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**U.S. Dairy Forage
Research Center**

Current Understanding of Techniques to Improve Baled Silage

Kevin Panke-Buisse, Matt Akins, Wayne Coblentz (retired)



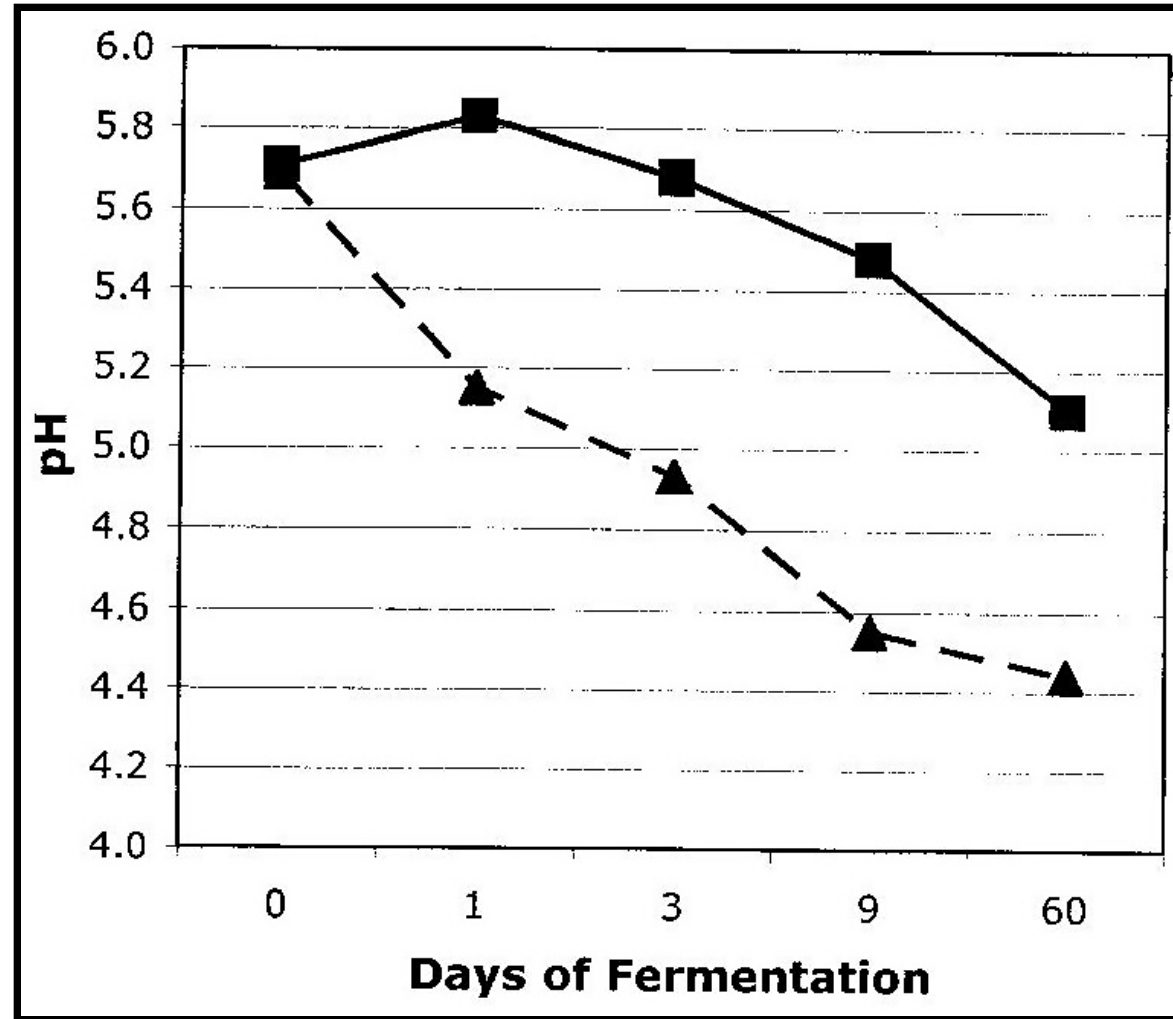
Baled Silage vs. Precision-Chopped Haylage



- **most principles of silage management are similar**
- **however, fermentation within baled silages is restricted by:**
 - **lack of chopping action**
 - **lower moisture concentrations**
 - **reduced DM density (maybe)**

Baled vs. Precision-Chopped Silage Alfalfa/Grass

■ Baled Silage
▲ Chopped Silage



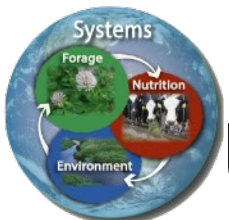
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Muck (2006) – adapted from Nicholson et al. (1991); mean moisture concentration was 61%

