Managing Wheat for Top Yields and Grain Quality

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Outline

- Seedbed Preparation
- Planting
- Growth stages
  - Tillering
  - Jointing
- Mid-season management
  - Nitrogen
  - Insecticides
  - Fungicides
- 2014 TN Wheat Quick Facts
Seedbed Preparation

• Prior crop harvest (very important if in a no-till system)
  – Chop and spread residue evenly behind the combine to the width of the header
    • A ‘windrow’-like concentration of the residue behind the combine is difficult to manage
      – Variability will exist in moisture under residue versus ‘bare’ soil
      – Subsequent issues with trafficability and consistency in seedbed
      – Difficulty placing seed at a consistent depth across planter
    • Even residue spread?
      – More consistent seedbed
        » Uniform moisture content across planter width
        » Easier planter set-up, more consistent depth placement of the seed and therefore more uniform stands
    • Very important for maintaining high yield potential

• Seedbed
  – Firm, weed-free, preferably well-drained
  – No-till
    • No-till is an excellent option on many TN acres
      – Less fuel, labor; very similar yields
    • If weeds are present, a burn-down herbicide should be applied
  – Conventional tillage
    • Disking at 2-4” typically sufficient
    • Conduct tillage early enough for seedbed to settle and firm-up
  – Wheat prefers well-drained soils
    • Water requirements for wheat are quite a bit lower than the seasonal rainfall received in TN
Planting

• Variety Selection
  – Arguably, one of the most important decisions made each year
  – Select high yielding, STABLE, disease resistant, adapted varieties
    • It is almost always a good idea to plant more than one variety!
      – Seasonal characteristics generally favor a given variety over others
      – Planting multiple varieties buffers you from potential loss associated with selecting only one variety
    • The University of Tennessee conducts variety trials throughout the state on 85+ varieties yearly
      – Resist the temptation to select varieties based on one site-year
        » The highest yielding variety from a given site-year may not be a consistent performer
        » ‘Stability’ is critical and should be considered.
      – Best selection method? Examine state averages and then move to location results.

varietytrials.tennessee.edu
Planting

• Planting Date
  – TN- between October 15 and November 10
    • Goal is to have a well-rooted plant with 3-4” top growth before December 21 (first day of winter)
    • Should attempt to find the ‘sweet spot’ between early and late planting
      – early planting
        » promotes sufficient growth to survive winter
          • Less prone to heaving
          • Established plant can survive lower temperatures
        » too early?
          • Excessive fall growth
          • Greater chance of spring freeze injury (earlier head emergence)
      – late planting
        » suppresses some insect and disease infestations
          • Aphid/Barley yellow dwarf virus complex
          • Reduce Hessian fly issues
        » too late?
          • Insufficient growth to survive winter (issues mentioned above)
          • Push maturity back
          • Potentially reduce yields

• Planting depth
  – 1-1.5 inches
    • Places seminal roots at an ideal depth to support seedling development without overly-stressing the developing seedling’s coleoptile
Planting

- **Planting Method**
  - Function of equipment availability, labor, field trafficability (season), and crop use
  - Target stand is near 25 plants per square ft
  - From an agronomic standpoint, drilling is preferred
    - As a monocot, seminal roots form at the depth of the seed
      - Very important to seedling establishment
        » Too shallow? Many concerns!
    - Drilling allows for the placement of the seed (& seminal root system) at the ideal depth and spacing
    - Supports rapid, uniform stand establishment
      - Requires less seed to reach target plant population
      - Generally results in higher yields than broadcast/incorporated
    - Utilizing a no-till drill in the no-till system allows for prolonged erosion control without sacrificing consistent stands and high yields
    - Drilling? Target 1.5 to 2 bushels per acre (1.2 to 1.5 million plants per acre)
  - **Broadcast/incorporated is typically a faster method**
    - Seeding rate should be increased to between 2-3 bushels (increase the drilled rate by 30-35%)
      - This is to compensate for uneven seed placement which can result in less-than-ideal soil/seed contact, increased potential for animal predation, reduced germination/emergence and susceptibility to frost heaving of seeds.
      - This method typically results in lower yields than drilling
    - If broadcasted with fertilizer, mixture should not be allowed to sit after blending
  - **Aerial seeding?**
    - Last resort. Increase seed rates from drilling recommendations by 40-50%
Growth Stage

