



Factors Affecting TMR Mixing That Can Impact Animal Health and Performance


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 BSEFT BSEFP BSEFTN BSEFTM BSEFTD BSEFTA BSEFTS BSEFTC BSEFTA BSEFTS


What Is A TMR Audit?

“A TMR audit is a value-added service that Diamond V provides to our customers. It is an on-farm evaluation of the feed storage and preparation, mixing and delivery of the tmr. It is designed to uncover the factors affecting TMR consistency and to help find solutions to improve the efficiency of the feeding operation.”




What the TMR Audit Evaluates

- Weigh backs
- Silage face feed out
- TMR wagon check list
- Feed center organization
- Loading sequence and mixing
- Coordination of feeding with milking, locking up cows, manure scraping and bedding
- Push ups
- Other tasks required of the feeder
- Feeder interruptions



TMR Audit Tools




- Digital camera with video capabilities
- Penn State Shaker box
- Stop watch
- Quart-sized Zip-loc bags
- One-cup sized scoop
- Grain sieves
- Thermometer
- Infrared camera
- Data collection sheet

Feeding Software TMR Batch Summaries


“Help Us Focus on Issues”

- Feed Supervisor
- TMR Tracker
- EZ-Feed
- Feed Watch
- Others



Penn State Shaker Box To Measure TMR Particle Size Variation

- ♦ 10 samples per load
- ♦ Penn State Shaker Box Used on each Sample
- ♦ Samples of Weighbacks to compare to TMR
- ♦ Calculate average and coefficient of variation (CV) for each load
- ♦ The CV is a measure of consistency...lower the better
- ♦ Goal is to have 5% CV or less




Penn State Shaker Box Results



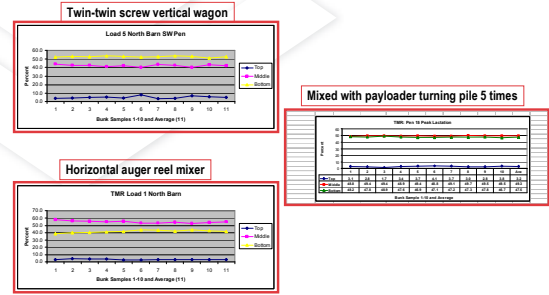

Coefficient of Variation Levels for TMR Consistency

- ◆ 1-2% excellent - mostly corn silage, haylage and/or chopped hay: easy to mix, new mixers
- ◆ 3-5% -good -no concerns yet
- ◆ 6-8%- start see issues with mixers not mixing well, due to poor design and overfilling
- ◆ 9-10% - not good, large round bales of hay, worn equipment
- ◆ >10% - bad, liquids loaded on the front or back of twin-screw wagons, and combination of the above issues

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Well Mixed TMRs Obtained By Different Methods



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Lactation TMR Mixing

Turned TMR 5 Times



Click photo to start video

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Mixing Close-up Dry Cow TMR

Turned TMR Two Times



Click photo to start video

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“Feed Particles Mix When Falling Together At the Same Time”

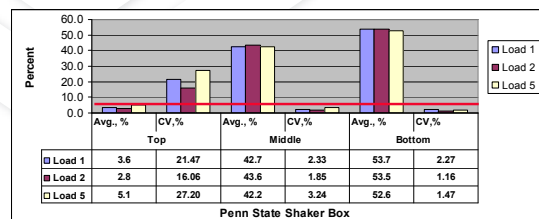
“Any ingredient or process that Interfers with this will affect TMR consistency”

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TMR Consistency Results via Penn State Shaker Box Test

Goal: < 5% CV for Middle and Bottom Screens



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Where Does Variation In TMR Come From?

