

Feeding Reduced Lignin Alfalfa-

How do we achieve the most from
this new technology?

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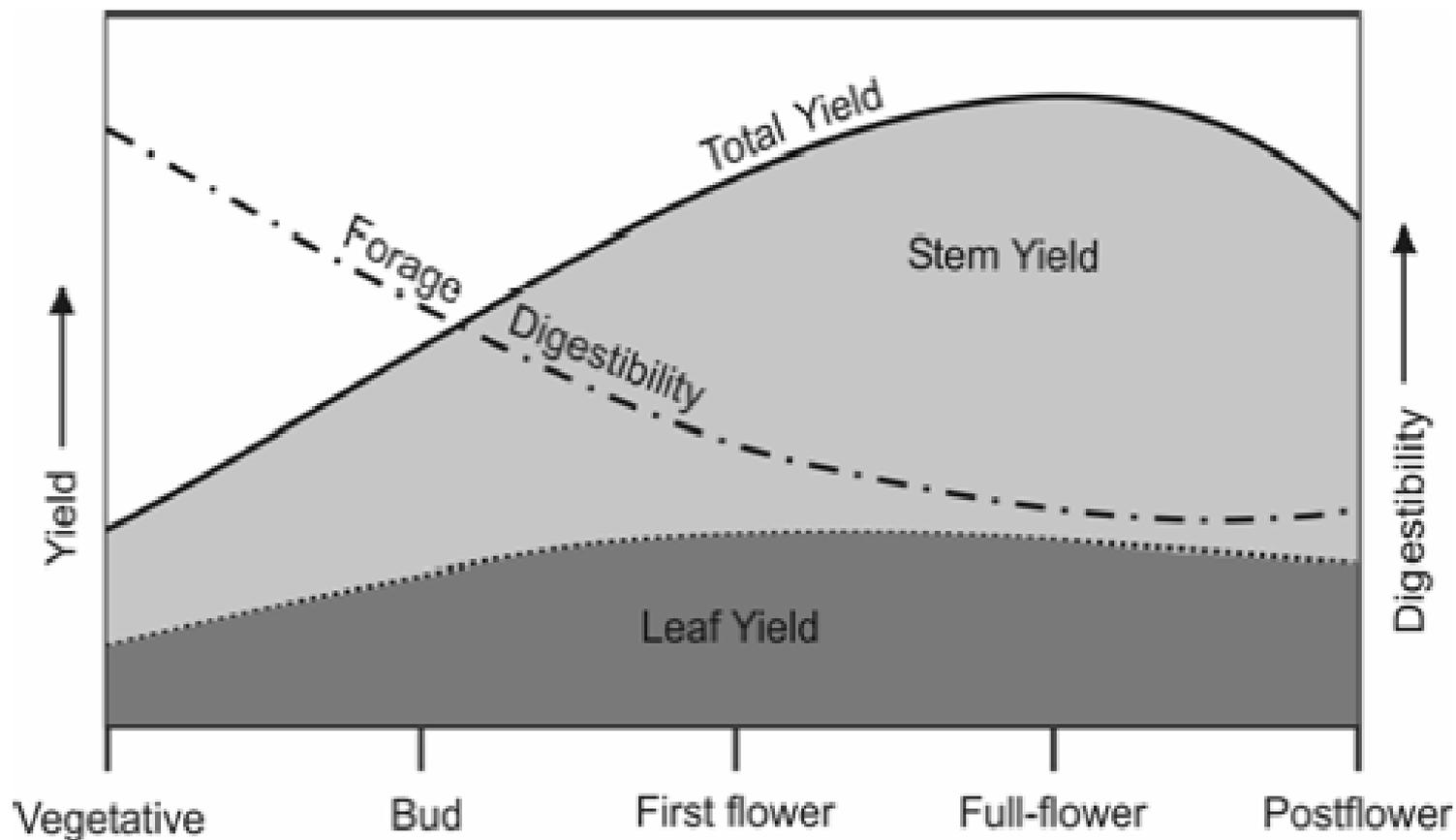


Why Lignin?



- Lignin is an indigestible phenolic compound in alfalfa cell walls
- As alfalfa matures, lignin content increases.
- Lignin cross-links with cellulose which decreases digestibility of fiber (dNDF)
- A 10% increase in fiber digestibility
 - Increase milk/beef by \$350M/yr
 - Decrease manure by 2.8M T/yr