- First step for in-season management for high quality/yield?
  - Understand and be able to identify growth stage
  - This will allow the proper timing of inputs of nitrogen, insecticides, herbicides and fungicides

Image courtesy North Carolina State University; http://ipm.ncsu.edu/grain/smgrain521.html
Identification of Tillers

• ‘Tillering’ usually begins after three or four leaves have developed.
  – Primary tillers form in the axils of true leaves at the base of the main stem of the plant
  – Secondary tillers may develop from base of primary tillers
  – A coleoptilar tiller may form, but occurs sporadically and is influenced by many parameters
• Base of each tiller is a prophyll
  – Modified leaf which guides/protects developing tiller
  – Similar in function to the coleoptile
  – Identification can help in distinguishing developing tillers from main stem leaves

Image courtesy North Dakota State University;
http://www.ag.ndsu.edu/archive/entomology/ndsucpr/Years/2006/may/25/psci2.jpg
Tiller number and Yield

- Tiller number and wheat yield generally correlate very well to each other.
  - This is because tiller number frequently relates very strongly to head number (which in turn relates to wheat yield!)

- Number of tillers per foot (including mainstem) counted in late winter/early spring can be used to fine-tune nitrogen applications
  - Less than 70 tillers/ft at Feekes 3?
    - An additional 20 lb N added to the standard application near greenup can promote tillering and protect yield potential
      - Total of 50 lb N at greenup
  - Between 70 & 100 tillers/ ft at Feekes 3?
    - 30 lb N at green-up
  - In excess of 100 tillers per ft?
    - no green-up fertilizer N needed

Recommendations from, “High Yield Wheat Management” by Dr. Chad Lee, University of Kentucky

Proper heading is based on accurate seeding rates, proper placement of seed and strip seeding. Fertilizer should be spreader emplaced in the row and then covered by the blade. Early application of nitrogen to tillers might increase the crop, an early application would occur when wheat is about Feekes 2 or 3. If the crop is below 20 tillers per square foot, then an early application of nitrogen further than 30 lb/1000 square feet (about 70 lb per acre) can be added. When the crop is above 70 tillers per square foot, then no more than 20 lbs per 1000 square feet can be added. If the crop is above 100 tillers per square foot, then no application of nitrogen is needed.

Wheat can be managed and adjusted to fit the growth of wheat, which varies between years. In 2008, the total of both applications should be around 200 lbs per 1000 square feet for the initial and mid-season fertilizer N needed.

Proper nitrogen application is critical to the success of the crop. The rate of nitrogen depends on numerous factors. Proper application of nitrogen is critical to the success of the crop. Properly prepared beams for nitrogen will be determined by the distribution of the nitrogen applied. Proper nitrogen application is critical to the success of the crop.
Jointing Stage

• ‘Jointing’ and the beginning of the hollow-stem stage
  – Many growth-regulator herbicides cannot be applied after the jointing stage
  – After this growth stage, trafficking the field can decrease yields (wheels break stems)
  – Ideally, all N should be on prior to this stage (Feekes 6)
  – Similarly, for those managing dual-purpose wheat (grazing and harvesting grain) this is the stage grazing should be stopped
  – Best way to determine when this stage has begun?
    • Dig up wheat plant and identify main-stem
    • Feel for swollen bump on base of shoot (node)
    • Slice stem near crown and split stem (vertically up the stem)
    • Look at space between developing head and crown roots
      – ¼- ¾”? Hollow stem/jointing stage
  – Typically, no more yield-impacting tillers will develop after this stage
  – Maximum kernel number per head is determined at this stage

Image courtesy Purdue Extension; https://www.extension.purdue.edu/extmedia/ID/ID-422.pdf
Wheat N Considerations

- N uptake is very low for wheat in TN until after green-up
  - We typically see demand begin to increase by February 15th
    - Still low (relatively speaking) at this date
    - Usually between Feekes 2-3 at this date
    - Although demand is low, N applications in early February can increase tiller number (it is important this small N demand can be met!)

