What's New with Microbial Inoculants and Ways to Decrease Losses in the Silo

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Overview

- Inoculants
  - Types
  - How they work
  - When to use them
- Bunker covers
  - New approaches to reduce losses

Inoculants

- Silage additives whose main ingredients are lactic acid bacteria

Different Types of Inoculants

- Traditional homofermentative types:
  - *Lactobacillus plantarum*, *Pediococcus* species, *Enterococcus faecium*
- *Lactobacillus buchneri*, a heterofermenter
- Combination of homofermenters with *L. buchneri*

Homofermenter vs. Heterofermenter

- Homofermenter

  1 6-C Sugar $\rightarrow$ 2 Lactic Acid

- Heterofermenter

  1 6-C Sugar $\rightarrow$ 1 Lactic Acid + 1 Acetic Acid + CO_2

  1 6-C Sugar $\rightarrow$ 1 Lactic Acid + 1 Ethanol + CO_2

  1 Lactic Acid $\rightarrow$ 1 Acetic Acid + CO_2

End Product Comparison

- Lactic acid - strong acid; weak spoilage inhibitor; fermented in rumen
- Acetic acid - weak acid; good spoilage inhibitor; not fermented in rumen
- Ethanol - neutral; poor spoilage inhibitor; partially fermented in rumen
- Carbon dioxide - lost dry matter

So…

- If you want to preserve crop quality:
  - Lactic acid
- If you want a silage that doesn't heat:
  - Acetic acid

Homofermentative Inoculants

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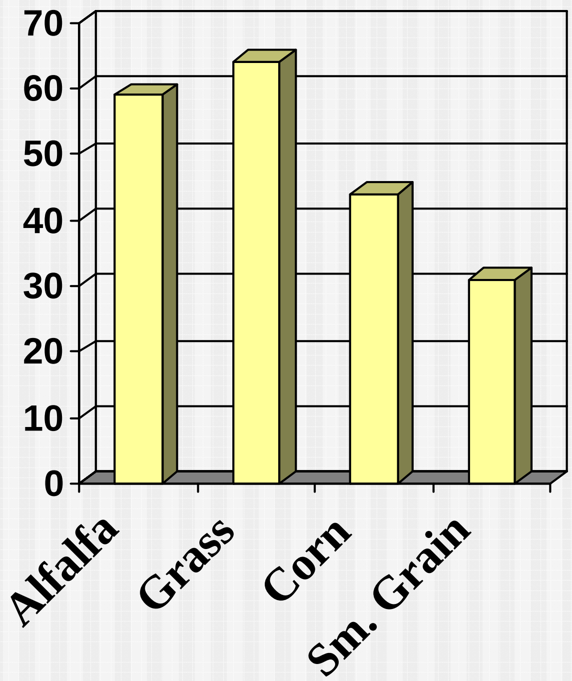
Homofermentative Silage Inoculants - Results

pH

- Lower but not all the time
- Works more often in hay crop than whole-grain silages

% Trials with lower pH



(Muck and Kung, 1997)

Homofermentative Silage Inoculants - Results

Dry Matter Recovery

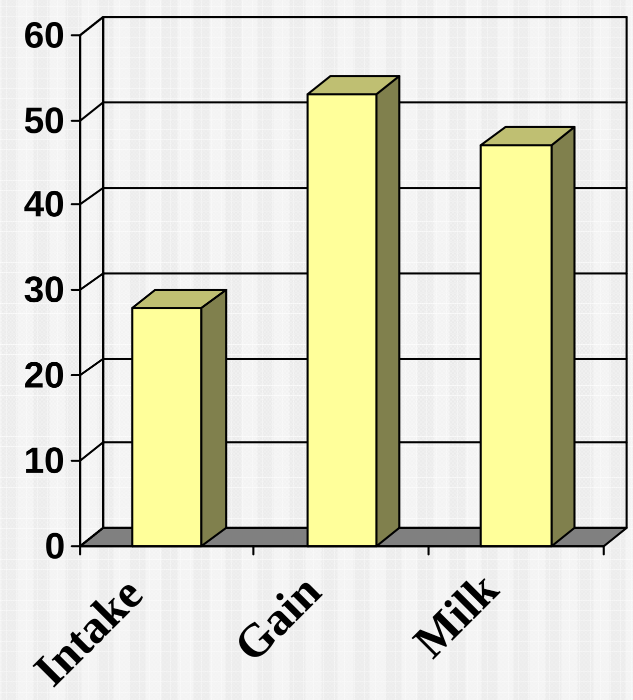
- Improved 38% of trials (Muck and Kung, 1997)
- Improvement when successful: 6%
- On average, 2-3% improvement