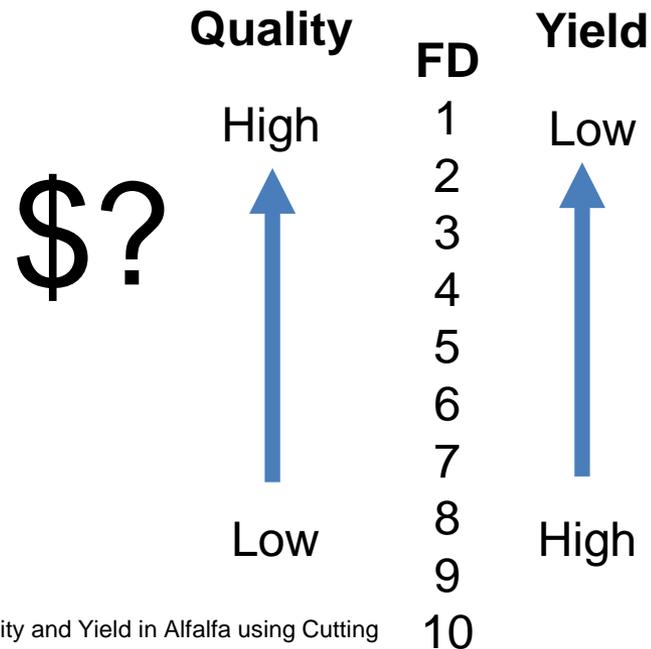
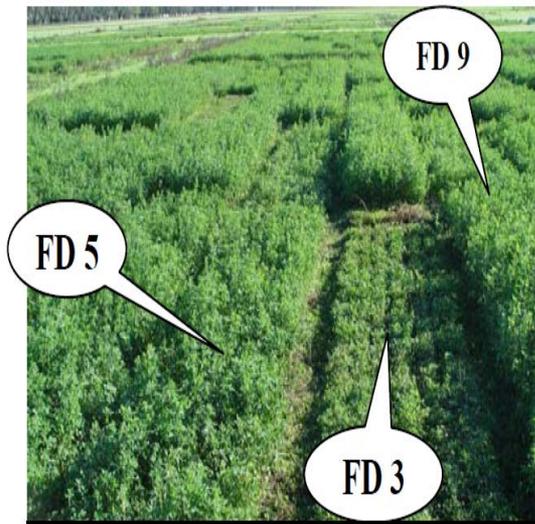
There is a tradeoff between alfalfa forage yield and quality with advancing stages of maturity



Source: Balancing Yield, Quality and Persistence. Steve Orloff and Dan Putnam
2004 Proceedings CA Alfalfa Symposium

TRADEOFF BETWEEN YIELD AND QUALITY

1. Timing of Harvest
2. Fall dormancy

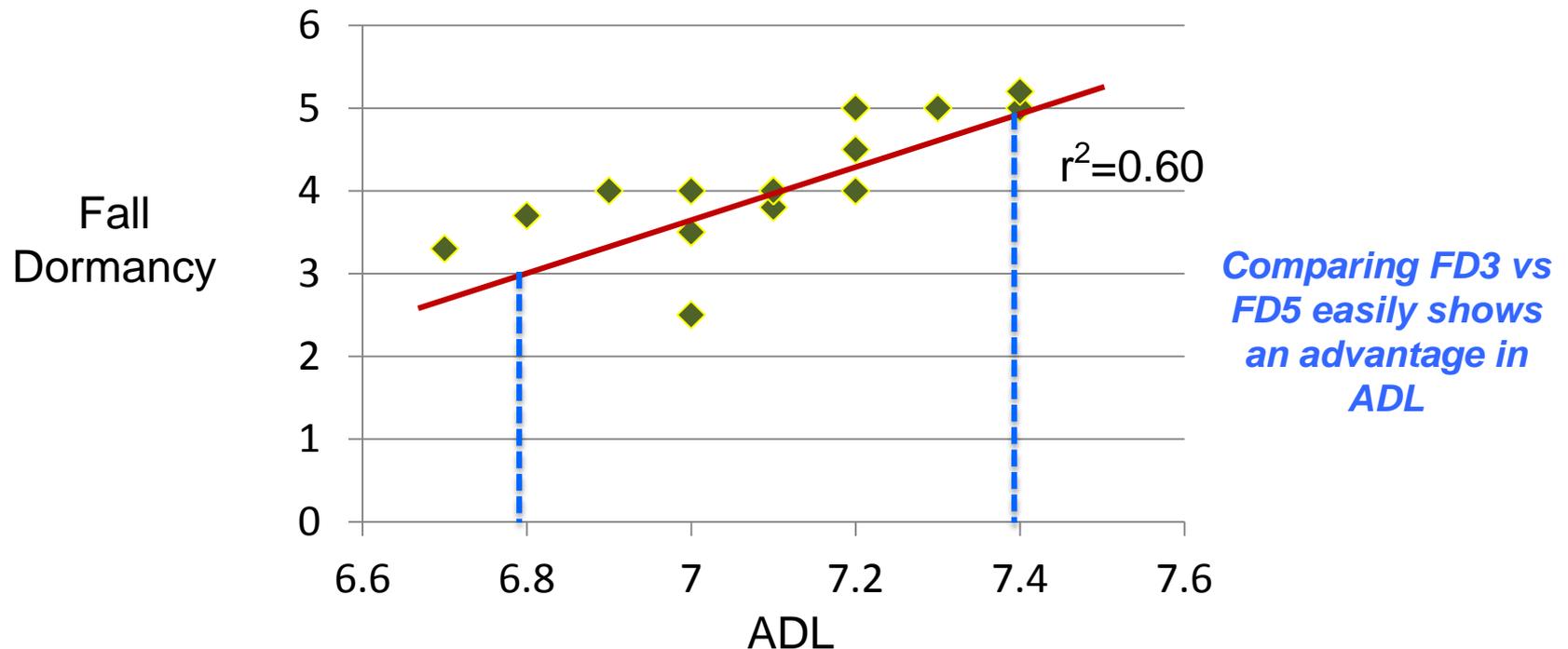


*Source: D. Putnam et al: Strategies for Balancing Quality and Yield in Alfalfa using Cutting Schedules and Varieties

