make the most of the area you decide upon, it is worth putting a plan together including maps, designs and sketches around what you want to grow where. How formal the plan you develop in is up to you but may also include plant lists and succession plans. (planning, page 17)

As part of this process, it is important to look at the soil where you intend to grow, by sampling it and then looking at its physical aspects like texture and structure, chemical aspects like pH and biological aspects. (Testing your soil, page 28)

Once your research has been done and decisions taken it is a case of working out what techniques to use in constructing the growing areas, including what you will use to mulch the areas once completed (Setting up your microfarm, page 46)

One of the things that makes a microfarm so valuable is that in most of Aus we have the ability to grow food all year round. It is worthwhile setting up plans so you can to take advantage of this capability once the microfarm process gets moving (succession planning and planting, page 82)

Of course, to have a productive microfarm it needs to be irrigated regularly and efficiently, getting the best out of the water you have available (setting up irrigation, page 90)

Rather than being reliant on the local nursery to supply your seedlings, it is cheaper and more efficient to grow your own. It is not a difficult thing to do but it is easier if you understand the process beforehand and know what you are doing (growing vegetables from seed, page 118)

To greenhouse or not to greenhouse, that is the question! Having access to a greenhouse entails extra costs, but makes raising your own seedling much easier, enables you to extend the growing season, and it is a great place to sit (if it is big enough!) on sunny but cold days. (Our greenhouse journey, page 152)

Even if you start out with ideal soil, as you grow it will be important to make sure that the right nutrients are available to your crops as they need them and are regularly topped up. Working out the process to maintain your soil fertility is important to include in your microfarm plans. (Maintaining fertility, page 160)

Also, along the road you are likely to run up against problems like pests, diseases and weeds. Having some idea on what you are likely to run into, how they can be prevents and what to do when they occur can be important to know! (managing potential problems, page 173)

We have been doing these things for many years and you may find it interesting to see how we have put vegetable growing systems together for our microfarm (Putting it all together, page 189)

There is always more to learn and sometimes you need more detail on a particular subject, so we have a list of links to other free eBooks available on our website and suggestions on print books for further reading (Resources, page 212)

2.0 Selecting Your Site

When you look over the area where you are thinking of placing a microfarm, there are a number of things that you need to consider and while none of them are deal breakers, picking the site with most of the right factors will make your journey into veggie growing easier, more pleasant and more productive. In the end, most difficulties can be fixed or at least allowed for, and your choices will be limited in an urban or suburban area so when looking for your site pick the best you can but don't worry if it isn't perfect, the important thing is to get out there and grow!

1. **Aspect** – In other words, which way does the land face, north or northeast is best, so that you get the most amount of light. This is very important in Europe, less so here in Australia with our abundant sunshine. Having said that it is possible to reduce light levels if you have plenty, less easy if you are already operating on the minimum level.

2. **Shade** – Also related to light levels, broken shade can lend itself to lettuce and strawberries, full shade can be very restricting. So where available, full sun it is!

3. **Soil type** – While you can grow almost anything in almost any soil, but the better your soil is to start with the less work you will have to do to make it productive. Generally, soil contains various percentages of sand, clay and silt. To get a rough idea what your soil is like, make a 2cm ball out of wet soil with your hand and then drop it. If it feels gritty and falls apart when it hits, it is mostly sand, if it feels greasy and slightly flattens when it hits it is mostly clay, but generally it will be somewhere in between! Sandy soil is hungry (needs nutrients and water) but is well drained, clay soil is very good nutritionally but has poor drainage. Put a calcium salt like agricultural lime or dolomite on a clay soil to break it up, and any soil will benefit from organic matter such as compost. If your soil is concrete and you don't want to dig it up, consider raised beds or container gardening. The process of testing your soil will be explored later in this eBook.

4. **Drainage** – this is how quickly water drains away when you stop adding more. In general terms a clay soil is poorly drained and sandy soils are well drained, but you might find boggy patches in low lying sections of any soil. If drainage is a problem, build a bog garden in the area or put in a pond, but if the whole of your back yard is poorly drained and your neighbours won't find it funny if you divert the water into their place, go for raised beds again.

5. **Slope** – this affects drainage and aspect, if you have steeply sloping land you might think of putting in terracing or swales, but more likely it will be a gentle slope because those are the areas we tend to build up. A gentle slope will assist in drainage and if it slopes down towards the north or northeast it will provide a better aspect.

6. **Existing plants** – If you have a yard full of tall trees (which council won't let you cut down) it makes growing veggies more difficult from the point of view of shading, but also the trees will pirate any fertility you try and put into the soil to grow veggies. Again, raised beds on an impervious base or use of containers may be the answer. On the other hand, if the land is growing a good crop of "weeds" or grass that may be a good indication of a well-drained, fertile soil.

7. **Access** – The easier it is to get to your veggies the more likely it is that you will take the time to wander down there and, weed, pick, mulch or generally lie down amongst them. If you have a big yard, you still might want to site the veggie patch close to the back door of the house to make access easier for yourself.

Remember, don't be too despondent if your site isn't ideal, almost any problem can be fixed or at least compensated for by the varieties of vegetables you grow.

All sites will suffer from one or a number of problems and unless you are looking to supply your local fruit and vegetable shop year around, you will be able to work out a compromise and produce some food in almost any area.

When you do go looking for your first (hopefully first of many) place to grow, don't fixate on the back yard, there are many other opportunities for setting up places to grow food –

The front yard – we have two wicking beds growing perennial as well as annual vegetables, our herb spiral, the banana circle and ten fruit trees in our front yard. We have never had a problem with pilferage. It is a sad fact that much of what you can grow in your front yard will not be recognised as food by the general public so it will probably be safe. On the plus side growing food in your front yard may produce opportunities to make friends and discuss urban food growing with your friends, neighbours or even passersby.

Patios, decks or Balconies – depending on their aspect and how much sun they receive can be a good place to site veggie boxes, wicking boxes or self-watering containers to grow fruit and veggies in. Even standard pots and planters can produce food with a little bit of effort and because they will be close to the house, they will be quick and easy to harvest. You do need to check that the structures will support the weight of the pot, growing medium and plants but in most cases, you should have no problems with a few Styrofoam veggie boxes.

Roofs – the flat roof of sheds or garages can be used as growing spaces too with the same things to look out for as patios, decks and balconies above. One way of using the extra space afforded by a roof is to build a no-dig garden which is lighter than conventional gardens for the same volume or a hydroponic set up could also be considered. One point worth noting is that there should be no drainage allowed from the growing container onto the roof if you plan to use the roof as a catchment for rainwater.

Window Boxes/Sills - While somewhat out of fashion a window box, either home produced or bought can be used to grow herbs or vegetables, depending on the light available. On the inside of the window, small self-watering pots can be placed on the windowsill and used to grow small vegetables, greens or herbs.

Inside the House – If you have a flat surface inside that gets a few hours of sun a day you can use it to grow Microgreens and even if you have areas that don't get any sun at all you can still grow sprouts or mushrooms.

Your Families', Friends' or Neighbours Yard – Even if you live in a flat with only one window that gets no direct sun at any time during the day, you can canvas your nearest and dearest or even those less near and dear to lend you growing space in their yard. Ideally within walking distance of your place of residence, land owned by others can be used by you to produce food for yourself, with a percentage donated to the land owner in lieu of rent. If you can get access to land owned by others you will still be producing food in the city or suburbs as well as developing your growing skills and improving your nutrition.

Allotments and Community Gardens – There may be land available in your area for nominal rent or for work done on the site in allotments, generally run by the local government or community gardens which may be run privately by members or by local government bodies as well. If you have no land or growing space on offer, contact your local council and see what is available in your area.

Before leaving the process of selecting your microfarm site, we do need to talk a little bit about how big the veggie patch should be. If you haven't grown vegetables before it is best to start off with a small space and work up, a small space worked effectively is much more productive than the larger one let go because it takes too much to keep up with. While I do have issues with those enthusiastic garden writers who declare "it is possible to grow all the vegetables for a family of 4 in a 3metre by 3metre square" (all I can say is that they must eat out a lot!) with care and planning you can grow a proportion of your veggies even in a flat.

The beds are best kept 1metre to 1.2 metres wide so that you can get to all parts by leaning across them and not have to walk on the beds themselves, because this causes soil compaction, reducing the amount of air in the soil and causing poor drainage.
We currently have about 35 square metres of veggie beds and they provide food (in a larger or smaller amount) almost every day of the year.

So after looking at all of these points and deciding roughly where would be best to put in your veggie bed(s) and how big they should be, it is time for a bit of planning.

3.0 Planning

3.1 General Considerations

Before we delve into the bowels of the planning process, there is one point that is worthy of consideration, if only because it caused me all sorts of stress and hassle when I first started trying to grow my own food. We who are born into the supermarket culture are used getting what we want, when we want it! Unfortunately, the real world ain't like that.

I caused myself no end of hassle by trying to ensure that we had enough planted of all the different types of veggies we like to eat all year 'round. It just isn't possible. So save yourself the hassle and embrace seasonality. In other words, plant only the veggies that do well and give you good a crop at the time of year you are planting, rather than bust a boiler by trying to grow out-of-season crops. By accepting seasonality it helps you to understand how artificial our supermarket culture is, gives you an appreciation for crops grown in their proper season and means you are working with nature rather than against.

Any plan will be very family specific because only you know which vegetables your family eats how much of each one you need. If you have the patience, make a list of the veggies you eat and then make a note of how much you buy of each type over a year. If you are not that pedantic (like me!) then just talk it over with your family and wing it. Also, don't be afraid to try new stuff, there is a wide range of veggies available that you don't see in the shops, so start out small and discover some new family favourites. Working out what types of vegetables your family eats, at least to start with, will give you an idea of the sorts of vegetables you will want to grow. Following is a list of veggies that is reasonably comprehensive, tick off the ones that you currently use and then pick a couple of new ones to have a go at –

Vegetable	Yes	Vegetable	Yes	Vegetable	Yes
Amaranth		Artichoke (Globe)		Artichoke (Jerusalem)	
Asparagus		Beans (Broad)		Beans (Dwarf)	
Beans (Climbing)		Beetroot		Bok Choi	
Broccoli		Brussels sprouts		Burdock	
Cabbage		Capsicum		Carrots	
Cauliflower		Celeriac		Celery	
Chicory		Chilli		Choko	
Choy Sum		Collards		Cucumber	
Egg Plant		Endive		Fat Hen	
Honeydew Melon		Kale		Kohl Rabi	
Leek		Lettuce		Mallow	
Mibuna		Mitsuba		Mizuna	
Mustard		Okra		Onions	
Parsnip		Peas		Perilla	
Potatoes		Pumpkin		Quinoa	
Radicchio		Radish		Rhubarb	
Rock melon		Salsify		Scorzonera	
Shallots		Silver beet		Spinach	
Squash		Swede		Sweet Potato	
Sweet Corn		Tatsoi		Tomato	
Turnips		Watermelon		Wong Bok	
Zucchini					

A copy of the above list is available in the **Resources/Downloads** area of our website.

Once you have a list of veggies you wish to grow, they can then be fitted into a sowing plan, which will help you maintain a steady harvest throughout the year. For many years I planted up big in spring and then had gluts and shortages for the rest of the year. With a good sowing plan those problems are solved.

It is not possible to consider each person's circumstances in terms of climate and favourite veggies, so it is time to do a bit of research! Get hold of seed catalogues, preferably from producers of open pollinated heritage seeds, your local seed savers group and/or local permaculture group. Scour them to work out what varieties suit your climate and when you should sow them, talking with existing gardeners in your neighbourhood will also yield useful information on which types and varieties do well in your location and which don't. You may want to plant different varieties of the same vegetable to spread your growing season.

Then decide on how much of each vegetable you want to plant at each time, bearing in mind that the plan is always evolving and some things you may discover you want to grow more of over time, others you will reduce because you don't like them as much or as often as you thought you did.

To develop a sowing plan, work out how often you want to sow/plant out your veggies, my system is based on twice monthly sowings and works well for me. Having decided you sowing interval, draw up a matrix with each veggie you want to grow and the variety down one side and the interval of sowing across the top. To make it easy for me to develop and keep up to date I use an Excel® spreadsheet on our computer.
The finished plan may look something like this (at least ours does) -

Vegetable	Variety	July		August		September		October	
		Week 1	Week 3	Week 1	Week 3	Week 1	Week 3	Week 1	Week 3
Basil	Sweet	4 plants		4 plants		4 plants		4 plants	
Beans					1 row	1 row	1 row	1 row	1 row
Beetroot	Crimson Globe						1 row		1 row
Bok Choi					4 plants	4 plants	4 plants	4 plants	4 plants
Broccoli	Green sprouting	4 plants	4 plants	4 plants	4 plants	4 plants			
Broad beans	Coles Dwarf	1 Row							
Black Turtle beans								Full bed	
Cabbage	Sugarloaf	1 plant	1 plant	1 plant	1 plant	1 plant	1 plant	1 plant	1 plant
Capsicum	California Wonder	4 plants			4 plants			4 plants	
Chilli	Cayenne	2 plants			2 plants			2 plants	
Carrots	All year round				Half Bed				
Carrots	Chantenay				Half Bed				
Cauliflower		2 plants							
Celery	Golden Self Blanching				2 plants		2 plants		2 plants
Cucamelon									
Cucumber	Lebanese			1 plant		1 plant		1 plant	
Garlic									
Kale	Scottish								
Leek							12 plants		
Lettuce	Mignionette - green	2 plants	2 plants	2 plants	2 plants	2 plants	2 plants	2 plants	2 plants
Lettuce	Oakleaf	2 plants	2 plants	2 plants	2 plants	2 plants	2 plants	2 plants	2 plants
Luffa						3 plants			
Malabar spinach						3 plants			
Onions	Gladalan white or brown								

To download a copy of my current Veggie Plan, use the following link:
Vegetable Sowing Plan 2019

3.2 Strategies for a Small Vegetable Garden

One of the constant challenges of urban/suburban food growing is that we have very limited land on which to grow and that has to fight with other needs like recreation. We have a total block size of about 600m2 but only 300m2 in the back yard, not taking into account the land taken up by sheds and the greenhouse so like farmers the world over, we always want more land. I do appreciate though that there will be urban farmers out there whose mouths will water at the thought of a 600m2 block so the trick is to make the best of what you have got. To help you out as to how you might do that here are some ideas –

Develop a plan – Assess the resources you have for food growing and compare them to the strategies listed here. Some will work for you, some won't and some you may need to trial to find out. Develop a plan which helps you get your head around what you are trying to do and makes sense to you, such a plan may include –

- A sketch of your growing area showing what structures/plants are there now and what you intend to change to increase your productivity.
- A succession plan of what to sow/plant out to keep production up.
- Designs or sketches for things you need to build (cold frame, mini-greenhouse, trellises or compost bin etc).
- An action plan of who is responsible for doing what, when

By recording your plan on paper or electronically you will be able to keep track of your progress and record your successes and failures.

Aspect – The way your veggie growing area faces can have a great bearing on how much you produce. The best aspect is north around to northeast and if your growing area faces south and gets no sun you will have problems. If you have a choice go for the

best aspect that you can. It is possible to grow crops which can cope with a lower amount of light (generally leaf crops) or use mirrors to deflect sunlight towards your plants but the better your aspect is to start, the easier your veggie growing adventures will be.

Think Vertical – many varieties of vegetables and fruits can climb such as beans, cucumber, chokoes, peas, or be trained upward such as tomatoes or even pumpkins. In the 2011 season we got the best harvest of huge pumpkins ever by growing them across the back fence. So maximise your horizontal space by growing vertically against any vertical surface you can, by building free standing trellises, by growing up established trees or even using growing veggies as a living trellis eg by growing beans up corn stems. You can even put some growing medium in a large pot next to a structure and grow fruiting vines like squash or pumpkin up over the roof. More information about vertical growing techniques is available in our eBook about growing veggies vertically – Upwardly Mobile with Vertical Veg

Use succession planting (Stack in Time) – This doesn't give you more growing space, but allows you to get more out of the growing space you have and is, simply put, replacing any vegetable harvested with another one straight away. To make this work you have to be right on top of maintaining your fertility, have a great plan and be constantly sowing so you have seedlings ready. A detailed article on succession planting is available in a later section of this eBook.

Don't plant too much of one thing – getting the most out of your growing area means only planting just enough of any one vegetable for day-to-day consumption. Otherwise, you get a whole stack of one crop and need to reserve it somehow, but still have to buy in the rest of your veggies. A good plan will make sure that this doesn't happen.

Interplant where possible – rather than growing long rows of the same crop with blank space in between, plant out the whole bed with all sorts of different veggies grown together. You can plant so that all the veggies ripen over a period of time so that the beds are producing for a longer period and, again, a good plan will support this and

make it easier for you. Intercropping can confuse pests, reduce the amount of bare ground and increase the amount of produce per square metre of garden. This will require ignoring the spacing recommendations on the seed packets and some of the gardening books but a well-maintained organic garden will have the fertility to cope with it. We plant so that the veggies grow within about 30cm of each other. Note: This will not work for corn, which needs to be planted in a block to pollinate correctly.

Be prepared to experiment with unusual vegetables or varieties – One of the fun bits of growing your own is growing and trying new veggies and new varieties. Get hold of as many seed catalogues as you can manager and spend some time reading through and taking note of what will grow in your climate, how long it takes to get a harvest and how early or late in the year each variety grows. This can spread the harvest and perhaps by trying some new types of veggies, allow you to exploit slow times in the veggie growing year when you may otherwise strike a "hungry gap". We have tried new stuff that we have not been used to eating like Jerusalem artichokes, Asian greens, leeks and broad beans and found the greater variety is good for the garden and good for the cook. There is hardly a day when we can't go out to the garden and harvest something. Try a small amount at a time and then if they are good, add them to your plan if not at least you tried.

Consider perennial vegetable beds – Perennial veggies are the parts of plants which are harvested and eaten like vegetables and where the parent plant lives for more than two years eg asparagus, Jerusalem artichokes, chokoes, Malabar spinach and taro. Generally we tend to eat rather more annual vegetables than perennials and so annual vegetables are the type that make up the bulk of our veggie patches. While some perennials like asparagus and artichokes are available only for a short season, others like shallots and rhubarb crop for extended periods. There should be a place in everyone's veggie growing efforts for perennials.

Try medium/small varieties of vegetables – during your seed catalogue research keep your eye out for dwarf varieties and small types of vegetables that allow you to get more vegetable from the same space, like planting bush cucumbers or pumpkins rather

than runners, sugarloaf cabbage rather than drumhead types or Cherrytime capsicum rather than the larger Californian wonder.

Make a place for containers – There will always be some extra space where you can fit in the odd veggie box or self-watering container so if your do take advantage of some unused space don't forget to add that into your plan so you can manage the extra space effectively. They can also be built to be self-watering, making them water efficient and reducing the time require to keep them watered. This will be expanded on a bit later in this eBook, but for much more detail, consider downloading our eBook on growing food in containers – Growing Food Crops in Pots

Make initial thick sowings – work especially well for root crops like carrot or beetroot seeing as these need to be sown where they are going to grow (they don't take well to transplanting) sow thickly and then thin out as they grow, eating the thinning as baby vegetables. Some leaf crops like lettuce can be used in a similar way.

Indeterminate vs determinate veggies - a few vegetables, such as tomatoes, peas and beans contain varieties within their ranks that will grow, mature and be harvested within a specified time and a defined plant size. These are referred to as having a

determinate growth habit, also referred to as “bush” or “dwarf” varieties whereas other varieties of the same plant may continue to grow throughout the season. These varieties are referred to as indeterminate, also referred to as “climbing” or “staking” varieties and these will produce for as long as the soil and climatic conditions will allow. Determinate plants are more likely to give you a single major harvest then little or nothing while the indeterminates will spread the harvest out providing less at any one time but spreading the harvest out to give you more produce over the growing season.

Stacking in space – Rather than growing a single crop at one level, “stacking” your veggies allows you to maximise your productivity for a given area of land by growing productive species at several levels. A great example of this is the “3 sisters” guild of the Native Americans. They would grow corn (an upright crop) and once it was underway plant climbing beans to grow up the corn (providing nitrogen to the other plants) and squash to grow over the ground and act as a living mulch. So rather than just harvest corn from a plot of land they got three crops: Corn, beans and squash, thus tripling their productivity for no increase in growing space.

Use cut-and-come-again veggies – If you grow a cauliflower, as nice as it will be to eat, once you have harvested it the growing space will be non-productive, require replanting and will take some time before it is harvestable again. If you plant vegetables which can provide an extended harvest period by re-growing after partial harvest this will increase your overall productivity. Cut and come again veggies include Asian greens (mizuna, mibuna, tatsoi) non-heading lettuce eg oakleaf, celery, silver beet, spinach and broccoli will produce side shoots after the main head is harvested.

Use fruiting veggies – In the same way as cut-and-come-again veggies extend your harvest, some veggies which produce fruit such as solanum (capsicum, tomato and eggplant) and cucurbits (squash, cucumber, zucchini, cucumber) continue to produce throughout the growing season. A zucchini planted in early spring and another in midsummer can keep you in zucchinis for most of the frost-free part of your growing season.

Consider sprouts and/or microgreens – these two techniques are a no-land, low cost, high yield way to grow veggies. To grow sprouts the simplest way is to soak some suitable seeds in a container, drain. Rinse and drain again. Then rinse and drain twice a day for a week or so after which your sprouts are ready to harvest. Microgreens are a bit more complicated but basically, the seeds are germinated in a container of potting mix, then grown up to the four leaf stage at which point they are harvested with scissors. Detailed instructions about producing sprouts and microgreens are available in our eBook, which is accessible via this link – Growing Sprouts and Microgreens

Install a Straw Bale Garden – This is a quick and easy method to start a raised veggie garden and works by putting chook manure on hay or straw bales resting on the ground then watering them well and keeping them wet. Let them breakdown for a couple of weeks and then plant veggies into compost on the top of the bale. As the bale breaks down it supplies nutrients to the veggies and keeps them growing well.

Install wicking bed – wicking beds can be built in all shapes and sizes. These consist of a lower water reservoir filled with gravel to support an upper layer of growing medium. The bed works by keeping the reservoir filled with water (through filler tubes put in during construction) which then "wicks" up into the growing medium by capillary action. The wicking process ensures that the plant always has access to water but as little is lost via evaporation as possible. More information on wicking bed construction is available in section 5.2.3.

Exploit non-traditional growing spaces – If you are thinking of growing vegetables in your back yard, but don't have much room, there are other places which can be used to grow food which you may not have considered –

- Front yard and road verge at the front of your house
- Front yard/back yard of friends, neighbours or relatives (with or without produce sharing)
- Suitably reinforced flat roofs of sheds etc.
- Local community gardens
- Local schools or other institutions (with permission of course)
- Guerrilla gardening of local vacant lots or other waste ground

Extend the season – by the construction of microclimates (where this is feasible) you can sometimes extend the growing season so that you can plant somewhat earlier and harvest somewhat later than is usually possible. Covering crops with a lightweight fabric (so-called floating row cover) can keep temperatures up and ward off frost also avoid planting frost sensitive crops so that they will run into a time when frost is likely.

Consider Irrigation – one of the limiting factors, particularly for growing food in containers is ensure that the plants get enough water to grow well, particularly in hot weather. This can be especially important where growing in containers is concerned. At the planning stage it is worth including in some plans for getting water to your plants. Self-watering containers and wicking beds are good, and clay pot irrigation works well

when beds in the ground are used but consideration to a low cost irrigation system may be worthwhile also. More information on low tech irrigation techniques can be found in our eBook: Low Cost, High Efficiency Irrigation, sections of which are reproduced in section 7.0 of this eBook - Setting up to Irrigate.

It is unlikely that all of these techniques will suit your particular circumstances, but you can just about guarantee that at least a few will. Some, like starting out with a plan, will be good advice for anyone wanting to grow their own food in a small area. As part of your planning process, decide on a couple of these techniques which you consider most likely to work for you, put your plan together, then get out there and PLANT! Oh, and good luck!

3.3 Veggies to Consider Including in Your Plan

Good yield for space used:

Broad beans	Broccoli (Sprouting)	Onions
Runner beans	Carrot	Tomatoes
Dwarf beans	Lettuce	Silver beet
Beetroot	Zucchini (squash)	Snow peas

Easy to grow:

Broad beans	Silver beet	Onions
Runner beans	Spinach	Kale
Dwarf beans	Turnips	Snow Peas
Beetroot	Lettuce	
Carrot	Radishes	

Tolerate some shade

Beetroot	Salsify	Celery
Kohl Rabi	Radish	Spinach
Turnips	Cabbage	Silver beet
Carrot	Brussels sprouts	Lettuce
Parsnips	Cauliflower	

Once your plan is complete, or even while you are still working on it, you can go out and prepare your veggie beds so that they are ready for planting out when you are.

4.0 Testing your soil

4.1 General Considerations

There is a truism that says you can grow almost any plant in almost any soil; but the more fertile your soil is, the better the structure is and the more abundant the soil life is, the less you have to do to it to grow abundant fruit and vegetables. If your soil is so important to the growing process it seems to me that any information that you can glean about your soil will be worthwhile. By understanding your soil you can use techniques and additives that improve your soil over time rather than depleting it .

There are three aspects of the soil that can be investigated to help understand the soil we will be planting into –

Physical aspects – the type of soil and the constituents that go to make it up, which has an impact on soil structure, drainage etc.

Chemical aspects – how acid or alkaline the soil is and what sort of nutrient levels are present, which can impact how well any plants will grow can also affect the living organisms present in the soil.

Biological Aspects – what types of animal life can be found in your soil, which is also an indication of soil health.

I have used some tests that a "backyarder" such as myself can carry out where you do not need a PhD in soil science or the services of a fully staffed analytical laboratory, which is handy seeing as I have neither. Hopefully you can also use these tests to get a handle on how healthy or otherwise your soil is and use the results to plan on how you can improve your soil in the long term. Also, for those of a Permaculture persuasion, this can be some interesting research to carry out before you develop your Permaculture design.

If you are sampling your soil before putting in a veggie patch or some fruit trees it is a good idea to do your sampling a few months before you plan to start work, that way you get time to make adjustments if you find something out of kilter. It is a good idea to sample and test your growing areas every few years too, so you can keep a handle on how your soil is going. The actual time of year doesn't matter so much but if you have disturbed the area, say by double digging a veggie bed, it would be best to let things settle down for a month or two before sampling.

4.2 Sampling your soil

In the same way that a chain is only as strong as its weakest link, your soil testing result is only as good as the samples you have taken. Take enough and combine them well to form homogenous soil mix and your testing regime will be reasonably accurate. Do a crap job of sampling and your results will be skewed, so any decisions taken on the basis of those results will be crap too. It is the classic data cliché – garbage in = garbage out. So it is worth getting this step right!

The first thing is to look at your yard and where you intend to grow your fruit, veg and herbs, to identify the areas you wish to test. In our case we have three "blocks" of veggie patches we grow things in (plus a single patch over by the northern fence), and there are also a number of fruit tree growing areas too. To facilitate this, a map of the

area you are going to sample will come in handy, even a hand drawn mud map will help.