Homofermentative Silage Inoculants - Results

Animal Performance

- Typical improvements when worked: 3 to 5%

% Positive Trials



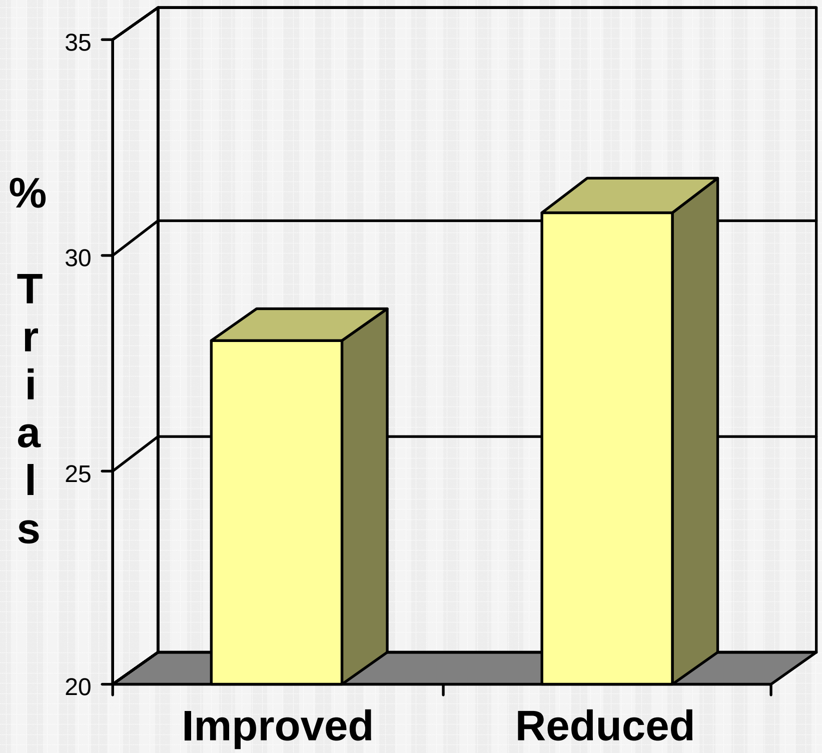
(Muck and Kung, 1997)

Homofermentative Silage Inoculants - Results

Bunk Life/Aerobic Stability

- Positive in hay crop silages
- Reductions largely in corn and small grain silages

Aerobic Stability in All Silages as Affected by Inoculants



(Muck and Kung, 1997)

Lactobacillus buchneri

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L. buchneri Silage Inoculants - Results

pH and Fermentation

Treatment	pH	Lactic	Acetic	Ethanol
Untreated	3.64	7.3	1.8	0.9
Standard A	3.71	8.9	2.3	2.0
Standard B	3.65	8.1	2.0	1.3
Standard C	3.62	7.5	1.6	1.0
Enhanced A	3.64	8.2	1.8	0.9
L. buchneri A	4.01	3.8	7.0	1.1
L. buchneri B	3.84	6.5	5.5	1.2

(Muck, 2002)

L. buchneri Silage Inoculants - Results

Relative aerobic stability, hours

Treatment	1999	2000	2001
Untreated	0	0	0
Standard A	16	-13	-39
Standard B	-4	-20	-6
Standard C	-25	-6	-9
Enhanced A	-24	-27	29
L. buchneri A	142	100	811
L. buchneri B	103	22	454

