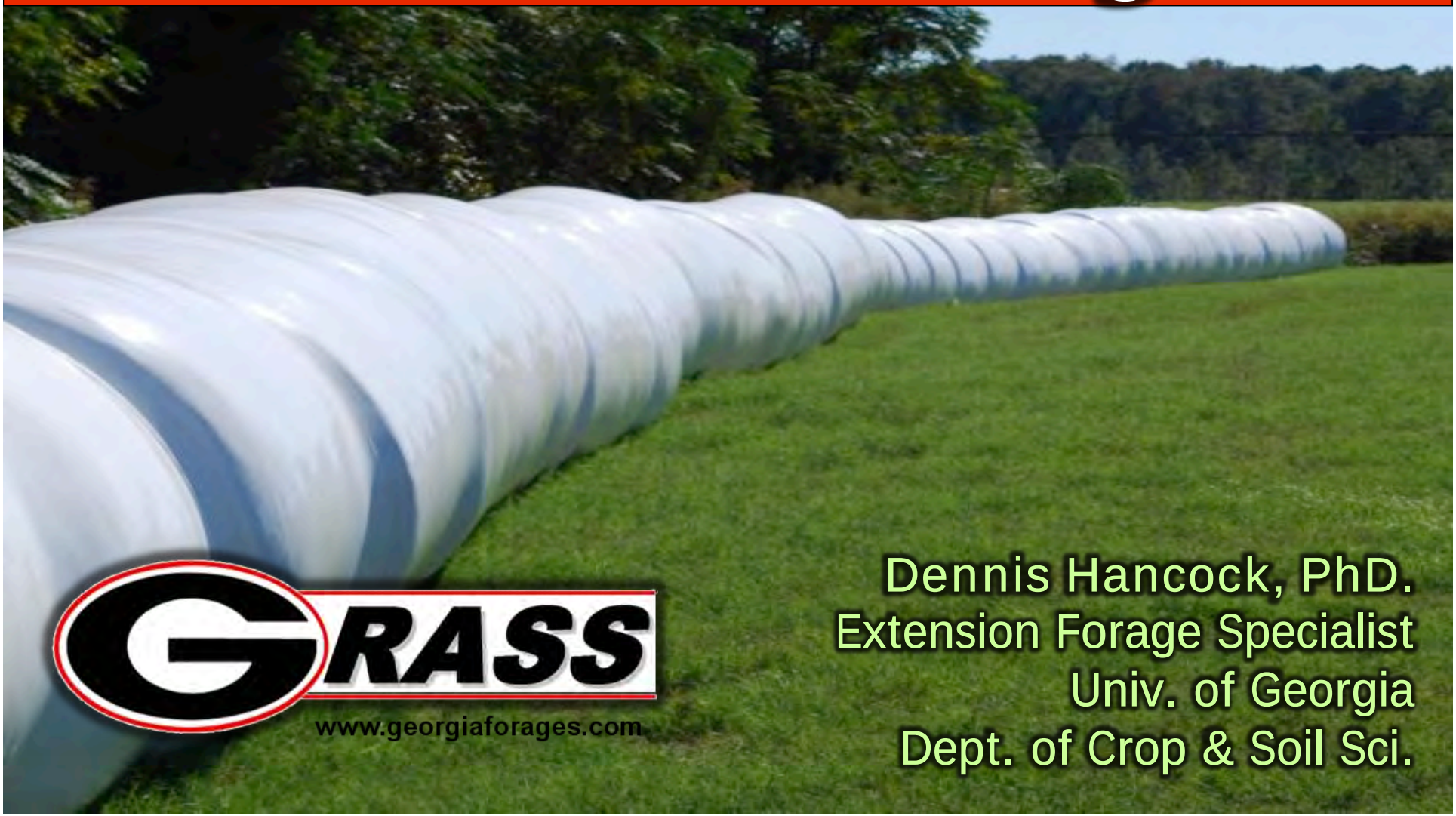
The Keys to Making Great Baled Silage



GRASS

www.georgiaforages.com

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Silage:
A Brief Overview

- 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)

