Effect of Rust and other pathogens on Forage Quality

A.T. Adesogan
O.C.M. Quieroz
S.C. Kim

Department of Animal Sciences
Introduction

- Significant crop losses to disease in ’02 and 03 in FLA
- Southern rust is one of the most common diseases
- Unpredictable incidence, yet v. aggressive
- Cause leaf death, stalk rot, lodging, crop failure
Southern rust

- Aggressive fungal disease; destroys field in 7-10 days
- Dispersed by airborne spores of *Puccinia polysora*
- Forms orange, circular pustules on upper leaf surface.
- Saps nutrients causing leaf death.
- Common with high temps, high humidity
Southern rust

Puccinia spp.

www.biomedia.cellbiology.ubc.ca/

http://www.ianrpubs.unl.edu/epublic/pages/publicationD.jsp?publicationId=720
Common Rust
- *P. sorghi*
- 60-77° F
- Both leaf surfaces
- Red to brown
- Sparsely scattered

Southern rust
- *P. polyspora*
- 77- 90° F
- Upper leaf surfaces
- Orange
- Dense clusters

(Jackson, 2008)
Southern leaf blight

- Appears at end of spring / during fall with warm to hot temperatures (68-90°F) and periods of extended leaf wetness (Raid and Kucharek, 2005).
- Caused by the fungus *Helminthosporium* or *Bipolaris maydis*
- Causes long, tan to brown, cigar-shaped lesions that can coalesce & make the entire leaf necrotic.
- Infestation begins with the mature leaves and proceeds up the plant.
Southern leaf blight

www.plant.uga.edu

www.plant.uiuc.edu

Helminthosporium

Bipolaris
Challenges

• Few resistant varieties hybrids exist and these may lack traits needed for silage production.

• Fungicides can only control the disease when applied early in the season.
Knowledge gap

- Little is known about:
  - Rust effects on nutritive value of corn silage
  - Safety of feeding rust-infected corn
Objective

- To determine how the level of southern rust infestation affects nutritive value, fermentation and bunk life of corn silage.

- To determine if a microbial inoculant can improve the quality of rust-infested corn silage.
Methods

- Pioneer 33V16 hybrid grown on a 130-acre field (July 6, 07)
- Infested by rust after tasseling
- Abound fungicide applied by crop duster (Sept, 7 07)
- Uneven coverage allowed some rust to persist
- Field classified into clean, medium rust or high rust areas
Rust treatments

Clean

Medium rust

High rust
High-rust treatment
Each treatment was ensiled in four replicate, 5 gallon mini silos for 97 days.

<table>
<thead>
<tr>
<th>No.</th>
<th>Rust</th>
<th>Inoculant</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Clean</td>
<td>—</td>
</tr>
<tr>
<td>2</td>
<td>Medium</td>
<td>—</td>
</tr>
<tr>
<td>3</td>
<td>High</td>
<td>—</td>
</tr>
<tr>
<td>4</td>
<td>Clean</td>
<td>+</td>
</tr>
<tr>
<td>5</td>
<td>Medium</td>
<td>+</td>
</tr>
<tr>
<td>6</td>
<td>High</td>
<td>+</td>
</tr>
</tbody>
</table>
Inoculant

- Buchneri 500 (Lallemand Animal Nutrition)
- Combo inoculant
- Applied at a rate that supplied $4.99 \times 10^{10}$ cfu/g of:
  - *Pediococcus pentosaceaus*
  - *Lactobacillus buchneri*
## Corn forage composition

<table>
<thead>
<tr>
<th></th>
<th>Clean</th>
<th>Medium rust</th>
<th>High rust</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM, %</td>
<td>39</td>
<td>41</td>
<td>58</td>
</tr>
<tr>
<td>NDF, %</td>
<td>45</td>
<td>49</td>
<td>55</td>
</tr>
<tr>
<td>ADF, %</td>
<td>26</td>
<td>29</td>
<td>33</td>
</tr>
<tr>
<td>CP, %</td>
<td>8</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>In vitro NDFD %</td>
<td>35</td>
<td>34</td>
<td>33</td>
</tr>
<tr>
<td>In vitro DMD, %</td>
<td>64</td>
<td>59</td>
<td>55</td>
</tr>
<tr>
<td>Mycotoxins, ppm</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Treatment effects on silage % DM

Effects:
Rust level ***
Inoculant ***
Interaction; ns

DM % increased by rust; slightly decreased by inoc.
Treatment effects on silage % NDF

- **Clean**: Control (44) - Inoculant (43)
- **Med rust**: Control (48) - Inoculant (49)
- **High rust**: Control (49) - Inoculant (51)

**Effects:**
- Rust level: ***
- Inoculant: ns
- Interaction: ns

*NDF% increased by rust; same trend for ADF*
Treatment effects on NDF digestibility, %

Effects:
- Rust level: ***
- Inoculant: *
- Interaction: ***

NDF digestibility was lowest in high rust; Inoc. increased values in clean & medium rust silages
Treatment effects on DM digestibility, %

DM digestibility was reduced by rust

Effects:
- Rust level: ***
- Inoculant: ns
- Interaction: ns
Nutritive value conclusions

Rust infestation:
- Dried the forage
- Increased NDF content
- Decreased digestibility of NDF and DM

Inoculant treatment:
- Increased NDF digestibility in clean & medium rust silages
Treatment effects on pH

Effects:
- Rust level: ***
- Inoculant: ns
- Interaction: ns

pH was slightly increased by rust
Treatment effects on Lactate %

**Effects:**
- Rust level: **
- Inoculant: ***
- Interaction: ***

Inoc. reversed the decrease in lactate caused by rust
Treatment effects on Acetate %

Inoc. reversed the decrease in acetate caused by rust
Effects:
Rust level ***
Inoculant : *
Interaction: **

Butyrate was detected in the high-rust silage
Fermentation conclusions

- **Rust infestation:**
  - Reduced the pH & fermentation acid production
  - Caused a poorer type of fermentation

- **Inoculant treatment:**
  - Reduced some adverse effects of rust on the fermentation
Treatment effects on Molds, log cfu/g

Effects:
- Rust level ***
- Inoculant: ns
- Interaction: ns

Molds were less in high-rust silages
Treatment effects on hours of bunk life

High-rust silages were more stable, particularly when inoc. treated.

Effects:
Rust level **
Inoculant : x
Interaction: *
High-rust control silages had more aflatoxin than FDA allows (20 ppb in feeds)
Treatment effects on zearalenone, ppm

Zearalenone was only detected in clean corn

Effects:
- Rust level ***
- Inoculant: ns
- Interaction: ns
Mold, mycotoxin & bunk life conclusions

- Rust reduced molds and improved bunk life but made the silage unsafe to feed due to excess high aflatoxin levels.

- High zearalenone in clean silages suggests late-harvested summer corn should be fed with mycotoxin binders.
Take home messages

- Rust infestation can reduce nutritive value and fermentation
- High rust infestation can cause dangerously high aflatoxin levels
- Inoculant application can reduce some adverse effects of severe rust infestation
- Use rust-resistant summer corn
- Feed late-harvested summer corn with a mycotoxin binder
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