Baleage: Another Option for Managing, Storing and Feeding Your Forage

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Neal P. Martin, Wayne K. Coblentz[1] and Richard E. Muck

USDA-ARS, Madison and Marshfield[1], WI

Round-Bale Silage – Management Issues to Consider

Wayne Coblentz
USDA-ARS
US Dairy Forage Research Center
Marshfield, WI

Fermentation Characteristics of Round-Bale Silages

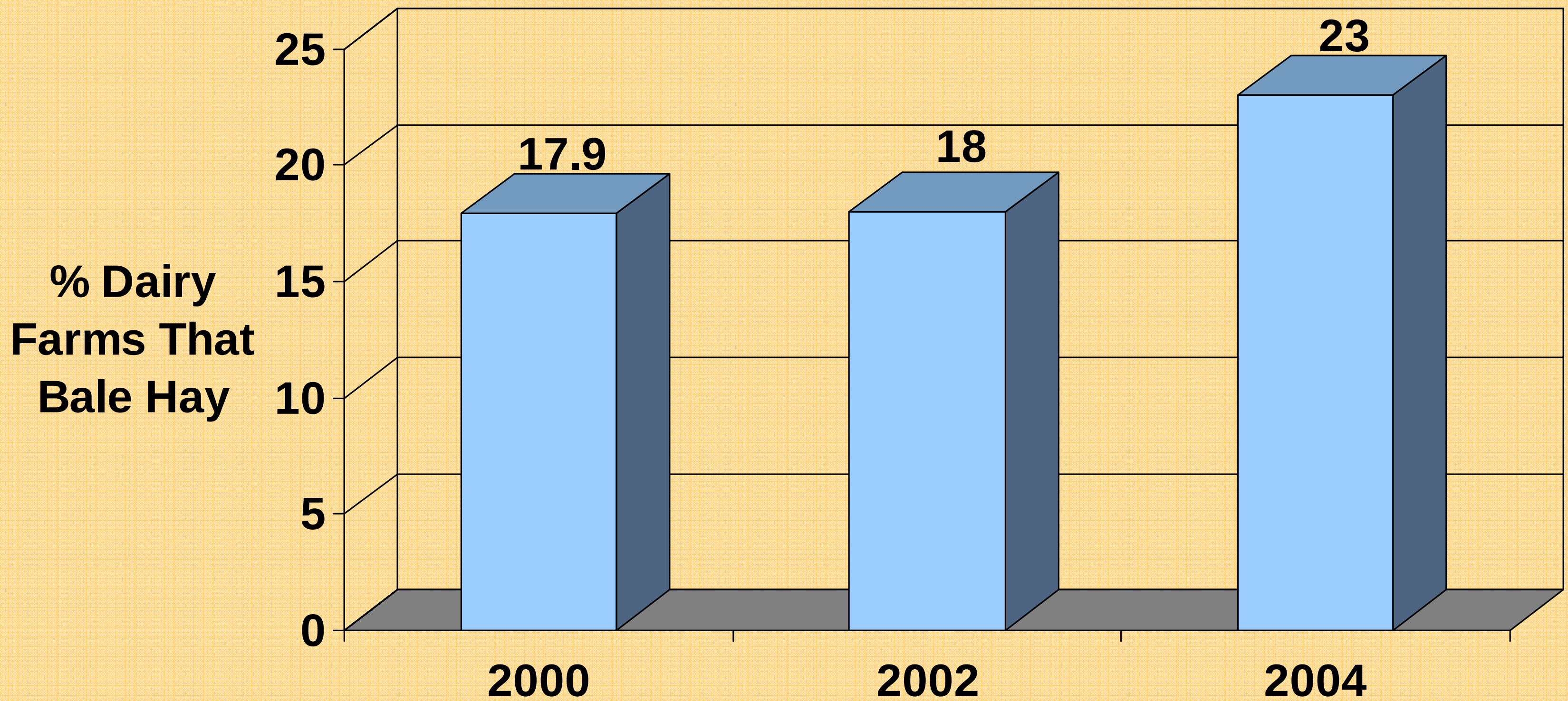
R.E. Muck

USDA, ARS

US Dairy Forage Research Center

Madison, WI

Increasing Use of Wrapped Round Bales



Hoard's Dairyman, 2005

Reasons for Increase

- Harvest flexibility
- Feed inventory
- Sell hay crop silage

Goal: Silage Preservation

- *Anaerobic (without air) bacteria convert sugars to lactic acid.*
- *This process lowers the pH and preserves the forage as silage.*

1. Regardless of silo type, most management principles are the same.

- ***start with high-quality forage***

- *manage moisture content*

- *excessively wet or dry silages can both be problematic*
- *standards vary somewhat with silo type*

- *eliminate air*

• *maintain silo integrity*

particularly important for plastic structures

• *avoid poor feedout management*

too much exposure to air is problematic

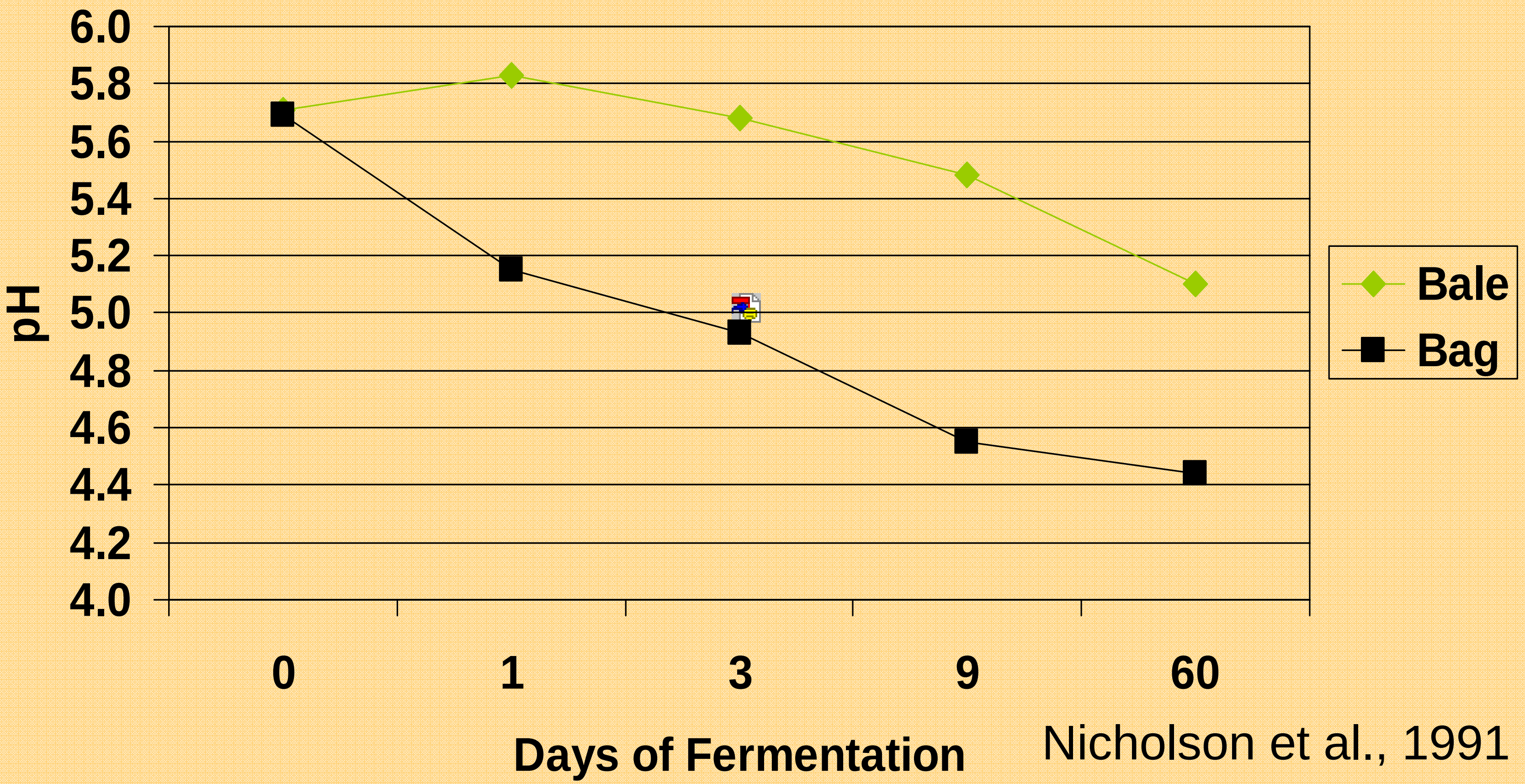
2. Round Bale Silage – Some Considerations