<http://alfalfa.ucdavis.edu/+symposium/proceedings/2005/05-237.pdf>

2014 FALL DORMANCY/ADL RELATIONSHIP

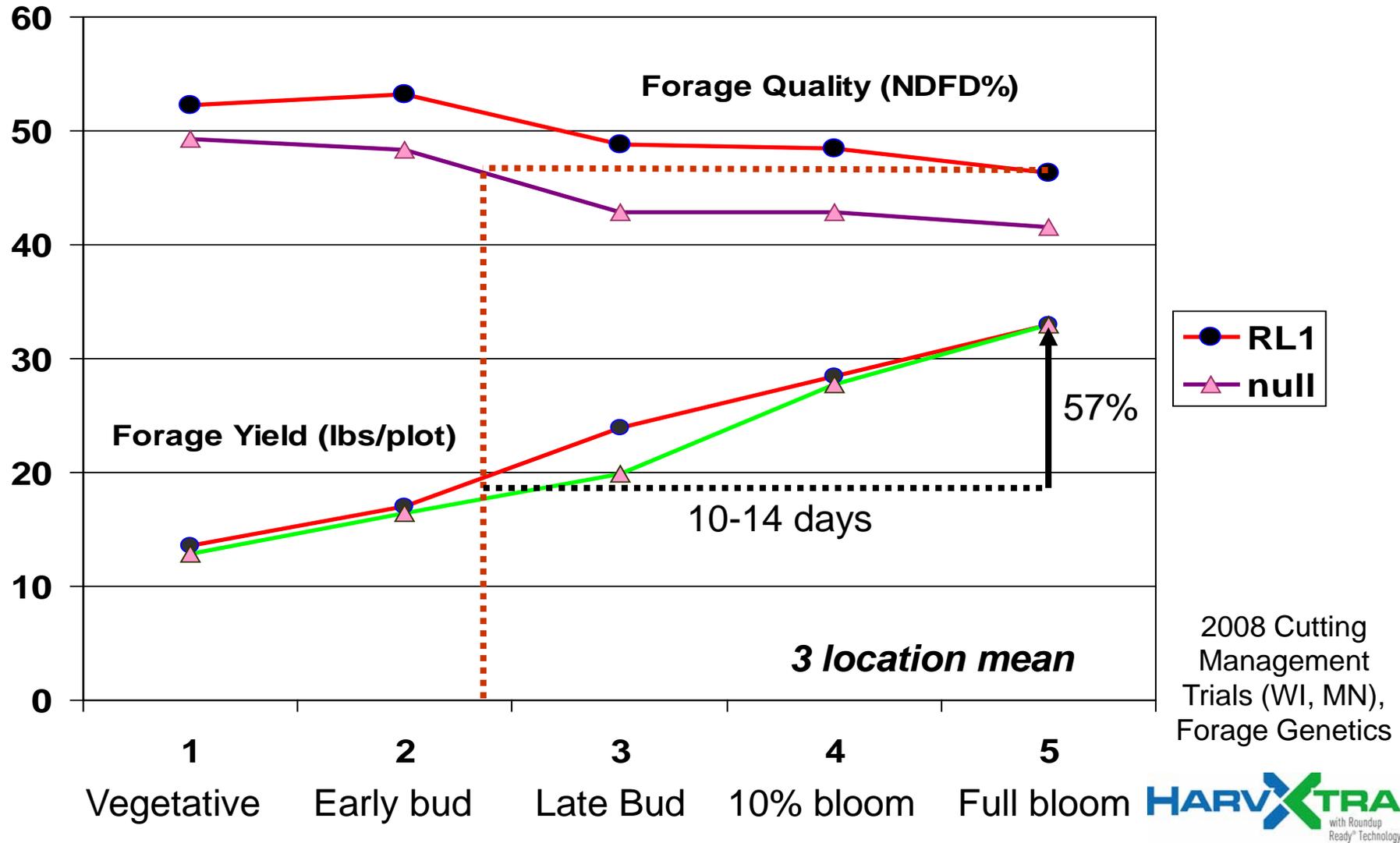
(MEAN OF FOUR CUTS IN 2013, WEST SALEM)



NOTE: ADL is Acid Detergent Lignin or indigestible plant component, giving the plant cell wall its strength and water impermeability.

