Feeding recommendations regarding reduced lignin alfalfa

- 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.

Does increasing NDFd increase energy content of alfalfa?

- YES, but only in small amounts
  - 10 lbs alfalfa DM x 1.0 mcal ME/lb DM x 42% NDF x 10% improvement = 0.42 mcal of ME
  - If we assume that all this ME goes to milk production you would get about 0.8 lbs of milk

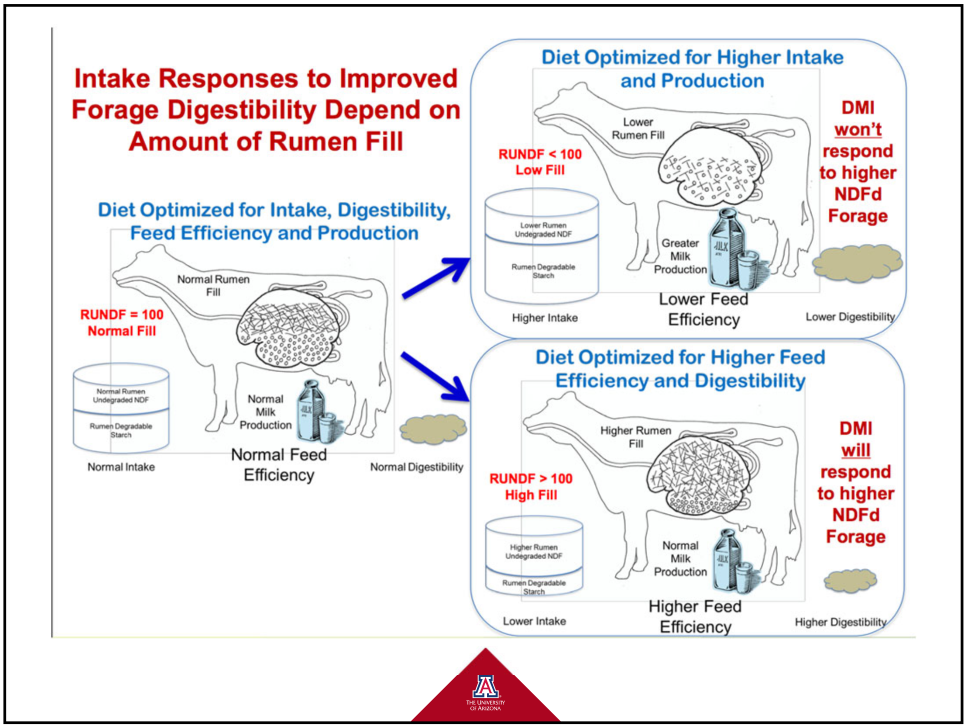
The energy response seems small. So, why feed alfalfa of higher NDFd?

- 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 NDFd

- » 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

RUNDF = 100
Normal Fill

Normal Rumen Fill

Normal Rumen Undegraded NDF

Rumen Degradable Starch

Normal Milk Production

Normal Intake

Normal Feed Efficiency

Normal Digestibility

Diet Optimized for Higher Intake and Production

RUNDF < 100
Low Fill

Lower Rumen Fill

Lower Rumen Undegraded NDF

Rumen Degradable Starch

Greater Milk Production

Higher Intake

Lower Feed Efficiency

Lower Digestibility

DMI **won't** respond to higher NDFd Forage

Diet Optimized for Higher Feed Efficiency and Digestibility

RUNDF > 100
High Fill

Higher Rumen Fill

Higher Rumen Undegraded NDF

Rumen Degradable Starch

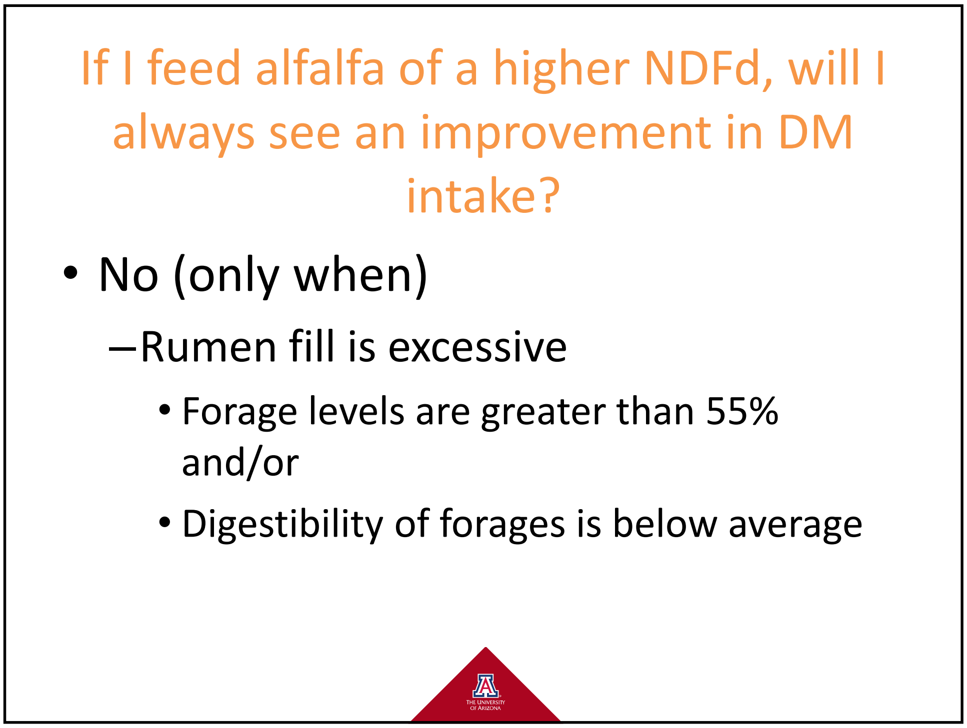
Normal Milk Production

Lower Intake

Higher Feed Efficiency

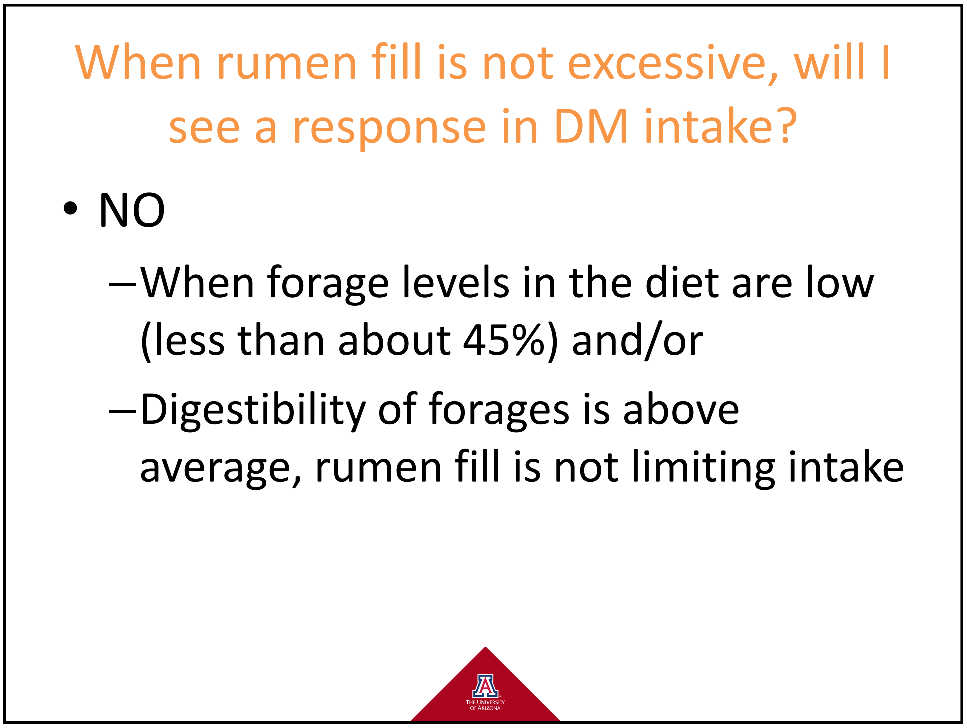
Higher Digestibility

DMI **will** respond to higher NDFd Forage



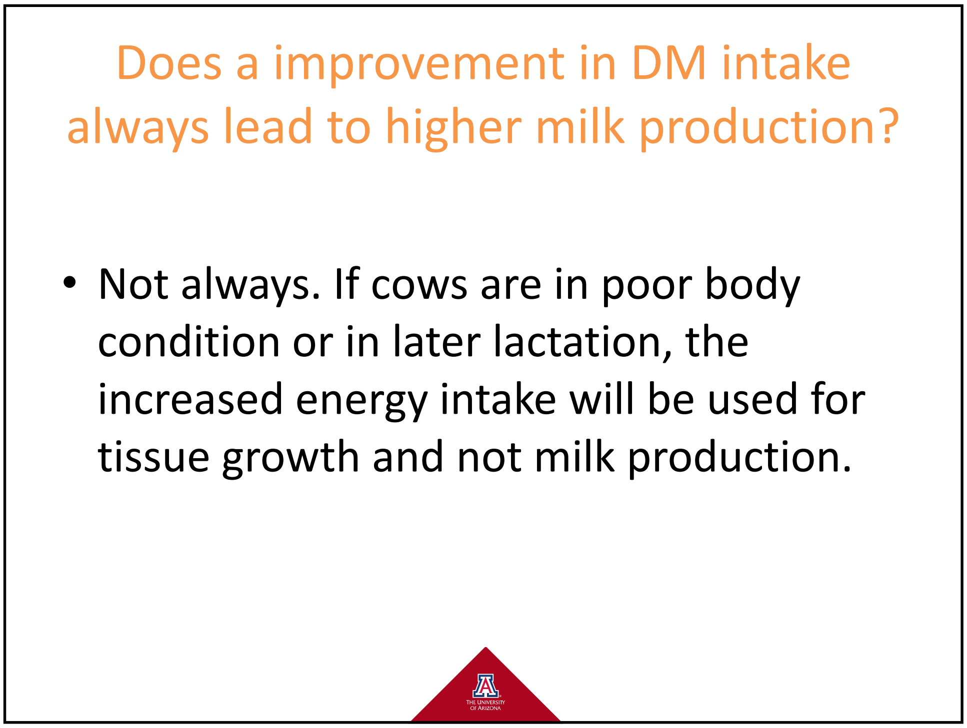
If I feed alfalfa of a higher NDFd, will I always see an improvement in DM intake?

- No (only when)
  - Rumen fill is excessive
    - Forage levels are greater than 55% and/or
    - Digestibility of forages is below average



When rumen fill is not excessive, will I see a response in DM intake?

- 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



Does a improvement in DM intake always lead to higher milk production?

- 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 expectation with feeding highly digestible alfalfa

It will depend on intake improvements, body condition and stage of lactation

Chances for more milk are better if:
DM intake increases
Body condition is good
Cows are in early lactation (<150 DIM)

One pound increase in DM intake provides enough energy potential for

2.5 lbs of additional milk production
or
0.35 lbs of body weight gain

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 and improvement in DMI intake and milk production?

Very likely. For every 1 lb. increase in DM intake, you should expect a 2.5 lbs increase in fat corrected milk (FCM)

- 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

- 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.

RFQ vs. RFV?

- What do the numbers tell me
- Do they provide pertinent information
- Feed quality of alfalfa depends to a great extent on maturity of the stand
- With increased maturity, plant structural carbohydrates, as measured by the ADF and NDF fractions, increase
- Relative Feed Value (RFV) has been used for years to compare the quality of legume and legume/grass hay and silages
- Having one index to price hay and predict animal performance has been very useful for both sides
- RFV estimates forage DM digestibility and filling capacity. Relative Feed Quality improves on RFV by accounting for NDF digestibility

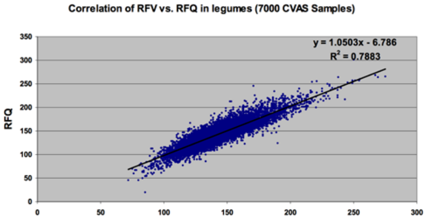
Relative Feed Value (RFV)

- RFV estimates the digestibility dry matter from the ADF (cellulose and lignin), and calculates the DM intake potential (as % of BW) from NDF (total cell wall portion ADF+ hemicellulose)
- This index ranks forages relative to the digestible DMI of full bloom alfalfa (assuming 41% ADF and 53% NDF). The RFV index at this growth rate is 100
- Example
  - Alfalfa hay or haylage with 32% ADF and 40% NDF
  - DigDM = 88.9 – (0.779 x32) = 63.97
  - DMI = 120/40=3
  - RFV = (63.97 x 3) / 1.29 = 149

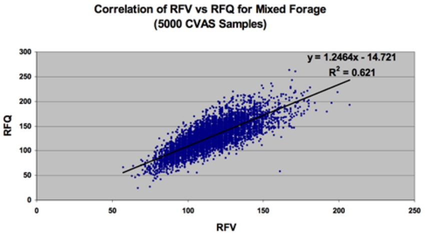
Limitations of RFV 1) DigDM and DMI are assumed constants for all forages 2) ADF and NDF are the only laboratory values used 3) CP concentration of forages is not used 4) RFV cannot be used in ration formulation or evaluation

Relative Forage Quality (RFQ)

- Fiber from grass and legumes naturally differs in digestibility, as it also when grown under different ambient temperatures.
- RFV of first-cutting alfalfa will be similar to that of second and third cutting harvested at similar stages of maturity.
- However fiber fraction digestibility could vary as it is influenced by ambient temperature at the time of growth and development.
- RFQ was therefore designed to account for fiber digestibility to estimate intake as well as the total digestible nutrients (energy) of the forage.
- RFQ Index is and improvement over RFV index for those that buy and sell forages because it better reflects the performance that can be expected from the cattle (It also differentiates legumes from grasses)



Correlation of RFV vs. RFQ in legumes (7000 CVAS Samples)



Correlation of RFV vs RFQ for Mixed Forage (5000 CVAS Samples)

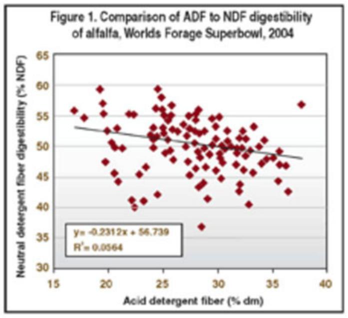


Figure 1. Comparison of ADF to NDF digestibility of alfalfa, Worlds Forage Superbowl, 2004

RFV and RFQ are closer for alfalfa when fiber digestibility is average. They differ primarily as fiber digestibility varies from average

The handoff between agronomy and nutrition

Agronomy concerns (seed seller, grower)

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

* Did it test correctly????

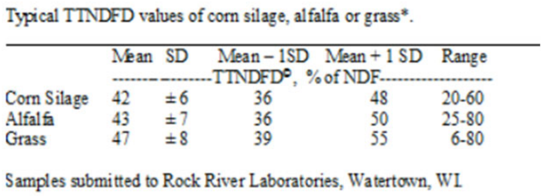
Nutrition concerns (nutritionist, dairy producers)

- NDF/NDFd
- RDS
- RUNDF
- DM
- Protein

* Are the cows going to perform better????

What should we use?

- TTNDFD



Typical TTNDFD values of corn silage, alfalfa or grass*.

	Mean	SD	Mean – 1SD	Mean + 1 SD	Range
	TTNDFD[c], % of NDF				
Corn Silage	42	± 6	36	48	20-60
Alfalfa	43	± 7	36	50	25-80
Grass	47	± 8	39	55	6-80

Samples submitted to Rock River Laboratories, Watertown, WI.

- %ADL – acid detergent lignin
- NDFom/uNDFom – om or ash free – 30/120/240 to calculate rate of fiber digestion (kd)

Summary

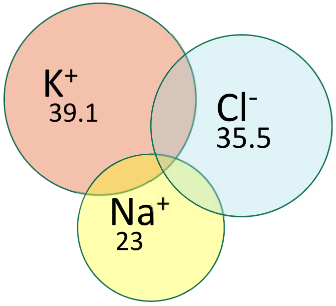
- Should I expect increased milk production?
  - “It depends” Chances are better if:
    - Alfalfa is harvested for quality (normal cutting schedule)
    - DM intake increases
    - Body condition is good (>3.5)
    - Cows are in early lactation (<150 DIM)
  - Can’t always expect a milk production response!

Summary

- Is there anything that we need to do to the diet to feed highly digestible 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

Take Home

- Crossroads between agronomy and nutrition
- Analysis of forage digestibility
- Will we be ready to maximize new technologies/climate
- Dairy feeding studies still limited



"Coordinating DCAD and the Electrolytes; It's More Important than you Think?"

Rich Erdman

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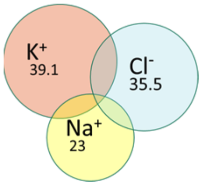


Dietary Cation Anion Difference (DCAD)

DCAD Represents the Relative Difference in (mEq/kg) in the primary dietary electrolytes:

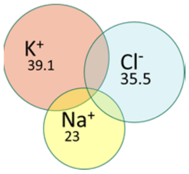
DCAD= mEq K + mEq Na - mEq Cl

DCAD-S = mEq K + mEq Na - mEq Cl – mEq S

Uses of DCAD:

- Dry cows-Low DCAD-preventing milk fever
- Lactating Cows-High DCAD
    - Intake, Milk Production, Rumen pH, Milk Fat, Acid Base Balance

DCAD is a relative Difference in Electrolytes, Not an amount !



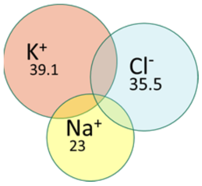
					DCAD, mEq/kg DM	DCAD-S, mEq/kg DM	Electrolytes	
Diet	K%	Na%	Cl%	S%			%	g/d
Basal (Corn Silage)	1.20	0.25	0.40	0.25	303	147	1.85	426
Basal +0.5% Salt	1.20	0.45	0.70	0.25	303	147	2.35	541
Alfalfa/Small Grain + 0.5% Salt	1.53	0.25	1.00	0.25	303	147	2.98	685

Assumes 51 lb DMI

Three diets can have the same [DCAD] but be very different in amounts of electrolyte fed..

Extra electrolytes have to eliminated by the kidney

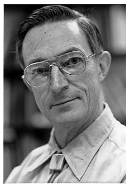
The Electrolytes (Na, K, Cl) are Strong Ions?



The term "Strong Ion" coined by Peter Stewart (Canadian Physiologist) in paper:

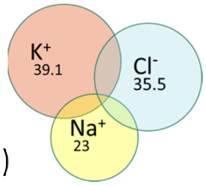
- "Strong Ion Theory of Acid-Base Balance"

(*Respiration Physiology* (1978) *33, 9-26)*


Peter Stewart

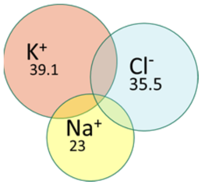
- Strong Ions are completely dissociated n biological fluids
  - Cations: Sodium (Na), Potassium (K) Magnesium (Mg)
  - Anions: Chloride (Cl), Sulfate, Lactate, Volatile Fatty acids, Beta-hydroxy butyrate.
- Dietary K, Na, and Cl are the principal dietary strong ions.

4 Characteristics of Strong Ions?



- Primary Functions:
  - Active Transport of Nutrients (glucose, amino acids)
  - Neural Transmission
  - Osmoregulation: Water balance across tissues
    - Digesta vs intestine, intracellular vs. extracellular, fecal water, etc.
- Minimal reserves
  - Deficiencies manifest themselves quickly (1-2 days)
  - Share common deficiency symptoms:
    - Decreased feed and water intake, dry manure
- Highly available: Nearly 100% absorbed from diet
- Excess Strong Ions are excreted in the urine, Not in the feces

The Strong Ion’s Role in Osmoregulation
(Normal Osmotic Pressure: ~300 mOsm)



Ion	Intra-cellular	Blood	Rumen Fluid
	------ mEq/L ------		
Na^+	12	145	84
K^+	139	4	27
Cl^-	4	116	8
HCO_3^-	12	29	6
Amino acids & proteins	138	9	(VFA’s) 105
Mg++	0.8	1.5	4.2[1]
Ca++	<0.0002	1.8	3.5[1]
Osmoles	290	290	315[1]

[1] Adapted from Bennick et al. (JDS, 1978)

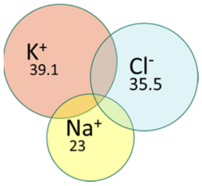
Ruminants Evolved on Forages

	------- % of DM -------			------- mEq/kg DM -------		
Forage	K	Na	Cl	K	Na	Cl
Corn Silage	1.20	0.01	0.29	307	4	82
Alfalfa Haylage	3.03	0.03	0.55	775	13	155
Grass Silage	2.81	0.05	0.64	795	22	181
Barley Silage	2.42	0.13	0.72	621	57	203
Rye Silage	3.34	0.05	0.90	854	22	253
Orchardgrass	3.58	0.04	0.67	916	17	188

Comments:

- Nutritional environment: High K, Low Na, and Moderate CL
- Ruminant are equipped to get rid of excess K
- Forages are high DCAD feeds

Dietary Electrolytes are not Expensive to Supplement



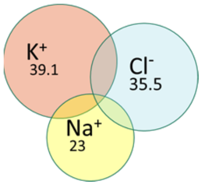
The Relative Costs of Increasing Diet K, Na, and Cl by 100mEq/kg (98, 58, and 89 g/d, respectively)[1,2]

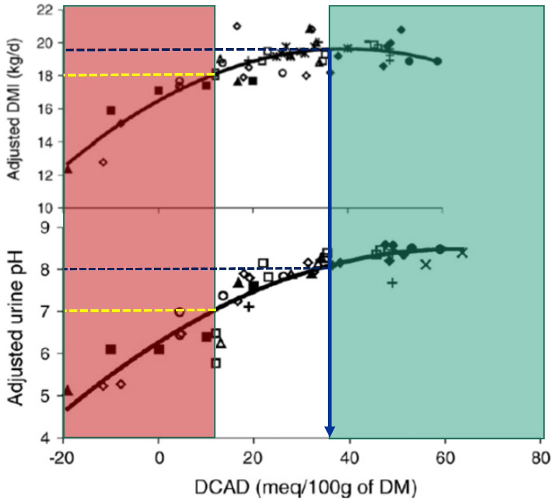
	Added Cost, $ per Cow/Day		
Mineral Supplement	K	Na	Cl
Salt		$0.02	$0.02
Potassium Chloride	$0.10		$0.10
Potassium Sesquicarbonate	$0.25		
Sodium Bicarbonate		$0.13	
Sodium Sesquicarbonate		$0.09	

[1] Cow consuming 25 kg (55 lb) DM per day

[2] Dietary K, Na, and Cl increase by 0.39, 0.23, and 0.35%, respectively

Dairy Cows Like to Operate with an Alkaline Urine (pH=7.5 to 8)

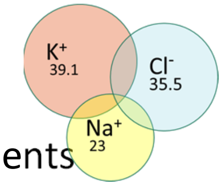




- Peak DMI occurs when urine pH is about 8
- That point is reached with DCAD of ~ 37.5 mEq/100 g
- Dry Matter Intake (DMI) falls off rapidly as urine pH drops to 7 or below.
- Low DCAD diets reduce urine pH (dry cows)
- Don't feed lactating cows for low urine pH!

Mongin DCAD (K + Na –Cl)
Adapted from Hu and Murphy, 2004, J. Dairy Sci. 87:2222

What Regulates Urine pH?

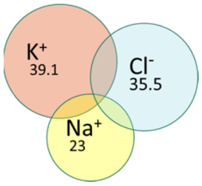


- Strong Ion intakes in excess of requirements
  - Excreted in the urine
- SID (Strong Ion Difference) = $Na^+ + K^+ - Cl^-$
  - DCAD is a Proxy for Urinary SID
- Urinary Strong Ion Excretion (Eq. Basis)
  The cations must equal the anions:

$$Na^+ + K^+ + H^+ + (NH_4^+) = Cl^- + OH^-(HCO_3^-)$$

Cations Anions

Alkaline Urine pH



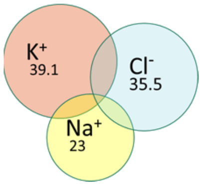
When there are Excess Cations(K,Na)

$$Na^+ + K^+ + H+ (NH_4^+) = Cl^- + OH^-(HCO_3^-)$$

↑ Urinary Bicarbonate, ↑ urine pH

Results in an alkaline urine: This is normal for ruminants

Acid Urine pH



When there are Excess Anions (Cl)

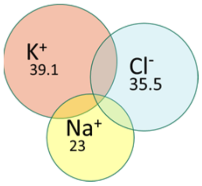
$$Na^+ + K^+ + H+ (NH_4^+) = Cl^- + OH^-(HCO_3^-)$$

↑ Urinary NH_4^+, ↓ Bicarbonate, ↓ pH

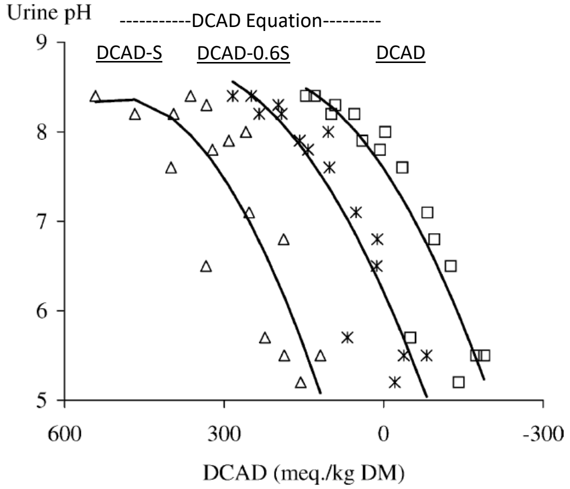
Too much Cl in relation to K and Na results in an Acid Urine (This is abnormal in ruminants)

Remember: Dairy cows like to operate with an alkaline urine (pH=7.5 to 8)

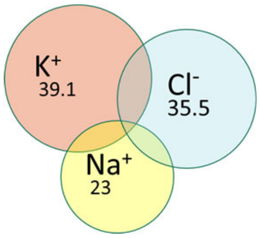
DCAD is strongly related to Urine pH



M. Spanghero/Animal Feed Science and Technology 98 (2002) 153–165



- In low sulfur diets each DCAD equation fits well, but given a different number with each equation.
- DCAD-S may overestimate S effects in diet.



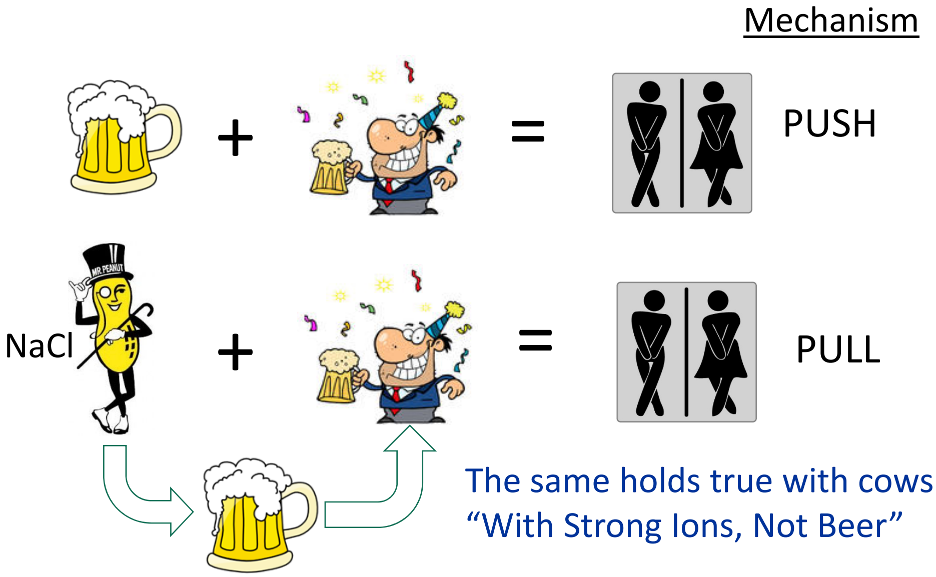
Excess Strong Ions Drive Cows to Drink!!

(OK, Not that kind of drink)

Erdman is a German name.
For those of you who do not know, beer is an important food group for all Germans

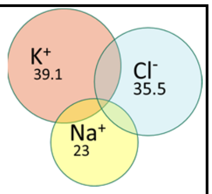
Beer is also an Excellent Source of Water!!

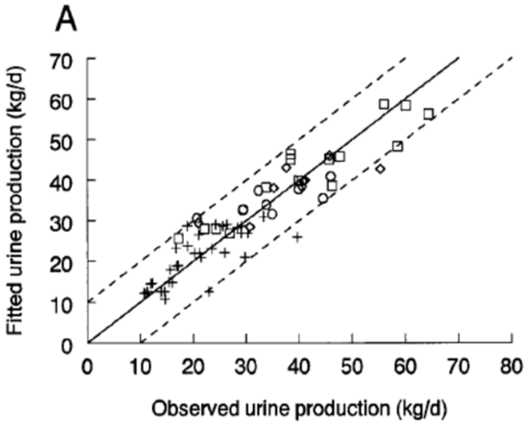
(That must be eliminated)



The same holds true with cows!
"With Strong Ions, Not Beer"

Electrolyte (Strong Ion) Intake Drives Urine Output in Dairy Cows





Urine Volume, kg = 0.115 Na Intake, g/d +
0.058 K Intake, g/d

(R^2 = 0.848, SE = 5.16)

From Bannink et al., 1999, J. Dairy Sci 82:1008

9 g/day Excess Na
or
17 g/d Excess K

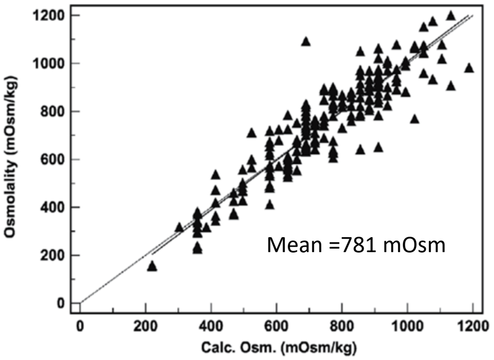
1 Liter Extra Urine

Is this the:

- Push Mechanism?
- Pull Mechanism?

There is a Limit to how Concentrated Urine can be

Observed Range in Urine Concentration
(Milliosmoles/Liter)



In Bannink et al. 1999

The projected urine conc.

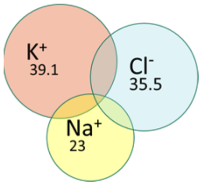
K = 881 mOsm

Na = 756 mOsm

This suggests that the cow is minimizing the amount of water lost in order to get rid of excess K and Na

From Alcántara-Isidro et al. (2015) RRJVS 1:34

Add First Glance, Added K Appears to Improve N Use (lower MUN)



	-------- Added Potassium, mEq/kg DM -------			
Milk	0	125	250	375
MUN, mg/dL	15.5	14.0	13.6	12.0
Protein %	2.95	2.99	2.95	2.92
Protein, g/d	1143	1174	1158	1124

[1] Iwaniuk et al., 2015 J. Dairy Sci. 98:1950

- Don't be fooled: Milk MUN went down because urine volume went up to get rid of excess K.
- Same amount of Urea-N was excreted in a larger urine volume

Summary: Strong Ion Effects on Water Intake, Urine Output and pH

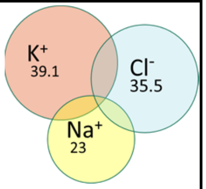
- Excess K and Na, Increases
  - Water Intake
  - Urine Output
  - Urine pH
- If you want cows to drink more, increase diet K and Na
  - More Water Intake, More Watering Space
- Excess Cl:
  - Decreases urine pH (Cows like an alkaline, NOT AN ACID Urine)
  - Increases urine output
  - Requires more K and Na that will also increase water intake

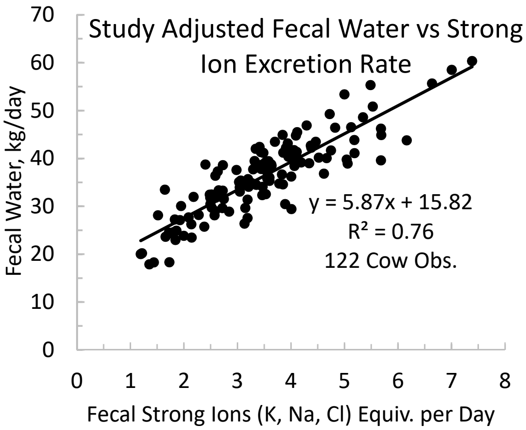
Dumping extra electrolytes (strong ions) in the diet has consequences

Pay attention, especially to Cl!

Cow Manure is 85% Water

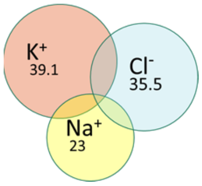
(Something has to hold that water)





- Just like other body fluids:
  - Fecal water is related to osmotic pressure
  - Strong ion (K, Na, and Cl) contents
- Implied Strong Ion Osmotic Effect
  - 170 mOsm (more than 50% of total (300)
  - Other Fecal Minerals (Ca, P, Mg), VFA, bicarbonate contribute
- This suggests a metabolic fecal strong ion requirement to maintain a constant fecal water

Cow Manure is 85% Water



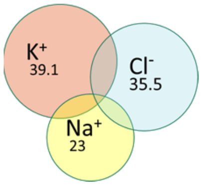
Preliminary Lucas Plot (Regression) Analysis

Apparently Absorbed Ion = Dietary Ion (both as g/kg Diet DM)

Strong Ion	Intercept (Met. Fecal) g/kg DM	Slope (Abs. Coeff.)	RMSE g/kg DM	*P* <
K	-2.48	1.02	0.27	0.001
Na	-1.45	0.98	0.53	0.001
Cl	-1.11	0.92	0.52	0.001

- Implied Absorption Coefficients-Very High
  - ~100 % for K and Na, 92% for Cl
- Most Fecal K, Na, and Cl is Metabolic
  - 2.48, 1.45, and 1.11 g/kg Diet DM, respectively
- Consistent with maintaining constant fecal H_2O

What Do Cows Need for? Milk production



Strong Ion	2001 NRC	Castillo et al., 2013[1]	Difference, g/kg	% Change
K, g/kg milk	1.50	1.54	+0.04	+2.6
Na, g/kg milk	0.65	0.41	-0.24	-37.1
Cl, g/kg milk	1.15	1.03	-0.12	-10.4

[1] Castillo et al., 2013. J. Dairy Sci. 96 :3388; 39 herds averaging 787 cows per herd

- Potassium concentrations seem fine
- More recent data suggests Na = 0.40 and Cl = 1.0
  - Lower than current 1989 NRC
- Why is milk Cl and especially Na so much lower now?

Why are milk Na and Cl so much lower today?

Strong Ion	2001 NRC	Normal Milk[1]	Milk with High SCC[1]	% of Normal
K, g/kg	1.50	1.73	1.54	91
Na, g/kg	0.65	0.57	1.05	184
Cl, g/kg	1.15	0.91	1.47	161

[1] From Review by Harmon, 1994, J. Dairy Sci 77:2103

- 2001 NRC values based on 1965 British estimates
- Mastitis increases milk Na and Cl
- Milk SCC has declined rapidly during the last 50 years?

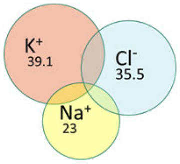
What Do Cows Need? 2001 NRC Maintenance Req.

Strong Ion	Endogenous Fecal & Urinary, g/kg BW	Metabolic Fecal (g/kg Diet DM)	Severe Heat Stress g/100 kg BW
K	0.038	6.1 (2.6)	0.40
Na	0.038	--	0.50
Cl	0.0225	--	--

Comments:

- Endogenous Urinary Excretion-Impossible to Measure
  - Dependent on the relative excess of other strong ions
- Metabolic fecal minerals, usually expressed per unit diet DM
- Heat stress values not large nor well defined

What Do Cows Need? 2001 NRC Maintenance + Milk Requirements (g/d)[1,2]



Ion	End. Fecal-Urinary	Met. Fecal	Heat Stress	Total Maint	Milk	Total	% Diet DM	DCAD, mEq/kg
K	29	153	3	185	83	268	1.07	273
Na	29	--	4		32	64	0.26	113
Cl	16	--	--		58	72	0.29	81

[1] 1540 lb (700 kg) cow consuming 55 lb (25 kg) DMI producing 110 lb (50 kg) milk

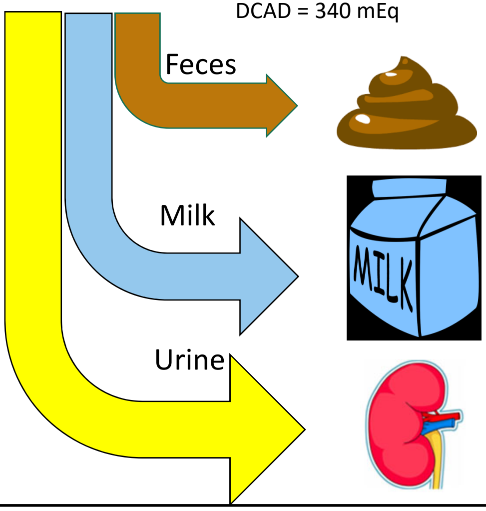
[2] Assumes true absorption coefficient of 90% for each strong ion

Diet DCAD = 304

How many people feed diets with those concentrations of K, Na, and Cl?

The ratios of SI in feed are not the ratio that ends up in urine

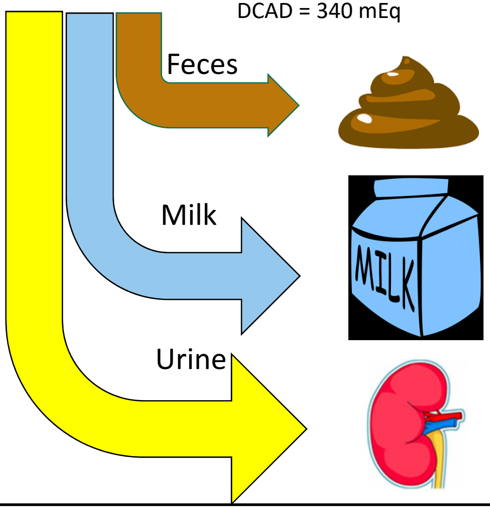
1540 lb Cow, 55 lb DMI,
110 lb milk,
Diet K, Na, Cl:
1.20, 0.30, and 0.35%
DCAD = 340 mEq



Ion	g/d	Eq/d	Eq Ratio, K:Na:Cl
K	300	7.7	3.1
Na	75	3.2	1.3
Cl	88	2.5	1.0
Minus			
K	63	1.6	1.7
Na	36	1.6	1.6
Cl	34	1.0	1.0
Minus			
K	75	1.7	1.2
Na	20	0.9	0.6
Cl	50	1.4	1.0
Equals			
K	162	4.1	36.7
Na	19	0.8	7.3
Cl	4	0.1	1.0

If we increased diet Cl to 0.6%

1540 lb Cow, 55 lb DMI,
110 lb milk,
Diet K, Na, Cl:
1.2, 0.3, and 0.35%
DCAD = 340 mEq



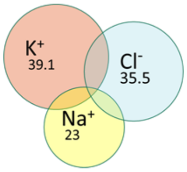
0.35% Dietary Cl
Urinary Bicarbonate:
= Urinary (K + Na – Cl)
= 4.1 + 0.8 – 0.1
= 4.8 equivalents (288 g HCO_3^-)

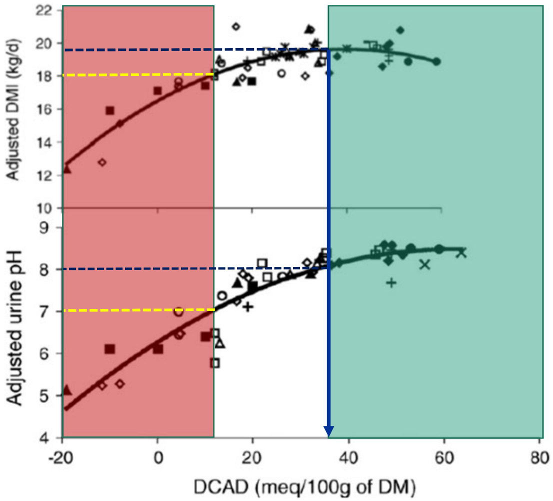
0.60% Dietary Cl (+63 g, +1.8 Eq)
Urinary Bicarbonate:
= 4.1 + 0.8 – 1.9
= 3.0 equivalents (188 g HCO_3^-)

Small change in Cl, Big impact on urinary HCO_3^- and pH

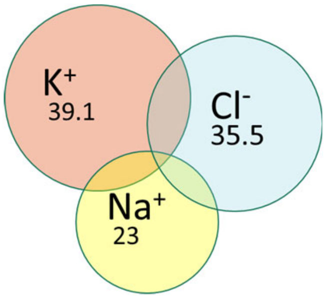
Ion	g/d	Eq/d	Eq Ratio, K:Na:Cl
K	162	4.1	2.4
Na	19	0.8	0.4
Cl	67	1.9	1.0

Again: Milking Cows Like an Alkaline Urine



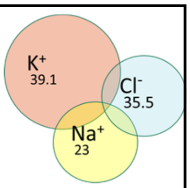


- Alkaline pH requires excess urinary cations, (K + Na) vs anions (Cl)
- Overfeeding Cl will lower DCAD and urine pH



Always Remember:
Excess Strong Ions Drive
Cows to Drink!!

Summary: Coordinating DCAD and the Electrolytes



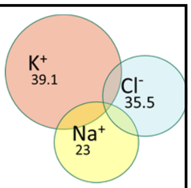
Feed for an alkaline urine (pH ~ 7.5 to 8)

- Remember High DCAD is only a proxy for Urinary SID
- Cows need much more urinary K/Na than Cl
- Adding more NaCl or KCl to diet won't help you!

Watch Cl, Do Feed Analysis!

- Feed enough to meet milk and maintenance needs
- Not too much in excess, leads to lower urine pH
- Small grain and grass silages, can be fairly high in Cl
- If Cl is too high
  - Add Na or K Carbonate/Sesquicarbonate instead of NaCl or KCl

Summary: Coordinating DCAD and the Electrolytes

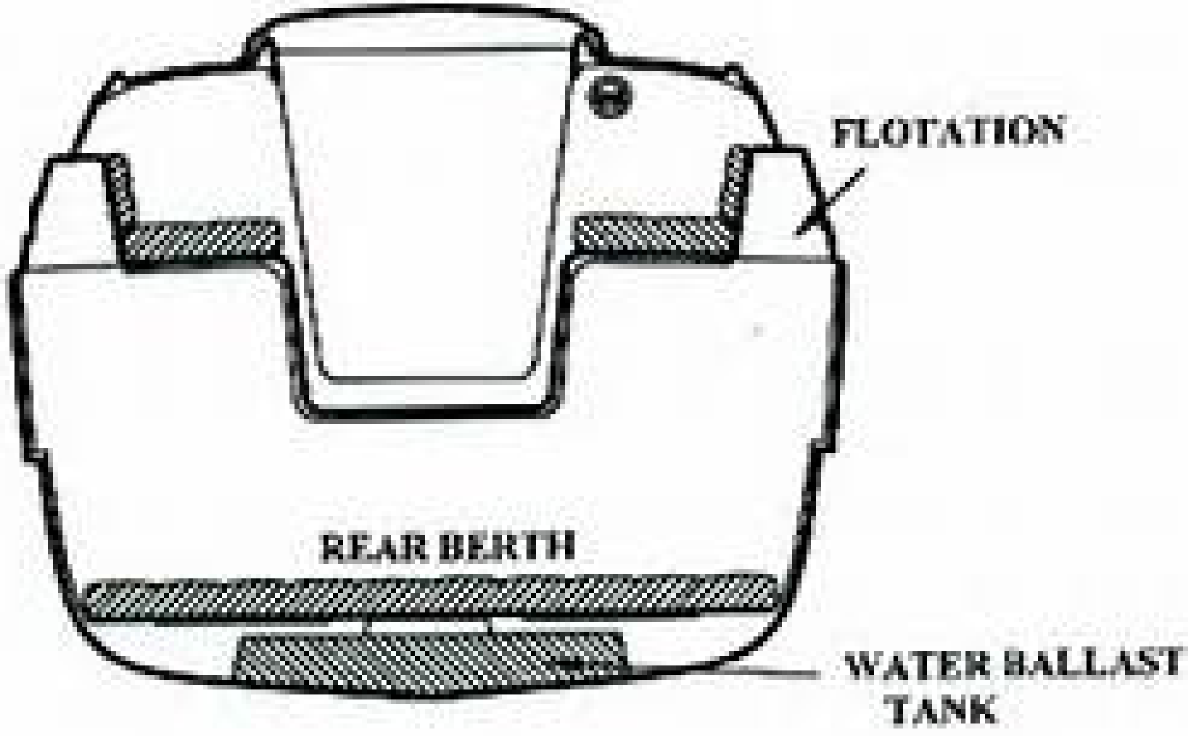


Water Intake

- 9 grams extra Na, 17 grams extra K increase H2O by 1L.
- If want to increase H2O intake:
- Add dietary K, Na
- Make sure that you have good quality water, adequate watering space

Finally, Pay Attention:

"Dumping extra strong ions in the diet has consequences. The cow can handle extra K and Na, but not Cl."



Fiber Analysis and Application in Modeling

Lynn Gilbert, PAS – Ag Model and Training Systems (AMTS) LLC

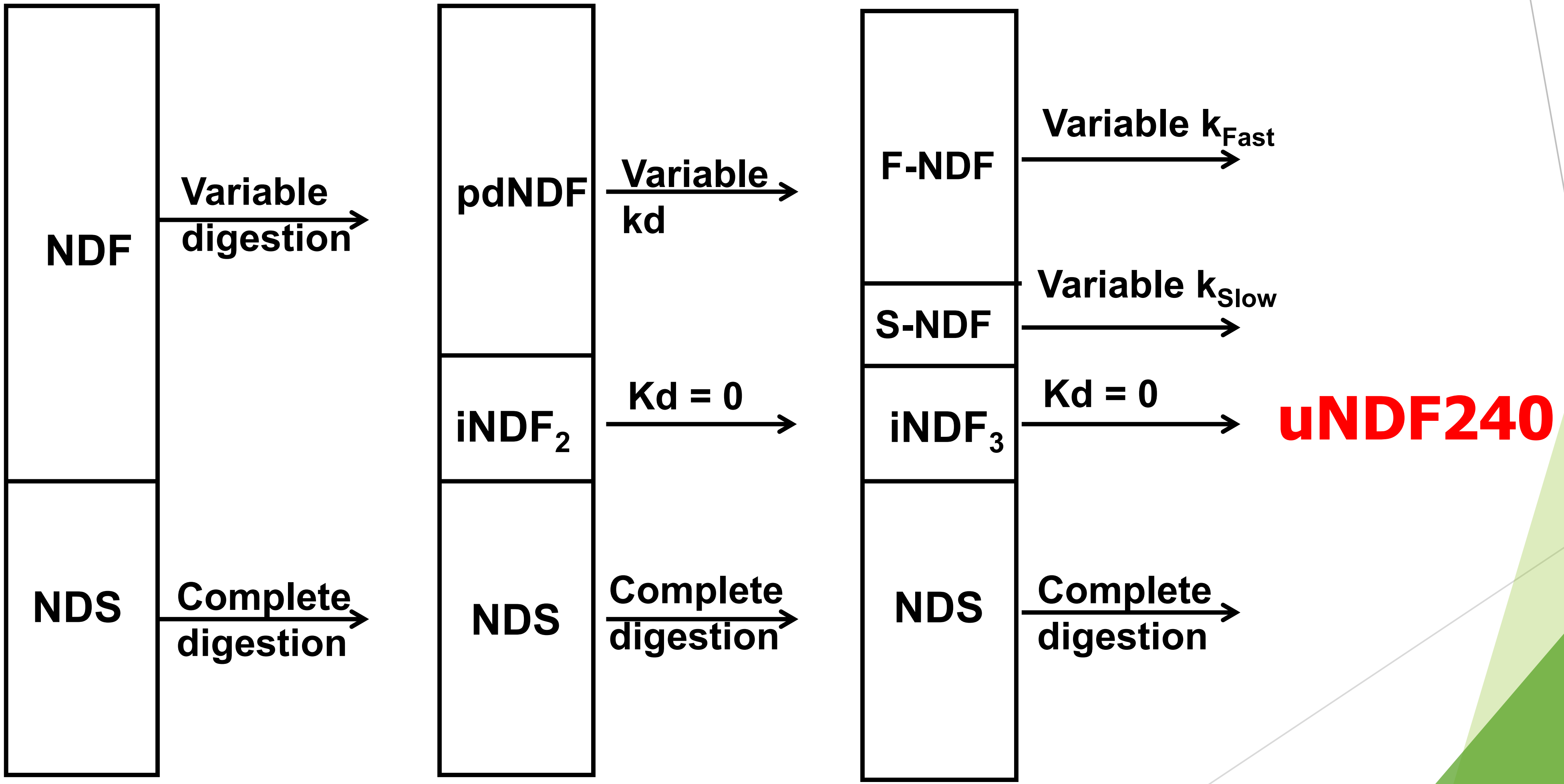
Sarah E. Fessenden, PAS – Dairy One Forage Laboratory

Let’s start with the basics

Current status: fiber digestion

3-pool model

(Mertens, 1977; Raffrenato and Van Amburgh, 2010; Cotanch et al., 2014)



NDF

Variable digestion

NDS

Complete digestion

pdNDF

Variable kd

iNDF$_2$

Kd = 0

NDS

Complete digestion

F-NDF

Variable k_{Fast}

S-NDF

Variable k_{Slow}

iNDF$_3$

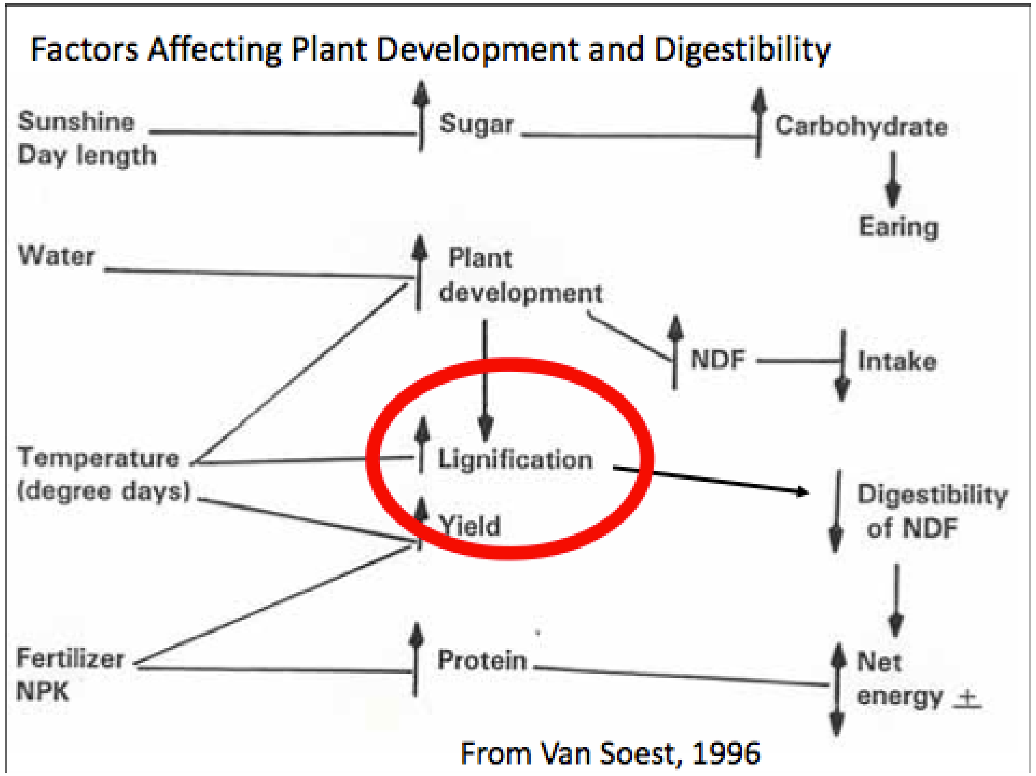
Kd = 0

uNDF240

NDS

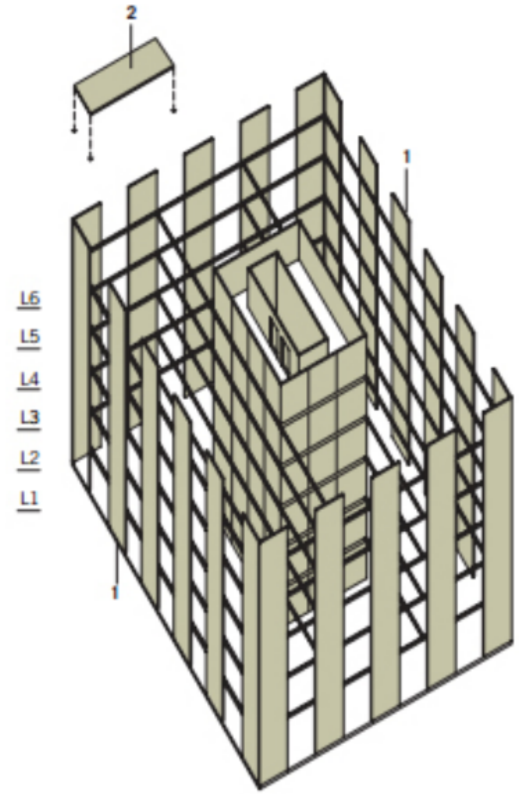
Complete digestion

NDF – Relations to Digestibility



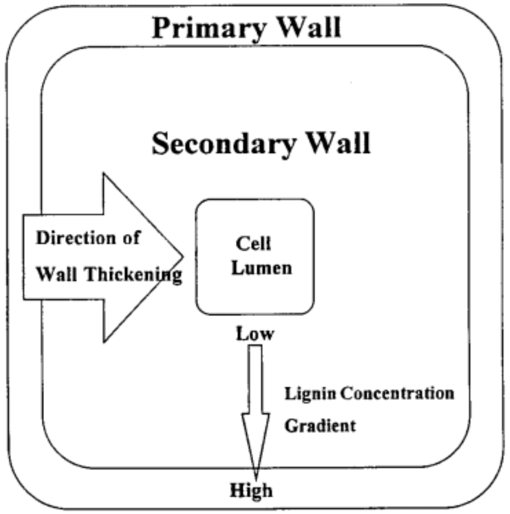
Factors Affecting Plant Development and Digestibility

From Van Soest, 1996



https://diagram+of+tall+building+structures

- **Lignin highest in primary wall & moves into secondary wall as plant matures**
  - **ML and 1° wall often indigestible (for fiber particles)**



To Lignin or Not to Lignin

Lignin itself does NOT correlate well with NDF digestibility

- It is all about the cross-linkages between lignin and hemicellulose and cellulose that dictate digestibility

There will no longer be a need to determine lignin!

- Makes labs happy as NIR calibrations for lignin are difficult.

Lignin is not Lignin is not Lignin

2.4 factor to calculate CHO C is NOT constant

- BMR corn silage hybrids, **3 to 5**
- Conventional hybrids **2 to 7**
- Alfalfa **1.9 to 3.2**
  - (with 80% between **2.2 and 2.8**)
- Grasses **1.5 to 5.5**
  - (with immature grasses varying from **1.9 to 7.5**).

uNDF

Some papers call it iNDF to represent indigestible NDF

Mertens has pushed for us to call it uNDF for undigestible NDF and uNDF is becoming the *de facto* standard term uNDF and intake appear to be very highly correlated

It appears in Holsteins that the cow will reach a steady-state uNDF rumen level

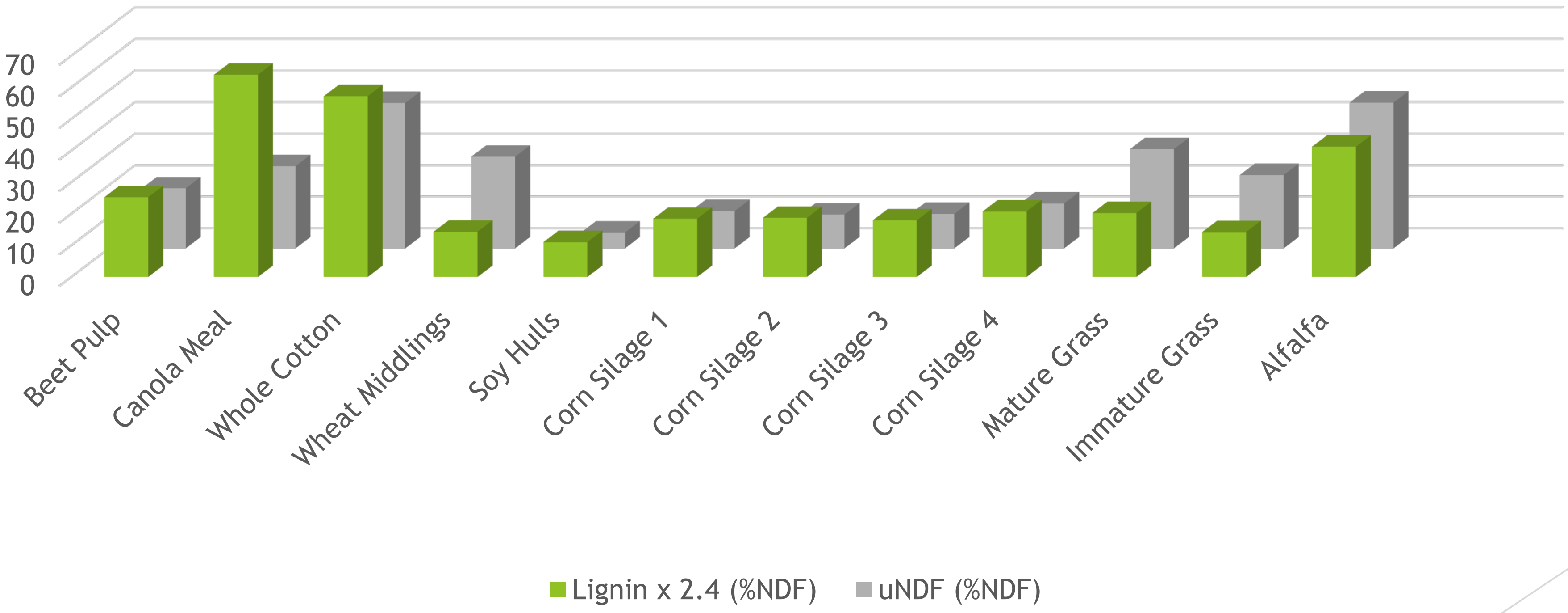
- **4-5 kg or 8.8 to 11 lbs.**

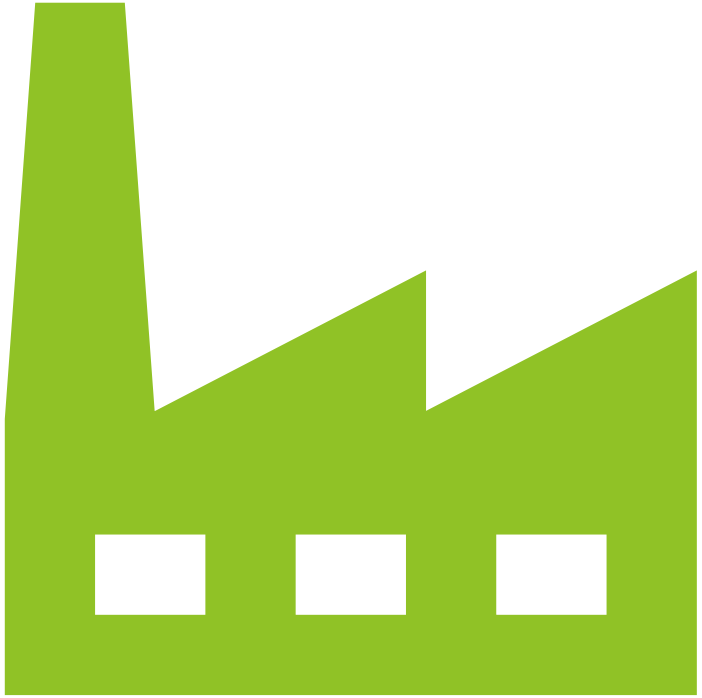
For her to consume more feed, an equal amount of uNDF must escape the rumen first

uNDF has 0 kd so completely regulated by passage rate

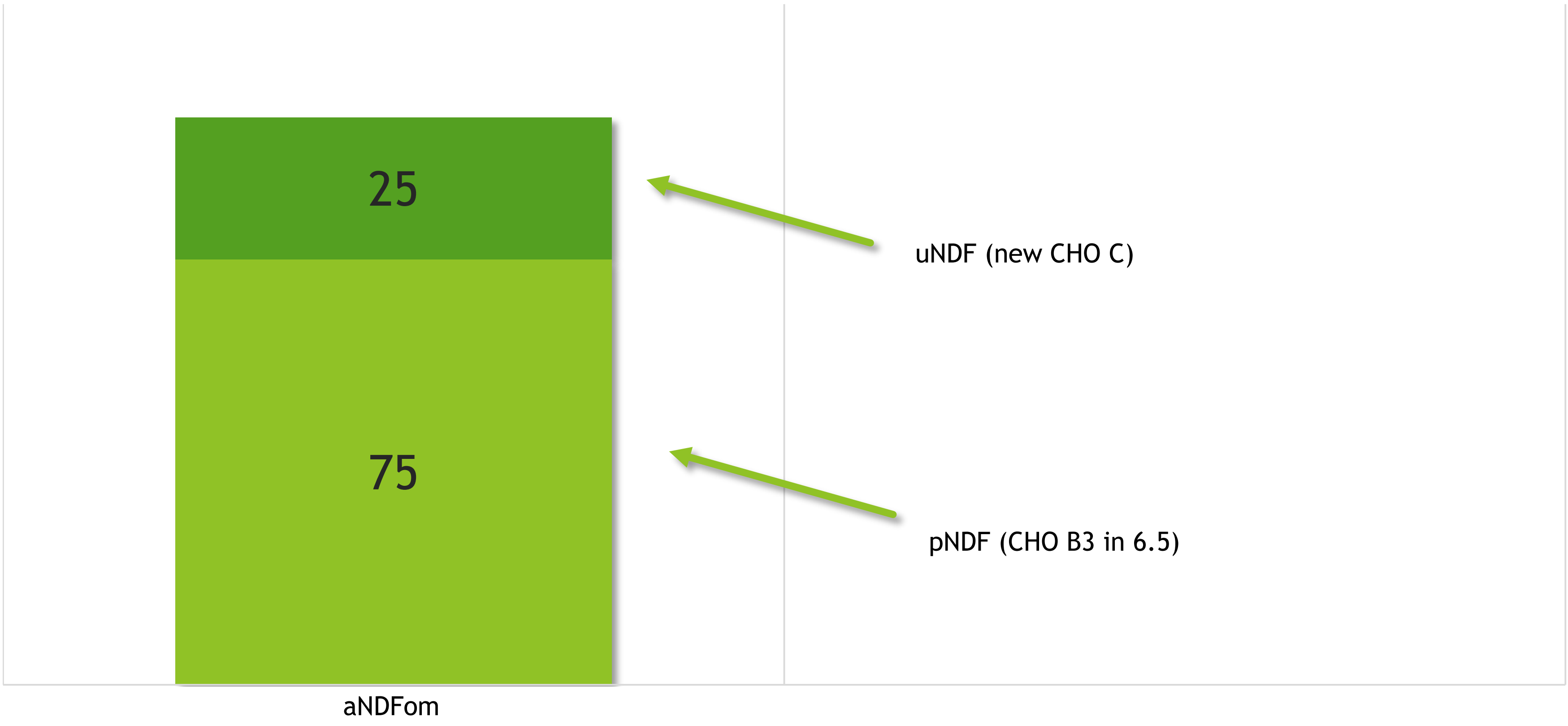
This has massive potential impact on formulation, procurement, and manufacturing thinking

uNDF vs Lignin x 2.4 in Select Feeds





pNDF = aNDFom - uNDF

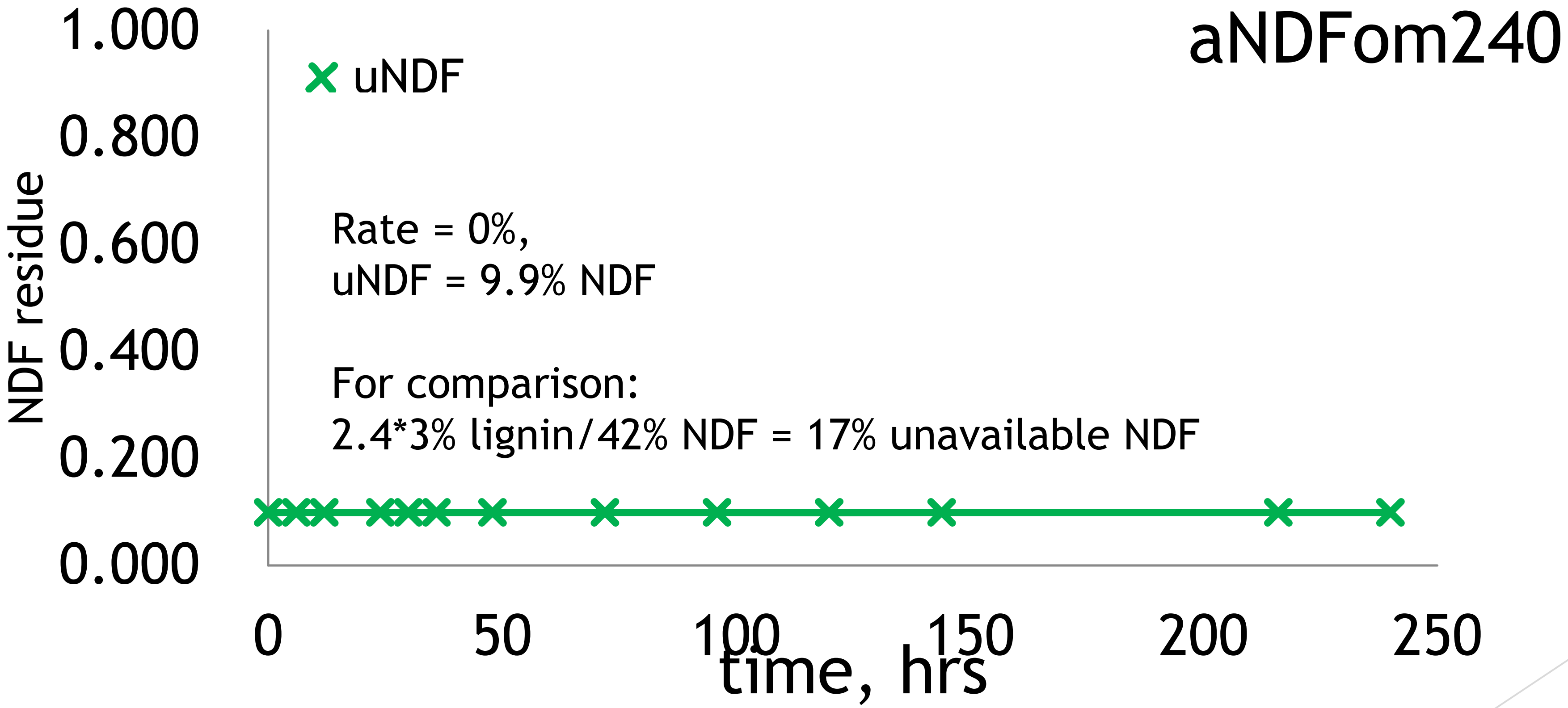


uNDF (new CHO C)

