Horse Manure Issues and Management

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Manure Production and Management
Horse Manure Production

- Manure – 9.1 tons / 1000 lb / year
- Bedding – 1.5 to 2.7 tons / 1000 lb / year
- Total – 11 to 12 tons / 1000 lb / year
- Volume – 94 cubic feet / ton
  - A typical 6’ pickup bed holds ~60 cubic feet
- Total Volume – 1,000 to 1,150 cubic feet / 1000 lb / year

(Sources: John Chastain, Ph.D.; Hudson, 1994; NRCS; Wheeler, 2006)
## Manure Comparison

<table>
<thead>
<tr>
<th>Manure Type</th>
<th>PAN (lb/ton)</th>
<th>P$_2$O$_5$ (lb/ton)</th>
<th>K$_2$O (lb/ton)</th>
<th>Fertilizer Equiv.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh Horse</td>
<td>11.2</td>
<td>4.6</td>
<td>9.2</td>
<td>0.5 - 0.2 - 0.4</td>
</tr>
<tr>
<td>Horse w/ Bedding</td>
<td>13.5</td>
<td>4.5</td>
<td>13.5</td>
<td>0.6 - 0.2 - 0.6</td>
</tr>
<tr>
<td>Dairy</td>
<td>10</td>
<td>8</td>
<td>14</td>
<td>0.5 - 0.4 - 0.7</td>
</tr>
<tr>
<td>Broiler</td>
<td>45</td>
<td>69</td>
<td>46</td>
<td>2.2 - 3.4 - 2.3</td>
</tr>
<tr>
<td>Layer</td>
<td>35</td>
<td>64</td>
<td>39</td>
<td>1.7 - 3.2 - 2.0</td>
</tr>
</tbody>
</table>
## Amount of Manure required

<table>
<thead>
<tr>
<th>Crop</th>
<th>N Req’d</th>
<th>Fresh Manure</th>
<th>With Bedding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bermuda Pasture</td>
<td>150 lbs/ac</td>
<td>13.4 ton/ac</td>
<td>11.1 ton/ac</td>
</tr>
<tr>
<td>Fescue Pasture</td>
<td>100 lbs/ac</td>
<td>8.9 ton/ac</td>
<td>7.4 ton/ac</td>
</tr>
<tr>
<td>Annual Rye</td>
<td>120 lbs/ac</td>
<td>10.7 ton/ac</td>
<td>8.9 ton/ac</td>
</tr>
</tbody>
</table>

BUT not all of this N is available the first year.
How Much N is Available?

• According to Wheeler and Zajaczkowski, 1997, Manure with bedding:

\[ \text{PAN} = \text{OA}_f \times \text{Organic-N} \]

• Year one: \( \text{OA}_f = 0.2 \)
• Year two: \( \text{OA}_f = 0.5 \)
• Year three: \( \text{OA}_f = 0.25 \)
• Year four: \( \text{OA}_f = 0.13 \)
• (Organic-N \( \approx 0.71 \times \text{Total N} \))
Example

- Total N = 13.5 lb/ton
- Organic N = 13.5 x 0.71 = 9.6 lb/ton
- If we apply 10 tons per acre one year:
  - 10 tons x 9.6 lb/ton = 96 lb Org-N/acre
    - Year 1 – 0.2 x 96 = 19 lb N/acre
      (plus 39 lb NH4-N / NO3-N)
    - Year 2 – 0.5 x 77 = 38.5 lb N/acre
    - Year 3 – 0.25 x 38.5 = 9.2 lb N/acre
    - Year 4 – 0.13 x 29.3 = 3.8 lb N/acre
- 109.5 lbs of N potentially utilized – about 81% of total N over a 4 year period
Limited N Availability

• With only 20% of the organic-N available the first year we need to think of management
• Supplementing with 34-0-0 is the obvious choice
• Manure provides organic matter and some of the crop N requirement
Nitrogen Available from Multiple Year Applications
(10 tons per acre per year, bermuda pasture)

