

# The Keys to Making Great Baled Silage



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# Silage: A Brief Overview

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- Forage preservation by fermenting sugars into acid, which prevents spoilage
  - Plant sugars -> lactic acid (1°), acetic acid (2°), & other products
  - Must occur in anaerobic conditions to prevent spoilage by molds, yeasts, and bacteria.
  - Low pH reduces enzyme activity, inhibiting growth undesirable bacteria (e.g., clostridial bacteria)
- Ensiling started ~1500 B.C. (Egypt and Carthage)





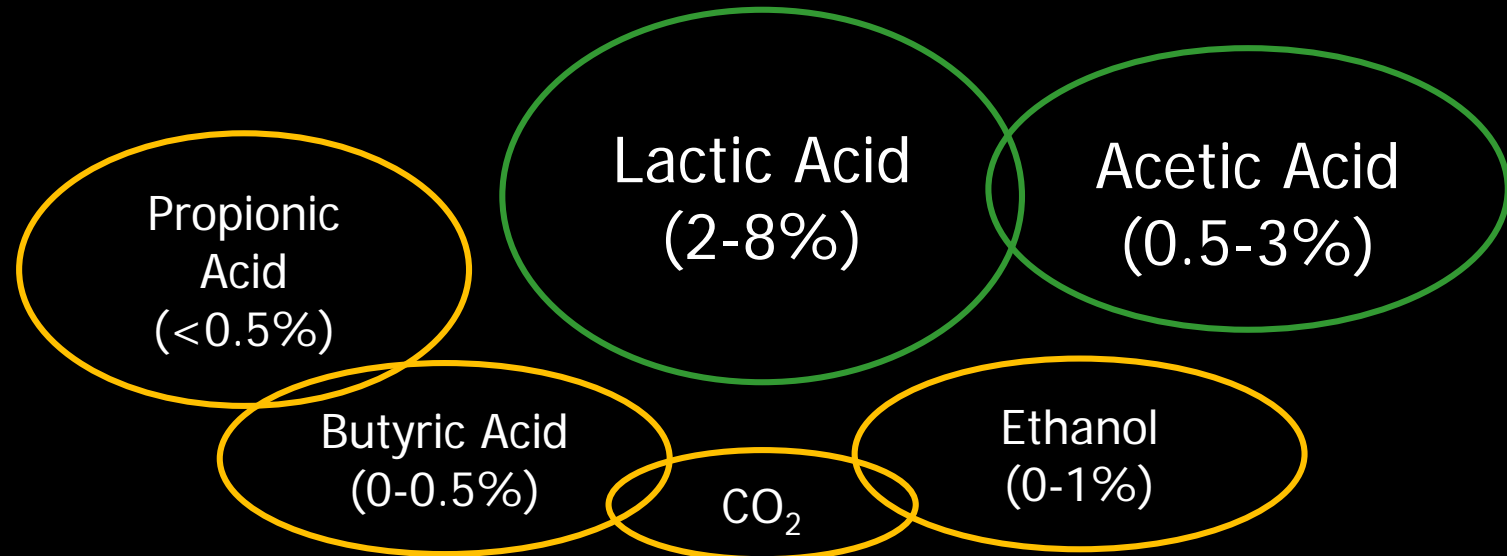
# Baled Silage Products

Forage

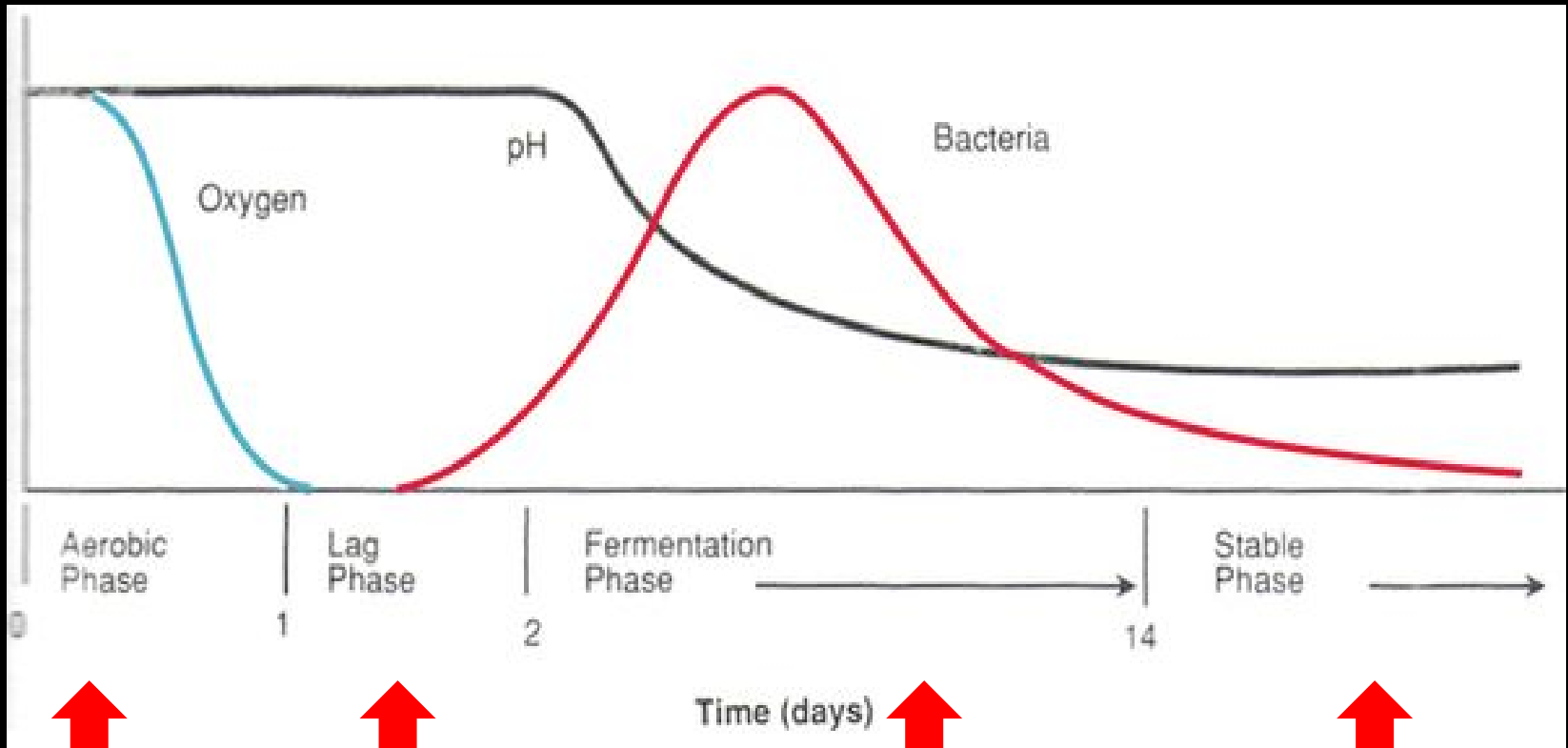
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Oxygen

Fermentation



# Baled Silage



↑  
Heat  
produced

↑  
Plant cell  
breakdown

↑  
Lactic Acid  
Bacteria

↑  
pH 3.8-5.0





# Baled Silage

Can be more efficient...

Fewer Losses  
Accumulate With  
Each Step

End Result:  
90% of Original DM

# Advantages – The Southeast





# Quality Advantages

- Enables timely harvest
  - Reduces drying time
  - Lowered risk of rain damage
  - Less shatter loss
- Higher forage quality<sup>1</sup>
  - Lower NDF, ADF, ADL
  - Higher CP
  - Increased digestibility
  - Increased palatability



<sup>1</sup> Han, et al. 2005; Hancock and Collins, 2006.

# But Remember . . .

*"Garbage in = Garbage Out"*







**But How?**





**But How?**

**... The Keys**





# 1: Cut down no more than you can handle.

- Bales should be wrapped w/in 12 hrs of baling.
- Amount cut = how much can be baled and wrapped on same day.
- Lay down an appropriate amount of forage for wilting, baling and wrapping.
  - Cut mid-afternoon on one day, bale & wrap the next day.



# Effects of Delaying Wrapping on Internal Bale Temperature (63% M)

Wrap Delay	At Wrapping	Day 1*	Day 2	Day 4	Day 6	Day 14
h	°F					
No wrap	99	121	127	150	145	135
0	91	93	95	89	84	76
24	110	119	114	101	92	75
48	136	142	130	109	95	72
96	147	145	133	110	92	73

Vough et al. (2006): data adapted from Undersander et al. (2003); all square bales of alfalfa wrapped with eight mils of plastic film.

