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Composting Horse Muck

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A typical horse weighing 1,000 pounds will produce approximately 50 pounds of manure and 10 pounds of urine per day. Horses that are housed in stalls may generate an additional 20 pounds of soiled bedding, depending on the type of bedding and the amount removed. Therefore, Kentucky's horse population (approximately 200,000) has the potential of producing about 14 million pounds of waste per day (assuming 100 percent housing). Improper management of this waste has the potential to pollute Kentucky's surface and ground waters.

Composting is the acceleration of a natural biological process that converts organic matter into a stable humus-like material. This process is a great way to convert horse muck into a more desirable product. Composting produces a material that can be used as a low-grade fertilizer, mulch for reducing weed infestation, and soil amendment for retaining soil moisture. Land application of compost is also more environmentally friendly than stacking horse muck in low-lying areas and sinkholes or applying it directly to pastures. Besides volume reduction, composting kills unwanted microorganisms and weed seeds while creating a more stable nutrient source.

Important Issues

Monitoring the four factors listed below will ensure that the best end product is obtained and will help the environment.

Carbon to Nitrogen (C:N) Ratio

Typical horse manure has a C:N ratio of approximately 10-18:1. However, commonly used bedding materials, such as straw and wood shavings, contain high C:N ratios. Approximately 80 percent of horse stalls are bedded with wood shavings, which may have C:N ratios of nearly 700:1. The blend of horse manure and bedding called muck will typically provide a C:N ratio of 50:1, which explains why muck piles will not noticeably decompose over time.

Microorganisms need carbon (C) and nitrogen (N) in order to live, but they need these elements in the correct ratios. The ideal ratio is 30 parts carbon to 1 part nitrogen (30:1). Low C:N ratios (<20:1) do not provide enough energy for beneficial microorganisms to function. Therefore, compost piles with low C:N ratios will decompose slower and possibly lose N in the form of ammonia gas. Conversely, N is immobilized in compost piles with high C:N ratios (>40:1), which also impedes the decomposition process. Research has shown that raw horse muck applied to soils immobilizes the N in the soil creating forages low in N, which exhibit light green to yellow-green hues.

The C:N ratio can be determined by submitting a manure sample to a land grant university through the local cooperative extension service or to a private laboratory for analysis. The existing C:N ratio can be adjusted up by adding more C (straw, dried leaves, wood shavings, sawdust, dried grass, etc) or down by adding N (green grass, ammonium nitrate, fecal material (manure without bedding material), etc).

Moisture

Moisture allows compost to degrade properly by helping to mediate the temperature and provide a means of transportation for microorganisms. Ideally, the moisture content should be between 40 and 60 percent. Lower moisture contents allow the temperature to rise too high, which destroys beneficial bacteria and decreases decomposition rates. Moisture contents above 60 percent cause a lack of oxygen (anaerobic) in the compost pile, which decreases decomposition rates and can cause offensive odors. (Although the sense of smell is subjective, an anaerobic smell can be described as a putrid odor similar to rotting garbage.)

Adjusting the moisture content is simple. If the moisture content is below 40 percent, add water or recycled compost runoff to the pile. If the moisture content is above 60-70 percent, turn the pile every day to allow the compost to dry out. A quick method for determining the moisture content is to squeeze a sample of the waste in your hand. A pile is too wet if more than three drops can be removed, and too dry if the palm of your hand is not wet.

Oxygen

Aerobic (with oxygen) decomposition is more efficient than anaerobic (without oxygen) decomposition. Aeration keeps the biological processes from becoming anaerobic and allows the compost to reach and maintain optimum temperatures. A common method of aeration is turning compost piles. Small, rotating drums can be used to store and turn the compost for small quantities. For larger quantities, windrows are formed and turned with a tractor and front end loader. The turning frequency depends upon the moisture content of the compost. Normally, the pile should be turned 3-5 times every 2-3 days when the moisture content is between 40 and 70 percent. However, greater aeration (turning) in the initial stages of composting intensifies microorganism activity. The increased activity decreases the time and land area needed for composting.

Temperature

Because the microorganisms produce heat, temperature is a good indication of the level of biological activity taking place. The ideal temperature range is 135°F to 160°F. Temperatures below this range require more composting time to kill pathogens and other unwanted pests, and temperatures above this range will kill beneficial bacteria needed for decomposition. It is best to maintain temperatures at approximately 150°F to kill the eggs of parasites, oocysts (dormant larvae in a capsule-like sac), and flies.