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Baled Silage

Can be more efficient…

Fewer Losses Accumulate With Each Step

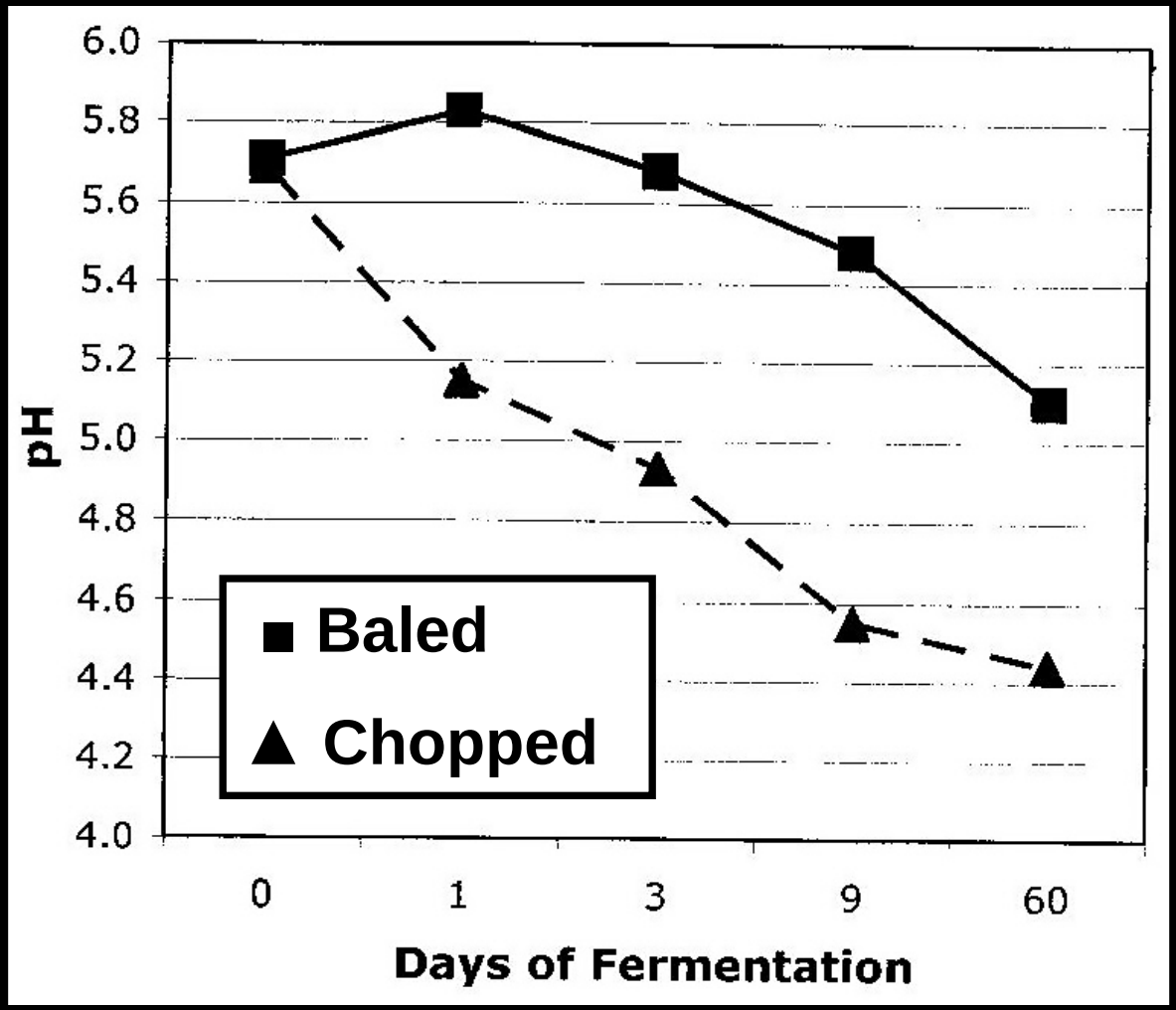
End Result:
90% of Original DM

Quality Advantages

- Enables timely harvest
- Lowered risk of rain damage
- Less shatter loss
- Higher forage quality[1]
  - Lower NDF, ADF, ADL
  - Higher CP
  - Increased digestibility
  - Increased palatability
- However,
  "Garbage in = Garbage out!"

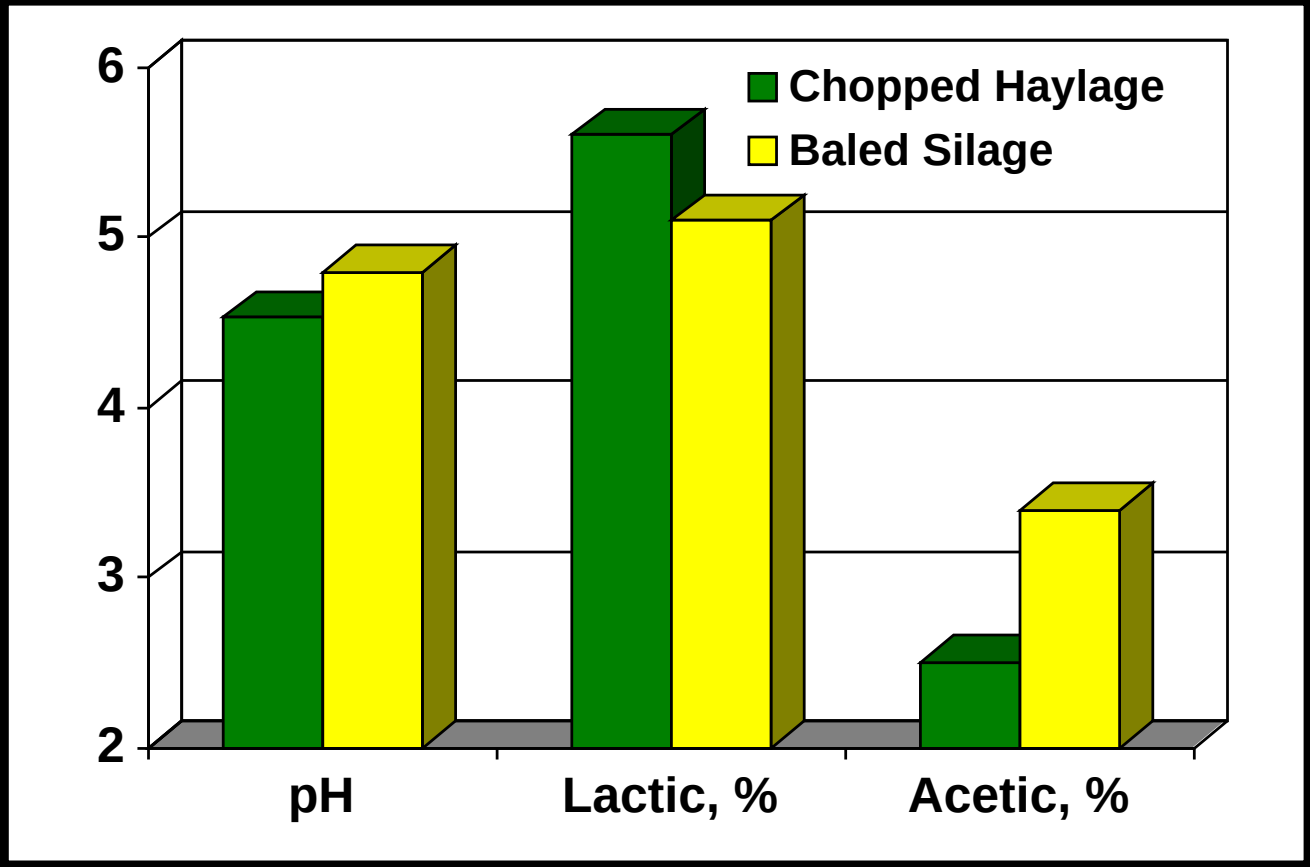
[1] Han, et al. 2005; Hancock and Collins, 2006.

Baled vs. Precision-Chopped Silage Alfalfa/Grass



Muck (2006) – adapted from Nicholson et al. 1991; average moisture content of silages was 61%. ***Slide credit: Dr. Wayne Coblentz, USDA-ARS***

Fermentation Characteristics Chopped Haylage vs. Baled Silage



Annual ryegrass silages harvested mid-April in southeast Louisiana (1993-94). Baled silage was 4 x 4 round bales

McCormick et al. (1998) *Slide credit: Dr. Wayne Coblentz, USDA-ARS*

1: Cut down no more than you can handle.

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

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.

Slide credit: Dr. Wayne Coblentz, USDA-ARS

2: Choose the right bale wrapper.

