

**Fusarium Issues in Grain Crops**

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**Fusarium spp.**

- Large fungal genus, common in soil and plants but can also infect animals.
- Belong in the Division Ascomycota.
- Most *Fusarium* spp. are saprophytic or opportunistic.
- Several species are pathogenic to plants
  - *Fusarium graminearum* can cause seedling blight, root rot, Fusarium head blight (scab), seed scab (blight), grain molds.
  - *Fusarium venenatum* for human food (*Quorn*).

**Mycotoxins from *Fusarium***

- Mycotoxins=toxic substance produced by fungi
- Include Fumonisins and Trichothecenes
- Trichothecenes can also be produced by *Trichoderma, Myrothecium, Cephalosporium, Trichotecum, Stachybotrys* and other species.
- Trichothecenes include Deoxynivalenol (DON), also known as vomitoxin.

**Mycotoxins from *Fusarium***

- Several *Fusarium* species frequently infect corn, wheat, oats, barley, rice, and other grains in the field or during storage.
- DON is produced by *Fusarium* species that infect wheat, oats, barley, rice, corn, and other grains at the field or storage level.
- Other toxins from *Fusarium* include zearalenone.
Fusarium in Wheat

Crown and root rot

Pythium spp. (water mold)
Can cause root and crown rot of grasses and non-grasses (indicator of wet soil, wet weather conditions, or poor drainage)

Hale Co. April 2012: Crown rot & root thinning by Fusarium sp. & Bipolaris sp.

Fusarium foot (crown) rot
Fusarium Head Blight

Seed Quality (from wheat head in middle picture of previous slide)

Tombstone/Shriveled seed

Discolored wheat kernels

Fusarium seed scab (blight)
(*Fusarium graminearum/Giberella zeae*)

Orange Sporodochia

Fusarium Head Blight
(*Fusarium Head Scab*)-FHB

- Affects wheat, barley, rye, corn, triticale, forage grasses.
- Reduction in yield, grade, quality.
- Shrunken, low weight kernels
- Fungus favored by warm weather (60-86F, optimum ~80F) during flowering, high humidity, rain (12 hrs or more), inoculum (spores) from residue or wind-blown, resistance levels in variety.
- FHB ≠ DON
DON (vomitoxin) from *Fusarium graminearum* and other spp. in wheat

- At least 90% of tricothecenes in grain.
- 1ppm on wheat products (flour, germ)-humans
- 10 ppm on grain or by-products for ruminating beef and feedlot cattle older than 4 months.
- 5 ppm on grain or by-products for swine (and not exceed 20% of diet).

http://www.scabusa.org/pdfs/don_white-paper_6-07.pdf (Cowper et al.)

DON (vomitoxin) from *Fusarium graminearum* and other spp. in wheat

- 5ppm on grain or by-products destined for other animals (not exceed 40% of diet).
- In Kansas/Northern Great Plains, grain elevators can test for DON, and many impose discounts against wheat contaminated with more than 2 parts per million (ppm).
- To increase seed quality and decrease potential DON levels when harvesting, adjust combine air velocities to remove lightweight kernels.

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**Fusarium in Corn**

*(Fusarium graminearum/Giberella zeae)*

*(Giberella stalk rot)*

**Giberella/Fusarium Stalk Rots**
Fusarium stalk rot

Fusarium ear rot

2006 FUMONISIN DISTRIBUTION

2012 Fumonisin Distribution
Fumonisin (*Fusarium*)
- Favored by rainy weather at/after flowering
- Seedborne or in crop debris
- Enhance by insect injury
- Can grow in plant tissue prior to flowering and infect kernel
- Infection ≠ toxin
- Kernel moisture for toxin ~20%; halts at below 18%

Conclusions
- FAW direct damage begins at milk stage
- Visible fungal damage begins at dent
- Fungi took 56% of kernels, FAW 44%
  - was 58:42% in 2011 preliminary dataset not reported here
- Yield loss for one FAW in lower 2/3 of the ear = 0.2394 lbs.
- FAW damaged ears vs. tip damage only:
  - 7.9% reduction in test weight (53.4 vs. 58 lbs.)
  - 680% increase in damaged kernels (26.7 vs. 4%)
  - Significant increase in fumonisin levels

FAW (Fall Armyworm) damage and mycotoxins

<table>
<thead>
<tr>
<th>EAR STATUS</th>
<th>FUMONISIN (PPM) (SD)</th>
<th>AFLATOXIN (PPB) (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minor tip damage</td>
<td>11.5 (4.6)</td>
<td>6.9 (13.4)</td>
</tr>
<tr>
<td>Average tip damage</td>
<td>33.6 (8.8)</td>
<td>12.0 (12.3)</td>
</tr>
<tr>
<td>FAW damage lower 2/3 of the ear</td>
<td>69.8 (5.6)</td>
<td>11.7 (14.4)</td>
</tr>
</tbody>
</table>

ANOVA’s conducted on Log transformed mycotoxin levels.

Fumonisin Treatment Prob > F < 0.0037. Means separated by t-test.
*P* value = 0.0509 (not quite significant at the 0.05 level of probability)
Aflatoxin Treatment Prob > F < 0.1266 (no significant differences)
Fusarium in Sorghum

- Fusarium stalk (and root) rot
  - Fusarium root and stalk rot, caused by Fusarium thapsinum, F. proliferatum, F. moniliforme, F. graminearum, others.
  - Usually found in same areas where charcoal rot develops.
  - Most severe in drought-stressed plants.
  - The pith in the lower stalk appears red, outside of the stalk remains green.

Fusarium root rot (seedling damping off, seedling blight)

Fusarium on the stalk and head

- Fusarium stalk rot
- Fusarium head mold

Climbing the “Probability Ladder” for Foliar Disease Problems.

- Susceptible host
- Continuous crop
- No-till
- Planting Date
- Yield potential
- Irrigation
- Disease activity after flowering

Testing for DON in wheat- “quick’ method used (June 15, 2015)

- Qualitative procedures/tests can detect at positive levels (> 1ppm) or negative (<1 ppm).
- If greater than 1ppm, quantitative testing needs to be done to determine actual concentration of DON.
- One sample tested had 65% shriveled kernels (from 4 heads), 2 grams of ground seed was tested = Negative. Therefore, FHB ≠ DON.
THANK YOU

For more information:

http://sickcrops.tamu.edu