What you will need

- A clean spade or trowel (while it doesn't matter for the purposes of this exercise, if you think you might want a full, professional analysis done on your samples at some later stage, do not use brass or galvanised tools to take the samples, it will give a falsely high reading on copper or zinc)
- A bucket (plastic works well here, a galvanised one may cause obvious problems)
- Pen & Paper (for any notes) and a clip board really helps!
- Your mud Map.
- Plastic bags – large, resealable and felt tip pen for labelling

Look over the area you wish to sample and then mark out where you are going to take your samples using a zigzag pattern, working from one side of the area to the other with the sample areas about a metre apart. For most backyard veggie growing areas 5 or 6 samples would be plenty. The sample depth should be as follows:

- Usual veggie garden type areas – 100 to 150mm
- Shrub areas like some larger herbs or berry bushes – 150 to 200mm
- Trees such as fruit or nut trees – 100 to 200mm

Taking the samples

Brush away any mulch or vegetation on top of the soil before taking a sub-sample. Using your spade or trowel, dig a vee shaped hole down to the required depth. Place the spade or trowel near the edge of the hole at about 1 centimetre away. Push down steadily so that you cut a 1 cm slice from the ground level all the way down to your sample depth. Pick up the slice and dump it into your bucket. Move to the next sample area and repeat the process until all areas have been sampled.

Using your hand, break up any soil lumps and then scoop the soil around in the bucket to ensure it is well mixed. If there has been rain and the soil is a bit muddy you may need to let the sample dry out a bit, do this by spreading it out on clean paper out of the sun and let it air dry naturally for a few hours. Alternatively, sample after the soil has had time to dry out a bit.

Once you are happy with your sample, place it into the plastic bag. If you have more than one sample don't forget to label each one and then mark on your mud map where the samples were taken.

Recording

As well as marking your soil sample points on your mud map, it is handy to keep a tally of what samples have been taken where and when, what tests have been done on them and what the results of the tests were. One way to do this is to fill out the Soil Test Results Sheet, available as Appendix 1**.** This will help you keep a running tally of where you are at with your soil testing program and provide a handy summary to be reviewed when you are making decisions about soil improvements. If you are doing this for somebody else it also acts as a useful one page report that you can give them.

4.3 Soil Testing - Physical Aspects

The physical aspects of a soil consist of how its parts work together to form the soil structure, dictating how well or otherwise a given plant will thrive on that soil. Soil is generally broken down into three physical components; Sand; silt and clay but you can also add a fourth – organic matter.

Sand – a sandy soil, like those found around Perth (Aus) have very coarse structure with good drainage but a sandy soil lacks clay and loam and so will not hold water and will tend to lack nutrients. Sandy soils are easy to dig into and plant roots can penetrate them easily but dry out quickly after rain. Too much sand can be as bad as not enough.

Clay – on the other hand, clay soils have very fine particle size, they generally can provide the plant with good nutrition, but drainage is poor and they tend to waterlog easily. There is nothing like planting into good old Sydney clay! Unfortunately, when the clay soil does dry out it can go hard as a rock and be very difficult for plant roots to penetrate and a bugger to have to dig.

Silt (often referred to as "Loam") – silt is weathered rock and in particle size sits between sand and clay. It feels like flour when dry but has a silky feel when wet. It provides some nutrients to plants and allows for some soil water retention.

There is a complicated little **phase diagram** which, once you know the percentages of each of these three components, will allow you to work out what type of soil you have. It might be clay, clay loam, sandy loam etc. To me the name is fairly meaningless because I am a back yarder not a soil scientist, but the components of my soil will let me know how well I will be able to grow the plants I want but also give me some hints on what I can do to improve my soil.

Organic matter – This is the part of the soil contributed by the plants and animals which live in, under and on top of the soil. It is comprised of humus, particulate matter like mulched up sticks and leaves or partially decomposed animal dung and, especially

where bushfires are a feature of the landscape, charcoal. Strangely enough soil organic matter not only improves drainage but also improves soil moisture retention, as well as providing nutrients for plants and other soil life.

Conducting the Test

It would seem a good thing to have a rough idea about the sort of soil you are blessed (cursed?) with and what you can do about improving it, so what follows is a simple test anyone can carry out once you have correctly sampled your soil.

1. Get hold of some glass jars, somewhere between 500ml and 1 litres (I use recycled 500ml jars because it is what I have). You will need to have one jar per soil sample (see soil sampling). If you use recycled jars remove the labels, you will need to be able to look through the side of the jar and it is easiest to compare relative amounts of the soil components if the jar has parallel sides.

2. Label each jar so you know which sample is in it, I just use a simple number to denote which is which, but it is a good idea to write down somewhere what each number means. A good place to do that is the soil test results sheet.

3. Add a soil sample of approximately a quarter of the volume of the jar, I use 500ml jars so to put the sample in I used a half-cup sized measuring cup (1/2 cup = 125mls).

4. Add water up to approximately 80% of the volume and then place on the lid (firmly!) and then give the whole apparatus a good shake. A loose lid lets it gush out all over the place and if you happen to be doing it in the kitchen and the lid comes off your popularity score with your significant other could take a considerable dive. (not that that happened to me of course!)

5. Let the samples stand unmolested overnight and they will be ready to read the next morning.

This process works by stratification, the heaviest materials sink quickest, while the finer materials can take much longer to settle. So over time a series of layers are laid down and these can be read through the side of the glass jar. The bottom layers will consist of any rocks, followed by coarse sand, fine sand, silt and then progressively finer particles until the clay layer deposits, although the really fine clay may take days or weeks to come out of suspension.

Another indicator of the type of soil you have to work with is the layer of floating material on top of the water. This layer is formed by the soil organic matter, so the thicker the layer the more organic matter in the soil.

The relative thickness of each layer will give you an idea of how your soil is made up. A quickly sinking thick layer of coarse material indicates a very sandy soil whereas rough equal amounts of all components indicates a good loamy soil that won't take much effort to grow plants well.

“Feel” Test

There is an even quicker and lower tech soil test which requires no equipment and can be carried out in the field. Dig down with your fingers into the soil and make a ball of soil and squash it between your fingers, smear it about a bit. How does it feel?

If the texture has a “silky” feel to it your soil will have a high clay content but on the other hand if it has a “gritty” feel it will be a predominantly sand containing soil.

Altering Your Soil

Regardless of the soil you are working with you can improve it, or you can make it worse. To improve a sandy soil, add organic matter in the form of compost and mulch it well. This will both provide nutrients for the plants and improve the soil’s capacity to hold water.

If you already have a silty/loamy soil you probably won’t need to do much, but every soil is improved by adding organic matter so you may want to add some to ensure nutrient levels remain high. Depending on your climate, mulching usually improves things too although in a very wet climate it can cause too much water retention.

If you have a clay soil there are additions which you can make that will directly improve drainage and soil structure. Fine clays are sodium clays and while they are nutritionally good for the plants they tend to get waterlogged very easily. To overcome this adding a source of calcium will cause a chemical reaction which changes the clay from being a sodium clay to being calcium clay which has a much more open texture and much better drainage. To achieve this either add powdered gypsum (a mineral) which is neutral and will not affect soil pH or, if the soils are acid add either agricultural lime (calcium carbonate) or dolomite (a mix of calcium and magnesium carbonates) which will raise the pH, making the soil less acid.

Unfortunately, it is also possible to alter your soil for the worse and this will occur if it is cultivated too much. Cultivating the soil by digging, double digging or rotary hoeing breaks down the soil structure reducing drainage and air penetration into the soil. It

also has other undesirable effects such as reducing the amount of living things in the soil and exposing organic matter to the air and sun where it can be oxidised or “burned out” of the soil. The more often the soil is cultivated and the more aggressively it is cultivated eg by a rotary hoe rather than a spade, the more marked this effect will be.

4.4 Soil Testing - Chemical Aspects

When it comes to the chemical aspects of your soil which you can test yourself, it usually boils down to three facets, pH, soil nutrients, particularly the major nutrients nitrogen, phosphorous and potassium (NPK) and salinity.

pH

The pH of the soil refers to how acid or alkaline the soil is, which can have a significant impact on plant nutrient uptake and subsequently plant health. There is a fairly simple qualitative test that you can use with stuff you probably have hanging around your house –

Acidity test – put a dessert spoon of the soil you wish to test into a cup. Add ¼ cup of water then sprinkle over some sodium bicarbonate (baking soda) and mix in. If you get bubbles, ie the sample fizzes, your soil is quite acid.

Alkalinity test – put a dessert spoon of soil into a cup then add a dessert spoon of vinegar and mix. Again, if you get fizzing then your soil is alkaline.

This is a pretty simple test which you can do quickly, cheaply and easily but it does not give you a number so to be really sure of what pH you soil is, it is best to pick up a soil test kit and use that.

Soil Nutrients

There is no simple home developed test for NPK but there is a test kit you can get which will allow you to test for these nutrients as well as pH. The process is similar for all the tests and involves taking a soil sample of 1-2 grams then place into a plastic tube (part of the kit) and add a similar amount of water. Filtering the solution by forcing an inner tube inside the outer tube so that a soil solution is forced through a replaceable filter on the bottom of the inner tube. Into the filtered solution is then added a measured amount of chemical reagent(s) and the solution left to develop a colour or level of opacity which is then read against a chart supplied with the kit.

While not providing a number as such, it does give you a readout against a scale from "very low" to "very high". It is easy to see, once all the tests are done, if you have a nutrient imbalance and get a general idea of the nutrient status of the soil for the macronutrients at least.

There are soil nitrate meters available which can give you a direct readout of your soils' nitrate content in the same way a pH meter gives you a direct reading of soil pH but they are expensive. They cost hundreds of dollars (up to $600) and they require regular calibration using a calibrating solution which has to be bought as well. The other alternative is to submit samples to a soil testing laboratory who can not only conduct a battery of tests but also provide a report to help you interpret the results of the tests.

If it is clear that there is a nutrient lack or imbalance, information on recovering the situation is available in Section 4.0

Salinity

The term soil salinity refers to how much salt is present in the soil and this is one of those cases where the less there is, the better it is for the plants. Salt in the soil results in loss of soil structure, loss of soil porosity, reduced water and air movement through the soil, reduced ability by the plants to take up water and nutrients.

Salinity is usually tested using a soil conductivity meter, the principle being that the greater the salt level the greater the conductivity of a soil solution. These meters cost from $200 up to over $1000 so unless you are really enthusiastic the cost may be a problem. Even low cost meters can have other functions though such as being able to read pH as well. In general terms, to use a salinity meter requires you to take a soil sample, dry it, mix a measured amount of soil with a measured amount of distilled water and take reading. The reading must them be multiplied by a factor taking into account the type of soil being measured which converts the result into a number which can be compared against a scale to enable the result to be interpreted.

There is another way to check if you have a salt problem, by looking at what is happening with the veggies you are growing. Salt levels that are high enough to cause a problem generally to manifest themselves in one or more of the following symptoms –

- sudden wilting,
- stunted growth,
- marginal burn on leaves (especially lower, older leaves),
- leaf yellowing,
- unusual leaf fall,
- dead roots,
- restricted root development,
- sudden or gradual death of plants

Two factors that may modify a plant's reaction to salty soil are high rainfall, which washes the salt downward in the soil profile out of the root zone and high temperatures and low humidity which dry the soil out, concentrating the salt and making its effects worse.

Response of all veggies to a given salt level is not the same, some are tolerant and some are less so, see the list below –

Salt Sensitive Vegetables

Beans, carrot, onions, parsnips, peas

Moderately Salt Sensitive Vegetables

Broccoli, Brussel sprouts, cabbage, capsicum, cauliflower, celery, cucumber, eggplant, lettuce, potato, pumpkin, radish, spinach, sweet corn, sweet potato, tomato, turnip, watermelon

Moderately Salt Tolerant Vegetables

Beetroot, button squash, zucchini

Salt Tolerant Vegetables

Asparagus

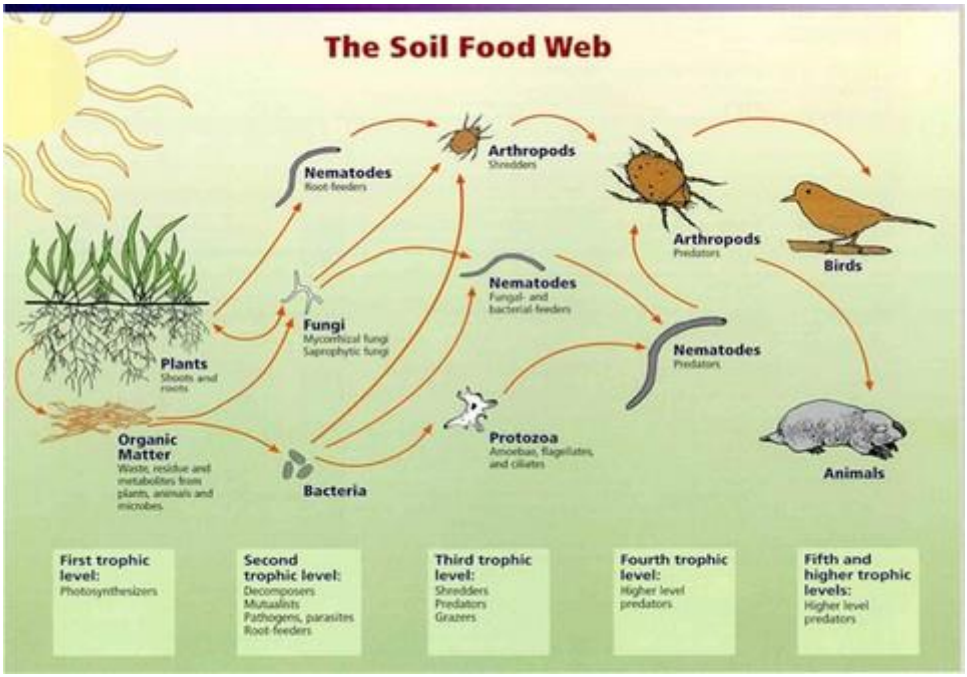
If you are getting the plant symptoms mentioned above it could be worthwhile looking at the types of veggies most affected, which could give you an indication of how bad your salt problem is, ie the more salt tolerant the plant affected, the bigger the problem. The good news is that if your beans, carrots and onions etc are not showing any salt contamination symptoms, salinity is not a problem in your veggie garden.

Salinity Remediation

If salinity does turn out to be a problem for you, there are techniques which can be used to reduce the concentration of salt in affected soils. Working the soil to a depth of 50 to 100mm and then adding calcium (eg calcium sulphate also called gypsum) will displace the sodium in the soil profile, improving soil structure and reducing plant difficulties. This will take some time and it is really handy to have a soil conductivity meter to be able to keep track of how the process is going and the amount of gypsum required can be worked out from the soil conductivity. Well rotted manure can also be used as a substitute for gypsum if it is available.

4.5 Soil Testing - Biological Aspects

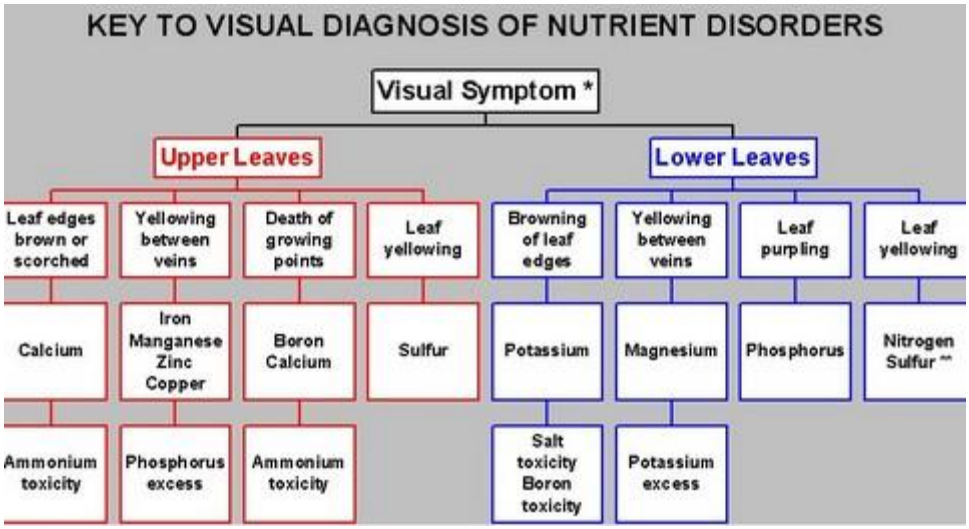
The soil supports a web of life or food chain commencing with the plants themselves, which start the whole thing off by using sunlight and chlorophyll to create simple sugars, made use of on a microbial level by bacteria, fungi and nematodes (microscopic worms). As you move up the chain, organisms become larger and more complex until you reach the climax predator(s) for the particular bioregion where you live. This is summarised by the illustration below.



But how does all this relate to testing the soil in the veggie patch in your backyard?

Using Plants to Detect Soil Nutrient Deficiency

Symptoms and signs of disease exhibited by the plants growing in your back yard may provide an indication of the deficiency of certain soil nutrients or their abundance to the point where they cause toxicity in the plants which are growing there. I have several books in my library which contain many hundreds of photographs illustrating how nutrient deficiency and toxicity symptoms manifest in individual fruit, vegetable, grain and pasture plants. On the surface, sorting through this mass of data and decoding what these symptoms mean to you in your situation could provide a daunting task. However the following diagram (developed by the University of Minnesota Extension Service and published **here**) provides a wonderful summary and flow chart making the job considerably easier.



* Symptoms refer to deficiency unless otherwise stated.

** Symptoms of sulphur deficiency usually occur on upper leaves first, but a general yellowing of the entire plant may occur under prolonged deficiency conditions.

Worm Numbers in Soil

The number of worms in a given amount of soil from your veggie patch or whatever may act as an index as to the health of your soil. The test is carried out as follows –

1. Ensure that the soil temperature is at least 10°C and has not recently been cultivated.
2. Using a trowel and spade dig out a 30cm cube of soil and place onto a tarp, garbage bag etc.
3. Gently sift the soil (if possible) through a garden sieve and then count the worms present in your sample.
4. Count up the number of worms discovered.

Ten worms per test confirms that your soil is in good shape whereas 9 or less may point to problems such as lack of soil organic matter (in association with other tests) or the soil is too dry, there are pH problems, there may be pesticide contamination or the soil is too compacted.

In the event of a low worm count the idea to correct the situation is not to supply more worms but to fix the underlying problem – “if you build it they will come”.

5.0 Setting Up Your Microfarm

I am a busy fella! So when I first started out on this track I bought myself a Masport rotary hoe, to whip through the cultivation quickly, and I did that for many years. Eventually it broke down and I was able to re-evaluate what I was doing. Over the years I had learned a bit, and it seemed that this was not the right way, it was comparatively easy but –

- The action of the rotary hoe destroyed the soil structure creating hard pans at the bottom of the cultivation level.
- It destroyed worms and gave the soil organisms a hard time by cutting through the soil and exposing them to sunlight.
- It consumed fossil fuels and generated a lot of noise and fumes.
- It raised my stress levels by refusing to start when I needed it to and requiring lengthy tinkering to coax it back into life.

No doubt about it, the rotary hoe, had to go – so it went!

5.1 Double Digging

Without the rotary hoe it was time to use a bit of appropriate technology……. A spade and a garden fork, I was going to double dig! One word on tools before getting on to the mechanics of this process, there are times when you can get away with skimping a bit on the cost of your tools, this isn't one of them. Only buy high quality garden tools that can take the pressure put on them by regular double digging eg Cyclone tools, the cheapie imports will fail very early in the process and require replacement – not very sustainable!

When double digging you mark out the area of the bed, and dig out a trench one spit (spade length) deep and wide the full width of the bed, place the soil into a wheelbarrow. Then, using the garden fork, open up the soil at the bottom of the trench so it is loose and will admit water, air and plant roots and add some compost or well

rotted manure. The fill in the trench by digging another trench next to it, loosen the bottom with the fork and add manure or compost, then full it in with the soil next to it. Continue this process until you have a trench left at the far end of the bed and fill this in with the soil form the first digging in the wheelbarrow. The result is a vegetable bed that bulges above the previous soil level with improved aeration and drainage and natural fertilizer already incorporated.

If you are going to cultivate, the double dig method has much to recommend it.

- The soil depth for roots is increased
- The whole bed is aerated and drainage is improved
- The compost/manure is where it's needed – in the root zone.
- No fumes or noise, just good exercise
- The soil organisms are treated a bit more kindly.

The downside is – ignore what I said above about good exercise, it's hard work! Even with press ganging my son-in-law to help it is slow and it is hard work. If you like to dig (and I know that there are hardy souls out there who do) then double digging is the way forward for you. But if you (like me) prefer the easy way, there is a better solution!

5.2 The Chook Tractor

I haven't double dug for many years now, I get animals to do it for me. I place **chook tractor** which is a bottomless chook house placed over the bed or area I want to be a bed for two weeks or more. The chooks dig up everything, including grass, and turn the area into a (fertile) wasteland. This provides chook poo as fertiliser and gets rid of plants, seeds and pests from the planting area – not much can survive the chooks. I then hoe the surface, even it out and break up any areas compacted by the chooks (which happens particularly in wet weather) and apply a 5 to 10cm layer of mulch. The mulch is usually straw that has been worked over by chooks in the shed and keep the area moist. This attracts a host of worms that then dig the bed from underneath,

aerating it, improving drainage and adding worm castings. The result is ideal growing conditions with very little manual input – your back will love you for it!
More details on the construction and use of our chook tractor can be gained from the eBook about chooks and the choko tree, available form the following link –
Chooks and the Choko Tree

5.3 Sheet mulching

If digging isn't your bag, and for whatever reason a chook tractor isn't for you, sheet mulching is a great way to start out your adventure with your microfarm

The sheet mulch can go straight over grass, weeds or bare earth and will ensure a bountiful harvest once it starts to break down. You can also sheet mulch almost any sized area if you have the materials and a few willing hands to help.

The idea is to create a barrier between what is currently growing in the area and what you will be wanting to grow and then put down several layers which will decompose down to form a fertile growing medium and then a protective mulch layer on the top to keep the moisture in.

The Barrier

The barrier is designed so that it will eventually break down, but only after the plants underneath have died from lack of light and frustration in general. The two materials of choice are cardboard or newspaper. If using cardboard, the large sheets used to make packaging for appliances and other large boxes work very well, but having said that, used fruit or veggie cartons are also OK. Make sure that you don't use waxed veggie cartons, however because they will not break down due to the wax coating. One layer of cardboard is usually enough.

If newspaper is to be used this can usually be gotten free or at very small cost in the form of unsold papers form your friendly local newsagent or get friends and family to save them up for you rather than putting them in the recycling bin. If you are using newspaper a good thickness is required, so open the paper out flat and use the whole

thickness of the paper, overlapping them by 100mm or so to reduce the likelihood of those pesky weeds threading their way through.

It is a good idea to soak the papers for a while before laying them down; it has several advantages. Wet newspapers will not fly all around you and your neighbour's yard if the wind picks up and they will be easier to breakdown and feed the soil bugs. An alternative method is to lay the papers down and give them a good soaking with the hose but soaking the papers in a wheelbarrow full of water for a few hours before laying them is the better way to go.

The Main Course

Anything organic can go in the middle bit but you need a layer somewhere around 200mm – 250mm thick. Unless you live on a farm and a while stack of organic matter floating around it is highly likely you will need to buy the material(s) for this layer. I use Lucerne hay because it has a higher nitrogen content than straw (but also is more expensive). Both hay and straw will expand out once taken out of their bale and if you are using straw, adding some high nitrogen manure such as chook poo while you are laying the straw down. This will help the mainly carbonaceous straw to break down into a fertile growing medium by providing some nitrogen for the bugs to eat as well.

In either case (straw or hay) you will need to wet it as you spread it out on your barrier layer, otherwise it will take an age to break down. You want it to be as wet as a sponge that has been just rung out, that is to say moist but not dripping. Last time I put down some sheet mulch I did not wet the Lucerne down, I ran out of time but it rained heavily that night, which worked pretty well.

The next layer should be 25mm – 50mm of compost. This provides more nutrients and just as importantly lots of beneficial bacteria and other microbes to help the bulky layer

below it decompose into a fertile growing medium. It also provides a layer to plant into if you want to get things growing right away. The best compost is home-made compost but this process can require quite a bit of compost so you may need to make a special load (difficult to do if you on a small block) or buy some in.

The Topping

If you are using hay, straw or any of the other bulk organic materials in your main course there is a possibility that they may include some seeds, which of course will become weeds. Wheat straw, cheap as it is, will definitely have at least wheat seeds within it from ears of wheat which the harvester has missed. To prevent these from germinating a 25mm – 50mm covering of seed-free mulch is needed as a topping.

I used sugar cane mulch because it is weed free and relatively cheap for what you get (it's like the 4th dimension – the stuff just keeps expanding!). You could also use wood shavings, rice hulls or dry leaves if you can get enough.

Planting Out

If you can leave your new creation for a week or three for breakdown to commence that is a good thing, but if (like me) you are too impatient it will still work out OK. Seeds

can get lost in the layers so starting out with seedlings is best. Plant them into the compost layer through the weed free topping. For larger plants make pocket into the bulk layer and line it with soil or compost, then plant into that.

An application of sheet mulch may take 6 months to rot down and really get things going and should provide several years of fertility, but you can top it up with more compost etc. when needed to keep it percolating along.

5.4 Raised beds

Raised beds are great to use for a microfarm, especially if –

- You don't have access to soil but do have a flat area to grow on, or
- Your soil is one of the three c's (contaminated, concrete or crap!)

Following are a couple of ways you can put a raised bed garden together.

5.4.1 Standard Raised Bed

First off, I got hold of some timbers to make a 30cm high raised bed. It was a commercially available veggie bed "kit" based on timber preserved with Alkaline copper quaternary (not CCA – copper, chrome, arsenic) which is safe to grow food in. I put it

together and placed it on the grass where I wanted it to go. To prevent the grass growing through I put a thick layer of newspaper underneath and placed bed so that the newspaper projected under the timber frame.

On top of the newspaper I laid down some “biscuits” of Lucerne hay. When hay or straw is harvested the machine makes the bales by compressing the plant material into sections. When the restraining blue string is cut the plant materials comes away from the rest of the bale and are generally called (around here at least) biscuits. I placed two layers of Lucerne hay biscuits over the paper on the inside of the assembled bed, so in other words I did not pull the hay apart of fluff it up, I left it densely packed. I gave both layers a good watering to make sure that they were thoroughly wet. This speeds decomposition which makes the nutrients in the hay available to the insectary plants.

With the Lucerne in place, I did a similar thing with some straw bales which had been given to me by a friend. That almost filled up the bed and I gave the straw a thorough watering as well. The remaining 25 – 50mm between the top of the straw and the top of the bed I filled with compost and then gave it one more good watering. After the bed was finished, I left it for a few weeks for decomposition to commence. It was winter so it would take a while to break down in the cooler weather as well as the fact that the seeds for the insectary plants could not be planted until spring.

This particular raised bed was designed as an insectary bed to provide food for and to attract beneficial insects, but the process is the same regardless of what you want to grow in it.

5.4.2 Hugelkulture Raised Bed

Essentially, growing using hugelkultur is a process whereby logs, branches and twigs are mounded up starting with the largest diameter material on the bottom working up to and finishing with the smaller diameter stuff at the top. The mound is then covered in earth and allowed to breakdown a bit, then planted out with vegetables, herbs or whatever.

The advantages of a hugelkulture approach are that –

- All that woody material absorbs water and holds onto it, making available to the plants over time, hence the techniques is very water efficient.
- As the woody material breaks down it releases nutrients into the soil, increasing soil fertility.
- Due to the fact that the material is hilled up, the hugelkulture bed has good drainage.
- It enables you to use biomass from your site (or gathered off site if you don't have any at your own site) which might be difficult to use in another way.

A good size to start with when building a hugelkultur bed is two metres long by one metre wide but I really didn't have that space hanging around in any area where it made sense, but I have read of people making a standard raised bed using hugelkulture techniques and I thought I would give that a go. Thus, it is sort of hugelkulture but not really.