pNDF (CHO B3 in 6.5)

uNDF is determined with different time points for forages vs. non-forages

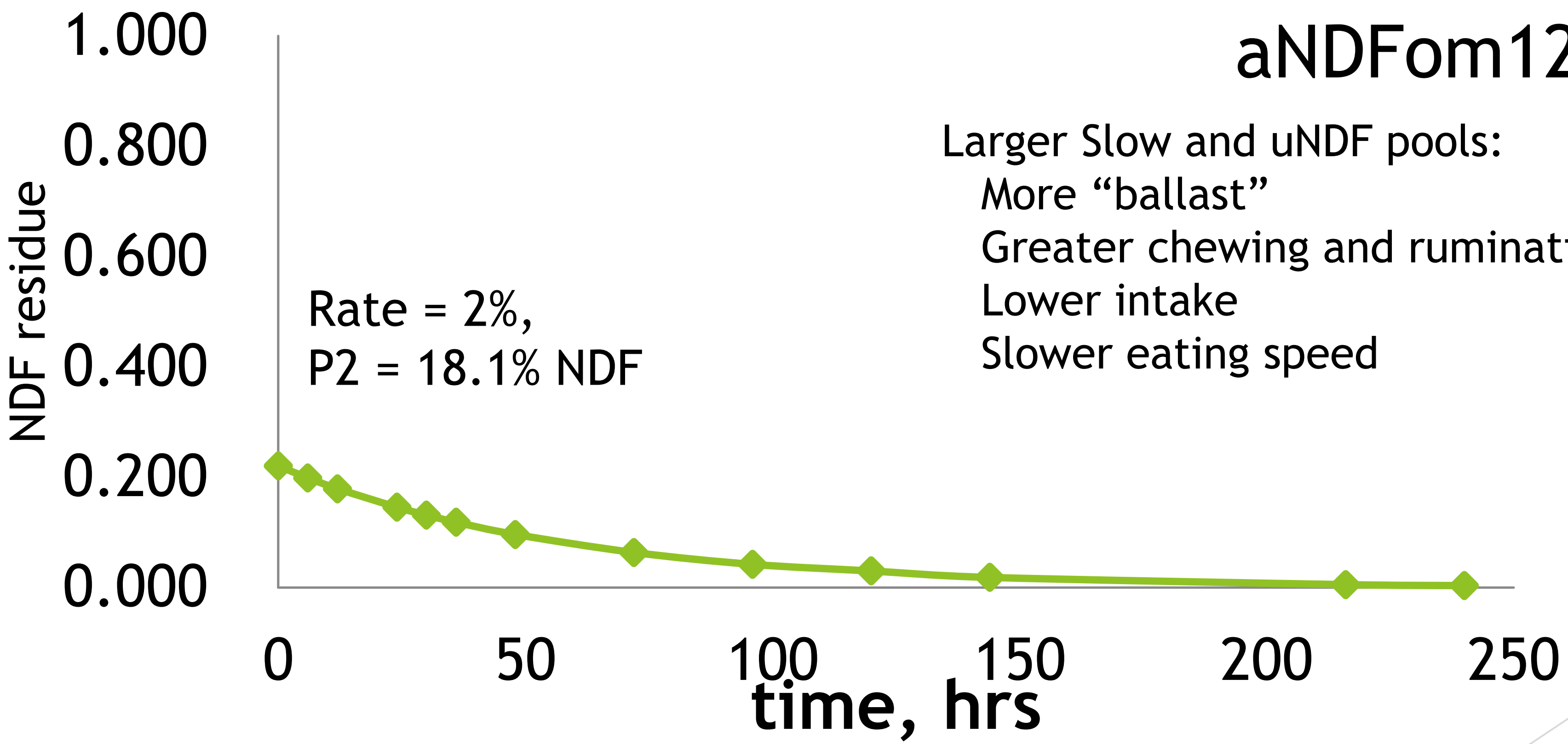
Corn silage example: uNDF



Rate = 0%,
uNDF = 9.9% NDF

For comparison:
2.4*3% lignin/42% NDF = 17% unavailable NDF

Corn silage example: slow pool

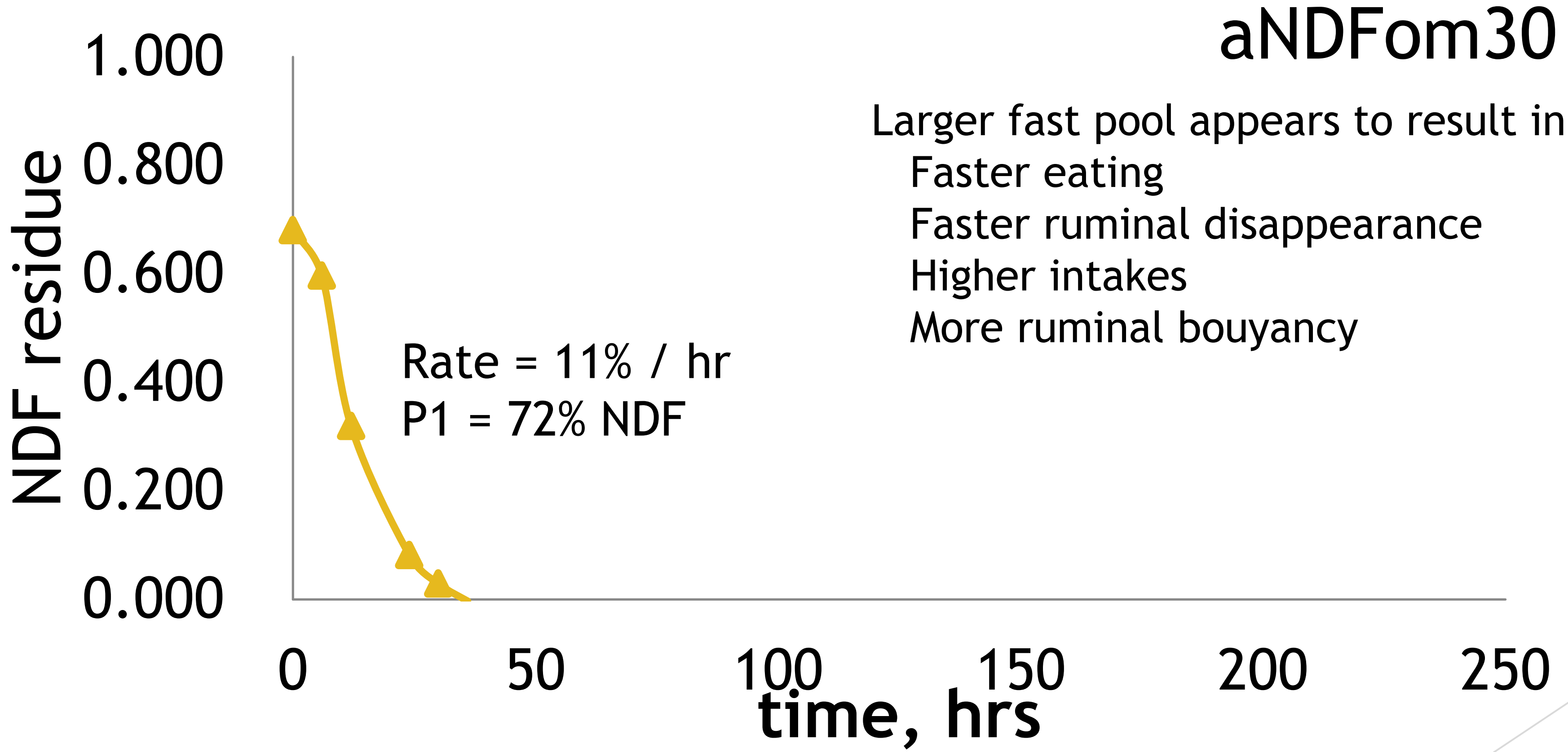


Rate = 2%,
P2 = 18.1% NDF

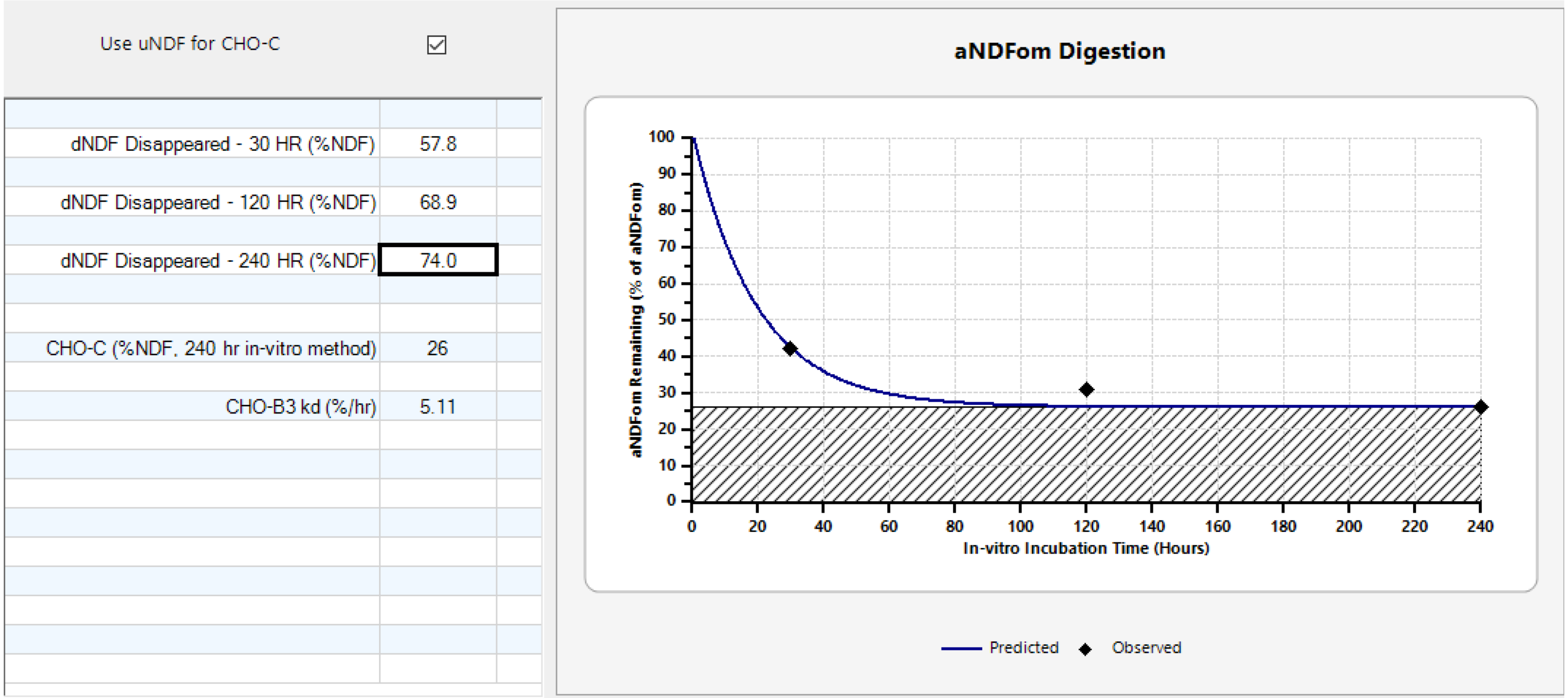
aNDFom120

Larger Slow and uNDF pools:
- More “ballast”
- Greater chewing and rumination
- Lower intake
- Slower eating speed

Corn silage example: fast pool



Larger fast pool appears to result in:
- Faster eating
- Faster ruminal disappearance
- Higher intakes
- More ruminal bouyancy



Use uNDF for CHO-C ☑

dNDF Disappeared - 30 HR (%NDF)	57.8
dNDF Disappeared - 120 HR (%NDF)	68.9
dNDF Disappeared - 240 HR (%NDF)	74.0
CHO-C (%NDF, 240 hr in-vitro method)	26
CHO-B3 kd (%/hr)	5.11

Neutral Detergent Fiber (NDF)

- Procedure used to describe the total fiber content of feed
  - Collectively cellulose, hemicellulose, and lignin
- Sample is boiled in ND solution for 1 hour to dissolve the unwanted nutrients leaving the fibrous residue behind
- Various chemicals are employed to dissolve the unwanted nutrients
  - Sodium dodecyl sulfate – protein and fats
  - EDTA (ethylene diamine tetra acetic acid) – Ca, Mg, Zn, and pectins
  - Triethylene glycol – starch
  - Sodium borate – buffer
  - Sodium phosphate dibasic - buffer

Neutral Detergent Fiber (aNDF)

- Procedure modified in the 90s to clear more of the noise
  - Amylase – enzyme to breakdown starch
  - Sodium sulfite - protein

Neutral Detergent Fiber (aNDFom)

- Now encouraged to use “organic matter” or “ash free” basis for NDF
- Contamination of ash comes from large harvesting equipment, flood irrigation, and other sources
- Elevated total ash content of some feeds can sometimes contribute to elevated NDF values
- Can lead to an underestimation and underfeeding of fiber and the problems associated with low fiber diets.

Neutral Detergent Fiber (aNDFom)

- Ash free fiber involves taking the fiber residue remaining after ND extraction and "ashing" it at 550C for 2 hours
- The NDF value is then corrected for the ash content
- The organic matter (om) or ash free NDF is reported as aNDFom

Forage Statistics 2015-2018

Haylage	**n**	**aNDF**	**aNDFom**	**diff**
Legume	2,878	43.84	40.07	3.77
MML	8,549	46.40	45.15	1.25
MMG	14,688	54.82	51.70	3.12
Grass	3,202	58.71	55.51	3.20
Hay	**n**	**aNDF**	**aNDFom**	**diff**
Legume	40,933	38.48	36.20	2.28
MML	2,413	47.09	42.78	4.31
MMG	10,052	60.10	57.22	2.88
Grass	19,012	60.97	60.45	0.52
Corn Silage	**n**	**aNDF**	**aNDFom**	**diff**
	21,183	42.93	41.11	1.82

Corn Silage NDF Digestibility by NDF and Lignin Content

NDF, %DM	Lignin, %DM		
42.3	3.01		
42.6	3.32		
42.6	3.24		
42.6	3.24		
42.3	3.18		
42.3	3.00		

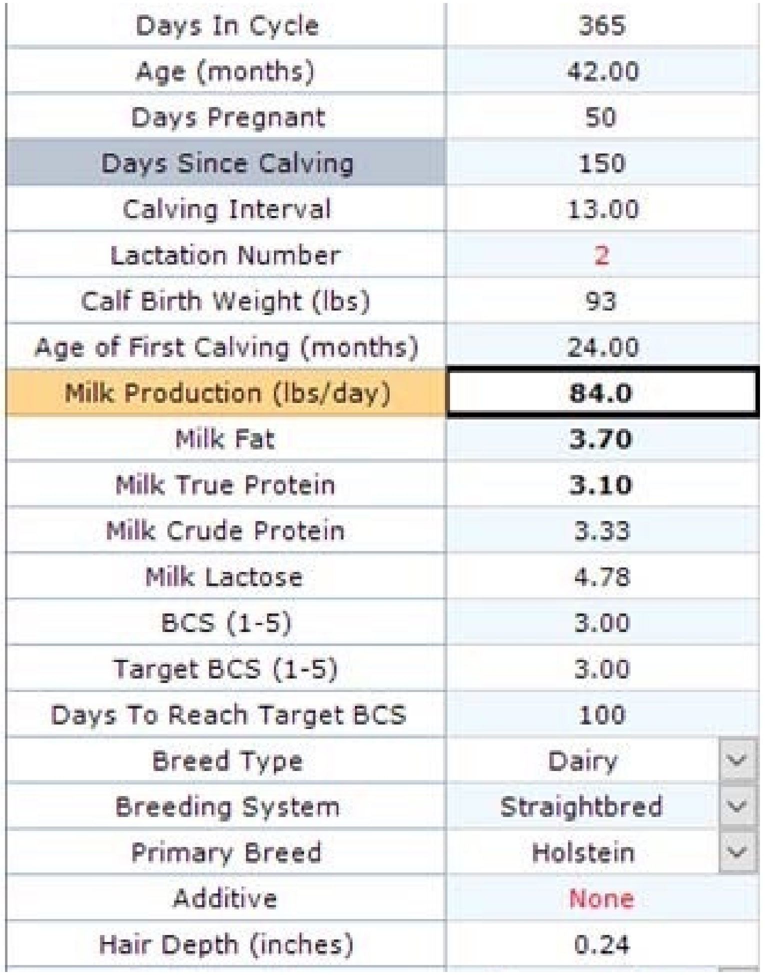
Courtesy M. Van Amburgh, Cornell University

Corn Silage NDF Digestibility by NDF and Lignin Content

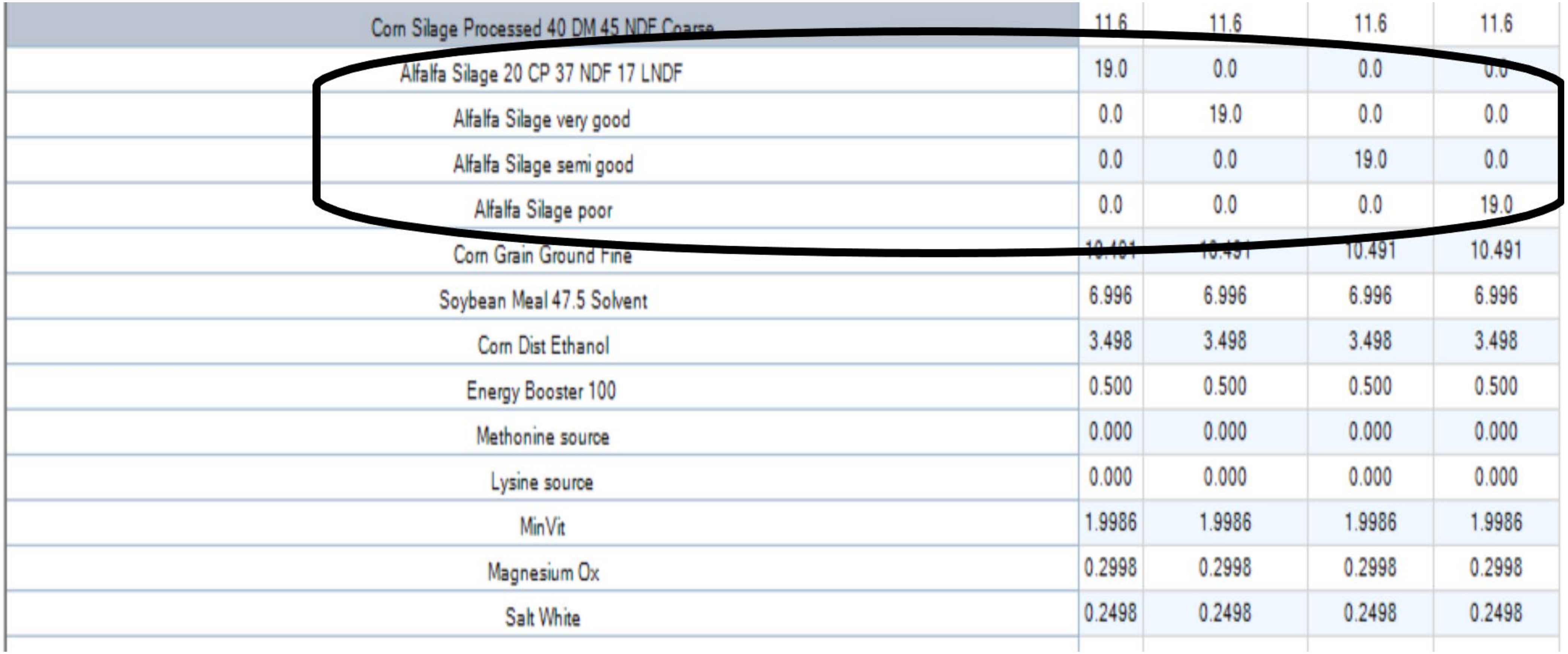
NDF, %DM	Lignin, %DM	NDFD% (30hr)	Est. NDF kd, %hr
42.3	3.01	42.2	2.63
42.6	3.32	44.1	2.90
42.6	3.24	44.6	2.92
42.6	3.24	50.8	3.60
42.3	3.18	56.7	4.36
42.3	3.00	57.0	4.30

Courtesy M. Van Amburgh, Cornell University

Herd Demographics

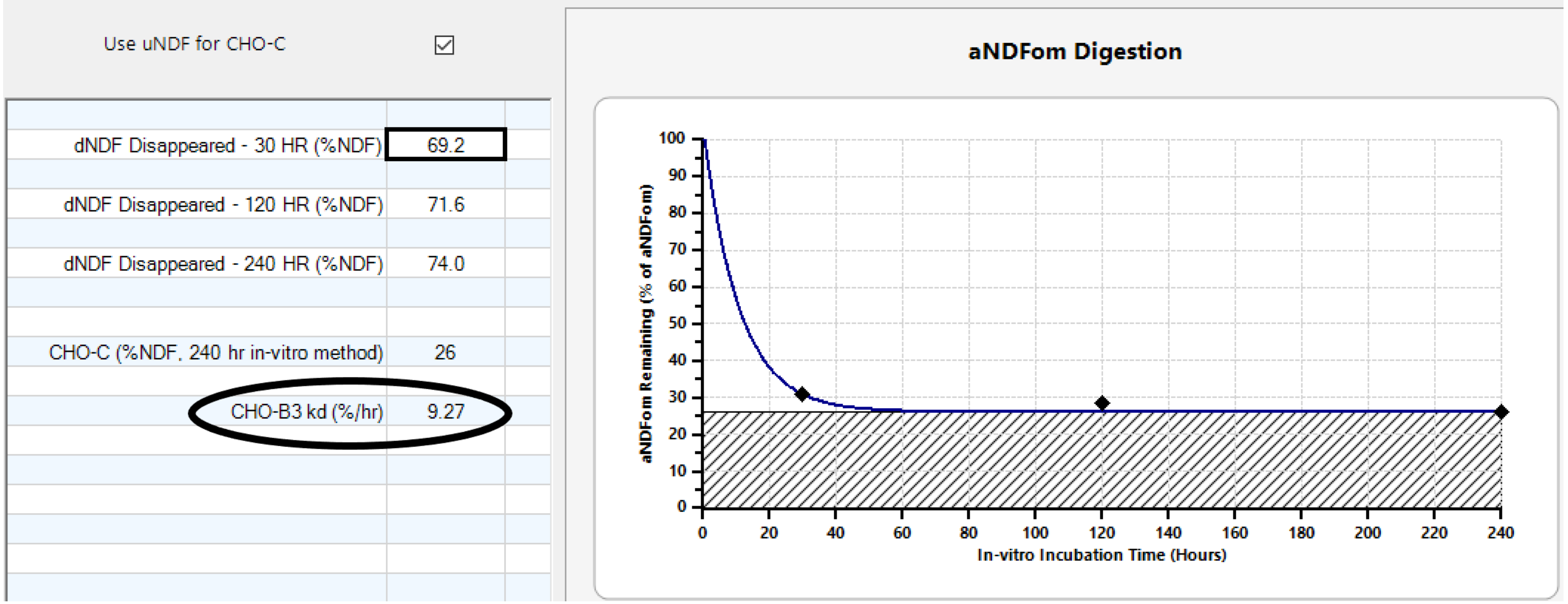


Days In Cycle	365
Age (months)	42.00
Days Pregnant	50
Days Since Calving	150
Calving Interval	13.00
Lactation Number	2
Calf Birth Weight (lbs)	93
Age of First Calving (months)	24.00
Milk Production (lbs/day)	**84.0**
Milk Fat	**3.70**
Milk True Protein	**3.10**
Milk Crude Protein	3.33
Milk Lactose	4.78
BCS (1-5)	3.00
Target BCS (1-5)	3.00
Days To Reach Target BCS	100
Breed Type	Dairy
Breeding System	Straightbred
Primary Breed	Holstein
Additive	None
Hair Depth (inches)	0.24



Corn Silage Processed 40 DM 45 NDF Coarse	11.6	11.6	11.6	11.6
Alfalfa Silage 20 CP 37 NDF 17 LNDF	19.0	0.0	0.0	0.0
Alfalfa Silage very good	0.0	19.0	0.0	0.0
Alfalfa Silage semi good	0.0	0.0	19.0	0.0
Alfalfa Silage poor	0.0	0.0	0.0	19.0
Corn Grain Ground Fine	10.491	10.491	10.491	10.491
Soybean Meal 47.5 Solvent	6.996	6.996	6.996	6.996
Corn Dist Ethanol	3.498	3.498	3.498	3.498
Energy Booster 100	0.500	0.500	0.500	0.500
Methonine source	0.000	0.000	0.000	0.000
Lysine source	0.000	0.000	0.000	0.000
MinVit	1.9986	1.9986	1.9986	1.9986
Magnesium Ox	0.2998	0.2998	0.2998	0.2998
Salt White	0.2498	0.2498	0.2498	0.2498

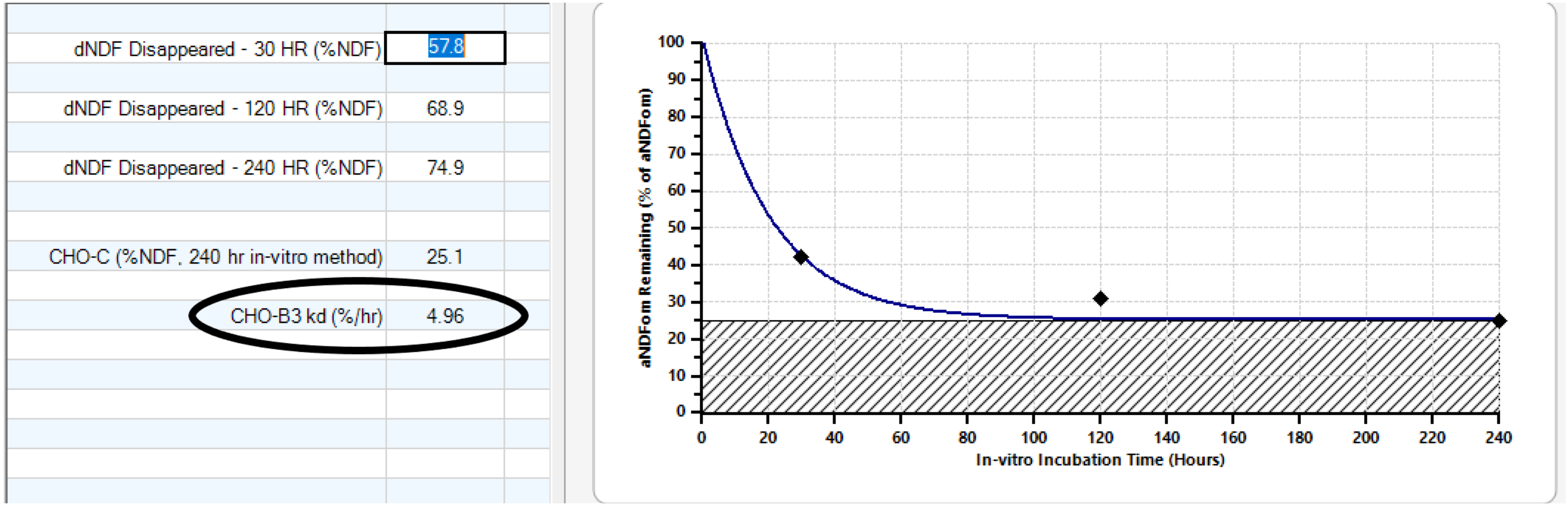
	RS#1	dndf time points	med quality	poor quality
Dry Matter Intake (lbs/day)	54.65	54.65	54.65	54.65
IOFC	15.91	17.25	16.50	14.98
Cost/hd	6.16	6.16	6.16	6.16
Forage (%DM)	56.02	56.02	56.02	56.02
Forage NDF (%BW)	0.85	0.85	0.85	0.85
DM (%)	49.63	49.63	49.63	49.63
ME Allowable Milk (lbs/day)	85.41	90.04	88.18	82.11
MP Allowable Milk (lbs/day)	84.90	90.18	87.16	81.32
ME (%Rqd)	100.41	104.16	102.65	97.76
MP (%Rqd)	100.00	104.21	101.79	97.22
Rumen NH3 (%Rqd)	230.45	208.69	224.89	249.51
NFC (%DM)	37.72	37.72	37.72	37.72
peNDF (%DM)	19.15	19.15	19.15	19.15
Sugar (%DM)	3.77	3.77	3.77	3.77
Starch (%DM)	21.57	21.57	21.57	21.57
Ferm. Starch (%DM)	15.47	15.47	15.47	15.47
EE (%DM)	5.17	5.17	5.17	5.17



Use uNDF for CHO-C ☑

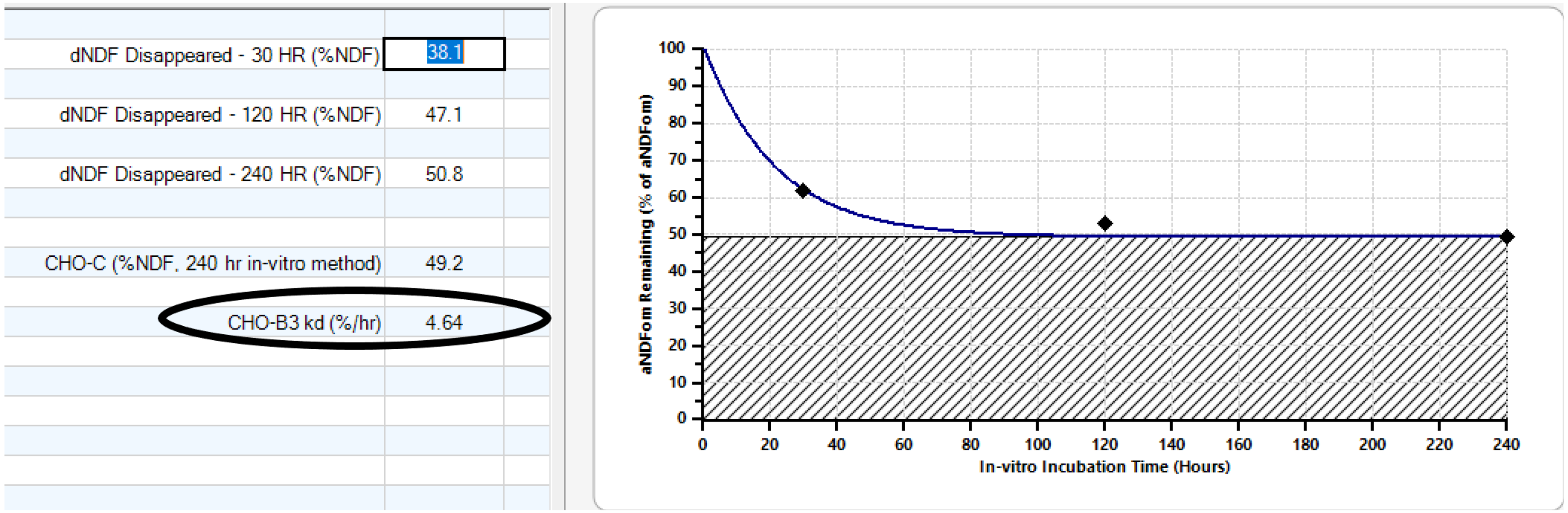
dNDF Disappeared - 30 HR (%NDF)	69.2
dNDF Disappeared - 120 HR (%NDF)	71.6
dNDF Disappeared - 240 HR (%NDF)	74.0
CHO-C (%NDF, 240 hr in-vitro method)	26
CHO-B3 kd (%/hr)	9.27

Good Quality and Good Digestibility



dNDF Disappeared - 30 HR (%NDF)	57.8
dNDF Disappeared - 120 HR (%NDF)	68.9
dNDF Disappeared - 240 HR (%NDF)	74.9
CHO-C (%NDF, 240 hr in-vitro method)	25.1
CHO-B3 kd (%/hr)	4.96

Good Quality- Semi-Digestible



dNDF Disappeared - 30 HR (%NDF)	38.1
dNDF Disappeared - 120 HR (%NDF)	47.1
dNDF Disappeared - 240 HR (%NDF)	50.8
CHO-C (%NDF, 240 hr in-vitro method)	49.2
CHO-B3 kd (%/hr)	4.64

Poor Quality- Very Undigestible

The size of the uNDF pool doesn't correlate with the rate AND the non forages don't have values in the model

NOW WHAT?!?

End of the Story

It’s very important to test all your feeds with the time points

Tests have come a long way and we’re still learning things from this

Open Discussion: What are you seeing in the field?

Thank you

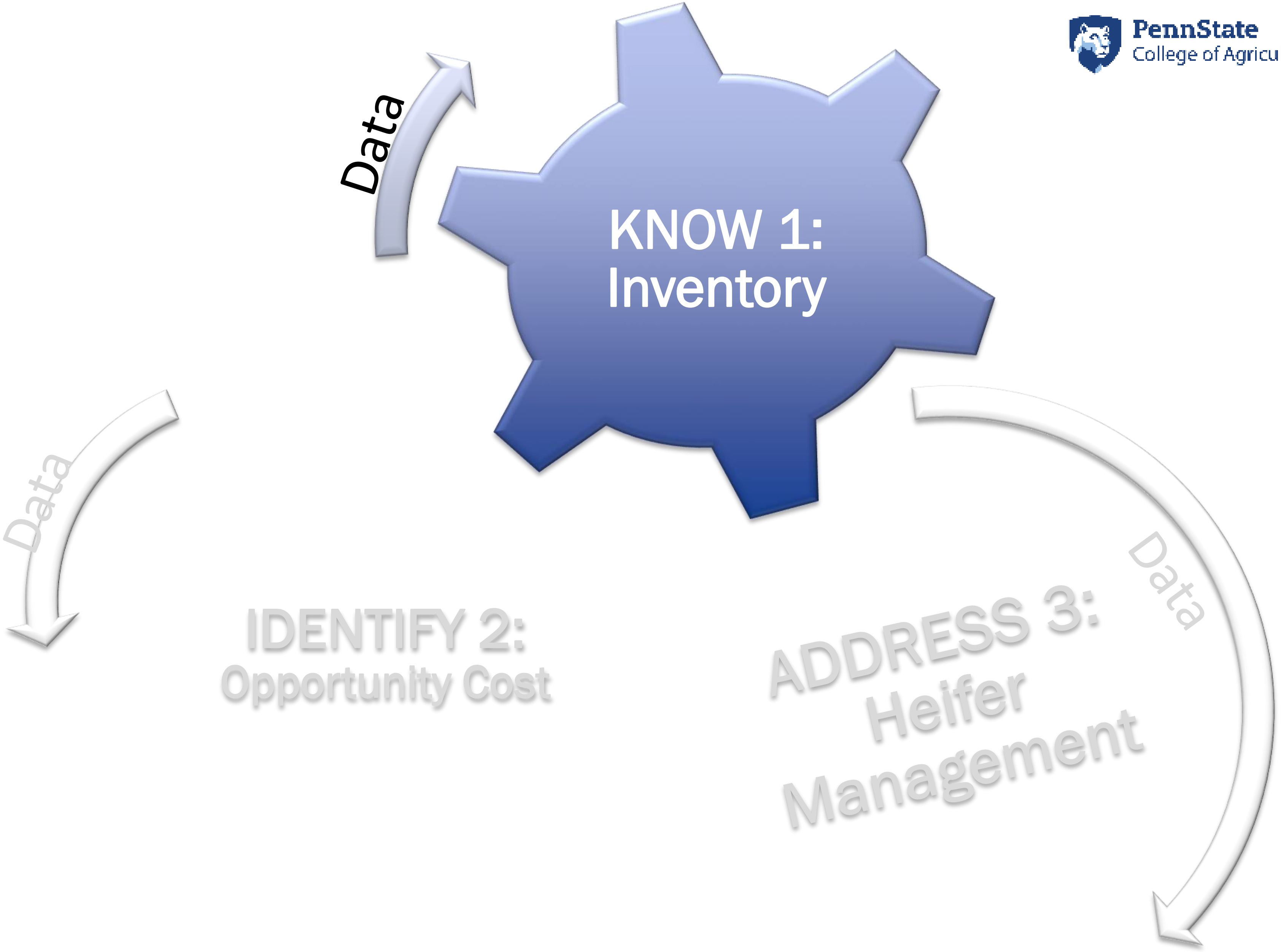
PennState
College of Agricultural Sciences

The heifer paradigm: know your future generation

Dr. Jud Heinrichs & Rob Goodling
Dept. of Animal Science, Penn State University

For the session

1. Know a herd’s inventory
   - Is there excess heifers?
   - What should the herd track?
2. Identify their opportunities
   - Cull cows play a part in the decision, too
   - Does it help feed inventories
3. Address the next steps
   - Costs to raise heifers
   - Too many heifers, who stays, who goes



Data

KNOW 1:
Inventory

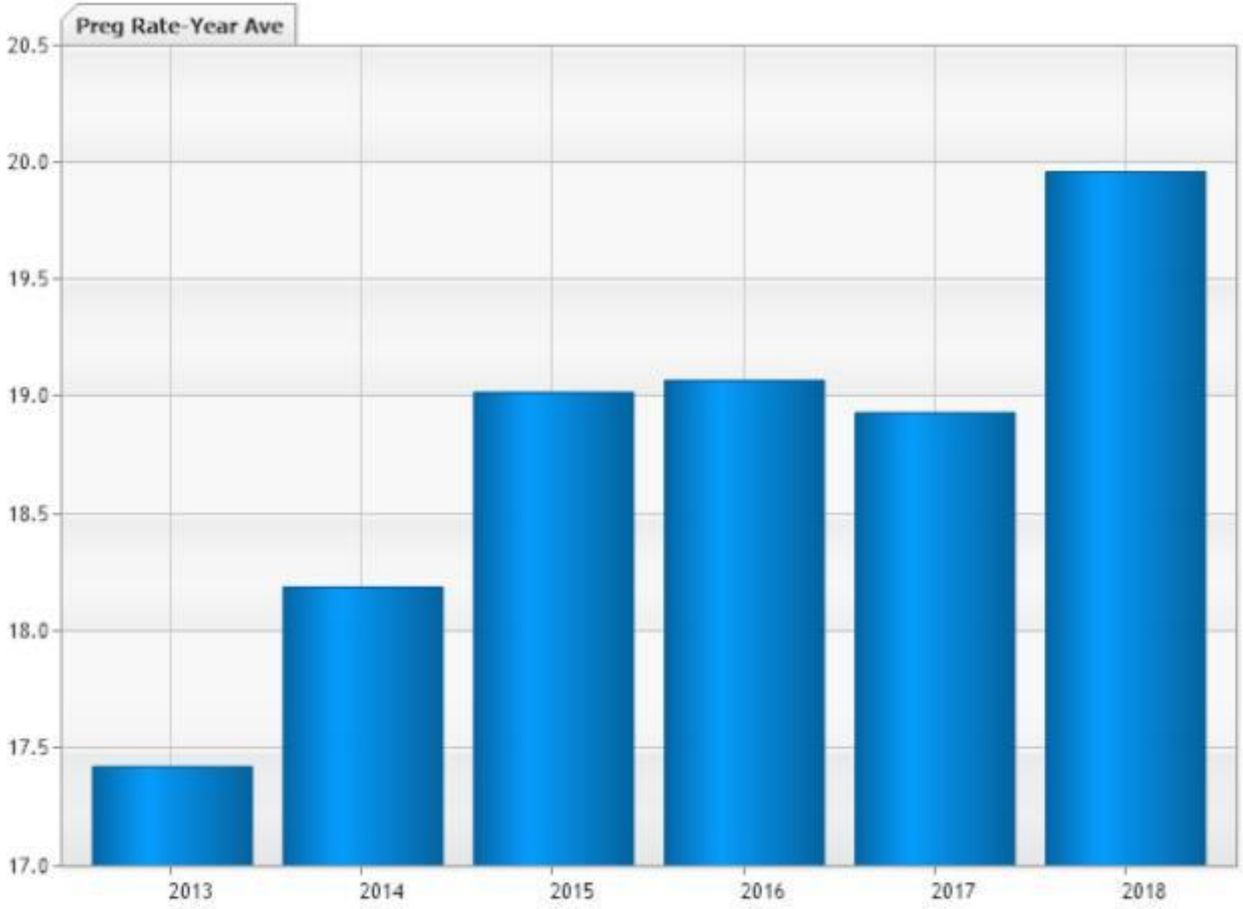
Data

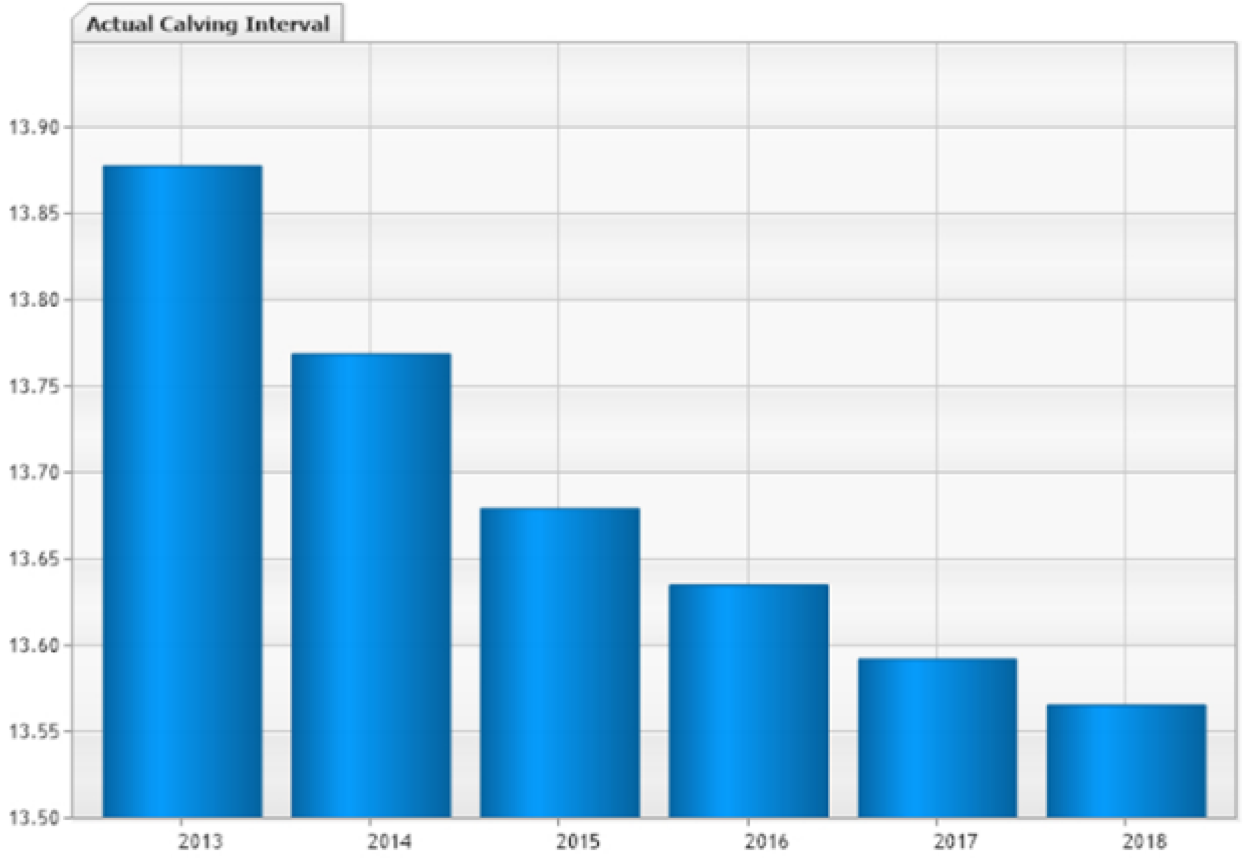
IDENTIFY 2:
Opportunity Cost

ADDRESS 3:
Heifer
Management

Data

PA Reproductive Metrics





(Dairy Records Management Systems, 2018)

Where Will Herds Go?

What are the goals next year

3 years down the road

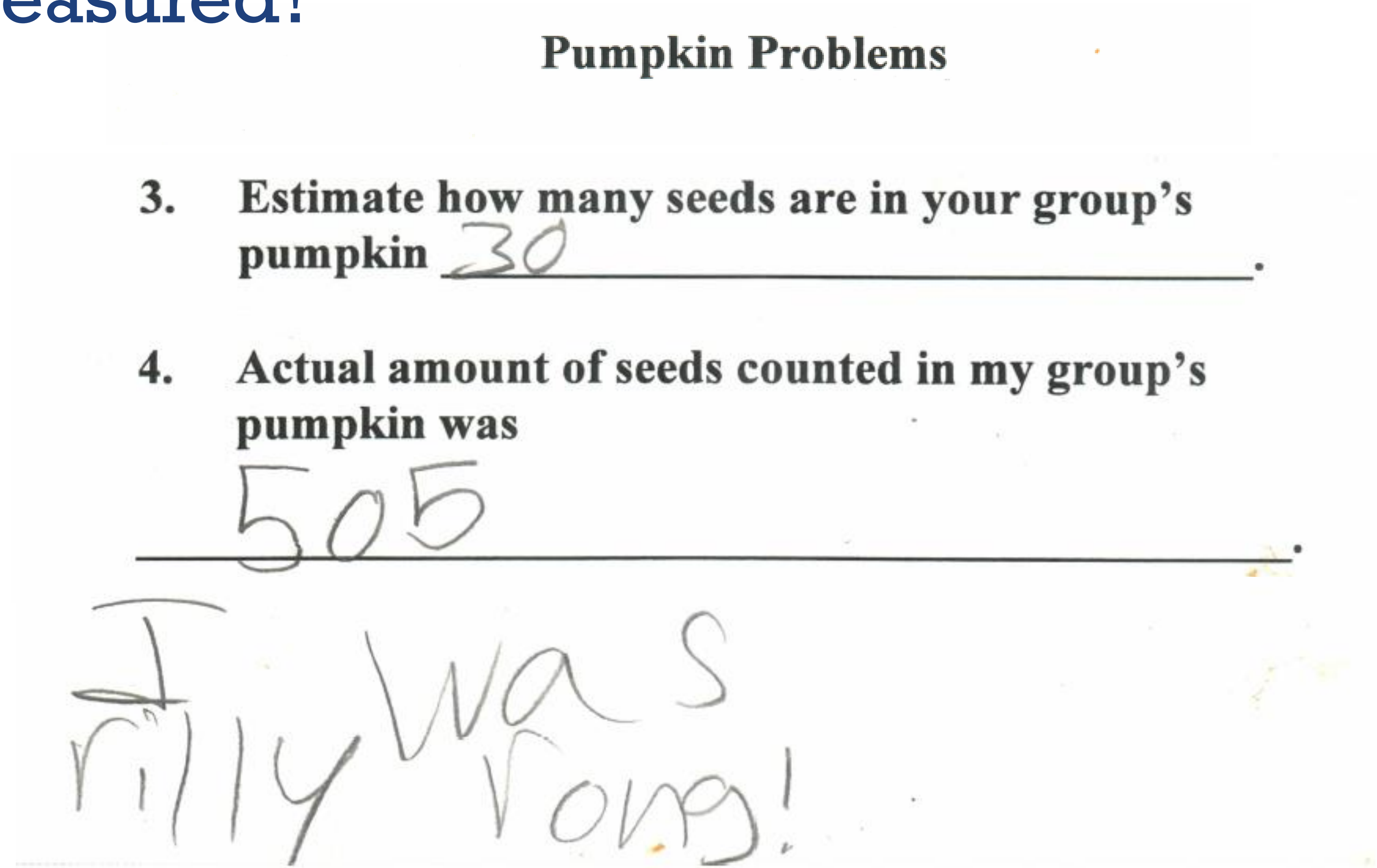
8 years down the road

MAINTAIN

EXPAND

SHRINK

Is it measured?



Pumpkin Problems

3. Estimate how many seeds are in your group's pumpkin 30.

4. Actual amount of seeds counted in my group's pumpkin was

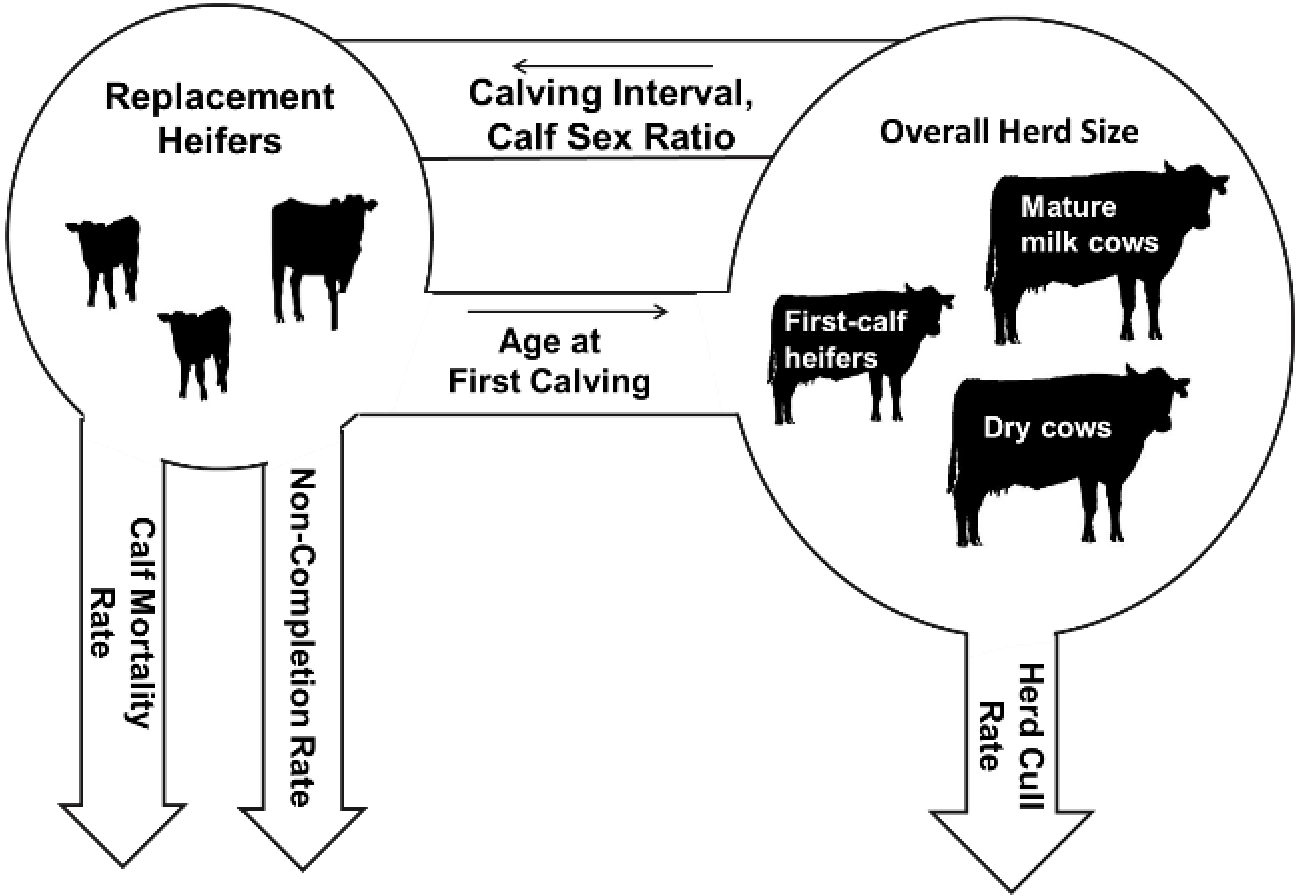
505.

I rilly was rong!

(really) (wrong)

KNOW 1: Animal Inventories

- What is your herds growth pattern?
- Do you have enough heifers?
  - What do I track
  - Where can I find it
- Tools that can help



Break into 2 equations

- Filling available slots (heifers needed)
  - (heifers entering vs. heifers and cows leaving)
  - Cull rate, non-completion rate, age first calving, herd size

VS

- Expected number of heifer calves annually
  - Calving interval, calf mortality, calf sex ratio, age first calving, herd size

A Case of Two Farms

Farm A

- Consistent culling
- Heifer Changes in 2015
  - Sexed semen
  - Improved heat detection
- Good reproduction

Farm B

- Sporadic culling
- Inconsistent Heifer Mgmt
  - Varied age at first calving
  - Waves of freshenings
- Moderate Reproduction

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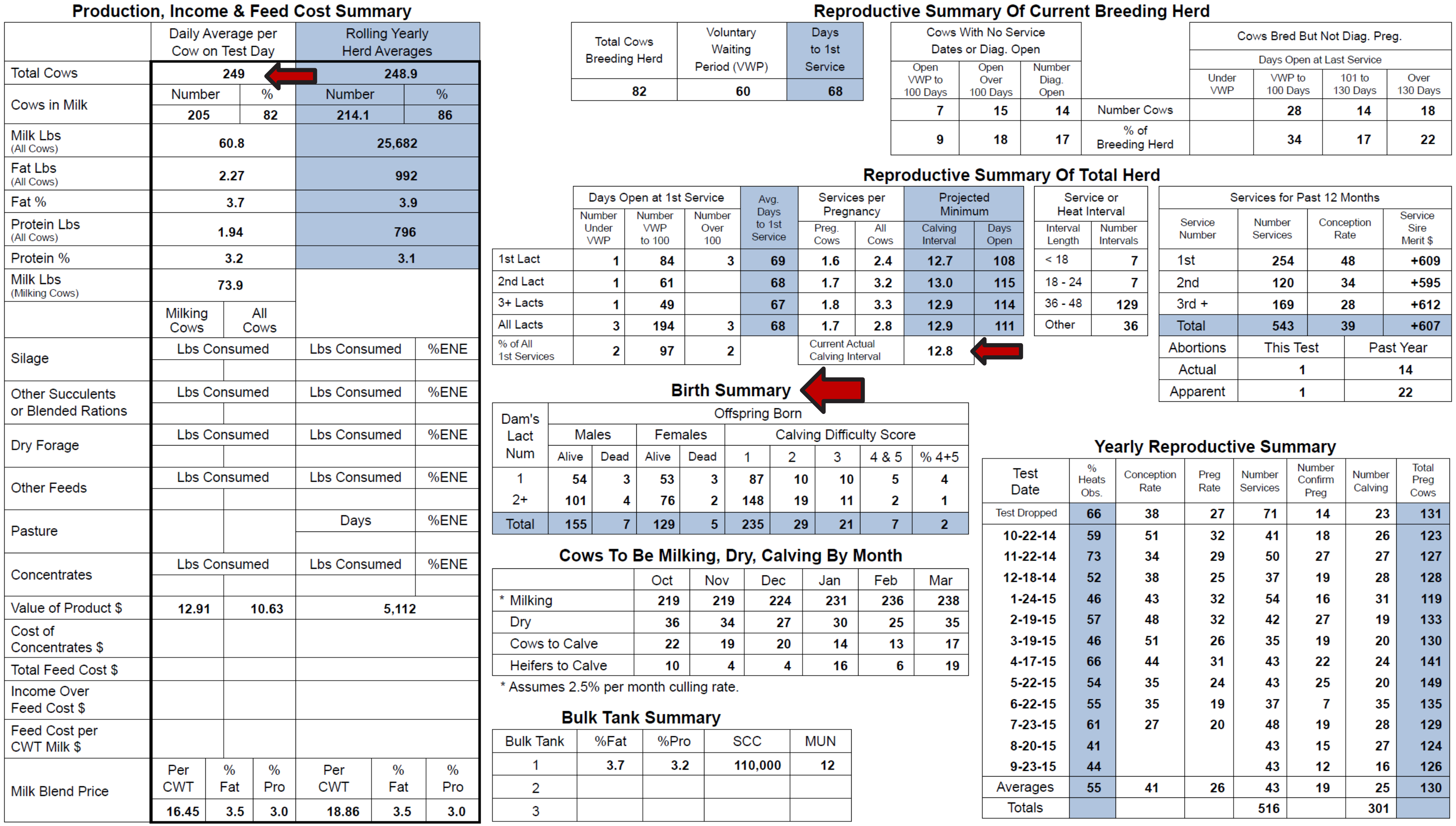
Front Page 202 Summary



Production, Income & Feed Cost Summary

	Daily Average per Cow on Test Day			Rolling Yearly Herd Averages		
Total Cows	249			248.9		
Cows in Milk	Number	%		Number	%	
	205	82		214.1	86	
Milk Lbs (All Cows)	60.8			25,682		
Fat Lbs (All Cows)	2.27			992		
Fat %	3.7			3.9		
Protein Lbs (All Cows)	1.94			796		
Protein %	3.2			3.1		
Milk Lbs (Milking Cows)	73.9					
	Milking Cows	All Cows				
Silage	Lbs Consumed			Lbs Consumed	%ENE	
Other Succulents or Blended Rations	Lbs Consumed			Lbs Consumed	%ENE	
Dry Forage	Lbs Consumed			Lbs Consumed	%ENE	
Other Feeds	Lbs Consumed			Lbs Consumed	%ENE	
Pasture				Days	%ENE	
Concentrates	Lbs Consumed			Lbs Consumed	%ENE	
Value of Product $	12.91	10.63		5,112		
Cost of Concentrates $						
Total Feed Cost $						
Income Over Feed Cost $						
Feed Cost per CWT Milk $						
Milk Blend Price	Per CWT	% Fat	% Pro	Per CWT	% Fat	% Pro
	16.45	3.5	3.0	18.86	3.5	3.0

Reproductive Summary Of Current Breeding Herd

Total Cows Breeding Herd	Voluntary Waiting Period (VWP)	Days to 1st Service
82	60	68

Cows With No Service Dates or Diag. Open				Cows Bred But Not Diag. Preg.			
				Days Open at Last Service			
Open VWP to 100 Days	Open Over 100 Days	Number Diag. Open		Under VWP	VWP to 100 Days	101 to 130 Days	Over 130 Days
7	15	14	Number Cows		28	14	18
9	18	17	% of Breeding Herd		34	17	22

Reproductive Summary Of Total Herd

	Days Open at 1st Service			Avg. Days to 1st Service	Services per Pregnancy		Projected Minimum	
	Number Under VWP	Number VWP to 100	Number Over 100		Preg. Cows	All Cows	Calving Interval	Days Open
1st Lact	1	84	3	69	1.6	2.4	12.7	108
2nd Lact	1	61		68	1.7	3.2	13.0	115
3+ Lacts	1	49		67	1.8	3.3	12.9	114
All Lacts	3	194	3	68	1.7	2.8	12.9	111
% of All 1st Services	2	97	2		Current Actual Calving Interval		12.8	

Service or Heat Interval	
Interval Length	Number Intervals
< 18	7
18 - 24	7
36 - 48	129
Other	36

Services for Past 12 Months			
Service Number	Number Services	Conception Rate	Service Sire Merit $
1st	254	48	+609
2nd	120	34	+595
3rd +	169	28	+612
Total	543	39	+607

Abortions	This Test	Past Year
Actual	1	14
Apparent	1	22

Birth Summary

Dam's Lact Num	Offspring Born								
	Males		Females		Calving Difficulty Score				
	Alive	Dead	Alive	Dead	1	2	3	4 & 5	% 4+5
1	54	3	53	3	87	10	10	5	4
2+	101	4	76	2	148	19	11	2	1
Total	155	7	129	5	235	29	21	7	2

Cows To Be Milking, Dry, Calving By Month

	Oct	Nov	Dec	Jan	Feb	Mar
* Milking	219	219	224	231	236	238
Dry	36	34	27	30	25	35
Cows to Calve	22	19	20	14	13	17
Heifers to Calve	10	4	4	16	6	19

* Assumes 2.5% per month culling rate.