\* Denotes days from wrapping.



## 2: Choose the right bale wrapper.

**Consider:  
Cost, Labor, Speed, Volume**





# Individual Bale Wrapper





# In-Line Bale Wrapper





# Integrated Wrapper









# 3: Explore your options.

Own for Own Use

Own & Custom on the Side

Custom Hire







## 4. Bale at the right range of moisture

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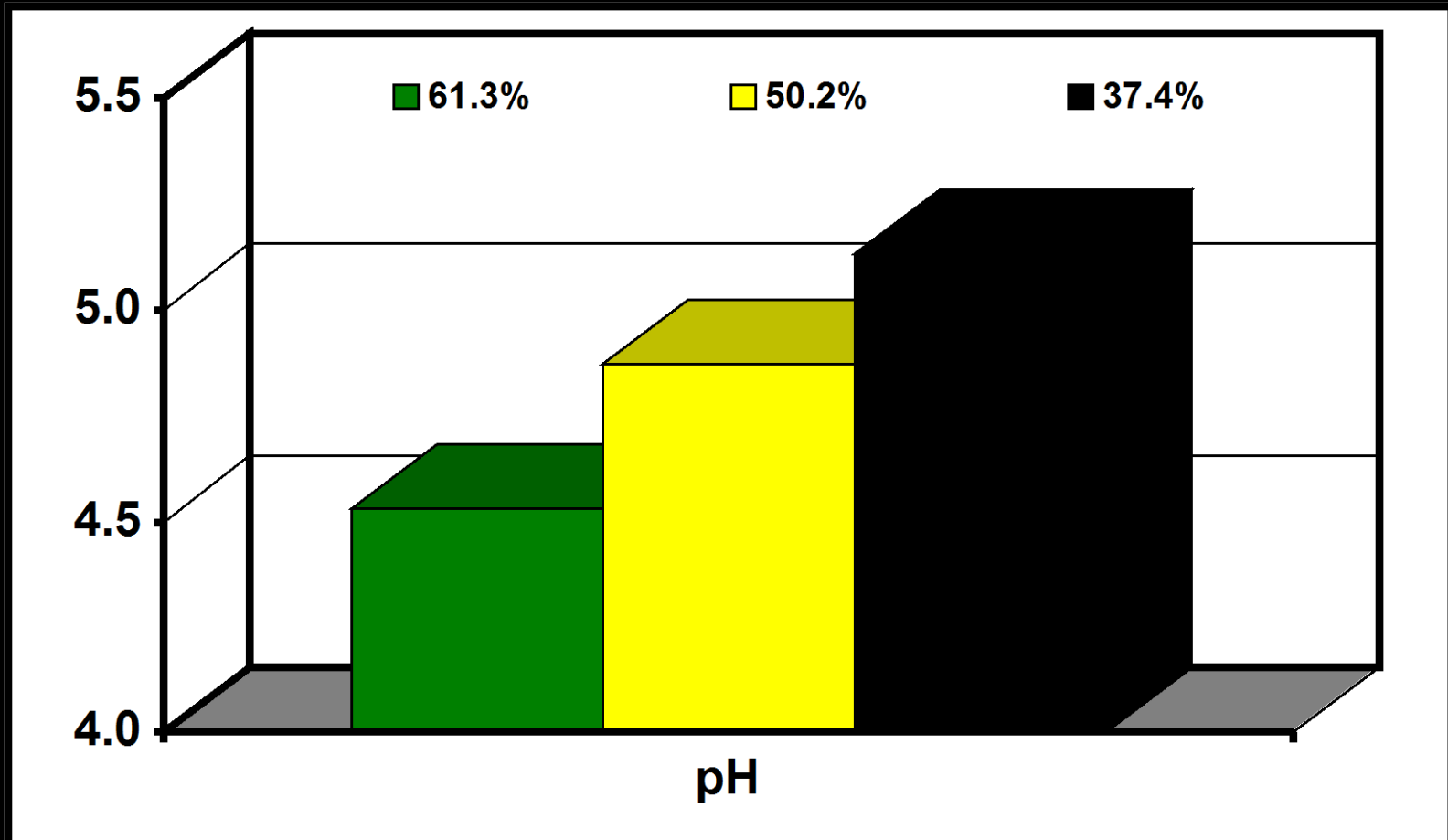
### Ideal Range, 50-65% Moisture