(Muck, 2002)

L. buchneri Silage Inoculants - Results

- Dry Matter Losses
  - Intermediate between untreated and standard inoculants
  - Expect 1-2% DM recovery improvement over untreated

L. buchneri Lactation Trials

- Aerobic stability: consistently increased
- Acetic acid: consistently increased
  - Even greater than 5.0% DM in several cases
- Dry matter intake: no effect
- Milk production: little or no effect

Combination Inoculants

L. buchneri +
Homofermentative
Lactic Acid Bacteria

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Combination Silage Inoculants - ***Expectations***

- Best of both worlds ideally
- Good fermentation except elevated acetic acid
- DM recovery and animal performance of a standard inoculant
- Bunk life/aerobic stability of *L. buchneri*

Combination Silage Inoculants - ***Reality***

- Too early to tell
- Several published small-scale studies
  - Combinations behaved more like *L. buchneri* treatment than homofermentative bacteria
    - Aerobic stability
    - Fermentation products, pH

Goals?

Choice of inoculants depends on goals:

- Make a good silage perform better
- Aerobic stability improvement

Make a Good Silage Better

Standard inoculants are the best route to improve DM recovery, animal performance

- Good fit for hay crop silages
- Less likely to be successful on corn
  - Harder to get consistent improvements
  - Bunk life issues when they work

Aerobic Stability Problems

- Is the problem a management problem that can be solved without an additive?
- If not, *L. buchneri* looks like a good alternative to propionic acid or anhydrous ammonia
  - Safer to handle
  - Competitive cost
  - Similar effects on DM recovery, animal performance with all three additives

Issues with *L. buchneri*

- Effective 80-90% of the time on corn silage
- However, slow grower that takes 45-60 days storage time before having much effect
- So, not an answer to heating problems with immature silage

Final Issues with Using Any Inoculant

- These products work only if the bacteria go on the crop alive!
  - Store them properly: generally cool and dry
  - Don’t use chlorinated water to dilute unless the chlorine level is less than 1 ppm
- These bacteria cannot move around; they depend on you to spread them uniformly

Final Issues with Using Any Inoculant

- Use products designated for the crop you are ensiling
- Don’t be shy to ask for research data, especially independent results, to back claims

Questions?

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Bunker Covers

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Bunker Losses Between Filling And Opening Are Affected By:

1) Quality, integrity of the plastic

2) Securing of the plastic to the crop

3) Plastic-wall interface

Standard Solution to Bunker Covering: Polyethylene & Tires

Tires touching tires

Silostop Covering Systems

- Two step system
  - Original system that we have tested for three years
- One step system
  - Substitute for traditional films
  - Currently under trial

Two Step Covering System

Consists of:

- Plastic film with 1/40 permeability to oxygen of standard polyethylene
- Woven tarp for UV, animal protection
- Gravel bags to hold everything in place