Harvest Factors (Rd-Bale vs. Precision-Chopped)

- *lack of chopping action forces sugars to diffuse from inside the plant to reach lactic acid bacteria located on the outside of the forage*

- *RBS may be less dense (DM/ft3) than some other (chopped) silo types, which also may restrict availability of sugars to lactic acid bacteria*

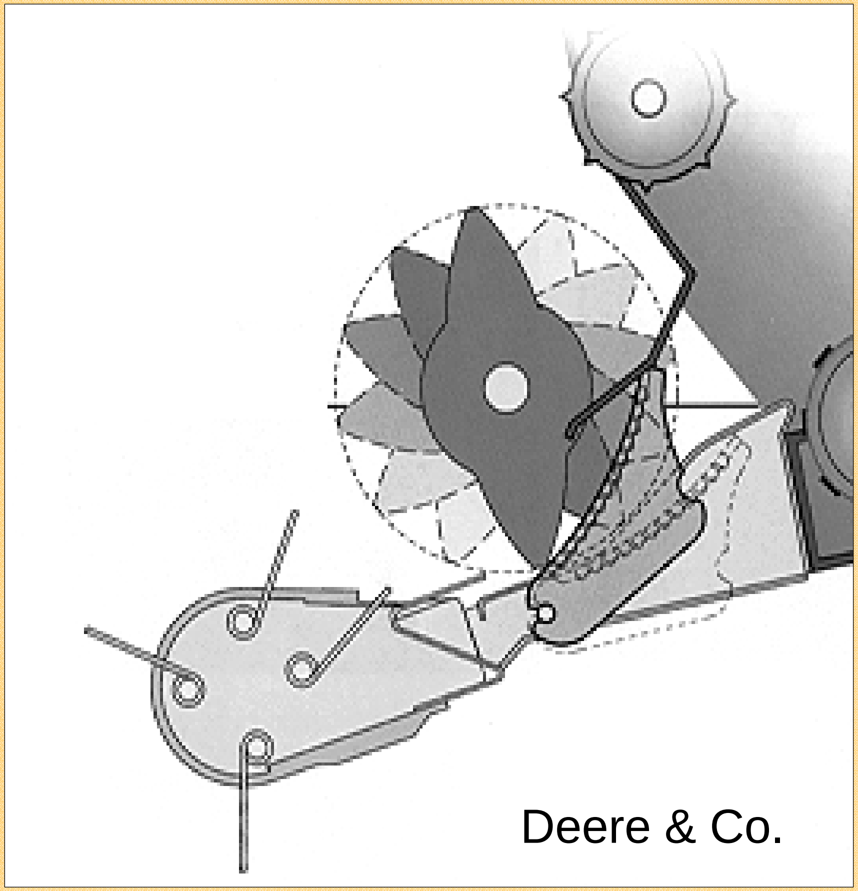
Bale vs. Bag in Alfalfa/Grass Silage



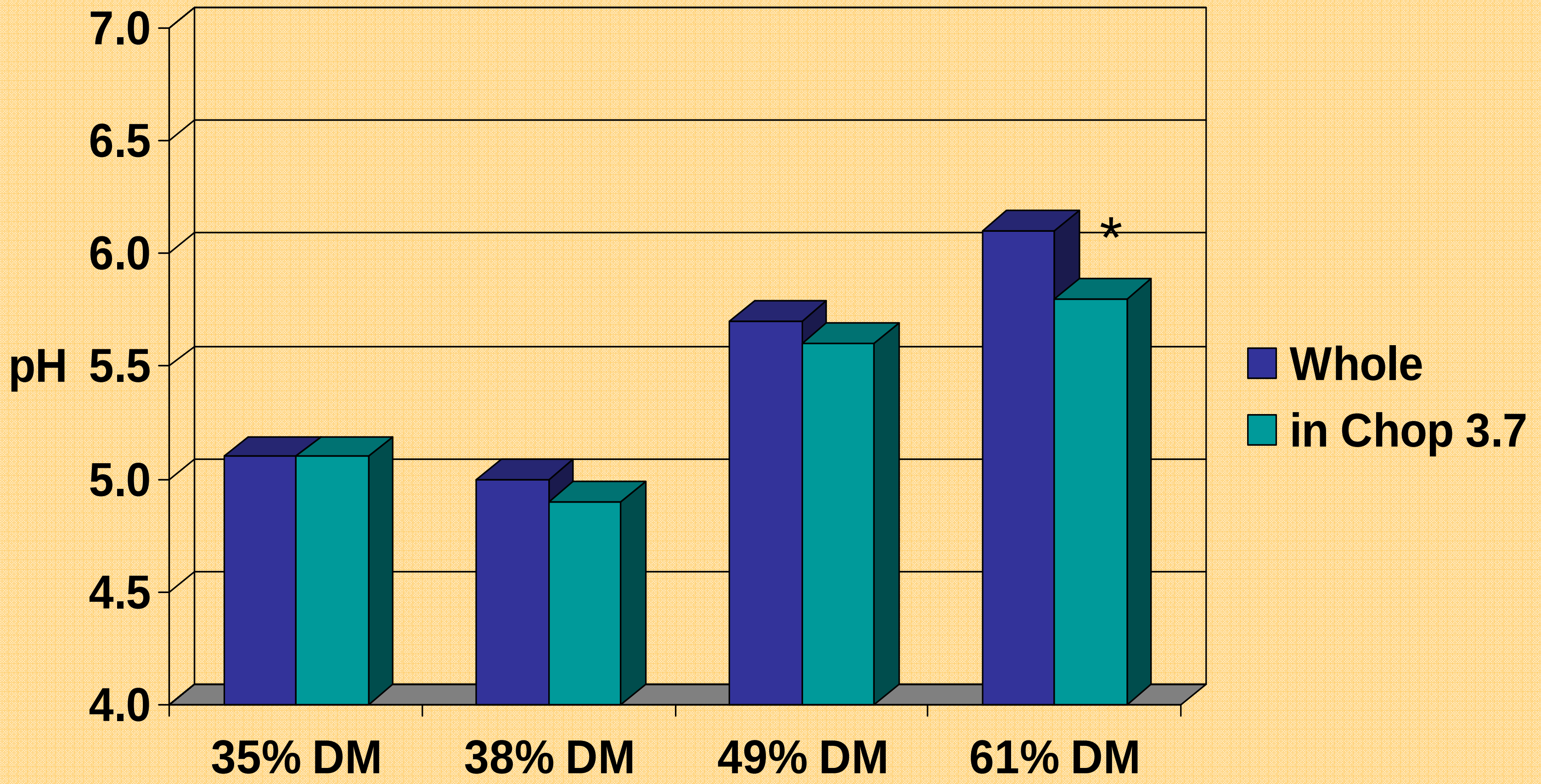
Nicholson et al., 1991

Chop Length

- Long forage affecting fermentation?
- Cutting systems available now
  - 1.5 to 6 in. lengths



Alfalfa Bale Silage - 3.7 in Chop



Borreani et al., 2006

Effects of Chop Length

- **Fermentation:**
  - Small positive effect
  - More in sugar-limited and/or dry silages
- **DM Recovery:**
  - 0.5 to 4.0% unit improvement
  - Avg. of 6 trials: 1.4%

