COMPOST FOR ORGANIC GROWING

What sustains the great forests that have never had a chemical application, yet they contain millions of magnificent healthy trees that are hundreds of years old? Leaves fall from the trees, other tree leaves and organic materials are blown in with sand and minerals; the great roots go deep into the ground to find beneficial nutrients; natural native ground cover assists with soil moisture and temperature control. Droppings from birds, rabbits, squirrels, deer, bear, coyotes and various forest animals provide the nutrients contained in manure. The bacteria in the compost, naturally forming on the forest floor, fully sustain the trees, convert nitrates into biomass for feeding the plants, and supply a natural soil mulch.

We found it difficult to accept that practices taught us over the years have been rendered invalid by new research. There is also much misinformation spread by the media, the internet and magazines, often repeating incorrect data.

Mycorrrhizal fungi form narrow threads in compost which attach themselves to plant roots and store food and moisture for plants. Plants draw on this food **when needed,** and in return the fungi receive exudates from plant roots. Compare this natural process to a system where **80% of chemical fertilizer, (which are salts),** is leached rapidly into the underground water table after rain and irrigation, **compromises soil and water quality and denies plants** most of the chemicals purchased for them. Instead we should apply compost to the surface of beds and lawns and spread amendments, including lime, on top of the compost. In this way nutrients are stored on the mycorrhizal strands to be taken up by plants when required.

There are good methods of making compost, other than the system we will describe, which has been designed for a certified organic **small vegetable farm or a large garden.**

For about **1 to 3 acres** of garden and vegetable growing, maintain about four 6’ wide x 4’ deep adjoining compost heaps at **various stages of maturity**. To keep the tops of the compost heaps reasonably **level, to maximize air circulation, to prevent spillage, and to simplify moisture control,** we contain the compost by arranging vertically, 4’ high, cedar-logs in a semi-circle, with removable 2x4” untreated cedar planks laid in a 4’ front gap, for access. This gap facilitates turning, watering, temperature measuring, and adding new material. We attach chicken wire around the rear of the logs to contain the material. When the compost heap is about 3’ 6” high, we move the compost to an adjoining box.

Instead of containing the compost by logs as above described, we sometimes use long ornamental grass prunings, laid around the intended heap and continue to lay prunings around and higher than the heap as it is built. This keeps the centre free to add materials and keep the top level. Although we shred much of the material, especially leaves, to speed up decomposition, we also incorporate plenty of un-shredded rough material so that many air gaps provide oxygen in the heap.

After the 150F/65C initially achieved and after the first turn of the outside material into the middle of the heap, keep the compost at 104 to 131 F/40-5 5 C. If it cools below 1 04F during this subsequent month, being the early maturing period, mix in high nitrogen green material; if it goes above 1 50F mix in brown material. Turn it again. We use the backhoe attachment on the tractor.

Use **mushroom** manure only if it is from an organic mushroom farm, as mushroom manures from non organic sources are usually heavily dosed with fungicides and pesticides which are bad for our health and also kill beneficial soil bacteria.

Use **cattle manure** for incorporating in compost, that **has not** been piled up uncovered outside for **flies** to lay their eggs in. Manure is often **sprayed with**

poisons to control pests and keep the smell down, which kills beneficial bacteria in the manure. Run off from manure piles percolates **into the water table and our lakes and drinking water.** Some farmers inject into or feed **antibiotics and growth hormones** to their cattle, and this manure must be avoided.

The departments of Soil, Water, and Climate, of Animal Science, and the Southern Research and Outreach Center, of the **University of Minnesota**, has established that some **antibiotics are absorbed by plants.** "The study points out the potential human health risks associated with consumption of fresh vegetables grown in soil amended with **antibiotic laden manures,** and also the possibility of people developing enhanced antimicrobial resistance by consuming these vegetables. **Do not use manure unless you know the farmer and the farm practices, and compost it aerobically, before use,** to avoid problems.

We compost the manure daily from 2 horse barns and turn-out areas. For 3 days after horses have had their 6 monthly de-worming treatment and annual immunization, we do not use the manure. Vets advise that one day is sufficient, but we wait three days just to be sure. We have our compost tested regularly by the Soil Food Web laboratories to ensure a high level of beneficial bacteria and fungi and that it contains no E-coli bacteria. We have always received highly satisfactory reports, so we know that the compost is free of any pathogens.

It is important to use only **manure** from known sources, and then add it to your compost, not to your vegetable beds. Manure that has not been composted may contain E-coli bacteria and should not be used. Manure is a valuable source of nutrients and contains Humic acid, (a beneficial ingredient that feeds beneficial micro-organisms, assists in breaking up compacted soil, increases seed germination rates and speeds up the composting process). It is available in powdered form and some farmers and gardeners add it to their compost tea. Horse manure compost is highly regarded by Eliot Coleman for vegetable growing.

