

# Growing School Gardens

## School Gardens - A unique but challenging opportunity.

This workshop will take you through how to make a successful start to school gardens.

School gardens like community gardens are all about growing connections, community and knowledge and less about growing food. Gardens fail because they are dependant on human surplus and good will not because plant fail to grow. So while its great to know about climate, soil, composting and plant growing, longer term success will be based on growing relevance, connections, community and thus passive support.

We are creating outdoor environments for learning via immersion, outdoor classrooms, nature play, gardens, orchards and wildlife habitats are all part of this School Garden space.

### 1. Who will Garden - Nature is always ready but are you ?

What school curriculum do you have supporting the gardens growth. Relying on a education department to get around to adding sustainability and food production into its programs is hopeful. There is lots of information online and in our shared notes on engaging non gardening teachers, and students with activities and thinking in the outdoor classroom that provide a unique opportunity to teach even those children unmotivated by class activities.

How many teachers are genuinely interested, and how can some of their time be freed up to get involved. You will need a passionate gardener in the teacher group to keep a ongoing focus and encouragement of the other teachers to keep involved. We have found that the energy/interest/motivation needs to come from the teacher rather than the allocation of x hours of dot time to do this new 'work'.

There is the reality that this will take time, the coordinating teacher might need 10 hours a week, and all other involved teachers will need 30 minutes of planning time and 15-30 minutes of their students class time out in the garden. Rushing children in and out of the dirty garden wont build much interest in any parties.

How can we get parents involved without making it a parent volunteer slave pit. You will need parent helpers, parents of kids in the class is best, stress they need know nothing about gardening they are their to help supervise the excitement of an outdoor classroom and hands on learning. The teacher needs to be involved. Once the classrooms teacher removes themselves from involvement there is no discussion or shared experience once you leave the garden, incorporation into the curriculum is not possible.

Parents are there to help, not run the class. Hopefully we have a helper or a child that is an experienced gardener, but they will not normally be able to teach or supervise.

The most important person in your school garden group will be the parent social butterfly, they know nothing about gardening but love to talk. Bringing after school parent chats and children's play into the school garden space will create engagement and ownership of the parent group and thus student group to the garden after hours. It will also create many more parent volunteers as they know what to expect.

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How and when do we get the kids involved. The school student group should be involved and encourage from the start, helping vision the space, helping draw/design the space, drawing elements they want to see in the space. We don't need to include all their ideas but the creation of their garden needs to involve them.

Have a community building day, parent, teachers, students, community groups and others all get together and build the garden in a day. Many people involved means many people with ownership and pride in their work.

The garden will need care over the weekends and during school term breaks, involving the community (elderly, community groups, neighbours) will allow a mutually beneficial school garden support. Reward these helpful locals by placing a community garden alongside, sharing produce, running skills sharing workshops, hosting swap, share, shuffles, and other community links.

## 2. Who can Help

Every Schools Biggest assets, The Kids, The Parents, and The Teachers. Don't forget to involve your gardeners and Canteen.

Local groups and Clubs - Rotary, Lions, Scouts, and other community groups.

Local business - Better if they are part of the school community (parents)- Supplies, organic wastes (coffee grounds, carbon, food scraps, skills.

Local gardening groups - Organic Association, PermacultureWest, Living Smart, Transition Towns Groups, Earth Carers, Waste Wise schools.

Experienced Individuals - Peter Coppin and Terra Perma (one free advice session to help you get started)

Experienced Schools - Your peers have done this before at many schools, visit them and have them come and help you. Stephanie Alexandra schools program is very detailed and helpful to review even if it is beyond your reach.

Large Corporations - Bunnings, Masters, Coles, Woolies, all looking to green wash themselves. While we need to avoid product placement we may as well utilise these slush funds to eco-educate our kids.

Government entities - Watercorp, Health Dept, Waste Authority -Grants and resources.

Private/ Association Entities - Nature Play WA,

## 3. Where to Garden

Whether you have lots of space (an old oval) or a small space (narrow strip between a path and building), you should start your veggie garden the same way. Start small and pack in all the goodies you can afford into the soil, provide your best observation and maintenance efforts, and grow healthy leafy greens that you can harvest each day to supplement your store bought veggies.

Success in this small space for you and nature allows you to work together towards expanding those successes and learning's into a larger network of 'mini gardens'. Think of a oasis of food and fun starting to grow, the fertility and surplus (human, soil and plant energy) of the first is used to grow new food islands, and gradually these connect to form a integrated school garden.

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Spreading your resources too thin in Perth is a good way to fail, Perth's climate, soil (sand!) and limited rainfall and water supplies are very unforgiving. Most of us are too busy to get into the garden to maintain it (harvesting for salad is not maintenance) during the week, if your garden can't survive the week without you it will generally die.

## 4. Locate the Garden

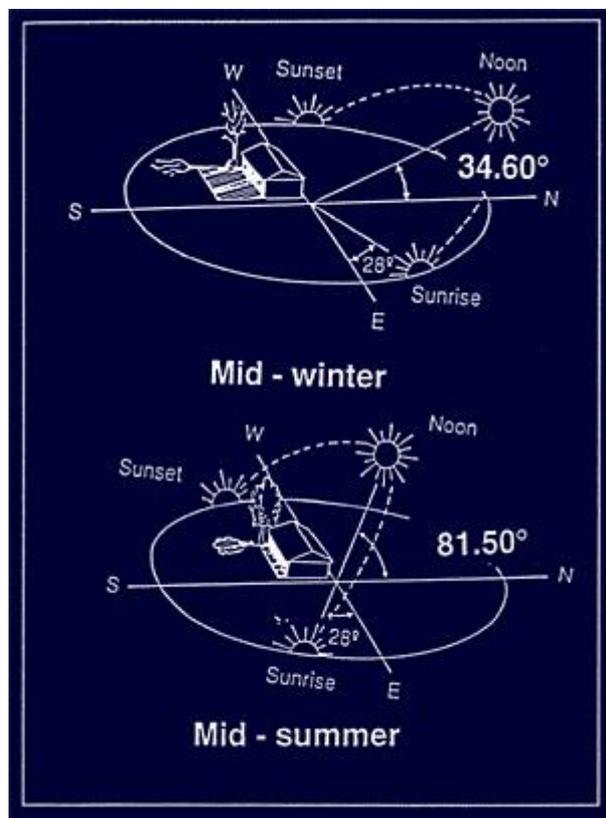
The location of the veggie patch and other elements in your space needs to be based on how those spaces are affected by sun and shade.

While other factors are important further considerations (soil, water source, accessibility), too much sun will kill veggies in summer. Aim for 3 hour early morning sun in summer (8 am till 11am). Then ensure/create dappled shade for the rest of the day, avoiding long afternoons of direct sun as these also kill stressed plants.

Getting out into your space - observing and feeling the sun, shade and heat - is the best way to identify current sunlight patterns, but we need to plan for the full year of growing.

A Sector analysis of your space is the best way to sort out how the sun and other factors impact over the year.

Note the longer sun arc in summer (more hours in the sky) and the different angle arcs of the sun (82 degrees in summer and 35 in winter).



## 5. A detailed Garden Design Process

Defining where to garden based on the sun, wind, and weather is the most critical in an urban backyard, but you can go into much more detail when looking at where to place all the elements you want in the garden. Sheds, paths, chickens, garden beds... etc, should be placed purposefully so they work together. You might like to use our design worksheets (summary below) on the website to have a go at this process. **For our Full Site Design Checklist For this Process and more details- See <http://www.terraperma.com.au/free-workshop-notes.html>**

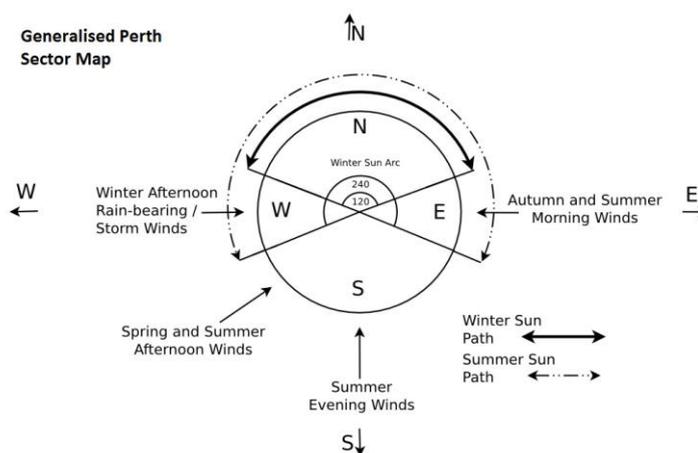
**Identify** - Needs/ Wants/Goals/Priorities/Clients (your school and wider community) Visions

**Onsite Data Collection** - Maps, Plans, Resources - Wood, Rocks, Waste, Existing Ecology - Plants, animals, Leaf litter. Climate, Rainfall figures, Sun angles, Sector Maps, Winds Energies. Water Sources, Soil - Types, pH, Site Problems, Waste/Opportunity

**Offsite - Think Big** - Unrestricted Imagination, First Impressions, Wildest Dreams

**Designing -Patterns to Details** - Broad to Specific - Wear the designers hat not owners hat.

1. **Sector Analysis** - Map the Natural Forces always acting on your site
2. **Sun** - Hot, Shade, Arc, Seasonal - Your design factor in Perth Urban.
3. **Water** - Runoff- harvesting vs erosion/leaching , Main design factor in WA rural.
4. **Nutrient Cycling** - Close the loop - Deep sandy soils mean this is essential to success in Perth.



- **Articulate Principles** - Review and ensure your being true to Permaculture Design Principles (<http://permaculturewest.org.au/resources/pw-principles-of-permaculture.pdf>)

### Detailed Planning, Element Research and System Design

- **Element Selection** - Plants, plant zones, structures, animals, habitat.
- **Element Analysis** - Map each desired element, document its needs and products.
- **Element Assembly** - Make connections, needs of one element met by products of another.
- **Zone planning** - Match your habits, frequent access elements kept closest.
- **Define Cyclic Nature of Systems (Interactions)** - Plants grow, fertility and minerals cycle, systems evolve.

**Define Timelines and Monitoring** - Keep it simple, start small, create in stages

## 6. Growing Soil - In Pots or in the Ground

Do you have a small space or large gum trees where you want to garden ? Or do you have a large soil space, and while you want some veggies, the bigger aim is establishing fruit trees and habitat ?

What you're aiming for will determine the better techniques of soil building, garden beds, and all other aspects?

On our urban home block have put 2 tonnes of clay, and 50m<sup>3</sup> of street tree mulch on my yard over the last 5 years as I want to turn the entire block into a food forest surrounded house with a semi closed canopy and highly diverse food ecology. This is a long term plan, perhaps 10 years in the making until the system will completely look after its self even in Perth tough summer climate. As I have fruit trees, herbs, veggies and companion plants all sharing the soil, it is a lower food yield than most veggie beds, however it is also lower input.

**There are two options to make a serious change to the sandy soils - clay or liners/containers.**

Either you must increase the water and nutrient holding capacity of your sand with clay, organic matter and dense plant systems in the topsoil; or you need to put a liner under the topsoil (like a perched water table) that stops the nutrients and water leaching out of the root zone.

Raised beds are accredited a lot of success, but this is more due to the fact of the total import of 100% new soil to fill the beds. This import of 'veggie mix' soil should give 12 months of good crops, but the reality is most of the nutrients will be flushed out into the deep hungry sand below, importing 100% new soil each year to refill these raised beds is a very costly process.

### 6.1 Pots - Containers and liners and Wicking Beds

Wicking beds are nothing new, think self watering pots and your pretty close already. They have a sub-soil reservoir (under the soil) catches water and nutrient runoff, then stores it allowing a slow and ongoing sub-soil 'upwards' watering via capillary action. This saves water, fertiliser, creates even 'natural' soil moisture conditions and allows much longer time between watering days.

Water travels upwards despite gravity thanks to capillary action and evaporation and condensation. Wicking Beds match our needs in Perth. Little or no rainfall and high evaporation over summer, watering restrictions, poor soils that leach/lose all water and organic matter rapidly

Advantages : all water and nutrients stay within reach of veggies, improved soil life / quality with soil moisture, cooler conditions, no hydrophobic issues and cycling of nutrients that would otherwise be leached away, don't require you to create loam soil, can be made cheaply from variety of materials.

#### Wicking Pots - Olive Barrel Pots

Wicking pots are based on the same principle as wicking beds, nutrient laden water normally lost below the shallow rooted vegetables and fruit trees is stopped and held under the soil to be brought back up as the above soil dries out. These pots are for high yield veggies (annual or perennial), avoid planting fruit trees and other larger perennial herbs that don't like wet feet in there.

This is not a new idea 'self watering pots' have been around for years. However we are re-purposing a by-product of olive importation (and old pot plants destined for landfill), the barrels are food grade and UV stable, so this is a great safe sustainable product.

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Compared to wine barrels they are much cheaper, and white ant and rot proof, and can be mobile (on casters or via occasional dragging). Compared to similar veggie pots which are especially made and imported from China.

A full 180 litre plastic barrel is used to make two pots, mark halfway between the ribs and cut with a saw. I use a circular cordless saw with a shallow depth to avoid it melting and blocking. A hand saw does a fine job but takes a little time to create the first cut to get the saw blade into.

Once you have two halves ensure the lid end has its rubber seal on and is tight so that it holds the water.

The drain hole shown is the only hole/outlet in the barrel.

This means the height you drill it defines the maximum height of the water reservoir. I aim for about the height of the pots as it is better if not too much soil is waterlogged and anaerobic.

To avoid anaerobic activity (smells) it is advised to allow the pots to dry out the reservoir each cycle. As the water moves up via capillary air comes in via the hole (replacing the void left by the water) to keep things aerobic.

The water sits in the bottom of the pot and is wicked (think candle wax or capillary action in trees) upwards into the soil as the soil/plants need it. Even without the water body touching the soil above, evaporation and condensation still allow the water to migrate up. The soil based capillary action works for about 30cm deep only so while you can make deeper soil you will need to top down water your seeds/seedling each day until they reach the wet zone.

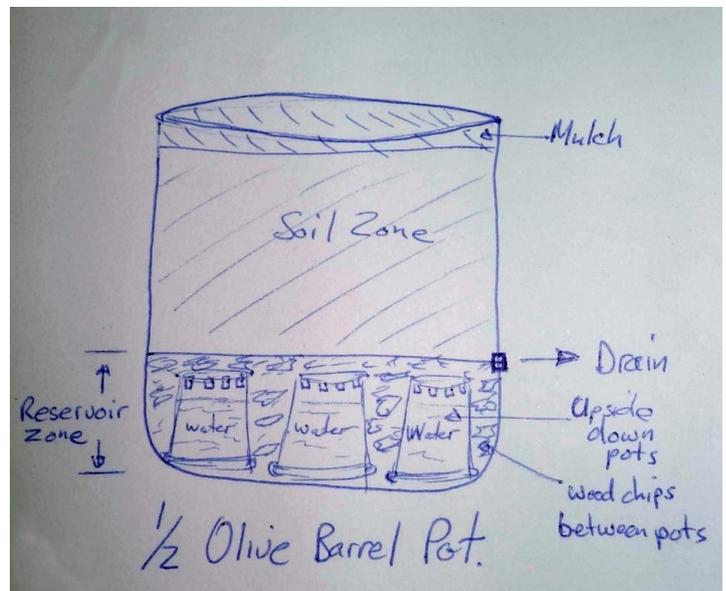
Water percolates down via surface watering or drip retic you don't need a tube down into the water to fill it.

There are many advantages of these pots, the main ones being your water and nutrients (fertiliser) that normally runs out the bottom of pots every time you water wont anymore. Saving you money and helping the environment.

Your reservoir can be created by the inverted seedling pots and mulch and should hold around 10 litres of water with another 10 staying in the wet soil. Empty pots are light, but strong enough to hold up soil, and crate a decent sized void for water to fill This 20L of water in the pot should allow you to water most plantings/veggies once a week in summer with mulching. You won't tend to water them in winter if it's raining.

Feed with compost, Lucerne/lupin mulch, coffee grinds, small amounts of manure to top up organic material. Feed with small amounts of complete organic fertiliser after yielding a crop or in 3 months time. Note that strong artificial fertilisers are likely to concentrate in the water zone and ruin your soil unless flushed out.

Keep your Wicking Veggie pot is in kit form until you have it in position as once filled with soil, watered and planted, they weight 60 kg. If you put it on casters which is a great option on decks/pavers etc, make sure the casters can take 50-60kg (recycle a office chair roller base). Purchase Olive Barrels (Plastic Barrels) via Gumtree 'search "plastic barrel". WA Barrels based in Doubleview - 0434206766



## 6.2 Wicking Beds - Lined garden Beds

The liner in a wicking bed can be anything that holds water, olive barrels are discussed above but wicking beds/pots can be made from broccoli boxes, buckets, bath tubs or anything else cheap and non toxic. One of the common options is to line a above ground bed (corrugated iron, brick, etc) with builders plastic, pond liner or a non toxic pond sealer paint.

There are options depending on scale, in bigger beds you might include a filler pipe, geotextile layer above the reservoir or a inert (long term) reservoir medium (like crushed brick, volumised clay, blue metal etc). Below is the design and construct instructions for the wicking Beds built at Duncraig Edible Garden outside Duncraig Library, you can visit them anytime.

### NOTES

- Wicking beds are ideal for high yield leafy greens and moisture loving herbs.
- not good for larger root veggies, fruit trees.
- allow reservoir to completely dry out to pull in oxygen and reduce anaerobic activity.
- keep drain clear to avoid watering logging in heavy rain and over watering.

Consider a wicking bed as just a fancy self watering pot - there is a reservoir of water under the soil. Hence we create a closed loop and very water efficient and nutrient efficient system where the only things leaving (as long as you mulch the top well) should be what you harvest and eat, plus a little transpiration (air-conditioning) from plant leaves.

### To create and lined bed or inground wicking bed,

Dig out the top soil, retaining the best (brownish), and remove the worst (grey. white, yellow) plain sand to another pile. Once the hole is 30cms deep, flatten/level the bottom and round the sides.

At this point you can choose to place a plastic liner down (cheap 200 micron builders plastic) or create a more expensive and tricky clay lining.

