

Composting & Manure

Management



*An Easy, Comprehensive Guide to
Manure Management and Composting*

Reprint of Second Edition:

“Composting and Manure Management – help for large acreage farmers and ranchers”



©2006/2007 Nevada County Recycles!
Nevada County Department of Transportation & Sanitation

Project Manager Lynne Cody, Nevada County Recycles!
Written by Marney Blair, Consultant

Table of Contents

An Easy, Comprehensive Guide to Manure Management and Composting

Why be concerned about an abundance of animal manure?	3
Composting Overview	3
Decay and Compost	4
It's Alive!	4
As Easy As Baking a Cake	4
Making Compost: Steps I thru V	
Step I: Getting Started	5
Food	5
Water	6
Air	6
Step II: Food Source	6
Animal Manures: They are not all the same	8
Animal Health	9
Step III: Moisture Content and Porosity	9
Completing the Recipe	10
Step IV: Adjusting your Composting Recipe	11
Step V: Let's Bake the "Cake"	13
Heat	14
Volume	14
Observation	15
Consistency	15
Designing Your Composting Operation	16
Choose a Method that Works for You	16
Composting Methods	16
Method 1: Turned Windrow	16
Testing for Moisture Levels	17
Method 2: Static Aerated	17
Method 3: Passive Piles with Working Recipes	18
Method 4: Vermicomposting	19
Pathogens	20

Troubleshooting Guidelines 22

Site Considerations 24

 Distance Guidelines 25

Benefits of your Compost 26

 Biological Benefits 27

 Chemical Benefits 27

 Physical Benefits 27

When is Compost Ready to Use? 28

Selling Compost 29

Conclusion 29

Definitions - Introduction to Concepts 30

 Compost Tea 30

 Manure Tea 30

References 32

 Websites 32

 Books 33

 Magazines 33

 Heavy Equipment for Composting 33

 Conferences 34

An Easy, Comprehensive Guide to Manure Management and Composting

This manual will guide you through the creation of a “recipe” for making compost from your manure and other organic materials. Troubleshooting tools and information about how to tell when your compost is “done” are also included.

Inside you will find easy step-by-step directions that will help you set up a quality composting operation. You will learn about ways to use your compost, and suggested steps to take if you want to sell compost.

Why be concerned about an abundance of animal manure?

When not properly cared for, too much manure may cause many problems on your land:

- It will compromise water quality (both well and ground)
- Nitrate salts will damage soils
- Stockpiled manure attracts flies that are unhealthy for your animals
- Manure left unattended causes odor problems

Composting Overview

In the past, farmers and ranchers viewed manure as a valuable part of a farm or a ranch’s soil fertility. With the proliferation of chemical fertilizers in recent years, many have forgotten the inherent value of manure. When manure is handled properly - turned into compost -it will supply more comprehensive fertility than any chemical fertilizer. Lucky for you, you have an abundance of this resource.



Manure decays and turns into humus, a vital part of soil.

Decay and Compost

Nature in her grand design created the “death and rebirth” cycle. It is such a basic part of life that we rarely think of it. Think of a leaf that falls to the ground. Over time this leaf decays and turns into other things. Everything in the natural world will follow this decay and regeneration cycle. So naturally, manure decays and turns into a component of soil over time. Over a long time.

Compost is the intentional intervention in this decay process. Placing manure and farm residuals in a heap and letting it rot is decay, not composting. By mixing ingredients in a certain ratio, turning the heap, and adding water, you are composting. If composting is done correctly you will have the best soil amendment there is.

It's Alive!

Composting is easy once you understand certain basic principles. Composting is a biological process that involves millions of microscopic organisms. As with any living thing, these organisms require the same basic things that your domesticated animals do - food, water and air.

FOOD • WATER • AIR

In this case, instead of hay for your horses, you will provide manure for bacteria and fungi that live in the compost pile.

As Easy as Baking a Cake

Building a healthy compost pile is like cooking; it is all in the recipe and observation. When you bake a cake, it is extremely important to have a good recipe. For example, if a cake recipe called for 10 eggs and 2 cups of flour, you should know that you would create a desert that is not edible. Paying attention to the proportions and the method used in creating a recipe are key



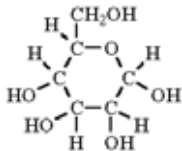
Building a healthy compost pile is like cooking; it is all in the recipe and observation.

components. As you mix the ingredients in the bowl, you are constantly making sure that it tastes good, and that it is not placed in the oven before all the steps are completed. Making compost takes the same amount of attention. In order to create excellent compost one must have a good recipe, observe the process, and be able to make corrections along the way.

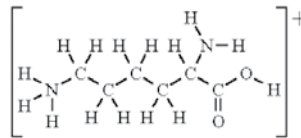
Making Compost: Steps I thru V

Step I: Getting Started

Let's begin to make a recipe for your manure so that it can turn into compost. The first step is to identify your ingredients.



Glucose



Amino Acid (protein)

Food

Compost is a living laboratory. In order to make good compost, you must provide the same things any living organism would need, food.

