Bear Machine West Africa Ltd.
Tema Office: 16/14 Export Processing Enclave, Kpone Road, Tema,
Private Mall Bag, Tema, Ghana.
Accra Office: Old Cargo Shed Road, K.I.A. Airways Catering Ltd., Tema, Ghana.
Email: bearmachineswa@gmail.com, prosec500uk@yahoo.com
Tel: +233-244315000, +233-233315000. +233-242-010000

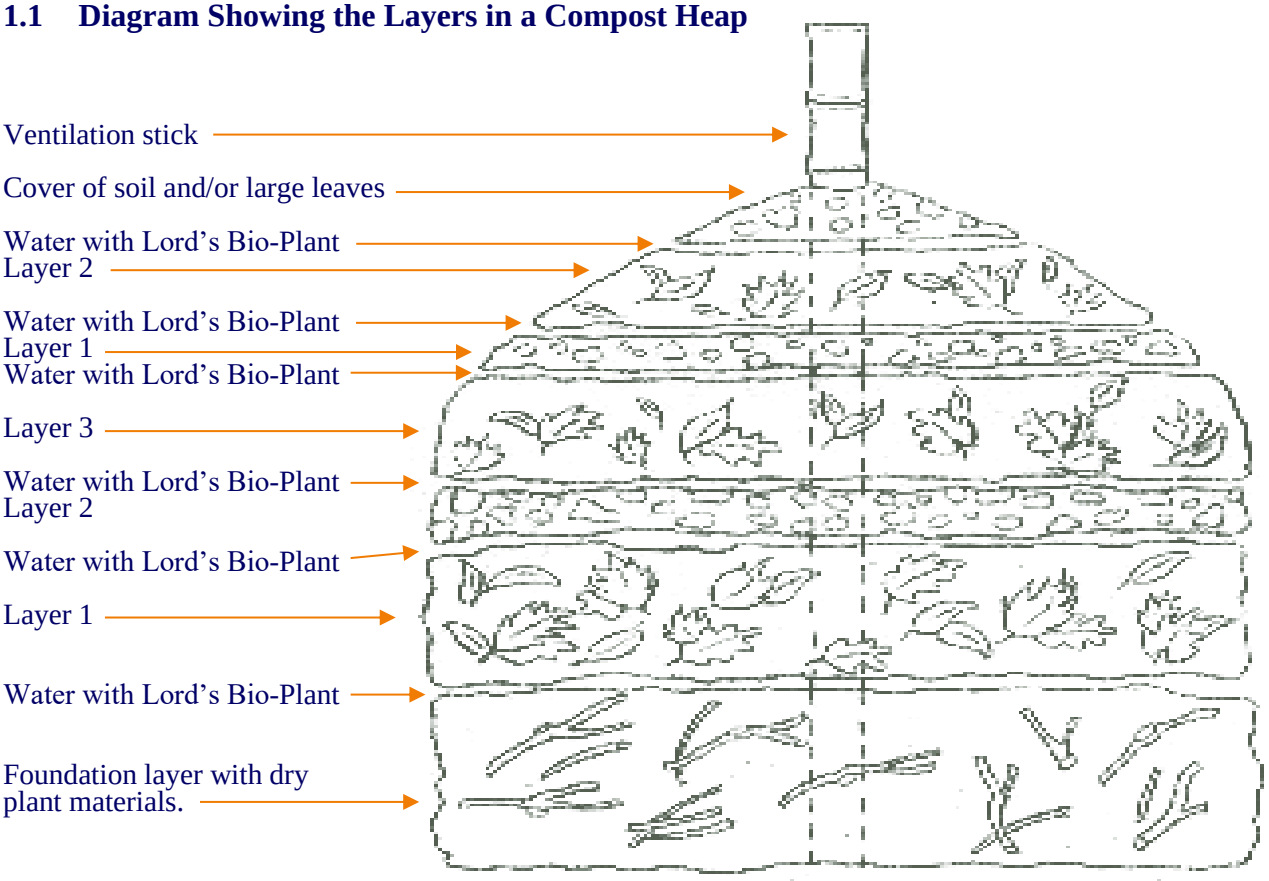
How to Make Rich Compost Using the 100% Organic, Liquid Bio-fertilisers, Bio-Plant and Pro-Plant.

