Dairy Precision Feeding and the Impact to the Chesapeake Bay Watershed

Virginia Ishler and
Rob Goodling (Ag Business Consultant, Horizon Farm Credit)

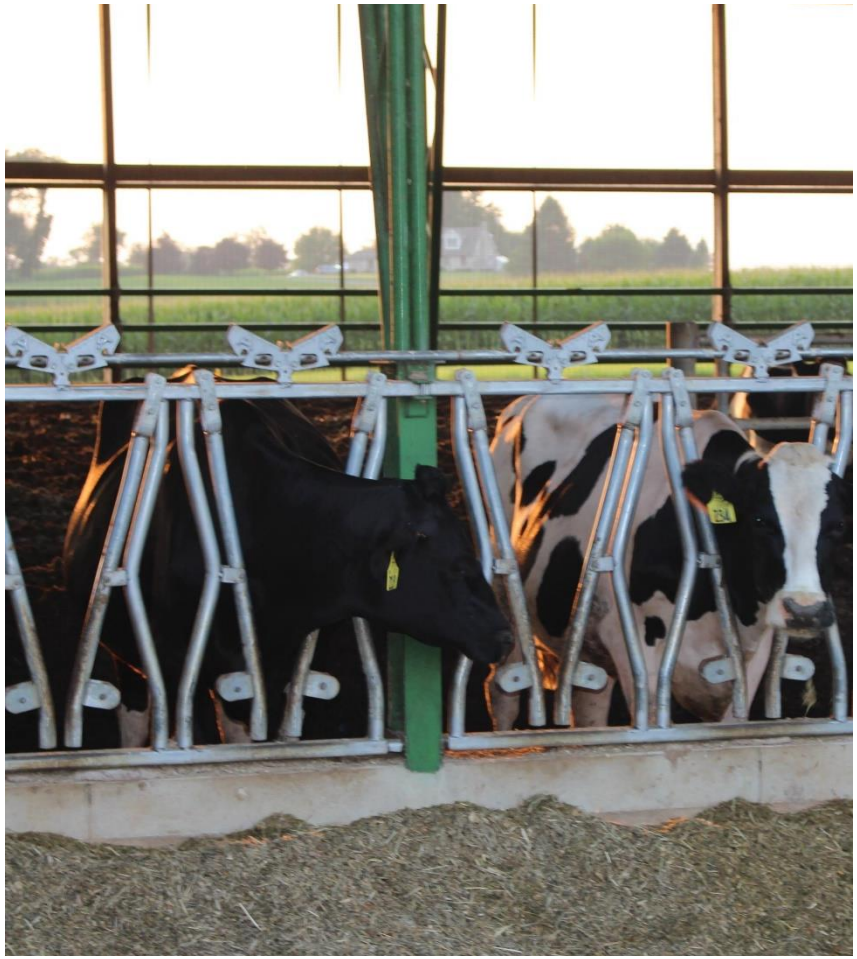
vishler@psu.edu

Photo credit: Penn State Extension

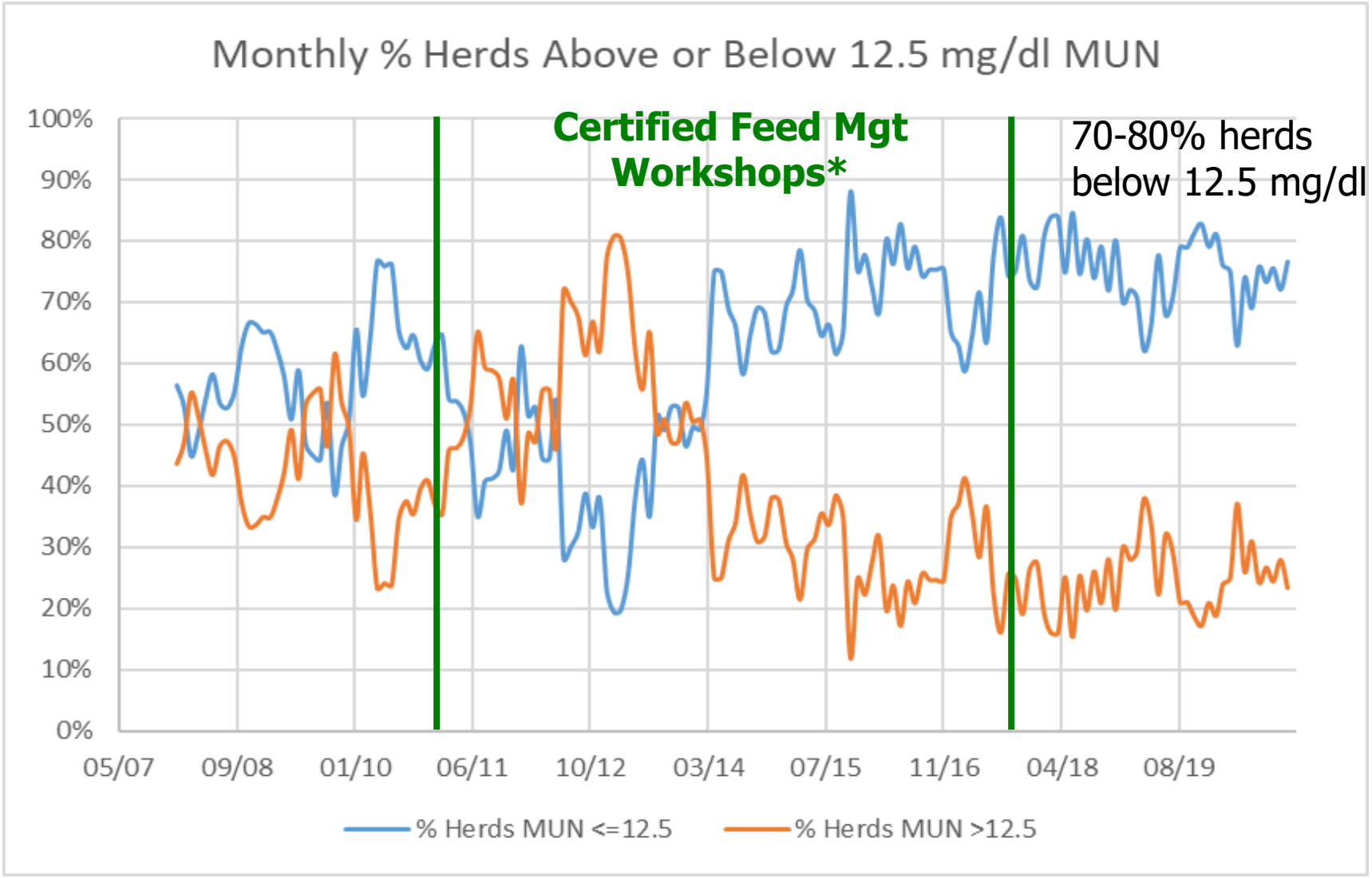
PennState Extension

Outline

- Recap on PA MUN results – DHIA and Milk Co-ops
  - Where are we now?
- Dairy Farm Feeding Assessments – Carly Becker and Rainey Rosemond
  - Applies to N and P
  - Applies to climate smart strategies, e.g., FE



Percent PA Herds with MUN < or >12.5 mg/dl



Source: DHIA data – 580 dairy operations – Jan 2008 – Dec 2020 (DRMS.org)

***2011 - 51 operations received EQIP funding for Feed Management**

MUN Comparison of DHIA and Milk Co-ops using Monthly and Annual Data - **2020**

MUNS Results for 2020	*DHI-Monthly*	*Co-op A-Monthly*	*Co-op B - Annual*	*Co-op C - Annual*
Mean	10.95	10.54	11.02	10.34
Standard Error	0.07	0.01	0.07	0.12
Median	11.00	10.40	11.20	10.50
Standard Deviation	2.51	2.36	1.74	1.66
Minimum	6.00	6.00	6.22	6.54
Maximum	24.00	29.30	17.66	15.24

DHIA – 580 herds
Co-ops – 1431 herds

Predicting N Excretion

Summary of N data collected from 1995 to 2015.