Ingredients:
 • purchased
 • home grown

Cow factors
 • Sorting
 • crowding

Load-to-Load Variation

Within-Load Variation
 i.e. mixing issues

Video

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Controlling Variation In The Major Ingredients

- Ingredient purchasing request high and consistent quality
- Facing and blending corn silage and haylage into piles
- Blending haylage from bags
- Blending alfalfa hay bales
- Processing straw and hay ahead of time
- Grinding corn to consistent average particle size
- On-farm blends

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Improper Facing Opportunity for Heating/Spoilage

Environment for Wild Yeast Mold Growth

115.5°

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Temperature Variation in the Silage Face

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Low Density also an Opportunity for Oxygen

Temp 117.7°
11.6 DM / ft³

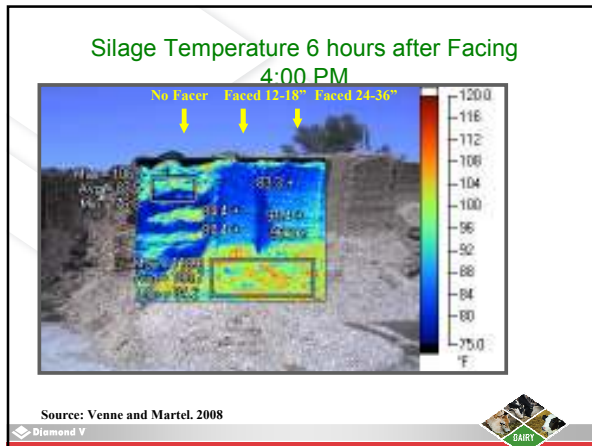
Temp 79.0°
18.2 DM / ft³

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Silage Face Heating

Source: Venne, 2007

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Haylage NDF – Sampling and Laboratory Consistency Evaluation

43.3	43.3
44.4	43.6
45.7	43.7
40.7	41.6
41.0	42.9
41.8	43.0
36.0	36.4
36.3	37.7
37.8	37.9

Stone, 2008

Silage Face Management Goals

- Remove spoiled silage
- Vertical smooth faces
- Remove enough silage to avoid heating
- Blend faced silage into a pile to minimize variation
- No loose silage at end of feeding
- Leading edge of plastic weighted with tires

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Moving Corn Silage To A Center Pile

Video

Excellent Face on Haylage Pile

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Blending Haylage from Ag Bags

Video

Let No Air Under The Plastic
No Loose Silage At End of Feeding



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Great Job of Facing Corn Silage In A
Bunker with a Payloader!!!



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Feed Storage Areas Are Clean
No Moldy Feeds



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Loading Alfalfa Squares or Large Rounds
Causes Batch to Batch Variation



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Video



Loading Large Round Baled Straw



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Loading Alfalfa Squares Into A Horizontal Mixer



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Mixing Large Rounds of Alfalfa...Tough Middle Core



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Blending Alfalfa Squares



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Processing Straw or Hay

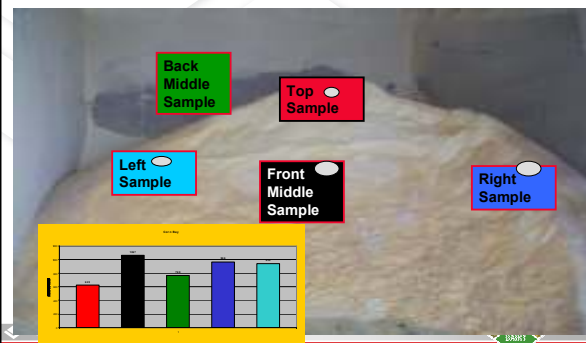


Video

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Ground Corn Sample Average Particle Size, Microns



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Variables Affecting The TMR Mixing Process

- Over filling
- Under mixing
- Under processing of hay
- Dull blades and worn kicker plates
- Improper loading of liquids
- Improper Ingredient loading sequence
- Low inclusion products not mixed

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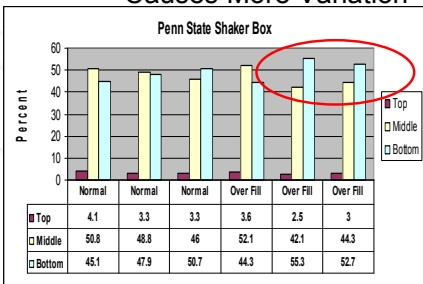
Over-Filling of the TMR Mixer?



Video



Over-Filling The TMR Wagon Causes More Variation



Oelberg, 2008.