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Total</th>
<th>34-0-0 Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>19+39</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>58</td>
<td>270</td>
</tr>
<tr>
<td>38.5</td>
<td>19+39</td>
<td>---</td>
<td>---</td>
<td>96.5</td>
<td>157</td>
</tr>
<tr>
<td>9.2</td>
<td>38.5</td>
<td>19+39</td>
<td>---</td>
<td>105.7</td>
<td>130</td>
</tr>
<tr>
<td>3.8</td>
<td>9.2</td>
<td>38.5</td>
<td>19+39</td>
<td>109.5</td>
<td>119</td>
</tr>
</tbody>
</table>
Multiple Year Cautions

• After 4 years the manure would be providing approximately 110 lbs of nitrogen each year
• Applying 10 tons of manure per acre for 4 years is a good bit of organic matter, but not unheard of (i.e., some municipal sludge applications)
• You may find the 10 ton per acre rate for multiple years, even though possibly beneficial from a nitrogen standpoint, is impractical due to soil compaction from many spreading equipment trips (depending on equipment type)
Complications – C:N Ratio

• Horse manure has a high C:N ratio
  – Fresh manure – C:N ratio = 19
  – Bedded Manure – C:N ratio = 20 to 50

• High C:N ratios (above 12) will **immobilize nitrogen** into organic forms, which are unavailable to the plants

• Fresh horse manure makes N **unavailable** to the crop
Crop Stunting

- Soil microbes use soil N to break down the bedding carbon
- This can result in crop stunting or reduced yield
- Adding 10 lbs of 34-0-0 or 21-0-0 per ton helps alleviate the stunting problem, before or after spreading (but much more would be needed for actual fertilization)
Composting Horse Manure
Why Compost?

• Provides a stable, low-odor product
• Does not tie up N in the soil
• Rich in organic matter
• Composting kills pathogens and weed seeds
• Composting kills parasite eggs
• Prevents crop stunting due to composting in-field
Compost Disadvantages

• Only about 12% of the Organic-N is mineralized for plant use

• $P_2O_5$ is 25% to 40% available (instead of 80% to 100% available in fresh manure)

• May need some facility

• Needs turning & labor for high quality

• Market (if needed)?
Composting

- Most horse manure has the optimum C:N ratio for composting (25-30)
- May need to add a bulking agent for void spaces for aeration

<table>
<thead>
<tr>
<th>Carbon-to-nitrogen ratio</th>
<th>Composting range</th>
<th>Horse manure range</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Range 20-40:1</td>
<td>Range 20-50:1</td>
</tr>
<tr>
<td>Preferred</td>
<td>25-30:1</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>30:1</td>
<td></td>
</tr>
</tbody>
</table>
Compost Moisture

• 50-60% moisture is recommended
  – rule of thumb: material appears and feels wet, but does not drip when squeezed
  – higher moisture content can lead to odors, leaching and poor processing

<table>
<thead>
<tr>
<th>Moisture content</th>
<th>Composting</th>
<th>Horse manure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range 40-65%</td>
<td>Preferred 50-60%</td>
<td>Range 40-80%</td>
</tr>
<tr>
<td>Average 72%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Courtesy Dr. Gary Heusner, University of Georgia
Composting

• Requires management and work
• Relies on oxygen; turning accelerates process
• Temperature should be monitored
• Moisture needs to be monitored

Courtesy Dr. Gary Heusner, University of Georgia (edited)
Composting

- Composting can be done in:
  - Vessels: similar home garden examples; small batches only
  - Covered bins: greater capacity, best storm water protection
  - Outdoor piles or windrows: greatest capacity; requires stormwater & run-off protection
Siting Compost Location

- Well drained high ground
- Storm water diversions
- All weather access for necessary equipment
- Isolated from:
  - water sources (surface, wells, env. sensitive areas)
  - live production areas
  - neighbors
  - public view/roads

Courtesy Dr. Gary Heusner, University of Georgia
Composting

• Horse manure will normally take four to six months to compost.

