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Invisible Losses from Corn and Cereal Silage Piles: What are 'real 'shrink losses?

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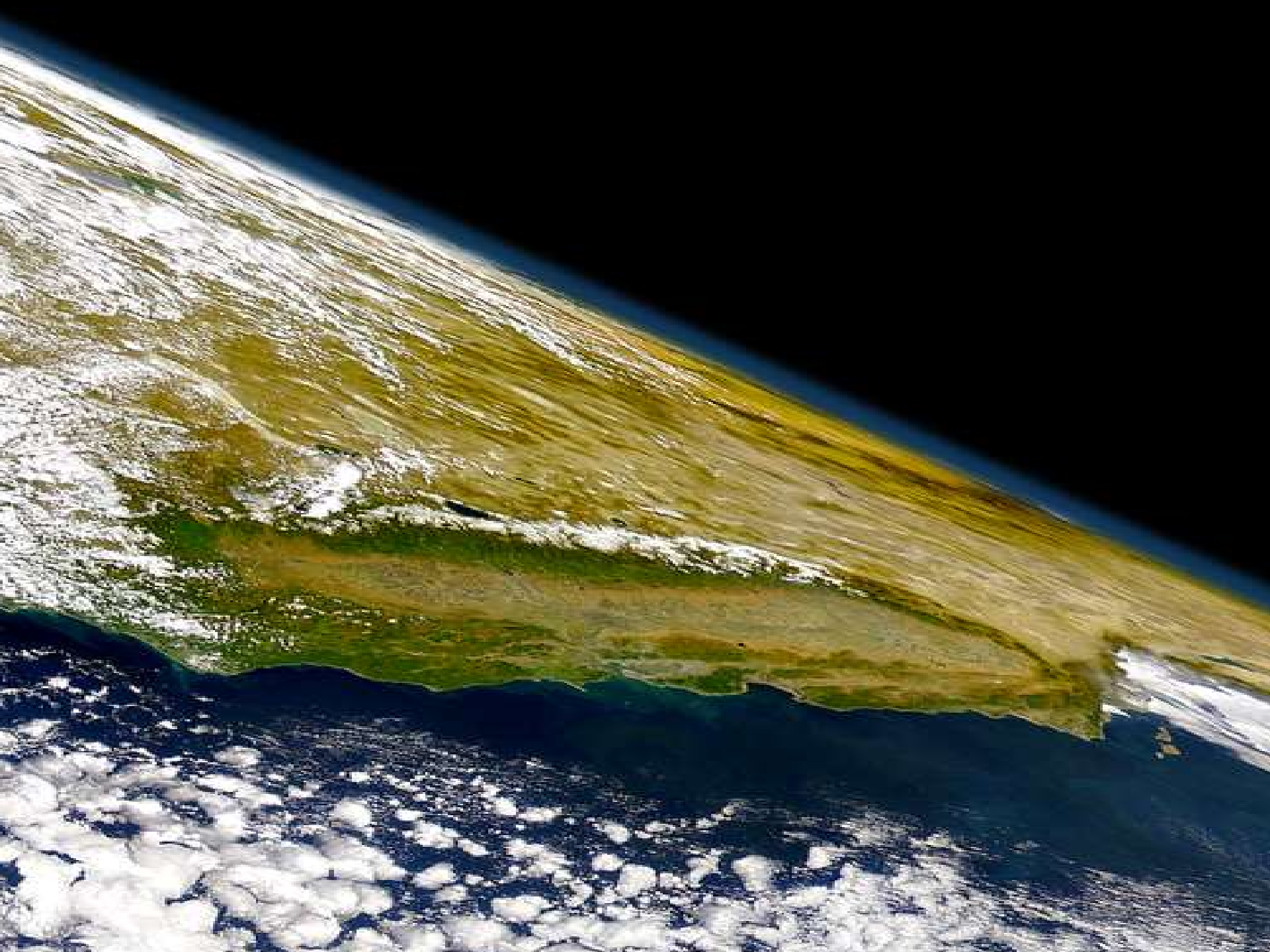
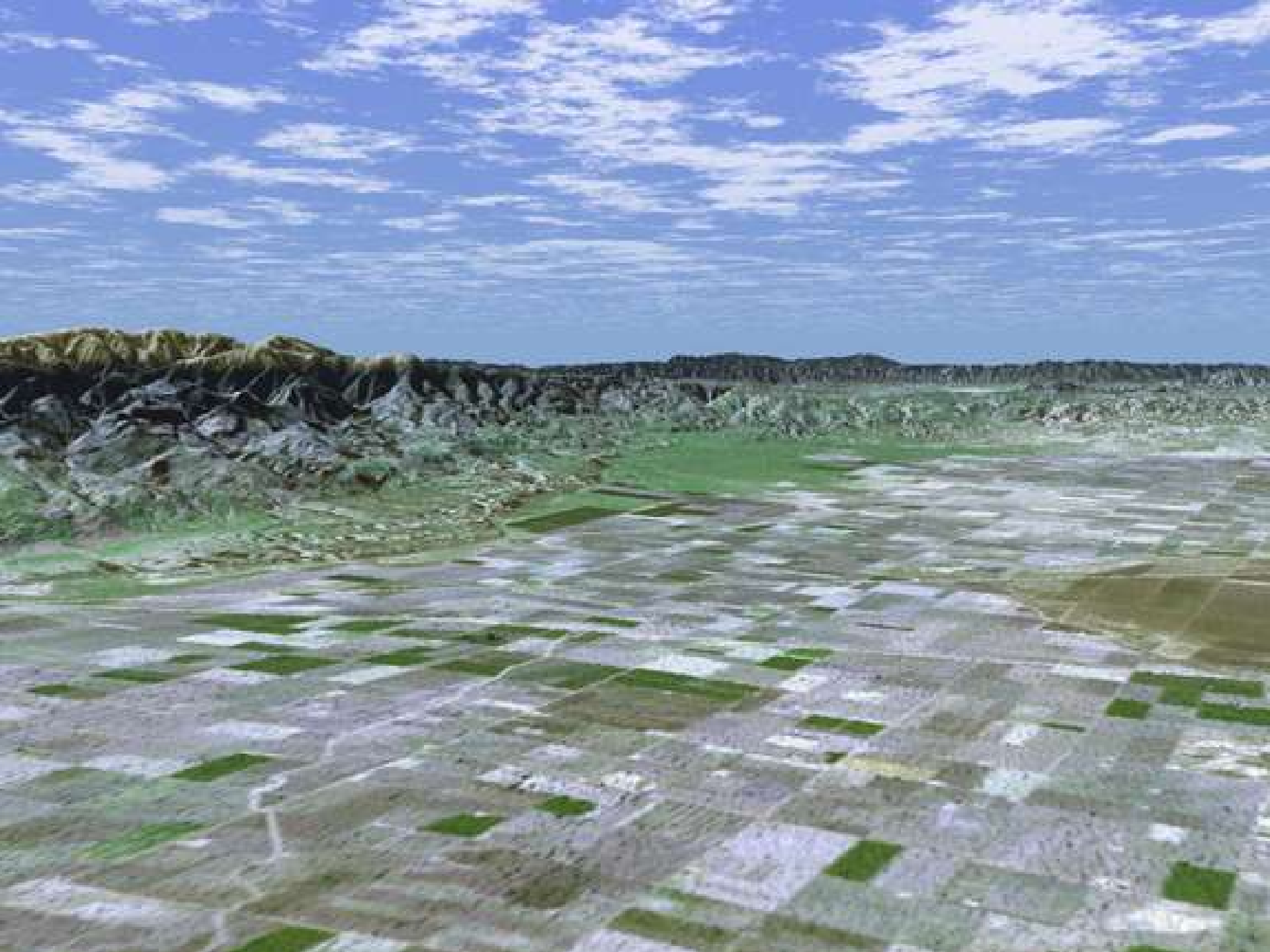
Rule 4570 (SJVAPCD)

- **Rule 4570 stipulates a list of mitigations, some of which must be used by dairy producers to reduce losses of volatiles from silages (primarily in piles)**
- **Volatiles emissions seem accepted by the SJVAPCD as real and substantive enough to impact air quality**
- **Volatiles emissions represent a loss of silage nutrients**





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- Volatiles emissions seem accepted by the SJVAPCD as real and substantive enough to impact air quality
- Volatiles emissions represent a loss of silage nutrients
- **Our Objective:**
  - ***Measure 'shrink' in silage piles and where it occurred***
  - ***Mission creep: Identify where shrink occurs***

What is shrink?

