Using Temperature Data to Develop A Standard Windrowing Protocol

Shawn Hawkins
Why Windrow?

• Quality bedding material
  – Scarcity
  – Rising Cost

• Improve litter quality
  – Pulverize cake
  – Heat & dry litter
    • Improve litter tilth
    • Pathogen control
  – Improve bird performance?
Windrowing Method(s)

- Methods abound – no standard technique
- Lack of data to inform what we should do
  - Should I prep litter for windrowing?
  - What size windrow should I make?
  - How long should I wait before turning?
  - How many turns should I perform?
  - How do I know it’s working?
  - Are there additives that improve heating?
Heating is Your Primary Goal

- Two important components
  - Temperature
  - Time

- No direct information for windrowed litter

- Decades of data for composted biosolids
  - $122^\circ\text{F} \geq 1 $ day
  - $145^\circ\text{F} \geq 1 $ hour

Which one is better?
Study Design

- 4 Houses, 10 sensors/house, 4 events
Windrow Heating Data

MidDepth

Temperature, °F

Initial Windrow (Turn 1)  Turn 2  Turn 3

MidDepth

Ambient
Grow

Initial Windrow (Turn 1) Turn 2 Turn 3
Windrow Heating Data

MidDepth vs Floor

Temperature, °F

Initial Windrow (Turn 1)

Turn 2

Turn 3

Floor

MidDepth

Ambient

Grow

Initial Windrow (Turn 1) Turn 2 Turn 3
Windrow Heating Data

MidDepth vs Floor vs Surface

Initial Windrow (Turn 1)

Turn 2

Turn 3

Temperature, °F

Floor

MidDepth

Surface

Ambient

Grow

Initial Windrow (Turn 1) Turn 2 Turn 3

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This is Why You Have to Turn

![Graph showing peak temperatures for Floor, MidDepth, and Surface with different values and statistics.]
Heating “Success” Rate and How Long It Takes to Get There

<table>
<thead>
<tr>
<th></th>
<th>Turn 1</th>
<th>Turn 2</th>
<th>Turn 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface</td>
<td>122 ≥ 1 day</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floor</td>
<td>2.2 Days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mid-depth</td>
<td>2.9 Days</td>
<td>145 ≥ 1 hour</td>
<td></td>
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</tbody>
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Moisture Primarily Controls Windrow Heating Performance

Moisture Content, %

20 25 30 35 40 45 50 55

Floor Peak Temperature, °F

60
80
100
120
140
160

Turn 1
Turn 2
Turn 3
Trend Line
Windrow Size Affects Heating Performance
Biochar As a Litter Additive

• What is biochar?
  – Residual carbon after plant materials are heated without oxygen present
  – Some indication it is beneficial soil additive
  – Few compost studies show improved heating
  – Adsorbs ammonia

• Two types tested (4,000 dry lbs/house)
  – Proton Power (mixed hardwoods)
  – City of Lebanon (Asian hardwoods-pallets)
City of Lebanon Biochar
Biochar Didn’t Improve Heating
Windrowing Causes Higher Ammonia Than De-caking

↓

Use Full Dose Acidifier and Ventilate Adequately, Biochar Did Not Reduce Ammonia
Take Home Messages

1. **Moisture is Critical**
   1. Don’t de-cake or till prior to windrowing
   2. Start windroweing ASAP
   3. Turn as soon as heat standard is met
   4. Ventilate minimally

2. **Temp varies within a windrow**
   a) **Surface** never reaches heat standards
   b) **Floor** usually reaches heat standards
   c) **Mid-Depth** always reaches heat standards
Take Home Messages

4. Make big windrows (16-24” deep)

5. Best heat standard: 122°F for 1 day: measure temp where litter contacts floor, once you hit 122°F, wait one day and turn

6. Perform 2 turns; 3rd good for drying

7. Spread as soon as heating is finished, ventilate to dry/reduce ammonia

8. Biochar doesn’t improve litter heating or reduce ammonia during subsequent flock