The edge of the bed can be steep if using plastic, but note that dry clay has a slumping angle so trying to create steep deep clay zones is futile unless you apply it wet like glue. The dry clay is spread, broadcasted so that you are getting a continuous layer of 20mm or so along the base and up the sides about 10cm if possible. While the sides are not essential, it will need less frequent watering in summer if I can apply more water less often, and have less risk of the nutrients leaching/overflowing out. Note that this clay can expand 5 times its size once wet so a rough 20mm thick layer should be plenty once it hydrates.

My garden beds are generally 2m long by 1.2 wide. This width is used as you can access them from both sides and reach around 60-70cm crouching and leaning. Note these beds should never be stepped on and compacted. Use wide walk planks if you need to. I chose these dimensions as it allows me to frame the in-ground bed with the old Jarrah sleepers if needed. There are lot of benefits having a formal edge to your garden beds that is trafficable, especially when you have kids. Basically, the bed is 1 sleeper long by ½ sleeper wide, there is no need to 'join' them. This leaves the arrangement flexible which I like.

After spending 2 years observing the excellent water and nutrient holding capabilities of in ground wicking beds lined with 200 micron builders plastic, I can highly recommend it, but I am now trailing the clay lined beds as a

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more long term tree friendly technique a long term view to moving to lower yield perennial food systems based on productive trees. Thus the fact that the clay, soil and moisture will in time be attacked/broken up by tree roots is not seen as a disadvantage but a bonus. In 2-3 years I will have a highly clayed, fertile, soft, growing zone for fruit trees and larger perennials, and will move high yield annual vegetable systems into other areas and systems.

After the clay layer, and while it was still dry (if adding water to the clay layer alone you must do it via fine mist or very slowly else you will blast a hole in your 'liner'), I threw in all the tree pruning's, branches 50mm thick, leaves, whatever there was, and cut it up enough so that it had a low enough profile to be less than the 300mm deep hole.

The hugelkultur aspect, borrowed off Sepp Holzer (and Austrian Permie) who put in whole trees into his contour beds on the alpine slopes of the Kromatahof. While we don't have frozen compacting soil to deal with (one of the main advantages of hugelkultur see more here <http://www.richsoil.com/hugelkultur/>), we do have sand with no organic matter or nutrient and water holding capacity. So the idea is to put lots of carbon in the bottom of the hole to create the 'water zone' of a wicking bed, and get lots of high nutrient compost and manures above it to grow on.

While there is much that might happen that is not expected, the primary needs of water and nutrient retention and leaching reduction should be sorted, and unlike the plastic lined beds the further needs of evolution into a permanent perennial food forest should also be well supported. In my case I was fortunate enough to have 1 year old 100mm thick street tree mulch everywhere, this was full of fungi action so a good 50mm layer of the best stuff went on top of the rough pruning's. The idea here is that the fungi will migrate to the pruning's to break them down further fast tracking the deep topsoil fertility development.

On top of the fungi I added the re-mineralisation, granite rock dust, basalt rock dust, and kelp powder was liberally broadcasted. The idea is that it is fungal and bacterial networks that farm trace elements and minerals and trade with plants for their sugars so I thought that I would make them nice and close.

I finally bough \$600 of vege concentrate from Greenlife soils as I (my soil) was ready. This was the 'soil' that I used in the top of the wicking hugelkultur beds.

I didn't use any barrier to stop the soil/sand/compost from silting down into the 'wet zone' and mulch/pruning's zone. While the water holding capacity of that zone will drop off I don't see it as a deal breaker given I am evolving the beds to become well amended perennial soils over time anyway.

I didn't add/use a slotted agricultural pipe of similar to get water in and air in. While it's important to do this to allow oxygen under the soil in a wicking bed to avoid anaerobic conditions, given the rough organic way I have made these beds I don't see this as essential either.

The clay was from a bulka bag, 1 Tonne from Milne StockFeeds (stockfeed suppliers are generally the cheapest source), I don't advise using 20kg bags at \$20 each to do this as it might take 3 per a bed. If you can manage the delivery/pickup a 1 tonne bag is only around \$300.

## 6.3 Above Ground Beds - Lasagna Bed

A Lasagna bed is a layered above ground bed made up of largely organic matter. It is almost a cold compost pile that you start planting/growing in straight away. IF done correctly this acts like a giant sponge, highly fertile but short lived (6 months). Often this type of garden bed is build in a raised bed (to keep it contained) or on top of a sheet mulch or road base/paving where it is not possible to garden down.

While you would not want your whole garden beds made this way it can be an excellent technique to rotate around to top up the organics in older exhausted beds. This is an organic input heavy technique so unless you have lots of scraps and access to straw and other carbon sources it will be a costly technique for a short term high output garden.

### Making Lasagna

All gardening should be done with what you have available, preferably a surplus/waste yield from your garden or local neighborhood, or at least a cheap bulk brown (carbon source) and a diverse range of green stuff, manures and food wastes. Add a little remineralisation and it's done.

The name Lasagna comes from the idea of layering the components, most simply you put 10cm thick carbon source, then 5 cm thick Green or Nitrogen Source. See the composting notes for what is considered carbon or nitrogen. Alternate these layers until you are 40cm to 60cm high. Note this beds rots down and sinks very fast and you can expect to end up with 1/3 the height of 'soil' once the carbon and nitrogen have composted so make sure you start with a thick/deep bed. You might choose to add 1/3 compost as a 3rd layer to give you more of a 'soil' for plants to grow into.

This techniques works well for plants like potatoes and others that don't mind their roots being shifted in the sinking soil or enjoy mounding up and growing extra roots up their trunks. Tomatoes will also enjoy this, but avoid root crops (carrots etc), legumes (to rich), and plants that take a long time to mature (onions, cabbage, etc).

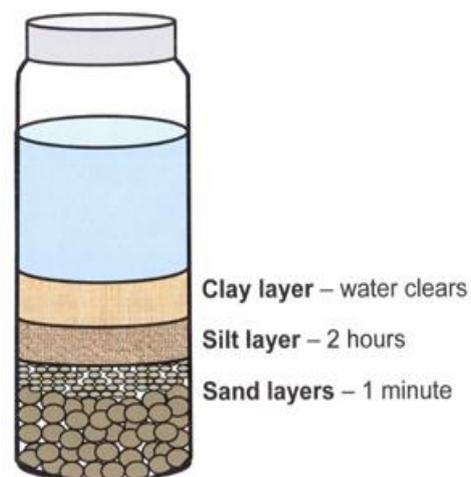
## 6.4 In the Ground - Claying and Blending your own Soil

Clay is the most important thing to add to Perth's sandy soils before adding organic matter and minerals. Watheroo bentonite is 100% clay. Good veggie soil contains 3-5% clay, so preferably cultivate into garden bed soil to 30-50cm deep at a rate of 10-15kg per m<sup>2</sup> or if this is not possible, then add 4-5 handfuls per m<sup>2</sup> under mulch (the clay is very sticky when it gets wet, so better to have it well mixed into soil).

Any clay is better than nothing.

Soil solver is a well blended soil amendment (clay, silt and minerals) with a high kaolin clay percentage.

Calcium bentonite which can also be used, it is 100% clay. This has the benefit of needing to add less to 'clay' your soil but you need to understand you are just adding clay. Bentonite sticks to



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bentonite so it must be mixed thoroughly or it will clump and be less effective.

A good soil is a mixture of sand, silt, clay and organic matter, just adding clay to sand does not make soil. Organic matter feed the soil food web, which intern feeds your plants so an ongoing supply (leaf drop, mulch, compost, manures, green manures) is also essential for long term soil health. You already have the '50% Sand' of loam, but you need replace the other 50% sand with 50% by bulk amendments. That is why building good permanent in-ground beds is a costly process, and should only be done IF you want/need that long term perennial soil.

## 7. Startup - Buy all your Garden Soil

An easy option is to buy Greenlife Soils Companies Veggie Concentrate and blend with 50% your sand. You should also add silt and clay for longer term soil texture and drainage. The concentrate can be purchased in bulk m3 or in bags. If you are using wicking pots we recommend using their potting mix instead.

Compost can be purchased from companies like custom compost, and C-Wise, the issue is that just adding organic matter to sand will leave you with just sand again in 12 months. 1/2 the organic matter is eaten by soil food web and fed to plants but the other half becomes small and rattles down through the deep course sand and out of the reach of plants. This is bad for your wallet and bad for ground water and rivers. So while some compost is great, compost and sand is also not soil.

## 8. Cycling the Nutrients - Waste to Soil

### So firstly, what are our wastes and what can we compost?

The best way to assess your nutrient cycling options is through mind-mapping. Firstly with "What wastes do I produce?" in the middle. Then followed by on with "Waste recycling options" in the middle. These will help us draw connections between what composting options are more likely to suit our lifestyle. For today we are mostly interested in what was once living so it can be recycled back into nutrients, but thinking as a Permaculture Designers, we should look at why we have all this waste and if it's possible to avoid getting it into our system in the first place (refuse/reduce).

### 8.1 Self Audit - your lifestyle and your rubbish

Education and Thinking starts with planning to Refuse, Reduce, Reuse, Recycle, Repurpose all things (not just food waste) in that priority. What do you throw out? Most people will have food waste, paper waste and plastic waste. By auditing your lifestyle and avoiding plastic (plastic free July is coming up if you want to take on that excellent challenge!) the carbon and food waste you are left with will determine what is the most useful waste composting system for you.

- Shop at home first. Use up what you have rather than buy more food. Learn to cook food to taste rather than strictly following a recipe. Use the internet, get a recipe for what food you do have in the pantry and the garden. You can list your ingredients and search for recipes based on that.
- Plan weekly meals (including quick and easy ones) so you only buy what you need, and are less reliant on packaging-intensive takeaways
- Take reusable produce bags and reusable grocery bags when food shopping to reduce plastic consumption. Unpack your food and pop the reusable bags straight back in the car!
- Buy unprocessed food with minimal or no packaging - Nude your Food! - <http://www.earthcarers.org.au/library/file/Fact%20Sheets/Factsheet%20-%20Nude%20food.pdf>
- Reuse leftovers rather than throwing them out.

**Organic 'waste' is a part of healthy wholefood diet so while we don't want to waste good food (leftovers, expired used by dates, etc) we will always have paper bags and cardboard boxes, apple cores, potato peels, outside cabbage leaves and other less desirable fruit and veggie 'packaging' to recycle.**

**Weeds and other garden wastes will also be part of a healthy natural space so these will be part of our nutrient cycling too.**

According to Foodwise, Australians discard up to 20% of the food they purchase, and up to 40% of the average rubbish bin is food. The average Australian household throws away over \$1,000 worth of food each year. Even before this food gets to us, 40% of the food the farm grows will be discarded as it is not perfect enough to reach the supermarket shelves.

Choose what wastes you want, if you can go plastic free nearly everything you buy is recyclable (council bins system) or compostable (at home) so you can be zero waste. It's your choice - feel empowered.

## 8.2 Add Minerals and Trace Elements to the Cycle

Composting our waste is essential, but we also need to realise that WA's soils are ancient and worn out therefore most things grown in our soils are mineral and trace element deficient. We've had no volcanoes or significant water flows from areas high in mineral content for a very long time and hence natural remineralisation has not occurred.

This means that compost made from these garden wastes (while well worth doing) is also low in minerals and trace elements. To address this you need to add the organic rock dust, rock phosphates, kelp and other remineralising amendments.

They are commonly found at farm supplies warehouses in bulk as 'farm fertilizers and stock feed supplements' or in smaller more expensive amounts in organic gardening stores as soil amendments. The cheapest place is to purchase them through stockfeed stores like City Livestock on Gnangara Rd, MicroBros, Elders, Green Life Soils. You might also find them closer at Dunn and Walton, and other small organic shops and nurseries.

We need to add the minerals in the establishment of a healthy, complete system. We need to understand the mineral requirements of the soil which acts as the plant feeding trough, but also where these minerals are being lost. A well managed composting system should cycle minerals once they are added with only what you consume from the garden acting as the 'loss'.

Where possible introduce remineralisation to the animals in your system rather than directly to the soil as this both balances the livestock health and adds biology to the excess nutrients that are then processed with the manure in your normal systems.

## 8.3 Composting Systems

Different composting systems suit different wastes and lifestyles. So what are the options and which should you choose after your "self audit"? Remember you can and should use multiple techniques to recycle your waste, as each one is suited to different wastes, volumes and frequencies. We should aim for diversity in our composting and be looking to integrate the composting into our lifestyle, animals and garden systems.

## 8.4 Bokashi

The smallest and most compact food waste recycling system is a bokashi bucket or container.

Bokashi composting is an anaerobic (it does not need oxygen) waste preserving system designed to be used in the kitchen. Food waste is layered with Bokashi mix (a pickling bacteria and it's bedding) in a Bokashi bucket. Due to the air-tight bucket and the micro-organisms present in the mix, the waste ferments (not composts). The Bokashi juice produced is alive with micro-organisms and can be used in the garden and around the home. When the bucket is full, the waste is transferred outside and buried beneath the soil to complete the composting process. Avoid putting this concentrated nutrient source in the same place each time. Too much of anything is not healthy.

This technique suits lower waste volumes or could be part of a combined system for larger homes. If you live in an apartment without an outdoor area for keeping a compost bin or worm farm a bokashi bucket may be the answer for you.

## 8.5 Garden Pruning, Chop And Drop, "Lazy Compost" and Mulch

Nature's way of recycling organic matter is to let the leaf and plant matter fall on the ground, pile up and reach a depth and concentration such that it holds moisture and supports bugs and biology which then break down the organic matter into humus and thus soil.

A quick and simple way of recycling your plant waste/pruning's is via 'insitu cold composting', basically chop and drop. You grow plants that produce lots of growth (organic matter) and you prune it heavily letting the plant matter drop around the plant on the soil. This is slow and ineffective at making usable compost but simple and quick to get done and in the long run the soil building effects are similar. The nutrients removed from the soil by the tree as it puts out new growth are then returned to the soil in the same general area.

Mulch is great for:

- Retaining moisture at the soil/mulch interface for a longer period of time, preventing 'crusting' of the soil surface, and providing a rich environment for worm and microbe activity which, in turn, aids the fertility of the soil and supplies nutrients to the soil for plants to use.
- Regulating soil temperature and protecting the root system and soil life from the extremes of summer and winter.
- Increasing the water penetrability of the soil.
- Controlling soil erosion by reducing water run-off.
- Controlling competing and unwanted self-seeding species.

Soil Cover Mulching, is highly recommended. If you don't have enough of your own to start with then get hold of street tree mulch and cover all of your exposed soil. Hopefully by the time that has broken down you might be creating enough of your own pruning's not need to get in more outside mulch.

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## 8.6 Composting Introduction

The organisms that make our compost need food, carbon, nitrogen, air, and water. When provided with a favourable balance, they will produce compost quickly. Other factors affecting the speed of composting include surface area/particle size, volume and temperature.

Our organic wastes provide food for organisms in the form of carbon and nitrogen. Bacteria use carbon for energy and nitrogen for building cell structure. Carbon and nitrogen levels vary with each organic material. **Carbon-rich materials tend to be dry and brown** such as leaves, straw, and wood chips. **Nitrogen materials tend to be wet and green** such as fresh grass clippings and food waste.

Almost all composting methods are considered to be either hot or cold:

### Hot composting (Brief)

This involves building and maintaining a high temperature at the centre of your compost pile, which is done by turning your compost regularly, keeping it moist and adding enough high-nitrogen materials. The heat generated breaks down organic matter extremely quickly and can even kill weeds seeds.

### Cold composting (Brief)

To cold compost, simply pile your organic waste and let nature take its course! While virtually no effort is required, this method takes a lot longer to create compost and won't kill seeds.

#### 8.6.1 The compost Cake - Ingredients

A Carbon to Nitrogen ratio (C:N ratio) ranging between 25:1 and 30:1 is the optimum combination for rapid decomposition. If ratio is more than 30:1 carbon, heat production drops and decomposition slows. You may have noticed that a pile of leaves or wood chips will sit for a year or more without much apparent decay. When there is too much nitrogen, your pile will likely release the excess as smelly ammonia gas. Values in table below are calculated on a dry-weight basis. Blending materials to achieve a satisfactory C:N ratio is part of the art of composting. That said, the C:N ratio does not need to be exact. As well as getting the C:N ratio right we also need to meet the key needs for the later controlling factors.

MATERIAL	C:N RATIO	MATERIAL	C:N RATIO
Woody Vege stalks	50-100:1	Manure, horse and cow	20-25:1
Fruit waste	25:1	Paper	170-200:1
Grass clippings	12-25:1	Sawdust	200-500:1
Hay, green	25:1	Seaweed	19:1
Leaves, deciduous	21-28:1	Straw	40-100:2
Leaves, pine	60-100:1	Vegetable waste/Weeds	12-25:1
Leaves, other	30-80:1	Wood chips	500-700:1

- **Nitrogen– Green**, newly cut – 1 pile of fine (eg fresh lawn clippings), one pile of coarse (eg freshly chopped up weed/tree stalks), a bucket of wet food scraps.

- **Carbon– Brown, dry** - one pile of fine carbon(eg old sawdust out the chookhouse), one pile of course carbon (Bail of Straw)
- **Activators**– molasses (diluted), kelp (diluted), liquid worm castings (diluted to the colour of weak tea), (mix up in a couple of watering cans and have ready to go on nitrogen layers), sour milk, old compost, herbs (comfrey, yarrow, stinging nettles) Try 1 kg of rock phosphate, 1 lts of molasses, and 1 lts of kelp powder .
- **Minerals** - Rockdust– to increase the mineralisation of your soil at least 1 kg.
- **Water**– have a hose ready to water in the carbon layers or watering can with water and molasses in it..
- Put all this in a pile 1.5m high x 1.5m wide, and it will start to compost if you look after it.

### 8.6.2 The Factors Controlling Compost

**Air** - Proper aeration is a key environmental factor. Many microorganisms, including aerobic bacteria, need oxygen to produce energy, grow quickly, and consume more materials. Aeration involves the replacement of oxygen deficient air in a compost pile with fresh air containing oxygen. Natural aeration occurs when air warmed by the composting process rises through the pile, bringing in fresh air from the surroundings. Air flow can be negatively affected if large quantities of finely sized materials (such as pine needles, grass clippings, or sawdust) are used, or if materials become water saturated.

