PENNSTATE College of Agricultural Sciences

Corn Silage

Saving More of the Silage You Make!

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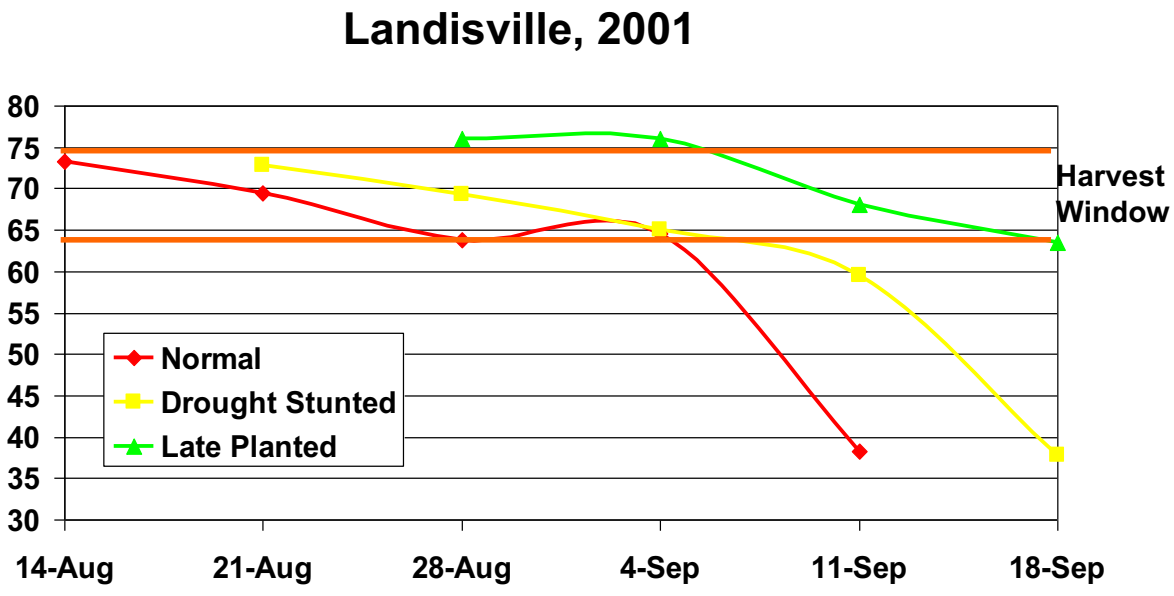
Two Parts to Making Quality Silage

- Production
- Harvest and Feed out Management

Timing Harvest

- Harvesting corn too wet (<28% DM) or too dry (>40% DM) can increase spoilage potential and decrease feed quality
- Corn dry down rates vary among years
- Visual indicators of moisture are not that good

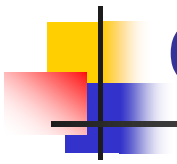
Corn Silage Drydown



Corn Silage Initiative: Shirk, Beck and Craig, 2001

Predicting Harvest

- Measure, don't estimate, dry matter in crop
  - Just as crop begins to dent, chop 3-4 representative plants from earliest fields
  - Determine moisture using Koster or microwave
  - Estimate harvest date using 0.6%/day drydown rate
  - Monitor throughout harvest
  - Select hybrids with maturities to match harvest needs



Other harvest considerations

- Length of Cut
  - Vary by crop conditions
    - Drier – shorter cut to minimize air pockets
    - Higher digestible hybrids – longer to maintain effective fiber
  - General Recommendations
    - Without processing – 3/8 inch TLC
    - With processed corn – 3/4 inch TLC

Processing Corn Silage

- Needed to maximize digestion of grain
- Can affect fiber length
  - Lengthen TLC to 3/4 inch
- Processor setting – 1 to 3 mm depending on TLC and moisture of grain (drier grain – more processing)
- Check crop to monitor kernel breakage

Introduction – Keys to Quality Silage

- Minimize Oxygen Exposure
- High Density of Forage Mass During Storage
- Rapid Feed-out Removal
- Seasonal Differences –Temperature Affect
- No Different for an Upright Silo or an Ag Bag