My original intention was to build a third raised bed in the front yard between the two existing ones and in front of the herb spiral, but this would have required buying in the structure to build the sides of the bed. Linda, with inescapable logic, pointed out that it would be better to convert the southern side raised bed which was originally built as a wicking bed but was never successful. It wasn't successful because it wasn't tall enough and rather than the water reservoir and growing area being 300mm deep each, they were only 150mm deep. It was an idea I wanted to try which turned out not to be a good one!

To convert it I first needed to remove the current incumbents, being some rhubarb plants, a few shallots and a feverfew plant then dig out the growing medium it contained and toss it onto a tarp so it wouldn't get away. It took a while with shovel, and hands, to remove it all but it was eventually done. I left the original builder's plastic which formed the wicking bed reservoir in place to frustrate any weeds coming up from below, but the shovel made a few cuts in it, guaranteeing drainage.

While digging out the soil from the inside I had loosened a couple of timbers by using the sides as a leverage point for the shovel, bad idea! I inspected all sides and found a

few loose timbers so I went around with my drill and some screws to shore up a couple of the corners. All in all the sides were in pretty good nick structurally but a few of the original screws had rusted away to virtually nothing, and with them replaced we were ready to go!

The next trick of course was to fill the woody material that I had into the raised bed. The general rule is to start with the big stuff and then work your way up to the finer material so that is what I did. Most of it had been harvested from the (very vigorous) mulberry tree in our front yard. This material would usually be either left until the following winter for burning or taken off site for composting. In this case I could use it immediately on our own site!

After each layer of material goes in, it should be thoroughly wetted down to ensure that it is soaked through as much as possible to assist the commencement of the biomass breaking down.

Once all of the woody material has been added and wet down there is a need to add some nitrogen. The woody material will commence breaking down but as it does so the bugs doing the breaking will get their carbon from the woody material, but to balance it out will need nitrogen and they get this from the surrounding soil, making unavailable

to plants. To counter this I added a few double handfuls of rooster booster, not having any spare chook manure or other high nitrogen material floating around.

Once I had applied the rooster booster, I shovelled back in all the growing material I had removed and then, because the bed was still not full, I added a bag of commercial compost and of potting mix, watering everything down well after addition. In this case the watering down rehydrates the growing medium, but also washes it down into any empty spaces between the woody material, allowing for a more uniform break down and no empty spaces to cause problems for plant roots.

I completed the process by adding a good 50mm – 75mm of sugar cane mulch to act as a……. mulch!

With the hugel bed complete I replanted the original inhabitants, as well as a stack of Egyptian walking onions given to me by a friend. My original plan was to prune all but two of the leaves off each of the rhubarb plants but I quickly found out that the root loss caused by the removal and replanting meant that the plants were only transpiring enough water to keep one leaf turgid, so I pruned the limp leaf of each plant, leaving one only.

With the bed now complete it is just a case of keeping it moist so the plants can re-establish and the bugs can start to feast on the woody material!

Note: Here is the bed 6 weeks later. It is thriving, although we did get a 40^0C day a short while back which knocked the rhubarb back somewhat!

5.4.3 Wicking Raised Bed – Part 1: The Original Construction (2010)

Wicking beds are a method of growing plants, in this case edible ones, that provides a reservoir of water that then wicks up to the root zone of the plant by capillary action. The use of this system may reduce water usage by up to 50% over conventional irrigation techniques and so is ideal for producing food in the warmer drier Australia we may be facing due to global warming. There are two types, open and closed but it is the closed system that is most suitable for the sort of intensive back yard food production that we practice here, the open style being more suitable for broad scale agriculture.

A closed wicking bed is similar in principle to a self-watering container as covered in other articles on this site and consists of a lower water reservoir, a means of inspecting and topping up the water supply and an upper growing bed. They may be constructed above ground or under a conventional vegetable bed. In its simplest form an above ground wicking bed could be a broccoli box half filled with sand, with a length of 50mm pipe inserted vertically into it and the rest of the volume of the box topped up with growing medium. Ours is just a little bigger.

Construction Method

1. Get hold of something to make the sides out of, we used timber that had been preserved with Alkaline Copper Quaternery (ACQ) in the form of DIY garden beds 1200mm x 1200mm x 310mm high. We got two; the reasons will become obvious a bit later on. If you are going to use treated timber, avoid copper, chrome, arsenic (CCA) treated timber so that the arsenic cannot be leached into your edibles.

2. We made up the first bed and set it up in the area where we wanted it to go. It looks quite nice so we put it in the front yard.

3. We got hold of some builder's black plastic sheeting to line the bottom bed to form a watertight reservoir. The ground under the bed should be smooth and without any projections that could puncture the plastic so you might want to put a layer of sand inside for the plastic liner to sit on.

4. To form the reservoir I place the plastic inside the bed and folded the edges to make a rectangular shape inside the bed, then using 20mm flat head tacks I secured the plastic to the top edge of the timber bed.

5. I got hold of some agricultural piping, the slotted stuff used to drain areas of excess water, and ran it along the bottom of the bed, with enough overhang on the short side to go up to the top of where the second bed would sit.

6. Once the agpipe was in place I filled the reservoir with hardwood chips that I had bought in bulk to do some mulching with and It took not quite half cubic metre of the wood chips to fill the reservoir. The easiest way was to shovel and barrow the wood chips from the stockpile where they were delivered directly into the reservoir.

7. Once the reservoir was set up, I put the second bed together and screwed on a piece of timber about 200mm x 100mm into the centre of each site to make sure the top section did not part company with the bottom when I started putting in the growing medium.

8. To make sure the agpipe filler tube did not get caught up when placing the growing medium I pulled it up so that it was level with the top of the top section, cut it off flush with the top and tacked it in place to the top section.

9. With this done I needed to put in the growing medium, which was a bulk potting mix that I picked up (with the help of a friend with a trailer) from a local supplier. I intended to us the same technique as the wood chips but with the top section on it was too high for the wheel barrow to dump into, so I made up a small ramp that got it high enough and problem solved!

10. Once the growing medium is in you can plant your wicking bed and you are ready to go. I wanted to grow asparagus, our rotation in the backyard is not sympathetic to

perennial crops so I planted up the wicking bed with two-year-old crowns, which by the way looked amazingly like small tentacle-ly aliens. Anyway once we planted the aliens we applied more wood chips as mulch then it was time to fill up the reservoir.

You could drill a small overflow hole so that you can tell when your reservoir is full but in practice the water starts leaking out between the joins in the timber once it gets over the waterproofed area so I didn't bother. Another advantage of using 50mm ag pipe as your filler pipe is that you can see down into it and get a rough idea where the water level is and if you need to top it up. It has been in for a few weeks and there does not seem to be much drop in the water level, the reservoir is comparatively big and with the mulch and small size of the plants there is not much evaporation.

5.4.3 Wicking Raised Bed – Part 2: The Revamp (2024)

A bit over fourteen years ago, I installed a wicking bed to grow asparagus in the front yard. See the above section.

Back in the day it was a very productive space providing us with lots of asparagus for several months every spring, but in recent years it was not very productive and the bottom bed had started to come apart. The problems as I saw it were –

- The original material in the bottom of the bed that supported the growing medium and acted as the water reservoir were wood chips, which I had on hand, rather than gravel or coarse river sand I would have had to buy in. These worked well for quite a few years but eventually broke down, allowing the growing medium to sink into the reservoir area.
- The raised beds were composed of a treated timber that allowed them to do their job for many years, but eventually the bottom part of the raised bed had started to come apart and while I had applied some reinforcing, it was not good enough.

Fourteen years later!

Slow decay!

There were also other problems that I was not aware of until we started to re-do the bed.

We started to remove the soil inside, being careful to look for asparagus crowns, and dumping the soil on a tarp. It was interesting that the southeastern corner of the wicking bed had lots of asparagus crowns that looked in reasonable condition (some actually looked like the facehuggers out of alien!) whereas the rest of the bed had a couple of really sad looking ones. That may mean something but I'm not sure what!

Removing the growing medium carefully and removing the asparagus crowns

As the soil continued to be removed, it became clear that the bottom section of the raised bed was in somewhat worse condition than I thought, so I figured it would be better to replace it with a new one. With all the soil removed another problem became clear – The builder's plastic that I had used to form the water reservoir had been ripped in various areas, apparently by tree roots looking to share the water, and perhaps nutrients as well.

Soil, plastic membrane and asparagus crowns removed!

The rebuild

I acquired a new raised bed to replace the bottom one and some builder's plastic to replace the shredded stuff. I actually wanted pond liner, but was not able to get hold of any so would do with two layers of builder's plastic. A friend on Facebook suggested that she had lined her wicking beds with carpet and pond liner, resulting in no problems with tree roots. If I had known about the carpet, and had some, I would have definitely done that!

Before we put the bottom raised bed in place we made sure to dig out all the roots that we could find, hopefully that will slow things down a bit. We the put to bottom bed in place and fitted in the two layers of builder's plastic. Rather than using wood chips this time in the bottom to act as the reservoir we used 10mm blue metal gravel…. And thereby hangs a tale!
I calculated that I needed about 750kg of gravel or a bit less, and rang up to order it from a local supplier. They had what I wanted but informed me that because I wanted less than a tonne, I would have to pay more for delivery. In the end it turned out that if I ordered a tonne instead of 750kg the overall cost would be about $20 less! Needless to say I went with the tonne and have used the excess in other areas. That made no sense to me at all!

Back, to the bed

We started putting in the gravel (then remembered to insert ag pipe watering point) and filled it up until it was mostly level with the top of the bed and the black plastic had been folded over the top of the bed. The gravel was formed so that there was a well in the centre, and a piece of 50% shade cloth was placed on top of the gravel before the growing medium was added. The idea was that the well in the centre would allow the bottom of the growing medium to sit below the water level, allowing water to wick up into the rest of the bed, and the shade cloth would prevent the growing medium from working its way down into the spaces between the gravel.

New plastic membrane, 10mm gravel and ag pipe watering point installed

With all of this done, it was then time to replace the top bed (still in reasonable condition) on top of the new lower bed and fill the top bed with growing medium. That was the theory, but when we placed the old top bed on top of the new lower bed we found that in the intervening years the manufacturer had decreased the size of the beds by a couple of centimetres. (Insert colourful language).

Extra boards and shade cloth installed

To get around this we removed four boards from the old bottom bed cut them down by a few centimetres and screwed them on the inside of the old top bed. This meant that the top bed could sit on the bottom bed without there being a gap that the growing medium could escape through, and the whole set up would be secure. With this done we could place the growing medium in the top bed.

Installing the growing medium and five of the removed asparagus crowns

The growing medium we used was a combination of the rotted down woodchip, growing medium from the previous bed and some added compost and potting mix. We filled it up about half full, then placed five asparagus crowns on the bed and covered them with the remaining growing medium.

Complete (and with the departure of out furry engineer, we had to make do with approval from the engineering brontosaurus!)

It was then just a case of trimming off the excess black plastic, adding a layer of sugar cane mulch and filling the water reservoir with tank water. The job is now complete, and I am waiting to see if the asparagus crowns will sprout this year!

Two weeks later and three of the five crowns are sending up shoots, and

5.5 Mulching

Mulch is a material that may be organic (compost, hay, straw) or inorganic (rocks, gravel) that is applied to cover bare soil. It has a number of advantages over leaving the soil bare –

- It reduces evaporation, keeping the soil moister and reducing the need for watering.
- It insulates the soil against extremes of temperature.
- If it is organic, it will break down and provide nutrients for plants
- It can help support bacterial or fungal soil biota (more on this later).
- Weed growth and the germination of weed seeds is suppressed
- Rain drops hitting bare soil can result in the soil surface being compressed causing the rain to then run off. Mulch absorbs the energy of the falling raindrops allowing water to infiltrate the soil rather than be lost.
- Soil erosion is reduced, due to reduced rain runoff.

So, you can see that there are lots of good reasons to use mulch when you are growing your fruit and veg, herbs, flowers etc. For these reasons I integrated mulch into our growing regime very early on. We use two main types of mulch, straw and wood chips with the occasional application of other stuff.

Straw Mulch

Straw is an organic mulch that supports bacterial soil biota which favours the production from our annual vegetable beds. Over the years that we have been growing, depending on availability, we use straw, but we have also used Lucerne hay when we wanted to add a nitrogen boost to the soil. Also, for a couple of years, there was a local producer of grass hay which we used extensively for as long as we could but they went out of business years ago. We now buy wheaten straw from a local produce merchant only a couple of kilometres away.

Bed mulched and ready to plant out

Wheat straw is great stuff for mulch but one downside is that it will contain variable amounts of wheat seeds. This is great if you want to grow a bit of wheat in your mulch, but not so much fun if you don't. We have strategy for this, before going onto the veggie patch, each bale of wheat straw goes through the 'Retirement Village'.
The retirement village is a shed where we keep our chooks that are a bit old for the chook tractor and not as productive and as I need I toss in a bale of straw for them to sort through. This has a number of advantages –

- They remove and eat the wheat seeds,
- They break the straw down a bit so it is easier to handle, and
- The add manure to it, increasing the fertility added to the soil and adding nitrogen to the high carbon straw to facilitate it breaking down.

The retirement village, where chooks root out and eat wheat grains and tell each other stories of what it was like "back in their day"

Once the chook tractor has dug over and manured a patch, the straw from the retirement village is applied roughly at the rate of one wheelbarrow full per metre squared. In most cases this is enough, but occasionally we might get a bit of a problem weed infestation (like oxalis) and I will get hold of some newspapers, soak them, then apply them in pack of 10 to 20 sheets, overlapping over the full bed, before applying the broken-down straw.

Bed with soaked newspaper applied and partially covered with straw

The mulch usually holds up for the six months that the bed is producing then the chook tractor comes back round and the chooks then dig in any remaining straw into the bed, and the process starts again.

This cycle has been ongoing for over 15 years, and we find it works very well.

Other Stuff

We do make some use of organic material that is produced on our place –
Corn Stalks – If we get a good season for corn, I will pull up the stalks and run them through our old electric shredder. Like me, it has some quirks and can be a pain at times, but eventually I got it to shred up the cornstalks from two patches, effectively providing free mulch for about half of one of the three metre beds.

Cornstalk mulch

Some old bugger shredding cornstalks in my back yard!

Banana leaves and papyrus – The Jerusalem artichoke bed gets a mulch that is a combination of dried out banana leaves and papyrus from the water garden. The banana circle in the back yard is prolific in shedding banana leaves all over the place so we gather these up and put them of the Jerusalem artichokes, and at the same time, we gather papyrus stalks that have dried off and place them over the top of the Jerusalem artichokes as well, forming a mulch that is light but which also has good coverage.

Papyrus and banana mulch on the Jerusalem Artichoke bed

Irrigation

We do get some extreme weather out here and it can get very hot and dry in summer, we have found that applying mulch where we can keep the soil and the plants happier, and means we don't have to irrigate as much. We have systems that allow us to irrigate through the mulch directly into the soil underneath including ollas, buried pipe and leaky pipe for the veggie beds. This allows us make the best use of water in dry times. For more details on these forms of low tech, high efficiency irrigation check out the 'Irrigate Wisely' section of this eBook.

Ollas

Downside

We have found lots of up-sides to mulch and not so many downsides, but one that we have found is that lots of rain, particularly in the colder parts of the year, can result in soil waterlogging. Plants that do not cope well with wet feet can be damaged. If this happens, we scrape the mulch away from the base of the plant until things dry out.

6.0 Succession Planning and Planting for Year 'Round Food

Creating The Plan

1. List what veggies you want to eat each year – There is a list to help you out here, but this will work out best if you do your own research. Start out with the veggie you are eating now and list the type and variety (if you know it). If you are only eating commercial veggies from Woolies this can be difficult. If you buy your veggies from a fruit and veg shop, organic shop or growers market ask the proprietors if they can help you find out. Mind you it would be a waste to grow some commercial veggie varieties, bred for transportability rather than flavour or nutrition but you must start somewhere.

At this point it is also worth doing some research. Hit the books, the seed catalogues and the net and see what varieties are produced in or near your area/climate zone. Local growers, especially backyard growers can also provide a mine of information on what varieties do well in your area and are worth eating (notice I did NOT say to hit the local growers!).

2. Find out when in the year each food likes to grow – The seed catalogues and veggie books come into their own here by providing general information on when individual vegetable should be planted to get the best out of them. Individual varieties will vary within these general figures (more on that later) but at this point the information you glean will enable you to work out which vegetables can be sown or harvested during which months of the year. Obviously the climate will have a considerable impact on these dates so you really should only look at information generated as locally as you can find. We live in the temperate zone here in Aus and so looking at recommendations for outside that zone will only be misleading.

3. Guess how much of each food you want to eat – This can be as complex or simple as you like. The numbers can be arrived at by keeping a food diary for year and entering what you eat each day in that, doing it for a month or to then extrapolating for a year (not as accurate due to seasonal supply issues) just sit down with the family and guesstimate how much veggies you will need.

4. Work out how much growing area you have – to get the most out of the plan you will need to factor in how much land you intend to put down to growing veggies. We found that a number of smaller (1.2m x 2.0m) beds worked out better for us, being easier to manage and rotate producing smaller crops more regularly. When you work out your growing area don't neglect some less conventional growing spaces you may have access to –

a. The front yard
b. Spare space in friends, relatives or neighbours yards
c. Community garden plots
d. Pots/containers on patios, roofs, driveways or other unused spaces

By having an idea of the area of land you have available to work with you can estimate how much food you can be growing at any one time. We work on a spacing of about 30cm between each plant and interplant rather than waste space with row plantings.

5. Create a plan – with all the homework done you can now draw up your plan. One of the things that amazed me when we convened a "Year Round Growing" group at Permaculture Sydney West to develop succession plans with people was the variety of plans developed. Everyone's plans, while accomplishing the same thing, looked and functioned differently. So while I include here a couple of examples to get you started, don't be afraid to have a go at developing your own from scratch.

6. Follow your plan – As stupid as it sounds, you really need to do this! I found by putting aside a Sunday morning twice a month to sow, pot on and plant out I got into a rhythm after a while and everything just flowed. What I did find was that if I did forget or didn't bother, the effect was not immediate but a couple of months down the track yields began to suffer and plants which I should be starting to harvest were just not there.

7. Record your harvest, to plan for next year – It is very rare to get anything right first time around, so record any successes and failures and review your plan once you have been following it for 12 months. Even if you adjust your plan on-the-run during the year an end of year review of what worked, and what didn't, can help you improve your plan year on year. Until you find you are the envy of your neighbours and they will be breaking down your door wanting to know your secret!

What to Plant	When to plant it	Amount	Sowing	Where?
Basil	Sep, Oct, Nov, Dec	$ / 1st & 3rd month	S or P or G	P2 I & B3M
Asian Greens	Mar, Apr, May (then,) Sep, Oct	$ /month	S or G	B1 I
Beans – Climbing	Jan, (then not until) Sept, Oct, Nov, Dec	10 / month	G	B4 I
Beetroot	Jan, Feb, Mar, Apr (then) Aug, Sept, Oct, Nov, Dec	10 /month	S or G	B4 M B1 I
Broccoli	Jan, Feb, Mar, Apr (then, not until) Sept, Oct, Nov, Dec	$ /month	S then, G	B2 M
Cabbage	Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec	$/month	S then, G	B2 M
Capsicum	Sep, Oct, Nov, Dec	10 /month	S then, G	B3 M
Carrots	Jan, Feb, Mar, Apr, May (then,) Sep, Oct, Nov, Dec	20/month	G	P M & I & E
Celery	Sep, Oct, Nov, Dec	$ /month	S then, G	B2 I
Chillies	Sep, Oct, Nov, Dec	$/ season	S then, G	P M
Corn	Jan , Feb (then, not until) Oct, Nov, Dec	15/month	G	B5 I & M
Coriander	Jan, Feb, Mar (then, not until) Sep, Oct, Nov, Dec	10 /month	S or G	P3 E & I & M
Cucumber	Jan, Feb (then, not until) Sep, Oct, Nov, Dec	$/ month	S or G	B3 M
Eggplant	Jan (then, not until) Sept, Oct, Nov, Dec	$/ month	S then, G	B4 M
Garlic	Apr, May, Jun, Jul, Aug, Sep, Oct	20 /month	G	B4 I
Kale	Jan, Feb, Mar, Apr, (then not until) Sep, Oct, Nov, Dec,	10 / month	S then, G	B4 E
Leeks	Jan, Feb, Mar, Apr, (then) Aug, Sep, Oct, Nov, Dec	$/ month	S then, G	B3 I
Lettuce	Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec	10/ month	S or G	B2 I
Onion	Feb, Mar, Apr, Jun, Jul, Aug	20/ month	S or	B1 I
Peas	Apr, May, Jun, Jul, Aug, Sep	$/month	S or G	B1 M
Potatoes	Aug, Sep, Oct Nov, Dec	10 tubers/month	G	B5 M or P3 M
Pumpkins	Jan (then, not until) Sep, Oct, Nov, Dec	5 once	G	B6 M
Spinach	Mar, Apr, May (then,) Aug, Sept	$ / month	S then, G	B4 E
Tomato	Jan, Feb Mar (then, not until) Aug, Sep, Oct, Nov, Dec,	10/month	S then, G	B4 M
Zucchini	Sep, Oct, Nov, Dec	$/month	$/month	P2 M

Sample Plan 1

Vegetable	Variety	July		August		September		October	
		Week 1	Week 3	Week 1	Week 3	Week 1	Week 3	Week 1	Week 3
Basil	Sweet	4 plants		4 plants		4 plants		4 plants	
Beans					1 row	1 row	1 row	1 row	1 row
Beetroot	Crimson Globe						1 row		1 row
Bok Choi					4 plants	4 plants	4 plants	4 plants	4 plants
Broccoli	Green sprouting	4 plants	4 plants	4 plants	4 plants	4 plants			
Broad beans	Coles Dwarf	1 Row							
Black Turtle beans								Full bed	
Cabbage	Sugarloaf	1 plant	1 plant	1 plant	1 plant	1 plant	1 plant	1 plant	1 plant
Capsicum	California Wonder	4 plants			4 plants			4 plants	
Chilli	Cayenne	2 plants			2 plants			2 plants	
Carrots	All year round				Half Bed				
Carrots	Chantenay				Half Bed				
Cauliflower		2 plants							
Celery	Golden Self Blanching				2 plants		2 plants		2 plants
Cucamelon									
Cucumber	Lebanese			1 plant		1 plant		1 plant	
Garlic									
Kale	Scottish								
Leek							12 plants		
Lettuce	Mignionette - green	2 plants	2 plants	2 plants	2 plants	2 plants	2 plants	2 plants	2 plants
Lettuce	Oakleaf	2 plants	2 plants	2 plants	2 plants	2 plants	2 plants	2 plants	2 plants
Luffa						3 plants			
Malabar spinach						3 plants			
Onions	Gladalan white or brown								

Sample plan 2

Note - the complete sample plan 2 and a blank to use for developing your own may be downloaded from our website **here**.

Choose Your Variety

From your review of the seed catalogues and other data it will become obvious fairly early that some veggies such as tomatoes will have hundreds of varieties whereas others such as Brussels Sprouts may only have a one or two. Having a large number of varieties is good because it means you have some choice over what you grow and eat within the broad heading of each vegetable. It also increases the likelihood of finding a variety or two which fits your particular soil and climatic circumstances and using different varieties can allow you to spread your harvest (see below).

However, the large number of varieties can make it difficult decide on which ones to grow and while it is very much a personal decision, here is some information that may help you decide –

Early, main crop or late? –Some vegetables have been bred to be harvested early in the season and so have a shorter time between sowing and harvest. Some even have the word 'early" in their name which is a dead giveaway, eg Early Jersey Wakefield cabbage, Early Scarlet Horn carrot or Phenomenal Early cauliflower but mostly the data from the seed catalogues will point you in the right direction. More often than not the more common varieties tend to be main crop, ie they have a growing time which allows them to be harvested at the height of the growing season. Others have even longer growing times and linger on being be harvested late in the season without a drop in crop quality. It is even possible to plant an early, main crop and late variety of the same vegetable all at once and harvest each one as it becomes ready, thereby spreading the harvest.

Growing Habit: Determinate vs indeterminate – a few vegetables, such as tomatoes, peas and beans contain varieties within their ranks that will grow, mature and be harvested within a specified time and a defined plant size. These are referred to as having a determinate growth habit, also referred to as "bush" or "dwarf" varieties whereas other varieties of the same plant may continue to grow throughout the

season. These varieties are referred to as indeterminate, also referred to as “climbing” or “staking” varieties and these will produce for as long as the soil and climatic conditions will allow.

Needless to say, determinate varieties will need to feature in your succession plan for regular replanting while the indeterminate varieties will occupy space in the garden for longer and may interfere with your rotation if you are rotating your plots. Determinate plants are also more likely to give you a single major harvest then little or nothing while the indeterminates will spread the harvest out providing less at any one time but spreading the harvest out to give you more produce over the growing season. Thus if your process calls for regularly planting determinates, this will provide more produce over the year (per unit of ground) than only planting indeterminates at the start of the growing season.

Flavour (and other attributes) will vary between varieties – back when I first started growing our own veggies and the kids were a lot younger, I was getting a good response from everyone for the dwarf stringless beans I was growing. I wanted to increase my production so I went from dwarf to climbing beans. The kids HATED them, and refused to eat them so it was back to the drawing board. You may want to try out a few varieties of each veggie before you settle on which ones you want to grow, or even try before you buy if possible, but keep the family involved!

Ask what varieties do well in your area – Again, talking to other backyard growers about what varieties they grow and why, what varieties do well in the area, what ones are particularly tasty, or keep well or both. Don’t lose heart if there are no backyard growers in you immediate area. See if there are any community gardens in the area and talk to growers there, contact your local permaculture or seed savers group for advice too.

Good Companions, Bad Companions

I don't know what your thoughts are on companion planting, in my experience it doesn't seem to do much either way, but here are some common-sense suggestions on plants that do and don't go together well -

- Plant short, shade-tolerant plants beneath taller, bushy plants.
- When you mix sun-loving plants, put tall ones at the south end of the plot and small ones at the north end (to reduce issues with shading)
- Plant herbs throughout the garden, especially basil, mint, sage, and dill but keep dill away from carrots.
- Plant marigolds here and there around the garden to repel pests and encourage the predators that prey on them.
- Do the same with chives, garlic, leeks or onions EXCEPT near or amongst legumes, they will inhibit the nitrogen fixing bacteria living in nodules on the legumes' root system.
- Exploit the different maturation rates of different crops: plant lettuce, spinach, or silver beet early where you plan to set out squash and melons later, so that weeds don't have a chance to move in, and you get two crops instead of just one.

Don't Forget Perennials

Perennial veggies are the parts of plants which are harvested and eaten like vegetables and where the parent plant lives for more than two years eg asparagus, Jerusalem artichokes, chokoes, Malabar spinach and taro. Generally, we tend to eat rather more annual vegetables than perennials and so annual vegetables are the type that make up the bulk of our veggie patches. While some perennials like asparagus and artichokes are available only for a short season, others like shallots and rhubarb crop for extended periods. There should be a place in everyone's veggie growing efforts for perennials.

We have a process where the beds are planted and then 5-6months later have the chook tractor put over them to clean them out and fertilise them, after which the beds are replanted. However, because perennials need a long term bed they don't integrate well with this system so we have dedicated beds for them. We have Jerusalem

artichokes growing in a triangular bed near the worm bath, rhubarb and asparagus growing in wicking beds in the front yard as well as (of course) the choko growing over the choko tree.