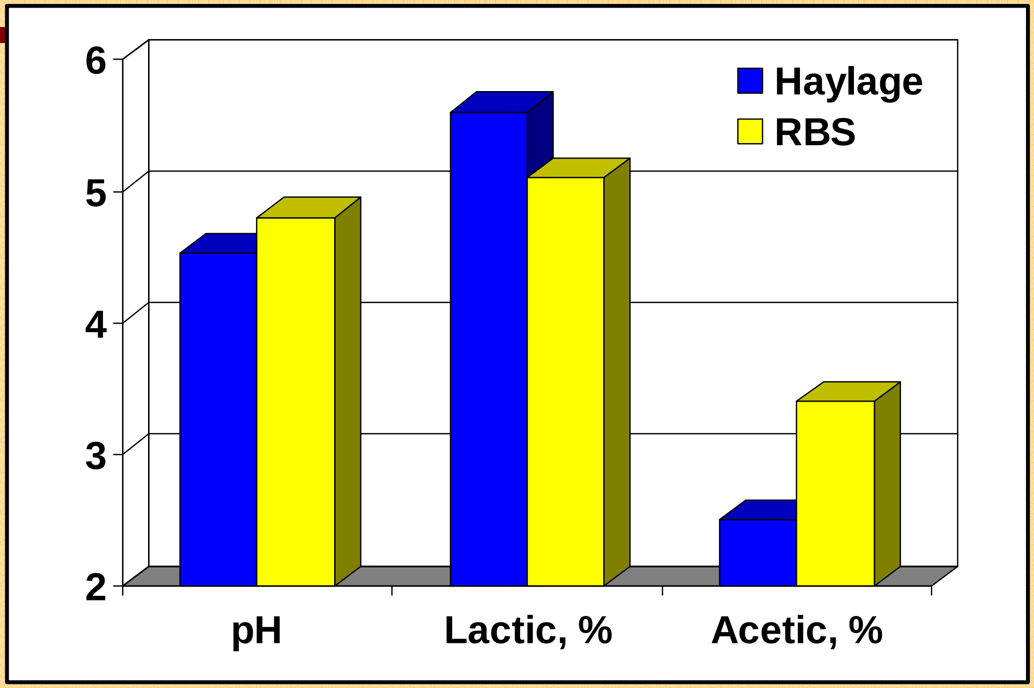
Harvest Factors (Rd-Bale vs. Precision-Chopped)

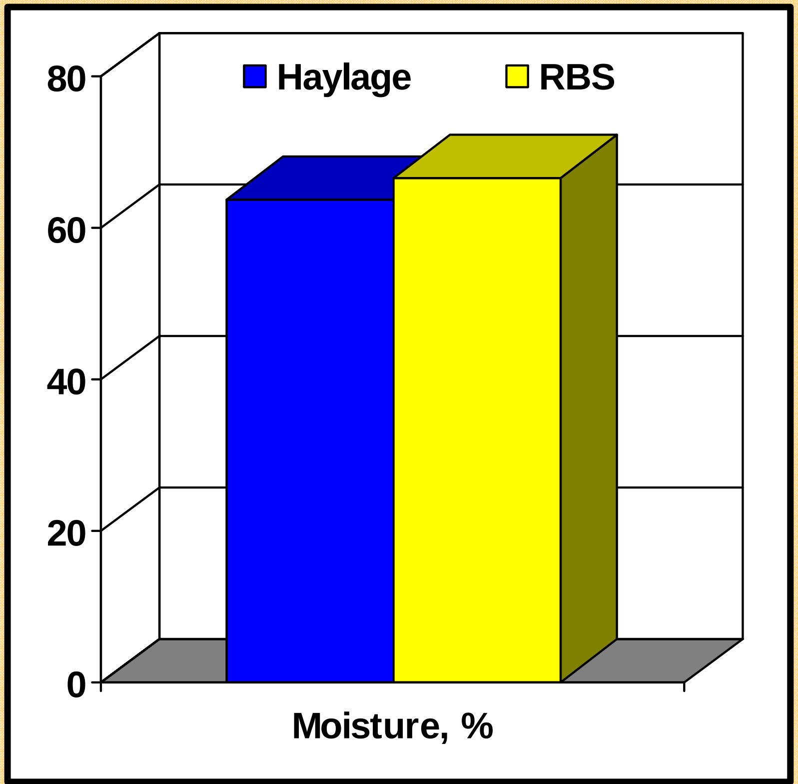
- *lack of chopping action forces sugars to diffuse from inside the plant to reach lactic acid bacteria located on the outside of the forage*
- *RBS may be less dense (DM/ft3) than some other (chopped) silo types, which also may restrict availability of sugars to lactic acid bacteria*
- *lower bale density, and greater ratio of surface area to bale volume, potentially make RBS more susceptible to entrapment and/or penetration by O_2*
- *recommendations for moisture content of RBS are 5 to 20 percentage units lower than for chopped forages; this alone will restrict fermentation*

Harvest Factors

Fermentation Characteristics - Haylage vs. RBS

McCormick et al. (1998)





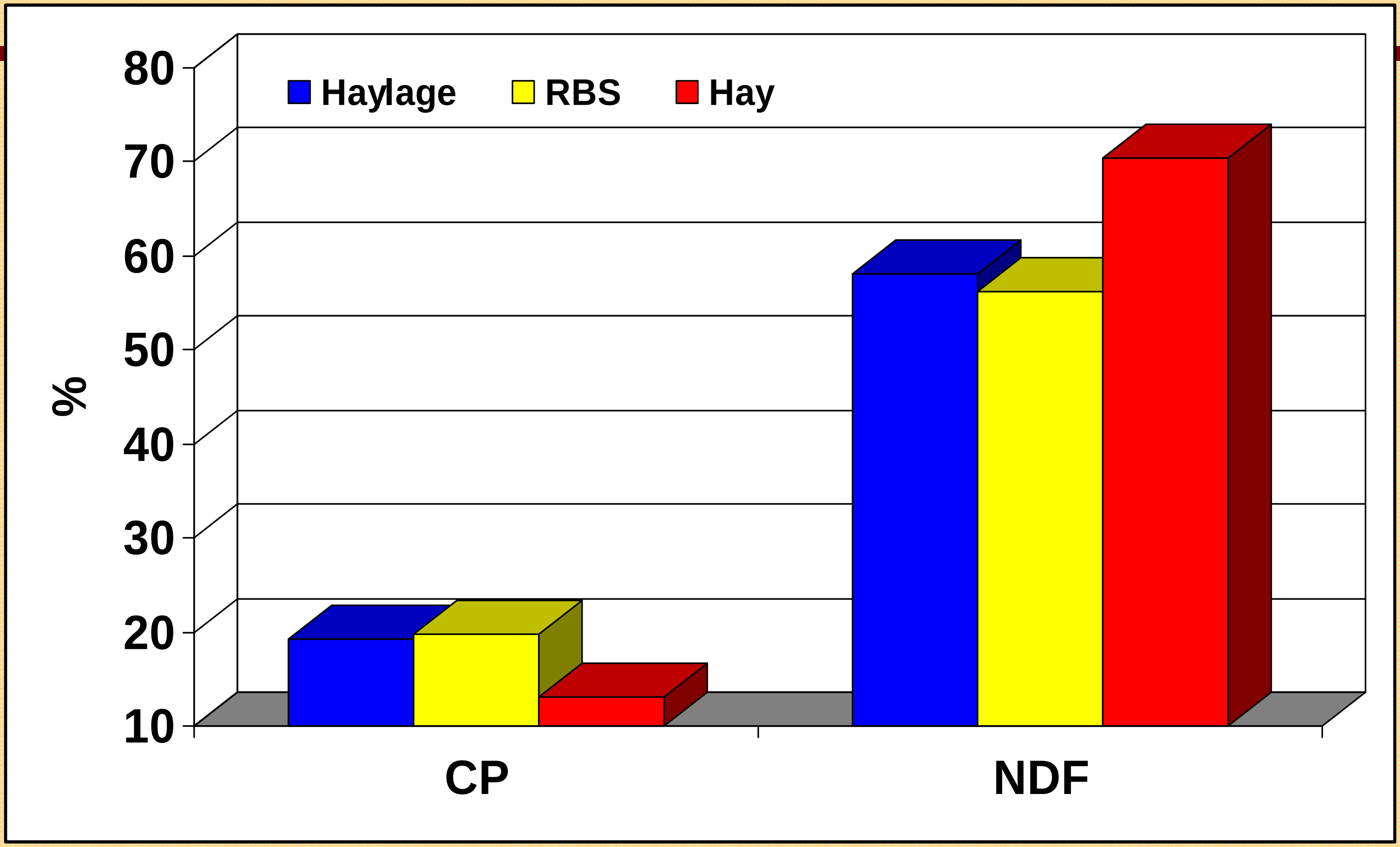
- *annual ryegrass (1993-94)*
- *4 x 4 bales*
- *silages harvested mid-April in southern Louisiana*

Harvest Factors (Rd-Bale vs. Hay)

- well-made RBS will often exhibit better quality characteristics than corresponding hays
  - harvest delays (inclement weather)
  - rain damage
  - spontaneous heating
  - weathering after baling (outdoor storage)

Harvest Factors

Annual Ryegrass – Delaying Haying for Favorable Weather



McCormick et al. (1998): annual ryegrass (1993-94); silages harvested mid-April, hay in early May