Forage Genetics, 2013

Harvesting reduced lignin alfalfa with a delayed harvest schedule can increase yields without compromising quality



Potential Benefits of reduced lignin alfalfa from an agronomic perspective

» **Forage quality advantage**

- Maintain current harvest schedule
- Higher likelihood of harvesting premium quality hay (higher NDFd and RFQ)

» **Delayed harvest**

- Fewer harvests
- Higher forage yield
- Improved persistence

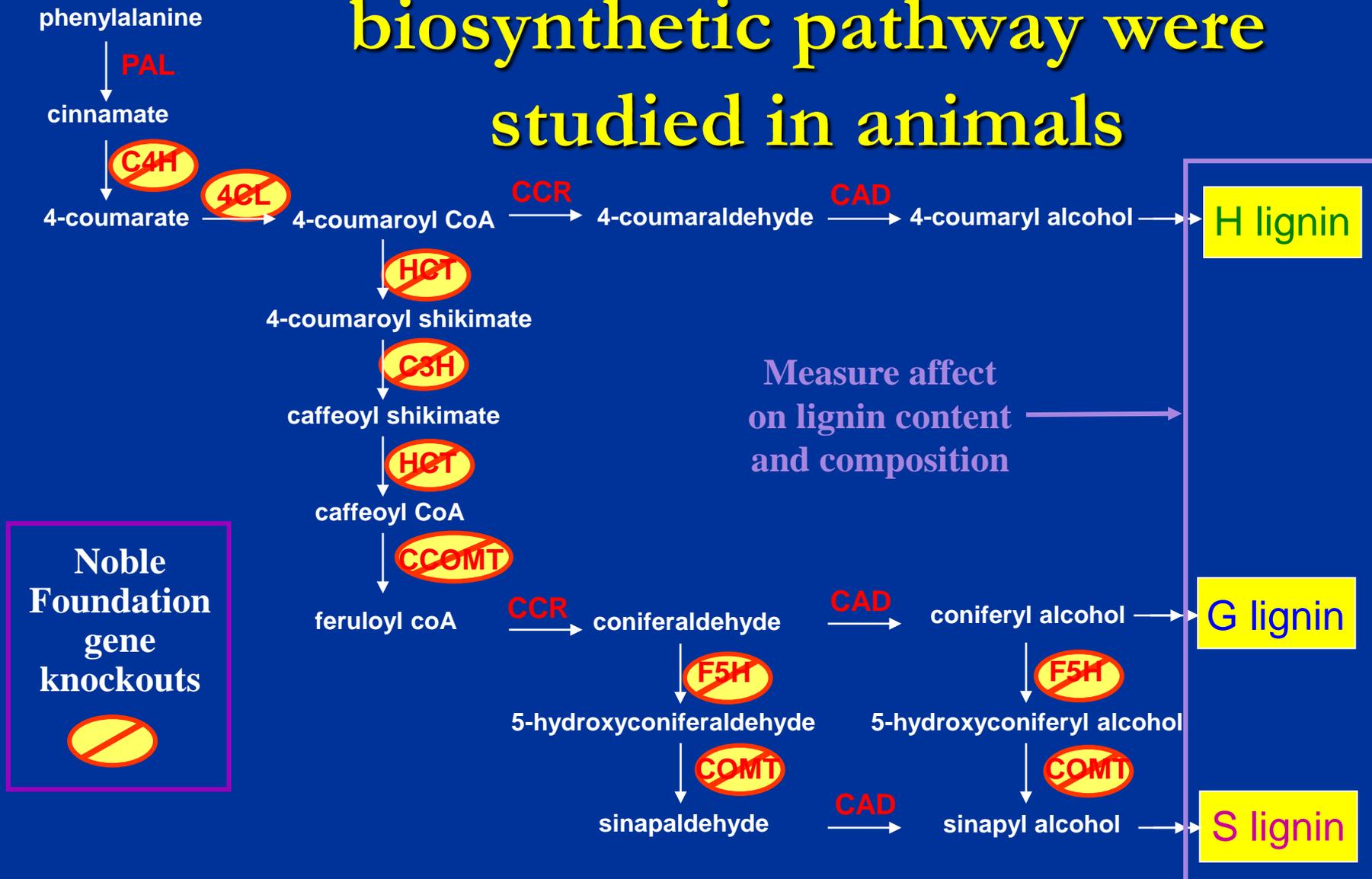
» **Flexibility**

- › Increased harvest timing flexibility

Reduced Lignin Alfalfa Animal Studies



Two key genes in the lignin biosynthetic pathway were studied in animals



Lactating Cow and Lamb Responses to Alfalfa Hays with Down-Regulated Lignin Biosynthesis

Treatment**	Cows ¹	Cows ¹	Lambs ²
	NDFd, %	FCM, kg/d	NDFd, %
COMT Active (Control)	42.5	37.3	46.7
COMT Inactive	53.5	38.5	52.3
CCOMT Active (Control)	44.5	39.4	43.8
CCOMT Inactive	48.6	38.4	43.8
COMT (Inactive vs. Active)	P<.01	P<.10	P=.006
CCOMT (Inactive vs. Active)	P<.01	N.S.	N.S.

**Diets contained 50% alfalfa hay, 10% corn silage and 40% concentrate mix

¹Weakley et al. 2008. J. Dairy Sci. Suppl. 1

²Mertens et al. 2008. J. Dairy Sci. Suppl. 1



Feeding Considerations Regarding Reduced Lignin Alfalfa

- People are asking about milk production expectations.
- Is there anything that we need to do to the diet to feed reduced lignin alfalfa?



Feeding Considerations Regarding Reduced Lignin Alfalfa

Reminder:

- Neither improved NDFd or milk production should be anticipated if grower is using delayed harvest to increase tons.
- Improved NDFd (and possibly milk production) is anticipated only when grower is using his normal (or early) cutting schedule.