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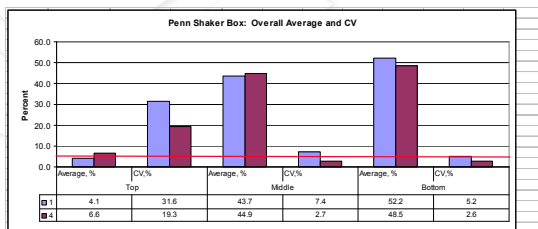
TMR Mixing Mono-Mixer Model 2090 Overfilled



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Overfilling A Mono-Mixer Causes More Variation and Increased Level on Bottom Screen



Goal: 5% CV or less for Middle/Bottom Screens

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Horizontal Reel Mixer Overfilled?



Video

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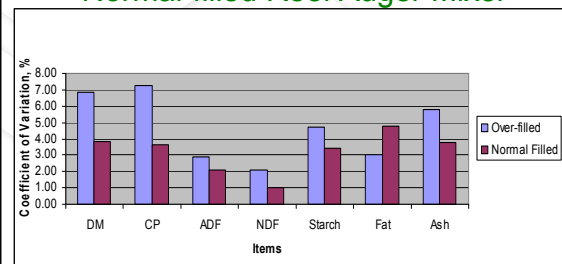
Horizontal Reel Properly Mixing



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TMR Consistency of Over-filled vs. Normal-filled Reel Auger Mixer



Oelberg, 2009.

Courtesy to Hubbard Feeds, Mankato, MN for providing lab analysis

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“Feed Particles Mix When Falling Together At the Same Time”

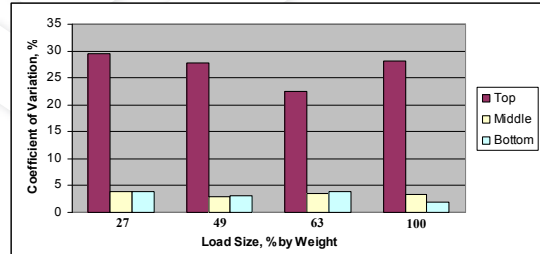
“Any ingredient or process that Interferes with this will affect TMR consistency”

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Influence of TMR Load Size on Particle Size Variation Across the Bunk

Triple-Screw TMR Wagon: 100% = 36,700 lbs
Goal: < 5% CV for Middle and Bottom Screens



Oelberg, 2009.

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TMR Mixing When Tops of Screws Are Covered



Video

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Observations on Filling TMR Wagons

1. Overfilling creates inconsistent TMRs
2. Vertical Wagons
 1. Fill to 75 to 95% struck volume
 2. Small loads need to go to top of screws to get good mixing
 3. Most commonly used on dairies
3. Reel Horizontal Wagons
 1. Fill to 70% max volume
 2. Watch fill level when adding very high levels of wet by-products seen with feedlot steer rations
4. 4-Auger Wagons
 1. Fill to 75% of max. volume
 2. Most commonly used in feedlot industry

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Mixer Design Issues

What to Look For

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DAIRY DEEP HOLETOP HORSE HORSE JAW KEY SPECIALTY

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Silage Streaks...TMR Wagon Not Mixing or Not Mixing Long Enough



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Twin-Screw Vertical (4 months old) Not Mixing?
Overfilled?
Poor Kicker Plate Design?



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Kicker Plate Design of Wagon That
Did Not Mix The Corn Silage



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Vertical Mixer: Proper Mixing Action



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New Wagon: Note The Tight Space
Between Kicker Plate and Wall



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Delay in Processing Large Squares
of Hay in a Vertical TMR Mixer



Video

Note: The feed software report doesn't show number of revolutions
Or rpms for this mix.

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TMR Loading

Not Loading On Center

Loading On Center...
Line Up on The Red Triangle



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Hay Not Loaded Between Augers
Causing It To Not Get Completely Processed



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Hay Not Getting Completely
Processed



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Sharp vs Dull Blade



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Effect of Dull Knives on Large
Round Bale Processing



Oelberg, 2008.