Consider:
Cost, Labor, Speed, Volume

Wrapper Costs

Wrapper Styles

- 3 point hitch ($8,000 - $22,000)
- individual ($14,000 - $26,000)
- in-line ($20,000 - $42,000)

Baled Silage Costs

Plastic Cost:
$6.00 - $8.00/ton DM

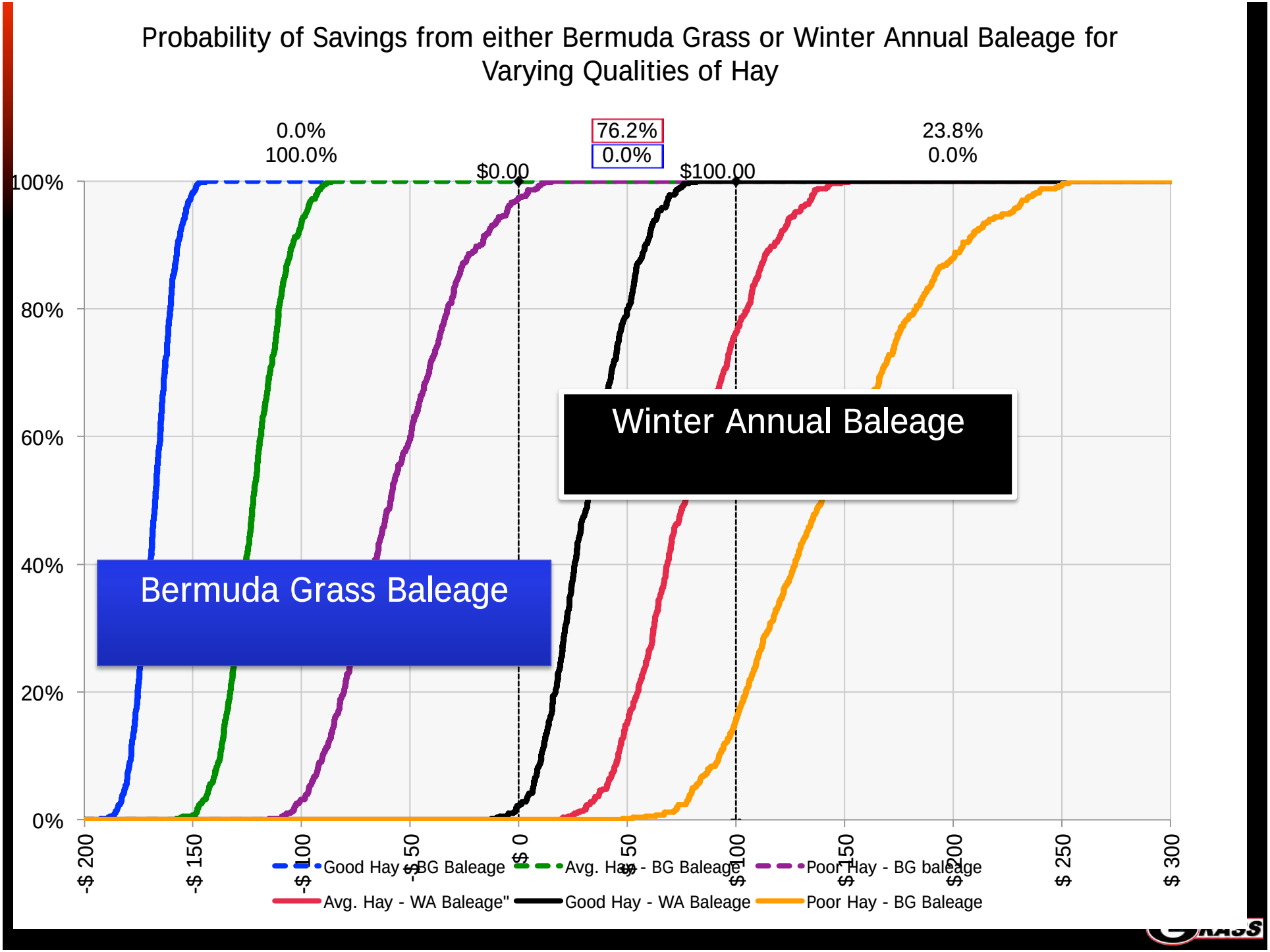
Wrapper cost:
$2.00 - $5.00/ton DM

Fuel & Repairs:
$0.50 - $5.00/ton DM

Labor:
$0.75 - $2.00/ton DM

The Unseen Cost of Hay Storage

	Expected Losses	Cost of Production ($/ton)			
		$80	$100	$120	$140
		Value of Losses in the System ($/ton)			
Hay, no cover/on ground	50%	$40	$50	$60	$70
Hay, under roof	25%	$20	$25	$30	$35
Baleage	15%	$12	$15	$18	$21


Probability of Savings from either Bermuda Grass or Winter Annual Baleage for Varying Qualities of Hay
0.0%
100.0%
76.2%
0.0%
23.8%
0.0%
$0.00
$100.00
100%
80%
60%
40%
20%
0%
Winter Annual Baleage
Bermuda Grass Baleage
-$ 200
-$ 150
-$ 100
-$ 50
$ 0
$ 50
$ 100
$ 150
$ 200
$ 250
$ 300
Good Hay - BG Baleage
Avg. Hay - BG Baleage
Poor Hay - BG baleage
Avg. Hay - WA Baleage"
Good Hay - WA Baleage
Poor Hay - BG Baleage

Summary of Economic Analysis

- Baleage technology has economic merit for medium-sized producers
  - Ex: Breakeven beef cow-calf herd size is approximately 100 cows to justify owning the equipment
- Combined reduction in feeding and storage losses helps make it economically feasible, but not enough
- Baleage becomes more economical with higher-quality forages such as:
  - Winter annuals, alfalfa, clovers/other legumes mixed with grass, high quality summer annuals
- VERY difficult to justify baleage only considering bermudagrass, bahiagrass, or lower-quality forages.

3: Explore your options.

