A Few Surprises: What Are the Best Recipes for Composting Large Bovine Carcasses in the Southern High Plains?

Brent W. Auvermann, Texas A&M University System
New Mexico/Texas Dairy Highlights
Clovis, NM

A Few Relevant Lessons
(Special thanks to the Taiwanese)

- Left to their own devices, large, intact carcasses will rot from the inside out
- Rotting carcasses generate lots of nasty gases
- Intact skin makes a decent balloon
- The larger the carcass, the more spectacular the failure

You've Got Other Options

- Burial (tut, tut)
- Incineration (fuel $$$, air quality regs)
- Biological and chemical digestion
- Pitch 'em out back

The ABCs of Messing Up a Compost Pile

Do Bacteria Really *Have* Knees?

- Screwing it up means *cutting off the thermophilic aerobes at the knees*
  - Imbalanced diet
  - Not enough insulation
  - Too much water (or not enough)
  - Not enough air (or too much)

Atkins™ vs. South Beach™

- Target carbon-to-nitrogen ratio (C:N) of 30.00000:1

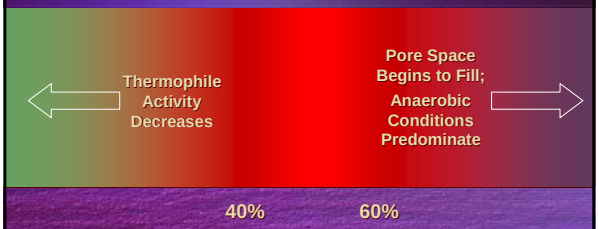
10 30 50

- Low-carb diet favors NH_3 release
- *Conventional wisdom: don't stray too far from 30:1*

Air and Water

1. Screwing up a pile means getting air and water out of proper balance
2. Water displaces air in a pile
3. Too wet goes anaerobic; too dry goes dormant
4. Too wet = >60%; too dry = <35%

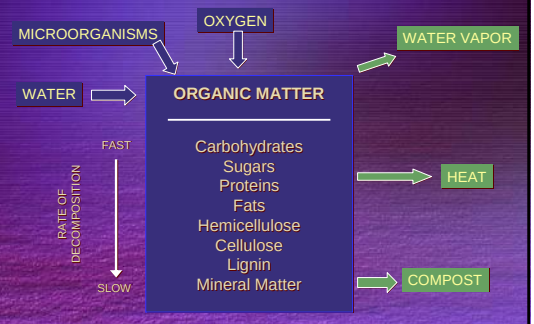
Optimal Moisture Conditions



Some Like it Hot

- The cooler the pile, the easier the screw-up
- Small piles can't insulate themselves
- Oversized piles reduce O_2/CO_2 transfer
- Optimal pile size depends on the distribution of pore sizes

So…how might we *mess up* a compost pile?



C:N Ratios of Some Carbon Sources

Feedstock	N (%db)	C:N Ratio	C (%db)
Fruit wastes	1.5	35	52.5
Yard wastes	1.3	23	29.9
Paper	0.3	173	51.9
Sawdust	0.1	511	51.1
Grass clippings	3.7	15	55.5
Leaves	0.9	48	43.2
Produce waste	2.2	20	44.0
Food wastes	3.2	16	49.9
Pine wood shavings	0.1	723	72.3
Oat straw	1.1	48	52.8
Wheat Straw	0.3	128	38.4

Tool Time™

- Carbon-rich materials
  - Variety of pore sizes
  - Total C is not the same thing as available C
- Big, heavy, exhaust-belching machines
- Reliable water source
- Long-stemmed thermometer
- Weaponry

Building for Failure

- Site selection
  - Right next to the road (or the mayor's house)
  - Bare, sandy soils
  - Sheltered from the wind
- Base material
  - Hydrophobic
  - Thin
  - Easily compressed

Nature Can Help You Blow It

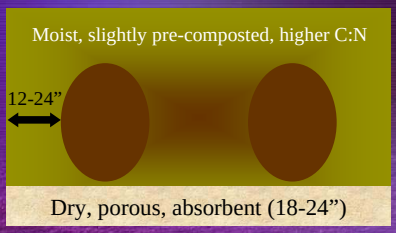
- Rain, snow and cold are the enemies
- Easterners and Southerners have one set of concerns
- Westerners have another
- Northerners have still another
- To shed or not to shed?