Item	Observations Number	Min g/d	Median g/d	Mean (SD) g/d	Max g/d
Lactating cows					
Urine N	**215**	**39.5**	**187.5**	**192.9 (70.5)**	**331.0**
Fecal N	213	69.2	176.0	177.3 (51.3)	308.0
Total manure N	211	151.2	368.0	370.1 (98.9)	606.4

Source: Johnson et. al. Journal of Dairy Science, 2016.

Note: 27 papers/equations developed over the 20 years

Predicting Urinary N Excretion

MUN	Grams N excreted/ cow/day	Lbs. N excreted/ cow/day
8	148.6	0.33
9	163.7	0.36
10	178.8	0.39
11	193.9	0.43
12	209.0	0.46
13	224.1	0.49
14	239.2	0.53
15	254.3	0.56
16	269.4	0.59

- Kohn et. al. Journal of Dairy Science, 2002
- (15.1*MUN)+27.8
- MUN ideal range is 8 to 12.5 mg/dl.

Updated N Excretion Numbers vs. ASAE D384.2 Mar2005 Standards

		JDS, 2016		ASAE, 2005
		Mean (SD)		
Total Manure N, g/d		370.0 (98.9)		450.0
Urinary N, g/d		192.9 (70.5)		234.6*
MUN, mg/dl**		11		14

*Estimated using 52% of total manure N like JDS 2016 data.

**Kohn et al. 2002 equation for estimated MUN

Note: MUN recommendation in 2005 was 12-14 mg/dl compared to current recommendation of 8 to 12 mg/dl.

Meta-analysis (162 experiments/22 institutions)

Input variable	n	Mean	SD	Min	Max
Animal characteristics					
DIM (d)	5,416	111	68.0	1	304
BW (lbs)	4,892	1410	167	950	1870
Dietary nutrient content (% of DM)					
CP	5,142	16.4	1.55	12.4	20.5
NDF	4,924	35.4	5.62	20.4	49.9
Performance variables					
DMI (lbs/d)	5,452	47.1	9.22	21.8	72.6
N intake (g/d)	5,219	569.1	130.41	207.4	944.0
MY (lbs/d)	5,385	70.6	20.46	16.1	125.2
MFat (%)	5,191	3.92	0.626	2.25	5.51
MProt (%)	4,813	3.26	0.310	2.42	4.07
MUN (mg/dL)	**4,350**	**11.2**	**4.541**	**1.5**	**24.2**
Nitrogen excretion (g/d)					
Fecal nitrogen	5,409	184.0	50.38	46.8	322.1
Urinary nitrogen	**3,621**	**175.5**	**66.22**	**7.0**	**365.2**
Total manure nitrogen	3,629	358.4	96.14	97.0	633.0

Prediction of nitrogen excretion from data on dairy cows fed a wide range of diets compiled in an intercontinental database: A meta-analysis **J. Dairy Sci. 105:7462–7481** https://doi.org/10.3168/jds.2021-20885 **(Published August 2022)**

Meta-analysis (162 experiments/22 institutions)

- Region-specific models

- DMI or N intake and MUN are required for good prediction of fecal, urinary, and total manure N excretion.

Prediction of nitrogen excretion from data on dairy cows fed a wide range of diets compiled in an intercontinental database: A meta-analysis **J. Dairy Sci. 105:7462–7481 https://doi.org/10.3168/jds.2021-20885**

Take Away Messages for PA Herds

MUNs are decreasing and fall within ideal range of 8 to 12 mg/dl since 2014.

DHIA and Co-op data agree that this declining MUN trend is real.