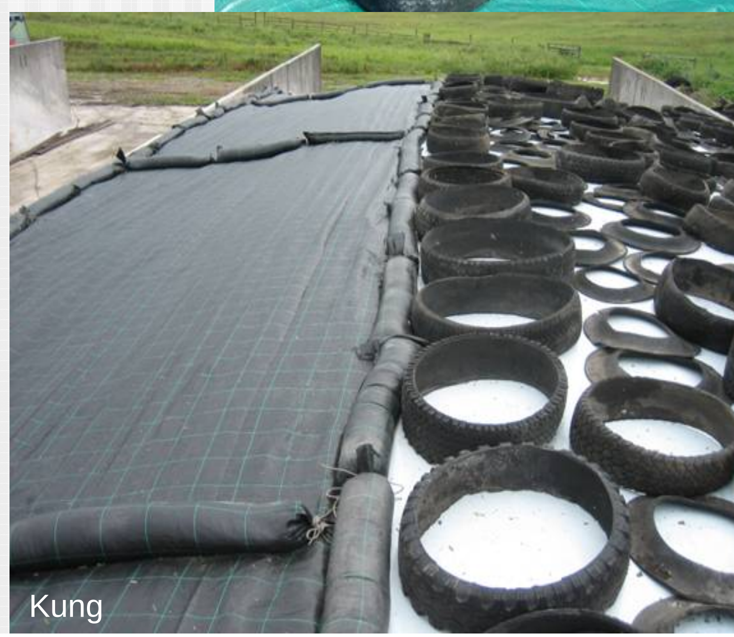
Two Step Silostop System

- Side-wall plastic
- Top sheet

Silostop film

Two Step Silostop System

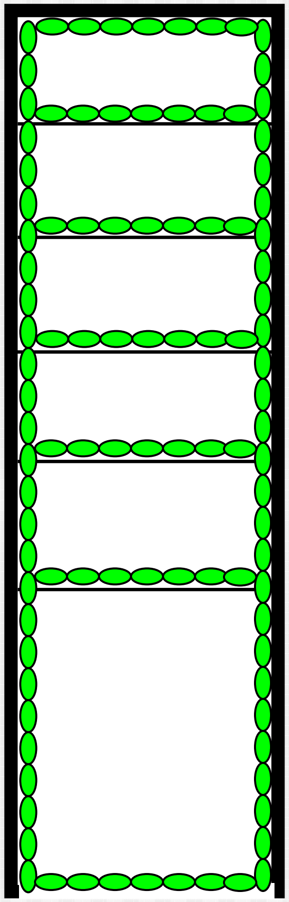
- A woven tarp is placed over top
- Tarp and plastic are secured with gravel bags at the walls, seams