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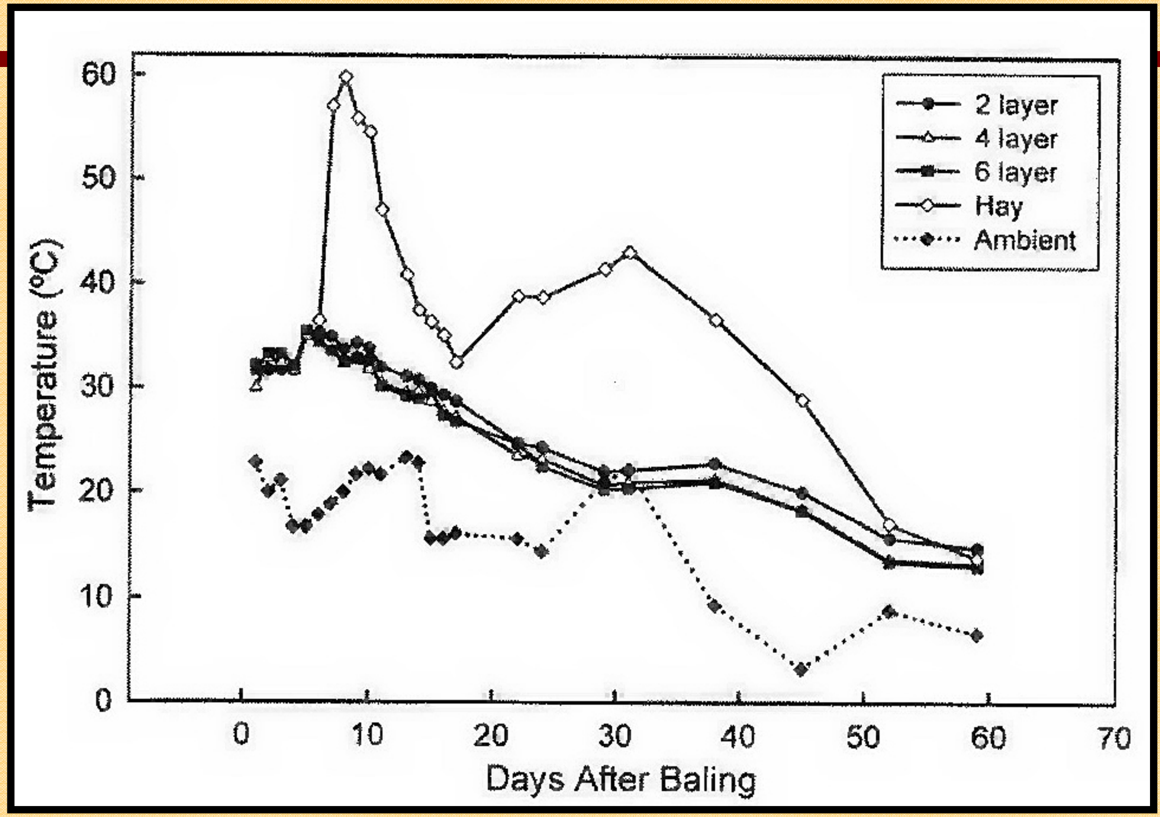
Harvest Factors

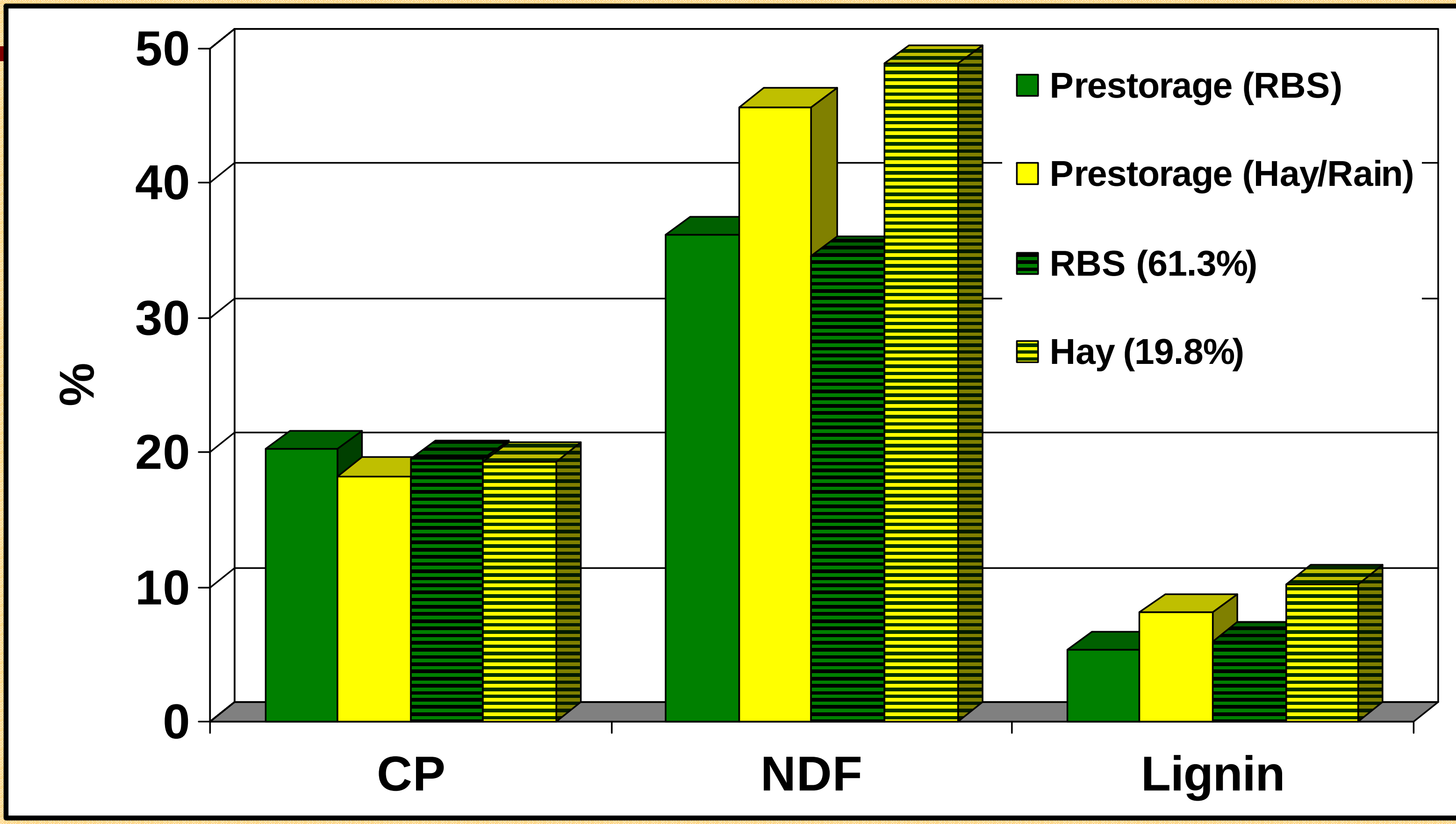
Alfalfa - Spontaneous Heating in Hay vs. RBS



Hancock and Collins (2006): ***alfalfa harvested at mid-bud stage of maturity; hay baled at 19.8% moisture and stored outside, uncovered; hay received two rainfall events totaling 0.6 inches prior to baling.***

Harvest Factors

Alfalfa – Effects of Rain Damage and Modest Spontaneous Heating



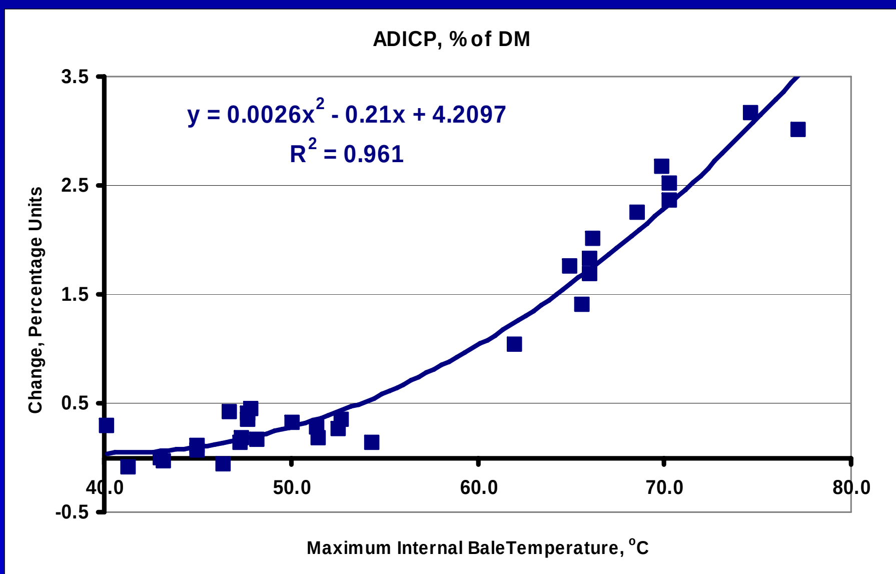
Hancock and Collins (2006): *alfalfa harvested at mid-bud stage of maturity; hay baled at 19.8% moisture and stored outside, uncovered; hay received two rainfall events totaling 0.6 inches prior to baling.*

