Integrated Management for Wheat Diseases

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Outline

- **Yield Response to Foliar Fungicides**
- Guidelines for using foliar fungicides
- Head scab – practices to reduce the incidence and severity of scab
- What fungicides can help control head scab?

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2008 Foliar Fungicide Trials

- Arlington and West Madison ARS
  - Effect of winter wheat variety and fungicide timing on yield
- West Madison ARS
  - Winter wheat foliar fungicide efficacy trial

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Growth Stages

- Feekes Scale:
  - F5/6 = Stem elongation into jointing
  - F7 = Formation of two nodes
  - F8 = Flag leaf appearance
  - F9 = Early boot stage
  - F10.5 = Heading complete
  - F10.5.1 = Beginning of flowering

Variety x Timing

- Varieties: Kaskaskia and P 25R47
- Fungicides:
  - Quilit, 13 oz/A @ F7
  - Quilt, 7 oz/A @ F7 fb Quilt, 13 oz/A @ F8
  - Quilt, 14 oz/A @ F8
  - Quilt, 14 oz/A @ F10.5
  - Proline, 5 oz/A @ F10.51
- Disease assessments were made twice: 17 May (plot scale) and 23 June (10 stems per plot)

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Arlington

- Varieties were different (P =0.01, LSD = 6.7)
  - Kaskaskia, 80.0 bu/A
  - P 25R47, 96.4 bu/A
- Fungicides were different (P = 0.019, LSD = 4.9)

UTC	87.2 bu/A
Quilt, 13 oz/A, F7	87.0 bu/A
Quilt, 7 oz/A @ F7 fb 13 oz/A @ F8	89.3 bu/A
Quilt, 14 oz/A @ F8	87.5 bu/A
Quilt, 14 oz/A @ F10.5	83.4 bu/A
Proline, 5 oz/A @ F10.51	94.6 bu/A

- No interaction
- Primary disease issue...more later

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West Madison

- Varieties were different (P = 0.02, LSD = 7.9)
  - Kaskaskia, 103.6 bu/A
  - P 25R47, 118.8 bu/A
- No differences among fungicide treatments
- No interaction between variety and fungicides
- Why no response?

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Efficacy Trial

- Variety: Kaskaskia

- Fungicides: 15 (including experimentals)
  - Applications were either at F9 () or a combination application of F5/6 fb F9

- Disease assessments were made on:
  - 1 May, 20 May and 31 May (plot estimate)
  - 24 June (10 stems per plot)

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Summary of Results

- Yield ranged from 86.7 to 98.6 bu/A
- The following treatments had yields higher than the untreated check (P = 0.003, LSD = 6.2)
  - Headline @ F9, + 7.2 bu/A
  - Quilt @ F9, + 10.2 bu/A
- Early (F5/6) + Late (F9) applications, while higher than untreated check, were not different from single application @ F9

2008 Fungicide Summary

- Results from the 2008 trials indicated that yield differences were influenced by:
  - Variety
  - Fungicide product
  - Application timing
  - Disease pressure

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- Yield Response to Foliar Fungicides
- **Guidelines for using foliar fungicides**
- Head scab – practices to reduce the incidence and severity of scab
- What fungicides can help control head scab?

Integrated Management for Foliar Fungicides

- Commit to scouting the field
- Determine the potential number of applications
- Know the disease reaction for the wheat variety planted
- Estimate crop yield potential
- Know the disease(s)
- Scout fields
- Determine disease levels
- Select fungicide
- Understand the risks

Adapted from Hershman and Hollier. 2008. Chapter 38, *Plant Pathology Concepts and Laboratory Exercises*

Scouting

- Identify the **growth stage**
- The **flag leaf** and its **importance**
- **Scout** the **entire field** and make assessments from **different locations**
- Identify current **diseases** and **severity** levels

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The Flag Leaf

- Fungicide applications are based on the risk of disease on the flag leaf
- Flag leaf becomes visible during Feekes 8
- Most important leaf for yield, accounting for upwards of 50% or more of final yield
- Disease on this leaf at scouting may indicate it is too late for a fungicide to reduce the effects of disease - scout early!