- **Forage ensiled which is not fed**
  - **total weight to the mixer divided by total weight ensiled**
- **Forage ensiled not fed or recovered as spoilage**
  - **total weight to the mixer + spoilage divided by total weight ensiled**

What are WW, oDM and vcoDM shrinks?

- **WW**
  - **loss of WW between pile building and the mixer**
  - **if 1,000 tons fresh weight to the pile and 920 tons silage to the mixer**
  - **So WW shrink = 80/1000 = 8.0%**

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- **WW**
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- **oDW**
  - loss of oDW between pile building and the mixer
    - 1,000 tons @ 35% DM = 350 tons
    - 920 tons @ 36% DM = 331 tons
  - So oDW shrink = 19/350 = 5.4%

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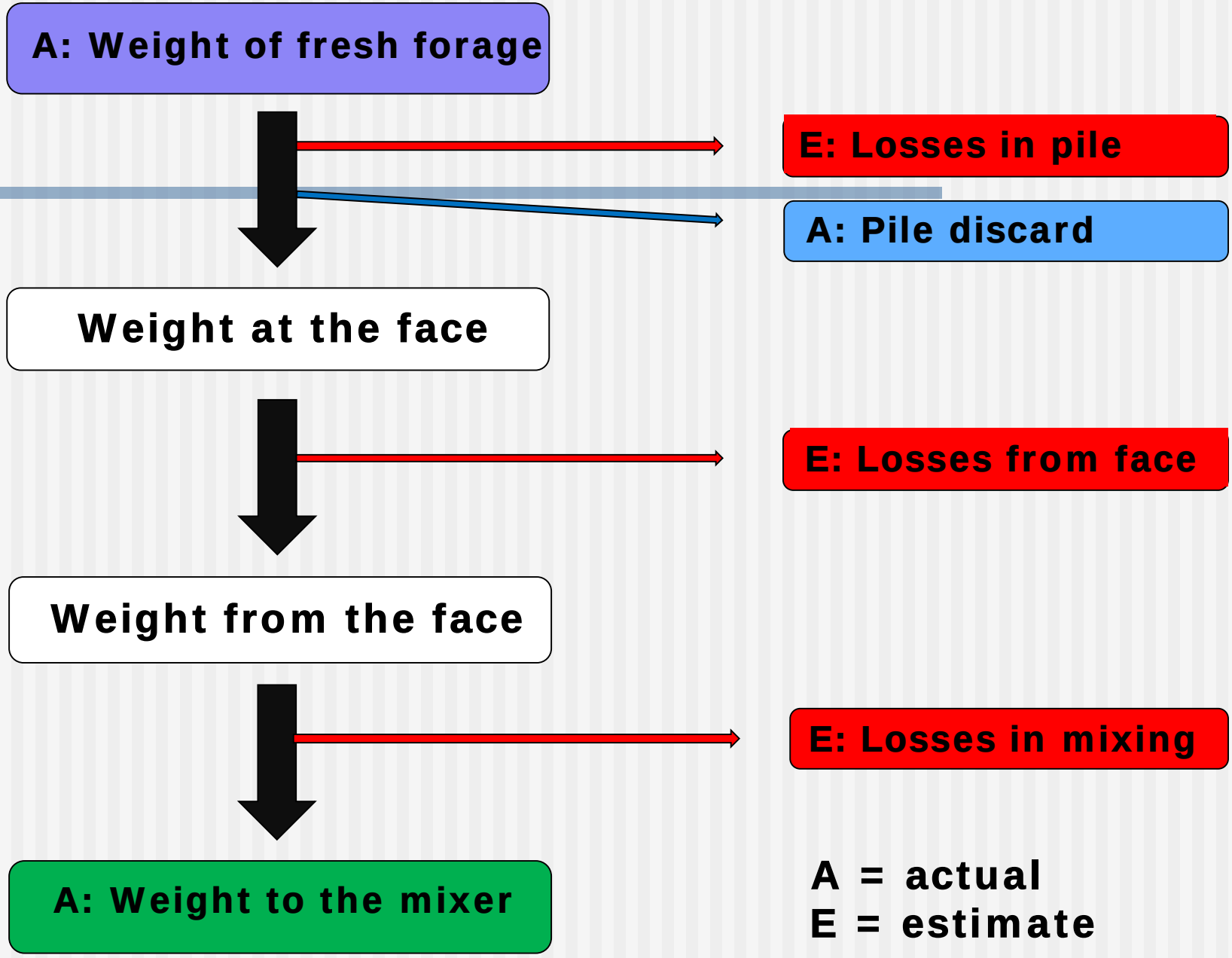
  - So oDW shrink = 19/350 = 5.4%
- **vcoDW**
  - loss of vcoDW between pile building and the mixer
    - 350 tons w 0.4% FW volatiles = 354 tons
    - 331 tons w 1.5% FW volatiles = 346 tons
  - So vcoDM shrink = 8/354 = 2.3%

The Corn Silage Aspect

- **7 corn silage piles (fall 2013 crop)**
  - 3 north and 4 south SJV
  - 4 wedge, 1 pit, 2 rollover
  - 4 concrete, 1 50/50, 2 dirt
  - black/white cover, OB underlay, tire chains
- **Measurements**
  - measurements of total weights to pile and to mixer
  - composition of fresh chop and silage to mixer
  - ‘buried bag’ lines (4 piles)
  - coring of ‘new’ and ‘old’ faces (all piles 2X, except 1 pile)
  - sampling of ‘drop down’ piles
  - assays for oDM and vcoDM to calc WW, oDW and vcoDW shrink


A: Weight of fresh forage
E: Losses in pile
A: Pile discard
Weight at the face
E: Losses from face
Weight from the face
E: Losses in mixing
A: Weight to the mixer
A = actual
E = estimate

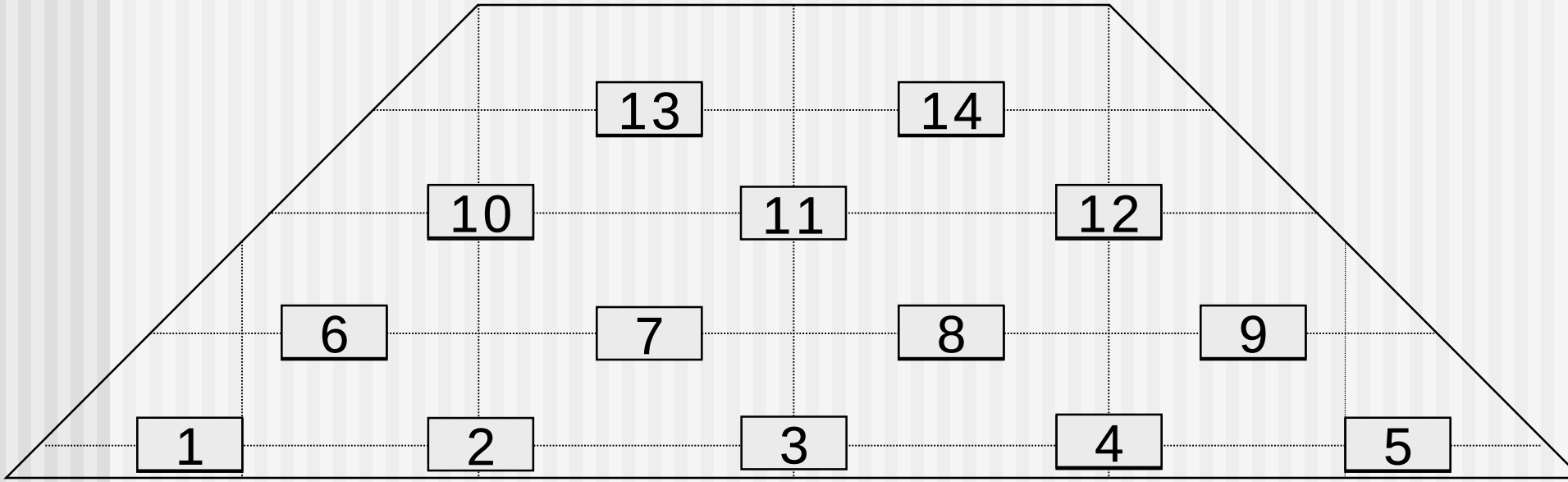
Losses in the silage mass

- How large are losses prior to face exposure ?