Silage Bunker Management

- High Capacity Harvesting Equipment Makes it Difficult to Keep Up With Packing to Achieve a Dense Pack
- Dr. Keith Bolsen, Kansas State University
  - "Out of Control Management of Bunkers"
  - 20 to 30% shrink loss plus feeding spoiled feed can lead to 3.0 to 4.0# loss in milk production/cow/day = $140 - $150/cow/year

Inverse relationship between DM density and DM loss in bunker silos

Density		DM Loss (Shrink), %	
lbs DM/ft^3	kg DM/m^3	96-day average	180-day calculated
10	160	10.4	19.8
12	192	8.0	17.9
14	224	7.6	16.0
16	256	6.2	14.2
18	288	4.8	12.3
20	320	3.4	10.4

Adapted from Holmes, 2006

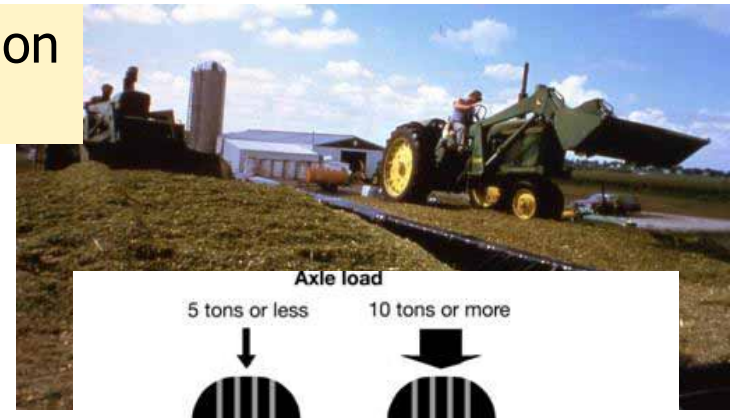
Assumptions:
- Extent of DM loss increases with length of storage.
- Based on hay crop silage in 19 bunker silos.

Factors influencing the density of the silage

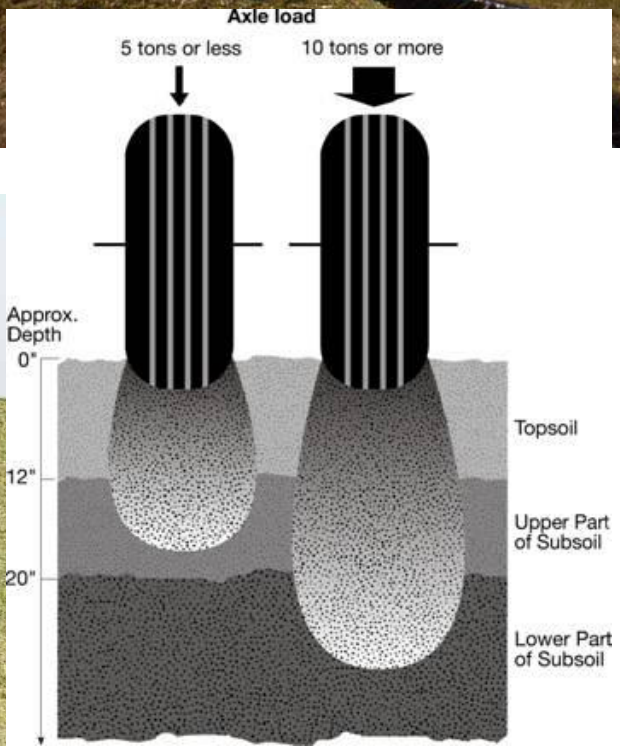
Dr. Brian Holmes, The University of Wisconsin

- Delivery rate
- DM content
- Depth of silage
- Average tractor weight
- Number of tractors
- Packing layer thickness
- Packing time
- 800# of packing weight/ton of silage per hour delivered
- Website with Prediction Equation <http://www.uwex.edu/ces/crops/uwforage/Silage.htm>