Pictured above is glucose and protein. Both of these are essential for any living creature, even the microorganisms in your compost. Scientists refer to this as the C:N ratio. Glucose has 6 carbons and no nitrogen. The protein has 6 carbons and 2 nitrogen. A well-balanced meal for the compost organisms would be 3 parts carbon to 1 part nitrogen. If it is not balanced you get piles that either don't break down or stink. Most glucose sources are called browns and nitrogen sources are called greens. Always balance your pile initially so that it is 3 parts brown to 1 part green. This will need a bit of adjusting later.

Browns

straw
cedar chips
corn stalks
dried leaves

Greens

manure
grass clippings
kitchen scraps

Water (Moisture Content)

Another ingredient we described is water. In “compost cooking school,” this is referred to as the moisture content. What this means is that those tiny organisms need water to drink and live in. If your compost pile is too dry, the critters will die and halt the composting process. If it’s too wet they will suffocate and die.

Air (Porosity)

The final ingredient you need to consider is air. Air means porosity in composting terminology. If the compost pile is too dense, then the air-loving organisms will choke and die off. Other opportunist organisms will take over; these are the anaerobic bacteria.

Unfortunately, we know these guys. They are the ones that produce that terrible sulfur smell that comes from a plastic bag of lettuce left in the fridge too long. By keeping the porosity in your compost pile, you will avoid odors and potentially toxic chemicals that come from these anaerobic bacteria.

As you can see, taking care of a compost pile will not be any more difficult than caring for the basic needs of your domesticated animals; it is just on a microscopic scale. Both are alive and share the basic needs for life: food, water and air.

Step II: Food Source

As a guide to help you understand the basics of composting recipe building, look at the chart on the next page. Compostable materials can be placed into two categories: browns and greens. The browns are the carbon source and the greens are the nitrogen source.

Circle what you have on the chart, or add your material:

Browns (Carbon)	Greens (Nitrogen)
corn stalks grape prunings newspaper saw dust straw wood chips	animal manure apple pumice grass clippings grape pumice

Remember that we are concerned about the balance because the microscopic organisms need food to eat that is in the right balance.

As a general rule, your browns should be $\frac{2}{3}$ of the volume to the greens $\frac{1}{3}$. Compare the volume of browns (carbon) you use to the volume of greens (manure - nitrogen). If it is not close to $\frac{2}{3}$, then you should consider adjusting it accordingly. This will get you closer to a good C:N ratio.

Browns	Volume	Greens	Volume
Pile #1 horse stable straw	6 wheelbarrow loads	horse manure	3 wheelbarrow loads
Pile #2 oak leaves	6 garbage cans	cow manure	3 garbage cans

Animal Manures: They are not all the same

Not all animal manure is the same, simply because not all animals are the same. For example, cows are relatively slow animals compared to horses. By looking at the behavior of each animal, we get clues about the manure as it emerges from the animal and how it will act once it is in a compost pile.

Horse Manure

Horse manure is light and tends to have an ammonia smell to it. It is also fairly dry. Horses by nature are quick animals and need their digestion to work this way as well. For this reason their manure tends to be not fully digested.

Cow Manure

On the other hand a cow tends to be a slow lumbering animal that does not need quick energy but rather long sustained energy. For this reason they have four stomachs. Each chamber is highly specialized and in the end extracts as much from the grass that it can. The manure from a cow is full of digestive enzymes and bacteria. It is green like the grass, but you cannot pick out any grass blades.

The Difference

As you can imagine both of these manures behave very differently in a compost pile. The horse manure tends to heat up quickly and get very dry. In comparison the cow manure tends to heat up slowly and be rather wet. Another characteristic of these two manures is their bulk density. Horses compared to cows are lighter, so it follows that their manure is lighter (less bulky) than cow manure.

Animal Health

The health of your animals affects the quality of your compost. Specifically, if the animals are unable to digest their food properly due to an illness or poor feed, the manure will be of poor quality. This means the manure may lack sufficient nitrogen to break down, lack sufficient microorganisms to convert the manure into compost, or the manure may have toxic residuals from the environment such as herbicides.

Step III: Moisture Content and Porosity

Now that we have looked at the food, let’s consider other aspects of compost building. Remember, the microorganisms need air and water to live. The ingredients you choose have certain characteristics that will determine how much air and water the mirco-organisms will receive. Below are the characteristics of animal manures and brown materials.

Animal	Cubic feet of Manure per day (per animal)	Nitrogen Source (Greens)	Moisture Content	Structure Porosity
chicken	0.0024	high	moist	poor
cattle	1.0	medium	moist	poor
horse	0.75	medium	dry	good
sheep	0.062	med-high	dry	good
swine	2.2	high	moist	poor

As you can see from the chart, pig and chicken manure is very “hot,” meaning there is a great deal of nitrogen in it. Chicken, cattle, and pigs have wet manure; consequently, their manure has poor structure porosity.

Brown Sources	Moisture	Porosity
corn stalks	medium	high
grape prunings	medium	high
dry leaves	low	medium
wet leaves	high	medium
wet newspaper	high	poor
saw dust	high	poor
straw	low	poor
wood chips	low	good

Porosity in this situation means that the material is able to keep air space even when it is wet. Straw when it is dry has a high porosity rating. However, when it is wet, it will collapse on itself. This is why it is rated with a poor porosity in the chart above. Cow manure also has a poor porosity rating because it is so dense. Wood chips or corn stalks have a high porosity rating, because they will retain the air space. Therefore, it is not advised to combine cow manure with wet straw.