The easiest way to aerate a pile is to regularly turn it with a pitchfork. Turning will fluff up the pile and increase its porosity (air flow paths) and should bring cold uncomposted material into the hot centre zone. To aid turning, contain the compost pile in wire wrapped in a circle, or light welded mesh., unclipping and removing the ring when you need to have access.

**Moisture** - Decomposer organisms need water to live. Microbial activity occurs most rapidly in thin water films on the surface of organic materials. A general rule of thumb is to wet and mix materials so they are about as moist as a wrung-out sponge. Material should feel damp to the touch, with just a drop or two of liquid expelled when squeezed in your hand. If a compost pile is too dry, it should be watered as the pile is being turned or with a trickling hose.

**Temperature** - Temperature is another important factor in the composting process and is related to proper air and moisture levels. As the microorganisms work to decompose the compost, they give off heat which in turn increases pile temperatures. Temperatures around 55°C indicates rapid decomposition, and will kill off pathogenic bacteria and fungi like Ecoli, but temperatures greater than 70°C reduce the activity of most organisms. Lower temperatures signal a slowing. The temperature range and what to do when is listed later.

**Volume** - In order to become self insulating and retain heat, piles should ideally be about 3m<sup>3</sup>. The larger size retains heat and moisture, but is not too large that the material will become unwieldy for turning. Smaller compost piles will still decompose material, but they may not heat up as well, and decomposition is likely to take longer. The more “surface area” available, the easier it is for microorganisms to work, because activity occurs at the interface of particle surfaces and air. But as mentioned before, don’t “powder” materials, because they will compact and impede air movement in the pile.

## 8.7 Hot / Thermal Compost

**As mentioned, hot composting is tricky and hard work, if you are going to do it do it properly.**

**Tumblers** - Compost tumblers can make hot composting 'turning' much easier. These systems can be purchased or home made out of drums with holes drilled. The benefits of thermophilic (hot) composts (killing pathogens, weeds seeds and composting meat and bones) can be produced in these systems, but the risk is (as always) that

you are not successful and end up with a contaminated mess. Compost rolling with simple ingredients like grass clippings and other fine food waste is recommended as a starting point.

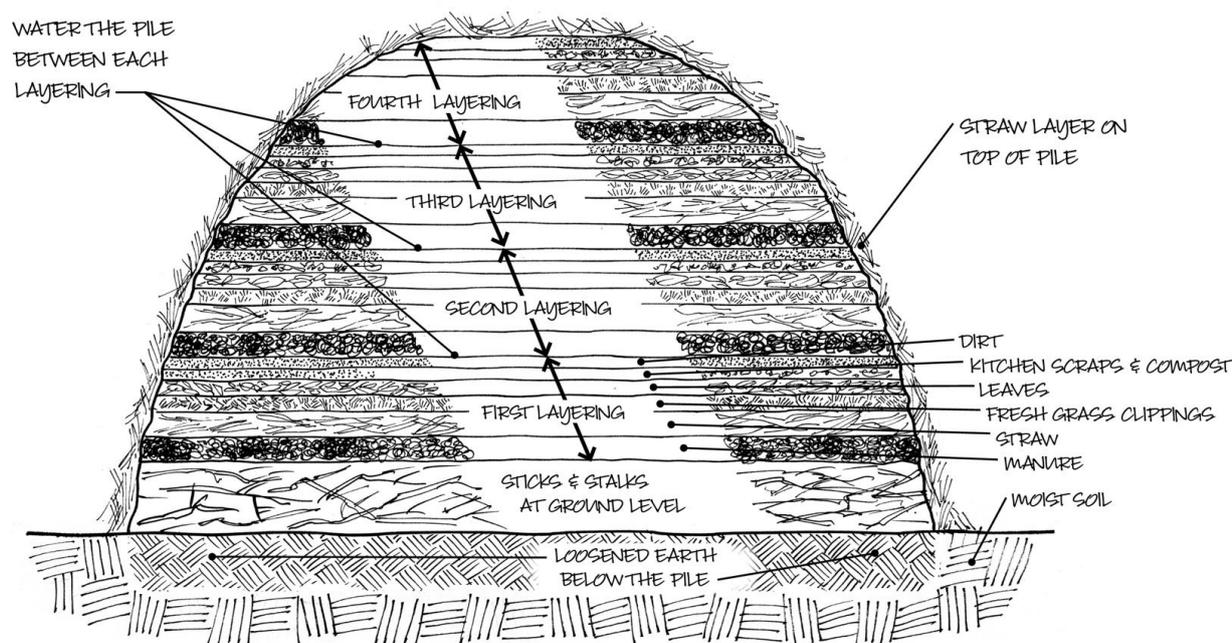
**'Pile' Thermal Compost Recipe** - Driving Principal: 'A diversity of materials ensures a diversity of microbes'

- 2 m<sup>3</sup> 'brown waste' - may include mixture of straw, old weeds, sawdust, wood chip, paper & cardboard.
- 1 m<sup>3</sup> of 'green waste' - may include a mixture of hay, fresh cut grass, fresh cut weeds, etc.
- 1 m<sup>3</sup> of high Nitrogen materials such as a mixture of manures, old wool, food scraps, etc

To the above we will add the following to build up minerals and trace elements, plus to make a best case compost we can to 'inoculate' the Aerobic Tea (Probiotic) Solution. You don't need these additions, but it's worth the expense to put in at least 1/3 the amount if you want remineralising compost.

- 10 kg of rock dust,
- 10 kg of rock phosphate,
- 10 lts of molasses,
- 10 lts of kelp powder
- Tarp to cover the compost usually about 5 mts x 5 mts.

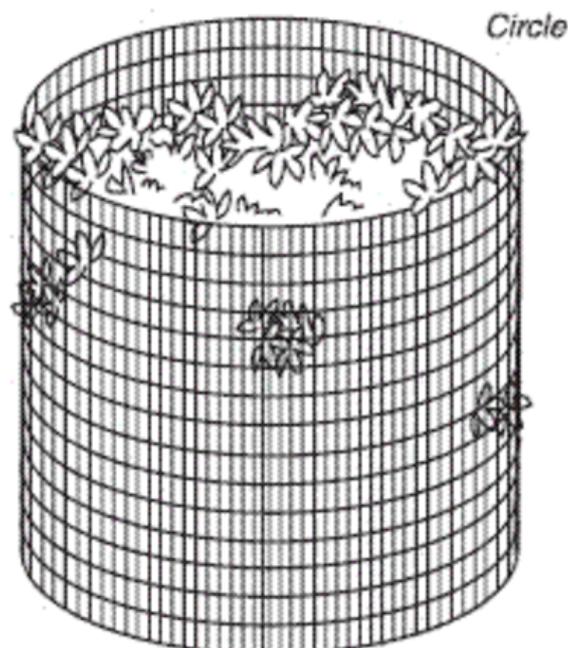
REPEAT LAYERING UNTIL THE PILE IS ABOUT 6 FEET HIGH.  
AS IT CURES, THE PILE WILL SHRINK TO ABOUT TWO-THIRDS  
OF ITS ORIGINAL HEIGHT.



**'Wire Cage' Thermal Composting Technique**

- Make the compost in a circular wire cage, use welded wire fence ~ 6m length. Mesh size is 50mm x 75mm and ideally about 1m height. If available, get the 'heavy duty' wire. To turn pile, undo wire, relocate within a fork throw, rejoin wire.
- A tarp to cover the compost usually about 5m x 5m.

- Compost materials - 'A diversity of materials ensures a diversity of microbes' - What we would like to have is a large diversity of materials, so some of everything you can find.
- Create a base of coarse carbon to allow low flow ventilation, then stack as per 4 brown, 3 green, 2 nitrogen, using a wheel barrow to portion it. Having coarse brown material allows air in so avoid too much paper, grass clipping and other fine carbon that will mat down and form dense "paper mache".
- Layering via the 4 brown (carbon)-3 green (carbon and nitrogen) -2 Nitrogen ratios with a wheel barrow allows good control and with coarse material allows good oxygen flow. This is why these compost piles should only need to be turned every 10 days, about 5 times (50 days) and it should be done. Over the course of the pile keep an eye on the moisture levels. It must be kept moist to allow the pile to 'cook' properly.
- As the centre of the pile is the hottest part, ensure that when turning, the cooler outer edges of the pile gets turned into the centre to ensure the correct temperature for killing weed seeds and possible pathogens.
- Turn compost when it approaches 68 to 70°C or too hot to keep hand in middle.
- Compost is done once composition is fine, earthy brown and cool.
- Finished compost can be kept for 3-6 months in a dark, moist environment. The bugs hibernate and can be re-energized. However as with everything the sooner the better.



### Detailed Temperature Management - Turning based on temperature not days

Below is a suggested guide for the turning temperature in your pile and the accompanying turning schedule. If the pile is turned in a way that maintains the correct temperature and moisture in the pile, you can be confident your oxygen levels are appropriate also.

- Day 1 temperature: 20°C, similar to air temperature
- Day 2 temperature: 10°C increase in temperature to 30°C-40°C
- Day 3 temperature: Optimally you have achieved 50°C-65°C in the core of the stack
- Day 3-10 temperature: Maintained between 50°C-65°C (with proper moisture levels maintained)
- Day 11 temperature, 1st turn: Turn the stack and temperature may drop to 40°C, moisten with fine spray if needed whilst turning and mixing the stack.
- Day 12 temperature: Returned to 50°C-65°C and maintained until 2nd turn at day 20.
- Day 20 temperature, 2nd turn: Turn the stack and it should be turned every 10 days to maintain moisture and for aeration, once stack is turned, temperatures should be in the 40s°C.

- Day 22-24 temperature: Similar to day 12. May be slightly cooler, temperatures in the 50s and maintain temperatures in the 50°C-60°C range for 10 days until the next turn.
- Day 30 temperature, 3rd turn: Materials should show signs of decomposition
- Day 30-35: Temperatures return to the 50s°C and maintain temperatures in the 50s for an additional 10 days with good moisture management.
- Day 40 temperature, 4th turn: Temperatures drop when turned, and increase to 45°C-55°C over the next 5 days. There should be significant signs of decomposition.
- Day 40-45 temperature: Temperatures in the high 40s – 50°C and maintained for the next 10 days until turned on day 50.
- Day 50 temperature, 5th turn: Temperatures dropping with increased signs of decomposition. Stack may now be about half its original size. (Note: you might reduce the diameter of the wire cage to increase height of the stack or combine two stacks into a single stack if making multiple stacks).
- Day 50-55 temperatures: Dropping to 30°C to 40°C with extensive decomposition once temperatures are 10°C above air temperatures, compost is ready to be used.

## 8.8 Cold Composting

Cold composting is slower at creating usable fine compost. However it is a lot less effort and you can put this 'compost pile' near a plant you wish to feed with the slow release of fertility that occurs as it breaks down.

Depending on what you compost, there can be issues with mice and cockroaches when you cold compost. Cold compost piles suit large and rough garden pruning waste, leaves, grass clipping and other dryer food waste. If you have lots of wet food scraps, you should use a container or go for an animal based 'composting' option.

**Pile or Heap** - If you have all the ingredients but no wire, you can make a heap/pile. Cold compost won't be turned so it goes initially hot then cools and composts slowly.

**Bays** - Compost bays are popular, 3 bays allows you to run two lots of compost on the outer bays and use inner bay to 'turn' the compost in between. Bays are also a neat way to accumulate/store ingredients for a big hot compost batch.



**Pit Composting (Scraps in holes)** - Pit composting is not recommended in Perth's coastal sandy soils, as nutrients rapidly leach away to contaminate rivers and ground water. If you pit compost be sure to add 30-1 carbon to nitrogen rich food waste.

**Containers** - Gedeyes Bins and other commercial compost bins (either above soil or partially buried) can keep pests out and allow an ongoing addition of scraps until full. Having more than one allows you to leave the full bin to compost over 3-4 months. Place these bins near a fruit tree and feed the tree without ever needing to 'harvest' the compost.

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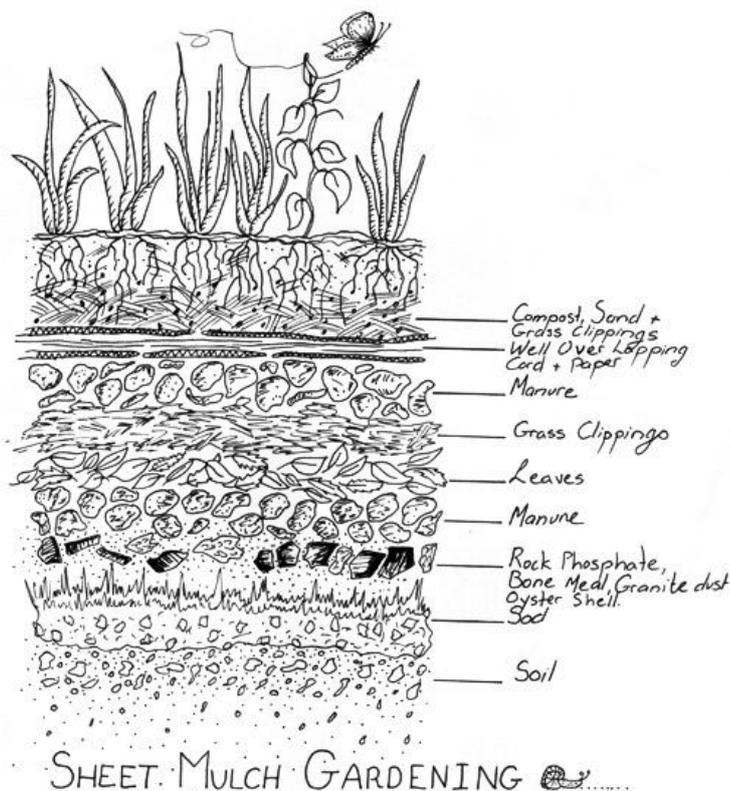
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## 8.9 Sheet Mulching

Sheet mulching is a technique we can use to cover the top soil (smother) to control weeds or garden above the generally deep poor sandy soil. Sheet mulching is often suggested to smother lawns to start a garden instead,



and while this does work you need to be very careful to use lots of cardboard/paper, overlap it well, avoid too many edges and tree holes, and be prompt about removing or treating runner grass that finds its way through. Feeding the grass under the mulch will actually make it rot faster, but you are not to plant trees below the cardboard layer (in the old soil) for 6 months.

Layer 1 is the "bottom layer" and consists of 'Concentrated Compost' up to 15cm thick. This layer is made up of material that is high in nitrogen and **note it can/should be contaminated with weed seeds** - often you are placing it on very invasive couch/buffalo grasses anyway. It's the best use of these seedy weeds. This nitrogen boost works to stimulate soil life and jump-start the decomposition process. Manure, yard waste, food scraps all work well. If working with sandy

top soil then add clay - Bentonite or whatever is available. Alternatively, if working with heavy clay soils, use a pitchfork or crowbar to break up and aerate them, and add gypsum instead. Consider any other necessary amendments, rock dust, trace elements, dynamic accumulator plant material, but the soil food web will evolve/create the new top soil issues so don't waste time correcting pH's etc.

Layer 2 is the 'Weed Barrier' - 4 to 6 sheets of newspaper (non-glossy), a layer of cardboard, bur-lap bags, etc. all work well. The biggest cardboard boxes recycled from nearby industrial area bins is the best as it allows fast minimal penetration points and lots of space for over lapping - Fridge companies, bike stores, car parts retailers etc. Overlap sections along seams by at least 10cm to prevent weeds from penetrating. Thoroughly wet it down to speed up de-composition and prevent it from being blown away.

Layer 3 is the 'Compost Layer'. Generally 5-10cm thick, use fully-decomposed compost, straw, grass, leaves or any other **weed-free** organic material.

Layer 4 is the final 'Top Layer'. Again use a high carbon, **weed-free** material such as straw, leaves, wood chips, bark or sawdust. This layer will need to be repeatedly renewed as it decomposes. You are likely to plant in seedlings with a little soil for roots or wait for this to rot down prior to planting. If doing this in summer, it is wise to apply a water saving mulch thickly as previously discussed.

## 8.10 Lasagna Beds or NO Dig Garden Beds

### What to use

**All and Any organic matter.** Whatever you have that is organic available in bulk and cheap or free, we are after a decent ration of carbon to nitrogen as we are composting but otherwise anything will do. Composting needs a ratio of 30:1 Carbon to nitrogen, so you need lots of brown (dry leaves, straw, cardboard, street tree mulch) if your other main material is food waste, green lawn clippings and manure.

### Why No Dig ? -

- Perth soils are very poor, the deep sand is hard/expensive to 'amend' to stop it losing ( via leaching and microbial activity) your fertility (compost/carbon) every year, when simply gardening and watering.
- Buying high quality garden soil or compost is expensive - \$100/m<sup>3</sup> so \$100-\$200 a Bed.
- **No Dig is 'cold composting' so you can grow in it, and it's easier than hot composting.**
- No Dig is also a worm farm (vermi-composting). Perth is hot, and nutrient rich, moist garden beds are a better place for worms than black plastic worm farms.
- No Dig automatically makes water and nutrient wise gardens, as your growing in a giant living sponge.

**Nature knows how to garden, so put in the 'food' and leave it up to the expert to grow your soil and veggies**

### Technique and Tips

- ✓ Place cardboard/Newspaper down first to smother weeds and give a bit more of a barrier to nutrient leaching. You can 'No dig' on hard stand, but the bottom layer should be coarse to allow drainage, and surround with lots of woodchip mulch to sop up excess nitrogen/leachate.
- ✓ Soak the paper and all carbon/dry materials in a wheelbarrow as it's much easier and effective than hosing them.
- ✓ DONT 'No Dig' over runner grass (couch or buffalo) unless you are very careful as you risk filling your garden with grass and having to move everything to get it out.
- ✓ The base layers are a good place to put weeds with seeds. Never to see the sun again.
- ✓ Alternate 10 cm of brown, dry carbon material (straw, mulch, shredded cardboard) with 5cm green nitrogen rich material (manure, food scraps, fresh grass cuttings). This is the same as compost, so think 30-1 carbon to nitrogen.
- ✓ The bed will end up half its high. If you want 30cm of black soil in 3 months create 60cm of lasagne stacked material now.
- ✓ If you top/cap you 'No Dig' with compost or soil you can plant straight away but understand it will subside. The soil will get better after a few weeks/months.
- ✓ Put a coarse mulch over the top to reduce water loss and airborne weed seed germination.

