The Renewable and Valuable Resource: Horse Manure

Introduction:

An average 1,000-pound horse produces 9 tons of manure a year (50 pounds per day) containing valuable fertilizer elements (See Table 1). Add to that an additional cubic foot of bedding material and you get 730 cubic feet of byproduct per year from one horse. The storage and treatment of this byproduct can determine whether it is a waste product or a valuable resource. The labor, storage and utilization costs for management of this resource can be considerable, so it is important to handle this product in a manner that maintains and improves quality.

Table 1. Average fertilizer content in horse manure on an as-is basis.

14 lb N/ton
4 lb P_2O_5/ton
14 lb K_2O/ton

The U.S. horse industry uses two principal feed management systems – pasture management and Stabled/Confined feeding systems. Information related to these feed management systems is provided on this site.

Characteristic	Pasture Management	Stabled/Confined Feeding
Housing	Horses graze full-time on pastures.	Horses are kept in box stalls, corrals or runs.
Bedding	Not necessary.	Necessary to absorb urine and provide cushion.
Manure management	Spread regularly by harrow cultivation to improve distribution and promote decomposition.	Must be composted, stockpiled or collected daily and land-applied.

Pasture System

Goal #1 – Distribute manure evenly. This can be achieved by adopting the following:

- Grazing management - Practice rotational grazing, if possible, to provide more uniform distribution of manure throughout the field. If pastures are too large, split them and move the horses back and forth between parts of the pasture to distribute the manure more uniformly. Providing several watering facilities within a pasture and moving feeding facilities periodically will promote a more even distribution of manure.
- Mechanical method - Mow two to four times a year and chain harrow (drag) to break up and spread manure piles.

Pasture System

Goal #2 – Avoid Parasite Problems. This goal can be achieved through the following.

- Mow two to four times a year and chain harrow (drag) to break up manure piles and expose parasite eggs to the elements.
- Graze young horses separately from older horses; the younger horses have a higher susceptibility to parasites.
- Follow horses with cattle or sheep before returning horses to the pasture. This interrupts the life cycle of the horse parasites.
- Deep harrow or plow pastures that are badly parasite-infested. Deep plow pastures and reseed every three to five years. This will help to break parasite life cycles.
- Deworm all horses on a regular schedule using an anthelmintic. Contact your local veterinarian for anthelmintic recommendations.

Pasture System

Goal #3 – Prevent contamination of surface water with run-off containing high levels of nitrogen, phosphorous and bacteria by following these tips.

- Don't overstock. Excessive stocking rates lead to overgrazing. Damaging the grass stand increases manure runoff potential from pastures.
- Avoid over irrigation of pastures.
- Avoid grazing during rainy periods when soils are saturated to avoid soil compaction and manure runoff.
- Restrict access to streams to avoid manure deposition in or near water bodies. This can be done through fencing and providing shade away from the streams.

Stabled/Confined Feeding System

Manure Collection

Confinement Housing (Stalls, Paddocks, Holding Pens, Corrals, and Runs). Daily maintenance of horses in a confinement setting requires intensive labor. Horses housed in stalls and sheds require soft absorbent bedding. According to the 1999, USDA, APHIS survey, two-thirds (67.5%) of operations used bedding for horses. The most commonly used bedding was straw or hay (45.4%) followed by wood savings (30.9%). Some other sources are corn stalks, shredded newsprint, peanut shells, peat moss, rice hulls, etc. The USDA, APHIS study also noted, approximately one-third (34.5%) of horse farms cleaned stalls daily or more often, while 60.2% cleaned stalls weekly or less, depending on the time these horses spend in the stalls. Remove manure and soiled bedding on a regular basis and handle appropriately to prevent fly infestation and disease transmission.

Manure Storage and Treatment – the options:

- Stockpiled - Manure is removed daily and stored in piles.
- Composted - Manure is removed daily and composted
- Daily land application - Manure is removed daily and spread on cropland.

