Enhancing Yield of Wheat and Oat

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Field Research Manager
Cereal Yields are Increasing, but have not kept pace with Oilseeds and Pulses

- Yield potential of varieties
- Lodging
- Diseases
How do we increase yield?

- Genetic improvement increases yield potential
- Improved crop protection prevents yield loss
- Improved management (e.g., Fertilizer and seeding practices) helps crop to reach their full yield potential
Disease Management

- Cereals
  - Leaf diseases on Oat and Wheat
  - Fusarium on Wheat
Fungicide Response by Oat: 4 Trials at IHARF and NARF sites in 2012 and 2013

- Very little disease = No Fungicide response
  - Triactor has good disease resistance
- Some growers have seen good responses
  - AC Morgan with poorer disease resistance
  - Late seeding may get Crown Rust
Input Supplier Oat Fungicide Trials near Tisdale (not NARF)

- 3 Headline, 1 Folicur in 2009
- Applied early heading
- Strip trials in farmer fields, repeated 2 X
- Low to moderate disease pressure
Oat Yield Response

Untreated = 158 bu/ac, Treated = 169 bu/ac a 7% increase
Fungicides for Wheat 2009-2011
applied at flag leaf stage

<table>
<thead>
<tr>
<th>Variety</th>
<th>Untreated</th>
<th>Tilt</th>
<th>Headline</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC Barrie</td>
<td>58</td>
<td>70*</td>
<td>72*</td>
</tr>
<tr>
<td>Infinity</td>
<td>67</td>
<td>73*</td>
<td>75*</td>
</tr>
<tr>
<td>2011 6503 HR</td>
<td>73</td>
<td>76</td>
<td>78</td>
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</table>
Fungicides for Wheat 2012 (bu/ac)

Yields in bold are statistically higher than untreated.
Fungicides for Wheat 2012 (bu/ac)

AC Barrie P leaf spot
F for FHB

5602 HR G for leaf spot
F for FHB

Infinity G for leaf spot
VP for FHB

AC Barrie
- Untreated: 51
- Tilt @ flag: 60
- Headline @ flag: 61
- Prosaro @ 50% bloom: 66

Infinity
- Untreated: 45
- Tilt @ flag: 48
- Headline @ flag: 49
- Prosaro @ 50% bloom: 61

5602 HR
- Untreated: 58
- Tilt @ flag: 60
- Headline @ flag: 62
- Prosaro @ 50% bloom: 73
Fungicide Timing on Wheat 2013

Twinline early Prosaro late

- Untreated
- Flag
- 75% Headed
- 50% Flower
- Flag + Head
- Flag + Flower
- Flag + Head + Flower

Unity VB
- 60.9
- 62.6
- 67.8
- 68.4
- 65.8
- 66.4
- 70.5

Shaw VB
- 68.1
- 71.9
- 73
- 74.9
- 73.8
- 80.9
- 77.1
Fungicide Timing on Wheat 2013

- Untreated
- Flag
- 75% Headed
- 50% Flower
- Flag + Head
- Flag + Flower
- Flag + Head + Flower

F for leaf spot
F for FHB
P for leaf spot
P for FHB
Input Supplier Wheat Fungicide Trials near Tisdale (not NARF)

- 3 Quilt, 2 Headline, 2 Folicur, 1 Prosaro = 8 trials
- Headline and Quilt at flag
- Folicur and Prosaro at heading to 50% bloom
Wheat Yield Responses

Untreated = 51 bu/ac; Treated = 57 bu/ac

Trial Number

Response

- Folicur
- Headline
- Prosaro
- Quilt
Summary; Wheat Diseases

- Critical to know what diseases to target
- Fusarium a bigger yield robber than leaf diseases in 2012 and 2013.
- Do optimum timings differ between varieties?
- Difficult to justify 2 applications.
Summary; Wheat Diseases

- Use resistant variety for leaf disease and fungicides for fusarium.
- Start applications at 75% head emergence so can finish by 50% flower?
Fertilizer Management

- Oat and Wheat N Responses
Optimum N Rates at IH, 2009-11

~Optimum N Rate @ 60 kg N/ha
Oat Yield Response to N at IHARF and NARF in 2012 & 2013

- IHARF 2012: $R^2 = 0.99$
- NARF 2012: $R^2 = 0.97$
- IHARF 2013: $R^2 = 0.99$
- NARF 2013: $R^2 = 0.92$
Oat Yield Response to N at IHARF and NARF in 2012 & 2013

After a series of years of favorable moisture and high yield, optimum N rates have increased, from 60 lb/ac in 2009-11 to 80 or 100+ lb/ac in 2012-13.