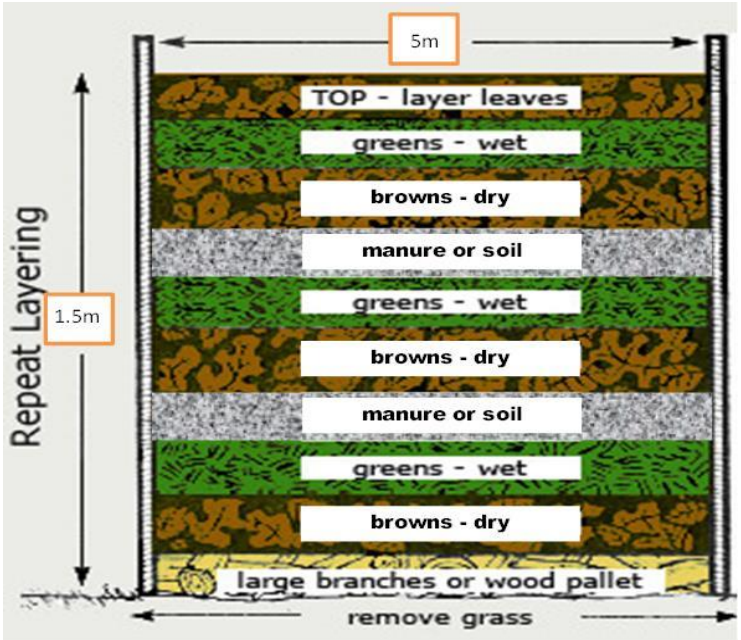
How to Make Rich Compost Using Bio-Plant and Pro-Plant.

1. How to Make a Layered Compost Pile

- This method is most suitable for vegetable growers when they clean their fields before the next crop is planted. The residues left after the crop has been harvested, such as stems and leaves from rice, maize, pumpkins, potatoes, tomatoes, chili peppers, zucchini, cabbage, banana trees, etc., and any damaged crops that cannot be sold or eaten, can be collected together and used to make compost.

1.1 Diagram Showing the Layers in a Compost Heap





1.2 Selecting the Site

- The following factors need to be considered:

1. The site should be accessible for receiving the materials, including water and/or urine, and for frequent watching/monitoring and follow-up.

2. The site should be protected from strong sunlight and wind, e.g. it should be in the shade of a tree, or on the west or north side of a building or wall.
3. The site should be protected from high rainfall and flooding.
4. You will never have too much compost. Make sure there is plenty of compost-making space.

1.3 Preparing the Site

- Clear the site of stones, weeds and grasses. Set up the site in the shade of trees. The trees will grow, provide shade and protect the compost heaps.

1.4 How to Start to Make the Compost Heap

1. Mark out the area for the compost heap. An area to make a minimum amount of compost for a hectare (5 MT) is 1 m x 5 m x 1.5 m. Including the covering layer, the height will probably be nearly 1.5 m. The pile should not be higher because the weight will compact the materials. If you want to make more than 5 MT, make separate compost piles, or make the length longer than 5 metres as opposed to making the heap taller.
2. Materials are added in layers to make the heap as shown in the diagram on page 2 and described in more detail below.

1.5 The Layers in Making the Compost Heap

1.5.1 The Foundation Layer

- The foundation layer provides ventilation for air to circulate, and for excess water to drain out of the upper layers. To ensure aeration of a heap built directly on the ground, a base can be constructed of drain pipes or bamboo poles spaced at 25-inch intervals and covered with a wire mesh or a layer of coarse material such as brush or stalky material. Twigs, thick straw, and stalks of maize and/or sorghum can be used to promote aeration of the pile. Or place bamboo poles or drain pipes on the ground, 1-2 feet apart, and build the layers on top.

1.5.2 The Three Basic Layers

Layer 1 (Carbon - Brown Material): Fungal Food

- Place a layer of **brown,** dry plant materials, such as dry leaves, crushed sugarcane waste, cocoa pods, straw, dried grass, dried weeds, stalky crop residues such as rice and maize stems, bran and rice husks, brown pruned material, and dry hay. It is important to make compost which is rich in fungi because then few weeds will grow.
- Fungal foods for the compost pile have a high C:N ratio, such as 60:1. The fungal component will shift the nitrate side of the soil to ammonium (NH_4), which weeds cannot use to grow. Weeds love the nitrates of chemical fertilisers. The layer should be about 6-7 inches thick. Cut the material into small pieces or grind it up.