Stockpiling.

Manure is commonly stockpiled prior to use. Adequate storage area allows for greater flexibility in timing of manure use. Therefore, be sure you have a large enough storage area to accommodate the manure produced. Over time, the manure shrinks from decomposition and moisture loss.

Proper site selection for the storage area is important to safeguard against surface and groundwater contamination.

- Place stockpiles at least 150 feet away from surface water (creeks and ponds) and wells.
- Establish and maintain grass buffer strips between water bodies and manure piles.
- Construct a perimeter ditch or berm around the storage area, if needed, to prevent runoff onto or off of the area.

Composting:

- Produces a relatively dry end-product that is easily handled.
- Reduces the volume of the manure (40 percent to 65 percent less volume and weight than the raw manure).
- At proper temperature, kills fly eggs and larvae, pathogens and weed seeds.
- Has less of an odor compared to raw manure and is more easily marketed.
- Produces manure that acts as a slow release fertilizer and an excellent soil conditioner.

To be done right, composting requires an investment of time and money. Machinery required includes a tractor, a manure spreader and a front-end loader. Some ammonia-nitrogen is lost during the composting process, and an ammonia odor may result for a short period. When composting is done on a large scale, additional land and machinery requirements exist.

The Composting Environment:

Microbes that drive the composting process require optimum conditions of

- Temperature - When microbes work properly, the compost temperature will be between 120 and 160 F. Cooler temperatures result from a lack of N. When the composting process is complete, the temperature will cool naturally.
- Moisture – The compost should be moist but not soggy, and may need to be watered or covered with plastic to maintain moisture.
- Oxygen - Aerate the compost by turning it regularly.
- Carbon:nitrogen (C:N) ratio. The C:N ratio should be between 25:1 and 30:1; horse manure has an estimate C:N ratio of 50:1. With the addition of bedding material (high carbon content), the C:N ratio will be even higher. Therefore, N has to be added to the manure for it to compost properly. The addition of grass clippings, hay, or fertilizer 125 to 30 pounds N/ton of manure (75 to 90 pounds of ammonium nitrate or 50 to 65 pounds of urea) should bring the C:N ratio into the optimum range. The manure and bedding particles should be about one-half inch to one and a half inches in size.

Composting does require effort, but the result is a more easily used and economically valuable fertilizer!

Utilization - Land Application

- **Manual vs. mechanical processes -** Manual loading and land application are labor intensive and impractical for managing the manure generated by more than 25 horses. Consider mechanical loading and application with a bobcat or tractor-operated loader when the manure or the land application becomes large.
- **Protect water supplies -** Do not apply manure to land that is highly erodible, frozen or saturated. To protect water sources from manure runoff, do not spread manure within at least 150 feet of a water source (such as a well, creek, or pond).
- **Avoid nutrient loss/ reduce odors -** Incorporate manure into the soil as soon as possible. Incorporating manure (mixing the manure with the soil) immediately reduces losses of manure nutrients to runoff and volatilization, and reduces odor problems associated with manure left on the soil surface.
- **Apply at the proper rate -** Base the manure/compost application rate on crop N needs and available soil and manure N levels. Test your soil and manure for N levels at a certified laboratory (maybe we could find a list of the certified laboratories that we could link to here?).

In general, the higher a crop yield goal, the greater the N needs. Irrigated crops also tend to need more N. If yield goals are lower than those shown in Table 2, decrease the manure application rate and increase the land application area. Soils high in organic matter and nitrate have higher available N in the soil and require less N fertilizer or manure to achieve maximum yields.

Table 2. Average manure application rates and land base (area) requirements for forages.

