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U of A System Division of Agriculture

Tuesday, Feb. 28th 2017
Kansas Convention Center, Kansas City, MO
3.05 PM – 3.20 PM

https://grain-processing-engineering.uark.edu/
Presentation Outline

• In-bin Drying and Storage Trends
• Research Gaps
• Research Objectives and Approaches
• Results
• Conclusions
In-bin Drying and Storage

- Green Rice (Wet)
- Drying Zone
- Dry Rice

MC cable  Temp. Cable  Fan Control System

Weather Station  Communication System
Sample guidelines: On-farm, in-bin drying in Arkansas

- **Drying duration ≤ 30 days**
- **Maximum DML ≤ 0.5%**
- **Percent over-drying ≤ 10%**

The **green squares** represent the **suitable** drying operation range. The **red squares** represent the **unsuitable** drying operation range.

<table>
<thead>
<tr>
<th>Air Flowrate, m³ min⁻¹ (cfm bu⁻¹)</th>
<th>0.69 (0.5)</th>
<th>1.39 (1)</th>
<th>2.08 (1.5)</th>
<th>2.77 (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Moisture Content (% w.b.)</td>
<td></td>
<td>18</td>
<td>16</td>
<td>18</td>
</tr>
<tr>
<td>15 Aug</td>
<td></td>
<td></td>
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<tr>
<td>15 Sept</td>
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<td>15 Oct</td>
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<tr>
<td>15 Aug</td>
<td>22</td>
<td>18</td>
<td>16</td>
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<td>15 Oct</td>
<td>22</td>
<td>18</td>
<td>16</td>
<td>18</td>
</tr>
</tbody>
</table>

**Note:** Air Flowrate = m³ min⁻¹ (cfm bu⁻¹)
Research Gaps

- Kinetics of mold growth especially at the top layer of the bin
- Mold growth may lead to mycotoxin formation (e.g. aflatoxin)
- Some mycotoxins are carcinogenic and known to pose health hazard
• Deterioration of milled rice quality characteristics:
  • Discoloration
  • Other sensory and functional characteristics

USDA Grade No. 1 rice: only 1 heat-damaged kernel per 500-g sample
Research Objectives

Study the kinetics of rice quality and mold growth profiles; and formation of mycotoxins (e.g. aflatoxin) on rice for conditions typically encountered during natural air in-bin drying and storage.
## Design of Storage Experiment

<table>
<thead>
<tr>
<th>Year</th>
<th>Cultivar</th>
<th>Moisture Content (w.b. %)</th>
<th>Temp (°C)</th>
<th>Storage Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>CL XL745</td>
<td>12.5</td>
<td>10</td>
<td>Week 0</td>
</tr>
<tr>
<td></td>
<td>XL753</td>
<td>16</td>
<td>15</td>
<td>Week 2</td>
</tr>
<tr>
<td>2015</td>
<td>CL XL745</td>
<td>19</td>
<td>20</td>
<td>Week 4</td>
</tr>
<tr>
<td></td>
<td>XL760</td>
<td>21</td>
<td>27</td>
<td>Week 6</td>
</tr>
<tr>
<td>2016</td>
<td>CL XL745 Fungicide treated</td>
<td></td>
<td>40</td>
<td>Week 8</td>
</tr>
<tr>
<td></td>
<td>CL XL745 Non Fungicide treated</td>
<td></td>
<td></td>
<td>Week 10</td>
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<td></td>
<td>Week 12</td>
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<td></td>
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<td>Week 16</td>
</tr>
</tbody>
</table>
Post-Storage Protocol

- Microbial growth determination
Discoloration Analysis

WinSEEDLE

Color Profile

- Pink/Red
- Yellow 2
- Yellow 1
- Brown/Red
- Yellow 3
- Black/Brown
- Light Pink
- White
- Yellow 2
**Head rice**: 75% or greater of original kernel length after milling (USDA, 2005).

**Head rice yield (HRY)**: The mass proportion of rough rice that remained as head rice after complete milling.
Mean \((\text{Log}_{10} \text{ CFU/g})\) 5.97
SD = 0.13
Results – Mold Growth CLXL 745(2015)

Mean ($\log_{10} \text{CFU/g}$)
5.68
SD = 0.07
Discoloration Patterns
2015

10°C

27°C

40°C

XP760, 21%, 10 weeks
Conclusions

Mold proliferation
MC levels (<16% wet basis); moderate temperatures (10-20°C)
Grain cooling/chilling may prolong safe storage of high-MC, rice.

Rice Discoloration
• Cooling to 10-15°C maintains kernel color with storage at <19% MC for up to 16 weeks
• Yellowing at low MCs, could indicate non-fungal source
• Unique colors prevalent in kernels could suggest fungal pigments

Head rice yield
• Preserved at all MCs with storage at 10-20°C
• Not affected by storage conditions until other qualities suffer
Acknowledgments

- Arkansas Rice Research and Promotion Board
- University of Arkansas Division of Agriculture
- University of Arkansas Rice & Grain Processing Programs

Arkansas Rice Check-Off

Arkansas Rice Producers

University of Arkansas System

Advancing Grain Storage Management
Thank you!