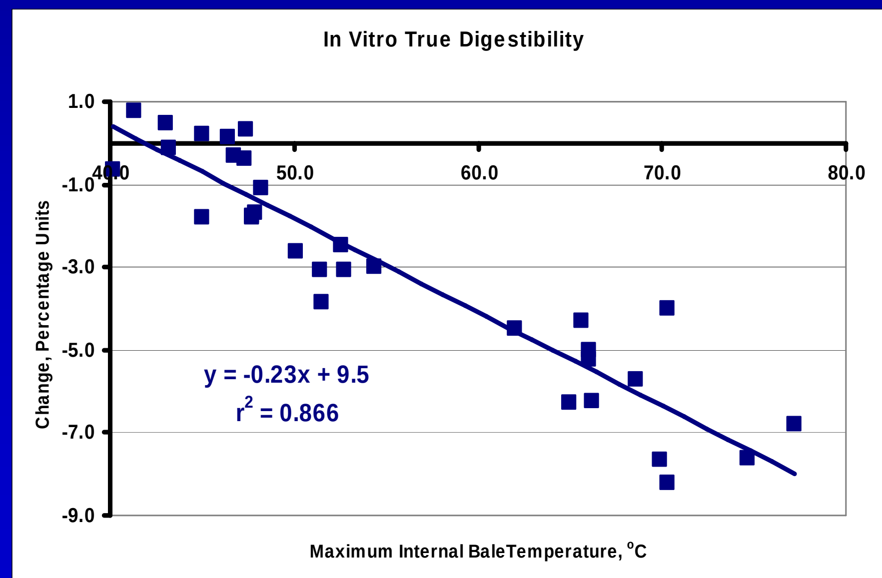
Spontaneous Heating of Alfalfa/Orchardgrass Hays In Large-Round Bales (Journal Dairy Science 92:2853-2874)

MAX = 72.9°C

MAX = 48.0°C

MAX = 43.0°C





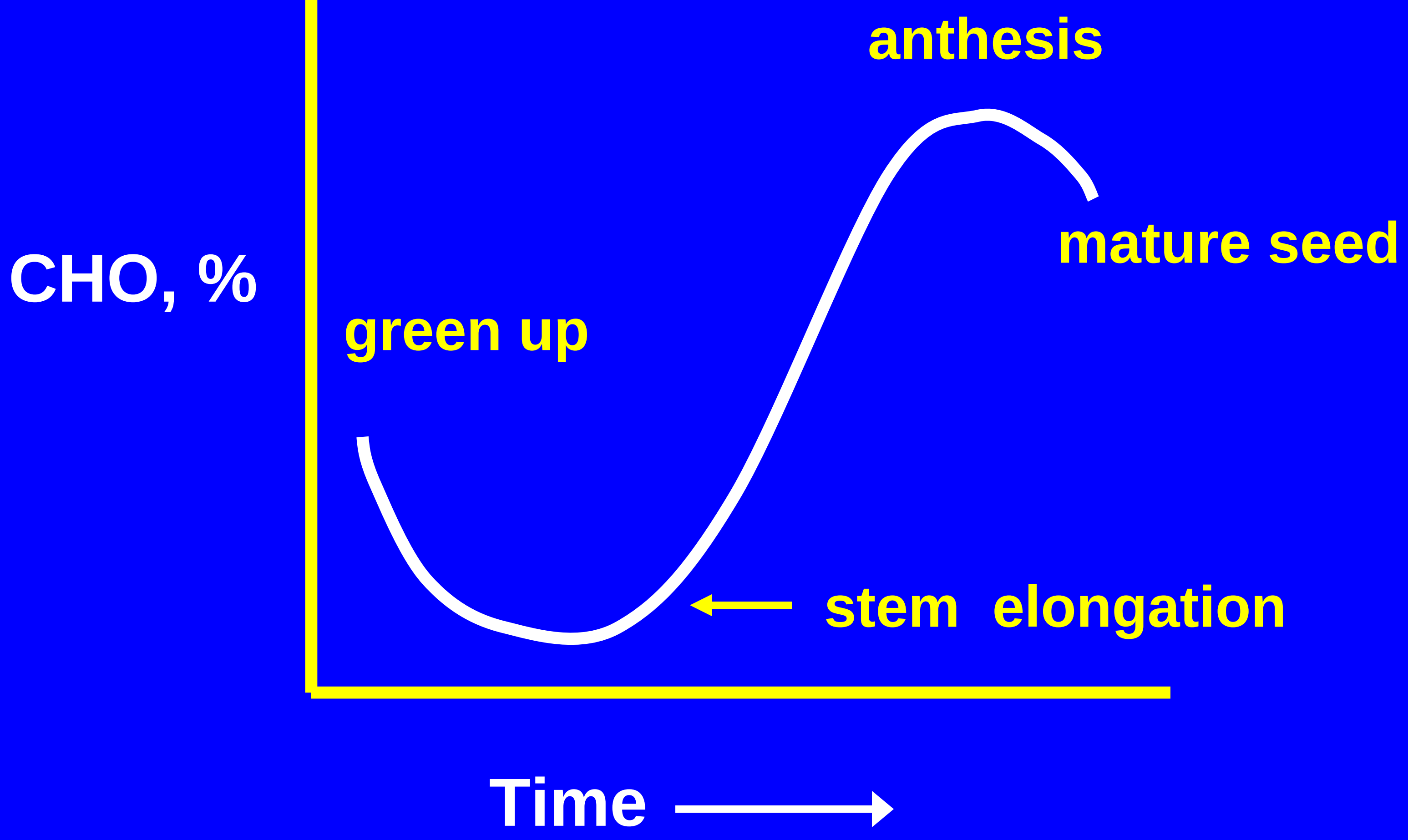
- Graphs summarize changes (Final – Initial) for 32 treatments from three trials during 2006-07

Crop Factors

- *harvest high-quality forages – expensive equipment generally will not improve forage quality*
- *damaged, or mismanaged forages that ferment poorly in conventional silo types also are likely to make poor RBS*
- *harvest at proper growth stage (sugar status)*
- *remember that forage species are inherently different*
  - *legumes ≠ cool-season (cs) grasses*
  - *cs grasses ≠ warm-season (ws) grasses*
  - *ws annuals ≠ ws perennials*

