

Pest Management in the Garden

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.

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 (Vegenet/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, bassicas 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.

IPM

A technique of pest management commonly used by commercial growers as well as informed gardeners is IPM – Integrated Pest Management. IPM information is also described well in the attached info sheet from Community Gardens Australia.

IPM primarily focuses on preventing infestation through careful planning (use of polyculture, pest-repelling plants, etc) and intervenes (preferably without use of chemicals) when this is found necessary after observation. Three basic areas are: Physical controls, Biological controls and Chemical controls.

Physical controls include:

- hand removal of insects, traps, decoys, barriers such as bird netting, fencing, and row cover.
- The most important part of commercial growers IPM is crop rotation. Crop rotation means allowing a three to five year time period between planting a member of the same plant family in the same plot of land. Rotating your crops will control a lot of pests, disease, and fungus because they are usually plant family specific.

NOTE: There are many reasons why interplanting and companion planting are sufficient and more practical in the home garden.

Biological controls are using other creatures to eat the undesirable insects. Following are a few examples of biological controls:

- Having a diversity in the garden to attract natural predators of insects.
- Insectary crops which attract beneficial insects. Notable for this are native plants, the fabaceae family which are legumes and the Umbelliferae family, which have umbrella-shaped flowers. Insect-supporting crops can be interplanted with garden crops or in an insectiary.
- Chickens eat all bugs but also your plants so watch them carefully.
- Ducks eat snails and slugs as well as plants.
- Introducing beneficial insects but BE careful with this as they can escape from your garden and you could introduce bad species. Find out before ordering beneficial insects that the species is alright for your area. Most nurseries should be able to help you with this or contact your local Agriculture department. Some beneficial insects include: ladybugs (make sure to get ladybugs native to your continent!), Praying mantises, Trichogramma wasps, Tachinid flies and Syrphid flies.

Chemical controls are considered a last resort in IPM but sometimes they are deemed to be needed in a commercial system. Unlike the methods noted above, they require direct action from the farmer. Some recipes will be discussed later but are not recommended. As mentioned before problems with chemical controls are that **bugs build immunity to them and they can stop working**. They are also **not species specific** so beneficial as well as harmful bugs are killed, and you may kill off the entire food source (pest) for the predators you do have.

NOTE, that besides green pesticides, artificial chemical pesticides too are used in commercial IPM. However, as they these can not be made at home, and have a ecological impact and finally are not well combinable with permaculture or other ecological farming techniques, they are not discussed here.

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 natures 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.

Pests are drawn to weak plants or plants with surplus sugars on their surface caused by sickness or often excess nitrogen creating excess plant tissue. This gives off a signal to the insects that it's dinner time as things are out of balance and need to be fixed, which may or may not end up in the plants' death but will certainly see it attacked.

As with all things, a balance, of nutrients in the soil and thus the plant, is critical for pest resistance.

Nutrient dense gardening (high Brix gardening) is one good way to minimise most pest issues and produce mineralized healthy food for you and your family. The simple representative measure of Nutrient density is Brix, measured by a BRUX Meter (Optical Refractometer). You can easily get a drop of juice/sap from your garden produce to evaluate its quality, but this device has the added huge bonus of allowing you to assess what you are buying at the shop or farmers market.

• YOU, not some scientist in a lab coat, can test the food you want to buy or test and improve home grown food quality. Also you can determine QUALITY at any point of sale. It's just a simple way for YOU to gain back a little control over YOUR life.

- A brix meter will set you back about \$70-80 dollars and last for life, at no running cost.

Take readings immediately after getting the juice drop. If the juice dries on the prism, it will give a false reading. You must also be wary when testing dehydrated produce. Drying a drop, or an entire fruit, creates a false high reading. HIGH BRUX produce also adamantly resists rotting in storage. Like other aspects easily testing by testing and storing HIGH-BRUX fruit or other produce.

Using a BRUX METER is simple, squeeze sap out of a plant/fruit, put 2 drops on the prism, close the prism cover, point to a light source, read the measurement where light & dark fields intersect. Check BRUX comparison charts for quality.

And why am I raving about this when this is about pest management, any crop with 12 or better leaf Brix will not be bothered by insect pests. Note, leaf not fruit reading

Centuries of wine making and work with other fruits and vegetables always show direct relations between high Brix and high quality, expressed most simply and directly as superior taste. The process is somewhat altered for the gardener or farmer in that they test the leaf of the growing plant much earlier and are therefore afforded the opportunity to correct soil deficiencies before the crop matures.

Know your Pests and How they Work. (Locally Expanded from Garden Australia info)

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.

