

Compost and Soil Biology Course Permaculture Research Institute - Zaytuna Farm

September 20 - 24 2010-09-29

Regen Ag.com

Sewage systems are essentially designed to produce greenhouse gasses.

Bacteria live forever - they only die if they are consumed. They just continue to divide or reproduce.

Compost:

- Soil pH
- Nutrient recycling
- Aerobic v's anaerobic v's facultative anaerobes
- Worm farms
- Fungi - fungal networks
- Biomass of microbes
- Chemicals v's compost
- Mulch
- Green manures
- Compost tea AACT
- Web resources
- Mineralisation
- Rotary tiller - machinery
- Soil degradation and regeneration
- Field indicators

Traditional farming: Pre chemical farming. Asian system w/cover crop and annual seed collection

Conventional farming: 1950s - war machine, chemicals, trees turned over to farming

Organic farming: Green manure, organically certified inputs -> organic food → becoming more corrupt. Certification becoming industrialised -> certification of farms, vegies, soils etc leading to increased cost. Can halve the price of organic produce by farming biologically. Organics not necessarily healthy especially when it comes to chickens;

Biological farming: Soil based → get the soil right and everything else follows → biological fertilisers.

Natural Systems Farming:

- Use local resources as basis of all inputs & management; Basis of distribution is cooperative resources and networking
- Cooperation, diversity, community, sharing → all natural systems have intrinsic diversity and very complex. We do not allow ourselves to have the benefits of natural systems and instead depend on artificial processes;
- Systems under stress (human and ecological) and then they get sick;
- Ecological design leads to a reduction in the stress on the system;
- Key performance indicators for sustainable management → after harvest, the soil should be better than at the beginning of the system ie. It should be a regenerative

system. This cannot happen with chemicals which are the second largest income earner for the USA;

- **Difference between biological agriculture and conventional is that conventional agriculture is a militaristic management system → kill everything when it goes into crisis is the first response. It does it well at considerable expense. Usually what is being killed is not causing the problem and is a male approach to ownership. Need to find a balance and a feminine element brings balance into the system. The # 1 reason why collapse occurs is because men fail to listen to the women. Need a rounded holistic approach that provides synergy and produces a harmonious system -> it is about the quality of life!**
 - o We are designing around credit card payments
- Root eating nematodes survive in low O² conditions especially if herbicides and insecticides have been applied. This creates toxic organic matter and the microbes cannot break it down and this encourages root eating nematodes.
- Gardening is a healthy interaction for families

Vital System - chooks in the backyard eating grass and laying

Vegie patch - producing value and assisting you to deal with the toxins you accumulate in your life → 3 metre diameter circle will produce enough high value mineral rich food for a family of 4 - a beginners garden.

- A 6 metre diameter after 2 years can produce as much as required
- Losing the ability to take care of ourselves

Soil biology is the only way we can sequester carbon and produce. Currently we are burning off carbon and quickly reducing the quality of our soils.

It takes 30,000 litres of natural gas to manufacture 1 MT of urea → totally unsustainable or 500 kilos of coal to manufacture 5 kgs of high N fertilise → embodied pollution in urea.

There are 75,000 MT of atmospheric N above every ha of soil so, why buy it?

When chemical N fertiliser is used, we kill off the soil microbes that sequester the atmospheric N → one part of urea burns off 5 parts of C in the soil.

Carbon, minerals, organic matter and microbes all act together to make a soil healthy → they consist of the 'bank principal' in your soil account

- ⇒ Need to earn interest via sustainable production ie. Harvesting plants and animals without degrading our system and using up the principal. Actually need to build our principal
- ⇒ Require a minimum 5% organic matter in a healthy system and you can achieve sustainable production
- ⇒ Have to have blue before you can have green before you can have black - that is, water, plants and carbon
- ⇒ Natural systems often have the look of chaos - Zaytuna farm such a resource. It is a the ultimate compost farm.
- ⇒ Personal responsibility with cooperation → can thrive with this combination.

