Composting and the Hole Picture
(intended as an educational guide only)

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

By Clarence L. Chavez, Soil Scientist
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.

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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.
Other Additives to the Pile

Manure

Finished Compost

Diatoms – Siliceous sedimentary rock

Soil

Non-chlorinated
## Estimated C:N Ratios of various products

- Clover 23:1
- Corn stalks 75:1
- Leaves 60:1
- Peanut shells 35:1
- Sawdust 325:1
- Wood chips 400:1
- Wood 25:1
- Food waste 20:1
- Grass clippings 20:1
- Manures 15:1
- Vegetable scraps 25:1
- Animal carcass 5:1

Cardboard, shredded 350:1
Fruit waste 35:1
Newspaper, shredded 175:1
Pine needles 80:1
Straw 75:1
Alfalfa 12:1
Coffee grounds 20:1
Garden waste 30:1
Hay 5:1
Seaweed 19:1
Weeds 30:1

C:N Ratios between 15:1 and 35:1 should be used.
High cellulose should be shredded – Corn, Branches, Newspaper etc…
Wood Chipper and Wood products

Woody is used for aeration and drainage
Equipment – for turning compost
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).

Cap off with a brown layer to prevent smells and flies.

Alternate layers of: Food Scraps, green and brown.

6 to 12” Base of Woody or Brush for Aeration.

Concrete slab or hard surface.
Compost Windrow Pile

Green: C:N
Woody for aeration and drainage

Aerobic Compost

Anaerobic Compost
Bacteria and Fungi

- Fungi with Ca crystals in aerobic compost
- Actino-bacteria in thermal compost
- Others in the Pile: Protozoa, Nematodes

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 be 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.
Raw Materials
Organic matter (in the form of, Protein, Bones, Grass and Woody)
Minerals: including nitrogen, carbon, and other nutrients.
Water

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

If the compost pile is built and managed correctly, then...
Finished Compost VS Manure
(Applying 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 Sources

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
  - Harvested Crops
  - Grazed
  - Applied to crops & soils
  - Compost
  - Manure

- **Crop Residue mgmt.** (i.e., surface residues & roots)
  - C & N harvested

- **Crop Residues**
  - Root Exudates
  - (Carbon inputs) e.g., sugarlike polysaccharides

- **CO₂ (Carbon losses)**

- **Soil Moisture**
  - Oxygen

- **Soil Surface Residues** (no-till)
  - Zone of major soil structure development (~ 0 – 4” depth)

- **Soil Food Web**
  - Carbon inputs: 
    - Nitrogen losses: Nitrate leaching
    - Ammonia volatilization
    - Denitrification
    - Soil erosion
    - Surface runoff

- **Healthy Soils**
  - The Soil Food Web makes water-stable aggregates and soil humus
  - 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.

- **CO₂ (Carbon losses)**

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

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

- **NOTE:** Intense predator-prey interactions occur in the Soil Food Web

- **NOTE:** Minimal soil structure development at deeper soil depths

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

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

- **Living Roots provide exudates & atmospheres & stabilise the soil**

- **CO₂ (Carbon losses)**

- **Nitrogen losses:**
  - Nitrate leaching
  - Ammonia volatilization
  - Denitrification
  - Soil erosion
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- **Healthy Soils**

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When using compost in an Integrated Cropping System along with Irrigation Water Systems:

You will see a -

- 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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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>Failure to Decompose</td>
<td>* Improper C:N ratio</td>
<td>* Turn Pile and adjust amount of bulking agent</td>
</tr>
<tr>
<td></td>
<td>Carcasses placed on the outside of edge of pile</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>
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<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>
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<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></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>* Too Wet</td>
<td>* Open/remove pile contents and add additional bulking agent.</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>
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<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 in a Soil Health Management System along with a Irrigation Water Systems

Main Sources for this presentation:

USDA-NRCS Policy:

Minnesota Board of Animal Health:
Any Questions?

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