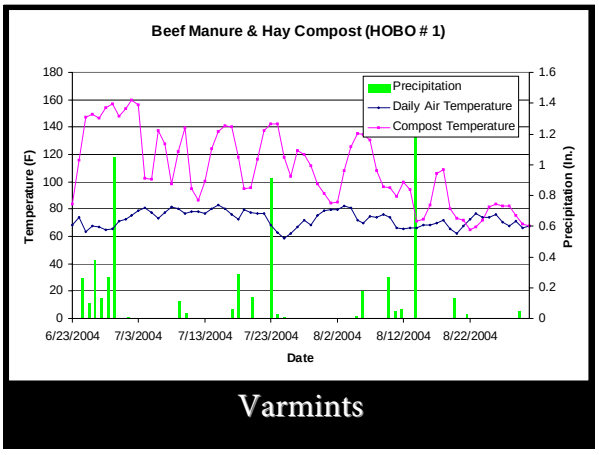
Failure Is an Option

Failure 101

- Choose a location with bare, sandy soil, nearby surface water and cozy neighbors
- Use whatever nasty waste materials you have on hand
- Soak 'er good
- Show off those (livestock) body parts
- Walk away

"Ideal" Carcass Pile

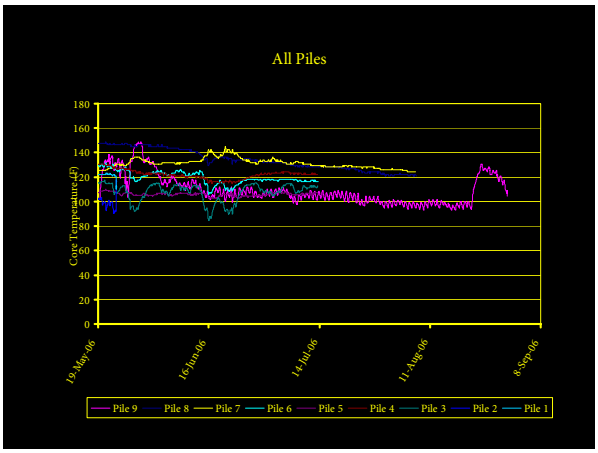


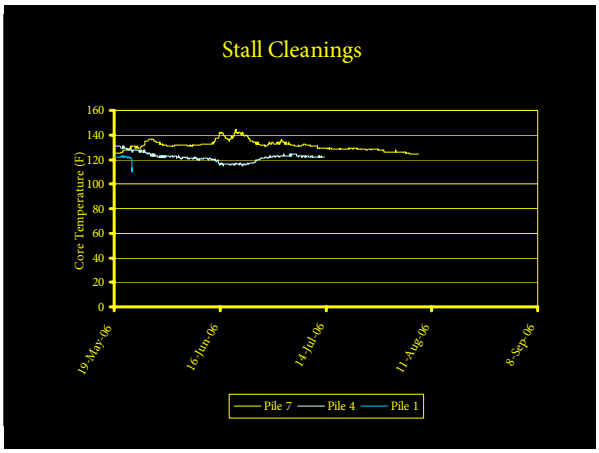


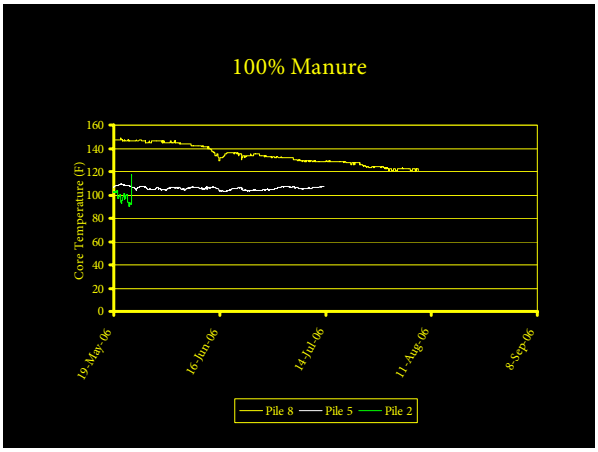
Varmints

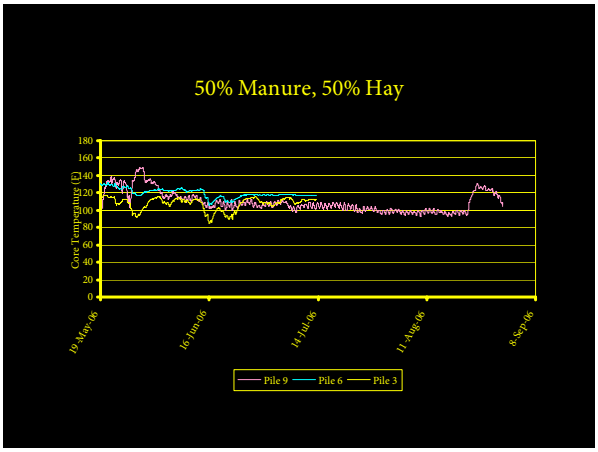
Equine Case Study

- Dr. Lance Baker and Ms. Laurie Brown, WTAMU
- 3 Treatments x 3 Replications
  - Beef feedlot manure only
  - Feedlot manure + hay
  - Horse manure/wood shavings (stall cleanout)
- Low-Ash Manure from Paved Pens
- Carcasses Slightly Smaller than Mature Dairy Cattle (900-1200 lb/hd)
- Interim Data (3 mos.) Only; 6-mo. Data Pending