• Well managed piles can compost in two months.
Composting Temperatures

Three phases:

a. Short warm-up to 105 °F

b. Hot composting phase to 110 to 150 °F
   - 122 °F internal parasites
   - 135 °F pathogens
   - 145 °F weed seed
   - 160 °F microorganisms (!)

c. Cool curing phase, less than 105 °F

Courtesy Dr. Gary Heusner, University of Georgia
Compost Row

• Make sure material is reasonably mixed
• Apply layers to site
  – Ideal time to mix in fertilizer or add H₂O if needed
  – 4 or 5 foot base and 3 to 4 feet tall
  – Size can be dictated by equipment
• Pyramidal shape; build row down over time
Compost Turning

- Releases heat and gases
- Bulks up and oxygenates pile
- Mixes materials
- Allows for outer material to compost

Bucket Loader

Specialized Turner: large and commercial operations

Courtesy Dr. Gary Heusner, University of Georgia
Compost Turning

• **Timing**
  – Based on microbial activity
  – When core temperature drops below 120
  – May take a few days to a week or more between turns

• **Work down row turning material in sequence as it was added**

• **After a few turns:**
  – If material appears consistent, allow to cool or cure for up to a month
  – If not, turn again allow to reheat
Compost Thermometer

Reotemp® Compost Thermometers

SKU: 89112  Availability: In Stock  Specs: 

Qty: 1  Add To Cart

Price: $69.95

Size: 36”L x 1/4” dia. stem

Clear 3” diameter dials are easy to read and hermetically sealed so they will never fog over. Sensitive bi-metal helix in bottom of pointed stem gives accurate reading to ±1% of scale. Rugged stainless steel construction.

Specifications
Temperature Range: 0°F to 200°F
Graduations: 2°F
Accuracy: ±1% full scale
Dial: 3” dia.
Uses for Manure and Compost

• Manure and Compost: land apply
  – Pastures
  – Crops
  – Lawn, landscaping and garden uses

• Manure and Compost: export
  – Sell
  – Give away

• Compost: arena footing
  – Mix with sand or other non-organic material
  – Must be well composted
Uses for Manure and Compost

• Be aware of drugs, herbicides and pesticides that may persist in manure; potential liability and danger for:
  - some lawn, landscaping and garden uses
  - organic production

• Specific examples:
  - Picloram
    - name brand: Grazon
    - control of woody and herbaceous weeds
  - Aminopyralid
    - Name brand: Grazon Next; Forefront
  - Horse manure from grazing of treated pasture has killed garden plants
  - Feeding hay from treated fields is also an issue

Courtesy Dr. Gary Heusner, University of Georgia (edited)
Compost Bin Sizing
Figure 8-9  Continuous composting bin construction for one to three horse stalls.

Based on *Composting System for Small Horse Farms*, F-1729, Oklahoma Cooperative Extension Service.
<table>
<thead>
<tr>
<th>No. of stalls</th>
<th>No. of bins</th>
<th>Length of bins (feet)</th>
<th>No. of posts</th>
<th>No. &amp; length of fence rolls</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 3</td>
<td>1</td>
<td>18</td>
<td>8</td>
<td>One 50’ roll</td>
</tr>
<tr>
<td>3 to 5</td>
<td>1</td>
<td>30</td>
<td>12</td>
<td>One 75’ roll</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>18</td>
<td>16</td>
<td>Two 50’ rolls</td>
</tr>
<tr>
<td>7 to 8</td>
<td>2</td>
<td>30</td>
<td>24</td>
<td>Two 75’ rolls</td>
</tr>
<tr>
<td>9</td>
<td>3</td>
<td>18</td>
<td>24</td>
<td>Three 50’ rolls</td>
</tr>
</tbody>
</table>

Courtesy Dr. Gary Heusner, University of Georgia
Other Compost Structures
Manure and Compost Application
Applying Manure or Compost

- Manure should be applied based on nutrient requirements of the crop
- Applying manure thinly and allowing it to dry is thought to help alleviate parasite issues
- Applying manure thinly in wet, cool climates may not have any impact on parasites
Applying Manure or Compost

• Applying manure thinly exposes more of the manure surface to ultraviolet radiation, which can help destroy pathogens and diseases

• Completed, cured compost should have no diseases or parasites – applications can be thicker or thinner
Small Spreaders are available

(Images courtesy University of Rhode Island Healthy Landscapes)
Spreading manure piles has long been thought to be a good practice because:

- Spreading manure piles helps distribute the nutrients in the manure more evenly.
- Spreading manure piles breaks them up to allow them to dry.
- Spreading manure piles exposes more of the manure surface to ultraviolet radiation.
However.....