Soil fertility levels appear to change over time, increasing when yields are low and decreasing in high yield cycles.
Oat Summary

- When yields are less than what we target with N
  - 60 lb/ac of N should be enough
  - Use oat to glean N after more intensively managed canola or wheat
- When yield is at or above target yields
  - Require higher N rates (80-100 lb/ac) to optimize yield.
Oat Summary

- On poorly managed or low organic matter fields
  - Require higher N rates
  - May need to rebuild soil nutrient supplies

- For 2014 consider higher N rates,
  - but be aware that excess N can reduce test weight, and crop may not meet milling quality
Wheat Response to N at IHARF and NARF 2012 & 2013

IHARF 2013 $R^2=0.94$

NARF 2013 $R^2=0.89$

NARF 2012 $R^2=0.63$

IHARF 2012 $R^2=0.60$
Optimum was about 60 lb/ac N in 2012, and 80 lb/ac at IHARF in 2013 but not NARF 2013. Why?
Wheat Yield and Lodging Response to N IHARF and NARF 2012 & 2013

R² = 0.6042
R² = 0.9423
R² = 0.6306
R² = 0.8778

Yield (bu/ac) vs. N Rate (lb/ac)

Lodging Rating (1-10 scale) vs. N Rate (lb/ac)
Lodging Likely Limits Yield Responses to Fertilizer More Than Anything Else!
Strategies to Overcome Lodging

- Lodging resistant varieties
- Restrict N Rates
- Growth Regulators
  - 2012 Results look promising
  - Expand research in 2013
Growth Regulators

- Cycocel
  - Restricts cell elongation to reduce crop height (no root shortening)
  - New formulations are more reliable
  - Most effective at 3 leaf stage

- 2013 trials
  - Melfort and Indian Head
  - Zadoks 2.1; or 3.1; split applications
  - 100%, 125% and 150% fertility levels
### Growth Regulator (Manipulator) Effect on Wheat Height (inches), IHARF 2013

<table>
<thead>
<tr>
<th>Growth Regulator</th>
<th>100 Fert</th>
<th>125 Fert</th>
<th>150 Fert</th>
<th>Mean</th>
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<td>39.1</td>
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<tr>
<td>Zadoks 2.1</td>
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<td>36.7</td>
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<tr>
<td>Zadoks 2.1 &amp; 3.1</td>
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<td>33.6</td>
<td>33.3</td>
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<td>35.6</td>
<td>35.5</td>
<td>35.1</td>
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100 Fert = 90-28-14-14 N-P-K-S
Growth Regulator (Manipulator) Effect on Wheat Height (inches), NARF 2013

<table>
<thead>
<tr>
<th></th>
<th>100 Fert</th>
<th>125 Fert</th>
<th>150 Fert</th>
<th>Mean</th>
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<tr>
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100 Fert = 90-28-14-14 N-P-K-S
# Growth Regulator (Manipulator) Effect on Wheat Yield (bu/ac), IHARF 2013

<table>
<thead>
<tr>
<th>Treatment</th>
<th>100 Fert</th>
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<td>Mean</td>
<td>77.2</td>
<td>78.8</td>
<td>84.1</td>
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100 Fert = 90-28-14-14 N-P-K-S
Plant Growth Regulator Summary

- Much higher yields are possible with PGR AND higher fertilizer rates.
- How reliable are responses to PGR?
- Are additional yield increases possible by combining PGR, Fert and higher plant densities, precision management)?
- Will other factors become limiting (micros, water)?
- What about PGR on other crops?
Some Take Home Messages

- Fertilizer Rates need to Increase in High Yield Cycles
- Consider Oat to ‘Glean’ excess N from previous years
- May need lodging resistant wheat to optimize N
- Growth Regulators may work better than lodging resistance
- Use resistant cultivars to avoid fungicides
- Know what diseases to target with fungicides
  - Resistant cultivars for wheat leaf diseases, fungicides for fusarium
Achnowledgements

Agriculture and Agri-Food Canada

Agriculture et Agroalimentaire Canada

Saskatchewan Ministry of Agriculture

Engage Agro

Growing Forward

NARF and AAFC Field Day July 23, 2014
Etheryl on Barley
Rooting of Wheat