Harvest and Storage of Silage

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Silage Production

• Goal is to harvest and store forages in a manner that will allow for

  1. Maintaining integrity of feedstuffs
     • Minimize spoilage and DM loss
  2. Maximizing nutritional quality of forage crop
Discussion Points

- Process of fermentation
- Harvesting
- Moisture testing
- Storage
- Silage Inoculants
- Troubleshooting problems
Process of silage fermentation

- **Phase 1** – Aerobic phase - lasts a few hours.
  - Continues until either O$_2$ supply or soluble carbohydrate is depleted.
  - Temperature increases due to respiration.

- **Phase 2** – Begins when trapped O$_2$ supply is depleted.
  - Lasts 24 to 72 hrs.
  - Anaerobic fermentation begins.
  - Heterofermentative bacteria produce both acetic and lactic acids.
  - These bacteria survive between 7 and 5 pH.
Process of silage fermentation

• **Phase 3** – Transitional phase that usually lasts only 24 hours.
  – Homofermentative bacteria rapidly drop pH through efficient production of **lactic acid**.
  – Temperature decreases and pH continues to drop.
Process of silage fermentation

• **Phase 4** – Continuation of Phase 3 with stabilization of temperature.
  – Homofermentative bacteria convert water soluble carbohydrates to lactic acid.
  – In well fermented silage lactic acid can account for over 65% of total VFAs.
  – Corn silage can reach a final pH of 4.0.
  – Legumes and grasses have less water soluble carbohydrate and higher buffering capacity and usually reach a pH of 4.5.
  – Phases 2, 3, and 4 are usually completed in 10 days to 3 weeks from harvest.
Process of silage fermentation

• **Phase 5** – This phase lasts through the remainder of storage where the fermentation process is stable as long as oxygen does not penetrate silage.
  – Final temperature will be between 75 and 85 degrees F.
Process of silage fermentation

• **Phase 6** – This phase occurs during feed out.
  – Can result in substantial dry matter losses as oxygen is reintroduced into the fermented crop.
  – Proper management of the silage face and at the feed bunk can minimize dry matter losses and optimize feed intakes by dairy cows.
Process of silage fermentation

**Figure 1. Phases of normal fermentation.**

<table>
<thead>
<tr>
<th>Phase 1 (Day 1)</th>
<th>Phase 2 (Day 2)</th>
<th>Phase 3 (Day 3 to 6)</th>
<th>Phase 4 (Day 7 to 21)</th>
<th>Storage (After Day 21)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxygen + Sugar</td>
<td>Sugar</td>
<td>Sugar</td>
<td>Sugar</td>
<td>Stable state until silage is exposed to oxygen</td>
</tr>
<tr>
<td>CO₂, Heat, Water</td>
<td>Acetic acid</td>
<td>Lactic acid</td>
<td>Lactic acid</td>
<td></td>
</tr>
<tr>
<td>Proteins</td>
<td></td>
<td>Acetic acid</td>
<td>Acetic acid</td>
<td></td>
</tr>
<tr>
<td>Degraded</td>
<td></td>
<td>Ethanol</td>
<td>Ethanol, Mannitol</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CO₂</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Chemical changes:**

- Oxygen
- Heat
- Water
- Proteins
- Degraded

**Microbial growth:**

- Aerobic Bacteria
- Acetic Acid Bacteria
- Lactic Acid Bacteria

**Temperature:**

- 80 to 100°F
- 70°F

**pH:**

- 6.0
- 5.0
- 4.2
- ~4.0

Image from Hubbard Feeds
Process of fermentation

• This process doesn’t just happen
• It depends on the producer applying good harvest, storage and management practices
Harvest
Changes in Corn Forage Yield and Quality with Harvest Date

Source: Darby and Lauer (2002)
Changes in Corn Forage Yield and Quality with Harvest Date

Source: Darby and Lauer (2002)
Changes in Corn Forage Yield and Quality with Harvest Date

Source: Darby and Lauer (2002)
Changes in corn forage yield and quality with harvest date

Each value = mean of 4 hybrids and 4 reps

Source: Darby and Lauer (2002)
## Optimum harvest stage and moisture levels for major silage crops