It is essential to use de-chiorinated water for making **compost tea** (as the object of making compost tea is to multiply beneficial bacteria and fungi, which are killed by chlorine). We have a 1 year renewable **filter on the water line** into the vegetable growing areas to remove **chlorine** from irrigation water. This is probably being too fussy, but it seems logical, and as we are de-chlorinating water for the compost tea we may as well filter the whole growing area.

This is a beneficial practice for ensuring that water added to the pond is also chlorine free, as chlorine can kill fish. Alternatively un-chlorinated water can be sprayed upwards in the air into the pond to dissipate the chlorine, or allowed to stand for four hours.

Good compost is aerobic. **Pathogens, including E-coli, do not thrive where plenty of oxygen is present;** oxygen encourages the multiplication of beneficial bacteria which feed on harmful bacteria; the action of bacteria in the compost causes it to heat up rapidly. Heat kills many non-beneficial bacteria and most weed seeds, provided the compost is turned. A compost thermometer is an important tool. Aim for about **140 -150 degrees F maintained for 3 days,** and then turn the compost. If the temperature goes much above 160 degrees F it will begin to kill beneficial bacteria, and should then be cooled by turning it or adding water if necessary. Compost should be moist but not saturated.

After the initial turning the compost should be turned 3 times more at about 10 day intervals and then kept moist and, before use, left to mature for a further 2 to 3 months in summer and about 5 months in winter. Cover it in rainy weather.

If a planting area is not going to be used for a season, compost that is not fully mature can be added to the soil surface, and amendments such as lime and alfalfa meal added above the compost, after applying the compost to the soil, so

that lime, for example, can retain calcium in the compost and in fungi strands, and not leached into the water table.

Nutrient cycling will <u>not</u> occur under <u>anaerobic</u> conditions as beneficial bacteria, nematodes, protozoa, micro-arthropods and filamentous fungi become dormant and will die if anaerobic conditions prevail. If unpleasant smells are detected, then the compost lacks air caused by anaerobic conditions, maybe from saturation or using materials in the incorrect proportions (for example dumping in a huge load of grass clippings without mixing in sufficient brown and some chunky woody materials to ensure good compost composition and adequate oxygen).

In areas drier than those on the Sunshine Coast, compost is covered with landscape fabric (which lets in some rain water and gases out). Here we cover our compost with tarps every evening if rain or heavy dew is expected, and uncover every morning. Cover during the day if rain is threatened.

The **moisture level** in the compost can be gauged by the **simple test of squeezing** a handful of compost. If it is too wet a drip or more of water comes out; the moisture level is just right if the squeezed compost mostly holds together and does not drip water. If the compost is too dry, water it with chlorine-free water.

Compost can be **'bacterial' dominated** compost or **'fungal' dominated** compost or **'balanced'** compost depending on **crop preferences.**

Bacterial compost is made with roughly, by volume, **25% manure, 45% green material and 30% shredded woody** material (a lawn mower can act as a shredder, if a shredder is not available).

Fungal compost is made with **25% manure, 30% green material and 45% woody** material.

Balanced compost contains roughly **equal quantities of green and woody material in addition to 25% manure.**

Sprinkle above each green compost layer a little rock phosphate, lime (for calcium), greensand and a little dried kelp or fish meal. This is facilitated by keeping a waterproof container containing a mixture of these nutrients next to the compost pile. Also inoculate the heap with about 2" of older compost.

Hasten rapid decomposition by using a chipper or mower for grinding up leaves and brown material, sprinkle with water and add some coarse woody material to ensure air gaps. Start the pile with about 12" of rough material as a base on the soil to prevent sogginess and for base aeration.

Plants that benefit most from various types of compost:-

Strongly bacterial: Broccoli, cabbage, and other cole crops (brassicas) grown in loam; if soil is sandy use more fungal material.
More bacterial than fungal: Row crops, tomatoes and grasses.
Equal bacterial and fungal: Berries, vines, shrubs and rhodos.
5 times more fungal: Deciduous trees.
Even more **strongly fungal:** Conifers.

Consider the power of the manufacturers of chemical fertilizers, herbicides, insecticides, GM seeds and food, their lobbying activities, and the funding they provide for educational activities and research. Governments should instead support financially **independent accurate research** which is so important to the health of crops and people. Serious public doubt is arising about conventional agricultural practices, but politicians and bureaucrats want as much cash as possible to promote their pet projects; are pleased to have vested corporate interests fund projects that should be fully researched independently **with no big business bias,** and most of them lack any knowledge of the benefits of organic practices in saving valuable soil and adding to instead of eroding fertility.

