USDA
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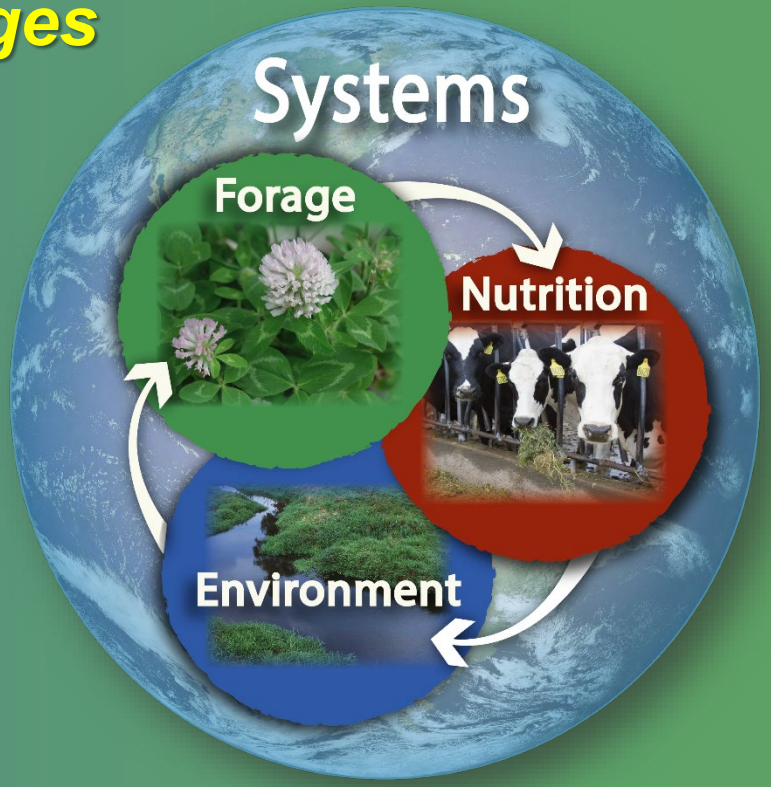
Baled Alfalfa Silages: Potential Advantages over Dry Hay, and Unique Differences from Traditional Precision-Chopped Silages



Rancher's Thursday Lunchtime Series:

Alfalfa Management for Beef Cattle Production

August 27, 2020

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Marshfield, WI

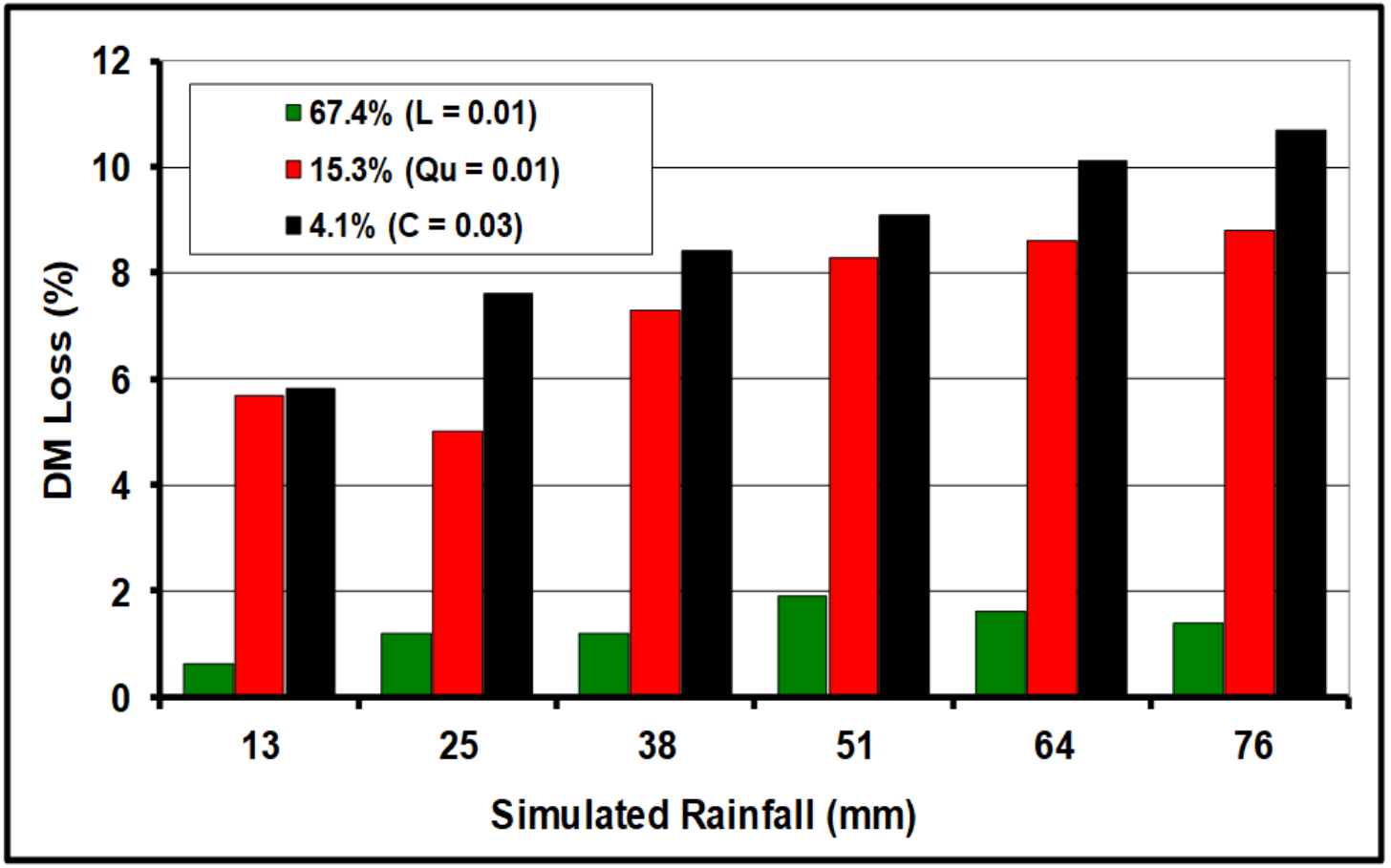
Why Choose Baled Silage Over Hay?

- ***well-made baled silage will often exhibit better quality characteristics than corresponding hays***
  - ***reduced risk/exposure to rain damage***
  - ***less leaf loss (legumes)***
  - ***improved opportunities for harvesting forages at the most desirable growth stage***
  - ***little or no spontaneous heating***
  - ***no weathering after baling (outdoor storage)***

Why Choose Baled Silage Over Hay? Reduced Risk

Orchardgrass Forages

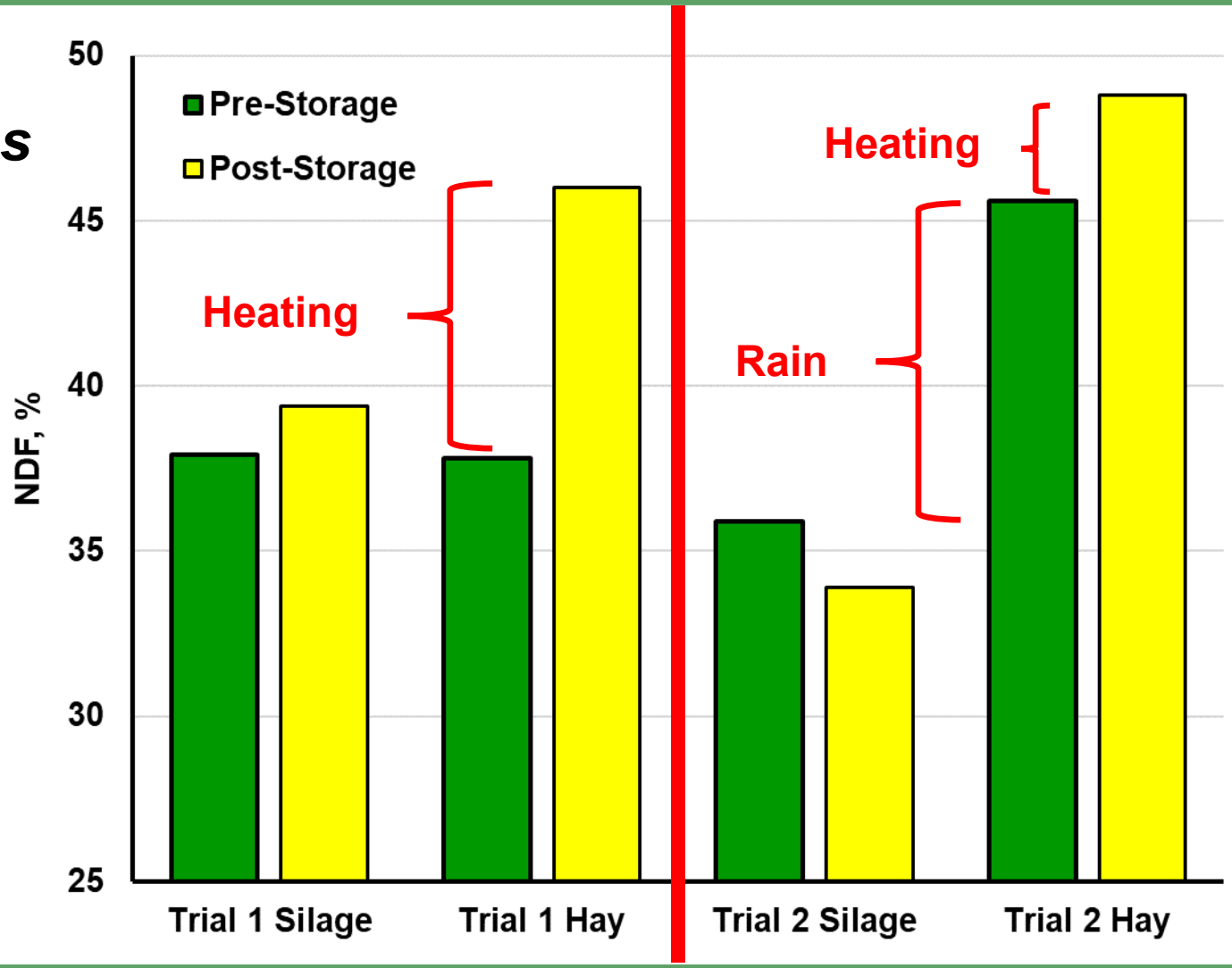
- *regrowth (2nd cutting)*
- *subjected to simulated rainfall in 13-mm increments*
- *rainfall applied after forages were wilted in the field to 67.4, 15.3, or 4.1% moisture*