E	Education	
O	Observation	A Balanced System
C	Contemplation	Nutrition and calibration are two
A	Ability to take appropriate action	remarkable alchemies of culture

Critical to take quality time off and communicate with family and partner → without this it is difficult to take appropriate action.

Cooperation not supported by Govt as it does not generate taxes. The more we cooperate the less energy in for maximum production. A decrease in energy inputs is an essential input for quality of life.

Organic Waste → convert to a resource as compost

- Making a specialised compost is called inoculum compost as making a special medium to make soil microbes;
- Has a biomass that is more than 50% microbe organisms - thousands of species and billions/trillions of individuals

Pacific Gyia - 12 identified (plastic dumps) → biomagnification of toxicity between humans who are at the top of the food chain and the fish that are ingesting the plastic (poetic justice)

Also the nano-particles that exist in the atmosphere now that is as small as pollen → more biomagnification

- ⇒ Home grown vegetables able to counter this toxicity build up
- ⇒ With composting you have micro-organisms tearing apart the toxic elements in the chain via biological activity. The product produced becomes less and less toxic at each stage.

Micro-organisms for good quality compost are washed off via a highly aerated process that naturally selects for aerobic microbes. Microbe food such as fish, kelp, humic acid and aerated over a 24 hour period to produce Actively Aerated Compost Tea.

Micro-organisms attach themselves to the compost and need to be washed off into a nutrient rich solution → hundreds become thousands become millions and billions over a 24 hour period of brewing.

In a liquefied form, there is produced high density water and can spray as a foliar spray or apply to the ground as a drench to re-innoculate the soil.

Spraying on to leaves provides protection from disease and adverse environmental conditions.

Aerobic organisms depend on organic matter and need soil structure → build it

- ⇒ If soil is compacted then aerobic organisms are destroyed
- ⇒ Will out-compete anaerobes eventually
- ⇒ Compost tea is sending a hoard of micro-organisms into the soil and after two years of applications, soil will be in much better condition

- ⇒ Other methodologies will make the application of tea more likely to succeed eg. add organic matter which is a powerful food for the sustaining of microbial life
- ⇒ Keyline ploughing an excellent means to condition the subsoil and can apply compost tea at the same time → decrease chemical inputs, increase productivity and reduce cost. Does not disturb the surface at all as it slices through like a knife. Soil is shattered approx 450 mls either side of the foot
- ⇒ This will enable plants to grow down through the anaerobic layer
- ⇒ O² a toxic gas for anaerobic microbes which will make every effort to recolonise the area so an injection of compost tea will enable the aerobic microbes to go to war with the anaerobic microbes.
- ⇒ Use of roundup will put you back into the succession process and will select for weeds.
- ⇒ When roundup hits protein it becomes carcinogenic and bioaccumulates -> lymphatic cancer did not exist prior to herbicide use

The more woody mulch is the better and more diverse it is. It is better for succession. Grasses select against trees and one must move towards perennial forest ecology. As C increases in the soil succession will move towards a more complex system

If a paddock is covered in thistles it indicates there is too much accumulated N in the soil. It can be eliminated with molasses. Artichokes will grow well in a thistle environment as they are of the same family.

Fungal relations is one way of describing degraded soil.

- ⇒ Start building soil and have a 1:1 fungal to bacterial ratio to successfully grow perennial grasses
 - ⇒ As it moves towards more fungal content then can establish early succession and as it becomes more complex, able to grow more complex systems.
 - ⇒ Increase organic matter
 - ⇒ Increase biodiversity of soil
 - ⇒ Increase soil depth
 - ⇒ Adequate rainfall
 - ⇒ Mineralisation
 - ⇒ Sunlight
- Enables forest regeneration or extremely well managed food forest - biology, minerals, organic matter, rainfall and sunlight.