Own for Own Use

Own & Custom on the Side

Custom Hire

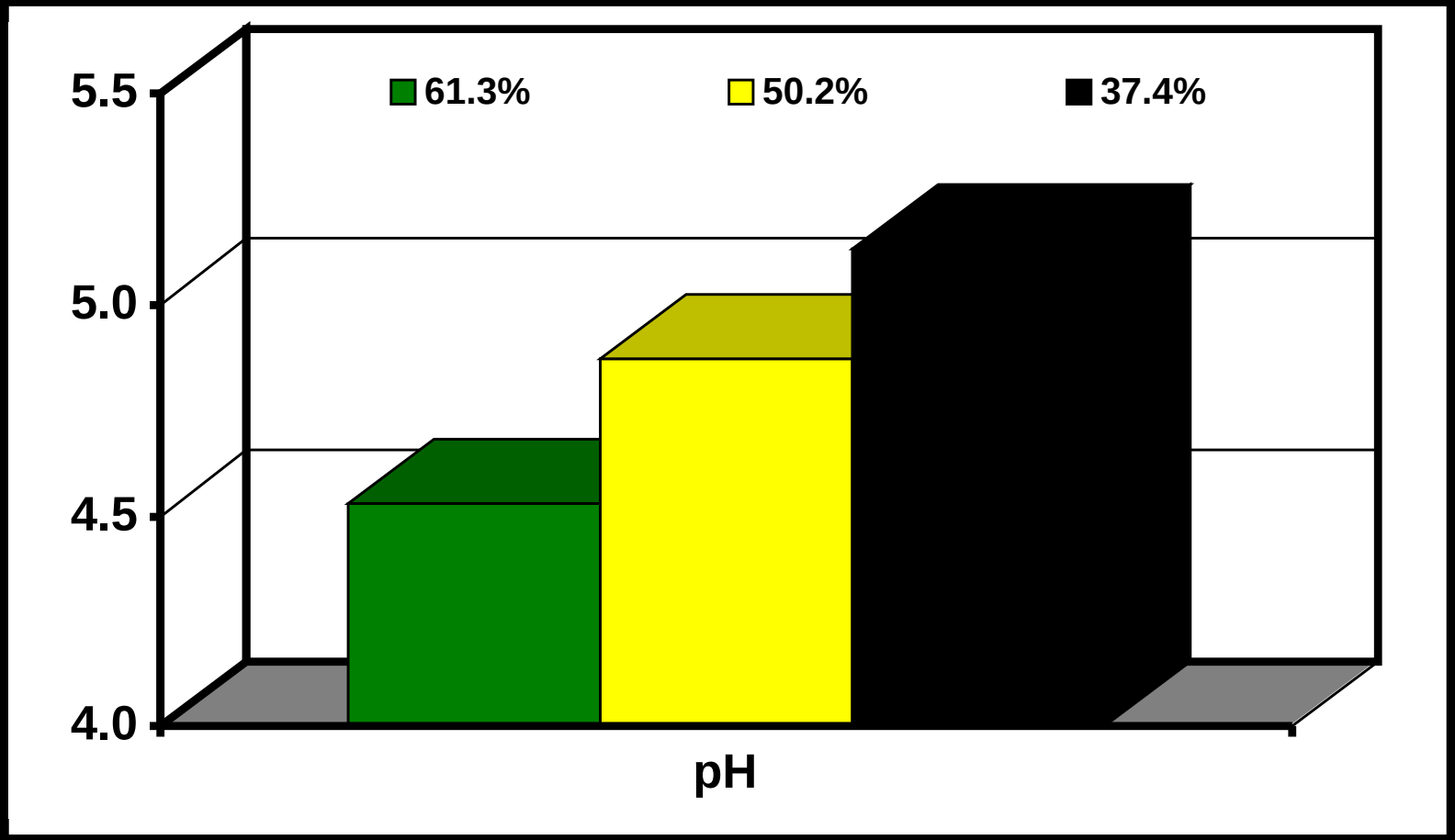
4. Bale at the right range of moisture

Ideal Range, 50-65% Moisture

Toxic Potential (Clostridial, Listeriosis)