adapted from Scarbrough et al. (2005)

Why Choose Baled Silage Over Hay?
Reduced Risk

Alfalfa Forages

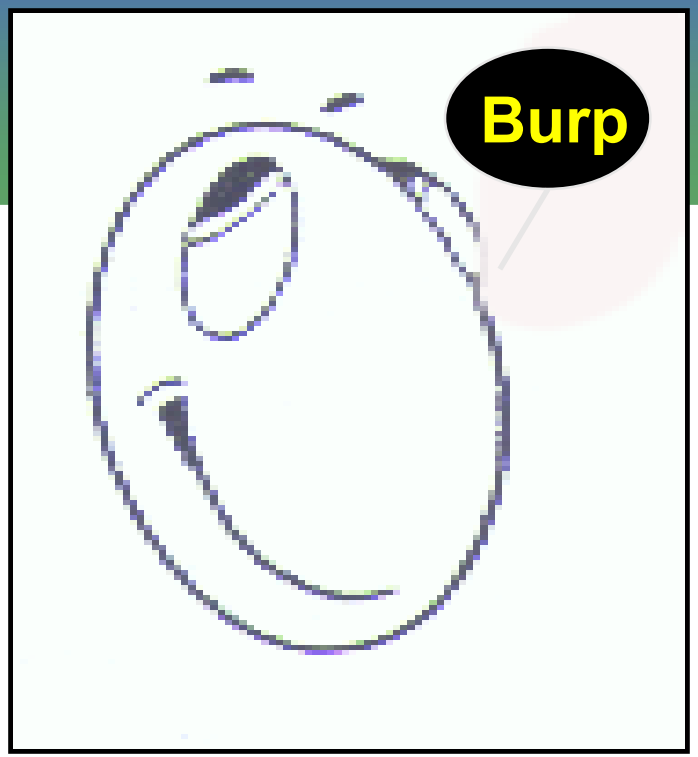


adapted from Hancock and Collins (2006)

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

- *start with high-quality forage*

- *ideally, the goal is to establish a stable silage mass by lowering pH and maintaining anaerobic conditions!*



Lactic Acid, The "Good Silage" Acid

plant sugars → lactic acid

Homofermentative

glucose or fructose + 2ADP + 2 Pi → 2 lactate + 2 ATP + 2 H_2O

Heterofermentative (multiple pathways)

glucose or fructose + ADP + Pi → lactate, acetate, ethanol, mannitol, ATP, H_2O, and CO_2

Plant Factors Affecting Fermentation

- ***Water Soluble Carbohydrates (WSC)***
- ***Buffering Capacity***

Fermentable Sugars
Water-Soluble Carbohydrates (WSC)

Sources of Variation for WSC

Species

Cultivar Within Species

Stage of Growth

Time of Day

Climate

Drought

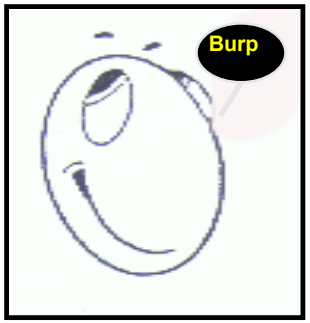
Frost Events

N Fertilization

Rain

Poor/Extended Wilting Conditions

Management



Lactic Acid,
The "Good Silage" Acid

plant sugars → lactic acid

Water Soluble Carbohydrates (WSC) for Selected Forage Crops

Crop/Species	WSC, % of DM
Corn Silage	10 - 20
Forage Sorghum	10 - 20
Sudan, Sorghum-Sudan, Millet	10 - 15
Rye, Oat, Wheat, Triticale	8 - 12
Ryegrass	8 - 12
Alfalfa	4 - 7
Bermudagrass, Stargrass	2 - 4
Bahiagrass	< 5
Limpograss	< 5
Perennial Peanut	1 - 4

Adesogan and Newman, 2013

WSC and Starch in Rain-Damaged Alfalfa (1.9 inches)

Coblentz and Muck, 2012

Buffering Capacities (mEq/kg DM) for Selected Forage Crops

Crop/Species	Range	Mean
Corn Silage	149-225	185
Timothy	188-342	265
Fall Oat (Headed)	300-349	323
Orchardgrass	247-424	335
Red Clover	. . .	350
Fall Oat (Boot)	360-371	366
Italian Ryegrass	265-589	366
Alfalfa (mid-bloom)	313-482	370
Perennial Ryegrass	257-558	380
Alfalfa (1/10 bloom)	367-508	438
Alfalfa	390-570	472
White Clover	. . .	512

compiled from various sources

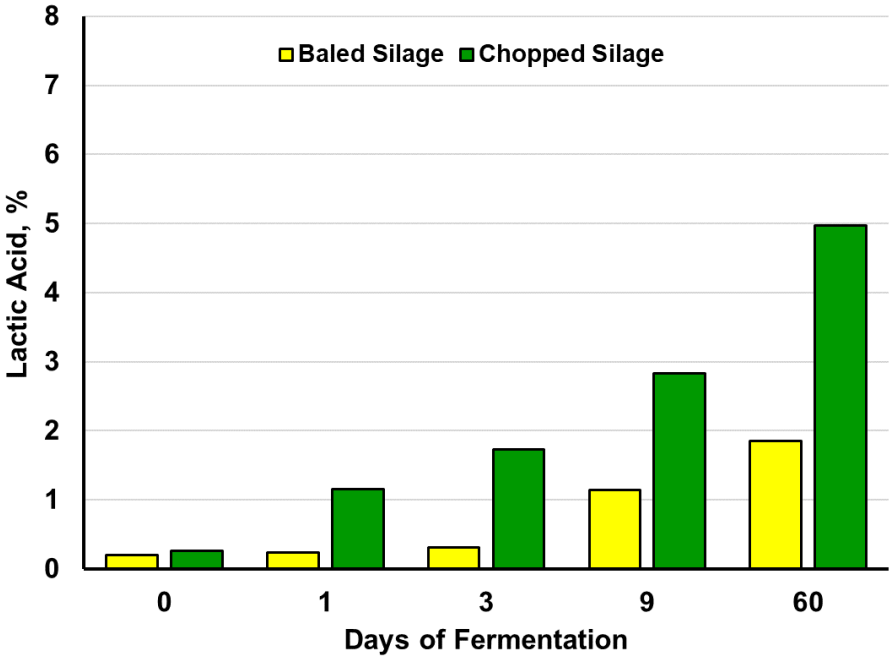
Baled Silage vs. Precision-Chopped Haylage

fermentation within baled silages is restricted by:

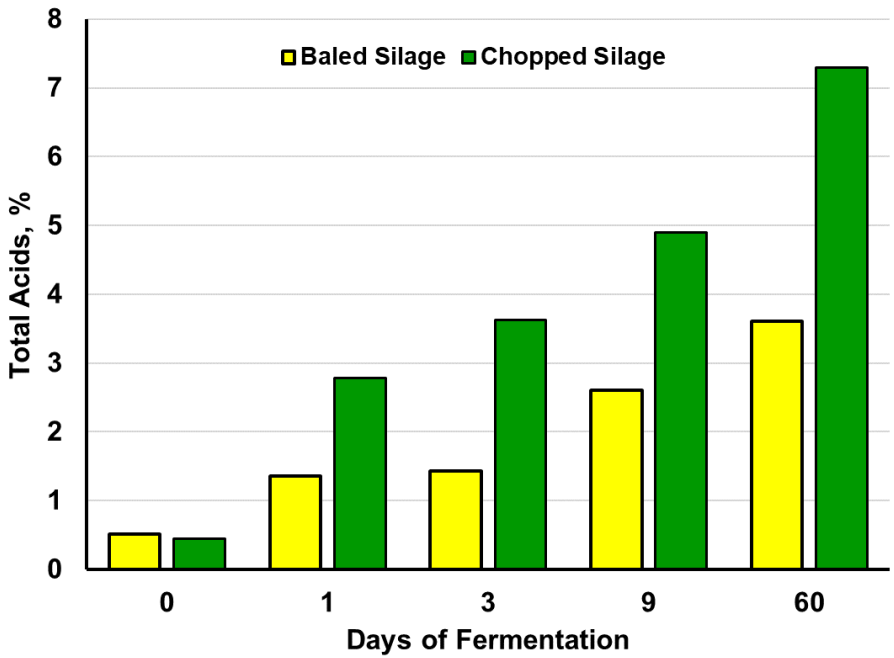
- ***lower moisture concentrations***
- ***lack of chopping action***
- ***reduced DM density (maybe)***

Fermentation Characteristics of Alfalfa Forages Ensiled as Large-Round Bales or as Precision-Chopped Silages[1]

Lactic Acid



Total Fermentation Acids



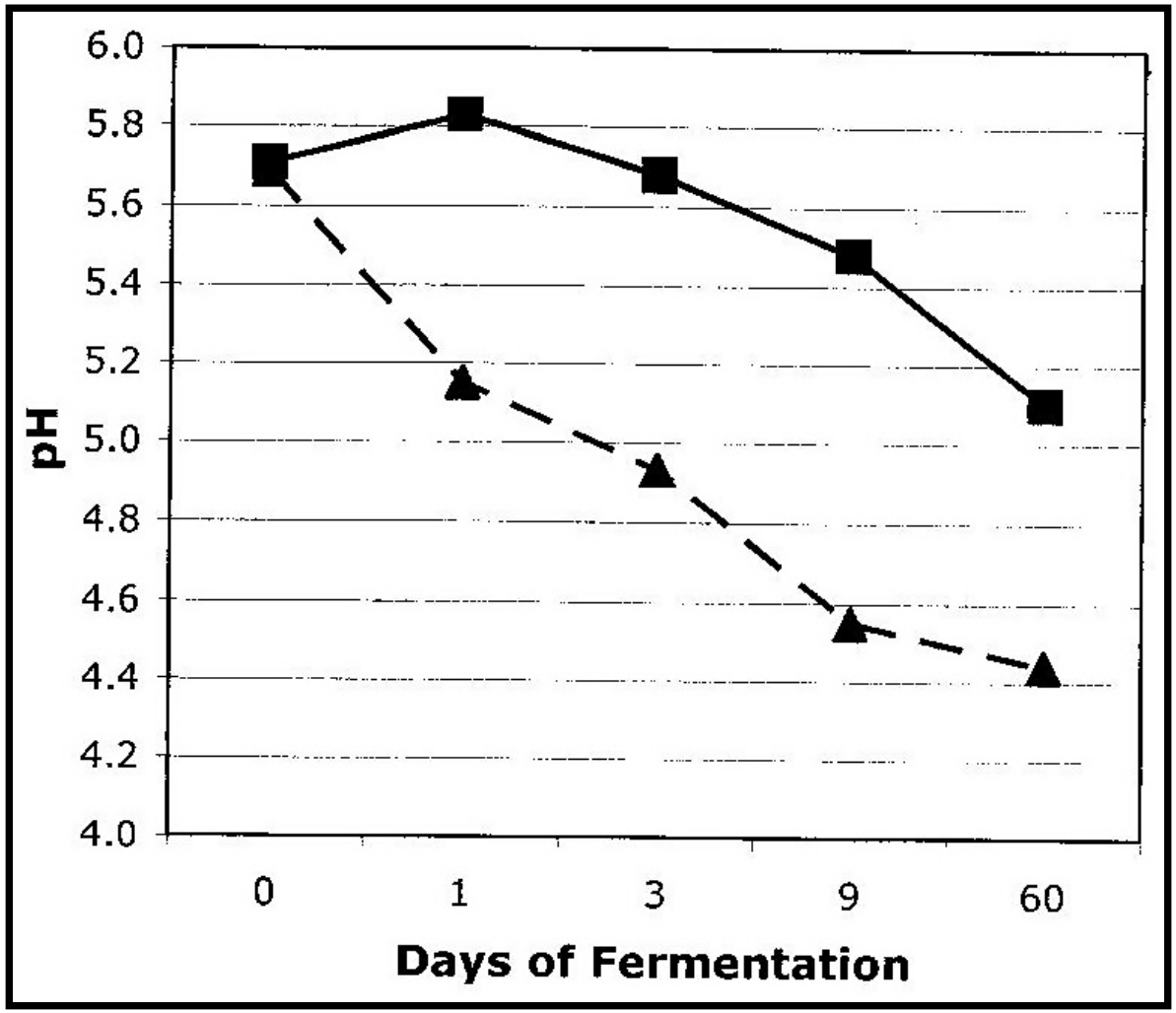
[1] Mean moisture concentration = 61%.

Nicholson et al. (1991)

Baled vs. Precision-Chopped Silage Alfalfa/Grass

■ Baled Silage

▲ Chopped Silage



Muck (2006) – adapted from *Nicholson et al. (1991)*; moisture concentration was 61%

Moisture Management

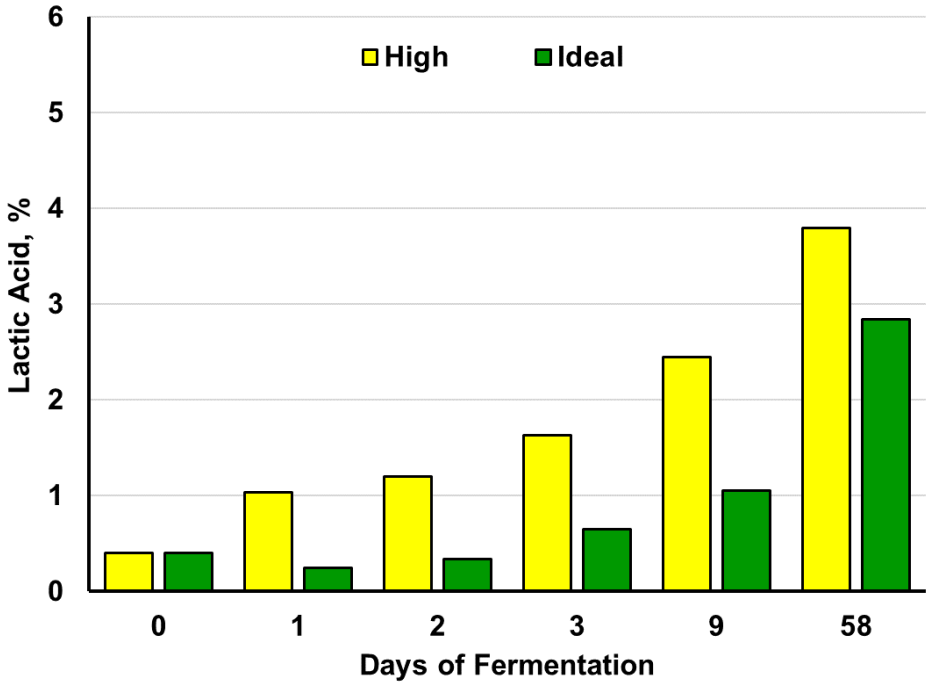
Moisture Management

Generally, baled silage should be packaged at 45 to 55% moisture (Shinners, 2003); the average for the whole field or group of bales should be about 50%.