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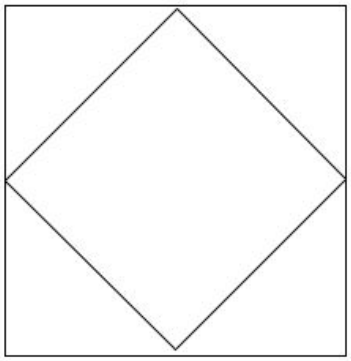
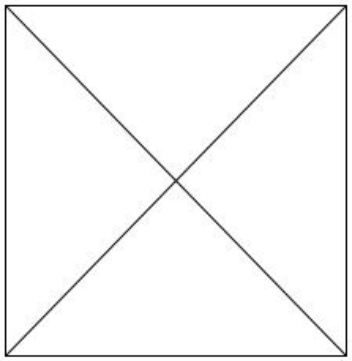
Scouting the Field

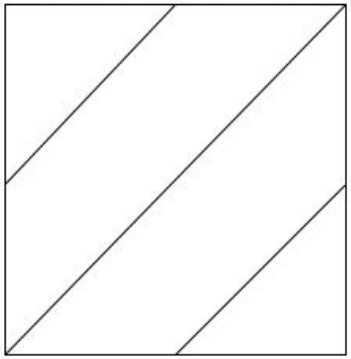


Diamond-shaped

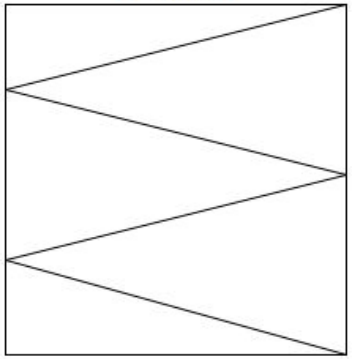


X-shaped

Triple diagonal-shaped



W-shaped



- Scout 10 locations within field
- Examine 10 plants selected at random from each of the locations
- Assess disease presence/absence (**incidence**) and how much area is infected (**severity**)

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What Are We Looking For?

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Powdery Mildew

- *Blumeria graminis*
- **Symptoms include powdery white to gray fungal growth**
- Symptoms on leaves, stems and heads
- Pustules first on lower leaves
- **Late symptoms: small, black fruiting bodes (cleistothecia) that contain spores (ascospores)**

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Powdery Mildew

- Primary inoculum = spores on volunteer wheat or spores within cleistothecia
- Infections first occur in fall
- Spores dispersed by wind
- Infection favored under **cool** (50 to 71 °F), **wet weather**
- **High relative humidity**
- Management: resistance; fungicide seed treatments; foliar fungicides when applied between Feekes 6 (1st detectable node) and 8 (flag leaf is visible); balanced fertility (avoid high nitrogen)

Septoria Leaf Blotch

- *Septoria tritici*
- Symptoms often part of complex with Glume blotch
- **Light green to yellow spots between leaf veins on lower leaves** (contact with soil)
- Symptoms elongate: irregularly shaped lesions that are tan to red-brown
- **Lesions age = black speckles (pycnidia) can be seen on lesion (good diagnostic sign)**

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Septoria Leaf Blotch

- Two phases
  - Fall just after wheat sown
  - Spring/summer on upper leaves
- Inoculum source = pycnidia on infested residue (survive 2-3 years) or mycelia in disease live wheat
- Infection favored by **cool conditions**: 59 to 68 ºF
- Six hours of **leaf wetness** required (maximum infection with 48 hours)
- Management: certified disease seed with seed fungicide treatment; some resistance; rotation of at least 2 years; foliar fungicides

Glume Blotch

- *Stagonospora nodorum*
- Symptoms often part of complex with Septoria leaf blotch
- **Brown spots on glumes (outer chaff), lemmas (inner chaff), and awns**
- Damage later (near maturity)
- Symptoms most common at tips
- **Diagnostic indicator = presence of small, round brown or black specks (pycnidia) - can be difficult to see with naked eye**

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Glume Blotch

- Similar disease cycle to Septoria leaf blotch
- Primary inoculum = seed or crop residue
- Spores dispersed via wind or rain
- **Temperatures** for infection: 68 to 81 ºF
- **Leaf wetness**: 6 to 16 hours
- Pycnidia can produce spores
- Management: certified disease seed with seed fungicide treatment; some resistance; rotation of at least 2 years; foliar fungicides