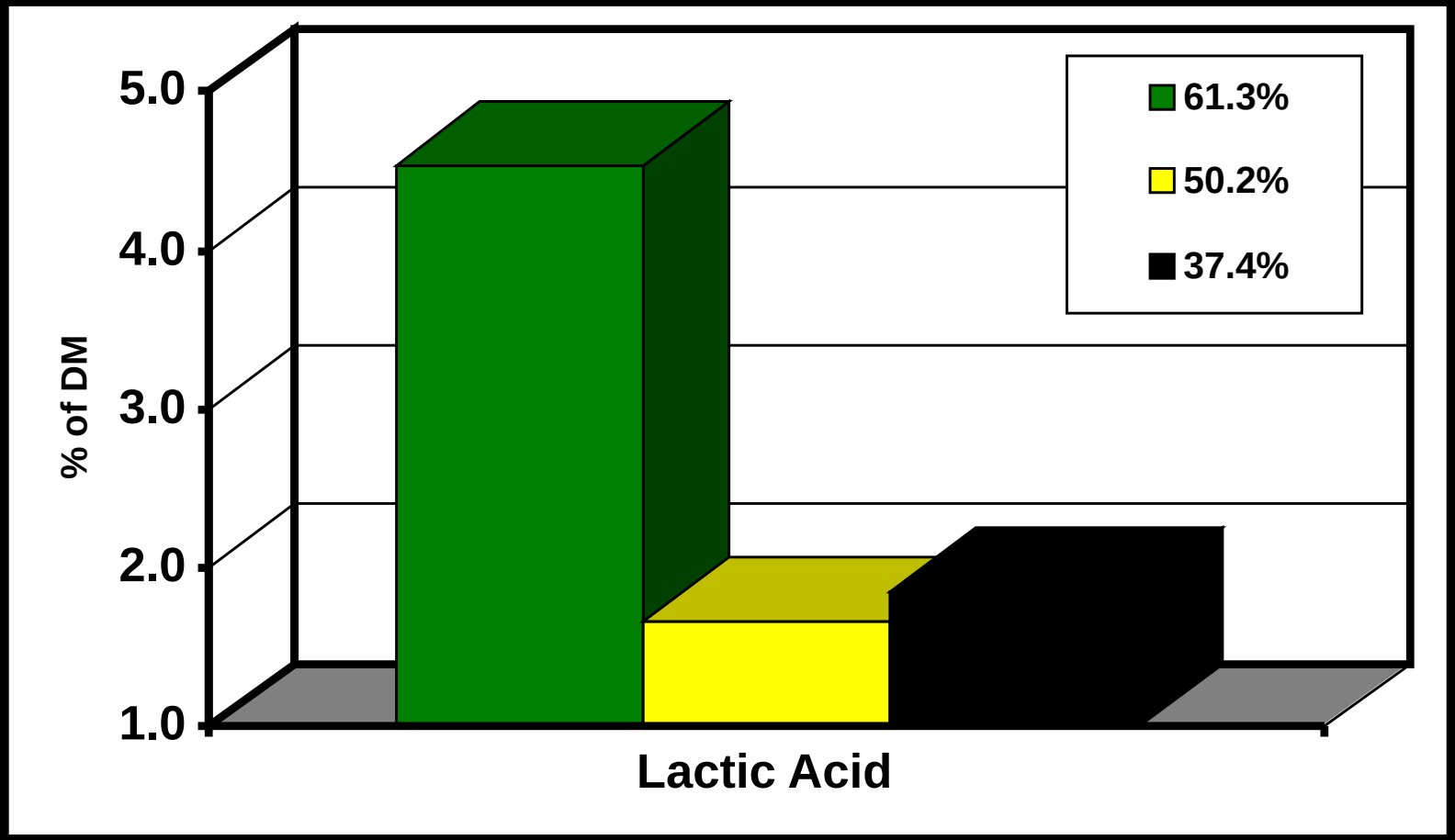
Poor Fermentation

Effects of Moisture Content on Silage pH



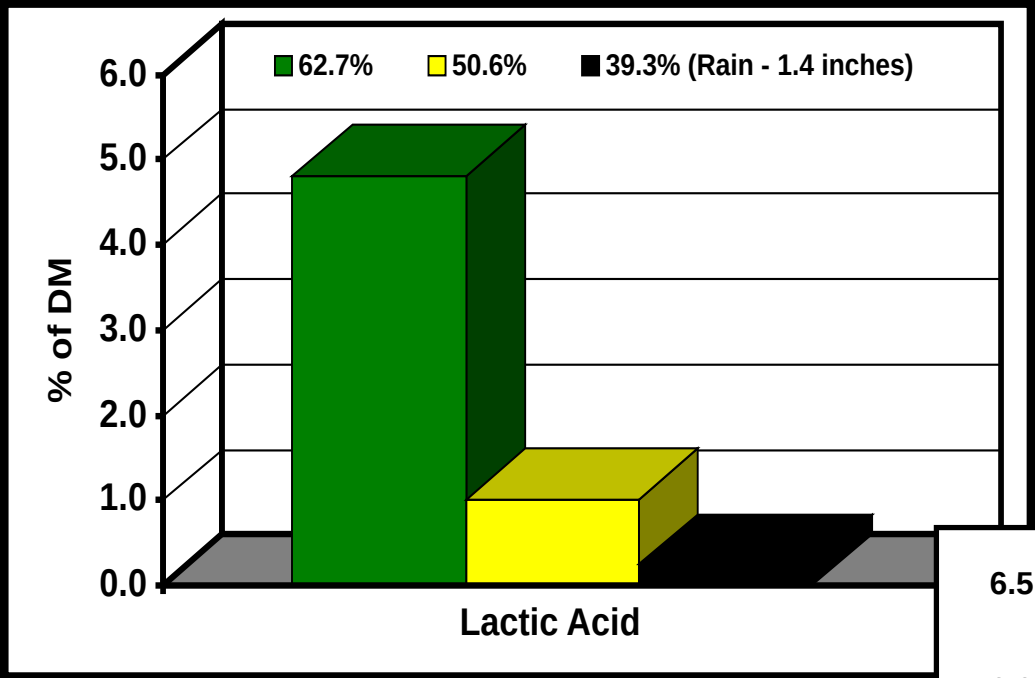
Hancock and Collins (2006): ***combined data from two trials; alfalfa harvested at mid-bud stage of maturity***

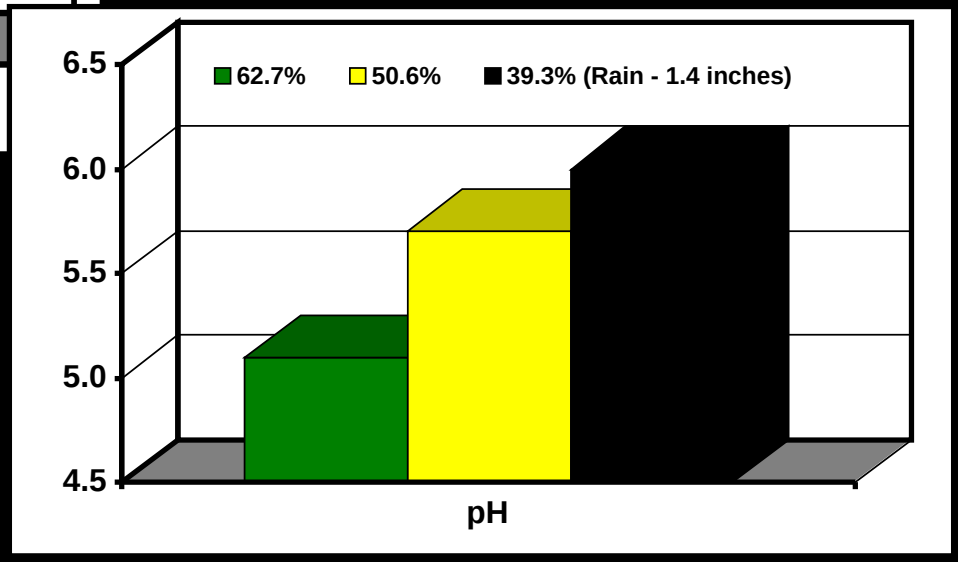
Effects of Moisture Content on Lactic Acid