- Use of buried bags
  - 2 lb of fresh material per bag
  - buried in the pile at filling
  - recovered at feedout

Buried Bag Placement

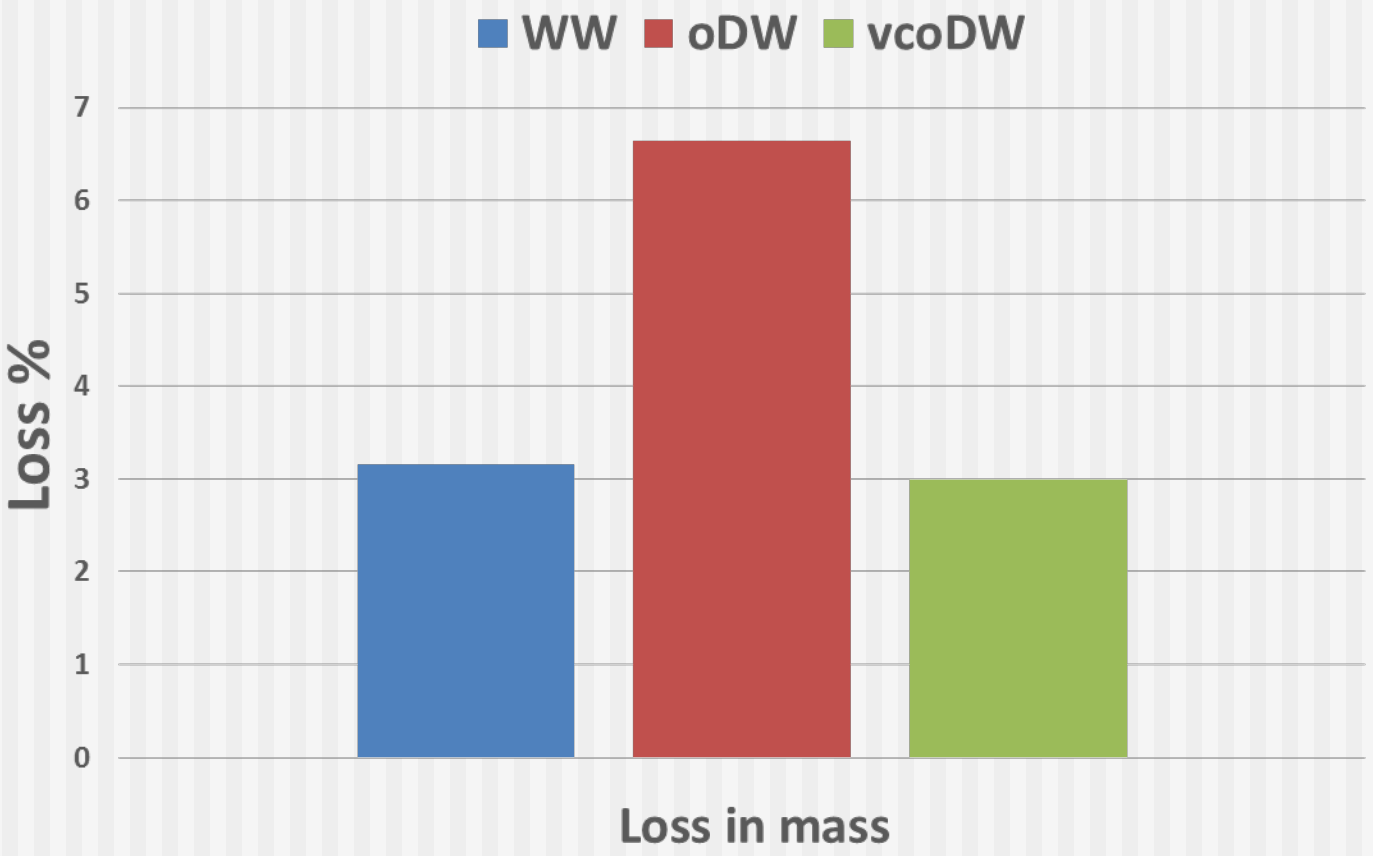
Target Placement locations

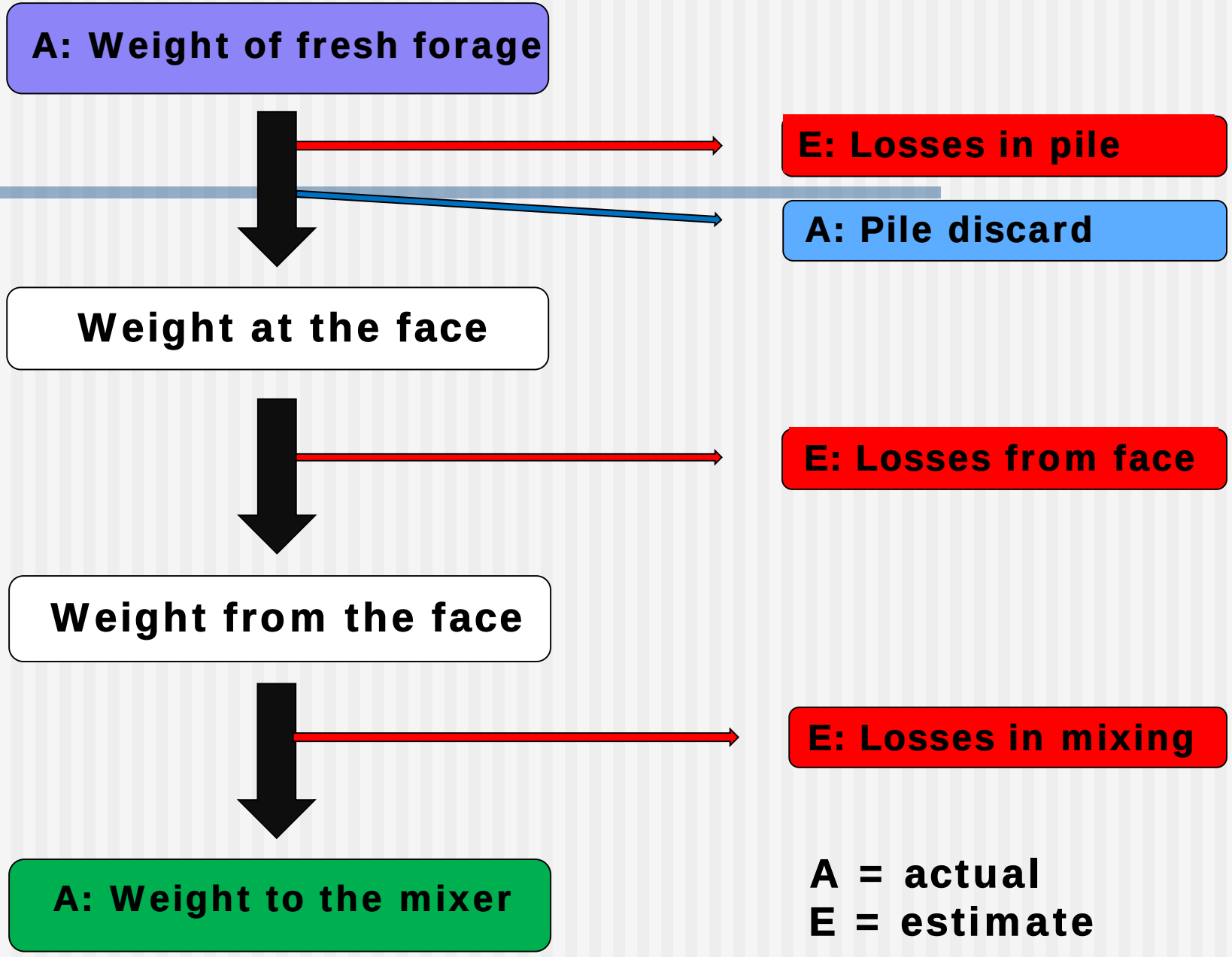


Burying the Bags

Recovering the Bags

Shrink Losses in the Silage Mass