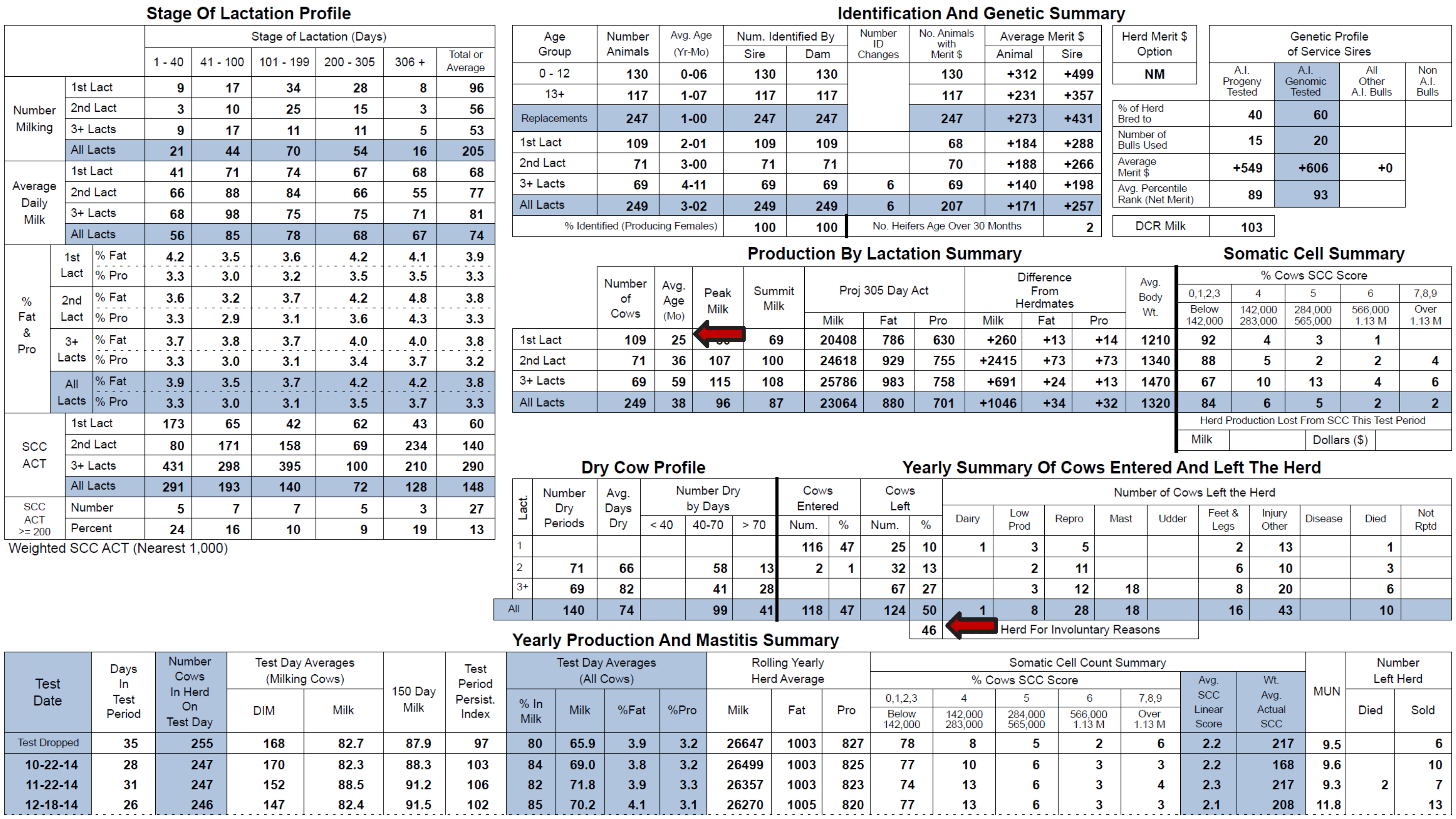
Bulk Tank Summary

Bulk Tank	%Fat	%Pro	SCC	MUN
1	3.7	3.2	110,000	12
2				
3				

Yearly Reproductive Summary

Test Date	% Heats Obs.	Conception Rate	Preg Rate	Number Services	Number Confirm Preg	Number Calving	Total Preg Cows
Test Dropped	66	38	27	71	14	23	131
10-22-14	59	51	32	41	18	26	123
11-22-14	73	34	29	50	27	27	127
12-18-14	52	38	25	37	19	28	128
1-24-15	46	43	32	54	16	31	119
2-19-15	57	48	32	42	27	19	133
3-19-15	46	51	26	35	19	20	130
4-17-15	66	44	31	43	22	24	141
5-22-15	54	35	24	43	25	20	149
6-22-15	55	35	19	37	7	35	135
7-23-15	61	27	20	48	19	28	129
8-20-15	41			43	15	27	124
9-23-15	44			43	12	16	126
Averages	55	41	26	43	19	25	130
Totals				516		301	

Back Page 202 Summary



Stage Of Lactation Profile

		Stage of Lactation (Days)					
		1 - 40	41 - 100	101 - 199	200 - 305	306 +	Total or Average
Number Milking	1st Lact	9	17	34	28	8	96
	2nd Lact	3	10	25	15	3	56
	3+ Lacts	9	17	11	11	5	53
	All Lacts	21	44	70	54	16	205
Average Daily Milk	1st Lact	41	71	74	67	68	68
	2nd Lact	66	88	84	66	55	77
	3+ Lacts	68	98	75	75	71	81
	All Lacts	56	85	78	68	67	74
% Fat & Pro	1st Lact % Fat	4.2	3.5	3.6	4.2	4.1	3.9
	1st Lact % Pro	3.3	3.0	3.2	3.5	3.5	3.3
	2nd Lact % Fat	3.6	3.2	3.7	4.2	4.8	3.8
	2nd Lact % Pro	3.3	2.9	3.1	3.6	4.3	3.3
	3+ Lacts % Fat	3.7	3.8	3.7	4.0	4.0	3.8
	3+ Lacts % Pro	3.3	3.0	3.1	3.4	3.7	3.2
	All Lacts % Fat	3.9	3.5	3.7	4.2	4.2	3.8
	All Lacts % Pro	3.3	3.0	3.1	3.5	3.7	3.3
SCC ACT	1st Lact	173	65	42	62	43	60
	2nd Lact	80	171	158	69	234	140
	3+ Lacts	431	298	395	100	210	290
	All Lacts	291	193	140	72	128	148
SCC ACT >= 200	Number	5	7	7	5	3	27
	Percent	24	16	10	9	19	13

Weighted SCC ACT (Nearest 1,000)

Identification And Genetic Summary

Age Group	Number Animals	Avg. Age (Yr-Mo)	Num. Identified By		Number ID Changes	No. Animals with Merit $	Average Merit $	
			Sire	Dam			Animal	Sire
0 - 12	130	0-06	130	130		130	+312	+499
13+	117	1-07	117	117		117	+231	+357
Replacements	247	1-00	247	247		247	+273	+431
1st Lact	109	2-01	109	109		68	+184	+288
2nd Lact	71	3-00	71	71		70	+188	+266
3+ Lacts	69	4-11	69	69	6	69	+140	+198
All Lacts	249	3-02	249	249	6	207	+171	+257
% Identified (Producing Females)			100	100	No. Heifers Age Over 30 Months			2

Herd Merit $ Option	Genetic Profile of Service Sires			
NM	A.I. Progeny Tested	A.I. Genomic Tested	All Other A.I. Bulls	Non A.I. Bulls
% of Herd Bred to	40	60		
Number of Bulls Used	15	20		
Average Merit $	+549	+606	+0	
Avg. Percentile Rank (Net Merit)	89	93		
DCR Milk	103			

Production By Lactation Summary

	Number of Cows	Avg. Age (Mo)	Peak Milk	Summit Milk	Proj 305 Day Act			Difference From Herdmates			Avg. Body Wt.
					Milk	Fat	Pro	Milk	Fat	Pro	
1st Lact	109	25	[illegible]	69	20408	786	630	+260	+13	+14	1210
2nd Lact	71	36	107	100	24618	929	755	+2415	+73	+73	1340
3+ Lacts	69	59	115	108	25786	983	758	+691	+24	+13	1470
All Lacts	249	38	96	87	23064	880	701	+1046	+34	+32	1320

Somatic Cell Summary

	% Cows SCC Score				
	0,1,2,3 Below 142,000	4 142,000 283,000	5 284,000 565,000	6 566,000 1.13 M	7,8,9 Over 1.13 M
1st Lact	92	4	3	1	
2nd Lact	88	5	2	2	4
3+ Lacts	67	10	13	4	6
All Lacts	84	6	5	2	2

Herd Production Lost From SCC This Test Period			
Milk		Dollars ($)	

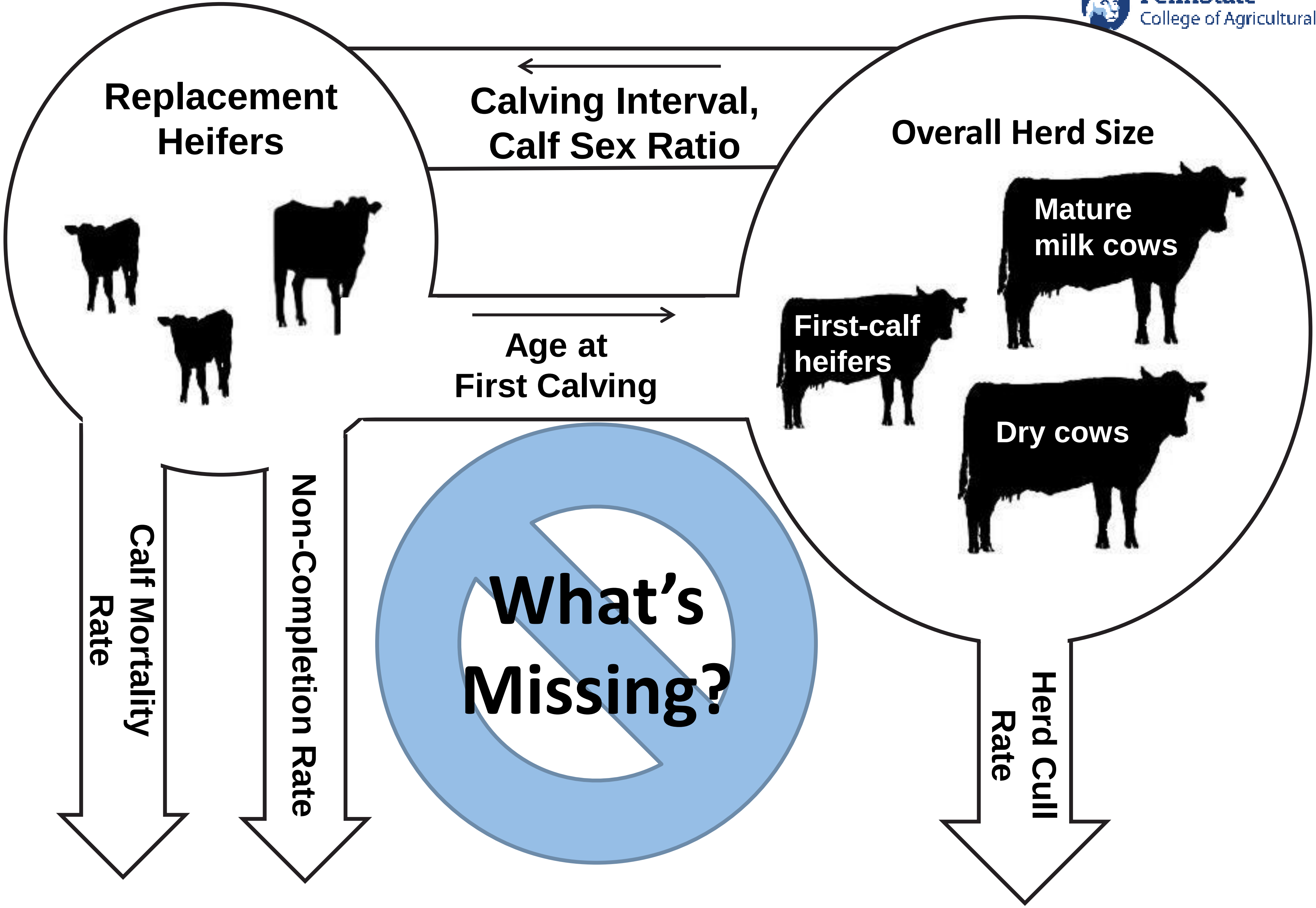
Dry Cow Profile

Yearly Summary Of Cows Entered And Left The Herd

Lact.	Number Dry Periods	Avg. Days Dry	Number Dry by Days			Cows Entered		Cows Left		Number of Cows Left the Herd									
			< 40	40-70	> 70	Num.	%	Num.	%	Dairy	Low Prod	Repro	Mast	Udder	Feet & Legs	Injury Other	Disease	Died	Not Rptd
1						116	47	25	10	1	3	5			2	13		1	
2	71	66		58	13	2	1	32	13		2	11			6	10		3	
3+	69	82		41	28			67	27		3	12	18		8	20		6	
All	140	74		99	41	118	47	124	50	1	8	28	18		16	43		10	
									46	Herd For Involuntary Reasons									

Yearly Production And Mastitis Summary

Test Date	Days In Test Period	Number Cows In Herd On Test Day	Test Day Averages (Milking Cows)		150 Day Milk	Test Period Persist. Index	Test Day Averages (All Cows)				Rolling Yearly Herd Average			Somatic Cell Count Summary							MUN	Number Left Herd	
														% Cows SCC Score					Avg. SCC Linear Score	Wt. Avg. Actual SCC			
			DIM	Milk			% In Milk	Milk	%Fat	%Pro	Milk	Fat	Pro	0,1,2,3 Below 142,000	4 142,000 283,000	5 284,000 565,000	6 566,000 1.13 M	7,8,9 Over 1.13 M				Died	Sold
Test Dropped	35	255	168	82.7	87.9	97	80	65.9	3.9	3.2	26647	1003	827	78	8	5	2	6	2.2	217	9.5		6
10-22-14	28	247	170	82.3	88.3	103	84	69.0	3.8	3.2	26499	1003	825	77	10	6	3	3	2.2	168	9.6		10
11-22-14	31	247	152	88.5	91.2	106	82	71.8	3.9	3.3	26357	1003	823	74	13	6	3	4	2.3	217	9.3	2	7
12-18-14	26	246	147	82.4	91.5	102	85	70.2	4.1	3.1	26270	1005	820	77	13	6	3	3	2.1	208	11.8		13



Replacement Heifers

Calving Interval, Calf Sex Ratio

Overall Herd Size

Mature milk cows

First-calf heifers

Dry cows

Age at First Calving

Calf Mortality Rate

Non-Completion Rate

What's Missing?

Herd Cull Rate

Non-Completion Rate

- Not easily identified
- % of heifers enter system but do not calve in
  - Typical start after first 48 hrs. old
  - Number heifers left (for any reason)
  - Essentially a heifer cull rate
- Case Farms (Last 12 mo)

	# Heifers Culled	÷	Avg # Heifers	=	
Farm A:	23	÷	284	=	8%
Farm B:	4	÷	170	=	2%

Are They Achieving…

<13.3	**Mo. Calving Interval**
22-24	**Mo. Age at First Calving**
50	**% Heifer Calves**
<5	**% Calf Mortality Rate**

Stresses on Heifer System

___Are They Achieving

• <8	% Non-completion
• 22-24	Mo Age at First Calving
• 33-35	% Cull Rate**

Stresses on Adult Cow System

PSU Herd Metrics App

- https://extension.psu.edu/penn-state-dairy-herd-metrics
- Enter Your herds 7 key metrics
- Save scenarios
    - Test “What if” scenarios
- Enter economic values
    - culled cows or heifers to see impact of a herd’s status

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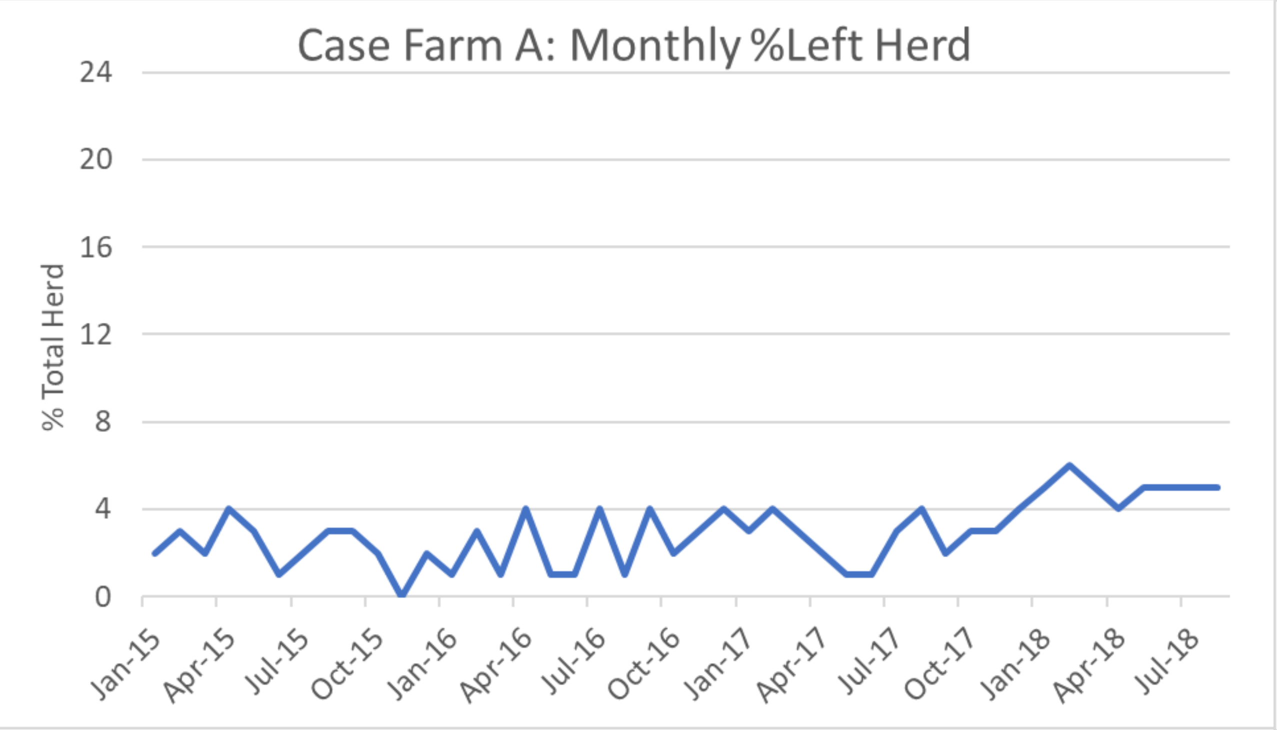
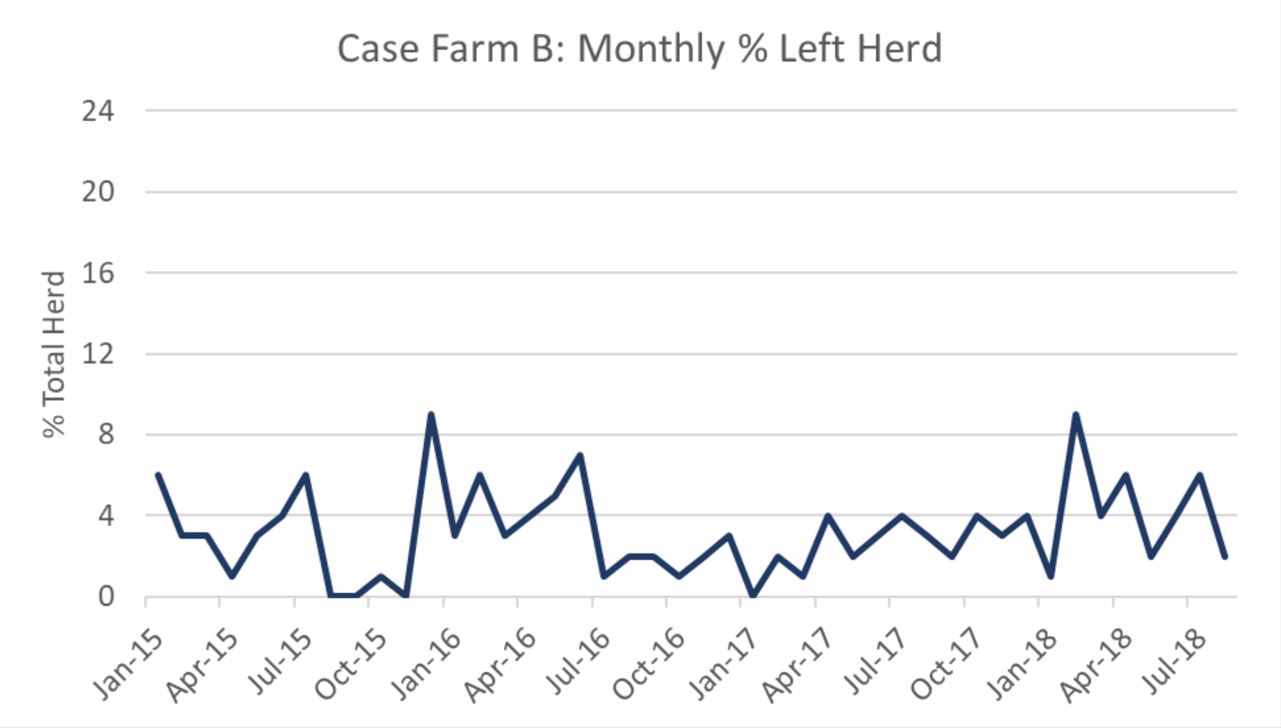
Monthly % Left Herd





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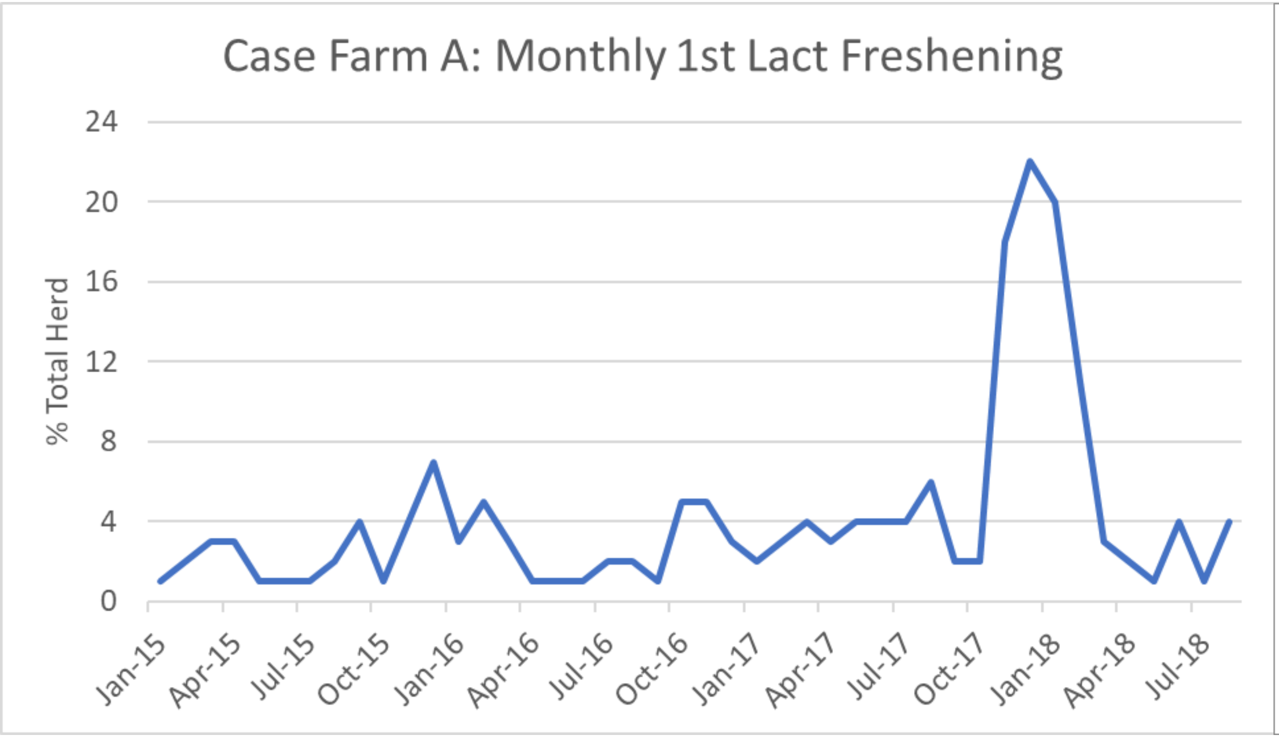
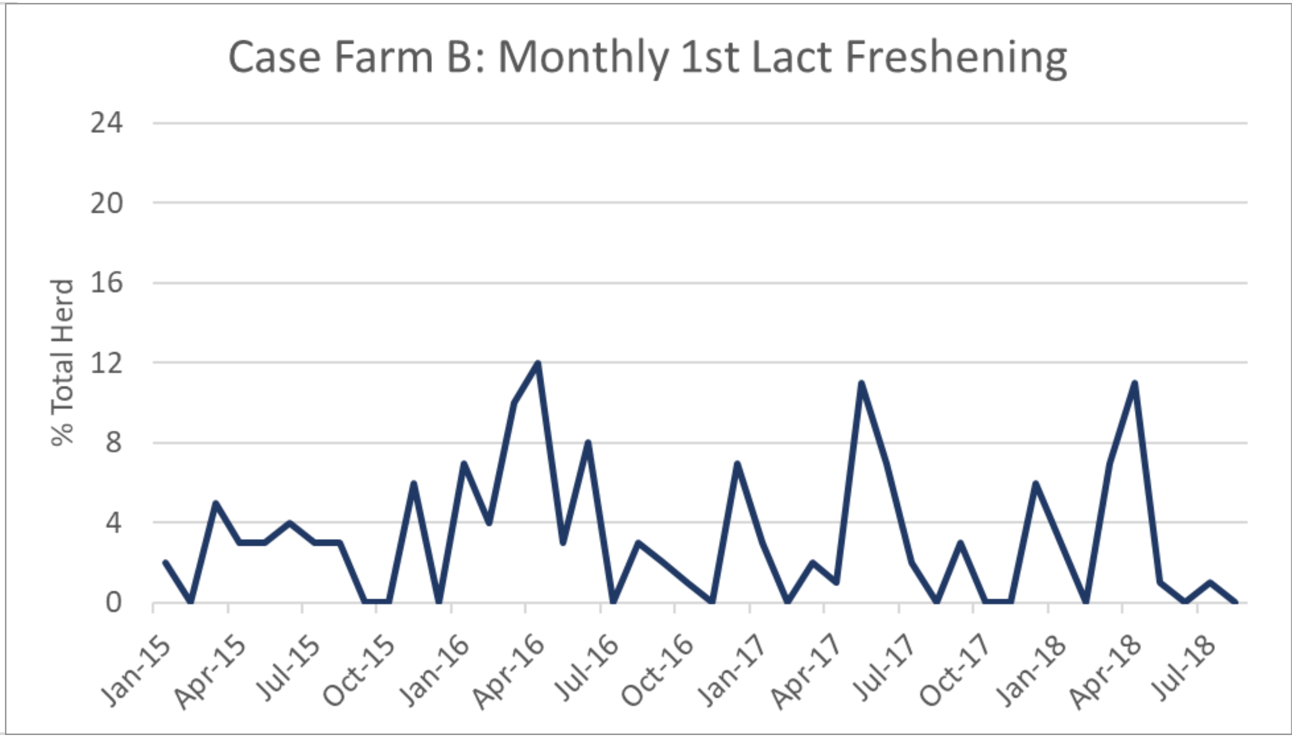
Monthly % Herd 1st Lact Freshening



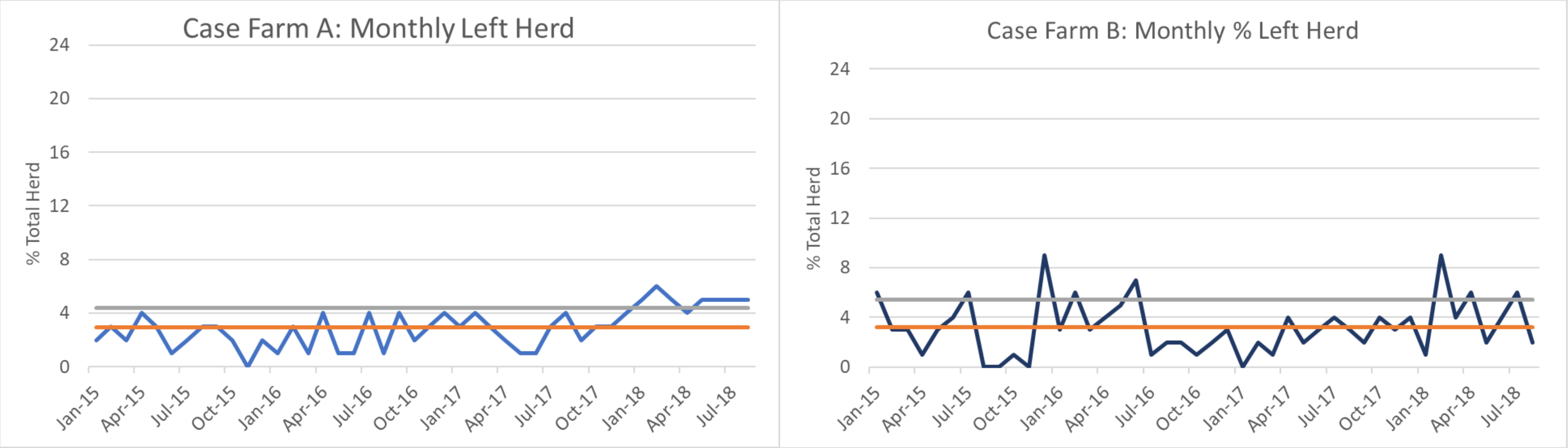


You decide

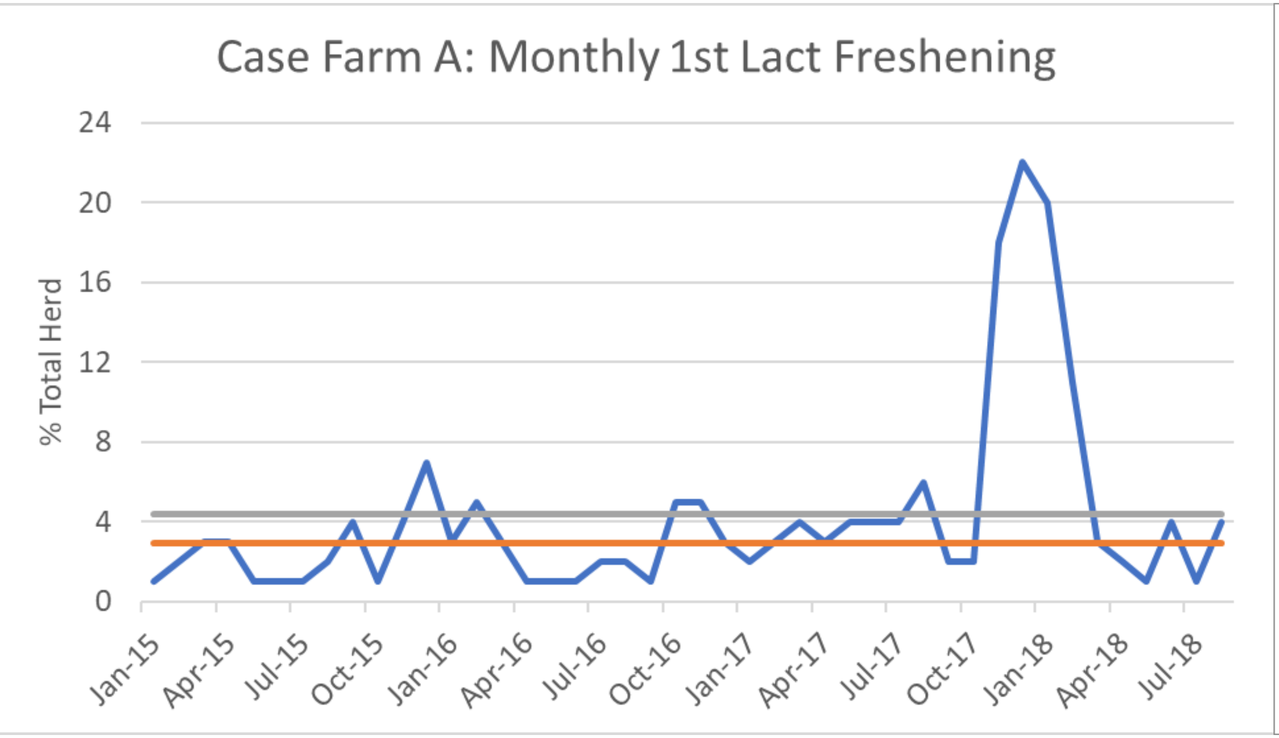
- What is the average % left herd for each farm

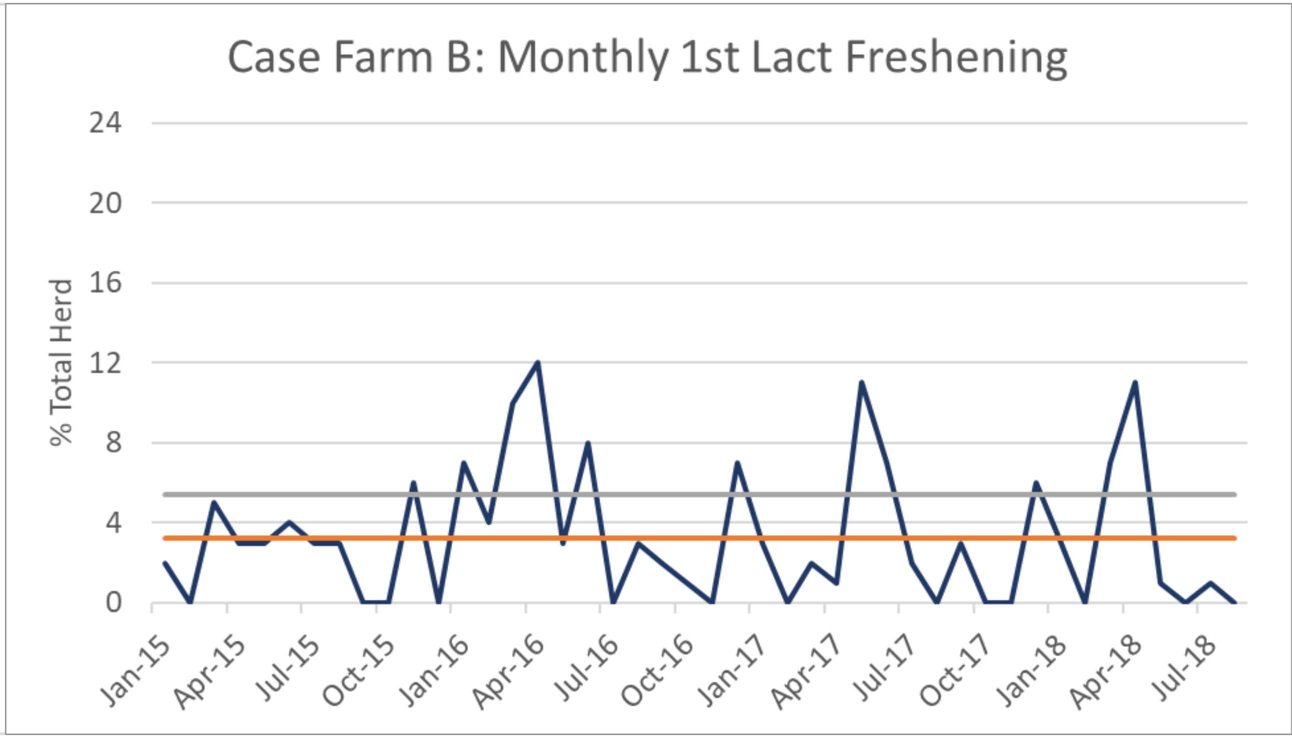
- What would the average + 1 Deviation be?

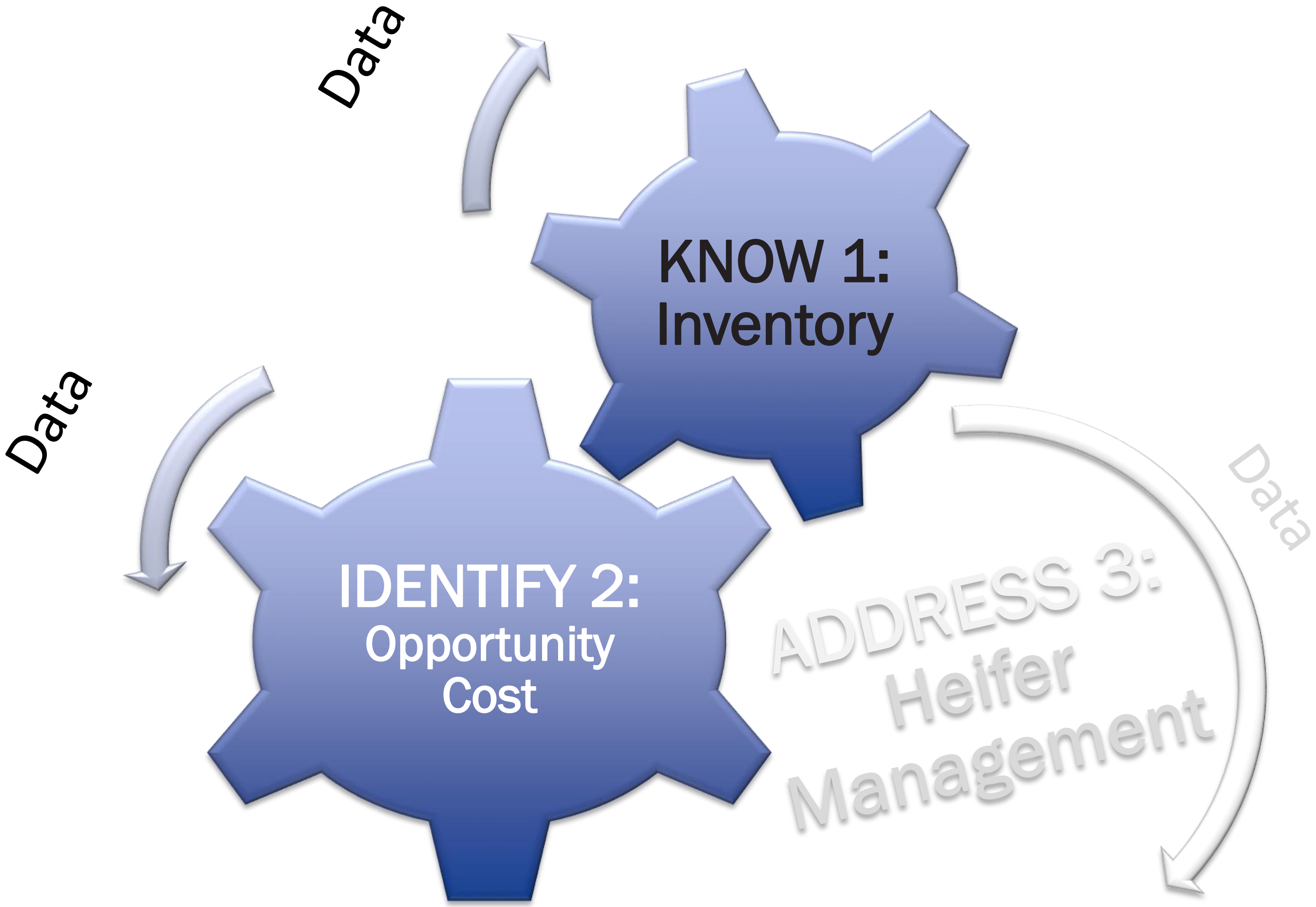
Monthly % Left Herd



1st lact fresh with % left controls







Data

KNOW 1:
Inventory

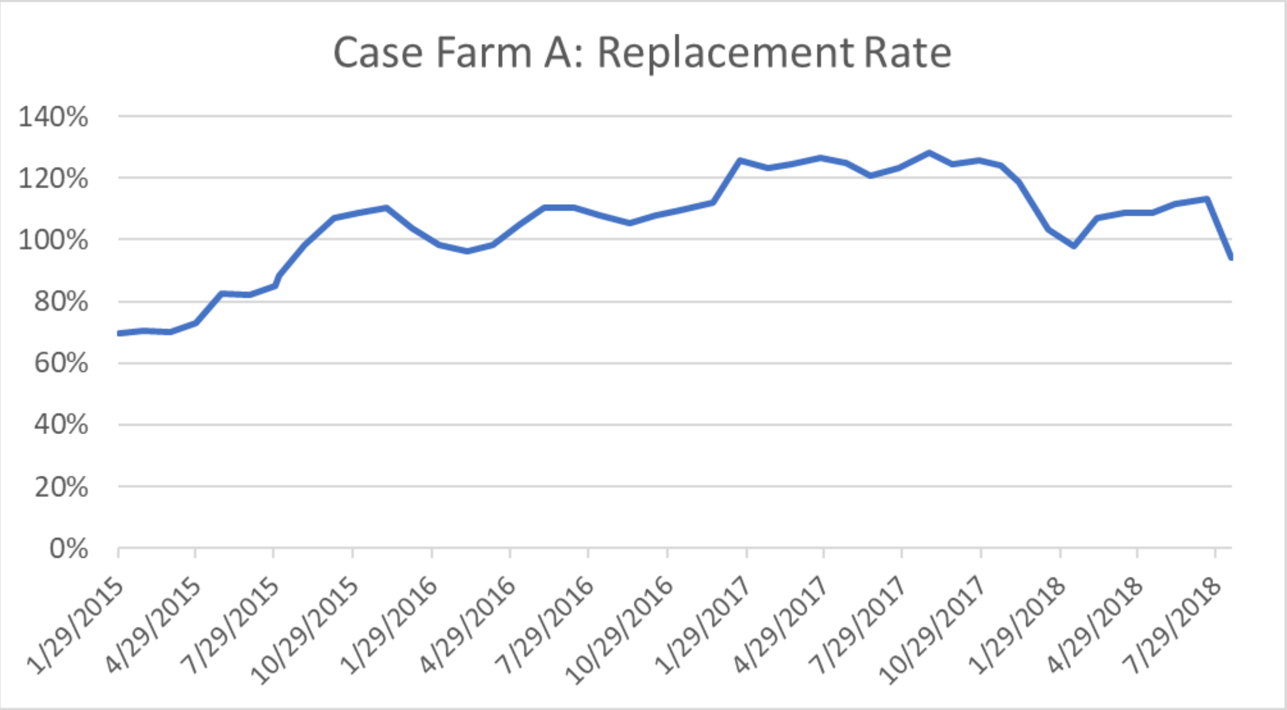
Data

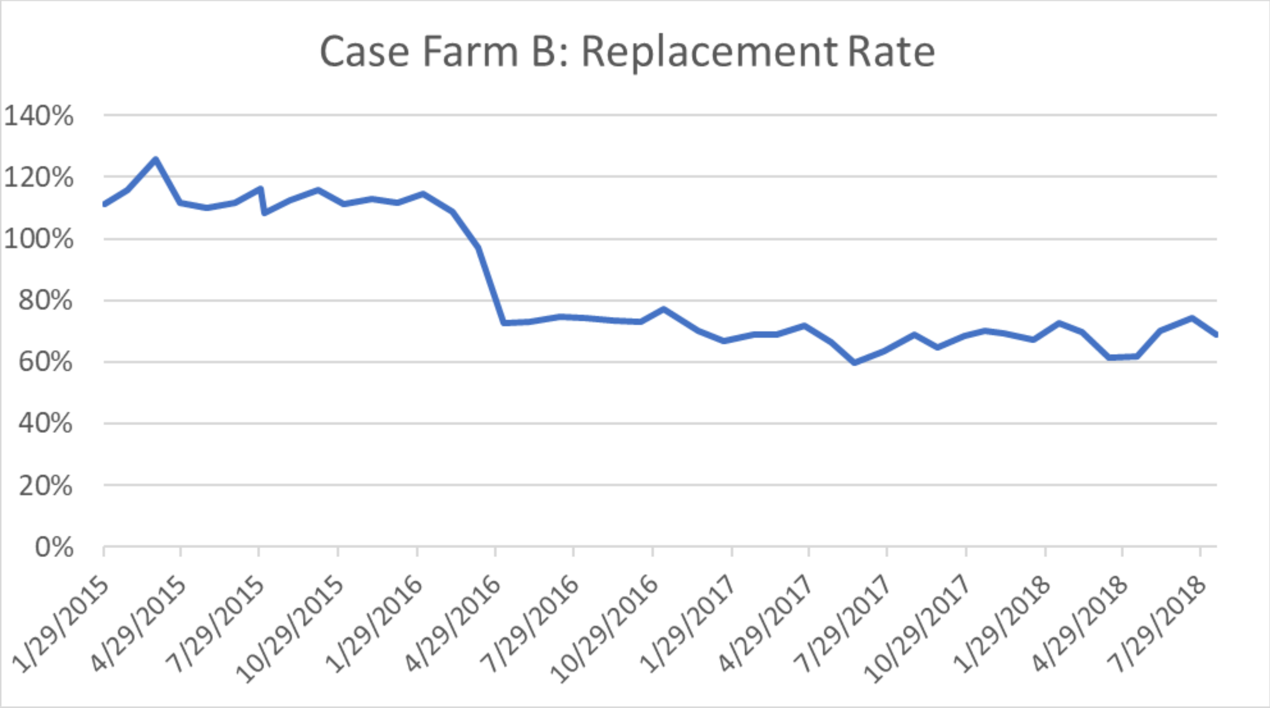
IDENTIFY 2:
Opportunity
Cost

Data

ADDRESS 3:
Heifer
Management

Replacement Rate





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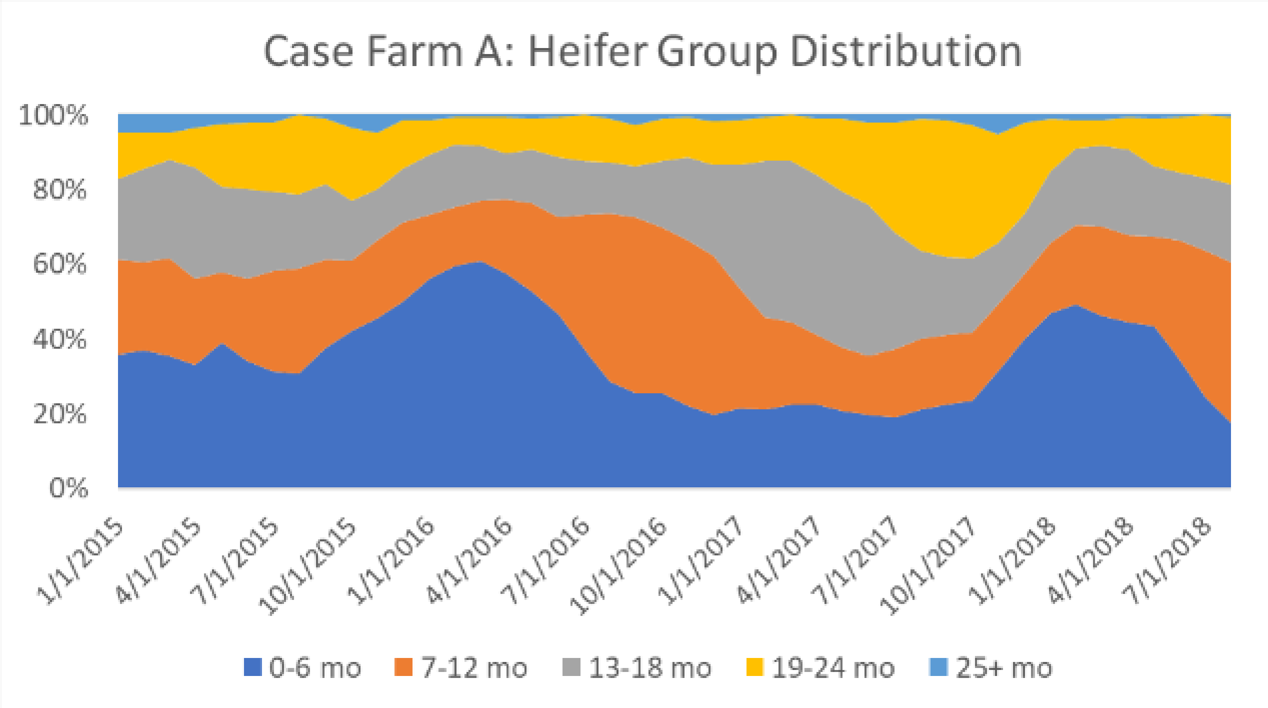
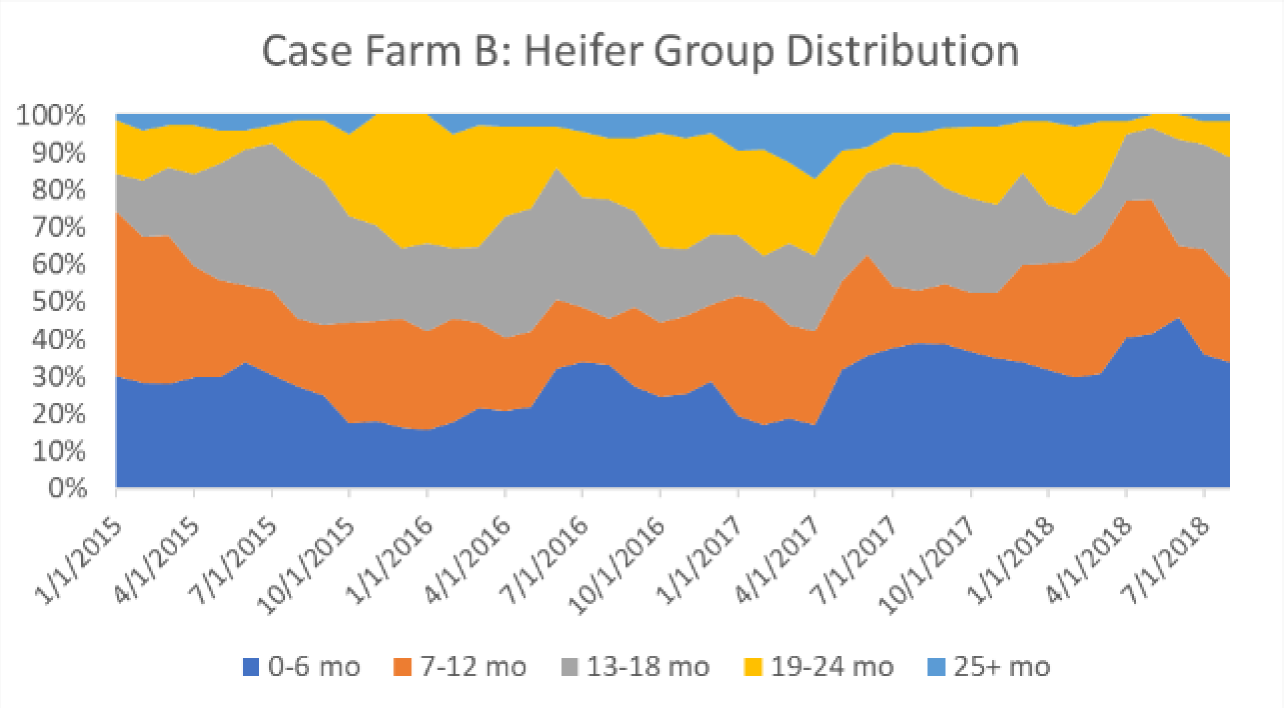
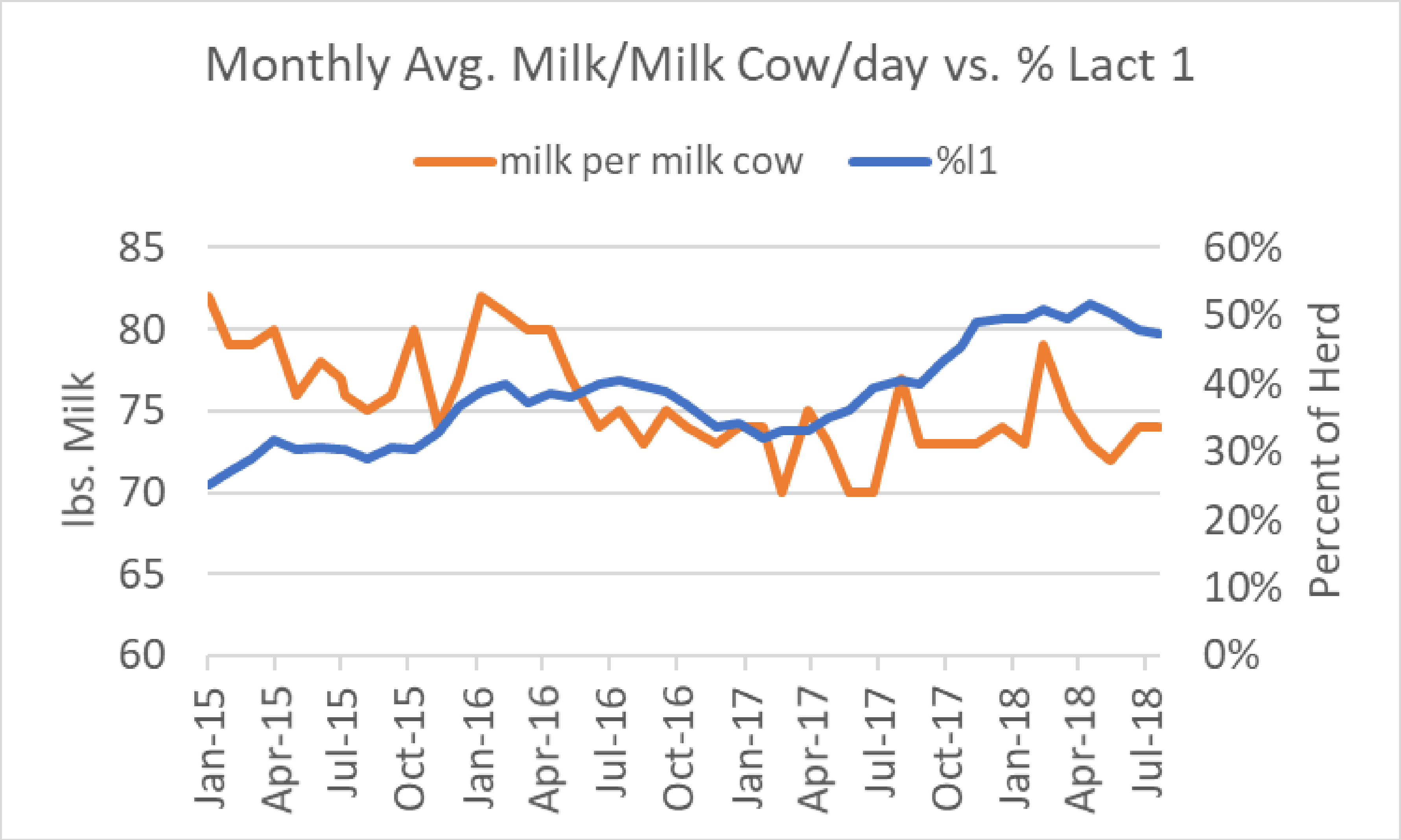
Heifer Distribution by Age Group

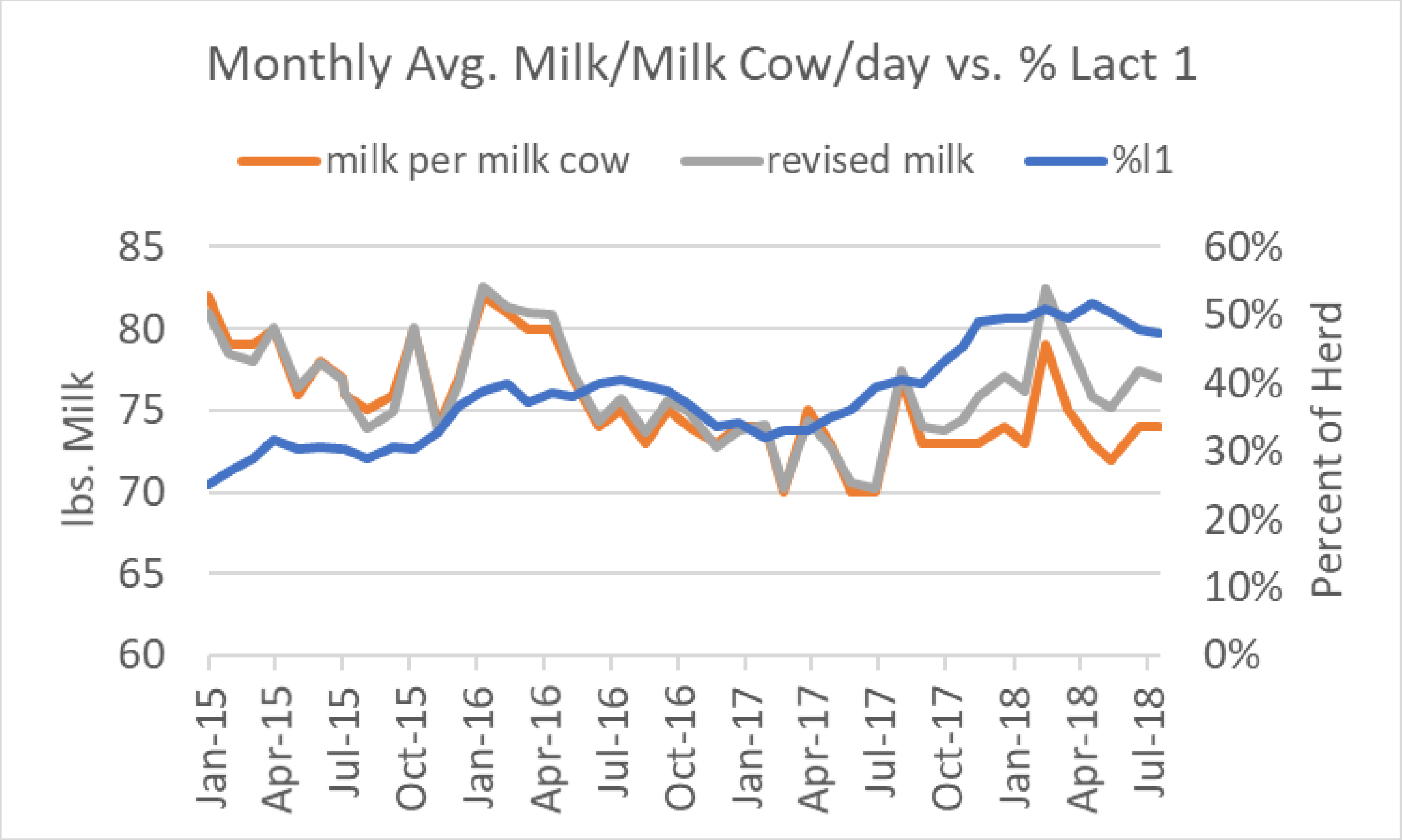




Why too much culling may be counter productive

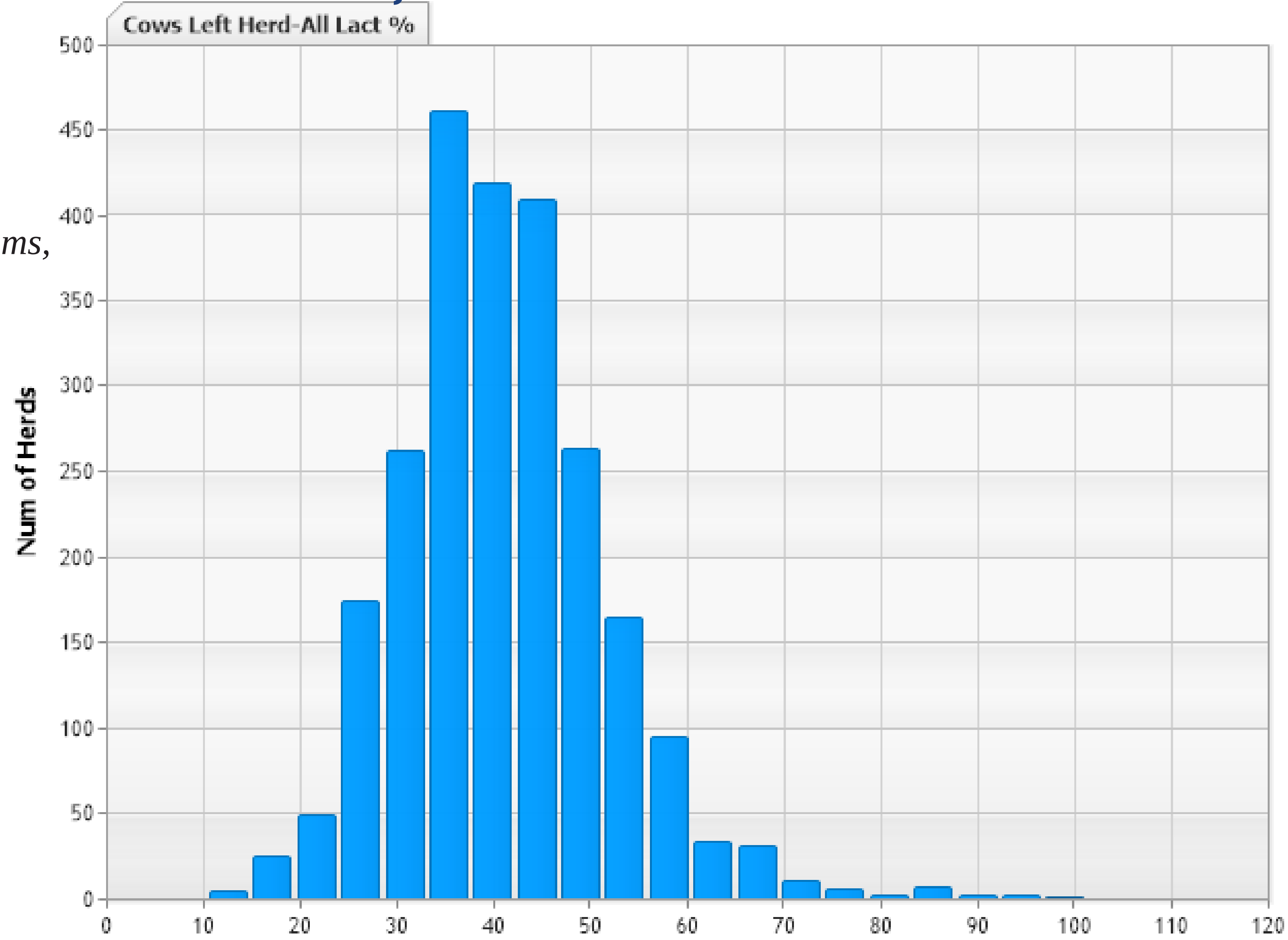


Same herd, 35% L1, pro-rated to L2 & L3+



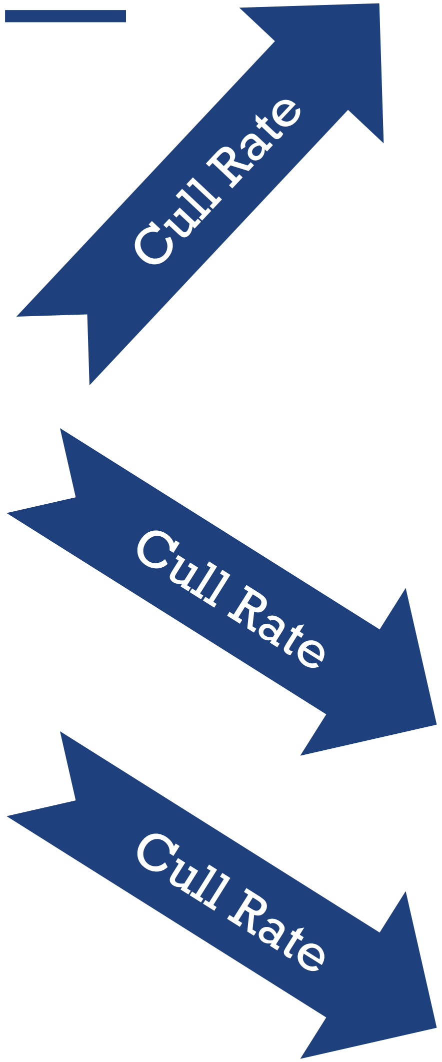
% Cows Left Herd, PA DHI Herds >50 cows

(Dairy Records Management Systems, September, 2018)



- Average Herd Turnover is ~40% in PA (and nationally)
- Think about this a bit differently
- After calving, how many years will they stay in the herd
    - 1 year ÷ 40% = 2.5 years in herd before culling (i.e. productive life)
    - What if that was 3.5 years, or 1 year?

