The Art of Composting

Koanga Booklet

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The Koanga Garden Guide

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Change of Heart

The Koanga Garden Planner

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Composting at Koanga

I've been making compost for possibly 45 years and I had to admit that at a point just before we left Kaiwaka in 2007, I could not understand why my compost was not seeming to be feeding my crops or growing healthy soil able to grow high brix* crops. I was still having to put on liquid fish or fish meal or liquid manure or comfrey to get my plants to look amazing.

It has been the past 10 years that have taught me how to make high quality compost that can grow amazing seedlings and vegetables without the need for adding fish meal or liquid fish or any other nitrogen source. I can see now that all those years I had been making compost that was having no benefit to my garden, and I can see now that it actually had a negative effect.

The compost I was making had such a big imbalance of minerals (not enough available calcium for a start) that it unbalanced any fertiliser I tried to use, and it prevented fungi and microbe growth in the soil and more. I would have been better off without using it.

On top of that putting on nitrogen that is not attached to carbon unlocks the soil carbon and degenerates the soil rather than regenerating the soil and it grows low brix food, containing low level nitrates which we know are carcinogenic.

I did that for 15 years in a certified organic garden. I was ruining my soil, whilst being certified organic, and my vegetables were low brix.

I went on a journey to find out what was really going on and I've learned to make great compost.

Many well known biological agriculture consultants around the world today are actually advising people not to make compost if they want nutrient dense food, not because compost is inherently bad but because we have mostly been doing such a bad job of making it.

I don't want to be dependant on buying in unsustainable sourced fertiliser or minerals in the medium/long term, so I'm committed to finding another way.

The past 10 years have been a wonderful journey deeper and deeper into understanding what healthy soil is, and how that soil affects the quality of our food and our health.

We literally are ONE, and we understand now that the way we take care of the earth, our Mother, can be degenerative… we lose the carbon and the minerals and microbes in the soil over time and we lose the health of our vegetables and

our own health. Or it can be regenerative… raising soil carbon levels, mineral levels and microbe populations, the brix of our food, our health, and health of our entire ecology!

Here at Koanga we are 100% committed to regenerative, and we are doing that through our compost.

Our compost is not any old random compost, it is very carefully designed and made.

Our compost heaps are designed to:

- Be aerobic… essential for it to work as soil food.
- Make the maximum amount of high quality humus.
- Turn carbonaceous material into highly mineralised biologically active humus, capable of growing nutrient dense food.
- Hold the range of minerals that plants need attatched to carbon, in the form of humus, making a super efficient use of the minerals that are not water soluble, so they remain in the top soil where the plant roots need them for longer. When the minerals are attatched (electrically bonded) to carbon they can only be used by plants or microbes and are not water soluble and do not wash away in the rain or when watering the garden like most others.
- Make efficient use of the compost materials we have, especially the carbon.
- Include all 84 minerals our plants need in roughly the right relationships for optimal cell growth.
- Use mineral sources from our own back yards wherever possible in the medium term… it's a process.
- Make efficient use of our time.
- Be easy enough for everybody to do with no expensive tools or machinery.

In the seed gardens here at Koanga we focus on making the best possible compost we can and we are recording what we're doing… of course the proof will be in the vegetables and seeds we grow from that compost, over time!

The advantages of this kind of compost heap as I see it are:

- We require no technology like chippers or shredders or tractors etc, a garden shark is useful.
- All of us can do it with a little practice.
- The heaps require no turning with a little practice.
- It is the most efficient way to use our precious carbonaceous material.
- It can be done with 100% materials from the garden you are gardening, and recycled minerals from our own back yards… with small amounts of minerals brought into the system in the short term… Possibly 5–7 years.
- It is possible to plan your garden so that you know that you are growing enough carbon to be actually growing soil in a measurable way.

Our research trials are based on the information in the Ecology Action ***Composting and Compost Materials Booklet*** and our experience. We totally recognize that we stand on the shoulders of the work at Ecology Action in the USA, and give thanks to John for his life work that is now available to us all.

brix*

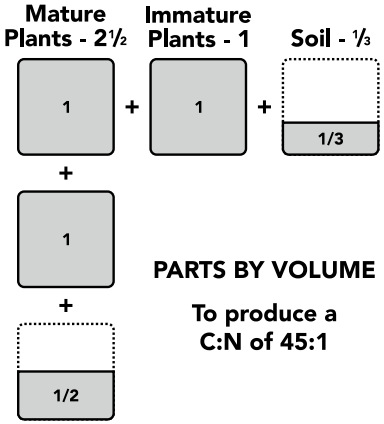
- The true measure of the mineral supply coming from the soil is the sugar content of the juice of those plants.
- This concentration of sugars, vitamins, minerals, amino acids, proteins, hormones, and other solids dissolved within the juice is measured in BRIX (ratio of the mass of dissolved solids to water) and the same method can be used to determine the nutritional density of most foods, and the sap of plants.
- When plants are grown in soil with balanced and high fertility, the BRIX reading of the plant sap and juice of the produce is significantly higher than the same plant grown in less than ideal conditions.