Highly Digestible Alfalfa NDF

Q & A

- Q: Does increasing NDFd increase the energy content of alfalfa?
- A: Yes, but relatively little:
 - 10 lbs. alfalfa DM x 1.0 mcal ME/lb DM x 42% NDF x 10% improvement = 0.42 mcal of ME
 - Enough for 0.8 lbs of milk (assuming all the increased ME went for milk production).



Highly Digestible Alfalfa NDF

Q & A

- Q: The energy response seems small. So, why feed alfalfa of higher NDFd?
- A: To reduce rumen fill and increase DM intake
 - The greater impact of higher alfalfa NDFd on milk production is from increasing DM intake, rather than increasing energy concentration

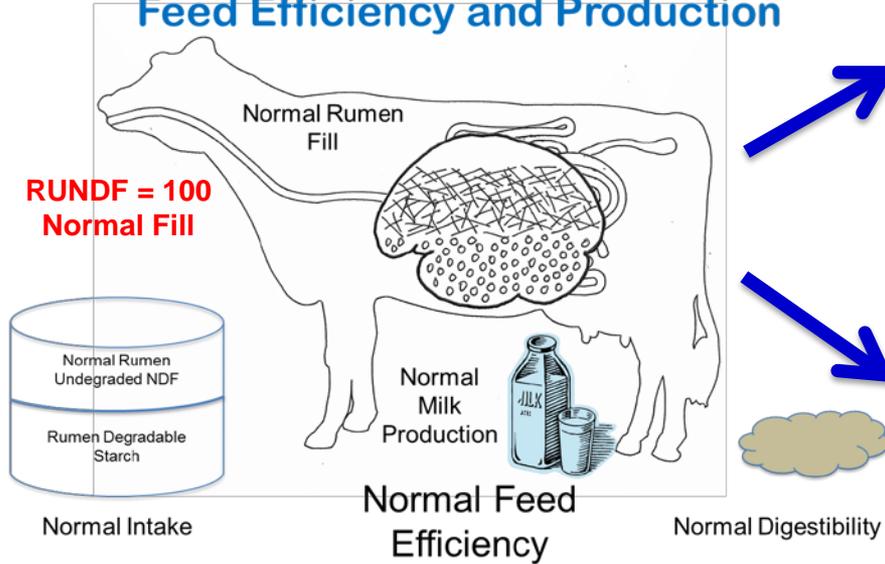


INTAKE POTENTIAL INCREASES WITH INCREASES IN NDF DIGESTIBILITY

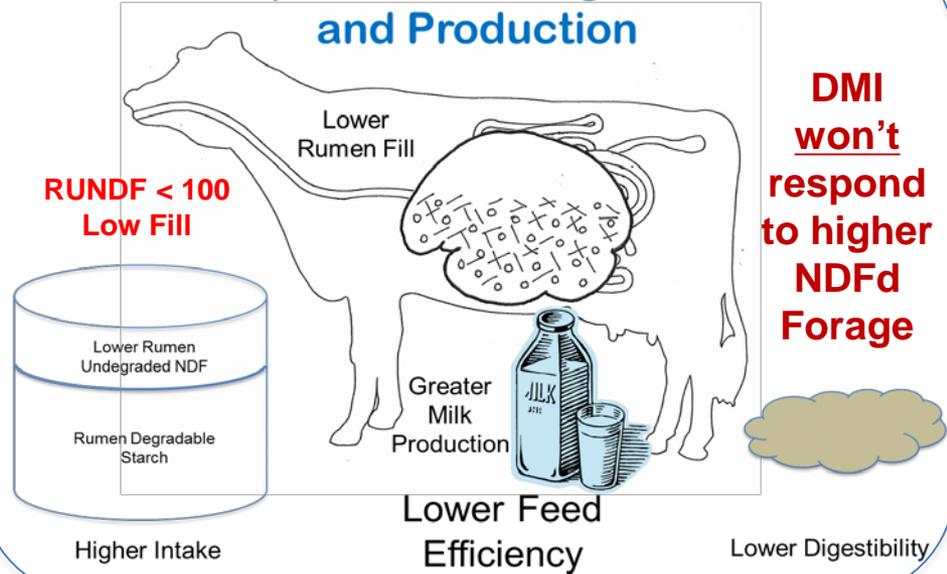
- » A one unit increase in in-vitro digestibility of NDF was associated with a 0.37 lb/day increase in dry matter intake (DMI) and a 0.55 lb/day increase in 4% fat corrected milk yield per cow (Oba and Allen, 1999)
- » Greater DMI responses are observed with early lactation, higher producing cows that are more bulk fill limited.
 - Less noticeable with lower producing cows