A good source of mycorrhizal fungi is soil from a forest. The spores can also be purchased from firms such as Mycorrhizal Applications Inc who have OMRI certification. (www.mycorrhizae.com). The spores can be added directly to plant roots by applying through small holes made in the soil with a rod, around an existing tree or directly to the wetted planting hole when transplanting seedlings. Wetted seeds can be rolled in the medium when sowing. The spores should also be applied at the same time as compost or compost tea. This has nothing to do with inoculant for peas and beans relating to nitrogen fixation on legume roots.
Compost should be applied to the soil surface. No tilling should take place as tilling breaks up fungal threads, earthworm and bacteria pathways, and kills most of the earthworms in the soil. About an inch per application of quality compost should be spread around shrubs and trees, especially over the whole root zone, which extends at least to the drip line, and kept about 6" away from the stem.
Use the **aerobically brewed water extract** known as **compost tea** as:

1. Compost is a scarce commodity to cover the whole growing area adequately.
2. The aerobic brewing process causes the number of **beneficial bacteria extracted from the compost to multiply enormously.**
3. Check the information available at www.soilfoodweb.com and order a copy of The Compost Tea Brewing Manual, 5th edition
4. Before making the tea, remove chlorine from water by **spraying** it vigorously into buckets and letting the water stand for a couple of hours. When the tea is ready, strain it through a fine mesh (panty hose). Dilute it with chlorine-free water about 5-8 parts water to 1 part compost tea in a backpack sprayer. Spray the diluted tea to soil around the plant and to plant stems and both sides of leaves. The beneficial bacteria will eat disease-causing leaf fungus. The tea also foliar feeds the plant. Celery farmers in California report harvesting **100 boxes more celery per acre** by spraying with compost tea.

An adequate and reasonably priced compost tea brewer is available from Bob's Brewers (www.bobsbrewers.com) and their larger pump should be specified. More sophisticated machines are available from recommended manufacturers such as Keep It Simple (www.simplici-tea.com).**Check first with Soil Food Web before purchasing a brewer** as they have tested many machines, their performance, prices and ease of cleaning; check also with Soil Food Web Canada (www.soilfoodweb.ca), located in Alberta.
This list of compost materials is taken from Jeff Cox' s excellent book "Your Organic Garden" (obtainable from Rodale):-

Greens (high nitrogen materials), including:

Coffee grounds, cover crops, feathers, fish bones, shells, (ground shells are a good source of calcium and do not alter the pH of the soil in the way that lime does), fruit wastes, grains, grass clippings, hair, leaves, manure, seaweed, vegetable peels, weeds.

Browns (dry, high carbon materials), including:

Corn cobs/stalks, hay, paper, pine needles, sawdust, straw, seeds.

The **carbon to nitrogen ratio** can be confusing without the following data. Ideally compost starts off with a ratio of about **35 carbon to 1 nitrogen**. So when making compost keep an eye on these ratios while building your compost:-

Alfalfa hay	12:1	
Table scraps	15:1	(do not add meat or cooked table scraps)
Grass clippings	19:1	(mix with brown materials to prevent matting)
Rotted manure	20:1	Timothy hay 25:1
Young weeds	30:1	Fruit wastes 35:1
Dry leaves	80:1	(to prevent matting, shred leaves and mix)

Straw	80:1	Pine needles 100:1
Newspaper	170:1	(shred paper, use sparingly mixed with greens)
Sawdust	500:1	

Include as many different materials as possible, bearing the above ratios in mind, noting that the ideal compost carbon to nitrogen ratio starting range is 30:1.

Too much high-carbon material seriously slows the composting process as it ties up the nitrogen in the compost. A sprinkle of water between each layer of dry material is also important, but do not saturate. Avoid weeds such as Canada thistle that sprout from small pieces, and grass sod, as sod often contains wireworms, is slow to compost and sheds grass seed. The best way to treat grass sod is in a separate grass sod pile. Layer the sod, face down, continue layering in this way to a convenient height, and leave that pile to compost for a couple of years, when it will become good top soil if kept moist.

Organic growing includes planting the right cover crops immediately spent plants are removed, (some cover empty beds with straw or weighted down newspapers without coloured ink, but cover crops are preferable), rotation, mulching, companion planting, under-sowing, using row covers to prevent attack by insects and larvae such as the carrot fly and flea-beetles, and raising seedlings in a mix such as 30% compost, 30% peat moss, 20% perlite and 20% vermiculite. Seedlings grow faster with less incidence of disease when mature compost is used.