Layer 2 (Nitrogen - Green Material): Bacteria Food

- Add a layer of **green,** plant materials, either fresh or wilted, e.g. weeds or grass, plants from clearing a pathway, green stems and leaves left over from harvesting vegetables, damaged fruits and vegetables, waste fruit from a fruit processing factory; leafy branches from woody plants as long as the materials are chopped up, and cut up green banana tree leaves and pseudo-stems. The Greens are food for bacteria at around 30:1. The layer should be about 3-4 inches thick. Cut up the material into small pieces or grind it up.

Layer 3 (Manure): High Nitrogen

- Add a layer of **animal manure** collected from *dried and crushed* cow dung, horse, mule or donkey manure, sheep, goat or chicken droppings. Sprinkle water or urine mixed with Bio-Plant at the ratio of 20 cc in 20 litres of water with a watering can or scatter water evenly by hand over the manure so that it is wet. The animal manure can be mixed with soil, clay, old compost, some wood fire ash, and/or some rock phosphate to make a layer about 2 inches thick. Rock phosphate helps fungi to grow, so adding it is a good idea, if you can. If there is only a small quantity of animal manure available, it is best to mix it with water to make slurry, and then spread it over as a thin layer. This serves to make the bacteria and fungi grow rapidly so as to get the heat up and thereby kill the pathogens.

Notes:

- Another way of saying this is: Browns - 2 buckets. Greens – 1 bucket. Manure – Half a bucket. So, you might pour 10 buckets of Browns on a layer. On top you would pour 5 buckets of Greens. On top of that you would pour half a bucket of Manure. Keep this ratio as you build each layer to the required height.
- Add layers to the heap in the sequence Layer 1, Layer 2, and Layer 3 until the heap is about 1–1.5 metres tall. The layers should be thicker in the middle than at the sides so the heap becomes dome-shaped. If the heap is taller than 1.5 metres, the microbes at the bottom of the heap will not be able to work well.
- Remember, after every two to three layers, mix the layers thoroughly to evenly distribute the materials.
- Water or slurry (animal manure mixed with urine) mixed with Bio-Plant at the ratio of 20 cc of Bio-Plant in 20 litres of water should be sprayed or sprinkled with a watering can evenly over each layer making it moist but not soaking wet. When you squeeze the material only one or two drops of water will come out.
- Layers 1 and 2 are essential to make good compost. Make sure that the pieces are small or ground up. In Layer 3, if there is a shortage or absence of animal manure, use good soil instead.
- Place a ventilation stick vertically every 1 metre in the compost heap, remembering to have the stick long enough to stick out of the top of the heap. Ventilation sticks are used to check if the decomposition process is going well, or not. A hollow stick of bamboo makes a good ventilation stick as it allows Carbon Dioxide to diffuse out of the heap and Oxygen to diffuse into the heap.
- A testing stick should be stuck into the pile every day to check the progress of decomposition in the heap. If the stick is hot, then the process is going well. *(See* **Section 2** *on page 7 about testing the temperature.)*

1.5.3 Suggestions

1. Moisten the straw before using it.
2. Use no more than 30% of any one individual material. The best composts are made with the greatest diversity of materials.
3. Add a few shovels of good compost, or add a variety of other composts. This adds micro-organisms to the pile.

4. Add clay or a clay soil to the pile when constructing it. Clay will assist with moisture control during composting; greatly extend the life of your compost; and most importantly, promote the growth of mycorrhizal fungi when the mature compost is added to soil. Up to 10% of the pile can be clay. Add it thinly on top of any layer.
5. If you can, add up to 10% crushed basalt dust in the compost because it has a high paramagnetic property which means the Earth's magnetic field is enhanced in the soil. This is said to be beneficial to soil life. The paramagnetic effect can have a massive impact upon compost quality and has been shown to increase microbial subdivision by up to 400%. The compost will be more bioactive as a result and the paramagnetic effect of the rock dust will be transferred to your soil. Trace minerals in the rock dust are released more rapidly as a result of the enhanced bioactivity.
6. When building the pile, add humic acid to the compost when you turn it. Spray it over a few layers. It will supply around 70 trace minerals and ensure the growth of beneficial microorganisms. To make humic acid take 2 or 3 handfuls of already made compost, put it in a thin cloth, and run a litre of water through it slowly. The fungi in the compost will grow crazily.