Intake Responses to Improved Forage Digestibility Depend on Amount of Rumen Fill

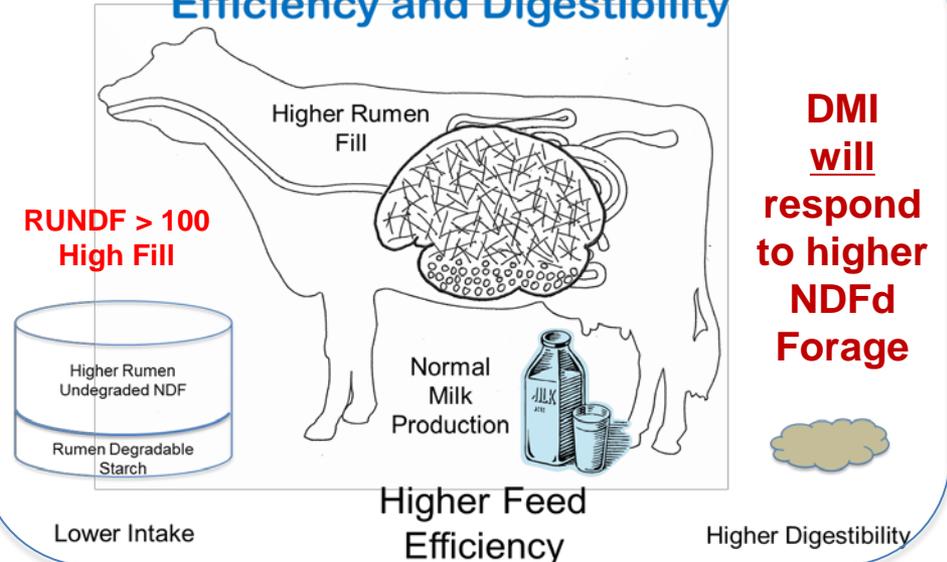
Diet Optimized for Intake, Digestibility, Feed Efficiency and Production



Diet Optimized for Higher Intake and Production



Diet Optimized for Higher Feed Efficiency and Digestibility



Highly Digestible Alfalfa NDF

Q & A

- Q: If I feed alfalfa of a higher NDFd, will I always see an improvement in DM intake?
- A: No. Only when:
 - Rumen fill is excessive
 - Forage levels are greater than about 55% and/or,
 - Digestibility of forages is below average



Highly Digestible Alfalfa NDF

Q & A

- Q: When rumen fill is not excessive, will I see a response in DM intake?
- A: No.
 - When forage levels in the diet are low (less than about 45%) and/or
 - digestibility of forages is above average, rumen fill is not limiting intake.



