BMR Update

Frequently asked Questions/Myths

Agri-Food Laboratories
May 1, 2008
Frequently Asked Questions/Myths
What is bmr?

- BMR = Brown Mid-Rib
- It is a genetic mutation (not genetically engineered)
- Mutation that results in less lignin
  - Mutation also results in a brown color of the mid-rib
BMR Mutants Contain Lower Lignin

s-adenosylmethionine

OMT

o-methyl transferase

Coumaric acid → ferulic acid → sinapic acid

Coumaryl alcohol → coniferyl alcohol → sinapyl alcohol

LIGNIN

CAD

POD
## Yield and Digestibility of Corn Plant Parts

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<th>Tissue</th>
<th>Percent Yield</th>
<th>Digestibility (%)</th>
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<td>73</td>
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<td>Kernels</td>
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Adapted from Deinum and Struijk, 1989
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Lauer, © 1994-2003
University of Wisconsin – Agronomy
NDF digestibility

- Bmr has an increased NDF digestibility:
  - 10 to 12 units
  - 18 – 23%
Michigan State University found that a 1 unit increase in NDF digestibility resulted in 0.17 kg. more dry matter intake (DMI), resulting in an increase in milk of 0.25 kg./cow/day.
BMR Development

- Marketed only since 1995
- Genetics still evolving
- Increase NDFD average 12 units
  - theoretically equates to 6.6 lb. more milk
- Contains less lignin (25% - 35%)
Brown Mid Rib

\[ bm_3 \]
bmr Normal

photo: Lauer-UW
bmr

- less lignin
- lignin present is “juvenile” lignin

conventional

post-anthesis
Relationships Among the Components of Fiber

Cellulose

Hemicelluloses

Lignin

Cellulose

Hemicelluloses

Lignin

H bonds

Covalent linkages or hydroxycinnamic acids crosslinks
BMR has a 20% Yield Drag

- Fact or Myth?
Improvement in agronomics

Advances in generations of bmrbmr

» taller plants
» greater tonnage
» better agronomics
» wider harvest window
4th generation hybrids:

- Taller plants
- Increased tonnage
- Better agronomics: disease resistance, root strength
- Wider harvest window: not only agronomics, but more hybrids to choose from

F2F566  F2F581

4th vs. 3rd generations

105 RM
BMR doesn’t stand?

- Fact or Myth?
Everyone can use BMR

- Fact or Myth:
Things we look for in Potential Customer

- Able to segregate the bmr silage
- Have very good crop management
- Have capability to harvest at proper moisture levels and fill the storage structure in a short period of time
Ability to chop at 3/4” minimum cut length and have enough particle size in the total diet

Use of total mixed ration (TMR) is highly recommended

Have adequate silage storage
- Be willing to feed a minimum of 55% forage in the ration and at least 40-45 lbs (18 – 20 kg) as fed of bmr silage per cow per day

- Nutritionist willing to make ration adjustments
Should bmr be processed?

- It depends......
# Mechanical Processing Effects On BMR Corn Silage

<table>
<thead>
<tr>
<th>Item</th>
<th>Unprocessed</th>
<th>Processed</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM intake, lb/d</td>
<td>52.7</td>
<td>56.8*</td>
</tr>
<tr>
<td>Milk, lb/d</td>
<td>93.4</td>
<td>98.0*</td>
</tr>
</tbody>
</table>

*Ebling and Kung, 2001*
Is Mycogen the Only Company to Market BMR?

- Bmr are public genetics
- Other bmr products are beginning to show
- We are well into 4th generation of material
Other BMR’s

- Observations:
  - height differences
  - stage differences

L – R: F2F444, F2F485, F2F357, comp 100 day

25/07/2006
Other BMR’s

L-R Competitive 112RM, 105RM, 100RM, F2F566 (105RM), F2F444 (100RM)
Can bmr be harvested for grain?
### Do BMR’s form grain?

<table>
<thead>
<tr>
<th>Hybrid</th>
<th>Moisture %</th>
<th>Yield bu/ac</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>2R426</td>
<td>16.9</td>
<td>206.8</td>
<td>G</td>
</tr>
<tr>
<td>2D555</td>
<td>18.9</td>
<td>198.4</td>
<td>G</td>
</tr>
<tr>
<td>2K540</td>
<td>19.3</td>
<td>244.2</td>
<td>G</td>
</tr>
<tr>
<td><strong>F2F721</strong></td>
<td><strong>21.2</strong></td>
<td><strong>215.9</strong></td>
<td><strong>S</strong></td>
</tr>
<tr>
<td><strong>F697</strong></td>
<td><strong>23.3</strong></td>
<td><strong>198.5</strong></td>
<td><strong>S</strong></td>
</tr>
<tr>
<td><strong>F2F581</strong></td>
<td><strong>21.1</strong></td>
<td><strong>185.4</strong></td>
<td><strong>S</strong></td>
</tr>
</tbody>
</table>

Plainview MN 2005, Kruger Plot
Can bmr be harvested for grain?

- NO
  - Plant would be too brittle to stand for grain production
  - Quality of grain
    - Starch is more floury
    - Softer kernels
Is the quality of bmr consistent?
Quality of Silage-Specific™ BMR Forages

Field Trial Database - 2001-2006
BMR Performance – NDFD

Advantage over conventional

Year

2001
2002
2003
2004

Advantage

0
2
4
6
8
10
12
14

NDFD
## BMR vs Conventional

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional</td>
<td>58.7</td>
<td>46.9</td>
<td>69.6</td>
</tr>
<tr>
<td>BMR</td>
<td>70.1</td>
<td>58.9</td>
<td>79.5</td>
</tr>
</tbody>
</table>

Data from UW Marshfield

Data is 48 hr DNDF
How do I feed bmr?