1.5.4 Things Not to Compost

- Bread products: This includes cakes, pasta and most baked goods.
- Cooking oil: Smells like food to animal and insect visitors. It can also upset the compost's moisture balance.
- Diseased plants: Trash them, instead. You don't want to transfer fungal or bacterial problems to whatever ends up growing in your finished compost.
- Heavily coated or printed paper: This is a long list, including magazines, catalogs, printed cards and most printed or metallic wrapping paper. Foils don't break down, and you do not need a bunch of exotic printing chemicals in your compost.
- Human or animal feces: Too much of a health risk.
- Meat products: This includes bones, blood, fish and animal fats. Another pest magnet.
- Milk products: Refrain from composting milk, cheese, yogurt and cream. While they will certainly degrade, they are attractive to pests.
- Rice: Cooked rice is unusually fertile breeding ground for the kinds of bacteria that you don't want in your pile. Raw rice attracts varmints.
- Sawdust: Unless you know the wood it came from was untreated, stay away from it.
- Stubborn garden plants: Dandelions, ivy, and kudzu are examples of plants or weeds which will probably regard your compost heap as a great place to grow, rather than decompose.
- Used personal products: Tampons, diapers, and items soiled in human blood or fluids are a health risk.
- Walnuts: These contain juglone, a natural aromatic compound toxic to some plants.

1.5.5 The Carbon to Nitrogen Ratio

- To keep it simple, aim for a ratio of 2 to 2.5 parts of Browns to 1 part of Greens. 2 shovels of Brown, 1 shovel of Green and ½ shovel of manure (High Nitrogen).
- This is important because the right amount of Carbon and Nitrogen makes the microbes grow fast. Having fast-growing microbes means that the composting process happens quickly and the pile heats up to desirable temperatures. So, for fast compost it is important to feed the microbes the right ratio of Carbon to Nitrogen.
- The 30:1 ratio in compost is the most desirable to supply the microorganisms with the amount of both the carbon they need for energy and the nitrogen they need for protein synthesis so they can function efficiently and quickly. To estimate the C:N of a mixture, average the ratios of the individual materials. For example, a mixture of equal parts grass clippings and leaves might have a C:N of $(20 + 50) \div 2 = 35$.

- If you use too much Browns, the pile will decompose slowly and the pile will not heat up enough. If you use too much Greens, the pile will smell unpleasant. You need Greens to make the pile hot. But not too much. If you do not have much Greens, add more chicken or cow manure or urine.

1.5.6 Making the Covering Layer

1. The finished heap needs to be protected from drying out, and also from animals pushing into it and disturbing it. The covering layer can be made of thick straw or wet mud mixed with grass or straw, with or without cow dung; or wide leaves of pumpkin, banana trees, fig trees, etc.; or plastic; or any combination of these materials, i.e. mud plaster covered with leaves or plastic, or leaves covered with plastic.
2. The cover should be put on both the sides and the top of the heap with only the ventilation stick coming out of the top.
3. The Covering Layer:
   a) Prevents rain water from getting into the heap and damaging the compost making process; b) Helps keep heat inside the compost making heap. (*See **2.** below for how to check on the heat and moisture in the compost.)*
4. The compost heap is best left untouched until it is time to turn it over. *(See 3. below on how to turn the compost pile.)* When the compost is turned over, water should be sprinkled over each layer to keep all the materials moist. It is not necessary to try and keep the original, different layers when turning over the compost. It is best, if all the materials can be mixed well together, then added in layers about 25 cms. in height, and then water is sprinkled or splashed over each layer.
5. A mature compost heap is about half the height of the original heap, and the inside is full of a dark brown or black earthy substance, namely humus, which smells good. When the compost is mature, it should be very difficult to see the original materials. This will take about 7 weeks.
6. This mature compost can be used immediately in the field or plantation after it has cooled down, or it can be covered and stored until the growing season. *When it is put in the field, it should be covered quickly by soil or mulched with leaves so that the sun and wind do not damage it, and the Nitrogen does not escape into the atmosphere.* Therefore, it is best to put compost on a field just before ploughing, or at the same time as sowing the crop. In the case of row-planted crops, it can be put in the furrows with the seeds. In the case of transplanted crops, it can be put in the holes with the seedlings.