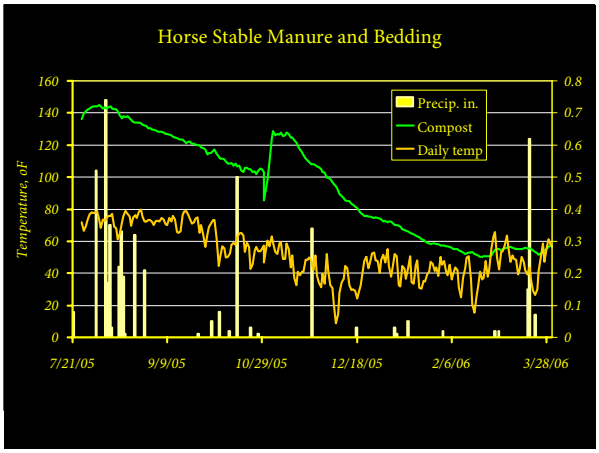


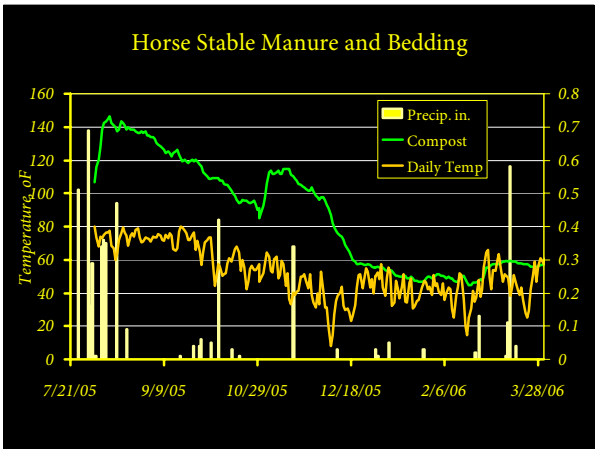


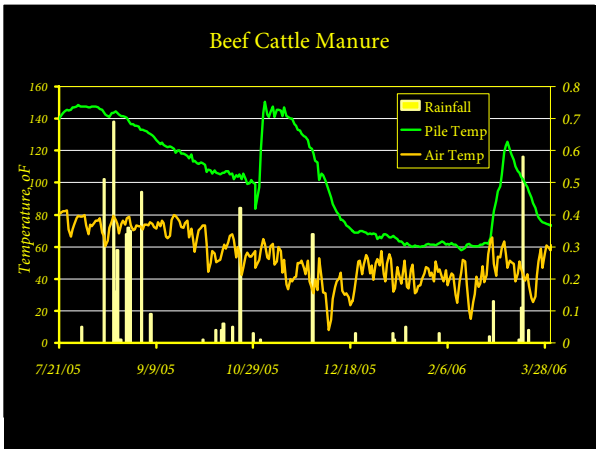


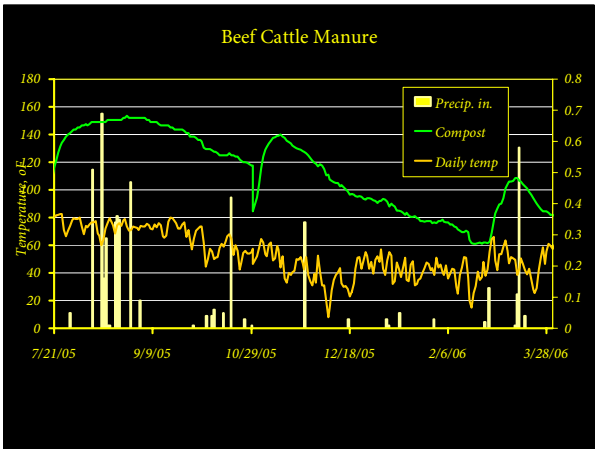
Beef Cattle Case Study

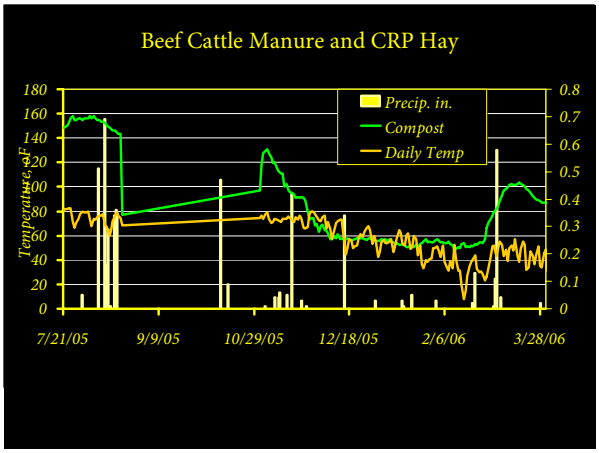
- 4 Treatments x 2 Replications
  - Beef feedlot manure only
  - Feedlot manure + hay
  - Horse manure/wood shavings (stall cleanout)