Some Principles And Patterns We Are Basing Our Method On

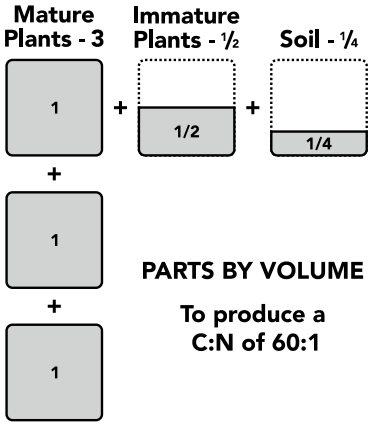
Gleaned from the Ecology Action Composting Booklet…

1)

- You will produce more humus, per unit of material with which the pile is built, when you make a heap with 45:1 to 60:1 carbon/nitrogen ratios.
- When you build a heap with 1 layer of mature materials, then an equal layer of immature materials, it will be around 30:1 carbon/nitrogen ratio.
- A 60:1 ratio provides by far the most efficient results in terms of humus production… ***and making high quality humus efficiently is the goal of all of this isn't it?***
- At 60:1 the pile may heat to 57°C in first two weeks but then goes from 49°C to ambient, and cures slowly, if it has been made well following these instructions.
- These heaps have a more efficient decomposition, less oxidization, and up to 30% more cured compost than in a 30:1 pile, or a 45:1 pile.
- They also have in the end a wider range of microbial life present.
- Mature material is plants that have gone to seed and then gone brown. Immature material is actively growing green leafy material.
- A 45:1 compost heap will be made up of: 2-2½ parts mature material; 1 part immature; ⅓ part soil.



- A 60:1 compost heap is made by using the following ratios of material: 2½-3 parts mature; ½ part immature; ¼ part soil.

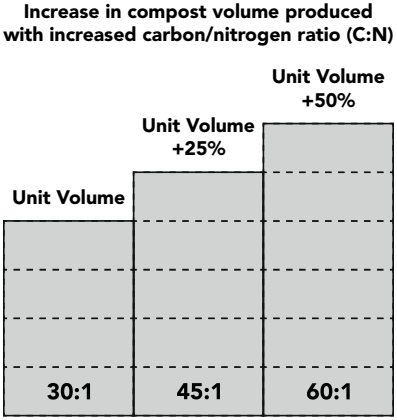


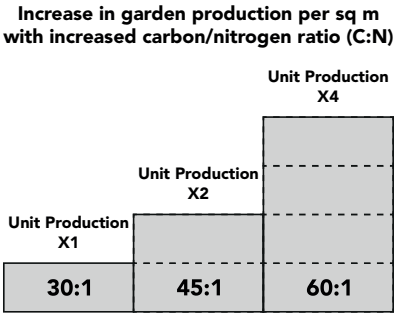
2)

- Use composting materials higher in lignin (found in plants with tough stems that will withstand high wind), eg. cardoon, sorghum, sunflower, corn and mature lupins because they are the most carbon efficient decomposers.
- When lignin decomposes it is transformed into complex structures that protect and store carbon, nitrogen and other structures that are then gradually released.
- Piles built with highly lignaceous materials will have greater amounts of slower releasing carbon and nitrogen in them.

3)

- Compost made using the 45:1 formula achieves twice the vegetable production of 30:1, and 60:1 twice as high again. i.e. If you make a compost heap with a 60:1 formula which means 2½-3 parts mature material; ½ part immature; ¼ part soil, you could end up with 4 times the vegetables per m^2 of garden bed as well as 30% more bed coverage!





These kinds of figures (taken from Ecology Action Composting Booklet, based on 40 years of research at Ecology Action) in a world losing 7-13 kgs of topsoil for every kg of food in the supermarket and with millions and millions of people either starving or with malnutrition, could mean the difference between life and death for many people right now, let alone when the current economic system collapses!