## How to make a no-dig garden

### 1. BED PREPARATION

- If you want to grow vegetables, choose a location for your garden bed that is protected from strong wind and that receives a minimum of four to six hours of sunlight a day.
- Cut long grass and clear stones and other unwanted materials such as dried seeds and weeds, so they do not grow in the mulch. Cut grass can be left on the ground.
- Prepare the garden bed by marking it out. To deter grass from invading your garden, construct sturdy edges with material such as timber or bricks.

### 2. SOIL PREPARATION: THE NITROGEN LAYER – AND WATER

- If you are building a garden on sandy or low-fertility soil, add a fertiliser layer about 2cm thick; compost, worm castings, manure and/or a sprinkling of dynamic lifter or blood and bone will improve soil fertility.
- To allow these nutrients, water and air to penetrate to the rootzone, open the soil using a garden fork. Push the fork into the soil as far as it will go, then move it back and forth to open, but not turn, the soil. Water sufficiently to moisten the soil to the root zone.

### 3. LAY THE WEED BARRIER: THE CARBON LAYER

- Cover the garden with newspaper that has been well-moistened so that it will not blow away – about 10 pages thick. If you have invasive grasses such as kikuyu or couch that spread by stems that grow horizontally, lay a thicker layer of newspaper to block light and discourage growth.
- Overlap pages by one-third their size to discourage weeds.

### 4. ADD A FERTILISER LAYER: A NITROGEN LAYER

- Spread a fertiliser layer of compost/wormcastings/grass clippings/manure to cover the paper. This will act as a slow release fertiliser and will become available to the plants over time.

### 5. LAY THE WEED-FREE MULCH: THE CARBON LAYER

- Lay mulch such as composted stable sweepings/hay/straw/lucerne hay on top the nitrogen layer to at least 10cm thick. A thicker layer is alright. Repeat nitrogen and carbon layers if needed.

### 6. PLANT SEEDLINGS AND SEEDS

- Germinate small seeds in pots for transplanting into the garden. Large seeds such as peas and beans can be sown directly into the bed.
- To plant the seedling or large seed, make small holes in the mulch to the depth of the newspaper, fill with compost and plant the seedling or seed into this. Don't plant the seed too deep – just to double the size of the seed. Some gardeners slit the newspaper with a trowel or knife so that the seedlings roots can penetrate the soil below.

### 7. WATER WELL

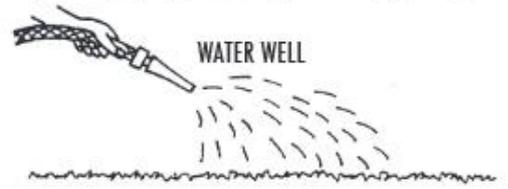
Give the garden a thorough watering to soak the mulch.

#### STAY WELL, STAY HEALTHY...

Compost and stable sweepings may contain living organisms that, on rare occasions, could cause illness. Precautions include:

- moistening compost/ mulch to avoid micro-organisms becoming airborne
- wearing gloves to protect broken skin
- washing hands after handling materials
- wearing a dusk mask if you suffer from asthma or respiratory disorders
- if you handle animal manure, such as found in stable sweepings, consider vaccination against tetanus
- protect yourself from sunburn with suncream and hat
- drink plenty of water while gardening.

#### CUT GRASS AND WEEDS



#### OVERLAP NEWSPAPER BY A THIRD



#### MARK OUT PATHS



#### ADD NITROGEN LAYER



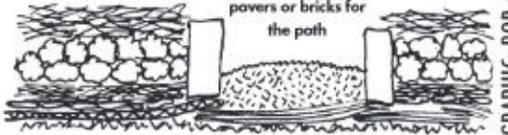
#### ADD CARBON LAYER



#### ADD NITROGEN LAYER



#### ADD CARBON LAYER



GRAPHIC: ROB ALSOP ©

#### REFERENCES

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## 8.11 Worm Farms and Vermicompost - Recycling using worms

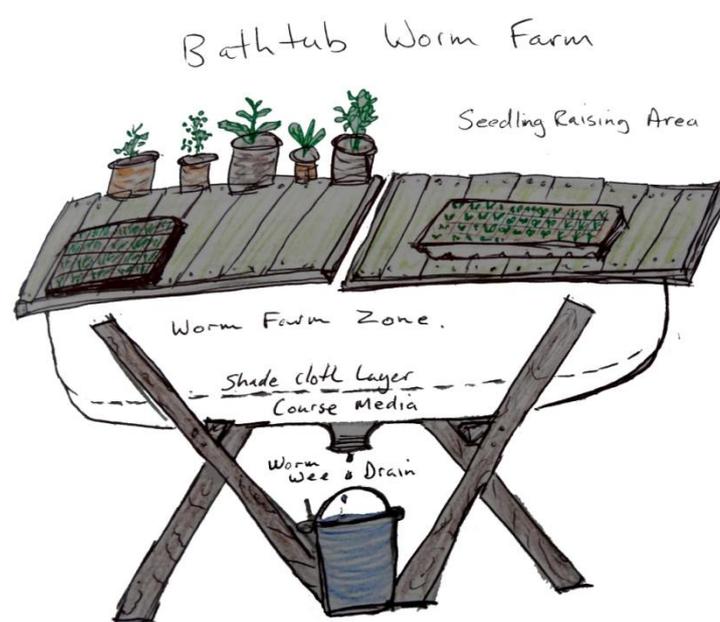
One of the easiest ways to recycle organic waste is to set up a worm farm. Particularly for urban environments or the novice composter, worm farming is the best. They recycle by digesting decomposing organic matter and converting it into a form that plants can assimilate as nutrients. They also till and aerate the soil, eating at the surface and eliminating lower down and by doing so, introduce organic matter to the deeper levels and increase the depth of the precious topsoil.

Worms eat their own body weight each day. Imagine if we did that! **HINT: Worms eat bacteria eating food scraps** the more you break up (blend) the scraps the more bacteria can access its surface area and the faster the worms can 'eat' the scraps. An whole apple will not be eaten by earthworms for months.

Under the right conditions they will breed approximately 20 new worms a month, that's about a million or more a year, and they'll be capable of eating through about a tonne of waste a day.

There are many models of worm farms on the market but it's too easy to make your own at home. Common worm houses can be bath tubs, concrete laundry troughs, foam boxes, de-commissioned fridges, plastic bins and even as simple as a perforated plastic pot half buried in the veggie bed that you put your kitchen scraps into.

Keep them in the shade; keep them moist, free draining and easily accessible for the best success. Harvest the friable castings as super rich fertiliser for the garden and the worm 'wee' as a gentle soil conditioner for all plants.



Worm towers. Can be buried in the ground

The fibreglass baths are built on trestle style legs with a gentle slope towards the plug hole which enables easy draining of the worm 'wee'. A slatted bench top in two sections gives access to a section at a time for feeding the worms & removing the rich castings.

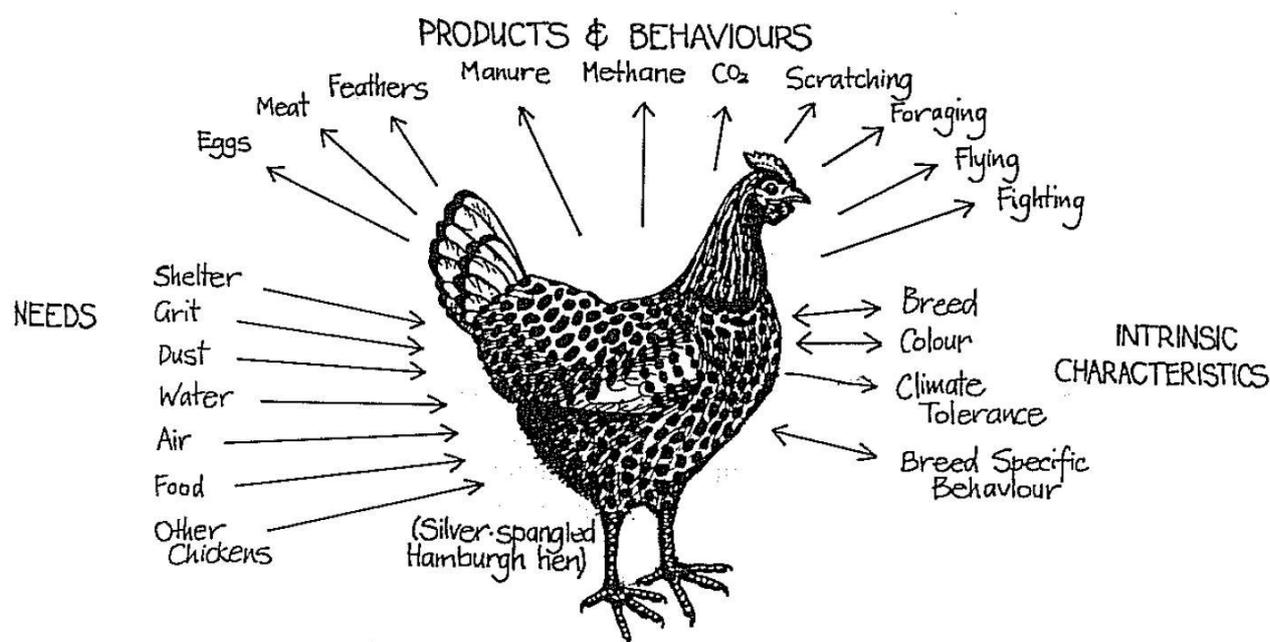
Worm juice, organic liquid fertiliser. I dilute it 10:1 for use on new plants, seedlings, fruit trees and vegetables. The worm castings generated also make an excellent organic fertiliser and soil conditioner. Some systems can harvest these some let nature do the harvesting.

## 8.12 Chickens - Compost large volumes of food waste.

Chickens make wonderful pets and are fun to observe plus they regularly produce eggs. But looking closer:

- you meet their easily homemade needs of shelter, food (kitchen waste), water and company (several chooks).
- they provide, eggs, meat, manure, feathers, soil cultivation, pest removal and weeding, and many hidden ecosystem diversity builders.

It amazes me that these animals seem to produce far more than they consume and are truly biology and food production catalysts for your system.



(Source - Permaculture, A Practical Guide to a Sustainable Future; Mollison, B.; 1990)

Managing chicken manure is perhaps the most off putting part for the lay person and thus an important part to get right. Much of the manure is produced while they are perched up in their coop, so (unless you want to be scraping out chicken poo on a weekly basis from your local council recommended cement floor chook house) we recommend an open bottom, deep litter, coop design. The chooks scratch out there own manure and compost it.

They eat all sorts of food scraps, including vegetable peelings (potato peel should be cooked first), leftover breakfast cereal, leftover school lunches, fruit scraps and any cooked vegetables.

Chooks also eat garden waste including vegetable leaves from the veggie patch, lawn clippings and most weeds

They turn the scraps they are given into wonderful fertiliser. Chicken runs can includes fruit trees, that mean the chooks get shade they need and fertilise the trees, eat any fallen fruit and control fruit fly and their insect pests pupating in the soil.

Other animals offer waste composting services, more waste ? Try Pigs. If you have lots of green waste you can use herbivores like rabbits or guinea pigs. Guinea pigs can mow your grass - no mower and no grass clippings.

## 8.13 Recycling Waste Water

Of the world's total water supply only 3% is fresh water, and of this amount 0.03% is available to us at anytime.

The rest is locked up in icecaps, clouds etc. This amount of water is finite and constantly cycling from solid to liquid to gas; from salty oceans to fresh rainwater, to soils & rivers and back to the ocean.

Perth is a dry place and our natural water supplies are reducing, much of our water now comes from expensive power intensive Desalination. So we should be looking to get more use of our 'waste water'. Greywater systems both commercial and home made allow us to capture slightly contaminated water to use in the garden. There are rules and sensible limitations to this so head to Grey Water website like

<http://www.greywaterreuse.com.au/> to read up on it. OR look at Terra Permas website for the Reticulation and Water supply notes.

## 9. Watering and Reticulation - Simple Cheap and Flexible.

**Rainwater is the best water to use on the garden and the soil is the best storage tank.**

So follow the ecological principle of planting the water before you plant the plant. Make sure your soil or garden bed can hold lots of water.

Make the most of catching all your winter rainfall and keeping it in the top soil of your garden. If it evaporates from the soil surface it is lost and if it sinks down into the deep sand soil (below your topsoil) it is normally lost. Another saying is the best place to store water is in the soil, so all money and effort that increases clay, organic matter and living plant roots/leaves is well spent and should be prioritised above rainwater tanks, and reticulation systems.

Calcium Bentonite can hold 5 times its weight in water, and quality compost and humus can hold 6 times its weight in water.

So if the best place to store water is in the ground you might want to spent a few thousand dollars on clay and organic matter enrichment of your soil prior to getting rain water tank to water you garden in summer. This is passive water harvesting, every time it rains your soil can again hold 5-10 times the amount water than if you had not improved it, that is not including the improved water holding that grows from this much healthier soil food web.

### 9.1 What do you have already ?

There are pro's and con's of any water source or system, so the best way to start is figure out what you have (bore, mains, rainwater - popup lawn, fixed bore- buried PVC, surface black poly) and best guess what you need. Most of us are not starting from scratch so there should be an existing water source and often a reticulation system. Modifying your existing system to be water efficient and grow you vegetables is the cheapest and best option.

Some sources are cheaper to set up (mains water), and others have cheaper water rates (bores). Rainwater needs tanks and is seasonal. When we do a detailed design we should carry out a water audit. See Terra Perma website or Water Corporation for how this is done.

Dripper systems that deliver water to your plants under mulch are universally agreed as the best general option. This can be achieved by modifying your existing system (mains, bore, rainwater) and directing water into the following DIY suggestions.

## 9.2 DIY Reticulation Options

Small container gardens and larger perennial gardens change over time, therefore we advise putting in reticulation that can also change over time. Cheap and adaptable above ground (hidden in the mulch) black poly pipe based water distribution seems to offer the best DIY option in my opinion. There are many specialist drip options, available at places like Total Eden there is an art to those systems but it is not one I find I have the priority (place the need) to learn.

We recommend a manual controllable/adjustable but still automatic reticulation supplied water system. As you can see from the above, flexibility is essential with an evolving design. I have a bore which has a controller that also runs the solenoid valves that switch over my areas of reticulation. If you run off mains water you might like to get a reticulation timer and automatic valve controller to reduce you need to be home and watering during the week or for holiday season.

I have used with success (although the Brand is a cheap one) Holman Water Whizz 4 tap outlet (with extra in ground solenoids controllers if required). [http://www.bunnings.com.au/tap-timer-holman-4outlet-rsr-waterwhiz-co1942\\_p3120504](http://www.bunnings.com.au/tap-timer-holman-4outlet-rsr-waterwhiz-co1942_p3120504). The main benefit this has over other reticulation systems is that it fits on a standard garden tap outlet and has 4 automated manifolded tap outlets, therefore you can run 3 dripper lines and 1 garden hose, 2 drippers, a hose and a sprinkler, etc. Each having a individual run days times etc. So you get 4 idiot proof already wired solenoid valves with your controller. It's not ideal for normal subsoil wide spread lawn retic but very suitable for our simple DIY flexible needs. I have had one working in full weather for more than 5 years so at least the old ones where reliable.

Another interesting timer that I have not tried, but does not have a easy tap supply and requires inground wired solenoid valves is Hydrowise - <https://hydrowise.com/pricing/>. This is for the techy gardening types or might give your other half something in common that they find interesting about your garden. Despite the fancy wireless mobile phone and computer controls it is not much more than standard retic controllers.

I have not found any of the battery operated timers to be reliable (the small batteries cant turn the valve once it gets a little fouled so last 2-3 months), hence this system has a power plug based supply (DIY 10m cable run) and the battery is just a backup to hold your reticulation settings if the power goes off the mains.

### 9.3 Black poly pipe Systems Suggestions.

Create a 25mm black poly pipe supply line (manifold or ring main) stepping down to 13mm offshoots for drippers reticulation to water wicking pot garden beds, sprinklers, trees and sprayers in nurseries.

Use VERIFLOW drippers (pope brand) so you can adjust 0-50L/hr dripper flow for each wicking pots needs (lots of lush green plant 50L/hr vs small dry herbs 5L/hr. Adjustable flow so you can match the current needs of the pot, plant, application.

When you need soil surface wetting (seed germination, green manure, etc) use 13mm barb end raindrop sprinklers (brass base and choice of spinning raindrop or fixed raindrop) can be put on 13mm poly.

Rain drop sprinklers (better than finer misting heads) can be valve isolated (barbed 13mm inline tap) This allows you to run the sprinklers if needed with the drippers off (i.e. all individually adjusted closed) and negate the hand watering, or sprinklers off whilst only the drippers are needed.

Zones (individual solenoid valves control this) within reticulation for the garden should have similar watering frequency needs. While we can adjust the flow at a dripper we cant change its frequency. Nursery areas and veggie gardens (non wicking) need at least 2-3 day watering in summer.

The higher yield garden will require more watering than other areas and will be going all through summer.

13mm poly can run along the top of the wicking pots or, at more cost, micro dripper pipe can come up to allow a less "ugly" look. Another option is to run micro dripper pipe into the drain holes but this means you won't see the inflow or overflow.

In-ground wicking beds are better off with drippers every 30 cm but you could get away with one inlet if the bed had a fill pipe.

Adjustments will need to be made to the flow nozzles as plants evolve.

Avoid watering following a decent rainfall (20mm or 2-3 days of 5 mm in the week) to minimise the chance of overflowing the reservoir.

Hand water any brand new seedlings daily then return the barrel to the reticulated system once established.

Include a hand watering hose (not off the reticulation stations) for small specific watering as required. Locate as is logical (on side of house on a hose reel) in a spot where a tap exists or is easily run through the wall.

