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Compost Program at Morris Arboretum

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An independent study project report by The Alice and J. Liddon Pennock, Jr. Endowed Horticulture Intern (2012-2013)

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Disciplines
Horticulture

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INTRODUCTION

The importance of compost has been extensively talked about in the gardening realm, along with the horticulture community as a whole. Compost provides a wide range of benefits including: promoting healthy plant growth, improving soil structure, and reducing waste. "Composting is a process that allows naturally occurring microbes to convert yard waste, such as leaves and grass clippings, to a useful organic soil amendment or mulch" (Brown 2009). Therefore, the production of quality compost is dictated by the microbial communities present within the system. Beneficial soil microbes not only increase soil fertility and health, but improve nutrient availability for plants, promote growth, and reduce the impact of pests and pathogens (Dixon 2012). By maintaining favorable conditions to maximize these organisms, the Morris Arboretum can ensure the production of high quality compost.

The use of organic fertilizers such as compost goes back centuries. The Akkadian Empire in Mesopotamia referenced the use of compost for agricultural purposes on clay tablets 4,500 years ago in 2350 BCE. Since then compost has been seen in every major civilization including the Romans, Egyptians, and Greeks (Thomsen 2002). Marcus Cato, a Roman Statesman wrote a book entitled De Agri Cultura, which outlines the importance of soil fertility with a focus on the economics of agriculture. He highlighted the use of compost, and that was 2,000 years ago. In the 1800s George Washington Carver was an important advocate for compost stating "make your own fertilizer...compost can be had with little labor and practically no cash outlay" (Minneapolis Department of Public Works 2013). More recently, in 1931, Sir Albert Howard, an English botanist and organic farmer, published a book entitled, "The Waste Products of Agriculture: Their Utilization as Humus." In the book, special attention was given to the heating phase, carbon-nitrogen ratios, the importance of aeration, and the need to keep materials moist in the composting process (Saskathewan Waste Reduction Council 2005). Howard's ideas formed the foundation of modern composting practices and today he is known as the Father of Compost.

Compost was the most widely used form of fertilizer until a German scientist named Justus von Liebig started researching plant nutrients. He was able to prove that "plants obtained nourishment from certain chemicals in solution," after which, he dismissed the importance of compost because it was insoluble in water (Friend 2013). This discovery increased the concentration on chemical use in agriculture fields to increase crop production. Today Justus von Liebig is known as the Father of the Fertilizer Industry.

Currently the focus seems to be shifting back to more organic alternatives due to some negative impacts of inorganic fertilizers. The difference between organic and inorganic fertilizers is that organic fertilizers are made up of natural ingredients from plants and animals, while inorganic fertilizers are manufactured from minerals or synthetic chemicals (Lenahan 2013). The environmental impacts of these synthetic chemicals have caused many unforeseen problems. Plants are unable to absorb all the nutrients provided in the fertilizer before it begins to leach out of the system, causing pollution of waterways. All inorganic fertilizers focus on nitrogen, phosphorus, and potassium content. The nitrogen in fertilizer appears to be of most concern in environmental issues. Increased nitrogen in the water causes excessive algae blooms, reducing the available oxygen within the water, leading to fish mortality (Perlman 2013). Soil acidification, high cost, fertilizer dependency, and a lack of long-term sustainability on the landscape, are just a few of the major remaining problems produced by inorganic fertilizers.

In recent years, compost tea has become increasingly popular within the horticulture community. Compost tea is simply a brewed, water extract of compost, which concentrates the soil microbes found within a compost pile into water-based application (Ingham 2005). Essentially, finished compost is collected and placed within a large tea bag and aerated in a multi-gallon brewer filled with water. As the water is aerated, the micro-organisms come into suspension and multiply quickly due to the high concentrations of oxygen. Additives such as fish extract are added to the brewing process as a food source for the microbes, further aiding in reproduction. The major benefit of compost tea is the little amount of compost needed to positively impact large areas within the gardens.