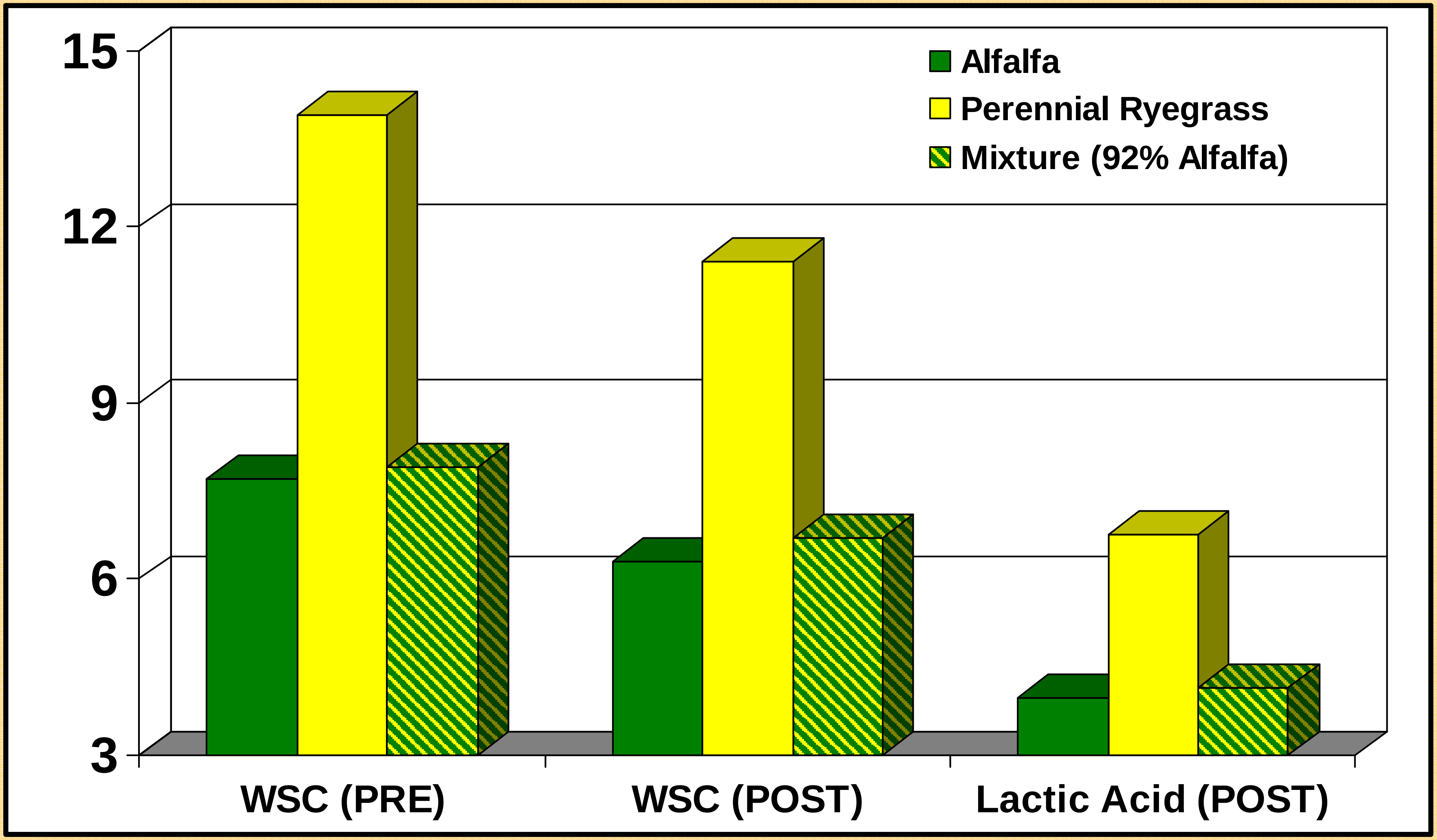
Crop Factors

Sugar Status - Nonstructural CHO in Stem Bases of Perennial Cool-Season Grasses



Crop Factors

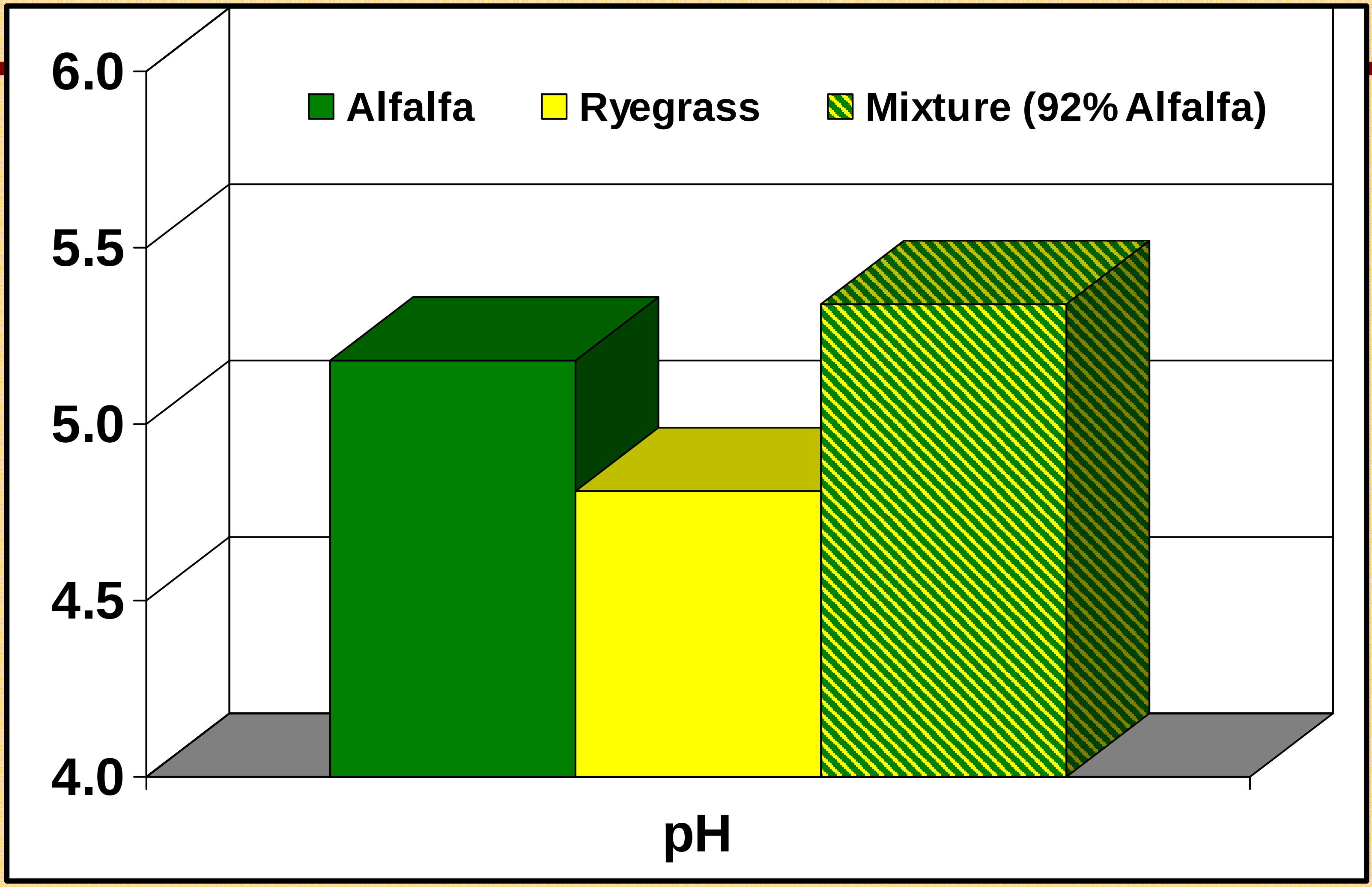
Species Differences - Fermentation Characteristics