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A: Weight to the mixer
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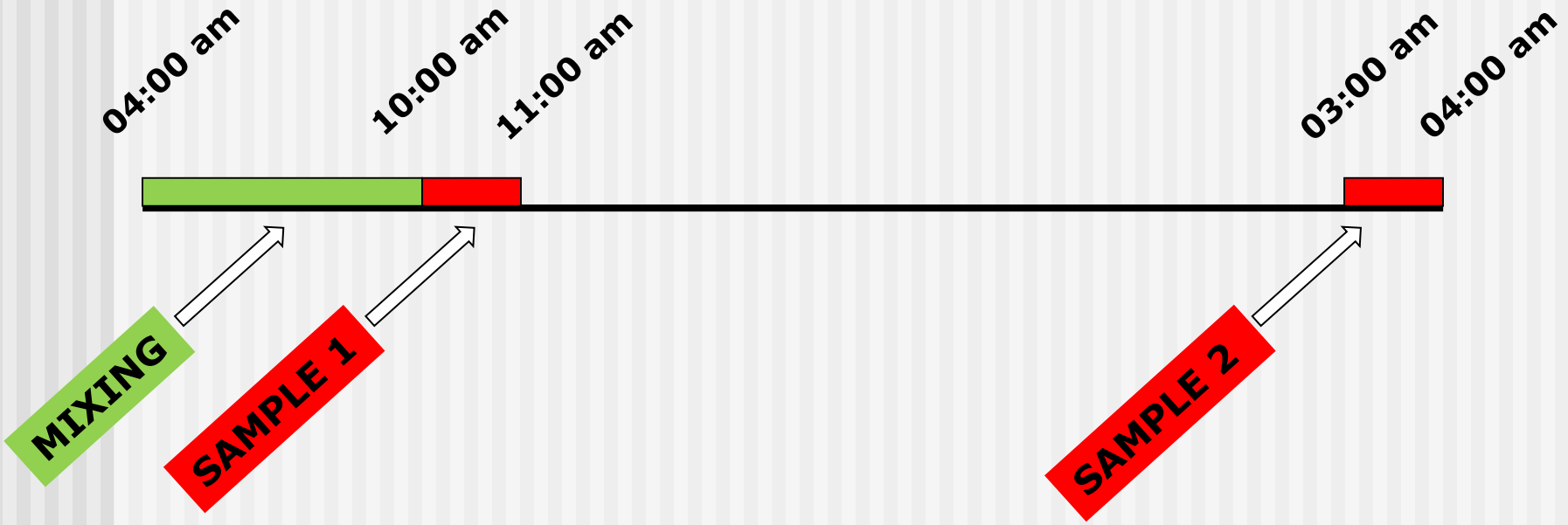
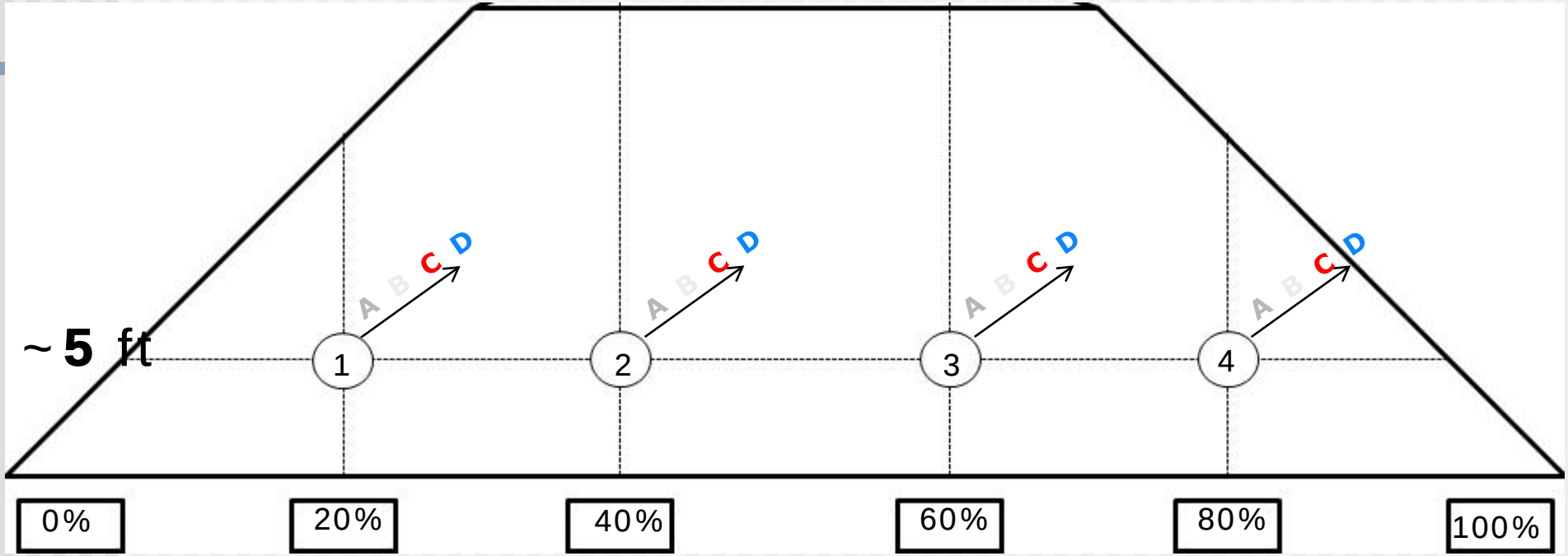
Shrink Losses from the silage face

- How large are the face losses?
- Use of repeated core sampling
  - of a ‘fresh’ and an ‘old’ face
  - at depths to 20 inches into the face

