

2015 Master Composter Student Project
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Improving Composting Operations at La Paloma Greenhouse

The following outlines a presentation that teaches the basics of compost piles and vermicomposting with the goal of improving the current composting methods at La Paloma Greenhouse and identifying activities for individuals of varying capability. About an hour, it would consist of PowerPoint slides as well as props such as a plexiglass box to show the layering of materials in a compost pile and a worm bin with castings.

I. Purpose of Presentation

- a. Identify opportunities for improved management of existing composting methods at the greenhouse in order to improve their effectiveness
- b. Identify opportunities for individuals to participate in new activities appropriate to their interests and abilities

II. Purpose of Composting

- a. Maintain an optimal environment for microbes and/or worms in order to break organic matter down into nutrient-rich humus
- b. Doing so eliminates waste from the landfill, decreases greenhouse gas production, and produces a finished product that enhances the health of soils
- c. Do this by balancing 5 factors
 - i. Green organic matter high in nitrogen (e.g. grass and plant clippings, food waste)
 - ii. Brown organic matter high in carbon (e.g. dry leaves, paper towels, branches)
 - iii. Air
 - iv. Water
 - v. Time

III. Current Composting Methods at La Paloma (include pictures of each)

- a. Compost Pile
- b. Worm Bin

IV. Compost Pile

- a. Can be maintained as **either** a hot or cold pile—maintaining a certain temperature is an option, not a necessity
 - i. Hot Pile
 1. Heat is generated by the microbial metabolism of organic matter; more heat increases microbial activity, thus speeding up the decomposition process further

2. A hot pile reaches temperatures between 140° and 160°; in order to achieve these temperatures, the pile needs to be of adequate size (between 3'x3'x3' and 5'x5'x5') and there needs to be the correct ratio of nutrients for microbes, namely carbon and nitrogen
 - a. Carbon, which comes from brown materials, is used for energy, while nitrogen, which comes from green materials, is used for building proteins
 - b. Adding too much carbon causes decomposition to halt as microbes use up available nitrogen and can no longer reproduce
 - c. Adding too much nitrogen can lead to offensive odors and leaching of excess nitrogen
 - d. Optimal C:N ratio is about 30:1
3. While anaerobic organisms, which require little to no oxygen, are capable of breaking down organic material, the process is slower and generates odors; thus keeping a pile adequately aerated favors aerobic organisms which decompose matter quicker and minimize odors; aeration can be achieved by layering in bulking materials such as branches, corn cobs, pine cones, etc.—anything that creates space in the pile and prevents compaction
4. While aerobic organisms require air, they also require water to live, and these factors are often at odds with one another in the desert: while we want to maintain air flow, we also want to retain moisture, about 50%; to do this, it is important to soak brown materials before adding to the pile and keep the pile covered
5. Hot Pile Construction & Maintenance
 - a. Include diagram of a hot pile cross-section and pass around plexiglass box to illustrate layers
 - b. Should be constructed with sealed walls made of cinder blocks, pallets, or chicken wire lined with plastic to minimize water loss
 - c. Start with a 6-12" layer of bulking material at the base and begin layering a 2:1 mixture of pre-soaked browns and greens on top; every 6", add another 4" layer of bulking material—throughout the layering process, continue adding water, either with a hose or buckets
 - d. Once the pile is 3-5' tall, cover securely with any combination of plastic, tarps, and/or rugs, again to minimize moisture loss

- e. Monitor temperature regularly; within a few days, it should reach temperatures between 140° and 160°; once it starts to cool down, the pile can again be turned
- f. Turning the pile is very similar to constructing the pile: add a base layer of bulking material and begin using a pitchfork to move the partially decomposed material over, layering in bulking material, fresh greens & browns, and water as necessary

ii. Cold Pile

- 1. Because maintaining a high temperature is not a concern, many of the factors that are of importance in maintaining a hot pile—correct C:N ratio and aeration—are not a major concern with cold compost piles; however a lower temperature also means a longer decomposition time
- 2. Does not need to be layered with browns, greens, and bulking materials like a hot pile; typically an open pile or a purchased compost bin to which you add materials as they become available
- 3. Turning is not necessary, though aeration and mixing in of new nutrients will speed decomposition
- 4. As in a hot pile, however, retaining moisture is important and the pile should be covered

iii. Why choose one form over the other? Consider 4 major factors:

- 1. Time: How much material do you have available and how long do you want the process to take? Hot composting can produce a finished product in 3-6 months, while cold composting can take 12-18 months
- 2. Labor: Hot piles require more time, attention, and physical labor, though this also means more opportunities to get individuals involved in new activities
- 3. Pathogens: Only the temperatures in a hot pile are capable of killing pathogens and weed seeds; thus, if adding manure, a hot pile should be the chosen method (animal waste and food products such as dairy and meat should be avoided completely)
- 4. Worms: If the addition of worms is desired, it is necessary to maintain it as a cold pile as worms cannot survive the temperatures of a hot pile

iv. Include picture of current pile at La Paloma

- 1. In its current state, what method would this be considered? (cold pile)
- 2. What could you change to improve efficiency? Examples:

- a. Cover with tarps and/or rugs—moderately easy activity for people with somewhat limited physical strength
 - b. Close spaces between cinder blocks, either by rebuilding the walls, covering the blocks, or stuffing the gaps—ease of this task varies depending on method chosen; can be a really good project for someone who enjoys heavy physical labor
 - c. Rebuild piles to include layers of bulking material between a 2:1 mixture of browns:greens—another good activity for people with limited physical strength as material can be added to the pile in small batches
 - d. Take temperature regularly to determine when to turn the pile—for someone who enjoys more of a mental challenge, the data could even be plotted in an Excel graph
 - e. Turn the pile when it begins cooling off, adding greens, browns, and bulking material as appropriate—tasks such as adding water and new material are better suited for people with limited mobility and strength, while the actual turning of the pile with a pitchfork is ideal for people who enjoy heavy manual labor
 - f. Others?
3. While simple steps to minimize water loss should be taken, steps to maintain it as a hot pile are optional
- b. Questions on Compost Piles?

V. Worm Bin—Pass around worm bin with castings during this portion

- a. Another form of cold composting, worms are used to aid microorganisms in the breakdown of organic matter into worm castings
- b. Process uses red worms—not earthworms—which require a container, bedding, a steady source of nutrients, grit, moisture, oxygen, moderate temperatures, and a dark, quiet area free from vibrations
 - i. Container: the commercial stackable worm bin currently in use is an ideal container that contains holes for ventilation, a spigot to remove leachate for use as a fertilizer, and individual trays for easier harvesting
 - ii. Bedding: the bottom of the bin should contain a few inches of wet bedding material that provides a medium through which the worms can travel; it can be any combination of dampened shredded paper, small pieces of corrugated cardboard, straw, or shredded leaves

- iii. Nutrients: each tray is approximately 1 cubic foot, which can accommodate about one pound of worms, which will consume about one pound of food per day; over feeding can lead to acidic, anaerobic conditions in the bin which is toxic to the worms; worms can consume a variety of food scraps, coffee grounds, and tea bags; animal products such as meat & dairy, animal waste, and acidic foods such as citrus should be avoided
 - iv. Grit: worms have a gizzard which they use to grind food instead of teeth, which means that they need some form of grit in the gizzard to aid in grinding; this can be pulverized egg or oyster shells, vermiculite, or garden soil; should be added in small amounts about once a month
 - v. Moisture: worms breathe through their skin, requiring ample moisture; contents of a worm bin should be kept wetter than a compost pile, about 70-80% moisture
 - vi. Environment: while worms can tolerate a wide range of temperatures, they thrive between 55° and 70°, and thus should be kept in a shaded area protected from extremes; they are also sensitive to light and vibrations, and should therefore be kept in a dark, opaque container in a quiet area; an inappropriate environment may cause the worms to crawl up the sides of the bin to escape
- c. Include picture of current worm bin at La Paloma
- i. Given this information, how could it be managed better?
Examples:
 - 1. Adding only food to one tray at a time: with the stacked tray system, add food to the bottom tray and once the worms have nearly finished breaking down the contents, begin adding food to the next tray to encourage worms to migrate upward; adding food to too many trays at once makes harvesting more difficult as worms are spread throughout each tray
 - 2. Not overfeeding worms: food scraps are often piled to the top of the tray, which can create a toxic, acidic, anaerobic environment for the worms; having such full trays also makes it difficult to check on the health of the worm population; worms should only be given what they can consume in a day (about one pound of food per one pound of worms), and any excess can be added to the compost pile
 - 3. Others?
 - ii. Adding food to the bin is an easy task for any of the individuals to do, however it is probably best that it be supervised to ensure that

food is being added to the correct tray and that the trays are not being overfilled

d. Questions on vermicomposting?