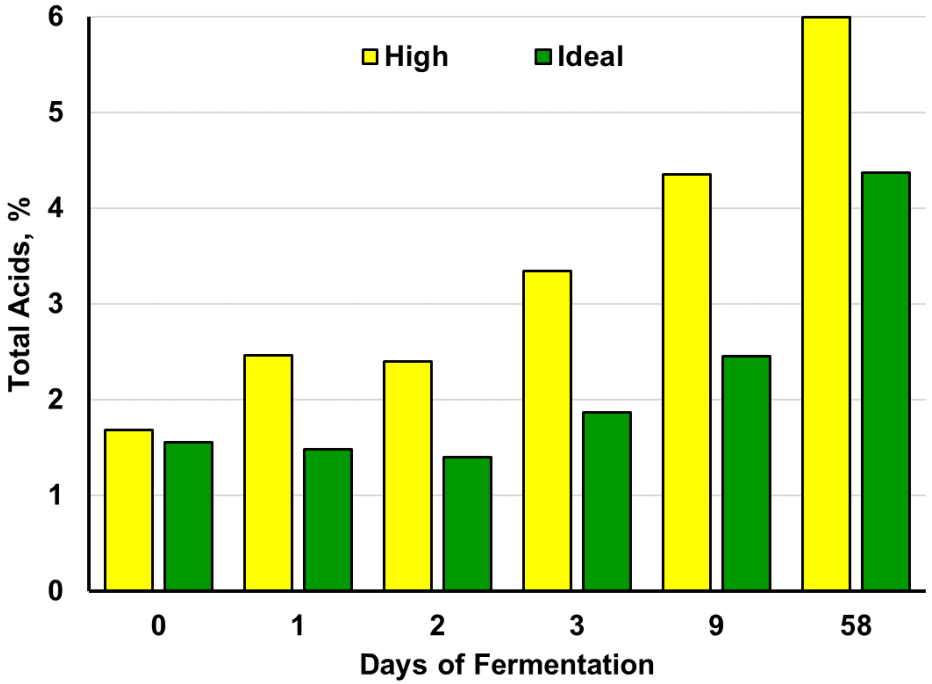
- ***most moisture recommendations for precision-chopped silages are wetter (< 70%)***
- ***production of silage fermentation acids is <u>positively</u> associated with moisture concentration***
- ***as a result, baled silage fermentation is inherently restricted, resulting in a slower fermentation, and a greater (less-acidic) final pH***

Fermentation Characteristics of Alfalfa Ensiled in Large-Round Bales at High (60 to 65%) or Ideal (49 to 54%) Moisture

Lactic Acid

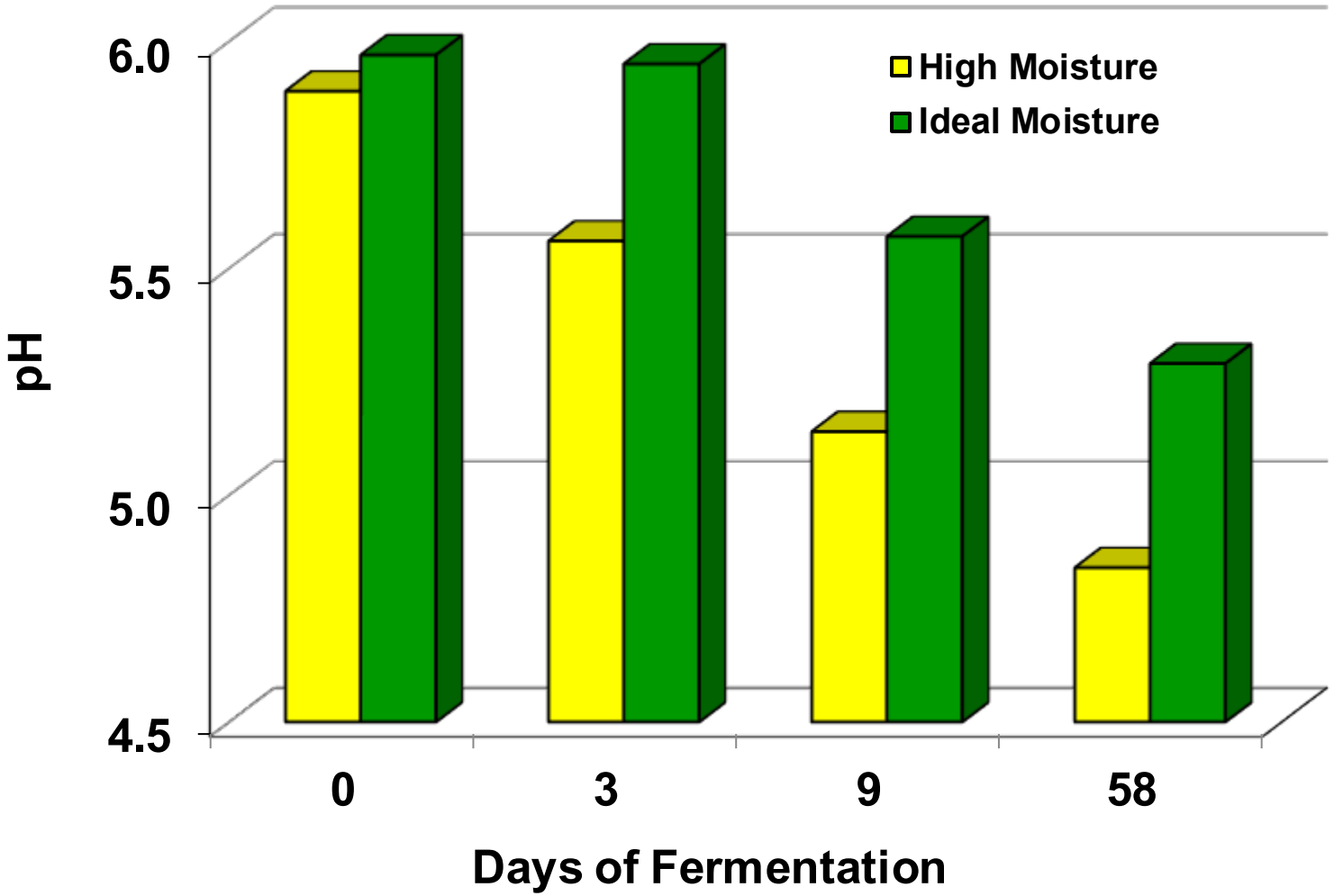


Total Acids



Nicholson et al. (1991)

Fermentation Characteristics of Alfalfa Forages Ensiled in Large-Round Bales at High (60 to 65%) or Ideal (49 to 54%) Moisture



Nicholson et al. (1991)

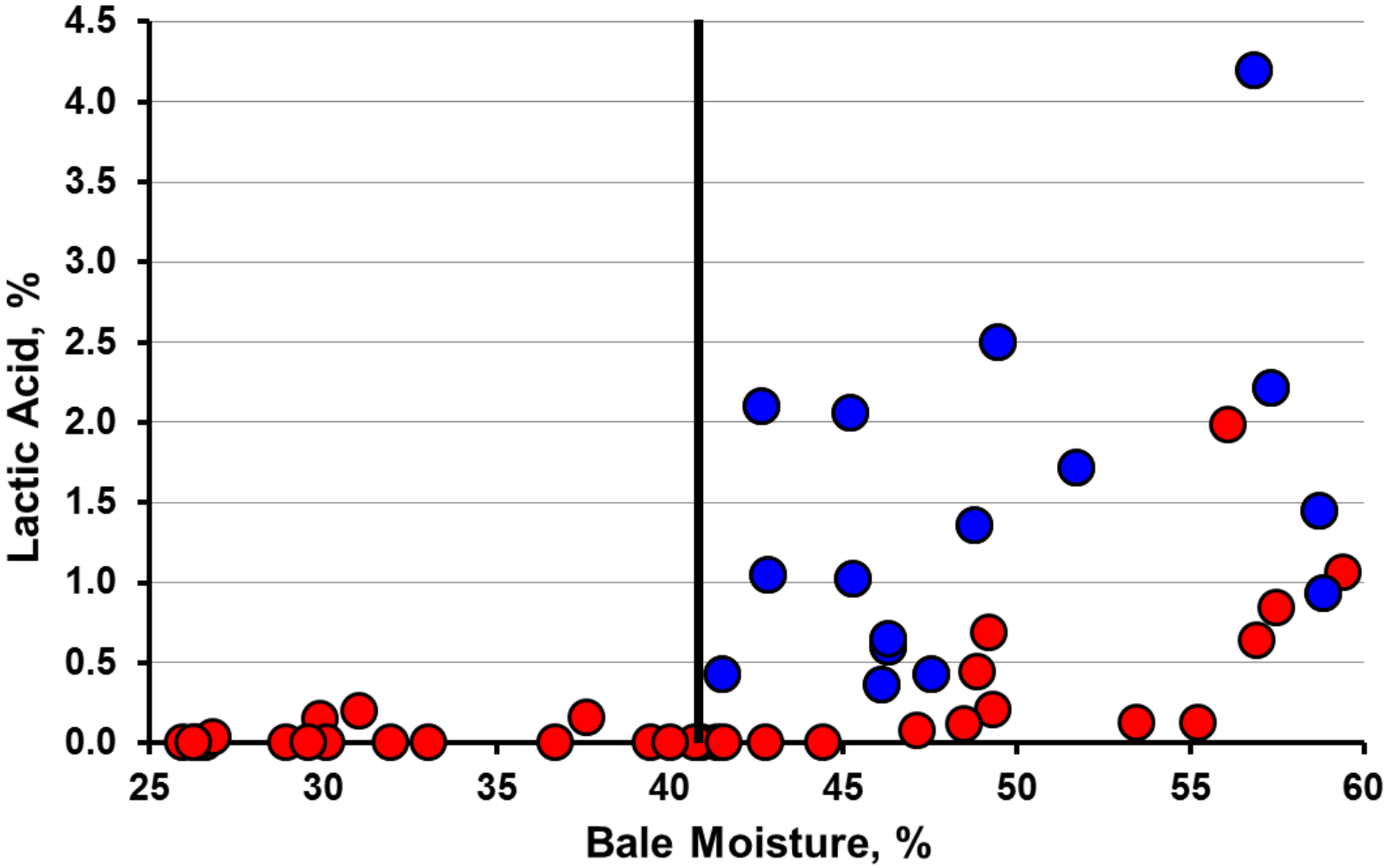
Dry Silages

"A second implication for management is that fermentation (or decreasing pH) is relatively unimportant in producing high-quality dry (> 55% DM) silages."