Wheat Leaf Rust

- *Puccinia triticina*
- Rust monitoring: Cereal Disease Laboratory (www.ars.usda.gov/Main/docs.htm?docid=9757)
- **Reddish-orange spore mass** (pustules or uredinia)
- Approximately 1/32 inch long and 1/64 inch wide
- **Initial symptoms in lower canopy that will progress upwards**

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Wheat Leaf Rust

- Survival = either in live winter wheat (mycelia) or on infested dead leaves (urediniospores)

- Infection favored by **moisture** on leaves (6-8 hours of **dew**) and **temperatures** from 60 to 80 ºF
  - In general, cool nights and warm days favor

- Management: resistance; fungicides (timing and severity of disease); fertility (excess nitrogen increases susceptibility)

Cereal Disease Laboratory : Home

http://www.ars.usda.gov/Main/docs.htm?docid=9757

cereal disease laboratory

Scientific C...at Evergreen | http://grou.../r-help-isu | STATSnetBAS...ces Online | Steenbock M...in Madison | Novell WebAccess | Corn and Soy...g for profit | Cereal Disea...tory : Home | Elsevier Edi...System -FCT

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Home

Cereal Rust Situation Reports and Cereal Rust Bulletins

Reports on the Current Rust Situation in the U.S. (*from the* Cereal Rust Survey Listserv list)

2007 Cereal Rust Bulletins:

- Bulletin #1 (3/21/2007)
- Bulletin #2 (4/17/2007)
- Bulletin #3 (5/1/2007)
- Bulletin #4 (5/16/2007)
- Bulletin #5 (5/30/2007)
- Bulletin #6 (6/12/2007)
- Bulletin #7 (6/27/2007)
- Bulletin #8 (7/17/2007)
- Bulletin #9 (7/31/2007)
- Bulletin #10 (Final bulletin for 2007)

Stem rust observation maps
(maps are updated as observations are received)
Please be aware these are large files.

2007

- Wheat (updated 7/30/07)
- Oat (updated 7/30/07)

2006

- Wheat
- Oat

Archived Cereal Rust Bulletins

- 2006
- 2005
- 2004
- 2003
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- 2000
- 1999
- 1998
- 1997
- 1996
- 1995
- 1994

Puccinia Pathway

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Wheat Stripe Rust

- *Puccinia striiformis (Puccinia striiformis* f. sp. *tritici*)
- **Yellowish, long stripes between veins** (leaves and sheaths) that have masses (pustules) of yellow spores
- Young plants = pustules appear in blotches
- Older plants = parallel striping that is distinctive
- **Difference from leaf or stem rust = appearance of reddish brown spore in those diseases**
- **Difference from Septoria leaf blotch = presence of gray leaf blotch with black fruiting body**

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Wheat Stripe Rust

- Life cycle is similar to leaf rust
- Initial source of inoculum = urediniospores that survive in crop residue
- Spores are formed during cool, wet weather and are wind-dispersed
- Infection favored by **moisture** on leaves (4-6 hours) and **temperatures** from 50 to 60 ºF
  - **Disease progression is ceased when temperatures > 70 ºF**
  - Warmer than normal winters followed by cooler April temperatures favor epidemics
- Management: resistance; fungicides (timing and severity of disease)

Tan Spot

- *Pyrenophora tritici-repentis*
- Symptoms include small tan, spots (lens-shaped)
- **Tan to brown, round to slightly elongate spot surrounded by yellow halo**
- **Center spot often diamond-shaped**
- **Plant matures: fungus invades straw - tiny black, raised fruiting structures (pseudothecia) formed**
- Severe infections: red smudge on seed (quality downgraded)

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Tan Spot

- Highest risk: wheat following wheat
- Primary source of inoculum = ascospores (found in crop residue)
- Initial infections under **cool**, **cloudy**, **humid** weather and **frequent spring rains**
- **Infection of wheat seed found to be positively correlated with severity of tan spot on flag leaf**
- Management: resistance (multiple mechanisms); foliar fungicides (application earlier than for rusts); tillage and rotation help reduce survival and infection

Source Information – Foliar Fungicides

- Boerboom, C., et al. 2007. Pest Management in Wisconsin Field Crops, UW-Extension, A3646.
  - Table 5-4, Page 192 = Fungicides for control of foliar diseases of small grains
  - Table 5-5, Page 193 = Seed treatment fungicides for small grains
  - Always consult the label for up-to-date information

Outline

- Yield Response to Foliar Fungicides
- Guidelines for using foliar fungicides
- Fungicide seed treatment effects on winter wheat yields
- **Head scab – practices to reduce the incidence and severity of scab**
- What fungicides can help control head scab?