Mealy bug (white fluffy scale) is another common sucking insect. Mealy bugs like sheltered conditions and are commonly found on plants under patios, in glass and shade houses as well as indoor plants. Being sap suckers, they cause the leaves to wilt and distort. They also produce honeydew, which leads to sooty mould fungus, also farmed by ants. The big ones can just be squashed with your fingers, but dab the little ones with methylated spirits. This dissolves the waxy coating, which causes them to dehydrate and die.

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. 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 aswell.

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)

Mice and Rats can reek 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 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.

Pests are part of nature and they will always be there. As permaculturists, 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.

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 Dring 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.

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 **repellant 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 repellant 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.

Replant plant 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.

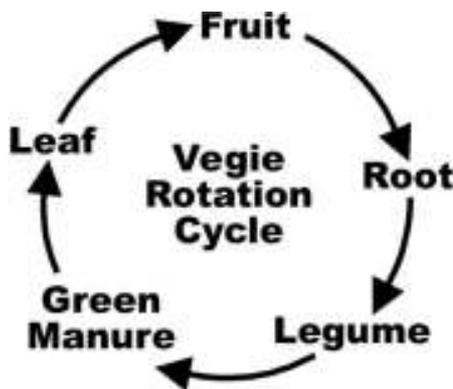
Let some of your vegetables go to seed, while they are setting you seed they are providing food with the flowers. Members of the cabbage family are magnets for pollinators. Their simple flowers are full of nectar and pollen. Another example is the flowering turnip, Mizuna and also Mustard are wonderful. 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 alysium 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.

Techniques - Recap

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

Companion planting, inter-planting and guilding is about creating a polyculture of vegetables, herbs, dynamic accumulators, shade and structure species and perennial food crops in a garden bed, micro climate, limited space. Typical companions of Tomatoes and Basil and the three sisters corn, squash and beans, are mentioned a lot, but it is more about planting plants that have growth habits and mechanisms that are not antagonistic to each other.

An excellent companion planting chart is available here - <http://permaculture.org.au/2010/07/30/companion-planting-guide/>

As much as people want to structure their garden and zones with fixed permanent landscaping, a ecological garden is always evolving, and succeeding in a cyclical improving dynamic system. Don't fight the pest or the change, but observe and use it to your advantage.

LAST RESORT organic sprays – NOTE: Organic does not mean safe !

Pyrethrum is actually quite poisonous until it breaks down. Chilli and garlic spray, used to control aphids, can be painful if it gets in your eyes, cuts. Always label containers, even if they're harmless, and keep out of reach of children. Remember, even natural sprays should only be used as a last resort, because they can also harm beneficial insects, some of which help keep pest insects under control.

Coffee spray. (for slugs and snail)

One part really strong espresso coffee, 10 parts water, and spray the seedlings and surrounding soil thoroughly. The slugs and snails cross, it absorb the caffeine and die. You have to reapply after rain or irrigation.

'Contact' insecticides need to be sprayed directly onto the body of the insect pest. The insecticides will remain useful for a couple of days but it's generally best to make them fresh every time.

Pawpaw Spray (For soft-bodied insects such as aphids and mites)

1. Blend a bunch of pawpaw leaves with enough water to make a paste.
2. Add a litre of boiling water and let it sit for a few hours.
3. Strain the concoction and add two litres of water.
4. Add 10ml of potassium soap per litre.
5. Add 2ml of vegetable oil per litre.
Stir it well and strain it again.
6. Spray generously all over the plant every couple of days or until you see a result. Remember to re-apply after rain or if you've used a sprinkler.

Chilli Spray (This works on all the insects except grasshoppers and beetles.)

1. Blend a cup of Birdseye chillies with enough water to make a paste. Birdseye chillies are extremely hot so, while working with them, don't breathe the fumes or touch your face, eyes or other sensitive parts of your body with your hands. Wash your hands thoroughly afterwards. Really, it's advisable to wear gloves.
2. Add 10ml of potassium soap.
3. Add 1 litre of water.
4. Let the mixture sit overnight.
5. Spray on top and bottom surfaces of leaves.

Oil Spray

Make the oil spray by blending two cups of vegetable oil with one cup of pure liquid soap, and mix it until it turns white. Dilute one tablespoon of the emulsion to one litre of water and spray all affected areas thoroughly. Do this during mild weather, because if it's hot it may burn the plant's leaves.

White Oil (Works on aphids and other stationary insects by suffocating them.)

1. Mix or blend one cup of oil, one and a half cups of water and a couple of millilitres of potassium soap.
2. Use one part of white oil to 10 parts of water.

Potassium Soap (Effective against thrips and mites. Gentler on plants than other soap sprays)

1. Add 20ml potassium soap to one litre of water. Spray it liberally on the plant, focussing on where the pests are located.
2. Repeat every 2 days until insect numbers are reduced.

Neem oil is a fungicide as well as insecticide.