R.E. Muck [J. Dairy Sci. 71:2992-3002 (1988)]

**** An observational trend (mine) is that producers (generally) are moving towards drier baled silages, placing increased emphasis on excluding air, and less on fermentation.***

Lactic Acid Production in Individual Large-Rectangular Bales of Alfalfa[1]



[1] Red and blue dots represent different harvests.

Coblentz et al. (2014)

Hay and Forage Grower

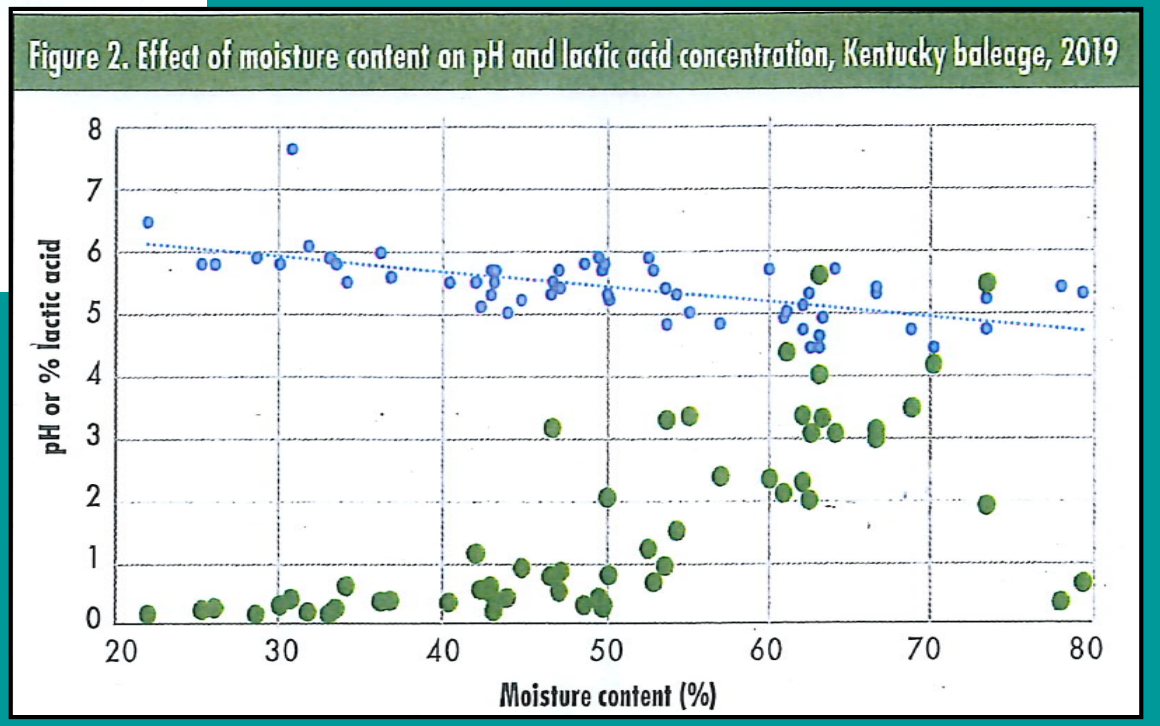
February 2020

Kentucky Producer Survey

Head off baleage feeding issues

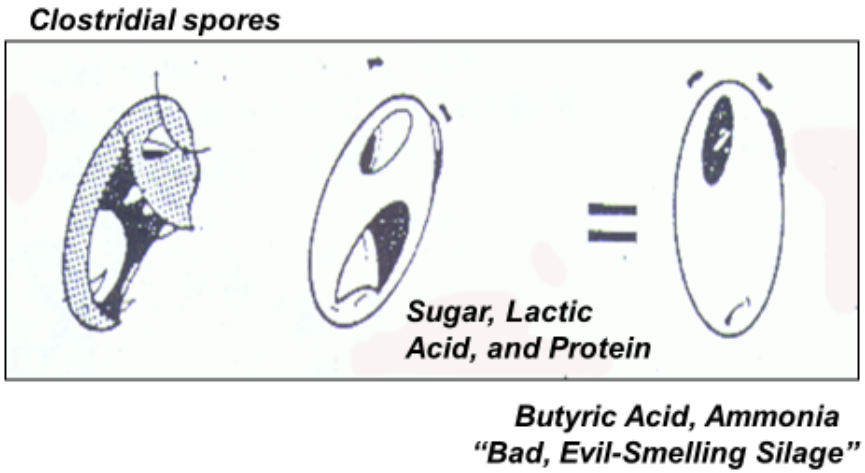
by Jimmy Henning

- Lactic acid
- pH



So Why Not Bale Forage Wetter?

- **Safety**
  - undersized tractors, 4 x 4-ft (1.2 x 1.2-m) bale can weigh 1500 lbs (680 kg)
- **Equipment/Baler**
  - most balers handle drier forages better than wet ones
- **Clostridial Fermentations***



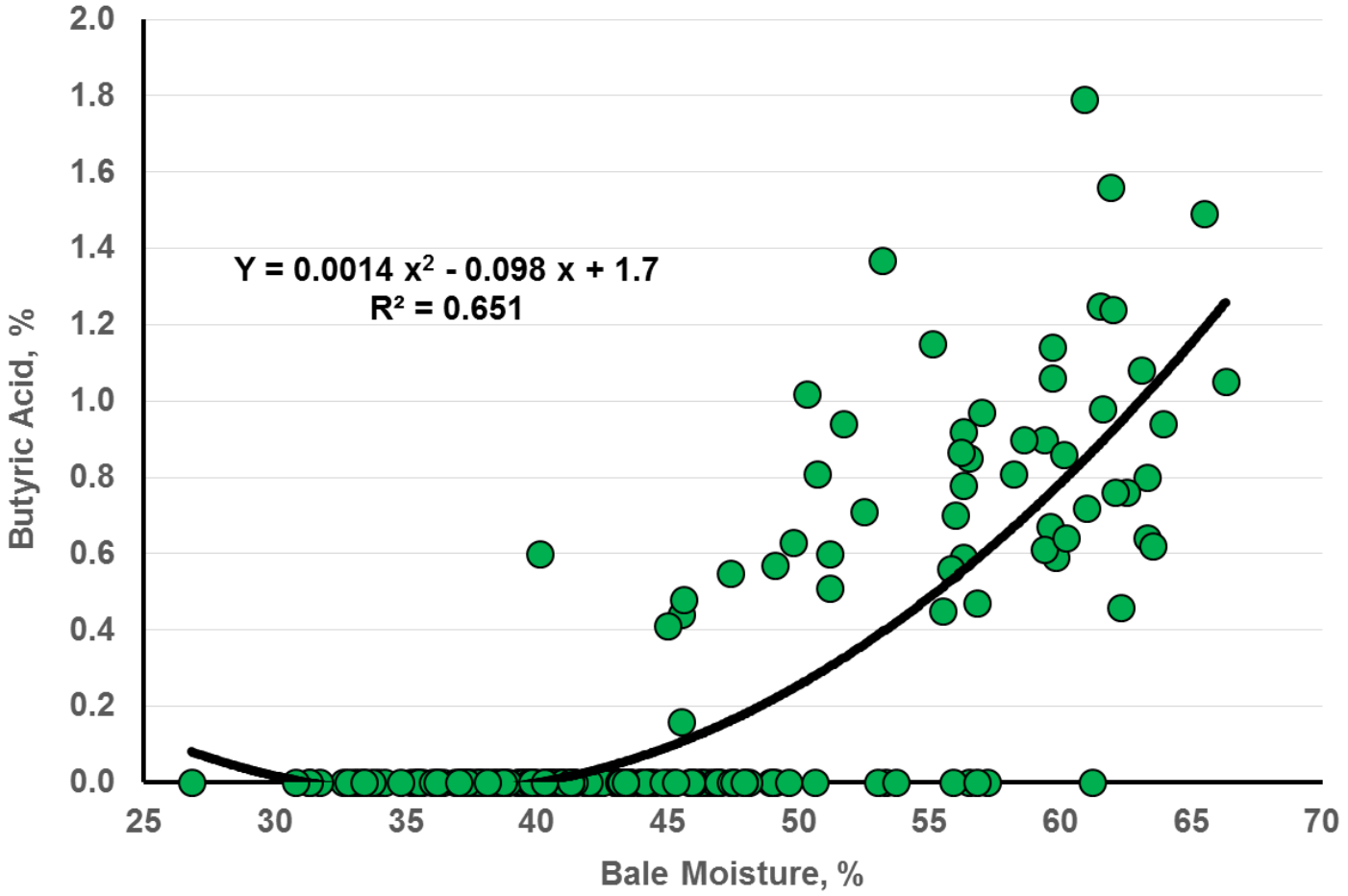
Clostridial Fermentations
(Products: Butyric Acid, Ammonia)

Some Characteristics of High-Risk Forages

- high moisture concentration
- direct cut forages
- immature, rapidly growing forages
- highly contaminated with dirt, manure, or both
- low sugar
- high buffering capacity
- high protein
- leguminous
- non-homogenous forages (baled silage)

The best prevention is to wilt the forage prior to ensiling! As such, baled silage is <u>generally</u> at low risk.