<table>
<thead>
<tr>
<th>CROP</th>
<th>Harvest Stage</th>
<th>Dry Matter Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>1/2 to 2/3 milkline</td>
<td>32-38%</td>
</tr>
<tr>
<td>Alfalfa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HMC/Cereals</td>
<td></td>
<td>65-75%</td>
</tr>
<tr>
<td>Cereals</td>
<td>boot to dough</td>
<td>35-45%</td>
</tr>
<tr>
<td>Grasses</td>
<td>boot</td>
<td>35-45%</td>
</tr>
<tr>
<td>Alfalfa Bunker or bag</td>
<td>bud to 1/10 bloom</td>
<td>35-45%</td>
</tr>
<tr>
<td>Stave Harvestore</td>
<td>bud to 1/10 bloom</td>
<td>40-55%</td>
</tr>
<tr>
<td></td>
<td>bud to 1/10 bloom</td>
<td>50-60%</td>
</tr>
</tbody>
</table>
Corn Silage Harvest Guidelines

• For good fermentation and minimum seepage:
  – **Horizontal silo** – 30 to 35% DM
  – **Conventional upright** – 32 to 37% DM
  – **Oxygen-limiting upright** – 40 to 45% DM
  – **Bags** – 30 to 40% DM
### Expected Dry Matter Losses of Corn Silage Harvested at Different Moisture Contents

<table>
<thead>
<tr>
<th>Moisture</th>
<th>Harvest</th>
<th>Storage Percentage</th>
<th>Feeding</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 70</td>
<td>4.0</td>
<td>13.4</td>
<td>4.0</td>
<td>21.4</td>
</tr>
<tr>
<td>61-69</td>
<td>5.0</td>
<td>6.3</td>
<td>4.0</td>
<td>15.3</td>
</tr>
<tr>
<td>&lt; 61</td>
<td>16.2</td>
<td>6.3</td>
<td>4.0</td>
<td>26.5</td>
</tr>
</tbody>
</table>
Effect of maturity on maximum milk yield

Maximum milk yield (%)

Source: Johnson et al., 1999
Harvest Timing
Silage Problems When Harvest Timing Is Off ...
What do we know?

- Too wet (> 70%)
  - reduced yield
  - souring
  - seepage
  - low intake by dairy cows

- Too dry (< 60%)
  - reduced yield
  - cause molds to develop
  - lowers digestibility, protein and vitamins A and E

- The decision of when to harvest corn silage depends upon the ideal moisture for the storage structure.
Corn Kernel Milk Line Progression

Photo credits: Dupont Pioneer
Corn Silage Harvest Guidelines

• Generally $\frac{1}{2}$ to $\frac{2}{3}$ milk line will be 60% to 70% DM

Source: Greg Roth, Penn State
Kernel Milk Stage “Triggers” for Timing Silage Harvest

<table>
<thead>
<tr>
<th>Silo structure</th>
<th>Ideal moisture content</th>
<th>Kernel milk stage &quot;trigger&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal bunker</td>
<td>70 to 65</td>
<td>80</td>
</tr>
<tr>
<td>Bag</td>
<td>70 to 60</td>
<td>80</td>
</tr>
<tr>
<td>Upright concrete stave</td>
<td>65 to 60</td>
<td>60</td>
</tr>
<tr>
<td>Upright oxygen limiting</td>
<td>60 to 50</td>
<td>40</td>
</tr>
</tbody>
</table>

"trigger": kernel milk stage to begin checking silage moisture
Silage moisture decreases at an average rate of 0.5% per day during September
Corn Silage Drydown During Harvest (Hendrickson, Manitowoc County, WI)

![Graph showing drydown of corn silage from 1996 to 2001. The graph plots forage moisture (%) against sample date from 22-Aug to 3-Oct. Each year has a different trend line with the following R-squared values: 1996 = 0.77, 1997 = 0.96, 1998 = 0.91, 1999 = 0.92, 2000 = 0.89, 2001 = 0.93.]

Source: Lauer
In-season Guidelines for Predicting Corn Silage Harvest Date

- Note hybrid maturity and planting date of fields intended for silage.