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

Effects of Moisture Content and Rain-Damage on Fermentation

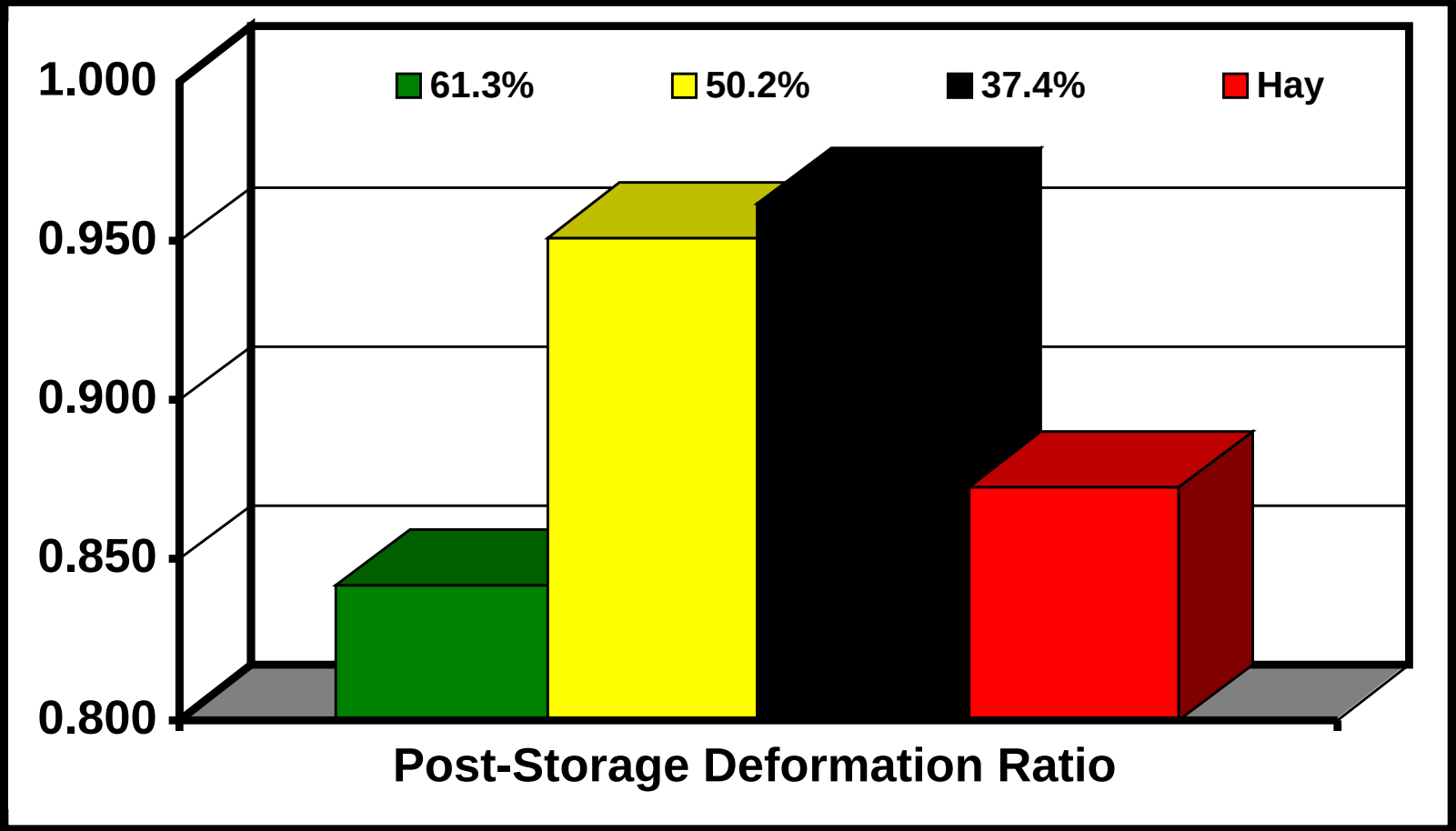




Borreani and Tabacco (2006)

Slide credit: Dr. Wayne Coblentz, USDA-ARS

Effects of Moisture Content on Bale Deformation (ft vertical/ft horizontal)



Hancock and Collins (2006): ***combined data from two trials; alfalfa harvested at mid-bud stage of maturity; estimate for hay is mean of bales made at 16.6 and 19.8% moisture, and stored outdoors, uncovered.***

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Determining Moisture

Methods:

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

http://bit.ly/MicroMoisture

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.

Adapted from: Southern Forages 4th Edition, Page 303

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

- Maximize bale size
  - match to tractor
  - dense bales
  - 4’x 5’ bale is most popular
    - 11-1500 lbs, depending on %M
  - square edges
- Use plastic twine or net
  - sisal twine degrades plastic

Effects of Bale Density on Fermentation

Moisture	------- 58.7% ------		------- 52.4% -------	
Density, lbs/ft^3	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, ^{o}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 x 10^3 Pa of chamber pressure; lower density bales made at 421 x 10^3 Pa.

Slide credit: Dr. Wayne Coblentz, USDA-ARS

6. Choose an appropriate site for wrapping

- Where feed out is easy
- Good sod and no stobs

- Wrap at the storage site
  - reduces handling
  - reduces risk of spoilage

7. Apply enough plastic but no more.

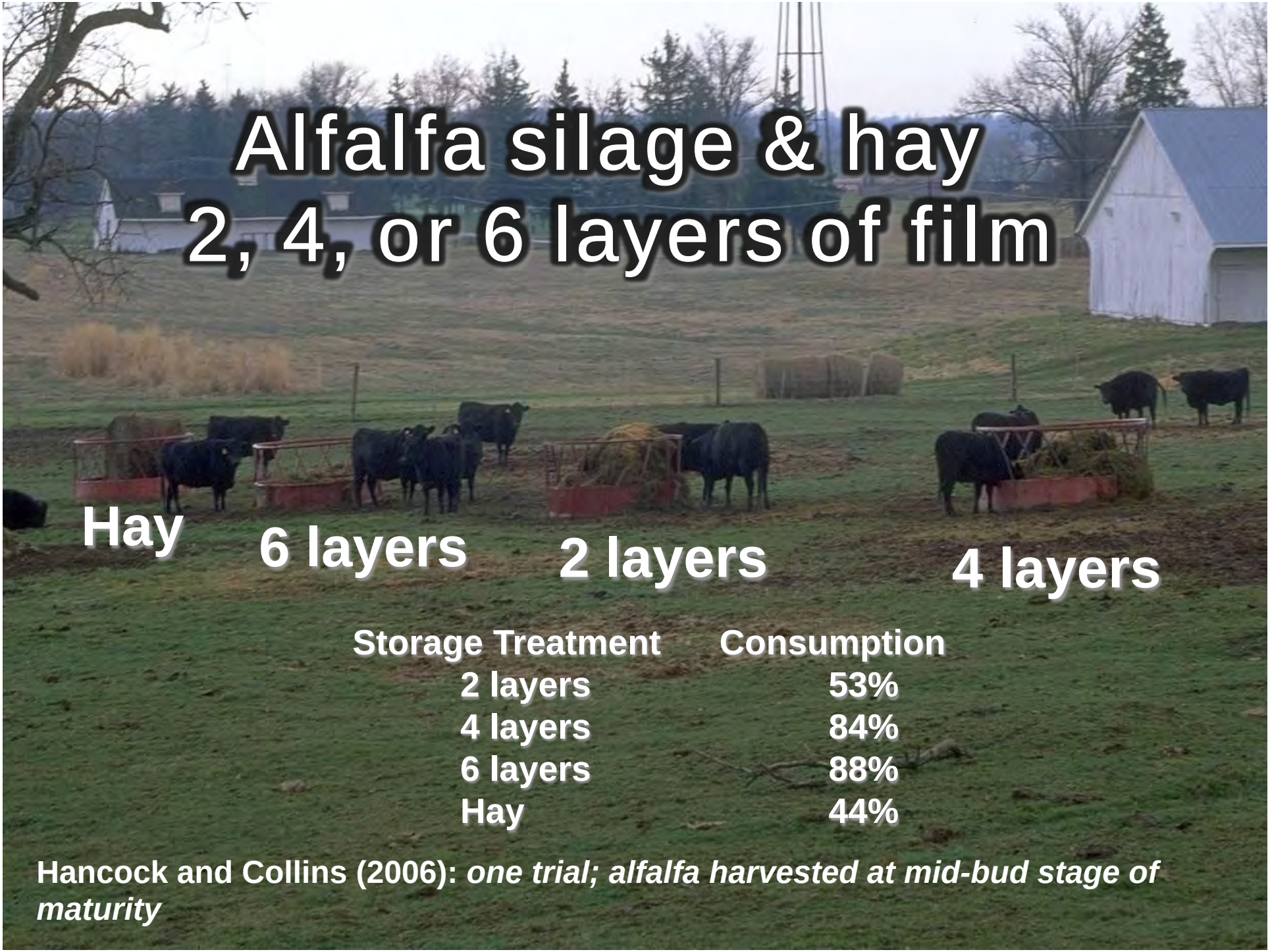
The plastic is not impermeable to oxygen. Each layer has a permeability of ~10,000 100% O_2 $cm^3/m^2/24$ h.