- N uptake has begun to increase exponentially by the jointing stage
  - Typically occurs after March 15th in TN

- Ideally application in time for movement into root zone and uptake

- Large applications in early January? Early February?
  - Far from peak demand
  - Increase potential for N loss

- Most states recommend little to no fall N

- TN recommends 15-30 lb N depending upon prior crop and planting date
  - Why? Little demand early!

- With that said, 2014 was an exceptionally wet year and many observed higher-than-expected yields
  - It is logical that many fields have less available N than they would in a more-normal crop year
For acres which did not receive fall N and did not follow beans-
  Preferred method is to wait until ‘greenup’ is about to occur and then assess tiller number. If necessary, then apply the first SPLIT of your target spring rate
  A split will:
    – Support tillering at ‘greenup’- thereby protecting yield potential
    – Reduce financial risks of applying entire spring application so early
      » Minimize potential for N loss
    – Reduce negative physiological impacts of large N applications in late winter
      » Large N applications in late winter can increase disease, burn, potential for streaking, encourage early heading and therefore potential for freeze damage
    – Allow adjustments to both timing and amount of the later-half of the split based on season

For acres which received fall N or are following beans
  – Again, assess tiller number
  – Benefits of split still apply (although many are slightly reduced)
  – If applying in a single-shot, target Feekes 4-5
Barley Yellow Dwarf

- **Bird Cherry-Oat Aphid**
  - Dark green in color
  - Most commonly responsible for transmission of BYDV
  - No thresholds established in TN, but early planted wheat is most susceptible
    - If planting early, insecticide seed treatments such as Gaucho, Cruiser, and NipsIt Inside can reduce transmission of BYDV
    - If no seed treatments are used, foliar applications during fall (within 30 days of planting) or late winter (prior to March) can reduce transmission
      - Trigger application during this period prior to populations exceeding eight aphids per foot of row (purpose of application to prevent the spread of BYDV)
Barley Yellow Dwarf

Yield Response of Wheat to Late Winter Foliar Insecticide

2007 - 2013 Planting Dates (untreated seed unless indicated)

Application January or February

<table>
<thead>
<tr>
<th>Year</th>
<th>Treatment</th>
<th>bushels per Acre</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>NipsIt</td>
<td>4.2</td>
<td>0.0504</td>
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<tr>
<td>2013</td>
<td>Gaucho</td>
<td>6.0</td>
<td>&lt; 0.05</td>
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<tr>
<td>2013</td>
<td>Gaucho treated</td>
<td>6.5</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>2012</td>
<td>NipsIt trt</td>
<td>5.5</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>2012</td>
<td>Cruiser</td>
<td>7.0</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>2012</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2011</td>
<td></td>
<td></td>
<td>&lt; 0.05</td>
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<tr>
<td>2010</td>
<td>Mississippi</td>
<td>9.0</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>2010</td>
<td>Gaucho treated</td>
<td>9.5</td>
<td>0.07</td>
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<td>2010</td>
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<tr>
<td>2007</td>
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</tbody>
</table>

Average for Trt Seed = 3.7 B/A
Average for Untrt Seed = 6.5 B/A
Growth Regulators

- Lodging can be a major issue in high-yield environments where large applications of N have been applied
- Agitated by high winds and/or excessive rainfall
  - Lodging can:
    - Slow harvest
    - Result in wheat yield loss in excess of 40%
    - Cause difficulty in planting the following crop
      - Standing residue easier to plant into
      - Combine head must run very close to ground
        » Increases residue which header takes in
        » Increases residue laying flat on the ground
    - Subsequent consistency issues in surface residue