Toxic Potential  
(Clostridial,  
Listeriosis)



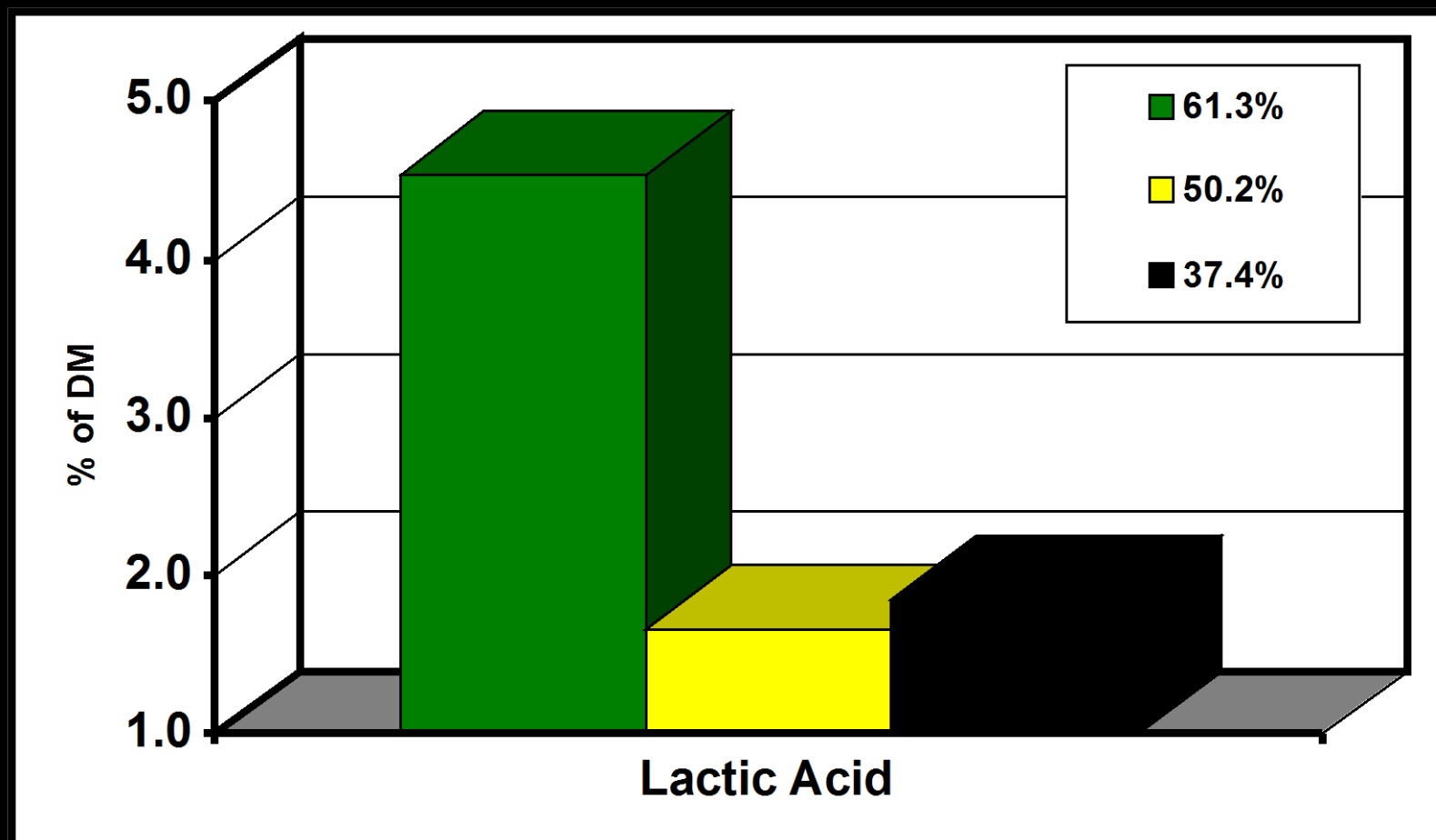
Poor  
Fermentation

# Effects of Moisture Content on Silage pH



Hancock and Collins (2006): *combined data from two trials; alfalfa harvested at mid-bud stage of maturity*