NB*** Don't burn as it turns resources into pollution

Humate - resistant to leaching

Biology → hold nutrient in the biology of the soil and nutrients do not leach out

- ⇒ Use of chemical N is not increasing the nutrient in the soil it is just stressing the system out - Like eating potato chips 3 times a day for food → produces lots of kilos but not healthy (movie - supersize me)

⇒ There is much less nutrition coming out of increased food production

Need to replace landscaping with food production and use public land to grow food.

If adding wood chip mulch to the soil, need to put approx 5 cms of manure on the soil first - creates a compost action that kills weeds and creates fertiliser. If the soil is healthy, the mulch will just disappear in a couple of months. If you just add chips then you get N drawdown as a result of the C content of the mulch.

Making Compost:

Law of Compost

Diversity of materials ensures diversity of microbes eg. Wood chip with cardboard or wood chip with bark and leaves.

- ⇒ Need 40% high carbon content material in general such as wood chip, macadamia husks. Can pre-compost chip by placing chips in a pile with manure. When you see mushrooms growing on the side they are ready for the compost heap;
- ⇒ Need 30% green waste - freshly harvested grass, leaves, shrub, banana - anything harvested green before it drops seed is 'green'. Once it has dropped seed, then it is brown as it has dissipated its energy into seed;
- ⇒ 20-30% high N - all N is not 'N' → eg. Bulk chicken manure mixed with straw but straight chicken manure is OK.

- ⇒ Layer it up:
 - C base with 4 measures of C in that layer
 - 3 measures of green
 - 2-3 measures of high N

⇒ Repeat 3-4 times.

⇒ Any material that has dropped its seeds is considered 'brown'

Can add egg shells, dolomite, basalt rock dust (can collect from road building areas). Rock dust should be fine enough for the dust to drift off like the fine dust found at the crusher.

If using blood and bone, ensure there are no preservatives in it (high N with Ca)

Throw some weeds in as this provides diversity of minerals

Wasted resources such as spoiled hay (and rock dust)

If putting animals into the pile, ensure that they are in the carbon layers (bottom first). Place them at least 300 mm in from the side of the heap and 300 mm deep. This is called mortality composting. This type of composting requires management. Animals should only make up around 5% of the pile.

Leave the pile for 10 days (check temperatures on a daily basis) before turning and this will also ensure that any dead animals are well cooked. The carbon layers bring the air flow into the heap.

Try not to turn the pile too much and ensure sufficient water is added to ensure the core of the heap is damp and this increases the numbers of fungi growing.

- ⇒ Moisture is the catalyst. When you squeeze the compost you should just about get a drip of water out of the mix. If too wet then reduce the moisture addition.
- ⇒ Need 55° C for 3 days or 65°C for 2 days to kill seed.
- ⇒ When turning the compost pile the outside should be the inside of the pile -> mist at the same time you are turning and do not rake the sticks out of the pile as they are full of inoculums.
- ⇒ Ensure that air can get under the tarp when covering the heap -> use branches or a couple of old pots to keep the tarp off the heap.

Monitor heap using moisture and temperature probe - it should not go over 65° C. When it reaches 65° turn the pile and mix all materials. However, if you have animals in the heap, should wait 10 days.

Can make vegetarian compost by using legumes instead of cow/horse manure etc;

If using a compost toilet on site, it is a good idea to add rock dust together with sawdust after a deposit.

Compost and compost tea are an integral part of the management system. Managing a compost pile takes only 10 mins per day.

When making compost, preparation is the key. Have everything ready for the heap

- ⇒ Compost heap tarp and material to keep the tarp off the heap and ensure air flow

- ⇒ Have a heat meter on hand
- ⇒ Make and monitor → have a record sheet for the heap
- ⇒ When checking the temperature, place the probe on each layer and also the centre of the pile
- ⇒ Moisture test → wick it with a misty spray
- ⇒ After 3 days and it is reaching 55° and moist, then you have it right
- ⇒ If it becomes dormant and dry it may need to add molasses → use 5 litres of molasses in 20 litres of warm water and pour it into the core. Do not use more than 10 litres of molasses as an activator as it will become too hot.
- ⇒ Take the temperature every day

Application Rates:

Less than 2% organic matter then must apply compost at a rate of 10 MT per ha.