We must remember that adding compost to garden beds that do not contain the actual minerals plants need to grow to be nutrient dense, will also not 'grow' soil or grow the quality of food required to maintain our health.

It takes time to learn this stuff, it's not just an intellectual persuit, it take practice and connection to the processes and compost… what better time to begin learning than NOW!!! You could learn in your own garden, if you need help or wish to fast track your learning then maybe a ***Koanga Biointensive Workshop*** is for you or even better a 10 week ***Growing Soil Food and Health Internship***, or visit us on a ***Guided Tour*** day to see for yourself how we are doing this.

More Patterns To Understand Before We Get To Action Time

- The size of the heap is critical. There is a minimum size that ensures you have enough volume to insulate the heap so that curing is possible and too high, or too wide, will mean a compacted anaerobic heap.
- Minimum volume 1m x 1m x 1m.
- Optimal 1.6m x 1.6m x 1.2m high.
- Maximum 3m x 1.6m high and any length you like.
- Immature vegetation contains metabolic carbon. Mature vegetation contains structural carbon. Together these two kinds of carbon make 90% of the volume of the heap.
- Top soil is 10% of the volume of the heap. Using soil increases the effectiveness of the heap, holds temperature down, helps prevent temperature spiking and prevents the oxidation of carbon/nitrogen and microbes. It also helps to hold minerals in the humus produced.
- Adding clay to your heap will increase the ability of the materials to create humus, especially if your garden soil is sandy or lacking in clay.
- Recycling the mineral deficiencies by using compost materials only from your garden will not grow nutrient dense food, we must design our plantings of carbon crops and bring in minerals so the compost will contain the minerals needed by the plants to grow to be nutrient dense.
- In NZ soils we are almost always low in available calcium and phosphate. Rebuilding the phosphate cycle in our soil is one of those critical things we do by making compost… humus holds on to the phosphate in the soil until our plant roots ask for it (electrically), then phosphorus goes into our plants in the phosphate form as the carrier of most other minerals into the photosynthesis process. Phosphorous is critical for high brix growth. If we do not have available phosphorous our plants take the minerals in in the nitrate form which unlocks carbon in the soil to the atmosphere and creates low brix, carcinogeous growth.
- Iodine is a key mineral for plant, animal and human health that is super water soluble. It is no longer in our soil in high enough levels because we have mined the carbon using industrial fertilisers and farming methods. When we mine the carbon (release it to the atmosphere), we not only help the process of creating climate change but our soil loses its ability to hold minerals and moisture. Almost all of us have an iodine deficiency resulting in abnormal thyroid function (see ***Iodine Why You Need It***, by Dr Brownstein) and lack of iodine is a serious implicating factor in breast cancer and prostrate cancer according to Dr Brownstein.

Making Compost – Action Time

So we're setting out to make a compost heap that we know will be capable of 'growing soil' over the long haul. This is our process:

1. Copy page 25 and keep accurate records of every layer in your heap to learn from for next time.

2. Collect your materials and place them in piles around the area. Our heaps will be:

    a. **Mature materials** which are those dry stalks and stems of plants that have been grown to maturity or at least until 10% of their flowers are open. At that point in the life of a plant their composition becomes more structural carbon than metabolic carbon. The more mature and dry the material is the better in terms of carbon weight and volume.

    Some plants are more carbon efficient than others, i.e. they grow more carbon into their bodies than others. We choose those carbon efficient plants to be our compost crops, and often they provide us with food as well.

    For example, corn stalks, grain stems (wheat, millet, amaranth, barley rye quinoa etc), sunflower stalks (especially the Koanga Giant Russian which has been bred to have strong huge stems and flowers), blue lupin stalks, lamb's quarters stalks, pampass grass, Jerusalem artichoke stalks, broadbean stalks, cardoon, globe artichoke, tic beans and essene flaxseed.

    The obvious first challenge is that most of us do not immediately have enough mature material to make heaps with. We went for a look around our neighbourhood and found that we had unlimited supplies of pampass grass growing along the sides of the rural roads around here. In fact 100 metres from our gate is a large enough supply that we will never run out!

    NB. Please note that mature materials such as wood chips and sawdust are not annual carbon sources and they do not break down as fast as annual crops, and they require different fungi and microbe balances do not use them in your home vegetable garden compost heap with annual carbon crops such as recommended above.

    b. **Immature materials**. We mainly just use garden weeds and everything that is not mature i.e. it is green. If they are weeds with lots of dirt on their roots that is OK, just take that into account when you are measuring the amount of soil that needs to be added, at the soil layer.

c. **Minerals**. Almost all of us have soils that are deficient in many of the key minerals in a form that is available to our crops. If your plant growth is slow, your plants are weak or not full size, or showing any deficiency symptoms, you have had a soil test done that shows mineral imbalances or lack of, or your refractometer shows low brix plants then it is essential to find a way to get them back in there if you are committed to growing soil and nutrient dense food.