Once the compost tea is ready, the extract is loaded into a sprayer and then applied to the desired area. The beneficial organisms within compost tea are then transferred to the foliage of the plants or the soil where the plants are growing. Once there the micro-organisms bind to the leaf and root surfaces, allowing no room for disease and other pathogens to infect the plants.

Public gardens have a unique opportunity to experiment with management techniques and educate the community about new improvements being discovered. The Rose Garden at the Arboretum recently changed to an organic management plan by using compost tea instead of chemical fertilizers. In 2011 the Morris Arboretum received a University of Pennsylvania Green Fund Grant to implement a Sustainable Landscape Management program. Through this grant, the Arboretum was able to purchase a compost tea brewer and other necessary equipment to start the new management program. Compost tea has been used in the Arboretum's Rose Garden for the past two years and has recently been added to the Azalea Meadow and the turf management practices around Widener. The compost currently being used to make compost tea is not the best, which limits the amount of good it can do for the plant and the soil. Therefore, the purpose of my project is to create high quality compost for use in the compost tea program.

CURRENT SYSTEM

The Arboretum currently works in partnership with Springfield Township to maintain a composting facility on the Bloomfield Farm property. All of the natural debris removed from the Arboretum's landscape is collected and placed in a pile on the northwest side of the farm. In the fall, all the Township's leaves are transported here and ground, along with the Arboretum's debris created over the year. Springfield Township owns a tub grinder, which makes the process move quickly. After the material is ground and formed into windrows, it is left over the winter to decompose. In the spring a majority of the leaf mulch is distributed throughout the Township, while the rest is left for use within the Arboretum.

This is a low maintenance system; however, low quality compost is created. The piles are not being properly aerated, causing lower numbers of beneficial micro-organisms as well as a non-uniform end product. Without the windrows being turned regularly, all the debris is not guaranteed to reach the middle of the pile. The high temperatures experienced in the center of the pile are required to kill the undesirable pathogens along with the weed seeds present in the debris. This past year I noticed a Bobcat repeatedly driving over huge piles of ground debris in order to make the stacks higher, completely compacting the material underneath. This decreases pore space, which decreases the availability of oxygen and water within the system. Without enough oxygen and water the micro-organisms within the decomposing material will also suffer.

Presently, the Township and the Arboretum do not have the time or the staff to dedicate to the proper management of a large scale compost facility. Unfortunately, not only is time a factor when running a compost site, but also having the proper equipment is vital. Currently there is no turner for the compost piles and without this critical piece of machinery, large amounts of quality product cannot be created. Hopefully in time, the necessary equipment will be obtained and there will be better coordination with Springfield Township to make sure that all the compost being made is high quality.

CASE STUDIES

Over the course of researching compost and production alternatives, I visited two local public gardens to observe their methods. Tom Brightman of Longwood Gardens and Nicole Shelby from The Scott Arboretum were gracious enough to show me around their compost facilities and answer any questions. Both facilities generate high volumes of compost for top dressing and use in their compost tea operations. Although my project is on a smaller scale than these public gardens, they provided me with a look at what the compost facility at the Morris Arboretum could become in the future.

Longwood Gardens has been composting since the 1990's and currently has an On-Farm Composting Permit from the Pennsylvania Department of Environmental Protection. This large scale operation allows Longwood to collect all of its horticultural waste products and recycle them back onto the property as compost, mulch, and field soil amendments. The onsite dining services, known collectively as The Terrace, also contribute materials to the compost that is created at Longwood. Compostable plastic silverware and vegetable scraps are all incorporated into the compost. Horse manure is the final component included in the compost and is brought in from local farms throughout the year. Due to the manure's high nitrogen concentration, it acts as a catalyst to jumpstart the microorganisms within the pile, initiating decomposition.