## 10. Mulch - Rule No 1 - Cover the Soil

Mulch is great for:

- Retaining moisture at the soil/mulch interface for a longer period of time, preventing 'crusting' of the soil surface and providing a rich environment for worm and microbe activity which, in turn, aids the fertility of the soil and supplies nutrients to the soil for plants to use.
- Regulating soil temperature and protecting the root system from the extremes of summer and winter.
- Increasing the water penetrability of the soil.
- Controlling soil erosion by reducing water run-off.
- Controlling competing and unwanted self-seeding species.

### 10.1 Water wise Hard Mulches

This is for summer soil protection and water conservation, needs to be made up of large irregular shapes that do not hold water. This is to prevent the mulch both forming a waterproof layer (think grass clippings rotting into a lump) nor the capillary action/wicking of the soil moisture back through the mulch to the sun and wind. It often is called street tree mulch - Leaf, bark and wood chippings, again is for **Water saving and slow release soil building and fungi food**.

This needs to be deep mulch, otherwise it will dry out, wash away and be otherwise ineffective. 5 cm deep would be the minimum, but a free or cheap source should be 10-15cm thick. As the tree clippings are a mix of leaves, bark and woodchips, you can see that the leaves and bark decompose rapidly and sink through the harder cellulosic woodchips, leaving a hardy water retentive irregularly mulch. The action of nitrogen draw down is not as much of an issue - the food supply is aimed at fungus rather than bacteria and the slowly released low amounts of nitrogen in the leaves and bark is enough to feed the fungus as it very slowly breaks down the hard woodchips at the soil/mulch interface. The beauty of this is it slowly builds to soil and soil biology while you concentrate your efforts on other higher input/output growing zones or other life priorities and, when you come back to it a few years later, you can have beautiful soil to evolve into more yielding systems.

You can also mulch Veggies and annual plants for summer evaporation reduction with tree pruning's but it doesn't feed the bacteria or other soil biology much. I recommend using a feeding mulch underneath at the same time.

### 10.2 Fertilising Soft Mulches

Crop Straw, Lucerne, Lupin, pea mulch or course aged animal manure makes great **soil feeding** slow release fertiliser and gradual supply of organic material to your soil. This is similar to digging in compost each time except the soil structure stays intact and nutrients are released and used as required rather than wasted all at once. I often put soft mulch under hard mulch as this ticks both boxes - feeds soil, protects soil.

## 11. Why Save Seeds

Seeds grow plants, veggies seeds grow food, food security comes from having access to the capability to grow food as required. We might not be dependent on our home saved seeds now but in hard times the food in the shop may disappear or become unaffordable. Biodiversity of commercial food plants is declining rapidly.

Gardening is one of the main hobbies, a simple money saving, community building, and rewarding hobby is saving the seeds of the plants you grow. **Seeds** are living, hibernating embryos, touching the very heart of mother nature has never been easier, embrace this gift, grow and save seeds.

Local seeds are better. Source some already localised seeds or start to localise your own by saving seeds each year from the best plants that suit your needs. This is how we create our own Heirlooms.

### 11.1 How to Save Seeds

I think the practice of saving seeds is due for a revival. Seed saving is rewarding in so many ways. It's very easy. Even a little seed saving is an empowering and powerful thing to do.

Instead of pulling out your plants as they flower, let those flowers feed your insect friends and as the flowers fall the seed pods will start to form. Generally these pods will dry out and the seed will fall onto the ground. Before these seeds fall you need to harvest them. Place on a rack/open container to ensure they are thoroughly dry (a few weeks to be safe) and then you store them.

It's as simple to get started, but as you learn these skills there is more to learn.

Getting good seeds at the right time involves knowing the usual life cycle of a plant and whether a seed will stay true. The following terms provide a basic understanding of seeds and seed production. You don't need to know all these by heart but they do make understanding seed saving easier. Please see our seed saving guides on Terra Perma website for all the details on Seed Saving. I also recommend you get the great Aussie seed saving book, *Seed Savers*, by Jude and Michel Fanton, many of the tables and information in this workshop comes from that book.

### 11.2 Plants Growth Characteristics

**Annual plants** (such as lettuce and tomatoes) flower and mature seed in the same year.

**Biennial plants** (such as carrots and beets) are normally harvested as food in their first summer or winter but do not flower or produce seed until the next year. Most biennials become tall and bushy when going to seed, taking up more space than they did the previous year. They can be thinned or transplanted to twice the usual spacing. You might try tricking your carrots, harvest them, refrigerate them a week and then replant, they will often go to seed in the same year thinking they just endured winter in that week of chill.

**Perennials** live for more than 2 years and bear seed year after year. Often these plants are grown from cuttings instead of seed as it is more reliable propagation method. You also get a bigger plant faster.

### 11.3 What to Save and Grow

I always advise people to buy open pollinating seeds and grow their own seedlings. This is a little harder than buying seedlings but the results are often better. A cheap plastic greenhouse propagator can be bought at any

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garden store to make this easy. While it seems like the easy option seed packets in Bunnings all come from UK, these are not local or even Australian suited plants as they have adapted to northern hemisphere Temperate climates and are increasingly hybrid types. **Don't buy them.**

**Open Pollinated Seeds** – Those that you can save the seed of and if not cross pollinated will produce the same plant that the seeds were saved from. **Open-pollinated** varieties are stable varieties resulting from the pollination between the same or genetically similar parents. Not hybrid.

**Heritage/Heirloom** – These are open pollinated seeds, saved for generations by someone to produce a specific taste/look/growth, specifically for home gardens, not factory farms.

**Locally Saved and Grown(generational) adapted Seeds are King** - Better than purchased non local heirlooms, locally saved seeds have been genetically selected and evolved by nature to grow better in our gardens in WA. A Heritage/Heirloom plant from Tasmania has adapted to Tasmania's cooler climate, fertile soils and pests, there is no guarantee it will do well in Perth.

**Hybrids** are varieties resulting from pollination between genetically distinct parents. The "F" in F1 hybrid stands for filial, another name for offspring. F1 means the first generation offspring after pollination. Depending on their genetic complexity, F1 Hybrids can be sterile or produce a majority of offspring unlike themselves.

## 11.4 Beginner Seeds - Try these first.

### Self-pollinating Annuals

These include lettuces, beans, tomatoes and peppers. It is easy to save a diversity of them and they are very significant crops to save.

**Lettuce** - A single lettuce can produce hundreds of small yellow flowers atop its stalk. The flowers become bunches of feathery little seed sites, each flower creating eight to fifteen seeds. The seeds are a miniature version of dandelion seeds, having a tiny parachute perfect for riding the breezes. Lettuce seeds keep a high viability for at least four years.

**Tomatoes** -Tomatoes are the best summer crop to grow and seed save from. Tomato flowers are self fertile and will rarely be crossed by insects. You can grow multiple varieties and save the seeds from each. Pulp from a tomato can be squished onto paper towel for easy quick tear off seed sheet, but the better tomato seed saving method involves letting ripe tomatoes ferment for a few days to prevent bacterial and viral diseases from persisting through the seed. Fermentation also breaks down the gel that covers tomato seed. Two or three days later you'll observe a moldy, fermented brew, scoop off slimy top and the clear water and the seeds will be below, pour these onto a fine mesh screen that collects the seeds. Allow them to dry. Seeds also remain viable for 5 plus years making this an even better beginner project.

**Beans/Peas** -These include fresh green and yellow snap beans, peas, chickpeas, soybeans and lentils. In the process of drying down, all these legumes lose their leaves until only the pods are left. Most get to the point where the beans rattle in the pods if you shake them. If your thumbnail can't make a dent in the seed, the beans are ready.

The best Seed saving book in Australia is, “The Seed Savers Handbook”, (buy it online I highly recommend it). This table shows other easy seeds to start saving, but the book has a page of instructions on each plant.

For the beginner * For the gardener with experience	** For the accomplished seed saver *** For the expert seed saver	
* Amaranth	Eschallot	* Peruvian Parsnip
* Artichoke	Fennel	* Poppy
* Asparagus	** Garland Chrysanthemum	* Potato
* Basella	Garlic	* Pumpkin
Basil	Garlic Chives	* Queensland Arrowroot
Bean	* Ginger	** Radish
** Beetroot	* Gourd	* Rhubarb
* Bitter Gourd	* Gramma	* Rocket
* Borage	** Guada Bean	** Rockmelon
Broad Bean	* Hibiscus Spinach	* Rosella
* Broccoli	* Hyacinth Bean	* Rosemary
*** Brussels Sprouts	* Jerusalem Artichoke	* Runner Bean
** Cabbage	** Kale	Sage
* Calendula	** Kohlrabi	Salad Burnet
* Cape Gooseberry	* Korila	* Salsify
* Capsicum & Chilli	* Leek	** Silver Beet
** Cardoon	Lemongrass	Snake Bean
* Carrot	Lettuce	* Sorrel
** Cassava	Lima Bean	* Soya Bean
** Cauliflower	* Luffa	** Spinach
** Celeriac	Marigold	* Spring Onion
* Celery	* Marjoram	* Squash
* Celtuce	* Mint	* Sunflower
* Chervil	* Mitsuba	Sweet Potato
* Chicory	* Mizuna	* Taro
Chilacayote	** Mustard	** Tarragon
* Chinese Cabbage	** Mustard Greens	* Thyme
* Chives	Nasturtium	Tomato
Choko	* New Zealand Spinach	* Tree Onion
** Collard	** Oca	* Tumeric
Coriander	* Okra	*** Turnip
*** Corn	** Onion	** Water Chestnut
** Corn Salad	** Orach	** Water Spinach
* Cowpea	* Oriental Cooking Melon	Watercress
** Cucumber	* Pansy & Violet	* Watermelon
* Dandelion	* Parsley	* Wax Gourd
Dill	** Parsnip	* Winged Bean
** Eggplant	Pea	Yam
** Endive	* Peanut	* Yam Bean

## 11.5 Where to get Open Pollinated Seeds or Heirloom Seeds

There are lots of Australian companies, most are over east though so it's a mail order or online buying process. Three local sources are **Greenhouse Organic** (Seedlings and Seeds), Daisy Chain Nursery and **Yilgarn Drylands Permaculture Nursery** so try them first and support local. Seeds can be ordered online or look at Absolute Organic, Green life Soil company and other organic food outlets. There are lots online. Basically put this in your search engine “**open pollinated seeds .au**”. Try some of these: Diggers : <http://www.diggers.com.au/> Green Harvest: <http://www.greenharvest.com.au/> Eden Seeds and Select Organic: <http://www.edenseeds.com.au/> <http://www.selectorganic.com.au/> The Italian Gardener: <http://www.theitaliangardener.com.au/> Cornacopia: <http://www.cornucopiaseeds.com.au/> The Lost Seed: <http://www.thelostseed.com.au/>

## 11.6 Growing Seeds and Seedlings

Make or purchase a seed raising soil mix. It should be reasonably light with drainage which is why vermiculite is often used to enable tiny roots to penetrate but it also needs to hold water ( cocopeat, worm castings and fine compost). The mixture doesn't need to be rich in nutrients, as the seed raising mix is a short term growth medium. 1/3 sharp sand, 1/3 Cocopeat or vermiculite, 1/3 compost or worm castings should be fine.

Generally you can follow seed packet instructions for seed planting. Don't plant them too deep, as a rule of thumb seeds should be planted 2-3 times as deep as the seed size. Thus many fine seeds are just scratched into the soil, and carefully kept moist. For carrots, rocket, lettuce and grain plants I cover the soil with shadecloth, if the soil surface dries out in the midday sun and the seeds have germinated they will die in 1 hour, this cover over shallow seeds also stops doves from coming and eating your seed.

Choose seasonal seeds following the "what to plant when guides", Greenlife Soil has a great local Perth list on their excellent information rich website. [www.greelifesoil.com.au](http://www.greelifesoil.com.au) , other options are Gardenate (online) or local gardening magazines and e-news letters.

Perth has a tricky climate most things grow most of the time if you fix the soil (clay and compost on the coastal sands) and apply water. I recommend people plant a few seeds/seedling of each type each month so that yearly/seasonal variations can be allowed for. Most plants are killed by 40oC summer peaks and if you have frosts this will also kill most (non winter) plants, hence those extremes define your "seasons".

Essentially the plant will grow well when the season is right. As I save my seed and have plenty for trial and error my preferred method is sow a few of all your seeds in your open bed any time it and you are ready to water and care for them. Nature will take over and they will germinate when they are ready if not eaten by birds etc. If you have limited seeds or are struggling to get plants to come up in your garden beds (insitu) you should set up a seed raising nursery.

While not all plants like transplanting (avoid this with carrots and most root crops) many can be carefully grown to a bigger stronger plant and then transplanted in a month or two. This is also great if you have slaters, slugs and snails in your garden that eat a new seedling in one night. It can also speed up your summer crops to raise them in a warm nursery in early spring (when you get frosts and cold nights) and transplant them out after the last frost. This gives you a 1 month longer growing season before it gets too hot to garden (or at least start young plants) in mid summer (Jan/Feb/March).

Seeds and seedling should be out in your garden 'sun hardening' by November, but note that hot days 36oC plus will kill most young seedlings out in the open.

## 11.7 Self seeding gardens and plants.

The more I read and experience the more it is clear that the **best seed bank is in the soil**, this is the seed bank that mother nature uses, put some seeds into the soil wherever and whenever you like.

You will find that self seeded plants will generally do much better as long as they are fed and watered. A self seeded plant not only comes up when it needs to but often where it needs to so the benefit is twofold.

Growing guides are just that guides, and even local ones made the year before may not suit the following year due to large climate and yearly temp and rainfall variations in WA.

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## VEGETABLES Seed Growing (Eden Seed's guide)

	Row spacing (cm)	Plant spacing (cm)	Depth (cm)	Mild Perth,	Subtropics Costal	Number of seeds per gram	Best Soil Temp °C	Average days to maturity
<b>Amaranth</b>	50-75	50	.5	Sep-Mar	Aug-Apr	900	16-30	50
<b>Artichoke</b>	200-240	160-180	1-2	Aug-Nov	Aug-Nov	22	15-18	300-400
<b>Asparagus</b>	90-120	20-35	1-2	Aug-Nov	Aug-Nov	23-28	16-30	2-3 years
<b>Bean, Broad</b>	60-90	15-25	5	Mar-Jul	Mar-Jun	5-1	6-24	90-120
<b>Bean, Bush</b>	50-60	8-15	2-3	Sep-Feb	Aug-Apr	2-4	16-30	55-70
<b>Bean, Climbing</b>	100	10-20	2-3	Sep-Jan	Aug-Apr	3-4	16-30	65-80
<b>Beetroot</b>	45-60	5-10	2	Jul-Apr	Any	50-90	8-30	55-70
<b>Broccoli</b>	50-60	35-50	.5-1	Sep-Apr	Feb-May	175-330	7-30	60-90
<b>Brussels Sprouts</b>	100	45-60	.5-1	Dec-Apr	Feb-Jun	225-300	7-30	85-95
<b>Buckwheat</b>	Broadcast	Broadcast	.5-1	Jan-Oct	Feb-Oct	30		30-45
<b>Burdock</b>	60	50	1-2	Sep-Apr	Aug-May	50		120
<b>Cabbage</b>	50-75	35-60	.5-1	Any	Any	20-380	10-35	60-110
<b>Capsicum</b>	100-150	50-60	.6	Aug-Dec	Aug-Mar	120-160	18-35	70-90
<b>Carrot</b>	25-30	2-5	.5-1	Sep-May	Feb-Nov	600-900	10-30	65-90
<b>Cauliflower</b>	60-100	45-60	.4-.6	Dec-Apr	Jan-Apr	240-420	10-30	110-155
<b>Celeriac</b>	45-80	15-30	.2-.5	Sep-Dec	Mar-Oct	2100-3000	8-21	90-120
<b>Celery</b>	45-80	15-30	.2-.5	Sep-Dec	Mar-Oct	2100-3000	12-21	120
<b>Chilli</b>	90-120	40-50	.6	Aug-Dec	Aug-Mar	130-190	18-35	65-80
<b>Collards</b>	50-100	40-50	.5-1	Feb-Apr	Mar-Sep	300	8-30	60-80
<b>Corn, Maize</b>	60-90	20-30	2-3	Sep-Feb	Aug-Mar	2-4	16-35	100-150
<b>Corn, Sweet</b>	60-90	20-30	2-3	Sep-Feb	Aug-Mar	4-7	16-35	80-100
<b>Cucumber</b>	120-150	40-60	1	Sep-Feb	Aug-Mar	30-40	16-35	60-70
<b>Eggplant</b>	80-90	50-80	.5-.8	Aug-Dec	Aug-Mar	200-250	24-32	90-110
<b>Endive</b>	45-60cm	20-30cm	.5-1cm	Sep-Apr	Mar-Jul	700-1000	15-25	70
<b>Gourd</b>	150	90-120	2	Sep-Dec	Aug-Jan	10	20-30	95-120
<b>Herbs, Parsley</b>	50-60	20-30	.5-1	Sep-May	Feb-May	500-650	10-30	65-135
<b>Kale</b>	50-100	40-50	1	Mar-Apr	Mar-Jun	250-370	8-30	50-65
<b>Kohl Rabi</b>	35-40	10-20	.5-1	Aug-May	Mar-Aug	250-350	8-30	55-70
<b>Leek</b>	30-75	10-15	.5-1	Aug-Apr	Jan-Mar	350-450	8-30	105-130
<b>Lettuce</b>	35-50	20-30	.6	Any	Any	600-1200	8-27	60-85
<b>Luffa</b>	150	45-75	3	Sep-Dec	Aug-Jan	6	20-30	80
<b>Marrow</b>	100-120	90-120	2	Sep-Jan	Aug-Mar	6-8	20-35	90-120
<b>Mustard Greens</b>	50-75	35-60	.5-1	Any	Any	300	10-35	40-60
<b>Okra</b>	90-120cm	35-60cm	1cm	Oct-Dec	Aug-Feb	15-25	20-35	80-98
<b>Onion</b>	30-40	5-10	.5-1	Feb-Aug	Feb-Jul	240-400	8-30	180-240
<b>Parsnip</b>	35-50	8-10	.5-1	Jul-Mar	Feb-Sep	230-400	6-21	120-140
<b>Pea</b>	45-60	5-8	2-3	Feb-Sep	Mar-Jul	3-5	8-24	65-80
<b>Pumpkin</b>	250-300	90-120	3	Sep-Dec	Aug-Feb	5-12	20-32	105-140
<b>Radish</b>	25-35	3-5	1-2	Any	Any	100-140	8-30	40-50
<b>Rhubarb</b>	60-70	40-50	1.2	Aug-Jan	Aug-Feb	60		

Rockmelon	120-150	40-60	1-2	Sep-Dec	Aug-Feb	25-40	20-32	75-115
Rosella	90-120	45	1	Oct-Feb	Sep-Mar	50-70	24-32	175
Salad Greens, Endive	45-60cm	20-30cm	.5-1cm	Sep-Apr	Mar-Jul	700-1000	15-25	70
Salsify	20-40	5-10		Aug-Mar	Mar-Oct	60-80		110-180
Shallots	20-30	2-3	.5	Feb-Sep	Feb-Sep	350-480	8-30	85-105
Silverbeet	50-60	15-30	1.5-2	Sep-May	Any	50-60	10-30	50-85
Squash, Button	90-120	60-80	2-3	Sep-Jan	Aug-Mar	7-12	21-35	50-60
Sunflower	50-100	20-30	1-2	Aug-Jan	Aug-Apr	7-15	15-30	70-80
Swede	45-70	10-20	1	Jan-Apr	Jan-May	380-480	15-30	70-75
Tomato	60-150	40-60	.5	Aug-Dec	Aug-Apr	250-400	16-35	60-120
Turnip	30-50	12-20	1	Sep-Apr	Aug-May	400-500	12-30	45-65
Watermelon	150-200	60-75	2-3	Aug-Dec	Aug-Feb	10-20	21-35	68-100
Zucchini	90-110	50-90	2-3	Sep-Jan	Any	6-12	21-35	44-63

## 11.8 Vegetative Propagation - Cuttings, Tubers, and More

Many perennials and hybrid but useful trees can only be propagated vegetatively. The benefit is the new plant will be genetically identical to the parent, and most techniques will produce a usable plant faster than by seed. The downside of this process is this lack of diversity, disease and pest cycle continuation, it is therefore essential to ensure the best disease free material is used. Material can also be sterilised by 10% bleach to further reduce risks.