First Principle of Compaction - Axle Load Affect

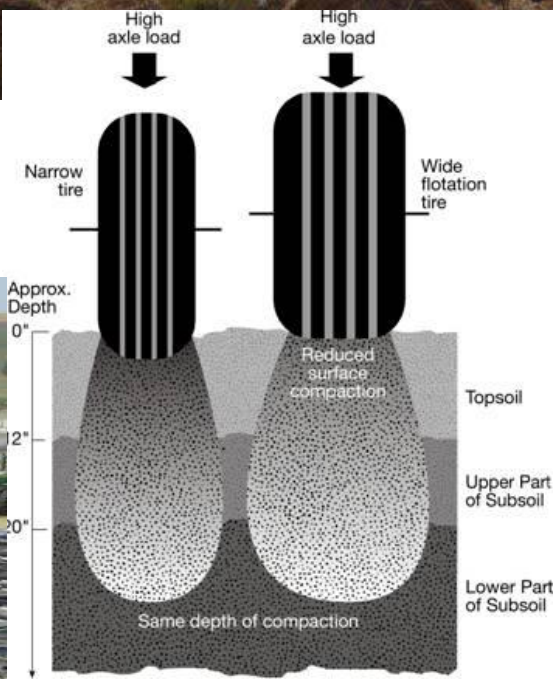


A Heavier Axle Load Compacts More and Deeper Than a Lighter Weight



Second Principle of Compaction - Surface Area Affect

At the same axle load a smaller footprint compacts to same depth but more compaction occurs at a shallower depth



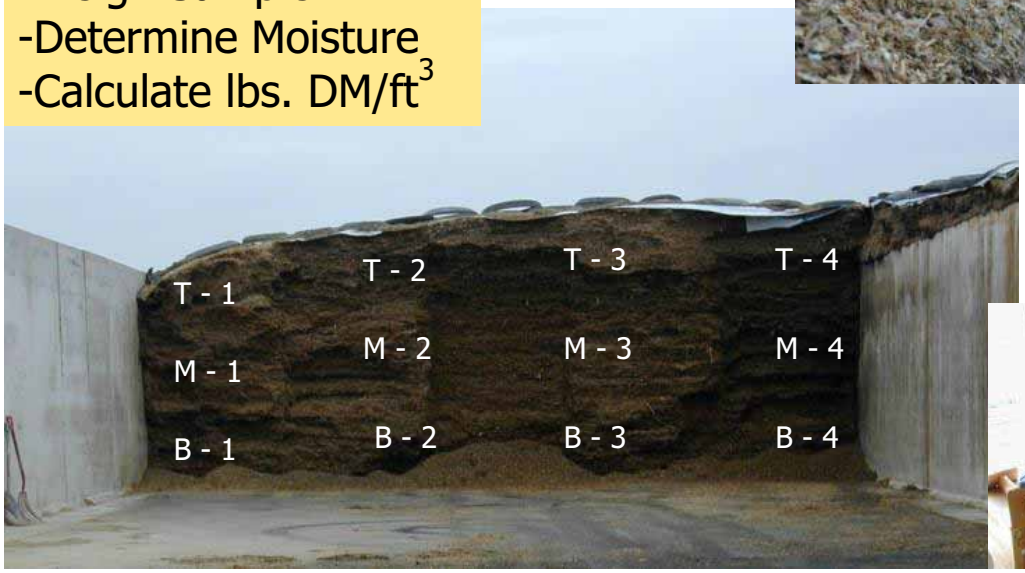
2004 - 10 South Central PA. Bunker Density Study

Project Goals

- Measure existing bunker and silage pile densities in South Central Pennsylvania
- Compare existing densities to the recommended goal of 15 # DM/ft^3
- Inform managers of practices to minimize shrink and improve forage quality
- Compare PA results to predicted densities based on Wisconsin equation

Dry Matter Density Sampling Procedures

-12 Sampling Positions
-Drill, Collect Sample
-Measure Depth
-Weigh Sample
-Determine Moisture
-Calculate lbs. DM/ft^3



Corn silage bunk density testing

- **Number of years sampling = 7**
- **Number of bunks sampled = 192 on 75 different farms**
- **@ 12 points each bunk = 2304 reference points**
- **Less than 25% of all sampled bunks exceed goal of 15 #DM/ft^3**