Longwood starts with separate piles of green waste, brown waste, and horse manure at the composting site where collection occurs during the season. Once a year Longwood rents a tub grinder to break up the large pieces of debris and mix them together. The ground materials are then placed into windrows, where they are marked with the start date and the recipe used to make up the pile. The temperature is monitored within the pile, and turning is dictated by these readings.

The Scott Arboretum of Swarthmore College, like Morris, shares their composting site with the local township. The Scott Arboretum sets aside materials to create their own compost separate from that of the township's. Every October, the township collects leaves all through the neighborhoods, depositing them on the concrete pad owned by Swarthmore College. The leaf piles are then shaped into windrows where they are turned and shredded by the township's equipment at undefined intervals. Turning times are primarily based on weather conditions and employee availability, rather than a set schedule. The leaf mulch is then sold back to the township in early April.

Once there is free space on the concrete pad, the mixed garden debris that Scott Arboretum has been collecting over the season, as well as some dining hall waste from the college, is moved onto the platform. The township then turns the Arboretum's compost periodically. The temperature is checked frequently by Arboretum staff to make sure the pile is staying between 130˚F and 160˚F to kill the weed seeds and detrimental microorganisms; however, turning is not dictated by temperature. Compost turners are expensive pieces of equipment that not many medium sized compost facilities can afford to purchase. Therefore, the township and Swarthmore College have reached an agreement, exchanging compost facility space for turner privileges.

The finished compost is then used all over the Scott Arboretum; including the intensive organic lawn section, where the lawn is top dressed with compost and routinely sprayed with compost tea as the management regime. The Scott Arboretum has been trained by Dr. Elaine Ingham from The Rodale Institute on compost production and compost tea application methods. Regular checks are conducted for micro-organisms under the microscope in order to determine compost health.

METHODS

Many different composting systems have been created over the years. Large commercial scale and small backyard operations are prevalent, but medium sized options do not seem to have a niche. When first proposing my project, I intended to apply to the University of Pennsylvania's Green Fund Grant with the goal of buying the Arboretum its own tub grinder. The creation of a medium scale operation was the hopeful outcome. After writing up a proposal, going over whether to include Springfield Township and the Compton Café into the plans, and what the real goal for my project was, applying for funding was not the logical option.

The Arboretum having its own grinder would be ideal if there was the staff and space to create a large scale composting facility. With the onset of such an extensive operation, the need arises to purchase more machines in order to turn the massive piles, which at this time is not feasible. The main goal of my project is to help create small amounts of quality compost to use in the production of compost tea. So we decided to retrofit a small backyard operation into something that could work at the Arboretum.

Large tumblers seemed like a good option, minimal effort is required once the material is compiled and turning the compost within the drum is a simple turn of the crank. Upon further review, tumblers are difficult to maintain at a specific moisture content and often become water logged. When the moisture becomes too high the compost can become anaerobic, which ruins the product. Simple wire fencing looped and attached with bungee cords was a cheap alternative; however, turning the pile is not ideal.

The final method considered was the 3-bin compost system, popular in homeowner backyards and smaller gardens. The wooden bins account for space to turn the compost and compartments to let it mature. The system is stationary, strong, and a simple design. Turning the pile will be easier due to the wooden slats in the front of the bins that can be removed for access. These slats, as well as the wire mesh for sides, will facilitate air flow through the piles, helping aid decomposition. All in all this system was the best option for the Arboretum.

Deciding on building materials for the compost bin is an important consideration that should not be overlooked. Leaching was a main concern when constructing the bins. Treated lumber is never appropriate to build with due to the harsh chemicals used to preserve the wood. Leaching from this lumber includes chemicals like arsenic and copper, both a cause for alarm. Naturally decay resistant wood is a good choice for building material, the main drawback being the high price. Composite plastic lumber was another choice considered for the bins. The manufacturers claim no leaching occurs and it lasts a long time, the main drawback is again the cost. For the compost bins at the Arboretum, I have chosen to use Douglas fir lumber, which is somewhat decay resistant, but cheaper than other wood like cedar. Douglas fir is also readily available in local hardware stores, so finding the material was convenient.