Perennials certainly Increase the volume and variety of available foods, we find that Jerusalem artichokes and chokoes make a considerable contribution to our diet in autumn and early winter, whereas the asparagus are a very tasty addition to our plates in Spring. Some familiar perennials can be bought from the fruit and veg shop in season and tried before you make a commitment to growing them (see the previously mentioned chokoes, Jerusalem artichokes and asparagus). Other less common ones (like oca, yacon, arrowroot or yam bean) may need to be grown in a limited fashion to give you a taste test so you can work out if they are worth growing more extensively. Another important factor is that many perennial vegetables are set and forget, they require much less maintenance than annual vegetables. One good example is the Jerusalem artichoke, you plant the tubers in a prepared bed wait for the stems to grow, flower and die. Once the stems have died the tubers can be methodically dug whenever you require them for a meal until spring rolls around. Then there are usually enough missed tubers or broken off bits of tubers to sprout and grow a crop for the new year with very little intervention from the gardener.

They also seem to require less intervention to stay healthy and pest free. The perennials I have grown including chokoes, asparagus, rhubarb, Jerusalem artichokes, shallots, ginger, galangal, turmeric, water chestnuts, arrowroot, sweet potato are all very hardy. They do not attract the attention of pests with the notable exception of a few aphids on the shallots and they do not seem to suffer much from diseases
If you make room in your plan for some perennial vegetables, they will make sure it is well worth your while.

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Other Bits and Pieces

It doesn't matter how good a gardener you are or how fertile your soil is, yields will vary from year to year. The best thing to do is get used to it and ensure that your plan

contains enough variety so that even if it is a crap year for one vegetable or one family of vegetables, other vegetables will find the conditions for growth more to their liking. Don't be afraid to experiment, there are a whole stack of vegetables out there that you may not have heard of or tried, which may be ideal for your situation. I grew Jerusalem artichokes for some years before I actually tried them and no, as mentioned earlier, they are a big part of our diet. (but they do cause life threatening flatulence) Try unfamiliar veggies, a bit at a time, get from the veggie shop & try first if possible
Note: If a variety is called "All Year Round" – don't believe it! In most cases it was wishful thinking by the plant breeder!

7.0 Setting up Irrigation

7.1 Overview

I have been using the ideas in the low-cost low-tech irrigation series for a while, some for years, and they all have their merits and their down sides. I started out making ollas from scratch and it was my intention to fill our 14 veggie patches with them (4 or 6 per patch depending on size), but it was a slow and expensive process, all I could manage was two every three weeks. Having said that I did manage to make over 30 of them before quitting.

The low-cost low-tech irrigation types discussed in this section are –

• Ollas, made from commercial terracotta pots, (I have made some from scratch with clay, but they are beyond the scope of this eBook).
• Buried pipe,
• Buried capsule

These have been installed in our backyard veggie patches

General Comments

The reason I made and used these different irrigation techniques is because here in western Sydney the summers are getting hotter and drier. I think climate change is catching up with us but that is for smarter minds than mine to debate! Nevertheless I find myself watering more and more in summer (as well as other times) to keep the food coming, so it made sense to do it the most efficient way possible.

The irrigation methods, while having their own peculiarities, do all seem to reduce the amount of time and water spent on irrigation, while putting the water exactly where it needs to go. There is no substitute for rain, but these irrigation methods do allow me to still get a harvest in the hot, dry times. The new methods have also allowed me to go for longer in the dry times, watering from the tanks rather than town water.
Here are some thoughts on what of learned through experience with the low cost/low tech irrigation techniques –

From Scratch vs Terracotta Pot Ollas

Apart from the obvious production difficulties if you are not a potter and/or have no access to kilns and such, from-scratch ollas will take more time to produce. I can make half a dozen ollas from commercial pots in a few hours but from scratch ollas would take me almost 2 hours each, plus drying and kiln time. Mind you, while I did get lots of production experience, I would not call myself a skilled potter so someone more skilled in the art (as they say) would be quicker.

Also, I was using a technique called coiling, which tends to be slower that say, throwing on a wheel or even better, slip casting so again, someone with more skill/experience than myself in these alternative techniques could do a quicker job.

My from-scratch ollas have thicker walls, 10-12mm or so whereas the commercial terracotta pots have walls half that thickness. The result is that water will move through the walls in a terracotta pot olla in a day or two but may take a week or more for a from-scratch olla to completely empty. The amount of veggie patch watered by each is a bit difficult to estimate but you get a quick watering with the terracotta and a longer slower watering with the from-scratch one.

Plug vs No Plug

All of the from scratch ollas have a purpose build top to keep crap and bugs (including mosquitos) out and water in, because they have a wide opening at the top, sometimes big enough to get my hand in. The opening in the bottom of a terra cotta pot is much smaller and some are of a size which can be fitted with plugs (bought from the 'irrigation fittings' section), again to keep the water in and crap out. To simplify watering, I tend to leave the plugs out, which makes it quicker and easier to get the water in, the plug will be refitted before the chooks get access to the area. Due to the quicker emptying of the plant pot ollas, mozzies seem to be less of a problem.

Watering

Putting water into the irrigations systems by hand (any automatic system would need to be completely removed before the chooks got access) can be a bit slow, although it is still a lot quicker than standing there with the trigger nozzle set on "shower" and hoping the water gets where it needs to go! Also, with experience I have come up with a way which makes watering reasonably bearable. Hoselink (look 'em up) have an item on their inventory called a "Root Waterer and Soil Breaker" which is essentially 840mm of 15mm diameter metal tubing fixed onto a trigger nozzle. The idea is you can push it into the ground and water roots of plants directly into the soil and while I haven't tried to, you could probably make one yourself (or just buy one of theirs).

What I have found is that it is perfect for going into the filling holes of both types of olla, the hole in the top of the buried capsule reservoir as well as the filler area of the buried pipes. It even fits the filler necks of our self-watering pots. The end of the tube is bevelled so most of the time I can lever it up under the cap of the from-scratch ollas, fill them with water, then pull the tube out allowing the cap to fall back into place.

In most cases it allows you do this in a standing position (unless you are hugely taller than me), easing the strain on your back while delivering the water directly to where it is needed. We have it set up so that it will work on the hose (through a pump) on the main tank or on the town water if our tanks are empty. The town water is a bit higher in pressure so reservoirs are a bit quicker to fill than when we use the tank. Having said that, even with the tank water it only takes a bit over an hour to fill all irrigation points in the backyard, every few days (unless you are in a real hot spot).

Reservoir vs Direct Water Use

While all of these techniques direct the water to where it is needed most, some provide an amount of water storage, while others just direct the water flow under the ground, thus minimising water wastage. Ollas (of either type) and buried capsules provide some level of water storage while buried pipes supply water but do not store it. This just means that reservoir type will provide a longer time between irrigations, although it is better to refill the ollas at least when they are half full to ensure the amount of water available is sufficient.

Installation

All irrigation methods will require to be dug in to be most effective. While this is easiest at the construction stage of the garden when beds, trees, shrubs and herbs are being put in, retrofitting is always an option.

Ollas and **buried** capsules can be dug in using an auger post hole digger, they usually come in 150mm or 200mm size, which is a good start even if your olla has a greater diameter.

Unfortunately, the **buried pipe** needs to be dug into the bed they are going to irrigate and that is all there is to it. I did it when the beds were vacant after being cleaned off by the chook tractor. That way I was only doing one at a time rather than a whole stack at once.

Final Comments

Putting the different irrigation methods into practice has been a lot of fun and taught me a lot. It has been good to look at my food growing systems with new eyes, to work out which methods will do best where and if you have knowledge of your options before putting a garden together it makes things easier. I didn't design my garden, it developed over almost 40 years, so being able to retrofit was important to me, but if you are looking at putting a garden together, cover your water issues first!

If you are in a place where your climate is likely to become warmer and drier and sadly that seems to be a lot of Australia, take a good look at these ideas, try them out and work out which ones are for you. At the very least you will save time and water! Information on more irrigation methods are available by downloading our eBook: Low Cost, High Efficiency Irrigation

7.2 Details – Ollas

Ollas (Spanish: pronounced oyyas) are unglazed terracotta pots, filled with water and then buried so that the water moves out of the pot over time and into the soil, thus irrigating plants. I was making them from scratch, moulding and firing them as part of a pottery group, and while I had made almost half of the number I needed, it was a slow process and was getting expensive. I was also second guessing myself, did they really work that well?

That was until one day towards the end of last summer at the tail end of a 4 month dry spell. I was inspecting a couple of veggie patches, one was lush and quite productive, and the other one just wasn't happy, with the plants growing in it looking decidedly wilty. When I worked it out the difference between the two veggie plots was that the lush one had ollas and the wilty one had no installed irrigation, just watering with the hose. Time to go full steam ahead on the olla project!

To reduce costs and improve the turnaround time I decided to buy in traditional terracotta pots (unglazed of course) and use them to make the ollas. A word of caution,

though if you intend to do a similar thing – having identified youy supplier of pots, buy two, make an olla, and then fill it full of water ie test the pots out before committing cash to buy a stack of them. Make sure the water will move through the terracotta that makes up the pots. If you are making them from scratch then you have some control over firing temperatures but you will have no idea about ones which you buy premade. If the firing temperature is too high they might not be porous enough so try before you buy.

Assuming you have sampled and tested the pots and found them to be acceptable, the process for turning them into ollas is fairly simple –

1. You will need 2 pots to make an olla, take the one which will become the bottom one, cut a piece of thick plastic (I use thick polythene bags used as packaging), sit it on your working surface and place the hole in the pot on top of it. Fill the hole in with

waterproof silicone material, dispensed from a cartridge gun is easiest. Allow 24 hours for the silicone plug to cure.

2. Get hold of some sheets of 200 grit sandpaper. Tack a sheet down abrasive side up to a piece of plywood, Pyne board etc larger than the sheet of sandpaper using drawing pins or similar.

3. Turn both halves of the olla (pots) so the rim is down and rub them on the sandpaper in a circular manner so that the normally rounded rim is worn down to a flat profile, this will allow the silicone joining each half to form a better seal. Warning – the dust generated by this operation will contain crystalline silica and should not be inhaled. Do the sanding outside with good ventilation but if you are still concerned wear a P1 dust mask.

4. Wipe off any dust left over from the sanding operation from each rim. Using the cartridge gun loaded with a silicone cartridge, run a bead of silicone around the rim of the bottom pot (the one with the drainage hole plugged) the width of the pot rim. Then invert the top pot and place it rim down on the siliconed rim of the bottom pot. To ensure a good seal, run your finger around the join to smooth the surface off and make sure all parts of the join are sealed with silicone.

5. Allow the silicone to cure for at least 24 hours, then test fill each olla to ensure they will allow water to seep through their surface. (I know you checked out the original one before starting but this is a final quality assurance test). If you want you can install a cork or rubber plug in the filling hole in the top of the olla to reduce evaporation and keep dirt and insects, lizards etc from getting into the olla and taking up space.

Once they pass the final test they will be ready for installation

7.3 Details - Buried Pipe

The original concept of buried pipe irrigation was getting hold of, or making, a whole stack of unglazed terracotta pipes which you would then bury beneath your veggie patch, leaving one end open at ground level so you could pump water into it. In the same way ollas work, the water in the pipe would diffuse out into the ground, thereby irrigating any vegetables etc planted above it very efficiently. The pipe would have been put in either directly under or to the side of veggies planted in rows.

Terracotta pipes seem to be fairly difficult to come by these days and are expensive when you do find them, but there is a modern alternative – ag pipe! Agricultural pipe (or Ag pipe for short) is a flexible corrugated pipe, usually with slots in it, the larger sizes (100mm+) are covered with a non-woven sleeve or sock. The idea is you bury it in an area that is poorly drained so that the excess ground water drains to stormwater or local watercourses etc, thus removing unwanted excess water. But…….

It can also be used to do the opposite, supply irrigation water underground to the roots of your precious plants. I find the best of the sizes to use is the 50mm diameter stuff, but it does not come with a sleeve or sock covering it. The idea of the sock in this

instance is it keeps roots and debris out of the pipe so it doesn't get blocked up, but it also acts as a wick, allowing the water run into the pipe to be wicked up so that it is available to the plants from the full diameter of the pipe.

Making the Sock

To make a sock for your 50mm pipe, get hold of a pack of 60cm x 6m drain matting, this is a non-woven fabric used as a filter in drainage trenches etc to keep them clear. I have used drain matting from RELN and from Everhard, and found the Everhard product to be a bit thicker, so I would use theirs again.

Remove it from the package and unfold it so it is sitting on the floor in a single layer, then start from one end and roll it up tightly to form a cylinder 600mm wide by about 150mm in diameter. Make sure you have a good solid leather glove on your non-dominant hand (which holds the straight edge used to guide the knife). Then place a metal straight edge across the role 200mm from the edge, (ie 1/3 the way in) and then cut through the drain matting with a sharp Stanley knife or similar, it will take a number of strokes. Measure in the middle of the remaining 400mm width roll and do the same

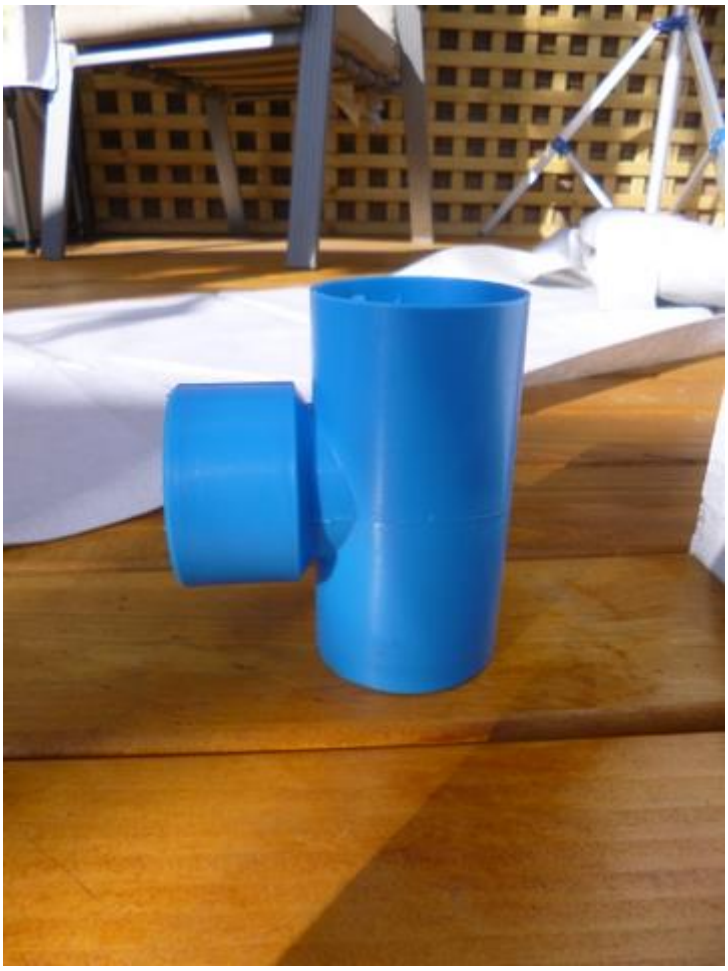
again. This will result in you now having 3 x 200mm wide by 6 metre long strips of drain matting.

The next trick is to find someone whose super-power is sewing (mine isn't but thankfully Linda's is, among other things!). Fold the matting over so that it is 100mm

wide and then sew down the open edge so that you then have a 6 metre long tube in effect. Slide the sock over the ag pipe slowly and carefully until it is fully covering the designed length of ag pipe. Your buried pipe irrigator is now almost ready to be installed.

The Filling Point

With most of the buried pipe……well, buried, there still needs to be an aboveground section where we can put the water in, it ain't gonna irrigate itself. With the pipe needing to be in a circuit I had to find some way to join the two free ends anyway, so it was very easy to use a Tee fitting, bought where I got the original ag pipe from. I made sure the sock covered up to the solid plastic part of the tee piece, then I fitted a short length of ag pipe into the upturned section of the tee to form the filling point. All I had to do then was add an end cap to keep out dirt and prevent critters like snails from using it as a base of operations for raiding parties.



Installation

I have run this type of irrigation in two beds, one 2.1 metres wide x 2 metres long and one 2.1 metres wide by 3 metres long. The general process was to dig out a 50mm – 100mm wide ditch down into the bed using a trowel and hand-hoe following a not quite square, not quite oval path, with a few wiggles along its length to increase surface area. Once I got below the level of cultivation I hit good old hard Sydney clay subsoil so I didn't get as far down as I wanted but 50mm to 100mm seems to work OK.

I placed the sock covered ag pipe onto the bed, formed it so it ran where I wanted it to go and then traced around it in the dirt. I then dug out the channel using the trowel and hand hoe, getting the bottom as level as I could. If the pipe runs uphill away from the filler point it could cause problems getting the water distributed evenly along the pipe so use a spirit level to make sure it is roughly level. To get that much soil out of the bed meant it kept falling back into the ditch rather than sitting on the top of the bed, so I

had my wheelbarrow nearby and was able to put some of the soil in there. Once the pipe was installed and covered I distributed the soil in the wheel barrow over the top of the bed.

I ran some water into it to make sure it worked and then mulched and planted out the bed. Finished! (almost!)

Testing the System (or - A trap for young players!)

When I installed the buried pipe in the 2 metre long bed, I left the furthest end from the filling point uncovered so I could check that sticking a hose in the filling point and turning it on watered the entire length of the pipe. This was a good test but I forgot to do that with the 3 metre bed so I decided to get technical, and inserted a cheapie moisture meter (you know shows dry-moist-wet soil) at the furthest end from the filling point.

I turned the hose on and waited and waited and waited. The needle did not move off the "dry" setting at all. Bugger! I figured I would need to install another tee fitting so I could fill from both ends. Just for the hell of it, I inserted the moisture meter halfway

along the buried pipe. Still no reading, this was not looking good. I had obviously screwed up something monumental. So I removed the meter and the inserted it right beside where the water was going in – still no movement. Hang on a minute!

Yes, the (newly bought) moisture meter was faulty, I could dip it in water with no response at all. I rummaged around and found an old one and it worked, and confirmed that my design was OK!

7.4 Details – Buried Capsule

Buried capsule irrigation uses the same sort of process as ollas, that is to say they are based on a water holding container made from unglazed terracotta, which allows the water to diffuse slowly through the side of the container into the soil. The surrounding plants can then send their roots towards the water source which is located (ideally) in the plants' root zone. The difference with buried capsules is the terracotta container is completely buried and there is a reservoir on the ground surface directly above the capsule which can be observed regularly so it is obvious when the buried capsule needs to be refilled.

While this method is probably the most technical and time consuming of the low tech, low cost irrigation methods to construct, it is still easy to put together with an afternoon's work.

Components

Terracotta Bits

It starts out with an unglazed standard terracotta plant pot and I use a standard 23cm (9.06") pot which is 20cm deep and has a drain hole 22mm across (this is an important measurement). Also required is a pot saucer of similar diameter to the top of the terracotta pot. Sometimes it can be difficult to find the exact size, in my case there were no 23cm pot saucers, only 21cm or 25cm. In most cases either will do as any gaps will be taken up with silicone sealant. I chose 21cm terracotta pot saucers, they were labelled as water impervious, but that is OK too because we want the water to be diffusing through the side of the pot rather than sinking into the soil through the bottom.

The pot and pot saucer together are used to construct the capsule.

Fittings

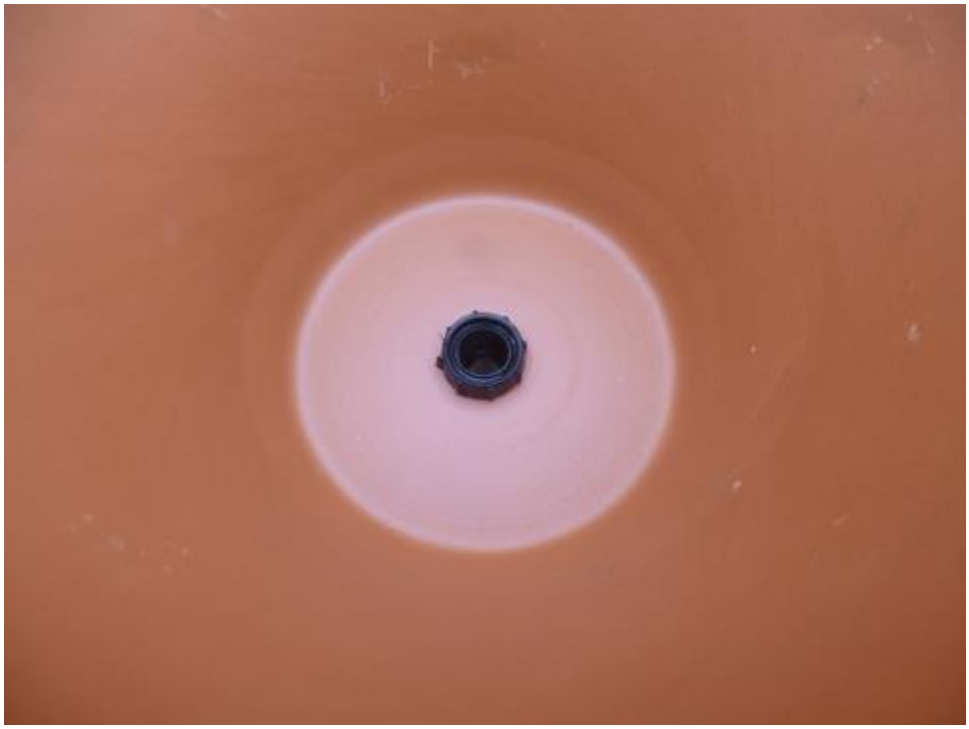
We now have the basis for the buried capsule itself, but now we need a way of connecting it to the above ground reservoir so I used some irrigation fittings. I got hold of fitting that had a 19mm thread on one end and a 15mm bsp barb fitting on the other, you need two per capsule. To help secure the fitting into the capsule I butchered a Garden Rain 15mm Female to Female Rural Poly Irrigation Coupling and to join the reservoir to the capsule a length of 19mm clear vinyl tubing (in this case 1 metre).

The reservoir

Just about any thin walled container that you can drill through will do, but if it is clear it will make it much easier to assess the water level at a glance and know when it needs to be topped up. I use a series of nominal 1.5 litre cylindrical plastic containers with a screw on plastic see through lid (although they hold about 1.8 litres when absolutely full) which are 19cm high by 11cm across the base, and easily available and cheap.

Putting Things Together – The capsule

To start, turn the pot you are going to turn into a buried capsule upside down so that the drain hole is uppermost. Cut some 3mm – 5mm thick rings from your 15mm Female to Female Rural Poly Irrigation Coupling, 4 will be enough for each buried capsule. I use a small electric band saw although you could achieve the same thing with a hacksaw (but with somewhat more effort!). Two of the rings will be used to secure the 19mm threaded fitting into the drain hole of the pot. First, screw one ring onto the 19mm fitting down as tight as you can, holding some cloth in your hand helps to grip the thin ring I find. Then place the fitting into the drain hole of the pot with the barbed end facing out, and on the inside screw the other ring down tight, to secure the fitting into the drain hole. A bead of silicon sealant (yet again, silicone is my friend!) will ensure a watertight seal.



With the fitting in place the pot saucer can be attached to the pot to form the capsule. If the saucer is the same size as the pot or smaller it will need to be put together right side up, if the saucer is larger it will need to be done upside down. All that needs to be done is to fit the saucer on the open end of the pot and apply a bead of silicon sealant between the two surfaces, while applying a bit of pressure to the nozzle to ensure that the bead is squeezed into the gap. If the bead is being applied right side up it will need to be set up so that the fitting sticking out of the drain hole is put into a slot between two lumps of timber to ensure that the pot has a firm base. It is easier if the saucer is larger, it can be done upside down and by putting the pot on a lazy Susan it makes it easier to rotate it as the silicone is applied.

When the silicone has been applied, use a finger to wipe over it and make sure that it has gotten into all crevices of the join. Leave the whole assembly for a day or two so the silicon sealant can set. Once the silicone is set, fill the capsule with water just to make sure there are no leaks, before moving onto the next phase of construction.

The Reservoir

As mentioned above, the reservoir I use is a plastic container often used to put dry foods in, which is 1.8 litres in capacity and has a screw on lid. A 19mm threaded fitting needs to be inserted into the bottom of the plastic container so that water run into it can be directed down into the capsule. The easiest way to use a 19mm spade bit to drill a hole in the bottom of the reservoir then use the same technique as fitting the 19mm threaded fitting into the capsule, and then seal with silicone sealant.

Unfortunately this won't work for me, because I need to lift the chook tractor over the veggie patch and the chooks are gonna dig the living daylights out of it so I needed to be able to remove the reservoir while leaving the capsule in place. I also needed to block the hole leading to the capsule so the chooks didn't fill it with dirt. so rather than use silicone sealant I used a soft washer between the bottom of the reservoir and the 19mm threaded fitting. I also have a cap for the fitting so that I can remove the reservoir then screw on the cap to seal the open end of the capsule.

So, we now have the reservoir and the buried capsule and all we need to do is join them together. I use some 19mm PVC tube, but how much you need will depend on how deep you want your capsule to be buried, ideally around the root zone of whatever it is you will be growing. By cutting the tube so that it just joins the two barbed ends, no tube showing in the middle and with the reservoir sitting on the ground the capsule is about 80mm below the soil surface and this is about the minimum depth. Any deeper and all you need to do is put in a longer piece of tube between the two ends.

To make sure there was no vacuum, I also drilled a 19mm hole in the centre of the top of the reservoir, but it seems that this is also a great way to refill it without removing the top. A long tube fitted to a hose can be used to refill the reservoir by inserting the end of the tube through the breathing hole and then filling it up from there. It also makes refilling easy if you are growing a tall or rampant crop which can make getting to the top of the reservoir difficult.

Installation

To install the buried capsules I first fitted the two barbed fittings and the pipe, so I knew roughly where the soil surface should be and then screwed the end caps over the top fitting to prevent dirt getting in. Using a soil auger which is about the same diameter as the capsule I dug down to the required depth, put the capsule in the hole and the covered it up with the spoil from the hole, to the point where only the cap was exposed. This is so the bottom of the reservoir is sitting on the ground and is firm, that way it can't move around and break the seal.

Once the first capsule was in place I installed the others, using a long piece of timber and a spirit level to ensure that they were at the same level in the soil. With all of the capsules dug in, I connected the reservoirs and then filled them with water. The bed was now ready to plant out.

8.0 Growing vegetables from Seed

8.1 Why Grow Veggies from Seed?

Next to being able to save seed from your own veggies, I think the ability to grow your veggies from seed is one of the most valuable skills to have. It is easy to learn, needs a minimum of kit and does not require a huge amount of time, money or effort, but why should we bother?

I'm glad you asked!

Reasons to grow from seed –

1. **Save Money** – A cheap punnet of 8 to 10 veggie seedlings can cost around $4.00 (AUD, 2023) and some can even run as high as $8.50, whereas a packet of 750 lettuce seeds can be had for as little as $2.00.

2. **Variety** – As far as commercially available seedlings go, you would be lucky to find 3 or 4 varieties of, say, tomatoes available at the hardware or nursery, whereas there are over 200 varieties of tomatoes that can be grown from seed. There may be a variety out there ideally suited to the environment you are growing in, and if you grow from seed you can try out as many as you want! Also, if you want to try growing an unusual vegetable, it may not even be available as a seedling and growing from seed may be your only option.