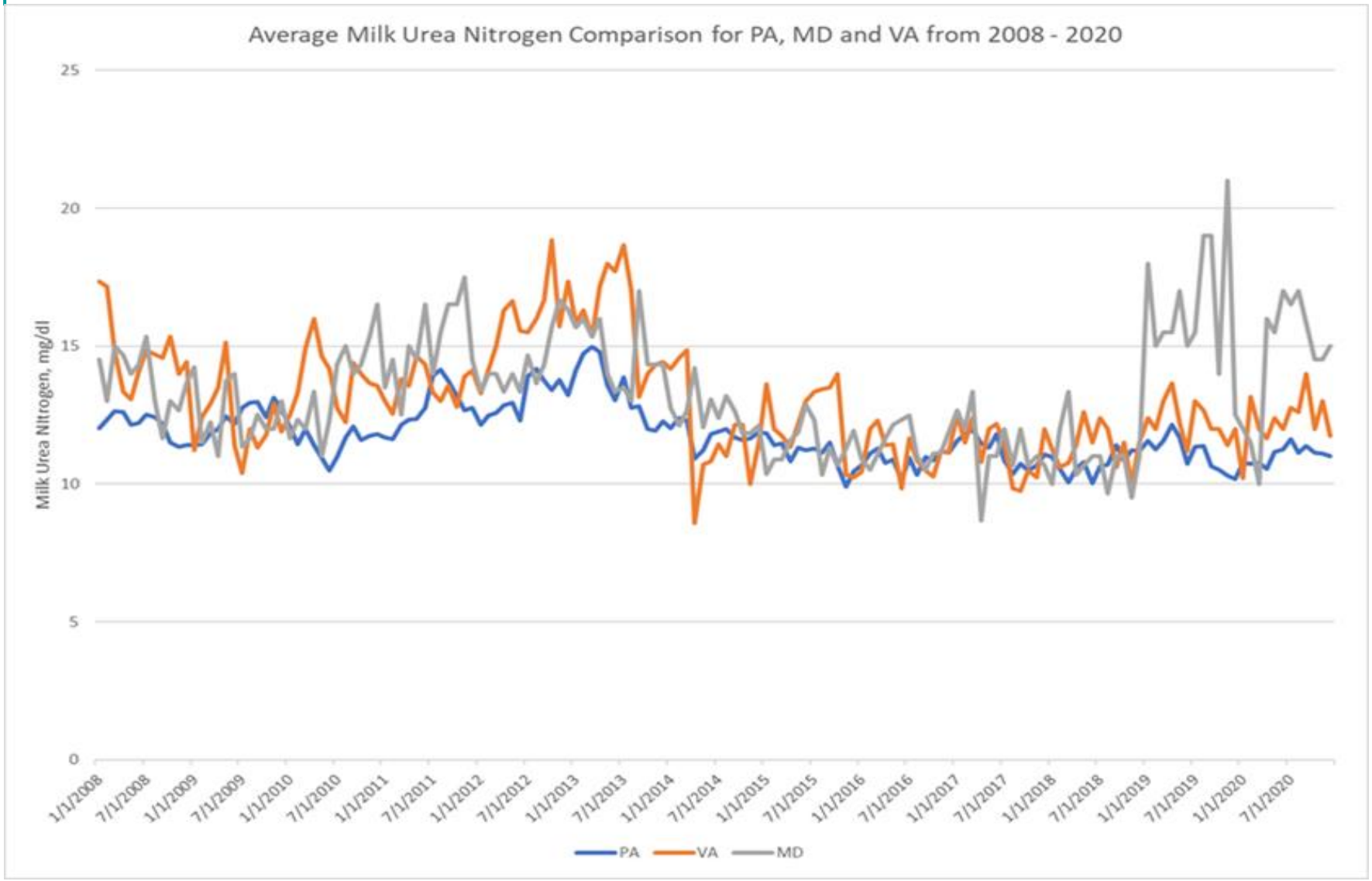
Co-op data would provide a more robust data set to validate N reductions

- Need discussions with co-ops on collecting cow numbers, milk production and herd identifiers.

What about MD and VA DHIA and Co-op data?

Follow-up with Co-ops

DHIA Results – PA-MD-VA



Note: The average # of herds tested on DHIA in this data set is PA-991; MD-219; VA-22
2017 USDA-NASS – Number of herds: PA-5,735; MD-359; VA-564

Moving Forward

- Need champions for:
  - MD and VA to pursue more data
  - Collaboration with co-ops
- Currently, Extension dairy team is conducting feeding system assessments
  - Applicable to N and P
  - Applicable to climate smart strategies, e.g., feed efficiencies

Meet the Presenters

Rainey Rosemond

Extension Dairy Educator, Berks County

Carly Becker

Extension Dairy Educator, Lancaster County

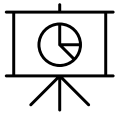
TMR Assessment Process

Overall goal: Optimize efficiency and production

Data Collection – On Farm

Call us!