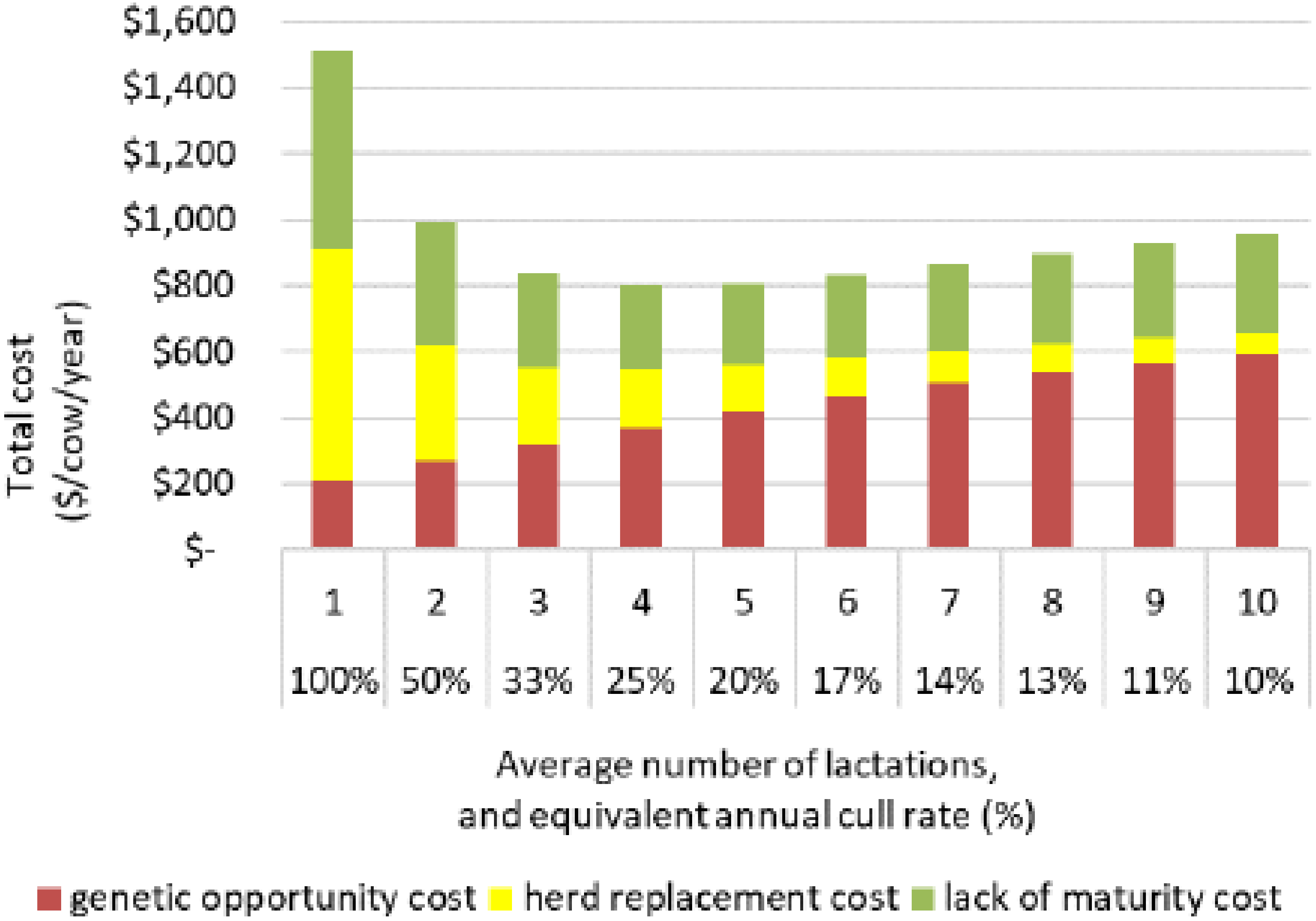
What areas drive cull rate

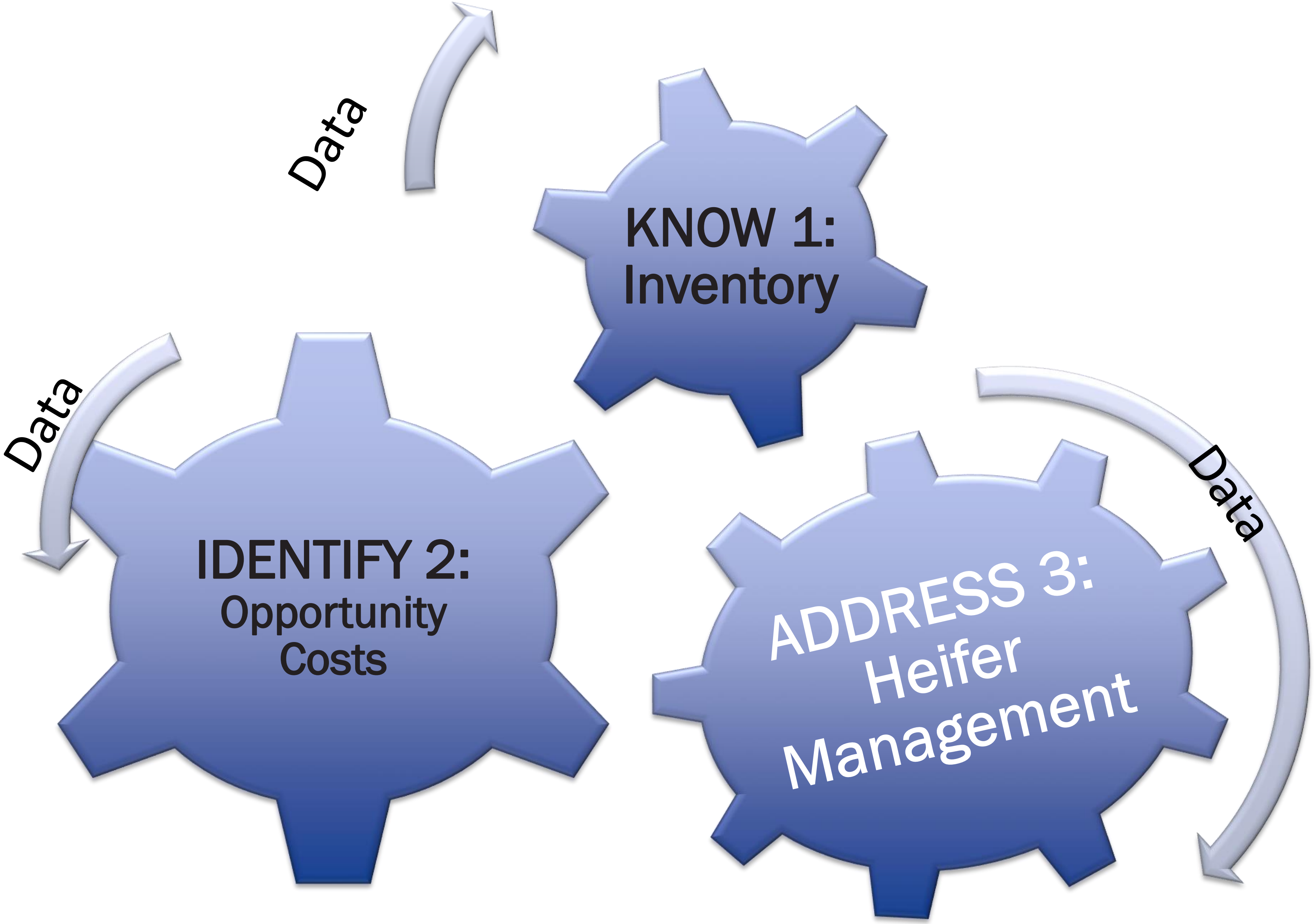


- Genetics
  - Heifers “should” be genetically superior
- Maturity
  - Mature cows net more milk per lactation
- Costs
  - Heifer rearing cost
  - Salvage income

Value of a Mature Herd

(De Vries, A., 2018)





KNOW 1: Inventory

Data

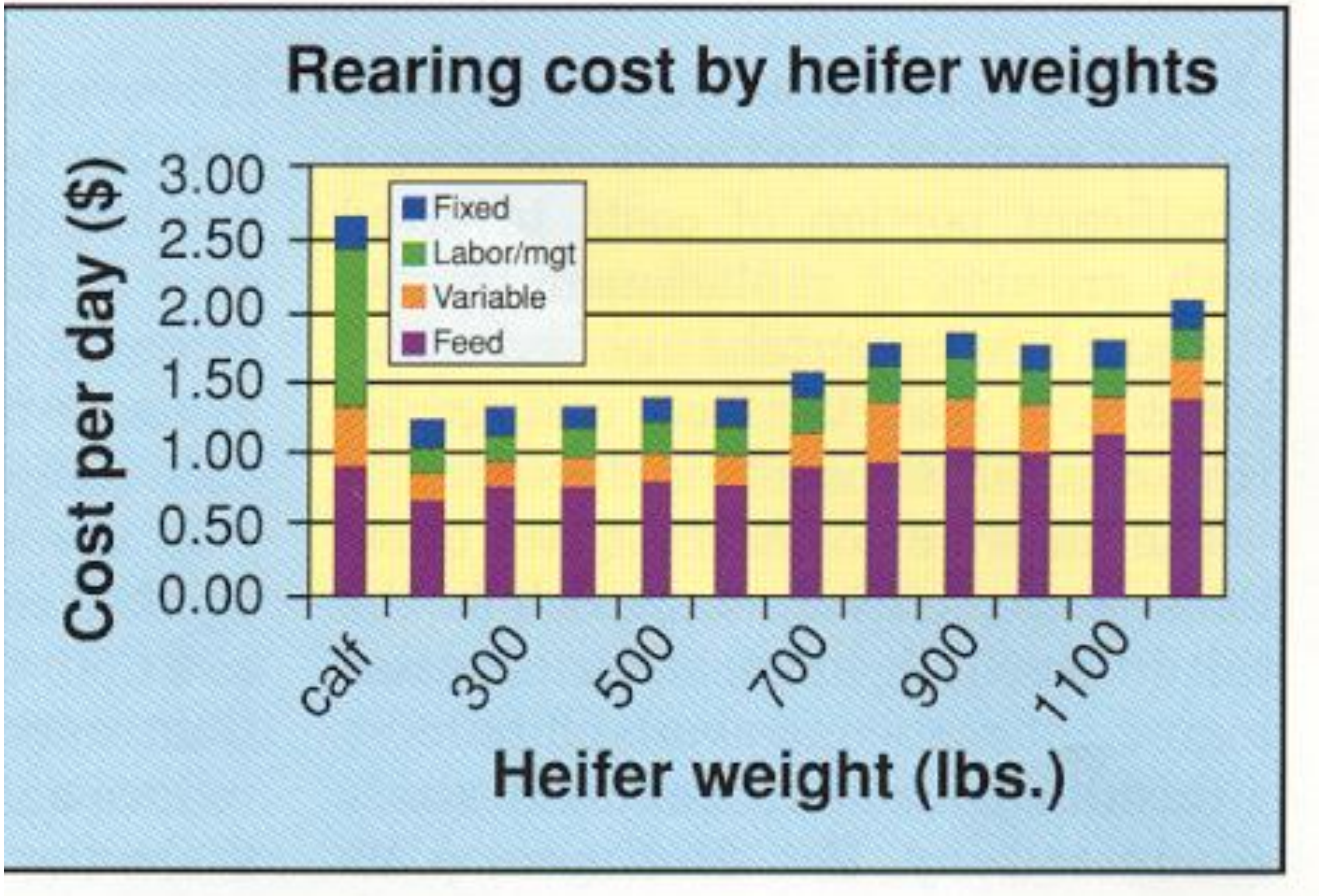
IDENTIFY 2: Opportunity Costs

Data

ADDRESS 3: Heifer Management

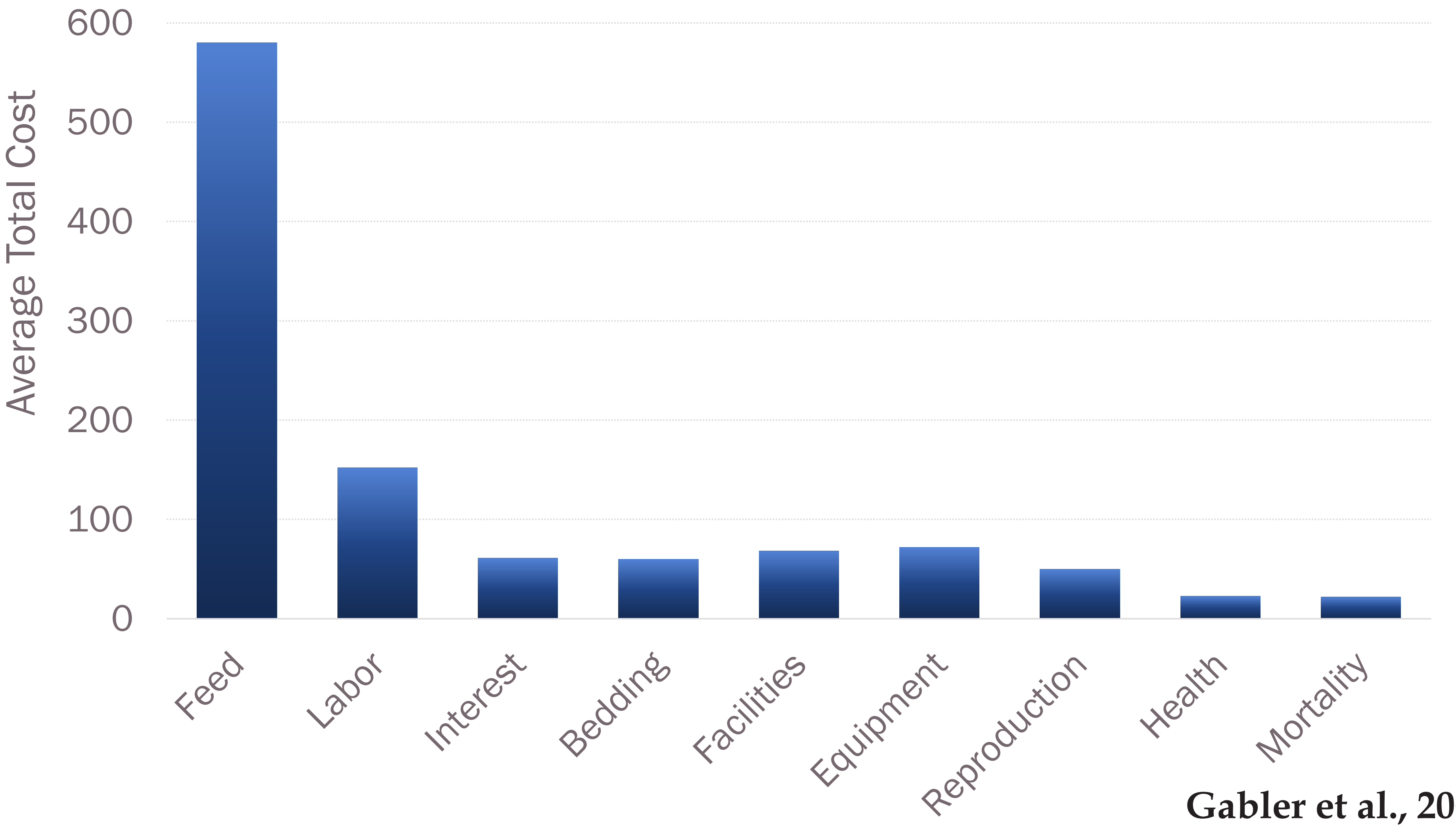
Data

Costs to Raising Heifers



Hoffman et al., 1999

Feed costs are the largest cost input for heifer production (>60%)
Heifer feed costs >12% of total farm expenses



Gabler et al., 2000

Costs to Raise Heifers, birth to freshening

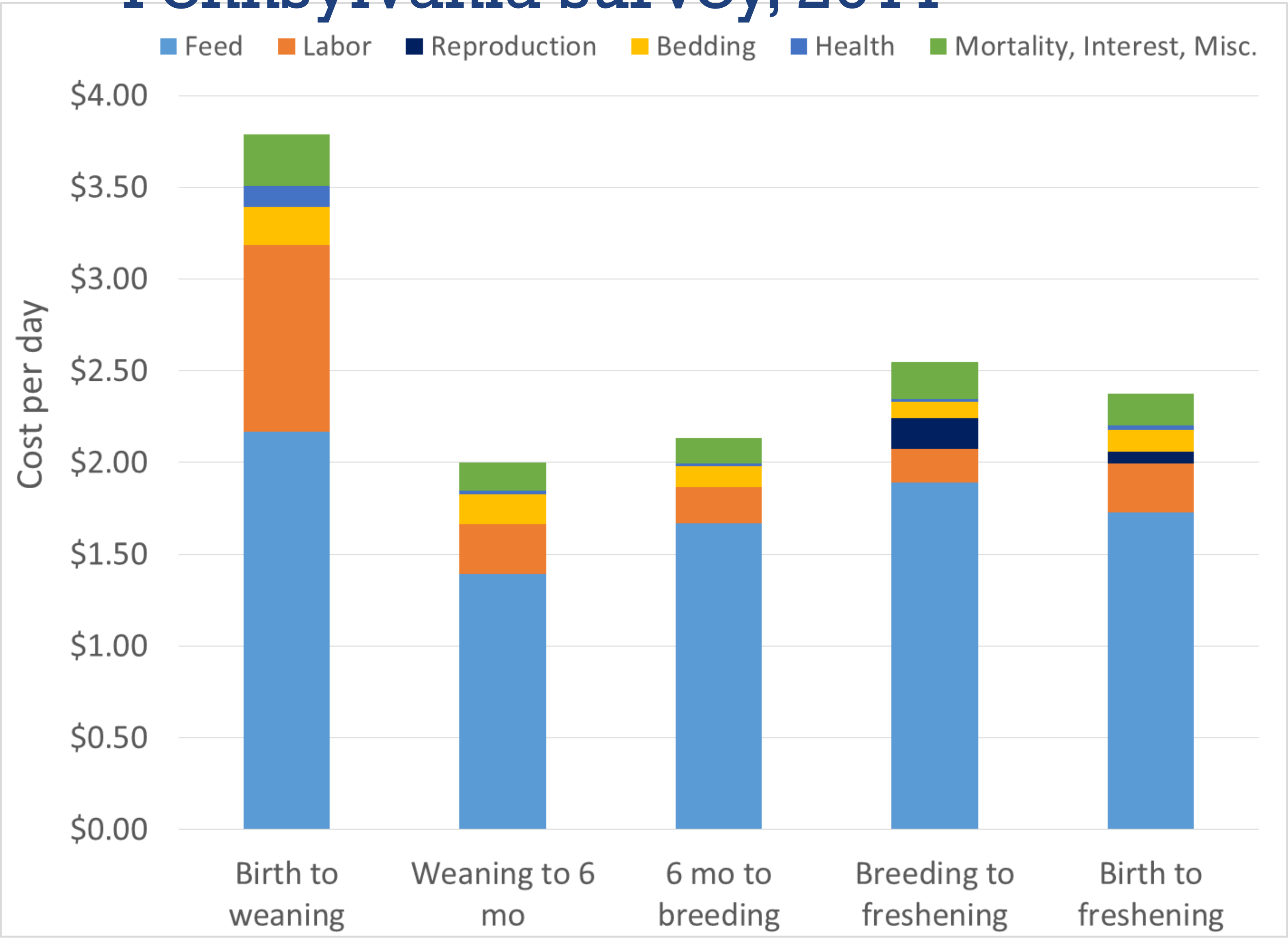
survey of 44 PA herds, winter 2011/spring 2012

$/heifer	Mean	SD	Min	Max
Feed	1,318	281	819	1,980
Labor	203	99	66	436
Bedding	90	81	10	392
Repro	49	22	13	122
Health	17	13	3	66
Total	1,808	339	1,129	2,505
Total/day	2.38	0.41	1.50	3.24

Heinrichs et al., JDS 2014

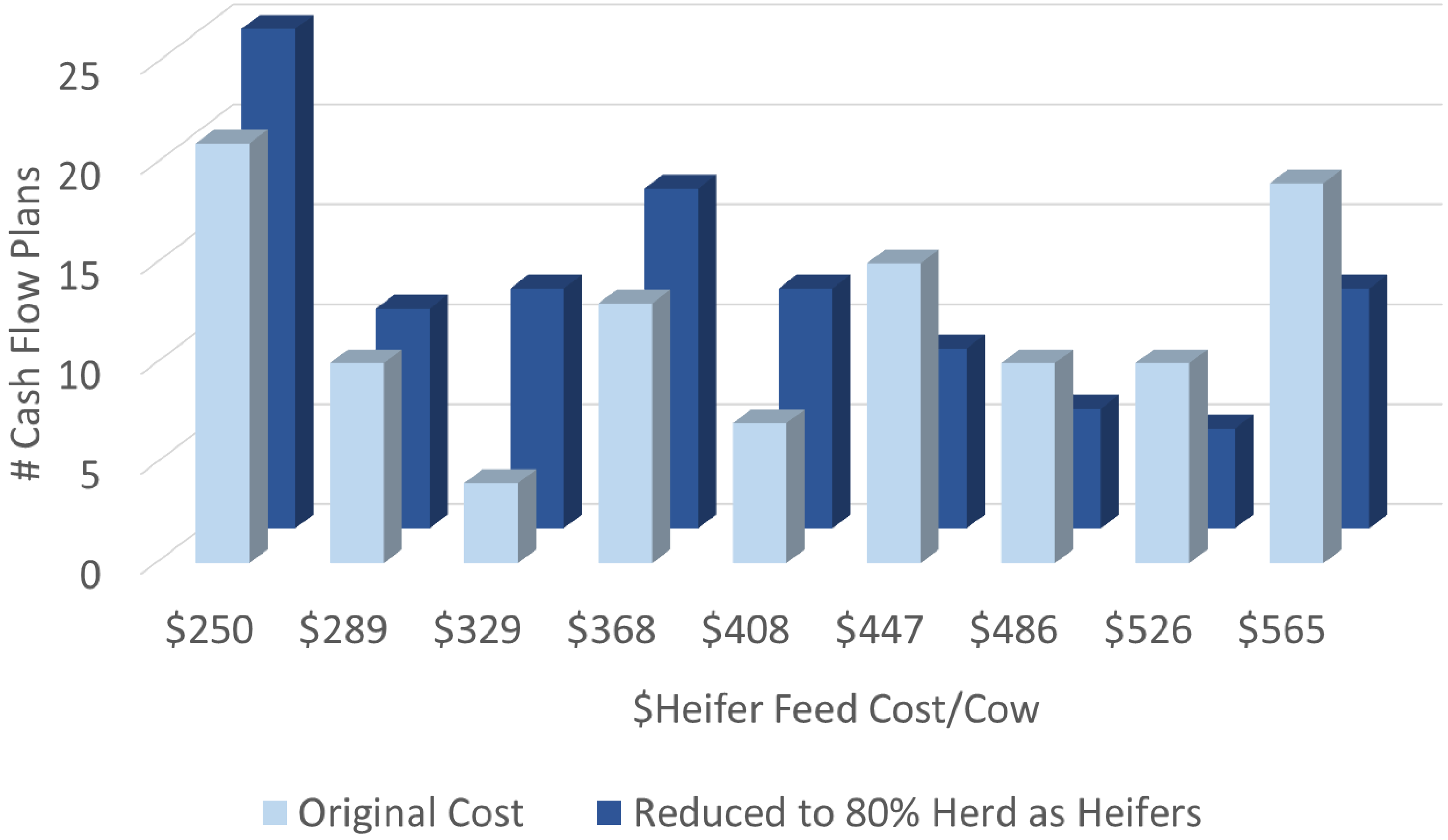
Average heifer rearing costs

Pennsylvania survey, 2011



Heinrichs et al., 2014

2017-18 Planned Heifer Feed Cost/Cow

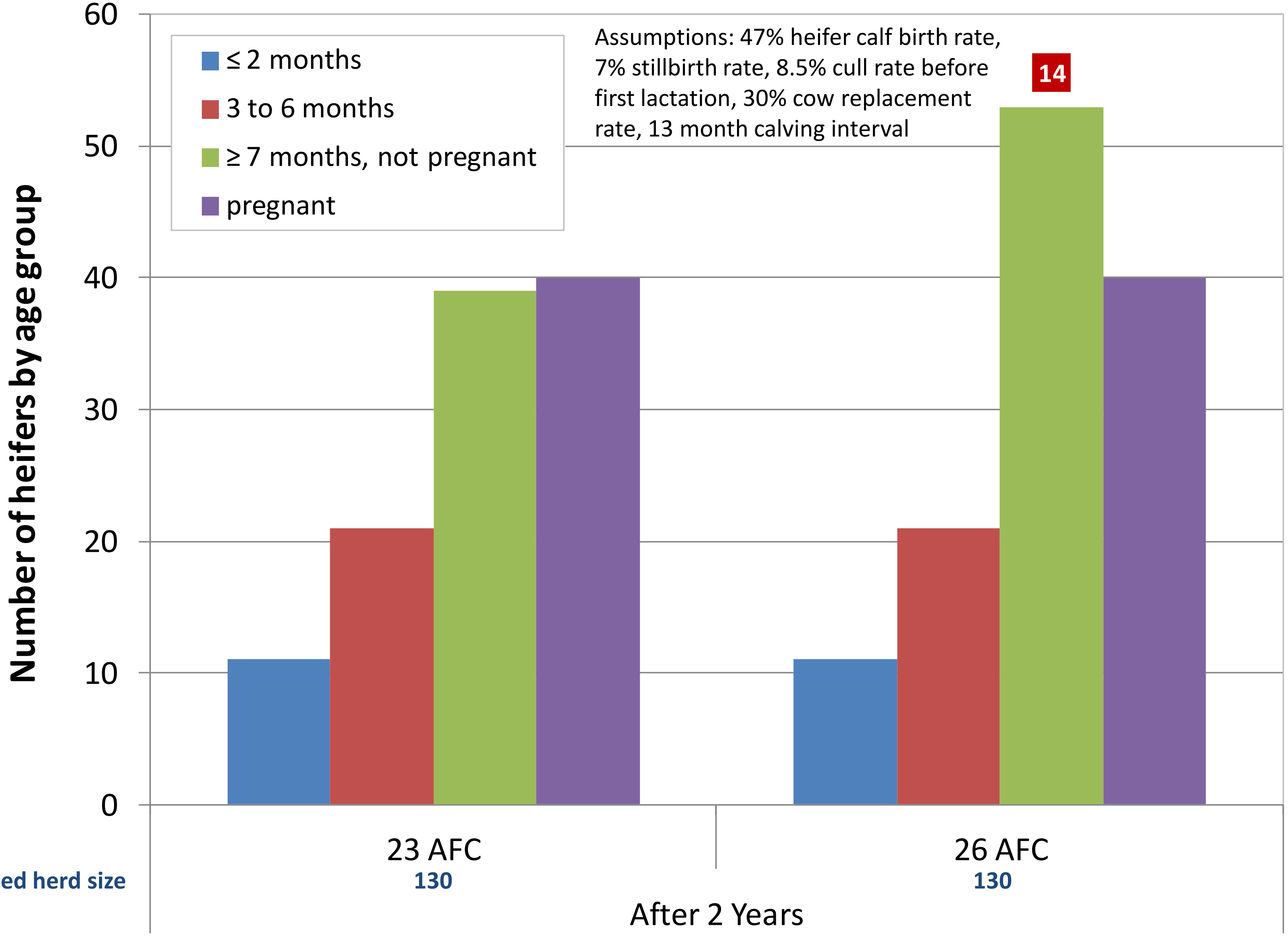


Reduction:
66 of 109 plans impacted
Average savings:
$55/cow

Effect of age at calving on heifer numbers

PennState College of Agricultural Sciences

Simulation for 100-cow herd



Assumptions: 47% heifer calf birth rate, 7% stillbirth rate, 8.5% cull rate before first lactation, 30% cow replacement rate, 13 month calving interval

Herd Structure Simulation Model, University of Wisconsin, Cabrera & Meyer

Looked at Efficiency of Heifer Raising

- Costs at all time points
- Nutrition/feeding rates at all time points/groups
- Growth at weaning, breeding, calving
- Age at calving
- DHI records- milk (total, fat, protein), reproduction, culling; all compared total herd averages

Heinrichs et al., 2013

Efficient farms compared to Inefficient farms

data envelopment analysis of 44 PA herds, winter 2011/spring 2012

	Efficient	Inefficient
Number	9	35
Feed costs ($/heifer)	1,137	1,364
Labor costs ($/heifer)	141	218
Milk produced by first lactation heifers (% of mature herd mates)	88%	82%
Age at calving (mo)	23.7	25.3

Heinrichs et al., 2014

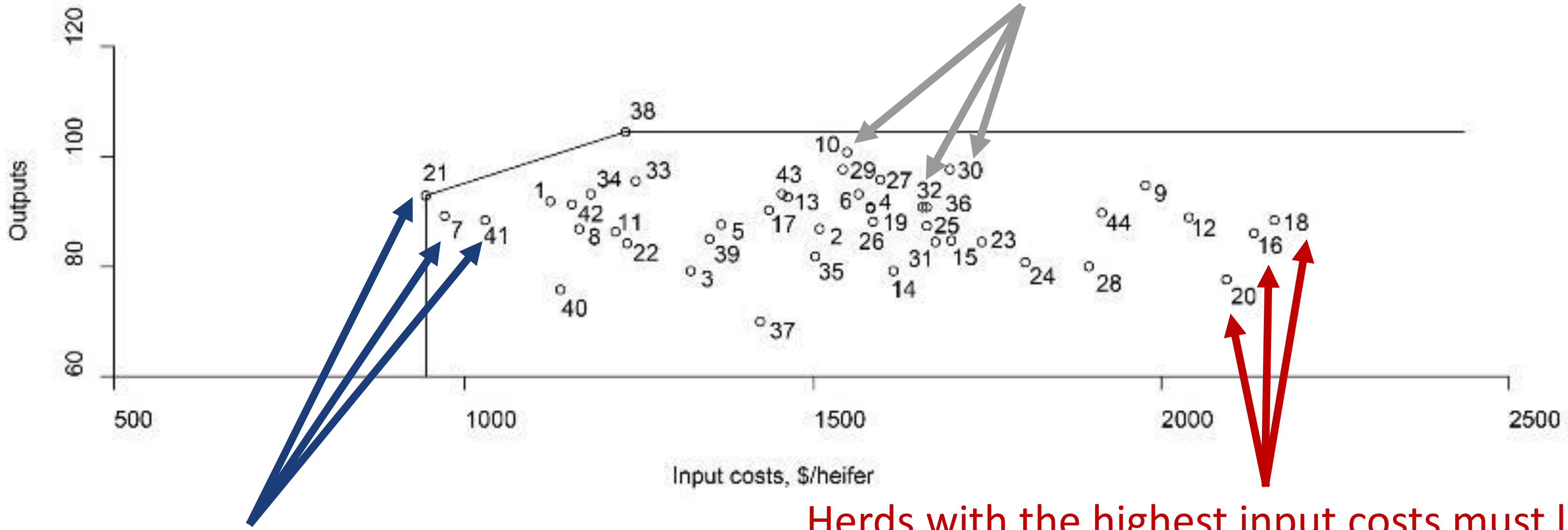
A little more about the efficient farms…

Farm #	Feed, $/head	Labor, $/head	AFC, mo.	Heifer milk production, % of mature herd mates
41	912.87	116.97	23.5	81.93
7	849.76	120.41	23.8	82.88
34	1,042.10	138.13	23.0	85.99
21	819.12	124.95	25.0	87.95
30	1,608.63	88.20	24.5	92.14
10	1,230.77	317.62	23.9	94.56
33	1,179.01	66.25	22.5	87.97
38	1,020.01	210.56	25.0	99.32
32	1,574.30	82.47	22.2	83.02

Heinrichs et al., 2014

Graphic presentation of data envelopment analysis

But, herds with higher input costs also attained efficiency if they had low AFC or high milk production of heifers compared to the other cows in the herd (10, 30, and 32).



Efficiency was attained by herds with the lowest input costs (21, 7, and 41)

Herds with the highest input costs must lower AFC and increase milk production of heifers to recoup the money they invest in heifers and increase efficiency.

Heinrichs et al., 2014

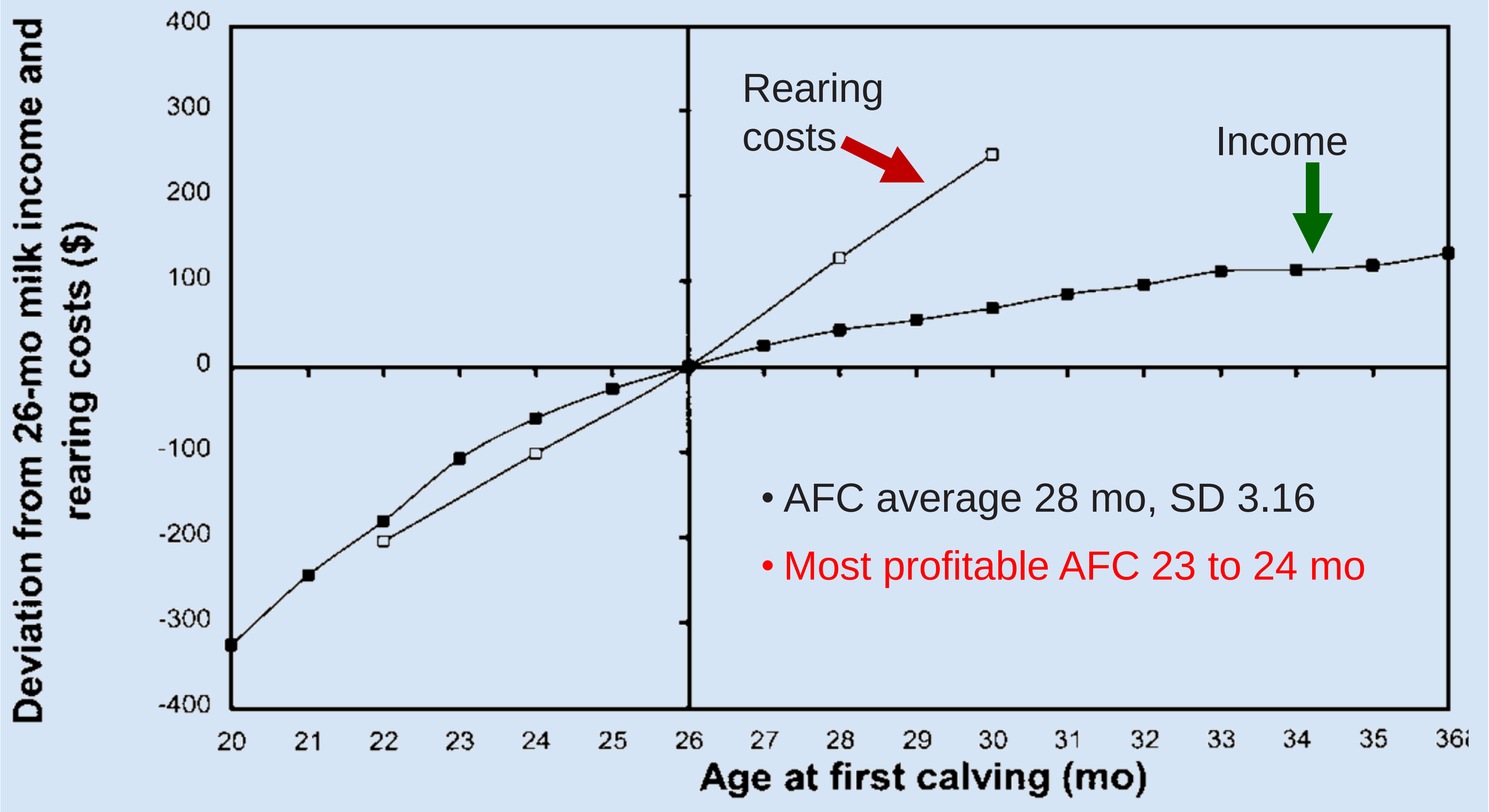
Major issues statewide that lead to higher heifer costs

- Weaning too late; high feed costs
- Breeding too late

- Bedding
- Age at calving #1

Age at Calving and Cost of Rearing

Italian Holsteins, calved from 1992-97



- AFC average 28 mo, SD 3.16
- Most profitable AFC 23 to 24 mo

Pirlo et al., 2000

What affects the costs of raising replacement dairy heifers:

A multiple component analysis (Tozer and Heinrichs, 2001)

- Herd culling rate
  - ⇓ 20% → ⇓ costs 24.6%
  - ⇑ 25% → insufficient heifers

- Age at first calving
  - ⇓ 1 mo AFC → ⇓ costs 4.3%

Costs of Age at First Calving

Tozer and Heinrichs, 2004

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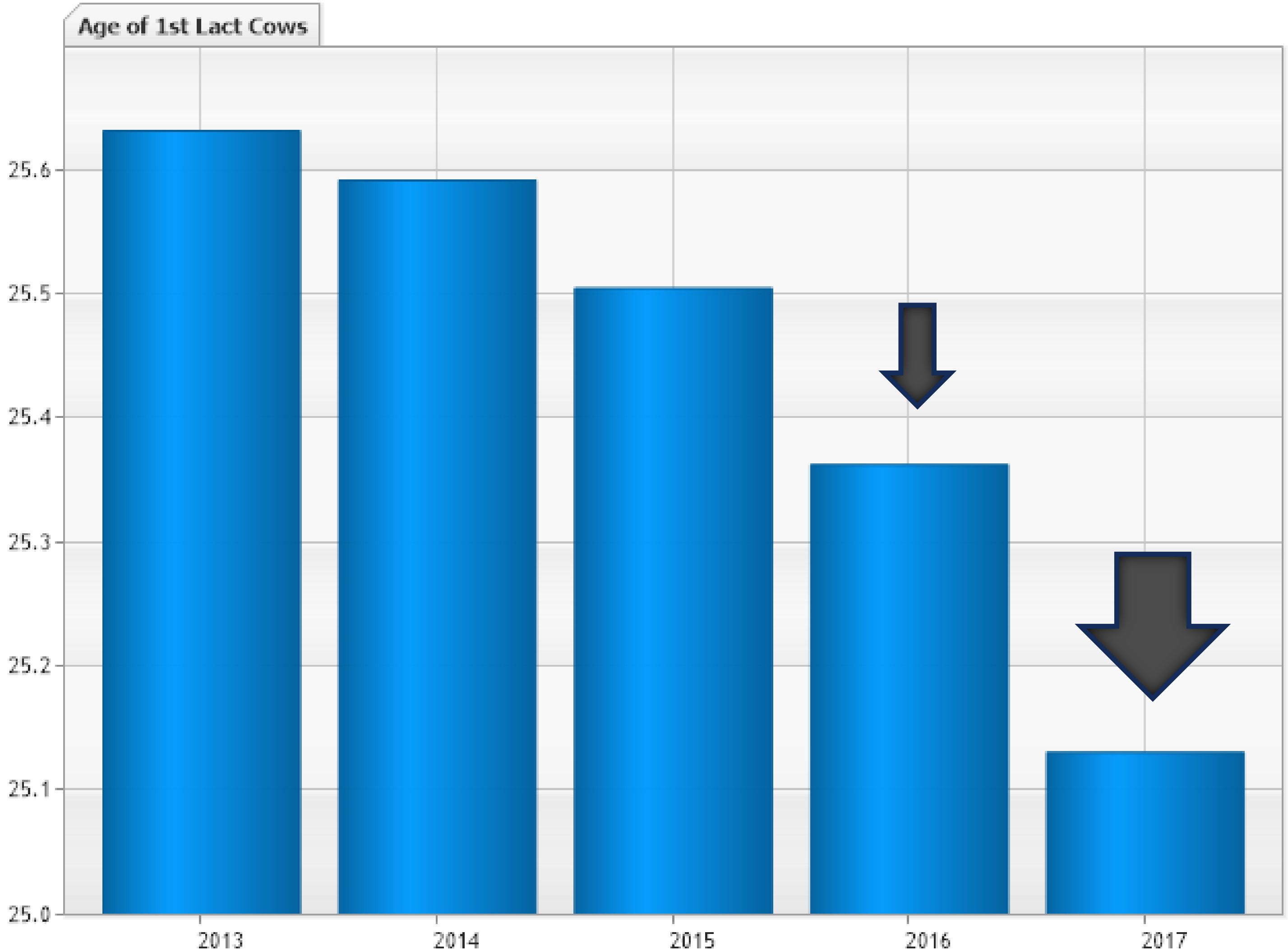
Herd Average Age at First Calving, PA Holsteins, last 5 years

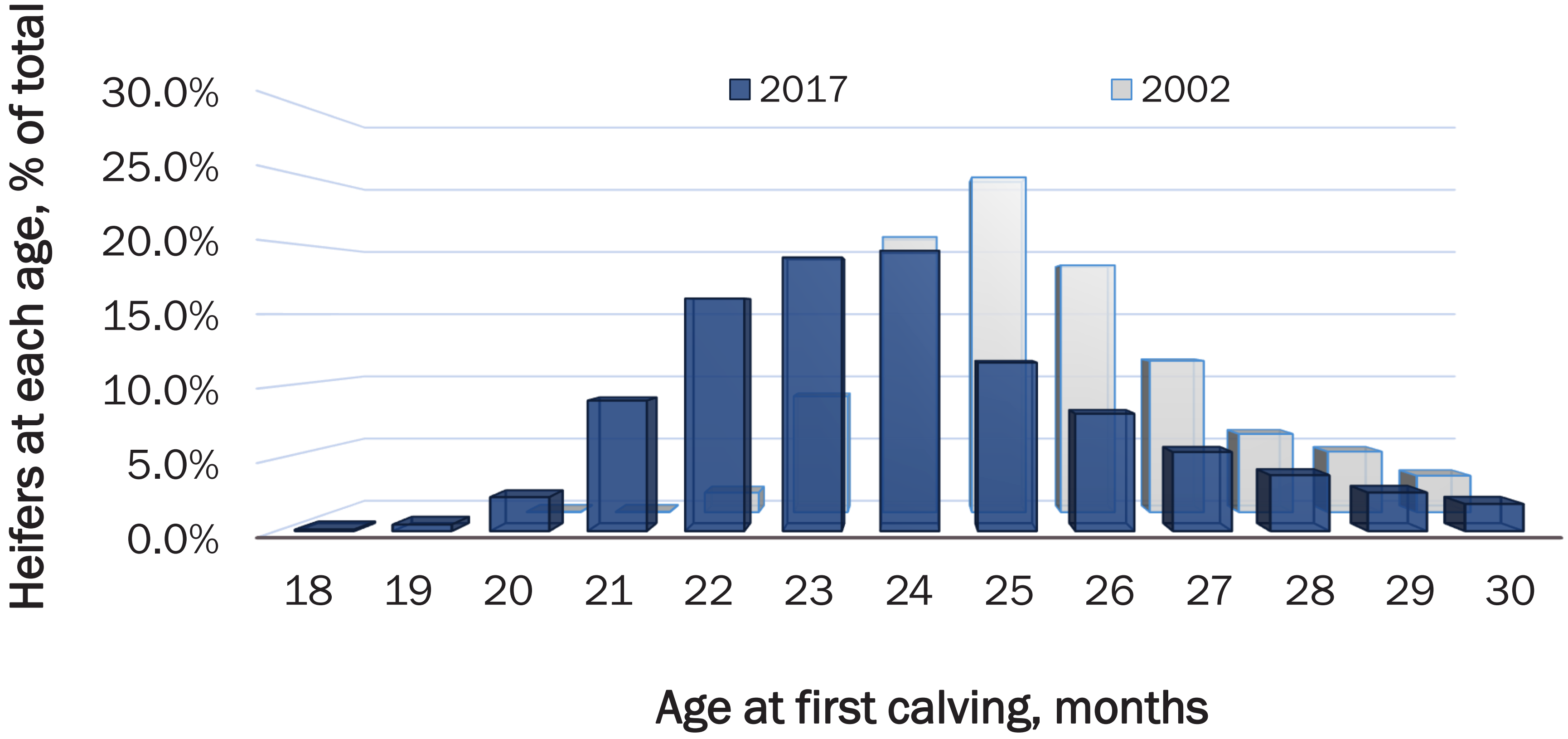


DRMS Dairy Metrics, 1/19/18

PennState
College of Agricultural Sciences

Distribution of age at first calving in PA Holsteins, 2002 v. 2017

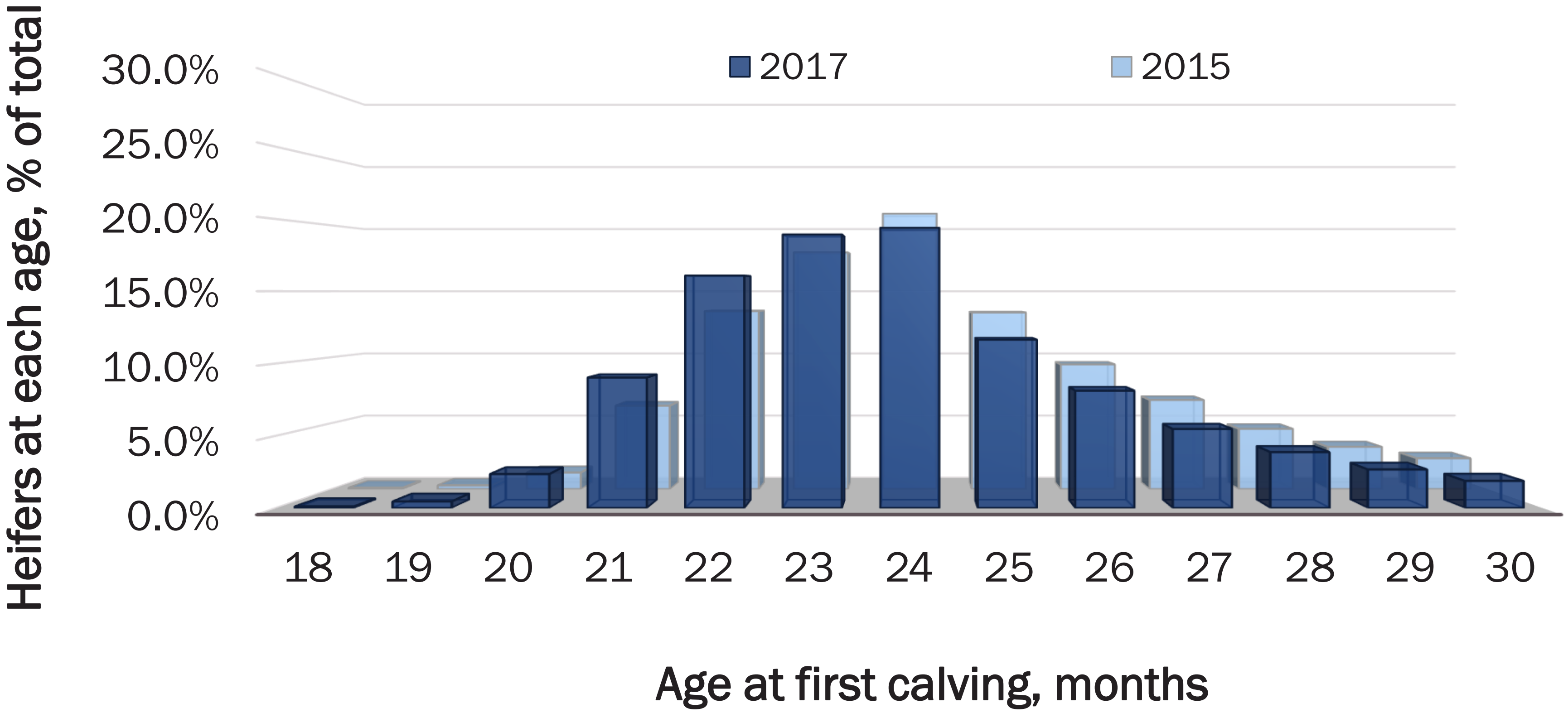
Heifers with AFC of 21 – 24 mo
2002 – 31.1% 2017 – 63.4%



DRMS data

Distribution of age at first calving in PA Holsteins, 2015 v. 2017

Heifers with AFC of 21 – 24 mo
2015 – 58.6%   2017 – 63.4%



DRMS data

Comparison of actual 305-d milk by age at first calving in PA Holsteins, 2010 v. 2017

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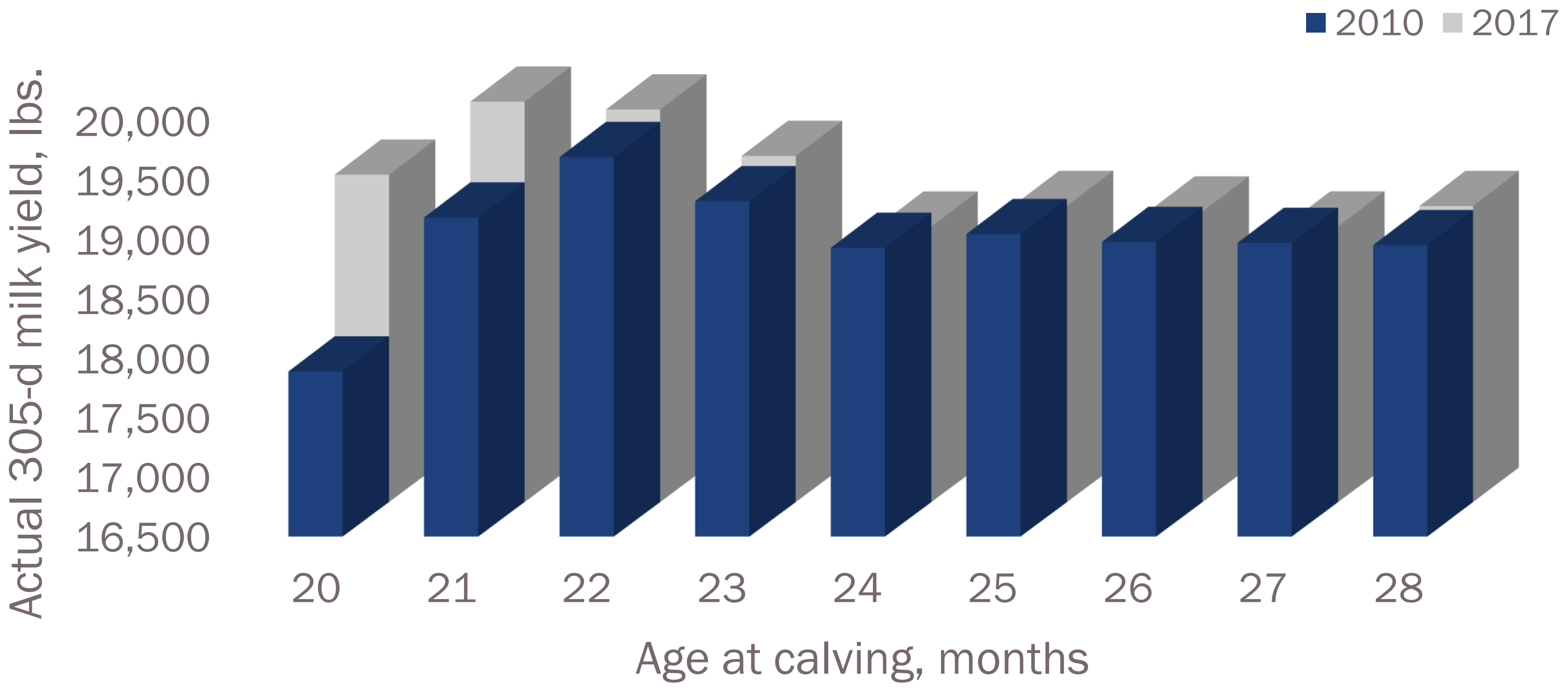

DRMS data

Heifer Health Events are Critical

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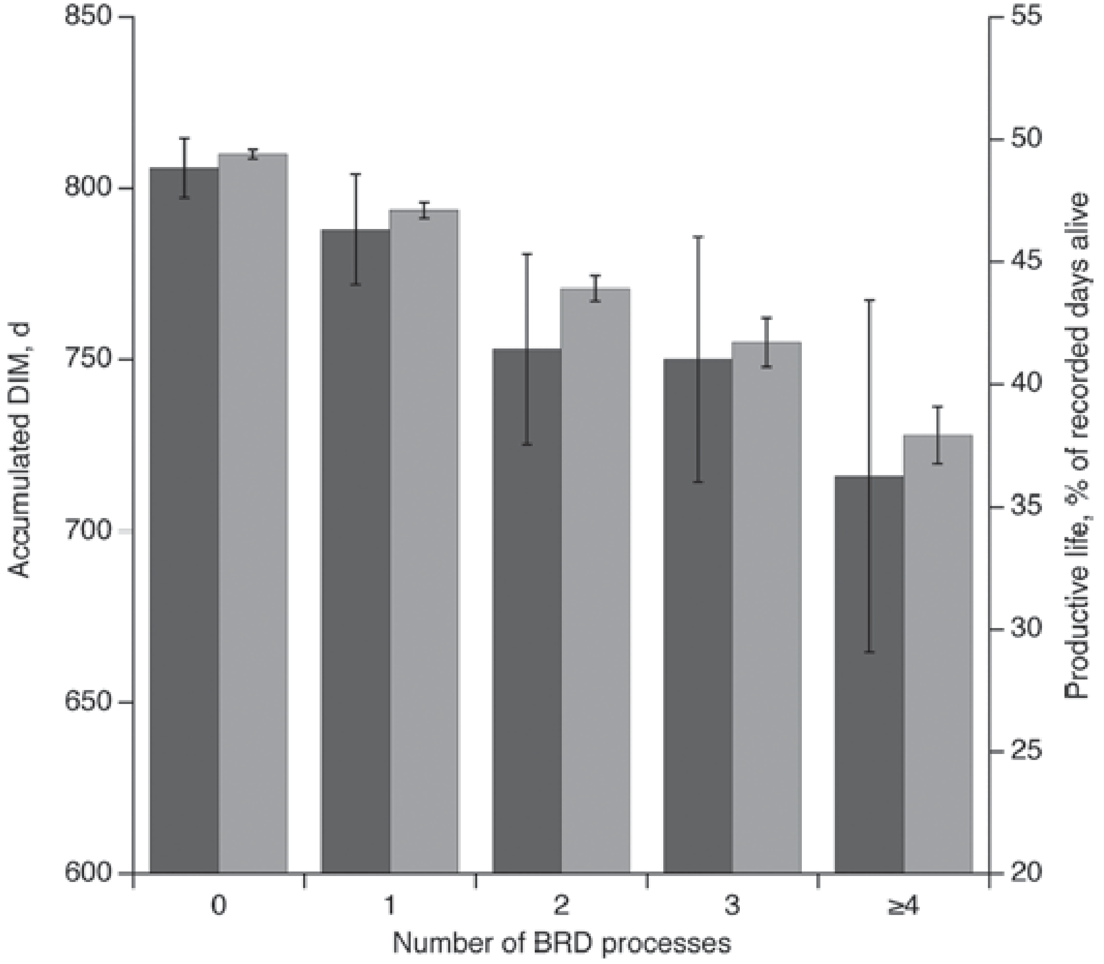
College of Agricultural Sciences

Effects of bovine respiratory disease (BRD) experienced before first calving

- Dark bars = accumulated DIM
- Light bars = productive life

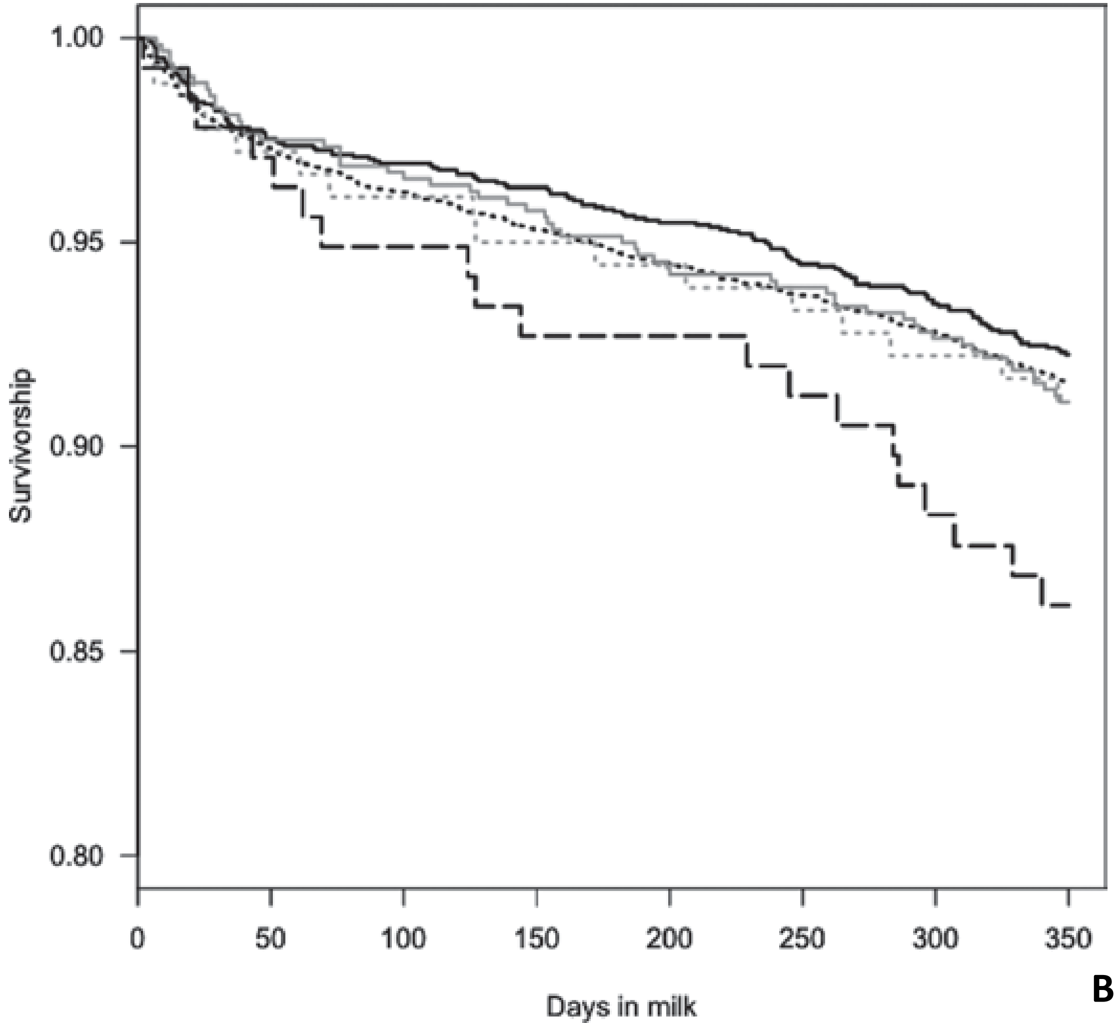


Bach, 2011

Survivorship throughout first lactation as influenced by the number of bovine respiratory (BRD) episodes experienced before first calving

PennState
College of Agricultural Sciences

- Solid black line = 0 cases BRD
- Solid gray line = 1 case BRD
- Dotted black line = 2 cases BRD
- Dotted gray line = 3 cases BRD
- Dashed black line = ≥ 4 cases BRD



Bach, 2011

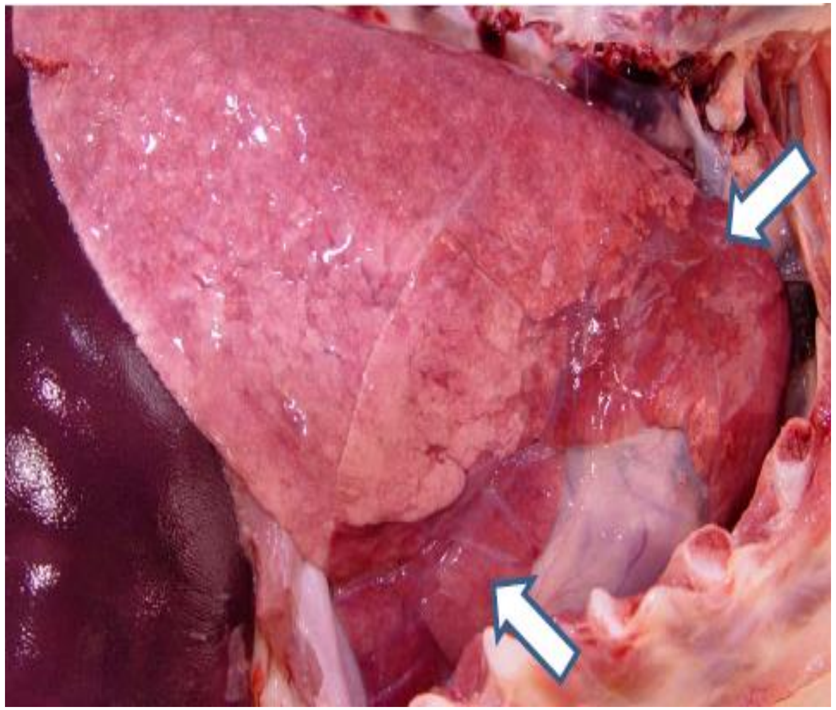
Calf health impacts ADG of heifers

- Diarrhea, septicemia, and respiratory disease can affect heifer growth
- Passive transfer of IgG affected health and indirectly height and weight

Donovan et al., 1988

Calf health and survivorship and age at calving

- Heifers treated for pneumonia – 2.5X more likely to die
- Heifers treated for diarrhea 2.5X likely to be sold
- Heifers treated for diarrhea 2.9X more likely to calve >30 mos.



Waltner-Towes et al., 1986

Summary

- Goal of raising dairy heifers is to minimize costs without sacrificing future productive potential
    - Age at first calving 22-24 mo

- Several management systems can work well
    - Choice depends on individual farm facilities, resources, and management preferences

What is needed

- Beef crosses (which ones, market value)
- “don’t put eggs in 1 basket”
- Back calculate needs in age groups

In Summary

- Need to know the numbers
  - Cost to raise heifers at various stages
  - Current metrics impacting cow flow
  - Current metrics impacting available heifers
- Current and future goals
  - Plan for possible bumps in the road
- No single answer fits every farm

Credits

“cows-calves-calf-farm-ag-1235910” by CLM-bv. Pixabay.com. cc0.
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Dietary Protein: How Low Can We Go?

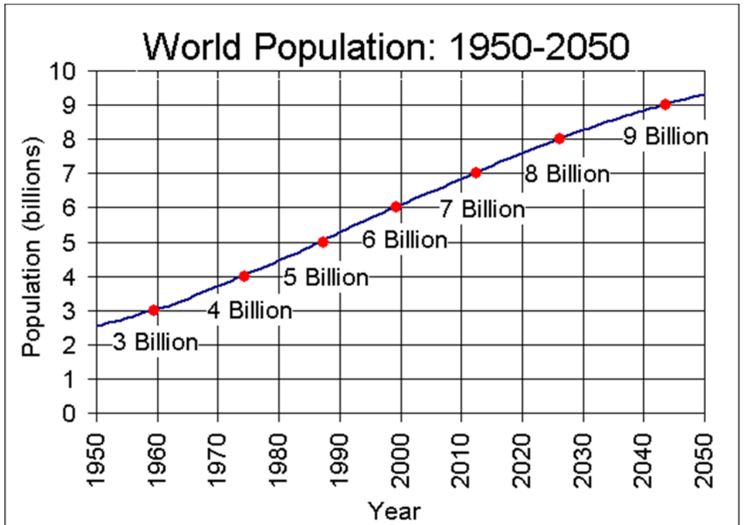
AFRI Grant: 2012-67015-19464

United States Department of Agriculture
National Institute of Food and Agriculture

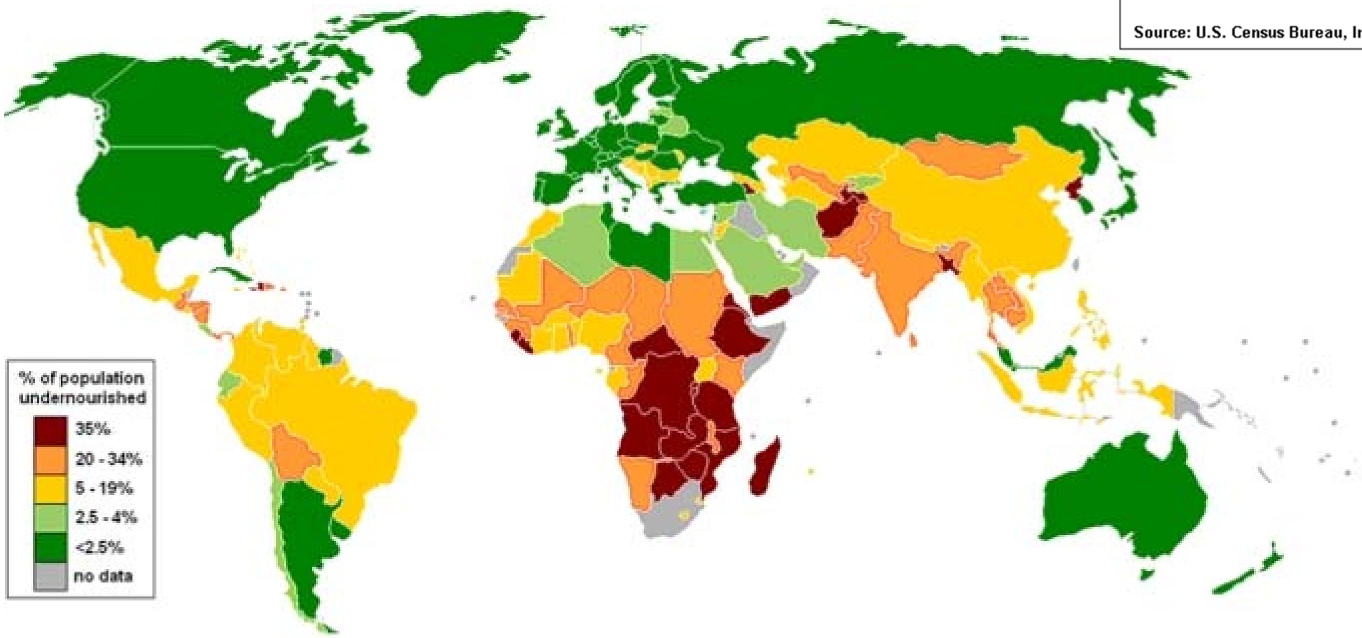
M. D. Hanigan
Dept. of Dairy Science

VirginiaTech
Invent the Future

Food production must increase by >50% by 2050



Source: U.S. Census Bureau, International Data Base, June 2009 Update.



http://www.restlessbeings.org/images/child_malnutrition_on_the_map.jpg

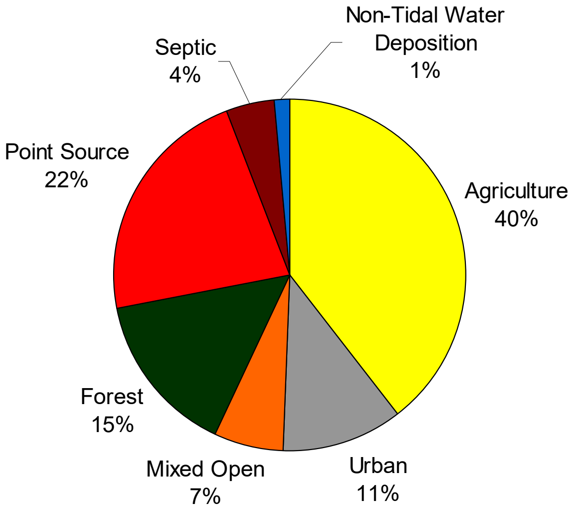
http://bryanking.net/wp-content/uploads/2009/02/malnutrition.jpg

http://www.census.gov/ipc/www/idb/worldpopgraph.php

Sustainable Food Production

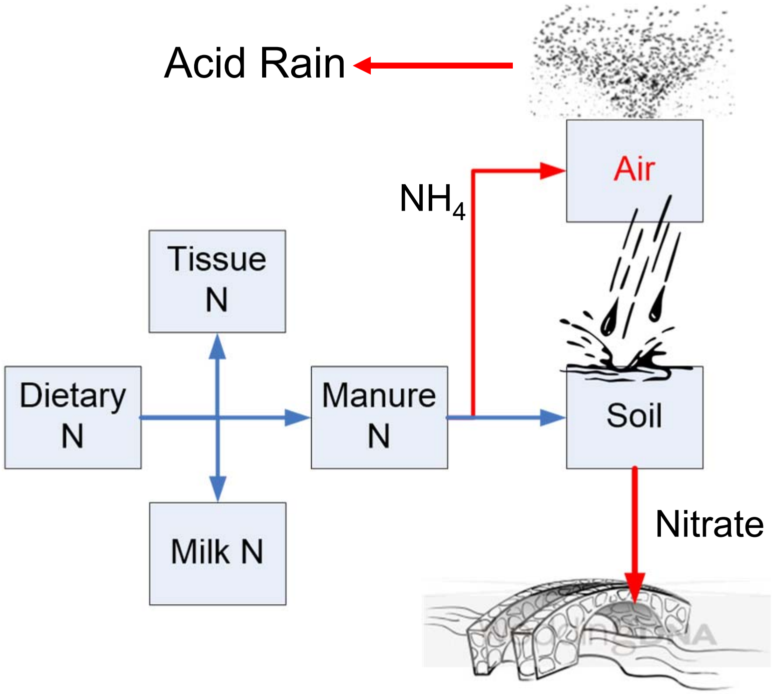
Income – Expenses = Profit

Chesapeake Bay Watershed - Nitrogen Loads (2003)



N Conversion Efficiencies are Relatively Poor for the Ruminant

↑ efficiency = ↑ food/ac and ↓ environmental loading!