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



Storage Treatment	Consumption
2 layers	53%
4 layers	84%
6 layers	88%
Hay	44%

Hancock and Collins (2006): *one trial; alfalfa harvested at mid-bud stage of maturity*

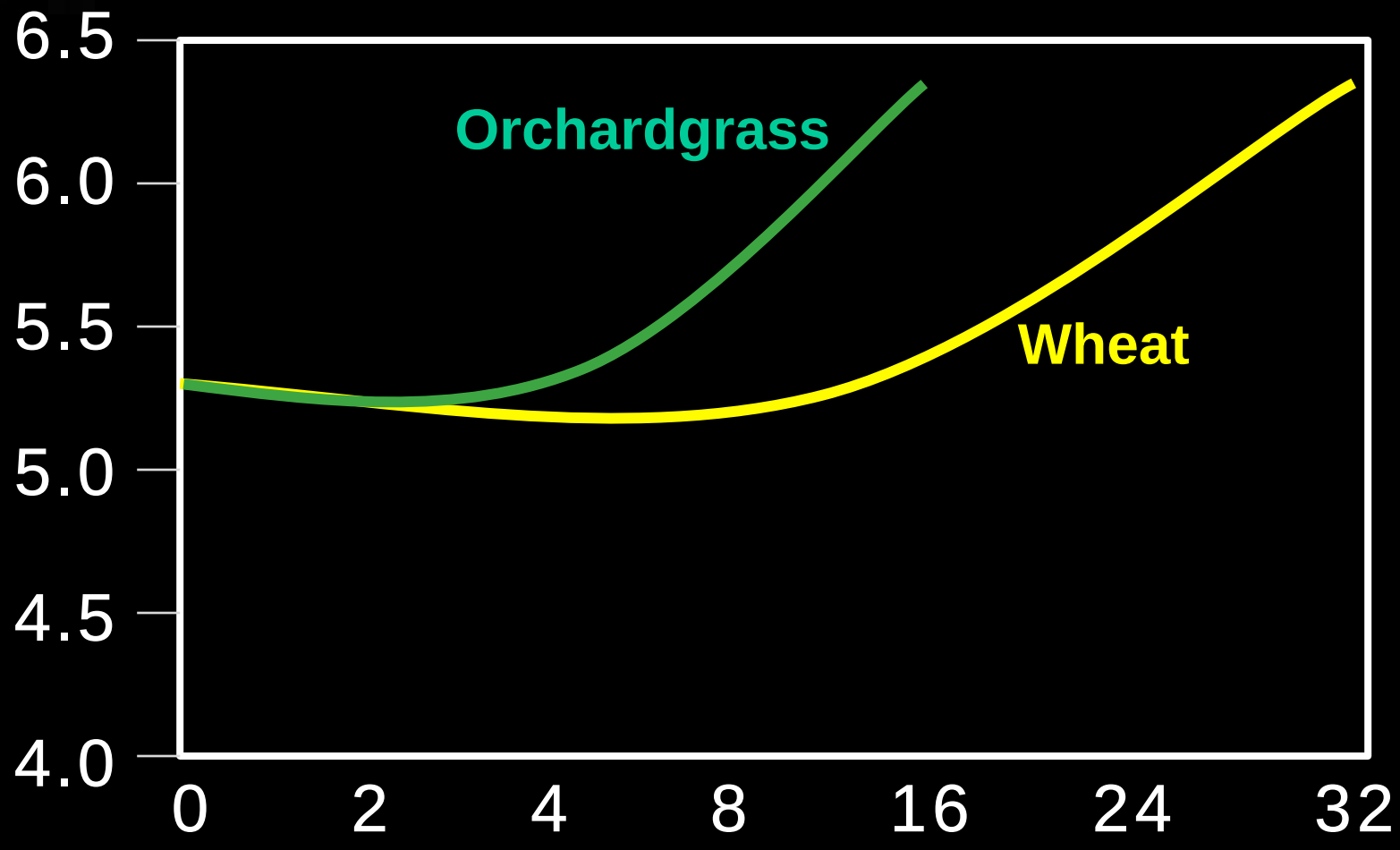
8. Feed it in an appropriate way.

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

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.

Surface pH after Exposure



Adapted from Rhein et al. (2005)

10. Have a plan for handling the plastic.

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

Resources

Baled Silage: Frequently Asked Questions

Dr. Dennis Hancock, Forage Extension Specialist

Some Points on Feeding Baled Silage

Dennis W. Hancock, Extension Forage Specialist, The University of Georgia

Silage makes an excellent feed for ruminant animals. However, feeding silage is much different than feeding hay. Silage, because it is much wetter than hay, is much more susceptible to deterioration. Sealed from oxygen during storage, the forage undergoes fermentation. However, when it is once again exposed to air when