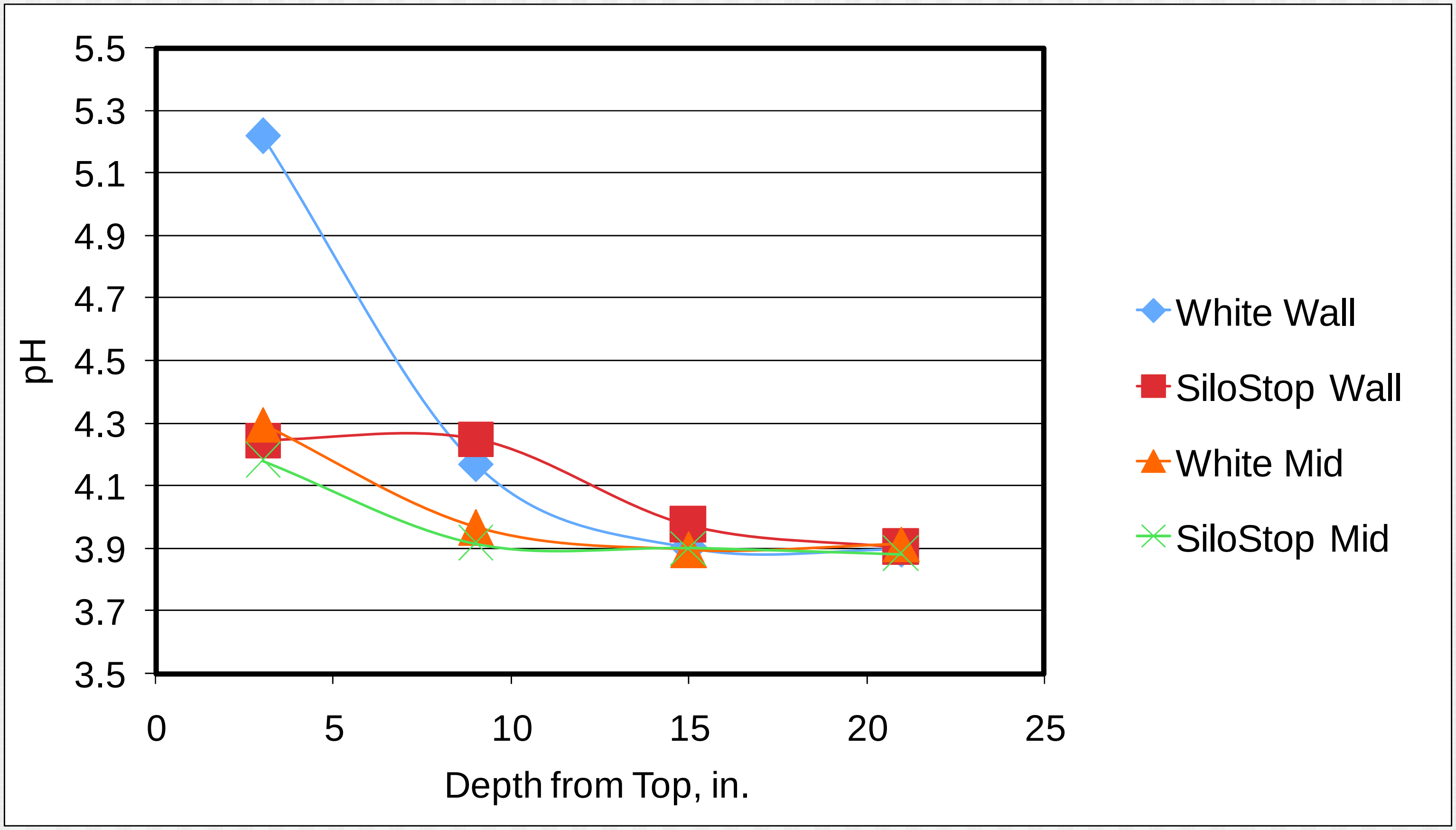
Kung

Two Step Silostop System

- Typical top view when done

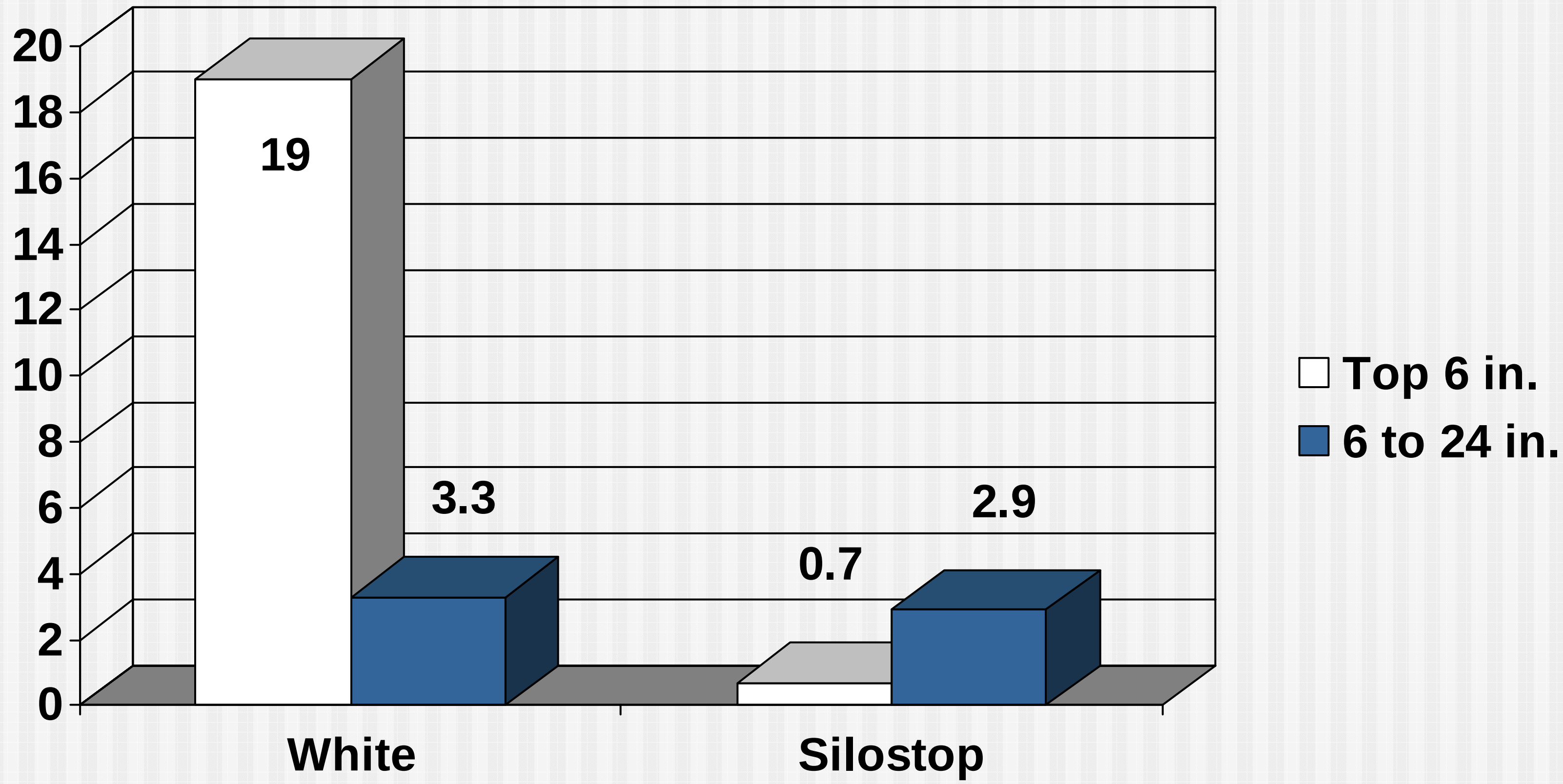