Acid Rain

Air

NH_4

Tissue N

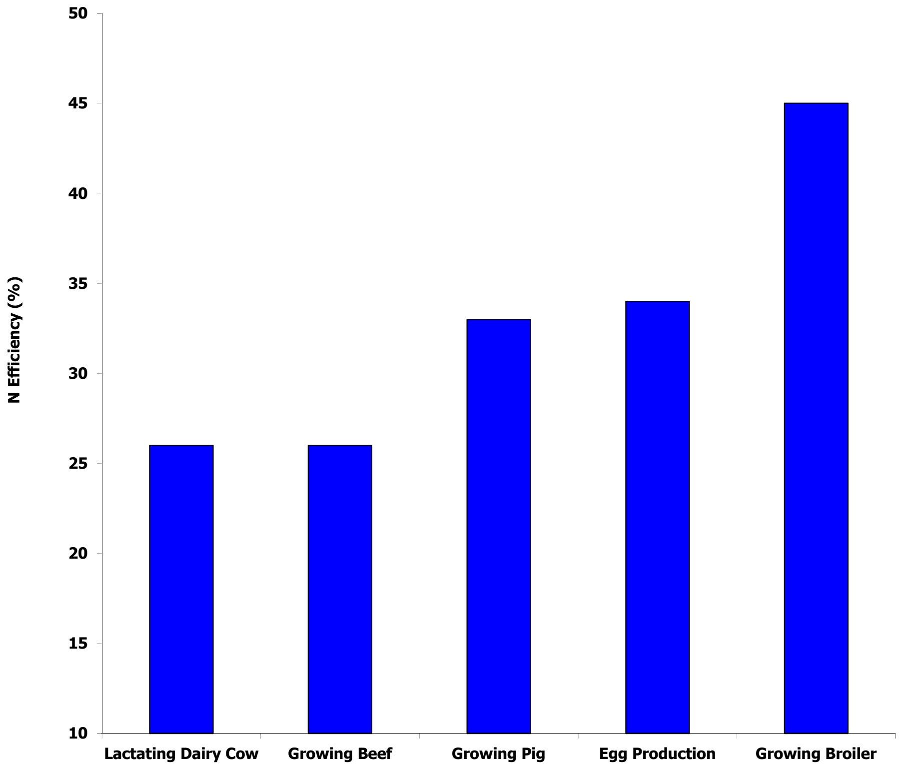
Dietary N

Manure N

Soil

Milk N

Nitrate



Bequette et al., 2003

Ohio Dairy Nutrient Prices

November 28, 2017 Evaluation
Buckeye Dairy News: Vol 10, Issue 6

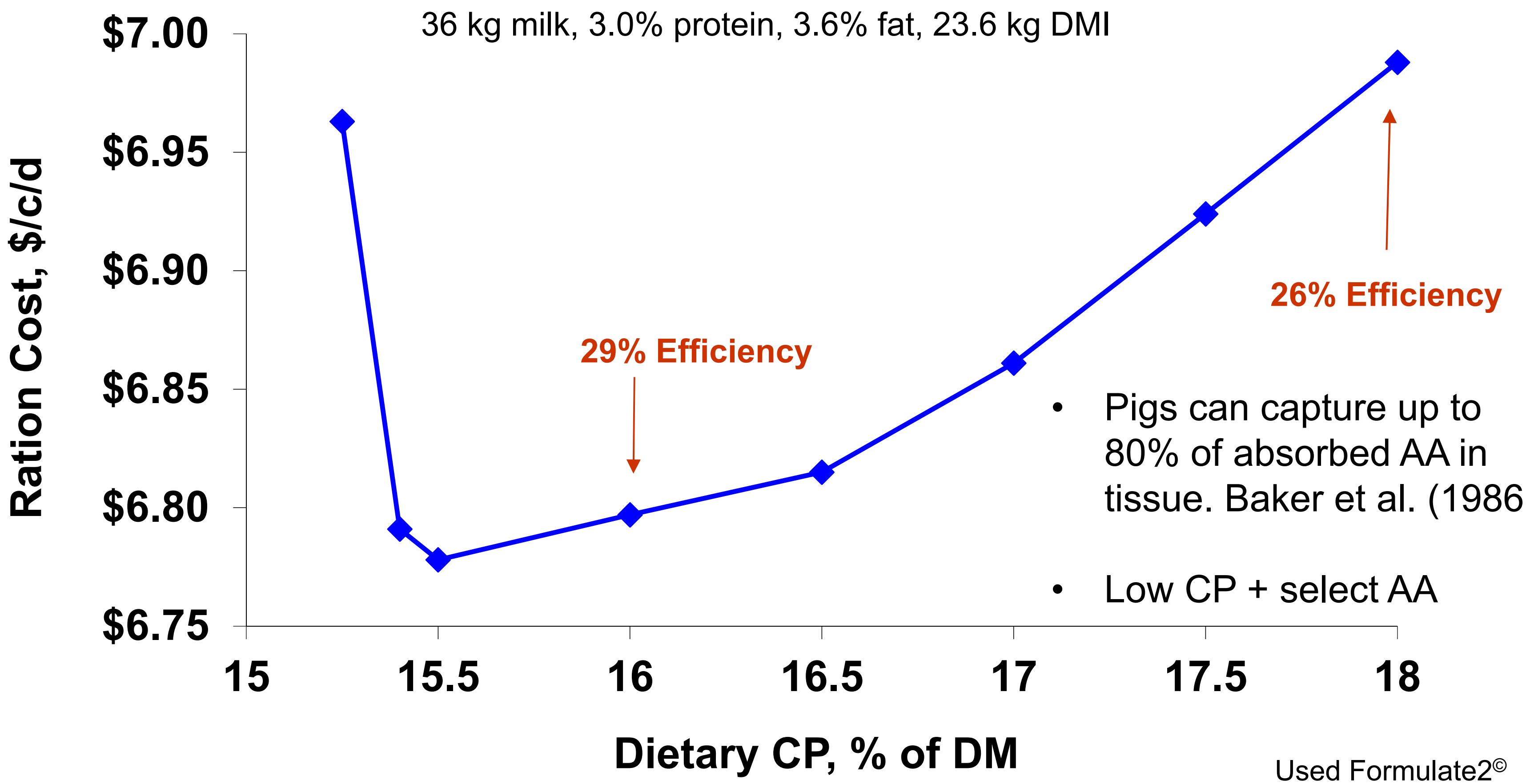
Nutrient	Cost/Unit	Daily Supply*	Cost/cow/d
NEL (3X, NRC 2001) MCal	$0.0664	35.4 Mcal	$2.35
Metabolizable Protein (NRC) Lbs	$0.4375	5.44 lbs	$2.38
Effective NDF (forage NDF) Lbs	$0.0321	10.4 lbs	$0.33
Non-effective NDF (Total NDF – Forage NDF) Lbs	-$0.0591	7.3 lbs	-$0.43
Total Cost for Energy, Protein and Fiber			$4.63

* 1600 lb cow, 80 lbs milk/d, 3.0% protein, 3.5% fat

https://dairy.osu.edu/newsletter/buckeye-dairy-news/volume-19-issue-6/milk-prices-costs-nutrients-margins-and-comparison

NRC 2001 Least Cost Rations

Balanced to NRC 2001 Requirements (MP & RDP)



36 kg milk, 3.0% protein, 3.6% fat, 23.6 kg DMI

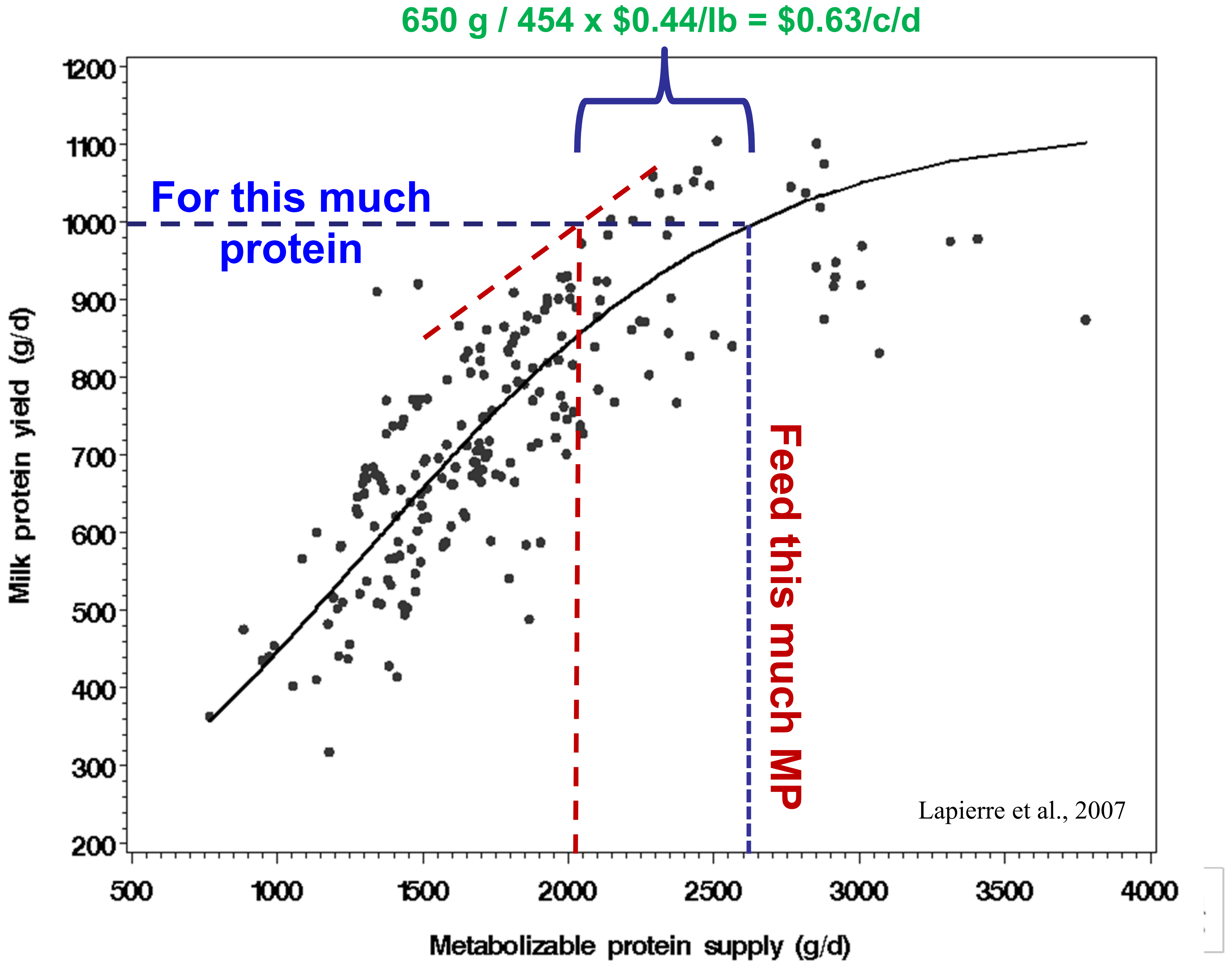
- Pigs can capture up to 80% of absorbed AA in tissue. Baker et al. (1986)
- Low CP + select AA

Used Formulate2©

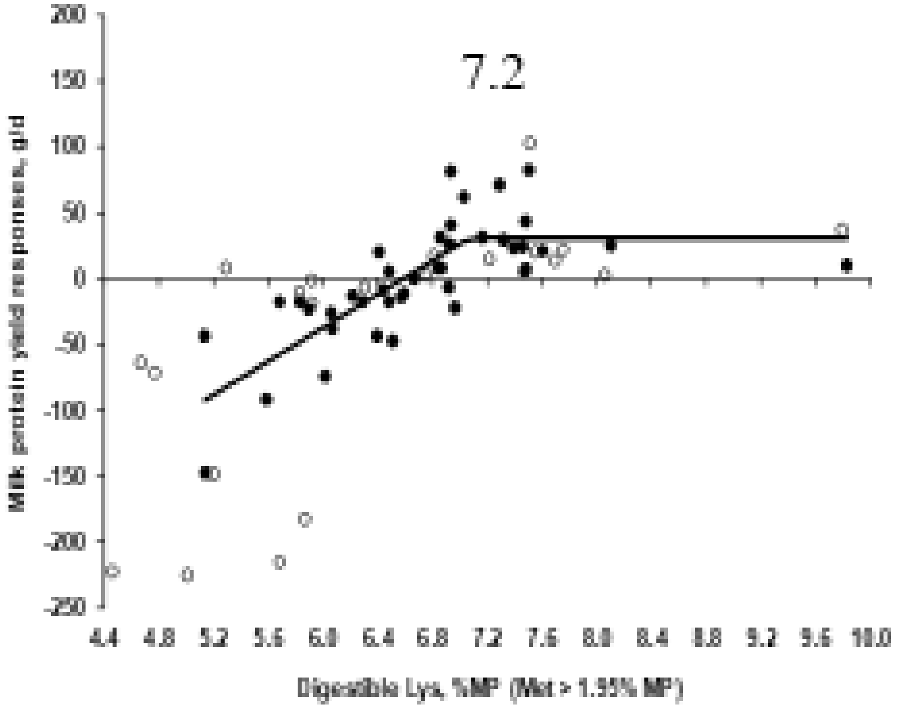
Mar, 2013 Ingredient Prices
ST-Pierre, Progressive Dairyman

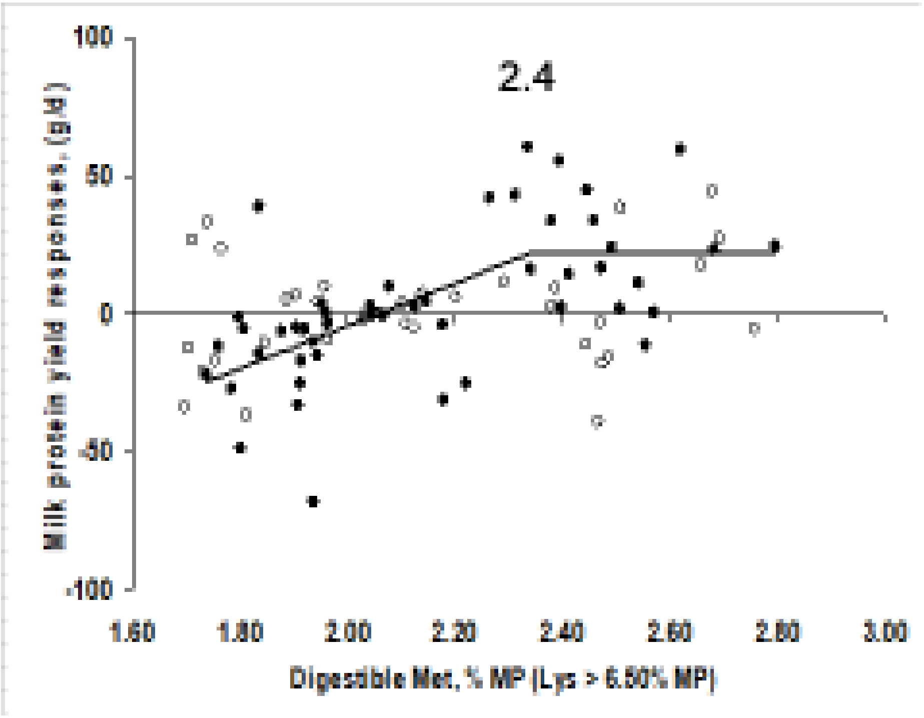
VirginiaTech
Invent the Future

Milk Protein vs Metabolizable Protein



Milk Protein Responses to Digestible Lysine and Methionine



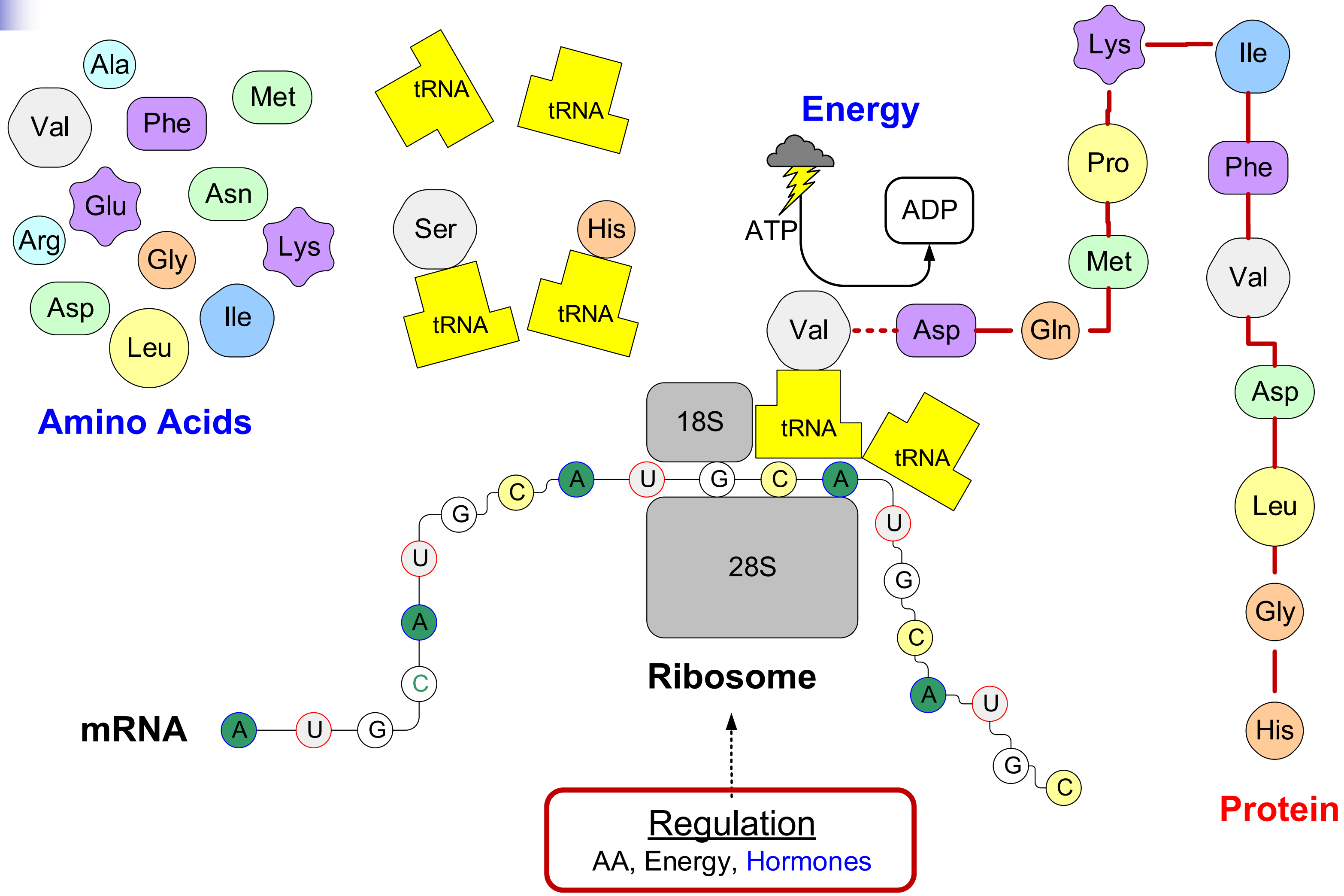


- Based on MP
- NO forward progress

NRC, 2001

Protein is a String of Amino Acids

∴ Amino Acids are Required



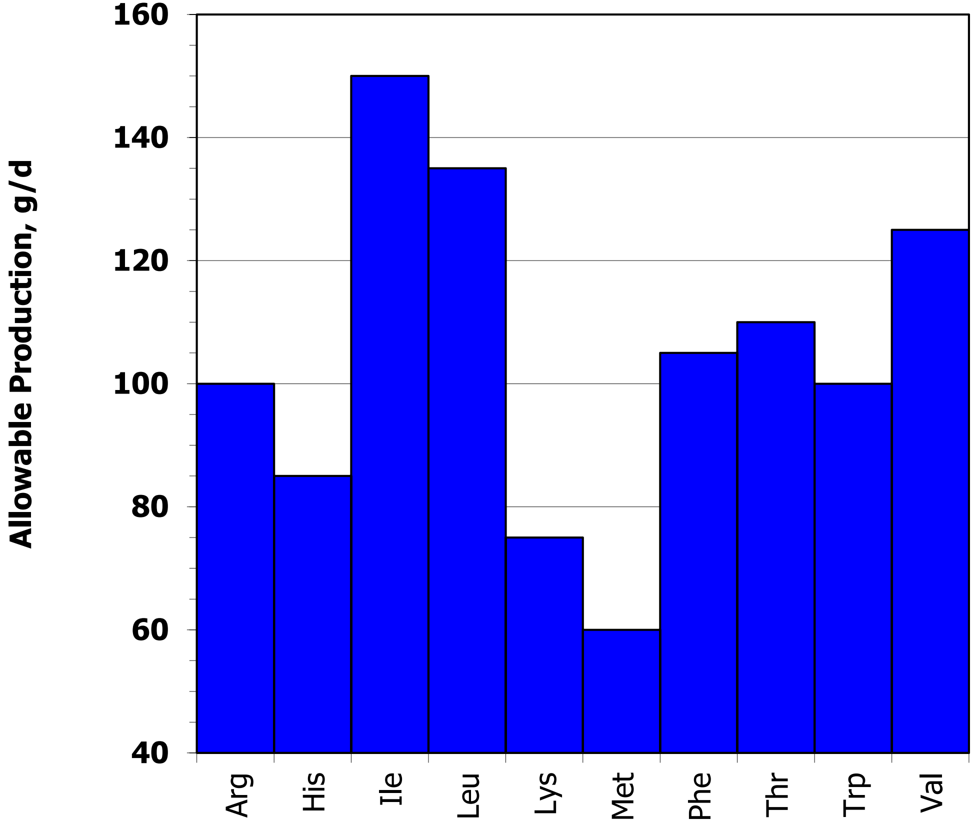
Regulation

AA, Energy, Hormones

Metabolic Representation of AA

Single Limiting Nutrient Theory

Water Barrel Analogy

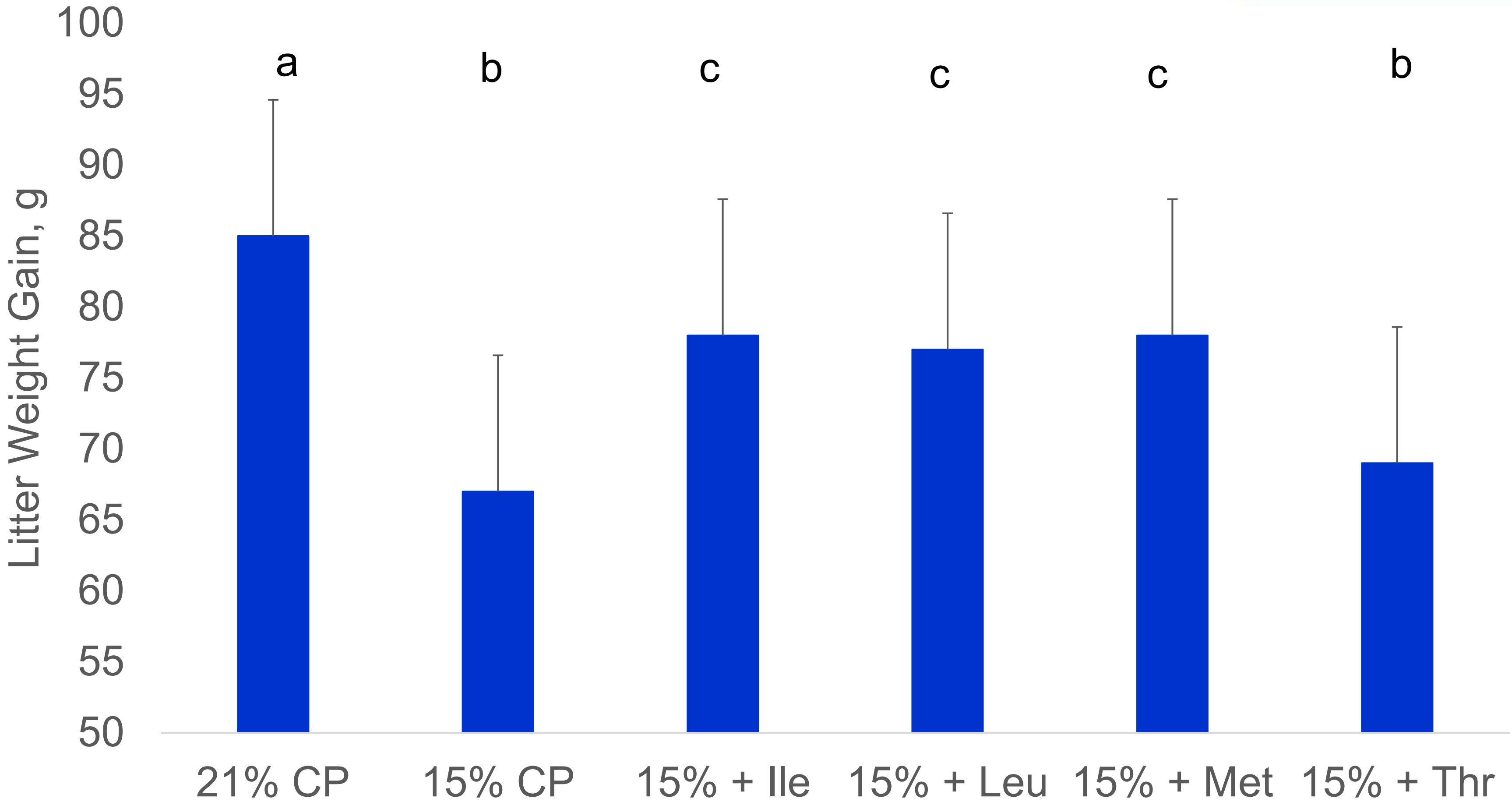


Absorbed AA

Arg	His	Ile	Leu	Lys	Met	…
150	127	224	201	105	90	

- Lowest Stave determines the water level in the barrel
- **Mitchell and Block, 1946**
  - Order of limitation
  - Barrel with staves
- Based on Constant Efficiencies of Conversion
  - No regulation
  - No Adaptation

Lactational Responses to Individual Essential AA in Mice



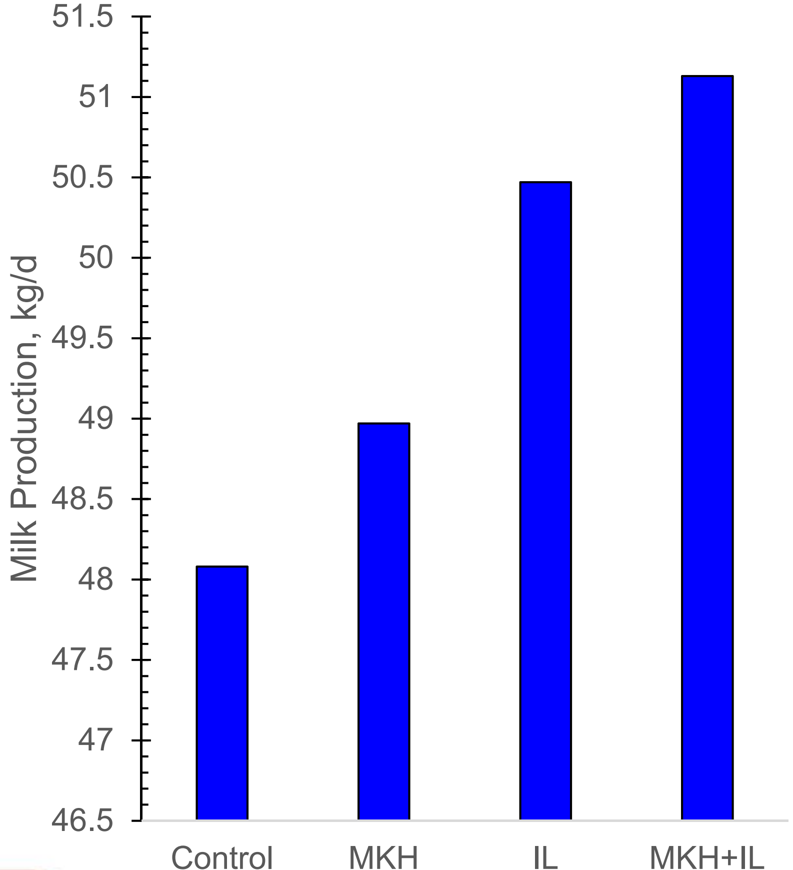
Liu et al., 2017

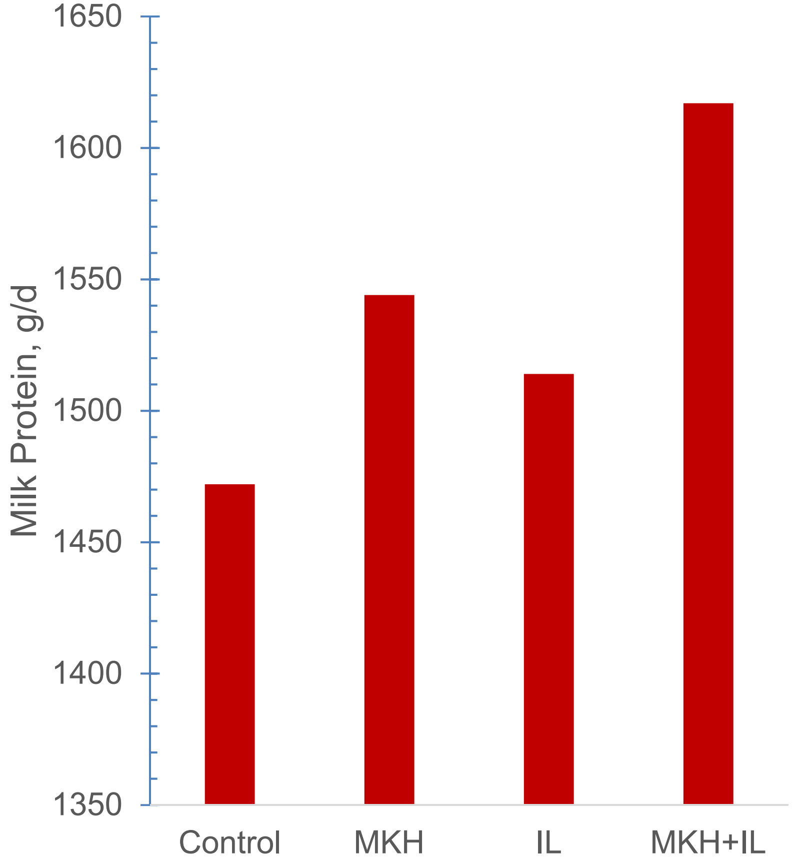
Responses to EAA

15.2% CP, 38% N Efficiency

Effect (P-values)		
MKH	IL	MKH*IL
0.39	**0.02**	0.89

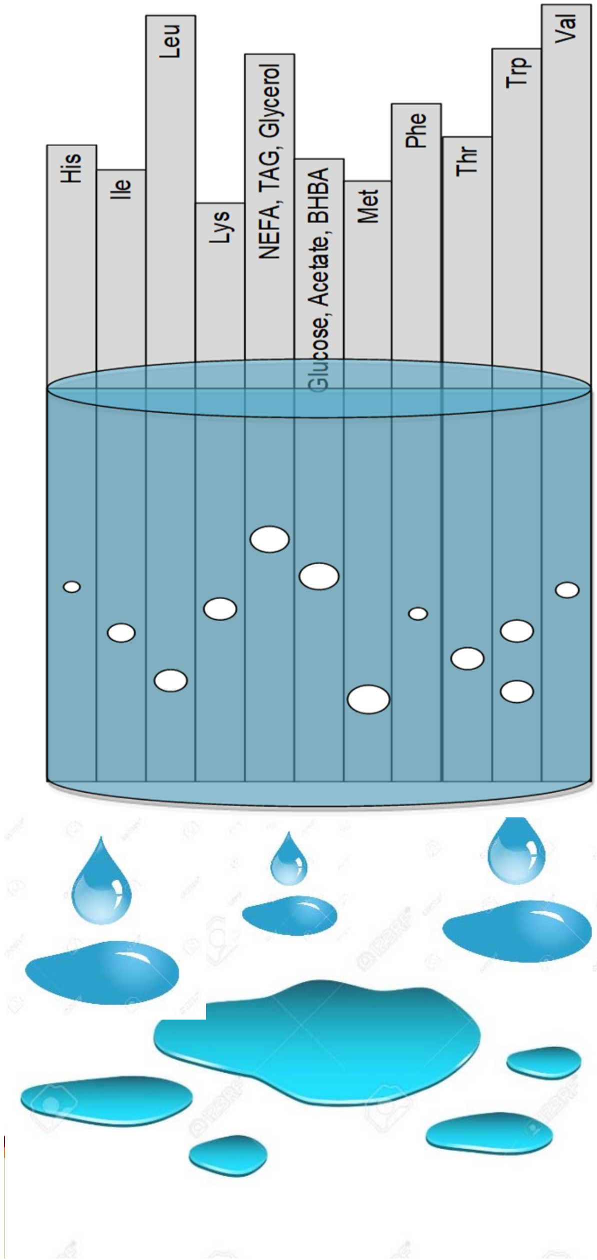
Effect (P-values)		
MKH	IL	MKH*IL
0.002	**0.02**	0.500

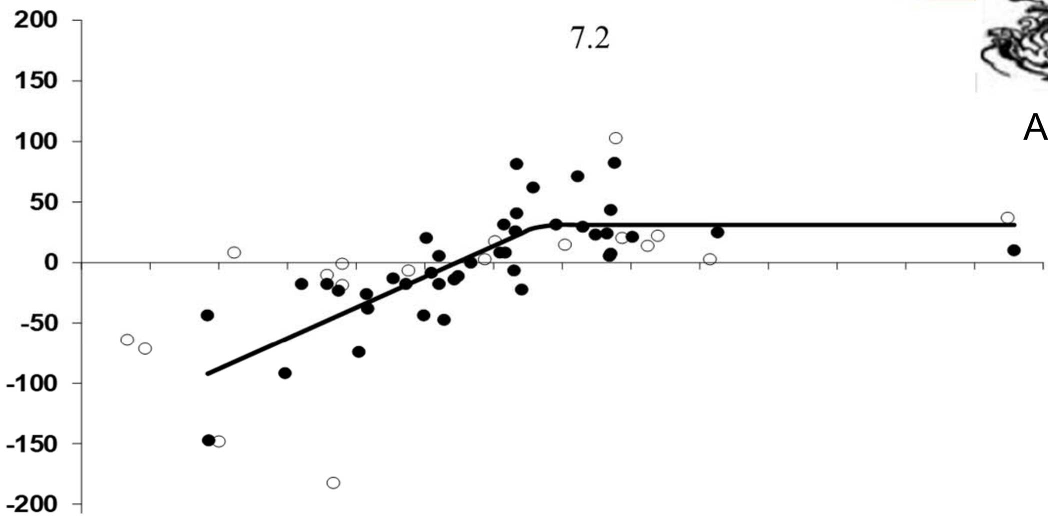




Yoder et al., 2018

Metabolic Representation





Alternative Facts

Real Facts: A Leaky Barrel

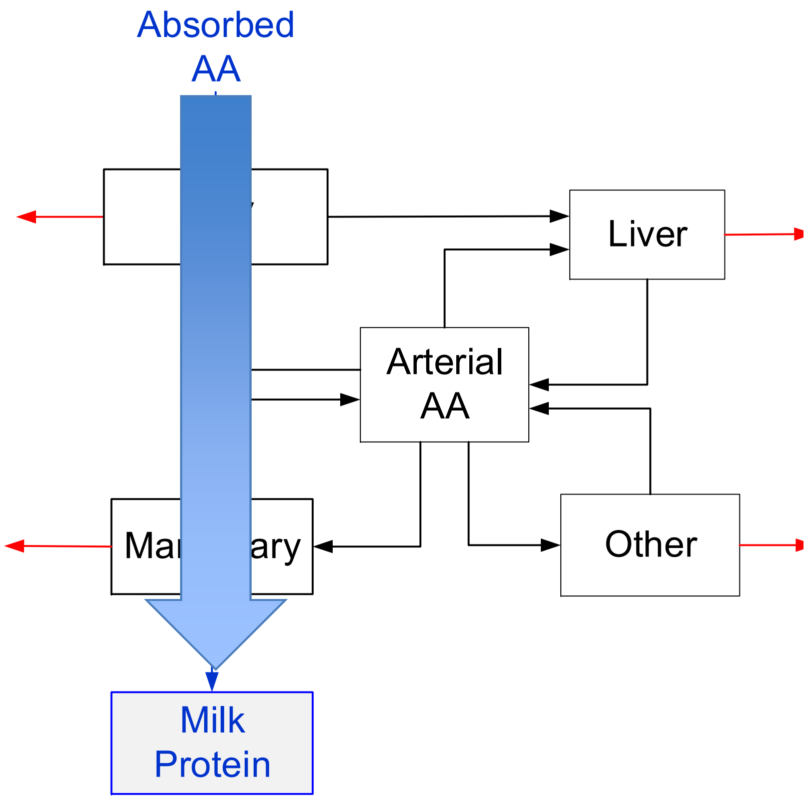
- Leaks define Efficiency
- ↑ level ⇒ ↑ leaks
- Size of each leak depends on the mix of nutrients
- Plugging ANY leak helps!
- Additive, independent responses

Predicted AA Outflow

Variable	N	Observed mean	Predicted mean	RMSE (%)	Mean bias (% of MSE)	Slope bias (% of MSE)	CCC
NANMN, g/d	236	212	197	37.2	3.97*	0.02	0.35
MiN, g/d	236	294	290	24.0	0.20	0.11	0.68
Arg, g/d	229	120	138	31.8	23.9*	2.2*	0.44
His, g/d	234	57.9	60.9	31.0	2.8*	0.6	0.44
Ile, g/d	234	122	138	31.4	16.1*	1.3	0.45
Leu, g/d	234	227	228	28.2	0.0	1.4	0.54
Lys, g/d	232	158	190	40.6	25.9*	3.2*	0.34
Met, g/d	233	49.1	55.5	32.1	16.2*	1.4	0.53
Phe, g/d	234	131	143	28.0	10.4*	0.2	0.51
Thr, g/d	234	125	138	26.8	15.1*	0.0	0.55
Val, g/d	234	140	152	30.6	7.6*	0.6	0.44

Myers Thesis, 2018

Predicting Milk Protein Output



Unadjusted for Study	Current (mPrt)	NRC 2001 (Milk)
RMSE, %	15.2	23.1
CCC	0.80	0.63
Mean Bias, % of MSE	0.17	5.3
Slope Bias, % of MSE	2.9	13.3

$$
\begin{aligned}
Milk\ Protein\ (g/d) = {} & 328 - 0.831(DIM) - 62.6(MilkFat\%) + 9.42(DEI) + 4.95(Arg) \\
& -0.021(Arg)^2 + 1.28(His) + 0.687(Ile) + 1.63(Leu) - 0.003(Leu)^2 + \\
& 0.393(Lys) + 1.024(Met) - 4.34(Val) + 0.009(Val)^2
\end{aligned}
$$

How Low Can We Go?

$$Milk\ Protein\ (g/d) = 328 - 0.831(DIM) - 62.6(MilkFat\%) + 9.42(DEI) + \\ 4.95(Arg) - 0.021(Arg)^2 + 1.28(His) + 0.687(Ile) + 1.63(Leu) - 0.003(Leu)^2 + \\ 0.393(Lys) + 1.024(Met) - 4.34(Val) + 0.009(Val)^2$$

Assumptions: 23 kg DMI, MP ~ 0.6 * CP, MP = $0.4375/lb, Milk Prt = $2/lb

	16.5% CP	**14.5% CP**	**12.5% CP**	**12.5% + rpAA**
MP, g/d	2280	2000	1725	1885
EAA, g/d	1170	1025	885	1007
Milk Prt, g/d	1080	1064	1042	1114
Abs His, g/d	56	49	42	56 (+14)
Abs Leu, g/d	214	188	162	214 (+52)
Abs Lys, g/d	179	157	135	179 (+44)
Abs Met, g/d	54	47	41	54 (+13)

? MP cost is nonlinear vs reduced dietary CP.

Going Forward

We

- Complete Model Evaluations
  - Cow trial
- Formulation System
  - Repeatable solutions
  - Reasonable solutions
  - Change in ingredient use
  - Value of EAA
  - Solution speed
- Feeding trial test of the solutions
- Incorporation into Commercial Software
  - AMTS
  - NDS
  - ??

You

- **Embrace optimization of diets**
  - Starch, sugars, NDF, eNDF, dNDF
  - Fat, fatty acids
  - Arg, Leu, Lys, Met, Phe, Thr, Val
  - Vitamins
  - Minerals
  - ~ 28 nutrients to balance
- **TRULY OPTIMIZE 28 NUTRIENTS BY HAND?!**
  - Linear in AMTS is a step forward
  - Nonlinear takes longer, but better
  - **$0.20 to $0.80/c/d on the table**
  - Allocate time to master.

Acknowledgements and Questions

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- John MacRae, Rowett
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- Robin White
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- Ashley Felock
- Rebecca Garnett
- Guimei Liu
- Xin Feng
- Veridiana Daley
- Meng Li
- Peter Yoder
- A herd of undergraduate students

VirginiaTech
Invent the Future

Understanding and Using MUN

Mark D. Hanigan
Professor
Department of Dairy Science
Virginia Tech

Ohio Dairy Nutrient Prices

July 25, 2018 Evaluation
Buckeye Dairy News: Vol 20, Issue 4

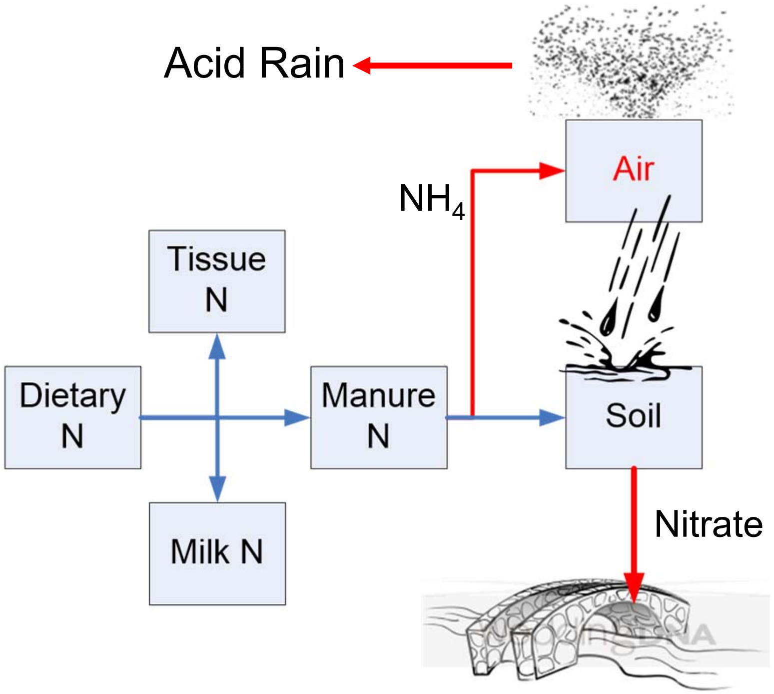
Nutrient	Cost/Unit	Daily Supply*	Cost/cow/d
NEL (3X, NRC 2001) MCal	$0.0704	35.4 Mcal	$2.49
RDP (NRC) Lbs	$0.162	5.07 lbs	$0.82
RUP (NRC) Lbs	$0.385	~2.4 lbs	$0.92
Effective NDF (forage NDF) Lbs	$0.150	10.4 lbs	$1.56
Non-effective NDF (Total NDF – Forage NDF) Lbs	-$0.043	7.3 lbs	-$0.32
Total Cost for Energy, Protein and Fiber			$5.47

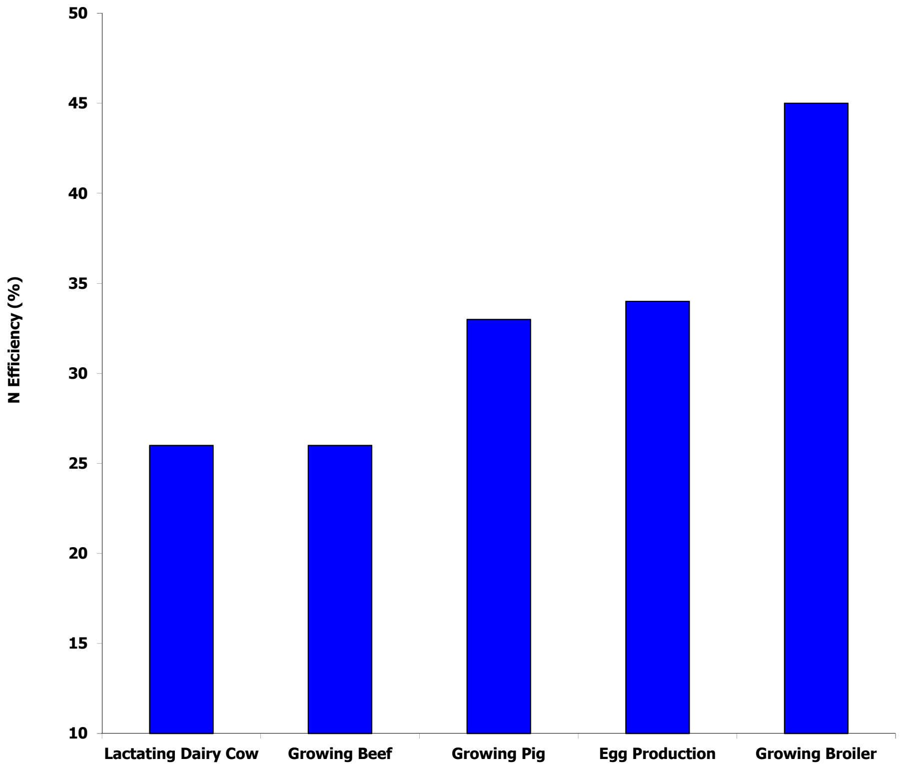
* 1600 lb cow, 80 lbs milk/d, 3.0% protein, 3.5% fat

https://dairy.osu.edu/newsletter/buckeye-dairy-news/volume-19-issue-6/milk-prices-costs-nutrients-margins-and-comparison

N Conversion Efficiencies are Relatively Poor for the Ruminant

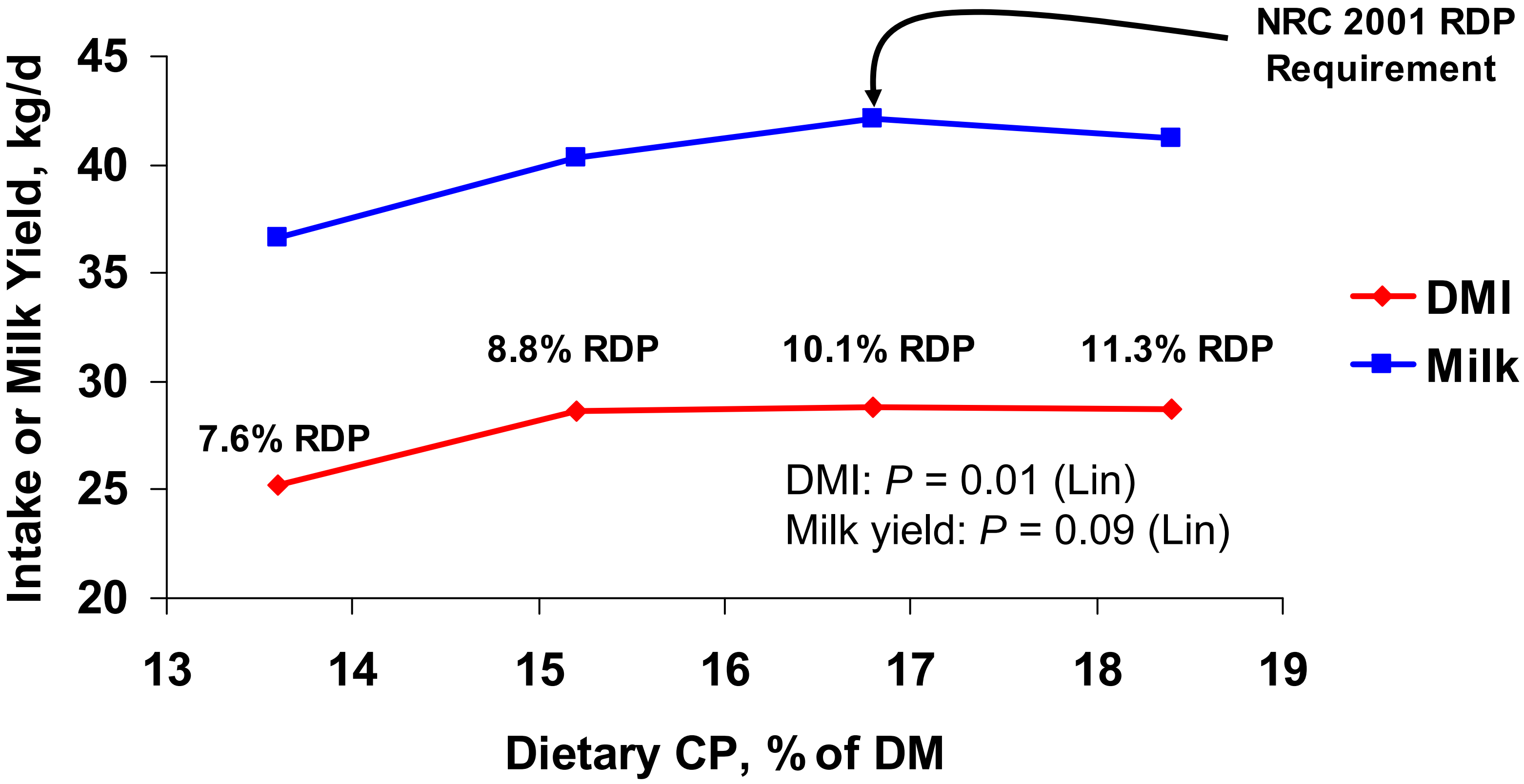
↑ efficiency = ↑ food/ac and ↓ environmental loading!





Bequette et al., 2003

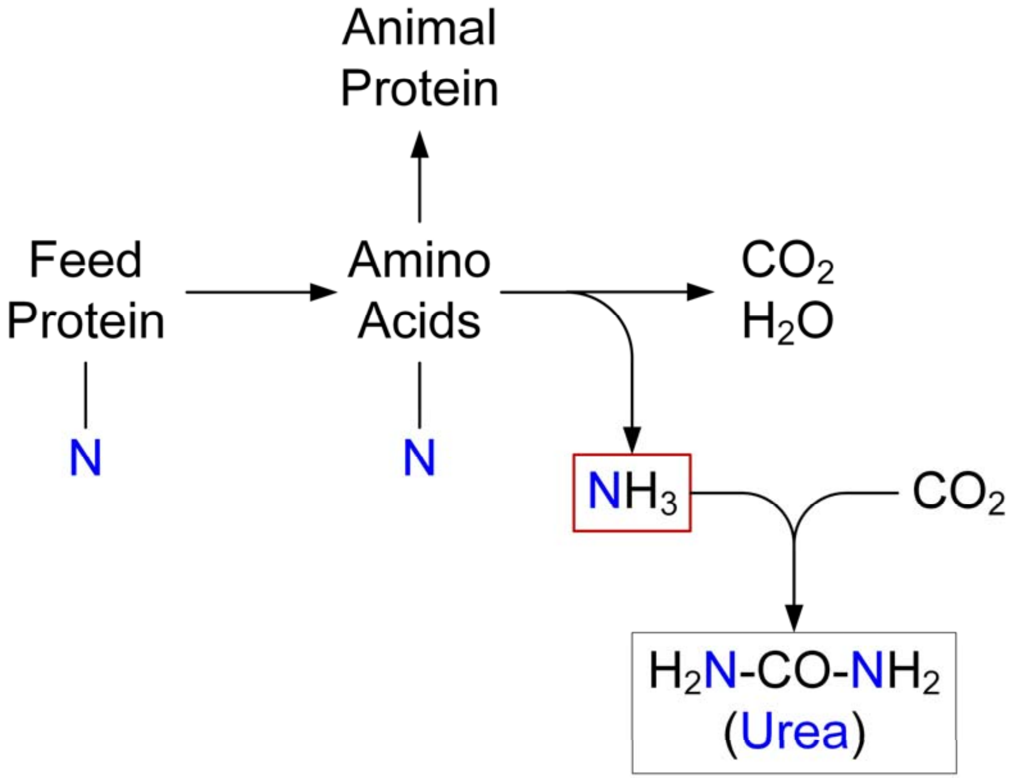
Effects of Dietary Protein (RDP) on Intake and Milk Yield



DMI: $P = 0.01$ (Lin)
Milk yield: $P = 0.09$ (Lin)

Cyriac et al., 2006

What is Urea



Animal Protein

Feed Protein → Amino Acids → CO_2 H_2O

N

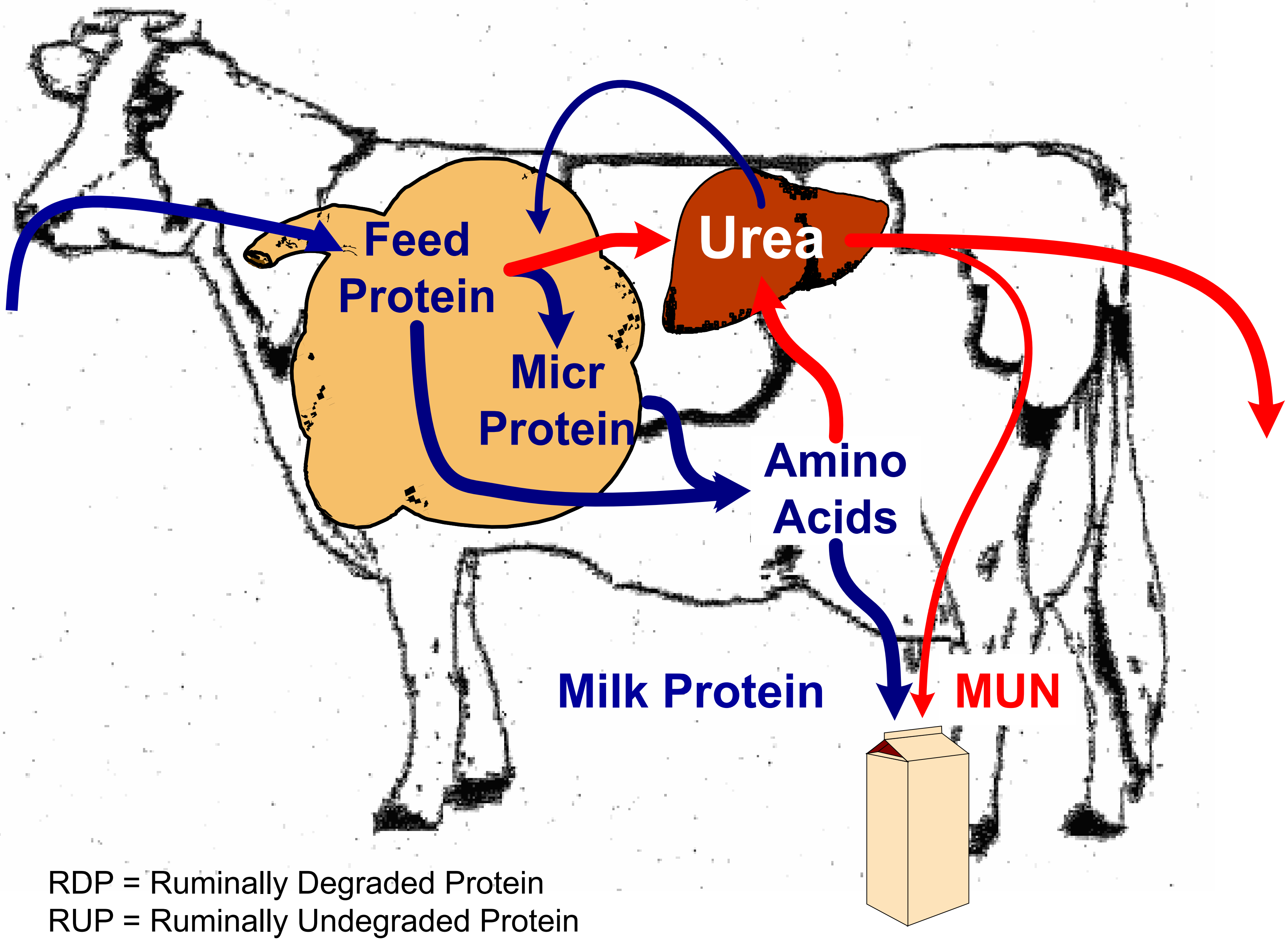
N

NH_3

CO_2

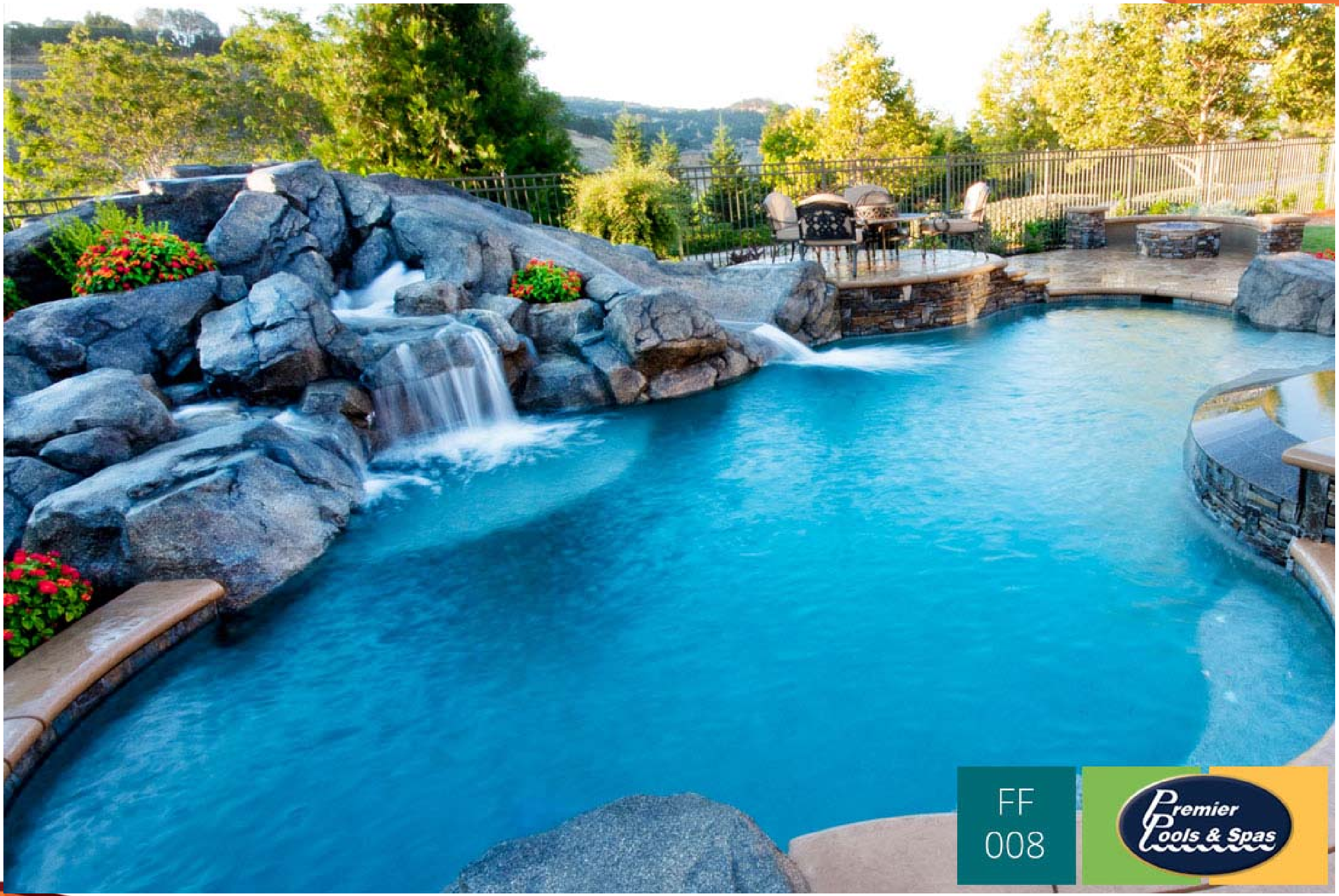
$H_2N\text{-}CO\text{-}NH_2$

(Urea)

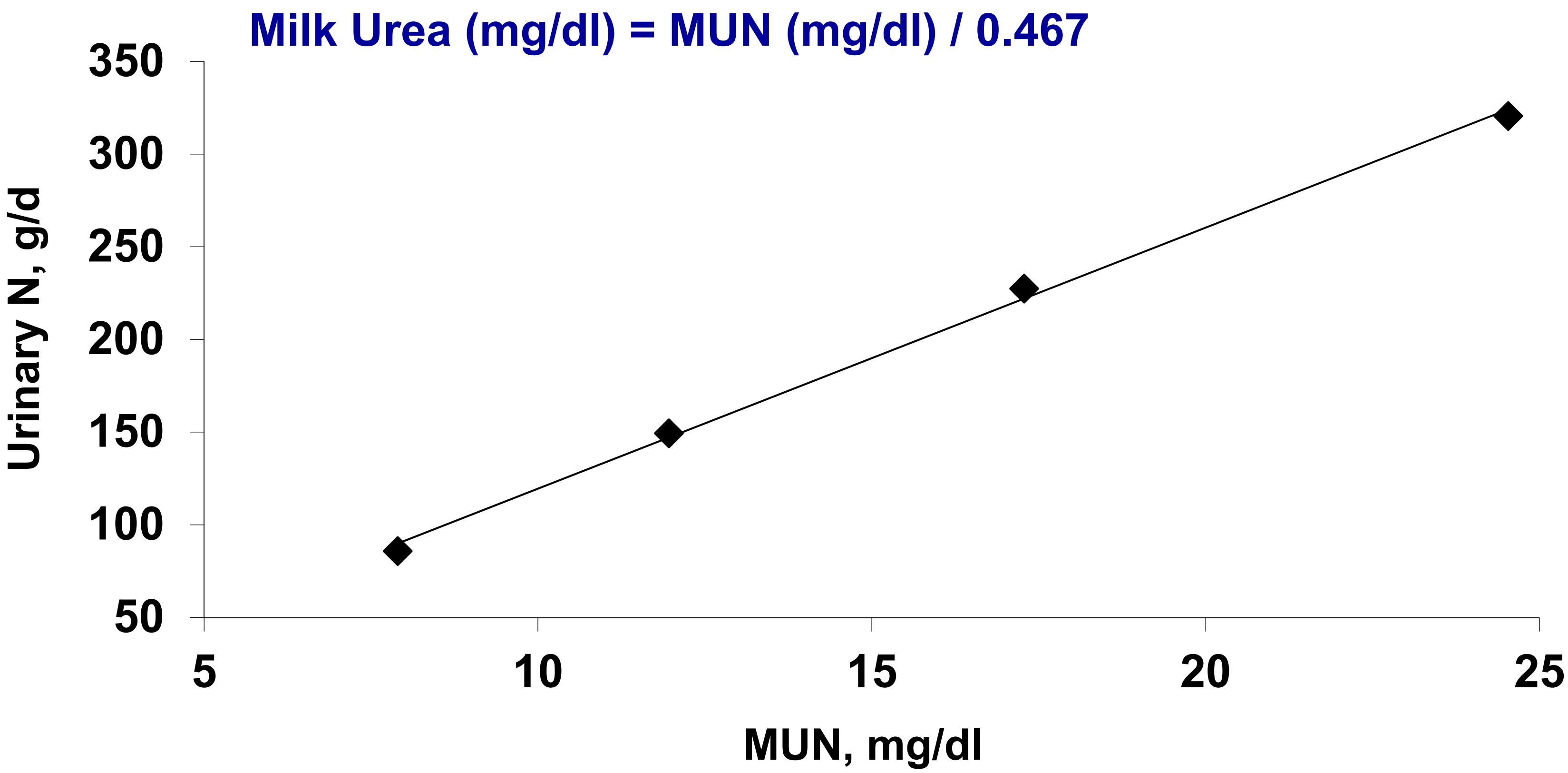


RDP = Ruminally Degraded Protein
RUP = Ruminally Undegraded Protein
CP = RDP + RUP
MP = Digestible (Microbial Protein + RUP)

What Goes In MUST Come Out!

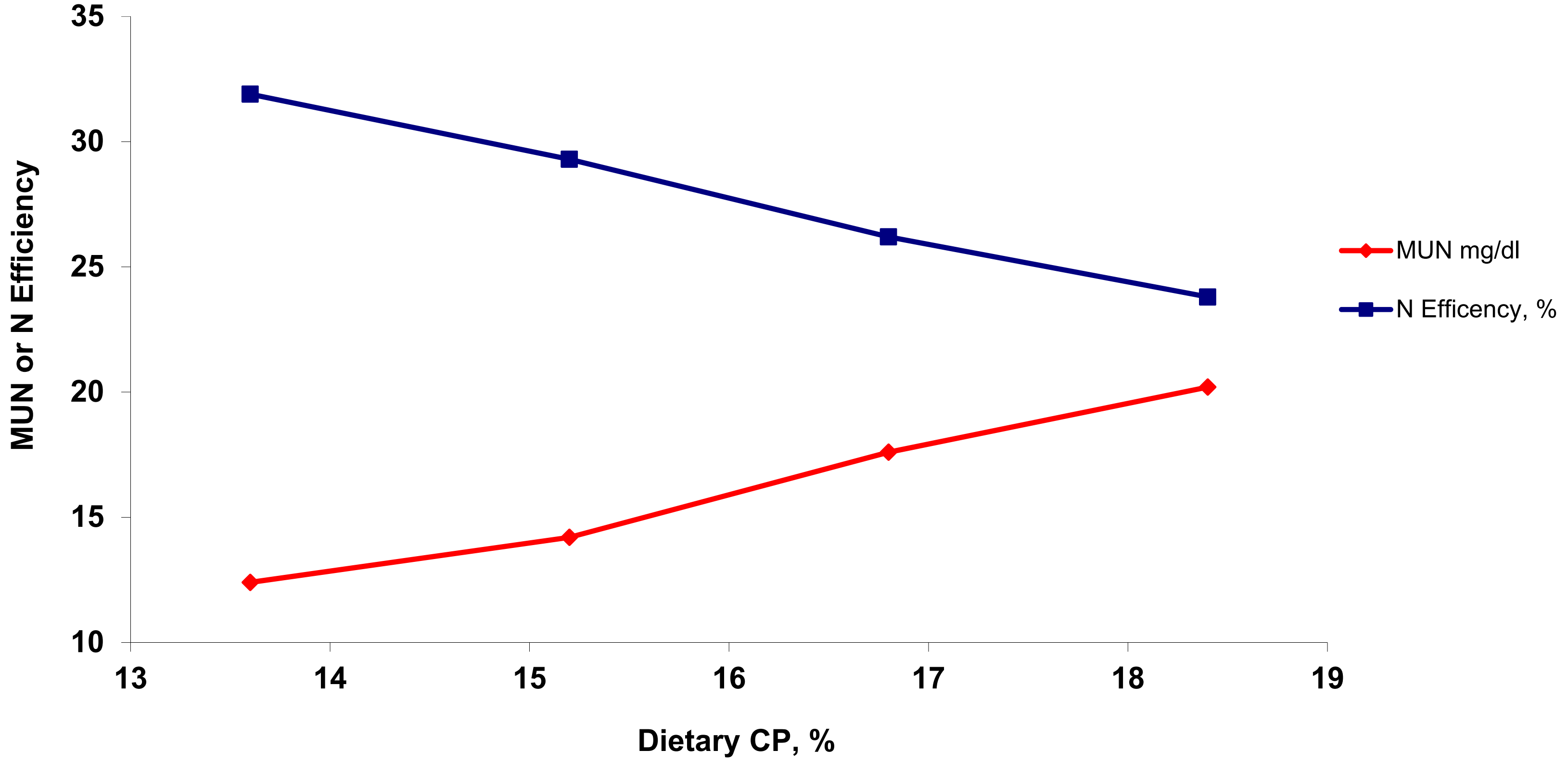


MUN and Urinary N Output



Burgos et al., 2007

Effects of Dietary Protein on MUN and N Efficiency

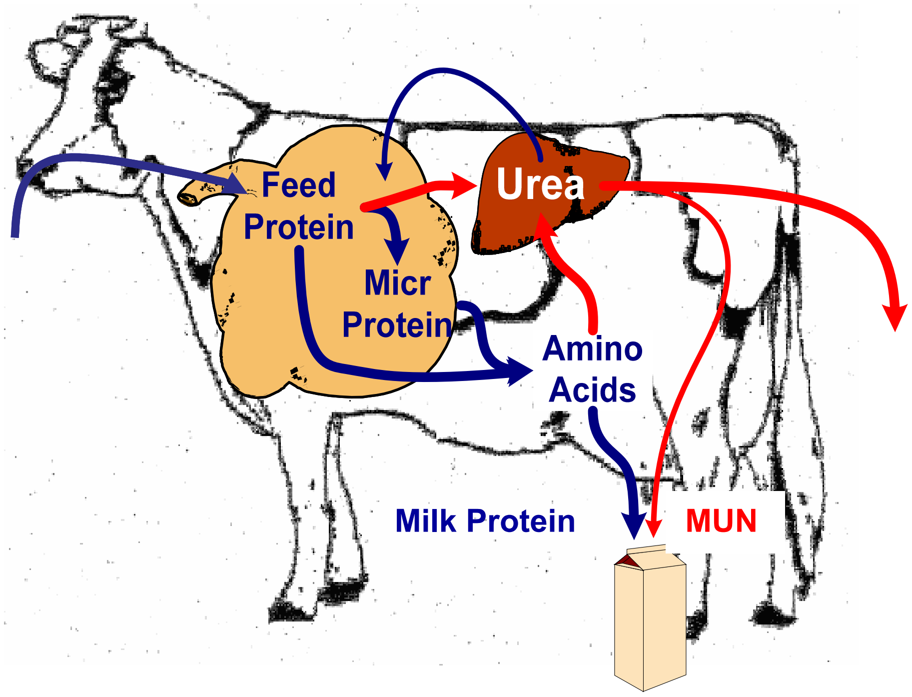


Cyriac et al., 2006

RDP/RUP and MUN

- Effect of more RDP?
- Effect of more RUP?

Can you tell which is a problem?



RDP = Ruminally Degraded Protein
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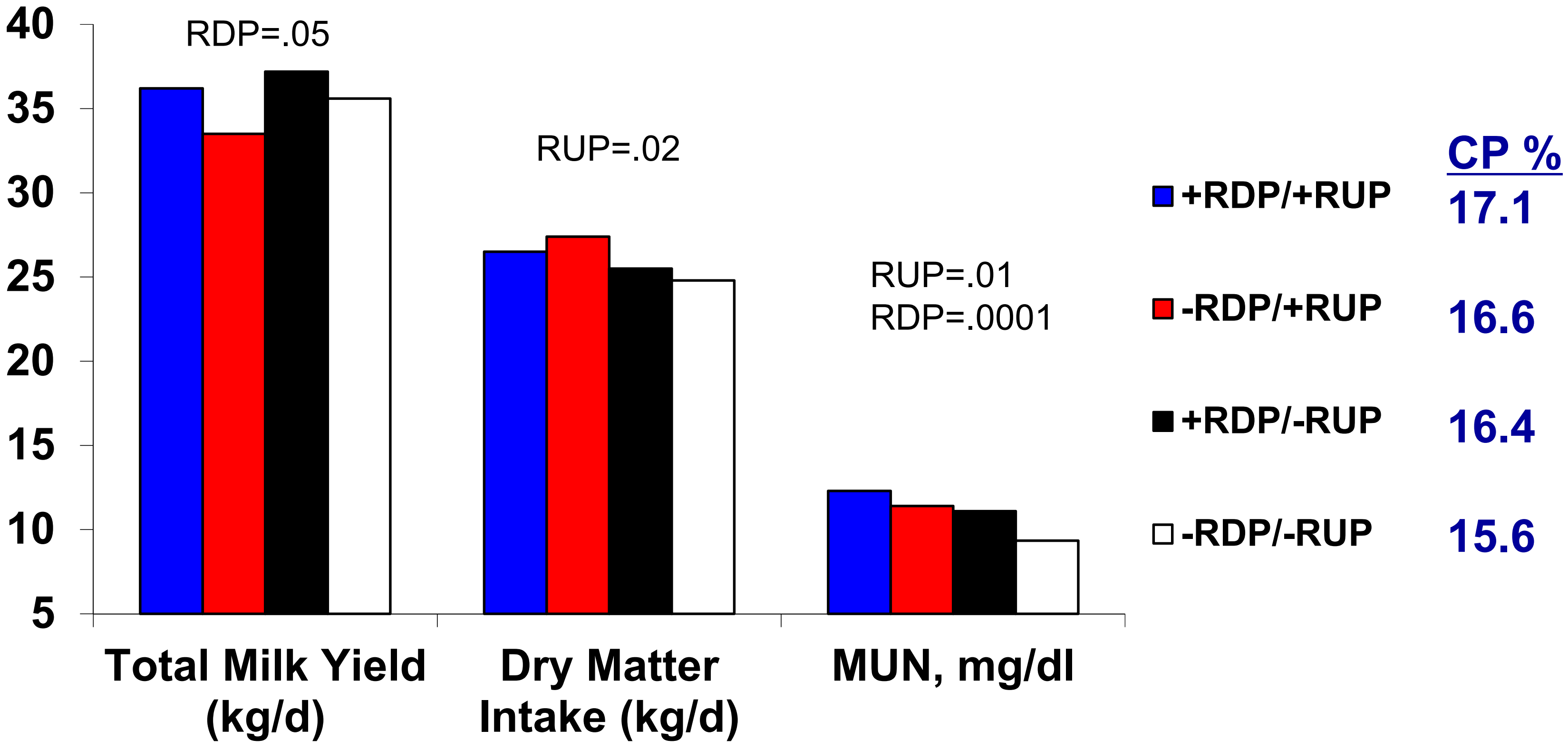
CP = RDP + RUP
MP = Digestible (Microbial Protein + RUP)

Effects of Varying RDP and RUP



Cows averaged 40 kg/d at the start of the study.