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Effect of New Knives on Large
Round Bale Processing

Dry Cow Ration

Replacement Heifer Ration



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Worn Out Vertical Augers



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Video



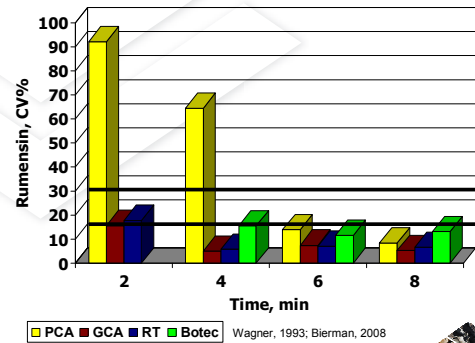
Wear and Stress Fractures on Edge Deflectors (Kicker Plates)



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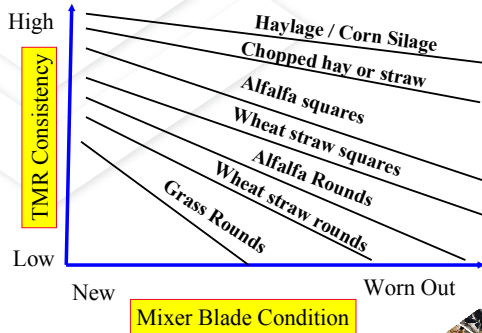
Mixer Condition and Mixing Time



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Influence of Forage Type and Mixer Condition on TMR Consistency



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Managing Mixer Wear and Forage Processing

- ♦ Keeping the TMR consistent with constant wear of mixer blades and with inconsistent hay quality...is nearly impossible to do
- ♦ Larger operations are processing hay ahead of time because:
 - More accurate loading
 - Reduce mixing time
 - More uniform TMR

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Proper Ingredient Mix Order

- ♦ Depends on the type of mixer-vertical vs horizontal...forage processing required?
- ♦ Avoid direct contact of wet sticky by-products with fine particle dry feeds
- ♦ Inclusion Levels of Ingredients
 1. Large squares or rounds of hay / straw
 2. Dry fine ingredients / Feed Additives
 3. Cottonseed or on-farm pre-blend
 4. Haylage
 5. Corn Silage
 6. Wet byproducts?
 7. Liquid



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Mix Order and Blending of Wet Corn Gluten Feed

Wet Corn Gluten Feed
Added Last



Wet Corn Gluten Feed
Added 2nd to Last



Oelberg, 2009.

Videos. Click each one to to play at same time

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Inclusion Level and Proper Mixing of Feed Additives

Is The Rumen By-Pass Fat Getting Blended?



Video

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Mix Time Displayed on Mixer Wagon Weigh Scale...5 Minute Countdown



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Hand Adding Ingredients



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Using Candy to Test Ingredient Mix Uniformity



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Candy TMR Mix Uniformity Results

Number of Candy Pieces

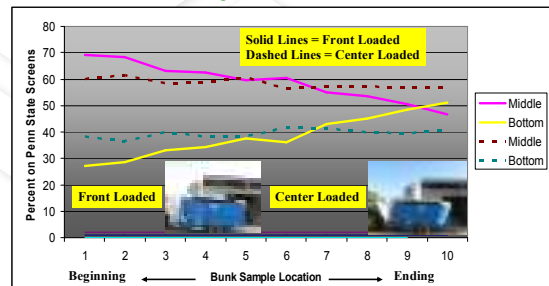
Bunk Location	Front Loaded				Center Loaded
	Load 1		Load 2		Load 3
	Red Hots	Licorice	Red Hots	Licorice	Licorice
Front	13	14	11	31	7
Middle	5	10	10	14	21
End	1	0	0	1	12
Average	6.3	8.0	7.0	15.3	13.3
Expected	10.7	10.7	10.7	10.7	15.6

Candy was mixed for 2.5 minutes
 Red hots -1/4" diameter and hard to find
 Licorice -1/2" x 5/8" (2.1604 grams/piece) and easy to find

Diamond V Oelberg, 2008



Liquid Supplement Loaded In the Front vs Center of A Vertical Mixer Wagon and TMR Particle Size

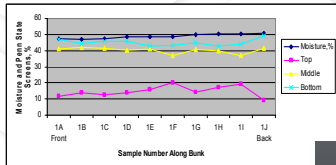


Oelberg, 2009.