- Particle size
- Sample collection for nutrient analysis
- Production data collection
- Feeding protocols



Data Analysis

- Forage analysis lab
- **Dry matter intake**
- **Feed efficiency**
- **Production efficiency**

Recommendations

- Develop personalized recommendations for on-farm feed management and ration program

Follow Up

- Sit down conversation with farmers where results and recommendations are presented. Allows time for conversation on identified opportunities.

Summary of MUN Data

	Cow #	Avg Milk Production	MUN 1	MUN 2	MUN 3	Milking System
Farm 1	50	72	12.9	12.9	12.9	tie-stall
Farm 2	43	75	11.7	11.7	11.7	tie-stall
Farm 3	146	66	15	15	15	robotic
Farm 4	61	74		13.7	12	tie-stall
Farm 5	900	63	8.2	8.2	8.2	free-stall
Farm 6	58	84	11.9	10.6	10.6	tie-stall
Farm 7	67	73	8.7	9.7	7.3	tie-stall
Farm 8	42	73		10.9		tie-stall
Farm 9	55	85	12.6	12.6	12.6	tie-stall
Farm 10	55	78	12.6	12.6	12.6	tie-stall
Farm 11	38	47	14	16	15	tie-stall
Farm 12	215	74	11.6	10.1	10.85	free-stall
Farm 13	44	77	10.8	13.1		tie-stall

Blue highlight = 3 x milking
Yellow highlight = Jersey herd

Production benchmark: 2x milking >75 lbs. and 3x milking >85 lbs.

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- Robotic herds:
  - Increasing popularity
  - PMR (partial mixed ration)
  - Vector feeding system
  - Not focused on bunk management

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- 3x Milking Herds:
  - Low MUN
  - Low milk production
  - Imbalanced ration
    - High sugar rations

Blue highlight = 3 x milking
Yellow highlight = Jersey herd

Production benchmark: 2x milking >75 lbs. and 3x milking >85 lbs.

Summary of MNE%

	Milk Production Form(Act)	DMI Formulated	CP% Formulated	Formulated MNE%	DMI Actual	CP% Actual	Actual MNE%	MUN	Ration Physical Form	Farm Type
Farm 1	84(72)	51.5	16.25	32.92	54.16	16.19	27.71	12.9	One group	Tie-stall
Farm 2	80(76)	51.29	15.11	33.86	52.48	14.77	31.14	11.7	One group	Tie-stall
Farm 3	80(66)	51.63	18.16	28.89	42.44	16.4	31	15	High/low	Robotic
Farm 4	80(73)	51.89	16.38	30.87	48.88	15.62	32.37	12.5	One group	Tie-stall
Farm 5	NA(63)				48.8	17.4	23.78	8	High/Mid	Free-stall
Farm 6	85(83)	56	15.1	32.97	53.18	15.77	31.52	11	One group	Tie-stall
Farm 7	80(74.5)	49.06	16.13	33.16	54.67	17.41	25.67	8	One group	Tie-stall
Farm 8	80(73)	53.75	16.03	30.45	43.19	16.55	32.41	10.9	One group	Tie-stall
Farm 9	NA(84)				58.12	16.41	28.89	12.6	One group	Tie-stall
Farm 10	80(77)	50.68	16.65	31.09	52.59	16.75	29.59	12.6	One group	Tie-stall
Farm 11	NA(47)				42.5	18	11.7	15	One group	Tie-stall
Farm 12	90(75)	51	15.73	36.44	51.08	16.2	29.73	11	High/low	Free-stall
Farm 13	76				45.54	16.4	34.45	12	One group	Tie-stall

*Farm 3: No pellet analyzed or included
*Farm 5&9: No reported formulated pounds produced or expected component %
*Farm 5: No reported formulated pounds produced or expected component %
*Farm 11: Jersey Herd

MNE,%	
<20	Low N Efficiency
20-25%	Opportunities to improve
25-30%	Average
30-35%	Great!
>35%	Super!