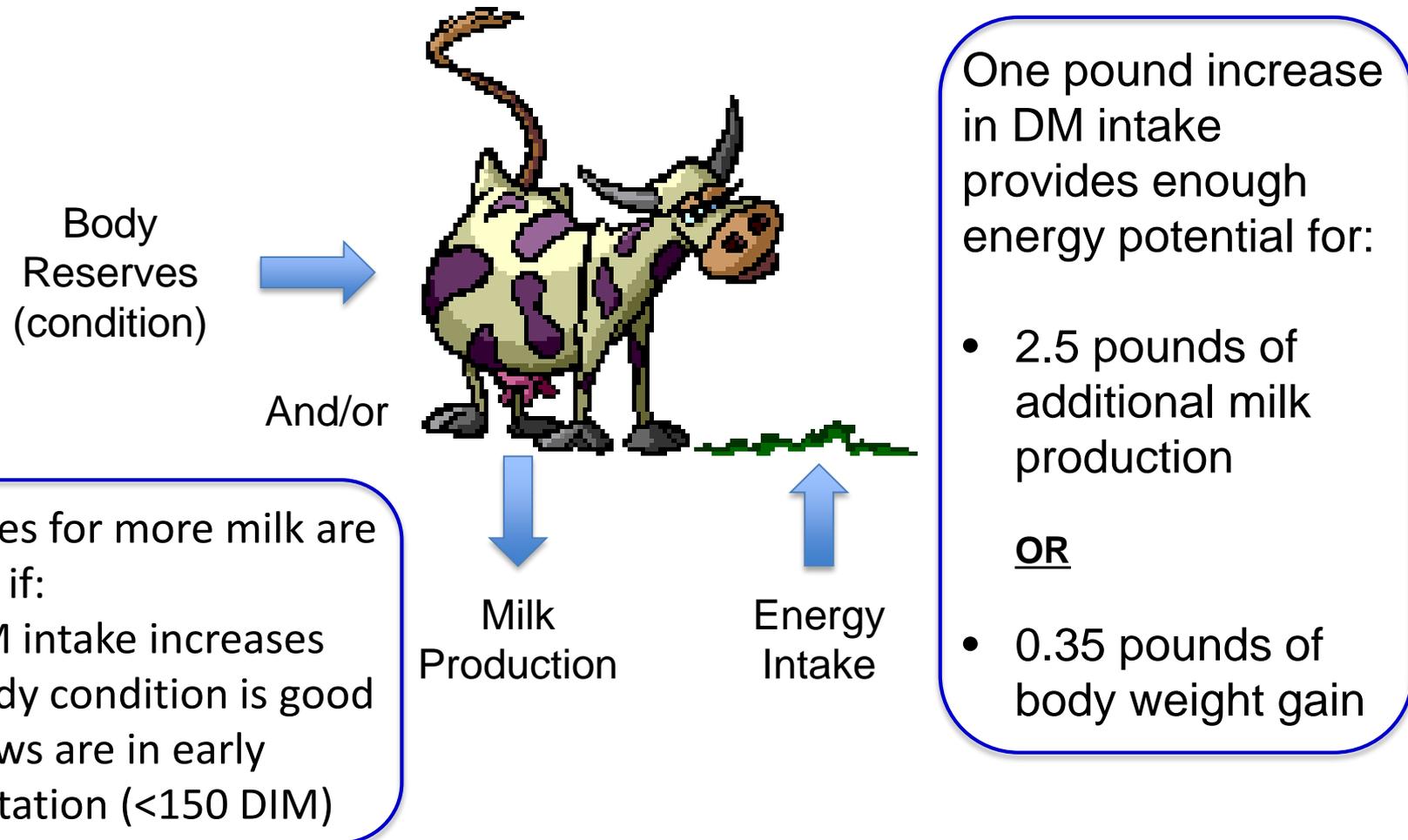
Highly Digestible Alfalfa NDF

Q & A

- Q: If I see an improvement in DM intake, will I always get a milk production response?
- A: Not always. If cows are in poor body condition or in later lactation, the increased energy intake will be used for tissue growth and not milk production.



Milk response expectations with feeding highly digestible alfalfa will depend on intake improvements, body condition and stage of lactation



Highly Digestible Alfalfa NDF

Q & A

- Q: If I substitute alfalfa of higher NDFd into the diet and rumen fill is high and body condition is good (> BCS of 3.5) and cows are in early lactation, should I see an improvement in DM intake and milk production?
- A: Very likely. For every 1 lb. increase in DM intake, you should expect a 2.5 lb. increase in fat corrected milk (FCM)



Highly Digestible Alfalfa NDF

Q & A

- Q: 2.5 lbs. more milk for every 1 lb. of DM intake increase is impressive. How much increase in DM intake can I expect with feeding alfalfa of higher NDFd?
- A: The higher the substitution rate and the greater the rumen fill, the greater the impact on DM intake.



Highly Digestible Alfalfa NDF

Q & A

- Q: Why would a grower ever want to grow alfalfa of higher NDFd, particularly if he doesn't own any cows?
- A: To sell hay of higher quality for a premium price



Highly Digestible Alfalfa NDF

Q & A

- Q: So, alfalfa hay of a higher NDFd will have a greater RFV (Relative Feed Value) or TDN (Total Digestible Nutrients), which commands a premium price?
- A: Unfortunately not. Neither of these indexes will reflect the higher NDFd.



Highly Digestible Alfalfa NDF

Q & A

- Q: So, if RFV or TDN won't reflect the higher NDFd, what will?
- A: RFQ (Relative Forage Quality) based on the associated NDFd measurement from a commercial laboratory. An NIR predicted NDFd may underpredict highly digestible alfalfa, but in vitro should be accurate.