The usual bin system is made up of three separate bins, each 3ft x 3ft x 3ft in size. This volume is the minimum size requirement needed in order to reach the high temperatures necessary to eliminate the unwanted seeds and disease causing pathogens within the compost pile. For the purpose of my project, I have decided to construct a four bin system. Using the Cornell Waste Management Institute's three bin system as a template (See Figure 1), an additional 3 ft^3 bin was built. The extra bin will allow ample room for turning and storage of the compost once it is ready for use.

Deciding where to place the compost bins once contracted was another major consideration. Ease of access was a main concern, which is why one of the cinderblock bins near the current compost site at Bloomfield Farm was chosen. The only drawback was the presence of a few the walnut trees near the site. Walnut trees produce a chemical known as juglone, which inhibits the growth of other plants in the area. All the cinderblock bins were checked for debris, mainly seeds, from the walnut trees. After careful inspection the two bins furthest from the trees were clean, while the other two bins contained some nuts. The furthest bin was chosen in order to be safe and it was a little larger than the others.

Some compost bins include a wooden base; however the concrete bin where the compost system was placed served as a manufactured bottom. When a compost pile is put together, all the material is added at one time to ensure the whole pile is finished decomposing at the same time. If new material is added after the process has already started, one cannot be sure which part of the pile is finished and which part has yet to fully decompose.

MANAGEMENT PLAN

The beneficial micro-organisms present in compost require oxygen, water, and food in order to survive and reproduce. The natural materials that make up the compost pile provide the necessary food, while regularly monitoring the temperature and moisture content within the pile will ensure the presence of the others.

The most important task in compost management is proper aeration. Once the pile becomes anaerobic, the beneficial organisms die, ridding the compost of its beneficial qualities. Checking the temperature of the compost daily will help determine what is happening within the pile and ultimately dictate when it has to be turned.

The temperature is driven by the micro-organisms. The hotter the pile, the more active the microbes are. Once the pile reaches a certain temperature, it needs to be turned in order to incorporate more oxygen back into the system. The compost pile only needs to be at 160˚F for one day, 150˚F for two days, or 131˚F or above for three days in order to remove the organisms and seeds that are not beneficial from the center of the pile (Ingham 2012). Once those conditions have been reached, the pile needs to be turned to incorporate the untreated compost into the center of the pile, and so on. Each time the pile is turned you must make sure the temperature is reached. The compost will be ready once the pile no longer reaches these high temperatures.

The compost bins constructed for this project are well exposed to the outside environment, helping the movement of oxygen into the system. The sides are made of galvanized ½ inch wire fencing, sturdy enough to hold the compost in the bin, but open enough for proper ventilation. A width of three feet will be maintained between the compost bins and the cinderblock wall housing the system. This will allow further air circulation and the ability to collect materials we may lose while turning the compost.

The recommended moisture content to maintain within the compost pile is about 50%. There are many expensive devices on the market that take moisture content readings, but a much similar method may be employed for taking readings of the compost here at the Arboretum. While attending a Composting Basics Class at the Rodale Institute, Dr. Ingham taught a quick and basic test that requires only your hand. Dig into the pile and take a handful of compost, squeeze the material as hard as you can and only 1-2 droplets should come out. If there are more drops the moisture content is too high, and if there are no drops it is too low. If the there is too much moisture, turn the pile to add some air into the system to aid in drying the material. If the pile is too dry, add some water using a hose.

Where the compost tea will be spread determines how to compose the compost pile. A high fungi-to-bacteria ratio is necessary for both the Rose Garden and turf areas; therefore, a higher amount of woody materials, such as woodchips, will be incorporated into the compost recipe. A recipe recommended by the Rodale Institute is a 60% brown, 30% green, and 10% high nitrogen material. When constructing the pile, add materials following a layer pattern, alternating the brown, green, and high nitrogen. Once the bin is filled, remove the front slats for easy access to the pile. Using a pitchfork, transfer the pile into the next bin mixing and watering the material as it is moved. This will ensure a well-mixed compost pile with proper moisture content.