Summary of Grouping

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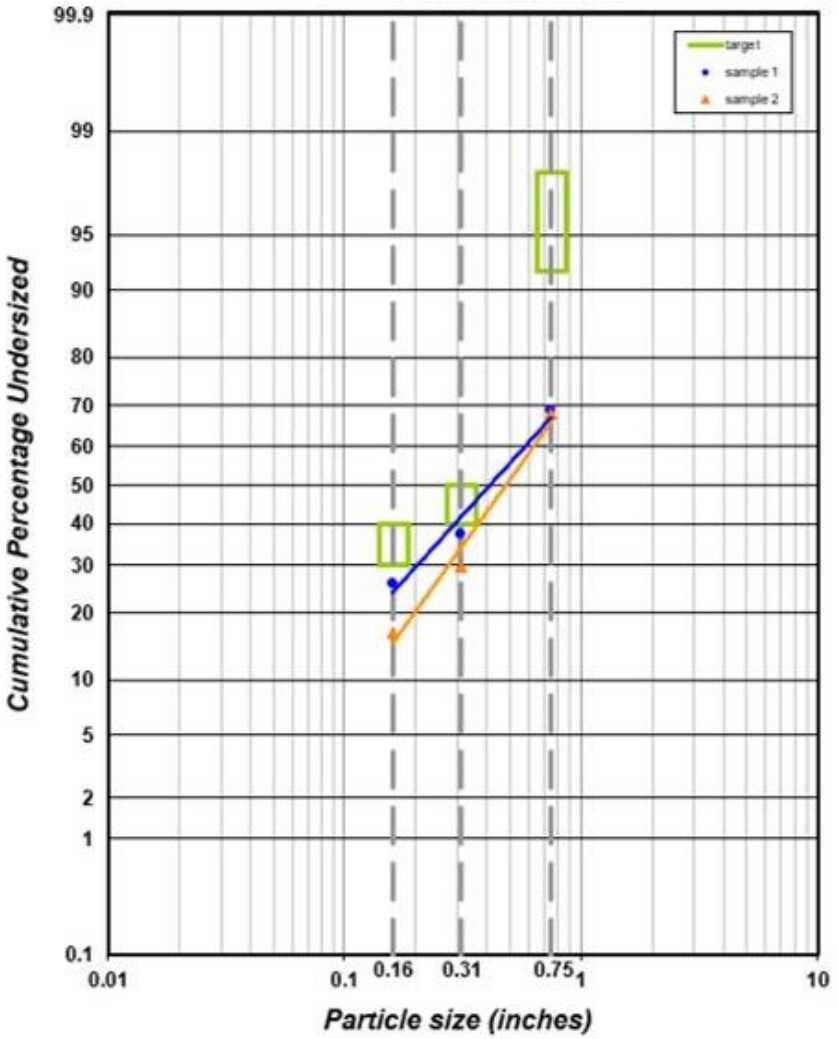
Light blue = top dress
Light gray = high/low groups
Yellow = one group
Green = high/low/first/sick groups

Contributing Factors

PSU Particle Size Separator: TMR Refusals – Sorting for Smaller Particles



- Blue line = Refusals
- Orange line = TMR

- Heavy sorting for smaller particles
- Some consumption of the longer particles, but not enough to balance sorting for smaller particles
- Further impacts on rumen health, hoof health, animal comfort, and fat percentage

Ration Nutrient Analysis - NDF (Neutral Detergent Fiber)

