This is only a small portion of the puzzle for developing Healthy Soils

By Clarence L. Chavez, Soil Scientist
Warning:

- The regulations regarding the disposal of livestock carcasses vary from county to county and state to state.

- This practice as is intended with the application of local and site-specific regulation requirements. As per New Mexico law – Farmers and Ranchers are exempt from being certified, unless they are processing over 25 tons per day.

- This presentation is to be used as an educational guide only.
COMPOSTING IS NOT AN EXACT SCIENCE.

EXPERIENCE WILL TELL YOU WHAT WORKS BEST FOR YOU...
**Compost Bulking Agents**

**Materials to Compost**

<table>
<thead>
<tr>
<th>Browns = High Carbon</th>
<th>Greens = High Nitrogen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood, Shredded</td>
<td>Alfalfa</td>
</tr>
<tr>
<td>Bark</td>
<td>Algae</td>
</tr>
<tr>
<td>Cardboard, shredded</td>
<td>Clover</td>
</tr>
<tr>
<td>Corn stalks</td>
<td>Coffee grounds</td>
</tr>
<tr>
<td>Fruit waste</td>
<td>Food waste (Carcass)</td>
</tr>
<tr>
<td>Leaves</td>
<td>Garden waste</td>
</tr>
<tr>
<td>Newspaper, shredded</td>
<td>Grass clippings</td>
</tr>
<tr>
<td>Peanut shells</td>
<td>Hay</td>
</tr>
<tr>
<td>Peat moss</td>
<td>Hedge clippings</td>
</tr>
<tr>
<td>Pine needles</td>
<td>Hops, used</td>
</tr>
<tr>
<td>Sawdust</td>
<td>Manures</td>
</tr>
<tr>
<td>Stems and twigs, shredded</td>
<td>Seaweed</td>
</tr>
<tr>
<td>Straw</td>
<td>Vegetable scraps</td>
</tr>
<tr>
<td>Vegetable stalks</td>
<td>Weeds*</td>
</tr>
</tbody>
</table>

*Avoid weeds that have gone to seed, as seeds may survive all but the hottest compost piles.*
### Estimated C:N Ratios of various products

<table>
<thead>
<tr>
<th>Product</th>
<th>C:N Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clover</td>
<td>23:1</td>
</tr>
<tr>
<td>Corn stalks</td>
<td>75:1</td>
</tr>
<tr>
<td>Leaves</td>
<td>60:1</td>
</tr>
<tr>
<td>Peanut shells</td>
<td>35:1</td>
</tr>
<tr>
<td>Sawdust</td>
<td>325:1</td>
</tr>
<tr>
<td>Wood chips</td>
<td>400:1</td>
</tr>
<tr>
<td>Wood</td>
<td>25:1</td>
</tr>
<tr>
<td>Food waste</td>
<td>20:1</td>
</tr>
<tr>
<td>Grass clippings</td>
<td>20:1</td>
</tr>
<tr>
<td>Manures</td>
<td>15:1</td>
</tr>
<tr>
<td>Vegetable scraps</td>
<td>25:1</td>
</tr>
<tr>
<td>Animal carcass</td>
<td>5:1</td>
</tr>
<tr>
<td>Cardboard, shredded</td>
<td>350:1</td>
</tr>
<tr>
<td>Fruit waste</td>
<td>35:1</td>
</tr>
<tr>
<td>Newspaper, shredded</td>
<td>175:1</td>
</tr>
<tr>
<td>Pine needles</td>
<td>80:1</td>
</tr>
<tr>
<td>Straw</td>
<td>75:1</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>12:1</td>
</tr>
<tr>
<td>Coffee grounds</td>
<td>20:1</td>
</tr>
<tr>
<td>Garden waste</td>
<td>30:1</td>
</tr>
<tr>
<td>Hay</td>
<td>5:1</td>
</tr>
<tr>
<td>Seaweed</td>
<td>19:1</td>
</tr>
<tr>
<td>Weeds</td>
<td>30:1</td>
</tr>
</tbody>
</table>

C:N Ratios between 15:1 and 35:1 should be used.

High cellulose should be shredded – Corn, Branches, Newspaper etc…
Other Additives to the Pile

- Manure
- Finished Compost
- Soil
- Non-chlorinated
- Diatoms - siliceous sedimentary rock
Woody is used for aeration and drainage.
Equipment – for turning compost

Caution Stand Back Flying objects…
Components to a compost mix by Volume

C:N Ratio of different ingredients

- **Fungal driven food source:**
  - 25% high nitrogen (carcasses), 25% green (grass, hay), 50% Brown (sawdust, woody)

- **Bacterial driven food source:**
  - 50% high nitrogen (carcasses), 25% green (grass, hay), 25% Brown (sawdust, woody).