Average pH in Corn Silage
3 Bunkers



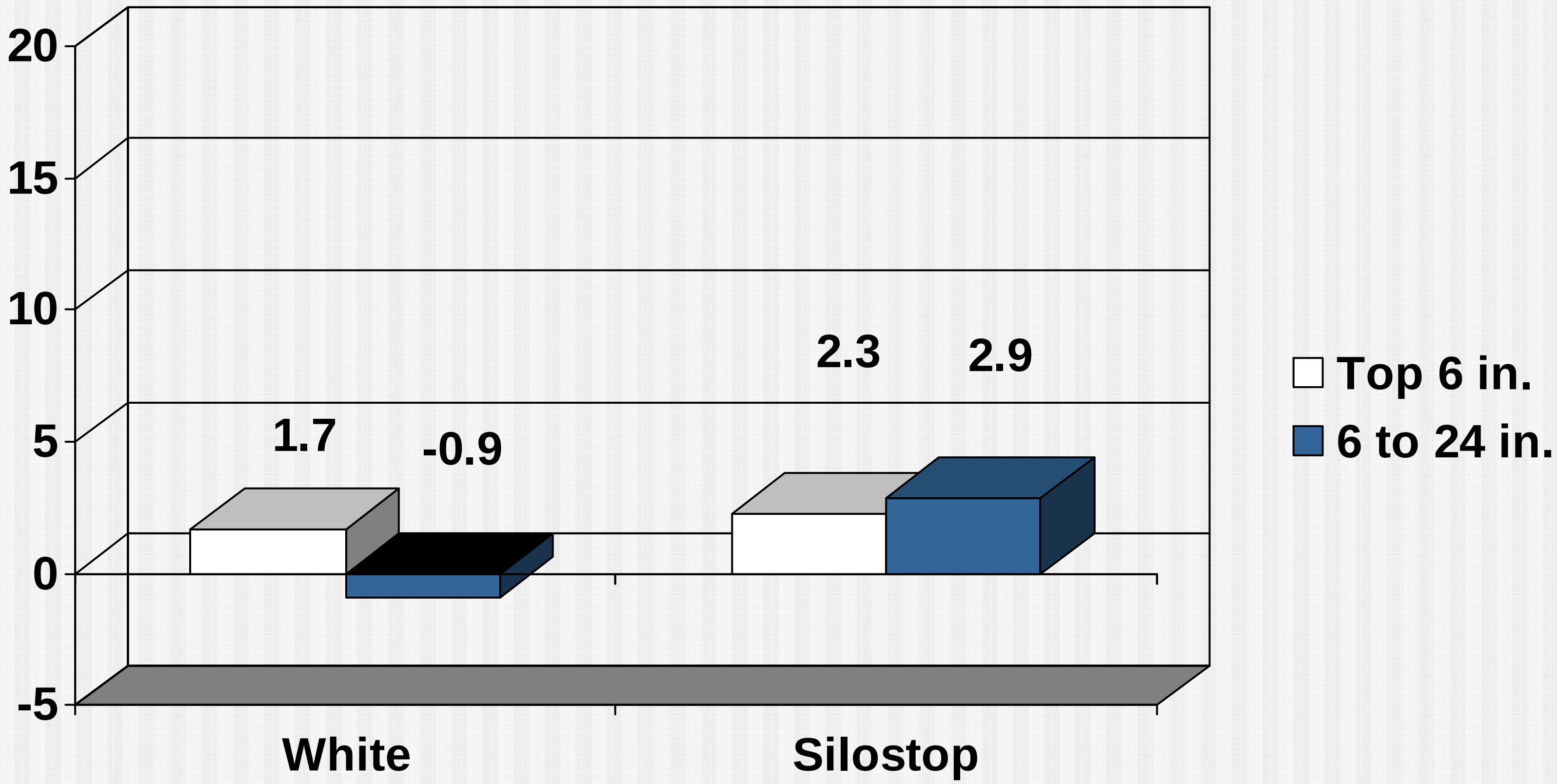
Reduced spoilage near the wall on the Silostop half.

