Response to Rye in Cattle Diets

Warren Rusche
SDSU Extension Beef Feedlot Management Associate
Why Study Cereal Rye?

• Cereal rye offers number of agronomic benefits in a crop rotation
  – New genetics and technology promise more productivity than previous varieties
  – Decreases weather risk

• Need market outlets for wider acceptance

• Ability to feed any crop to livestock provides more options
Why Study Rye in Cattle?

• Very little information on feeding value
  – Old (1930s to 1980s)
  – Higher levels of ergot alkaloids
  – Prior to corn processing co-products

• Questions to answer and objectives of our study:
  – Will cattle eat the feed?
  – Will they perform?
  – What is the energy value?
Rye Grain

- Hybrid rye provided by KWS Cereals USA, LLC
- Ergot alkaloid concentration, 392 ppb (NSDU Vet Diagnostic Laboratory)
- Cracked using a roller mill
  - Lone Star Enterprises, Lennox
  - Processed to a test weight of 42.5 lbs/bu
Treatments

• Four treatments (DRC:rye)
  – Base diet, 60% dry rolled corn (60:0)
  – 20% rye (40:20)
  – 40% rye (20:40)
  – 60% rye (0:60)
### Final Diets

<table>
<thead>
<tr>
<th></th>
<th>60:0</th>
<th>40:20</th>
<th>20:40</th>
<th>0:60</th>
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<tbody>
<tr>
<td>DRC</td>
<td>60.34</td>
<td>40.33</td>
<td>20.22</td>
<td>0.00</td>
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<tr>
<td>Hybrid rye</td>
<td>0.00</td>
<td>19.91</td>
<td>39.93</td>
<td>60.04</td>
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<tr>
<td>MDGS</td>
<td>18.90</td>
<td>18.95</td>
<td>19.00</td>
<td>19.04</td>
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<tr>
<td>Corn Silage</td>
<td>16.84</td>
<td>16.89</td>
<td>16.93</td>
<td>16.97</td>
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<tr>
<td>Liquid</td>
<td>3.91</td>
<td>3.92</td>
<td>3.93</td>
<td>3.94</td>
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<tr>
<td>Supplement</td>
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</table>
Experimental Design

- Used 240 crossbred steers
- Initial wt = 891 lbs (pencil shrink 4%)
  - 24 pens, 10 steers per pen
  - Six pens per treatment
- Carcass adjusted weights: HCW/0.625
- Steers fed once per day
  - Tyson, Dakota City, NE
  - Liver abscess and carcass data obtained
Adaptation period ADG and F:G (d 1 to d 18)

- ADG:
  - 60:0: 3.09 lbs
  - 40:20: 3.40 lbs
  - 20:40: 3.92 lbs
  - 0:60: 4.19 lbs

- F:G:
  - Not applicable

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## Gain & Intake First Two Periods

<table>
<thead>
<tr>
<th>Treatment</th>
<th>60:0</th>
<th>40:20</th>
<th>20:40</th>
<th>0:60</th>
<th>SEM</th>
<th>0 vs rye</th>
<th>Linear</th>
<th>Quadratic</th>
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</thead>
<tbody>
<tr>
<td>d0 to d19</td>
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<td></td>
</tr>
<tr>
<td>ADG</td>
<td>3.09</td>
<td>3.40</td>
<td>3.92</td>
<td>4.19</td>
<td>0.267</td>
<td>0.01</td>
<td>0.01</td>
<td>0.84</td>
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<tr>
<td>DMI</td>
<td>20.91</td>
<td>20.95</td>
<td>20.97</td>
<td>20.99</td>
<td>0.010</td>
<td>0.01</td>
<td>0.01</td>
<td>0.94</td>
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<tr>
<td>d20 to d47</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADG</td>
<td>6.27</td>
<td>6.47</td>
<td>6.39</td>
<td>5.86</td>
<td>0.191</td>
<td>0.87</td>
<td>0.13</td>
<td>0.07</td>
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<tr>
<td>DMI</td>
<td>24.36</td>
<td>24.36</td>
<td>24.35</td>
<td>24.37</td>
<td>0.000</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
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</tbody>
</table>
Treatment (DRC:Rye) effects on DMI (lb/hd/d)

- 60:0
- 40:20
- 20:40
- 0:60

Days on feed

DMI, lb/hd/d

DRC:Rye, P = 0.02
Day, P < 0.0001
DRC:Rye × Day, P < 0.0001
Effects on Feeding Behavior
October 30, 7 h 15 min after feed delivery

0% Rye

40% Rye

20% Rye

60% Rye
Results

- Performance measures shared today based on carcass-adjusted final weights rather than actual live weight
  - Snow and above freezing temperature last 40d led to increasingly muddy pens
  - All steers carried considerable amounts of tag
  - Carcass adjusted weights provide a more accurate indication of true differences
Carcass Adjusted Final Body Weight