Average Density for Bunk by Year:

2004	2005	2006	2007	2008	2009	2010
11.8	13.9	12.5	11.9	13.9	13.8	13.6

Range of ave. bunker densities: 8.6 to 17.2 DM/ft^3

Conclusions

- Greatest densities on lower levels
- Surface area least well packed
- High chance for significant spoilage on surface areas
- Attention to covering is critical
- Prediction equation effective in PA

Conclusion

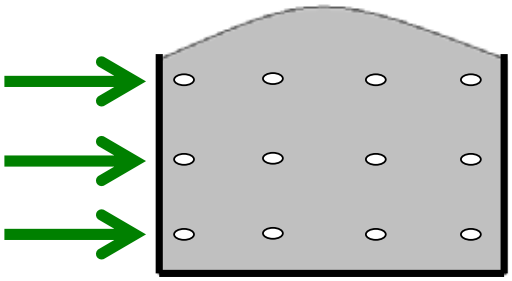
- Highest densities at interior
- Challenge to pack along walls
- Walls not airtight and rain/snowmelt infiltration along edges increase the risk of spoilage
- Producers adopting use of sidewall plastic

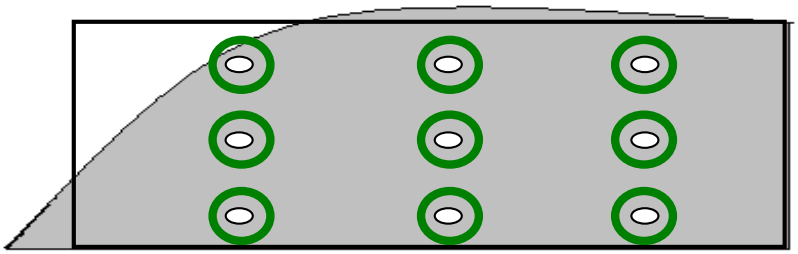
Relating dry matter density to dry matter loss in corn silage bunker silos in Southeastern Pennsylvania

Dr. Ken Griswold, Paul H. Craig,
Penn State Cooperative Extension
Southeast Region

Methods & Materials

- Two bunker silos: 182′ x 42′ x 8′ each
  - Buried 36 poly-weave nylon bags in each bunk
- Two upright silos: 12′ x 50′ (6 bags) & 14′ x 60′ (9 bags)
- 10 to 20 lbs of fresh-chopped whole plant corn per bag.