Completing the recipe

Think about the physical characteristics of the manure(s) and bedding you have and fill columns in the charts below. You can refer to the chart above and use the example below as a guide.

Green Source	Moisture	Porosity
cow	high	poor

Brown Source	Moisture	Porosity
straw	low	poor

Step IV: Adjusting your Composting Recipe

In this section you will see an example of an ideal composting recipe. These basic components are correct brown/green proportions, appropriate moisture and good porosity. All situations are unique, so do not expect your recipe to look like this. However, you should have the basic components.

Material Source	Volume	Carbon or Nitrogen Source	Moisture	Porosity
horse manure	12 wheel barrows a day	slight nitrogen (green) source	low-dry	good
straw	36 wheel barrows	carbon (brown) source	low-dry	poor

Looking at this chart, one can see that the ratio of brown and green sources are balanced, the overall volume is 2/3 wood chips to 1/3 manure. This is a good start. Moving to the next column we can see that we have a moisture problem. Both of these materials are relatively dry.

We could add another ingredient in our mix that is wet, like cow or chicken manure. However, the problem with that is then we have the increased nitrogen and the porosity characteristics to deal with.



You have reached the right moisture content when you can squeeze materials in your hand and it acts like a damp sponge; it's moist but no water is dripping out.

Remember too much water will change porosity.

In this case, it would be best to add water to the two ingredients at the beginning of making a pile, but it will most likely need water later on. A sprinkler system works well, or rain.

You have reached the right moisture content when you can squeeze materials in your hand and it acts like a damp sponge; it's moist but no water is dripping out. Remember too much water will change porosity.

As it gets wet, straw begins to collapse in on itself and mat together. This limits the airflow and creates a very bad porosity rating. Although the recipe

looks good at the beginning, it is important to pay attention to the materials as you change them (add water, grind them up, etc).

To remedy this situation, we would add wood chips to increase the porosity. When wood chips get wet, they still retain their ability to stay stiff and allow air pockets to exist. However, by adding wood chips we have increased our need for water and our carbon source. So we will need to add a bit more water and add less straw to raise the nitrogen levels.

Our final recipe may look like this:

Horse Manure	12 wheelbarrows
Straw	30 wheelbarrows
Wood chips	6 wheelbarrows

Here is another example to show you how you will need to adjust your final recipe to accommodate for C:N (Brown/Green) ratio changes, air and moisture content.

You have chicken manure available. So the first step is to dry out the manure. Initially, you will start with 12 wheelbarrows of chicken manure. To this, you will add newspaper because you have a lot of it on hand, 36 wheelbarrows. You mix these together in a nice pile.

Unexpectedly it rains on your chicken manure and newspaper mixture. This causes it to heat up, but then the pile starts to smell putrid. This means the pile is too dense and needs more porosity. Luckily, you have some chipped up grape and apple tree prunings. By adding 6 wheelbarrows of these to your pile, you will correct the moisture and nitrogen imbalance. Continue to monitor and make adjustments if necessary.

Step V: Let's Bake the "Cake"

Build a test pile. Use the ingredients from your chart and test your recipe for a real-life situation.

Adjust the volume of material so that you can build a small pile 3 feet high, 3 feet wide and 3 feet tall. This is the minimum volume for a compost pile; otherwise it is too small to retain heat and moisture. Add water as you build.

Let the pile sit for a couple of days, then begin your investigation. Remember that the compost pile is alive with living organisms, so we are looking for signs of life.

Review the information in the questions presented below and begin to answer them in the next couple of days.

1. Is the pile heating up? _____ (use a thermometer)
2. Did the size of the pile shrink? _____



Reminder: Nevada County provides FREE consulting for composting. If you need further assistance, please call the Recycling Hotline at 265-1768.



The heat that comes from your compost pile is a sign of biological activity.

Heat

The heat that comes from your compost pile is a sign of biological activity. The heat is actually energy being emitted by the microbes as they eat and multiply. Check the pile with a thermometer. The pile should reach 135 degrees Fahrenheit in 3-4 days.

If your pile does not heat up, this is an indication that the microbes did not have enough food and stopped eating and reproducing. Generally, this means that you did not have enough nitrogen (and too much carbon) for them. Make a note of this if it is the case. If the pile is over 165 degrees Fahrenheit, it is too hot, and there is too much nitrogen (and too little carbon).

Volume

Compost piles will shrink in volume as the microbes eat the food and use it for their own growth. This is a good sign. However, if your pile shrinks too quickly, you may have a pile that provided an unbalanced diet for the critters. In two days, if the pile has a collapsed top, then you may want to add more carbon to your recipe. It may also mean you had too much porosity. Wait 5 days and answer the questions below.

Check after 5 days

After 5 days, check the pile again and look for the following things addressed in the questions below:

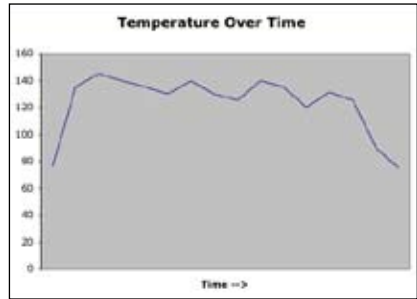
1. What is the pile temperature now? _____
2. How does the pile smell? _____
3. Dig into the pile and look at the ingredients.
What do you see? _____
4. Does the pile look uniform? _____

The compost pile should continue to heat up, and then it will reach a plateau until it starts to cool off. You might want to make your own graph of recorded temperatures.