Forage	Yield (tons/acre)	Annual Horse Manure Application (tons/acre)	Land Base Needed (acres/horse/yr)
Alfalfa 4	30	0.3	0.4
Alfalfa-grass	4	20	0.4
Bentgrass	2	21	0.9
Big bluestem	3	10	0.4
Birdsfoot trefoil	3	25	0.5
Bluegrass	2	19	0.5
Bromegrass	3	19	0.8
Little bluestem	3	11	0.5
Orchardgrass	4	20	0.4
Red clover	3	20	0.5
Reed canarygrass	4	18	0.4
Ryegrass	4	22	0.4
Switchgrass	3	12	0.8
Tall fescue	4	26	0.3
Timothy	3	12	0.8
Wheatgrass	1	5	1.9

The land base needed is the cropland requirement for manure application alone, not for grazing and forage needs.

One ton = 2,000 lbs.
One acre = 43,560 sq ft.

- **Distribute evenly -** Apply the manure/compost uniformly to achieve an acceptable application rate. The finer textured and more uniform the manure, the easier it is to apply uniformly. Spreaders apply manure/compost at different rates depending on ground speed, PTO speed, gear box settings, discharge openings, and manure moisture and consistency.
- **Keep Records -** Record keeping is an essential factor in land application of manure/compost. In some states, manure land applications (plant nutrient management) records must be kept for possible audit by state or local regulatory authorities. It is critical to know how much

manure/compost was applied to each field and when it was applied. Analyze manure/compost regularly and record the lab results for future reference. Note changes in nutrient value and factor them in when calculating future application rates.

Landfill.

Manure and compost are sometimes landfilled, dumped in gullies and used to repair roads. These are not recommended practices due to high runoff and leaching potential from gullies and roadways. If the areas are not vegetated and are waterways for storm runoff, the potential for runoff of manure nutrients into creeks and ponds is high. When excessive nutrients exist in surface waters, plant and algae growth becomes extreme, the oxygen supply is depleted, and fish can be killed.

Footing for Riding Arenas. An ideal arena surface provides resilient footing for optimum horse performance. The arena surface must be well drained, maintain adequate depth to protect horses' legs from contusions, keep the arena absorbent to hold moisture efficiently, moist enough to prevent dust and be odor-free. Composted manure/bedding makes an ideal surface addition when mixed with river sand and wood products. (**Uncomposted manure and bedding should not be used since it produces ammonia fumes that can cause respiratory problems in horses!)** Surface depth of compost depends on soil type and climate; too much organic matter can hold excess moisture and may cause the horses to slip and fall.

Marketing Plan (watermark $$$)

Horse owners have a responsibility to manage the manure that is a byproduct of their industry. Develop a management plan for manure and soiled bedding. Use it on croplands, arena surfaces, trail surfaces, and landscaping. If you can't use the manure yourself, develop a marketing plan so others can make use it.

Here are a few ways you might market your composted manure.

- Establish a contract to sell or donate compost to crop farmers, nurseries, community landscapers, parks, or neighborhood gardeners.
- Offer a discount to boarders if they dispose of manure.
- Market to the people who come to watch others ride.
- Deliver manure (usually at your cost) to a site where contractors do the composting. You will want to find out in advance the preferred bedding types in their compost mix.

Before you can market the product, it must be completely and properly composted and free of foreign material such as pop cans, wire, and needles!!!!

Manure Precautions

Disease Transmission. Virtually no viral diseases are transmitted between horses and humans through fecal material, but some bacteria and protozoans (such as *E. coli* and *Giardia*) can be transmitted. Therefore, handle manure carefully to prevent disease transmission. In addition, horse manure runoff into waterways may produce fecal coliform contamination levels that can potentially be hazardous to fish and anyone who drinks the untreated water.

Runoff. Runoff water from Paddocks, Holding Pens, Corrals, pastures, and manure storages or compost areas carries pollutants (such as nitrogen, phosphorous, and bacteria) into surface waters. Build berms or trenches around Paddocks, Holding Pens, Corrals or manure storage areas to prevent water from entering or leaving the area.