- Note tasseling (silking) date.
  - Kernels will be at 50% kernel milk (R5.5) about 42 to 47 days after silking.

- After milkline moves, use kernel milk triggers to time corn silage harvest.
  - Use a drydown rate of 0.5% per day to predict date when field will be ready for the storage structure.
  - See [http://cf.uwex.edu/ces/ag/silagedrydown/](http://cf.uwex.edu/ces/ag/silagedrydown/)

- Do final check prior to chopping.
Procedure for measuring plant moisture

1. Sample 3 to 5 plants in a row that is well bordered and representative.
2. Put in a plastic bag.
4. Chop as quickly as possible.
5. Measure moisture using NIR spectroscopy and/or by drying using a Koster oven, microwave, or convection oven.
Options for drying forages

Koster Tester

A Vortex Forage and Biomass Sample Dryer
http://extension.psu.edu/publications/i-101

G3151, Using a Microwave Oven to Determine Moisture in Forages
http://extension.missouri.edu/p/G3151
Effect of maturity on maximum milk yield

Source: Johnson et al., 1999
Drying Hay Crops for Silage

• Plant respiration rate is highest at cutting and gradually declines until plant moisture content drops below 60%.

• Rapid initial drying to lose the first 15% moisture will reduce losses of starch and sugars and preserve more total digestible nutrients in the harvested forage.
Drying hay crops for silage

Figure 2. Effect of wide swath vs narrow swath drying rate, Arlington, WI, July 30, 31, 2007
### Difference in composition of alfalfa haylage made from narrow and wide swaths after ensiling, 8 trials, UW Arlington & Marshfield, 2005-2007

<table>
<thead>
<tr>
<th>Factor</th>
<th>Wide – Narrow Swath Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours to dry to 65% moisture</td>
<td>-10.8</td>
</tr>
<tr>
<td>Crude Protein, %</td>
<td>0.5</td>
</tr>
<tr>
<td>NDF, %</td>
<td>-1.0</td>
</tr>
<tr>
<td>NFC, %</td>
<td>1.7</td>
</tr>
<tr>
<td>Ash, %</td>
<td>-0.2</td>
</tr>
<tr>
<td>Lactic acid, %</td>
<td>0.8</td>
</tr>
<tr>
<td>Acetic Acid, %</td>
<td>-0.2</td>
</tr>
<tr>
<td>Relative Forage Quality</td>
<td>11</td>
</tr>
</tbody>
</table>
Processing corn silage

• A lot of work has been done to evaluate the benefits of processing

• Not all trials agree on the magnitude of improvement but the trend is toward higher digestibility and animal performance from processed silage
Processing Corn Silage

Figure 1. Relationship between maturity and energy content in silage corn with and without processing.
Processing Affects Rumen Digestion

J. HARRISON and L. VAN WIERINGEN
Department of Animal Sciences, Washington State University, Puyallup, Washington

Figure 2. Processing affects rate of dry matter (top) starch (middle) and neutral detergent fibre disappearance in the rumen.
Affects on Total Tract Digestion

Figure 3. Total tract digestibility of dry matter (DM), starch, NDF and fat.

J. HARRISON and L. VAN WIERINGEN
Processing Effect on Intact Kernels, Starch Digestibility

Figure 4. Effect of percent whole intact kernels (top) and post-ensiling vitreousness (bottom) on whole tract starch digestibility.
Effects of Processing at Progressing Stages of Maturity - TMR

Figure 6. Effect of processing corn silage at two stages of maturity on digestible energy (left) and net energy of lactation, NEL (right) of the total mixed ration containing 27% corn silage (for MJ/kg, multiply Mcal/lb X 0.53).
Effect of Processing on Milk Production and Composition

Figure 8. Effect of feeding unprocessed and processed corn silage on feed intake (DMI) and milk production (left) and milk composition (right) (1 lb = 0.45 kg).
Cutting Height

- Nutritional quality of silage can be improved with higher cutting
- Obviously yield will also be affected
Relative change in silage yield & quality at different cutting heights during 1996