Body weight, lbs

- 60:0
- 40:20
- 20:40
- 0:60

0 vs Rye; $P < 0.01$
Linear; $P < 0.01$
Carcass Adjusted ADG

0 vs. Rye; $P < 0.01$
Linear; $P < 0.01$

ADG, lbs/d

60:0  40:20  20:40  0:60
Feed Efficiency and Intake

0 vs Rye; $P < 0.01$
Linear; $P < 0.01$

<table>
<thead>
<tr>
<th>F:G</th>
<th>DMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>60:0</td>
<td>6.01</td>
</tr>
<tr>
<td>40:20</td>
<td>6.03</td>
</tr>
<tr>
<td>20:40</td>
<td>6.38</td>
</tr>
<tr>
<td>0:60</td>
<td>6.63</td>
</tr>
</tbody>
</table>
# Carcass Measurements

<table>
<thead>
<tr>
<th></th>
<th>Treatments</th>
<th>P - values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60:0</td>
<td>40:20</td>
</tr>
<tr>
<td>HCW, lbs</td>
<td>895</td>
<td>892</td>
</tr>
<tr>
<td>Dressing %</td>
<td>60.1</td>
<td>59.1</td>
</tr>
<tr>
<td>Ribfat, in</td>
<td>0.51</td>
<td>0.51</td>
</tr>
<tr>
<td>REA, in²</td>
<td>12.9</td>
<td>13.1</td>
</tr>
<tr>
<td>USDA YG</td>
<td>3.4</td>
<td>3.3</td>
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<tr>
<td>Normal liver score, %</td>
<td>69</td>
<td>75</td>
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</table>
Effect of Rye Inclusion on Quality Grade

Rye effect, NS $P > 0.11$

Quality Grade Distribution

- **Select**
- **Choice**
- **Premium Choice**

<table>
<thead>
<tr>
<th>Rye Percentage</th>
<th>Select</th>
<th>Choice</th>
<th>Premium Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>60:0</td>
<td>20</td>
<td>50</td>
<td>30</td>
</tr>
<tr>
<td>40:20</td>
<td>15</td>
<td>55</td>
<td>35</td>
</tr>
<tr>
<td>20:40</td>
<td>10</td>
<td>60</td>
<td>40</td>
</tr>
<tr>
<td>0:60</td>
<td>25</td>
<td>50</td>
<td>20</td>
</tr>
</tbody>
</table>

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Feeding Value

• Performance derived net energy values
  – $\text{NE}_M = 87.6 \text{ Mcal/cwt}$
  – $\text{NE}_G = 57.1 \text{ Mcal/cwt}$
  – (84% $\text{NE}_G$ value of corn)

• Book estimates
  – $\text{NE}_M = 86 \text{ Mcal/cwt}$
  – $\text{NE}_G = 56 \text{ Mcal/cwt}$

(R. Preston, 2018 Feed Composition Tables, Beef Magazine)
Corn/Rye Blends

- Blends with 20% rye nearly equivalent to diet where corn was sole feed grain
- Positive associative effect
  - Combinations of grain with different rates of starch digestion
    - Reduced risk of acidosis compared to rapidly fermented grain alone
    - Improved performance compared to slowly fermented grain alone
Research Conclusions

• Rye can be successfully fed to finishing cattle
• Feeding higher amounts of rye did affect feed intake and performance
• Feeding 1/3 rye:2/3 corn equivalent to corn as sole grain source
Unanswered questions

• Rye/High moisture corn blends?
• Will starting cattle on higher rye diets followed by higher corn inclusion improve efficiency?
• Backgrounding diets?
• Are there ways to improve feed intake with higher inclusion rates of rye?
Tale of Two Farms

Corn-Soybean Rotation

- 1200 acres
  - 600 Corn
  - 600 Soybeans
- Assume 180 bpa corn and 45 bpa soybeans

Corn-Soybean-Rye Rotation

- 1200 acres
  - 400 corn
  - 400 rye
  - 400 soybeans
- Increase corn yield by 20 bpa and soybeans by 2 bpa
  - SERF, Beresford
- Rye yield = 100 bpa
How Much Grain Produced?

Two-Crop
• 108000 bu corn
• 27000 bu soybeans

Three-crop
• 80000 bu corn
• 40000 bu rye – (2:1 corn-rye ratio)
• 18800 bu soybeans
• 12000 more bushels available for feed
Increased Livestock Potential

• 12000 bushels corn/rye = 660,000 pounds as-fed or 560,000 pounds DM

• Assume 6.2 pounds feed/pound of gain and 60% of diet
  – Requires approximately 2000 pounds DM per steer (900 to 1450)

• Added feed grain production supports additional 275 steers
Acknowledgements

• KWS Cereals USA, LLC
  – Financial Support
  – In-kind contributions of rye grain

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  – Scott Bird, cattle feeding, care & management
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