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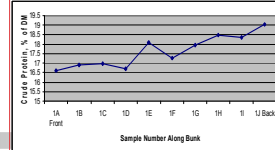
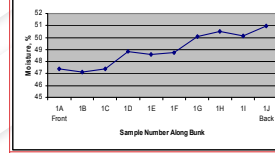


Adding Liquid Supplement In Back of TMR Wagon



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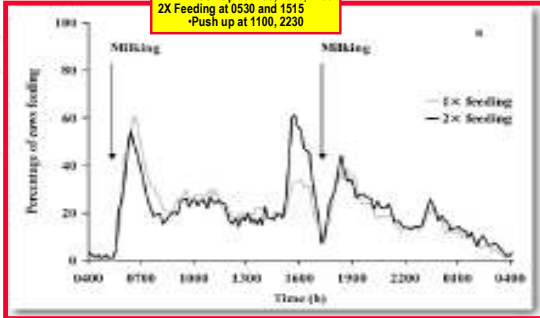
Influence of Adding Liquid at the Back of Mixer on TMR Moisture and Protein Levels



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One vs. Two Times Per Day Feeding

1X Feeding at 0530
 -Push up at 1100, 1515, 2230
 2X Feeding at 0530 and 1515
 -Push up at 1100, 2230

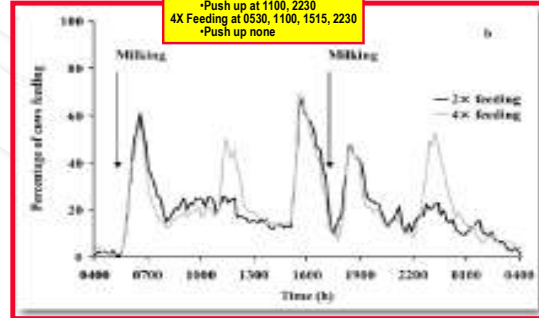


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DeVries et al. 2005 J. Dairy Sci. 88:3553

Two vs. Four Times Per Day Feeding

2X Feeding at 0530 and 1515
 -Push up at 1100, 2230
 4X Feeding at 0530, 1100, 1515, 2230
 -Push up none



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DeVries et al. 2005 J. Dairy Sci. 88:3553

TMR Mixer Wagon Check List

- Are blades sharp?
- Is the kicker plate in good condition?
- Is there good clean out?
- Are load cells weighing accurately?
- Is feeder allowing proper mix time after last ingredient is added?
- Is wagon level during loading?
- Is there twine wrapped around the mixer screws?
- Do you have super magnets installed on the discharge chutes?

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TMR Mixer Blades Are Sharp



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Watch Serrations on Blades... Top vs Bottom Blades



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Horizontal Mixer Blade Condition

Worn knives on horizontal auger



New horizontal 4-auger



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Wear and Stress Fractures on the Shoe



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Worn Kicker Plate Leaves Feed Trail Along Mixer Wall



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New Wagon: Note The Tight Space Between Kicker Plate and Wall



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Removing Rapped Twine



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Is the Mixer Completely Cleaned Out?



Oelberg. 2008. Video

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TMR Mixer Clean Out...Good



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Feeding Time Deviations

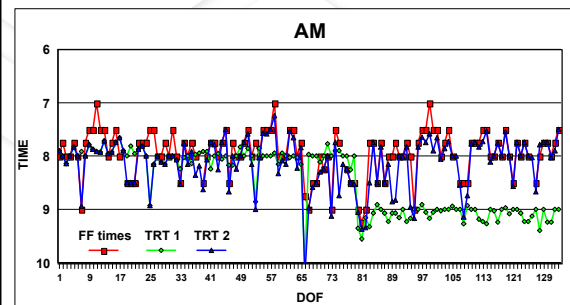
- ◆ Actual times from Farmer Feeder (FF) records
- ◆ Replicated in research feedlot
- ◆ Control is feedlot regular schedules
- ◆ Yearling heifers, 4 pens/TRT

Pritchard. 2010. South Dakota State U.

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Feeding Schedule Deviations

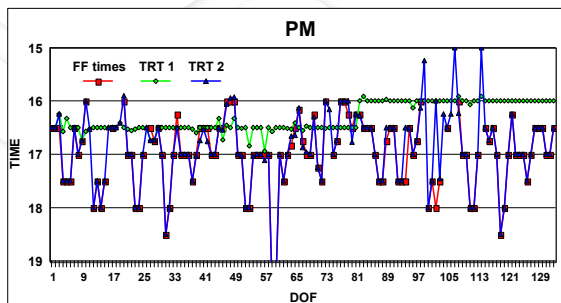


Pritchard. 2010. South Dakota State U.