Additional Memo

peNdf = 16.02% of DM, 60.43% of Ndf

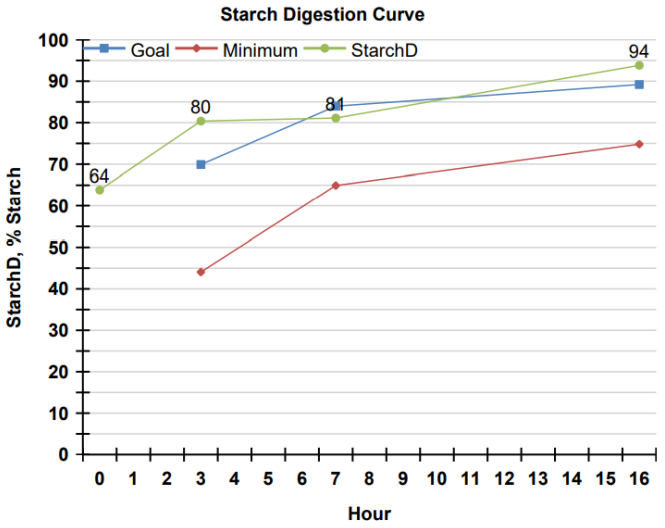
Additional Memo

peNdf = 19.53% of DM, 69.50% of Ndf

- peNDF is low and/or insufficient depending on what cows are eating
- Minimum is 19%
- Minimum forage intake 1.4% body weight
- No less than 40 to 45% forage in total ration dry matter
- Ruminal pH
- Animal health

Note: peNDF is Physical Effective Fiber

Ration Nutrient Analysis - Starch Digestibility



- From farm with sorting for longer particles
- Determining point of starch is difficult since it is a TMR sample and not the starch source alone
  - Fecal sampling for starch dry matter

Comparative Ration

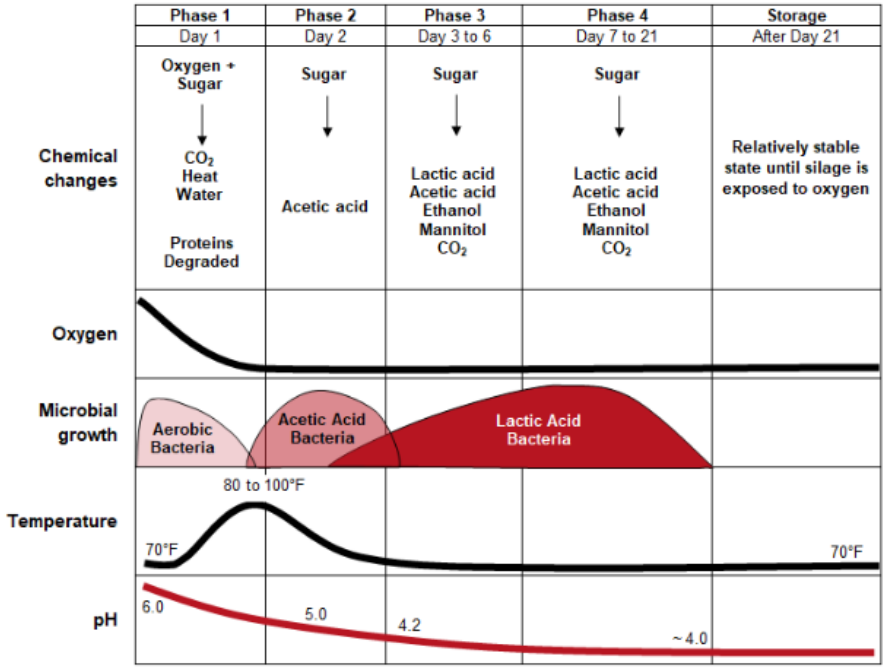
Measurement	Formulated (%DM)	Tested (%DM)	Difference	Percent Change	DMI Intake Formulated	DMI Avg Actual	Intake % BW (1425lbs) Formulated	Intake % BW (1425lbs) Actual
Dry Matter	42.41	43.24	0.83	1.957085593	50.68	51.3475	0.035564912	0.036033333
Net Energy Lactation (Mcal/lb)			0	#DIV/0!	0			
ME (Mcal/lb)			0		0	0		
Crude Protein	16.25	16.19	-0.06	-0.369230769				
Soluble Protein (%CP)	38	49.63	11.63	30.60526316				
ADF	19.11	17.14	-1.97	-10.30873888				
NDF	31.1	30.49	-0.61	-1.961414791				
Lignin			0	#DIV/0!				
Starch	26.45	26.62	0.17	0.642722117				
Ether Extract	3.13	2.61	-0.52	-16.61341853				
Calcium	0.77	0.5	-0.27	-35.06493506				
Phosphorous	0.33	0.34	0.01	3.03030303				
Magnesium	0.27	0.25	-0.02	-7.407407407				
Potassium	1.44	1.29	-0.15	-10.41666667				
Sulfur		0.12	0.12	#DIV/0!				
Sodium	0.45	0.3	-0.15	-33.33333333				
Chloride		0.51	0.51	#DIV/0!				
Iron (PPM)		501.96	501.96	#DIV/0!				
Manganese (PPM)		52.52	52.52	#DIV/0!				
Zinc (PPM)		54.23	54.23	#DIV/0!				
Copper (PPM)		14.56	14.56	#DIV/0!				