Milk Protein, kg/d, P_{RDP} = .06

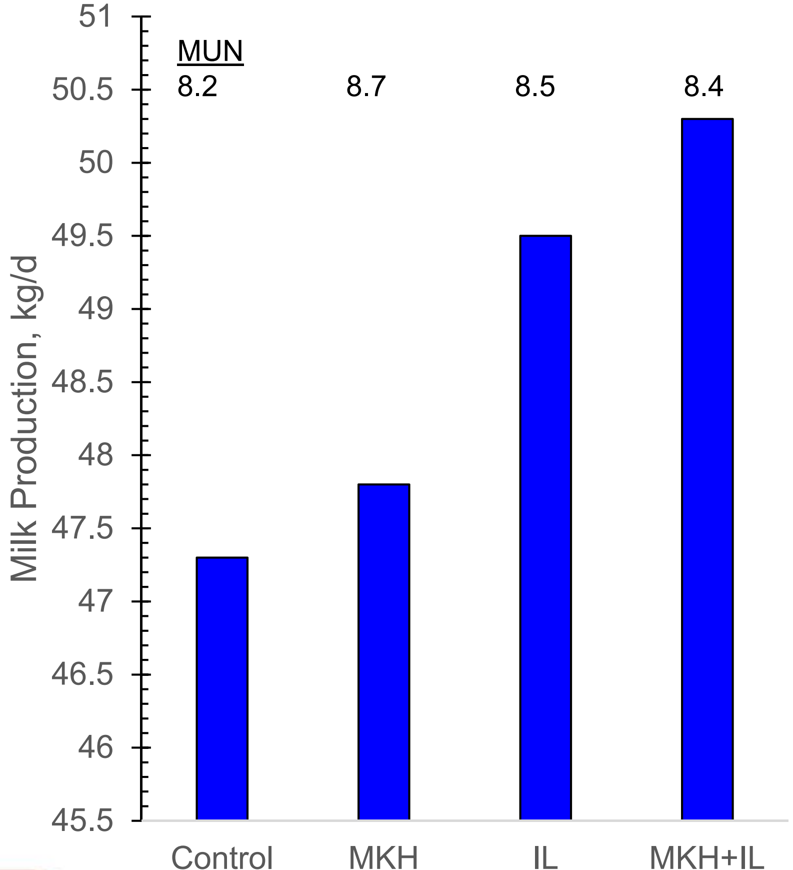
Aguilar et al. 2012

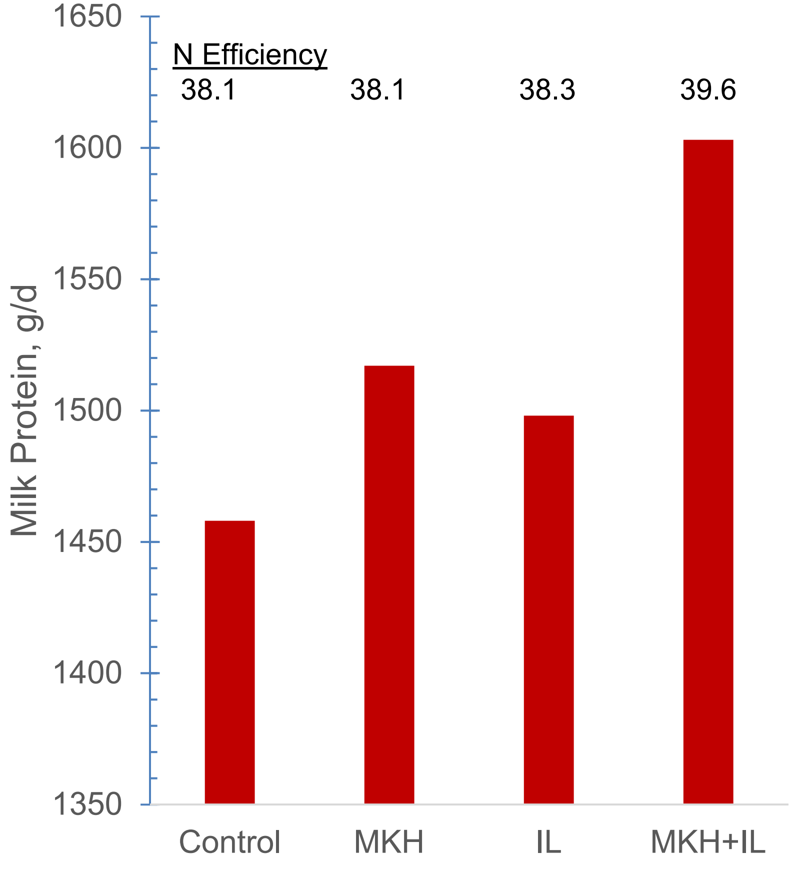
Low CP plus EAA

15.2% CP

Effect (P-values)		
MKH	IL	MKH*IL
0.31	**0.001**	0.86

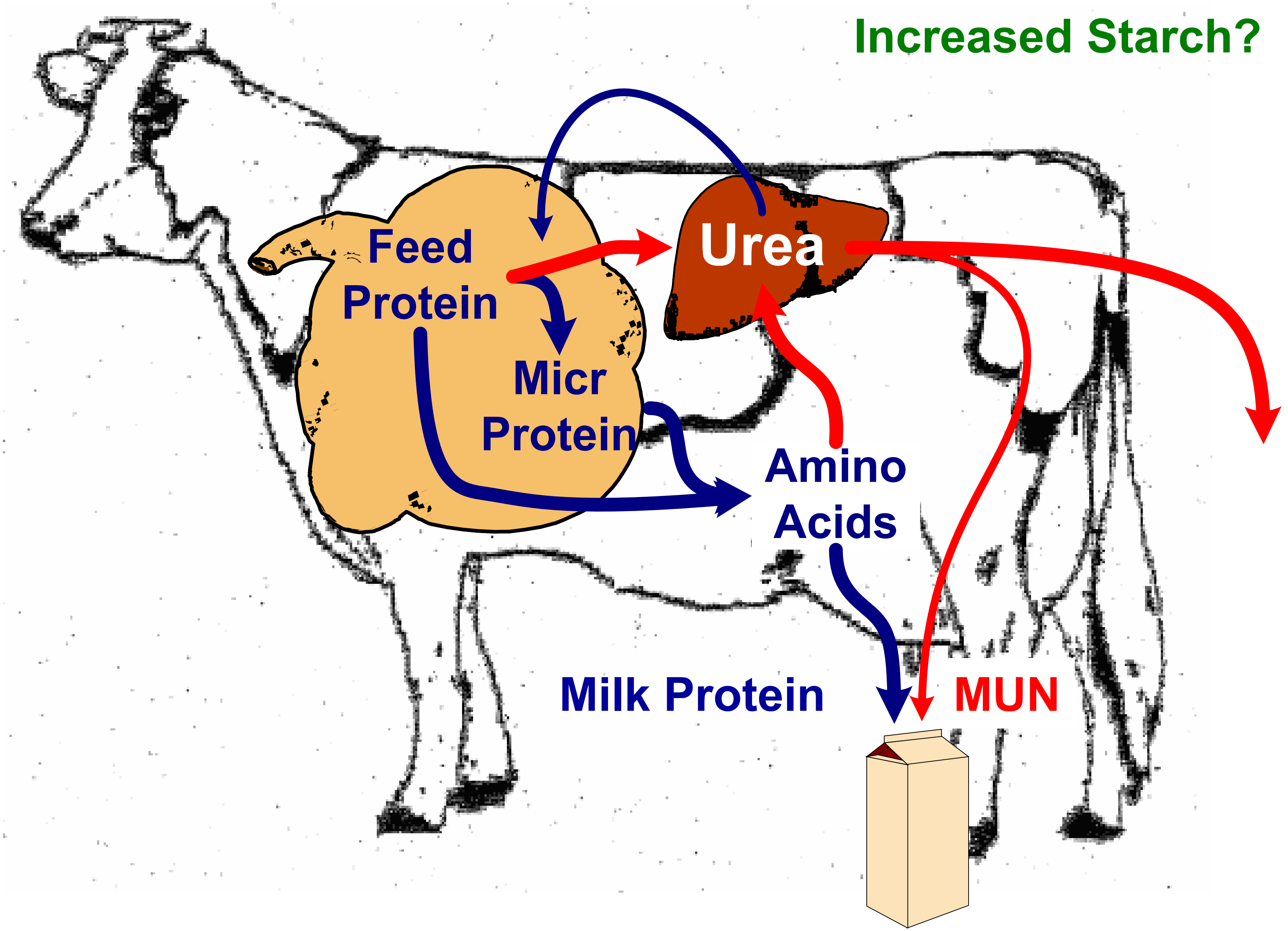
Effect (P-values)		
MKH	IL	MKH*IL
0.001	**0.01**	0.28



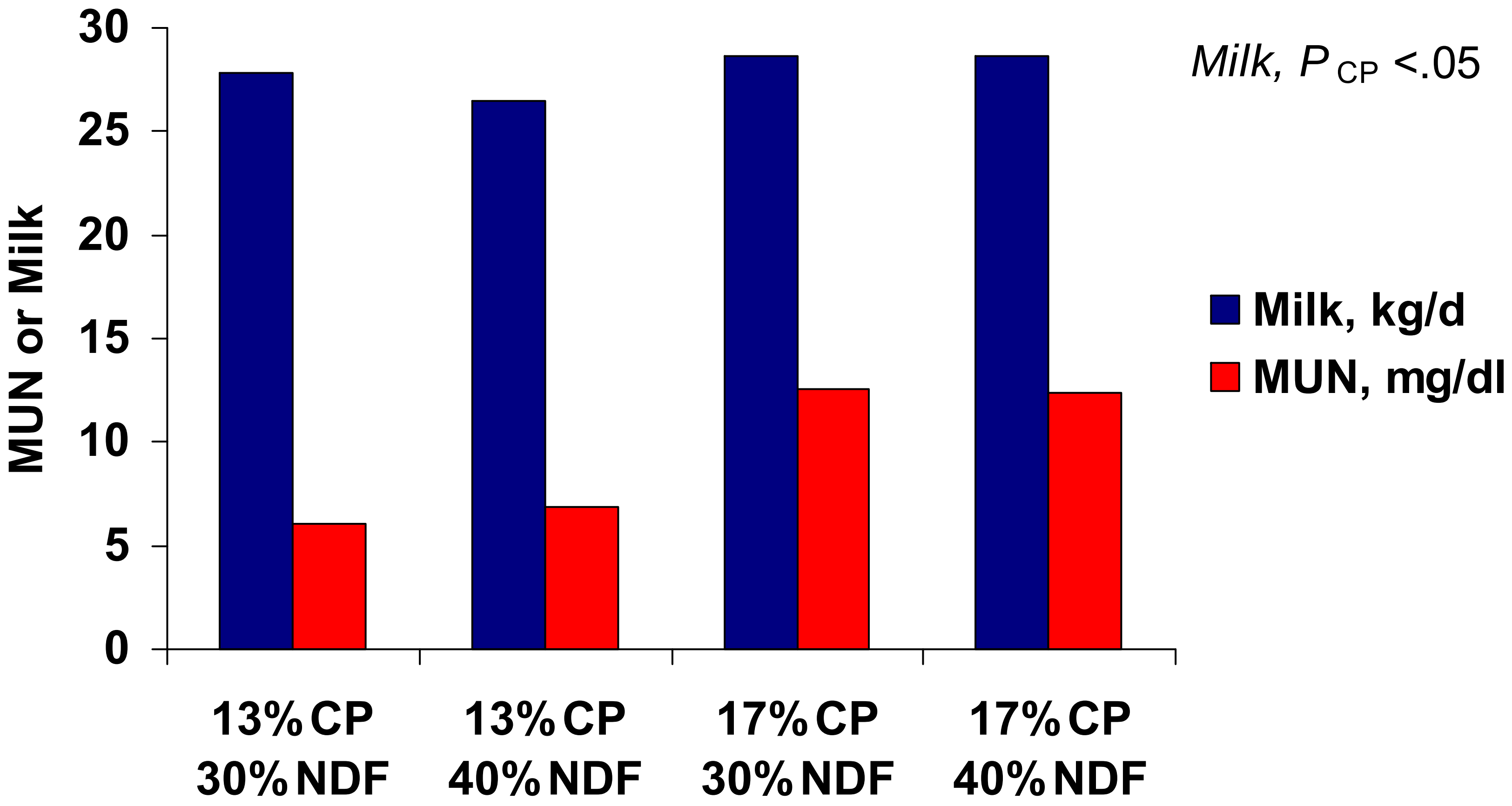


Yoder et al., 2018

Increased Starch?



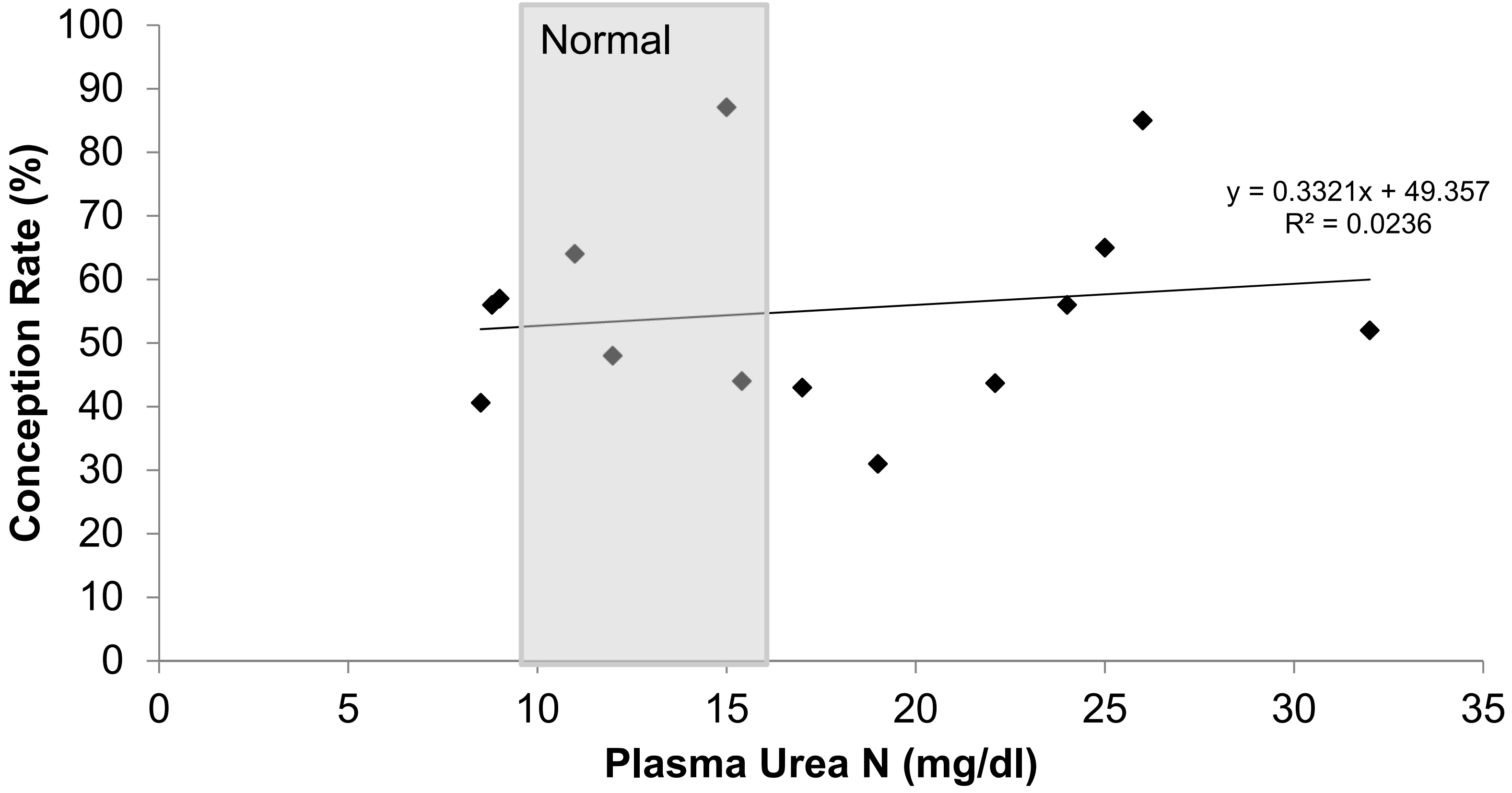
Dietary Crude Protein and Fiber



NEL: 30% NDF – 1.66 mcal/kg
40% NDF – 1.63 mcal/kg

Kaufman and St-Pierre., 2001

Plasma Urea vs Conception Rate



Adapted from Santos, J.E.P. 2001. Proc. 36th Pacific Northwest Animal Nutrition Conference. Boise, ID. pp. 189-219.

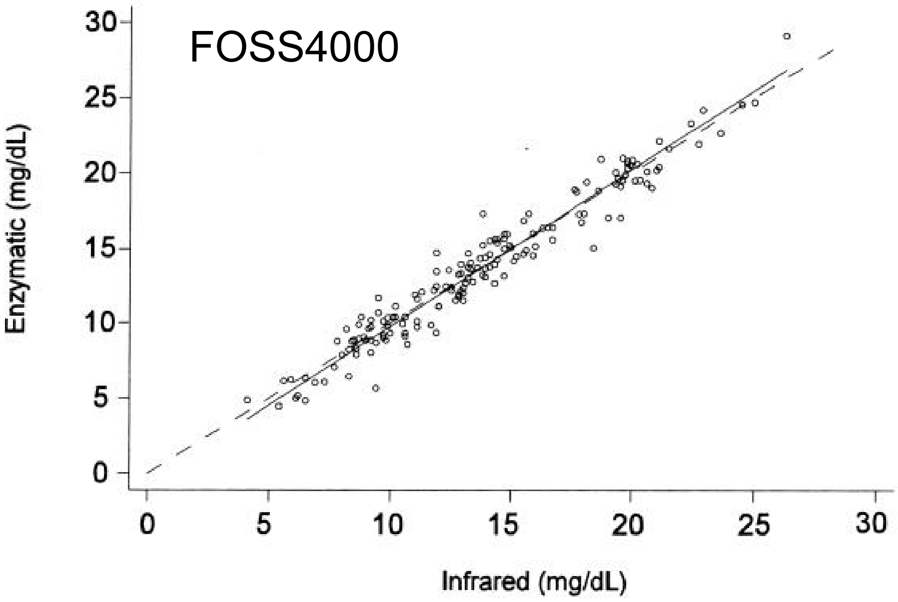
Effect of Salt on MUN

High NaCl = 1.29% Na
Low NaCl = 0.31% Na

	Low protein		**High protein**			**-------- *P*-value --------**		
	Low NaCl	**High NaCl**	**Low NaCl**	**High NaCl**	**SE**	**Protein**	**NaCl**	**Protein × NaCl**
Na-intake (g/d)	58	273	62	244	10.2	0.263	<0.001	0.110
DMI (kg/d)	19.2	19.3	19.6	20.0	0.28	0.068	0.383	0.507
Milk yield (kg/d)	22.4	22.0	24.7	26.5	1.03	0.028	0.285	0.126
Protein (%)	3.34	3.45	3.48	3.29	0.142	0.961	0.691	0.162
MUN (mg of N/dL)	5.29	3.66	9.29	7.45	0.342	<0.001	0.002	0.314

Spek et al., 2013 JDS

Wet Chemistry vs Infrared Analyses of MUN



Arunvipas et al., 2003 Can. J. Vet Res.

Table 1. Percent recovery of urea nitrogen among analytical methods.

Method	Recovery(%)[1]	SE(%)
Bentley	**92.1^{a}**	**2.76**
CL-10	85.0^{b}	2.76
Foss4000	47.1^{c}	9.88
Foss6000	95.4^{a}	10.1
Skalar	95.1^{a}	7.61

^{a,b,c}Means within a column with unlike superscripts differ ($P < 0.05$).

[1] Recovery = (Treated MUN - Control MUN)/4 mg/dL.

Peterson et al., 2004 JDS

United DHIA - Bentley

$0.25 / cow for full test

$10 for a single bulk tank sample

VirginiaTech Invent the Future

Genetics and MUN

Effect	**Estimate**	**SE**	***P*<**
Intercept	-166	26	0.002
Dietary CP, % of DM	5.4	1.1	0.0001
Dietary NDF, % of DM	2.84	0.45	0.0001
Milk Yield, kg/d	0.66	0.12	0.0001
Milk Protein, %	37.7	7.3	0.0001
CP x NDF	-0.038	0.018	0.03
CP x Milk Yield	-0.0194	0.0057	0.001
CP x Milk Protein	-0.73	0.24	0.003
NDF x Days in Milk	-0.00005	0.00002	0.009
NDF x Milk Protein	-0.65	0.11	0.0001
Milk x Milk Protein	-0.073	0.023	0.002
Random Effects			
Herd			**0.08**
Cow(Herd)			**0.0001**

Aguilar et al., 2012

Monitor MUN to Achieve Optimum Return

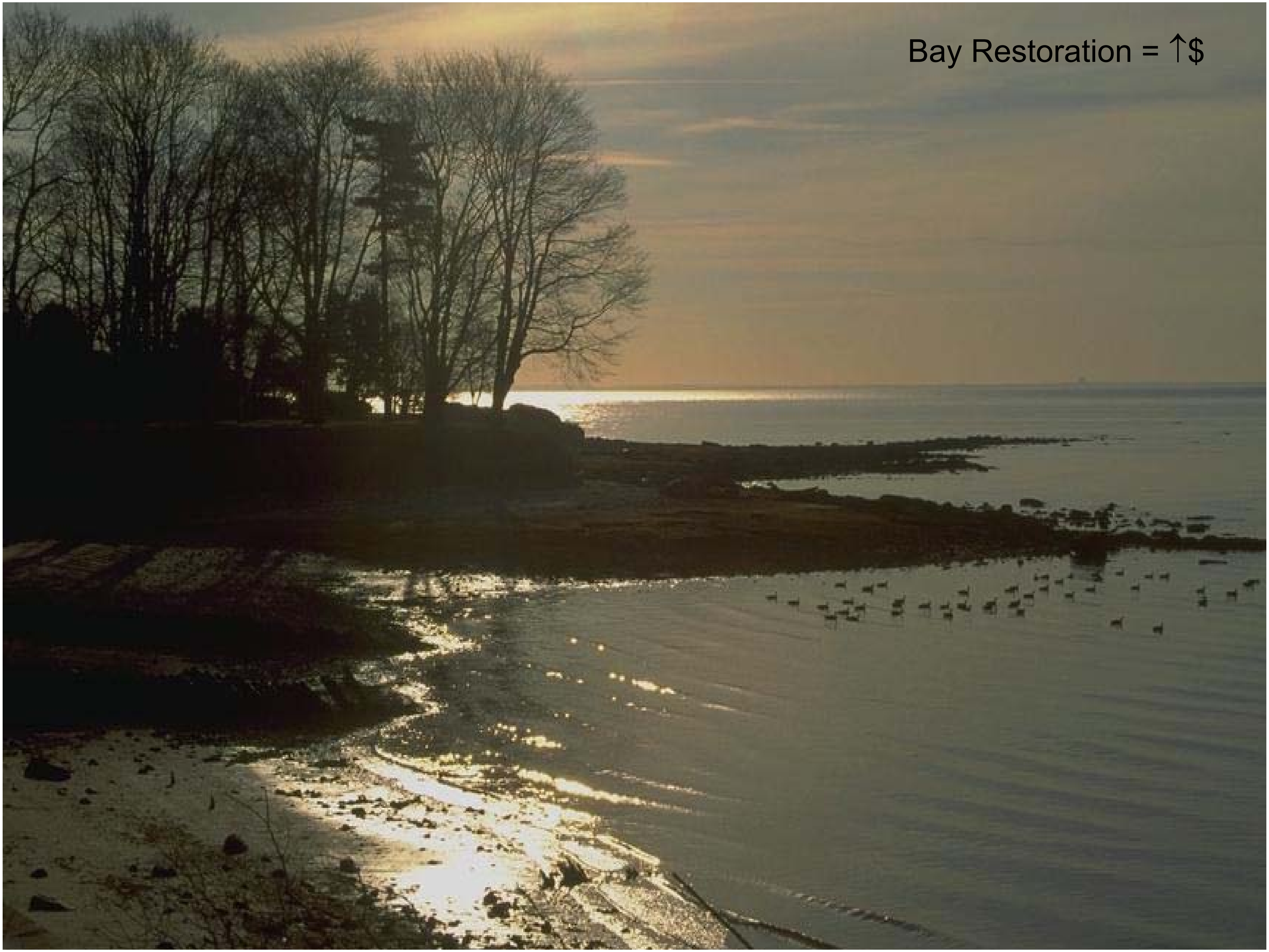
1. Establish a baseline for your herd
   - Some genetic variation
   - Dietary salt effects
   - Balance ration to NRC 2001 or equivalent
   - Feed ration for 2 weeks and Measure MUN (~11 mg/dl)

2. Systematically reduce RUP (0.25% units at a time)
   - For example, CP from 16.5% to 16.25% via RUP ($0.04/c/d)
   - Keep RDP and energy constant
   - Feed for 3 weeks; Monitor MUN and milk yield
   - MUN should ↓ by ~0.5 mg/dl
   - Any milk loss will be half of NRC predicted loss
   - Calculate Income/Feed Cost (IOFC)
   - If greater, retain reduction and lower another 0.25%

3. Reduce RDP by 0.5% of Diet DM while holding RUP constant
   - Same approach as for RUP, e.g. 16% to 15.5% ($0.08/c/d)
   - RDP $\geq$ 9% of DM is safe
   - ↓ DMI is first sign of deficiency

4. MUN at maximal IOFC is target for the herd
   - Can operate at 8 or below
   - May require RPAA → IOFC

Bay Restoration = ↑$



Bridging the Gap in Client Communications

Lisa A. Holden

It takes two to speak truth - one to speak and another to hear.

--Henry David Thoreau

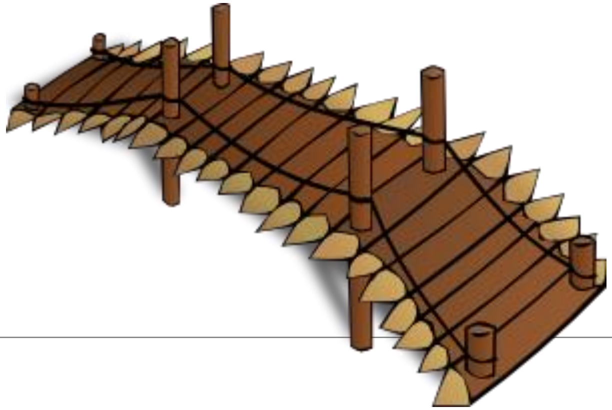
Retain, retain, retain

Acquiring a new customer is 5 to 25 times more costly than retaining an old one.

Increasing retention rates by 5% increased profits from 25 to 95%.

Source: Harvard Business Review, Oct. 2014

Today's Session



A little communication

A little personality/generations

A few examples

Action steps – to BRIDGE the GAPS!

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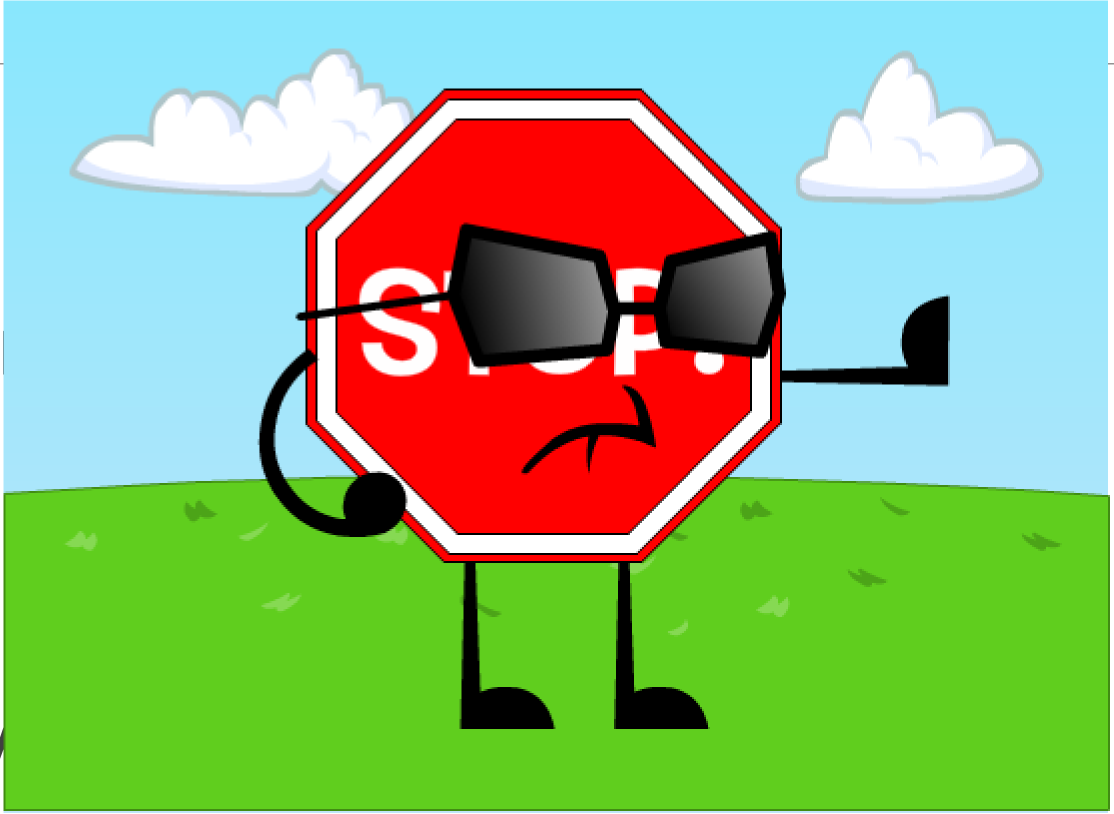
Activity

For the

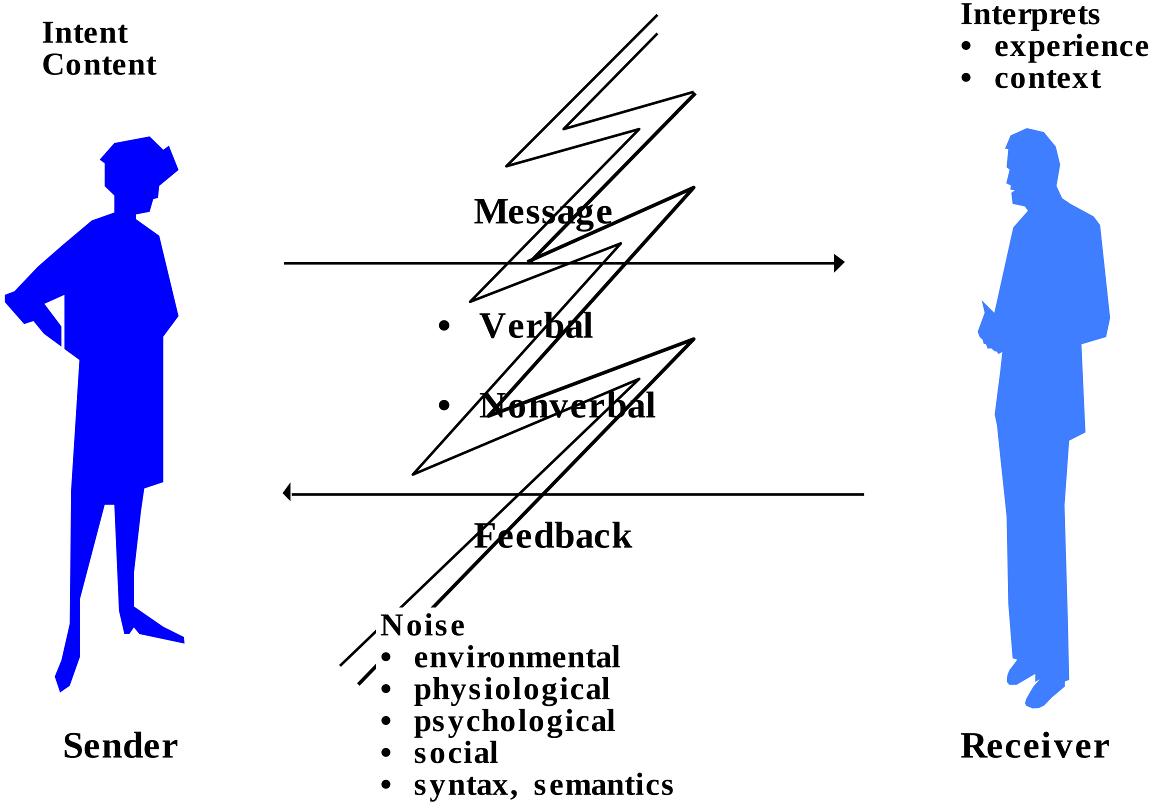
Commu
beside y



A.S.A.P.

WHAT DOES THIS MEAN???

The Communication Cycle



Intent
Content

Interprets
- **experience**
- **context**

Message

- **Verbal**
- **Nonverbal**

Feedback

Noise
- **environmental**
- **physiological**
- **psychological**
- **social**
- **syntax, semantics**

Sender

Receiver

Communication

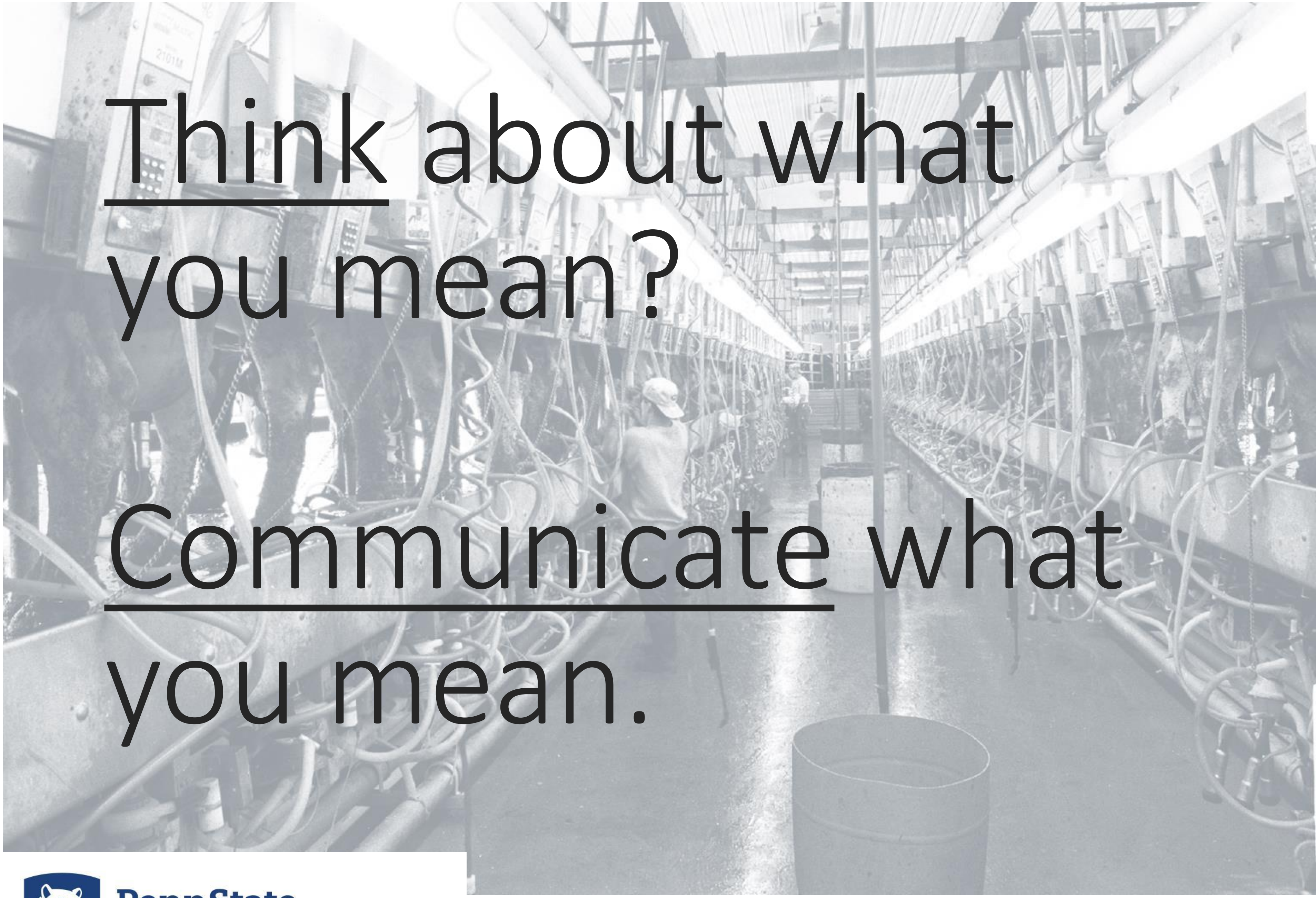
Sender – The one with the ball

- Pitcher
- Quarterback

Receiver – The one who wants the ball

- Catcher
- Wide Receiver
- Dog

Don’t drop the message!



Think about what you mean?

Communicate what you mean.

Consider this . . .

Manager: Tom I need you to move that heifer to Pen 6.

Tom: Sure thing, Boss.

Possible outcomes:

- Correct heifer moved to correct pen in timely fashion.
- Wrong heifer moved.
- Correct heifer moved . . . Eventually.
- Other??

What about. . .

Manager: Tom I need you to move heifer #355 to Pen 6 in the next hour.

Tom: OK, Boss.

Manager: Will you be able to do that? Do you need any help?

Tom: I'll get Bill to help me right after he is done pushing up feed.

Possible outcomes:

- Correct heifer moved to correct pen in timely fashion.
- Wrong heifer moved.
- Correct heifer moved . . . Eventually.

Understanding Why Communication Breaks Down

People misunderstand one another.

Speakers often assume.

Too little information is given.

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How about this . . .

Worker: Uh, there’s a cow in Pen 3 that looks a little off.

Manager 1: What is her number? Can you describe what you mean by a little off?

Manager 2: Does she need treated?

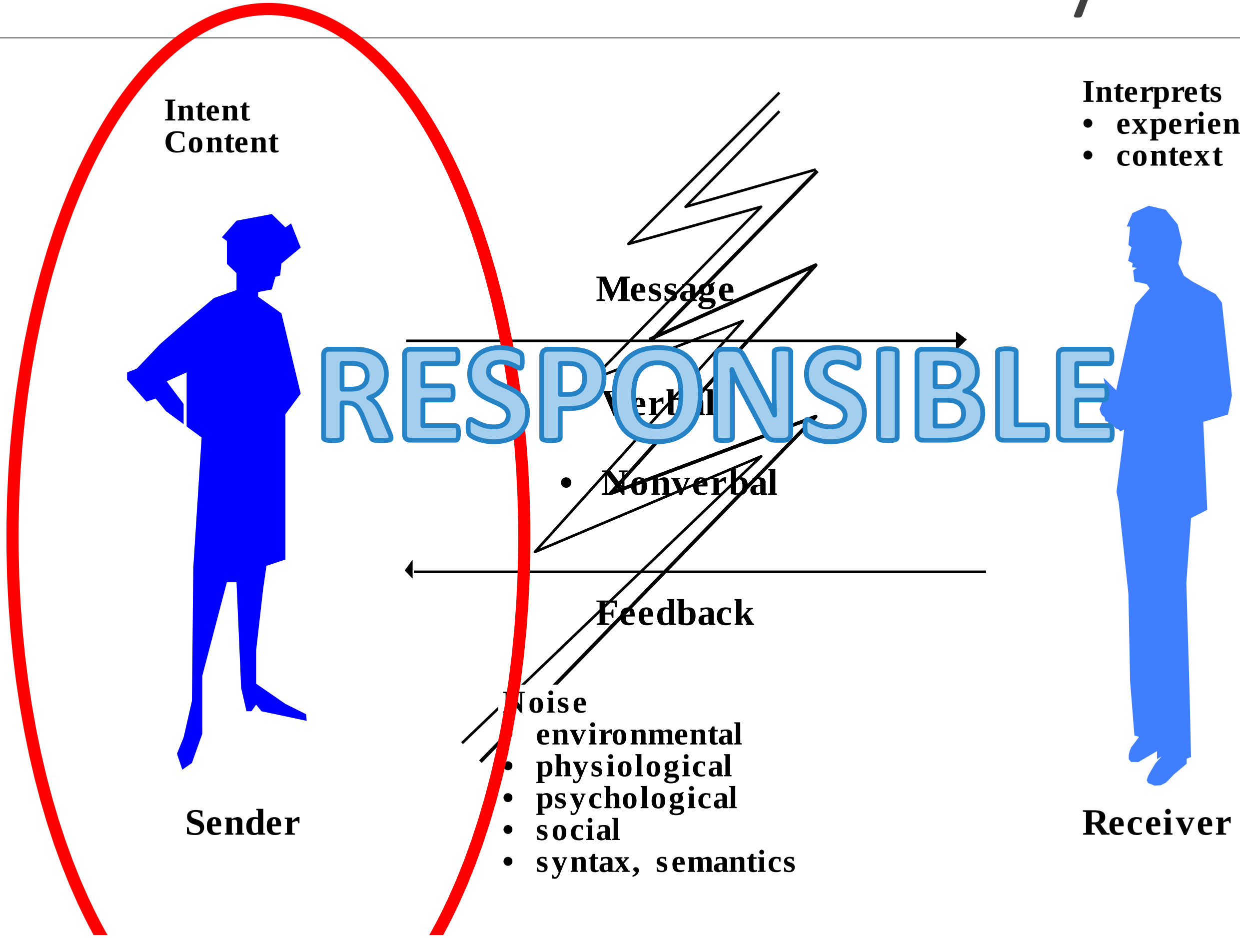
Understanding Why Communication Breaks Down

Information is given too fast.

Listeners are unwilling to ask questions.

Background noise, distractions.

The Communication Cycle



Intent
Content

Message

RESPONSIBLE

- **Verbal**
- **Nonverbal**

Feedback

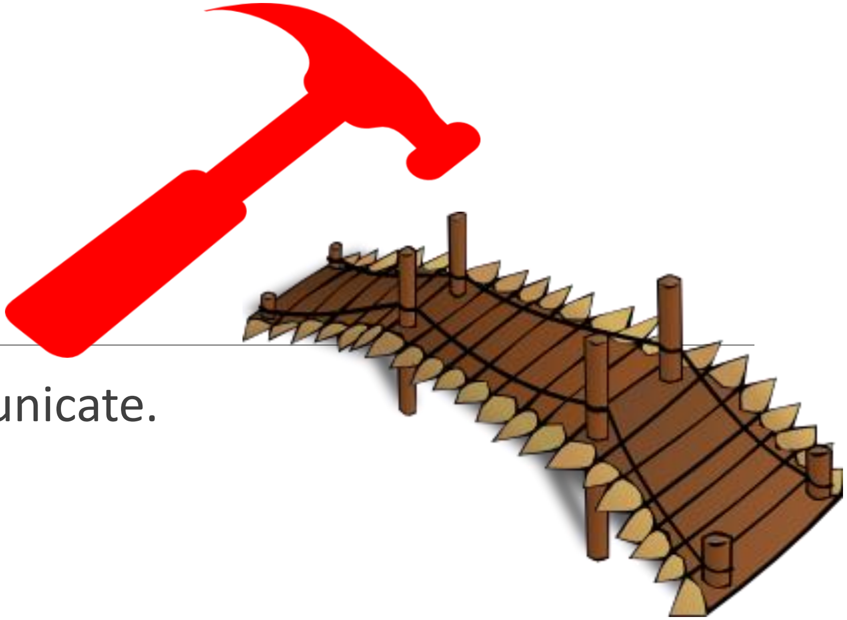
Interprets
- **experience**
- **context**

Noise
- **environmental**
- **physiological**
- **psychological**
- **social**
- **syntax, semantics**

Sender

Receiver

Action Steps



Think about what you want to communicate.

- Ask questions.

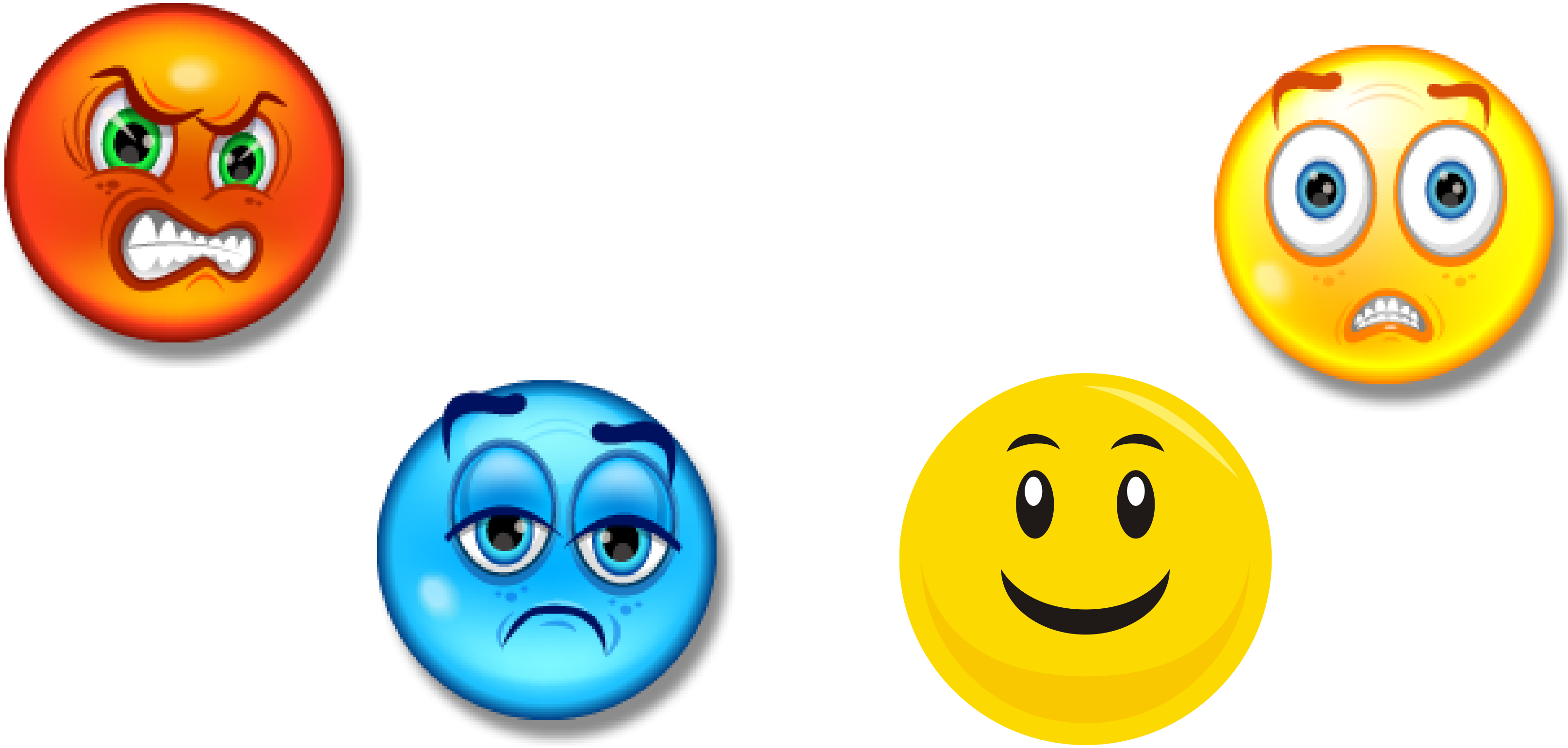
- NOT: Do you understand?

- BUT: I'm not sure I am being clear. Can you confirm for me . . .

Coach your clients to be better at COMMUNICATING!

What is Nonverbal Communication?

The Power of Nonverbals



Communication involves a number of choices

More than just WORDS.

The tone of voice.

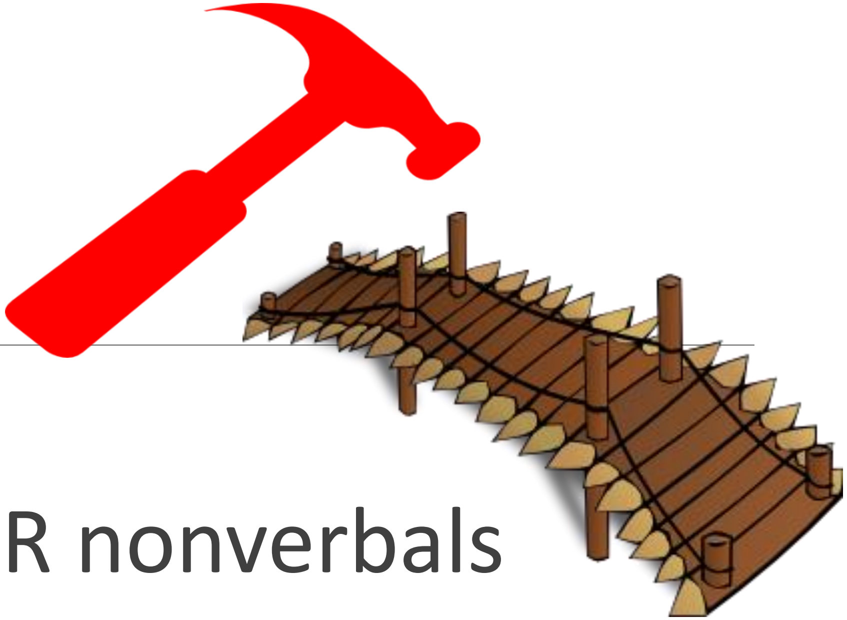
Inflection or variation in voice.

Pace or speed of speaking.

Volume or loudness.

Nonverbal: Such as body stance, eye contact, facial expression, physical distance, gestures.

Action Steps



Pay attention to YOUR nonverbals

WATCH the nonverbal of others

Improving Your Communication

1. Simplify the content.
2. Speak at a reasonable rate.
3. Give details in order.

4. EXAMPLE: Milker meetings.

   Change from quarterly with lots of information to weekly 20 minute "updates".

Improving Your Communication

1. Highlight important points.
2. Use more than one communication channel.
3. Seek feedback.

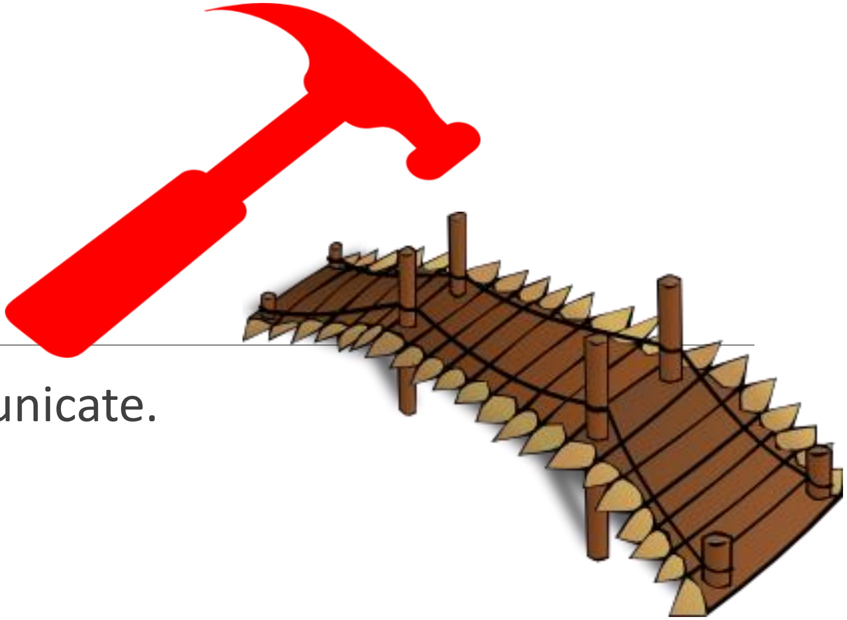
Milking practices

Wet towels spread bacteria. Make sure towels are dry.

Put a sign up on the dryer.

Check at the next milker meeting.

Action Steps



Think about what you want to communicate.
- Ask questions.

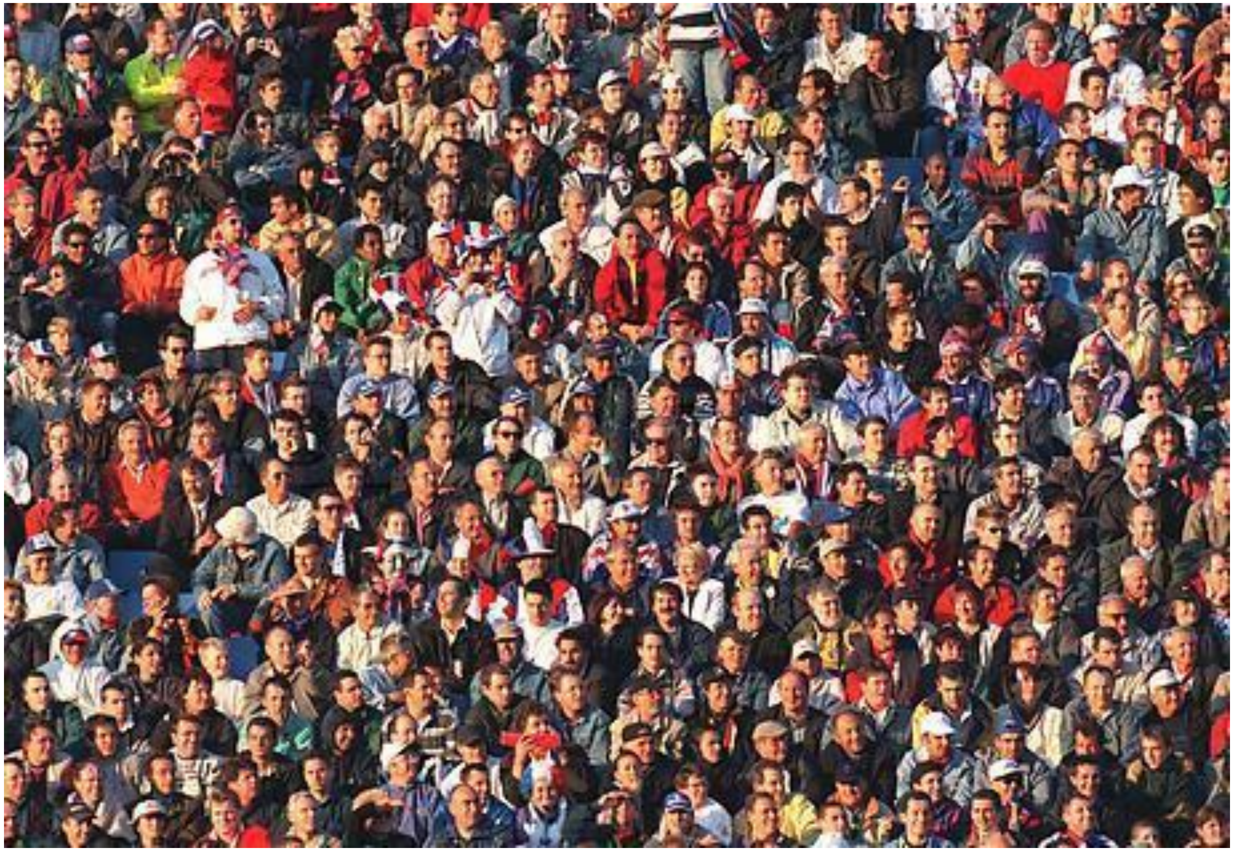
- NOT: Do you understand?

- BUT: I’m not sure I am being clear. Can you confirm for me . . .

Pay attention to “power gradient”.

Questions?

People



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The age of communication

Traditionalists	**Baby Boomers**	**Generation X**	**Millennials**
1900-1945	1946-1964	1965-1980	1981-2000
Being Respected, security	Being valued, money	Freedom, fewer rules, time off.	Working with bright people, time off.
Discrete. Show respect for age/experience. Good manners. Formal language	Diplomatic. In person, face to face. Like personal touch. Establish friendly rapport.	Blunt/Direct. Immediate. Present facts. Short sound bites. Tie message to results.	Polite. Email and voice mail #1 tools. Don't talk down. Action verbs. Humor. Be positive.
No news is good news. Want subtle, private recognition.	Like praise. Give something to put on the wall.	Not interested in public recognition. More interested in benefits.	Communicate frequently. Like feedback and will ask for it.

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Personality “TESTS” ???

Myers-Briggs

Kiersey

DISC

Others?

Four “types”

1. Driver
2. Analytical
3. Amiable
4. Expressive

So what . . .

Conversations: Texts, emails, phone calls, -- communication is constant.

Establish expectations

Time lines

Performance

Payments

Communication boundaries

Chalking the Field

People vs. Problem

Consider this conversation with a feeder

- Three times this week the fresh pen ran out of feed. The pen average has dropped by six pounds. Peak milks are being compromised and we are losing money.

- Implied?

People vs Problem

- The implied YOU
- Covey – Seek first to understand.
- Solve PROBLEMS together

People vs. Problem

Consider another conversation with a feeder

- **I wanted to talk with you about a problem that I noticed this week. You know its important to have the fresh pen feed delivered on time since intakes will greatly impact peaks. In looking at the data , I noticed that feed was late three times on the datasheet. Do you know what has changed and why this is happening?**
- **Implied?**

Situation One

Situation Two

Start off with a question

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How do you ask great questions?

SENTENCE STARTERS

WHO?

WHAT?

WHEN?

WHERE?

HOW?

Tell me more about that.

TIPS TO REMEMBER

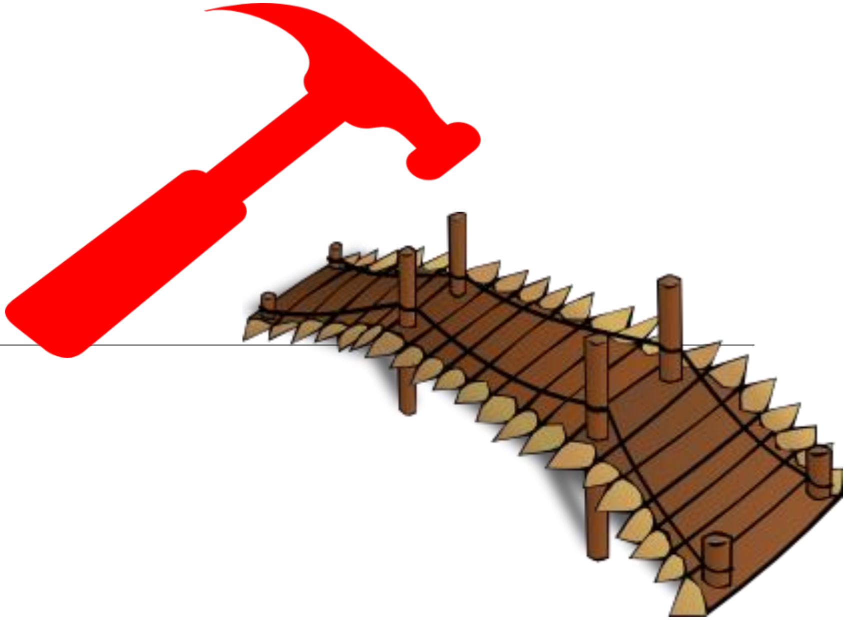
Don’t be afraid of a delay or a break in the conversation!

Silence creates magic!

Focus only on what the person is saying, formulate next question after they’ve finished responding.

Try not to be invested in the outcome, or ask questions that lead.

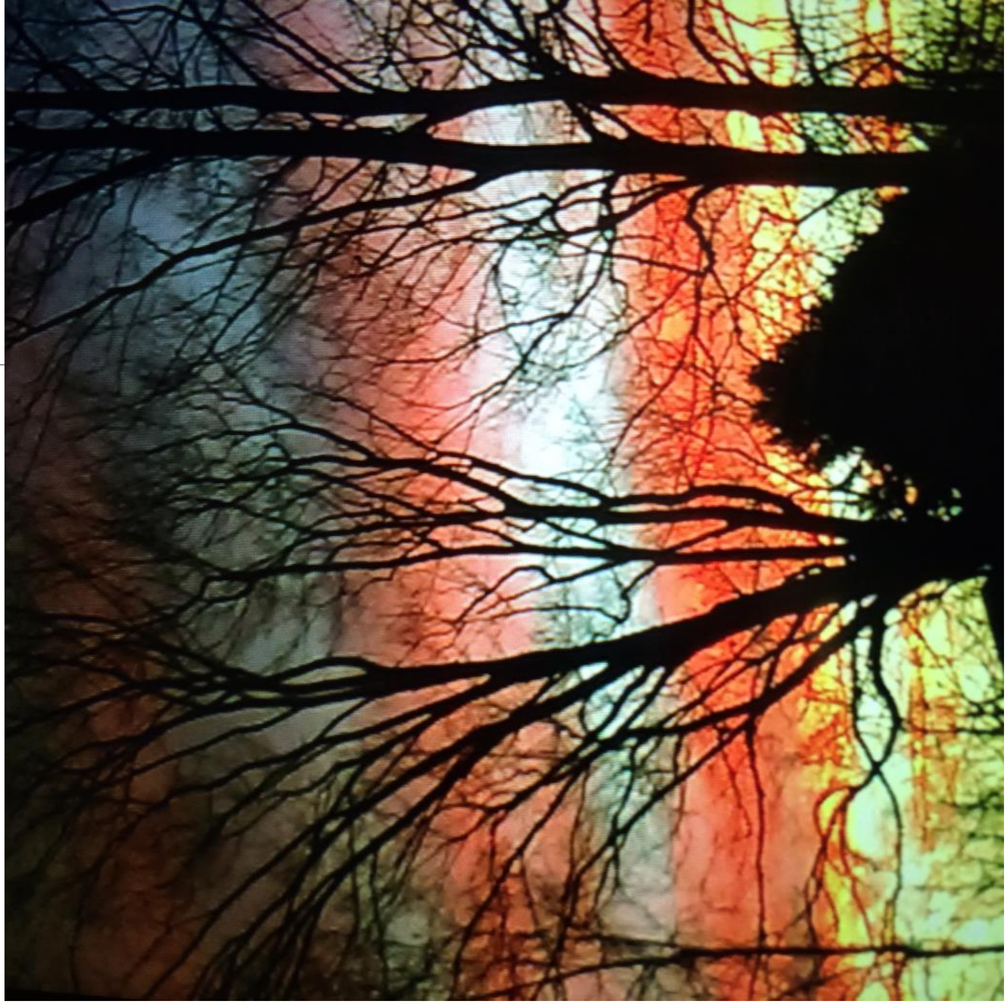
Action Steps



Be aware of differences

- Adjust when needed.
- Clarify expectations
  - Time and money
- Start the conversation
  - Ask good questions

Questions?



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Realizing the Potential from your Small Grain forages in the Northeast

Ron Hoover
Coordinator of on-farm research
Department of Plant Science

November 1, 2018

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Subtitle: Increasing production from each acre
… beyond what is possible from corn silage and alfalfa

- Why consider small grain forages?
- Key considerations: opportunities and challenges
- Opportunities to increase output/reduce risk of forage systems
- Paying attention to the agronomics
- Performance of recent small grain/cover crop trials
- Other possible crops/systems

→NOT advocating abandonment of corn silage OR alfalfa

Alternatives- why now?

- Variable feed costs, variable milk prices → tight margins

- Periodic droughts
- Improving no-till planting equipment
- New seed options
- Better understanding of utilization
- Soil/nutrient mgt management

Alternatives- an agronomist's view

- Precipitation issues
  - Summer droughts
  - Unused fall + spring
- Make use of possibly "wasted" fall and spring solar energy
- Improve on-farm cycling of nutrients

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Small grain crops as double-crops

- "spring-planted"
  - Oats
  - Some triticales
- "fall-planted"
  - Barley
  - Wheat
  - Rye
  - Triticale

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Key considerations for adding small grain crops to the rotation: ↑Management ??

- Animals that will consume these
- Storage considerations
- Soil/weather
- Timeliness:
  - enough labor?
  - Enough equipment?
- Fertility needs

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Double cropping basics

- Follow corn silage with a small grain for forage
- Harvest fall and/or spring
- Several basic options
  - Spring oats
  - Ann. ryegrass
  - Clovers
  - Winter rye
  - Winter wheat
  - Winter triticale
  - Winter barley

planted by early Sept.

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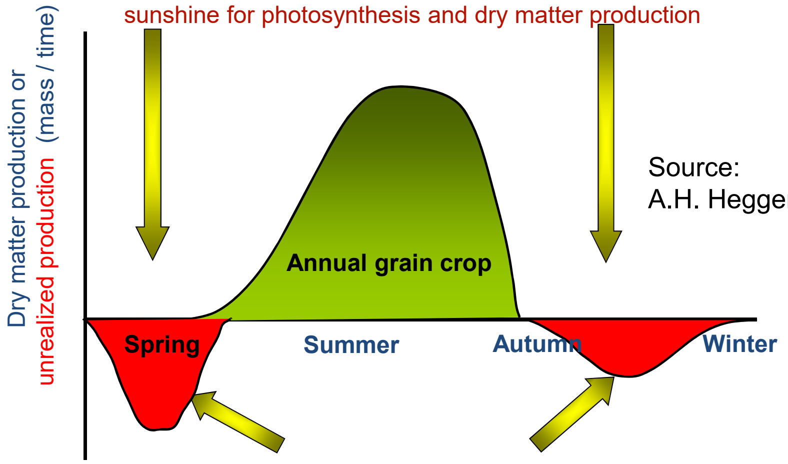
Current production model … and potential of winter double crops to increase seasonal dry matter production



Missed opportunities to use early spring and late-season sunshine for photosynthesis and dry matter production

… opportunities for additional forage production

Source:
A.H. Heggenstaller

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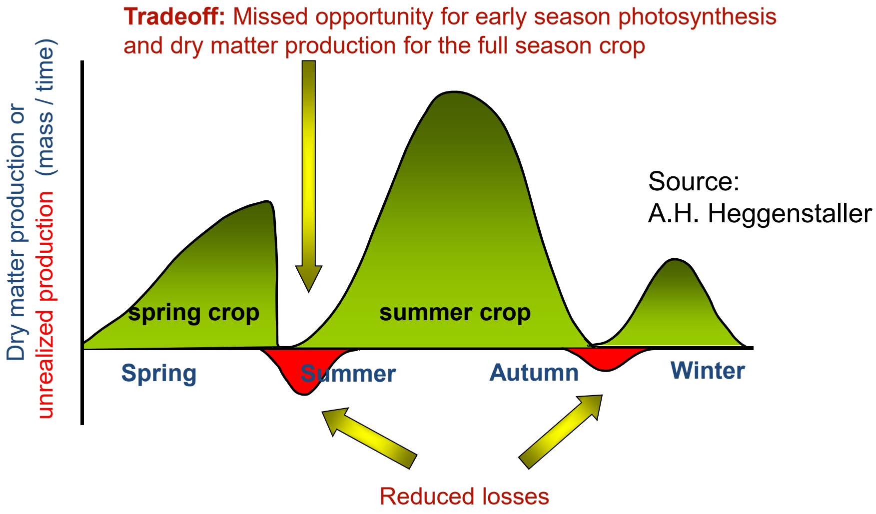
Biomass production in winter double crop systems



Tradeoff: Missed opportunity for early season photosynthesis and dry matter production for the full season crop

Source:
A.H. Heggenstaller

Reduced losses

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Double cropping considerations

- Is there enough growing season in the fall and spring to justify the investment?
- Will harvesting the spring crop impact the yield of the full season crop?
- Are some acres of the full season crop planted late anyway?