If the pile heats up quickly and then drops off quickly, check the moisture and porosity. The pile may have too much air space, or it has dried out.

Observation

- If you see moist materials that have a slight white color and may be breaking down a bit, you are on the right track.
- If you see material covered by grayish powdery “snow” and there is no moisture – your pile is too hot and has turned the carbon into ash. Don’t panic, just add more water and check it again in a couple of days.
- If it appears caked and smelly, then you lack sufficient porosity. The moisture is probably fine, just provide more air space.
- If nothing is happening check the moisture levels and nitrogen.



Consistency

- If the characteristic of the pile is uniform, the pile is sufficiently mixed.
- If areas of the pile are variable in temperature, you will need to mix or layer the pile better. Deconstruct it and mix more thoroughly.
- At day 5, the pile should heat up to 130 – 150 degrees F.

Congrats – you are a great cook!

As you can see, there is ample opportunity to make corrections to your compost pile. It is a learning process and each batch will get better and better.



Designing Your Composting Operation

Composting can be an easy or involved process; it all depends on how much time you want to spend. We will now show you how to get started with an easy-to-manage compost system. Once you have mastered this, contact Nevada County Recycles! at 265-1768; we will gladly assist you to advance your system further, free of charge.

Choose a Method that Works for You

It is important to choose one of the methods described below that fits your ranch or farm. The methods are designed to fit your needs, i.e. little time, limited space, odorous material. This is why there are so many methods for composting - there are many different types of ranches and farms.

Composting Methods

There are many methods of composting, and all these methods address basic composting principles we have discussed earlier.

- Introducing air
- Mixing
- Moisture

The three methods described below outline different ways to compost. There are many more, but these three are the most common. Please consult the reference guide or contact Nevada County Recycles!, if you need further assistance at (530) 265-1768.

Method 1: Turned Windrow

If you own a tractor, you should consider employing this method of composting. This is the most common method of on-farm (or on-ranch) composting. It requires that the materials be heaped into a windrow. A windrow is a fancy word for a long narrow pile. These windrows need to be turned with a bucket loader or a windrow turner. You may also use a manure spreader; however, this would take quite a bit of time if you have more than one windrow.

The more often the heap is turned the faster the composting process will proceed. This method will generate compost faster than the other methods.

It is important to turn a windrow so that you can introduce air into the pile. If the microorganisms do not get air, they will die and anaerobic bacteria will take over and create a smelly mess.

The windrows can be as long as you like. The height of the pile depends on the materials. If it tends to be heavy like chicken or cow manure, the higher you stack it, the less air will be available. A general rule is to start out at 3 feet high and see how it does. Horse manure piles can be built higher.

In the beginning stages it is important to turn the pile at least once a week, if possible. This will:

- Allow you to check water conditions
- Keep oxygen levels high
- Keep temperatures high
- Stop fly reproduction cycle
- Reduce odor problems

After 4 weeks the pile should be well on its way to being good compost.

Testing for Moisture Levels

During this time, make sure to keep the water levels high. To test, take some compost in your hand and squeeze it. If water drips off your hand, the compost is too wet. If the compost does not stick together, it is too dry. If the compost sticks together but does not have water dripping out of it, this is the perfect moisture level.

Method 2: Static Aerated

This method is used mostly for wet, dense compost, but also for individuals who do not own a tractor, and have a substantial amount of compostable materials. The concept is to provide air to the compost pile through tubes such as PVC pipe, instead of having to turn the pile



If the compost sticks together but does not have water dripping out of it, this is the perfect moisture level.

in order to introduce air. The air can either be forced using a blower or more cheaply by just allowing it to passively move through the bottom of the pile via pipe.

Determine the dimensions of your pile and lay down 4-inch PVC pipes that have holes drilled in them. The pipes are laid 12-18 inches apart along the bottom of the windrow. Each pipe has two sets of holes drilled into it every 12 inches. The holes are 1/2-inch diameter.

On top of the pipe add a layer of saw dust, peat moss, straw or some other light material that air can move through. Then place your compostables on top to a height of 3-4 feet. Cover with finished compost or straw.

Let this sit for a minimum of 6 months.

On the previous page, you can read about how to test for moisture levels in your pile. You want to make sure the moisture is optimal for the organisms inside the pile or your composting will come to a halt.

Method 3: Passive Piles with Working Recipes

When you have limited time to turn your piles and can wait for the compost to be done (at least 9 months), this is a good method.

The trick to successful composting in this method is the development of a good composting recipe. If you develop a good recipe, it is not essential to turn this pile (see pathogens section). Of course, the limiting factor with this method is space. If you have a lot of manure, you can imagine that, over time, if a pile is sitting for 9 months, many piles will begin to accumulate.

It is important not only to have a good recipe in place before you attempt this method, but also to keep the dimensions of the windrow

adequate. If the pile is too small, the composting process will stop. If it is too tall, the pile will collapse and the air will be pressed out. Even in this method, it is advised to turn the pile at least once or twice to check on things and introduce air. Turn the first time after two weeks, check moisture and porosity and amend as needed. Turn a second time after one month.