Division is the easiest way to propagate perennials, however the technique differs between plants. A comfrey plant can be simply split into several plants or you can cut the root into inch thick bits to create a new plant from each segment. Water celery can just be torn apart to create multiple new plants. For most root crops just harvest a tuber and plant it in a new location.

Layering involves the stems of certain plants being placed in soil to root directly from the wood. With a bit of patients these crops are easy to propagate, bend the stem to the soil, pin it down firmly, or even tie a wad of sphagnum to a branch near a node and wait for it to root. Many tropical trees propagate this way. Berries commonly both cane and native midyims will root and can be pruned to form multiple new plants. A very rapid way to form a living fence is to layer banna grass horizontally, keeping it moist, it will root at each node creating a new plant every 3-4 inches.

Softwood cuttings don't work for all plants but are the easiest way to propagate many species. Simply taking a tip cutting and placing it in water will cause these plants to form roots and the plant can be returned to soil in the chosen location. Sweet potato's are best propagated by this method as each new cutting is forced to at least form one tuber to survive on over winter. Many water plants Kang Kong, watercress, herbs like basil, Stevia, Mints and even shrubs like Elder Flower root in water, it can be as simple as placing a few cuttings in the pond and trying your luck. Another group of plants will root from softwood cutting but only in soil. Cut 3-6 inch sections of the green tip wood, and plant in moist soil. You can create a humid environment for more fussy strikers or if looking for a more reliable approach you can use a growth hormone powder or willow branch/bark soaked water equivalent. Cut ten two foot long willow branches after leaf drop in winter, cut into inch bits and pour over 4-5 litres of warm water and soak for a few days, this strained liquid will last a year in the fridge, label it appropriately though.

Hardwood Cuttings are generally used to propagate trees, shrubs, and woody vines. While they are much slower to take root they don't require as much care with humidity and soil, cuttings generally taken in winter can just be stuck in the ground and left to root. Again hormone treatment can be used to increase success. Wood is chosen from last season's growth, try and get 3-4 nodes, cut the top cut diagonally and the bottom horizontally to aid in identifying the right way up and avoid water 'pooling' on the top of the cutting and rotting it. A odd but effect way to strike cuttings is to put them in upside down in the soil, put a grain seed in a crack in the base (when the grain germinate the hormones trigger the cutting), and put a piece of black plastic or something else to warm up the soil early in the season.

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## 12. Food to Grow in Perth - More food in Less Space

To maximise diversity, resilience and yield make sure you have the best locally performing food and beneficial species of deep rooted (carrots, parsnips, kale), shallow rooted (broccoli, fat hen, lettuce), tuber producing (arrowroot, sweet potato), climbing (beans, sweet potato, luffa), bush/prostrate (plantain, dandelions, lettuce), tall stalked (Kale, leek), annual (fat hen, chrysanthemum), bi-annual (carrot) and perennial (artichokes, Moringa, Kale).

The following plants are easy to grow for me and are worth trailing first. They will generally be hardier and more nutritious than iceberg lettuce and other common greens, hence being chosen to fulfil this role in a more holistic, robust, self care food production system. One of the keys to coming to grips with this change is that these plants are very high in nutrients, you don't need to eat the whole plant, often a leaf will provide enough of what that plant offers of a particular nutrient or mineral. While this is a plant workshop you can't separate the consumers from the food, you will grow this and appreciate this far more if you understand it is feeding the human machine.

There are more reasons than I will remember to discuss as to why a particular plant has been chosen above others to trial, some reasons include, increasing diversity of species, immunity or better performance against common pests (Fruit fly, Eggplant Caterpillar, birds, rats etc), summer hardiness, tolerance of poor alkaline soils, growth habit, yield, storage capabilities of crop, flavour, and availability.

Plant diversity, plant robustness in the system and yield must drive plant selecting in urban and small scale human systems.

### 12.1 Edible raw greens.

These are essential in any system, they act as both a vegetative cover and ecosystem for the plants and animals but also the most important everyday vitality providing food for your body. You can't beat raw, fresh, home grown leaves for adding that minor but critical living element (lifeforce) to each meal. Kale, Broccoli and lettuce bought in the shop while looking like healthy veggies maybe 2 weeks old stored in the fridge until it is freshened up for your perusal at the shop.

Diversity is the key as always, this allows for 5-6 usable greens any time of year any weather. We cannot control the weather other than in small microclimates so we must choose plants and design our understory foods well enough to deal with rain and 10oC in winter, humid mildew shoulder seasons, and sun and 40oC in summer.

A bowl of 'garden salad' will normally contain at least 10 varieties of green leaves alone, then add flowers, vegetable fruits, and you can see why you only need 2-3 leaves of each plant species to be making a big salad.

Kale is a staple, better in winter and shoulder seasons but in good soil it is perennial and while suffering the heat of summer will come back with better flavour as cooler weather returns. There are several types of Kale, Red Russian is my favourite for flavour and flat leaves that are easier to keep/get white fly and aphids off. If you pick out the leader of the plant once a few months old it will bifurcate and provide more faster maturing but smaller leaves. I find this better when trying to harvest the leaves before too many aphids poo or mummify due to predators on it. The smaller leaves are better and more tender for raw salads, which is the best use of these leaves. Cooked they are a replacement for cabbage but as with all cooking a lot of goodness is lost.

English/French dandelions (not the wild yellow flowered 'dandelions' in most lawns they are cross bred with less palatable Cats Ear and other species), Chicory, Sow Thistle, provide year round staple supply of nutritious

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greens. Loose leaved plants they allow plucking of 2-3 new leaves per plant each week without any loss of vigour. There is more goodness in a single (sometimes bitter) dandelion leaf than an entire Iceberg Lettuce (except for vitamin A which is high in Iceberg but that's all it has). These plants are all mildly bitter so are a good minor addition, lots of mineral so we only need smaller amounts. One leaf of each per person in the salad is ample, if you don't like the taste view these as preventative medicine (no medicine tastes good), wrap the leaves around a chip like my kids and eat with meat, and you won't even taste it.

As with the above three, purslane, chickweed, fat hen, rocket, nasturtiums, parsley, mallow, and sorrel are self-perpetuating or self-seeding often weedy species. This makes them perfect for the open plan nature of an understory perpetual food supply system. The plants never become weedy as you are eating them every other day and they are naturally suited (hence becoming weeds) so need far less effort to maintain. The added bonus is that they have more nutrients than conventional veggies like broccoli, and lettuce.

Onion leaves/shoots, leeks, chives, garlic chives, shallots, etc can make a nice minor addition to salads, a bit like a salad onion but without having to wait the 3-4 months to grow the salad onion bulb. The point here is that you can get most of your garlic and onion flavours from the leafage rather than battling with growing times, season limits, and challenges of plumping up onions/shallots/garlic, but we can discuss this more in cooked greens.

A good source of hardy summer greens in Malabar (Ceylon) Spinach, a climbing succulent plant. Like the mallows it has mucilaginous leaves which people like or dislike. But if you don't enjoy it in salads it makes a fine cooked spinach replacement.

At the opposite end of the year Nasturtiums are an excellent peppery green leaf, delicious flower and even caper replacement (green seeds pickled like capers) for free. They like a moist shady location but will cope anywhere until late spring when temps get above 30 and the sun kills them off. Nasturtiums are also a great living mulch, trap crop and pest confusing with rampant growth and pungent mustard smell. While they can take over they are very easily removed and make great compost.

Perennial beans (7 year beans) specifically Lab Lab provide edible flowers, leaf tips and young pods. Lab Lab needs some space/trellis to climb. I have one growing up a deciduous Maple Box Alder tree, the added bonus is it is a nitrogen fixer, so is highly recommended. The Choko vine and perennial zucchini Chilacayote also provide edible leaves, flowers, and even roots, as well as their main vegetable fruit. These plants are easy growing once established, but all perennials take the first year to establish a large strong root system so don't expect a huge harvest or thriving vine in the year of planting.

Other less known but highly recommended raw greens are; Salad Burnet, Strilloto (Scullpit), Shinjuku (Chrysanthemum), scorzoni. All are hardy in Perth and provide green in summer when traditional leafy greens may be suffering.

In summary for the most hardy edible understory (wild garden) start with the following, Fat hen, Kale, Dandelions, Chicory, Garlic Chives, Parsley. These will grow on our poor sandy soils even before you improve the soil or create specific garden beds. All produce seed prolifically so can become weedy if you don't 'eat your weeds', but these are hardy easy food supplying Perth Permie Plants.

Weeds like Sow Thistle, Dandelion, Spiky Lettuce may arrive themselves, many weeds are edible and even nutritious, familiar yourself with the edible weeds articles on Terra Perma website to take advantage and even cultivate (cultivated weeds taste better) and avoid or remove inedible and very occasionally poisonous weeds.

## 12.2 Edible Cooking Greens.

While you can cook any of the greens some are only palatable cooked, or have toxins removed when cooked. Many weedy/wild species are often proportionally high in oxalic acid, which is why is add a lot of kale (replacing lettuce) to the salads to dilute the ratio. Cooking for 2-3 minutes (and disposing of water) can be used to remove oxalic acid, this technique is advised for consuming NZ Spinach (warrigal Greens) frequently or in bulk.

The best underutilised permie plant cooking green is sweet potato. While primarily a tuber crop, the leaves and plant tips are edible, numerous, virtually pest free, and grow all year round, especially in hot summer when most other fresh produce is suffering the heat. It has a mild coconut flavour to me and is great in Asian stir fries, soups or just cooked as a spinach substitute.

### PRODUCTS

Edible Tubers / Yams  
Edible Leaves and Tips  
Living Mulch (summer loving)  
Soil Decompaction and Aeration  
Chop and Drop Mulch

### NEEDS

Water (Limited)  
CO<sub>2</sub>  
Soil  
Nutrients



### CHARACTERISTICS

Heat and Drought Tolerant  
Water stress induces tuber growth  
Running and clumping types Vertical  
Trellising or Ground Cover  
Vigorous Growth  
Tendency to smother

Sweet Potato (*Ipomoea Batatas*)

surely the 'chicken' of the plant kingdom

The other best cooking greens include, Kale, Malabar Spinach, Mallow (wild and marshmallow), broccoli leaves, the general onion family (leeks, chives, shallots etc), parsely, hardy flavour enhancing pot herbs (sage/rosemary/thyme).

Less know but equally hardy cooking greens include, Curry Leaf (tree), Espazote, Wolf Berry, Stinging Nettles, Lovage, Kang Kong, and Evening Primrose. Curry leaf is the traditional curry flavour loving Perth climate. Espazote is a strong flavour (anti wind plant) weed traditionally eaten with beans, Jerusalem artichoke and other 'windy foods' to reduce the effects. Wolf berry or Gogi is know for it fruits but the leaves are a healthy cooked or even raw green. New lovage shoots have a strong parsley/celery flavour, and while celery is relatively easy to grow I find lovage and parsley much easier and similar hence substituting them.

Evening primrose is more a medicinal herb but has good eating young leaves that given it weedy nature should be one of your seasonal high yield high nutrient food supply.

## 12.3 Edible Flowers

Many of the edible plants listed earlier also have edible flowers, so other than advising you to look into which they are on the tables I won't go into it here. It need a little consideration and thought though as in some ways it will reduce yield and in others make no difference for example, the flowers of pumpkin and squash are a delicacy in many cultures - you can eat the male flowers and leave the females to produce fruit.

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Roses offer many yields other than beauty. Older traditional roses like *Rosa rugosa* or *R. gallica officinalis* have edible flowers and good sized rose hips that are high in vitamin C, and make good jelly/jam. These traditions roses are very hardy and can be often seen in house ruins where the date palm, fig and roses are still battling on long after the house has crumbled to the ground.

The elderberry bush (*Sambucus nigra*) has been used for centuries as a multi purpose plant in Europe - it's medicinal qualities are listed in most herb books, the fruit used for preserves and elder berry wine and the flowers are prized for pot pourri, wine making and most of all for making elder flower fritters . In Perth the elder rarer has berries but the yield in refreshing elderflower cordial or wine in the hot Perth summer is reason alone to grow this. Place near compost bins/systems as its bushy nature provides shade while its roots provided symbiotic benefits to the compost pile.

Day lilies are highly recommend, I have lost mine and must get some more as they are beautiful, hardy and prolific providing plenty of flowers for colour in salads and food value. Note: Many liliiums are not edible, so ensure you are getting plants of the *Hemerocallis* species and ask directly of the supplier as to their edible nature.

Robyn Francis gives a few hints on how to use edible flowers “regular ornamental flowers that can add colour and zest as a garnish for salads or sweet dishes: violets, pansies, petunia, carnations, calendula and gladiolus just to name a few. I love to garnish a mulberry pie with borage flowers, spice a baked custard with ginger flowers, toss nasturtium and calendula petals in a fresh garden salad, or top off a parfait with a couple of violets or heartsease.

## 12.4 Vegetables fruits and roots

There is lots of good information on growing common vegetables in vegetable beds in Perth out there already. Greenlife soil company have a good what to sow when calendar, gardenate.com have similar climatic charts on what to grow when, the Agdept has a vegetable growing guide, and while not organic/permie has some very local and sensibly advice.

So what I discuss here are the more hardy vegetables that can deal with some neglect, integration, will be an asset to the ecosystem/garden rather than a burden like many mainstream vegetables are now.

The easiest and most rewarding this to grow would have to be cherry tomatoes, a tried a true variety is tiny tom, but most cherry and plum cherry tomatoes do very well. In my area and many others around Perth these is a lot of bacterial and fungal wilts in the soil (likely form lots of old market gardens in my area) you will notice you tomato bushes yellowing, drying leaves dying and drying up from the soil up. There is no spray or cure for this, crop rotation and avoiding solanum crops is suggested but I have the virus everywhere so rotating to new soil while good practice is pointless.

While a few varieties are meant to be immune I have not gone to that effort of sourcing and trailing as I cant eat to many myself and cherry tomatoes grow faster than the wilt in good soil. The best other option is to grow tomatoes in a pot, buy some coconut husk (coir) fibre blocks and some compost, isolate the pot from the soil with a dish/base and feed the tomato with liquid foods. While this is not the most self reliant system it will provide good reliable crops and used ounce pot soil is a great garden amendment or fine for other types of pot plants next time.

The other option is to grow Tamerilos or tree tomatoes, these seem hardier to these soil borne issues. While they don't taste the same they are a tasty alternative, or as we always suggest grow both. Tree tomatoes often

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grow above 6 foot and are not that fond of wind so you do need a suitable space, but that might be above your garden beds, hence using vertical space and creating much needed shade.

Other hardy common plants worth either growing in vegetable beds or in a diverse interplanted fruit tree understory are; Capsicums (sweet fleshed Paprika forms for great), Chilli's (unless your eating a lot or using it for spray you wont need more than 2-3 varieties. I am trialing some of the original Bolivian chilli 'trees'. These can grow to 6 foot and provide huge yields, while also providing a bush like habitat and vertical stacking.

Bush beans and runner beans are great additions to any system most are hardy, nitrogen fixers and if regularly harvested should provide 2-3 long flushes of beans (bags of beans). Dragon Tounge is a good bush bean, and purple king and blue lake are good climbing beans to start with. These do well in spring/summer but once it start to heat up you are better off putting in snake beans and other sub-tropical varieties (winged bean, New Guinea bean (a gourd)). There are 7 year beans as discussed previously, Scarlet Runner is a strong perennial bean but is heat or day length sensitive so in Perth only fertilises flowers to beans in a small part of autumn and spring so not worth it. Lab Lab (I have Wentworth variety) is a great option, and while producing pods that look more like snow peas than beans, when picked young are a prolific and delicious vegetable.

High yielding but bland perennial crops such as chilacayote and Choko are essential parts of a Permaculture garden based on providing as much food as possible. Combined with sweet potato these high yield plants can provide staple bulk food. It is up to us to flavour and utilise this abundance rather than under value it given its commonality. Chokos and Chilacayotes can be a sweet or savoury bulk to meals from soup to jams.

Summer options also providing bulk once they get going are New Guinea bean, Armeniam Cucumber, Tomobonchino, Wax Gourd/Winter Mellon. All are worth planting early summer, providing a tree or substanting climbing frame and stand back. They do suffer from mildew so some ventilation of the massive growth is best, and keep water off leaves.