During the compost tea brewing process, fungal foods such as algae extract should be added to encourage the fugal growth within the tank. During the compost tea application, fungal strands suffer a loss, due to the pressure of the sprayer and size of the nozzle. Larger nozzles should be used to make sure these important organisms are not torn apart during application. This is another reason to bulk up the fungal numbers both when making the compost and during the brewing process.

RESULTS

In order to determine if the new compost created for the compost tea program is higher quality, soil tests were done. In September I collected soil samples from the compost created by the township and sent them to the Rodale Institute and Pennsylvania State University. The Rodale Institute offers the unique opportunity to test the life of the soil. Bacterial and fungal counts, along with nematode numbers and protozoa concentrations were reported (Table 1). Pennsylvania State University performs a standard soil test, reporting on pH levels, cation exchange capacities, and macro-nutrient levels (Table 2). We also ordered additional tests to determine the percentage of organic matter and micro-nutrient concentrations in the compost (Table 3).

According to the Rodale test, there are plenty of bacteria within the compost; however, there are virtually no fungi or protozoa present. Without the presence of these micro-organisms, the compost is of low quality and the compost tea being brewed will not greatly benefit the plants. Other than the lack of proper aeration in the current composting system, there is also a lack of material diversity. About 90% of the material used to create the compost is leaves. The lack of soil life reflects the lack of diversity represented in the compost piles.

After all the preliminary research was conducted, I set-up a compost pile in the beginning of March. I alternated layers of green and brown waste and then mixed the pile well with a pitch fork while adding watering. The temperature was monitored daily, and after a week, the high temperatures needed to kill the undesirable seeds and pathogens had not been reached. Milorganite, an organic fertilizer, was then added on the 8^{th} day as a high nitrogen source to boost the metabolism of the beneficial micro-organisms within the compost pile. Within a few days the high temperatures required were reached and the pile was then turned (Figure 2).

Due to time constraints, the first batch of compost will not be ready prior to the end of the internship. Soil testing will need to be done after the new compost is complete to determine if this compost system is an effective approach to making quality compost for the compost tea program.

FUTURE STEPS

In the future, there are several advances that the Arboretum should follow regarding compost. There needs to be more collaboration between Springfield Township and the Arboretum. With the current system in place to make compost specifically for compost tea, this does not solve the overall problem of low quality compost being used throughout the township and within the Arboretum as top dressing. By purchasing a compost turner, the quality of the product will vastly improve. This will allow the windrows to be properly aerated.

The sheer amount of debris brought in by the township is also too large for the space available at Bloomfield Farm for composting. This is an important consideration when moving forward into solving the larger issues faced by the Arboretum.

Even though the compost being created by Springfield Township is not the best quality, it can be made better by managing the weeds that grow in Bloomfield Farm around the area of the pile. By eliminating one potential seed source, this will reduce the amount of weed seeds being introduced into the Arboretum through the leaf mold.

The creation of a closed system for handling waste in the Arboretum is an admirable goal. Therefore, incorporating the food waste from Compton Café is another goal to strive for within the Arboretum. This system will set a wonderful example for all public gardens, as well as, create a teaching opportunity for the community.

ACKNOWLEDGEMENTS

I would like to thank the entire Horticulture Staff for their support and guidance on my project, especially my supervisor, Chief Horticulturist, Vince Marrocco. I would also like to thank Tom Brightman from Longwood Gardens and Nicole Shelby from the Scott Arboretum for giving me a tour of their compost facilities and answering my questions.

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TABLES AND FIGURES

Table 1. The initial Rodale Institute compost test results for the life in the soil.