Method 4: Vermicomposting

This method works well if you have no tractor, a limited amount of bedding and some space to build windrows. This method is not recommended for anyone that does not have time to devote to learning about worms. With a system like this, there is an initial learning curve on how to best manage worms.

Determine how much manure (and bedding, if that applies) your animals generate in a day. This volume will determine how long your windrows will be. Begin to create a layer of manure (and bedding) 18 inches tall, 6 feet wide and as long as six weekly volumes of material. The volume of material your animals generate in a day determines this length.

Water the material until it is as wet as a damp sponge. Now evenly distribute composting worms (*Eisenia fetida* – red wiggler, or *Eisenia andrei* – red tiger). Make sure the temperature does not climb over 100 degrees F. This heat will kill the worms. Allow the windrow to sit and the worms to digest the material for at least 1 week.

In the meantime, stockpile the manure generated by your animals. If you are using a dewormer, allow the manure to sit in the sun for two days to denature the chemicals.

After 1 week, check on the windrow. If the manure is beginning to transform, add more manure. Add another 3-inch layer of manure to the windrow. Water, and monitor digestion of newly added manure.



Some argue that vermicomposting, the use of worms, makes the best compost.



If you are planning on selling your compost or using it in organic growing operations it is important to consult the specific organic standards at:
www.ams.usda.gov/nop/indexIE.htm

Once the windrow reaches a height of 3 feet, start a new windrow using the same methods. Build the new windrow so that it is almost touching the old windrow. This will enable you to “harvest” the worms for your new windrow. The worms will migrate out of the old windrow into the new one because more food will be available.

Treat the worms like the other livestock on your farm. When the weather turns rainy and cold, protect them so that they can continue eating. Cover windrows during rainstorms and insulate with straw if the temperatures inside the pile reach below 55 degrees.

To begin it is best to start with the right worm to manure ratio. If you have one horse you will need 100 pounds of worms to digest the manure this horse produces in a week. For two horses you would need 200 pounds. If the manure has bedding added to it, you will need to double the amount of worms. Therefore, for one horse that would be 200 pounds of worms, two horses would need 400 pounds. Worms can be very expensive to buy initially. Luckily they multiply quickly. So start with the amount you can afford and adjust the amount of manure accordingly until the worms multiply. Contact the recycling office for good sources of composting worms at 530-265-1768.

Pathogens

If you are planning on selling your compost or using it in organic growing operations, it is important to consult the specific organic standards at: www.ams.usda.gov/nop/indexIE.htm. The standards are beyond the scope of this manual. We would be glad to help, just contact Nevada County Recycles at (530) 265-1768.

Compost is alive and thus is not sterile. Under certain conditions, pathogenic bacteria (i.e. E. coli) can regrow in your piles. It is important to manage your composting site.

Once viruses and parasites are reduced, they cannot be re-introduced unless you are using unclean practices (fresh manure on a pitch fork or loader bucket).

To keep harmful bacteria out of your piles follow these steps:

1. Prevent animal access to composting area
2. Keep your equipment clean
3. Maintain initial temperatures to 135 degrees Fahrenheit for 3-5 days
4. Use only fresh water after the piles begin to cool below 135 degrees F. (Thermometers can be purchased at a local farm supply business).

This is just a start. As you progress with your composting, you will be encouraged to experiment. Composting is a forgiving and creative process, so don't panic if at first your piles are not heating up or they smell bad. Make the appropriate corrections and observe what happens.

Troubleshooting Guidelines

Method: Turned Windrows

Smell

Characteristic	Problem	Remedy
Foul/Putrid	a. lack of oxygen b. C:N ratio is off (nitrogen too high)	a. turn pile b. add browns
Fungal with grey mold	a. too dry b. lacks oxygen	a. add water b. turn pile
Ammonia with caked material	a. lacks oxygen b. too much nitrogen	a. turn pile b. add browns
Ammonia with dry material	a. too fluffy b. too dry	a. compact pile b. add water
Ammonia with wet	too much nitrogen	add browns
Sweet fungal	good - no problem	none

Color

Characteristic	Problem	Remedy
Grey	pile is too hot	break apart & rebuild
White Mold	good - no problem	none
Grey Mold	a. pile is too hot b. too much nitrogen	a. break apart to cool b. add browns
Jet Black	too wet	turn pile
Dark Brown	good - no problem	none
Light Brown	too dry	add water

Temperature

Characteristic	Problem	Remedy
No Heat	a. C:N off (too much carbon) b. too dry c. no oxygen	a. add browns b. add water c. turn pile

Method: Turned Windrows (Troubleshooting continued)

Temperature

Characteristic	Problem	Remedy
Heat and then No Heat	a. C:N off b. too dry c. too wet & no oxygen	a. fix ratio b. add water c. turn pile
No Cooling after Heating Phase	C:N off (carbon too high)	add greens (nitrogen)
Wild Fluctuations	poor mixing	turn several times

Method: Vermicompost (Worm Composting)

Smell

Characteristic	Problem	Remedy
Foul/Putrid	a. too wet b. poor worm/ manure ratio	a. mix compost/manure b. add worms or manure
Fungal with grey mold	a. too dry b. lacks oxygen	a. add water b. mix compost/manure
Ammonia with wet black	a. lacks oxygen b. too much nitrogen	a. turn compost/manure b. add worms
Fungal	too wet	add fluffy browns
Earthy	good - no problem	none