- Silage yield
- Milk per Ton
- Milk per acre

Source: Cusicanqui and Lauer (1996)
Harvesting Corn Silage

• **Sharpen knives**
  – Uniform chop
  – Reduces energy requirement for harvest

• **Chop at correct length**
  – Recommended theoretical length of chop (TLC)
    • Grass and alfalfa – 3/8 to 1/2 inch
    • Unprocessed corn silage – 3/8 to 1/2 inch
    • Processed corn silage – 3/4 inch
    • Brown midrib silage requires longer TLC
Monitoring chop length

• Forage Particle Separator
  – Basic model has 3 screens
  – To measure chop length of silage use the top 2
    • 3/4 inch and 5/16 inch
  – Ideally, after sieving the material should be distributed:
    • 25-50% < 5/16 inch (bottom screen)
    • 40-50% between 5/16 and 3/4 inch (middle screen)
    • 10-20% > than 3/4 inch top (tray)
Storage
Filling the Silo

• A high density is desired to minimize spoilage losses and increase silo capacity.

• The most important factors to achieve high density include:
  – Harvesting at correct DM content
  – Spreading silage thinly
  – Using a heavy tractor(s) to pack
  – Packing time
  – Silo height
Filling the Silo

• Fill quickly – preferably in no more than three days
• Pack in layers no more than 6 inches deep
• Pack well – 15# DM/cubic ft.
• Storage Density Calculator
  http://www.uwex.edu/ces/crops/uwforage/DocumentationStorageDensity.pdf
Filling the Silo

Filling Rate (T/Hr) = \frac{\text{Packing Vehicle(s) Weight}}{800}

Packing Vehicle(s) Weight = \text{Filling Rate (T/Hr)} \times 800

Example:

If your tractor weighs 26,000 # you can fill at: \(26,000 \div 800 = 32\text{T/Hr}\)

If your chopper can deliver 45T/Hr you will need: \(45 \times 800 = 36,000\#\text{ Packing Wt.}\)
<table>
<thead>
<tr>
<th>Dry Matter Density (lbs DM/ft³)</th>
<th>DM Loss, 180 days (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>20.2</td>
</tr>
<tr>
<td>14</td>
<td>16.8</td>
</tr>
<tr>
<td>15</td>
<td>15.9</td>
</tr>
<tr>
<td>16</td>
<td>15.1</td>
</tr>
<tr>
<td>18</td>
<td>13.4</td>
</tr>
<tr>
<td>22</td>
<td>10.0</td>
</tr>
</tbody>
</table>
Filling the Silo

Progressive wedge
- Minimizes surface exposure to air and
- Maximizes packing efficiency

Covering

- Sealing the silo is crucial to minimize storage losses and make a stable silage
- Kansas study found average losses in top 18” to be > 40% in uncovered bunkers
Effect of Sealing Bunker Silos on DM Loss & Digestion (Berger and Bolson, 2006)

- % DM loss
  - Unsealed
  - Sealed

- % DM digestion
  - Unsealed
  - Sealed

Legend:
- 10 inches
- 20 inches
- 30 inches
Proper Plastic Sheeting
Charles Staples, U of Fla.

• 4 mil – Good(?), 6 mil – Better, 8 mil – Best
• UV Protection
• Two layers better than 1
• Oxygen barrier plastic “Silostop”
  -- 5 mil thickness
  -- Claims superior O₂ exclusion
  -- Oxygen transfer rate:
    • Conventional 5 mil plastic – OTR ≈ 1800 cc O₂/m²/day
    • Oxygen barrier – OTR ≈ 29
    • Can reduce DM loss in outer 1.5 to 3 feet by 50%
Color of Plastic on Silage Temp

Degrees F

Day of fermentation

White
Black
Sealing Recommendations from Charles Staples, U of Fla.

• Sealing the edges of a bunker can be challenging – this is an area vulnerable to deterioration.

• Plastic on sidewalls can help.
Plastic is laid down sides before filling begins and draped over sides.

Silo is filled and plastic is pulled to center.

A final sheet of plastic draped over back wall is then pulled over the corn and sealed at the bottom.