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

Crop Factors

Species Differences – Effects on pH



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

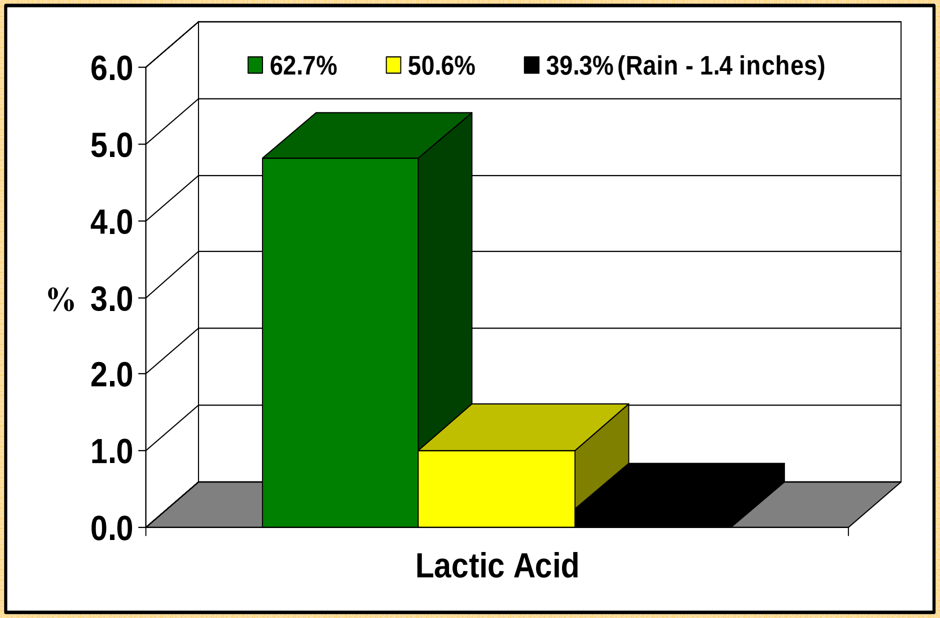
Moisture Management

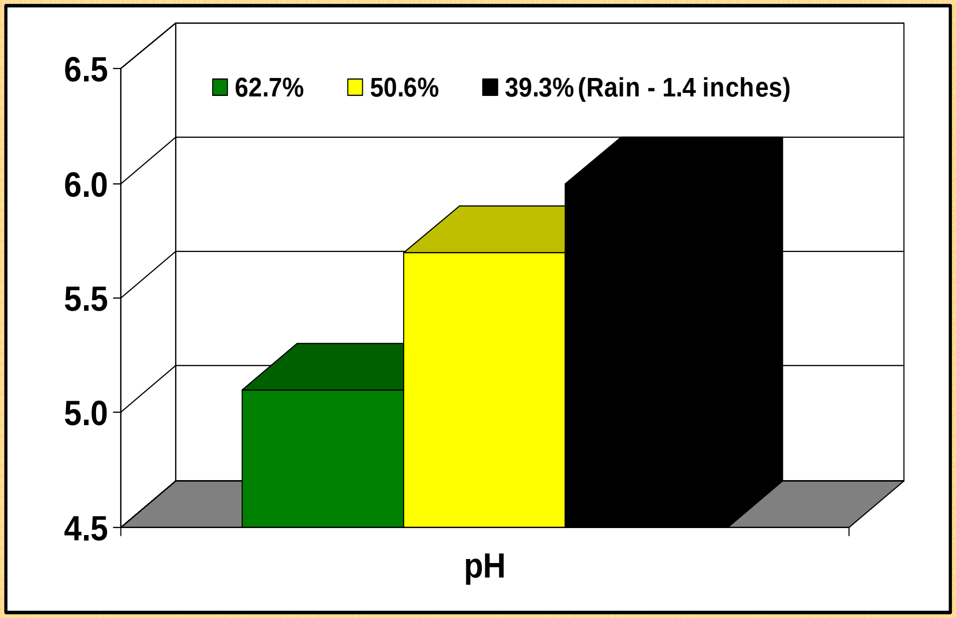
- ***Generally, RBS should be packaged at 40 to 60% moisture; the average for the whole field or group of bales should be about 50%.***
- ***Bale weight can be a safety/equipment issue.***
- ***Systems for RBS will generally accommodate excessively dry forages better than excessively wet ones.***
  - ***clostridial fermentations (wet)***
  - ***bale deformation, tensile stress on plastic (wet)***
  - ***migration/concentration of water***
  - ***integrity of plastic (dry)***
- ***moisture in the plant ≠ moisture on the plant***

Moisture Management

Alfalfa – Effects of Rain-Damage on Fermentation

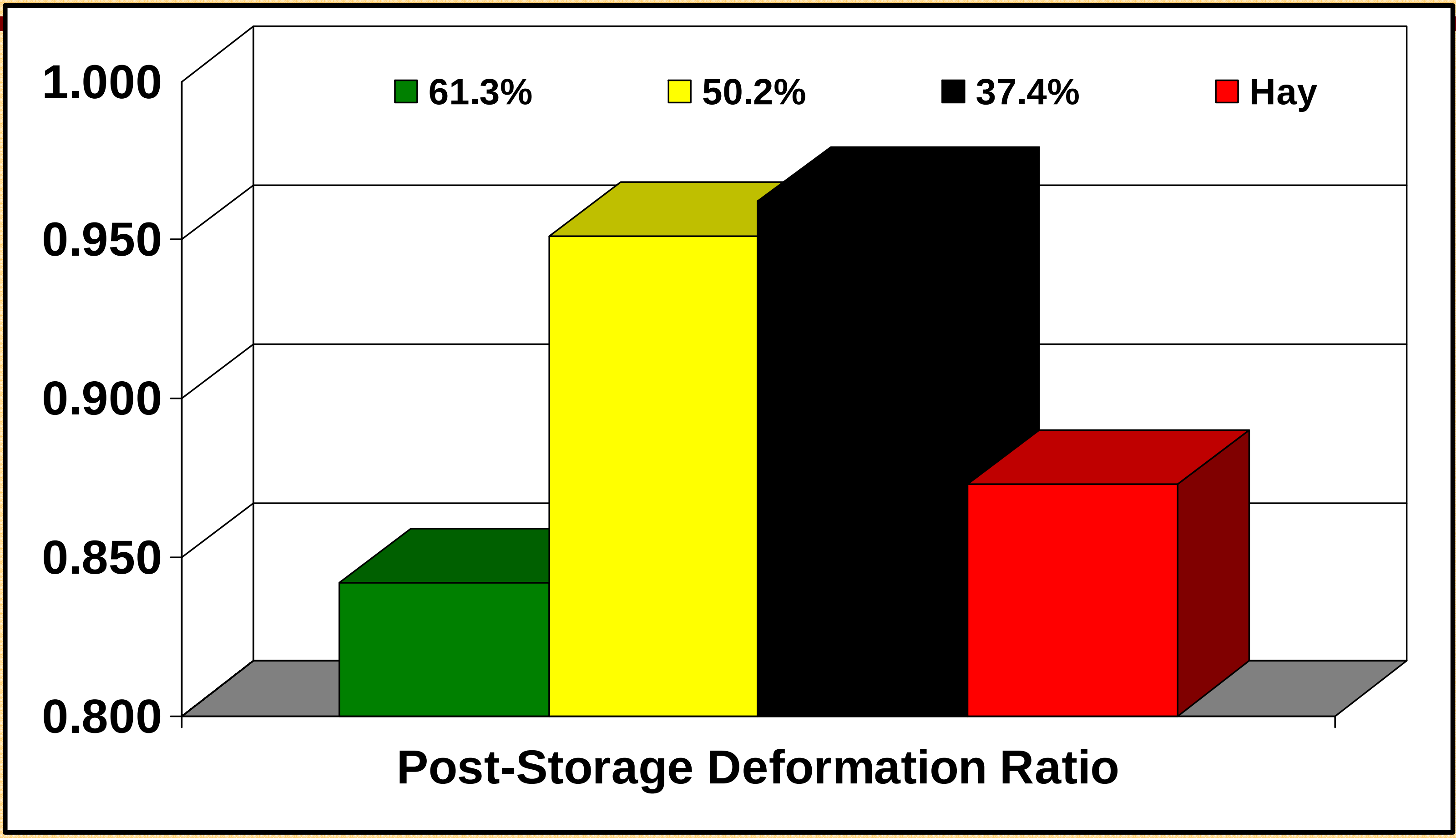
Borreani and Tabacco (2006)





Moisture Management

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



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

Elimination of Air

Why?

- *respiration of plant sugars to CO_2, water, and heat*
- *dry matter loss*
- *reduces pool of fermentable CHO (sugars)*
- *increases (indirectly) fiber content of the silage*
- *decreases energy density of silage*
- *heat damage to silage proteins*

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elimination of air

bulk density >10 lbs DM/ft^3

- ***reduce ground speed***
- ***increase PTO speed***
- ***thinner windrows will increase revolutions/bale***
- ***manage moisture appropriately (≈ 50%)***
- ***maintain constant bale size***
- ***baler/operator experience***

Elimination of Air

Alfalfa - 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, ^oF	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.

Elimination of Air

Alfalfa - Effects of Precutting System on Bale Density

			------ DM Density -----	
Trial	Moisture	Rain	Normal	Chopped
#	%	inches	---------- lbs/ft^3	---------
1	62.7	0	11.4	11.9
	50.6	0	12.3	12.8
2	39.2	1.4	10.7	11.2
3	62.3	0	10.2	10.4

Borreani and Tabacco (2006): 4 x 4-ft bales were chopped with a cutting system consisting of 15 knives spaced 93 mm apart.