Butyric Acid in Alfalfa Round Bale Silage



adapted from several studies

Head off baleage feeding issues

by Jimmy Henning

- Butyric acid

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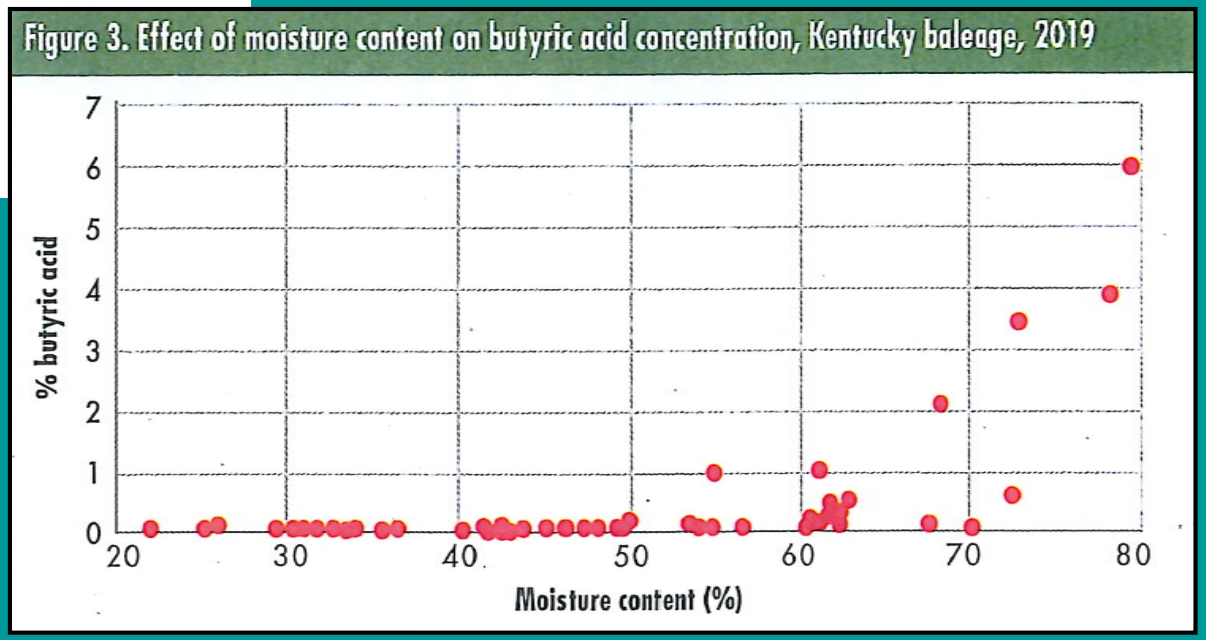
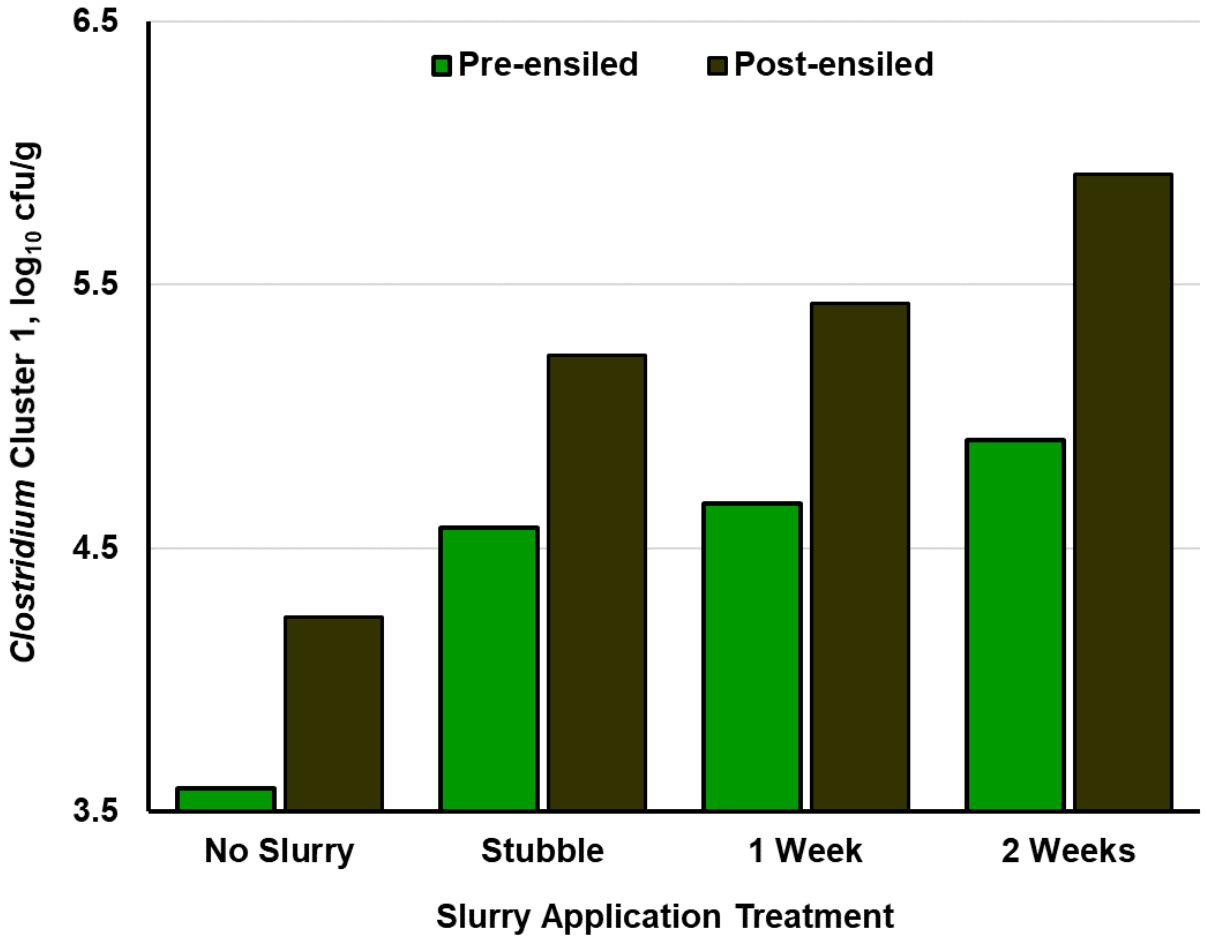


Clostridial Counts (log_{10} genomic copies/g) for Pre-Ensiled and Post-Ensiled Alfalfa Forages Following Applications of Dairy Slurry Using qPCR Methods[1]

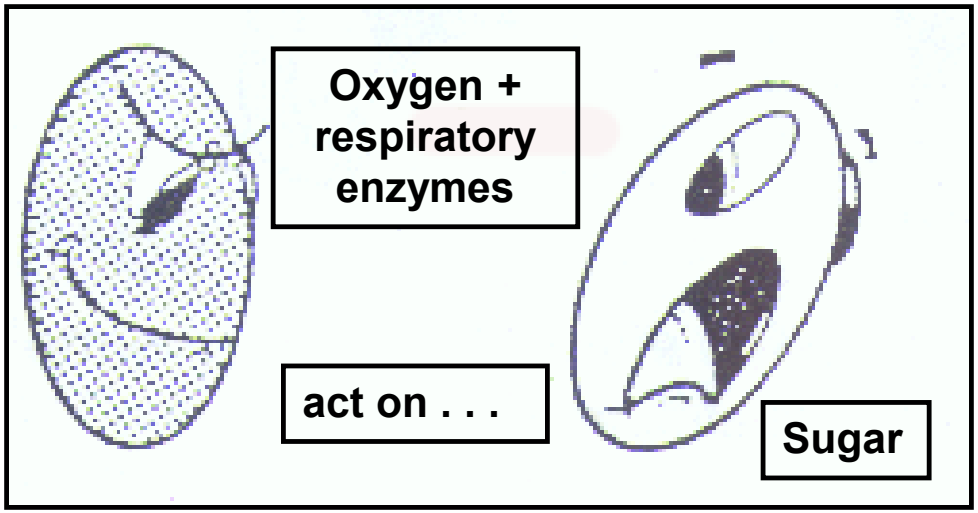


[1] *Clostridium tyrobutyricum* was not detected in dairy slurry or any forage/silage.