Sample	Total Bacteria (micrograms/ gram)	Total Fungi (micrograms/gram)	Protozoa (numbers of flagellates and amoebae)	Nematodes (numbers of majors groups observed)
1	1395 158 Actino	0	48000 F 16000 A	0
2	3021 158 Actino	132	16000 F 32000 A	0

Table 2. The initial Pennsylvania State University compost test results.

			Exchangeable Cations (meq/100g)					% Saturation of the CEC		
Sample	pH	Mehlich 3 (ICP)	Acidity	K	Mg	Ca	CEC	K	Mg	Ca
1	8.4	410	0	4.3	13.4	23	32.7	13.1	41	45.9
2	8.6	398	0	5.24	15.23	23.87	35.5	14.8	42.9	42.3

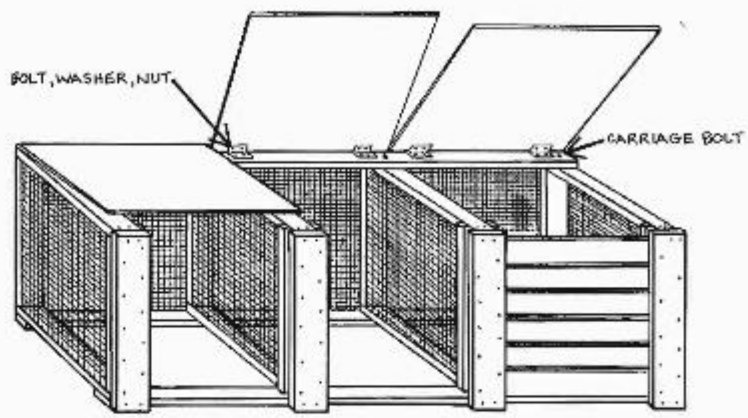
Table 3. The initial Pennsylvania State University additional test results for compost.

Sample	Organic Matter %	Copper (mg/kg)	Iron (mg/kg)	Manganese (mg/kg)	Zinc (mg/kg)
1	26.2	2.44	221.53	55.9	25.56
2	30.1	2.19	231.22	53.43	21.83

Figure 1. Compost bin design.

Wood and Wire Three-Bin Turning Unit

A wood and wire three-bin turning unit can be used to compost large amounts of yard, garden, and kitchen wastes in a short time. Although relatively expensive to build, it is sturdy, attractive, and should last a long time. Construction requires basic carpentry skills and tools.



What You Need

Materials

- 4 12-foot (or 8 6-foot) lengths of pressure-treated 2 x 4 lumber
- 2 10-foot lengths of pressure-treated 2 x 4 lumber
- 1 10-foot length of construction grade 2 x 4 lumber
- 1 16-foot length of 2 x 6 lumber
- 6 8-foot lengths of 1 x 6 lumber
- 1 4-x-8-foot sheet of 1/2-inch exterior plywood
- 1 4-x-4-foot sheet of 1/2-inch exterior plywood
- 22 feet of 36-inch-wide 1/2-inch hardware cloth
- 2 pounds of 16d galvanized nails
- 250 poultry wire staples (or a power stapler with 1-inch galvanized staples)
- 12 1/2-inch carriage bolts 4 inches long
- 12 washers and 12 nuts for the bolts
- 6 3-inch zinc-plated hinges
- 24 washers and 24 nuts for the hinges
- 1 quart wood preservative or stain

Tools

- tape measure
- hand saw or circular power saw
- hammer
- tin snips
- carpenter's square
- optional: power stapler with 1-inch galvanized staples
- drill with 1/2-inch bit
- screwdriver
- 3/4-inch socket or open-ended wrench
- pencil
- safety glasses
- ear protection
- dust mask
- work gloves

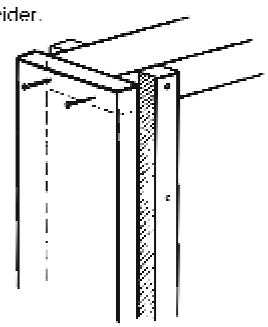
Building a Wood and Wire Three-Bin System

1. Cut two 31 1/2-inch and two 36-inch pieces from a 12-foot length of pressure-treated 2 x 4 lumber. Butt joint and nail the four pieces into a 35-inch x 36-inch "square." Repeat, building three more frames with the remaining 12-foot lengths of 2 x 4 lumber.