Image courtesy Louisiana State University AgCenter; http://louisianacrops.com/wp-content/uploads/2014/06/Wheat-lodging.jpg
The ability to increase stem thickness and control plant height during the early stages of wheat development could theoretically reduce lodging potential.
Growth Regulators

- Syngenta has recently introduced a plant growth regulator (PGR) for the purpose of reducing lodging potential
- Palisade EC (Syngenta)
  - Also available as 2EC
  - Active ingredient- Trinexapac-ethyl
  - Proposed benefits:
    - Shorten internode to lower center of gravity.
      - Reduce loss due to lodging
        » Increase harvest speeds
        » Allows for increased N rates
        » Easier planting double crop beans
    - Target application timing: Feekes 4-8, Ideally target Feekes 5-7
    - Target rate: 10.5-14.4 fl oz/ac
    - Maximum rate of 14.4 fl oz/ac
    - 45 day pre-harvest interval
Growth Regulators

- Palisade EC Trial
  - Syngenta
Growth Regulators

- Palisade EC Trial
  - Syngenta

[Images of improved soybean planting, lodged wheat stubble, standing wheat stubble, treated and untreated fields]
Dr. Angela McClure conducted a Palisade strip trial in Crockett County during the spring of 2014

Objective:
- evaluate Palisade at N rates of 130 and 160 lb N/ac

Treatment
- Nitrogen
  - 30 lb Urea Fall 2013
  - 60 lb Urea in Jan 2014
  - Remainder (to result in total applications of 130, 160 or 190 lb N/ac – farmer was interested in highest rate) was applied as Ammonium Nitrate on March 26, 2014
- Palisade EC
  - Applied at Feekes 5 - right at the suggested target date
  - Applied with an insecticide, low rate of Stratego and a micronutrient product
  - Non-Palisade receiving controls received the same insecticide, low rate of Stratego and micronutrient product
Growth Regulators

- UT Extension Crockett County Palisade EC Trial
  - Results
    - All wheat (regardless of treatment) stood well through the season and no lodging was observed in the plots.
    - Due to noticeable water damage, one treatment has been omitted.
    - This work will be repeated during the 2015 season.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Number Reps</th>
<th>Bu/Acre at 13.5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palisade + 130 N</td>
<td>2</td>
<td>76.8</td>
</tr>
<tr>
<td>No Palisade + 130 N</td>
<td>3</td>
<td>76.3</td>
</tr>
<tr>
<td>Palisade + 160 N</td>
<td>3</td>
<td>81.2</td>
</tr>
<tr>
<td>No Palisade + 160 N</td>
<td>3</td>
<td>84.9</td>
</tr>
<tr>
<td>130 N (treated and untreated plots)</td>
<td>6</td>
<td>76.9</td>
</tr>
<tr>
<td>160 N (treated and untreated plots)</td>
<td>7</td>
<td>81.3</td>
</tr>
<tr>
<td>190 N (treated and untreated plots)</td>
<td>3</td>
<td>83.5</td>
</tr>
</tbody>
</table>
• Understanding growth stage is also critical for determining if fungicide applications are necessary, and if so, when to time these applications.
Fungicides
(2014 Jointing/Heading Applications)

Non-treated yielded 110 bu/a
*Significantly greater than non-treated (at $P \leq 0.1$)

<table>
<thead>
<tr>
<th>Fungicide</th>
<th>Jointing</th>
<th>Heading</th>
<th>Jointing + Heading</th>
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</thead>
<tbody>
<tr>
<td>Headline (6)</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Quilt Xcel (14)</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Prosaro (6.5)</td>
<td>0</td>
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<tr>
<td>Tilt(4)+ Proscar(6.5)</td>
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<tr>
<td>Quilt Xcel(14)+ Proscar(6.5)</td>
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<td>0</td>
</tr>
<tr>
<td>Headline(6)+ Proscar(6.5)</td>
<td>0</td>
<td>0</td>
<td>0</td>
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</tbody>
</table>