- **EF: Nature's Garden**. A fast, perhaps short term solution to get all the right minerals in the right relationship in the cheapest most efficient way back into your garden.

- **Stock Iodine**. We go to Farmlands or any other farmers supplies store and buy Stock Iodine. We add ½ cup of Stock Iodine in a 10 litre watering can of water to each heap, sprinkled into the top half of the heap as it is made.

- **Burnt bones and shells (bone ash)**. Bones and shells are about adding available calcium, and take many many years to become available to plant roots if crushed. If we want to ensure we have these minerals available for plant growth now we may need to turn some of them into ash and put that in our heaps. To burn bones put them on the BBQ or build a fire that is large enough to burn them to ash. At the end of the fire the shells and bones will still be recognisable but if they have been burned hot enough they will shatter to ash when touched. This ash is highly alkaline so do not leave around for children to play with, but put it in a container to keep the children and the rain out as the goodies in it are also highly water soluble and will wash away in the rain.

- **Biochar** from anything at all, but especially bones, old newspapers, cardboard, tree prunings. Bone biochar is regarded as the best because it contains calcium and phosphate which can be unlocked over a long period by microbe action in the soil… and especially by being soaked in Soldier Fly Farm liquid exudate (a mixture of crushed bone, bone ash and Bone char is possibly ideal). Biochar adds a highly stable form of carbon that lasts for hundreds of years and holds onto minerals and moisture and together with compost and clay in the form of pottery shards helped build the incredible deep black earth called the Terra Preta soils of South America. It seems there is some kind of synergistic relationship between these 3 things that speeds up the building of amazing soil! See ***The Biochar Solution*** Albert Bates.

- **Garden Lime.** In the absence of bones add garden lime, not dolomite, to your compost heap.

- **Calcium Carbonate**. Available calcium is the most critical missing mineral in our soil, without which putting in all the others is pretty much useless. If our plants do not have access to adequate amounts of available calcium they can not use the other minerals.

- **Plants containing high levels of Phosphate**. Some times it is possible to harvest leaves of plants that contain high levels of phosphate from your wider environment and recycle that through the compost heap. We often plan our gardens so that our compost crops are those that unlock and sesquester phosphate into their bodies better than others, eg. lupins and especially oats. The reason why the brix of oats is always far higher than anything else in your garden is because of it's ability to unlock calcium and phosphate better than other plants. Putting that carbon back into our compost helps build mineral levels and high brix plant production

- **Animal/poultry manure** containing high quality phosphate and many other minerals and microbes. Animal manure is not essential and best used sparingly however poultry manure from organically fed, free-range birds contains relatively high levels of phosphate and other minerals, and cow manure in particular adds valuable minerals and many many valuable microbe populations. Even 1 cow pat diluted in a bucket of water poured over your heap will be super beneficial. It is critical to get your manure from organic cows. Many farmers now feed their cows GE feed.

- **Seaweed or Seaweed Powder**. Seaweed as we all know is magic stuff containing a complete range of minor minerals, growth promotants, hormones and microbes etc. Having seaweed in our heaps will go a long way to ensuring we have all the minor minerals covered (Koanga sells this as it's often hard for people to get access to).

- **Soldier Fly Farm liquids**. The liquid and solids from the soldier fly farm, or use the liquids to soak the bone char in before adding to compost heap (that will facilitate the release of phosphates in the bone).

Adding minerals is about ensuring we are choosing ingredients for our compost heaps that bring the minerals we need to supply our plants with the minerals they need, keeping in mind recycling the deficiencies will not do it, and we may need to use balanced minerals such as ***EF: Nature's Garden*** until we get it right.

d. **Soil**. Good bed soil with valuable micro-organisms will help to start the decomposition process. The soil will keep down flies and odours, help the pile to hold water, help prevent the temperature spiking, and therefore allow the pile to decompose more slowly, which will ensure an easier-to-maintain compost pile. The soil layer also helps hold the minerals in the pile whilst the humus is forming.

e. **Clay**. Having a pile of clay on hand to spread on top of the soil layer, 2 x 20 litre buckets for a 1.2 x 1.2 x 1.2 heap will be ample. This clay will improve the quality of the compost and the efficiency of the humus.