Figure 6. Cross sectional diagram of a bunker silo during filling.
<table>
<thead>
<tr>
<th>inputs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of the plastic sheets, tires, labor, $</td>
<td>$1000</td>
</tr>
<tr>
<td>Silage value, $/ton</td>
<td>$50/ton</td>
</tr>
<tr>
<td>Silage density, wet lbs/cubic foot</td>
<td>43</td>
</tr>
<tr>
<td>Silage lost in top 3 feet</td>
<td></td>
</tr>
<tr>
<td>Unsealed, % of crop ensiled</td>
<td>50</td>
</tr>
<tr>
<td>Sealed, % of crop ensiled</td>
<td>15</td>
</tr>
<tr>
<td>Silage in the top 3 ft, wet tons</td>
<td>516</td>
</tr>
<tr>
<td>Value of silage lost if unsealed, $</td>
<td>$12,900</td>
</tr>
<tr>
<td>Value of silage lost if sealed, $</td>
<td>$3,870</td>
</tr>
<tr>
<td>Value of silage saved by sealing, $</td>
<td>$9,030</td>
</tr>
</tbody>
</table>

Silo is 40’ wide by 200’ long; labor costs are $12/hour for 18 hours = $216.
Silage Inoculants

• Two types
  – Homofermentative
    • Produce lactic acid
    • Lactobacillus, Pediococcus, Enterococcus
    • Used to stimulate rapid fermentation
  – Heterofermentative
    • Produce lactic acid, acetic acid or ethanol, and carbon dioxide
    • Lactobacillus *buchneri*
    • Used to inhibit aerobic spoilage
Homofermentative Inoculants
(Fermentation aids)

• Improve the initial fermentation process
  – Speeds up lactic acid production
  – Prevents growth of undesirable microbes (Enterobacteria, Clostridia)

• Can lead to improvements in dry matter recovery (2%-3%)

• Sometimes lead to improvements in animal performance
Figure 1. The three major events that make good silage and factors that can affect the silage fermentation process.

- Moisture content
- Length of cut
- Good packing

Rapid Removal of Air → Fermentation with a homolactic acid inoculant

Silage pH

- Normal Fermentation
- Poor Fermentation

↑ Rapid Rate and Extent of pH Drop → Prevention of Air Penetration into the Silo Mass and Inhibition of Yeast

Moisture content
Length of cut
Sealing
Rate of feedout
Face management
Propionic acid
Ammonia

Removal of air
Type of bacteria
Number of bacteria
Buffering capacity
Fermentable sugars
Microbial inoculant
Enzymes

2 to 3 Days of Fermentation → Storage Time

<table>
<thead>
<tr>
<th>Type of Study</th>
<th>Intake</th>
<th>Gain</th>
<th>Milk Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Studies</td>
<td>67</td>
<td>15</td>
<td>36</td>
</tr>
<tr>
<td>Studies with Positive Responses</td>
<td>28%</td>
<td>53%</td>
<td>47%</td>
</tr>
</tbody>
</table>

(Kung and Muck, 1997)
Homofermentative Inoculants

- Effectiveness unpredictable in corn
- Work best on
  - Immature corn
  - Overly dry corn
  - Day after a killing frost

(Muck and Kung, 1997)
Heterofermentative Inoculants
(Spoilage Inhibitors)
Lactobacillus buchneri

• Have little effect on initial silage fermentation
• Improves aerobic stability of silage
• Increases production of acetic acid which is a potent inhibitor of yeasts and molds
Heterofermentative Inoculants

• Use to extend shelf life (bunk life)
  – Large bunkers or piles where the face may be too wide
  – Silage that will be sold and left on intermediate feeding piles for several days
  – Bags or bunkers that will be fed out during summer
Choosing an Inoculant

• An effective silage inoculant will have independent, statistically analyzed, and published data supporting its use – the more the better.
Feedout
Managing aerobic stability

• Silage quality can deteriorate rapidly during feedout.
• The exposed silage surface is open to air (oxygen) for long periods of time.
• In the presence of oxygen, yeast cells and mold spores that were dormant in the anaerobic environment can become active.
• **Yeast growth** is the primary cause of silage heating and is the primary cause of DM and energy losses at feedout.
Silo face management
Key steps to reducing DM loss and maintaining silage quality at feedout