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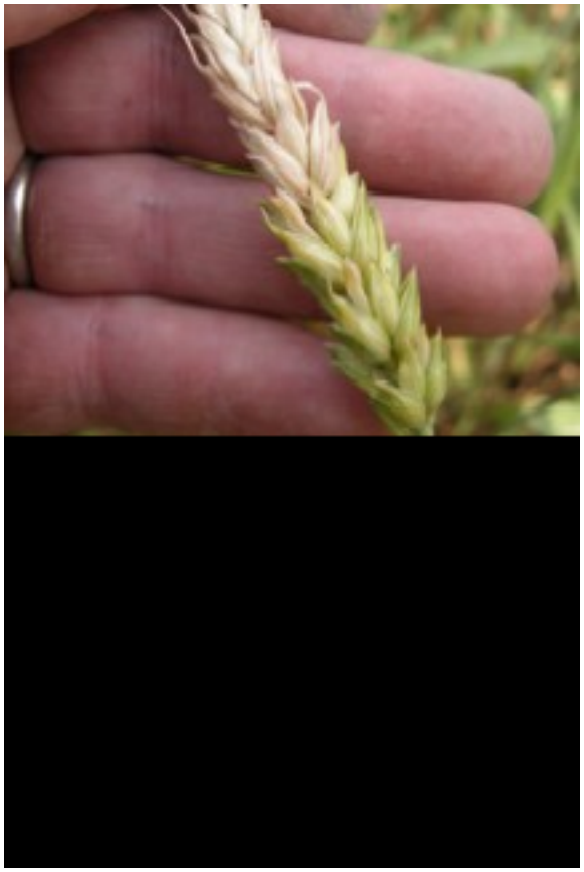
Fusarium Head Scab (Blight, FHB)



- *Fusarium graminearum*
- Any part or all of wheat head may appear **bleached**
- Often, part bleached, part green
- Infected spikelets and glumes = **salmon-colored spore masses of fungus** (prolonged periods of wet weather)
- Immediately below head, stem may be infected and have brown or purplish discoloration
- **Kernels shriveled and lightweight**
- Kernels with “tombstone” appearance = dull grayish or pinkish color (not consistent symptom)

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FHB

- Inoculum sources = crop residue; organism surviving soil
- Same organism that causes **Gibberella stalk rot (corn)**
- Spores wind or rain disseminated
- Infection occurs when spores land on heads (florets) of wheat
- Infection favored by prolonged periods of **rain** (or **dew**), high **relative humidity** and **temperatures** from 65 to 85 ºF
- Toxin concern: deoxynivalenol (DON) and zearalenone
- Management:
  - Rotation (avoid wheat after corn)
  - Fungicide sprays
  - Prediction tool: flowering date, wheat class (spring/winter), production practices

Flowering

- The highest risk of infection by *G. zeae* in wheat is when the female flowers are open
- Flowering begins during Feekes 10.5.1