- Bmr has a very high energy value
  - Not unusual to see 0.80 or higher NEL
- When using bmr, it becomes a high forage ration
Feeding bmr silage

- Feed a minimum of 40 to 45 lb. (18 – 20 kg) as fed
Based on data that shows a 1 percentage unit increase in dNDF means .56 lb. milk/hd/day, how much milk advantage can be expected?

- 2.3kg DM Fed = 0.6kg milk
- 4.5kg DM Fed = 1.2kg milk
- 6.8kg DM Fed = 1.9kg milk
- 9.1kg DM Fed = 2.5kg milk
Feeding bmr silage

- Suggested minimum forage to concentrate ratio is 55:45
- Minimum NDF level in the diet dry matter is 30%
- If bmr is more than 50% of the forage dry matter, minimum NDF level is 32%
Feeding bmr silage

- Nonstructural carbohydrates (NSC) level of 37-38% of diet DM
- Soluble protein levels of 32-36% of the total crude protein (CP)
- Rumen undegradable protein no more than 35% of total CP
- Watch Grain intake – feeding bmr allows for less grain to be fed
Additional Considerations

- Chop Length
  - Lower lignin content of BMR creates a more fragile cell wall
  - Longer chop is necessary to maintain appropriate fiber for rumen mat
  - Help to prevent “over packing” or crushing
  - Reduces seepage
## Chop Length Recommendations

<table>
<thead>
<tr>
<th>Storage Unit</th>
<th>No Kernel Processor</th>
<th>With Processor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bunk, Pit, Bag</td>
<td>¾ to 1 in.</td>
<td>1 to 1.5 in.</td>
</tr>
<tr>
<td>Upright/stave</td>
<td>5/8 to ¾ in.</td>
<td>¾ to 1 in.</td>
</tr>
<tr>
<td>Bottom Unloading</td>
<td>Not recomm.</td>
<td>Not recomm.</td>
</tr>
</tbody>
</table>
Harvest Maturity

- BMR often looks ready for chopping because of its brown stalk and leaf
- Milk line test is not accurate for BMR
- Best method is to test dry matter frequently
# Harvest Maturity

<table>
<thead>
<tr>
<th>Storage Structure</th>
<th>Moisture %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upright/Stave</td>
<td>63 to 68</td>
</tr>
<tr>
<td>Bunk/Pit</td>
<td>66 to 70</td>
</tr>
<tr>
<td>Silage Bag</td>
<td>66 to 68</td>
</tr>
<tr>
<td>Bottom Unloading</td>
<td>Not recommended</td>
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Feeding bmr causes more manure to be produced

- Fact or Myth:
Forage and Manure Output

Weiss, 2005

Lbs/day

<table>
<thead>
<tr>
<th>Corn Silage, % of Forage</th>
<th>Waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>161</td>
</tr>
<tr>
<td>~23%</td>
<td>134</td>
</tr>
<tr>
<td>~75%</td>
<td>134</td>
</tr>
<tr>
<td>100%</td>
<td>134</td>
</tr>
</tbody>
</table>

Weiss, 2005
Manure Output*

*total of feces and urine

Lbs./day

Low Protein | High Protein
150 | 158 | 157 | 163

BMR
Conv.

Weiss, 2006
What about feed efficiency?

Summarization of 20 comparisons
Can a high corn silage ration work?
Tons (1000's) Corn Silage Produced

- 1997: 80
- 1998: 85
- 1999: 90
- 2000: 95
- 2001: 100
- 2002: 105
- 2003: 110
- 2004: 115
- 2005: 120

NASS
Corn Silage Production in Top Dairy States (million tons)

- CA
- WI
- NY
- PA
- MN

NASS
Why the new Interest in Corn Silage?
Ethanol Plants in the US
Projected Ethanol Production and Corn Use by Marketing Year

CAST, 2006
The Science of High Corn
Silage Rations
Alfalfa Silage vs. Dual Purpose

- Full Lactation Study
- 45 Mature Cows, 19 1\textsuperscript{st} Lactation heifers
- 50:50 forage:concentrate ratio (DM basis)
- 0, 1/3, or 2/3 corn silage (DM basis)

Dhiman and Satter, 1997
Alfalfa Silage vs. Dual Purpose

- No difference in DMI or milk yields
- IOFC lowest for AS
- IOFC highest for 1/3 corn silage when corn prices were low
- IOFC was highest for 2/3 corn silage when corn prices were high
Production Response to Corn Silage

<table>
<thead>
<tr>
<th>Corn Silage % of diet DM</th>
<th>Milk</th>
<th>DM Intake</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>31</td>
<td>36</td>
</tr>
<tr>
<td>39</td>
<td>39</td>
<td>39</td>
</tr>
<tr>
<td>46</td>
<td>46</td>
<td>46</td>
</tr>
<tr>
<td>50</td>
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Corn% 28 22 16 15 6 0

Allen (2001), University of Minnesota
What about the cost of bmr?
Does feeding bmr affect butterfat?

![Graph showing the effect of feeding bmr on butterfat percentage. The y-axis represents Milk Fat % ranging from 2.5 to 4.5, and the x-axis distinguishes between bmr and non-bmr. The graph compares the milk fat percentages for both groups, indicating a trend that feeding bmr affects butterfat.](image-url)
Does feeding bmr affect butterfat?
Does feeding bmr affect butterfat?

- The feeding program affects butterfat – not bmr
- BMR is a high energy ingredient and requires that less grain be fed
- Research studies using bmr have not resulted in consistent drop in butterfat
- Effective fiber
- Starch levels
Thank you for your attention