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Feeding Schedule Deviations



Pritchard. 2010. South Dakota State U.

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Impact of Feed Schedule Deviations¹

	97 to 137d		1 to 137d	
	FF	Control	FF	Control
ADG	3.49 *	3.81	3.96 *	4.15
DMI	24.80	25.62	22.84	23.08
F/G	7.12	6.73	5.74	5.56

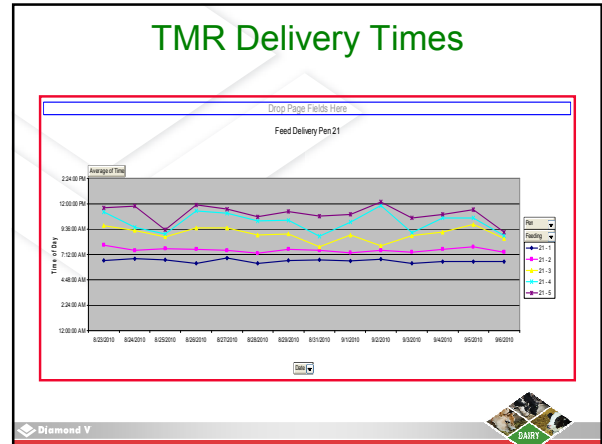
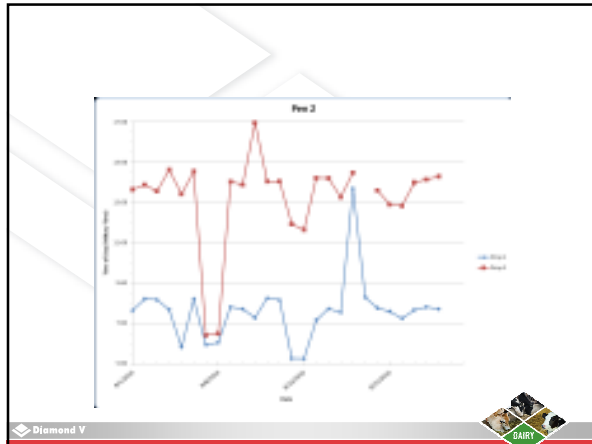
¹ n=4 pens/TRT

* Adjacent means differ (P<0.10)

Adapted from R.H. Pritchard Dept Animal & Range Sciences South Dakota State Univ

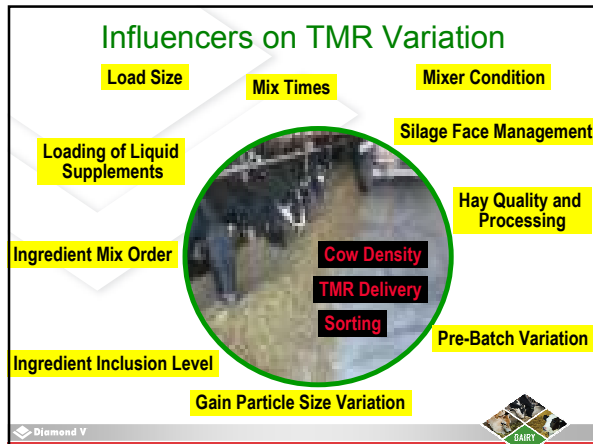
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- ### TMR Delivery and Coordination with Other Barn Tasks
- Was feed delivered or pushed up before cows returned from parlor?
 - Was feed delivered while cows were pushed to the parlor?
 - Does feeding co-inside with manure scraping, stall grooming and bedding?
 - Is TMR delivered evenly along the bunks?
 - Does feeder back up at the end of the load?
 - Is TMR delivered the same time every day?
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- ### Steps To Ensure Consistent TMRs
- Organizational chart so the feeder(s) know(s) who is the boss
 - Written job description for the feeder
 - Communication amongst the feeding team
 - Feed software to track ingredient load deviations, load size, drop and cycle times
 - Equipment is in good condition
 - Written S.O.P. on how to properly load and mix a TMR
 - S.O.P. for truckers unloading ingredients
 - Establish daily, weekly, monthly and quarterly routines
 - Training of new hire and current feeders
 - Forage management to minimize heating, spoilage and nutrient variation
 - TMR Audit
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