# Effects of Moisture Content on Lactic Acid



Hancock and Collins (2006): *combined data from two trials; alfalfa harvested at mid-bud stage of maturity*



# Determining Moisture

## Methods:

4. Hay Moisture Testers/Probes
3. By feel (if calibrated).
2. Microwave moisture test



## MEASURING THE MOISTURE CONTENT OF FORAGE USING A MICROWAVE OVEN

1. Chop fresh forage into short lengths (< 1 inch) for ease of handling and uniform drying.
2. Weigh out at least 100 grams (3.5 ounces) of chopped forage.
3. Spread forage thinly on a microwave-safe dish and place into microwave. (A cup of water placed in the microwave beside the sample will help prevent the sample from igniting once dry.)
4. Heat for 1-2 minutes and reweigh.
  - If forage is not completely dry, shake and redistribute the sample, and repeat the heating cycle until the sample reaches a stable weight. (Microwaves vary considerably in drying capacity. It is better to dry for short intervals and reweigh until the last two weights are constant, than to overdry and run the risk of burning and damage to oven.) If charring occurs, use the previous weight.
5. Calculate moisture content using the following equation:

$$\% \text{ Moisture Content} = \frac{W1 - W2}{W1}$$

Where: W1 = weight of forage before heating  
W2 = weights of forage after heating

Dry matter (DM) is the percentage of forage that is not water. DM equals 100% minus the % Moisture Content.

<http://bit.ly/MicroMoisture>

# Determining Moisture

## Methods:

4. Hay Moisture Testers/Probes
3. By feel (if calibrated).
2. Microwave moisture test
1. Moisture tester (e.g., Koster)





## 5. Make good bales



# Effects of Bale Density on Fermentation

Moisture	----- 58.7% -----		----- 52.4% -----	
Density, lbs/ft <sup>3</sup>	12.9	10.9	12.4	10.4
pH	4.7	4.9	4.8	5.1
lactic acid, %	7.0	6.5	7.1	6.3
acetic acid, %	2.4	3.8	3.3	2.0
max temp, °F	107	109	108	106
DM REC, %	98.6	98.6	97.8	98.3

Han et al. (2004): high density bales created at  $842 \times 10^3$  Pa of chamber pressure; lower density bales made at  $421 \times 10^3$  Pa.