Face Sampling Schedule

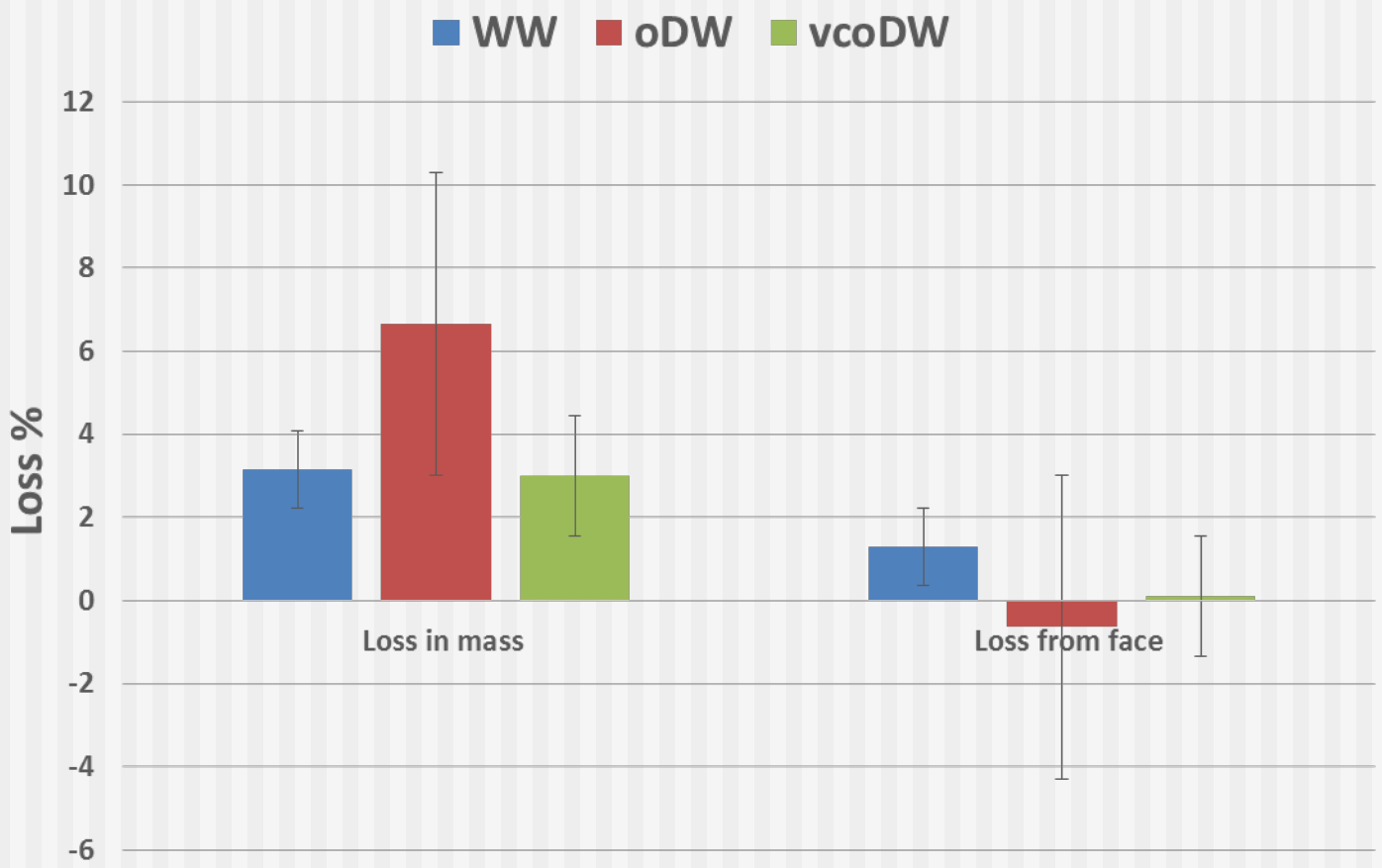


CORE SAMPLING

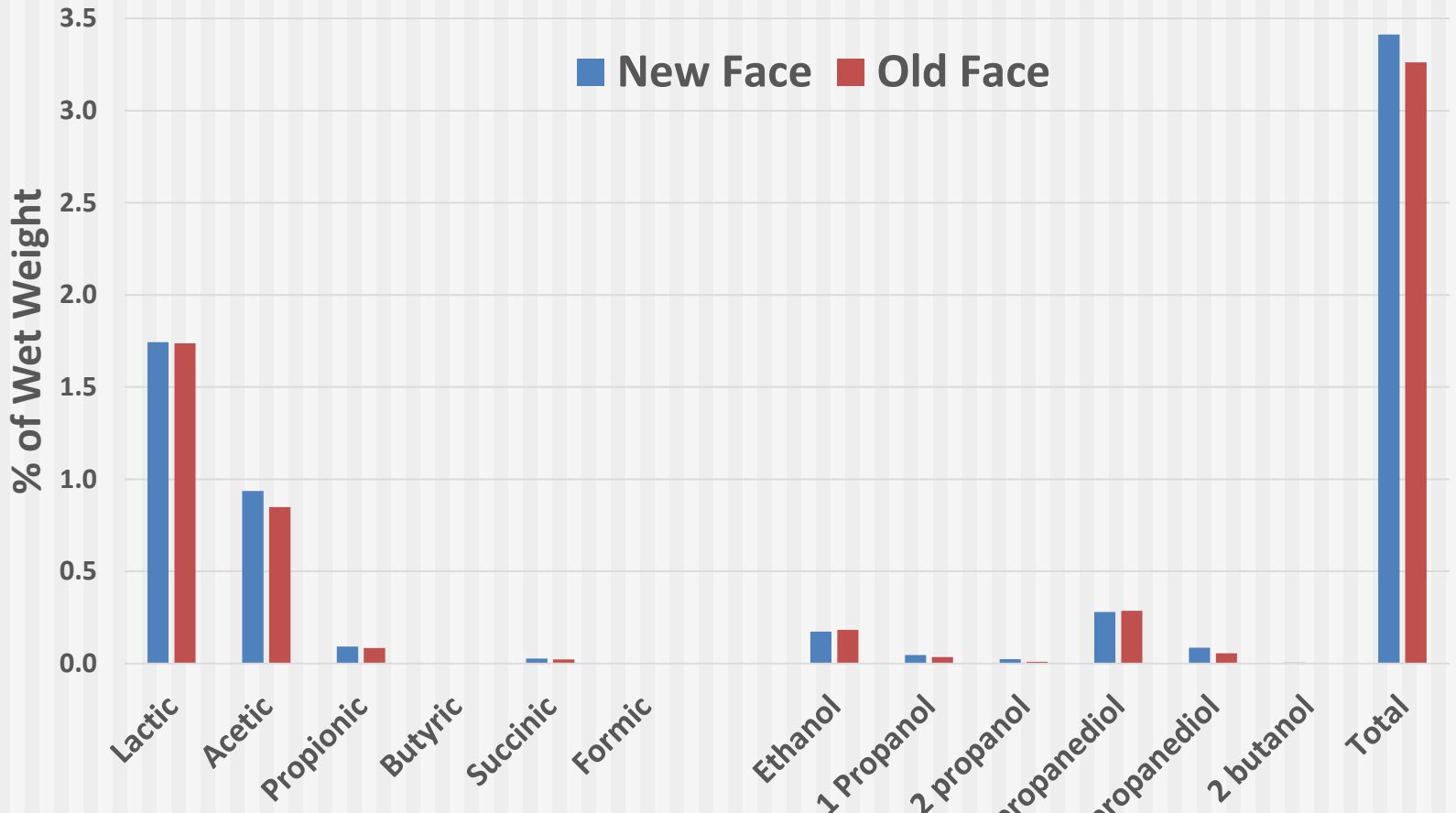


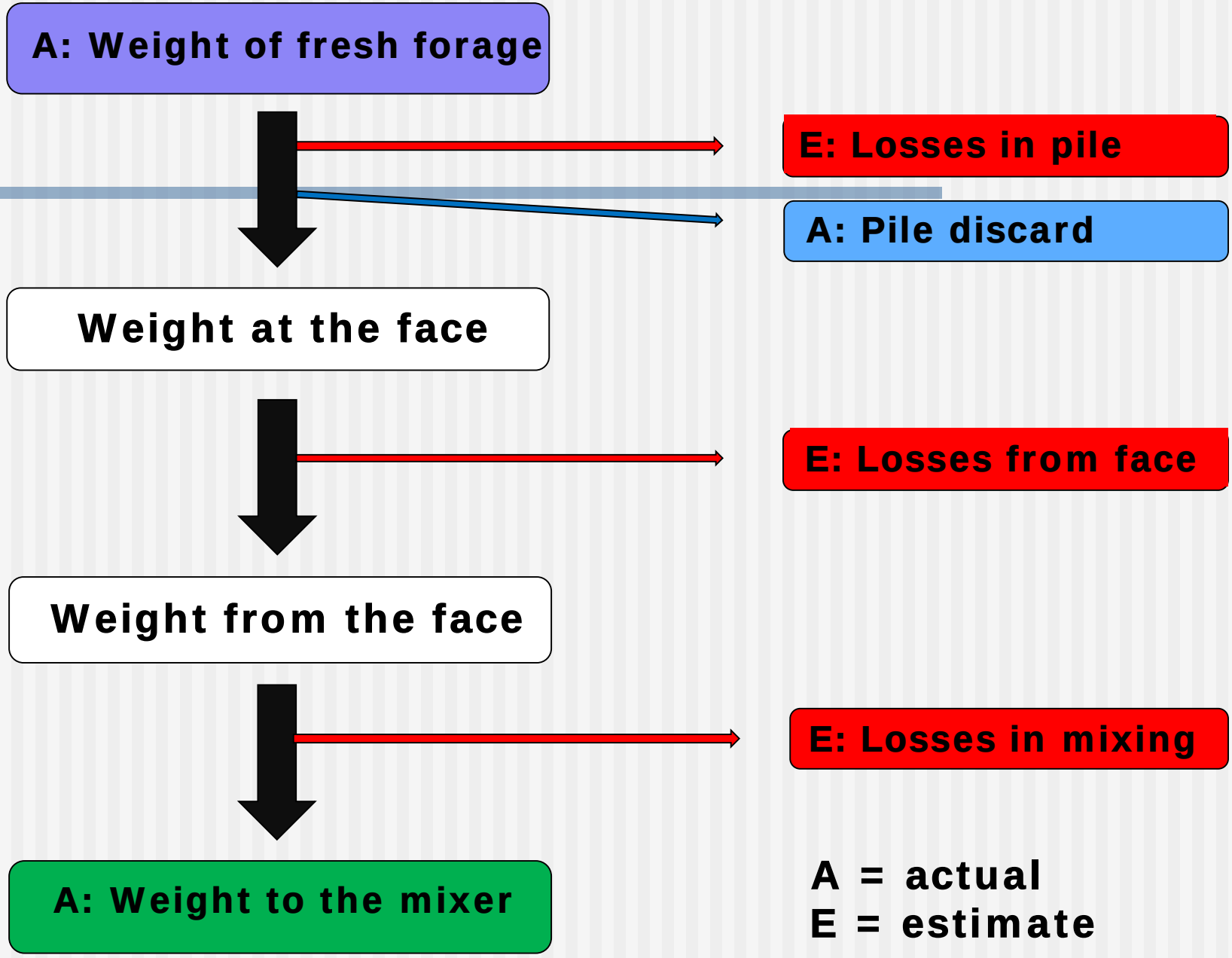
The Sampling Gadget

Shrink Losses from the Face



Change in Face Volatiles Levels

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Weight at the face
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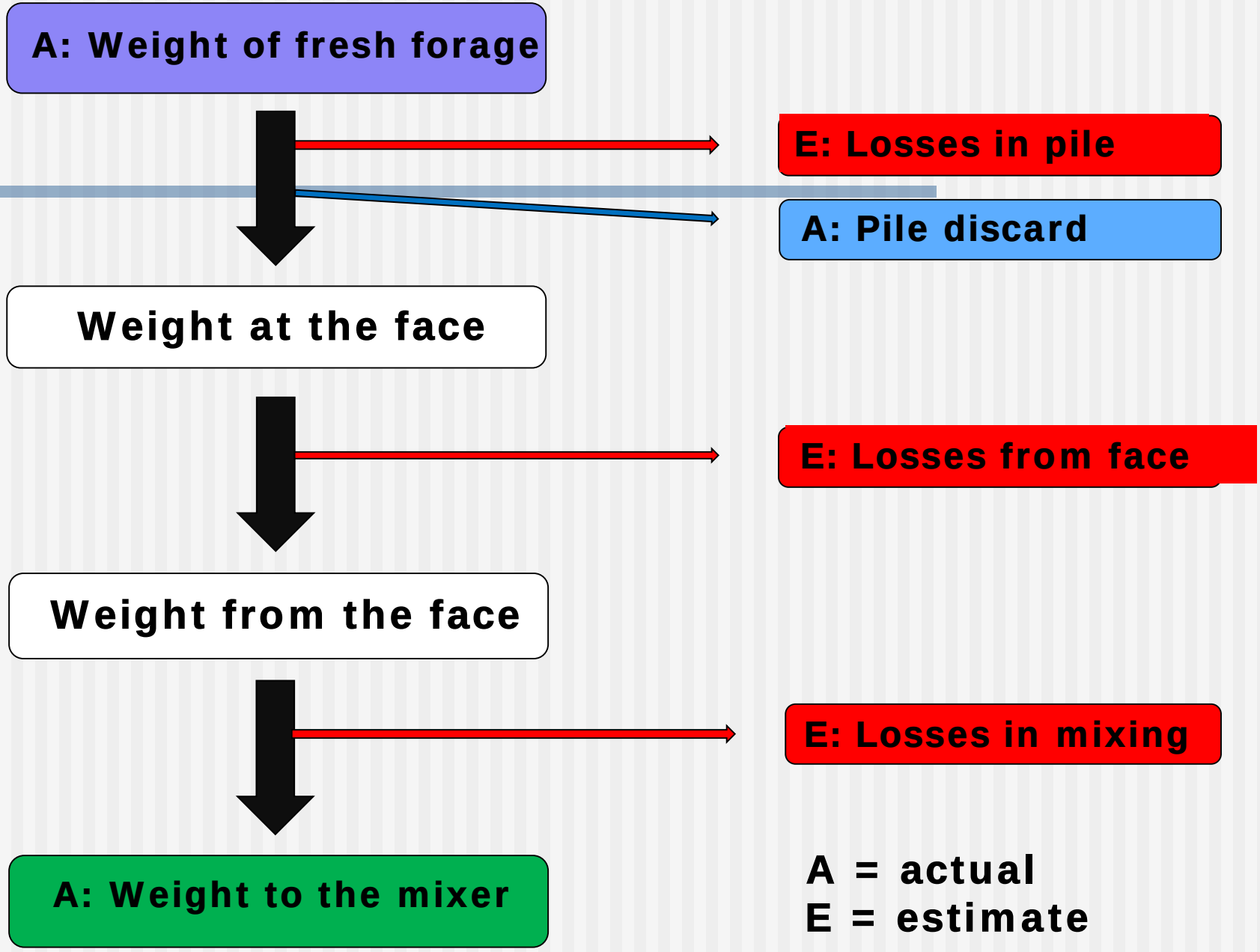
A: Weight to the mixer
A = actual
E = estimate

Shrink Losses from De-facing to the Mixer

- There must be some losses after defacing
  - impacted by violence of defacing?