  - Horse manure/shavings + feedlot manure
- Low-Ash Manure from Paved Pens
- Smaller Carcasses (400-1000 lb/hd)

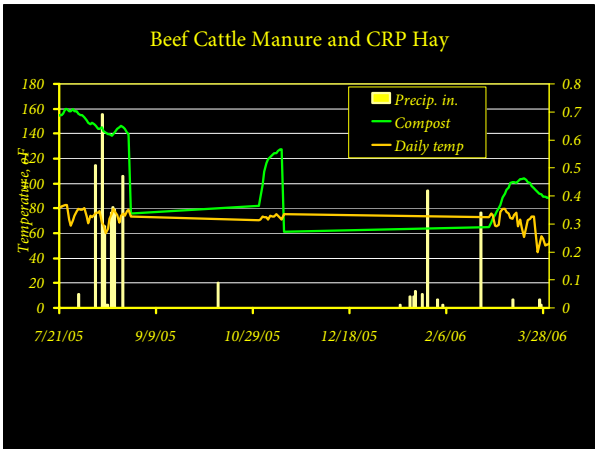


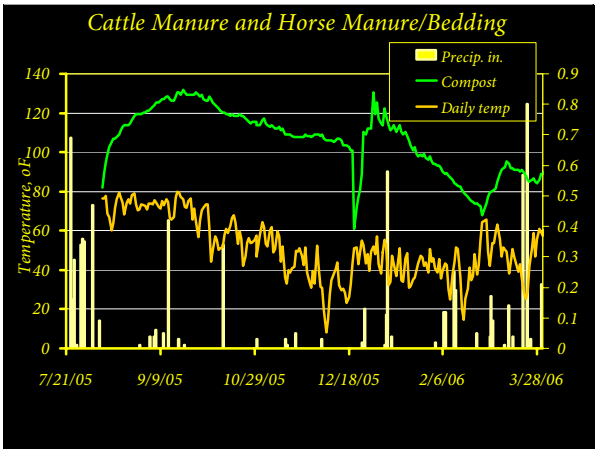

Horse Stable Manure and Bedding
Precip. in.
Compost
Daily Temp
Temperature, oF
160
140
120
100
80
60
40
20
0
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
7/21/05
9/9/05
10/29/05
12/18/05
2/6/06
3/28/06

