Role of Seed Analysts in the Management of Scab Disease

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Association of Official Seed Analysts, Inc. / Society Commercial Seed Technologists, Inc.
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MSU Agricultural Research Centers

AgCAN – Lethbridge

MSU – Bozeman

Bridger PMC

ID – Aberdeen

WY - Powell

Montana State University Extension
Mountains & Minds
**Scab = Fusarium head blight**

*causes seed decay / seedling blight*

*dryland crown rot / foot rot*

- “the Pink” *Fusarium* culmorum, graminearum
- Irrigated, high humidity, warm weather disease.
- Hosts include wheat, barley, corn
- Infests the flowers & spreads within the head.
- Diseased plant residue and colonized straw are inoculum source from year to year.
- *Fusarium* diseased kernels, inoculum source.
- “Tombstone kernels” and Mycotoxins
• Scab = FHB
• Infection of flowers
• Partial bleaching of infected heads
• ‘Pink’ fusaria
• “Tombstone kernels”
- Gibberella zeae ear rot
- Infection of ‘silk’, flowers.
- Pink-red to white mold on kernels.
- Warm, humid environment
Symptoms at spike development

• Partial bleaching of diseased spikelets.
• Pre-mature blight of entire head.
• Orange color of spore masses on the glumes.
Symptoms at harvest

- Diagnostic tan to brown discoloration of stem below the head.
- Head or spike appears normal yet contains “tombstone” kernels.
Tombstone Kernels = FHB

- Fusarium diseased kernels
- Appear chalky from the fungal mycelium.
- Shriveled endosperm and embryo.
Macroconidia
Foot cell “heal”
Apical cell “cone”

Fusarium graminearum
DON = Deoxynivalenol

- DON is a Mycotoxin produced by Fusarium culmorum and F. graminearum on wheat, barley, corn, rye.
- One of the least toxic to animals but may result in reduced consumption or feed refusal.
- Non-ruminants are most sensitive.
- Toxicity is such that animals or humans do not die from ingesting DON.

FDA Advisory Level at 1 ppm of DON in bran, flour or germ for human consumption. Approx. consumption 2 loaves of bread.
ALSEN, FHB TOLERANT
HANK, FHB SUSCEPTIBLE
HANK,
TOMBSTONES REMOVED
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<th>Variety</th>
<th>Germ Blot Test</th>
<th>DON Toxin</th>
<th>Pure Live Seed</th>
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Seed Analysts Alerts for Scab Disease

Inspect sample for “Tombstones”
Germ blot test as indication of DON
100-90%, minimal concern
<90%, caution, 1-2 ppm DON
<80%, extreme, 5-10 ppm DON

Gloves for handling, avoid inhalation of dust from un-cleaned grain.
Scab epidemic 1990’s

- Management of Scab has benefited by a rotation shift to Corn/Soybean or sugar beets, new fungicides, & tolerant wheat varieties.
- Barley production and malt facilities in the arid regions of MT, ID, and WY.

Severe Scab in Red
Barley Scab

Note healthy and scab infected florets
<table>
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<tr>
<th>Animal</th>
<th>Portion of Diet</th>
<th>Maximum DON Level</th>
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<tr>
<td>Ruminants, cattle older than 4 mos</td>
<td>Grain &amp; grain by-products not to exceed 50% of the diet</td>
<td>10 ppm</td>
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<tr>
<td>Chickens</td>
<td>Grain &amp; grain by-products not to exceed 50% of the diet</td>
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<tr>
<td>Swine</td>
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<tr>
<td>All other animals</td>
<td>Grain &amp; grain by-products not to exceed 40% of the diet</td>
<td>5 ppm</td>
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</table>
Minimizing DON in Grain

• Variety with Scab tolerance
• Foliar fungicide applied at flowering growth stage.
• Harvest combine adjusted to blow out the light weight scab kernels.
• Grain storage to prevent fusarium growth
  – Equilibrium moisture
  – Low temperature
  – Ensilement, barley feed
DON Toxicity & Human Health

- DON, or Vomitoxin, is metabolized rapidly, does not accumulate in tissues and effects are transitory.
- Emetic Response 0.05-0.10ppm. Highly sensitive.
- Growth reduction 0.06-0.12ppm. Reversible once DON is removed.
- Immunotoxicity 0.40-6.00 ppm. Immunostimulatory-suppressive.
- Reproduction 1.00-1.50 ppm. Maternal toxicity associated with feed refusal and weight loss.

FDA Advisory Level at 1 ppm of DON in bran, flour or germ for human consumption.

URL: http://dx.org/10.1080/10937400590889458
Risk Assessments & Their Limitations

- Dutch risk assessment 0.120 ppm with 200-fold std safety factors & based on consumption patterns for children.
- FDA guideline 1.0 ppm has only a 24-fold std safety factor, based on std safety net.
- Does the FDA guideline of 1-ppm DON adequately ensure human safety?
- Risk is reduced with a diverse grain diets and the sporadic nature of DON contaminated grain.
- No definitive cases of human gastroenteritis in US/Canada where 1-2 ppm regulatory levels are in place.
- No systemic studies on the presence of DON in outbreaks of gastroenteritis.

Major risk is the potential for inducing acute gastroenteritis with attendant vomiting after a single meal containing high concentration of DON.

Research Needs: Scab, DON & Human Health

• Variety development with FHB tolerance.
  – Semi-dwarf, high yield, ‘SuMai 3’ germplasm
• Effective fungicide and application at flowering.


• Efficient methods for DON analysis in grain commodities and processed foods.
• Comparative incidence of acute (e.g. gastroenteritis) and chronic (e.g. esophageal cancer, IgA nepropathy, cardiac effects) in geographical areas of high and low DON exposure, world food safety issue.

  Pestak, James J. and Smolinski, Alexa T. 2005

• Human clinical studies associated with outbreaks of gastroenteritis.