Color

Characteristic	Problem	Remedy
Grey	pile is too hot	add more browns
White Mold	pile is too wet	mix or add fluffy browns
Jet black	pile is too wet	add fluffy browns
Dark or light	good - no problem	none

Method: Vermicompost (Troubleshooting continued)

Temperature

Characteristic	Problem	Remedy
No Heat	a. too dry b. too wet	a. add water b. mix and add fluffy browns
Over 100 degrees F	too much nitrogen (greens)	a. fix ratio, add browns
65-75 degrees F	good	none

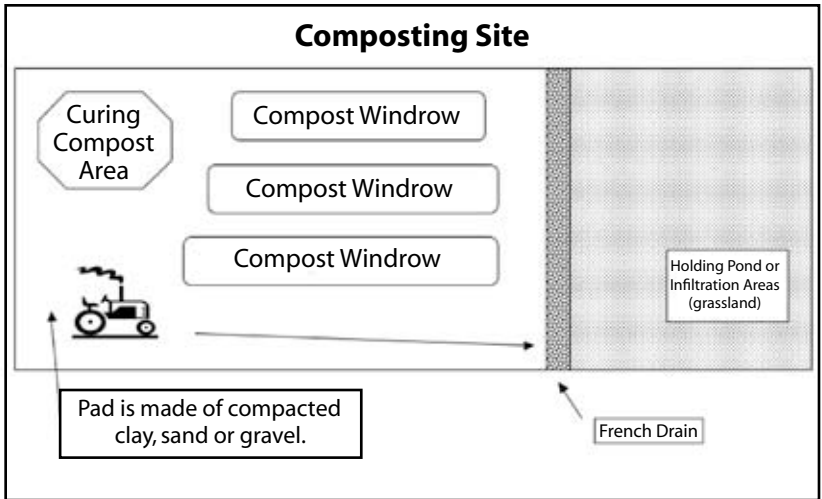
Site Considerations

Placement of your composting operation is as important as recipe formation. If your piles are not located in an appropriate location, you can cause water quality problems, dust problems, and potentially upset your neighbors with odor and critter problems. In order to avoid these problems, take these simple steps.

- Observe what direction the prevailing winds come from and place your composting operation so that your neighbors are not downwind from it.
- Consider the slope of your land and do not place your composting area above areas where water can pool.
- Keep compost far away from riparian (streams and rivers) zones.

Below is a diagram of an ideal composting site. Follow these suggestions if you plan on making a substantial amount of compost (over 700 yards annually).

- Construct a pad that is made of compacted clay, sand, or gravel.
- Make a 2-4% slope so that water will not pool.
- To catch run-off, construct a French drain and a grassland filtration zone.



Ideally, you want your composting area to be on soil that drains well, even if you are not making large volumes of compost. If this is not the case, consider placing wood chips or other absorptive materials down on the composting area before you begin composting.

Keeping your composting yard looking clear and orderly will always impress neighbors. If you have extra shrubs or trees, plant them around your composting area to provide shade and add a nice visual touch to your composting area.

Distance Guidelines

Follow these official regulations when situating your composting area:

Property line:

Minimum distance 100 feet (ideally 500 feet)

Residence: Minimum distance 1,000 ft.

Private well/potable water:

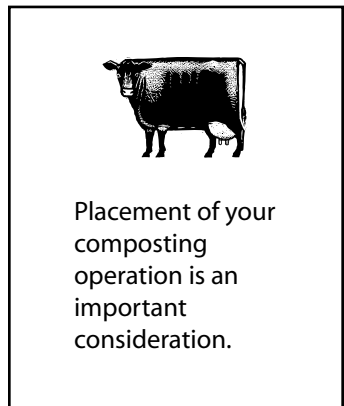
Minimum distance 100 feet

Riparian zone/wetlands:

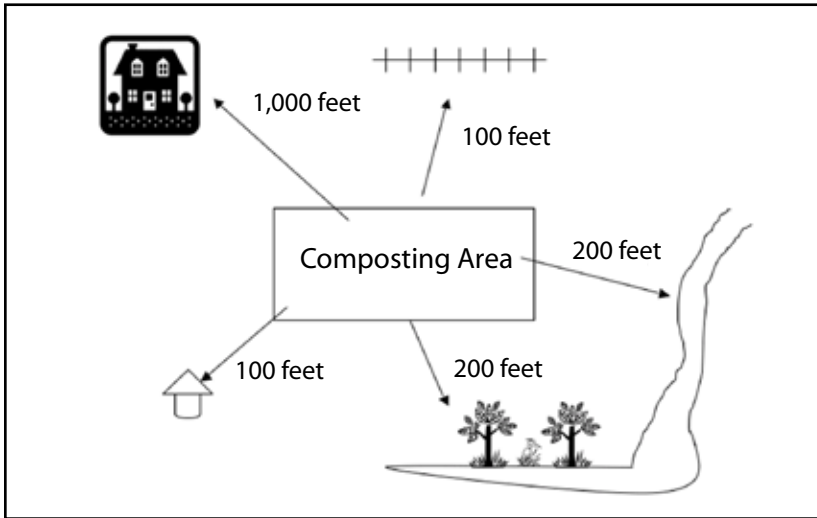
Minimum distance 200 feet

Water table: Minimum depth 3 feet

Bedrock: Minimum depth 3 feet



Situating Your Composting Area



Compost, by its very nature, is more dynamic than soil.