- Trial Conducted by Dr. Heather Young-Kelly
- Two different locations in 2014, but significant response only noted at one location
- Single applications made at two different timings
Fungicides
(2014 Flag Leaf Application)

- Trial Conducted by Dr. Heather Young-Kelly
- Two different locations in 2014, but significant response only noted at one location
- Very low disease pressure

Change in Yield (bu/a) 2014

Non-treated yielded 85 bu/a
*significantly greater than non-treated (at $P \leq 0.05$)
## Fungicides

Table covering efficacy of fungicides for wheat disease control based on appropriate application timings:
UTcrops.com (Wheat → Insects & Diseases)

### Efficacy of fungicides for wheat disease control based on appropriate application timing

<table>
<thead>
<tr>
<th>Class</th>
<th>Active ingredient</th>
<th>Product</th>
<th>Rate/A (fl. oz)</th>
<th>Powdery mildew</th>
<th>Stagonospora leaf/stem blight</th>
<th>Septoria leaf blight</th>
<th>Tan spot</th>
<th>Stripe rust</th>
<th>Leaf rust</th>
<th>Stem rust</th>
<th>Head scab</th>
<th>Harvest Restriction</th>
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</thead>
<tbody>
<tr>
<td><strong>Strobilurin</strong></td>
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<tr>
<td>Picoxystrobin 22.6%</td>
<td>Aproach SC</td>
<td>6.0 - 12</td>
<td>G</td>
<td>--</td>
<td>VG</td>
<td>VG</td>
<td>E</td>
<td>VG</td>
<td>NR</td>
<td>30 days</td>
<td>30 days</td>
<td>Foomes 10.5 and 45 days</td>
</tr>
<tr>
<td>Fluoxastrobin 40.3%</td>
<td>Evito 480 SC</td>
<td>2.0 - 4.0</td>
<td>G</td>
<td>--</td>
<td>VG</td>
<td>--</td>
<td>VG</td>
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<td></td>
<td></td>
<td>Foomes 10.5 and 40 days</td>
</tr>
<tr>
<td>Pyraclostrobin 23.6%</td>
<td>Headline SC</td>
<td>5.0 - 9.0</td>
<td>G</td>
<td>VG</td>
<td>VG</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td></td>
<td>G</td>
<td>Foomes 10.5</td>
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<td><strong>Triazole</strong></td>
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<tr>
<td>Metconazole 6.6%</td>
<td>Caramba 0.75 SL</td>
<td>19.0 - 17.0</td>
<td>VG</td>
<td>VG</td>
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<td>VG</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>G</td>
<td>30 days</td>
<td>Foomes 10.5</td>
</tr>
<tr>
<td>Propiconazole 41%</td>
<td>Tilt 3.6 EC</td>
<td>4.0</td>
<td>VG</td>
<td>VG</td>
<td>VG</td>
<td>VG</td>
<td>VG</td>
<td>VG</td>
<td>VG</td>
<td>G</td>
<td>30 days</td>
<td>Foomes 10.54</td>
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<tr>
<td>Prothioconazole 41%</td>
<td>Proline 480 SC</td>
<td>5.0 - 5.7</td>
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<td>VG</td>
<td>VG</td>
<td>VG</td>
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<td>VG</td>
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<td>G</td>
<td>30 days</td>
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<tr>
<td>Tebuconazole 38.7%</td>
<td>Foilcur 3.6 F³</td>
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<td>VG</td>
<td>VG</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>F</td>
<td>30 days</td>
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<tr>
<td>Prothioconazole 19%</td>
<td>Prosaro 421 SC</td>
<td>6.5 - 8.2</td>
<td>G</td>
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<td>VG</td>
<td>VG</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>G</td>
<td>30 days</td>
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<td><strong>Mixed modes of action</strong></td>
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<tr>
<td>Metconazole 7.4%  Pyraclostrobin 12%</td>
<td>TwinLine 1.75 EC</td>
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<td>VG</td>
<td>VG</td>
<td>VG</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>VG</td>
<td>NL</td>
<td>Foomes 10.5</td>
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<tr>
<td>Fluxapyroxad 14.3%  Pyraclostrobin 28.6%</td>
<td>Priaxor</td>
<td>4.0 - 8.0</td>
<td>G</td>
<td>VG</td>
<td>VG</td>
<td>VG</td>
<td>E</td>
<td>VG</td>
<td>VG</td>
<td>G</td>
<td>NL</td>
<td>Foomes 10.5</td>
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<tr>
<td>Propiconazole 11.7% Azoxystrobin 7.0%</td>
<td>Quilt 200 SC³</td>
<td>19.5 - 14.0</td>
<td>VG</td>
<td>VG</td>
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<td>VG</td>
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<td>VG</td>
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<td>Propiconazole 11.7% Azoxystrobin 13.5%</td>
<td>Quilt Xcel 2.2 SE</td>
<td>19.5 - 14.0</td>
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<td>VG</td>
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<td>VG</td>
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<td>Foomes 10.5</td>
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<td>VG</td>
<td>VG</td>
<td>VG</td>
<td>VG</td>
<td>NV</td>
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<td>Foomes 10.5 35 days</td>
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<td>Cyproconazole 7.17% Picoxystrobin 17.94%</td>
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<td>--</td>
<td>VG</td>
<td>VG</td>
<td>E</td>
<td>VG</td>
<td>--</td>
<td>NR</td>
<td>45 days</td>
<td></td>
</tr>
</tbody>
</table>

