

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

Manure type	PAN lb/ton	P ₂ O ₅ lb/ton	K ₂ O lb/ton	Fertilizer Equiv.
Fresh Horse	11.2 <i>(Total N)</i>	4.6	9.2	0.5 - 0.2 - 0.4
Horse w/ Bedding	13.5 <i>(Total N)</i>	4.5	13.5	0.6 - 0.2 - 0.6
Dairy	10	8	14	0.5 - 0.4 - 0.7
Broiler	45	69	46	2.2 - 3.4 - 2.3
Layer	35	64	39	1.7 - 3.2 - 2.0

Amount of Manure required

Crop	N Req'd	Fresh Manure	With Bedding
Bermuda Pasture	150 lbs/ ac	13.4 ton/ac	11.1 ton/ac
Fescue Pasture	100 lbs/ac	8.9 ton/ac	7.4 ton/ac
Annual Rye	120 lbs/ac	10.7 ton/ac	8.9 ton/ac

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:

$$PAN = OA_f \times \text{Organic-N}$$

- Year one: $OA_f = 0.2$
- Year two: $OA_f = 0.5$
- Year three: $OA_f = 0.25$
- Year four: $OA_f = 0.13$
- (Organic-N $\approx 0.71 \times$ Total N)

Example

- Total N = 13.5 lb/ton
- Organic N = $13.5 \times 0.71 = 9.6$ lb/ton
- **If we apply 10 tons per acre one year:**
- $10 \text{ tons} \times 9.6 \text{ lb/ton} = 96 \text{ lb Org-N/acre}$
 - Year 1 – $0.2 \times 96 = 19 \text{ lb N/acre}$
(plus 39 lb NH₄-N / NO₃-N)
 - Year 2 – $0.5 \times 77 = 38.5 \text{ lb N/acre}$
 - Year 3 – $0.25 \times 38.5 = 9.2 \text{ lb N/acre}$
 - Year 4 – $0.13 \times 29.3 = 3.8 \text{ lb N/acre}$
- **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)

Year 1	Year 2	Year 3	Year 4	Total	34-0-0 Needed
19+39	---	---	---	58	270
38.5	19+39	---	---	96.5	157
9.2	38.5	19+39	---	105.7	130
3.8	9.2	38.5	19+39	109.5	119

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

	Composting	Horse manure
Carbon-to-nitrogen ratio	Range 20-40:1 Preferred 25-30:1	Range 20-50:1 Average 30:1

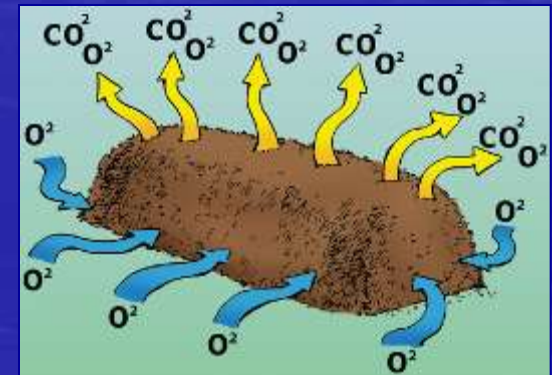
Compost Moisture

- 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

	Composting	Horse manure
Moisture content	Range 40-65% Preferred 50-60%	Range 40-80% Average 72%

Composting

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



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

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

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

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



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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