Benefits of Your Compost

Compost improves the biological, physical, and chemical properties of your soil. Farmers around the world have used compost for centuries to improve and fertilize their soil.

You can use compost to grow your starts, as a top dressing for pasture, to line your chicken coop and to place around your fruits trees.

Increasingly, compost is being used for other applications, such as soil remediation, potting soil mixes, and to make compost tea (see definition on page 30).

Biological Benefits

Compost is alive. Application of compost to your soil inoculates the soil with many organisms that in turn breakdown chemicals such as growth hormones for your plants. This mutual relationship occurs naturally in your soil. With the addition of compost, this biological activity is amplified.

If you have used herbicides and pesticides on your land, many of these organisms such as beneficial fungi will have been killed off. Addition of compost to the soil will help to rebuild this soil activity.

Chemical Benefits

Compost has nitrogen, phosphorus and potassium. Many of these chemicals are held in larger conglomerate molecules. This enables the nitrogen and other molecules to be released slowly over time. This slow release is the optimum condition for soil, so that the organisms and soil do not proceed through a boom and bust cycle, but instead have a steady flow of nitrogen, potassium and phosphorus (NPK).

Well-made compost has humates - organic molecules saturated with ions. Humates allow for the slow release of NPK due to its unique molecular structure, it also neutralizes the pH of your soil. (If you are interested in further detail, consult the reference - Edaphos Dynamics of a Natural Soil System by Paul D. Sachs).

Physical Benefits

Compost, by its very nature, is more dynamic than soil. Thus, when you add it to your soil, it will change your soil in a beneficial way. For example, compost with a neutral pH will change either basic or acidic soil to a more neutral state. It does this because it is a dynamic product.

Compost will also make clay soils more porous and sandy soils loamy. The most important component of compost is its organic matter. Organic matter is the slippery part of compost. This component adds life, natural compounds, and dynamic physical characteristics to your soil.

When is compost ready to use?

It is important to determine the right time to use your compost. Unfinished (immature) compost can deplete nitrogen and other nutrients from your soil.

There are several ways to determine if your compost is mature enough to use. Maturity is also a relative term; your particular application determines how mature you will need your compost to be (please see chart on next page).



Most compost that is well made can be sold for \$25 - \$35 dollars per yard.

Compost has reached its first level of maturity when it shows the following characteristics:

- A uniform appearance - most particles are the same size
- An earthy smell
- The pile has cooled down to ambient temperatures and will not heat up again with application of water
- A pH of 6-7.8 (Use a pH kit to test your soil.)

Compost will continue to decompose and breakdown until it looks like fine soil. It is not essential for you to wait until this point to use your compost. At the beginning, determine what uses you have for your compost, and then refer to the chart to see at what level of maturity you will need your compost to be.

	Potting Soil	Top Dressing	Soil Amendment
Use	growing medium	stimulate growth in pastures and turf	improves soil
Color	dk.brown to black	dk. brown to black	dk. brown to black
Odor	earthy	no objectional odor	no objectional odor
Age	at least 1 year	at least 5 months	at least 7 months
pH	5.0 - 7.6	5.0 - 7.6	depends on crops

Selling Compost

Compost can be a lucrative product to sell and a great way to divert your manure. Most compost that is well made can be sold for \$25 - \$35 dollars per yard. For many farmers and ranchers this can add up to a nice side income. The FDA and USDA have specific guidelines for selling compost that must be followed to ensure the safety of public health. If you are planning on selling your compost, it is advised you contact Nevada County Recycles! at (530) 265-1768 for further technical assistance.

Conclusion

Composting is an ancient art, going back thousands of years. The longevity of this practice speaks to its importance. Today we have the benefit of modern science to help us understand and improve our composting methods.

Definitions - Introduction to Concepts

Once you have produced compost, there are other techniques to apply to put nutrients back into the soil. They are discussed below.

Compost Tea

Compost tea, generally defined as a liquid extract of compost, has gained acceptance by homeowners and commercial growers around the world for its ability to stimulate soil biological activity, improve soil structure, and enhance overall plant health and vigor. Reported benefits of using compost tea include enhanced disease suppression, reduced fungicide and fertilizer requirements and associated cost savings. Research efforts to validate these benefits are expanding.

The contemporary compost tea industry by and large uses the term “compost tea” in reference to an aerated extraction process. Though designs vary, most commercial aerated tea systems consist of a tank, a mesh container/filter for holding compost, and an aeration system.

Compost tea has many of the same beneficial attributes of compost, but it is clearly a different product. Unlike compost, it can be applied directly to plant foliage, providing nutrition and beneficial microorganisms that colonize leaf surfaces. This is thought to be instrumental in the disease suppression capabilities of compost tea.

Compost tea applied directly to the soil is a way to boost biological activity when application of solid compost is not practical, or as a supplement between compost applications.