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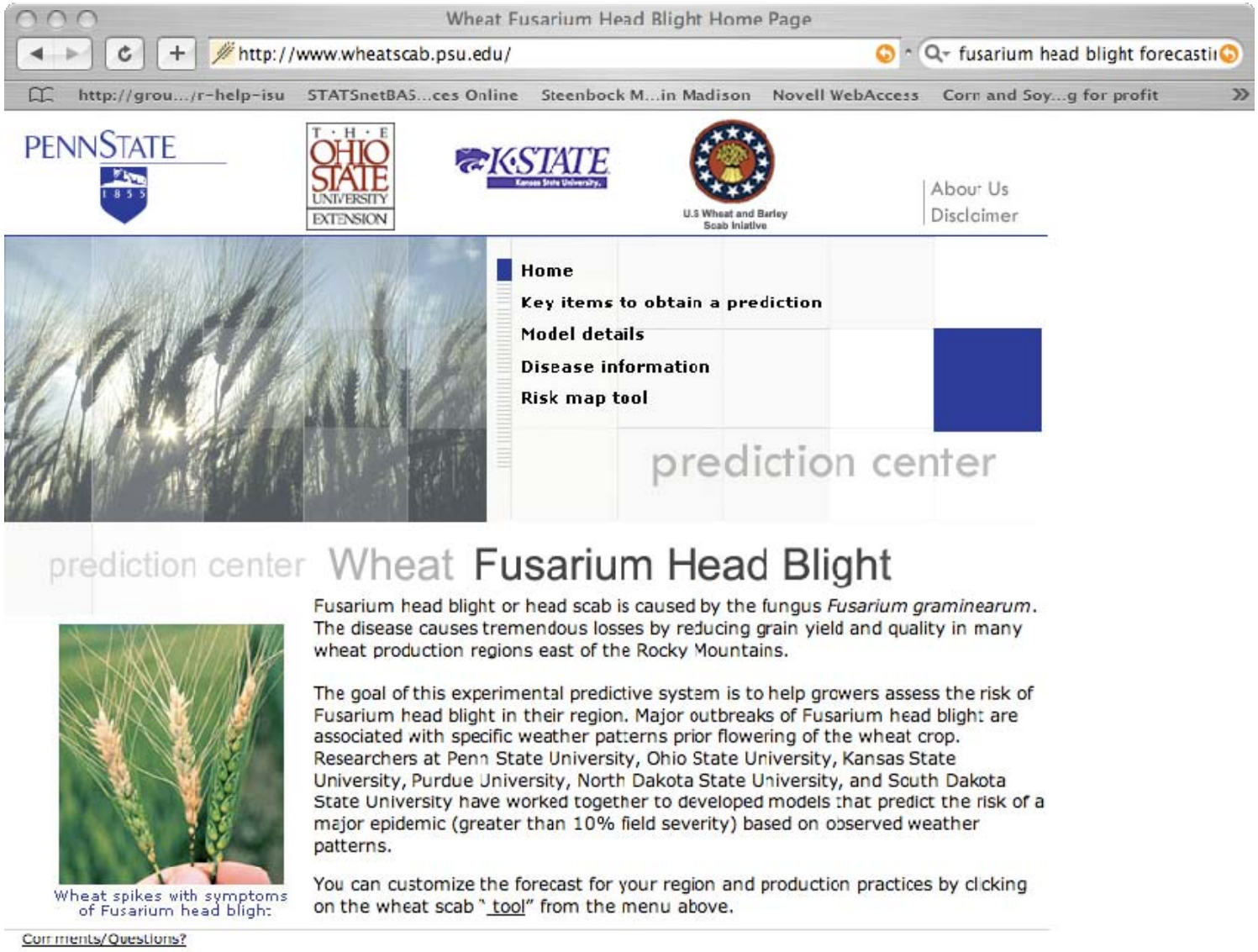

