The Smuts (and non-smuts) in Rice: Kernel Smut, False Smut, Leaf Smut, Black Kernel, Sooty Mold

Causes, Sources of Inoculum, Disease Cycle, Varietal Reactions, Management and Yield Losses

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Definition of Plant Disease

• Disease results from the continued irritation by a primary causal agent or environmental factor that leads to malfunctioning of host cells and tissues and leads to the development of symptoms.
Disease Triangle

Source: Plant Disease: Pathogens and Cycles, University of Nebraska
General Plant Disease Cycle

Source: Hollier. PLHL 4001, PPCP, LSU AgCenter
Infection Process

Source: Common processes in pathogenesis by fungi ad oomycetes. bmcmicrobiol.biomedcentral.com
Definition

• Yield Loss vs Crop Loss
  – Yield loss is the reduction of the measurable product of a crop
  – Crop loss is the reduction in value and/or financial return due to damage/disease. (loss by multiple causes, quality, difference between actual yield and attainable yield)

Kernel Smut

• Cause: *Tilletia barclayana*
Kernel Smut

Image Source: DE Groth

Image Source: DE Groth
Kernel Smut (KS)

• Losses: KS reduces grain quality and yield and losses up to 15% have been reported. The disease also causes breakage and reduction in head rice yield and problems in the par-boiling process. If the percentage of smutted kernels is too high, the final milled rice product will be gray.

Source: Compendium of Rice Diseases and Pests, 2nd Edition

• Louisiana losses are estimated at 1%

Source: DE Groth
Kernel Smut

Disease Cycle

1. Pathogen survives as spores on soil and crop residue and in infected seed.

2. Spores germinate and are forcibly discharged upward and infect open flowers.

3. Flowers are infected as the germinating spore enters the pistil and grows to the ovary.

4. The endosperm is partially or completely replaced by a mass of spores.

Source: Compendium of Rice Diseases and Pests, 2nd Edition
Rice Flower

Image source: botany.org
# Kernel Smut

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Kernel Smut Rating</th>
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<tr>
<td>CL153</td>
<td>S</td>
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<tr>
<td>CL111</td>
<td>S</td>
</tr>
<tr>
<td>Cheniere</td>
<td>S</td>
</tr>
<tr>
<td>Mermentau</td>
<td>-</td>
</tr>
<tr>
<td>CLXL745</td>
<td>S</td>
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<tr>
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<td>MS</td>
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<td>PVL101</td>
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</tr>
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<td>Diamond</td>
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Source: DE Groth
Kernel Smut

• Conditions for Development
  – High nitrogen rates early in the season
  – Infected seed
  – Fields that had Kernel Smut in the previous crop

Source: Compendium of Rice Diseases and Pests, 2nd Edition
Kernel Smut

- **Disease Management**
  - Some less susceptible cultivars available
  - Plant early
  - Avoid excessive N
  - Kernel smut primary fungicide target
  - Propiconazole has best activity
  - 6 oz/A at boot to boot split growth stages
  - Certain fields tend to have a history of disease

Source: Compendium of Rice Diseases and Pests, 2nd Edition
A boot application followed by the heading spray may be necessary if diseases pressure is high and the variety is susceptible.

An early application may be necessary if sheath blight appears early and is severe followed by the boot to heading application.

Late planted rice requires earlier application of propiconazole for Cercospora control.
False Smut

Cause: *Ustilaginoidea virens*

Image source: DE Groth
False Smut

Image source: DE Groth
False Smut

Losses due to False Smut are not limited to the field development. Most losses are due to the rejection of loads by the buyer. As spore balls (galls) are ruptured and spores are distributed, grain discoloration occurs.

Source: Compendium of Rice Diseases and Pests, 2nd Edition
False Smut

The disease cycle has not been completely characterized. It has been reported that infection can occur in the ovary, but other spore types can infect maturing grain. The fungus survives as sclerotia or spore balls for up to 4 months under field conditions. Spores can be carried on the seed and distributed to new fields.

Source: Compendium of Rice Diseases and Pests, 2nd Edition
False Smut

Image source: ResearchGate
False Smut

Image source: arkansas-crops.com
# False Smut

<table>
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<td>PVL01</td>
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<tr>
<td>Diamond</td>
<td>3.8</td>
</tr>
</tbody>
</table>

Source: DE Groth
False Smut

• Conditions for Development
  – High nitrogen rates early in the season
  – Infected/infested seed
  – Late planting
  – Susceptible cultivars

Source: Compendium of Rice Diseases and Pests, 2nd Edition
False Smut

• Disease Management
  – Some less susceptible cultivars available
  – Plant early
  – Avoid excessive N
  – Propiconazole has best activity
  – 6 oz/A at boot to boot split growth stages
  – Certain fields tend to have a history of disease

Source: Compendium of Rice Diseases and Pests, 2nd Edition
Arkansas Recommendations

- **PROPICONAZOLE FUNGICIDES** can be applied to suppress *kernel smut* and *false smut* of rice.
- Research has shown the most effective application timing for lower rates of propiconazole fungicides to be when the main tillers are in the **SWOLLEN BOOT STAGE BUT PRIOR TO ANY HEAD EMERGENCE**.
- Earlier applications of low rates of propiconazole fungicides may not be effective! Applications after heads start to emerge are not legal!
- Fields most likely to benefit from suppression of *kernel smut* or suppression of *false smut* with these fungicides include those with a severe history of the disease such as **FRANCIS, COCODRIE, CHENIERE, CL161, CL 152 OR CYPRESS CULTIVARS** and that received high rates (> 160 units) of nitrogen fertilizer.

**Dosages:**

- Tilt, PropiMax, Bumper: 6 oz/A
- Stratego: 19 oz/A
- Quilt: 21 oz/A
- Amistar Top: 10 oz/A

Source: University of Arkansas
Leaf Smut

Cause: *Eballistra oryzae*

Image Source: DE Groth
Leaf Smut

Image Source: Bugwood
Leaf Smut

Leaf Smut is one of the most commonly observed leaf diseases worldwide. But is considered minor and causes little yield loss. Light yield losses have been reported when severe leaf smut has caused premature desiccation of the leaves.

Source: Compendium of Rice Diseases and Pests, 2nd Edition
Leaf Smut

The pathogen survives between crops as teliospores on diseased leaf debris in the soil. As the teliospores germinate, the sporidia are spread to rice leaves where they germinate and infect in the late growth stages after booting.

Source: Compendium of Rice Diseases and Pests, 2nd Edition
Leaf Smut

• Conditions for development
  - Late planting
  - High nitrogen levels

Source: Compendium of Rice Diseases and Pests, 2nd Edition
Leaf Smut

• Disease Management
  – Maintain adequate nitrogen for best grain development
  – Bury previous crop residue

Source: Compendium of Rice Diseases and Pests, 2nd Edition
Black Kernel

Cause: Curvularia spp.

Image Source: DE Groth
Black Kernel

Image source: Bugwood
Black Kernel

• Regarded as a weak pathogen and a common saprophyte.

• Disease management: not warranted!

Source: Compendium of Rice Diseases and Pests, 2nd Edition
Sooty Mold

Cause: Several fungi... *Capnodium* spp.

Image source: DE Groth
Sooty Mold

Not a disease!

Image Source: DE Groth
Items to Consider...

1. Scout the fields properly.
2. Know the cultivar.
3. Identify diseases correctly.
4. If the pathogen can/should be managed, do so properly (choice of method; choice of fungicide; proper rate and timing; if available, rotate modes of action)