1.5.7 Making Compost with Cocoa Pod Husks (Browns)

- A layer could be created using cocoa pods. The pods should be crushed, ground up, sliced, or cut up into small pieces so that they break down and compost easily. They also make very good mulch!
- Treat this layer in the same way as Layer 1 in the Heap Method. The layer should be about 25 cms. thick, i.e. as deep as a hand. Water or slurry mixed with the Lord's Bio-Plant at the ratio of 20 cc in 20 litres of water should be scattered by hand or sprinkled with a watering can evenly over this layer making it moist but not soaking wet.
- A benefit of this approach is that the temperature during the composting will kill any pathogens in the cocoa pods.

Rorak ditches between cocoa tree rows.

- If the farmer does not wish to make compost with the cocoa pods using layers, then he could create a long layer of ground-up cocoa pods about 25-50 cms high; cover it with water mixed with Lord's Bio-Plant at the ratio of 20 cc in 20 litres of water by hand or sprinkled with a watering can evenly, making it moist but not soaking wet; mix in a lot of chicken manure and burned rice husks; and then cover the layer with plastic so as to keep in the heat. Ideally, follow the ratio of crushed cocoa pods (20 parts), chicken manure (20 parts), and burned rice husks (1 part). Basically, the composting method would be the same, but with just one layer.
- Crushed cocoa pods can also be placed in **rorak ditches** and mixed with leaves and other organic waste between the rows of cocoa trees where the roots extend out to.
- The rorak ditches should be covered in leaves to keep in the moisture.
- The soil will then be full of minerals and micro-organisms, which will increase the fertility of the soil rapidly.

2. What to Do During the Compost-Making Process

2.1 Using a Temperature Stick or Rod

- A long stick, length of bamboo, or a metal rod can be inserted vertically in the centre of the heap so it goes through all the layers, and left there for the whole composting period. The stick must be longer than the height of the heap so that it can be pulled out and examined.
- Alternatively, put a metal rod or stick in the compost pile for 10-15 minutes to test the temperature. Place it on the back of your hand. If you are not using a thermometer, you will have to feel the different temperatures so that you know when the temperature is too high.

1. If the stick feels hot and the smell is good, the temperature is normal for the compost and good decomposition has started. Turn the pile when the temperature starts to feel too hot.
2. If the stick feels cool or cold, the temperature is too low for good composition. This usually means that the materials are too dry, and some water and/or urine should be added. *(See 2.3 on how to correct this.)*
3. If the stick is warm and wet, and there is a bad smell like ammonia, this indicates that there is too little air and too much water in the compost. The materials will be rotting and not making good compost. *(See 2.3 on how to correct this.)*

2.2 Using Your Arm to Assess the Temperature

- If you can hold your arm in the pile up to your elbow for longer than a few seconds, the heap is not 55^{o} Celcius and is not hot enough.
- If you can hold your arm in the pile up to your elbow for just a few seconds, the heap is probably hot enough.
- If, however, you cannot even hold your arm in at all, then the heap is over 65^{o} Celcius and too hot. (An overly hot heap loses excessive amounts of nutrients and micro-organisms.)

2.3 Checking the Temperature

- The first 15 days are important. You have to reach the correct temperature of about 55 degrees Celcius in order to kill all pathogens. Within 72 hours the compost pile should be hot at this temperature. If it is not, you have to add more High Nitrogen material inside.
- If the temperature continues to rise above this temperature and the pile is becoming very hot (65-70 degrees Celcius), then it is time to turn the pile as the organisms are growing so fast that they are using up all the oxygen in the pile.
- When it becomes too hot again, turn it. 2-3 days later it will be too hot again so you will have to turn it again. Do this every 2 to 3 days in the first 15 days.
- A pile should be aerated by turning it at least 5 times during the first 15 days.

- After 15 days the pile will heat up to close to the 55 degrees Celcius level before cooling again. When you notice it is cooling, turn the pile again. Keep doing this until the temperature no longer increases and the compost has a beautiful earthy smell and a fine texture with little or no evidence of the original ingredients.
- If you start to smell bad smells, you should already have turned it. Every day smell the wooden stick you put into the centre of the pile.
- After one month, you should have turned the pile about 7 times, probably every 2-5 days after the first 15 days. By then you will not be able to tell the Greens from the Browns as the organic matter will have broken down. The stick or rod will gradually feel warm rather than hot, and as the heap cools it will sink more and more.