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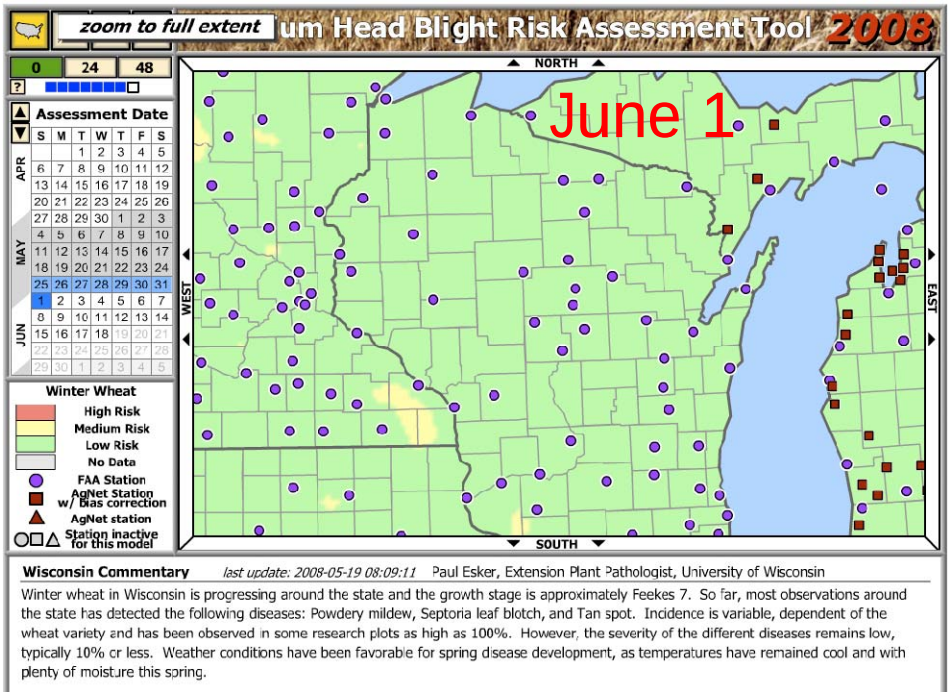
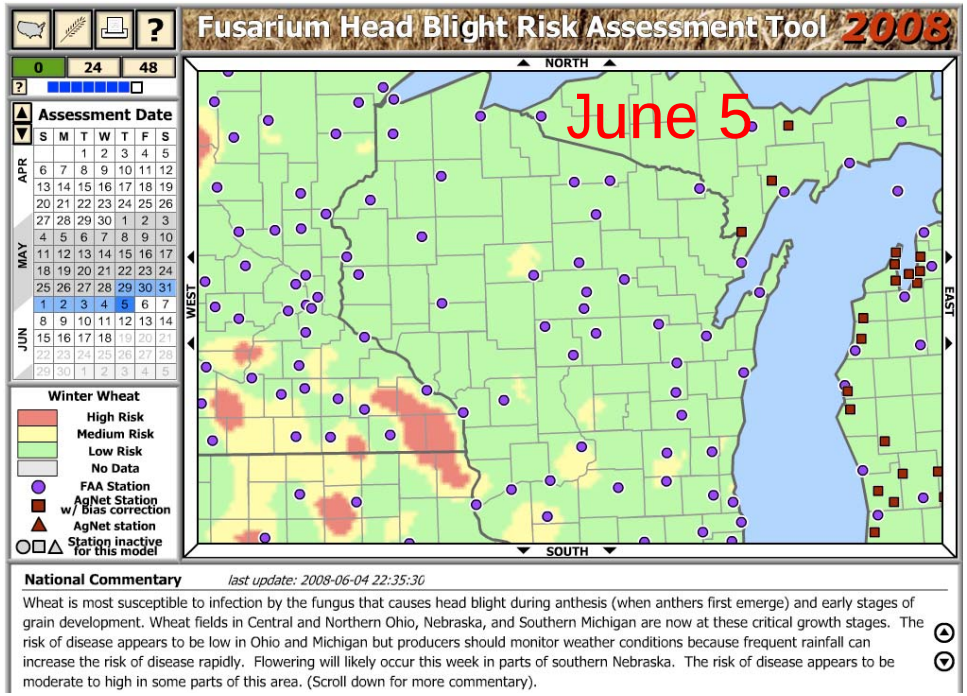
zoom to full extent um Head Blight Risk Assessment Tool 2008



Wisconsin Commentary *last update: 2008-05-19 08:09:11* Paul Esker, Extension Plant Pathologist, University of Wisconsin

Winter wheat in Wisconsin is progressing around the state and the growth stage is approximately Feekes 7. So far, most observations around the state has detected the following diseases: Powdery mildew, Septoria leaf blotch, and Tan spot. Incidence is variable, dependent of the wheat variety and has been observed in some research plots as high as 100%. However, the severity of the different diseases remains low, typically 10% or less. Weather conditions have been favorable for spring disease development, as temperatures have remained cool and with plenty of moisture this spring.