Compost Bin Sizing

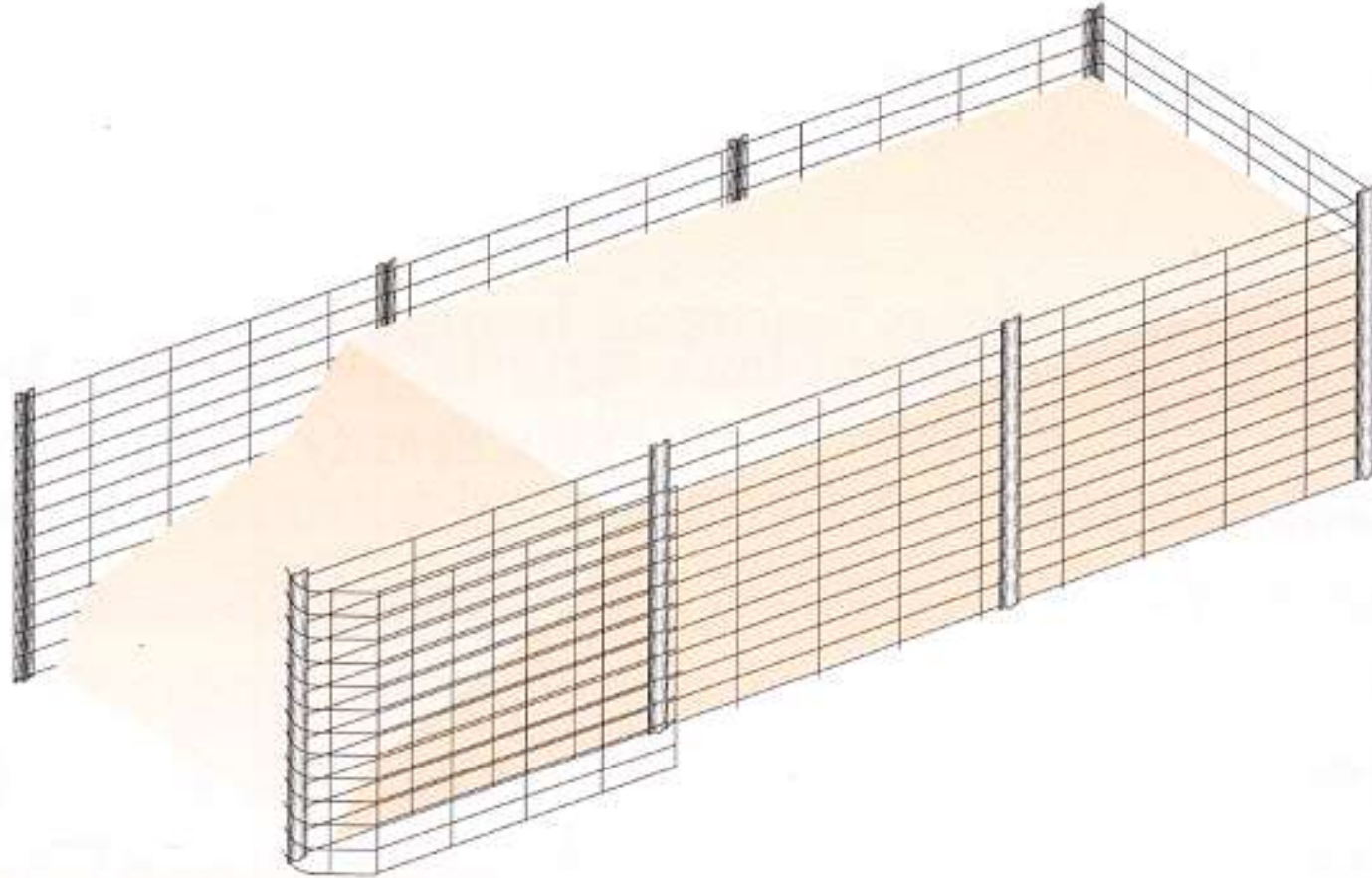


Figure 8-9

Continuous composting bin construction for one to three horse stalls.

Based on *Composting System for Small Horse Farms*, E-1729, Oklahoma Cooperative Extension Service

No. of stalls	No. of bins	Length of bins (feet)	No. of posts	No. & length of fence rolls
1 to 3	1	18	8	One 50' roll
3 to 5	1	30	12	One 75' roll
6	2	18	16	Two 50' rolls
7 to 8	2	30	24	Two 75' rolls
9	3	18	24	Three 50' rolls

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

- Spreading manure piles in the pasture has long been thought to be a good practice
- 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



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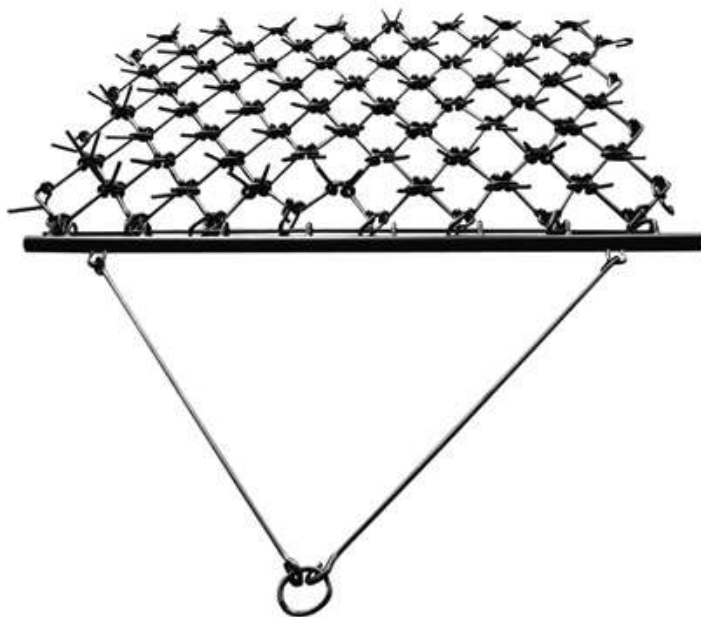
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Pasture Drags



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

(Image courtesy University of Arkansas)

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.



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

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