Estimated % DM Losses at the Wall - 2 Alfalfa Bunkers



Reduced spoilage near the wall in top 6 in. with Silostop.

Estimated % DM Losses under the Middle of a Sheet - 2 Alfalfa Bunkers



No significant difference in the middle of sheets, but…

Fermentation Products at Middle of Top in Two Bunkers

	Depth, in.	pH	Lactic Acid	Acetic Acid	L:A
Haylage			% DM		
White	3	4.89	2.5	4.0	0.6
Silostop	3	4.82	4.5	2.2	2.1
White	9	4.82	4.5	1.7	2.6
Silostop	9	4.75	3.8	1.4	2.7
Corn					
White	3	4.02	3.2	1.6	2.0
Silostop	3	3.98	3.0	1.2	2.6
White	9	4.00	4.1	1.4	2.9
Silostop	9	3.97	3.9	1.2	3.1

Consistently better fermentation quality under Silostop.


SiloStop System
Normal Plastic/Tires
McDonell and Kung, 2006
Unpublished, Univ. of Delaware

30 h NDF-D, %

	Top 6" Silage			
To Wall	4"	12"	20"	5'
Control	43	53	58	57
Silostop	57	58	58	60

McDonell and Kung, 2006

Summary of Two Step Silostop Trials

- Virtual elimination of visible spoilage
  - Biggest difference at the shoulders (wall)
- More homofermentative fermentation across the top, indicating a better seal.
- Evidence of better dry matter recovery, especially near the wall.

Silostop One Step

- Reduced permeability white plastic
- Sealed with gravel bags
- Results later this year

Thoughts on Using Silostop

- Make sure side sheets go at least 3 ft. onto the top.
- Use pea gravel instead of sand in the bags so that rain drains out better.
- Make sure bags are butted up against each other.
- Sand bags can get frozen into low spots; slope the sides to drain rainwater forward.

Thoughts on Using Silostop

- If you use tarps, get narrow ones. They're easier to remove as you feed out.
- System is about twice as expensive as traditional white plastic and tires. Worth it??
- A polyethylene sheet instead of a tarp? Yes, but you may need more bags across the width to prevent billowing of the plastic in the wind.

What About Regular Polyethylene On The Walls?

- Certainly will reduce shoulder spoilage.
- Performance may not be quite as good as Silostop.