3. **Grow from your own** – As I mentioned above, being able to save your own seed is a valuable skill to have, but to be able to capitalise on that of course, you also must be able to grow vegetables from your saved seed.

4. **You can grow root crops** – Root crops need to be direct sown where they are to grow and do not do well if raised in a punnet then transplanted. I know that it is possible to buy carrot seedlings in punnets, but they will not do well and are a

waste of money. The seeds need to be sown directly, and a knowledge of growing from seed will assist!

5. **Resilience** – You can store seed, home grown preferably, but commercially available as well. This will increase your options should there be personal issues like unemployment, or if there were to be something more widespread, like another pandemic. In the middle of the Covid pandemic, when there was a renewed interest in home growing, seedlings and then seed became difficult to get. If you are used to growing your own veggies from seed, you won't be reliant on others for seedlings and so more resilient in your food growing.

6. **Spread the Harvest, reduce waste** – One of the things with buying, say, a punnet of 8 to 10 lettuce seedlings, is that they all go in the ground at the same time and mature at the same time. So, unless you have a big family it is highly likely that you will harvest two or three of your lettuces before the rest start to bolt to seed and become bitter. Sowing your own means you can grow as many as you want, when you want, reducing the amount of your crop that doesn't get eaten.

7. **Control** – You will know what has been applied to the seedlings, and what has not. There is no way of knowing if commercial seedlings have been treated with chemicals of some type. Note - If you want to grow organically and are growing from commercial seed, check the packet to ensure that the seeds have not been coated with a fungicide prior to being packaged. It should make note on the packet that the seeds are not suitable 'for food, feed or oil'.

8. **Satisfaction** – it is remarkably satisfying to be able to harvest and eat a vegetable which you have nurtured throughout its entire life journey, from germination to maturity.

Whether you are direct sowing your seeds, or sowing into punnets to grow your seedlings, it is worthwhile from so many angles. It is a simple skill worth acquiring, why don't you give it a go today?

8.2 Sowing, Potting on and Planting Out

8.2.1 Sowing seed into punnets

Planting seedlings rather than seeds means you can get a jump on the weather by raising the seedlings under plastic early in the season and then planting out when the weather is warmer. Planting well grown seedlings also gives them a jump on pests set to devour frail little plants, and when you plant a seedling you don't waste time and garden space waiting on seeds that are not going to germinate.

The following method also allows you to hold seedlings for a while if you get inclement weather, don't have the beds prepared or life happens, and you are short on time. It also minimises transplanting shock on the seedlings too.

Generally speaking, the seeds of root crops like carrots, parsnips and beetroot etc, need to be sown directly into the soil where they are to be grown. If they are started in punnets and transplanted they will not grow well. Large seeds like those of peas, beans, corn etc can also be direct sown but will also work if the following process is used. All other vegetable crops will thrive using the process of sowing into punnets, potting on into newspaper pots and then planting out.

These are some punnets in my collection

I have a world class collection of plastic punnets! They are all left over from when I used to buy seedlings from the nursery and before I realised how easy they are to grow yourself. I use the punnets with eight divisions or cells in them although for larger seeds like pumpkin I can still use the older style with no divisions.

If you are re-using your seedling punnets you should wash them in disinfectant and dry them off before you use them. This is to prevent a build-up of diseases like damping off, I usually use Dettol® or one of the "el cheapo" quaternary ammonium disinfectants available from the supermarket. Another way is to wash them with soap and water, then put them out in the sun to be dried and disinfected by the sun's rays.

This is the style of punnet I use mostly today

To fill the punnets I make a seed raising mixture that it composed of -.

- 1 Part by volume coarse sand (not brickies sand or the sand that goes in a child's sand pit, that is too fine)
- 2 Parts by volume of sieved (and preferably home produced) compost or worm castings*
- 3 Parts by volume of cocopeat or horticultural coir

Sieved compost (L) and Raw compost (R)

*When I started out, I was using compost exclusively, and while being stored in the greenhouse it got a bit of heat treatment which may have killed off any pathogens, I make a cool compost. I started to get problems with the seedlings keeling over from damping off and changed over to the worm castings. That was over 15 years ago and the damping off has not returned so you may take what you will from that.

This is what the mix looks like

The compost/worm castings give some nutrition and body to the mix, the cocopeat ensures water retention and the sand ensures drainage. I was adding one part of perlite to the mix and also tried vermiculite, but both were expensive so I left them out and it did not seem to make any difference. I use a 500ml plastic Chinese food container as a measure. All of this is placed that wonderful product, the cat litter tray – cheap, available and mind bogglingly useful, more on them later. Mix by hand and voila! Homemade seed raising mixture.

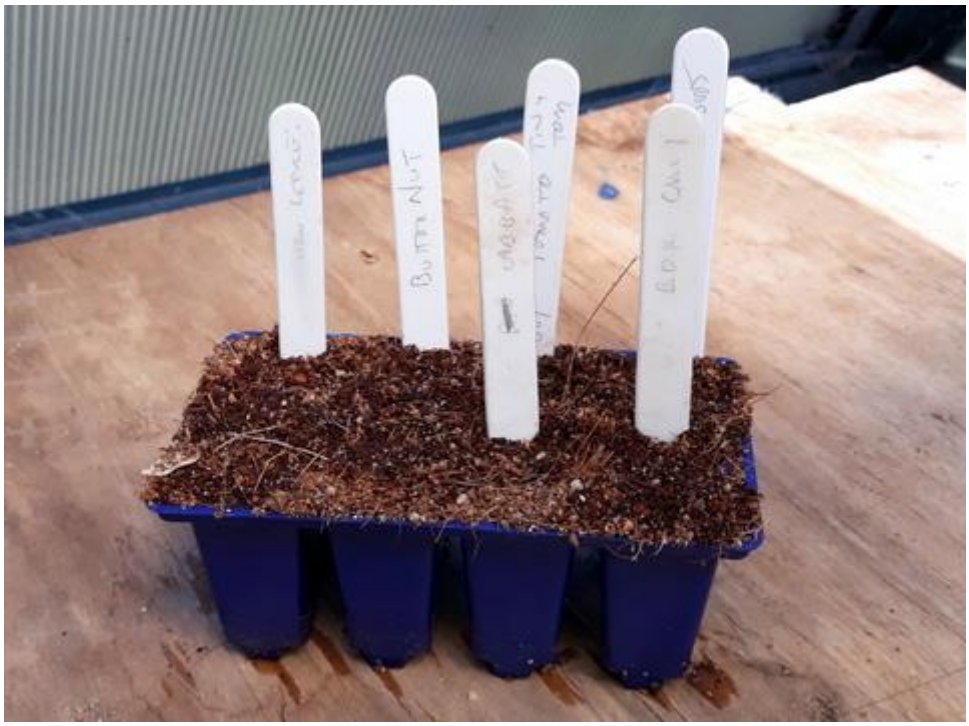
Vermiculite (L) and Perlite (R)

A Quiet Warning

I don't know the technicalities, but some people have gotten sick with Legionella infections after working with commercial potting mixes, when they inhaled the dust. If you keep all your raw materials moist that should keep the dust down and mixing outdoors where there is plenty of ventilation will also reduce the risk. If you are still concerned, purchase an Australian Standards approved dust mask to wear while doing this work.

One of the things about buying commercial seedlings in punnets is that you get a load of the same veggie seedling at one time, meaning that they will all get planted out together and then be ready to harvest together. This means that some will bolt to seed

or become over ripe before you can consume them. To avoid this eventuality, I use eight cell punnets and then sow a few seeds of each type or variety of veg in each cell. This is the way our system is designed to work by providing a continuous small harvest which is consumed quickly rather than a large harvest at once which then needs to be preserved. There are some exceptions to this such as corn and onions but this is the system we have been running successfully for over fifteen years.



A punnet sown and labelled

To sow your seeds in these punnets, place your homemade seed raising mix in the punnet and firm it down with a finger, leaving a small depression in the centre of each cell. Place a few seeds into the depression and add a light cover of potting mix over the top and press down gently to give good seed raising mix to seed contact. As a rule of thumb, seeds should be sown a maximum of two to three times their diameter deep into the soil or seed raising mix. Some seeds, such as lettuce, will germinate better if they have access to light and so should be sown more shallowly.

The veggies have sprouted!

The surface of the seed raising mix should be flush with the surface of the punnet so that there is good air drainage, otherwise still, moist air can favour damping off, a fungus which causes the new seedling to look pinched where they emerge from the soil, killing them. Label the division with a tag (These can be cut from an ice cream carton with scissors) showing the vegetable type and variety, plus sowing date if required. Follow this process for the rest of the punnet divisions.

Once the punnet is full it needs to be kept warm and moist until the seeds germinate, but watering from the top can wash the seeds out of the seed raising mix so they need to be watered from underneath. The easiest way to do this is to make a capillary bed by getting one of the aforementioned cat litter trays and half filling it with coarse sand (fine sand will crust over) I use the same sand I add to the seed raising mix. Add a couple of bottles as water reservoirs and you are good to go!

Capillary bed in action

Place the punnet(s) on the sand and then water the sand until there is just a little free water over the top of the sand. The seed raising mixture in the punnet will absorb the water through the bottom by capillary action eliminating the need to water the punnets directly. Also, the sand will form a reservoir of water reducing the amount of the attention needed by the seedlings. In hot weather place the capillary set up under some shade cloth and in cold weather make a small plastic house, green house or cold frame to keep the seedlings warm. More detail on making a capillary bed is available in Section 3.0 of this eBook.

To ensure a continuing harvest of veggies, I sow a mix of veggies into punnets twice a month. They are then potted on into newspaper pots somewhere between two and four weeks after sowing (depending on time of year) and then planted out two to four weeks after that (depending on time of year). The seeds will take longer to germinate and are slower to grow after potting on in the colder parts of the year.

8.2.2 Potting On

Once the seedling has grown to the four leaf stage, it can be potted on into a larger single container to grow further until you are ready to plant it out into the veggie bed. Originally, I used to do this by making up a potting mix that is a bit richer than the seed raising mix –

1 part by volume of coarse sand

2 parts by volume cocopeat

3 parts by volume sieved compost

But I found the original seed raising mix worked just as well so I now use that mix alone for both operations.

I used to pot the seedlings on into 100mm lengths of cardboard tube that I was getting from where I was working at the time (They are the spool around which paper for the plotter is wound) which were thrown out. To start off with I coated them in wax and the used a wooden slug to push the seedling out so that the tubes were re-useable, but I found that the transplanting shock for the seedling was considerable and after 2 or 3 uses the tubes carried all sorts of bugs that caused damping off etc. so I gave up on that idea and used them uncoated as a single use only, allowing them to rot down and allow the roots out into the soil over time.

The old system

However, I left that place of employment and after 12 months my stock of tubes had depleted, so I moved over to making newspaper pots to do the same job. The seedlings did much better in the newspaper pots and the newspaper pots rot down much more quickly than the cardboard tubes did anyway!

To pot the seedlings on I fill a newspaper pot with seed raising mix then push a hole down the centre of the mix in the pot with my finger. I then dig the seedling(s) out of

the punnet with my space age technical potting on tool (a paddle pop stick). I push the stick down into a cell of the punnet and then push it back while lifting, levering the seedlings, their root mass and the seed raising mix out of the punnet. This minimises damage to the seedlings.

My potting on tool!

I tease the mass of roots and seed raising mix apart and choose the largest and most well grown seedling(s) to pot on, keeping as much of the seed raising mixture around the roots as possible. I place the seedling gently into the newspaper pot, then top the newspaper pot up to level with the edge and place it in a plastic flat (designed for holding punnets) which holds 20 newspaper pots. I carry the freshly filled newspaper pots out to the greenhouse then place them directly onto a capillary bed to keep moist until they are ready for planting out.

8.2.3 Direct Sowing

As mentioned previously, the seeds of root crops need to be sowed directly where they are going to grow if they are to thrive, and large seeds can be direct sown into veggie beds rather than raised as seedlings first. This requires no specialised equipment or training (although a trowel can help to loosen any compacted soil) just some appropriate seeds and a place to grow them. However, each veggie has their own requirements in terms or sun, water, nutrients, soil pH, planting time and so on, so before sowing it is worth doing a bit of research to make sure that will do OK where you are intending to sow them.

Loosening up the seed bed

When it is time to direct sow, check the soil to make sure it is level, moist and has a fine tilth, especially when sowing small seeds like carrot, and that there are no sticks or rocks to inhibit the seedling's growth. This is also a great time to check for and remove any weeds growing in the area.

Seed bed ready to go

Sowing depth is two to three times the seed diameter. For larger seeds you can dig a furrow at the correct depth, sow the seeds the correct distance apart and then cover them over with the surrounding soil, or push them into the damp soil with your finger as I do with our peas and bean seeds. Smaller seed like carrot needs a bit more care and can be sown onto the surface of the bed and then covered with a light dusting of soil, sand or cocopeat.

Pushing in the bean seeds

Once sown, larger seeds can be given a light layer of mulch (1 -2 cm) to maintain soil moisture, but smaller seeds may find it difficult to make their way through a mulch so the soil should be left bare until the seeds have sprouted. In any case, it is important to ensure that the soil stays moist until the veggies are poking their heads through the soil, as this will also prevent a crust forming on the soil that inhibits sprouting.

8.2.4 Planting out

When the seedlings have grown enough, this is usually 4 to 6 weeks from sowing, they can be transplanted directly into the bed newspaper pot and all, the pot rots away and allowing the seedling roots to push through into the soil. Generally, seedlings should be transplanted in the late afternoon or early morning to minimise transplanting shock due to drying out of the seedling by the sun, but when using the newspaper pot method this can be less of a problem. More on this later.

The chook tractor doing its job

The bed that the seedlings in newspaper pots are to be planted out into will have had the chook tractor on it for a period of two weeks, during which time they will have dug it over, removed any weeds or leftover crops and thoroughly manured it. Once the chook tractor moves on, the patch will be mulched with 4cm to 6cm of straw mulch which has been dug over and thoroughly gone through and any remaining wheat seeds eaten by the chooks in the retirement village. During this process they will have broken the straw stalks down and added their quota of high nitrogen manure to the straw.

A mulched bed

Only once these processes are completed is the bed ready to receive the veggie seedlings and depending on the time of year, the time between the chook tractor moving on and the seedlings being planted may be a week or two or up to a month.

The usual process of potting on is simple enough, a narrow trowel is used to move the mulch aside and dig down into the soil until a hole in the soil is produced a bit larger than the newspaper pot. The newspaper pot is lowered down into the hole and the surrounding soil scraped in to ensure the seedling is stable and well covered with soil. For plants that send out adventitious roots like tomatoes, the hole will be a bit deeper and the soil heaped up around the seedling to provide extra room for the roots.

Mulched bed, planted out

Each of the seedlings will be planted into a pattern, starting with four seedlings across the width of the bed, followed by three in the next line, then four, then three and so on until the bed is filled. The resulting pattern allows the veggies to be roughly 30cm away from their nearest neighbour, maximising space while allowing room for the veggies to spread out as they grow. As well as planting out the seedlings using this pattern, the seedlings are interplanted, that is to say (as much as possible) the seedlings of the same vegetable family are not planted next to each other. This can reduce issues due to pests, diseases and can increase yields by allowing closer plantings.

Corn grown in a block

There are some exceptions to these planting rules, such as corn, which needs to be grown in a block to ensure cobs are wind fertilised and onions which we grow, harvest and process as a single crop.

8.2.5 Sun Protection

Originally I found, that while the late afternoon planting works in spring and autumn, planting seedlings in the full heat of a western Sydney summer causes a certain mortality rate anyway, so I developed a movable shade cloth frame. I used it when planting out during the hottest times of the year. Since I operate with standard size beds, I had two half size and two full size covers and they did the trick. By the time the next bed needed it, the original seedlings were strong enough to take the full sun.

Seedling sun shade

Unfortunately, with the effect of climate change, the western Sydney summers are getting hotter and it seems as if the sun is getting more intense, so about ten years ago I came up with the idea of installing semi-permanent veggie bed covers. The framework stays in position all year, but sometime around mid-spring, 50% shade cloth covers get installed and stay in place usually until sometime around mid-autumn at which point they are removed and placed in the shed. More details on the veggie patch covers can be found in Section 8of this eBook.

Semi-permanent cover for three veggie beds

8.3 Making a capillary bed and Newspaper Pots

8.3.1 Making a capillary bed

The amount of water held by punnets in which seedlings are grown is fairly small, and there is nothing quite so demoralising as coming home after a weekend away or a particularly hot day to find all of your seedlings have dried out and are now fried. Fortunately there is a piece of kit which you can throw together quickly, most likely from stuff you already have hanging around, which can prevent fried seedlings from ever happening again. Enter the capillary bed!

Another advantage of using a capillary bed is that it allows you to keep your punnets moist without having to water them from above and possibly washing some of the seeds out. This can be a real problem, particularly with the smaller seeds.

A capillary bed in use

In basic terms a capillary bed is a container of coarse sand which acts as a store of water. Seedling punnets or other plant pots are sat on the sand and water passes up

into them and keeps them moist by, you guessed it, capillary action. The better ones have a method of keeping the water topped up too.

To start making your capillary bed get hold of a cat litter tray, they are available from the el cheapo shops for a few dollars and are mind bogglingly handy for plant propagation and other grow-it-yourself tasks. They are great for mixing seed raising/potting mix, carrying stuff like punnets or pots around and they can be used when sorting seeds from trash. Let's face it, if all else fails you could use it for your cat!

To fill the cat litter tray, you need coarse river sand. Course sand is best because it doesn't crust over and river sand has no salt issues attached as beach sand may. Fill your cat litter tray almost to the top with the coarse sand and then water with a watering can until the sand is saturated. It is then just a case of resting your seedling punnets, newspaper pots etc on the moist sand.

Judging the water level using a pot

I have operated these for years and they work very well, and no fried seedlings!
With a little bit of effort you can extend the period between waterings even more. Get hold of a small pot, the one I use is 70mm long by 50mm in diameter at the top, and

sink it into the sand as far as it will go. Then get hold of a small empty bottle where if you insert the neck into the small pot it comes about half way down.

The pot I used

Fill the bottle of water (I use a 600mm soft drink bottle) and insert it neck down into the pot. As the water level drops below the level of the bottle neck due to evaporation and usage by the seedlings, more water till flow out of the bottle to maintain the level. This will happen until the bottle is empty and requires refilling.

Sand and pot in place

It is a simple thing to make, but it makes growing your own from seed much easier and more secure.

8.3.2 Making Newspaper Pots

For years the process that I followed to produce my veggie seedlings was to put the seeds into punnets, then once they were at the four leaf stage I would fill cardboard tubes with the same homemade mix we used to state the seedlings off and then pot on the seedlings into the tubes. I got the tubes from work, they were 800mm long and 60mm wide so I used my band saw to cut them into 100mm long planting tubes. Unfortunately, about 12 months ago, I was retrenched from that particular job so the supply dried up. It took me the 12 months to burn through the tubes I had in storage but all of a sudden i had to come up with something new.

I have been aware of the old newspaper pot trick for years and never had to use it, but with my tubes all gone, the newspaper pot seemed like the answer to a maiden's prayer, or at least mine anyway. I was concerned that they would not stand up to the task of being moist and full of growing medium for weeks at a time, but they have surprised me! Another surprise has been that the seedlings actually seem to hold better for longer and are happier in the newspaper pots rather than the old tube style, so if you want to follow my ideas give it a go.

Plunger and base - pot maker and they work well

There are apparatuses that you can buy to help you make the pots that consist of a plunger and a base (OK so it is a hopeless description.....just look at the photo!) but you can achieve the same thing with a straight sided drinking glass or jar. For the purposed of making the pots to take out seedlings to grow them on before planting out, a base size of 60mm to 80mm would be best.

1. Get hold of some newspaper and cut it into strips 10 to 12 cm wide by about 60cm long (ie the length of an open newspaper page). If the glass you are using is bigger than the recommended 6 to 8cm the strips will need to be proportionally larger.

2. Wind the strip around the open end of the glass with about half the diameter of the glass or a bit more overhanging the edge.

3. Fold the free edge over into the open end of the glass so that it is lying along the inside surface of the glass. Then slide the paper off the open end of the glass.

4. Place the bottom end of the pot on a flat surface and fold down the inner flap of paper to form the base of the pot then reverse the glass and push it into the pot bottom first so you can push down and flatten out the bottom of the pot. This is easier to do if you are working on a firm, flat surface like a table.

5. Job done!

The pot can now be filled with the seedling raising/potting mix and a seedling. Making the pots is easy; you can make a stack while sitting in front of the TV at night and then plant them out as needed.

8.4 Germinating Seeds with a heat pad

Over the years I have liked to be able to get some warm weather seedlings such as tomatoes (particularly), cucumber, zucchini, capsicum and on the odd occasion chillies, up and going early. We have a greenhouse, which makes things easier, but we still get to zero Celsius or a bit below and there is no artificial heating in the greenhouse.

Considering these factors, even though I like to sow them early, they rarely come up. While I was aware of heating pads to assist such endeavours, my original thoughts were that I would have to provide 240v power to the greenhouse to operate said heating pad. This, of course, was incorrect. The use of the heating pad is purely for the purposes of getting seeds to germinate, and the veggies I wished to germinate do not need light. Once they are germinated the seeds can be relocated to said greenhouse, and they will thrive.

So I decided that I needed to get myself a heating pad!

I think that it is worth noting that if you germinate your seeds inside your house, they do not require a lot of extra heat, (tomatoes need to be somewhere between 20^{o}C to 30^{o}C depending on who you read). We don't heat the house overnight and it can get chilly here, down to 15C or less inside.

There are various levels of complexity, some with variable thermostats, some without, and of varying sizes and shapes. It also appears better to use a heating pad that is designed for use with seedlings rather than for other purposes such as keeping pet reptiles warm or brewing beer in colder areas.

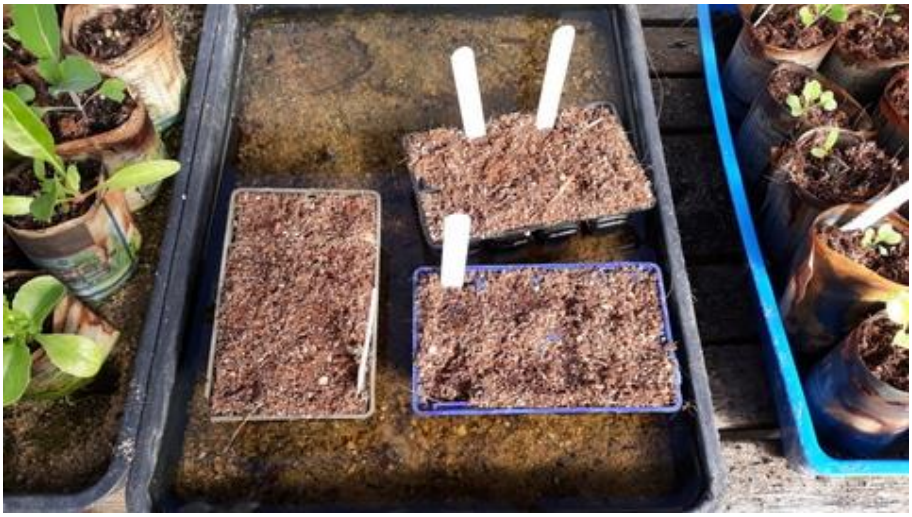
The one I got was a 'plug in and run' with no controls or lights of any description, but it was available immediately from the hardware store and seems to do the job. It also uses a ridiculously small amount of energy at 10 watts so that even if you are totally off grid it would not be an unacceptable overnight power drain.

The instructions stated that it heated the seedlings up to 10^{o}C above ambient temperature. If you were doing this outside in winter (at least around here) that would not be enough, but inside it worked fine. The instructions also make the point that the heat pad should not be located near a heat source such as an appliance or in full sun because this may cause overheating of the seeds. Also, getting it wet should be avoided because it is electrical equipment.

How I set it up, and the results

Obviously it needs a source of 240vAC electricity to run it, so I set mine up on our dining room table next to our table top oven. Yup! I did make sure it was few centimetres away and on the rare occasion the oven was in use it did not add anything to the temperature of the seedlings. In this position it was also near a western window where the punnets got some indirect light but were protected from direct sunlight by an awning. This meant it was also in an area where I could keep an eye on the whole set up.

Once set up and running I put together some 8 celled punnets with tomato, cucumber, zucchini and capsicum. I did some monitoring of the temperature and, for example, with an ambient air temperature inside the house of 18^{o}C the mat temperature was 28^{o}C and this translated to a temperature at the top of the punnet of 22^{o}C. Over a couple of days the punnets dried out somewhat so I placed them in a tray of warm water in the greenhouse for 20 minutes during the day to rehydrate. I then gently shook out any excess water and placed them back on the heating pad once they were rehydrated.



The result was that after 4 to 5 days the cucumbers started to come up, followed by the zucchini a couple of days later, with the tomatoes coming a few days after that. The

capsicums never did eventuate but I think that that was due to the seed being a bit old rather than a problem with the system.

I am very happy with the way things worked out and am a little chagrined that I did not apply this approach sooner. However, I am now tooled up with an understanding of the process and will be starting my spring crops earlier than I can with just the greenhouse.

Growing well!

8.5 Troubleshooting Your Seedlings

What happens when your seedlings don't come up? Or they come up then keel over? If you are having problems turning your seeds into seedlings, here are some problems you may be having without knowing it, and how to deal with them.

8.5.1 Seed Germination problems

Too wet or too dry? – Some seeds can be finicky about the amount of water they need and when you have seeds in a punnet keeping them damp but not flooded, and not letting them dry out too much can take some effort, especially if life gets busy. Fortunately the solution to this one is simple, make yourself a capillary bed from a cat litter tray, some coarse sand, a small pot and a bottle. The capillary bed is a container of coarse sand that is kept moist by an upturned bottle of water, allowing the water to move up into the seed punnets by capillary action. This keeps the seed raising mix damp but not sodden. Another benefit is that you don't need to water your punnets from the top, taking a chance that small seeds can be washed out during the process and possibly contribute to damping off (see below). How you can make your own capillary beds is covered previously in Section 8.3.

Capillary bed in use

Too cold or too hot? – Like moisture, seeds can be touchy about temperature too. Most veg will be OK to germinate between 25^{o}C and 30^{o}C although seed germinating conditions can vary outside this range, generally to the warmer side, a little research at the start can prevent frustration later! A greenhouse (even a small one) in a sunny spot will help keep temperatures up, but if that is not an option or you are starting crops indoors early in the season to get a jump on your growing, a heating pad can be worth investing in. There is more detail on using a heating mat **is** covered previously in Section 8.4 of this eBook

Too Deep – sowing your seeds too deeply, particularly for the smaller seeds like celery or carrot, can mean that the energy within the seed will expend itself before it can break through all that overhead cover. Fortunately there is a fairly simple equation to help you sow each seed at the correct depth – seeds should be sown two to three times their diameter deep into the seed raising mix or soil. Thus if your celery seed has a diameter of 1mm, it should be sown 2mm – 3mm deep. Simples!

Out of Date or Dud Seed – Seed has a definite shelf life, some like parsnip will only last a year, while cucumber seed may last ten years. So it is worthwhile when you are saving your own seed to write down when the seed was harvested for future reference. If you are buying your seed commercially, take a note of the 'sow by' date and use them up beforehand to prevent waste. Unfortunately, you can get a dud batch of seed from a commercial supplier, or maybe your seed has not been stored well and it is no longer viable. To eliminate this as a possibility for seedling no-show, you can do a germination test. This means wrapping the seed up in a moist, warm atmosphere and then seeing how many germinate. More detail on conducting a germination test is available in Appendix 1 of this eBook.