3. Ensure the ground under your compost heap space is moist, not boggy or hard as concrete.

4. Mark the edges of your heap with bamboo or similar poles to keep the sides of the heap straight up and measurements accurate, by poking the bamboo vertically into the ground around the edges of your imaginary heap, maybe 8 of them if you are making your heap in a circle, which we often do. Deciding how big to make your heap will come with experience, it is usually defined by the amount of carbon available. Begin with the smallest size described above.

5. Use a fork to loosen the soil. This facilitates proper drainage/moisture levels and aeration. Poke the fork into the ground, push down as far as you can and pull handle back, then pull fork out, no turning is required. This will be easier if you have covered the area first to kill any vegetation.

6. Make yourself a stick with marks up it to 1.3m high to use as a gauge when building the heap. This will save you measuring everything that goes on the heap in volume amounts (buckets) to get the ratios right. It is far easier to use a stick to measure the thickness of the layers going on.

   - For a 45:1 heap mark the stick at the following distances above ground level (leave enough below ground level distance to poke the stick into the ground in the beginning): 10cm, then in layers of 8cm, 3cm ,1cm, 8cm, 3cm, 1cm, repeated until you reach 1.2m high.

   - For a 60:1 heap begin again with a mark 10cm above ground then in layers of 12cm, 2cm, 1cm, 12, 2, 1 repeated until 1.2 m high.

7. We're making a 60:1 heap now. Place a 10cm layer of rough mature vegetative material, eg. corn stalks, sunflower stalks, parts from last heap that didn't decompose like corn end stalks with roots on them, over the moist forked loose ground, focusing on the outside edge not the middle. It works best to place everything individually in its place around the outside of the heap.

8. Next add a 12cm layer of mature vegetation then moisten. When you ring with two hands 1 drop of moisture should come out and no more! If you have more it will be too wet, if you have less it won't heat up at all.

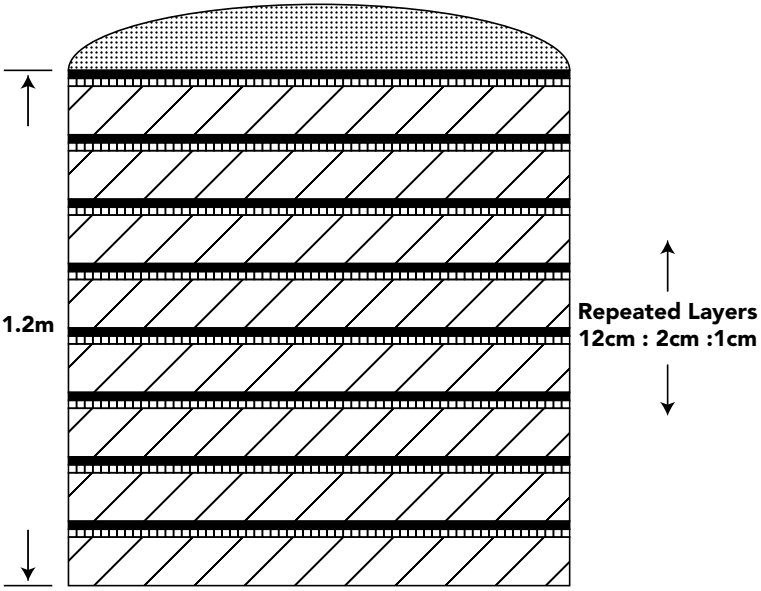
9. Add a 2cm layer of immature vegetation and moisten, as above.

10. Add a 1cm layer of soil.

11. Sprinkle a handful of whatever minerals you have, possibly seaweed, bone ash, Biochar, garden lime, etc. and Nature's Garden. I would use 5kgs of Nature's Garden in the entire 1.2 x 1.2 compost heap, and 1kg of dried seaweed meal, and ½ a cup of Stock Iodine in 10 litres of water sprinkled through the top half of the heap as it is made, for a heap that is 1.2m x 1.2m x 1.2m.

12. Continue as in 7, 8, 9, 10, above until 1.2m high.

13. Cap with straw or hay etc. so that the top of the heap forms a mound to run water off, as in diagram.



14. Watch moisture levels super carefully after every layer added, each layer should be as moist as a wrung out sponge, a drop or two… too much moisture means less air flow and anaerobic, not enough makes decomposition difficult. Getting the moisture wrong could ruin the heap so take your time to get it right! It will take a little time to get the hang of this, it is not possible to wring out corn stalks and pampass grass but most other things can be. Over a period of time you will get to see how this works. You'll soon know if it's too dry, if you have a thermometer, it won't heat up, and too wet it may heat up too fast and go anaerobic.