Coblentz et al. (2014)

Elimination of Air

Consequences of Air Access! (Mostly Before Sealing)

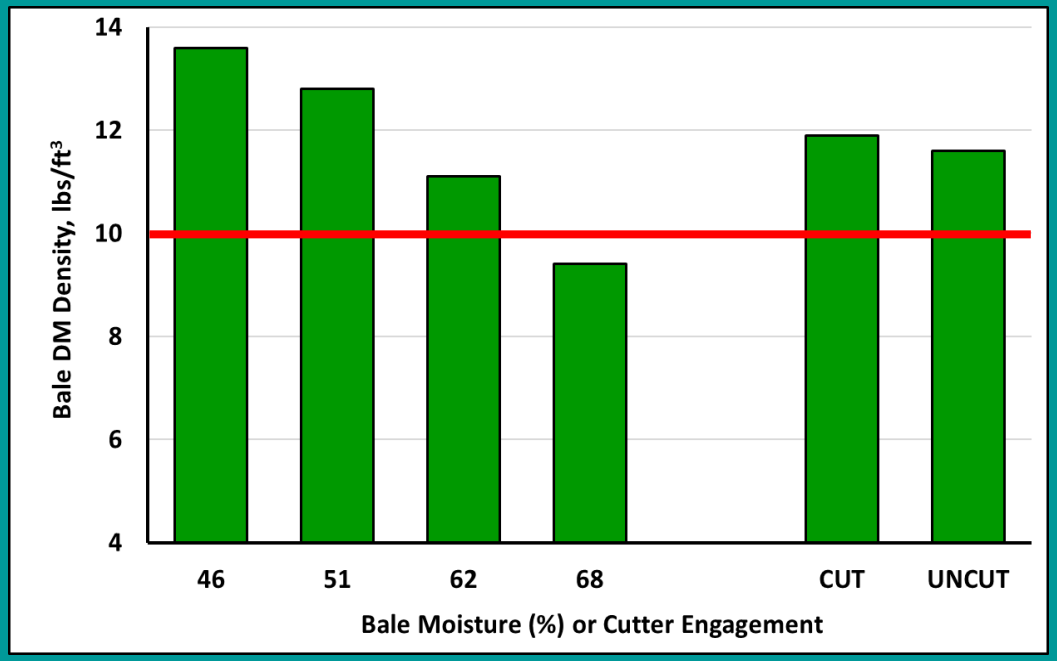


- *respiration of plant sugars to CO_2, water, and heat*
- *reduces pool of fermentable sugars*
- *dry matter loss*
- *increases (indirectly) fiber content of the silage*
- *decreases energy density of silage*

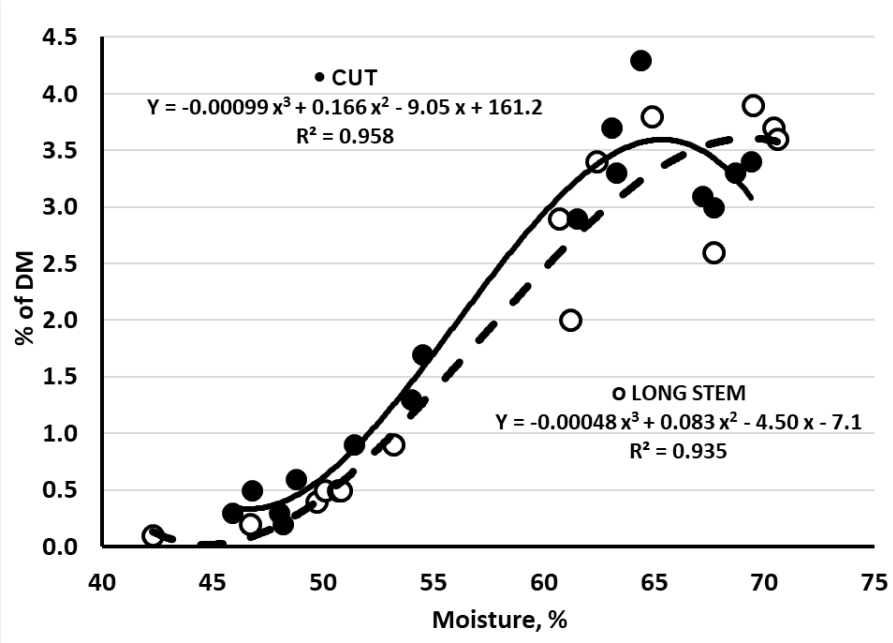
bulk density >10 lbs DM/ft^3

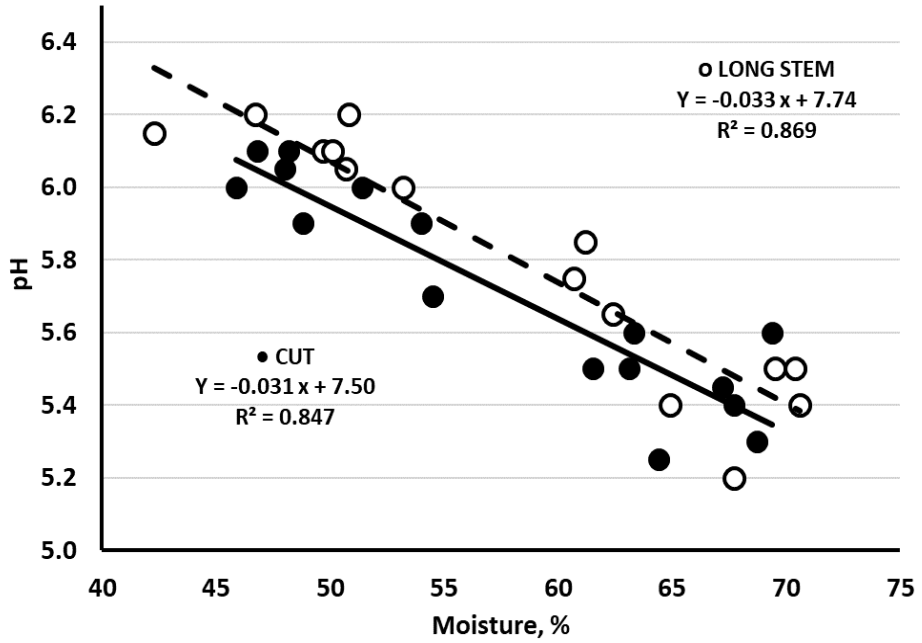
- *reduce ground speed*
- *thinner windrows will increase revolutions/bale*
- *manage moisture appropriately (≈ 50%)*
- **maintain constant bale size*
- *baler/operator experience*

Coblentz and Akins, 2019;
5.5 mph constant ground speed



Bale-Cutting Effects: Long-Stem vs. Cut Baled Alfalfa/Grass Silages





Lactic Acid

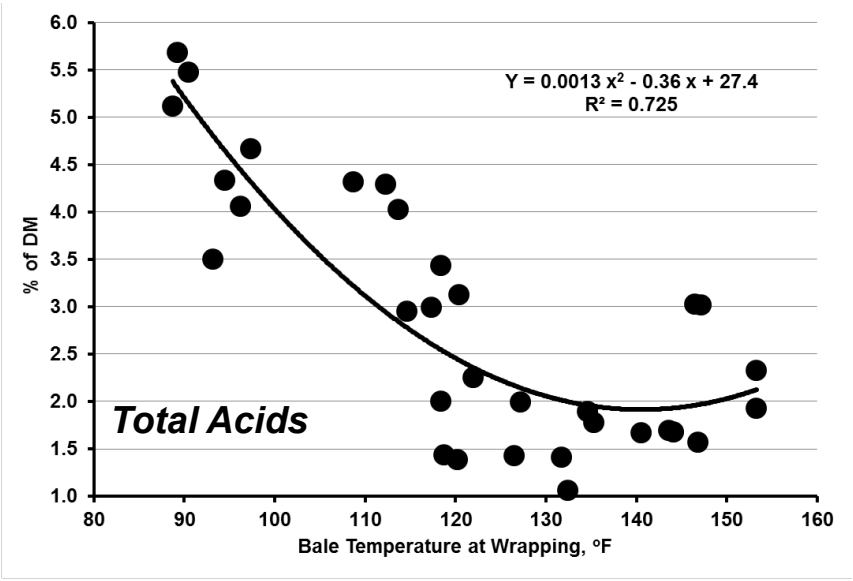
Final pH

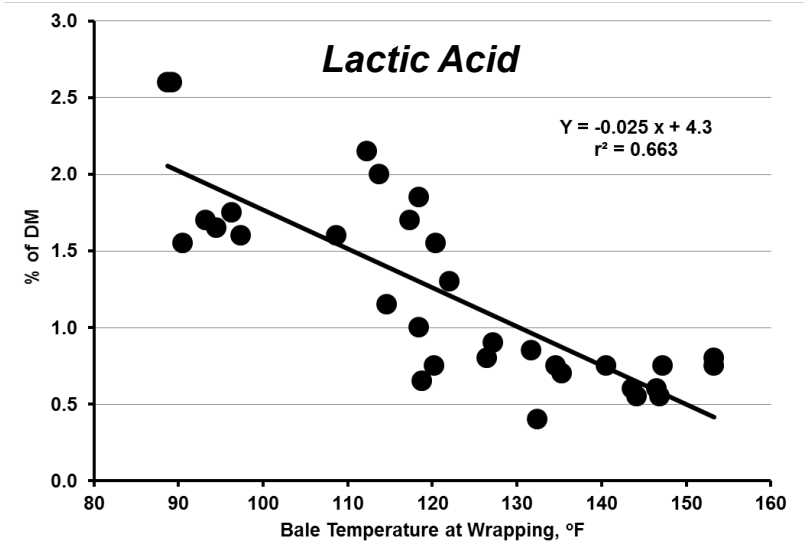
Coblentz and Akins (2019)