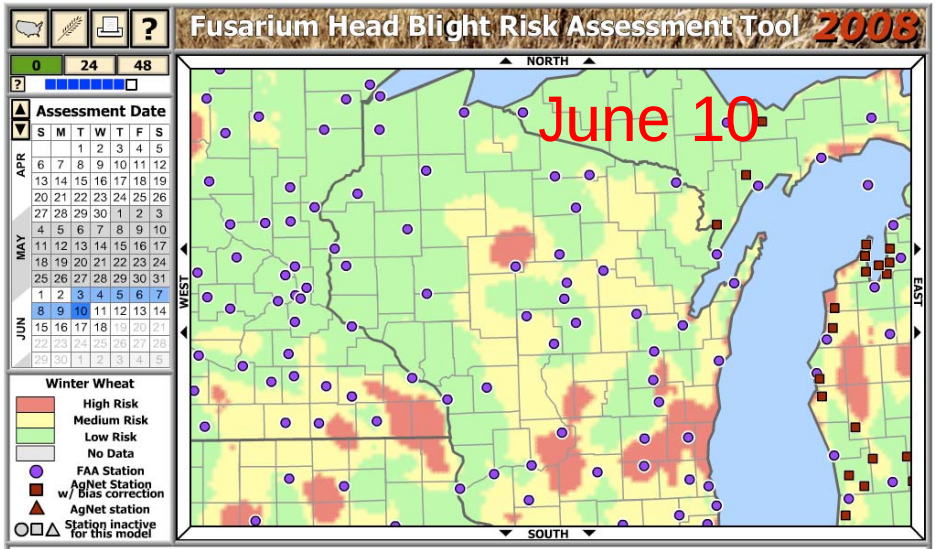
Fusarium Head Blight Risk Assessment Tool 2008



National Commentary *last update: 2008-06-04 22:35:30*

Wheat is most susceptible to infection by the fungus that causes head blight during anthesis (when anthers first emerge) and early stages of grain development. Wheat fields in Central and Northern Ohio, Nebraska, and Southern Michigan are now at these critical growth stages. The risk of disease appears to be low in Ohio and Michigan but producers should monitor weather conditions because frequent rainfall can increase the risk of disease rapidly. Flowering will likely occur this week in parts of southern Nebraska. The risk of disease appears to be moderate to high in some parts of this area. (Scroll down for more commentary).

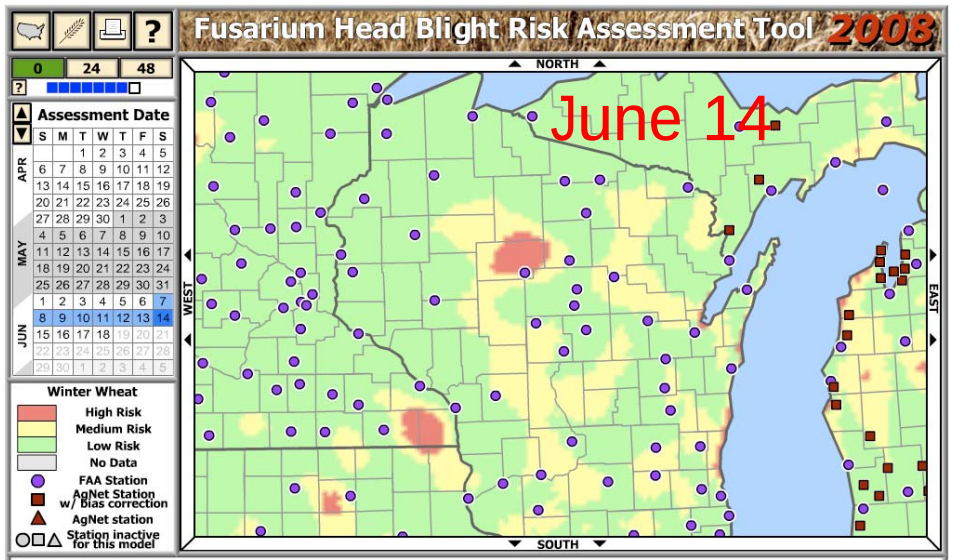
Fusarium Head Blight Risk Assessment Tool 2008



Wisconsin Commentary *last update: 2008-06-08 19:08:40* Paul Esker, Extension Plant Pathologist, University of Wisconsin