# Silage Balers with Pre-Cutting Systems



# Silage Balers with Pre-Cutting Systems

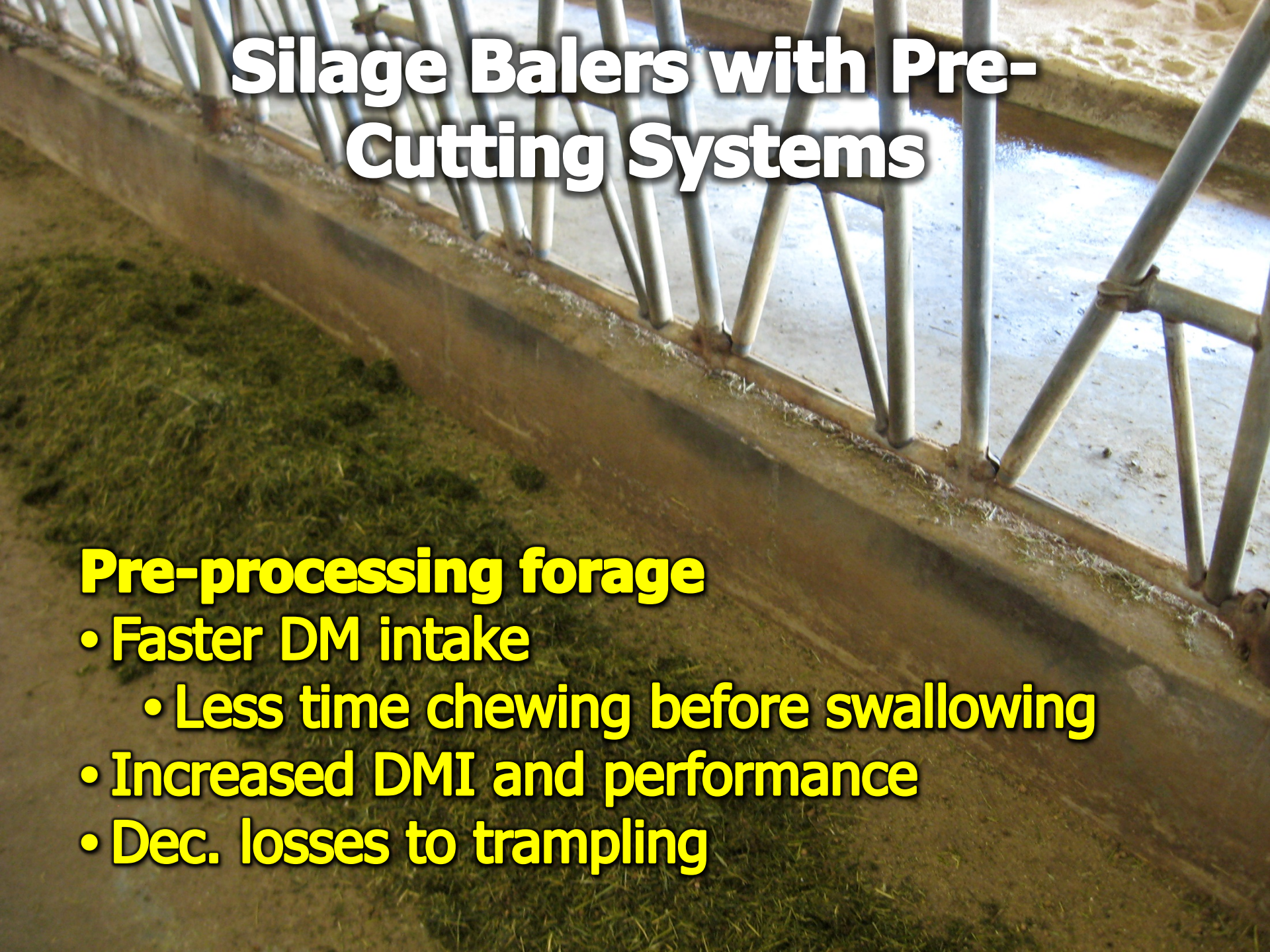


## **Pre-processing forage**

- Useful for mixed ration or feeding in troughs or bunkers.
- Makes for denser bales
  - Increased labor and field efficiency



# Silage Balers with Pre-Cutting Systems



## **Pre-processing forage**

- **Faster DM intake**
  - **Less time chewing before swallowing**
- **Increased DMI and performance**
- **Dec. losses to trampling**





## 6. Choose an appropriate site for wrapping

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- **Wrap at the storage site**
  - reduces handling
  - reduces risk of spoilage
- **Where feed out is easy**
- **Store individual bales on flat end**



# Effects of Plastic Layers and Storage Side on Mold Coverage

Plastic Layers	Store Position	Surface Mold Coverage (%)		
		Side	End	Total
4	End	4.5	26.0	12.6
4	Side	27.7	5.1	19.2
6	End	6.7	6.8	6.7
6	Side	20.1	0.0	12.6

\*  $P < 0.01$ ; \*\*  $P < 0.001$

*Bisaglia et al. (2011): Bales consisted of half Italian Ryegrass, half Lucerne; storage period 180 days*



# 7. Apply enough plastic but no more.



*Remember - The plastic is not impermeable to oxygen.*

# Application Amount – Inline Wrapper

- Eight+ layers (+ double on joints)
  - 12.5 – 16.7% overlap
  - two rolls rotating around bales
- Pre-stretched to 50-70%
- Tacky side towards the bale
- 60-80+ bales per hour



# Application Amount – Ind. Wrapper

- **Six+ layers (2 + 2 + 2 system)**
  - 50% overlap
  - Three full bale rotations
  - If short term, 4-layers may be ok
- **15-40 bales per hour**