Temperature should remain constant until the compost reaches its final stage of curing. Compost is considered cured when, after turning and when optimum conditions are met, the core temperature does not rise more than 15 degrees above ambient temperature. A temperature drop prior to curing is a sign that microbial processes are being affected by a lack of moisture or oxygen.

Thermometers with a 3-foot stem are recommended for easy monitoring of temperatures (Rynk et al. 1992). The temperature may be read directly off the dial. The easiest way to cool the pile is to decrease the height; increasing the height will allow heat to be retained.

Figure 1. One example of a moisture probe. (Notice the temperature of 151°F.)

Figure 2. An example of a dial type thermometer. (This pile needs to warm up.)

Mixing and Handling the Ingredients

Beef and dairy manure, when available, are excellent sources of N for decomposing horse muck. Inorganic forms of N (34-0-0) can be added when N sources such as beef manure are not available. A simple way to lower the C:N ratio at the beginning of the mixing process is to add ammonium nitrate to the horse muck as the stall is being cleaned out. Research shows that only a third of a pound (150g) of ammonium nitrate per horse per day must be added to reach proper conditions when wood shavings (not straw) are being used. If proper moisture and air space requirements are

Figure 3. Front end loader gathering horse muck for composting.

Figure 4. Loading horse muck into a mixing wagon.

Figure 5. The actual windrow can be built using a front end loader or mixing wagon.

met but the compost pile is not heating up, add one-third cup of a commercial nitrogen fertilizer.

Mixing horse muck with other N sources to achieve the proper blend can be accomplished using a front end loader, dump wagon, or mixing wagon. Typical rules of thumb can be developed from practice. For example, a properly formulized compost windrow may require 2 front end bucket loads of beef/dairy manure to 3 loads of horse muck.

Occasional turning of the pile is required to mix the windrow contents to allow the heat to destroy pathogens, cool the pile to prevent overheating, and provide needed oxygen to beneficial microorganisms. Turning can be accomplished using a front end loader; however, horse muck requires more mechanical aeration to break up the horse dung. Another method to accomplish turning is to use a mechanical turner.

Figure 6. Turning compost with a mechanical turner.

Ways to Compost

Obviously, there are several factors that remain the same regardless of the method used to compost. However, some aspects of the pile may vary depending on the volume of manure produced as well as the type of bedding material used. The factors that vary mainly deal with the dimensions rather than the content of the pile. Below are the suggested ways to compost manure in small and large volumes.

Bins and Vessels

Small farms (1-3 horses) may only need small composting bins. The bins may be boxes, areas on the ground, or cylindrical containers supported above the ground and rotated around an axis. While rotating bins look nicer and are easier to maintain, they have a higher initial cost and may not hold enough volume to generate sufficient temperatures to kill pathogens. In addition, rotating cylinders may not turn fast enough to adequately disintegrate horse dung. Therefore, rotating cylinders may not be the best choice. If bins are on the ground, they need sufficient drainage to keep the bottom of the pile from becoming too moist.

Figure 7. Open style composting bins.

Windrows

Larger farms (more than 3 horses) may need to use windrows for composting. The length of the windrows does not matter, but the height is crucial for proper composting. Short windrows will lose heat and moisture, decreasing rates of decomposition. Tall windrows will compress under their own weight, reducing pore space and hindering the aerobic process. Tall windrows also increase compost temperature by retaining more heat, which can kill needed bacteria.

Ideally, the windrow should be about 3-6 feet tall with a rounded top so rain will run off. Research has shown that properly managed windrows are able to destroy 99.9 percent of the harmful pathogens within 4 days of building and turning. The amount of time needed to properly decompose horse muck ranged from 6 to 18 weeks depending on the time of year and the moisture conditions. A covered composting structure has added benefits because typically the winter months slow down the decomposition process. Additional water can always be added to compost in a covered structure, but it is difficult to remove excess moisture from compost on an open lot when temperatures and precipitation events are working against you.

End Product

The end product should have a texture and color similar to peat moss or potting soil media. Stable compost can be applied to pastures and gardens and around trees and shrubs as a mulch or soil amendment. Stable compost will contain low concentrations of macro nutrients (N, P, and K) with a ratio of approximately 2:1:2. However, if the compost material is not stable (continues to reheat when wet), it will require additional nitrogen. Studies have shown that the compost material will draw N from the soil after land applications have been made. Compost should be applied during the growing season. Excess compost may be stored, given away, or sold.

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