- **Balanced food source: (recommended)**
  - 33% high nitrogen (carcasses), 33% green (grass, hay), 33% Brown (sawdust, woody).

Layering the Compost Pile

- 6" B
- Wall
- 12" Bulking Agent
- from Bin Wall
- 12" Bulking Agent
- 6" Between Carcasses and above
- 12" Base of Bulking Agent (Woody)
- Concrete slab or hard surface
Compost Windrow Pile

Green: C:N

Woody: aeration and drainage

Aerobic Compost

Anaerobic Compost
Fungi with Ca crystals in aerobic compost

Actino-bacteria in thermal compost

Others in the Pile:
- Protozoa
- Nematodes

Temp and Moisture Sampling depth
What Does It Smell Like

- Should smell like fresh Earth or have no odor

- Smells caused by anaerobic conditions
  - Acetic Acid - Vinegar
  - Butyric acid – Sour milk
  - Valeric acid - Vomit
  - Putrescine – Rotting flesh
Management of Compost Pile: Temp, Time, Turning & Moisture

This compost is not finished – needs to turned and moisture added.
Temperature and Turning

Note: Turn when Temp reaches 131 degrees Fahrenheit for at least 5 times.
Do not let the temp go over 160 degrees Fahrenheit – it starts to kill beneficial microbes.
Compost Moisture

- Must maintain 45%-85% moisture content
  - Ensures healthy environment for organisms
  - Too much moisture creates anaerobic conditions
  - Too little will slow decomposition

Moisture Meter $25 to $60
Compost Fires
If Compost Management is done 10 to 15 min a day: “Record Temperature, add Moisture and turning compost when needed then - piles will self ignite and create fire piles.

CAUTION
This Compost Pile may
Self Ignite
If Not Maintained
Kinds of Compost Piles
Cover to minimize excess moisture and minimize evaporation of moisture.

Plus protect from sun damage or microbial degradation.
Finished Compost includes organic matter, protein, plant nutrients, nitrogen, minerals, water and microorganisms.

Also other nutrients that can be taken up by the roots or stored in the soil.

It takes at least 4 to 8+ months for a finished product.
If the compost pile is built and managed correctly, then...

- Low Cost
- Can be Any Size
- Can be done with any Animal
- Low Cost
- No Flying Pests
- Can Be Done in Winter
- Animal Bones are not Recognizable
- Minimal Labor
- No Smell
- Use any kind of Bulking Agent: Leaves, Grass, sawdust etc...
- No Varmints: mice, skunks,
- No Spread of diseases or pathogens as long as it is 130 degrees F for 2-3 days
Finished Compost VS Manure
(Applied based on agronomic rates)

ICS/IWM can assist in determining the amount to be put on: 3-5-7 Tons/Ac

Finished compost can be 1/3 the volume of the original manure pile

No Seed Source (weeds)
No Disease (Pathogens)
Helps to Retain Water
Variable Salt Content
Good Nutrient Source / Increase Microbes

Potential Seed Source (weeds and other)
Potential disease (Pathogens)
Can seal the top soil if not incorporated
Potentially higher Salt Content
Good Nutrient beneficial microbial Source s

Both are based on an Integrated Cropping System
USING COMPOST OR MANURE IS A MAJOR COMPONENT OF NUTRIENT MANAGEMENT TO SUPPLEMENT CROP NUTRIENTS AND APPLY BENEFICIAL MICROORGANISMS.

APPLICATION OF ORGANIC MATTER IS ONLY A SECONDARY BENEFIT.
Uses of Compost

As a Nutrient Amendment and Increase Microorganisms.
Introduction to Section 1 (1b – Managing Organic Matter & Nitrogen Inputs to Improve the Soil Resource)

- **Cash Crop/Crop Rotations** (the more diverse, the better) or **Pasture**
  - **Grazed**
  - **Harvested Crops**

**Crop Residue mgmt.** (i.e., surface residues & roots)

- **NOTE:** Keep the soil covered with residues and/or crops

**Crop Residue**

- **Carbon (C) & Nitrogen (N) harvested**

**Cover Crop Cocktail Mix** (legumes, grasses & brassicas)

- **Organic Matter (OM) feeds the Soil Food Web**

**Soil Surface Residues** (no-till)

- **Zone of major soil structure development (~ 0 – 4" depth)**

**Soil Humus Decomposition**

- **CO₂ (Carbon losses)**

**Soil Food Web**

- **Living Roots provide exudates & vitamins that stabilize the soil**
- **NOTE:** Intense predator-prey interactions occur in the Soil Food Web