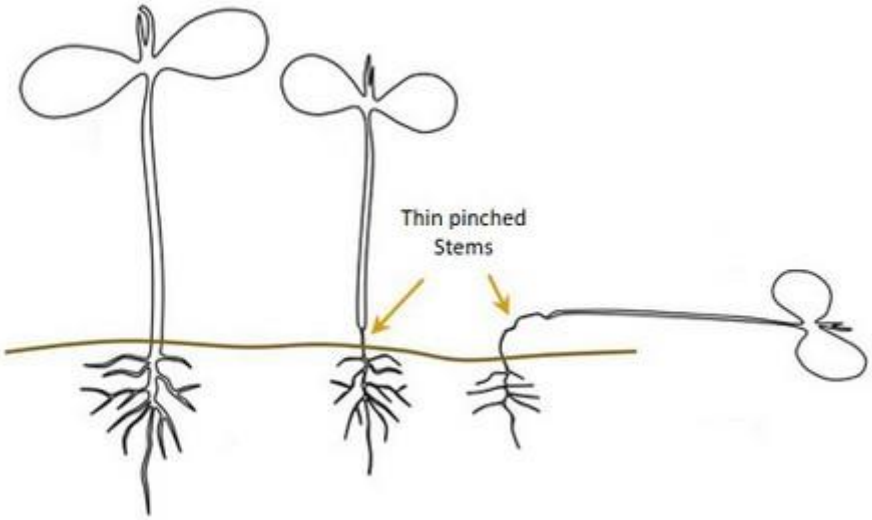
8.5.2 Seedling problems

Once your seeds are up and going you are almost there. Almost! There are a couple of things that can still derail your plans pretty effectively.

Leggy seedlings – This is the term used for seedlings that have grown long and spindly and is usually due to a lack of light where the seedlings are growing. This could happen if the seedlings were being germinating on a heat pad inside the house, but once they germinated they were not directly transferred to a sunny area, if they were germinated in a dark area or if they were sown so densely they shade each other. So, to avoid leggy seedlings ensure they have access to plenty of light. But, if you already have some seedlings that have gone leggy, you still have some options. If the problem is that the seedlings are too close together, break them up and transplant them further apart. Leggy seedlings can also be transplanted deeper into the seed raising/potting mix although this will work better with some seedlings than others. It will work well with tomatoes, capsicum, cucumber and squash, but not so well with leaf crops or root crops. In the end you can just plant them out when they hit the stage of having three to four true leaves and see how they go.

Leggy seedlings!

Damping off – So, your seedlings are of and growing well…….then all of a sudden, they fall over and DIE…….. Welcome to damping off! Damping off is caused by a fungus (usually Pythium species and Rhizoctonia solani but there may be others) that attacks the seedlings at or below the soil surface, resulting in the newly emerged seedlings collapsing. Damping off can become a problem where there is still, moist air that encourages fungal growth, also contributing can be old seeds being planted into cool, damp soil. To prevent damping off the following actions can be taken –



Drawing by Kevin Mechelmans

- Soak all seedling punnets, pots and trays in 10% bleach solution for 20 minutes between uses. Exposing them to direct sunlight will also help. This prevents a build-up of fungal disease on your germination equipment.
- When sowing seeds into the punnets, the surface of the seed raising mix should be level with the edge of the punnet to ensure good air drainage.
- If damping off is a real problem, seed raising mix can be sterilised by microwaving at full power for 90 seconds per kilo of seed raising mix.
- Sow seeds thinly to prevent overcrowding, improving ventilation and reducing damp conditions.
- Watering from below rather than above (see 'too wet, too dry' above) using a capillary bed will prevent water getting on the seedlings.
- Don't let your cat use your seed raising mix as a toilet (don't ask!)

Damping off

Direct Sowing – Some seeds (large seeds, root crops) can do better if sown directly into the soil where they are to be grown. When this is the case it is best to research what the optimum soil temperature for the seed to be sown is and then confirm the soil has reached that temperature with a soil thermometer. Also, the use of a soil moisture meter to ensure the soil is not waterlogged prior to sowing the seed. These actions together will go a long way to preventing damping off in direct sown seed.

8.5.3 Conclusions

From my experience, growing your own plants from seed will be successful 95% of the time and problems are rare, but if you do have issues with failures to grow your own seedlings, it can be intensely frustrating. It is therefore handy to use the above process to work through what the problem is and how to fix it.

More details on growing vegetables from seed is available by downloading our eBook: Growing Veggies from Seed

8.6 Our Greenhouse Journey

When I started out producing my own seedlings, I worked out pretty quickly that it would be much easier if I had a greenhouse of some description. This was in the days before I discovered how to make the low cost mini greenhouse. As well as providing a dedicated area to keep the seedlings and going some way towards providing a warm environment, the greenhouse would keep out pests like the cabbage white butterfly which could lay waste to a brassica crop before it started. So began my journey.

The small one

We started out with a small steel tube and plastic fitting one with a clear plastic cover that zipped up in the front, the original one we bought had three shelves, which for the work I was doing at the time was plenty. It had a small footprint of roughly 50cm x 70cm and was probably about a metre high so it could fit in almost anywhere.

You need to visit your greenhouse regularly to water it and check on your seedlings so while I would like to have put it on the back deck next to the back door for easy access, that side of the house faces west, not north. To get the best out of the winter sunshine it needs to go against a north wall, but to keep it easy to get to I put it more out in the open.....bad idea! The first time we got more than light winds it blew over; wasting all of the work I had done to get the seedlings that far. Needless to say I made space for it against our north wall, which is protected from the prevailing southerly wind. The lesson to be learned if you are using one of those small greenhouses, is tie it down unless it is in an area well protected from wind.

These small greenhouses are very handy because they are small, easily relocatable and best of all cheap! Although they do have some disadvantages like the wind problem above, their small size means they gain and lose temperature quickly and if you are planning to use one to grow your winter supply of tomatoes, forget it! They are a great way to start out though and for places like units or flats may be your only option. After a while what it did was to convince me to get a bigger one.

A Bigger One

I was still not flush with cash, but I saw a larger greenhouse in one of those "order this and we'll love you forever" catalogues that turn up in the mail regularly, at least around here they do. It was 2 metres by 3 metres and high enough for me to walk in comfortably; it had green translucent plastic cover with a zippered entry door in one end and a zippered roll up window in the other. The skin fitted over a steel tube and plastic connection inner framework. All up it cost $130 which I considered to be a bargain!

I bought one and put it up in the north western corner of the yard. This cut down some of the light and heat that the greenhouse got since it was against the northern and western fences but it still got enough sun overall and most of the morning sun. It really kept quite warm in winter. I put in three black barrels full of water to act as thermal mass, some concrete pavers down the centre and a steel framed potting bench with a mesh top I had welded up which gave me a surface to work on. The other side from the

bench had a table which held the seedlings, and I used some of the space there to grow tomatoes quite successfully.

In the end the black water-filled barrels didn't seem to make much difference to the overnight temperature and since the inside of the greenhouse did not freeze I wound up taking them out to give me more room. I did leave one barrel in which had a tap in the bottom which performed the dual function of retaining some thermal mass and holding liquid manure. I got hold of some horse, cow and chook manure, shoved it all into a woven chook feed bag and then suspended it in the drum three quarters full of water, instant liquid manure!

By and large I was really happy with my el cheapo greenhouse and while it was big enough and warm enough to do the job it still had one teensy problem. After not quite 12 months, the outer skin covering fell to pieces. It only just made it through one Aussie summer and that was it. The steel tube frame was still in good condition and it seemed such as waste to throw it all out and start from scratch! What to do?

The Next Step

It's funny how things work out, I used to drive past this place on the way to see my father that handled commercial greenhouse supplies, so I stopped in to see them and for a very reasonable fee (around $80 I think) I was able to get an offcut from the end of one of their greenhouse plastic rolls. The offcut was large enough to cover the entire top and sides of the greenhouse with plenty left over to go around each end. The next challenge was to work out how to wrap it around each end and close it off to keep the heat in, but still allow me access into the greenhouse.

The way I worked out was to make a doorframe out of scrap timber, about 1.9 to 2.0 metres high and about a metre in width for each end so that it sat in the middle of each end. I secured the doorframe to the steel tube above it with a piece of sheetmetal strap which was screwed to one side of the frame, then run up and over the tube, down over the other side and screwed into the other side of the door frame.

What that enabled me to do was, after I had pulled the plastic taut over the top of the frame I pulled the plastic around the back and then folded it around the rear doorway and, using a staple gun (and looooots of staples!) I fixed it to the inside of the door

frame, all the way around. This secured the plastic nicely so that I was able to pull the plastic taut around the front doorframe and do the same thing. I then made up two light doors by making up a frame of scrap timber the same dimensions as the inside of the door frames and covered them in the greenhouse plastic by cutting it to size then stretching over the frame and tacking in place with the staples.

Since the back “door” was going to be against the fence anyway I just screwed it into place through both the door and door frame with long screws. The front one I hung using a couple of old hinges that I had floating around. I also put on a bolt to keep the door closed when I needed to. There was no ventilation beside the front door but the greenhouse proved satisfactory for raising seedlings for probably 7 or 8 months of the year. During summer it just got too hot, so I installed a shade cupboard (well, it was far too small to be called a shade “house”). Although a couple of years back we got a really wet summer and the shade cupboard worked too well and I was getting leggy seedlings due to lack of light. There was just not enough light getting through so I had to transfer the set up back to the main greenhouse.

This set up worked well for another 3 or 4 years when due to all that time in the Aussies sun, the plastic connectors themselves started to break down resulting in a very sad and wilty looking greenhouse. Again it was time for a change!

The current situation

I started checking up and it seemed that at that time a proper glass and aluminium glass house was about $5000, which was somewhat more than I could spring for so I kept looking. We were driving past a place that sold sheds and they had a wonderful little greenhouse that was made from polycarbonate corflute type material and plastic glazing bars. It was a RION brand from Israel and the bloke was getting a new shipment in a couple of months, so we paid a deposit and waited.

When it finally arrived I pulled the old one down, cleared the area and put a brick surround in, then put square concrete pavers down each side of the site and crushed terra cotta tiles in the centre to walk on, then I could put the new one up! At 2.4metres by 2 metres it was a bit shorter than the original one and it took about three days by myself to put the thing up, but it was a joy to behold! Due to its shorter length I had to

carry out some radical surgery on my steel work bench to make it fit but my trusty angle grinder made short work of it!

In the five years or so that we have had it, it has performed wonderfully and allowed me to produce countless seedlings as well as a bit of out-of-season stuff too. It has proved to be a wonderful place to work on a sunny winter's day or even just a place to sit and relax in the warm. To make it easier to check when I got home from work on a long winter's night, I installed a 12 volt caravan fluorescent light and wired it back to the 12 volt system in the garage. It gives me plenty of light to do what I need to do.

This summer we have added a new wrinkle. Some friends wise in the ways of growing came over to have a look at what we were doing and asked when I put shade cloth on the greenhouse. I replied as I wrote earlier that we move to the shade cupboard for summer growing but his question sparked some thought. This year I have placed some black shade cloth over the top and rear of the greenhouse to try and cut the summer sun down a bit. It is still in the early stages of summer yet, but the difference can easily be felt and I am sure that it will prove to be a great modification.

Your own greenhouse is not a necessity, unless you are growing lots of stuff all year ‘round, but it makes the job easier and gives you a nice place to retreat to when the weather is cold and windy.

9.0 Maintaining fertility

9.1 Adding nutrients

Just like animals (including us) plants need the right sort of nutrients in the right amounts to be happy healthy and productive and when we remove crops from the soil and consume them, the nutrients must be replaced. Originally this was done with naturally occurring materials such as manures, ash and compost but with the invention of inorganic fertilisers (originally called artificial manure) we went away from naturally occurring materials and, as usual, stuffed things up. The inorganic nutrients don't take into account the importance of soil micro-life and as the yields reduce more fertiliser is needed to keep pace. They also tend to be very soluble being easily leached into our waterways and ground water causing pollution and some are oil based and come with all the problems that entails.

However, the wheel is turning and organic farming and gardening is making a very strong comeback and you can be part of that comeback in your own backyard veggie patch.

The theory at the start may be a bit heavy but it will give you a good basis on which to make decisions on how to use the materials available to you to keep your little patch of heaven producing the food you love.

A little Bit of Chemistry

While it does not tell the whole story, a measure of the usefulness and effects that a fertiliser will have, for both chemical and organic fertiliser is the NPK ratio. The NPK ratio gives an indication of how much of the three major nutrients a given fertility increasing material contains, but perhaps I am getting ahead of myself because we need to talk a little bit about the chemical elements that a plant needs and these are generally divided up into three major nutrients, three secondary nutrients and six minor or trace nutrients. What follows is a summary of what each nutrient does, what the

effects are when the plant is suffering from a deficiency of that particular nutrient what you can add to the soil to bring the nutrient level back to scratch.

The Major Nutrients

The major nutrients are nitrogen (chemical symbol "N"); phosphorous (chemical Symbol P) and potassium (chemical symbol K) hence the three together are referred to as NPK.

Nitrogen (N) – is important for leaf growth – deficiency results in pale or yellowing leaves - The best way of correcting a nitrogen deficiency in an existing crop is to add a well rotted high nitrogen manure such as chook or pigeon or to dilute human urine 1:10 with water and apply with a watering can.

Phosphorous (P) – is important for healthy plant growth, the formation of flowers and setting of fruit and seeds – deficiency results in poor root growth and stunted and sometimes purplish leaves – To correct this deficiency add bone meal if you can get it or blood and bone or apply human urine as above.

Potassium(K) - is important for strong support cells in plants and to ensure plants are healthy and resistant to disease – deficiency causes weak stems with limp yellowish leaves that may have scorched looking edges. Fruit set will also be reduced on fruiting plants – to correct potassium deficiency wood ash is the best additive or seaweed as mulch or made into a tea as set out under Trace Nutrients.

The Secondary Nutrients

These are the "tweens", being required in relatively larger quantities than the trace nutrients but not so much as the major nutrients.

Calcium (Ca) –is important for strong cell walls and growing tissue like root tips – deficiency results in new growth being stunted and distorted and growing tips curling/dying, can cause blossom end rot in tomatoes – Correcting calcium deficiency is usually done with agricultural lime although dolomite or gypsum (both made of ground rock) will not affect pH but still add calcium. Ground eggshells or sea shells can be used if you can get enough and blood and bone will also contribute calcium as will most manures.

Magnesium (Mg) – is important in photosynthesis for the plant – deficiency causes leaves to get yellow stripes, the older leaves being affected first – to correct a

magnesium deficiency the classic thing is to dissolve 1 tablespoon of Epsom salts (magnesium sulphate) in 4 litres of water and apply with a watering can but dolomite (a mixture of calcium and magnesium carbonates) will also work.

Sulphur (S) – sulphur is a component of plant proteins and is associated with the formation of chlorophyll – Deficiency results in the older leaves going pale, followed by the whole plant. To correct a sulphur deficiency adding composted brassica leaves (cabbage, cauliflower, broccoli etc) or garlic to the soil will help. The classic fix was to apply a dusting of elemental sulphur or Epsom salts.

The Minor or Trace Nutrients – also referred to as "trace elements".

While these nutrients are required in very small quantities, some can be toxic to plants when present in excess, they also make their presence felt when they are lacking, sometimes presenting strange symptoms as a clue to the deficiency disease you may be dealing with.

Boron(B) – is important for growing tissue in young plants – deficiency results in stunting of growth with yellowing stripes on the leaves and pale green tips of leaves, it can also result in breakdown of internal tissues in vegetables such as celery stems and broccoli flower buds.

Copper(Cu) – Is an enzyme activator and important in photosynthesis – deficiency results in "burning" of the leaf margins and yellowing with resetting or multiple bud formation in flowering plants. It may cause dieback in citrus and some other fruit trees.

Iron(Fe) – is also important for formation of chlorophyll in plants and is an enzyme co-factor – deficiency results in yellowing between the veins of young leaves but no initial stunting of growth, later older leaves become affected and growth becomes stunted.

Manganese(Mn) – is similar to iron – deficiency results in yellowing similar to iron leading to a striped or spotted appearance of the leaves.

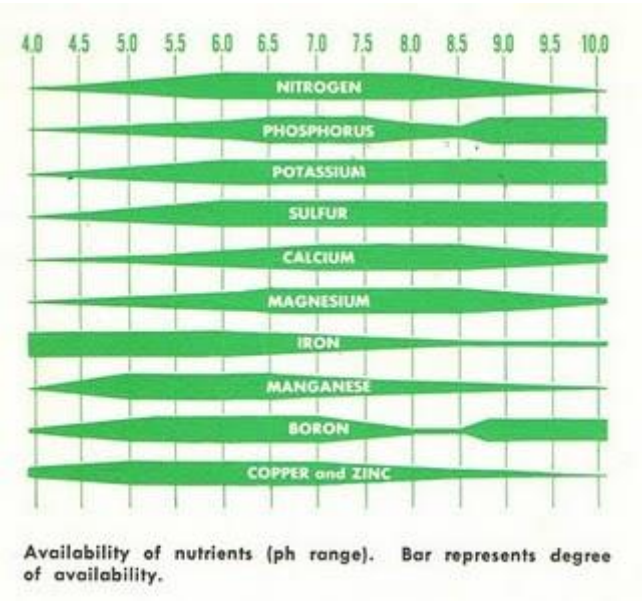
Molybdenum(Mo) – is important to allow the plant to convert nitrogen into plant proteins – deficiency shows similar symptoms to nitrogen deficiency leaves turning pale green then stunting of the whole plant and leaves bleaching and withering.

Zinc(Zn) – is an enzyme activator similar to copper – deficiency results in growth stunting and the formation of "little leaf".

The easiest way to provide trace elements for the veggie patch is to add wood ash, compost, well rotted sawdust, horse manure or seaweed tea made by washing the salt of seaweed in fresh water then steeping in fresh water for three to four weeks and dilute to the colour of weak tea and add with watering can or spray onto affected plants.

What about pH?

The soil acidity or alkalinity, generally referred to as soil pH and covered in detail in other articles, also has an impact on the nutrition of you backyard veggies because if the pH is wrong, some nutrients may be bound up and unavailable to your plant while others may be available to the point of toxicity. The graph below has been around forever and is reproduced by everyone and it gives an excellent representation of the availability of nutrients as the pH varies. The wider the line the more available the nutrient, of course the message to take away from all this is if you pH is between 6.5 and 7 you have nothing to worry about, but as you move away from this ideal range the availability reduces in most nutrients to a greater or lesser degree.



Availability of nutrients (ph range). Bar represents degree of availability.

NPK of Materials available in or close to urban/suburban areas

So now you hopefully understand a bit more about what nutrients plants need to be healthy and productive, here is a list of commonly available organic materials that can

be added to the soil to increase fertility and what the NPK levels are for each. These figures are rough and will vary from batch to batch

Material	N	P	K
Beans, Garden (seed & hull)	0.25	0.08	0.3
Blood & Bone	3.6	8	10-20
Cattle manure (fresh)	0.29	0.25	0.1
Chicken Manure (fresh)	1.6	1.0-1.5	0.6-1.0
Clover	2.0	0	0
Coffee Grounds	2.0	0.36	0.67
Corn cobs	0	0	2.0
Cornstalks	0.75	0	0.8
Compost	0.5	0.27	0.81
Couch Grass (green)	0.66	0.19	0.71
Cucumber skins (ash)	0	11.28	27.2
Eggs	2.25	0.4	0.15
Eggshells	1.19	0.38	0.14
Feathers	15.3	0	0
Grapefruit Skins (ash)	0	3.6	30.6
Grass clippings	1-2	0-0.5	1-2
Hair	14-15	0	0
Horse Manure (fresh)	0.44	0.35	0.3
Human Urine	15-19	3-5.4	1-2.5
Lemon Skins (ash)	0	6.33	1.0
Lucerne hay	2.45	0.05	2.1
Milk	0.5	0.3	0.18
Mud (fresh water)	1.37	0.26	0.22
Oat straw	0	0	1.5
Orange Skins	0	3.0	27.0
Peanut shells	3.6	0.15	0.5

Material	N	P	K
Pea Pods (ash)	0	3.0	9.0
Pea (vines)	0.25	0	0.7
Pigeon manure (fresh)	4.19	2.24	1.41
Pine Needles	0.5	0.12	0.03
Potato Skins (ash)	0	5.18	27.5
Potato haulms (dried)	0.6	0.16	1.6
Rabbit manure	2.4	1.4	0.6
Seaweed (dried)	1.1-1.5	0.75	4.9
Sheep & Goat Manure (fresh)	0.55	0.6	0.3
Sorghum Straw	0	0	1.0
String Beans (strings & stems, ash)	0	4.99	18
Tea leaves (used)	4.15	0.62	0.4
Tomato leaves & stems	0.35	0.1	0.4
Wheat bran	2.4	2.9	1.6
Wheat Straw	0.5	0.15	0.8
White clover (green)	0.5	0.2	0.3
Wood ash	0	1.0-2.0	6.0-10.0
Worm castings	1.0	1.0	1.0

Home Produced Soil Additives

Compost – is a good all purpose fertility improver and by composting leftover food waste some of the nutrients removed in harvesting can be returned to the soil. More details on **composting** and making a **bokashi** bucket are covered in articles elsewhere on this site.

Wood ash – if you have a wood burning stove or have friends with one, rather than throwing out the ash, add a light dusting next time you are preparing a veggie bed for

planting. It is alkaline and so may raise the pH of your soil but a small amount added to healthy organic soil is unlikely to have a huge effect. Wood ash is great for adding potassium to your soil.

Seaweed/kelp – seaweed is a great addition to the veggie patch if you can get hold of it, gather it and bring home a bag full next time you take the kids to the beach. As well as contributing major nutrients it is a good source of the trace nutrients as well, but make sure you wash the salt off before you use it. You can dry it out, crumble it up and add it to the bed before planting, add it to an existing bed as a mulch or steep it in a bucket of water for three to four weeks and apply with a watering can as a general tonic.

Worm castings – In an urban/suburban area you are most likely going to be producing this in smaller amounts, but it is very rich in beneficial soil bacteria as well as chemical nutrients. You can use it to make seed raising mixture, spread it around growing plants under the mulch or add it into the hole before planting your veggies to give the plant a boost when the roots find it.

Poultry manure – Even in the city most people can find room for a few chooks and while their manure is a bit rich to add fresh to growing plants it will give the soil a boost if added when preparing the bed or composted first. Rather than haul the stuff around, we use a chook tractor which means that the chooks apply it direct to the bed, and then when the bed is watered and mulched before planting, it attracts worms into the bed. If you have to buy it in, check that it has not been sprayed with insecticide to keep the flies down.

Urine- There is talk about "peak phosphorus" because we currently get our phosphate fertiliser supplies from deposits of ancient guano which are then mined, and is starting to run out. The answer is to recycle nutrients by diluting our pee ten to one with water and applying to the veggie bed. Contrary to popular belief urine is not sterile so if you are not well, particularly due to bladder infection, don't use it. I wouldn't broadcast

about this fertilising practice too much either, the neighbours might not understand your good intentions.

Liquid manure – In general terms liquid manure is made by steeping a nutrient rich material in water for a time to extract the nutrients and then diluting the resultant "tea" until it looks like weak tea and then applying directly to the plants. The nutrient rich material can be seaweed as mentioned above, manure or better yet a mix of manures, comfrey or nettle leaves or even just a mixture of weeds steeped in water.

Bought In Soil additives

Blood and bone – This is a great way to add phosphorous and potassium to your veggie patch although if you are vegetarian or vegan you may have some ethical problems using it. You should keep it in a sealed container away from pets; years ago my father's dog broke into his garden shed and ate his entire blood and bone supply. It didn't hurt the dog but sure crapped off my father.

Rock dust – Rock dust adds trace nutrients to the soil in an insoluble form that is only accessible slowly as the dusts is broken down by the enzymes released by soil microorganisms. Rock dust also is good for and attracts worms to your soil. You might not see it in your local nursery or hardware store but it is available from supplies on the net such as remin.com.au who are on the south coast of NSW.

Horse/Cow manures – If you don't know what the worming history of the horse is it is better to compost horse manure before applying it to the veggie bed but well rotted or composted horse or cow manure is a great way to add organic matter to your soil.

Dolomite & gypsum – These materials are ground rock containing calcium and, in the case of dolomite, magnesium as well. If you struggle with clay soils as we do around here adding a calcium containing material will improve soil structure. The clay is sodium clay and has very fine pores, adding the calcium material allowing it to react with the clay replaces the sodium with calcium and calcium clays have a much more open

structure, so the soil becomes much more free draining. Gypsum is often sold as “clay breaker”.

Maintaining soil fertility is basic to producing our own veggies, and keeping our plants happy and healthy so that they have the same effect on us when we eat them. By returning nutrients to the soil using organic production principles you will make sure that your veggie production is maintained in a sustainable manner.

9.2 Management Techniques

Crop Rotation

Crop rotation is the procedure of growing different crops successively on the same plot of land instead of growing the same crop on the same land year after year . This results in a number of benefits :-

A) As each crop takes or returns different nutrients to the soil it prevents or minimises the drain of nutrients on the soil so maintaining soil fertility . By crop rotation , mulching and adding compost regularly to the soil artificial fertilizers become unnecessary .

B) It prevents a build-up of pests and diseases which will attack a crop when it is grown year after year in the same ground.

One plan for crop rotation is as follows :-

I. Root crops to start - eg potatoes , carrots , parsnips , turnips or onions . Root crops break up the soil and bring deeper soil nutrients to the surface.

FOLLOWED BY
II. A legume crop , eg beans (in summer) or peas (in winter) . Legume crops fix their own nitrogen (an essential plant nutrient) from the air so when the root system decays the nitrogen remains for the next crop .

FOLLOWED BY
III. A leaf crop , eg lettuce , silver beet , spinach or cabbage . Leaf crops require a lot of nitrogen to produce a good yield of edible leaves so they make use of the nitrogen left behind by the legumes .

FOLLOWED BY
IV. Other crops such as capsicum , tomatoes , cucumber , broccoli or any others which do not fit into groups I. to III. above . Alternatively the fourth part of the rotation can be to leave the ground fallow to grow volunteer weeds which can then be dug under (BEFORE flowering and setting seed) to provide organic matter for the next crop .
THE ROTATION THEN STARTS AGAIN .

Other examples of crop rotations are -

A three course rotation I have heard of that has been used in the UK is potatoes, followed by brassicas, followed by and “other” crop ie everything else.

Rotation by family – This simply means that you don’t sow plants from the same family in the same bed one after the other. The plant families are as follows

a. Alliums – onions, garlic, leeks, shallots, spring onions, chives
b. Beets (also referred to a chenopodiaceae) – beetroot, silver beet, spinach

c. Brassicas (also referred to as crucifers) – Brussels sprouts, cabbage, kohlrabi, cauliflower, broccoli, kale, radishes, turnips.

d. Compositae – salsify, endive, lettuce, globe artichoke

e. Cucurbits – cucumbers, melons, gourds, squash, pumpkins

f. Grains – sweet corn, dent corn, wheat, rye

g. Legumes – peas (dwarf and runner), beans (dwarf and runner), broad beans

h. Solanum – potatoes, tomatoes, egg plant, capsicum, chillies

i. Umbellifers – parsnip, parsley, carrots, celery, dill, fennel, coriander

Mulching

Mulching is the practice of forming an organic layer on top of the soil around the plants, even over the entire vegie patch. This organic layer has a number of effects on the soil and plants in the surrounding area:

1. It keeps the soil surface cool in summer allowing micro-organisms to function at the soil surface and continue to breakdown organic matter and release nutrients.
2. It conserves moisture - A very important point in times when water may be in very limited supply. A mulch as well as reducing evaporation from the soil surface also

increases the proportion of the soil water present in the plant root zone, where it counts.