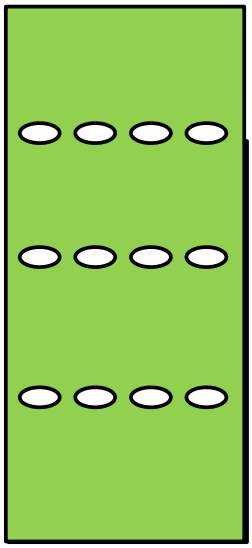




Placing the Bags during Filling

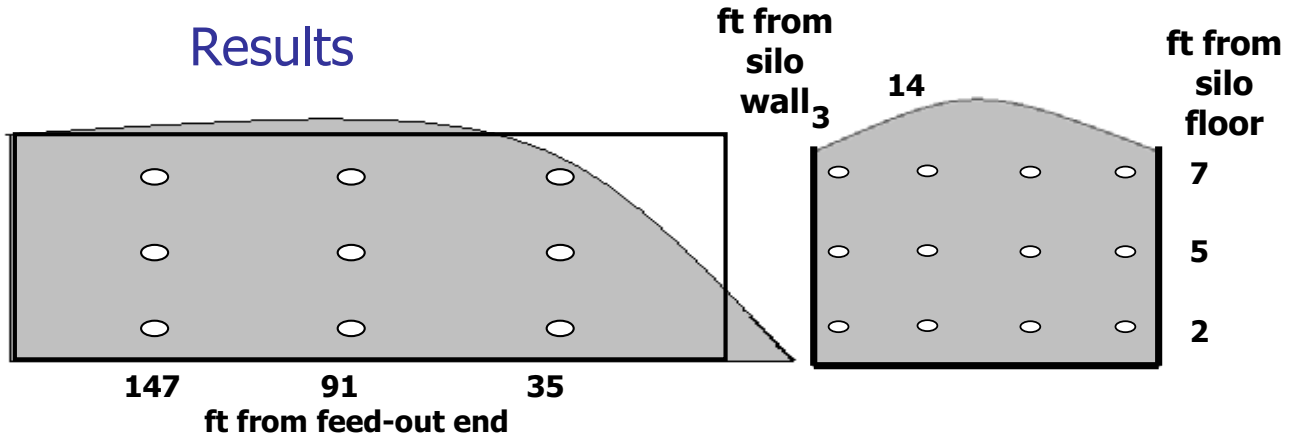
Methods & Materials

- Bag Removal
  - During feedout, bags were dug out of the face when the first blue tape was seen.
  - DM determined using Koster Tester
  - Measure the DM loss from each bag.
  - Determine a core density at each bag location in the face.
- Data analysis
  - Proc Mixed and RSReg in SAS

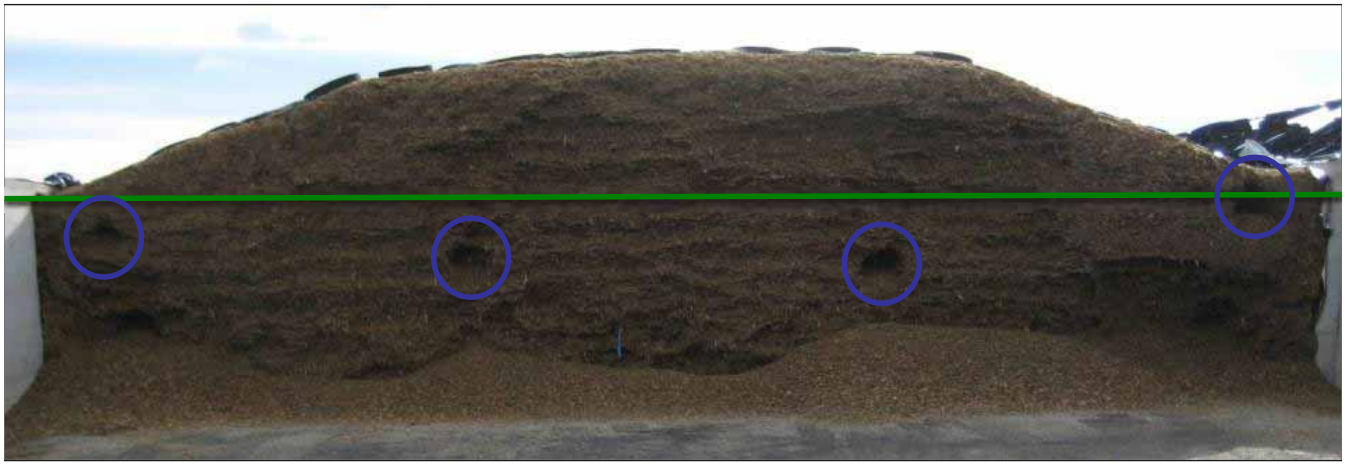


Collecting the Buried Samples at Feedout

Results



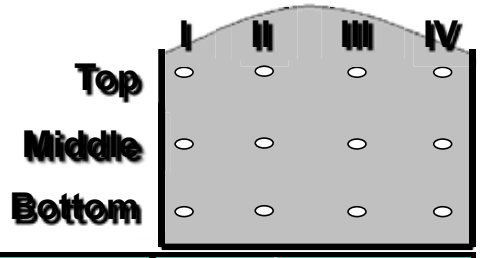
Location of top layer bags showing greater compaction in center of pile