Sealing the Bale

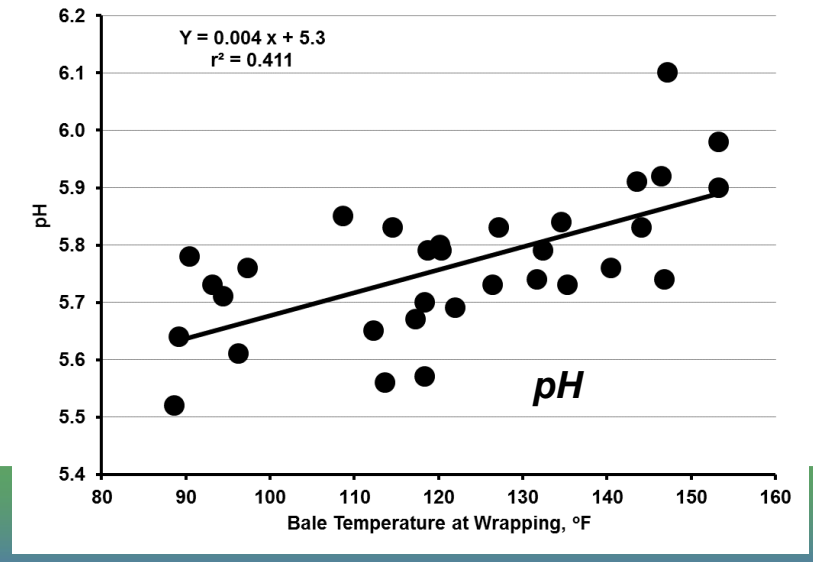
- *wrap as quickly as possible after baling (within 2 hours is ideal; minimal damage likely within 24 hours)*
- *use (at least) four layers (1 mil or 25 microns) of stretched plastic (at least 6 or 8 for long-term storage and/or in southern states)*
- *storage site selection/maintenance is important*
- *do not puncture plastic - isolate from cattle, pets, and vermin*
- *patch holes with appropriate tape*

Fermentation Characteristics of Alfalfa Ensiled in Large-Round Bales as Affected by Wrapping Delays





Initial Bale Moisture = 59.1%



Coblentz et al. (2016)

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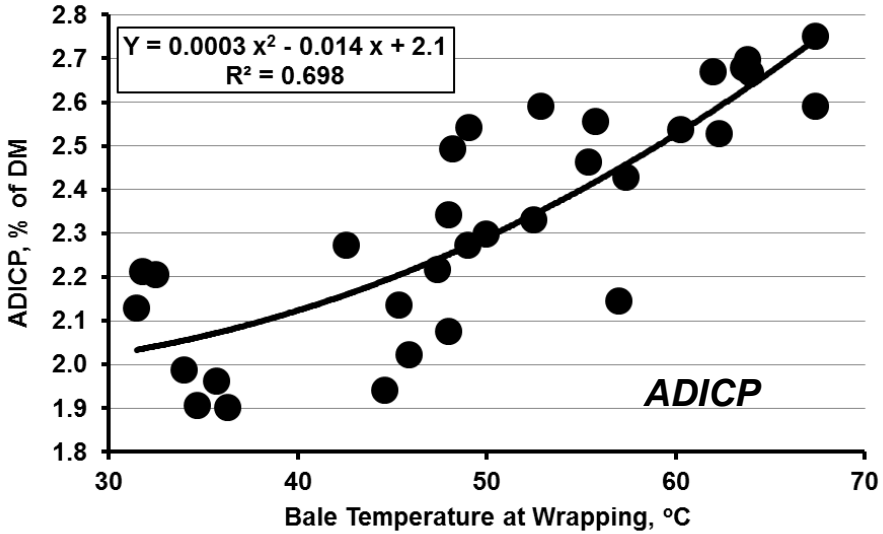
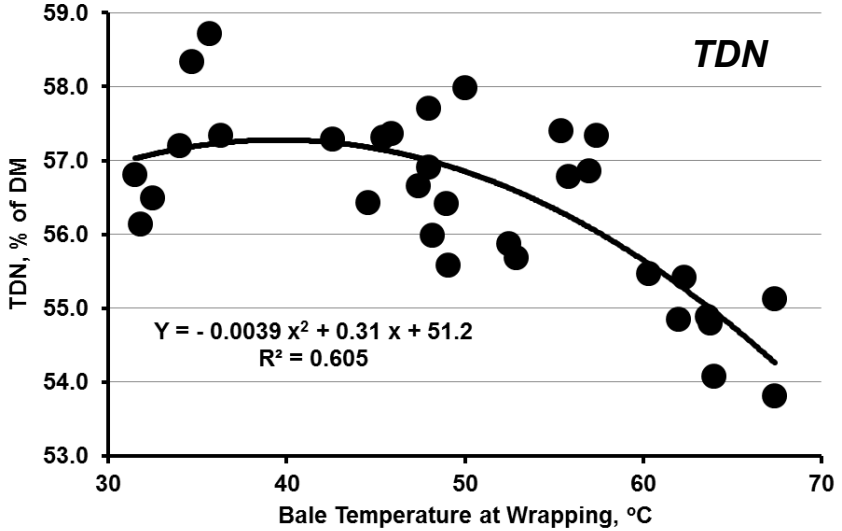




Initial Bale Moisture = 59.1%

**** While bales should be wrapped as soon as possible, this study suggests damage within the first 24 hours is relatively minor.***

Coblentz et al. (2016)

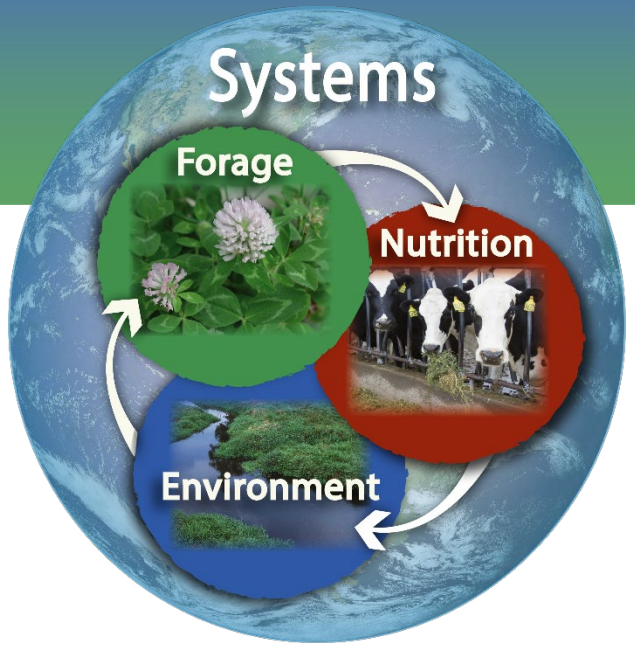
Summary

- *Most principles of management for conventional chopped silage still apply to baled silage.*
- *Moisture management is important; generally, baled silage techniques will accommodate drier (< 50%) forages better than relatively wet (> 60%) ones.*
- *Fermentation occurs at a slower rate for baled silage because forages are:*
  - *ensiled on a whole-plant basis*
  - *usually drier and less dense than chopped silages*

Summary

- *As a result, producers should diligently address other management details:*
  - *maximize bale density (> 162 kg DM/m^3 or 10 lbs DM/ft^3)*
  - *consider an inoculant (LAB), especially if forage is damaged, manure has been applied, or if bale moisture approaches 60% (alfalfa); grasses are a bit more forgiving*
  - *apply plastic wrap promptly and properly (damage is likely relatively minor up to 24 hours)*
  - *protect the product (4 plastic layers is the minimum, 6 or 8 are better)*
- *General observations suggest that forages are baled at increasingly lower moisture concentrations, placing additional emphasis on exclusion of air.*

QUESTIONS?



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