3. Weeds are suppressed - This reduces or eliminates the need for cultivation or worse yet, pulling out the little buggers by hand. This is an important point because weeds will compete with your crop for light, nutrients, water and space and in so doing can seriously reduce crop yields .

4. Nutrients are released by the breakdown of the mulch so that the vegies are have a built in, time release food source. The organic matter when incorporated into the soil will also improve soil structure and therefore fertility.

5. The surface of the soil under the mulch is not compacted by rain drops so water runoff is reduced, and infiltration of rain correspondingly increases. By the same token if rainfall is high and drainage not what it should be, mulching can contribute to waterlogging of the soil so keep an eye out for this.

Some materials used for mulching include –

a) Compost - Ideal .

b) Hay or straw - Ideal .

c) Grass Clippings - Can tend to form a water impermeable layer so they should be

mixed with sawdust of compost prior to use .

d) Dry leaves - Can also form an impermeable layer so should be shredded or mixed with other material prior to use .

e) Sawdust and wood shavings - Radiata pine material is not suitable as a mulch .

f) Animal manures - should be old and well-rotted down before use or they can burn the plants .

More detail on mulching is also provided under section 5.6, previously in this eBook.

Green Manuring

This is the process of growing a crop on your vegie patch and then digging it in to provide organic matter. This is a good idea when you are opening up a new area or as part of a crop rotation. The most value is obtained by using a legume eg peas, beans, clover, or lucerne which fixes nitrogen at the same time, releasing it to the plants as it breaks down. At least two weeks should be allowed between turning in the green manure and planting vegies to allow the green manure some time to break down. The green manure should also be turned in before it flowers so it is at a succulent stage of growth and will break down earlier and no seed is set to come up as a "weed" later. More information can be found by downloading our eBook: Keeping the Place Fertile

10.0 Managing Potential problems

10.1 Organic pest control

Introduction

If you are going to grow your own food, you are going to attract pests to a greater or lesser degree and as much as you don't want to share with them you are bound to lose some and the trick is to contain your losses to an acceptable level. The current agricultural practice of wholesale chemical use is unsustainable and in the long term counterproductive for the following reasons –

- 98% of even the best applied pesticide spray damages non-target organisms ie pest predators, fish, bees, humans – you get the idea.
- The pests have the ability to evolve almost as fast as we can make new pesticides so in the end we lose.
- Pesticides in use are oil based so as the oil becomes more expensive so too do the pesticides.
- They are made by big business/big chemistry and can't be home produced.
- They can build up in the environment – organochlorine compounds like DDT, Chlordane etc. are a case in point

So, there must be a better way and indeed there is, looking after your fruit and veggies organically! Unfortunately over the years we have all been brainwashed by too many pesticide ads on TV, you know the type – "if you have problems with this type of bug just grab your can of 'BugBeGone', spray to your heart's content and your bug problem will be gone!". The organic method of protecting your crops is more holistic than the spray-em-dead approach and while the use of environmentally friendly pest control is part of the process, it is only part of the process. There are some things to think about before reaching for the spray.

Which Bug?

There are a wide number of both good (predators and pollinators) bugs and bad (pests) bugs out there," good" bugs include –

Ladybirds (most species)	Lacewings	Hover flies
Ground beetles	Predatory flies	Assassin bugs
Rove beetles	Praying mantis	Centipedes
Dragonflies	Springtails	Millipedes
Earwigs (Australian)	Predatory wasps	Spiders

While "bad" bugs you might see in your garden could be -

Ants	Cabbage white butterfly	Grasshoppers
Aphids	Loopers	Earwig (European)
Ladybird (26 & 28 spotted)	Budworms	Flies (inc Fruit Flies)
Weevils	Cockroaches	Scales
Shield bugs	Crickets	Snails and slugs
Cabbage moth	Locusts	Thrips

The moral of the story is that there are a huge number of types of bugs out there, good, bad or indifferent and you need to know which ones you have and you can do this by a combination of observation and research. Get hold of some books from you library, join an online organic growing forum (Like Aussies Living Simply) or get hold of leaflets from your local Dept of Agriculture, often also available free on line and identify the ones, both good and bad, that you need to look out for.

The Organic Approach

Rather than go for short term Band-Aids in the form of pesticides (no matter how enviro-friendly) we need to look at our backyard crops as being part of our backyard ecosystem and then try to keep the ecosystem in balance. We can also be smart and avoid pest problems before they get to the point where a spray is necessary by using some or all of the following strategies.

Observe your back yard and make notes about what you find. Take the time to look at the types of pests and the types of predators already existing in your garden and do it regularly because things change over time. This summer alone I have identified three or four new types of insects that I haven't seen before in our back yard. So, take the time and really observe what is happening in your garden so you will know what you are up against, action early on can prevent a major infestation later in the year.

Start with a healthy soil – healthy soil means healthy plants and healthy plants means they are less likely to become a target for pests. If you follow organic principles and use organic manures and fertilisers, if you mulch well, use green manures and maintain soil organic matter and avoid cultivating and exposing your soil to the sun you are much more likely to have healthy soil. Check and adjust your soil pH if necessary, as well, as soil that is too acid or alkaline can be rough on the microbes in your soil as well as your fruit and veggies.

Attract predators to your back yard – We alter the natural ratio of predator to prey when we use pesticides because we kill off both, but the pest bugs make a quicker comeback, so we need to attract predators to our growing are and keep them there. Providing a source of water in the form of a pond or birdbath is one way, so is allowing some of the veggies we grow to go to seed, because the adult forms of many predators are attracted to the nectar in the flowers. Not using pesticides will obviously help as will allowing some weeds to grow and flower to provide predator habitat.

Practice companion planting and interplant – Nothing is more like ringing the dinner bell for pests than monoculture – a large block of one sort of crop. So grow some strong scented herbs and flowers in your veggie beds to confuse pests and grow differed crop plants interspersed with each other like basil with tomatoes and onions with carrots. My personal experience with companion planting has been mixed and in practice no amount of companion planting I've tried has ever confused the cabbage white butterfly but give it a go and see how it works for you.

Plant resistant varieties – The varieties of vegetables available today is very small in comparison to years gone by, even in plant nurseries the variety of seedlings is only slightly better than the stuff we can get in the supermarket. Fortunately there are specialised seed suppliers like Eden Seeds, Phoenix seeds, Greenpatch seeds and Green Harvest who can supply a broader number of varieties and some will be more resistant to than others to the pests in your back yard eg Roma tomatoes and cherry type tomatoes are more resistant to fruit fly than many main crop varieties. A little research can pay off big dividends in the war against pests.

Time plantings to avoid pests – sometimes, if a troublesome pest has a short season you can avoid planting susceptible crops for that time and this is where your time and trouble in observation will pay off. We have a problem with one of the brassica pests – Cabbage Moth (not to be confused with cabbage white butterfly) which forms webs on the plants and can denude and kill a seedling in a matter of days. Around here though they are a problem only for a month or so in late summer so not planting brassicas at that time can head off any hassles with them.

Non-Chemical Pest Controls

If after you have put the above strategies in place that make sense for you and your situation you still have pest problems it might be time to set up a more targeted pest control plan like the ones suggested below.

Manual removal – In other words, picking the pests off by hand and squishing them, drowning them or feeding them to the chooks. This works best on the bigger but slow moving stuff like snails and slugs (ewww!), caterpillars, shield bugs or cockroaches (may be a bit fast...). The shield bugs are also called stink bugs for very good reason and the can eject a foul smelling and very irritating liquid when threatened so wear gloves and safety glasses if you are going after these buggers. I wouldn't feed them to the chooks either, drown them in water with a bit of soap or dishwashing liquid.

Catch and hold – These are traps that attract and hold pests such as the slug and snail beer trap, made by getting a glass jar and burying it until the lip is level with the ground, then pouring in some beer diluted 50:50 with water, the snails and slugs are attracted, fall in and drown, but at least they die happy. There is also a bottle trap used with fruit flies that is described in another article on this site. Flying insect pests are attracted to red and yellow colours so a trap can be made by coating red or yellow cardboard with non-drying glue or molasses and then hanging them up where the pests are evident.

Barriers – by placing an obstacle between the pest and its target you can reduce the damage considerably. The barrier can take the form of a ring of irritant substance around a plant or plants to keep out slugs and snails such as wood ash, sawdust, lime, diatomaceous earth or alum. Care must be taken because some of these materials are soluble and can alter the pH of your soil, obviously they won't work to well in rainy weather either. Panty hose or paper bags can be placed around fruit including tomatoes and capsicums to deter fruit fly and fine nets can be erected against flying pests including birds.

Environmentally Friendly Chemical Pest Controls

The following chemical controls can be used in moderation and in association with the other techniques covered in this article to treat infestation of specific pests.

Pyrethrum spray (commercial or home produced) can be used on most flying and crawling insects. The pyrethrum daisy can be home grown and the active constituent pyrethrum extracted using water or alcohol. The addition of a small amount of sesame oil or sassafras oil will improve the effectiveness of the pyrethrum spray.

Derris dust – can be applied as a spray or a dust and acts as a stomach poison for chewing insects. There is some toxicity to humans although Derris will not build up in the environment so when applying use a dust mask or respirator.

Oil – either light mineral oil or vegetable oil can be sprayed onto plants for scale and other bugs, it clogs up their air holes and suffocates them. Spraying needs to be done in the early morning or late afternoon and spraying in the middle of a hot day can result in burned leaves.

Bug juice – Yep, tastes as good as it sounds! Gather some of your target pest manually, mulch them up and place them in water, shake them around and then strain out the bits and spray onto the affected plants. For some reason bugs will keep away from plants sprayed with the innards of their relatives.....mind you, so would I.

Chilli and garlic spray .

Nicotine – soak a quarter of a cup of cigarette butts in a litre of warm water overnight, filter out the butts and add a bit of liquid soap or dishwashing liquid to help the spray wet out and bottle. WARNING: this is a nasty so use gloves when handling and don't inhale the spray.

10.2 Organic disease control

In a similar way to dealing with pests, if you grow fruit or veggies of any description it is likely that you will have to deal with disease in those plants at some stage. Dealing with diseases is different to dealing with pests in that diseases tend to be very specific to each plant and while some general rules can be formulated about preventing disease and dealing with the various causes of disease it is important to research and make sure the disease is correctly diagnosed before acting. It is not possible to cover all the possibilities in a short article like this one, so this is more an overview to help you gain an understanding of plant disease so you can then move on to further research.

Having said all that my experience with disease in backyard grown vegetables is fairly limited and while we have had the odd outbreak of blossom end rot in tomatoes mostly our disease profile is restricted to mildew of cucumber and zucchini and the odd

occurrence of damping off. It's good to keep an eye out on what is going on but don't obsess about infected veggies, life's too short.

The Causes of Disease in Plants

In general terms plant disease is caused by viruses, bacteria or fungi and the most common cause of disease in your veggie crop is likely to be a fungus. Some plant diseases or disorders can also be caused by a lack of one or more nutrient elements or by excess of a particular nutrient to the point where they become toxic to the plant, usually due to incorrect soil pH. These nutritional disorders are touched on in the article on keeping up fertility organically by adding nutrients while this article will focus more on the biological causes of disease.

The Organic Approach (Prevention Rather than Cure)

Rather than go for short term bandaids in the form of disease control chemicals like fungicides (no matter how enviro-friendly) we need to look at our backyard crops as being part of our backyard ecosystem and then try to keep the ecosystem in balance. We can also be smart and avoid disease problems before they get to the point where a chemical control is necessary by using some or all of the following strategies.

- **Observe** your back yard veggie crops regularly for signs of disease and if you do, diagnose as best you can or get advice from other gardeners, books or the 'net and once the disease is diagnosed act accordingly. By identifying and acting quickly a minor irritation can be prevented from becoming a major headache.

- **Start with a healthy soil** – healthy soil means healthy plants and healthy plants means they are less likely to become a target for diseases. If you follow organic principles and use organic manures and fertilisers, if you mulch well, use green manures and maintain soil organic matter and avoid cultivating and exposing your soil to the sun you are much more likely to have healthy soil. Check and adjust your soil pH if necessary as well, as soil that is too acid or alkaline can be rough on the microbes in your soil as well as your fruit and veggies.

- **Mulching** – As mentioned above mulching will help improve soil health but aside from this mulch will prevent soil and spores being splashed up onto the plant during rain and reduce the likelihood of infection, particularly fungal infection, by this route.

- **Don't overcrowd your plants** - allow room around them for good airflow although in my experience if you have healthy soil and are growing organically your veggies can be planted much more closely together without causing a problem than if your growing using chemical techniques. When planting the usual stuff in our backyard beds we generally use about 30cm spacing and that causes no problems, allowing separation of the plants and airflow when they are young and vulnerable but making good use of space when they are grown.

- **Plant resistant varieties** – The varieties of vegetables available today is very small in comparison to years gone by, even in plant nurseries the variety of seedlings is only slightly better than the stuff we can get in the supermarket. Fortunately there are specialised seed suppliers like Eden Seeds, Phoenix seeds, Greenpatch seeds and Green Harvest who can supply a broader number of varieties and some will be more resistant to than others to the diseases prevalent in your area.

- **Keep your growing area clean and tidy** – dying plants, rotting fruit and other organic material lying around and provide a place for disease to build up or even over-winter. Diseased plants should be removed from your site in the green waste bin or burned as the organisms may re-infect your veggies even if composted if unless your compost system is really hot. Don't take the chance.

- **Hygiene** – Maintain your hygiene levels when raising seeds, potting on and planting out. Regularly wash all your flats, punnets, labels, trowels etc in a disinfectant solution like Dettol or one of the quaternary ammonium disinfectants to prevent a build up of disease organisms and get your seedlings off to a good start. Exposing your equipment to the sun will help to as the

disease organisms generally don't like the ultraviolet light (they have never heard of sunscreen I guess....).

- **Practice crop rotation** –by not planting the same family of veggie in the same plot two years running which not only helps maintain fertility in the soil it prevents a build-up of crop specific diseases in the soil.

- **Avoid overhead watering when possible** – because this raises the humidity and can cause fungal problems when the leaves stay wet for an extended period of time. If you water in the morning so that any excess water is dried off by the sun the likelihood of this causing a problem is reduced.

- **Don't water your veggies with greywater** – apart from the possibility of passing on human pathogens to the crops you will later eat, you may also pass on plant pathogens. Use greywater for watering fruit trees and apply direct to the soil or subsurface.

- **Plant at the correct time of year for the seed being grown** – forcing a plant to grow outside its normal season can reduce its vigour and cause it to become prey to disease as well as pests.

Disease Transmission Routes

You may say, with justification, that your backyard crops are disease free and so they should remain disease free unless a disease is introduced from outside, but there are a number of ways that diseases can be transmitted onto your property which you need to be aware of –

Infection from plant material brought in – this may be commercial seedlings or plant bought in by mail order or from surrounding nurseries or the likes of Bunnings. In general they should have enough of a handle on hygiene for infection due to this source to be possible but unlikely, however plant material provided by friends, neighbours or other backyard growers may be a different matter.

Infection from your neighbours – windblown spores can be blown in from your neighbours if they are growing veggies or other host plants. Spores like those produced by the powdery mildews are released in warm dry weather and may travel considerable distances on the wind.

Infection due to contaminated soil – again this may be soil brought in with purchased or donated seedlings but may also be carried into your backyard on dirt clinging to boots, garden tools such as spades or garden forks or even wheelbarrows that have been used off site.

Infection due to debris – imperfectly rotted compost or vegetable trash left around your backyard can act as a source of infection, particularly for fungal diseases.

Infection from seed – some diseases are able to infect the seed and in that way be transmitted to the next generation of vegetables. Again this is unlikely with commercially obtained seed but underscores the need to only save your own seed from only healthy plants and to make sure that any seed donated by friends is from healthy stock. If in doubt, don't use the suspect seed.

Infection by insects – while insect pests cause their own havoc, the small sucking insects like aphids and thrips can spread disease, particularly viruses between plants that are anywhere within their flying range.

General Symptoms of Disease

This is not a comprehensive list of symptoms but a rough guide for some things to look for if your fruit and veggies are failing to thrive.

Viruses – Mosaic patterns of the foliage of the plant along with malformed or yellow foliage and stunted growth with the plant possibly assuming a strange shape'

Bacteria – soft foul smelling rot, black or brown spots or patches on leaves which may shrivel and die

Fungi – fall into four main groups; root and stem rots, mildews, rusts and leaf spots -

Root and stem rots – Cause rotting of the stems, roots and a condition called collar rot, they attack the conducting tissues of the plant resulting in wilting and eventually collapse of the plant.

Mildews – cause a white or ash grey powdery film over the surface of the leaf, usually older leaves which eventually wither and die.

Rusts – cause orange or red pustules on leaves or stems.

Leaf spots – as the name suggests result in black spots on the leaves of several types of vegetables.

Control Options

Viruses – There are no real control options for virus infected plants but to "rogue" them ie pull out and remove them preferably by burning to destroy the virus. Do NOT compost them.

Bacteria – a double strength garlic spray may improve matters, Bordeaux mixture can be used on perennials

Fungi – seaweed foliar spray; milk, garlic and chilli spray, urine (use full strength and fresh!); chamomile tea; chive tea, sulphur or lime sulphur spray.

10.3 Organic Weed Management

What is a weed? A weed is a plant out of place.

Why remove them? They compete with target plants and can act as a host for pests and diseases; they can cause allergies, dermatitis or physical damage and in some cases, poisoning. They can inhibit germination or growth of other plant species, cross-pollinate with target species and they can look like crap. (umm, have poor aesthetics).

Know your Weeds

Follow this process to discover what weeds you will be dealing with. Of particular help later on is to find out which are annual, and which are perennial weeds.

Divide your weedy spaces up into manageable areas and then download a plant identification app if you are going to use one or get hold of some weed identification books. Go out into your weedy area and systematically identify all weeds in the area using your app and/or weed identification books. Then record all information (common and scientific names) on all weeds present. Once the area is complete, transfer the information to weed spreadsheet. Once you know what weeds you have you can research more about them with confidence.

Assess your weeds (optional)

Look at each weed in turn and rate them on their invasiveness and persistence from 1 to 5 then multiply the two figures together to get the PITA score, then record that on your spreadsheet. This will help to identify which weeds will be a priority to treat first.

The PITA Score

Invasiveness	1	2	3	4	5
Persistence					
1	1	2	3	4	5
2	2	4	6	8	10
3	3	6	9	12	15
4	4	8	14	16	20
5	5	10	15	20	25

= Minor PITA

= Moderate PITA

= Severe PITA

Prevention is better than cure

Be aware that weed seeds and runners can be brought onto the property in materials bought in from off site, and by wind, water, animals or ourselves. They will also be some pre-existing weed seeds in the soil.

Strategies

To prevent weeds being brought in by materials imported from offsite – buy seeds from reputable suppliers, start seeds in punnets rather than direct sow. Consider buying shrubs and trees bare rooted, if not buying bare rooted, consider root washing. Consider using chooks to remove seeds from mulch, use mushroom compost rather than other amendments and/or compost amendments before using them.

In all cases research what you are bringing onto your property to identify problems first.

Where existing seeds are being dealt with – avoid cultivating the soil, use mulch on bare soil, apply water directly to where it's needed rather than indiscriminate use of sprinklers, encourage ants which will feed on the weed seeds and keep an eye on bird roost areas.

Weed control

General considerations – be knowledgeable about the weeds you are dealing with, and research the best ways of controlling each weed species. Apply controls when weeds are young and not established, or at least before they have had time to seed. Be aware of hazards and act appropriately, always keep an eye out for budding weed problems. Start from the edge of the weed patch and work inwards, and be realistic about what you can achieve and don't kill yourself, but be thorough and don't move on until the current patch completed. Don't let spaces remain empty and be responsible, don't let your weeds become your neighbours' or the local bush's problem.

Physical control methods – These are broken down into a number of groups such as heat, barriers and physical removal. Heat includes solarisation or covering an area with plastic and killing weeds over an area with solar heat, or using targeted heat in the form of boiling water or a flame weeder. Barriers include plants used as a barrier, soil compaction or mulch to protect an area from weed invasion and physical removal is exactly what it sounds like – weeding, using various implements.

Chemical control methods - I have tried a number of homemade organic weedicide sprays and of all of them vinegar, with perhaps a small addition of dishwashing liquid to help it coat the leaves, is the most effective. Avoid all weed killers that contain salt as it will take a long time to wash through the soil and may inhibit plants growing where it is applied for a long time. There are others but most are not recommended.

Cultural control methods - These techniques work by improving the ability of our target crops to compete more effectively with weed species. Cultural controls include using high quality seeds, planting well grown seedlings, planting them closely together. Where direct seeding is required using increased seeding rates. Maintaining good soil fertility and use techniques such as cover crops/green manures and crop rotation which are effective. The use of cleaning crops, animals such as chooks and interplanting are

also good weed control techniques. Also using the 'stale seed bed' technique which involves - preparing the veggie seed bed including any cultivation to ensure a fine tilth, Irrigating to encourage weeds stimulated by the tillage to germinate and emerge from the soil, once the weeds have emerged, kill them off with the minimum or soil disturbance by solarising or using a flame weeder then sowing or transplanting your target crop.

While cultural techniques on their own will not control weeds they are effective techniques to include in weed control strategies and have many other side benefits as well.

Maintenance

Weed management is a long-term commitment and once they are under control, the system needs to be maintained to keep them under control. Maintenance activities include continuing to keep an eye out for potential weed infestations and remembering that prevention is still better than cure, making sure that activities to this end are continued. Also continue any cultural controls in place to reduce weed infestations in the long term. Recording your successes and failures is also worthwhile in the longer term so that if a problem weed raises its ugly head you will know what to do (and what not to do!).

More detail on all of these weed control methods can be found by downloading our eBook Managing Your Weeds Organically

11.0 Putting it all Together

11.1 How we Grow our Annual Vegetables

As mentioned previously, we live on 600m2 in Sydney's greater west and for years I would contribute to the family larder by growing vegetables but what this meant generally was –

1. Cultivating like mad each spring using a petrol powered rotary hoe
2. Buy in lots of manure (primarily chook and horse), spread it around and dig in
3. Buy in a load of straw and mulch everything in sight
4. Buy in a load of seedlings and plant everything in sight.

The result of this fevered action was trickle of vegetables into summer, a glut of just about everything in mid to late summer and then little else from then through to the next spring when the whole thing started again. There had to be a better way!

The Five Processes

This was not only expensive it was not particularly environmentally friendly either so over time I developed a series of processes that has made us much more self-reliant and reduced our outgo and environmental impact at the same time. This is how we did it, using five innovations developed by others or ourselves –

1. Developing a sowing plan
2. Putting in the Plots
3. Raising our own seedlings
4. Installing the chooks
5. Saving our seed

Vegetable	Variety	July		August		September		October	
		Week 1	Week 3	Week 1	Week 3	Week 1	Week 3	Week 1	Week 3
Basil	Sweet	4 plants		4 plants		4 plants		4 plants	
Beans					1 row	1 row	1 row	1 row	1 row
Beetroot	Crimson Globe						1 row		1 row
Bok Choi					4 plants	4 plants	4 plants	4 plants	4 plants
Broccoli	Green sprouting	4 plants	4 plants	4 plants	4 plants	4 plants			
Broad beans	Coles Dwarf	1 Row							
Black Turtle beans								Full bed	
Cabbage	Sugarloaf	1 plant	1 plant	1 plant	1 plant	1 plant	1 plant	1 plant	1 plant
Capsicum	California Wonder	4 plants			4 plants			4 plants	
Chilli	Cayenne	2 plants			2 plants			2 plants	
Carrots	All year round				Half Bed				
Carrots	Chantenay				Half Bed				
Cauliflower		2 plants							
Celery	Golden Self Blanching				2 plants		2 plants		2 plants
Cucamelon									
Cucumber	Lebanese			1 plant		1 plant		1 plant	
Garlic									
Kale	Scottish								
Leek							12 plants		
Lettuce	Mignionette - green	2 plants	2 plants	2 plants	2 plants	2 plants	2 plants	2 plants	2 plants
Lettuce	Oakleaf	2 plants	2 plants	2 plants	2 plants	2 plants	2 plants	2 plants	2 plants
Luffa						3 plants			
Malabar spinach						3 plants			
Onions	Gladalan white or brown								

Developing a sowing Plan

I needed to be able to provide a mix of veggies for us throughout the year and to do that I needed to develop a **sowing plan** that showed me how much of what veggies to plant when. Seeing as nothing like that existed that I could find, I developed my own.

I got hold of seed catalogues from producers of open pollinated heritage seeds and scoured them to work out what varieties suit our climate and when to sow them. Over the years we have experimented with different varieties of the some of the vegetables to spread your growing season. I then worked out (guessed really) how much of each vegetable we wanted to plant at each time, mind you the plan is always evolving and

some things we discovered we wanted to grow more of over time, others we reduced because we didn't like them as much or as often as I thought we might.

Then, to develop a sowing plan, I worked out how often we needed to sow/plant out your veggies, based on twice monthly sowings. I then drew up a matrix with the name and variety of each veggie we wanted to grow down one side and the interval of sowing across the top. To make it easy for me to develop and keep up-to-date I use an Excel® spreadsheet on our computer.

Putting in the Plots

We have Fourteen 1.2 metre x 2 metre veggie plots that are divided by 100mm square wooden borders and the plan that I developed allows us to plant one out every two weeks, so that if you were to come to visit at any time of the year you would find plots producing veggies, plots growing up getting ready to produce, plots freshly planted out and plots ready to be dug over.

Originally I double dug the plots and even used a small rotary hoe but now we don't dig the plots over at all, we put the chook tractor on them to dig over from above and then mulch to attract worms that come in and dig from below.

Raising Seedlings

We make our own seed raising mixture based on one part coarse sand, two parts worm castings (from our **worm bath**) and three parts cocopeat, this is placed into eight compartment punnets, one type of veggie in each compartment. I fill up the punnets with our seed raising mix and then use my finger to press down each compartment. When the seeds go in each compartment I fill it with seed raising mix to the top, which aids air drainage (and preventing damping off) and it also shows me which compartments are yet to be sown with seeds. A label finishes the process off.

For large seeds like corn or beans where we need a quite a few they get sown in several (6 or 8) punnets of their own. The full punnets are placed in a cat litter tray half full of damp sand to keep them moist and left in the greenhouse for about two weeks. Once the seedlings are up and at the four leaf stage they are potted on into rolled newspaper pots filled with the same seed raising mix. They stay in the greenhouse for two to four weeks, that way they get a good start ahead of the pests, and they can be left a bit longer if you get busy or the weather turns to crap!

Installing the Chooks

For many years we had chooks in a dedicated chook pen, but after reading about the Permaculture way of doing things we decided to put a **chook tractor** together so that

the chooks could dig over and manure the plots for us, while still providing wonderful eggs. I built the tractor from scratch; it is A-frame in shape and has the same footprint as the veggie patches with the bottom surrounded by chook wire and the enclosed top housing laying and roosting areas.

As mentioned earlier, they spend two weeks on each bed cleaning and manuring prior to replanting. When it comes time to move to the next bed all I do is cut down the taller stuff with an old machete and then we get on each and of the tractor and carry it to the next bed to be dug over. The chooks love getting onto a new bed and line up along the side of the tractor to watch me cut down the next bed, clucking with excitement.