Results

Silo 1: 16.1 lbs DM/ft³, 32.3% DM, 6.9% DM loss

Silo 2: 17.2 lbs DM/ft³, 31.7% DM, 5.7% DM

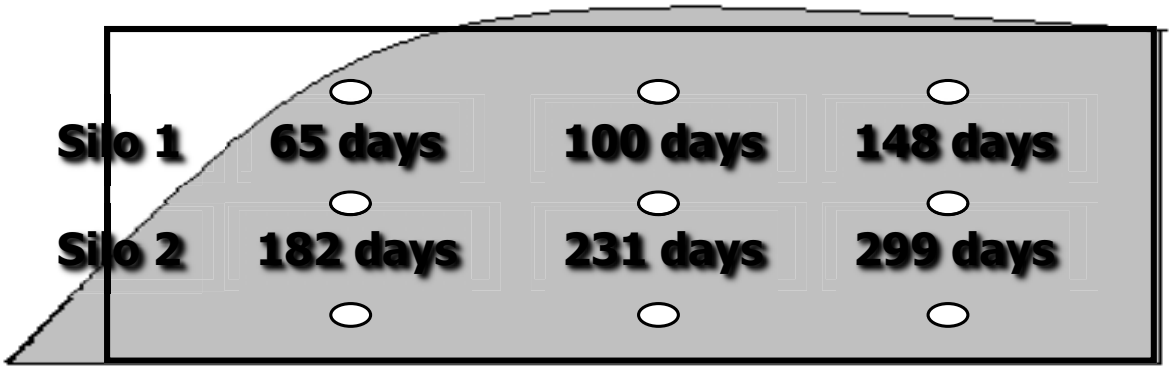


Parameter	Level			SE	P-value
	Bottom	Middle	Top		
Density, lbs DM/ft³	17.9[b]	17.4[b]	14.6[a]	0.28	< 0.0001
DM, %	32.0[a,b]	32.6[b]	31.4[a]	0.31	0.032
DM Loss, %	5.6[b]	4.6[b]	8.7[a]	0.5	< 0.0001

Parameter	Location				SE	P-value
	I	II	III	IV		
Density, lbs DM/ft³	15.6[a]	17.7[b]	17.9[b]	15.4[a]	0.3	< 0.0001
DM, %	31.1[a]	32.6[b]	32.4[b]	32.0[b]	0.36	0.0208
DM Loss, %	7.3	5.5	6.5	5.8	0.56	0.13

[a,b,c] **denotes significantly different LS Means within a row (*P*<0.05)**

Results



Parameter	Depth in Bunk			SE	P-value
	Front	Center	Back		
Density, lbs DM/ft^3	14.3^a	18.0^b	17.7^b	0.28	< 0.0001
DM, %	30.6^a	32.1^b	33.4^b	0.31	< 0.0001
DM Loss, %	8.0^b	5.3^a	5.6^a	0.5	0.0006

^{a,b,c} **denotes significantly different LS Means within a row (*P*<0.05)**

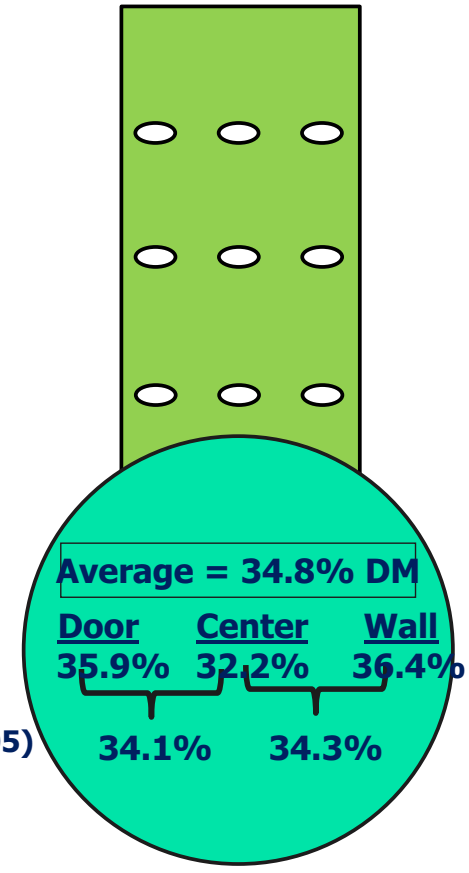
2 Upright Silo Results

Silo 1: 14.6 lbs DM/ft^3, 32.4% DM, 2.1% DM loss
Silo 2: 16.3 lbs DM/ft^3, 33.3% DM, 2.8% DM loss