2.4 Correcting the Problems

- **If the materials are cool and dry:**
  1. Lift up the top layers and put them to the side of the pit or heap.
  2. Sprinkle water or cattle urine diluted with water on the material at the bottom.
  3. Then put back the material in layers of about 25 cms. each sprinkling water or a mixture of water and urine over each.
     Replace the testing stick and cover the heap or top of the pit with soil, leaves, plastic, etc., as described earlier.

Troubleshooting the Composting Process

SYMPTOM	PROBLEM	SOLUTION
The compost has a bad odor.	Not enough air	Turn the pile, add more PVC pipes.
The compost has a bad odor and is soggy.	Not enough air and too wet	Mix in dry ingredients like straw or shavings, add PVC pipes and cover with a tarp.
The inside of the pile is dry.	Not enough water	Add water when turning the pile. Should be as damp as a wrung-out sponge.
The compost is damp & warm in the middle, but nowhere else.	Pile is too small	Collect more raw material and mix it into the old ingredients. Piles smaller than 3-foot-square have trouble holding heat.
The pile is damp and smells fine, but is not heating up.	Too many shavings, wood chips or bedding (carbon source) and not enough manure (nitrogen source)	Mix in a nitrogen source—straight manure, fresh grass clippings, blood meal, or ammonium sulfate.

- **If the materials are too wet:**
  1. Try to remove the wet material. Leave it to dry and then use it as Carbon in the next compost pile.
  2. Or, collect some more dry plant materials and/or some old dry compost. Break up and mix the new and wet materials. If old, dry compost is not available, use only dry plant materials.
  3. Lift off the top of the heap or take out the wet material and put it to one side. Mix the new dry materials with the wet compost materials. Then rebuild the compost pile.
  4. Make a new test of the moisture after another few days.

- **If the compost heap smells:**
  - Decomposition of organic materials must take place aerobically, i.e. with sufficient oxygen present. If the compost becomes smelly it is a sure sign that anaerobic decomposition has taken place (insufficient oxygen available).
  - "Smelly" probably means lost nutrients and the production of some nasty organic acids by anaerobic microbes.
  - In severe anaerobic cases, the compost may become phytotoxic (kills plants). It is probably best to park this pile for at least a year or use the failed compost in a later compost pile. (Use it as the "Brown" component in the next pile).

2.5 Checking the Moisture Level

- Moisture level is critical and should remain between 45-55% during the heat cycle. This is measured by taking a handful of compost from near the centre of the pile and squeezing it hard:
  - If water runs out – compost is too wet and well in excess of 55% moisture.
  - If one drop comes out – compost moisture is excellent at around 50-55%.
  - If no drop comes out but the compost stays in a tight lump, the moisture is between 45-50%. Adding water when turning the pile is not essential, but monitor the moisture level.
  - If no water comes out and the squeezed compost breaks apart - moisture is less than 40% - add moisture when you turn it. (Note: Mature compost will have a moisture content of around 40%).

3. Turning the Compost Pile

3.1 How to Turn the Pile

- Use a fork to build a fresh heap next to the original pile. Take the top off and put it on one side. Take the hot centre and place it on the ground around the edges of the new compost pile. Place the outside of the old pile and put it in the new centre. Place the old top of the pile in the new centre as well.
- Every time you turn the compost, make sure you bring the pile's exterior material into the interior. This enables all material to be evenly broken down. Water can be added to maintain the correct moisture levels, but be careful as the pile will cool if it is too moist.

3.2 Why You Should Turn the Pile

- Turning allows you to re-introduce oxygen that is rapidly being used by the aerobic microbes. It is also likely that additional moisture will be required at each turn of the pile. This is because air is travelling into and out of the pile and taking moisture out. This sometimes looks like steam coming from the pile.
- Air is important to the decomposition process. The mix of Carbon (BROWN) and Nitrogen (GREEN) organic material in your pile is like a fire; air is necessary to keep it going. Aerating your compost pile gets the bacteria all fired-up again.
- Aerating remixes ingredients, exposing new surfaces for bacteria to munch on. This aerobic form of composting heats up the pile once again.
- Turning creates new passageways for air and moisture before the pile compresses. As material decomposes your pile will compress and shrink in size. This will naturally cool down the pile sooner than the material is fully decomposed. Turning exposes more material to heat. It fluffs it all up, thereby allowing the mix of air, moisture and heat to continue the decomposition process.

3.3 Turning Speeds up the Composting Process

- A cold pile breaks down very slowly, like a fire going out or extinguished. Each time you turn your pile you create more surface area for the vegetal material, enough so that the pile will reheat itself repeatedly after each turning.