Types of Compost - see handout

Berkley Compost System -> bacterially dominated and good for vegies.

Indore Method -> first system put into a science and originally a traditional method in India.

- ⇒ Final amount of N at the end of the process is greater than the inputs.

The Leubeke Method -> waste management plan for Europe and turned 20 times over 6-8 weeks

Heinrich Phiffer -> taken by Luebeke and developed. Worked with Steiner to create bio-dynamics

Static Composting -> giant heap of various materials with 20% N, moisten it down and leave it. Need 10 cu mtrs to work properly:

- ⇒ 3 mtrs high x 6 mtrs wide => keep damp as cooks faster
- ⇒ Outer layer does not heat up much
- ⇒ Collapses into ½ its original biomass
- ⇒ Cover with a loose tarp with holes so it can breathe
- ⇒ Centre of the pile is anaerobic -> gas off
- ⇒ If there is 1mtr above the core then microbes in the layers above will absorb all the gas
- ⇒ Can use dead animals in this system though need to inspect regularly as it could explode -> a good way to dispose of dead animals but need a good 6 months of composting if using dead animals
- ⇒ Can then use the finished product as inputs for normal composting
- Feed compost to cattle in Europe and no reason as to why it cannot be fed to other animals as well

Compost tumblers -> no good as they get too hot

Soil Biology - see handout

Organic material content in the soil can be raised to a required 4% level within 5 years whereas it used to take 20.

- ⇒ Population numbers of soil organisms + complex diversity of soil organisms
 - Drives soil function
 - Soil structure, soil moisture, soil fertility and disease suppression

Green manure crop - cut and drop and don't turn it into the soil and leave roots in the soil.

Fine humus layers are stripped off the tops of compacted soils instead of soaking in as they should.

Microbial world → everything once living or alive will be consumed by microbial decomposition at some time -> can turn it into compost.

- Using herbicide collapses the soil structure
- Pathogens require fungicide and insecticides to flourish
- Degrades the vitality of the plant and increases the toxicity of the soil and crops

Every kind of microbe occurs everywhere plants and animals exist. Every surface is a home → life interacts with life to create a healthy system.

In a 2 cu mtr pile you can use up to 30 kgs of fish guts and skeleton material

10 litres of molasses with warm water will regenerate the compost heap if it is too cold

Background - Slide show with music

Regenerative agriculture instead of destructive → reduction in soil toxicity → healthy plants → reduction in use of chemicals → a circular process

Avocadoes require beneficial organisms and high quality air above and around roots -> spraying herbicide around them encourages disease;

We are throwing away resources and buying it back all the time eg. Not collecting water, and installing a desalination system

- Pruned leaves that are brown are still green material as the sugars are still retained in the material
- A urea based system cannot sequester carbon
- A healthy diversity of fungi is critical for carbon sequestration and urea kills them.
- Diversity -> plants, topography -> gives different microclimates
- Soil testing lab in Adelaide has never tested an Australian soil that was low in P
- N harvesting microbes are not available in the soils to harvest atmospheric N in a chemical based system ->
- Feeding inoculated plants with N will kill the ability to generate N nodules
- Seasol is only 30% seaweed concentrate and 70% water → very expensive and can be replaced by compost tea.