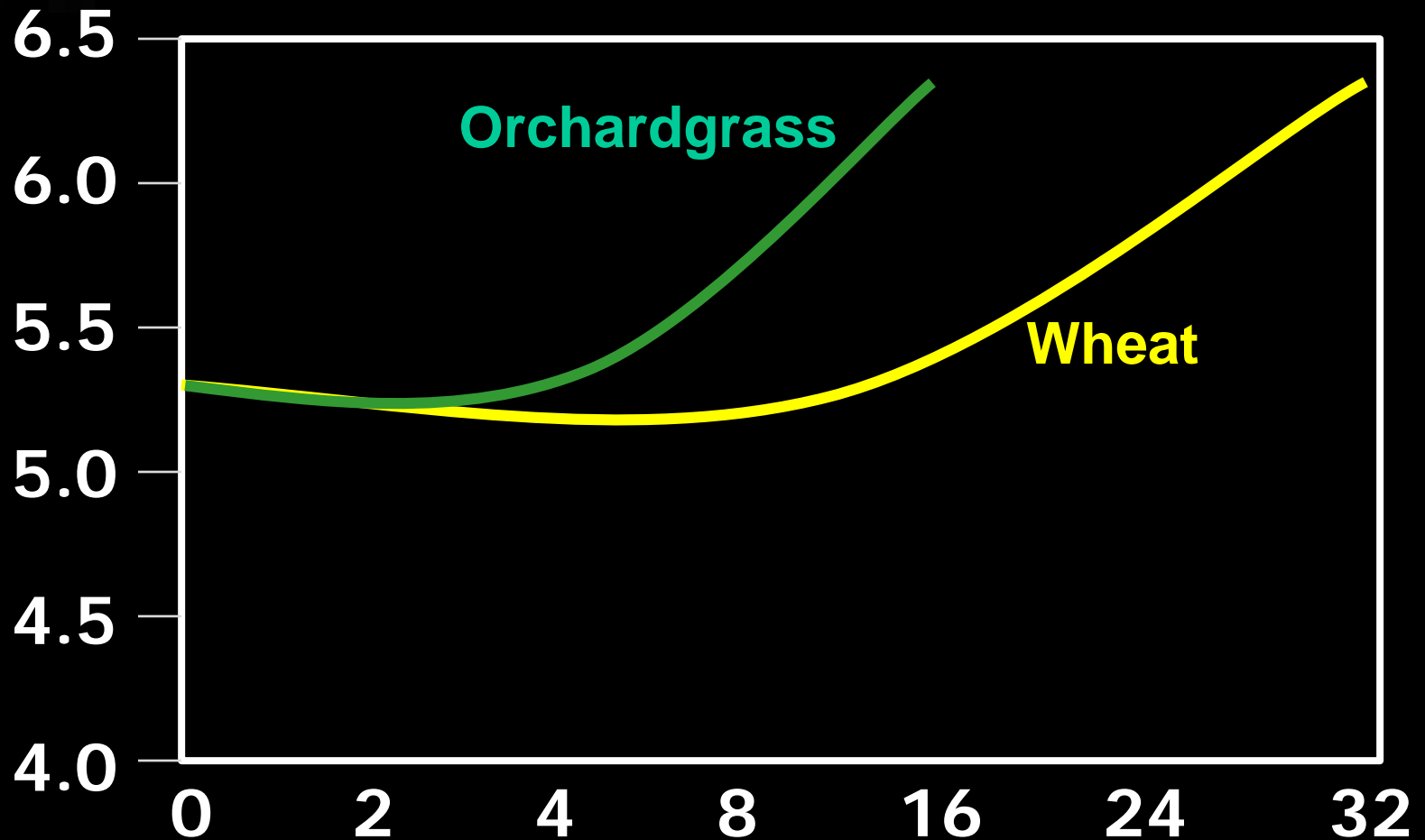


## 8. Feed it in an appropriate way.

- Match quality to animals needing that quality
- Use a ring (or cone) feeder
- OK for mixed rations
  - Bale grinder
  - May need to be sliced



# Surface pH after Exposure



Adapted from Rhein et al. (2005)



## 9. Feed the bales within 9 months.

- Bales will squat and be difficult to handle.
- Plastic will deteriorate over time.
- Bales will begin to spoil.

*But – waiting 8 weeks after wrapping to feed bales ensures bale stability*





## 🔑 10. Have a plan for handling the plastic.

- Recycling is not currently an option
- Reduce the bulk to aid in handling



# Questions?



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