- Samples of A,B,C,D cores and overnight ‘drop-down’ piles to calculate weight loss
  - ash as ‘indigestible marker’ for losses of WW, oDM and vcoDM

Shrink Losses from De-facing to the Mixer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Weight at the face
E: Losses from face
Weight from the face
E: Losses in mixing
A: Weight to the mixer
A = actual
E = estimate

Shrink Calculated from in/out Weights

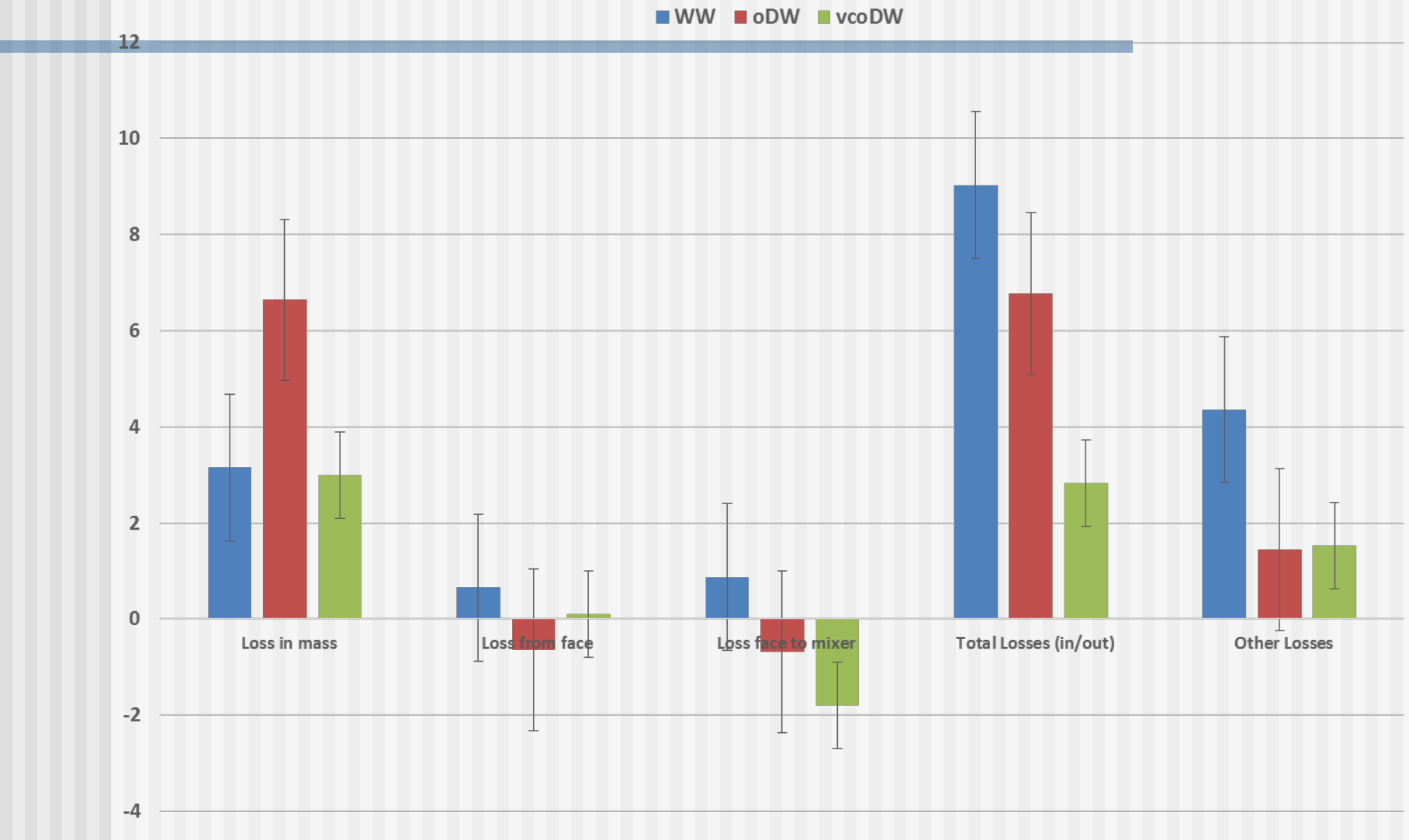
- Total weight in
  - truck weights and samples
  - as WW, oDM and vcODM
- Total weight out
  - mixer weights and samples
  - as WW, oDM and vcoDM