- Some popular discussion suggests that spreading manure piles may also spread any parasites in the manure over a larger grazing area.
- Horses do not seem to graze readily where fresh manure is present.
Spreading Manure Piles

• The best time to spread manure piles would be when the temperatures are warm, the days will be sunny, and there will be no rain for a period of time.
• This allows them to dry, helping alleviate some parasite pressure, and allows time for UV to kill any pathogens.
Spreading Manure Piles

• Spreading manure piles during rainy, cloudy, or overcast time periods will spread nutrients, but may increase parasite or pathogen issues.

• Attempting to spread manure piles over deep forage may be an exercise in frustration.....!
Pasture Drags

NorTrac Harrow Rake for Cleaning, Leveling Soil and Stimulating Growth — 4ft.W x 7 1/2ft.L

Item# 42016

5 Stars

Only $199.99

1

Add to Cart

In Stock Online

View Shipping + Delivery Estimates

Check Store Availability
Pasture Drags

This drag is used to help create soil contact and a slight amount of cover when broadcasting clovers, but a modified version with smaller tires may work in a pasture for manure pile leveling.
Pasture Drag SAFETY

• Chain-link style drags usually have few issues due to their flexibility
• If a solid-type drag is used, much care should be directed toward its use
• Solid-frame drags pulled with cables or chains can catch on clumps and flip toward the tractor or ATV, causing injury
• Using an old gate or pallet with a chain or cable is not a good idea!
Safety Comes First!

- A private airport manager used this drag to smooth his field in 2013
- Chains connected to the top front of the drag were attached to the tractor
- An obstruction caused it to flip over, hitting the driver in the head.

https://www.cdc.gov/niosh/face/pdfs/13mi102.pdf
Regulations and Laws
Regulations and Laws

• R.61-43 Standards for the Permitting of Agricultural Animal Facilities (June 28, 2002)

• On the web: http://www.clemson.edu/camm
Manure Utilization and Storage

• Manure must be applied at agronomic rates (i.e., nutrient requirement only)
• Manure cannot be applied to water saturated land, frozen land, or snow-covered land
• Manure may not be applied within 300 feet of a residence or 100 feet of a water body
Manure Utilization and Storage

- Manure may not be applied within 50 feet of ditches or swales
- Manure may not be applied within 100 feet of a well
- Manure stacked or stored for more than 3 days must be covered (tarps work fine, but must have a hole for venting)
Manure Application Times

- Manure is best applied when some wind is moving – mixing helps disperse the odor.
- Friday may not be the best time, especially if the neighbor is planning an outdoor event.
- Morning applications may be better than evening applications.
Confined Animal Facilities

• A confined animal facility is defined as a facility where animals are confined for 45 days in a calendar year (note this does not say consecutive days)
Confined Animal Facilities

• Any confined animal facility with less than 10,000 lbs average live weight must have a waste management plan

• Any confined animal facility with between 10,000 and 30,000 lbs average live weight must have a waste management plan and submit a copy of that plan to SCDHEC
Confined Animal Facilities

- Any confined animal facility with **more than 30,000 lbs** average live weight must have:
  - A waste management plan
  - A waste management permit from SCDHEC
  - Certification through the Confined Animal Manure Manager Program (CAMM)
Vector Facts

- One pound of manure can generate 100 to 1,000 flies
- Mice may enter a building through a 1/4 inch hole, rats through a 1/2 inch hole
- Softwood doors are no barrier to mice
- A 3 foot wide gravel area 3 inches deep around a building and a clean landscape are good deterrents to mice
References


References

• Composting Horse Manure, North Carolina State University Extension.

• NRCS, AWNFH. Chapter 4.


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