Definition by the compost tea industry association (www.composttea.org)

Manure Tea

Manure tea is an extract of manure that has been used for centuries by farmers. Generally speaking it is the extraction of the components of manure into water. The manure is extracted this way, because it is easier to spread the fertilizing effects of manure on the pastures when it is in a

liquid form. A manure tea is also made because it enhances the overall effect of just direct application of manure. It is believed that the “fermenting” process involved in making manure tea creates this enhancing effect.

Manure tea is made by placing fresh manure in a burlap sack and suspending it in a 55-gallon drum that is filled with water. Let this drum sit for several weeks, with an occasional stirring. The smell will disappear and will turn somewhat sweet. This means the slurry is ready. Dilute the tea 1:10 or 1:20. A 55-gallon drum can treat 2-3 acres.

To enhance your manure tea, you can add kelp powders, a small amount of wood ash (2 lbs.), and rock dust.

It is very important to let your manure tea ferment and not apply the diluted manure immediately. The fermentation is similar to composting and allows the bacteria that can be harmful to your animal die off and the beneficial ones to thrive. Animals can become very sick if they are allowed to eat pasture that has been sprayed with their fresh raw manure.

References

Nevada County Recycles! www.NevadaCountyRecycles.com
Recycling Hotline: (530) 265-1768

Websites

Compost

Compost Resource Page - www.HowToCompost.org
Cornell Composting Web Page
http://compost.css.cornell.edu/Composting_Homepage.html
Maryland Composting Resource Page - Composting School
www.bre.umd.edu/recyclegreen.htm
Maryland Composting Resource Page - Formulating Compost Recipe
www5.bae.ncsu.edu/programs/extension/publicat/wqwm/ebae173_93.html
United States Composting Council - www.CompostingCouncil.org/index.cfm
University of Maine Composting School - www.composting.org

Composting Equipment

Composting Instruments - www.reotemp.com
Growing Solutions - www.GrowingSolutions.com
Peaceful Valley Farm Supply - www.GrowOrganic.com

Compost Quality Testing

BBC labs - www.BBCLabs.com
Woods End - www.WoodsEnd.org

Compost Tea

Articles on compost tea - www.BioCycle.com (search: compost tea)
Compost Tea Industry - www.CompostTea.org
A company that sells compost tea and supplies for commercial use is:
Nature Technologies, 747 Mt. Howell, Colfax, CA 95713
530-637-1951
Soil Food Web – www.SoilFoodWeb.com

Vermicomposting

California Integrated Waste Management Board
www.ciwmb.ca.gov/organics/worms/default.htm
Wormwoman - www.WormWoman.com

Books

- Applehof, Mary, 1982, *Worms Eat My Garbage*, Flower Press, Kalamazoo, Michigan
- Brinton, William F. (Ed.) *Earth, Plant and Compost; Principles of Composting for Garden and Farm*. Mount Veron, Maine: Woods End Agricultural Institute
- Corrin, George 1995. *Handbook on Composting and the Biodynamic Preparations*, Biodynamic Agricultural Association (This booklet can be ordered from the U.S. Biodynamic Association at 415-561-7797).
- Minnich, Jerry and Hunt, Marjorie (Editors)1979. *The Rodale Guide to Composting*, Rodale Press, Emmaus, PA
- NRAES, 1992. *On Farm Composting Handbook*, Northeast Regional Engineering Service #54, Cooperative Extension, Ithaca, NY
- Sachs, Paul D. 1993. *Edaphos: Dynamics of a Natural Soil System*, The Edaphic Press, Newbury, Vermont
- Silverstein, Alvin and Virginia, 1972, *Life in a Bucket of Soil*, Dover Publication, Mineola, New York
- Tompkins, Peter and Bird, Christopher 1989. *Secrets of the Soil: New Age Solutions for Restoring Our Planet*, Harper and Row Publishers, San Francisco

Magazines

- Biocycle Magazine: www.Biocycle.net
Compost Science and Utilization: www.JGPress.com

Heavy Equipment for Composting

Allu Group
861 Main St.
Hackensack, NJ 07601
800-939-2558
www.AlluGroup.com

Heavy Equipment for Composting (continued)

Brown Bear Corp.
P.O. Box 29
602 Ave. of Industry Park
Corning, IA 50841
641-322-4220
www.BrownBearCorp.com

EarthSaver
Equipment, Inc.
P.O. Box 7325
Kalispell, MT 59904
866-227-2244
www.EarthSaverEquipment.com

Frontier Industrial Corp.
P.O. Box 700
Lyons, OR 97358
503-859-3454
www.FrontierIndustrial.net

HCL Machine Works
15142 Merrill Ave.
Dos Palos, CA 93620
209-392-6103
www.HCLMachineWorks.com

Midwest Bio-Systems
28933-35 E St.
Tampico, IL 61283
815-438-7200
www.MidwestBiosystems.com

Scat Engineering, Inc.
2255 Little Wall Lake Rd.
Blairsburg, IA 50034
800-843-7228
www.scat.com

Wildcat Manufacturing
Hwy. 81, Box 523
Freeman, SD 57029
800-627-3954
www.WildCatMfg.com

Conferences

Biocycle has several regional and one national conference per year.
Check out the dates at www.JGPress.com

US Composting Council has one national conference per year.
Check out the website at www.CompostingCouncil.org/index.cfm

NOTE: Vendors are listed as a courtesy and are not endorsed by Nevada County.