• Use proper harvesting and storage techniques
• Feed at least 6 inches of silage per day from a bunker silo face
• Use good face management
• DO NOT feed moldy silage; it can cause serious health problems and/or production losses!
Effect of Feeding Spoiled Silage on DMI and Total DM Digestibility

Source: Whitlock et al., 2000
Fermentation Analysis

- Can tell us the quality of fermentation that has occurred
- Can help explain poor nutritive value or low intake
- Should be used in conjunction with standard chemical analysis

- [http://fyi.uwex.edu/forage/files/2014/01/Fermentation.pdf](http://fyi.uwex.edu/forage/files/2014/01/Fermentation.pdf)
Fermentation Analysis

Table 1. Typical concentrations of common fermentation end products in various legume and grass silages.

<table>
<thead>
<tr>
<th>End product</th>
<th>Legume silage (30-40%)&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Legume silage (45-55%)&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Grass silage (30-35%)&lt;sup&gt;1&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>4.3-4.7</td>
<td>4.7-5.0</td>
<td>4.3-4.7</td>
</tr>
<tr>
<td>Lactic acid (%)</td>
<td>7-8</td>
<td>2-4</td>
<td>6-10</td>
</tr>
<tr>
<td>Acetic acid (%)</td>
<td>2-3</td>
<td>0.5-2.0</td>
<td>1-3</td>
</tr>
<tr>
<td>Propionic acid (%)</td>
<td>&lt;0.5</td>
<td>&lt;0.1</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>Butyric acid (%)</td>
<td>&lt;0.5</td>
<td>0</td>
<td>0.5-1.0</td>
</tr>
<tr>
<td>Ethanol (%)</td>
<td>0.2-1.0</td>
<td>0.5</td>
<td>0.5-1.0</td>
</tr>
<tr>
<td>Ammonia-N (%) (of CP)</td>
<td>10-15</td>
<td>&lt;12</td>
<td>8-12</td>
</tr>
</tbody>
</table>

<sup>1</sup> Dry matter basis
Troubleshooting silage problems

• **pH too high**
  – Cause could be slow fermentation, yeast growth
  – No smell, alcoholic, or earthy
  – Could be due to slow filling, poor packing, chop length
  – Inoculant may help prevent
Troubleshooting silage problems

- **Silage heats**
  - Can be caused by yeast, bacillus growth
  - Could be caused by slow filling, poor packing, chop length
  - Spoilage inhibitor may help prevent
Troubleshooting silage problems

• Mold
  – Musty smell
  – Grows in presence of air
  – Possible causes
    • Poor packing
    • Poor sealing
    • Slow feedout
Troubleshooting silage problems

- **Silage pH too low**
  - Sweet acid smell
  - Usually results from activity of “wild” lactobacilli
  - Often follows a slow initial fermentation
    - Fast fermentation usually prevents establishment of “wild” lactobacilli
  - To avoid practice fast fill rate, good packing, and use a homolactic inoculant
Troubleshooting silage problems

• **High ammonia**
  – Caused by Enterococcus or Sreptococcus faecium - bacteria that break down protein
  – Or possibly caused by clostridia
Troubleshooting silage problems

• **Clostridial fermentation**
  – Can occur with wet silage or with high ash content-
    soil inclusion
  – Silage will have a fecal/putrid/decaying odor
  – Intake will be low
Recommended references

• Team Forage – University of Wisconsin Extension – http://fyi.uwex.edu/forage/

• QualitySilage.com - http://qualitysilage.com/

• The Silage Zone – Pioneer
https://www.pioneer.com/home/site/us/livestock-feed-nutrition/
Take Home Messages

• Manage to maximize
  – DM recovery
  – Forage quality

• Harvest at correct time
  – Moisture content
  – Maturity

• Chop and process correctly

• Use inoculants appropriately
Take Home Messages

• Fill quickly
• Pack densely
• Cover well
• Feedout to minimize aerobic instability
The End of the Row – Questions?
Thanks for your attention!