Shrink Calculated from in/out Weights

- Total weight in
  - truck weights and samples
  - as WW, oDM and vcODM
- Total weight out
  - mixer weights and samples
  - as WW, oDM and vcoDM

These values are not related to the prior measures

Summary Corn Silage Shrink Losses



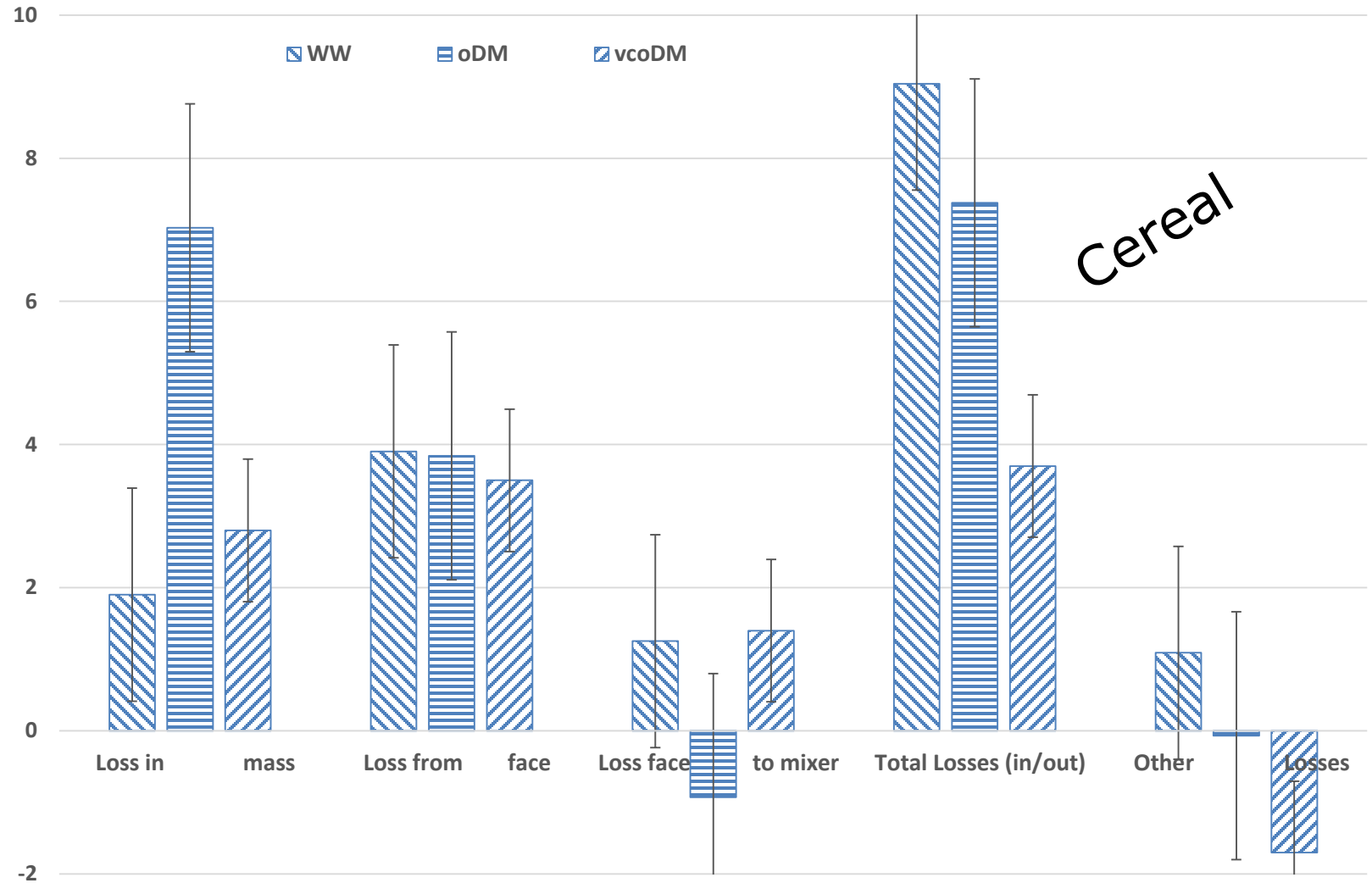
The Cereal Silage Aspect

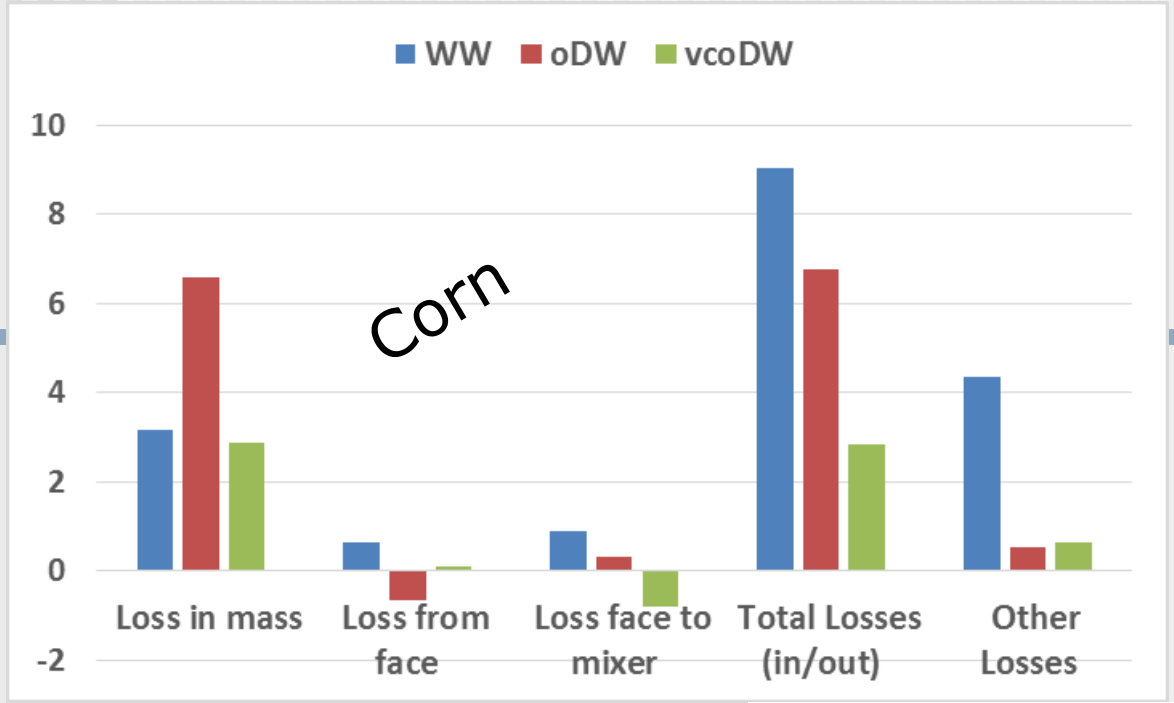
- **6 cereal silage piles (spring 2014 crop)**
  - **3 north and 3 south SJV**
  - **6 wedge**
  - **4 concrete, 1 50/50, 1 dirt**
  - **black/white cover, OB underlay, tire chains**

