

# Low Lignin Forages: BMR corn and reduced-lignin alfalfa

Ev Thomas  
Oak Point Agronomics, Hammond, NY



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### An inconvenient truth

- BMR corn yields less than conventional corn.
- It always has, ever since the first Cargill BMR hybrid.
- Maybe it always will.
- BMR yields have increased, but so have conventional corn hybrid yields.
- No university trial data showing that BMR yield is “catching up” to conventional corn yields.

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### Increased focus on forage quality

- In recent years two developments have brought increased focus to the topic of forage quality.
- Reduced-lignin alfalfa varieties were developed using both conventional plant breeding and genetic engineering.
- And Dupont-Pioneer started selling BMR corn hybrids, considerably expanding BMR’s market exposure.

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### 2017 Penn State silage trials Average of 3 sites, 110-115 RM

Hybrids	DM.%	Yield, T/A @ 35% DM	Lignin, %	Starch, %	30-hr NDFd % (range)	240-hr uNDF,%
BMR 4 entries	32.1	18.3	2.4	31.9	64.5 (62-68)	22.1
Conv. 44 entries	32.2	21.9	3.0	36.1	53.8 (51-57)	33.6

- Conventional hybrids had 20% higher yield than BMR.
- Note modest range in NDF-d among 44 conventional hybrids.
- The best conventional hybrid for NDF-d was 5% points lower than the worst Mycogen BMR hybrid for NDF-d.

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### Experience from 15 years of growing BMR corn

- BMR hates “dry feet”. Avoid thin, droughty soils. Plant on your best corn ground, expect 10-15% yield drag.
- BMR ain’t pretty. If you care what “the boys in the coffee shop” say, plant the guard rows to a leafy hybrid and plant the rest of the field to BMR.
- BMR has less lignin, often will bend but not break during summer storms, then recover quickly.
- Don’t let BMR mature past about 35% DM.

## BMR Corn Silage



## BMR gene: BM-1, BM-3 ...or is it all BS?



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## BMR is just different

- BMR cell walls are more fragile. May need to chop BMR at more than 19-20 mm to get enough physically effective fiber.
- Cows need a certain amount of chewing for optimum rumen function.
- Therefore, feed a high % of forage when feeding BMR, and if necessary supplement with less digestible, lower fragility forages: straw or late-cut grass.

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## 2015 Penn State Corn Hybrid Trials

4 Mycogen and 2 Pioneer 110-116 RM hybrids

	DM %	T/A @ 35% DM	Starch %	Lignin %	24-hr NDF-d %	Milk/T	Milk/A
Mycogen	35.8	18.7	31.3	2.8	58.4	3405	22527
Pioneer	37.7	18.6	33.4	2.6	53.4	3428	22546
*Conv.	38.9	24.1	37.0	3.1	48.7	3180	27144

\*BMR average of 4 sites, conventional hybrids average of 3 sites. Conventional hybrid NDF-d via NIR, BMR NDF-d via wet chemistry. Conventional hybrids: 29% higher yield.

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## Weird BMR stuff from Miner Institute

- Several chewing studies compared BMR vs. conventional corn silage. Cows ate more BMR corn silage and ruminated fewer minutes per pound of NDF consumed.
- Cows on the BMR ration spent 5-10 fewer minutes eating per pound of NDF consumed.
- That adds up to significantly less time at the feed bunk-- 30 minutes less/day in one study. Important if bunk space is limited by high stocking rates?

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## Data Drought

- Universities test the hybrids that seed companies enter in their silage hybrid trials.
- No BMR hybrids are entered in most state university corn silage hybrid trials, and only one or two in others, with the notable exception of Penn State.
- **Result:** Very limited data comparing the performance of BMR hybrids, and virtually no data on standability of any hybrids harvested for silage.

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## BMR milk response is rate-dependent

- BMR should be at least 20% of **total ration** DMI. Optimum: 30% or more.
- 55 lbs. DMI = at least 11 lbs. of BMR DM.
- Half the rows planted to BMR & half to a conventional hybrid = ~55% conventional CS and ~45% BMR "silo blend" because of BMR yield drag.
- Therefore to get 11 lbs. of BMR DM from that "silo blend" you'd have to feed over 70 lbs. of corn silage/cow.

## Therefore...

- ▶ Either plant BMR or don't plant BMR, but don't mix BMR and conventional hybrids in the field.
- ▶ Store BMR corn silage in a separate silo, give priority to the cows that will most benefit from it: Transition cows, high group cows. Breakeven ~60 lbs./cow.
- ▶ Limited inventory of BMR? Feed during the heat of summer. Better to feed 11+ lbs. BMR DM/cow during hot, humid weather than to try to stretch limited supplies over the entire year.

**Reduced lignin alfalfa =  
High digestibility alfalfa**

### Foliar fungicides for BMR corn

▶ Photo: Greg Roth, Pennsylvania, 2012. Northern Corn Leaf Blight.

▶ Mycogen BMR hybrids were most affected but Pioneer BMRs were also blighted.

▶ Many Pennsylvania farmers apply fungicides on their BMR corn—but only on BMR.



## Reduced-lignin alfalfa

- ▶ Two main types of reduced alfalfa on the market: HarvXtra (GMO) and Hi-Gest (non-GMO).
- ▶ All HarvXtra varieties are glyphosate tolerant (Roundup Ready).
- ▶ Both types are lower in lignin and higher in NDF-d vs. conventional varieties. Hi-Gest has similar % change in lignin and NDF-d, while HarvXtra has twice the % change in lignin as in NDF-d.