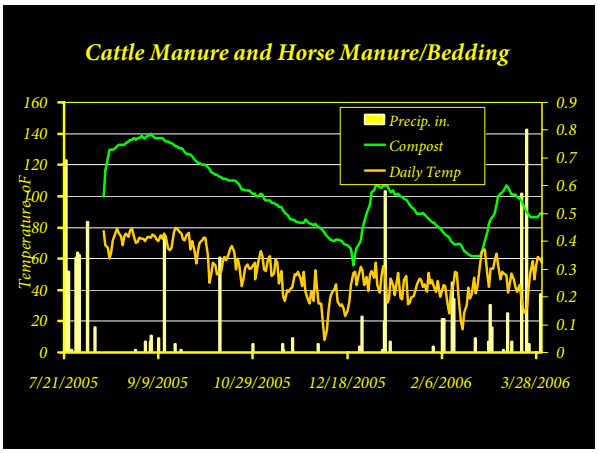

Beef Cattle Manure
Rainfall
Pile Temp
Air Temp
Temperature, oF
160
140
120
100
80
60
40
20
0
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
7/21/05
9/9/05
10/29/05
12/18/05
2/6/06
3/28/06

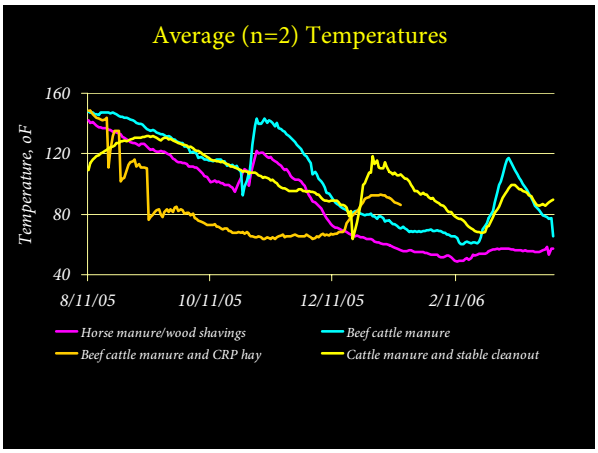

Beef Cattle Manure
Precip. in.
Compost
Daily temp
Temperature, oF
180
160
140
120
100
80
60
40
20
0
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
7/21/05
9/9/05
10/29/05
12/18/05
2/6/06
3/28/06


Beef Cattle Manure and CRP Hay
Precip. in.
Compost
Daily Temp
Temperature, oF
180
160
140
120
100
80
60
40
20
0
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
7/21/05
9/9/05
10/29/05
12/18/05
2/6/06
3/28/06


Beef Cattle Manure and CRP Hay
Precip. in.
Compost
Daily temp
Temperature, oF
180
160
140
120
100
80
60
40
20
0
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
7/21/05
9/9/05
10/29/05
12/18/05
2/6/06
3/28/06


Cattle Manure and Horse Manure/Bedding
Precip. in.
Compost
Daily temp
Temperature, oF
140
120
100
80
60
40
20
0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
7/21/05
9/9/05
10/29/05
12/18/05
2/6/06
3/28/06





How They Stacked Up

Bin	Recipe	Overall Rank	Recipe Rank
1	Horse manure + wood shavings	5	3
2	Horse manure + wood shavings	6	
3	Cattle manure only	2	1
4	Cattle manure only	1	
5	Cattle manure + CRP hay	4	2
6	Cattle manure + CRP hay	3	
7	Cattle manure + stall cleanout	7	4
8	Cattle manure + stall cleanout	8	

Interim Conclusions

- HOBO devices must be watched closely while in the pile (protected cables; check them weekly)
- Horse manure/wood shavings bedding composts easily by itself but is not optimal for carcass composting
- Low C:N ratios (~15:1) of cattle manure or manure + hay are not a major detriment temperature-wise

Other Observations

- Ending moisture contents ranged from 32-47% wet basis
- C:N ratio "conventional wisdom" needs to be reconsidered, or at least taken with salt grains
  - Excellent results in rainy weather (2004) even with C:N of 11 or 12
  - C:N ratio and porosity distribution show some interactions in overall pile performance
  - *Effective* carbon differs from *total* carbon