AGR-173

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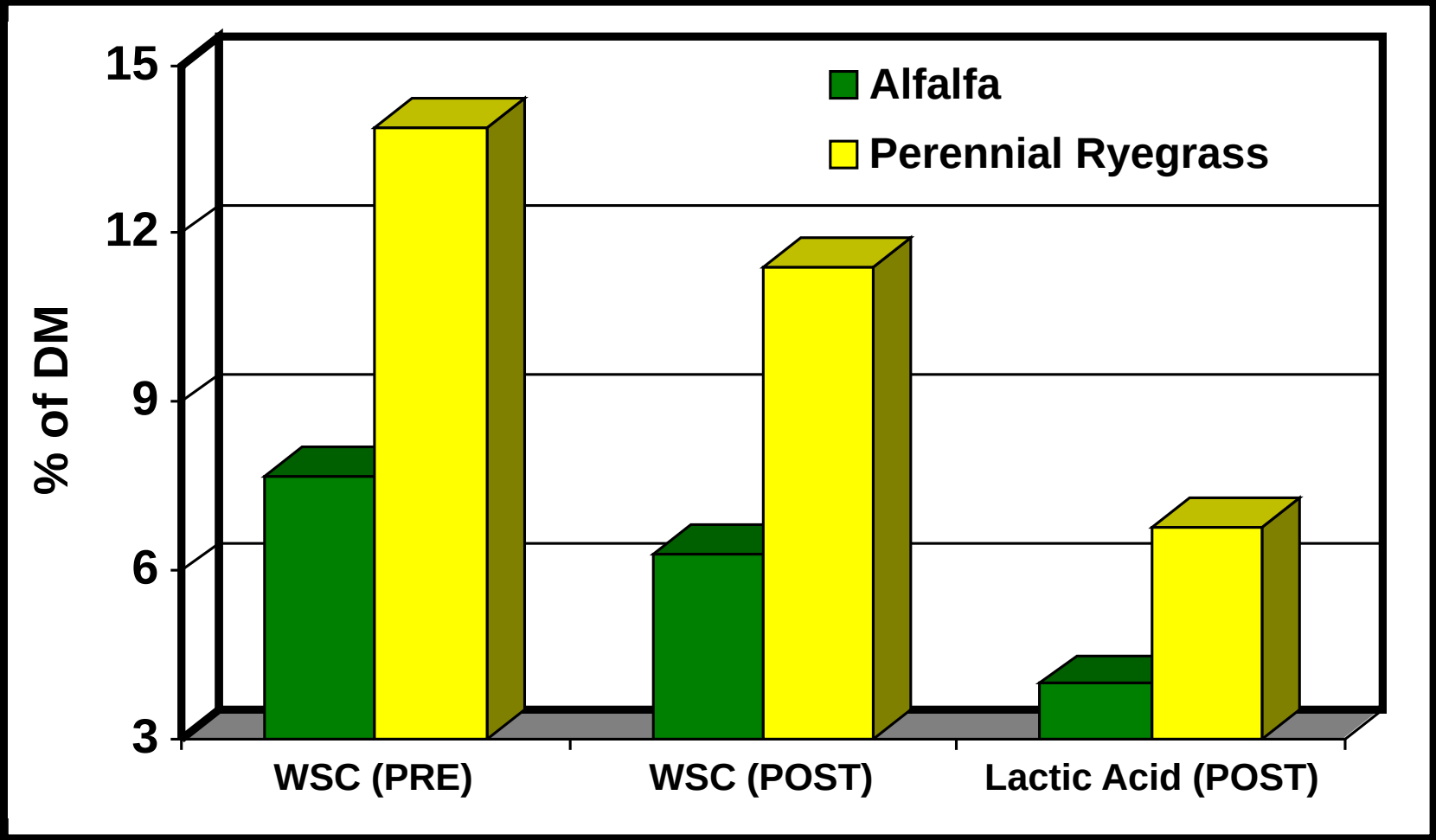
Baling Forage Crops for Silage

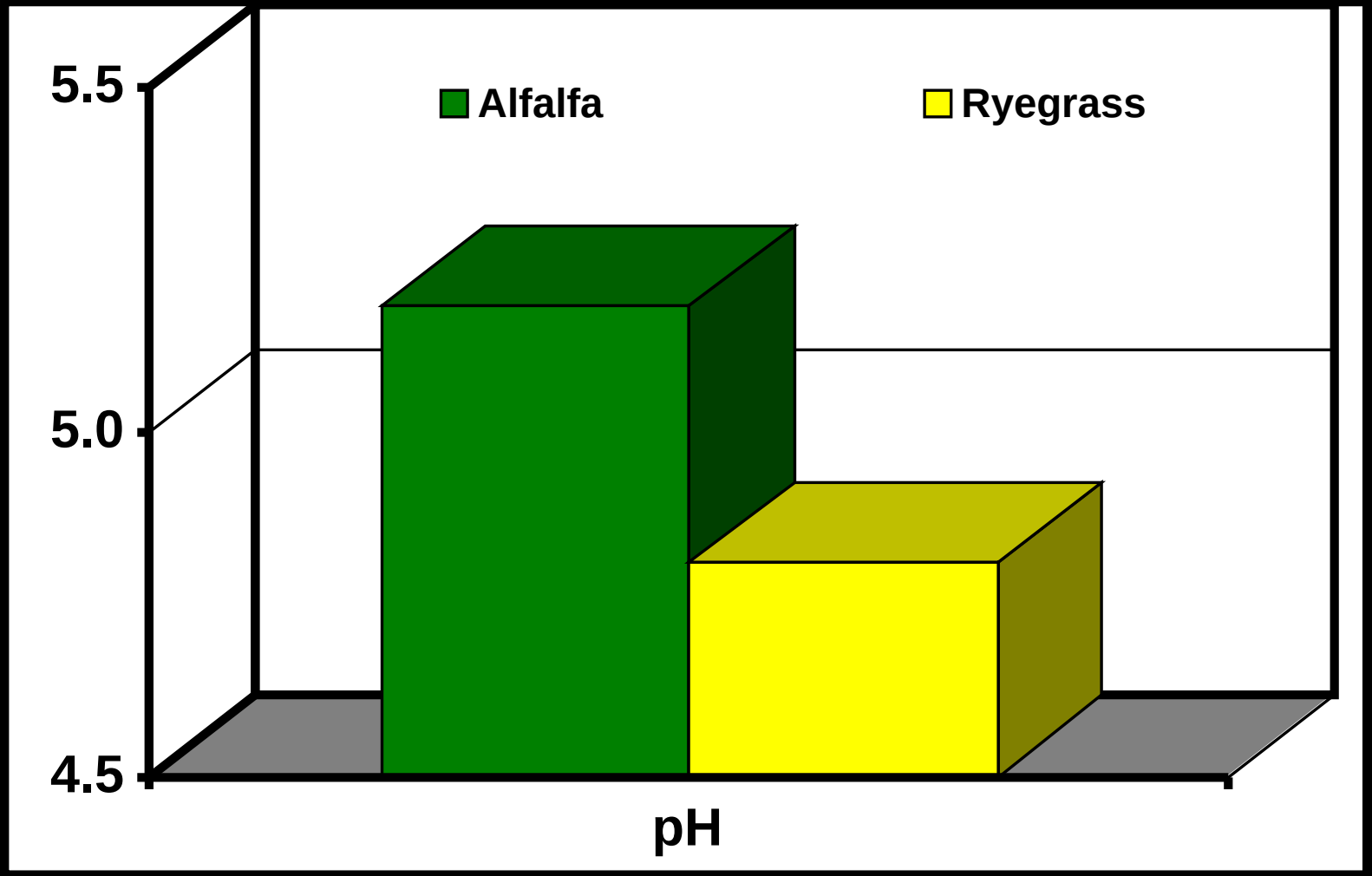
Jimmy C. Henning, Michael Collins, David Ditsch, and Garry D. Lacefield

Species Differences: Fermentation Characteristics



Han et al. (2006): mean of ideal (48.8%) and low (29.5%) moisture bales

Species Differences: Effects on pH



Han et al. (2006): mean of ideal (48.8%) and low (29.5%) moisture bales