Parasite Prevention and Control. Horses pick up parasites by ingesting grass, feed, or water that is contaminated with parasite larva and eggs. The most common internal parasites of horses are the ascarids, strongyles (large and small), pinworms and bots.

- Deworm all horses on a regular schedule using an anthelmintic. Contact your local veterinarian for anthelmintic recommendations.
- Don't feed on the ground. Use feeders, racks, bunks or mangers for feeding hay and grain. This will prevent feed from getting mixed with feces.
- Provide horses a clean, fresh supply of drinking water.

Insect Control. Excellent fly-breeding conditions occur in mixtures of manure, spilled feed and decaying bedding. To help eliminate these areas, remove and spread the manure regularly and prevent accumulation of other wastes. Composting at proper temperatures inhibits fly development. Several pesticides can be used on manure piles to kill maggots. Cover manure stockpiles or compost sites to exclude flies and prevent their development.

Non-composted manure piles can provide an ideal environment for the bumble flower beetle. White grubs feed on decaying matter and are often found in manure. However, these grubs do not damage home lawns so control is not necessary.

Mosquitoes require standing water to produce; therefore, it is imperative to prevent ponding of water in manure storage areas.

Salinity. Manure tends to be high in salts, which when land applied at excessive rates, contribute to soil salinity. Soil salinity causes plants to become water stressed or, in extreme cases, die. When manure is not soil-incorporated, as in applications to pasture, the salts accumulate on the soil surface unless they are leached into the subsoil. Irrigation or rainfall may move salts out of the topsoil and move them into deeper depths of the soil profile. If salinity levels in the soil and manure are known, use Table 3 to determine acceptable maximum rates of manure applicable for most forages to avoid excessive soil salinity.

Table 3. Maximum manure application rates to avoid soil salinity problems.			
Manure EC	Soil EC (mml~/cm)		
(Mmhos/cm	1	2	3
10 20 30 40	84 T/A 30 T/A 18 T/A 12 T/A	56 T/A 20 T/A 12 T/A 8 T/A	28 T/A 10 T/A 6 T/A 4 T/A

T = ton; A = acre ; EC = electrical conductivity measured in units of millimhos/centimeter.
Note: The manure application rate should be based on N needs of the crop within this maximum range. (This table assumes that manure is not incorporated, which is typical for perennial forage crops).

Weeds: A weed is an unwanted, or out of place plant. Weeds compete with crops for limited resources such as water, nutrients and light. Manure has been a major contributor to weed problems where it has been applied to cropland. Use composted manure to avoid these problems. When manure is composted, the high temperatures achieved during the composting process kill most weed seeds. In pastures, weed infestations may be the result of overgrazing rather than manure applications.

Stabled/Confined Manure Management Tips:

1. Remove all manure from stalls, small corrals, and paddocks on a daily basis.

2. Compost all manure to a temperature of 145 F for at least two weeks to kill most parasite eggs, or compost at lower temperatures for longer periods of time.

3. Spread manure on pastures only after composting.

4. Manure that has not been composted should be spread only on cropland or other ungrazed, vegetated areas.

References:

Follett, R.H., and R.L. Croissant. 1990. .549, Use of manure in crop production. Colorado State University Cooperative Extension

Spencer, W., and D. Tepfer. 1993. 3.762, Economics of composting feedlot manure. Colorado State University Cooperative Extension.

Wilson, C.R., and J.R. Feucht. 1996. 7.212, Composting yard waste. Colorado State University Cooperative Extension.

National Animal Health System, Highlights of Equine '98 Study Results: Part III, USDA:APHIS:VS Center for Epidemiology and Animal Health, Fort Collins, CO.

Author Contact Information:

Dr. Ann M. Swinker
Cooperative Extension Horse Specialist and Associate Professor
Penn State University Department of Dairy and Animal Sciences
309 Agricultural Sciences & Industries Building
University Park, PA 16802
Phone: 814-865-7810
E-mail: aswinker@das.psu.edu