Carrots are great, there are good heirloom varieties so don't get the pack of seed uniform orange that all mature within a week and are tasteless. The older varieties are hardy, longer yielding prior to getting woody and colourful. A better option to carrots in Perth is Burdock, this root crop has been used by Japanese for hundreds of years as a superior replacement for carrots. The Burdock like well drained deep soil (sand is perfect) and the roots can reach half a meter so the only trick is getting them out. Salsify is also a good carrot like root crop to include in this mix, and let's not forget some parsnip for the essential soup flavour. All species set seed in the second year, so don't harvest them all, they readily germinate (self seed) if left to drop seeds insitu so are a great deep rooted soil centered vegetable. Observation of Burdock seeds lead to the invention of Velcro so you might want to harvest and store these seeds rather than get them in your socks and pets, also not the seed husk/fluff is very itchy like fiber glass so take care when processing it. Burdock also has large broad leaves rather than fern like fronds like the others. Appreciating the difference in even similar/equivalent plants allows us to use them to the best advantage in gilding and dense interplanted poly cultures.

## 12.5 Tubers and Roots Crops

The best tuber crop in Perth is clearly sweet potatoes, some varieties produce a huge yield for very little effort or water input. They would be the equivalent to potato staple food of the Irish. This is fortunate in many ways as we have lots of pests for Solanum species of which the potato is one.

Common sweet potato varieties are the orange skinned orange fleshed, the red skinned (purple when freshly dug) white fleshed one, and the small tuber white skinned white and purple flecked flesh. The orange one

seems to be more sub-tropic harder to grow variety. The large red one provides the largest easiest found yields that I have found so far. An observation I have made recently is that the running varieties (above ground and climbing growth) seem to set tubers close to the base, whereas the clumping varieties tend to send runners/tubers out several meters. This is logical as other than seeds (which don't set in Perth) the runner propagate and move via rooting runners and the clumpers move via long ranging roots and tubers creating new plants next season.

Jerusalem Artichokes are also prolific hardier producers. Called Sun chokes in other countries these plants have a sunflower on top but set small tubers under the plant. One 4 foot choke can yield a 10 litre bucket of tubers. The one downside is the inulin in them is not possible for the body to breakdown and creates gas. The upside is this chemical is very beneficial in other health reasons. The plant has very few predators and is well worth growing. Tubers can be eaten fresh raw (crispy like apple) or are excellent roasted in the oven.

Arrowroot (Edible Canna's) are a great permie plant, arrowroot starch is a primary flour for many nations that is extracted simply from the root rhizome by mashing/crushing it in water. I am currently trailing Cassava (Tapioca flour) which is another islander staple.

Potatoes can do well but require hilling, fairly rich soils, avoidance of many pests and climatic conditions. Potatoes are worth growing in the vegetable garden but are less suited to a hardy natural garden system. I recommend Royal Blue as the main variety to grow, the suds are smaller than white ones but rich, yellow and dense for excellent cooking qualities.

## 12.6 Berries and Vines

Perth is quite hot for most berries and most won't thrive. That said Bramble Berries (blackberry, Younger, Boysen Berry, Silvan) will grow and bear well in the right situation. Some might require a bit of shade at midday in summer, and afternoon shade/protection is also important for all berries in Perth. Bramble berries and raspberries can be invasive so need to be isolated and managed. Raspberries are like mint their roots sucker prolifically and seek out the best and moist soil and start growing there, up to 3-4 meters from your patch. The others propagate by the canes growing long and falling over and the cane tips rooting and forming the next plant. Hence keeping the root zones of raspberries isolated (wicking bed/pot) and the canes of others tied up and pruned these berries are controllable and worth a go. The thing to remember is they are full of flavour so a little bit goes a long way in flavouring other more bland things (choko/chilacayote/jam mellon/apples). There are now non suckering thornless blackberries cultivars that take a lot of the issues out, for a raspberry variety stick with the old 2 crop a year Heritage in my opinion it does well on neglect.

Don't bother with currants as they require chill and cooler temps than Perth and would even be marginal in the hills. Instead I recommended (I love the sour sharp flavour) Cape Gooseberries (Golden Berry) . They are a vigorous bush and propagate via lots of seeds, so once you have one the birds will make sure you get a few seedlings around the place for ever more. These are easily removed so not weedy. The main issue I find is they are susceptible to red spider mite if allowed to get to big, dry and/or under water stress, and they are again of the solanum species so have many pests. That said I highly recommend this berry.

Similar but lesser known and more widely feared is the Blackberry Nightshade, often incorrectly called Deadly Nightshade (Beladonna is very rarely found in Aus) Blackberry nightshade provides a bountiful supply of small black berries. The green berries are not edible, but if you give the bunch a tickle or the plant a shake those ripe berries will fall off. Chooks love these berries and will go straight for the bush if they ever escape the run. So why not maximise this relationship, plant (or transplant your volunteer weeds) to the side of the chook run and have

half the out of hand fruit for you and the missed daily crop can fall to the chooks. This cursed weed is certainly a lost opportunity in most gardens, as it is the most pest resistant easiest of the berries to grow in Perth.

Strawberry's will do very well if you can keep the roots moist and give them plenty of sun, the trick is keeping the bugs out of them so you get some. I recommend some kind of elevated self water pot arrangement (hanging baskets tend to dry out to fast). A Japanese variety called Hokawasi and the small alpine white and red strawberries are good options. They can be used as ground cover/producers. Varieties sold in shops tend to produce bland fruits so look around for traditional varieties.

While not a berry the Pepino is also worth growing. It is a clumping dark green bush (again Solanum family) that has hand sized oval shaped fruits that taste somewhere between honeydew and rockmelon. It is a heavy feeder and the fruit need to be kept of the ground (try growing up into and wire frame) to avoid black beetles and slugs having a field day with the thin skinned delicious fruit.

The native Midyim produces a multitude of tiny berries, a smaller native version of a blue berry. IT is a hardy prostrate ground cover to bush and well worth growing.

## 12.7 Edible and Medicinal Herbs and Companion Plants for Perth

Isabel Shipards book, How can I use Herbs in my Daily Life, is an excellent discussion of the true value and necessity of herbs in garden and human health. Without a fancy understanding of herbal medicine one can used the book to ensure a rounded herb/food intake as a preventative to dis-ease.

Herbs that grow easily in Perth are list below.

ALOEVERA	FENNEL	POPPY
AMARANTH	FEVERFEW	ROSEMARY
ASHWAGANDA	FIGWORT	RUE
BALM LEMON	GINGKO	SAGE
BASIL	HERB ROBERT	SKULLCAP
BORAGE	HOLLYHOCK	SOAPWORT
DANDELION	HOLY BASIL	SORREL
BERGAMOT	HYSSOP	SOUTHERNWOOD
BETONY	LAMBS EAR	SPEEDWELL
BORAGE	LAVENDER WILD	STRAWBERRY
SALAD BURNET	LEMON VERBENA	TANSY
CALENDULA	MARIGOLD	BLESSED THISTLE
CATNIP	MARJORAM	TARRAGON
CELERY	MARSHMALLOW	SOW THISTLE
CHAMOMILE	MINT	THYME
CHICORY	MOTHERWORT	VALERIAN
CHICKWEED	MUGWORT	VERVAIN
CHIVES	MULLEIN	VIOLET
CLARY SAGE	NASTURTIUM	HERB WILLOW
RED CLOVER	NETTLE	WOAD
COMFREY	PANSY	WORMWOOD
CORRIANDER	PENNYROYAL	YARROW
EVENING PRIMROSE	PLANTAIN	

As you can see that we can easily grow and consume our own preventative medicine as part of the supporting understory of our forest garden or garden beds. Herbs are excellent plants, providing the medicine cabinet, food and habitat to insects and wildlife, dynamic accumulation of elements and a complex diversity that is essential of management (confusion of pests).

Plant worth special mention due to the excellent overall health vigor tonic nature that grow very well in Perth are Herb Robert (and edible Geranium), Ashwaganda (Indian Ginseng). Herb Robert is easier to use 1-2 leaves a day whereas Ashwaganda can involve root harvesting but both should be in your living medicine cabinet. More will be learnt about these and many more by reading that book.

**Herbs are your health food, grow them, eat them and treasure them.**

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## 13. Pest Management

### *Sprays both Chemical and Organic kill indiscriminately*

Where there are pests there are their predators, many are small and difficult to detect, and when you spray you will kill both and destroy the natural order and balance that was trying to occur. Pests adapt to new situations, food supplies faster, but predators will catch up in a season or two, you need to be patient in the first few years and go out of your way to provide nectar, food (pests) and habitat for your growing predatorial helpers.

To effectively get nature to control your pest you need to encourage a huge variety of creatures. This is achieved by creating diversity of plants and micro-landscapes providing shelter, pollen, nectar, and by not spraying, to ensure a few pests to be there so the predators have got lunch.

While this might seem unrealistic to those who fall back on sprays frequently. Start with this simple solution, if you don't have the time or size of garden to reach this ecological equilibrium **use exclusion techniques, not spray.**

### Simple and Ecological Pest Management Technique

1. Start by exclusion meshing (Vegnet/fruit flynet) small areas of high yield vegetable growing beds. You will get a yield and be encouraged and fed, but at a high \$ cost.
2. Then install and grow your ecology, pack in all the Biomass, Habitat, Predator Food plants you have space for.
3. Use species diversity, inter-planting, companion planting to expand the garden.
4. Start planting high yield veggies in these areas without exclusion mesh, brassicas are a great option, observe, accept some losses, pests need to breed up before predators will come for the food source.
5. Review and increase elements of IPM over time.

### 13.1 Know your 'enemy'

**Pests are a normal part of every garden.** They come and go with the seasons without really causing too much drama. In healthy gardens, they are kept in check by birds, frogs and lizards as well as beneficial predatory and parasitic insects. The simple best preventative management is growing healthy, mineralized soil to keep the plants in good shape, because weak, sick and stressed plants are more prone to attack. Cultural practices like crop rotation, companion planting and my preference, diverse inter-planting, further reduce the risk of attack.

Laborious and expensive traps and barriers should be saved to protect vulnerable plants such as seedlings, and high yield juvenile vegetable garden beds.

#### Why do you get Pests

Pests are nature's cleanup crew, they are one of the mechanisms of ensuring the best, strongest most suitable plant species are growing in a specific area.

In short, if you have insect pests you have plant/soil problems. Address those rather than the pest.

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**Pests are drawn to weak plants or plants growing outside ecological limits (artificial fertiliser junkies) with surplus sugars on their leaf surface caused by sickness or excess nitrogen creating excess plant tissue.** This gives off a signal to the insects that its dinner time as things are out of balance and need to be fixed, which may or may not end up in that plants demise but will certainly see it attacked.

As with all things, a healthy soil food web and its slow and steady diversity of minerals and nutrients in the soil create healthy plants, and pest resistance.

## 13.2 Pests Species and How they Work

**Scales and Aphids** shoot a sweet substance called honeydew. Ants literally farm the scale to feed on the honeydew. They'll pick them up and they'll move them all over the tree. Honeydew also leads to sooty mould, a black dusty fungus that grows over the leaves and stems. Controlling the scale will also get rid of the sooty mould. Controlling the ants is an essential aspect in avoiding rapid expansion of scale on the host plant and those surrounding. Vaseline around the circumference of a plant (placed on top of a tight tape/barrier, as the vaseline can ringbark some plants) will stop ants as long as the plants is not accessible via other routes. If you only have a small amount of scale, scrape it off with a fingernail or toothbrush. Larger infestations can be controlled by spraying with an oil to suffocate them but if practical a heavy prune of the plant is more practical as the scale is there because the plant is under stress/old/etc.

**Citrus leaf miner** is a common pest during summer and autumn affecting all citrus. The larvae tunnels in the leaf, forming a squiggly silvery window pattern. When it's fully grown, it curls the edges of the leaf together and pupates to emerge as a small moth about five millimetres in length. The moth is only active at night, so it's rarely seen and its lifecycle may take as little as three weeks. The leaves often become severely distorted, which can stunt growth and reduce yield, but rarely kill a tree. Damage is normally on new sappy growth and can be controlled by cutting off and destroying the damaged parts. Citrus leaf miner like warm weather, so fertilise citrus at the end of autumn and in early winter so the new growth won't be attacked. During warm weather, you can also protect new growth by spraying with an oil spray, similar to that for scale.

**Slugs and snails** are common garden pests and can cause damage, particularly to young seedlings, but it's surprisingly easy to keep numbers down. Set some beer traps. Just half fill a jar with beer and lay on its side, where slugs and snails are likely to strike. They will be attracted to it. They'll crawl in there for a drink, get drunk, and die. It's also a good idea to lay traps in cool, damp places where snails hide. If you can't stand to waste beer, try coffee spray.

**21 Spotted Lady Bird.** A dull orange large lady bird with a long head compared to others, identify it in a book before you start squashing them. If you have a Solanum (Eggplant, Spuds etc) or Curcabit being eaten to bits and its covered in big ladybirds they are most likely 21 spotted. Collecting and squashing early in the attack is best.

**Caterpillars** are another very common pest, the common white butterfly is the most obvious targeting Brassicas and other plants with medium sized green caterpillars. But there are many types of moth (night time) and butterfly (day time) larvae that feed on our vegetables and natives. The best control is wasps, birds, prey mantis and the many species specific tiny parasitic wasps. A good ecologically diverse garden should not have a caterpillar problem. Try planting mustard densely in winter as a trap crop to inoculate the soil, breed up the caterpillars and thus breed up the predators. Once the mustard has flowered and feed nectar to the predators, mulch make the predator look pests on the rest of your new spring seedlings for their lunch.

**Pear Slugs** – Similar to caterpillars above, they target plums, pears, almonds, cherries, etc, putting chickens under your trees will break the life cycle as they pupae in the ground. If this isn't practical dust the tree and slugs with ash, spray off with high pressure or use a BT (*Bacillus Thuringiensis*) i.e. Dipel spray.

**Eggplant Caterpillar** – More like the fruit fly below, it is a tiny moth with boring grub, and it has no effective control measures at this point other than exclusion. Luckily the Solanums it targets (Eggplant, Tomatoes, Potatoes, Capsicums/Chili's) don't need insect pollination so can be continuously exclusion meshed. Plan this aspect into your crop rotation and bed plantings now.

**Fruit Fly.** While there are many traps and baits for fruit fly and I will list a few in the Organic Spray section, basically fruit trees or at least the fruit need to be fruit fly netted. Unless we have a whole community concerted and ongoing effort to trap all fruit flies and reduce the population occasional traps (while the right thing to do) are not going to stop your fruit getting stung. Aiming to keep smaller trees at 2m height in intelligent groupings of plants that need to be netted after pollination is essential. One fruit fly can sting your entire crop by itself, so trapping while reducing the number and worth doing, is not a good way to protect your crop. Commercially they spray poison every few days on the surface of the fruit as the only control that works. The simple solution for the home gardener (to costly for commercial orchard) is Fruit Fly mesh, or individual bagging of the fruit (calico and other non transparent material work fine). If you have rats a strong, smell proof cover might protect your fruit from them as well.

**Nematodes** cause lumps and round bumps on plant roots, similar to the nitrogen nodules on a legumes roots. While the soil pest can make gardening hard for a period, the cause is the soil not the pest. Root knot nematodes (note there are 1-2 bad nematodes and 100's of good ones) like dry sandy conditions, so add lots of compost and keep the soil moist and ,mulched (like you should anyway) and they will move away. While people suggest marigolds and mustards to be grown and turned into the soil to fumigate the soil, this may discourage all nematodes. Good nematodes eat bad nematodes, and black scarab beetle larvae, weevil larvae, mole crickets and fungus gnats, so you want to keep your good ones around.

### **Two Spotted Mite (Spider Mite)**

Spider mites also called web spinning mites, are the most common mite pests and among the most ubiquitous of all pests in the garden and on the farm. To the naked eye, spider mites look like tiny, moving dots; however, you can see them easily with a 10X hand lens. Adult females, the largest forms, are less than 1/20 inch long. Spider mites live in colonies, mostly on the undersurfaces of leaves; a single colony may contain hundreds of individuals (Figure 2). The names "spider mite" and "web-spinning mite" come from the silk webbing most species produce on infested leaves (Figure 3). The presence of webbing is an easy way to distinguish them from all other types of mites and small insects such as aphids and thrips, which can also infest leaf undersides. Adult mites have eight legs and an oval body with two red eyespots near the head end. Females usually have a large, dark blotch on each side of the body and numerous bristles covering the legs and body. Predator mites can be purchased, but keeping your garden moist and diligent removal of plants that are building up a wave of mites is most effective.

**Mice and Rats** can wreak havoc on crops. They can be controlled by normal baiting though that is not recommended as the animal becomes a toxin to the garden/world. Traps include, snappy ones, cage ones, rubber ring ones, and home made slippery bridge water buckets. Or hopefully nature will take its course and your glut of vermin will feed some endangered owls, reptiles or even neighborhood cats. Exclusion or natural predation is often not practical so I look to reduce the numbers myself.

**Parrots** as above, beautiful birds they may be they often ruin a fruit tree crop in one sitting. Bird netting is the most effective and cheap, but if you are in Perth you should just use fruit fly net and achieve all the needs with

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one product. Scarers, flashing objects and scarecrows etc might work for a while but end up scaring more predator birds than parrots so your system loses in the long run. NOTE: If using parrot mesh around trees ensure it is off the ground and attached to the tree trunk, reptiles are easily caught in the net and die otherwise.

### 13.3 Pests are part of nature and they will always be there.

As Permaculturalists, we need to replicate nature to ensure our 'simulate eco-systems' (natural and cultivated) are strong and resilient and we do that by following nature's example.

Nature's response to pests and disease is multi-faceted and complex, holistic and layered. So to, we need to replicate this in our home vegie gardens.

Firstly, understand that pests have a role in the garden - they provide food to keep predators in your garden. So our aim is to keep it pest numbers manageable, not to wipe them out,

You might use host plants (hibiscus for aphids, sunflower for spider mite, flowering broccoli/kale for white fly) and trap crops (mustard/nasturtium for caterpillars, Sow thistle aphids) to keep your predators food source and therefore your predators, around all year.