- Worm juice is a form of compost but does not have the diversity of microbes that are required in compost tea. Don't know which microbes are doing the work but we do know that a diversity of microbes is required
- 200 litre brewer is \$1770 and can use the same unit to actually power 2 x 200 litre brewers at the same time.
- Compost tea application increases the productivity of sugar cane by increasing the CCS
- 20-50 litres of compost tea to 1000 litres in a trough for cattle as a preventative health measure for cattle
- Use of compost tea has eliminated nematodes and fungi in greenhouses in Saudi
- When using chlorinated water aerate for 1 hour to blow the Cl off before actually beginning the brewing process as Cl is detrimental to micro-organisms
- Need to remove all filters on the spray unit
- Add extra food into the water and mix thoroughly prior to adding the compost into the brewer.
- Should use fine ground limestone instead of lime or dolomite to increase the pH of the soil. Lime and dolomite provide an immediate response but kill off the beneficial organisms → need soil structure to have healthy micro-organisms

Compost tea:

- ⇒ Yeast, bacteria and fungi all work together in the break-down process -> looking for a balance of foods to breed diversity and allow nature to select. Diversity of food -> a diversity of microbes. Soil biologists only know 10% of what is to be known about microbes but claim 100% of credible authority
- 1. Need fish kelp and humate to provide a diversity of food -> humic acid (added at a rate of ½ to 1 litre/100 litre) acts as a buffer for toxins in the water and this is therefore added first. Then, add liquid fertiliser - deep sea fish fertiliser which is an enzyme digested fish **NB**. Black worm tea is rich in humic acid.
- 2. Add 200mls molasses per 100 litres of tea
- 3. Add 2 litres of kelp and 2 litres of fish (if using molasses then decrease the fish by ½ litre)
- 4. Add ½ kilo of soya or oat flour
- 5. Add 2 litres of worm juice
- 6. If use carbohydrates or ½ litre of flour, no change is required to other ingredients.
- 7. If the weather is hot, use less and in cold weather we can use slightly more food ingredients
- ⇒ Looking for a balance so not to overdo it! Peak microbial activity is around 15-18 hours of aeration and an over abundance of food can over activate the number of microbes and therefore decrease O² levels. Need to have O² at a minimum of 6ppm → Hack O² metre or Ecotech dissolved O² meter. Kelp has a tremendous ability to grow.

- ⇒ If the water temperature increases to 30° then the ability to hold O² decreases
- ⇒ If the water is suspected of being high in salt or toxic from ag chem pollution, then need to add more humic acid to buffer the pollution.
- ⇒ If humic acid powder is purchased, then will need an alkaline base to solubilise the mixture.
- ⇒ N conversion in compost is very high. Compost has a high mineral and biological diversity thank worm tea or castings. However worm product is a good addition to aerobic composting.
- ⇒ Can refrigerate compost tea at around 10° C over a week to increase its long-term effectiveness but it is best to utilise the product immediately following manufacture.

Application of Compost Tea

- ⇒ Spread one litre of finished compost tea per one ha of land;
- ⇒ Can apply as much compost tea as you like but the minimum is 1 litre/ha.
- ⇒ When chemical fertiliser is placed on grass the root system stays around the fertiliser. When injecting compost tea with the seed, the root system develops and spreads and can lead to a 10% increase in production and a huge decrease in chemical import costs
- ⇒ Use of high N application provides huge amounts of upper growth but minimum root development.
- ⇒ Gilgai farms place compost tea in the trough water as it has a positive impact for the control of parasites in ruminants. Application of tea to pasture also reduces parasite levels.
- ⇒ Using compost tea etc can save 60% of chemical input costs

Compost Tea Recipe

Require a 200 litre brewer. Brew for 24 hours → 200 litres of actively aerated compost tea.

Recipe:

1. 200 mls humic acid
 2. 1 litre kelp
 3. ½ litre fish
 4. 100 mls molasses
 5. 250 grams flour
 6. 2 litres of compost
- Add more if warm and less if cool. This is a safe recipe**

Not anywhere close to the 1000 litre brewer as you can grow a better diversity of food in the 1000 litre brewer. It is a more commercial system.