1. Efficacy categories: NL=Not Labeled; NR=Not Recommended; P=Poor; F=Fair; G=Good; VG=Very Good; E=Excellent; -- = Insufficient data to make statement about efficacy of this product.
2. Efficacy may be significantly reduced if only strobilurin products are applied after stripe rust infection has occurred.
3. Multiple generic products containing the same active ingredients also may be labeled in some states. Products including tebuconazole include: Embrace, Monsan, Muscle 3.6 F, Onset, Oxilus 3.0 F, Tebucon 3.6 F, Tebuzol 3.6 F, Tegrol, and Toledo. Products containing propiconazole include: Bumper 41.6 EC, Fitness, Propiconazole E-AG, and PropiMax 3.6 EC. Products containing propiconazole + azoxystrobin include: Avans 200 SC.
4. Products with mixed modes of action generally combine triazole and strobilurin active ingredients. Priaxor is an exception to this general statement and combines carboxamide and strobilurin active ingredients.
Many are concerned with DON after 2014.

Visit the site as the crop in your area is approaching heading and flowering. You can customize the prediction by selecting a state, use the winter wheat model. You can also select different assessment dates through a calendar interface.

http://www.wheatscab.psu.edu/
FHB Forecasting Model

- May 4, 2013

**Winter Wheat Model** - model with **moisture** and **temp** parameters

Model with **moisture** parameter only

[http://www.wheatscab.psu.edu/](http://www.wheatscab.psu.edu/)
Disease Management in 2015?

• Watch the weather
  – Relatively warm?
  – Relatively wet?

• Use FHB Forecasting website
  (http://www.wheatscab.psu.edu/)

• Avoid QoI/Strobilurin fungicides around flowering
  – Can increase DON levels
  – Instead, use a Triazole
Disease Management

- Know your variety’s disease resistance/susceptibility level
- Scout for diseases
- Consider foliar fungicides if:
  - Disease is present
  - Can properly time application
  - Application can increase yields at a level to cover application cost and risk
    - Take into account price of wheat
- More information can be found at: UTcrops.com
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