**Healthy Soils**

- **Crop roots & Soil Food Web activity are a function of proper aeration, moisture, temperature & nutrient conditions, as well as the C:N ratio of all organic carbon sources.**

**Note:** Minimal soil structure development at deeper soil depths

**Agronomy Tech Note 76** (http://www.nm.nrcs.usda.gov/technical/handbooks/iwm/nmiwm.html)

*Images: Soil Biology Primer*

**CO₂ (Carbon losses)**

- **Soil Moisture**
- **Soil Temperature**

**N Inputs**

- **Oxygen**

**Soil Food Web**

- **Nitrogen losses:**
  - Nitrate leaching
  - Ammonia volatilization
  - Denitrification
  - Soil erosion
  - Surface runoff

**Zone of major soil structure development (~ 0 – 4" depth)**

**Healthy Soils**

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**Agronomy Tech Note 76** (http://www.nm.nrcs.usda.gov/technical/handbooks/iwm/nmiwm.html)
When using compost in an Integrated Cropping System along with Irrigation Water Systems:

You will see:

• Suppress disease in plants and soil
• Retain nutrients/prevent leaching
• Make nutrients available at rates plants require
• Decompose toxins
• Enhance soil structure/potential of reducing run-off erosion
• Reduce water requirements, increase water holding capacity
• Increases rooting depth (minimum till, cover crops, crop diversity etc.)
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EXPERIENCE WILL TELL YOU WHAT WORKS BEST FOR YOU.

YOU MAY HAVE TO TROUBLESHOOT SOME PROBLEMS
<table>
<thead>
<tr>
<th>Problem/ Symptom</th>
<th>Probable Cause</th>
<th>Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improper Temperature</td>
<td>* Too Dry</td>
<td>* Add Water</td>
</tr>
<tr>
<td></td>
<td>* Too Wet</td>
<td>* Add bulking agent and turn pile</td>
</tr>
<tr>
<td></td>
<td>* Improper C:N ratio or bulking agent used is too porus</td>
<td>* Evaluate bulking agent and adjust amount as necessary.</td>
</tr>
<tr>
<td></td>
<td>* Adverse Environment</td>
<td>* Ensure adequate cover with bulking agent to provide insulation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure to Decompose</td>
<td>* Improper C:N ratio</td>
<td>* Turn Pile and adjust amount of bulking agent</td>
</tr>
<tr>
<td>Carcasses placed on the outside of edge of pile</td>
<td></td>
<td>* Maintain 1’ of apart and away from edges.</td>
</tr>
<tr>
<td>Odor</td>
<td>* Too Wet</td>
<td>* Add bulking agent and turn pile</td>
</tr>
<tr>
<td></td>
<td>* Too low C:N ratio</td>
<td>* Evaluate type of bulking agent used. Add bulking agent.</td>
</tr>
<tr>
<td></td>
<td>* Air flow restricted</td>
<td>* Maintain one 6 - 12 inches of bulking agent near outside of bin &amp; turn the pile.</td>
</tr>
<tr>
<td></td>
<td>* Extended periods of low temperature</td>
<td>* Follow steps in temperature section</td>
</tr>
</tbody>
</table>
## Monitoring and Troubleshooting

<table>
<thead>
<tr>
<th>Problem/ Symptom</th>
<th>Probable Cause</th>
<th>Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oder</td>
<td>* Inadequate cover over carcasses</td>
<td>* Cover carcasses with 1 foot of Bulking Agent</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flies</td>
<td>* Inadequate Brown over pile</td>
<td>* Add bulking agent and turn pile.</td>
</tr>
<tr>
<td></td>
<td>* Poor sanitation conditions</td>
<td>* Avoid leaching from pile. Maintain a clean, debris free area near the pile.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>* Failure to achieve proper temperature</td>
<td>* Follow steps in temperature section</td>
</tr>
<tr>
<td>Scavenging Animals</td>
<td>* Inadequate cover over carcasses</td>
<td>* Maintain one 1’ of bulking agent near outside of bin &amp; turn the pile.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>* Avoid initial entry by establishing a fence or barrier</td>
</tr>
</tbody>
</table>
Compost is only one part of the puzzle it should only be used with in an –

Integrated Cropping System along with Irrigation Water Systems

Main Sources for this presentation:

USDA-NRCS Policy:

Minnesota Board of Animal Health:
Additional Resources
www.compostcouncil.org
www.soilfoodweb.com
www.attra.gov
www.composting101.com
www.earthfort.com

Any Questions?

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