15. Cover compost in wet or hot, or super cold weather.

16. Measure/monitor temperature, moisture levels, aeration, colour and smell. Watch heap go through two stages, heating then cooling and curing. If you measure the temperature you will soon begin to know very fast how well you made your heap and if it is working according to plan. If you record what goes into each heap, and record the temperatures each time you make one you will accumulate the information to do it a little better each time.

17. Watch moisture levels carefully, you may need to water the outside to prevent drying out. You may need to soak the heap to get it working again if it doesn't warm up etc.

18. Stop the composting process:

    - When most of original material and ingredients are unrecognizable.
    - The compost smells fresh and woodsy like spring water.
    - The material is dark brown or black, soft and crumbly.
    - You can look and still see life in there.
    - Before stage 3 when the compost mineralizes, which means all the reactions take place that release energy for your plants to grow. If these reactions have already taken place then you will be essentially adding good soil back to your garden not compost… why go to all that trouble if you don't get it on at the right time!

The length of time your heap will take to reach the end of stage 2 will depend totally on how you made it and what the temperature is at that time of the year. It will take in New Zealand conditions from 3 to 6 months. I aim for it to take 6 months so that it is perfectly ready to use when I reach the next planting season. The more lignaceous carbon material I use the longer it takes and better compost it is. If I use only carbon that breaks down fast (like oat stalks) then it will be ready

in 3 months, and will not feed my plants for long either!

If you keep in touch with your heap on a daily basis, or at least a weekly basis and write down what you see and feel and smell you will over time begin to notice subtle changes and it becomes easy to tell the difference between all 3 stages. Once the compost heap ends stage 2 and settles into stage 3 you see less and less life. As all the energy transactions have taken place the microbes and worms etc all move out…

To stop a heap from becoming soil before you are ready to use it the compost must be dried out to stop the process. I don't really have time to be bothered to do that so I put my energy into ensuring each heap has a lot of carbon and especially carbon that breaks down slowly i.e. carbon high in lignons like corn stalks. I know if I do that the heaps will take 6 months to break down in our climate and be ready when needed.

Compost Thermometers and Covers

Compost thermometers are not essential equipment but they make a big difference to the time it takes to become a master of this art. Watching the temperature of your newly made heap gives us instant feedback on how well we made it and is the fastest way to learn how to get it better and better. Together with using the Record Keeping Sheet we use on page 25, compost thermometers make a huge difference. I recommend them.

Here at Koanga we have only a few hand tools that we use constantly and a compost thermometer is one of them, up with spades and forks and rakes and niwashi!

We have also found that having a cover on hand all the time to cover a heap if it is too wet or to windy or too hot and dry is also worthwhile. It is one of those jobs that doesn't happen if hay is not on hand easily and getting organic hay is not easy for most of us. A cover that can be put over the heap fast and easily and packed away again afterwards and that lasts for years could be great thing and make a big difference to the quality of your compost.

Things To Look For As Your Heap Ages

Stage 1

a. The temperature will go from 50°C to maybe 60°C, however do not be alarmed if it does not go over 50°C. At Koanga we prefer heaps that moulder slowly and stay low in temperature thereby holding more carbon in the heap

(rather than sending it up into the atmosphere in the form of CO2) and nitrogen to create more humus and taking a little more time in the process. The lower your heap goes the wider the range of microbes and nutrients will be there in the end as well. The heap should not stay up at 60°C for long, it will spike and come back down quickly as stage 2 begins. We aim to make our compost heaps rise no higher than 50°C.

b. The heap will be damp.

c. The colour will be brown/green to yellow to light brown.

d. The aroma will be musty.

Stage 2

a. The temperature will show a marked decrease.

b. There will be a noticeable drop in moisture or dampness.

c. The colour will turn dark brown to black brown.

d. The smell will be earthy to woodsy.

The success of your heap will be determined by how well you made it.

- The temperature is managed by the carbon/nitrogen ratio, the amount of soil used and the moisture level of the pile. It could easily become too hot and anaerobic if there is too much immature material, or too much water applied.
- Moisture levels are managed by proper watering during the making of the heap and covering the heap afterwards.
- Aeration is managed by the size of the pile, the size of the material used and the amount of moisture present.

IT ALL COMES DOWN TO TAKING YOUR TIME TO DO AN EXCELLENT JOB OF MAKING THE HEAP!