Cline Cellars Vineyard have **increased their grape tonnage by 30%** after using **Actively Aerated Compost Tea** for two years, where in other areas where the tea was not applied production declined by 30%. ('Adding Biology' by Elaine Ingham, PhD. and Carole Ann Rollins, available from (www.nature-technologies.com). An excellent book is 'Teaming with Microbes', from Timber Press, written by Jeff Lowenfels & Wayne Lewis

What will make the bureaucracy and politicians wake up to the benefits of organic farming, or is there too much cash, lobbying, donations, favours, and hunger for power, at stake? Sometimes it is lack of knowledge, or just plain idleness, or too much trouble or fear of risk-taking, to 'rock the boat'.

Questions that have arisen from the above

Why use manure when plant material will produce good compost on its own?

Manure speeds up the composting process and contains active beneficial bacteria and humic acid. Manure has valuable nutrients and improves soil structure. Temperature control and turning also destroys any pathogens and most weed seeds.

What about worm composting, and the value of worm castings?

Vermicomposting is very valuable provided the right food is used. The value of incorporating worm compost into finished compost is that the passage of ingested material through the digestive tract results in the destruction of pathogens, eggs and pest larva and root feeding nematodes. The castings contain a considerable variety of beneficial bacteria. The same benefits also extend to the contact of material with the outside of the worm. This also kills pathogens and the eggs and larvae of pests in the soil that come into contact with the worm exterior. The soil aeration also benefits from worm tunnels, (Read more in "Adding Biology" by Elaine Ingham, PhD. and Carole Ann Rollins).

The published results of the analysis of compost compared to chemical fertilizers shows higher concentrations of nutrients in chemical fertilizers. By combining compost with chemical fertilizers, would not the benefits of soil texture improvement from compost and the benefits of chemical fertilizers be achieved?

Chemical fertilizers work in a completely different way to natural organic plant feeding. Chemical fertilizers are in the form of soluble salts which diffuse into plants through the roots. **Salt destroys, by dehydration, many beneficial organisms and has serious long term detrimental effects to soil**. Chemicals do not have the disease suppressive organisms that compost has and therefore require increasing volumes and more repetitive fertilizer/pesticide applications. Toxic chemicals such as fungicides, insecticides, etc. kill beneficial organisms that would normally out-compete disease-causing bacteria. Valuable plant nutrients are held by the mycorrhizal fungi attached to plant roots, very often measuring **more than 80 km** in length in **one gram** of earth around the roots. They store food for plants until the plants need them. Compost and chemicals are incompatible and **no chemicals, salts, fungicides/insecticides are required.** It is the practice of some chemical companies to ignore the way the soilfood web feeds plants by making incorrect comparisons which are designed to confuse the public, politicians and some well intentioned garden article writers.

In what different way do organic nutrients become available top/ants other than by diffusion through the roots?

Organic nutrients are not in salt form so they are not soluble and **are only to a very limited extent therefore absorbed by diffusion** The best way to answer this is these abstracts from "Adding Biology" by Elaine Ingham PhD. and Carole Ann Rollins:-

> "Organic systems require carbon in the form of sugars, starches, amino acids, proteins, lipids, etc.---. Organic compounds include both the living organisms, as well as their waste products and dead bodies.--- Biology is required to transform these organic nutrients into plant available forms. Bacteria and fungi take up nutrients that plants exude, for the express purpose of feeding microbes around their root system, or decomposing plant material. --- **In inorganic/synthetic** systems, nitrogen, in the form of nitrate encourages disease causing organisms. **In organic/biological systems,** beneficial micro-organisms **convert nitrogen from nitrate to biomass**. - Bacteria do not directly release the nutrients, they take up from organic matter, all by themselves, instead they retain nutrients (N,P,S,Ca,Fe,etc) in their biomass. Protozoa and nematodes are then needed to complete the nutrient-cycling process. -- Bacteria produce glues to attach themselves to surfaces — leaf surfaces, root surfaces, soil and soil-less media surfaces. Beneficial organisms occupy the space, and use the food that would otherwise be present for, and enhance, pathogen growth"

Is leachate a beneficial fertilizer?

No. Water leaching from compost can be anaerobic. Further, the **energy in the circulated air in aerated compost tea** strips the bacteria and fungi off the soil crumbs, as bacteria have slime and fungi have glomain **to stick and remain stuck to plants**. Pouring water through compost, or rain water running through it (which makes the liquid 'leachate') will not strip off the required bacteria and fungi.

As mentioned above, for more depth and lots of interesting and scientific research material, read "TEAMING WITH MICROBES, A GARDENERS GUIDE TO TFIE SOIL FOOD WEB" (www.timberpress.com/books/isbn.cfrn/O- 88192-777-5), and also **The Compost Tea Brewing Manual by Dr Elaine Ingham** (www. soilfoodweb. corn)