While the chooks in the tractor dig and manure the plots, we have a “retirement village” for those chooks getting a bit long in the tooth (or is that beak?) to produce eggs. The retirement village is a deep litter system based on locally produced grass hay what they dig over, break down and eat any weed seeds from. The result is used as mulch on the veggie plots and calls more willing workers (lotsa worms) to help break down and cultivate the soil once the chooks have moved on so I no longer need to cultivate at all beyond a light hoeing to break up any compaction due to the chooks, particularly in wet weather.

Saving our Seed

This closes the loop and means that we can develop our own seed varieties over time that are adapted to our climatic conditions. I started out with the bigger easier seed like peas, beans and corn but then graduated to the biennials like carrots and onions and the promiscuous ones like brassicas.

To do it properly we needed to allow room in the beds for veggies to complete their life cycle and of course we needed to start with open pollinated varieties but that was not a problem as we had only been using open pollinated varieties for years. It is then a case of identifying our best examples of the types of veggies we wanted to plant then saving the seed from them.

Veggie bed covers

I noticed the increasing difficulty of getting a decent harvest during January and February some years ago and started fooling around with shade covers for the veggie bed. We have had coves for when I put the seedlings in during the hotter parts of the year for upwards of 15 years, but this was new. The shade covers use 50% shade cloth to knock the intensity of the sun back, allowing the plants to grow and reducing their need for water in the hot weather.

I have tried different types but it appears to me that the best design is to get 50mm irrigation pipe and put it over star pickets, then run a bit of timber along to support the shade cloth. The shade cloth usually goes on mid-spring and comes off mid-autumn, so that we are covered for the hotter parts of the year, but full sun can get through in the cooler parts. Without the shade cloth, getting any harvest at all during summer would be difficult, and our water consumption with be greatly increased.

High Efficiency Irrigation

Ollas buried pipe irrigators and buried capsules are now used to provide irrigation for all annual veggie beds in our backyard. More detail is available in section 7.0 of this eBook, setting up to irrigate wisely.

Veggie Beds - We have also had to muck around with our veggie beds a bit, and 7 (half) are now 3 metres long by 1.2 metres wide, giving us an extra 8 and a bit square metres of growing space, but which has to be balanced against the removal of the bed closest to the northern fence from service. The window of time we had to grow in it where there was sufficient direct sun was too small get a meaningful crop, so we do not use it

anymore. We have also started replacing some of the timber bed surrounds which are rotting, with Besser bricks, as can be seen above.

11.2 How we grow our perennial Vegetables

The difference between annual and perennial Vegetables is a fairly simple one, annual vegetables complete their lifecycle (seed sown, plants grow, flower and then seed) in one year. Perennial vegetables complete their lifecycle in more than two years. In between there are vegetables which complete their lifecycles in two years, referred to as biennials. There are quite a lot of biennial vegetables such as beetroot, carrot, kale and onions that are grown as annuals, being harvested before they can complete their lifecycles.

There are a number of advantages that perennial vegetables have –

- Once they are in and productive, they can remain that way for many years and don't need replanting annually.
- They are hardy and look after themselves, requiring less water and fertilising than many annual vegetables.
- They tend to be more resistant to pests and diseases that cause problems for annual crops.
- They can extend the harvest season – around here autumn can be a reduced produce time when the summer stuff has died off but the winter veg is not yet producing and Jerusalem artichokes and chokos are great contributors to our diet.
- They work well with no-till systems, you don't need to dig em up and replant them every year.
- Some like rhubarb and walking onions do well in full shade.

Taking into account the above, why would you grow anything else? Well they do have disadvantages, some, like asparagus, can take years to establish before you get a crop. Others, like Jerusalem artichoke, can take over if you don't watch them and some of the

perennial greens can become very strongly flavoured over time. The reality is that we enjoy our annual veg, but growing perennial vegetables complements our harvest of annuals, increasing the variety of foods we grow.

Arrowroot (*Canna indica*)

I originally placed some donated arrowroot them at the south end of our water garden where excess water drains out and while they grow fairly well there, the bananas are encroaching on their space these days. I harvested some of these roots previously and inadvertently put them down on the northern (asparagus) wicking bed in the front yard. It appears they like this area and have competed rather effectively with the asparagus. Some time ago I decided to try them out as food and harvested and peeled the roots and tried them boiled and baked. I was underwhelmed by their flavour. They would be OK if that was all there was to eat. I also extracted the starch from the tubers for use as a thickener in food, and it works well.

Homemade arrowroot starch thickener

Asparagus *(Asparagus officinalis)*

We have been growing asparagus in our front yard in a wicking bed for over ten years. It was so successful that we added a second one slightly north of the first one, but this has not been as successful because the mulberry tree has gradually encroached on it, reducing the amount of light it gets and some accidental arrowroot took over….. I add a bit of soil and mulch each year and not much else, the wicking bed ensures they gets plenty of water. As the spears come up in early spring, I harvest them and then after a couple of months of regular production I let them grow up into fronds. They will then sit there, sending up the odd spear until winter hits and they die back and I cut them off, ready for the process to start again in early spring.

Early spring and the asparagus spears are making their way to the surface

After harvesting is complete, they grow up and return energy to the roots

Broad Leaf Arrowhead (*Sagittaria latifolia*)

Also known as 'Duck Potato', Broad Leaf Arrowhead is a north American food plant which grows in water and produces an edible tuber that can look disconcertingly like an eyeball. It is quite productive but can be invasive so it needs to be isolated from the natural environment. I got hold of some when buying water chestnuts by mail and bought some arrowhead at the same time. I planted them at the same time and in the same manner as the water chestnuts (see below). We have also eaten them cut up in a stir fry like water chestnuts but find the water chestnuts to have a better texture. They also die back in winter, but sprout more quickly than the water chestnuts in spring.

Arrowhead corm on the left

Choko (*Sechium edule*)

The choko is the mascot (for want of a better word) of our website and we have been growing them for over 25 years. We primarily grow it over an old orange tree (now dubbed the choko tree) in our back yard. We have also grown it over the western wall of the chook retirement village to provide shade as well as chokoes. They grow up over the tree and onto the roof of the garage, and in a wet year they can go so far as to obstruct the solar panels and have to be pruned. They produce chokoes in autumn then die back in winter, providing lots of organic matter for composting system. They are easy to grow and you can start with a single sprouting choko. The young leaves and tendrils are edible and go well in a stir fry, although the older leaves are a bit tough to be palatable. The roots are also edible and have a water chestnut-like texture (At least that's what they seem like to me) We find that while the fruit is edible at almost any size, when harvest small – 25mm to 30mm long –and stir fried, they taste best, with a nutty flavour and crunchy texture.

The choko tree

Choko - Over the Chook Shed

Dandelion (*Taraxacum officinale*)

We don't grow dandelion in the sense that we cultivate it, but we do allow it to grow throughout the back yard and eat it ourselves as well as feeding it to the chooks. For the most part we just eat the leaves, generally in a soy sauce based stir fry with other

leaf crops, the salt in the soy sauce reduces the bitterness. The roots are edible as well but we have yet to do anything with them.

Jerusalem artichoke (*Helianthus tuberosus)*

This is another vegetable that is ridiculously easy to grow and is hugely productive, although you do need to keep an eye on it because it can become invasive. Many years ago I bought some tubers from the local supermarket in autumn, then kept them in the fridge and planted them out the next spring. Being aware that they can take over, I planted them in a triangular bed next to the northern fence and at the side of the worm shed. To make watering easier I installed three ollas, also in a triangular pattern. I cover the bed with some mulch from the banana trees and trimmings from other plants once they have died back. They have been there for many years and are still productive, but recently they have started mounting an expeditionary force towards the wood pile. They die back in autumn and we harvest and use them from then to early spring when they start to resprout. They are great roasted or in soups, just be aware they are fairly flatulogenic.

Ollas and partial harvest

The main bed

Making a break for it!

Okinawa Spinach (*Gynura crepioides*)

I was given some Okinawa spinach cuttings by one of the ladies at Permaculture Sydney West and I placed the cuttings in water for a few days so they could grow roots. Okinawa spinach is tolerant of heat and shade, but needs regular watering, is frost tender and if it gets away it can also become invasive. We decided to circumvent any of these potential problems by growing it in a large pot with a central olla, near the front brick wall of the house. It grows well and provides the occasional harvest, while being largely unaffected by the cold and/or dry weather we can experience here. It slows down but does not die back in winter due to the warmer microclimate being close to the thermal mass of the house.

Rhubarb (*Rheum rhabarbarum*)

We grow rhubarb in the front yard in a bed that was originally designed to be a shallow wicking bed, but it didn't really work like that and was converted to a conventional raised bed. About three years ago I decided to convert it to a hugelkulture bed, pulling the rhubarb and all the soil out, placing in a whole stack of tree trimmings and then refilling it with soil. I cut the rhubarb back pretty savagely and replanted it and it has since continued to thrive.

Sweet potato (*Ipomoea batatas*)

Sweet potatoes come in various hues, but from experience I have found that we only like the orange ones, so that is what we grow. While I have tried growing sweet potato in 20 litre buckets, they seem to do best straight in the ground. I originally grew them just by planting out commercial tubers but about 5 years ago I let a tuber grow slips (sprouts) cut them off and placed them in water to grow roots, then planted them out. It worked very well. We grow them in the front yard, in the LUFFA (Longitudinal understory food forest area) where the vines climb around the other trees and shrubs. They also die back in winter somewhat and then come back up in spring. They seem to taste best if they are harvested and then cured for a week or two in a warm dry place. We use them in curries, soups, cut up and fried as chips or just as a steamed vegetable. The leaves are also edible and are included in some of the recipes using greens that we cook.

Taro (*Colocasia esculenta)*

We do grow taro in the constructed wetland in the back yard and, along with some of the other perennials, they die back partially in winter, but not completely – they always retain some leaves which I think is due to the warmer microclimate near the back of the house. While the root is edible, we do not eat it because it is part of our greywater treatment system and so not suitable for consumption.

Water chestnut (*Eleocharis dulcis*)

Having enjoyed the delights of water chestnuts in Chinese restaurants and later used the tinned ones in our own home made Chinese food, I wanted to try growing them. Initially I tried in plastic pots sunk in a large concrete pot shaped like a half barrel filled with water, but for whatever reason they were never happy and certainly not productive. I decided to try a different tack and got hold of an old metal bath, sunk it in the ground and then put gravel in the bottom. I filled it with water then got hold of some 200mm plastic pots and cut 6mm holes in the side with a small wad punch. I filled them with potting mix, planted the tubers about half way down the pot, filled them up and put a layer of gravel on top to keep everything in place and sunk them into the filled bathtub. They have been growing there ever since. The die down in autumn and I harvest and use them until they start to sprout back up again the following spring. The water chestnut plant is easily distinguishable from the Broadleaf Arrowhead by their thin reedy leaf as opposed to the large arrow shaped leaf of the arrowhead.

Water chestnut on the right

Try Before You buy

Growing perennial vegetables has worked out well for us and I would recommend that anyone interested should give them a go. I have found when considering a new vegetable to grow, and this is especially applicable to perennial vegetables, get hold of some and cook them up for yourself or your family. This can save lots of frustration in the long run from spending all the time and effort growing them, only to have them rejected by the family because they don't like the taste or texture. Good luck!

12.0 Resources

12.1 Links to eBooks referred to in the text

Upwardly Mobile with Vertical Veg

Growing Sprouts and Microgreens

Low Cost, High Efficiency Irrigation

Chooks and the Choko Tree

Growing Veggies from Seed

Keeping the Place Fertile

Managing your Weeds Organically

12.2 Books

Indoor Kitchen Gardening – Elizabeth Millard – Cool Springs Press (US) 2014 ISBN 978 1 59186593 3 – This small book has lots of info about indoor gardening. Rather than getting stuck into growing it covers how to find growing space, getting started with indoor growing covering subjects such as soil, containers, artificial lighting and air circulation. The general stuff continues with details on common pests and diseases then moves onto indoor crops including microgreens and sprouts, mushrooms, wheatgrass, Pea, popcorn and sunflower shoots. The final section covers more conventional indoor vegetable crops. Glossy paper and lots of colour photos.

The Rurbanite – Alex Mitchell – Kyle Books (UK) 2013 ISBN 978 0 85783 072 2 – There are lots of ideas here on how to grow food in the city, from the soil up. Container growing is covered as well as seed saving, guerrilla gardening street gardening. Wild food and wildflower foraging is covered as well as raising chooks, quail, ducks and bees in the city. Lots of colour photos.

Paradise Lot (The making of an edible garden oasis in the city) – Eric Toensmeier - Chelsea Green Publishing (US) 2013 ISBN 978 1 60358 399 2 – This is the sort of book you read from cover to cover. It is the story of two guys who bought a duplex in the US city of Holyoke and proceeded to turn their shared backyard into a permaculture based,

low maintenance edible garden. A great read! No drawings, but there are a dozen or so colour photos in the centre of the book.

The Quarter Acre Farm – Spring Warren (Yup, that's her name!) Seal Press (US) 2011 ISBN 978 1 58005 340 2 – This is another cover-to-cover read. The author wanted to grow 75% of their food on their suburban block. There is a fair bit of "this is how I did it" and recipes for your home-grown produce are included. We have used a couple of the recipes. She also talks about preserving, animals and eating the weeds. No photos just a few line drawings.

Veg Street – Naomi Schillinger – Short Books (UK) 2013 ISBN 978 1 780 72112 5 – This one is a bit of a coffee table book, lots and lots of colour photos but not hugely information dense. It is set out with each chapter covering a month (starting with January) and each month giving information about which plants can be planted and which can be harvested that month (for the northern hemisphere of course). There is also a small section called Community Corner covering ways of revitalising your community around growing things, a page or two on potting various plants and also a "simple but Brilliant Ideas" page. Good if you want basic information.

The Small Edible Garden – Diana Anthony – David Bateman Ltd (NZ) 2008 ISBN 978 1 86953 705 0 – A very small book too! (64 pages) It gives good basic information on setting up and managing a small food garden, including containers as well. Details on soils, watering, sowing and planting are covered with information on growing fruit, veg and herbs as well as organic management principles. Lots of colour photos, good basic info.

Vertical Gardening – Derek Fell – Rodale Press (US) 2011 ISBN 978 1 60529 083 6 – The book opens with a discussion of what constitutes vertical gardening and its advantages, moving from there into choosing your site and preparing the soil. This is followed by several chapters discussing the vertical gardening options (arches, pergolas, trellises, hanging planters etc.). Composting, seed starting, pests and diseases, watering pruning and fertilising (all organic) are covered and there is a section on fruit and vegetables

suitable for vertical gardening. The book has some line drawings and colour photos as well as a fair amount of balck and white photos.

Vertical Vegetables and Fruit – Rhonda M. Hart – Storey Publishing (US) 2011 ISBN 978 1 60342 998 6 – The book is divided into 3 parts, the first part covers why you should garden vertically and the sorts of techniques used such as trellises, teepees, hanging, stacking, making towers etc. The second part goes into the details of growing annual vines vertically like beans, peas, cucumber and squash; and part three covers vertical growing of specific perennial fruit crops like berries, grapes and kiwifruit. There are no photos, but some coloured line drawings which work very well.

The Edible Balcony – Indira Naidoo – Penguin Group (AUS) 2011 ISBN 978 1 921382 53 6 – This is a great book! The main part is set up around the four seasons and what you can grow and harvest during that season and includes recipes. The great part of the book is at the front, where the author goes through how to plan and set up your balcony garden. Lots of great info, lots of colour photos too, and a few line drawings.

The Edible Balcony – Alex Mitchell – Kyle Cathie Ltd (UK) 2011 ISBN 978 1 85626 946 9 – As well as balconies, this one covers roof gardens as well. The technicalities of growing various crops in the city is covered including which are most prolific, which are easiest to grow, which do best in shady areas etc. Lots of colour photos.

The Edible Front Yard – Ivette Soler – Timber Press (US) 2011 ISBN 978 1 60469 199 3 – First the author goes into lots of detail on the sorts of crops that look good in a front yard, gives you a couple of designs and then shows you how to assess your own front yard. She takes you through how to drag your front yard back to scratch, what infrastructure you will need to put in and once everything is in, how to maintain it using organic gardening principles. Lots of information about setting up an under-used space to grow food. Lots of colour photos, but lots of how-to as well.

Ground Breaking Food Gardens – Niki Jabour – Storey Publishing (US) 2014 ISBN 978 1 61212 061 4 – This is not an in-depth how-to book. It is a very good ideas book though. The book shows you 73 different garden designs with each design being described in two or three pages. Designs include edibles on a patio, vertical vegetables, an edible knot garden, 52 weeks of salad garden, an Elizabethan garden….the list goes on. No photos but lots of colour diagrams. If you want to grow food but have run out of ideas, this one is worth a look.

Little House in the Suburbs – Deanna Caswell and Daisy Siskin – Betterway Home (US) 2012 ISBN - This is a broad brush book that starts out with why you would want to live the productive lifestyle in the suburbs and moves through growing veggies, keeping chooks, mini goats and bees to preserving and making your own skin care and cleaning products. The authors also take you through improving community in your neighbourhood and finish off with a stack of appendices about planting plans and other resources. The authors also operate a blog of the same name. There are quite a few colour photos illustrating the how-to stuff.

Growing Food in Containers

From Container to Kitchen – D.J.Herda- New Society Publishers (CAN) 2010 ISBN 978 0 86571 665 0 – This one bills itself as the "complete guide to the no-yard garden". It covers, among other things, selecting the right container and location, optimising soil nutrients, managing light, water and humidity, choosing fruit & veggies and treating pests and diseases. While not being a big book, it has lots of good information. There is a group of colour photos in the centre of the book, with black and white photos scattered throughout the book where appropriate.

Grow Your Own Crops in Pots – Kay Maguire – Michael Beazley (Royal horticultural Society) UK 2013 ISBN 978 1 84533 686 8 – The book is broadly broken up into sections covering fruit, vegetables, herbs and edible flowers. The book starts with a discussion of general planting techniques, planning, nurturing and protecting your crops in pots. It follows with a comprehensive listing the plants in each section, how to plant them in

containers and how to keep them happy. Each plant only gets a page or two but there are a large number of plants covered. Lots and lots of colour photos.

Permaculture in Pots (how to grow food in small urban spaces) – Julie Kemp – Permanent Publications (UK) 2012 ISBN 978 1 85623 097 1 – This book is also set out on the one-month-per-chapter principle. The stat of the book covers general principles and techniques of organic growing and permaculture. Then each chapter/month starts out with what is growing on her balcony that month and what food growing related things can be done during the month. Following is a few pages of discussion about a specific technique or project and the chapter is wound up with a page on the "herb of the month". Lots of colour photos.

Crops in Pots (Part of the "Green Guides" series of books) – Rachelle Straus – Flame Tree Publishing (UK) 2011 ISBN 978 1 84786 719 3 – This book has a small amount of information on a lot of subjects. It covers why you would want to grow food in containers, how to get started, what to grow and how to grow it,harvesting the produce, pests and diseases. There are also sections on the specifics of growing vegetables, salads, fruits, herbs and edible flowers as well as a section on frugal gardening. There are lots of colour photos.

Grow Your Own Vegetables in Containers (Also called "Organic Crops in Pots") – Deborah Schneebeli-Morrell – Cico Books (US) 2009 ISBN 978 1 907030 06 2 – The book starts out with general principles of organic gardening and how to get started and then goes into specifics of how to set up over 30 different types of gardens in pots. Some examples are sweet basil in a clay pot, red lettuce and shiso in metal tins, potatoes in woven sacks and eggplant in a rubber bucket. Lots of colour photos.

Urban Agriculture – David Tracey – New Society Publishers (CAN) 2011 ISBN 978 0 86571 694 0 – This is an ideas book with some how-to. It starts out with why we should care, turning your garden into a productive area, container gardening for condo's, adding food to home garden design, community gardens, community orchards and

urban farms. There are colour photos in the centre of the book with some black and white photos and drawings scattered throughout the book.

Citizen Farmers – Daron Joffe – Stewart, Tabori and Chang (Abrams) (US) 2014 ISBN 978 1 61769 101 0 – Lots of good basic how-to in this one based around biodynamic principles and permaculture. There are lots of plant lists (top 10 annual crop for edible landscaping, top 10 plants for making compost, top 10 edible fruit and nut trees etc) and tool lists (tools for sowing, tools for tilling, tools for growing etc.). The tilling advice does not translate to Australian soils however. Lots of colour photos.

Lawns into Lunch: Growing Food in the City – Jill Finnane – New Holland Publishers (AUS) 2005 ISBN 1 74110 209 X – This is a collection of stories about people growing their own in the cities, with an undercurrent of Permaculture and sprinkled with hints and recipes. Inspirational as well as practical, this is a good one.

Fresh food From Small Spaces – R. J. Ruppenthal – Chelsea Green Publishing Company (US) 2008 ISBN 978 1 60358 028 1 – Even taking into account this is from the US it has lots of good info about growing food in the city/suburban environment. Some unusual things like mushrooms and fermented foods like kefir are covered as well as bees, chooks and worms. Well worth having.

Urban Eden – Adam and James Caplin – Kyle Cathie Ltd (UK) 2004 ISBN 1 85626 501 3 – Not vast amounts of “How To” but a very inspirational book that has some great ideas for small spaces.

Fabulous Food From every Small Garden – Mary Horsfall – CSIRO Publishing (AUS) 2009 ISBN 978 0 643 09597 7 – A great book that really covers everything you need to know to get the best out of your urban/suburban space. Mary is the ex co-editor of Grass Roots magazine, how can it get better than that?

The Apartment Farmer (The Hassle Free Way to Grow Vegetables Indoors, on Balconies, Patios, Roofs and in Small Yards) – Duane Newcombe – J.P. Archer Inc. (US) 1976 ISBN 0 87477 047 5 – If you can get hold of, this is a good one. Lots of info about growing under lights and in containers and good detail on individual vegetables.

The Edible Container Garden (Fresh Food From Tiny Spaces) – Michael Guerra – Gaia Books Ltd (UK) 2000 ISBN 1 85675 089 2 – Good general book on container gardening, how to make and use containers as well as details on individual vegetables, it even makes reference to Permaculture.

Grow Your Own Fruit and Veg in Pots, Plots or Growbags – Steve Ott, Emma Rawlings & Roxanne Warwick – Foulsham Books (UK) 2008 ISBN 978 0 572 03494 8 – This is set out as an A to Z guide to growing vegetables, fruit and herbs with 1 or 2 pages per plant including varieties, growing tips and recipes. Good for what it is bearing in mind it is written for the UK experience.

Successful Small Food Gardens – Louise Riotte – Garden Way Publishing (US) 1993 ISBN 0 88266 818 8 – Good for those with some land around them in the suburbs although it does contain a section on mini gardening for mobile homes. There is also a section on edible flowers and one on edible landscaping.

Grow Your Own Groceries (How to feed your family from your own back garden) – Linda Gray – Spring Hill (UK) 2009 ISBN 978 1 905862 31 3 – Good detail on growing and using veg, herbs, berries and edible flowers. Also covers egg production and use and some information on preserving the harvest.

Harvesting the Suburbs – Jeff Hodges – Nature & Health Books (AUS) 1986 ISBN 0 949099 02 3 – While not a lot of data on individual vegetables this book is inspirational and gives lots of good information on planning your productive backyard based around Permaculture principles.

The Complete Urban Farmer – David Wickers – Fontana/Collins (UK) 1977 ISBN 0 00 635096 8 – This book has good sections on planning you layout and improving your soil as well as raising vegetables from seed, ideas for containers to grow in and storing, preserving and cooking the harvest.

Raise Bed Vegetable Gardening Made Simple – Raymond Nones – The Countryman Press (US) 2010 ISBN 978 0 88150 896 3 – everything you wanted to know about raising backyard vegetables based around a system consisting of three, four foot by eight foot raised bed modules.

Patio Produce – Paul Peacock – Spring Hill (UK) 2009 ISBN 978 1 905862 28 3 – Lots of good stuff about growing individual vegetables, fruit and herbs on your patio or small outdoor space as well as how to plan and get the best out of you patio farm. Obviously the section on the patio gardeners year needs to be adjusted to fit in with the seasons here in Aus.

A Little Piece of Earth – Maria Finn – Universe Publishing (US) 2010 ISBN 978 0 7893 2027 8 – A great little book covering growing fruit and veggies indoors, in window boxes, on terraces and balconies in borders, patios and pergolas. The book is unusual in that it includes section on rooftop gardening, foraging and community gardening. You gotta love it!

The City Peoples Book of Raising Food – Helga and William Olkowski – Rodale Press (US) 1975 ISBN 0 87857 095 0 – This is a great little book that covers the usual stuff like planning your garden, raising plants from seed and keeping up the fertility but then goes into some more unusual stuff like integrated pest management, roof gardening and community gardening. Another one to grab if you can find it.

Square Foot Gardening – Mel Bartholomew – Rodale Press (US) 1981 ISBN 0 87857 341 0 – Ground breaking at the time of its release, this book covers a system of backyard vegetable raising based on squares rather than row cropping. It is a comprehensive and

detailed manual on how to make the system work for you. There is a companion volume by the same author called “Cash from the Square Foot Gardening”.

How to Grow More Vegetables* (*than you ever thought possible on less land than you can imagine) – John Jeavons – Ten Speed Press (US) 1979 ISBN 0 913668 98 2 – This is a manual on how to implement the Biodynamic/French Intensive method of growing vegetables in your back yard. It goes through planning and preparing your beds, fertilisation and composting, seed propagation, companion planting and how to develop a natural backyard ecosystem. I had some difficulties with the process but maybe my understanding was faulty. This has recently been updated and republished. There is also a simplified edition by the same author called “Lazy-Bed Gardening”.

Escarole in the Bedroom (Growing Food Plants Indoors) – Jack Kramer – Little, Brown and Co (US) 1977 ISBN 0 316 50314 2 – As well as some good detail on how to grow individual food crops, this book provides some interesting information on areas to grow the plants indoors, using artificial light and what sort of containers to use.

One Magic Square (grow your own food on one metre square) – Lolo Houbein – Wakefield Press (AUS) 2008 ISBN 978 1 86254 764 3 – This is a wonderful book for the backyard food grower. Written for Australian conditions the author sets out a process of growing compatible plants in one metre square combinations, with lots of detail on each combination and individual crops. She also covers the why’s and wherefore’s of food self sufficiency and a whole stack of tips to make the process easier.

Incredible Vegetables from Self Watering Containers – Edward C. Smith – Storey Publishing (US) 2006 ISBN 978 1 58017 556 2 – This book covers how to make and use self-watering pots, what potting soil to use and which vegetables to plant in them to get the best yield. Although the emphasis seems to be on using commercial self watering pots, the data is good just team it up with the information on self watering pots on this site and you’re away!

Vasili's Garden: from the garden to the kitchen Mediterranean style – Vasili Kanidiadis – Wilkinson Publishing (AUS) 2008 ISBN 9781921332340 – This is a fun book, good to browse through, set out in a section for each season, it gives tips, hints and recipes for growing and using backyard veggies. It is very easy to read and was put together to support the TV series of the same name.

Vegetables for Small Gardens and Containers – Peter De Vaus – Hyland House Publishing (AUS) 1991 ISBN 0 947062 37 8 – This book covers location and planning of veggies, tools, crop rotation, preparation and planting, pest and disease control and harvesting and storage of your veggies. A good book for small scale growers and one of the first to cover container growing veggies seriously.