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Double cropping considerations

- Newcomers don't have to start with drilling all acres available
- Start small and "grow" the acreage
- Increasing crop diversity should result in increasing productive potential for farm… **but will require increased management !**

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Double cropping advanced topics

- Mixtures of multiple species
  - Fall/spring mixes
    - Oats/wheat
    - Oats/triticale
  - Spring mixes
    - Ann rye/triticale
    - Ann rye/crimson clover
    - ??
  - Relay cropping
    - Triticale in alfalfa

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01 10 2012 12 45

'Hercules' oats + 'Aroostook' rye vs 'Everleaf' oats + 'Aroostook' rye

Do I stay with a grain type? Do I consider a forage type?

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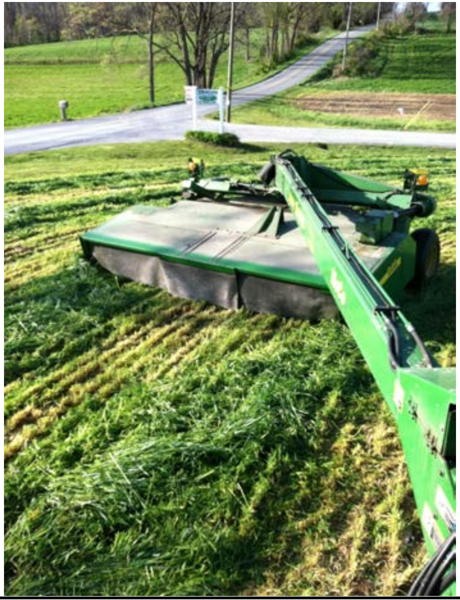
Eric Risser, Meadow-Vista Dairy, LLC in Bainbridge, PA



Why double cropping?

1. Need more forage…for cows and heifers
2. Opportunity to use manure nutrients→ comply with Nutrient Management Plan
3. Erosion control
4. Improve soil health via crops growing during most of the year
5. Help reduce soil compaction
6. Maximize crop production on expensive farmland→ reduce cost per unit of feed by spreading land costs over more tons

Penn State **Extension**

Eric Risser, Meadow-Vista Dairy, LLC in Bainbridge, PA

Ryelage forage analysis

Sample Date	DM	CP	ADF	NDF	TDN	NEL	RFV
May 19, 2011	32.2	16.2	34.6	56.5	62	0.64	102
Oct 6, 2011	27.6	11.5	32.7	56.2	61	0.63	105
Sept 26, 2012	38.0	13.0	36.5	58.3	61	0.63	96
May 22, 2013	34.2	14.6	35.7	57.6	62	0.64	97

Skyview Laboratory, INC

Penn State **Extension**

On farm small grain forage analyses

Type	DM	Crude Protein	NDF	NEL	Potassium
Rye	40.5	14.1	51.7	0.68	2.73
Wheat	32.1	13.3	53.8	0.63	2.61
Triticale	36.8	13.6	52.7	0.68	3.89
Triticale	45.3	14.9	45.5	0.68	2.91
Triticale	47.6	11.4	51.2	0.66	2.86

Courtesy: Agri-Basics

Penn State **Extension**

Penn State **Extension**

Paying attention to the agronomics

- Small grains often need <u>more,</u> not less mgt…
  - – Weeds controlled?
  - – Timely planting (earlier vs. later)
  - – Soil tested, fertility appropriate
    - Adequate N and other nutrients, exp. K
  - – Species, *variety* selection critical
  - – Is quality seed being used?
- Avoid the cover crop “plant and forget” mentality

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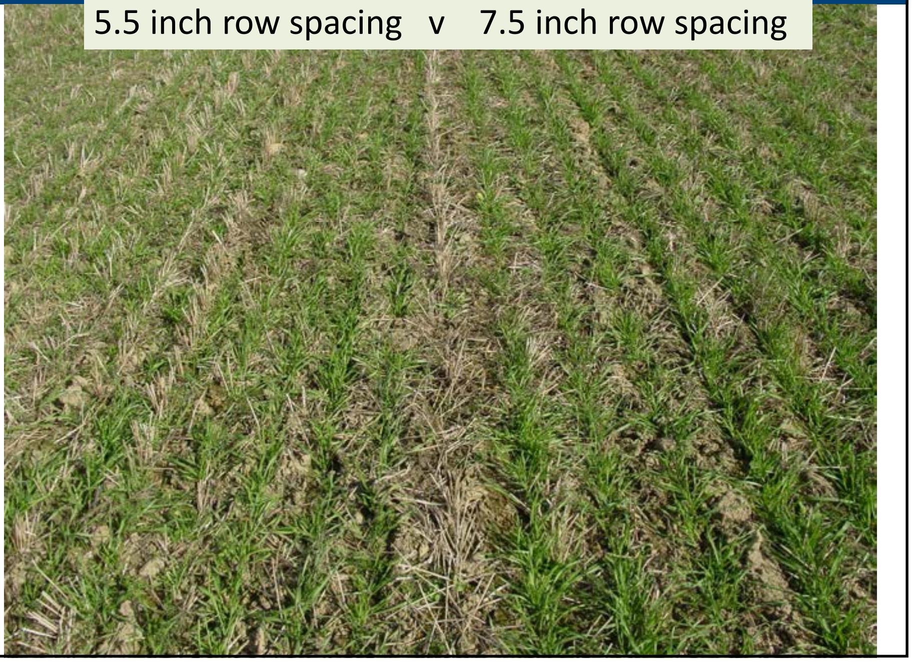
5.5 inch row spacing v 7.5 inch row spacing



Penn State **Extension**

Importance of timely planting

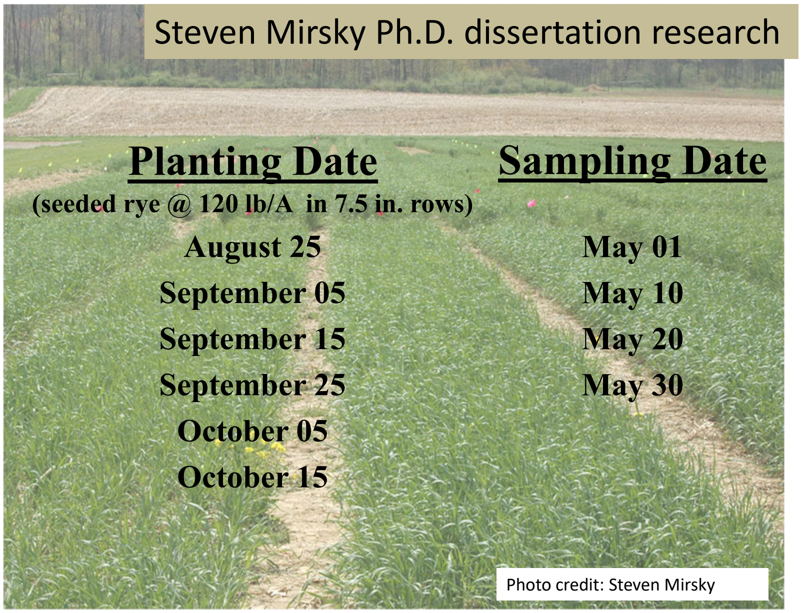
Photo credit: Eric Risser

Drilled: Oct. 21 vs Sept. 30

Photo taken
Dec. 27, 2013

Penn State Extension

Production of cereal rye for no-till mulch: effect of fall planting date on spring growth



Steven Mirsky Ph.D. dissertation research

Planting Date (seeded rye @ 120 lb/A in 7.5 in. rows)	**Sampling Date**
August 25	May 01
September 05	May 10
September 15	May 20
September 25	May 30
October 05	
October 15	

Photo credit: Steven Mirsky

Penn State Extension

Spring (April 1) Rye Biomass increases with earlier fall planting

Aug 25

Sept 5

Sept 15

Sept 25

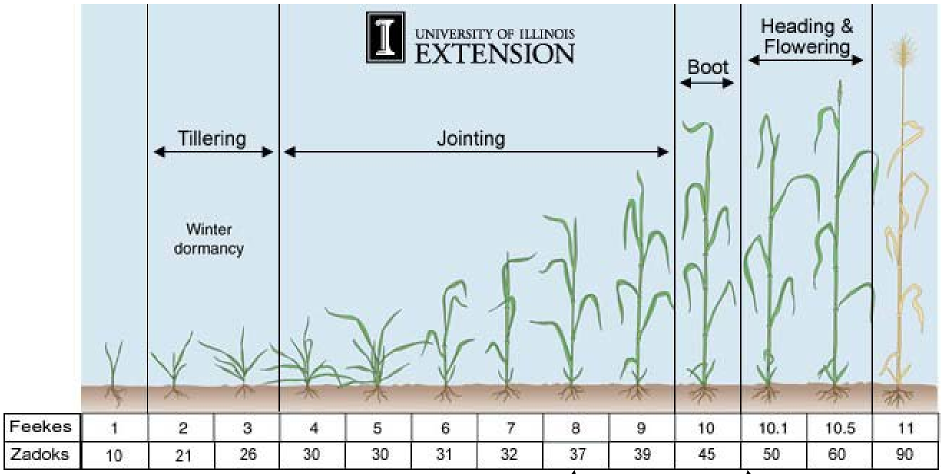
Oct 5

Oct 15

Photo credits: Steven Mirsky

Penn State **Extension**

Cereal Grain Phenology



Feekes	1	2	3	4	5	6	7	8	9	10	10.1	10.5	11
Zadoks	10	21	26	30	30	31	32	37	39	45	50	60	90

Better forage quality

Better yields

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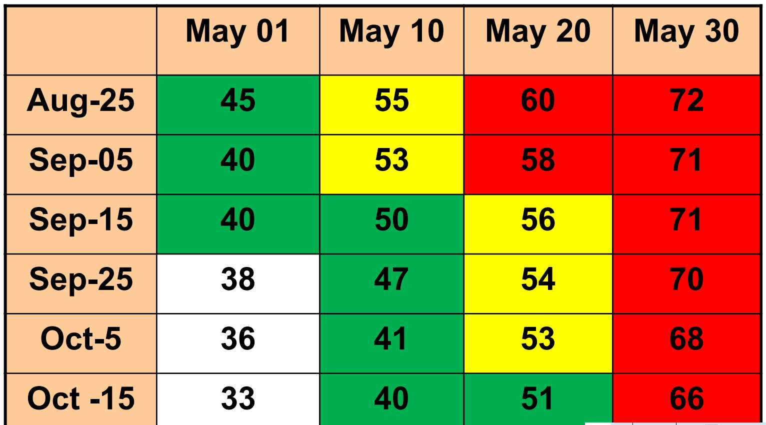
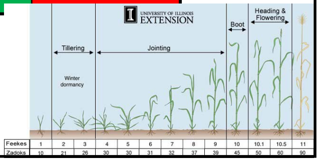
Cereal Grain Phenology: Zadoks scale



	May 01	May 10	May 20	May 30
Aug-25	45	55	60	72
Sep-05	40	53	58	71
Sep-15	40	50	56	71
Sep-25	38	47	54	70
Oct-5	36	41	53	68
Oct -15	33	40	51	66



Penn State **Extension**

Photo credit: Eric Risser

Photo credit: Eric Risser

Photos taken
Jan. 2, 2014

Penn State **Extension**

Penn State **Extension**

Tillering encouraged by:
- Moisture
- Warm temperatures
- Fertility (esp. N)
- Time (earlier planting)

→ Possible to reduce seeding rates when conditions for tillering are ideal

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Spring (April 1) Rye Biomass increases with earlier fall planting

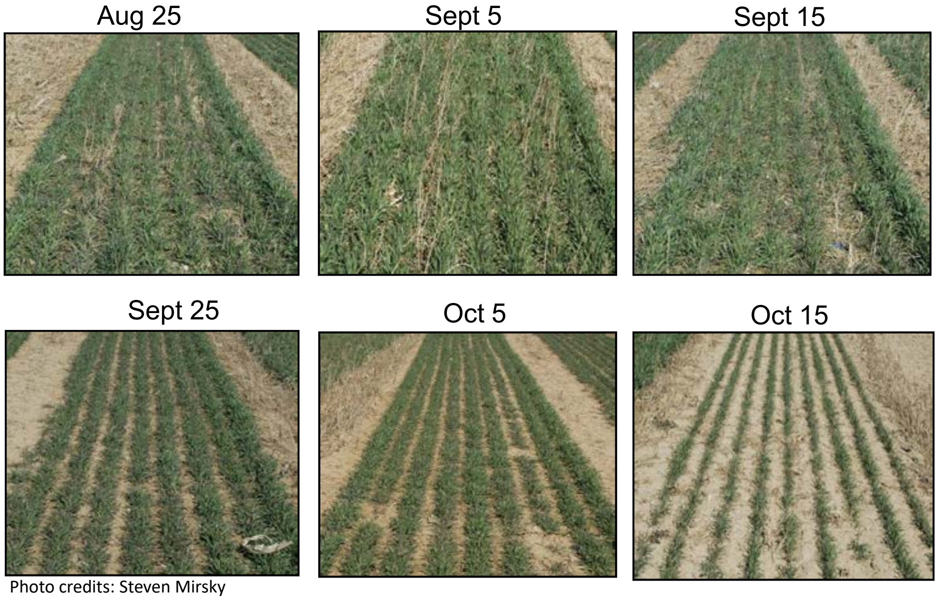

Photo credits: Steven Mirsky

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Certified rye seed v farm-grown seed

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Fall-harvested Crop Mgt Challenges

- Delaying planting past mid-Sept. will reduce yields
- Time management: Plant immediately following silage harvest for best soil conditions and yield potential
- Plant/harvest traffic + Wet fall = Soil compaction
- Delayed harvest: Cool temps, forage difficult to dry
- Oats alone → no cover for fields by spring
- Species mixtures: Seed segregation→patchy stands

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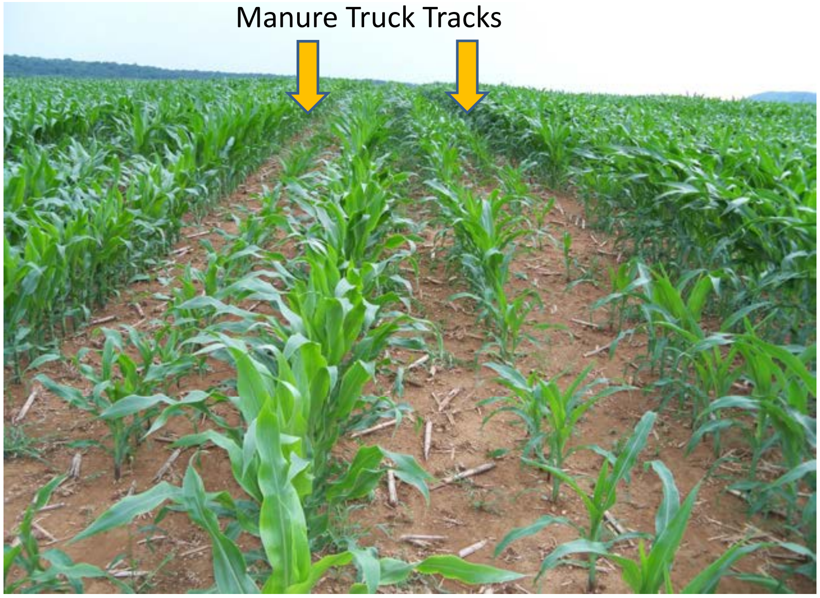
Spring-harvested Crop Mgt Challenges

- Harvest traffic + wet spring = soil compaction
- High labor requirements (harvest, manure spreading after harvest, and planting of next crop)
- Good planning and access to custom operators beneficial
- Delayed harvest or N def. reduces forage quality
- Delayed harvest can impact yield of next crop
- Small grains harvested at soft dough can develop mycotoxins



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Fall or Spring Crop Opportunities

- Make use of sunlight otherwise “wasted”
- Cover crop benefits: erosion control, increase soil OM, improved soil structure, better no-till
- Sequester nutrients from manure that “has to be spread”
  - Nutrient management plan benefits
  - Reduce amount of purchased fertilizer
- Manure following planting can help with cover crop germination

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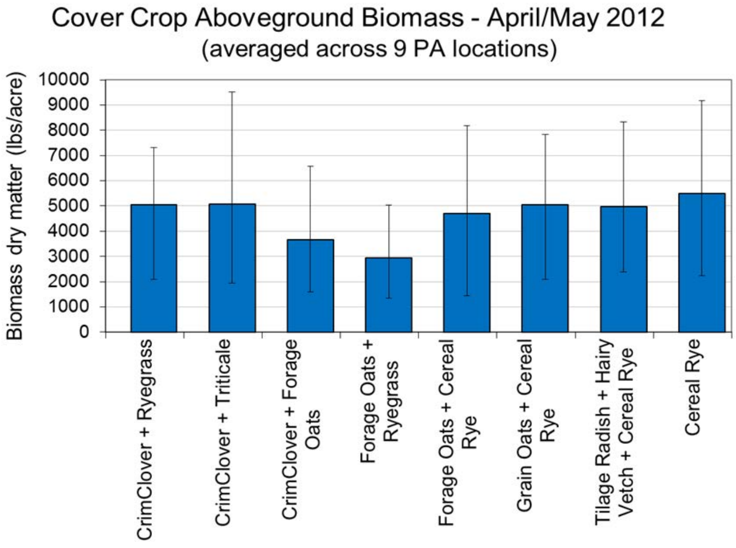

1. “I-bars” represent minimum and maximum values measured for a specie or mixture
2. Fall growth was somewhat below average due to several weeks of cloudy and wet weather beginning in mid-September (low light, loss of N)

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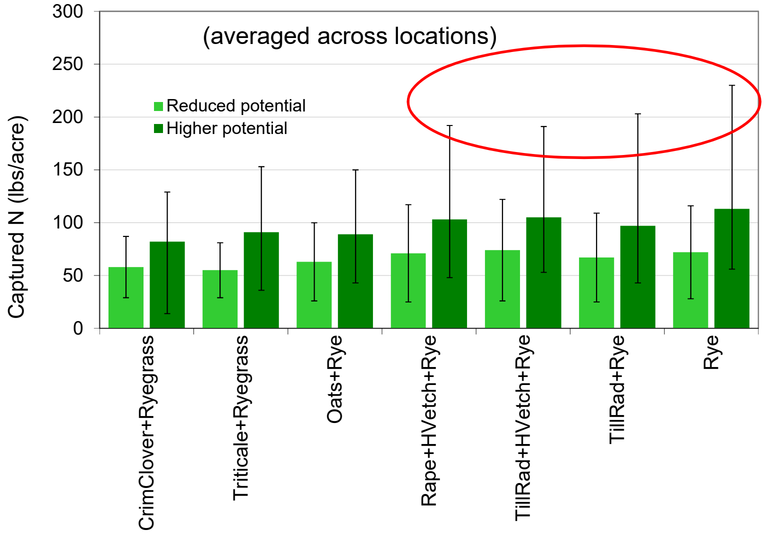
2010-11 Penn State On-Farm Cover Crop Trial
Spring Cover Crop Nitrogen Capture



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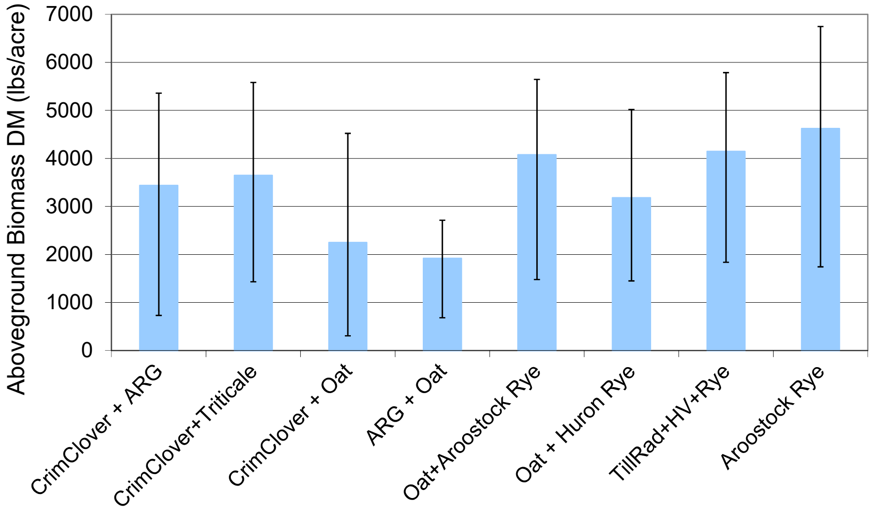
Forage Dry Matter of Cover Crops

Sampled mid-April 2013 from 6 SE Counties



Vertical bars indicate minimum and maximum values for a treatment

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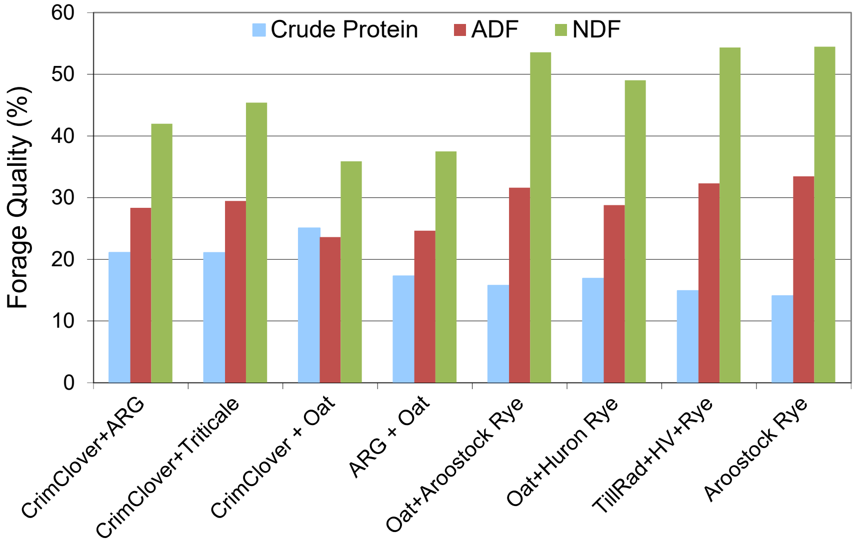
Forage Quality of Cover Crops

Sampled mid-April 2013 from 6 SE Counties



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Annual Ryegrass + Crimson clover v Triticale + Crimson clover

photo: 16 April 2012 Location: Blair County, PA

Penn State **Extension**

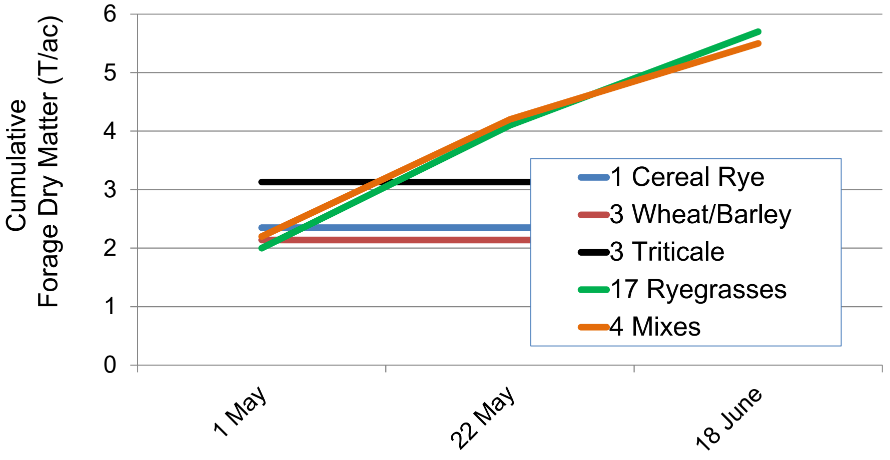
Aroostock Rye @ late boot/early head

Photo: 16 April 2012 Location: Blair County, PA

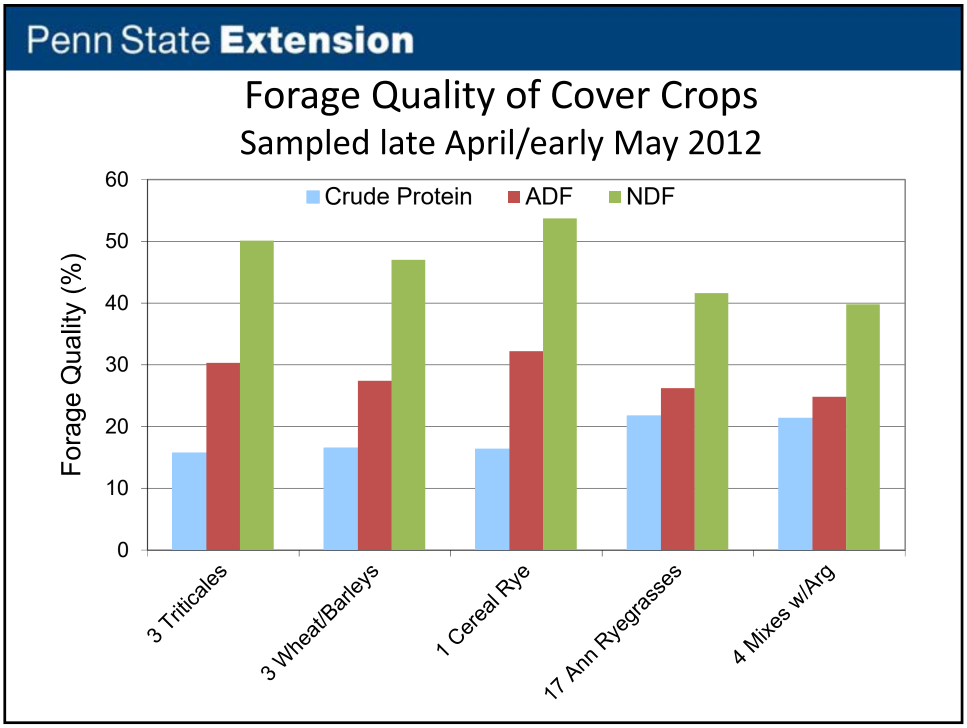
Penn State **Extension**

Cumulative DM Yields of Cool-Season Cover Crops

PSU Rock Springs Research Center (2011-2012)



* All entries seeded 19 September 2011



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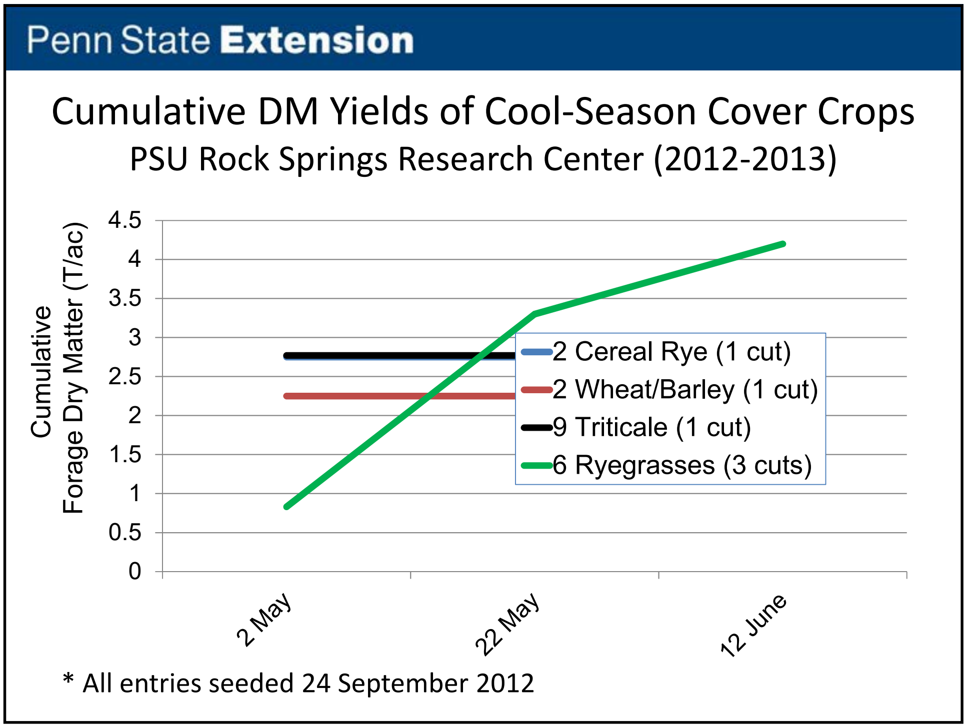
Forage Quality of Cover Crops

Sampled late April/early May 2012



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Cumulative DM Yields of Cool-Season Cover Crops

PSU Rock Springs Research Center (2012-2013)

* All entries seeded 24 September 2012

Assessing the Economics

- Yield potential of corn and winter crops
- Impact of delayed planting on corn yields
- Availability of manure to offset increased fertility costs
- Increased use of fixed assets like land and machinery
- Potential value of the alternative forages
  - Replacement for corn silage or medium quality hay

Other Examples

Direct cut barley @ Soft dough

- 3-4 tons DM possible
- Rapid harvest possible
- Nearly full season double cropping
- Good substitute for CS
- Environmental benefits

Sample	DM	CP	ADF	NE/Lact
1	35.3	7.6	29.9	0.68
2	35.0	8.3	30.5	0.69
3	37.0	9.8	34.0	0.69
Corn sil'g	41.7	8.0	23.4	0.75

Fall Grazing

Summary

- Small grain forages can fill gaps in the cropping season and improve seasonal DM yields
- Small grains able to use moisture when plentiful!
- Alternatives can improve nutrient balance and soils
- Management is critical..both in the field and barn
- Careful assessment of economics is important
- New focus on management details

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Discussion/Questions?

Economically Rethinking How We Grow Forages on Our Dairy Farm

by John Kemmeren-AngelRose Dairy

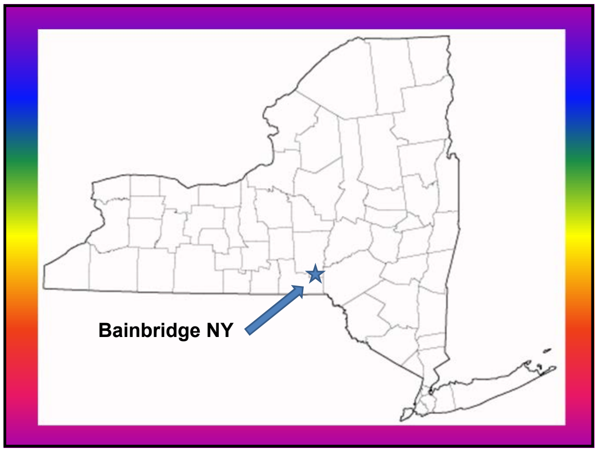
Angelrose Dairy

The Kemmeren Family

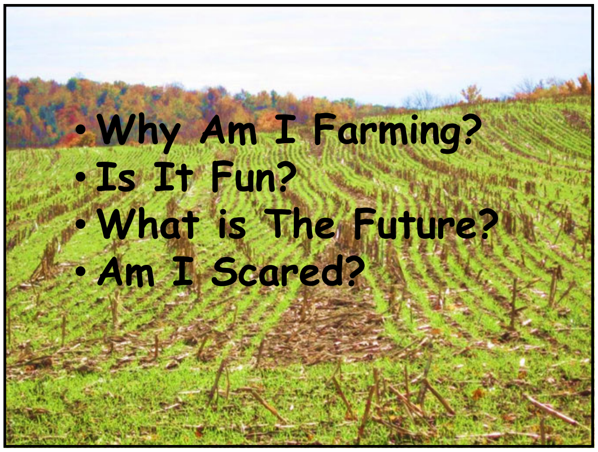
Bainbridge New York
607-967-7440

Who We Are

- John and Dianne
  - Children
    Peter & Katy
  - Granddaughter
    Ava
- 100 Milking cows
  - RHA 27000 milk
  - 4.0 Fat 1075 Fat



The most dangerous phrase in the language is "we've always done it this way."



- Why Am I Farming?
- Is It Fun?
- What is The Future?
- Am I Scared?

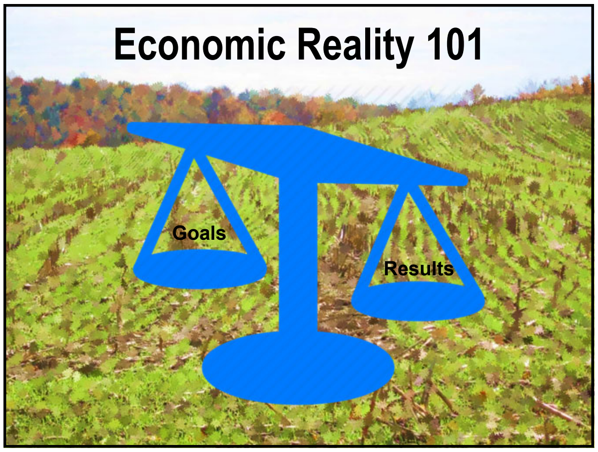
- Have a Plan- At Least an Idea.
- The Highest Yield is My Goal #1
- Cutting Costs is Second! #2
- Learn From Others. Successes and Failures.
- Attend Many Meetings. Great Advice and Free Food.
- Every Failure is a test Plot Learning Experience.
- Can I Seed Two things at Once.
- Take Many Photos for Your Records.
- Write it Down. Paper and Pen or Tablet.
- Grow Cow Quality Feedstuff.

Technology

Machinery and Equipment Developed from the Application of Scientific Knowledge.

One Size Doesn't fit all..

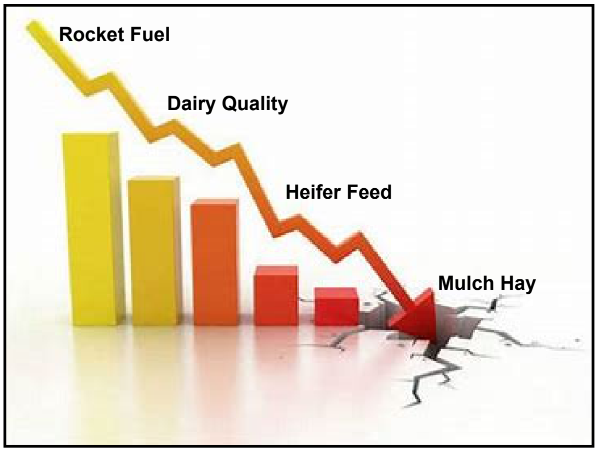
New Tools For Greater Efficiency



Economic Reality 101

Goals

Results



Rocket Fuel

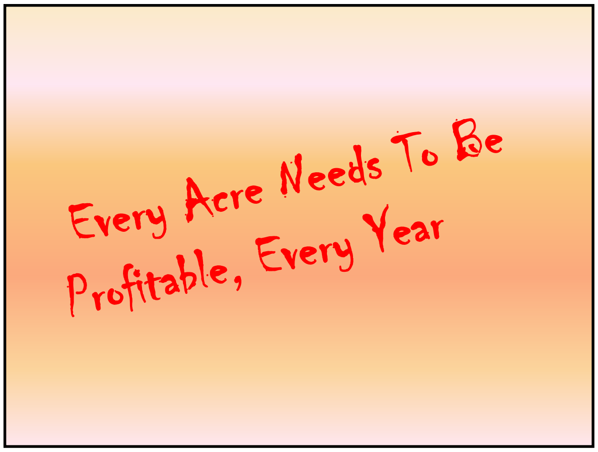
Dairy Quality

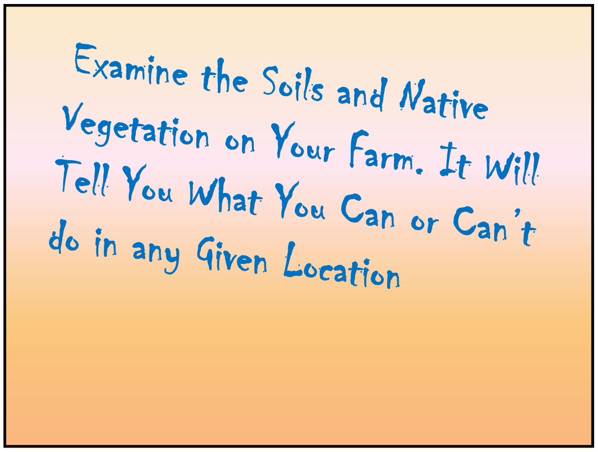
Heifer Feed

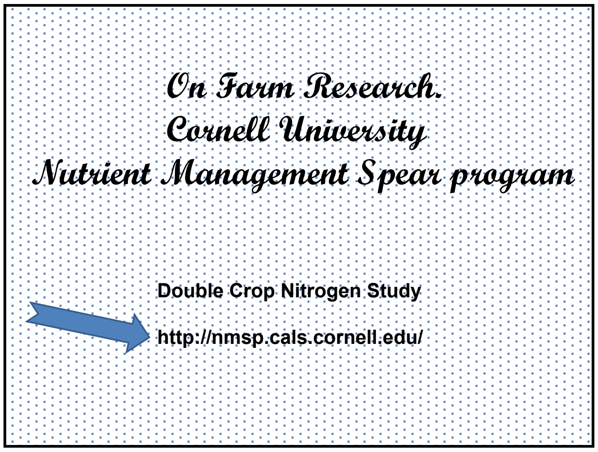
Mulch Hay

How do You Expect Me to Formulate a Ration With This?

My First Corn Planter

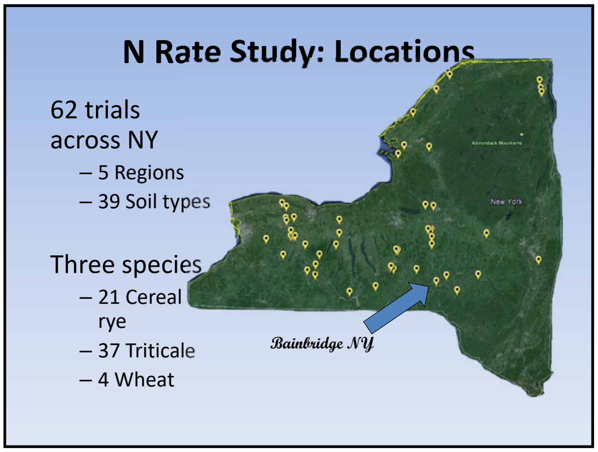

Every Acre Needs To Be Profitable, Every Year


Examine the Soils and Native Vegetation on Your Farm. It Will Tell You What You Can or Can't do in any Given Location


On Farm Research.
Cornell University
Nutrient Management Spear program

Double Crop Nitrogen Study

http://nmsp.cals.cornell.edu/


N Rate Study: Locations

62 trials across NY
- 5 Regions
- 39 Soil types

Three species
- 21 Cereal rye
- 37 Triticale
- 4 Wheat


Cornell Fertilizer Trials

MANURE MANAGEMENT

Manure Storage Is Extremely Important in a No-Till System Due to the Timeliness and Adequate Field Conditions. (Compaction and Ruts are Very Costly)

Applied manure at the time of covercrop seeding allows the covercrop to store nutrients for future crops. And to prevent leaching.

Where Did My Covercrop Go ?

2009

100% ground cover. 100% of the Time. This is Very Important to Our Success

One Martin Spike and One Rubber
Closing Wheel Has Worked Very Well

Planting Into Living Rye-
2015

BEST WEED CONTROL EVER!

FERTILIZER

ATTENTION !

The Most
Important
Thing You Can
Put In Any Field
is **Yourself.**

First Things First.
Always Take a Soil Test

All Grass Field Are Topdressed

Four times

- Adding Lime Regularly Can Yield Big Returns
- I Believe This Is One of the Biggest Drawbacks on Many Farms

Add Lime Regularly
in Smaller Amounts

Corn Fields Receive Top-dressed Protected Urea at V6

No-Till Alfalfa

Has Always Been a Challenge

Alfalfa is Cut Every 28 days
Yielding 4-5 Cuttings

Alfalfa Grown on Well Drained or Gravel Fields Only

Grass Is Grown on 200 Acres and Harvested 4 or 5 Times Per Year.

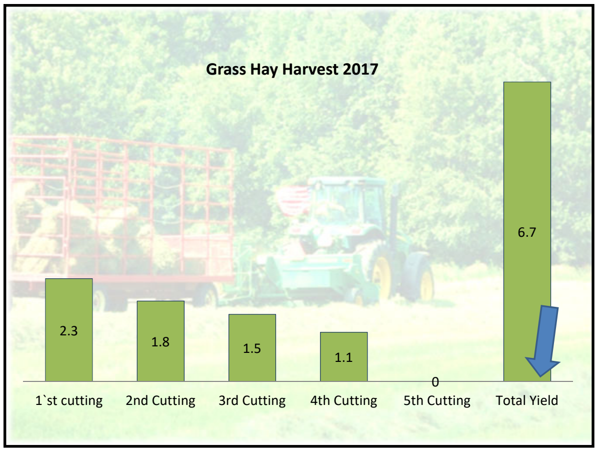

Don't Lose Everything You Worked So Hard For

Katy Says

Not Ours


Inline Bale Wrapper Can Wrap 85 Bales Per Hour

Always A Great Sense of Pride When You Can Bale Beautiful Hay on Memorial Day



Grass Hay Harvest 2017

Pre-Cut Cereal Rye (Head Straw)

This is Four (Tons/Acre) Yield

BMR SUDANGRASS


Sudangrass and Red Clover
after Rye Harvested for Straw


One cut BMR Sudangrass


SudanGrass At 45 Days
Post Planting
JOHN DEERE

Second Year Red Clover


Interseeding with Festulolium and Orchardgrass after fourth cutting.


Interseeded with Festulolium and Orchardgrass on 9-15-14


Sudangrass and Cowpeas


Greenspirit

Italian Ryegrass

Instead of Growing Corn

Seeding Italian Ryegrass At 45 Lbs./Ac

10 Days Post Seeding

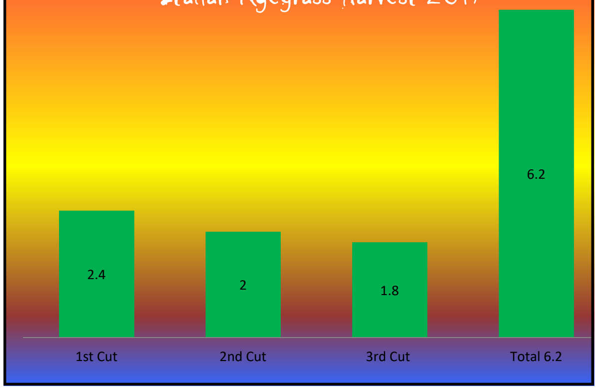
20 days post seeding

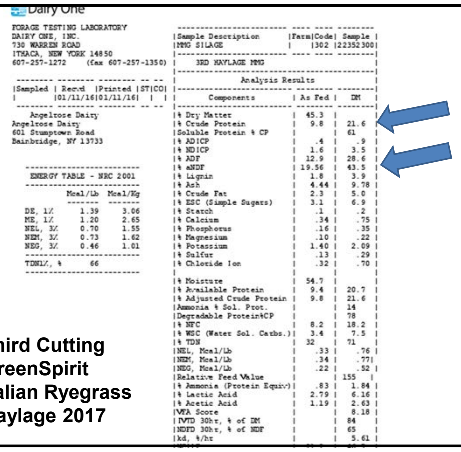
25 days post seeding

Italian Ryegrass at 35 Days Post Planting


45 Days Post Seeding

Italian Ryegrass Harvest 2017




Dairy One

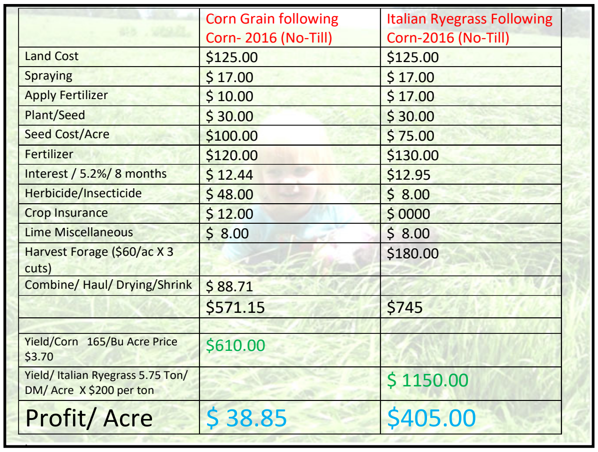
```
FORAGE TESTING LABORATORY
DAIRY ONE, INC.
730 WARREN ROAD
ITHACA, NEW YORK 14850
607-257-1272     (fax 607-257-1350)

 -------- -------- -------- -- --
|Sampled | Recvd  |Printed |ST|CO|
|        |01/11/16|01/11/16|  |  |
 -------- -------- -------- -- --
   Angelrose Dairy
Angelrose Dairy
601 Stumptown Road
Bainbridge, NY 13733

   -------------------------
    ENERGY TABLE - NRC 2001
   -------------------------
             Mcal/Lb  Mcal/Kg
             -------  -------
   DE, 1X      1.39     3.06
   ME, 1X      1.20     2.65
   NEL, 3X     0.70     1.55
   NEM, 3X     0.73     1.62
   NEG, 3X     0.46     1.01
   -------------------------
   TDN1X, %       66
   -------------------------
```

```
 ---------------------- ---- ---- --------
|Sample Description     |Farm|Code| Sample |
|MMG SILAGE             |    |302 |22352300|
|---------------------- ---- ---- --------|
|    3RD HAYLAGE MMG                      |
|-----------------------------------------|
|            Analysis Results             |
|---------------------- -------- --------|
|       Components       | As Fed |   DM   |
|---------------------- -------- --------|
|% Dry Matter            |  45.3  |        |
|% Crude Protein         |   9.8  |  21.6  |
|Soluble Protein % CP    |        |  61    |
|% ADICP                 |    .4  |    .9  |
|% NDICP                 |   1.6  |   3.5  |
|% ADF                   |  12.9  |  28.6  |
|% aNDF                  | 19.56  |  43.5  |
|% Lignin                |   1.8  |   3.9  |
|% Ash                   |  4.44  |  9.78  |
|% Crude Fat             |   2.3  |   5.0  |
|% ESC (Simple Sugars)   |   3.1  |   6.9  |
|% Starch                |    .1  |    .2  |
|% Calcium               |   .34  |   .75  |
|% Phosphorus            |   .16  |   .35  |
|% Magnesium             |   .10  |   .22  |
|% Potassium             |  1.40  |  2.09  |
|% Sulfur                |   .13  |   .29  |
|% Chloride Ion          |   .32  |   .70  |
|                        |        |        |
|% Moisture              |  54.7  |        |
|% Available Protein     |   9.4  |  20.7  |
|% Adjusted Crude Protein|   9.8  |  21.6  |
|Ammonia % Sol. Prot.    |        |  14    |
|Degradable Protein%CP   |        |  78    |
|% NFC                   |   8.2  |  18.2  |
|% WSC (Water Sol. Carbs.)|  3.4  |   7.5  |
|% TDN                   |  32    |  71    |
|NEL, Mcal/Lb            |   .33  |   .76  |
|NEM, Mcal/Lb            |   .34  |   .77|
|NEG, Mcal/Lb            |   .22  |   .52  |
|Relative Feed Value     |        | 155    |
|% Ammonia (Protein Equiv)|  .83  |  1.84  |
|% Lactic Acid           |  2.79  |  6.16  |
|% Acetic Acid           |  1.19  |  2.63  |
|VFA Score               |        |  8.18  |
|IVTD 30hr, % of DM      |        |  84    |
|NDFD 30hr, % of NDF     |        |  65    |
|kd, %/hr                |        |  5.61  |
```

**Third Cutting
GreenSpirit
Italian Ryegrass
Haylage 2017**

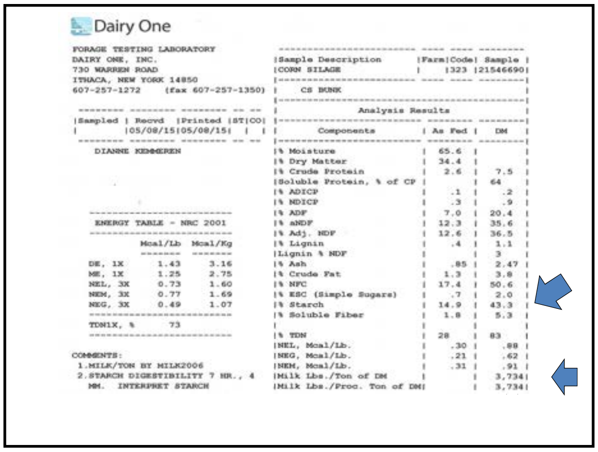


	Corn Grain following Corn- 2016 (No-Till)	Italian Ryegrass Following Corn-2016 (No-Till)
Land Cost	$125.00	$125.00
Spraying	$ 17.00	$ 17.00
Apply Fertilizer	$ 10.00	$ 17.00
Plant/Seed	$ 30.00	$ 30.00
Seed Cost/Acre	$100.00	$ 75.00
Fertilizer	$120.00	$130.00
Interest / 5.2%/ 8 months	$ 12.44	$12.95
Herbicide/Insecticide	$ 48.00	$ 8.00
Crop Insurance	$ 12.00	$ 0000
Lime Miscellaneous	$ 8.00	$ 8.00
Harvest Forage ($60/ac X 3 cuts)		$180.00
Combine/ Haul/ Drying/Shrink	$ 88.71	
	$571.15	$745
Yield/Corn 165/Bu Acre Price $3.70	$610.00	
Yield/ Italian Ryegrass 5.75 Ton/ DM/ Acre X $200 per ton		$ 1150.00
Profit/ Acre	$ 38.85	$405.00

Corn Silage Harvest 2018

91day
2200GDD
220 BPA

82 Day Corn Hybrid.
Planted after First Cut
Hay, on May 31, 2018
26 Ton Silage, 187 Bu/
Acre Grain Yield



Dairy One

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730 WARREN ROAD
ITHACA, NEW YORK 14850
607-257-1272 (fax 607-257-1350)

Sampled	Recvd	Printed	ST	CO
	05/08/15	05/08/15		

DIANNE KEMMEREN

ENERGY TABLE - NRC 2001

	Mcal/Lb	Mcal/Kg
DE, 1X	1.43	3.16
ME, 1X	1.25	2.75
NEL, 3X	0.73	1.60
NEM, 3X	0.77	1.69
NEG, 3X	0.49	1.07

TDN1X, % 73

COMMENTS:
1.MILK/TON BY MILK2006
2.STARCH DIGESTIBILITY 7 HR., 4 MM. INTERPRET STARCH

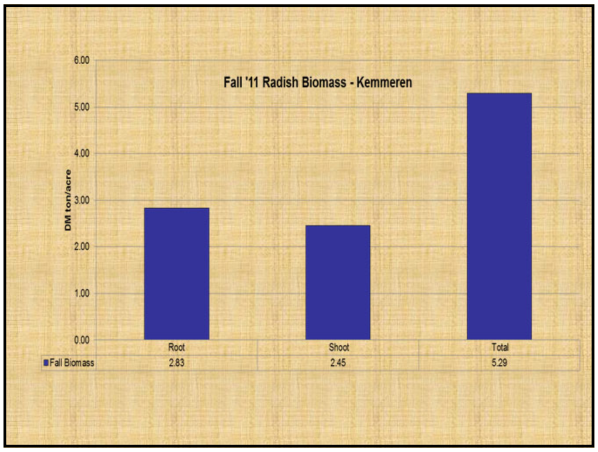
Sample Description	Farm	Code	Sample
CORN SILAGE		323	21546690
CS BUNK			

Analysis Results

Components	As Fed	DM
% Moisture	65.6	
% Dry Matter	34.4	
% Crude Protein	2.6	7.5
Soluble Protein, % of CP		64
% ADICP	.1	.2
% NDICP	.3	.9
% ADF	7.0	20.4
% aNDF	12.3	35.6
% Adj. NDF	12.6	36.5
% Lignin	.4	1.1
Lignin % NDF		3
% Ash	.85	2.47
% Crude Fat	1.3	3.8
% NFC	17.4	50.6
% ESC (Simple Sugars)	.7	2.0
% Starch	14.9	43.3
% Soluble Fiber	1.8	5.3
% TDN	28	83
NEL, Mcal/Lb.	.30	.88
NEG, Mcal/Lb.	.21	.62
NEM, Mcal/Lb.	.31	.91
Milk Lbs./Ton of DM		3,734
Milk Lbs./Proc. Ton of DM		3,734


Great Plains

Cornell Cover Crop Trials-Radishes



No-Till Demo Day (August 2012)

Elizabeth A. Tomlin 08/21/12

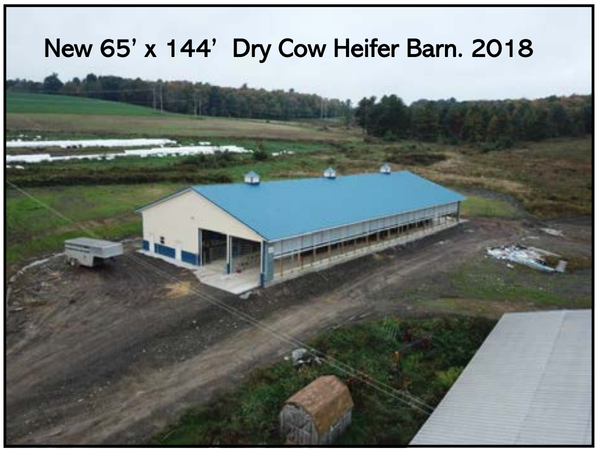
Elizabeth A. Tomlin 08/21/12

Pasture Renovations

Pasture Reseeding in Springtime

When seeding pastures it is best to use a mixture of many different grasses and legumes. Some start earlier in the spring, some handle drought and heat better, and some provide nitrogen and high protein.

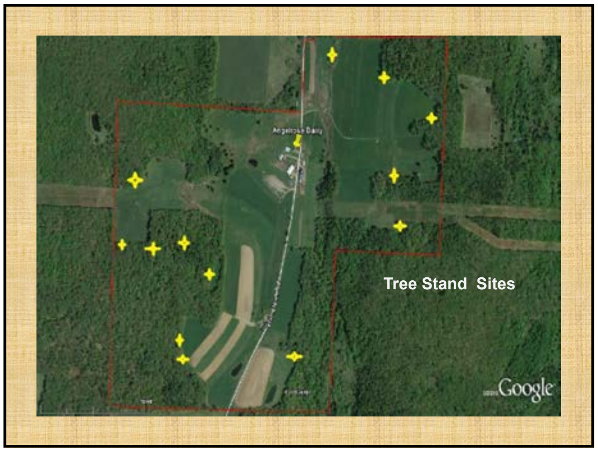
Seed To Soil Contact Is
An Absolute Necessity
To Good Germination
And To Your Success!



New 65' x 144' Dry Cow Heifer Barn. 2018

Wildlife Plot Seeded
10 Days Post Planting

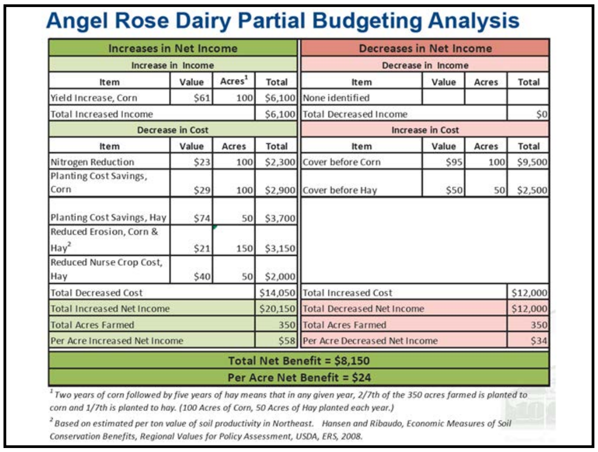
Keeping a Watchful Eye on The Crops



Tree Stand Sites

Good Soil Structure Is A Beautiful Sight!

Although Not Fancy, Our Ability to Spray When Conditions are Right is Very Important



Angel Rose Dairy Partial Budgeting Analysis

Increases in Net Income				Decreases in Net Income			
Increase in Income				Decrease in Income			
Item	Value	Acres[1]	Total	Item	Value	Acres	Total
Yield Increase, Corn	$61	100	$6,100	None identified			
Total Increased Income			$6,100	Total Decreased Income			$0
Decrease in Cost				Increase in Cost			
Item	Value	Acres	Total	Item	Value	Acres	Total
Nitrogen Reduction	$23	100	$2,300	Cover before Corn	$95	100	$9,500
Planting Cost Savings, Corn	$29	100	$2,900	Cover before Hay	$50	50	$2,500
Planting Cost Savings, Hay	$74	50	$3,700				
Reduced Erosion, Corn & Hay[2]	$21	150	$3,150				
Reduced Nurse Crop Cost, Hay	$40	50	$2,000				
Total Decreased Cost			$14,050	Total Increased Cost			$12,000
Total Increased Net Income			$20,150	Total Decreased Net Income			$12,000
Total Acres Farmed			350	Total Acres Farmed			350
Per Acre Increased Net Income			$58	Per Acre Decreased Net Income			$34
Total Net Benefit = $8,150							
Per Acre Net Benefit = $24							

[1] *Two years of corn followed by five years of hay means that in any given year, 2/7th of the 350 acres farmed is planted to corn and 1/7th is planted to hay. (100 Acres of Corn, 50 Acres of Hay planted each year.)*

[2] *Based on estimated per ton value of soil productivity in Northeast. Hansen and Ribaudo, Economic Measures of Soil Conservation Benefits, Regional Values for Policy Assessment, USDA, ERS, 2008.*

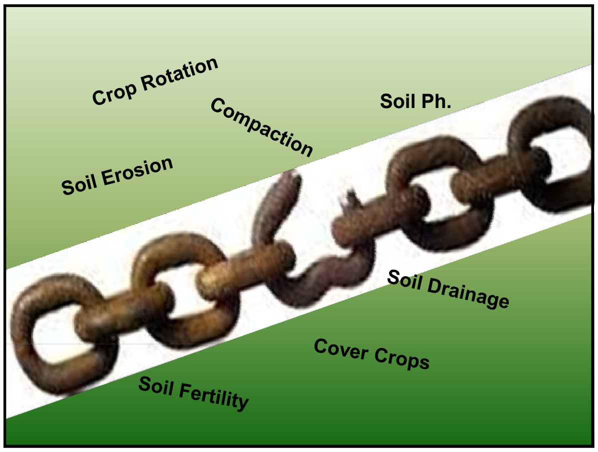
150

If You No-Till, it Will Grow.

Crop Scouting is Very Important.
We Have Always Made it A Family Affair.

Responsible Nutrient
Management Award
2016- NNTC

World Dairy Expo Forage Analysis SuperBowl
2015 Grand Champion Grass Hay



Crop Rotation

Compaction

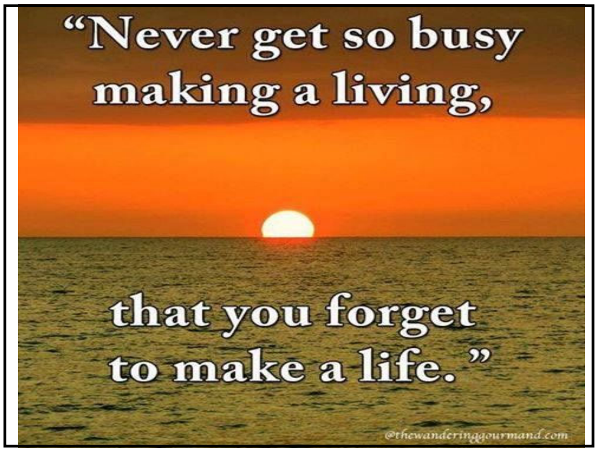
Soil Ph.

Soil Erosion

Soil Drainage

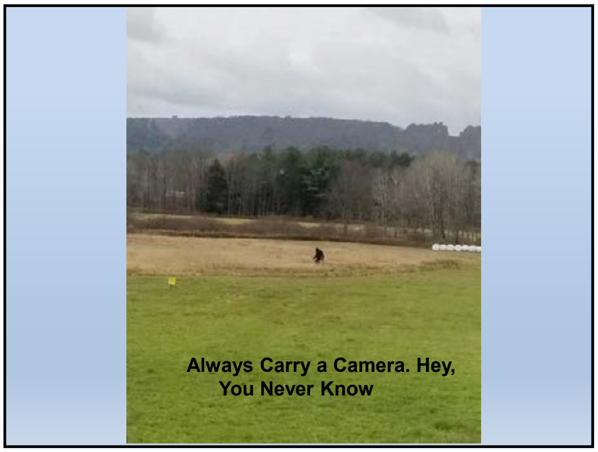
Cover Crops

Soil Fertility



"Never get so busy making a living, that you forget to make a life."

@thewanderinggourmand.com



Always Carry a Camera. Hey, You Never Know

Seeded 9-05-2018. Radish, Red Clover, Cereal Rye.

Hmmm

Some Of My Neighbors in Disbelief (Dog, Tick, and Woim)

This really Happens more often than you would think

I would like to thank Penn State, It's employees and the Nearby Farm Support Community for Inviting Me, and the Opportunity to Speak at This Nutrition Conference about our Farm. It is Always a Pleasure.
John K

Reaping the Benefit of Higher Quality Alfalfa Genetics

Tom Kilcer, CCA

Advanced Ag Systems LLC

www.advancedagsys.com

Where do You Start, What reaches the Mouth of the Cow

At Field Time of Harvest

Harvest losses

Storage Losses

Feed-out Losses

At Field Time of Harvest

Harvest losses

Storage Losses

Feed-out Losses

Highly Digestible Alfalfa Genetics

Not a Magic Bullet

But a critical tool to increase

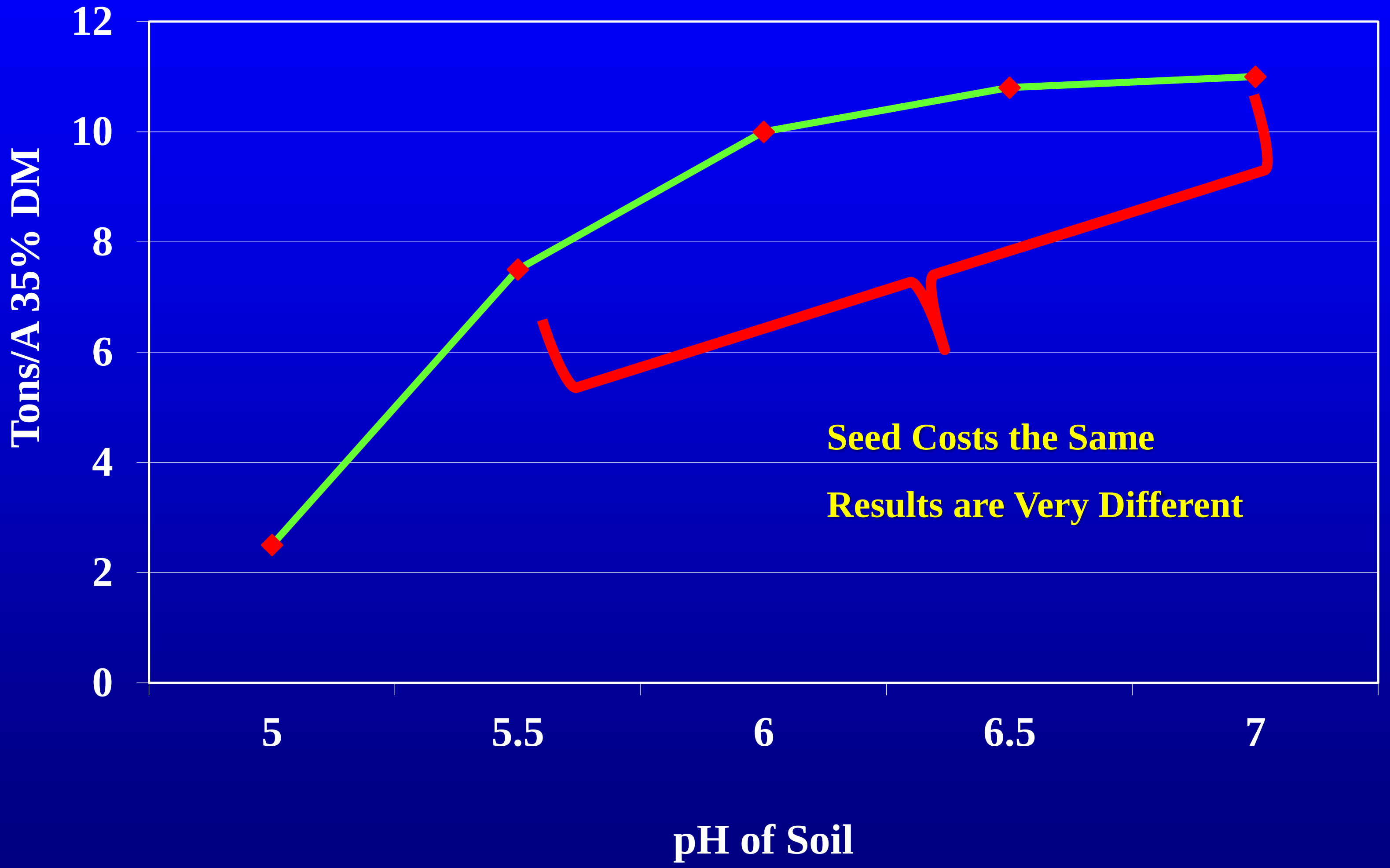
or get profitability

Field at the Time of Harvest

When was Last Soil Samples?

pH : This is not magic alfalfa

It Makes A Difference - Alfalfa



Seed Costs the Same

Results are Very Different

Was Great Alfalfa Beginning of Year

pH: 5.8

Advanced Ag Systems LLC

Field at the Time of Harvest

When was Last Soil Samples?

pH : This is not magic alfalfa

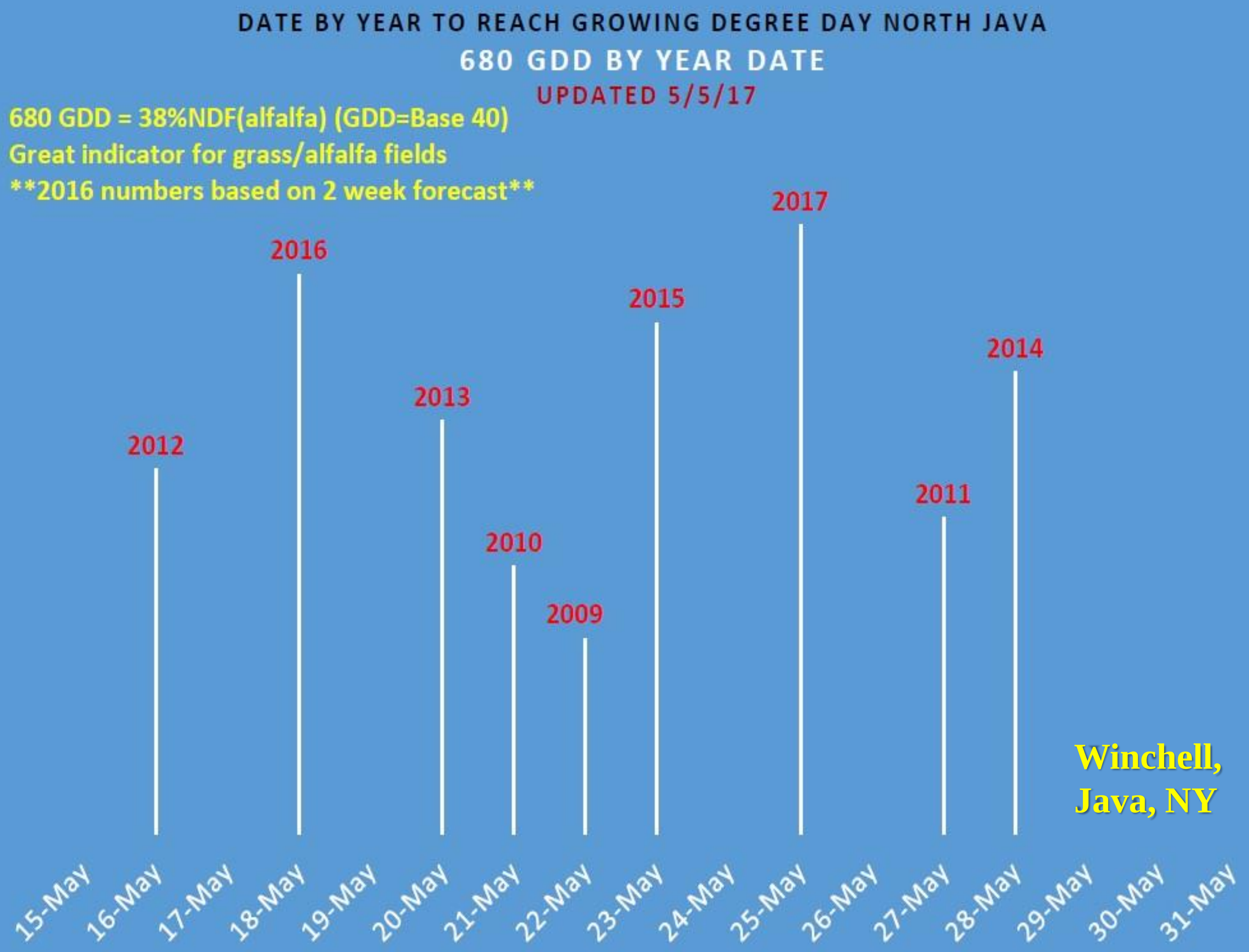
Sulfur: Critical for protein

Sulfur deficiency in alfalfa.