## Focus on what's important

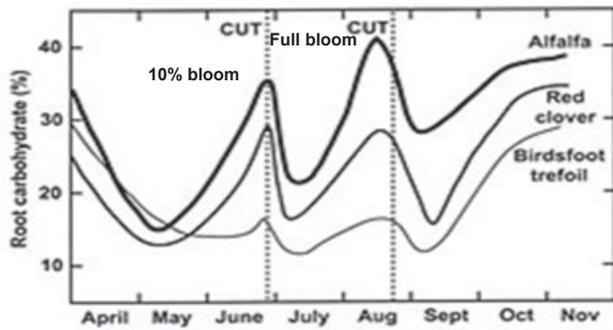
- ▶ BMR corn is so different (yield, digestibility, stress resistance) that it acts like it's a unique species: *Zea mays* vs. *Zea bmr*.
- ▶ Fed at the right rate to the right cows, BMR should result in a 3-5 lb. milk response. (Metanalysis 3.1 lb.)
- ▶ 3 lbs. of milk will pay for a 20% yield drag.
- ▶ BMR has its challenges, but it puts milk in the tank.

## Potential advantages of clear-seeded reduced lignin alfalfa

- ▶ Allows farmers to delay harvest by 7 -10 days (to 10% bloom) *while maintaining high forage quality*.
- ▶ Delayed harvest may reduce the number of cuts per year. Result: increased yield and possibly longer stand life.
- ▶ Longer stand life due to less field traffic and better root carbohydrate recovery between harvests. Higher yields in last 1-2 years of stand.

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## Alfalfa harvest management 1962 Cornell University recommendation



1962 N.Y. average milk/cow: 8500 lbs.

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No manure →



3 day delay →

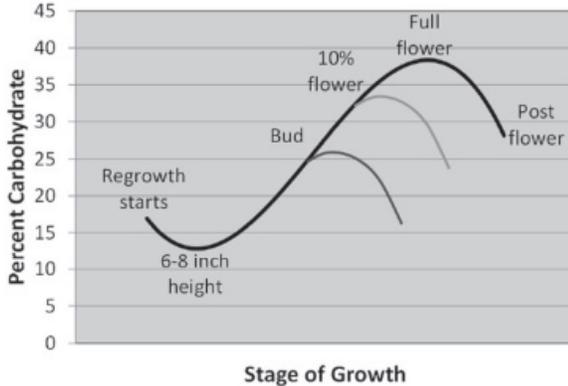


7 day delay →



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## Root carbohydrate levels



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## Fewer harvests = Healthier, higher-yielding alfalfa

University of Wisconsin: Over four years, 15-20% higher yield with **3** vs. **4** cuts of a *conventional* alfalfa variety .

1. Impact of less field traffic. Heavy equipment damages crowns, opening them up to diseases and desiccation. More trips = more crown damage.
2. Harvesting at bud stage never allows the alfalfa to fully recover root carbohydrates. *Neither does delaying harvest by 7-10 days, but closer to ideal.*

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## An accumulation of insults

- Repeated harvests at the bud stage, especially if followed by a fall harvest, may deplete alfalfa stands. Not just a root carbohydrate issue: Harvest also affects rhizobial nodules and root hairs.
- "Winter damage to alfalfa is an accumulation of insults." Jerry Cherney, Cornell University forage agronomist.
- With a 3+ cut schedule, every plant in the field is run over at least once by something heavy, often resulting in crown damage.

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## Reduced lignin questions

- Lodging problems due to less lignin? Plant breeders, farmers and university trials all say no.
- Problems if late summer cuts of reduced-lignin alfalfa are harvested at the bud stage? Penn State trials @ 28-day harvest interval: 3<sup>rd</sup> cut = 30% NDF, 4<sup>th</sup> cut = 25% NDF. (Dairy One average: 45% NDF) "Cow candy?" Maybe not!
- Will farmers pay the higher cost of reduced-lignin alfalfa seed? What if the farmer doesn't need the \$140 Roundup Ready trait in HarvXtra?

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## Harvesting 1<sup>st</sup> cut reduced-lignin alfalfa at bud vs. 10% bloom

- ▶ 7-10 day delay in first cut harvest means more time to harvest other first cut forage, complete corn planting and other spring fieldwork.
- ▶ Wide windrows are a must when delaying 1<sup>st</sup> cut harvest to 10% bloom because this increases yield by about ½ ton of DM/acre.
- ▶ Bud stage harvest allows for seeding alfalfa-grass, which has higher yield and higher milk production potential than clear alfalfa. Also allows for unexpected harvest delays due to weather, breakdowns, etc.

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## Reduced lignin alfalfa + grass: An ideal match?

- ▶ One drawback of alfalfa-grass is that (especially in first cut) the grass usually matures ahead of the alfalfa.
- ▶ But meadow fescue + reduced-lignin alfalfa harvested in the bud stage can result in excellent forage quality.
- ▶ Bud stage harvest doesn't result in a change in a farmer's normal schedule, assuming he normally harvests alfalfa in the bud stage.

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## Working reduced-lignin alfalfa into a forage system

- ▶ Seed a portion of the alfalfa acreage to reduced-lignin alfalfa or alfalfa. *Choose your best alfalfa land.*
- ▶ Harvest any alfalfa-grass fields first, conventional alfalfa next, then reduced-lignin alfalfa.
- ▶ Objective: Uniformly high forage quality from the first field harvested to the last. Extends the ideal harvest window.

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## Goals and risk management

- ▶ Reduced-lignin alfalfa harvested at 10% bloom doesn't allow plants to fully accumulate carbohydrates—less stress, but still there.
- ▶ However, the goal of dairy forage management is the production of forages that will meet the quality needs of high producing cows.
- ▶ Risk can be managed, but some risk is unavoidable.