Questions?

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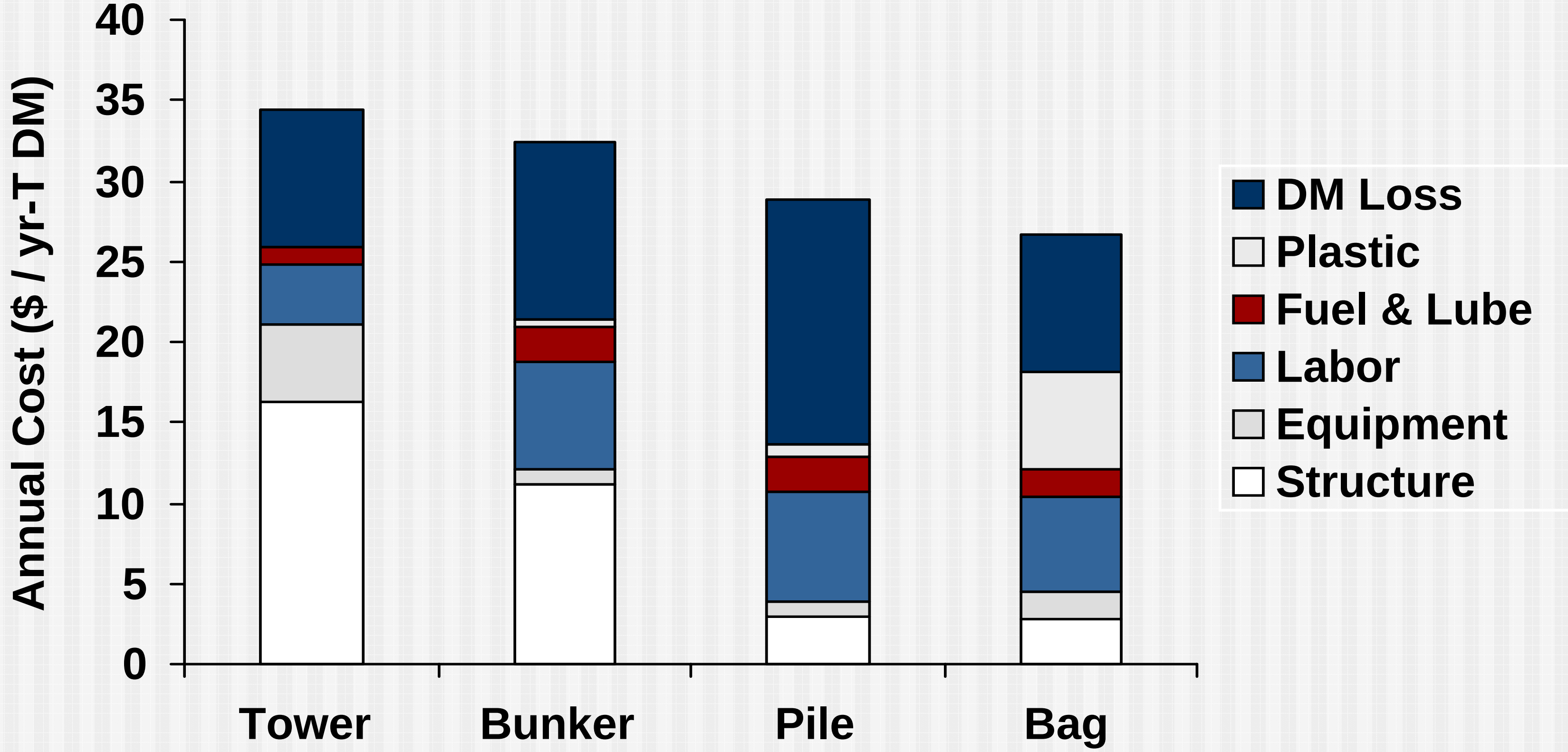
Annual Costs

3072 T DM Stored - Good Management



Holmes, 1998

Bunker or Pile Covers
- No Good Alternative to Plastic