Elimination of Air

Sealing the Bale

- lack of uniformity will create air pockets for in-line wrapped bales
- use UV-resistant plastic
- wrap as quickly as possible after baling (within 2 hours is ideal)
- use (at least) four layers of stretched plastic (six for long-term storage and/or in southern states)
- storage site selection/maintenance is important
- do not puncture plastic - isolate from cattle, pets, and vermin
- patch holes with appropriate tape

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Hydraulic Bale Grapple

Elimination of Air

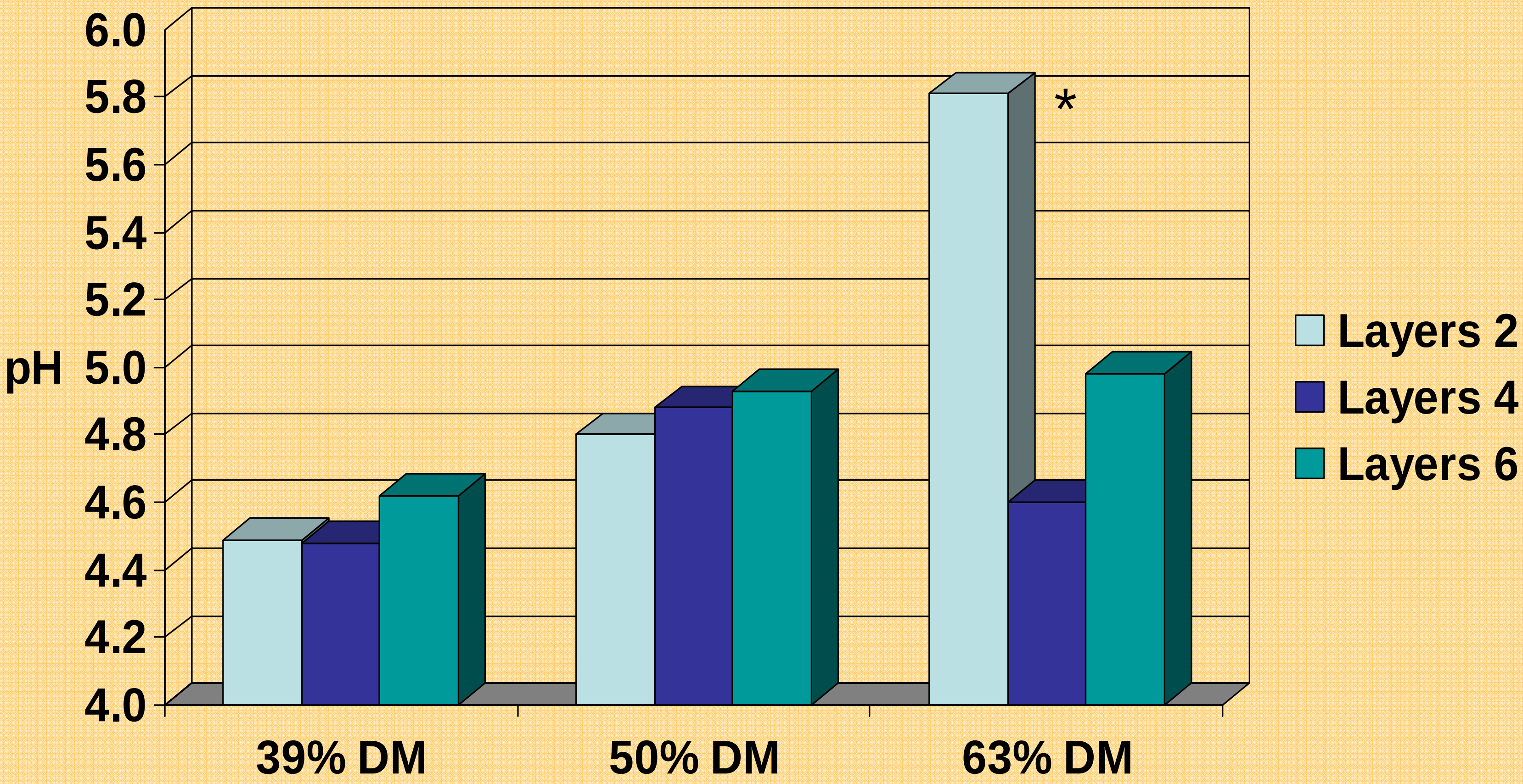
Alfalfa - Effects of Delaying Wrapping on Internal Bale Temperature (63% Moisture)

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 wrapped with eight mils of plastic film.

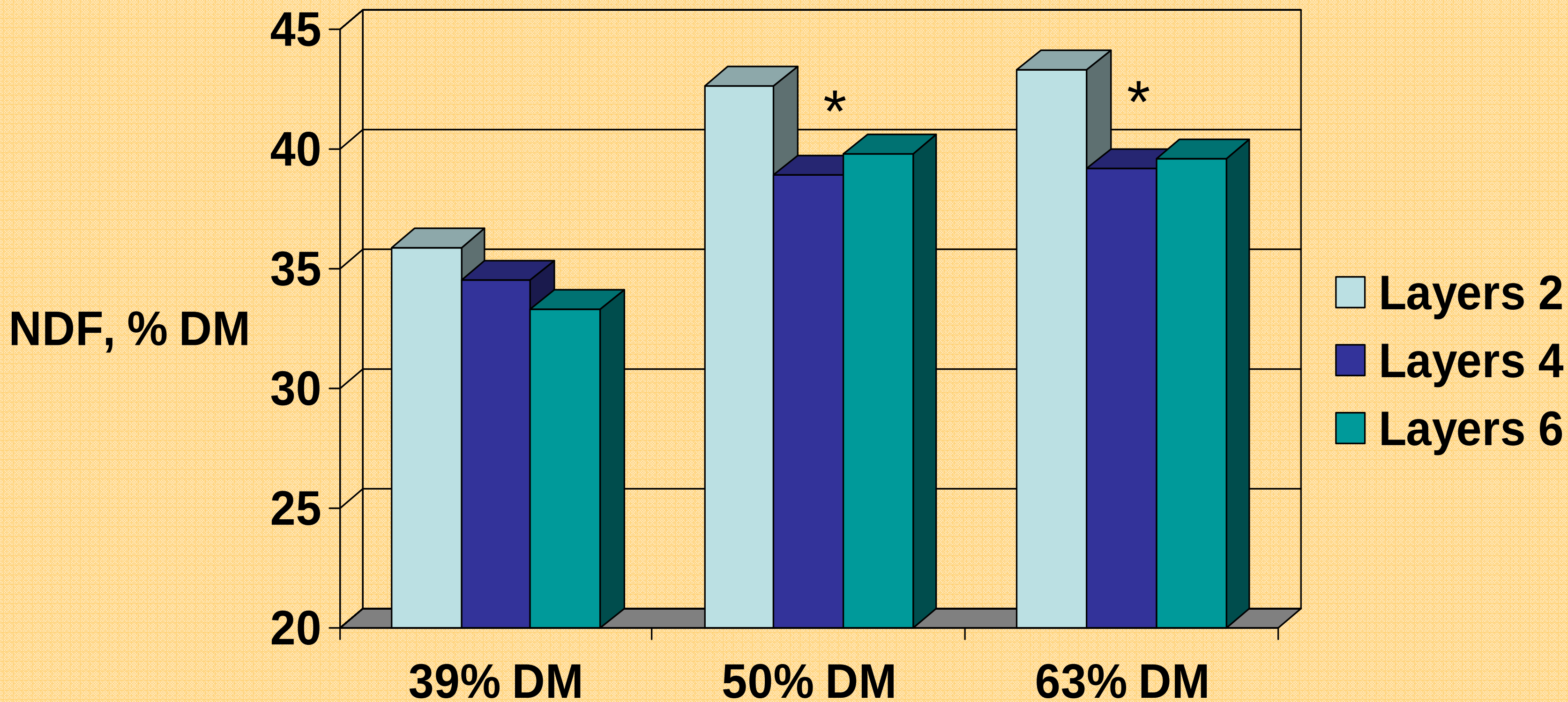
*** Denotes days from wrapping.**

pH In Alfalfa Bale Silage



Hancock and Collins, 2006

NDF In Alfalfa Bale Silage



Hancock and Collins, 2006

Summary

- Producers can make good silage using baling and wrapping techniques.
- Most principles of management for conventional chopped silage still apply to RBS.
- Moisture management is critical; RBS techniques will accommodate drier (<50%) forages much better than relatively wet (>65%) ones.

Summary

- Recommendation: start baling about 5+ percentage units drier than for making silage in other silo types to avoid a clostridial silage.

Summary

- Can get a good fermentation over a range of moisture contents.
- But fermentation is somewhat restricted (occurs at slower rate) compared to other silo types.
- Differences appear due to a combination of density, chop length, layers of plastic.

Any questions ?