Parameter	Level			SE	P-value
	Bottom	Middle	Top		
Density, lbs DM/ft^3	18.8^c	16.2^b	11.3^a	0.68	0.0007
DM, %	35.8^c	33.2^b	29.5^a	0.71	0.0032
DM Loss, %	3.1	3.3	1.0	0.6	0.155

Parameter	Location			SE	P-value
	Door	Center	Wall		
Density, lbs DM/ft^3	15.7	15.4	15.2	0.76	0.88
DM, %	33.4	32.0	33.0	0.81	0.42
DM Loss, %	2.8	2.2	2.3	0.69	0.79

^{a,b,c} **denotes sig. different LS Means within a row (*P*<0.05)**



Bunker Feedout Face Management

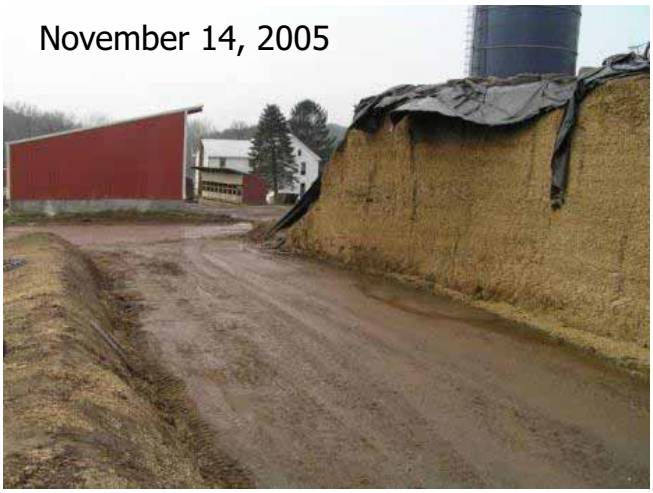
Reducing Shrink

2006 Multi-Pass Feedout Project Goals

- Evaluate effect on forage quality during feedout of a large pile of silage
- Measure variability over time
- Measure affect of aerobic instability
- Record packing density across the pile

Background

- 7,000 Ton Corn Silage Pile
- Wall on one side, cement floor
- Multi-pass feedout
- Use of a facer to manage feedout and spoilage



Procedures

- Sampled feedout face at 4 levels
  - 2 and 5 ft. below surface
  - 3 and 6 ft. above floor
- Samples taken at 3 distances in from the outside exposed area
  - 6, 12, and 18 inches
- Sampled monthly from March – July, 2006

Data Collected

- Dry Matter Density
- Forage Analysis
- Acidity Profile
- Mold and Yeast Counts

Results

- Significant Variability in Forage Results
  - Impact on Forage Analysis
    Testing and Monitoring
- DM Density of pile was well managed
  - Average 12.8 # DM/ft^3
  - Highest 17.5 # DM/ft^3
  - Lowest 4.2 # DM/ft^3

Statistical Trends

- Date of sampling did affect results – environmental effect – summer/winter bunk mgmt.
- Differences between levels in pile had an affect, vertical variation, different silages at harvest
- There was an effect of date that was consistent across the levels – again, related to environment effect
- Distance (6, 12, 18") from the exposed edge showed no consistent negative affect
- No affect of date on this distance

Conclusions

- Significant Variability within a silage pile
  - Hybrids produced, crop maturity, soil and environmental conditions, harvest factors, packing variability
  - Need to consider steps to minimize variability
- Importance of Frequent Forage Analysis
  - DM and Nutrient Content

Conclusions

- Good Silage Density can be achieved in piles
  - Surface packing and covering important
- Seasonal affect on silage pile needs management considerations
- Possible to utilize a multi-pass feedout program with large piles of silage for extended periods.

Conclusions

- Strategy for Silage Production, Harvest, Silo Filling, Covering and Feedout
- Pay Attention to Details

Silage Safety

- Overhangs, under cutting of face
- Have access to equipment to dig out
- Avalanches
- Stay away from the face
  - Not a gathering place
- Never alone
- 3X Rule