Some Ideas For Management Guidelines

Outer Section

- If the outer layer becomes dry, light and fluffy it will be ok, however cover in case of lots of rain to prevent it becoming too wet inside. Covering the heap will prevent the outer layer drying out too much.

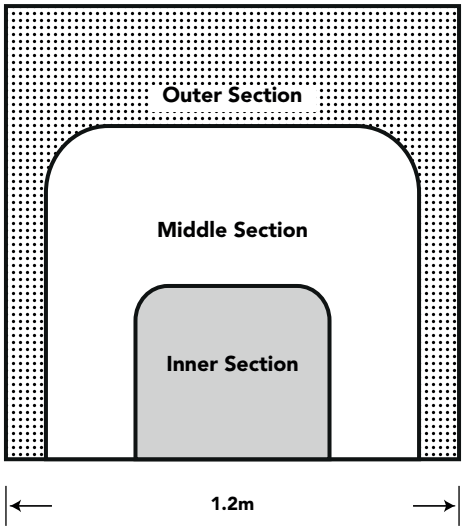
Middle Section

- If the heap doesn't heat up it may be because it is to dry. In this case you will have to turn the pile and water again carefully bringing the moisture level up a little.
- If the pile is too wet, again you will have to turn the pile to evaporate excess moisture, and be careful to add less next time you make a heap.

Inner Section

- If you can smell a sour odor then it is too wet and anaerobic in the very inner section so you will need to turn the heap immediately and use the inner section for the outer section in the new heap!

Compost heap temperature variations



A Step By Step Process – For designing our gardens so that they produce all the high quality carbon we need to make enough compost to be growing soil and high quality plants.

Our aim is to ensure that we are producing enough compost to maintain soil health and productivity.

Useful Patterns To Understand Before We Begin

These patterns have been gleaned from the work at Ecology Action plus our own 15 years of following Biointensive methods:

a. Ecology Action research has identified production levels of dry carbon in our carbon crops at 3 levels of soil fertility. They call them beginning, intermediate and high. Most of us will be starting at 'beginning' if we are on 'poorish' soils, some of us may be lucky enough to already be at intermediate levels and very few will have soils good enough to be producing high levels of carbon. This can be worked out by harvesting your carbon crop, air-drying it and weighing it. Be sure to keep a track of how many m^2 it came from, to compare your results with these:

   Beginning level ..... 7kgs per $10m^2$

   Intermediate..... 12kgs per $10m^2$

   High..... 26kgs per $10m^2$ or more

b. Ecology Action also identified appropriate (essential) compost application for achieving:

   Beginning level ..... 1 cubic foot - ⅛ inch (0.3cm)

   Intermediate..... 2 cubic feet - ¼ inch (0.6cm)

   High..... 4 cubic feet - ½ inch (1.3cm)

c. 30:1 carbon/nitrogen is made by using:

   Mature: 2 parts, Immature: 2-3 parts, Soil: ½ part

   45:1 (M: 2-2½, I: 1, S: ⅓)

   60:1 (M: 2½-3, I: ½, S: ¼)

d. Yields of weight of air-dried biomass yield per $10m^2$ (intermediate yield) for our most efficient carbon accumulators:

Corn 21kgs

Amaranth 10kgs

Millet 18kgs

Sorghum 22kgs

Wheat, rye, oats, barley, lupins 13.5kgs

Sunflowers 18kgs

Broadbeans (9 months in the ground) 16kgs

Broad beans (6 months in the ground) 7kgs

Quinoa 18kgs

Jerusalem Artichoke 18kgs

Process to ensure you are designing your garden and compost crops so that you have enough enough carbon to make enough compost to be building soil, and growing high quality vegetables

We will follow the intermediate yield figures and the 45:1 carbon/nitrogen formula… for many people getting enough carbon to build a 60:1 heap is initially difficult, and we will work on a 10 x $10m^2$ bed garden:

1. Plan to plant half of your garden each season in carbon efficient crops such as mature corn, sorghum, grains, sunflowers, Jerusalem artichokes, lupins, alfalfa, broadbeans, cardoon and globe artichokes. For example, in a 10 bed garden… 5 beds in summer in carbon crops and 5 beds in winter in carbon crops, total 10 crop beds of carbon crops. (If you are using the ***Koanga Garden Planner*** you will be able to choose carbon crops that fit with your vegetable crops, or carbon crops that can produce edible seed as well. Doing that requires a lot of skill and the ***Koanga Garden Planner*** will give you the tools to do that).