Problem of people always wanting to add more as 'more' is seen to be 'better'

- After brewing for 24 hours, take the 200 litres of compost tea and place in a 1000 litre container

- Add 200 litres of water;
 - Add 5 litres kelp
 - Add 5 litres of fish
- ➔ this produces your fertiliser and is ready as a foliar spray and an extremely dynamic fertiliser

Best plant response is in spring, summer and autumn and also provides a stronger frost response in winter.

- ⇒ If applying as a foliar spray and require plant growth add more fish
- ⇒ If having disease issues then reduce the fish component
- ⇒ If mineral deficient then add more kelp

Bio-fertiliser Fermentation

- ⇒ Fill 200 litre barrel with fish guts and skeletons
- ⇒ Add 10 litres molasses
- ⇒ Add ½ kilo of bread yeast (low alcohol)

Need a length of hose from the lid into a bottle of water to take the methane produced.

seal

- ⇒ A slow ferment 300 mm of air space

200 litres

Bio-fertiliser ferment

Aerate the finished product and make compost tea with it.

Life - Need Trees

- ⇒ need roots
- ⇒ need birds for pollination and pest control, fertiliser
- ⇒ need insects
- ⇒ soil life -> earthworms, microbes and bacteria, fungal webs
- ⇒ swings
- ⇒ percolating water
- ⇒ biological associations from the tree, plants and animal organisms
- ⇒ etc etc

Root development depends upon soil health - fungi and bacteria appear in rocks and the roots follow and then the fungi and bacteria follow the roots and life follows life. A healthy wheat plant has 2 kms of roots in association with fungi and beneficial bacteria and soil structure.

Birds, insects and plants depend on each other -> there are different and often invisible associations going on → powerful chemical reaction between one life form and another. Also all animals are decomposing something which leaves food for microbes etc. Diversity of the insect world has collapsed as a result of chemical treatment, clear felling and burning.

=> Tree of life that provides the essential and integral parts of life on earth -> sequester C, transforms to CO₂ and gases it off as Oxygen so we can breathe.

The agricultural response to this system is chemical attack

- ⇒ insecticides wipe out bacteria
- ⇒ ditto on insects
- ⇒ pollute the air

→ turns the soil and the environment into a shell of its former self. This is both insanity and psychotic.

China has invented an artificial egg -> doesn't produce life but it does fry!

→ Use of integrated natural systems using compost tea etc enables us to grow food for free from waste products that are available in the wider community or on the farm.

- ⇒ Can produce endless nutrient from the system but it is difficult to obtain cooperation from the community
- ⇒ Natural systems have so many layers of abundance it is difficult to imagine
- ⇒ Driveway the best place for an orchard as it is most accessible. Weeds are an asset in an orchard as they are nutrient stores for the trees.
- ⇒ Appears to be a biological control system between grass roots and tree roots layers
- ⇒ People too used to seeing 'landscaping' as 'beautiful' and normal as opposed to natural production systems as normal
- ⇒ Food and plant diversity encourages insects and birds and therefore more balance there
- ⇒ Prominent blueberry farmer has moved to a compost tea management system

Bio-fertiliser

Bones -> can be burned and placed in the compost or form a part of a bio-fertiliser recipe after burning. Turned into fine powder and forms a high silica ash which is also high in P

Bio-fertiliser is a reduced oxygen process - not really an anaerobic process.

Recipe consists of:

- Water
- Fresh milk or whey

- Molasses or honey
- Wood ash
- Fresh cow manure (only)
- Rock dust from basalt powder/road base. Needs to be small enough to go through a fine mesh
- Add 3-4 kilos of kelp

Bio-fertiliser Recipe

- 50 litres of fresh cow manure
 - 2 litres of fresh milk/whey
 - 2 kgs of wood ash
 - 2 kgs of basalt rock powder (can be found on road building sites)
 - 100 litres of water
 - 2 litres of Kelp
 - 2 kgs of burnt bone
1. First drill a hole in the container lid and place the pipe on the fitting - ensure it is sealed
 2. Place the 50 litres of fresh cow manure into a 200 litre plastic drum first
 3. Dissolve the 2 litres of molasses and 2 litres of milk into 10 litres of water. Add to the container and mix in the ash and bone, rock powder and kelp
 4. Place the lid on tightly and add the clamp - ensure it is airtight
 5. Fill a bottle with water and the hose from the container into the bottle and seal
 6. After 3 months it will be able to be used - it is a fermentation process that is more active in the warmer part of the day