Actual AF intake
118.75

Note: Excessive ration soluble protein can cause high MUNS if energy is insufficient.

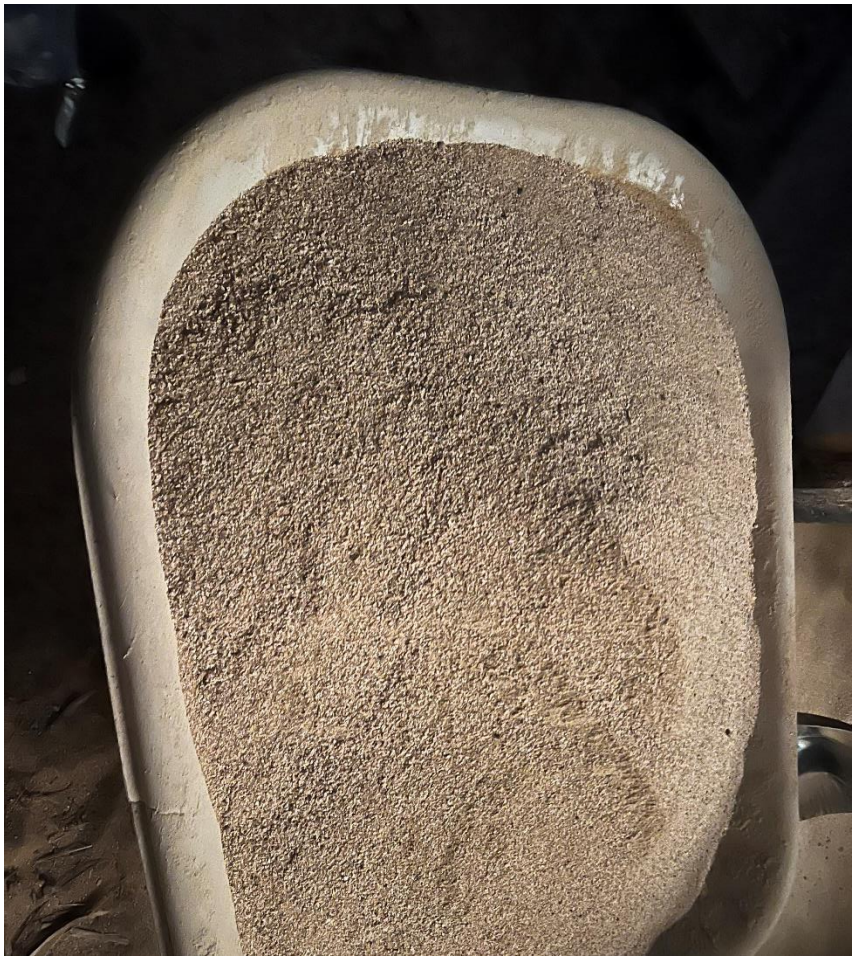
Corn Silage – High Soluble Protein

Figure 1. Phases of normal fermentation.



- Ensiling management
  - Removing oxygen
  - Dense packing
- Harvest time
- Harvest dry matter
- Chop length
- Excess N application

Feed Quality



Moving Forward

- Conflicts
  - Milk co-op transparency
  - Re-formulation for MUN values
- Frequent forage testing
- Continued management/monitoring
  - Feed assessment is currently a one-shot deal
  - Limited opportunity for additional trouble shooting
  - Limited opportunity for continued management/tracking of MUN
  - Continued education/management implementation
  - Evaluation of heifers and dry cows

AgWG "Ask" to Move Forward

- Support
  - ✓ Commitments from the other jurisdictions to provide support in obtaining data.

Or

  - ✓ PA initiate the review and approval process with the partnership for PA to move forward with an approved method for verifying the CBP BMP through MUN data.

Question?