2. Choose the carbon crops you will grow to produce your 'mature' material and work out carbon yield in cubic metres:

   - 5 beds of winter carbon crops, as above, yields 67.5kgs (5 x 13.5kgs).
   - 5 beds of summer flour corn yields 110kgs (5 x 22kgs).
   - **Total 177.5kgs mature biomass divided by 56.4 = $3.14m^3$ of biomass.**

     This '56.4' is a figure Ecology Action work with to change biomass to volume in this situation after 40 years of research and testing!

3. Work out how much immature material we need to go with the mature material we will have:

   - 45:1 compost ratio means we need 2½:1 ratio by volume of mature/ immature compost ingredients.
   - So we need ⅖ of $3.14m^3$, = $1.26m^3$ of immature material.
   - **Total volume of mature + immature material (3.14 + 1.26) = $4.4m^3$.**

4. What is the volume of garden bed soil we will need to add to the compost heap?

   - All heaps are to be 10% soil.
   - $4.4m^3$ divided by 9 = $0.48m^3$ (volume of top soil).

5. What is the total volume of our compost heap at the time it is made?
    - 4.4 + 0.48 = 4.8m^3.
6. What volume of cured compost will we get from that initial pile?
    - 4.8m^3 will cure to approx. 25% of built size on a 45:1 pile.
    - 4.8 x 0.2 = 0.96m^3.
    - 0.96m^3 of organic matter remaining in cured pile.
    - 0.96m^3 organic matter + 0.48m^3 of soil = 1.44m^3 of compost to put back onto beds.
7. Is this enough to enable us to apply a intermediate amount of compost to our beds when planting?
    - This will give us 0.14m^3 of compost for each 10m^2 bed.
    - The recommended amount for the intermediate level is 0.06 and the high level is 0.1 (see b. above) so we are well above our goal of meeting the intermediate level recommended amount.

Conclusion

It's clear we can make enough compost, with our designated area planted in our chosen carbon crops. It's also clear that in 4 beds I can grow more flour corn than we could eat so we have room for some flexibility and creativity in terms of food security and ecosystem health and connection.

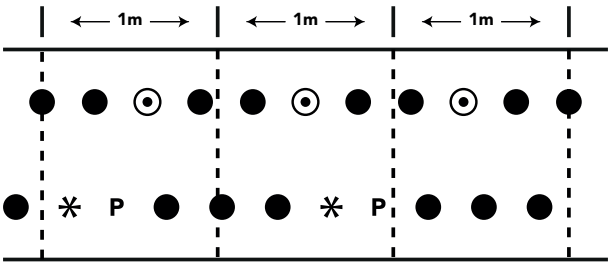
Can we now design the system to be as diverse and integrated as we might dream? For example:

- A 10m^2 flour corn bed with ⅘ normal rate of corn.
- Plus ⅙ sunflowers (also great carbon).
- Plus 1/12 pumpkins (very little carbon but great garden companions and edible crop).
- Plus 1/12 flowers (great ecosystem enhancers, very little carbon except amaranth).
- Plus corn beans growing up the corn that has the most air space and on the sunny side of the bed (very little carbon but creates diversity/food security, companion planting).

Will that produce a similar amount of air dried high quality carbon?

It looks as though we'll get ⅝ of the carbon which is enough to give us enough finished compost, plus a whole range of other benefits… sounds great to me! What other variations can you come up with? I'd love to hear of your creations that meet the heavy application rate for compost production.

Diversity and Integration - Example



30cm diagonal spacings

Key:

- Corn
- Sunflowers
- Flowers
- P Pumpkin

Compost Record Sheet Year: _____

Persimmon / Compost / Thorny Croft / River

Date Started		Size	(length x width x height) or (diameter x height)	Pile Number	
Date Finish		Location		Monitored By	

Mature Materials Used	Amount Used

Immature Materials Used	Amount Used

Soil	Amount Used

Date	Temperature

Date	Temperature

Minerals	Amount Used

Recommended reading

Composting and Compost Materials - Ecology Action

Nourishment Home Grown - A.E.Beddoe

How To Grow Nutrient Dense Food Booklet - Kay Baxter

Koanga Garden Planner - Kay Baxter

The art of composting lies in understanding the 'laws of nature', or principles and patterns, behind composting and building soil, and then getting into relationship with your materials and your compost heap, closely observing the process and fine tuning it.

A desire to be a part of the solution, part of the regeneration process is a great start... this booklet and a compost thermometer will be a great help in the absence of tribal gardeners in our lives on a daily basis.

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