Use: 5-10 litres of bio-fertiliser in 100 litres of water. Foliar application is best but can also be used as a soil drench to feed the microbes. Spray on early in the morning or late afternoon - before 0900 or after 1800 as it is more efficiently utilised and stored by the plant during this time

Can also use bio-fertiliser in compost tea and currently trials are underway to establish as to whether the kelp and humate that is added to compost tea can be replaced by the bio-fertiliser in the compost tea food mix.

When using whey, ensure that it is the by-product of 'cold' cheese, that is, heated to less than 40°C. Otherwise it kills all the bacteria if heated past this temperature.

Carbon and Nitrogen Cycle

Manure - N in this is NO₃

- ⇒ Eaten by bacterium and the metabolic process undergone or the death of the bacterium creates NH₄. NH₄ is preferred for less weeds while NO₃ is best for weeds. NH₄ is not as available and weeds are looking for freely floating goodies

- ⇒ ploughing oxidises C which is detrimental and defeats the soil C process
- ⇒ bio char is not available to plants and pretty useless without microbial activity
- ⇒ Bushfires and fire management:
 - Destructive management system
 - Sets succession back by burning off P & N and selects for fire resistant plants.
 - Kills microbes
 - Kills beneficial insects
 - Kills beneficial fauna
 - Produces CO₂
 - Gasses off organic C
 - Burns off organic matter
 - Accelerates erosion
- ⇒ 1% increase in soil C will increase water holding capacity by 140,000 litres per ha (Dr Christine Jones - Amazing Carbon - <http://www.carboncoalition.com.au/> and, Kurt Gadzic - Holistic Management) & See handout ref. Climate Change issues and soil carbon.

Other

Once minerals are taken up by microbes they become plant available. Chemical fertilisers are soluble and their application can stress the plant as it has to take it up with moisture. Plant has no choice and stress occurs because fertiliser is salt based and this concentrates in water. When the plant transpires the salt remains.

- ⇒ Chemical fertiliser destroys healthy soils
- ⇒ Better to grow weeds or, by another name, dynamic accumulators

Pest control:

- ⇒ Soluble silica is a good means of insect control
- ⇒ Vinegar, whey or molasses make good herbicides -> 20 litres of molasses for the elimination of fireweed and thistle

Weeds:

- ⇒ Thistles an excellent mineralisation or bio-accumulator
- ⇒ Mullein a broadleaf plant found on roadsides or compacted soils
- ⇒ Spiky amaranth - loves microezyal (*VAM) fungi -> bury fine rock dust in a coke bottle full of holes alongside the amaranth and the amaranth will grow its roots into the bottle. Dig out carefully and then use the rock dust in water as a fertiliser in the root zone. Amaranth has a red stem, with a spike on each node under each green leaf);

When making a compost pile there is $\frac{3}{4}$ MT in one m^3 → one litre of compost tea/ha -> full of the backbone of natural processes and harness natural processes to produce food

First thing to do on a property is build a compost pile and if have cash then making compost tea is # 2; # 3 is animals

1 ha of land in NNSW/Sthn Qld can produce approximately 50MT of food a year

⇒ See Bill Mollison in equatorial climates on a stacked system with animals, aquaponics → Indian Ocean Territories proposal

Microbial weight required per ha is 200 MT

Fraser Island

The fungal mass on Fraser Island is incredibly rich and the island provides remarkable examples of fossilisation of vegetative matter.

Fraser Is lakes are sealed by fungal mass.

Worm farm: Put axle grease on the legs to keep the ants and rats out of the worms