We are entering a critical period for wheat scab in the state. The most up-to-date risk maps indicates that we have moved into a moderate to high risk in the southern portions of Wisconsin. In the past few days, we have seen temperatures move into the lower 80's with high humidity and heavy rainfall. As our our wheat assessments late last week, the growth stage ranged from Feekes 9 (when the ligule of the the flag leaf is visible) to Feekes 10.3- 10.4 (heading almost complete). Flowering should be occurring during the next seven days or so, which is also the most favorable period for head scab development and vomitoxin accumulation. Growers should be actively scouting their fields, also for determination of wheat leaf rust and wheat stripe rust. Many of the current fungicides cannot be used after Feekes 10.5 or 10.5.2, so

Fusarium Head Blight Risk Assessment Tool 2008



Wisconsin Commentary *last update: 2008-06-11 07:37:22* Paul Esker, Extension Plant Pathologist, University of Wisconsin

June 11, 2008 Update

The past few days has seen extensive rainfall in parts of Wisconsin, along with low-lying flooding. The current risk model has increased the risk of scab in parts of the state. Flowering is beginning in some wheat fields, which also coincides with the greatest risk for infection. Please check http://thesoyreport.blogspot.com/ for our latest information regarding effective fungicide timing for winter wheat.

Arlington

- Varieties were different ($P < 0.10$, LSD = 6.7)
  - Kaskaskia, 80.0 bu/A
  - P 25R47, 96.4 bu/A
- Fungicides were different ($P < 0.10$, LSD = 4.9)

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Proline, 5 oz/A @ F10.51	**94.6 bu/A**

- Yield gain ranged from 5.3 to 7.6 bu higher

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Variety Trials

- Fusarium head blight was variable around the state in 2008
- Most uniform location for FHB was Lancaster (consult A3868)
  - FHB index: 0-100, where 0 indicates no disease and 100 = complete infection
  - Index ranged from 0.8 to 8.9 (0-100 scale)
  - 0.8 in Truman (Public), which has resistance
- Some reports of dockage
  - Example: $0.25/bu for DON levels > 2.0 ppm

Fungicides for Head Scab

- Best timing = Feekes 10.51
- No product provides 100% control
- Some products include:
  - Caramba (BASF), metconazole
  - Folicur (Bayer CropScience), tebuconazole
  - Proline (Bayer CropScience), prothioconazole
  - Tilt (Syngenta), propiconazole
  - Prosaro (Bayer CropScience), prothioconazole

Fungicide Timing - PHI

- In 2008, there were reports of grain in Kansas being held up for residue analysis
- Always consult the label regarding application timing, amounts, and restrictions
- For example:
  - Tilt: “Do not apply within 30 days of harvest for forage, 40 days before harvest for grain and straw, and 45 days before harvest for hay.”
  - Proline: “A maximum of 9.37 fl oz. of PROLINE® 480 SC may be applied per acre per year. Do not apply two applications at 5.7 fl oz per acre per year. PROLINE® 480 SC may be applied up to the point where wheat heads are in the full flower growth stage (Feekes 10.52). Do not apply within 30 days of harvest. **Hand-harvesting is prohibited.”**

Management Tactic	Diseases Affected
Rotation	Fusarium head blight; Septoria leaf blotch; Glume blotch; Tan spot
Resistance	Wheat leaf rust; Wheat stripe rust; “Septoria leaf blotch”; “Glume blotch”; Powdery mildew; Tan spot
Seed fungicides	**Loose smut; Septoria leaf blotch; Glume blotch**
Foliar fungicides	**Fusarium head blight; Wheat leaf rust; Wheat stripe rust; Septoria leaf blotch; Glume blotch; Powdery mildew; Tan spot**
Soil fertility	Wheat leaf rust; Powdery mildew

Some Recent Articles

- Wisconsin Crop Manager:
  - Foliar Fungicides for Winter Wheat in 2008, 10 April 2008
  - Identifying wheat diseases controlled by foliar fungicides, 10 April 2008
  - Understanding and using the Fusarium head blight prediction center, 24 April 2008
  - Flag leaf emergence and foliar fungicides in winter wheat, 29 May 2008
  - Wheat scab beginning to occur in Wisconsin, 26 June 2008
- The Soy Report (http://thesoyreport.blogspot.com)
  - Postings have included observations and discussions of scouting for wheat diseases, wheat rust risk, fungicide decisions, head scab updates and information from harvest and DON testing.
  - To sign up, please discuss with Shawn Conley

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