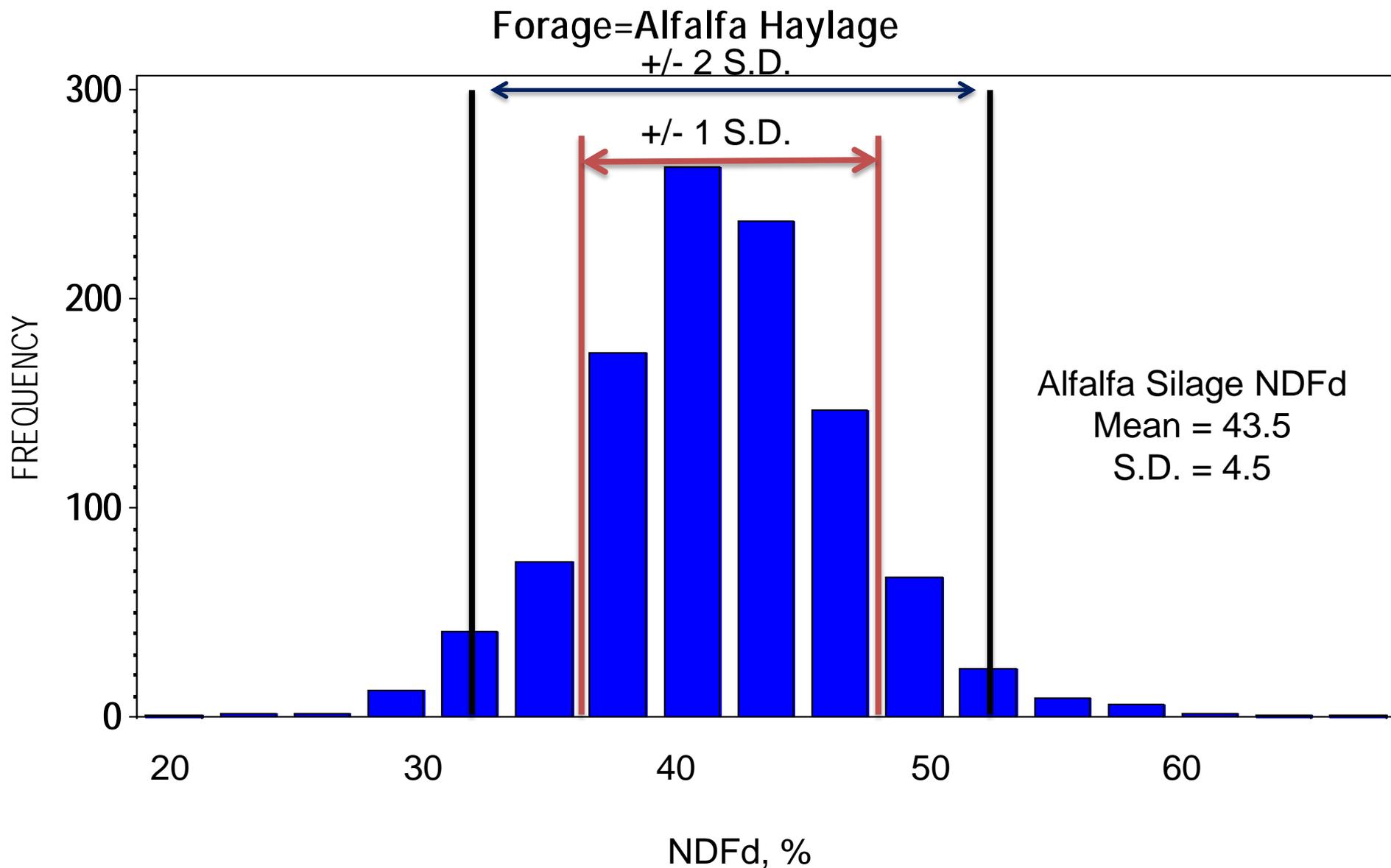
Highly Digestible Alfalfa NDF

Q & A

- Q: Will all commercial labs report a higher NDFd and RFQ?
- A: Not always. If the commercial lab prediction equations for NDFd are poorly represented at the extreme of the population of higher NDFd alfalfa, NDFd will be under-predicted.



NIR prediction accuracy depends on the size, range, and quality of the lab database



ISSUE - HIGH QUALITY ALFALFA CAN BE UNDER-PREDICTED FOR NDFD

- » Why – NIR requires data to be accurate across a wide range of forage quality. By how much could they be under-predicted? Over 20% is not uncommon.
- » How often is this a problem? It is an issue for alfalfa of unusually good and unusually poor digestibility (new alfalfa varieties that tend to be high quality could be an issue).
- » Forage Genetics has populated data extremes and is offering the NIR predictions to large commercial labs.

The challenge splitting samples and comparing labs

Green Corn Silage									
	Calibrate Lab			Commercial Lab			Difference		
Sample	DM	Starch	NDF	DM	Starch	NDF	DM	Starch	NDF
Dairy A	32.5	21.3	46.1	35	26.1	44.2	(2.50)	(4.80)	1.90
Dairy F	33.1	22	45.6	29.3	16.6	51.6	3.80	5.40	(6.00)
Dairy D	31.7	34.3	38.9	34	38.2	35.6	(2.30)	(3.90)	3.30
Dairy B	41.5	31.8	42.1	45.2	23.7	48.5	(3.70)	8.10	(6.40)
Dairy C	41.8	27.2	43.2	43	22.6	47.6	(1.20)	4.60	(4.40)
Dairy E	42.7	20.1	49.8	47.1	28.9	41.8	(4.40)	(8.80)	8.00
Tom	42	34.7	36.5	44.7	35.5	35.9	(2.70)	(0.80)	0.60
Joe	38.9	22.2	46.4	37.8	30	40.6	1.10	(7.80)	5.80
Grady	39.8	37.2	34.5	42.1	28.5	44.5	(2.30)	8.70	(10.00)
John	38.3	33.5	38.5	43	21.9	47.4	(4.70)	11.60	(8.90)
Little John	45.7	38.7	36.5	43.9	36.8	36.2	1.80	1.90	0.30
Average, 11 samples	38.91	29.36	41.65	40.46	28.07	43.08	(1.55)	1.29	(1.44)

- It is very difficult to split unprocessed samples, particularly forages and TMR's
- These green chop samples were not representatively subsampled
 - Whenever the starch level increased at one lab, NDF was decreased by a similar amount

How do you make use of forage quality measurements?

Agronomy Concerns (Seed Seller, Grower)

- Yield (tons/acre)
- **RFQ (alfalfa)**
- RFV (alfalfa)
- TDN
- Milk/ton (corn silage)



Agronomist

Nutritionist

Nutrition Concerns (Nutritionist, Dairy Producer)

- NDF/NDFd
- Starch/Starch dig. (corn silage)
- RDS
- RUNDF
- DM
- Protein

“Did it test correctly?”

“Is the diet responsive?”

In Summary

Nutritional Questions Concerning Reduced Lignin Alfalfa

- Should I expect increased milk production?
 - “It depends”. Chances are better if:
 - Alfalfa is harvested for quality (normal cutting schedule)
 - DM intake increases
 - Body condition is good
 - Cows are in early lactation (<150 DIM)
 - Can't always expect a milk production response!



Nutritional Questions Concerning Reduced Lignin Alfalfa

- Is there anything that we need to do to the diet to feed Highly Digestible reduced lignin alfalfa?
 - Not really. Formulation similar to that used with high NDFd alfalfa.
 - If rumen fill amounts are low, there is opportunity to increase forage levels in the diet.
 - Do not fall prey to the “add wheat straw” reaction.



Thank you