Making peace with the pests in your garden is the first step. Don't try to fight nature, you won't win. Your garden's systems are there 24-hours a day, every day of the year. You can't be, so don't rely on sprays and poisons as you'll never get them out in time or as often as you need to.

Instead work on an holistic approach to pest management. Put your time and energy into attracting the good guys, not killing off the bad guys.

The following points adapted from Toensmeir provide another good summary for managing Pest, and Disease.

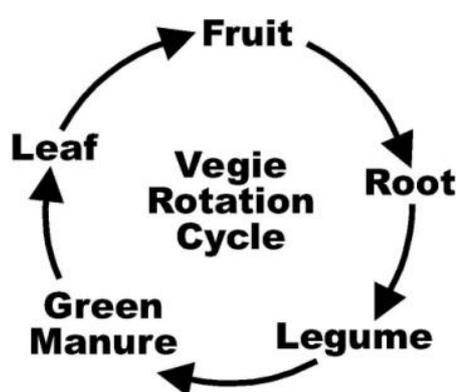
1. Provide optimal growth conditions (healthy mineralised plants are less targeted)
2. Ensure good air circulation (also allows you, birds and predators better access to observe)
3. Plant in diverse polycultures (lots of different plant families together, see last workshops for plant families charts)
4. Select resistant and local species and varieties
5. Beware of viruses (Tomato wilts are so prevalent and hard to control I grow all tomatoes in pots isolated from the soil with potting mix changed each crop)
6. Inoculate with beneficial organisms, or feed the ones you have with good organic compost.
7. Prevent wet foliage with appropriate irrigation
8. Use good garden sanitation processes (poor pruning techniques and tool hygiene can make it easier for disease)
9. Give perennial veggies an immune boost (you tend to over harvest them as they are always producing so feed them more and give them a break)
10. Learn to identify, prevent and control the disease and pest that effect your crops.

11. Use and encouraging insect and animal predators
12. Use least toxic, pest specific, spray as last resort when variety rather than harvest may be lost.

Its very important to **encourage and feed native pest managers**, Willy Wag tails can eat 2000 insects a day, many other nectar birds consume similar amount of bugs. Lizards and frogs are voracious predators. These DIY native predators combined with our domesticated predators chickens, ducks (under fruit trees can break fruit fly lifecycle) provide a essential tool in pest management. Creating ponds, rock piles and dense habitat trees for these predators will greatly stabilise and build the diversity and complexity of our food ecosystem.

### Avoid Monocultures and target a diverse range of Food Plants

Food production and protection techniques that, depending on your system, can be utilised include; crop rotation, companion planting, guilds, and Integrated Pest Management as mentioned previously.



Crop rotation involves changing where types of plants grow each season to break pest cycles, utilised soil nutrients, vegetatively build soil, and allow focused heavy cropping of target annuals. Crop rotation normally involves several garden beds, four or more, where each bed sees a continuous rotation of legume, green manure, leaf or fruit and then root crop. Variations are made based on desired crops and number of beds. Crop rotation becomes difficult and ineffective the more you move into perennial food crops and ideas like forest gardens, at that point highly diverse guilds and natural succession and seasonal

### 13.4 Help Nature Help You - Predator Habitat Creation Techniques

**Ponds** (small as you need it to be) are essential to provide an accessible safe water source for most of your predators. Birds, frogs, wasps, and many other of the most effective pest eaters need water in your yard to be able to eat your pests. A pool is not useful by itself as it becomes a hazard and toxin for the predators and bees and other garden helpers. A well vegetated pond or large wine barrel/blue barrel will require little care, no aeration, provide a yield of food and mulch, and create this water source habitat that you must have. See the PermacultureWest website for Pond designs.

**Logs and Rock Piles.** I have observed a huge increase in skinks where I have piled, bricks, wood, stones etc in a warm spot. They breed up fast a eat bugs all day. Keeping the spots warm and dry keeps out the slugs and snails.

**Holes and Stick Bundles.** Drilling holes of various sizes in any dry hardwood will provide a home for many predatorial wasps and native solitary bees species. You can add it as a feature like Josh Byrne did recently on Gardening Australia or just start drilling all the suitable dead wood around your yard. Another method for breeding lacewings and other predators is making bundles of trigs about Drinking Bottle size and either wiring them together or pushing them into a piece of PVC water pipe. Providing a dense dry and physically size restricting space will make homes for many helpful predators.

**Biomass Stacking and Storage** – The simplest way of getting life in your garden is stacking it with Biomass. By biomass I mean any organic healthy material, carbon and organic matter is the food of soil bugs, these soil bugs if feed breed up in their millions and develop your soil and kick start your ecosystem. The best thing you can do is lay 10-15cm deep tree pruning mulch everywhere and stand back and let nature show you how

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## 13.5 Plants in Pest Control

While I use and encourage replacement of annual high labor crops, with perennial long term plants, one of the problems with perennials can be that they grow in the same ground and harbor the same pests all year round, i.e. Kale and Whitefly. Longer term observation of this 'problem' shows it again is just part of the ecology, as with the continuous supply of pests (food) there will grow a residential colony of predators.

Pest management in densely populated areas has its limitations, and effectively in Perth for guaranteed harvest soft fruits, and most solanaceae we will need to use insect exclusion mesh/net now as a control measure for fruit fly and Eggplant Caterpillar. While Permaculture offers lots of solutions to these pests most are unmanageable in an urban yard with careless neighbors and breeding grounds all around you.

**Pest controlling plants** come under three categories - **those that repel or confuse pest insects** with strong scent, those that **attract beneficial insects**, and those that **distract pests as an alternative food source**.

**Pest repellent plants** actually work in three different ways.

The first -**masking plants** - include thyme, lavender and scented geranium. These produce strong, volatile oils and scent that actually masks the plants the insects might be looking for.

There are also **repellent plants** such as cotton lavender or santolina, tansy and wormwood. These plants produce a scent or taste that is so bitter or putrid it drives insects away.

Finally, there are **plants that contain natural toxins or poisons** which can be used to make sprays or washes. These include fennel, which can be used as a flea repellent for animals, feverfew, or chamomile, which can be used as an anti fungal agent, and the dried flower of pyrethrum or chopped chilli, which can be used as insect sprays. Rue, Jicama Bean and Tobacco are some others.

Tansy is terrific at repelling ants and flies so you might want to plant it outside your back door or near windows. But pick the leaves and rub them on the back of your cat and dog because they'll actually get rid of fleas. Lavender, which has an incredibly strong scent, can be planted to protect nearby plants from pests such as white fly, and it's also used to mask the scent of roses from aphids. Basil is another companion plant that is often used to repel aphids. But if you grow a pot near your barbecue area, it will also keep away flies and mosquitoes. Sweet marjoram is often planted near gardenias or roses so that its strong scent will mask or confuse pests attracted to their flowers. Plants such as elder, dill and fennel all have umbels made up of hundreds of little flowers, and these are grown to attract hover flies, which eat other pests in the garden.

**Wormwood** has a strong pungent scent that's fantastic at deterring insects. I've used it around our vegetable patch and it's really good at keeping away white cabbage moth, and it makes a great nesting material for chicken laying boxes.

**Plants that attract beneficial insects**, are many, often it is the flowering that is the main attractant and those herbs and plants with the smallest (to us insignificant) flowers are the best. If you plant Salvias, Sage or Rosemary, are hardy helpers. Carrot flowers, Rue, Sow Thistle, Parsley, Holy Basil (Tulsi), borage, elder, dill, coriander and fennel plants have flowers that attract insects (normally by providing nectar) that prey on other pests in the garden. Predatory insects to look for and encourage include Assassin Bugs, Hover Flies (larvae), Lady Birds, Robber Flies and Praying Mantises.

**Let some of your vegetables go to seed**, while they are setting you seed they are providing food with the flowers. Members of the cabbage family are magnets for pollinators. Their simple flowers are full of nectar and pollen. Another example is the flowering turnip, Mizuna and also Mustard are wonderful. But apart from pollinators, they'll bring in beneficial insects like Lacewings and Hoverflies and they're really important for controlling aphids.

Plenty of **cottage garden flowers** are also extra helpful attractants so choose those to brighten up your yard, golden Rod, cosmos, pineapple Sage, phacelia and alyssum are easy and selfseeding. Planting many of these flowers, herbs, trees and letting in your veggies go to seed often in the garden will not only diversify your design, but also add attractive, interesting and aromatic elements to it.

## 14. Weeds

**Weed is a term humans have 'made up' for a plant that is growing where we (humans), with our very limited wisdom/purpose, would prefer it did not.**

**The hatred of weeds, vast array of chemicals and the expensive fight to control them is largely driven by the flawed idea of monoculture farming. (most of our agriculture)**

Nature does not have weeds (it does not do weeding). Weeds are nature's pioneers they are deliberately prolific, opportunistic, vigorous and short life cycled.

To do them justice we call weeds 'Pioneer plants', 'soil improvers' and 'dynamic accumulators'. They are the first plant species to move into a damaged area of soil to 'fix' it for more complicated, sensitive plants (most of our veggie garden plants) and the hopeful eventual aim of succession to forests.

Shallow mat rooted weeds are for bare soil stabilization and shading bear ground. They stop the top soil blowing or washing away and allow time for deep rooted weeds and other dynamic accumulators to bring up minerals and trace elements deficient in the top soil (initial germination and growing zone). Once a few generations of weeds have grown, seeded, died, composted and provided habitat for a accumulating little ecosystem, more advanced but sensitive plants can start to germinate.

Instead of fighting weeds while you garden it's great that you are taking the time to come and learn to identify them, work with them as opposed to compete. If everyone did this there would be many issues solved from weeds in agriculture to malnutrition.

Stopping weeding to do your research is in the long run timesaving, rewarding and empowering activity. It is a slow but rewarding process to learn their habits, function and which are edible and useful, and ultimately how to make weeds help you garden.

Ultimately once you understand the purpose of the weed you can choose to out compete it. Fix the cause of this weeds germination (not fight the symptom - the weed growing). Damaged soil, free soil, sunlight, water, space, opportunity, these all queue weeds to grow, nature is in a rush to fix its ecosystem if you dont manage these issues with plants you want to grow, or mulch, nature will fill the niche with 'weeds'.

In the areas of Biodynamics and Permaculture a lot of time is taken, and detail literature written, to explain the purpose and uses of 'weeds' and the larger pioneering plant group. This booklet is a 'pocket guide' to identifying

Perth Edible Weeds, so to learn more about the natural purpose and usefulness of weeds I advise further reading or courses in those areas.

**This Biodynamic reference is excellent, <http://www.biodynamiceducation.com/library/>**

I have written a booklet titled "Edible weeds and foraging guide for Perth Western Australia", as many of our garden weeds are actually more nutritious than the vegetables they are outgrowing.

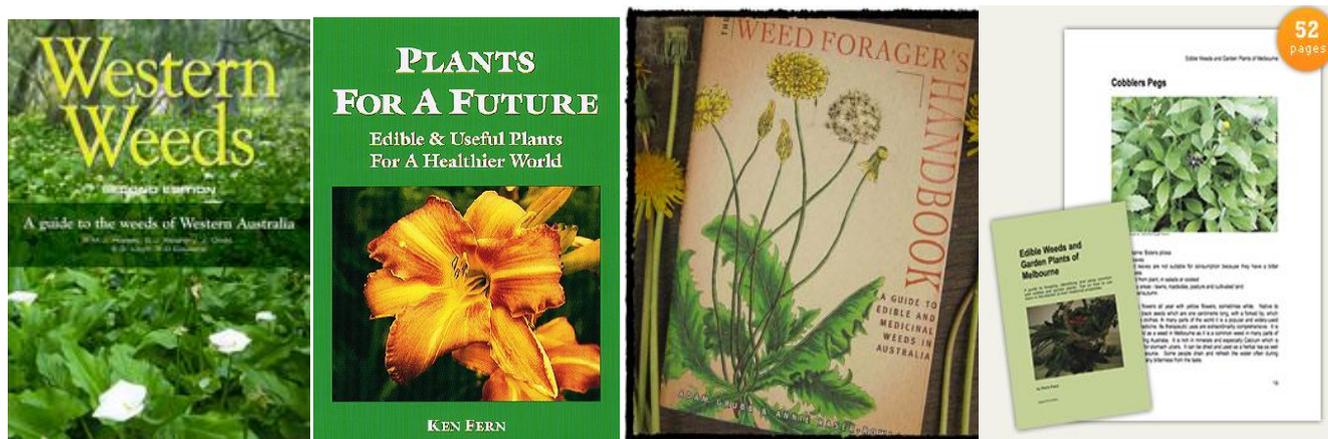
**NOTE: The booklet contains descriptions and Colour photos of common weeds to aid identification, head to our website and grab a copy as this section is just a summary of the info there.**

## 14.1 Identifying Weeds - Edible, Medicinal, or Not

Most people are shocked at the things I try when I am asked if it's edible, but I have done lots of research prior to putting it in my mouth. Truth is most weeds are edible. The reason I will eat it rather than just saying yes, is, 'the power of the guinea pig', people are rightly worried about eating food that may be poisonous.

I highly recommend getting a \$35 copy of, **Western Weeds – A Guide to weeds of WA**

([http://www.wswa.org.au/pps\\_publications.htm](http://www.wswa.org.au/pps_publications.htm)), as a weed guide that has every 'weed' in WA at the time of publishing. Unfortunately it doesn't tell you which are edible but it's clear photographic identification and botanical names allow you to identify the plants you have. Once you know what it is, searching its edibility and medicinal uses is both easy and truly astounding. The internet has much on edible weeds, not all of it is correct, so as per all research cross reference and make sure a few people are advising it as edible.



A great place to start once you have the botanical name is Plants for a Future - It has a huge online referenced database on all things edible and medicinal, including palatability rating to see those that are not worth it. This is community funded so consider a donation or purchase the database to support the site.

<http://www.pfaf.org>

**There is far more information on each plant than I can fit in this booklet so take the time to look up each plants detailed edible and medicinal uses, you will be amazed !**

Once you have a little more confidence there is lots great info and photos on the internet, search "edible weeds .au". A few books you could look for are; Doris Pozis - **Edible Weeds and Garden Plants of Melbourne**, *The Weed Forager's Handbook: A Guide to Edible and Medicinal Weeds in Australia* by Adam Grubb and Annie Raser-Rowland, Wild Food A.B and J.W CRIB, and by the same authors Wild Medicine (good info on natives and

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weeds, very few pictures). Wild Food Plants by Tim Low and Self-Sufficiency and Survival Foods by Isabell Shipard both have extensive list of edible weeds. Useful Bush Plants by Peter Bindon is a great indigenous food and medicine plant guide for Australia.

The best international weed centered website is <http://www.eatthatweed.com/edible-weeds/> (and its accompanying youtube series) and <http://edibleweeds.com.au/edible-weeds/facts/> are both excellent Australian sites with reliable information and blogs. There is an amazing article on 100 plus edible flowers.

There is also a collaborative google Perth Foraging Map - Public Fruit Trees in Perth map here: <https://maps.google.com/maps/ms?msid=206354188419166343422.00049b37e6cc15ff4446f&msa=0>

## 14.2 Eating the Weeds

The trick with many leafy edible weeds is to eat the young leaves before the plant starts to flower. If you have ever tried picking loose leaf lettuce after it starts to flower, in the hope of getting just a few more leaves before the plant is inedible, you will know how bitter they can be. It is the same with most weeds, and while the leaves still have a definite flavour to them and can be cooked, they are more palatable when harvested before flower growth.

Eating weeds is best approached from a 'super food' perspective, most are highly mineralized and powerful plants, eating them alone may not be enjoyable, but, putting a handful of mixed weed greens in a salad greatly increases interest, nutrition and food security. Many of the tougher or strong flavored weeds/herbs can be used the traditional way of throwing plant material in a pot roast or drying to make a tea.

Currently we are fortunate that we can mix edible and medicinal weeds with normal vegetables to introduce ourselves gradually and learn the names and flavors along the way.

Take this gentle introduction opportunity now as you may find yourself relying solely on weeds some day.

Eating weeds from public places in high usage urban areas does have some risks. Councils and many house holds use glyphosphate and other chemicals to wage war on these free and hardy plants as they make pathways, parks and rosebeds untidy.

Apply common sense, if a plant looks sick don't eat it, even if it hasn't been sprayed sick looking plants are not healthy food. Also bear in mind that plants like dandelions are hardy and have a strong root system, they may have been sprayed multiple times so there could be higher levels of chemical buildup. Though this is not something to stop you foraging be sensible, ask questions of the council or owners, and if you want the plant but are concerned about its toxicity take it home and plant it in a pot, when it goes to seed or propagates you can then eat those toxin/risk free plants.

Another debated concern with consuming weeds is they are often higher in oxalic acids than most common vegetables. Warrigal greens, oxalis, docks, amaranth, fat hen, and purslane are all numerically high. While the body produces its own oxalic acid internally, eating it in high intakes, is becomes an anti-nutrient, limiting the absorption of some nutrients, particularly calcium and iron. Moderation and diversity is always the key, so I dont tend to worry as weeds are high in all minerals so when oxalic acid comes with calcium and magnesium in the food it is not an issue. Oxalis and Docks, if eaten alone, should be consumed in limited amounts for this reason. If you need to consumer large quantities you can blanch for 2-3 minutes and discard water some of the mobile acid is removed in the water, or add yohgurt or other high calcium additions to precipitate/complex out the acid. Excessive oxalic acid can contribute to kidney stones, gout, and arthritis in some people.

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As we discussed before treat weeds as a super food, mix it with kale, root veggies, and other foods and you will not need to worry about oxalic acid.

Many native bush tuckers and seaweeds etc might have restrictions on their harvesting, many are rare and essential parts of threaten ecosystems. Avoid harvesting native roots (lillys, yams, etc) and killing plants unless it a matter of your survival. No-one will miss introduced weeds and often thank you for removing them, so while a knowledge of indigenous edibles is essential concentrate your use on common garden escapes and weeds.

Again I caution **do take care identifying weeds prior to eating them or using them medicinally**. Good pictures, knowledgeable friends or local groups, and hands on foraging workshops are helpful.

When foraging food not in your own backyard ensure the plant has not been sprayed/contaminated. **If it looks sick don't eat it. If you are not sure what it is don't eat it. Especially important for fungi which I have not the experience to cover at this point.**