Dr. Ketterings, Cornell University

Quality Forage

When You Harvest



DATE BY YEAR TO REACH GROWING DEGREE DAY NORTH JAVA

680 GDD BY YEAR DATE

UPDATED 5/5/17

680 GDD = 38%NDF(alfalfa) (GDD=Base 40)

Great indicator for grass/alfalfa fields

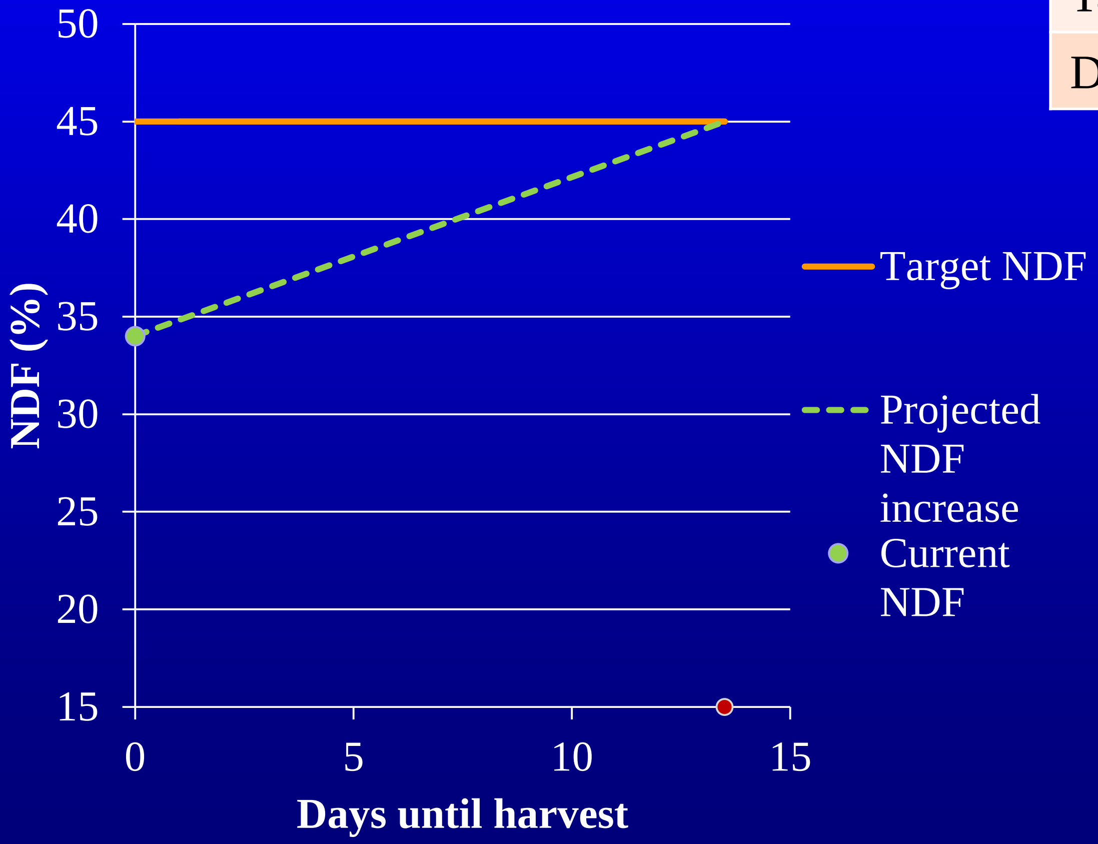
2016 numbers based on 2 week forecast

Winchell, Java, NY

Dr Cherney, Cornell U

Forages.org

Harvest Decision	
Alfalfa Height	12
% Grass	50
Target NDF	45
Maturation Rate	Normal
Current NDF	34
Target Height	25.5
Days To Harvest	13.5



Quality Forage

How You Harvest

Minimum Tillage Haylage

Where is alfalfa regrowth when you start to mow

Sid Bosworth, UVM

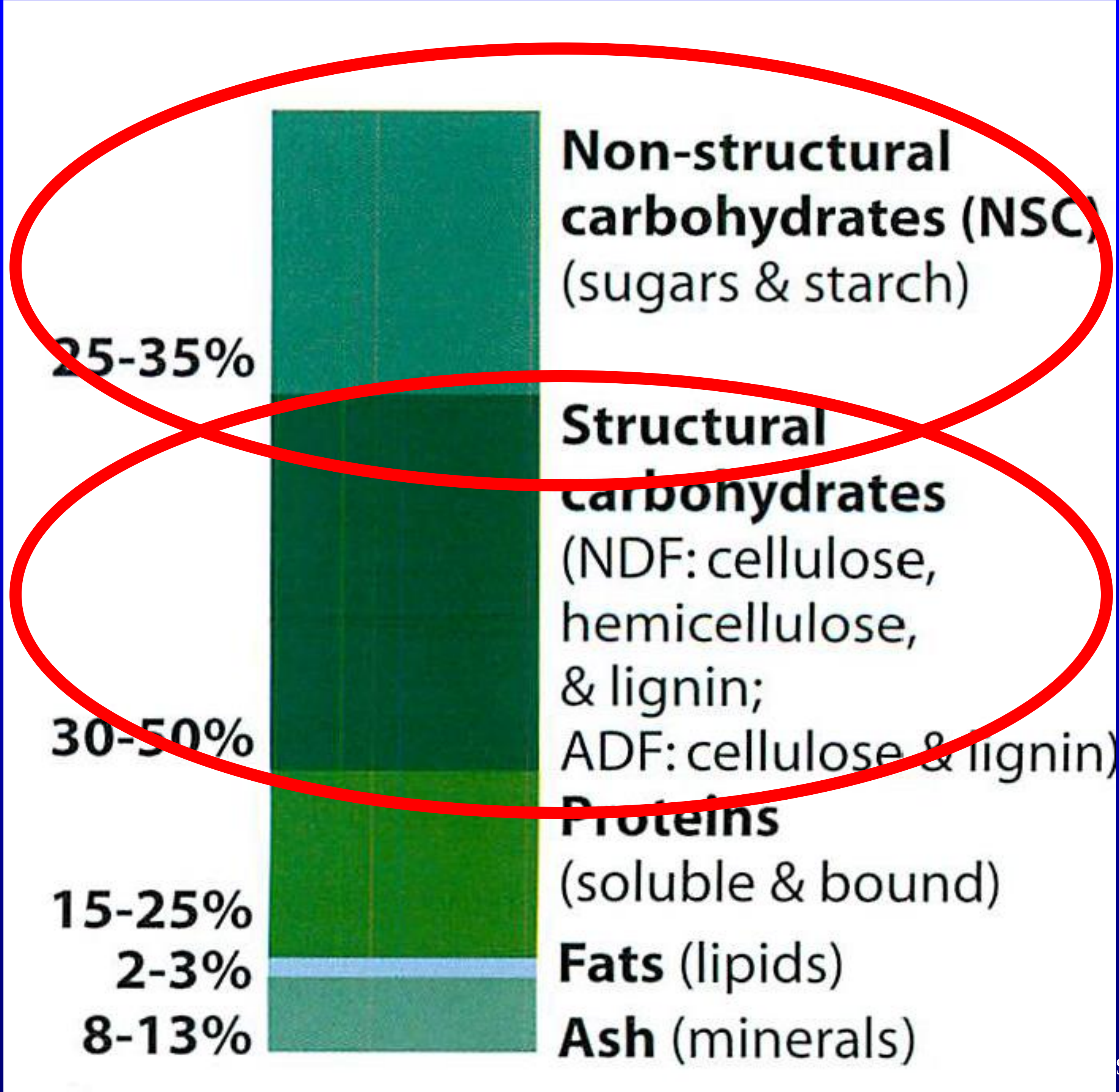
Cutting Height: Directly Impacts Ash

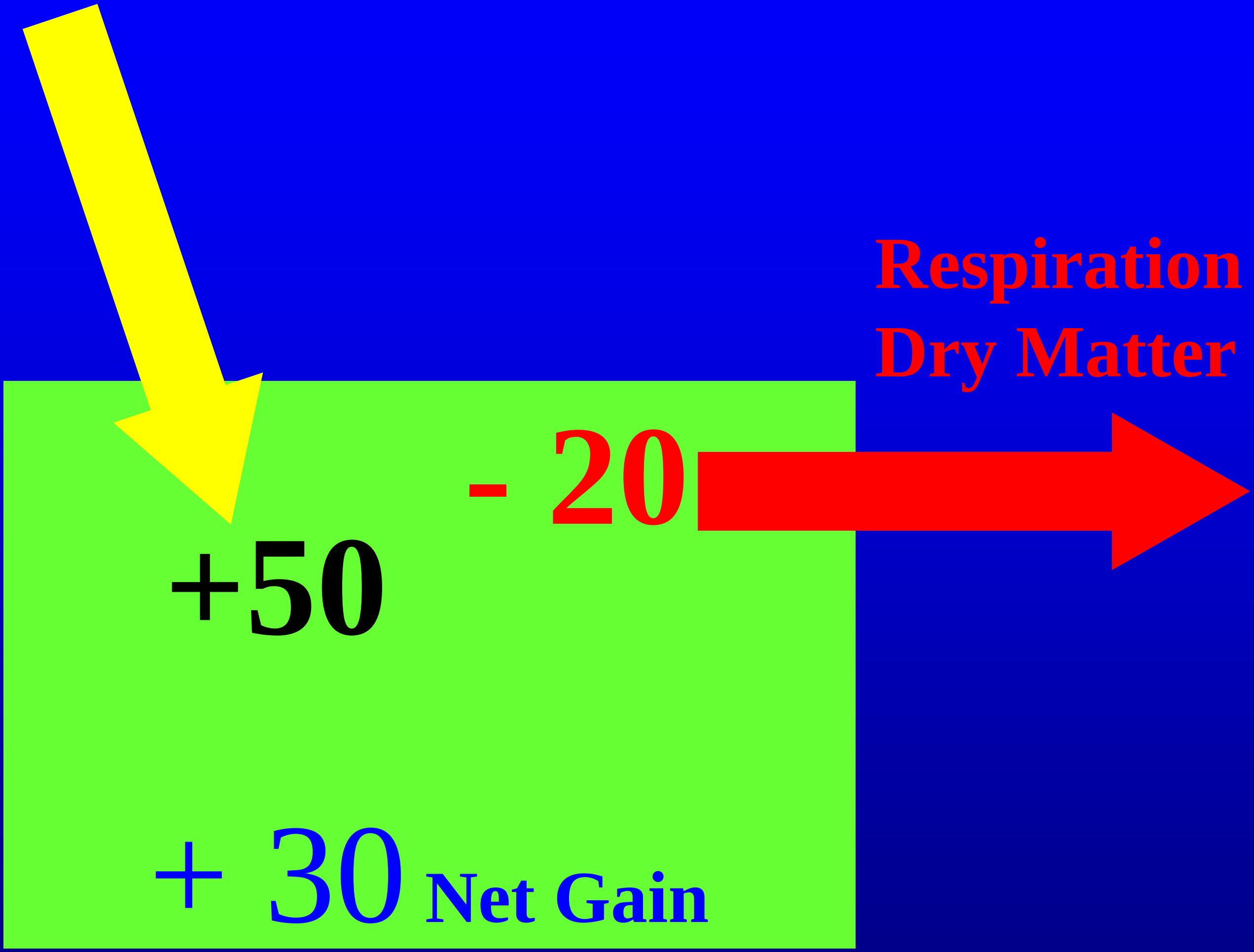
Tilted Knives and Mowing Close
9% vs 11% Ash

- you **lose 1.9 lbs of milk** compared to the same forage without that much ash
- in 305 days with 1000 cows is 5795 cwt @ $15/cwt = **$86,920**
- It can be made up by more grain, at a price and by money leaving your farm unnecessarily.

Many Farms Have +72 NEL Haylage

Why is Your Haylage 54 - 61 NEL?


25-35%
Non-structural carbohydrates (NSC)
(sugars & starch)
30-50%
Structural carbohydrates
(NDF: cellulose, hemicellulose, & lignin;
ADF: cellulose & lignin)
15-25%
Proteins
(soluble & bound)
2-3%
Fats (lipids)
8-13%
Ash (minerals)



Sunshine Produced Dry Matter

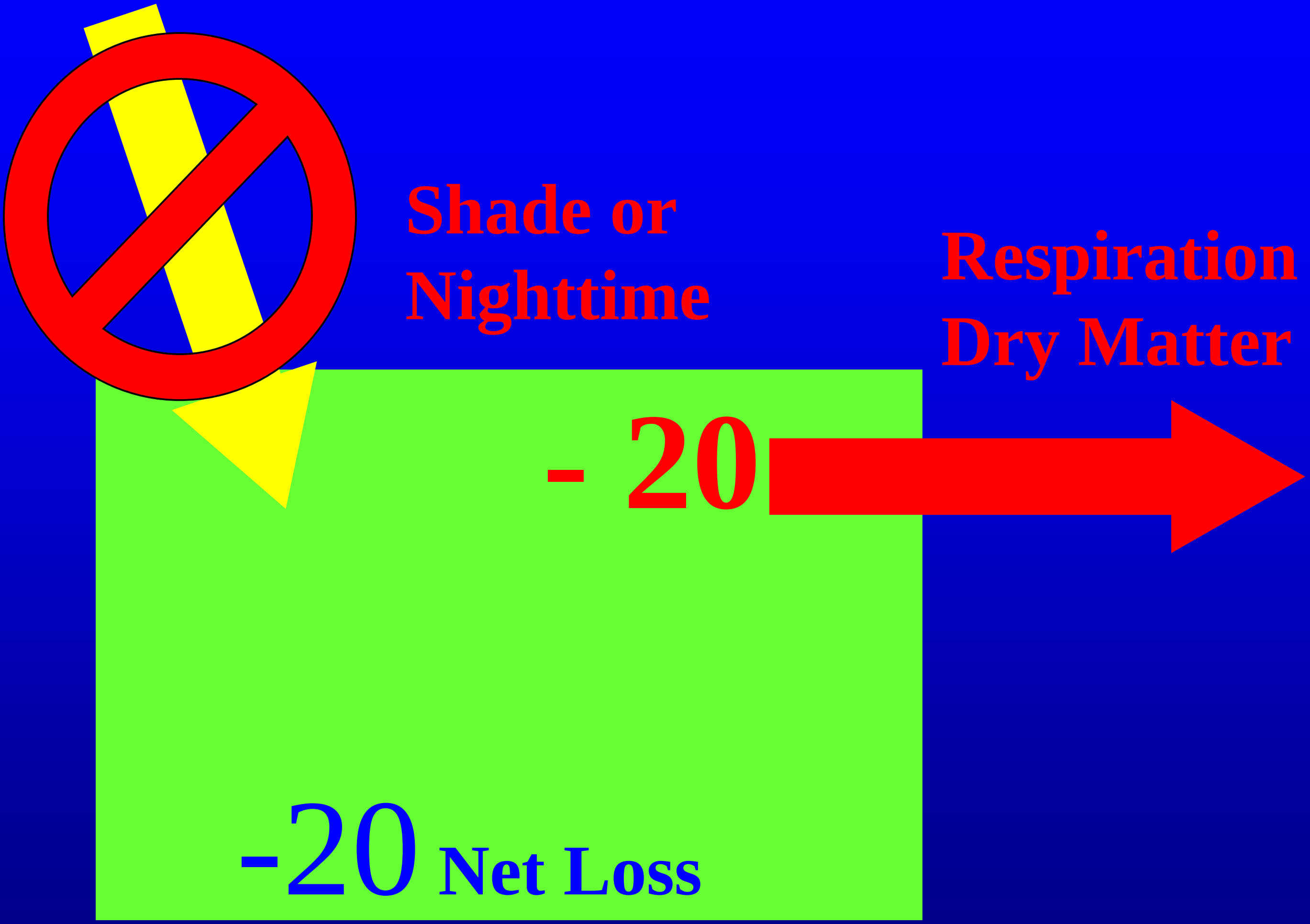
+50

- 20

Respiration lost Dry Matter

+ 30 **Net Gain**

Sunshine Produced Dry Matter



Shade or Nighttime

Respiration lost Dry Matter

- 20

-20 Net Loss

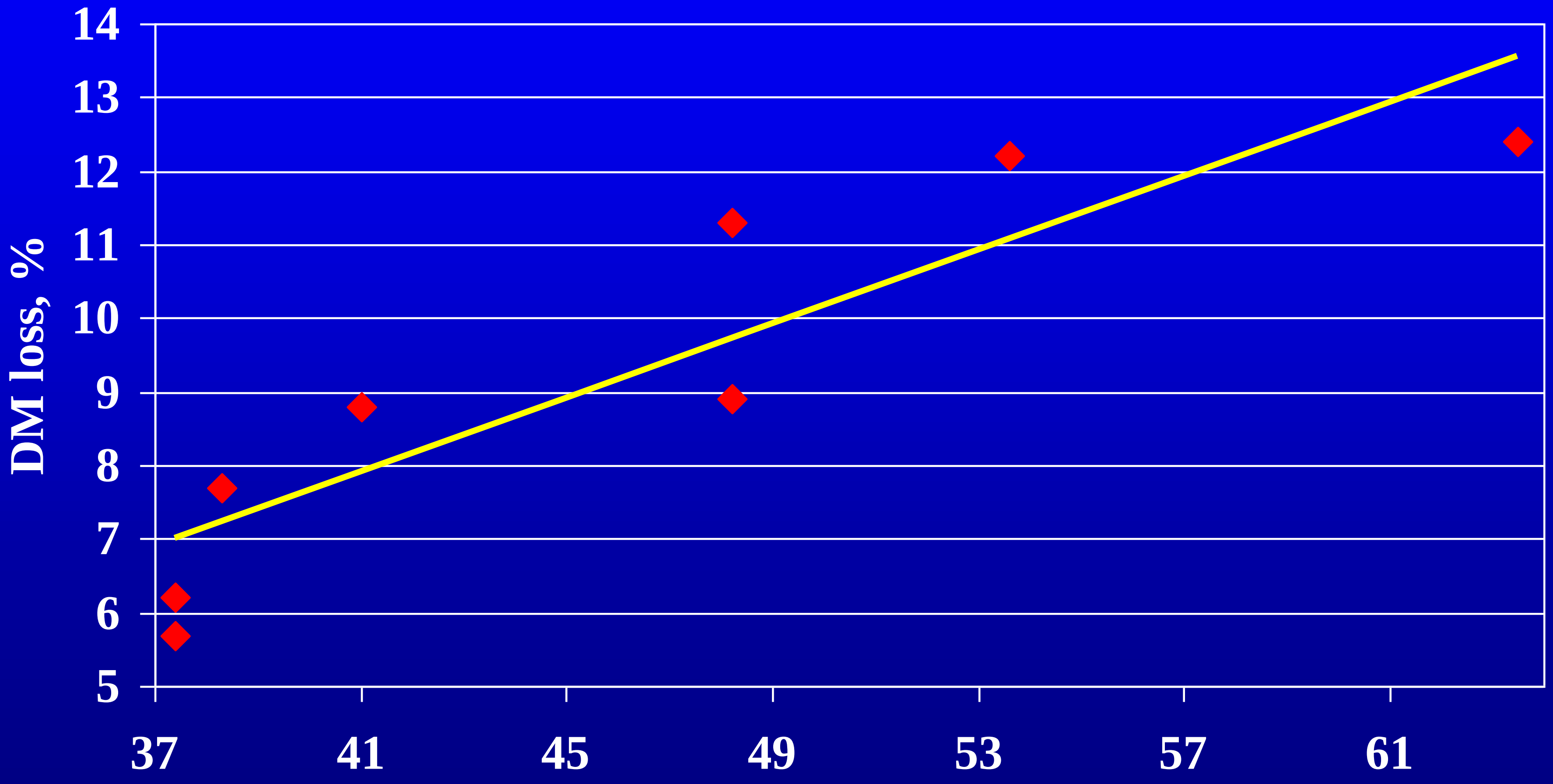
Biology: Photosynthetic Drying

$CO2 + H2O = CHO + O2$

In the presence of **Sunshine**

Increasing Energy In Forage

Relationship between overnight DM loss and minimum night temps



Min temp, degrees F

Knapp et.al. 1973

EVERT VELDHUIZEN
32340 VELDALE FARM

519-537-1139
519-456-5866 (F)

RATION INGREDIENT ANALYSI

Milk cow 650 35 4.0-

	RATION	PR. CORN SIL-BU	2ND CUT HAYLAGE
		14456770	14995950
As fed level	121.20	62.50	31.30
Dry matter, %	42.81	36.00	48.00
Crude protein, %	16.3	6.9	22.4
Soluble Protein, % CP	42.0	43.0	61.0
RDP, % CP	67.7	71.0	77.0
RUP, % CP	32.2	29.0	23.0
TDN, %	73.2	75.0	67.0
NE, lactation, Mc/lb	0.76	0.77	0.70
Forage, %	74.1	100.0	100.0

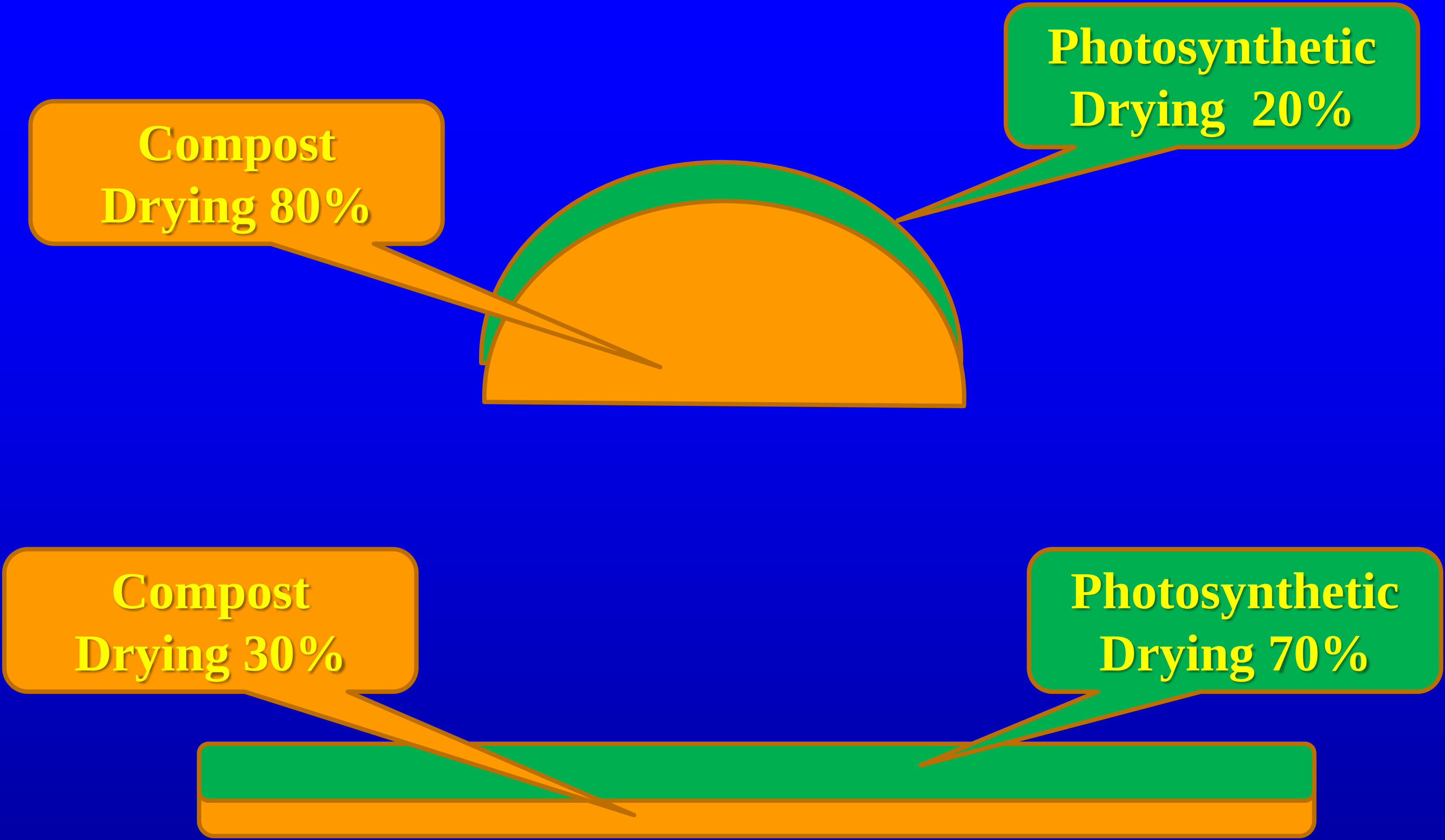
Windrows are Compost Drying

Drying Reduced

10 – 100X

Harris & Tullberg 1980

- **100% humidity in windrow = No drying**
- **No sunlight = No photosynthesis energy/drying**
- **Respiration reduces energy level**
- **Sugar reduced 19%**
- **Starch (concentrated energy) reduced 92%**
- **No substrate for rapid fermentation which burns off more energy**

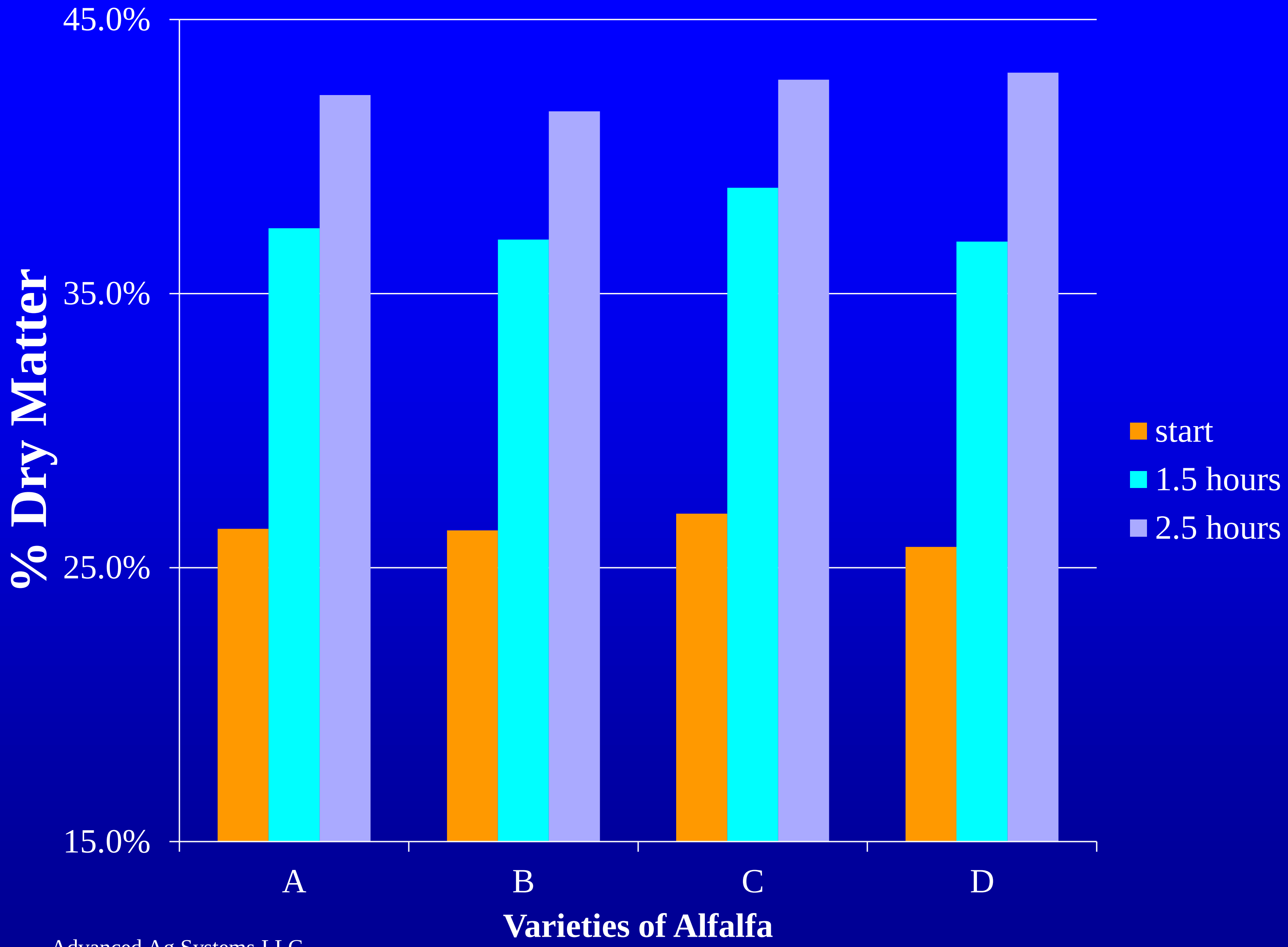


Compost Drying 80%

Photosynthetic Drying 20%

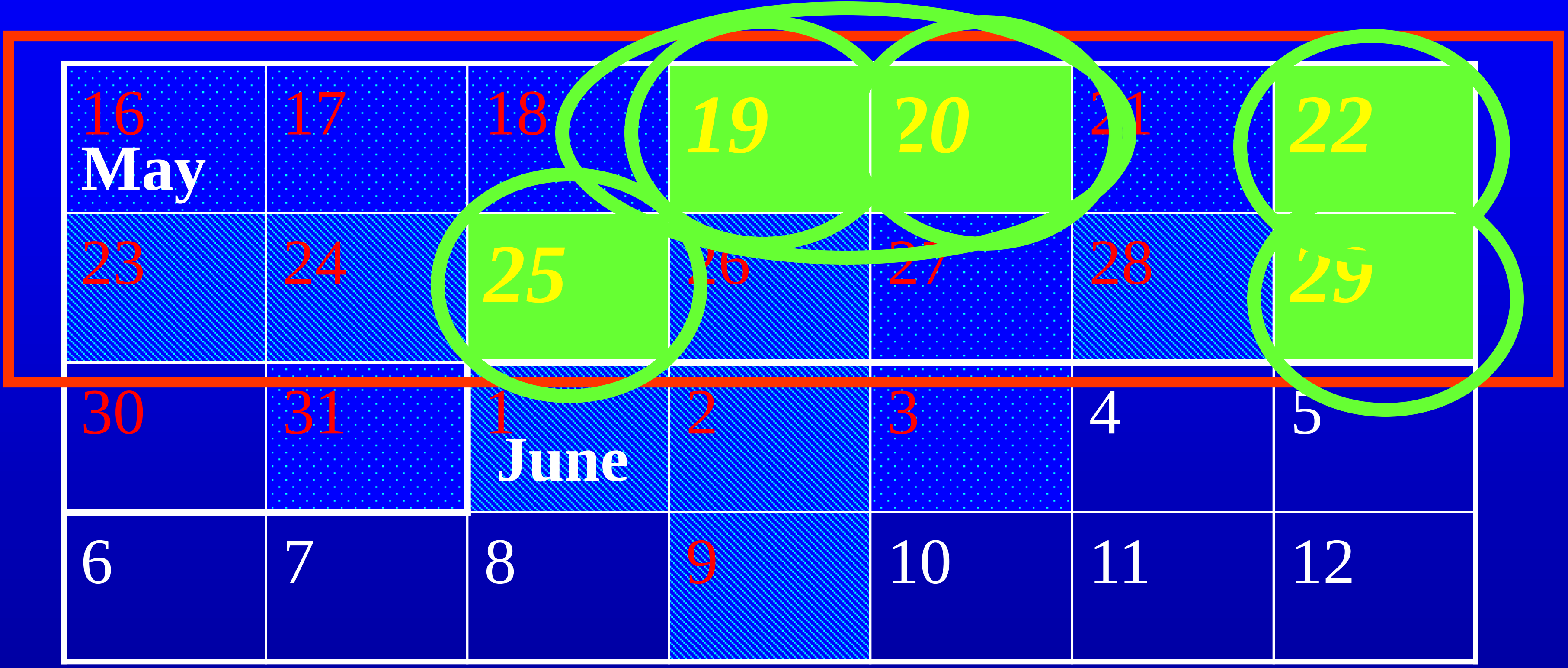
Compost Drying 30%

Photosynthetic Drying 70%



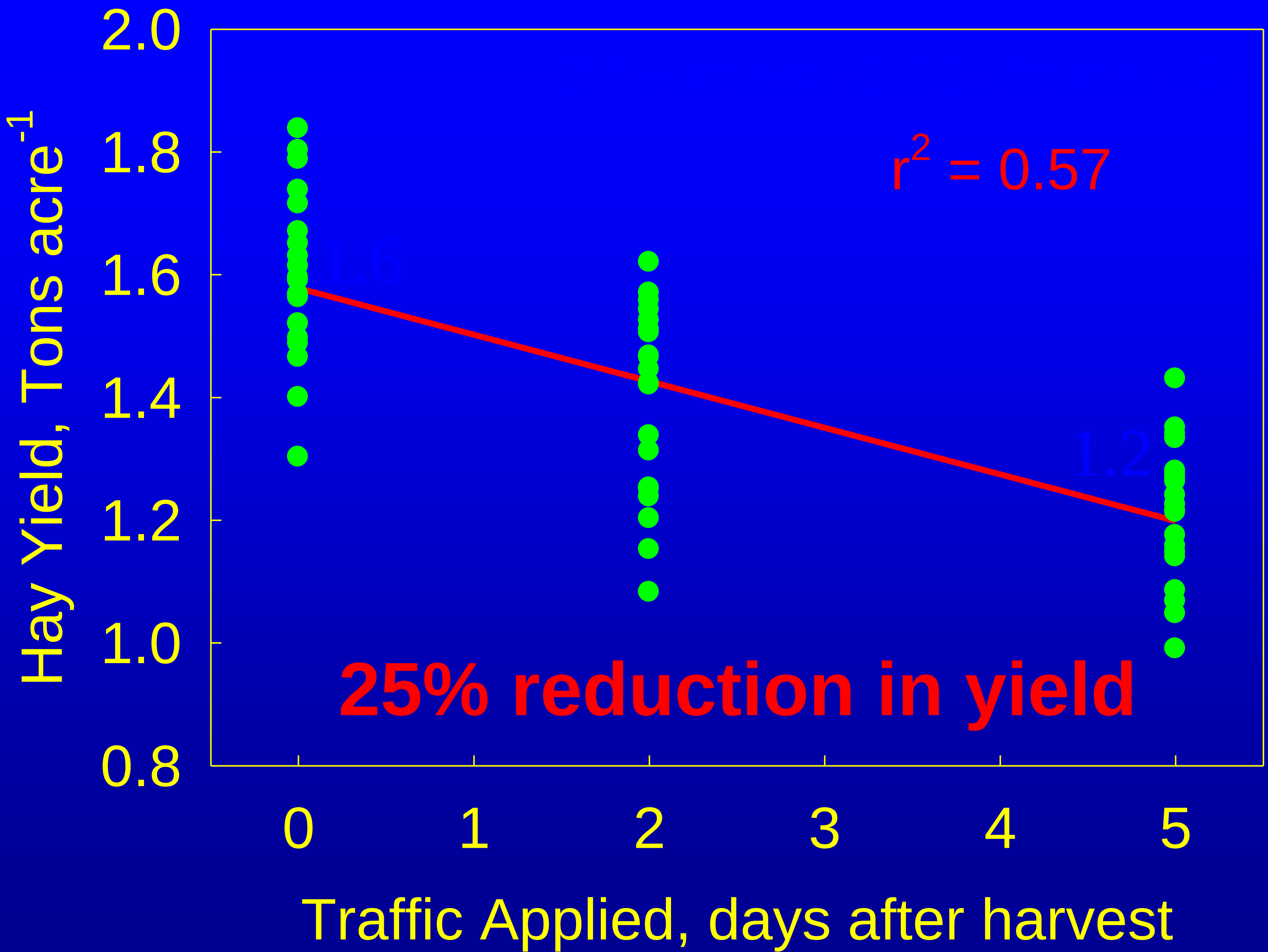
Advanced Ag Systems LLC

1st Cut Harvest Window



16 May	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31	1 June	2	3	4	5
6	7	8	9	10	11	12

Light rain ▨ **Heavy rain** ▨ **No rain** 🟩



Dr. Undersander , U of Wisconsin

Width Matters More Than Conditioning – Alfalfa- Swath Not Moved

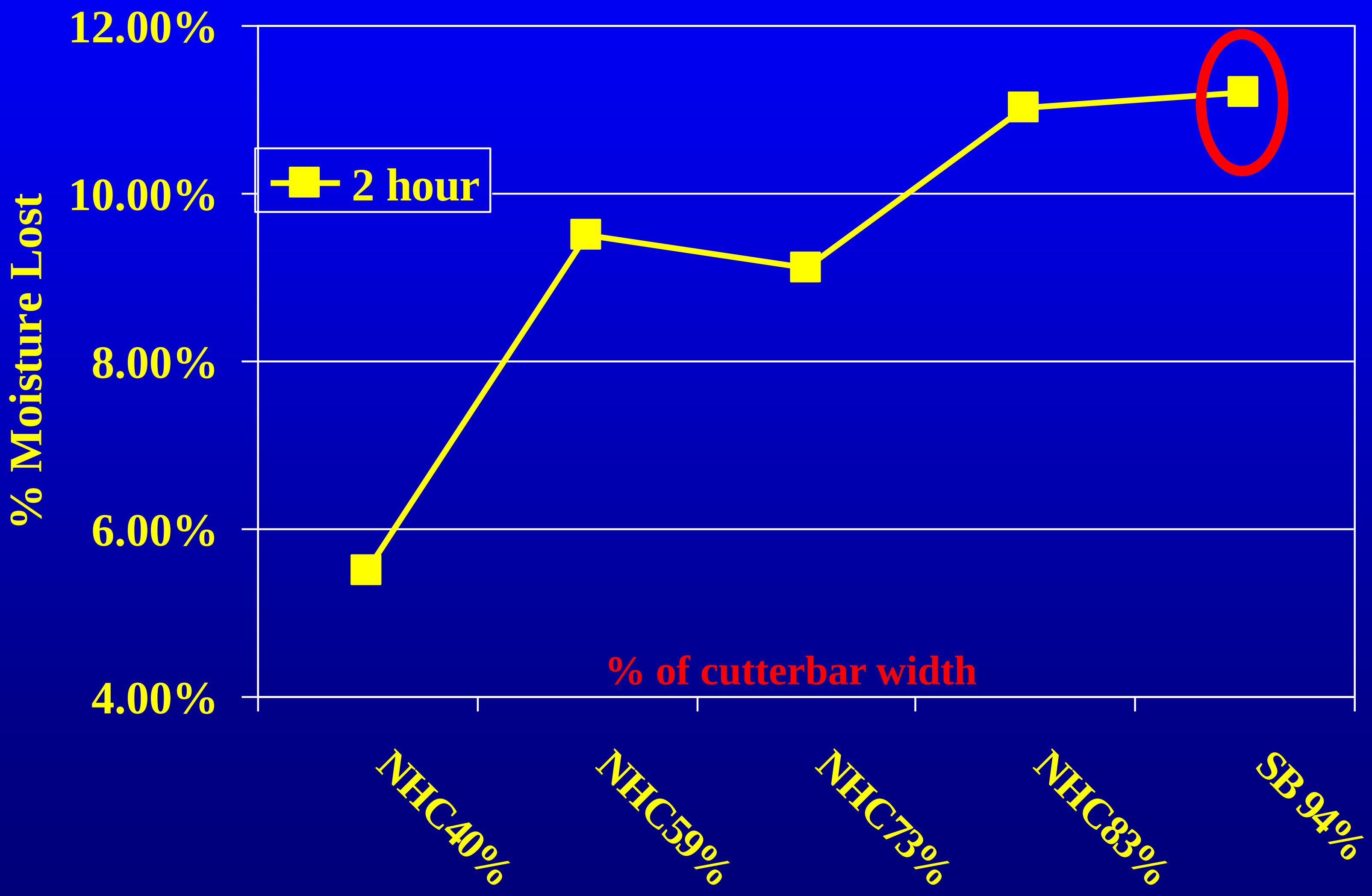
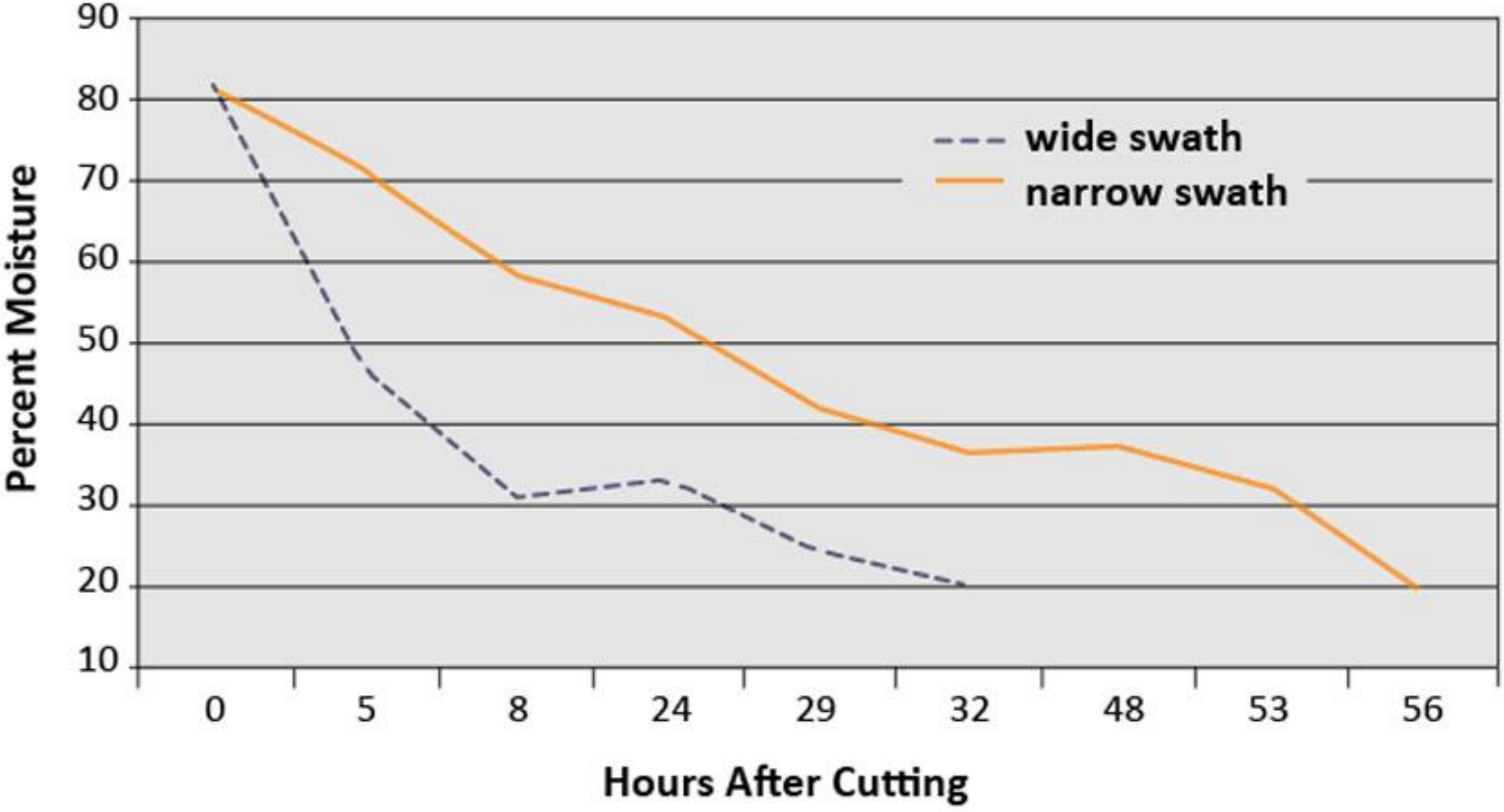


Figure 2. Effect of wide swath vs. narrow swath drying rate, Arlington, Wisconsin, July 2007

Representative of drying curves for narrow and wide swath widths.

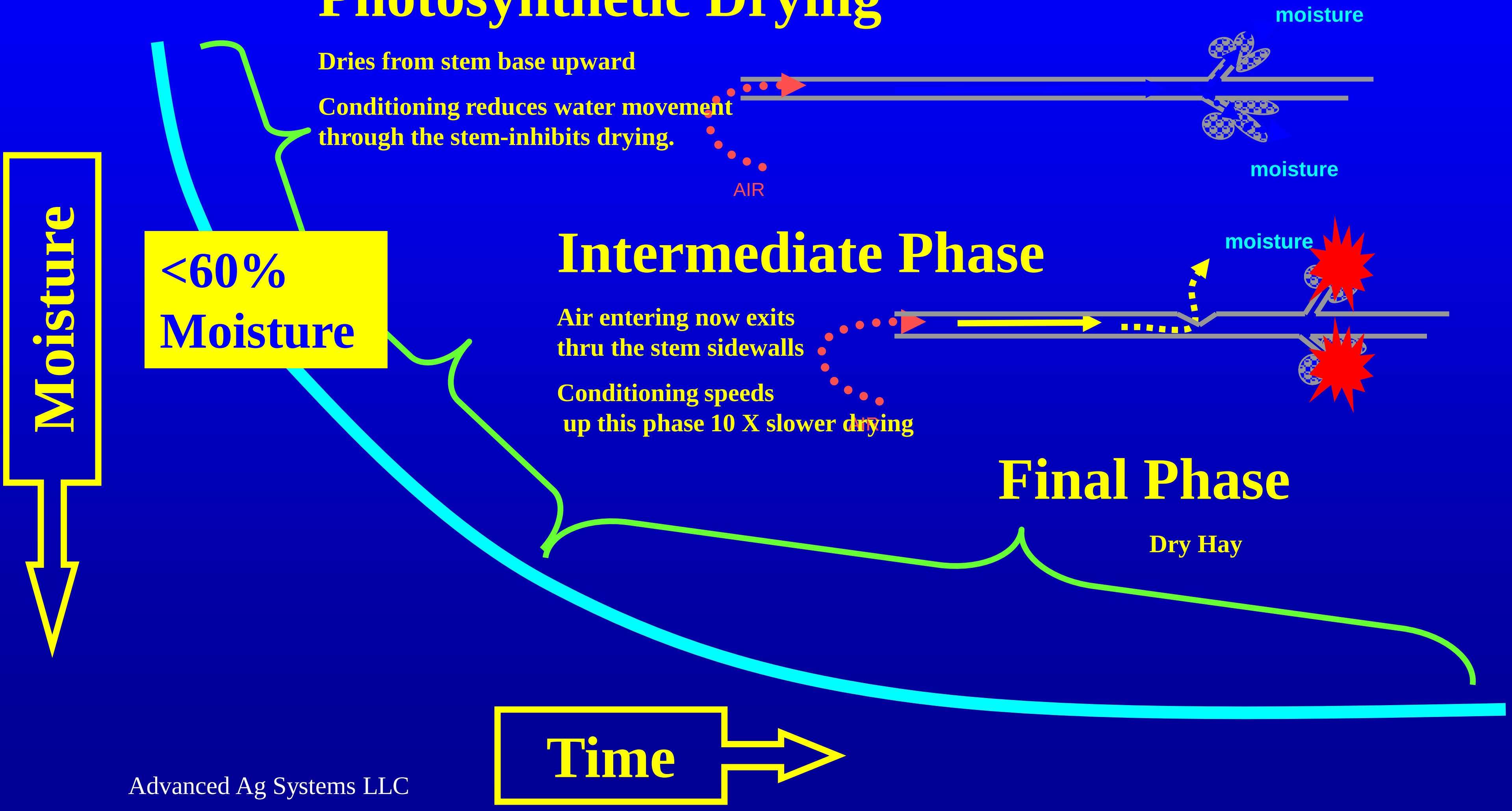


Vemeer TM 1200

Dave Schwantes,
Minnesota

92.8% of Cutterbar

Biology of Drying Forages



Photosynthetic Drying

Dries from stem base upward

Conditioning reduces water movement through the stem-inhibits drying.

Intermediate Phase

Air entering now exits thru the stem sidewalls

Conditioning speeds up this phase 10 X slower drying

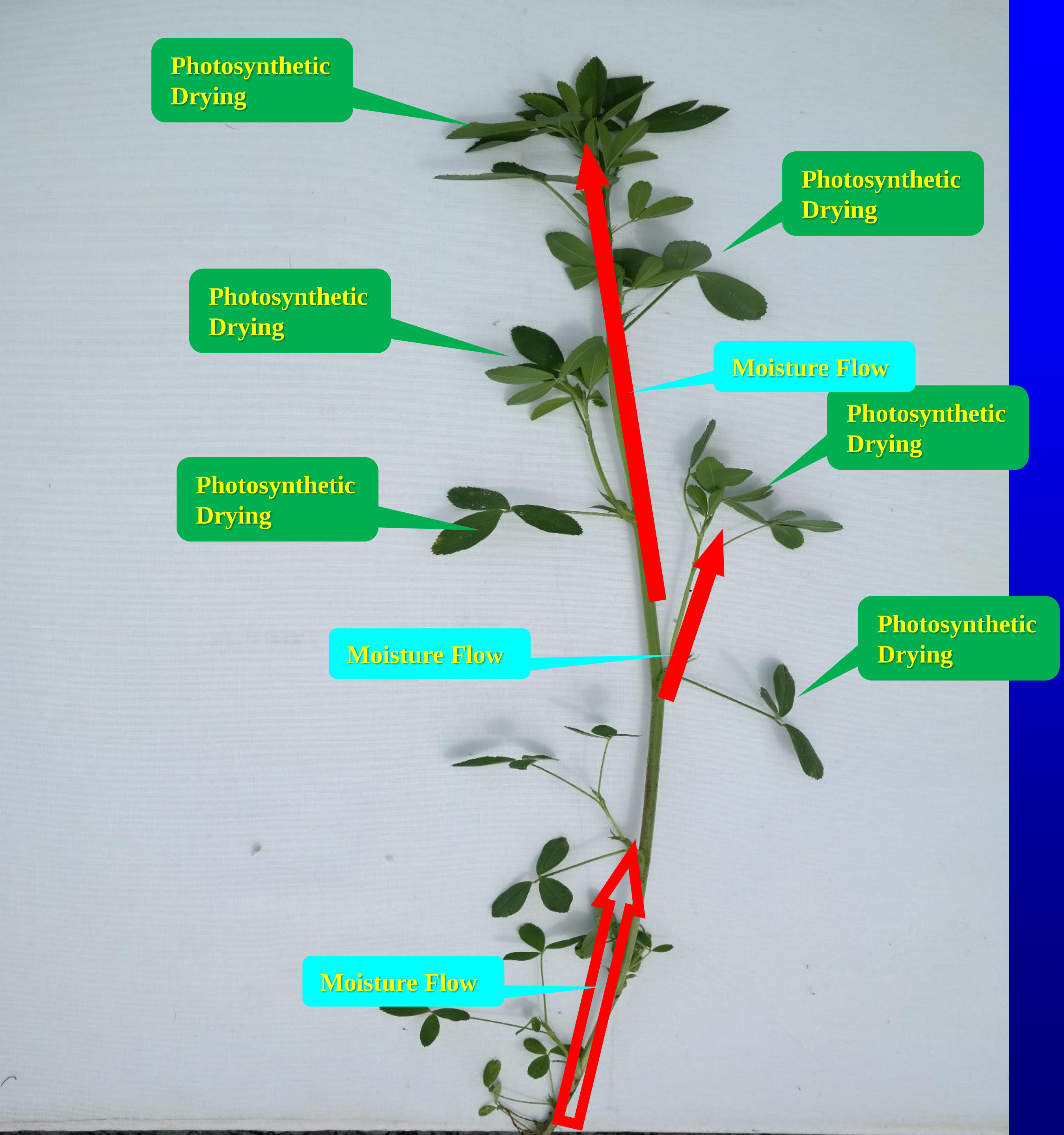
Final Phase

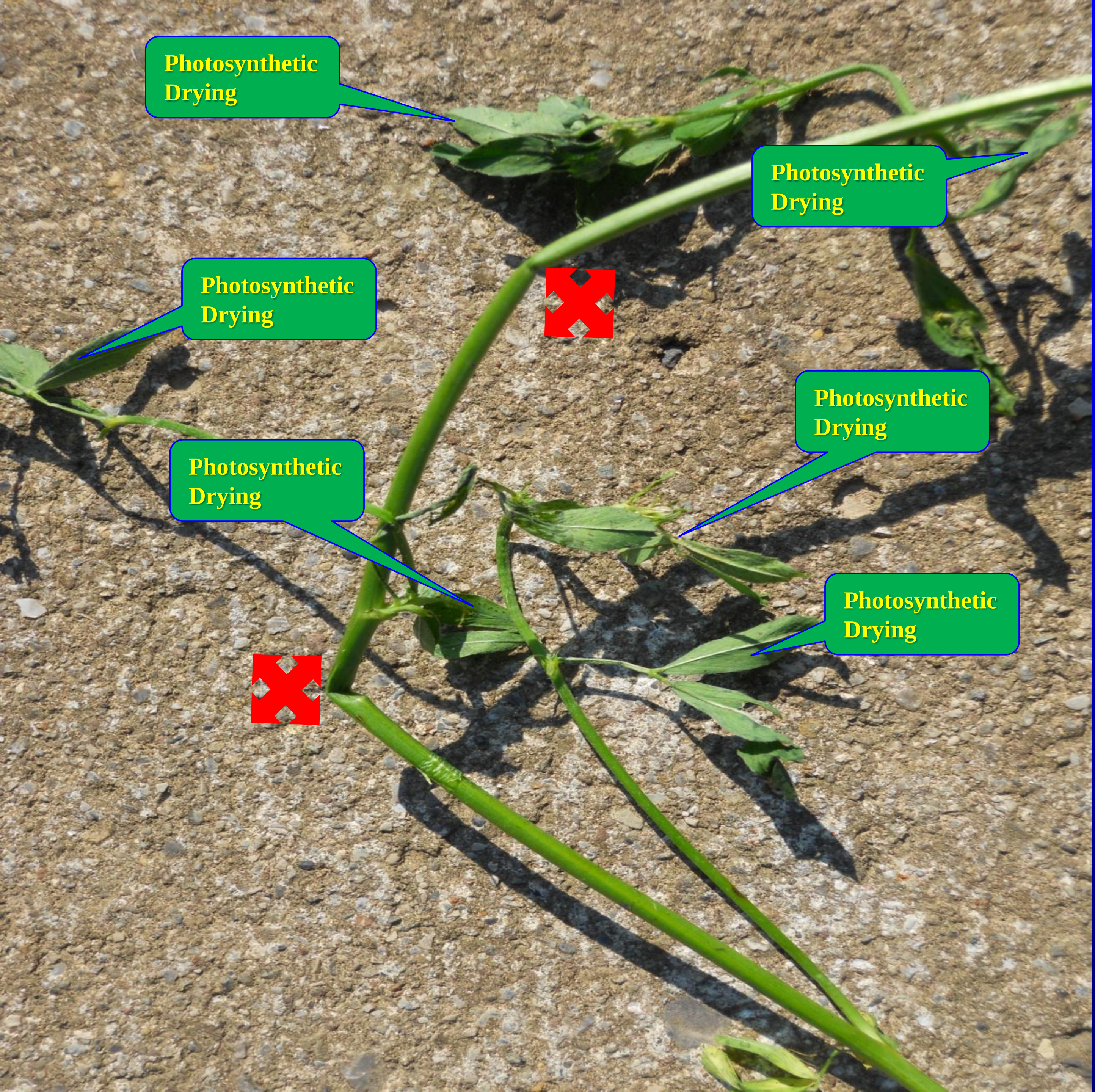
Dry Hay

<60% Moisture

Moisture

Time

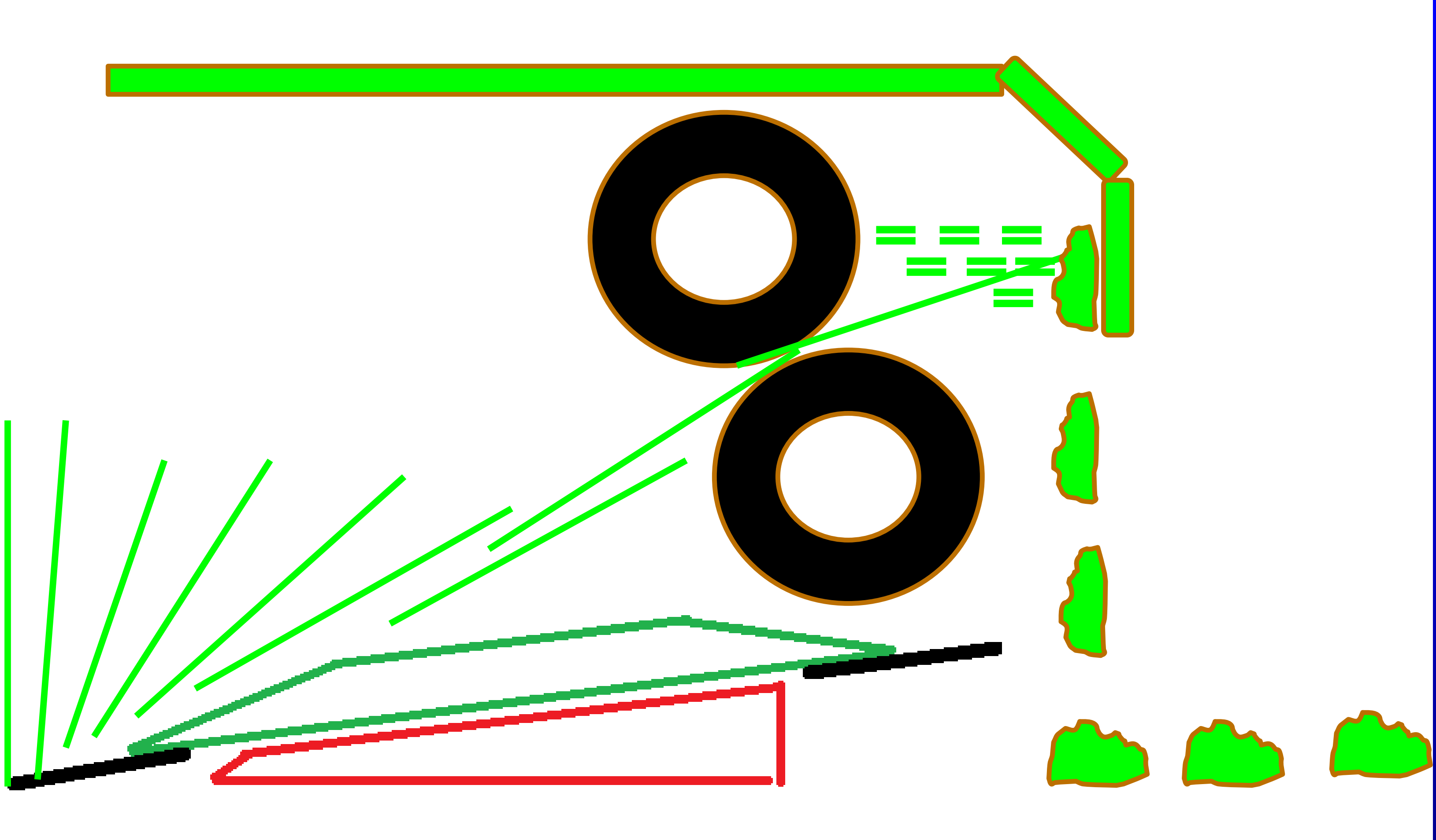

Photosynthetic Drying
Photosynthetic Drying
Photosynthetic Drying
Moisture Flow
Photosynthetic Drying
Photosynthetic Drying
Photosynthetic Drying
Moisture Flow
Moisture Flow

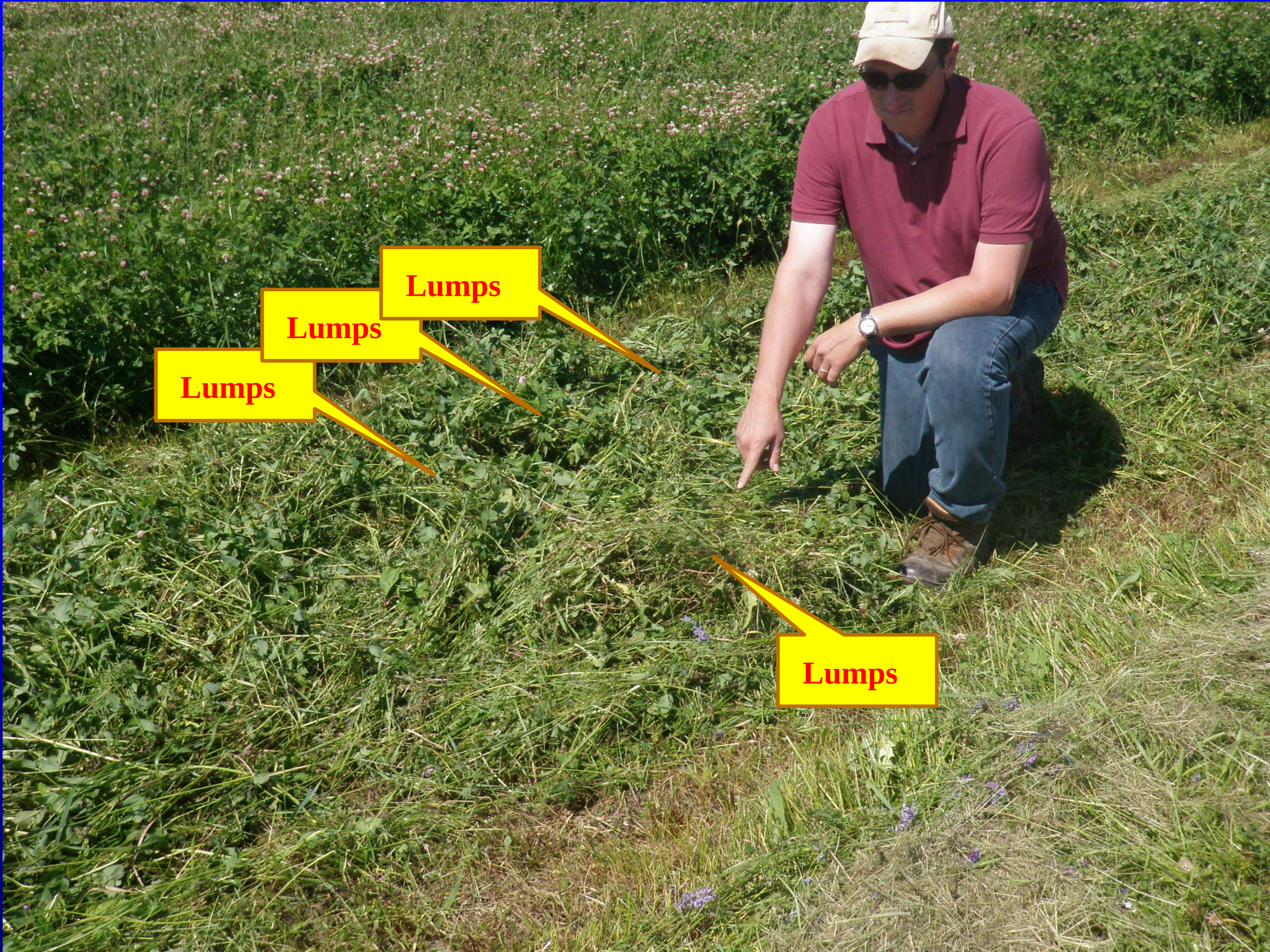

Photosynthetic Drying
Photosynthetic Drying
Photosynthetic Drying
Photosynthetic Drying
Photosynthetic Drying
Photosynthetic Drying

Rolls Conditioner

2002; 350 cows, average leaf loss
average protein loss = $15000

Flail condiitoner




Lumps
Lumps
Lumps
Lumps

Steve Adsmond, PAS
Richhart Consulting

Mergers run to fast for material or run to close to the ground – vacuums everything up.

Steve Adsmond, PAS
Richhart Consulting


oxbo

USE AN INOCULANT!!!

	NDFd 30	Lignin/NDF
Inoculant 1	67.05 a	7.49 c
Inoculant 2	67.78 a	7.87 b
No Inoculant	63.13 b	8.25 a

= to 2.3 pounds of milk/cow/day

Photo by Ketterings

Questions??

Advanced Ag Systems LLC.
http://www.advancedagsys.com