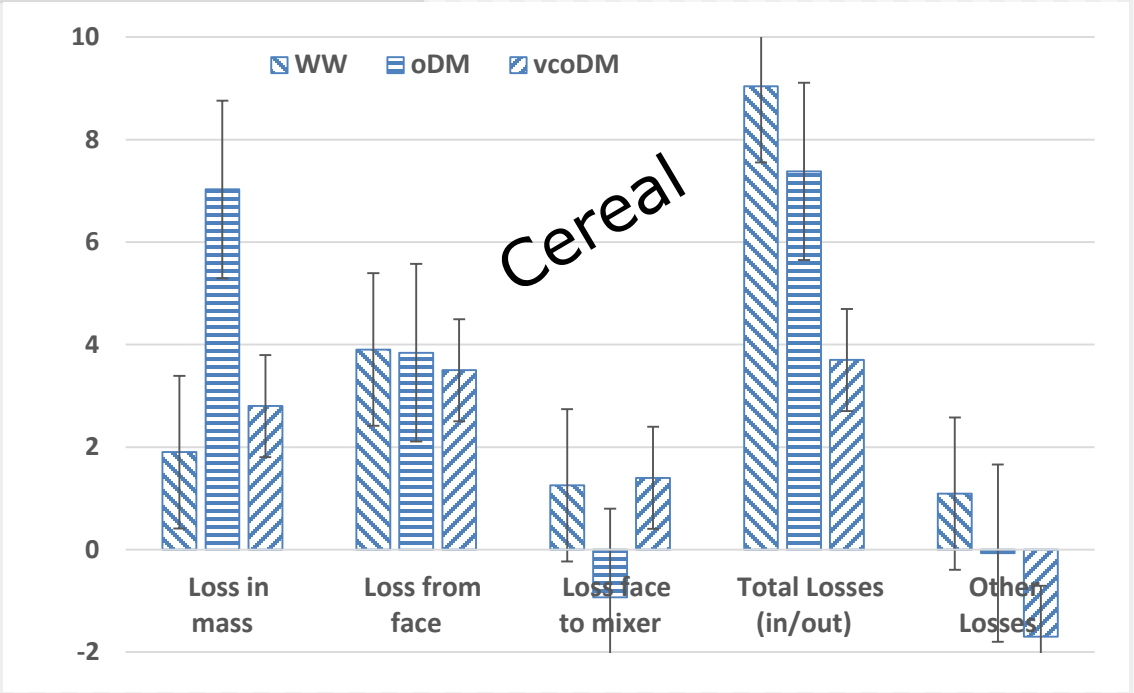
- **Measurements**
  - **measurements of total weights to pile and to mixer**
  - **composition of fresh chop and silage to mixer**
  - **‘buried bag’ lines (5 piles)**
  - **coring of ‘new’ and ‘old’ faces (all piles 2X)**
  - **sampling of ‘drop down’ piles**

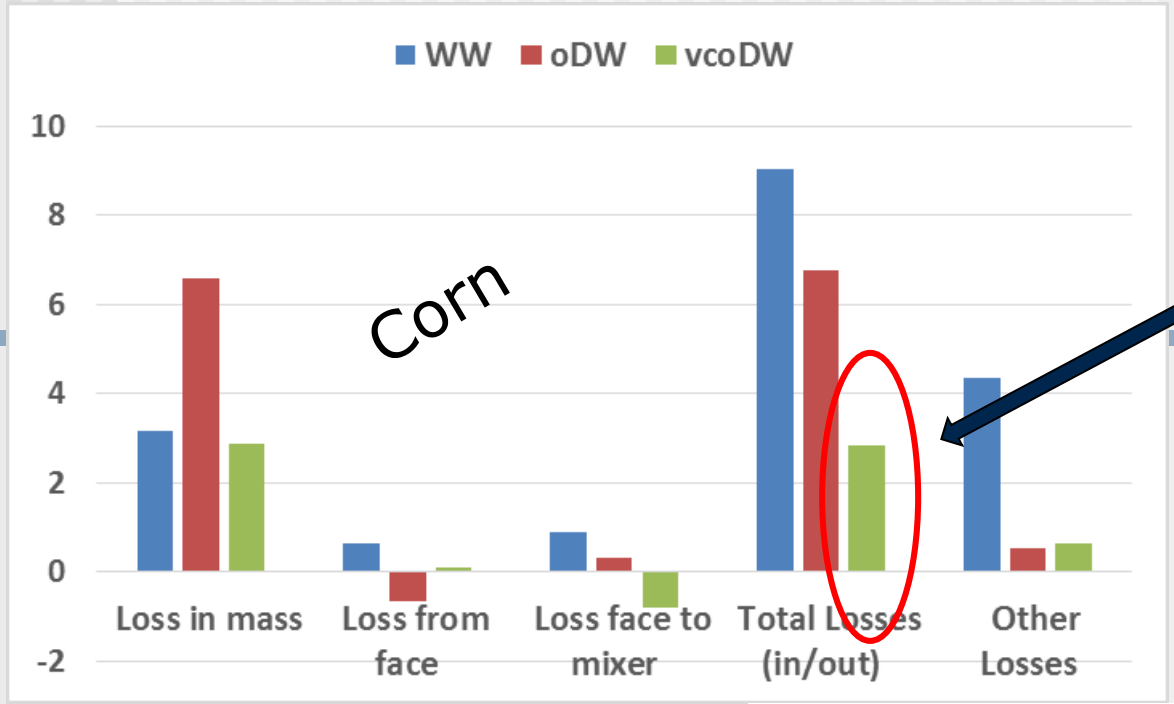
  - **assays for oDM and vcoDM to calc WW, oDW and vcoDW shrink**

Summary Wheat Silage Shrink Losses



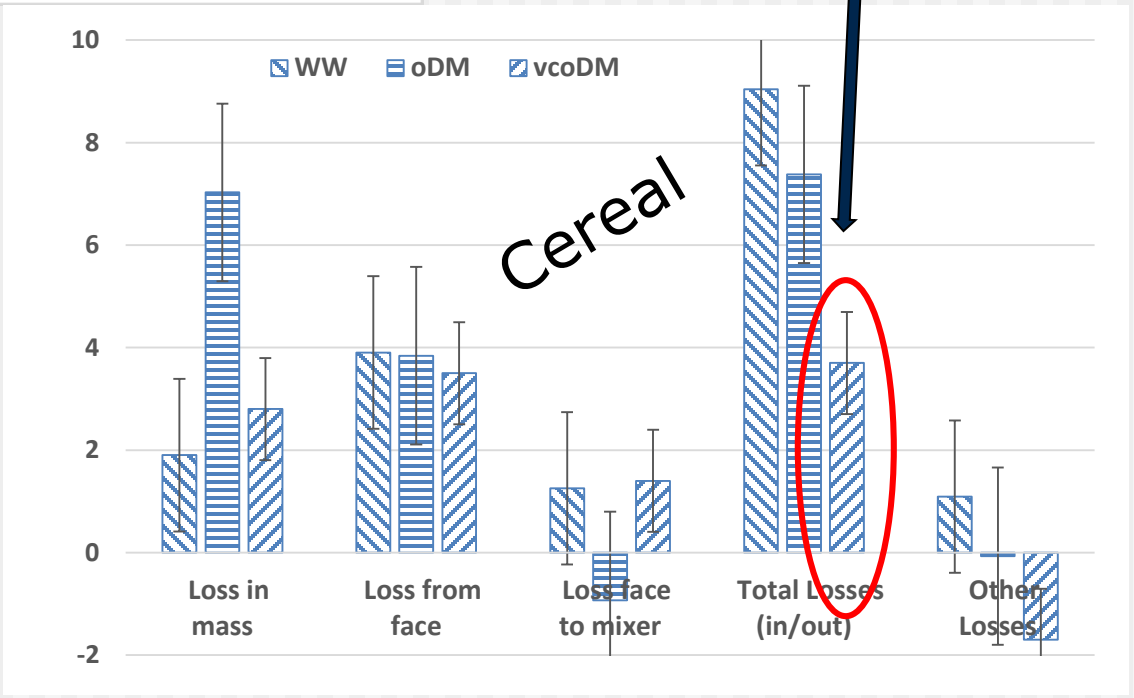

WW
oDW
vcoDW
10
8
6
4
2
0
-2
Corn
Loss in mass
Loss from face
Loss face to mixer
Total Losses (in/out)
Other Losses


WW
oDM
vcoDM
10
8
6
4
2
0
-2
Cereal
Loss in mass
Loss from face
Loss face to mixer
Total Losses (in/out)
Other Losses


WW
oDW
vcoDW
10
8
6
4
2
0
-2
Corn
Loss in mass
Loss from face
Loss face to mixer
Total Losses (in/out)
Other Losses

2.8%

3.5%


10
8
6
4
2
0
-2
WW
oDM
vcoDM
Cereal
Loss in mass
Loss from face
Loss face to mixer
Total Losses (in/out)
Other Losses

Overall - Shrink

The ability to measure WW, oDM and vcoDM shrink in large corn silage piles, and where it occurs, is possible.

Variation among piles higher than desired due to low values in general (esp. vcoDM) and the heterogeneous nature of silage.

The face is <u>not</u> the major source of shrink, but is higher in cereals.

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The ability to measure WW, oDM and vcoDM shrink in large corn silage piles, and where it occurs, is possible.

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The face is <u>not</u> the major source of shrink, but is higher in cereals.

The extent of the silage shrink problem is much smaller than was assumed by the SJV Air Board, especially when real shrink (i.e., vcoDM) is used.