CONSIDERATION OF PHYSICAL PROPERTIES FOR VARIABLE-RATE SPREADING OF LITTER

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Poultry Litter...

- Mostly land applied as an Organic Fertilizer
- Environmental Stewardship
  - Over-application plus concerns for off-site nutrient transport
  - 4Rs to Nutrient Stewardship - accurate metering and placement
- Physical properties: highly variable
  - Difficult to apply accurately and uniformly
  - Most physical properties dependent on moisture content (including bulk density).

Density is a required setup parameter in spreader rate controllers.

Objective

Evaluate the effect of litter density on metering (rate) and placement (distribution) for spinner-disc spreaders.

Treatments

Two sources of litter used:

<table>
<thead>
<tr>
<th>Type</th>
<th>Mean Moisture Content (%)</th>
<th>Mean Bulk Density (lb/ft³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>22</td>
<td>26</td>
</tr>
<tr>
<td>B</td>
<td>28</td>
<td>30</td>
</tr>
</tbody>
</table>

Controller-Spreader Settings:

- Two Gate heights (7 and 13.75 inches)
- Four application rates
- Density – Actual (correct) and Virtual (incorrect)
  - 26 and 22 lb/ft³ (Litter A)
  - 30 and 26, 34 lb/ft³ (Litter B)
METHODOLOGY

Conveyance Tests
- Litter metering – discharge rate
- Accuracy ≤ 10% Target
- Data Analysis – compared actual conveyor discharge vs. theoretical discharge

Uniformity Tests
- Litter placement – distribution pattern
- Single-pass and standardized patterns
- Data Analysis – compared distribution patterns at different densities

RESULTS: CONVEYANCE TESTS

Litter A (MC-32% & BD-26 lb/ft³)  Litter B (MC-28% & BD-30 lb/ft³)

Rate errors (>10%) when incorrect density value.

RESULTS: UNIFORMITY TESTS

Standardized Pattern = Single-pass pattern at each transverse position
Mean Overlap rate for simulated overlap pattern

- Typical "W" shape patterns
- Difference in patterns around and at center (6 ft to 12 ft)
- Density affects material distribution

SUMMARY

- Conveyance - application errors (>10%) due to incorrect density values.
- Pan/Uniformity Tests - Shift in distribution patterns as density varies.
- Accounting for litter density and/or moisture content variations during spreading will improve metering and placement.
- So what’s the next step…

FUTURE EFFORT

- Development of moisture/density sensing device on a spreader for real-time feedback to controller.
  - Evaluating different sensor technology (good relationships)
  - Incorporate as control feedback into VR controller.