2. Cut four 37-inch lengths of hardware cloth. Fold back the edges of the wire 1 inch. Stretch the pieces of hardware cloth across each frame. Make sure the corners of each frame are square and then staple the screen tightly into place every 4 inches around the edge. The wood and wire frames will be dividers in your composter.

continued on next page

3. Set two dividers on end 9 foot apart and parallel to one another. Position the other two dividers so they are parallel to and evenly spaced between the end dividers. The 58-inch edges should be on the ground. Measure the position of the centers of the two inside dividers along each 9-foot edge.
4. Cut a 9-foot piece from each 10-foot length of pressure-treated 2 x 4 lumber. Place the two treated boards across the tops of the dividers so each is flush against the outer edges. Measure and mark on the 9-foot boards the center of each inside divider.
5. Line up the marks, and through each junction of board and divider, drill a 1/2-inch hole centered 1 inch in from the edge. Secure the boards with carriage bolts, but do not tighten them yet. Turn the unit so the treated boards are on the bottom.
6. Cut one 9-foot piece from the 10-foot length of construction grade 2 x 4 lumber. Attach the board to the back of the top by repeating the process used to attach the base boards. Using the carpenter's square or measuring between opposing corners, make sure the bin is square. Tighten all the bolts securely.
7. Fasten a 9-foot length of hardware cloth to the back side of the bin with staples every 4 inches around the frame.
8. Cut four 36-inch-long pieces from the 16-foot length of 2 x 6 lumber for front runners (Save the remaining 4-foot length.) Rip cut two of these boards to two 4 3/4-inch-wide strips. (Save the two remaining strips.)
9. Nail the 4 3/4-inch-wide strips to the front of the outside dividers and baseboard so they are flush on the top and the outside edges. Center the two remaining 6-inch-wide boards on the front of the inside dividers flush with the top edge and nail securely.
10. Cut the remaining 4 foot length of 2 x 6 lumber into a 34-inch-long piece and then rip cut this piece into four equal strips. Trim the two strips saved from step 8 to 34 inches. Nail each 34-inch strip to the insides of the dividers so they are parallel to and 1 inch away from the boards attached to the front. This creates a 1-inch vertical slot on the inside of each divider.



11. Cut the 6 8-foot lengths of 1 x 6 lumber into 18 slats, each 31 1/4 inches long. Insert the horizontal slats, 6 per bin, between the dividers into the vertical slots.
12. Cut the 4-x-8-foot sheet of exterior plywood into two 3-x-3-foot pieces. Cut the 4 x 4-foot sheet of exterior plywood into one 3-x-3-foot piece. Center each 3-x-3-foot piece on one of the three bins and attach each to the back top board with two hinges.
13. Stain all untreated wood.

Adding Wastes

Do not add wastes as they become available with this system. Collect enough wastes to fill one of the three bins at one time. You can collect woody as well as nonwood wastes. Add thin layers of different kinds of organic materials or mix the wastes together.

Before adding new wastes to an empty bin, collect enough to fill the entire bin.

Maintaining Your Compost Pile

Take the temperature of your pile every day. After a few days, the temperature should reach between 130° and 140°F (54° to 60°C). If your pile gets very hot, turn it before the temperature gets above 155°F (68°C). In a few days, the temperature will start to drop. When the temperature starts going down, turn your compost pile into the next bin with a pitchfork. The temperature of your compost pile will increase again and then, in about four to seven days, start to drop. Turn your compost pile into the third bin. The total time for composting should be less than one month.

Figure 2. Daily temperature of newly created compost pile.