3.4 Turning Eliminates Odours and Matting of Material

- A pile that stinks probably has too much Nitrogen (GREEN) materials and/or is too moist. It is also probably compressed under the weight of so much moisture in the green materials. Adding more Carbon (BROWN) materials to balance out the greens is important. Turning the pile is critical to fluff up the organic material. Also, turning odourous or matted compost heaps exposes more surface area so that air and heat can move again through the pile.

4. When is the Compost Finished?

- Compost is ready when it looks, feels, and smells like rich, dark earth rather than rotting vegetables. In other words, it should be dark brown, crumbly and smell like earth. The compost might not heat up when it is turned, but this does not mean that it is ready to be used. Compost is not finished until it has been cured. Curing takes 1-2 months once the pile is cool.

4.1 The Importance of Curing Compost

- When the pile no longer heats up, mesophilic micro-organisms move in to finish the compost. The extra time for curing allows the microbes that operate at lower-temperature to put their finishing touches on the pile. It also allows earthworms and other larger organisms which do not tolerate high heat to move back into the compost. They improve the compost itself and then they improve the soil where the compost is added.
- Keep the pile damp by spraying water on it. These micro-organisms need moisture.
- Curing assures that the compost will be of a much higher quality. For example:
  - The pH will become neutral.
  - Uncured compost may contain substances damaging to plants, including acids and pathogens. Soil micro-organisms will colonise the compost and impart disease-suppressing qualities to it.
  - If there is too much Carbon in the compost because you got the ratio of carbon to Nitrogen wrong, this will cause a temporary Nitrogen deficiency in the soil. Why? Because the micro-organisms will take Nitrogen from the soil to break down the rest of the Carbon. But the micro-organisms will restore the balance of Carbon and Nitrogen to the compost during the curing process. Having said this, if there was too much Carbon, the pile you would know because it would not become very hot and it would take a long time for the compost to develop. So you would have added green material.
  - Curing makes the compost optimum for plant growth.
- For all of these reasons, it is important that compost is thoroughly mature before it is used.

4.2 How to Know When the Compost is Ready

- If you have a hot pile that has been turned regularly, knowing when it is done is easy: it will not heat up any more, even after being turned.
- Check for fine particle, dark-coloured humus-like appearance and an earthy smell.
- In completely finished compost made from shredded materials, none of the original ingredients will be recognizable. If you do not shred ingredients, however, the decomposition will take a long time.
- The important test for whether cool compost is done is the look, feel, and smell of it. Mature compost does not contain slimy things, for instance. The ingredients should be unrecognizable, save for the occasional woody stem or autumn leaf. If many ingredients can still be picked out and named, the compost needs more time.

4.3. Screen the Compost Before Using or Bagging

- There are several ways to deal with *over-size* woody pieces in the compost that will not fit through about a half-inch wire mesh.
- You can use the compost as is with the over-sized pieces in it, pick the biggest pieces out by hand, or screen the entire batch, returning the bigger bits to the active compost pile for another round. If you do remove the overs and return them to the pile, they take with them the composting micro-organisms that adhere to them which give a boost to the fresh compost.
- The first option is to ignore them. Just use the compost as is, even with the occasional recognizable peanut or egg shell. These things will decay in your soil, though it is true that the process requires a certain amount of Nitrogen. It is therefore not recommended to add compost with a high proportion of uncomposted refuse to Nitrogen-poor soil.
- Alternatively, you can pick the biggest offenders — the corn cobs and avocado pits — out of the finished compost and toss them back into the active pile for another go-round. This can be done easily with things as large as corn cobs, but if you find yourself picking through the compost to find individual peanut shells, it is time to set up a screen.
- Screening compost takes time and a certain amount of energy but it results in a gorgeous, light and uniform soil.
- Take out the biggest pieces by hand, or screen the entire batch, returning the bigger bits to the active compost pile for another round. When you return them to the pile, they take with them the composting micro-organisms that adhere to them. These will give a boost to the fresh compost.
- You could, of course, ignore the large pieces and just use the compost as is, even with the occasional recognizable peanut or egg shell. These things will decay in your soil, though it is true that the process requires a certain amount of Nitrogen. It is therefore not recommended to add compost with a high proportion of uncomposted refuse to Nitrogen-poor soil.