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Recent Baled Silage Research Topics

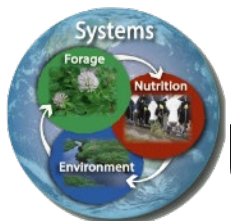
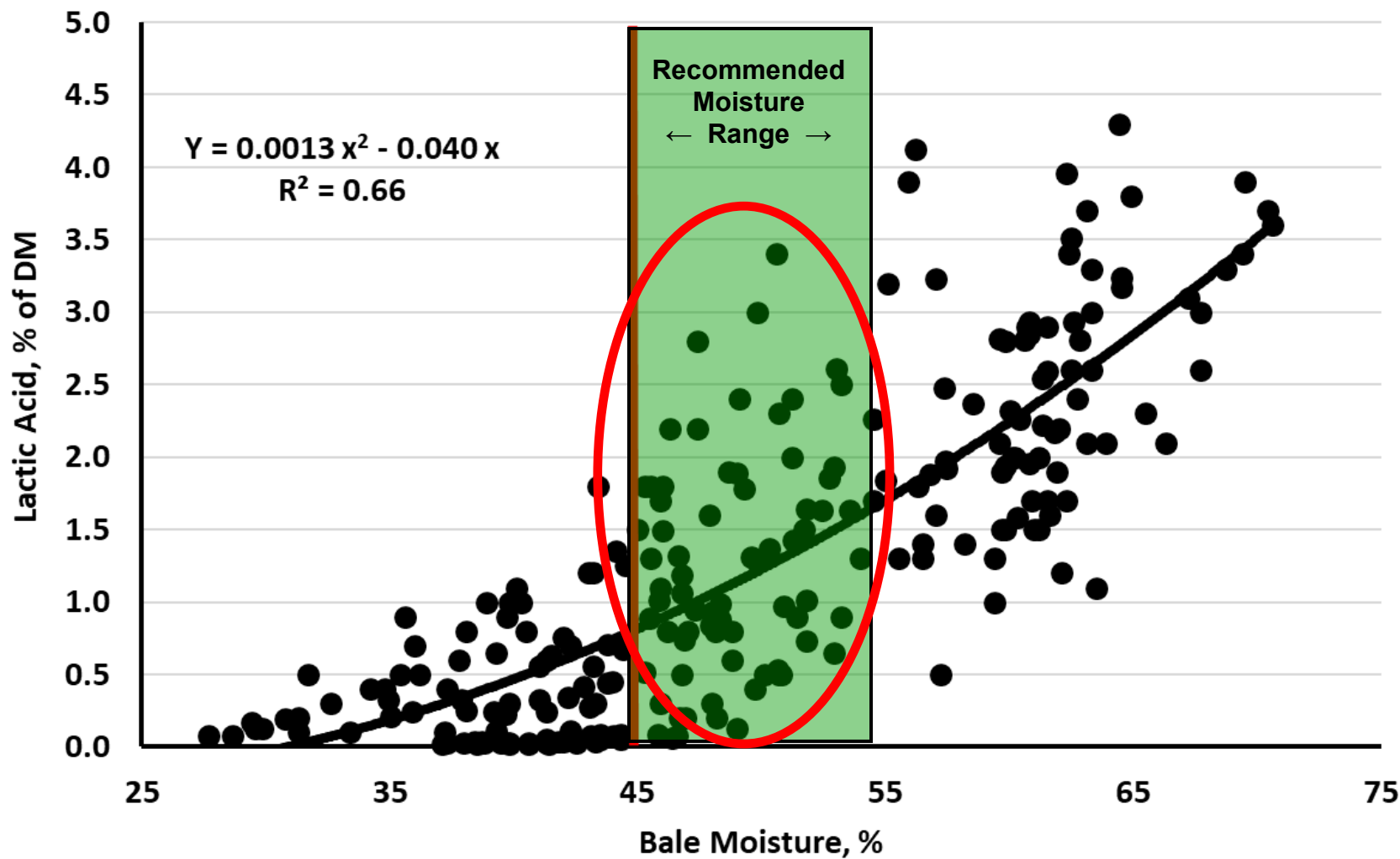
- ***moisture effects (dry silage)***
- ***aerobic stability/preservatives***
- ***wrapping delays***
- ***silage fermentation in cold weather***



Moisture Management



Lactic Acid Production in 243 Round-Baled Silages at Marshfield, WI¹



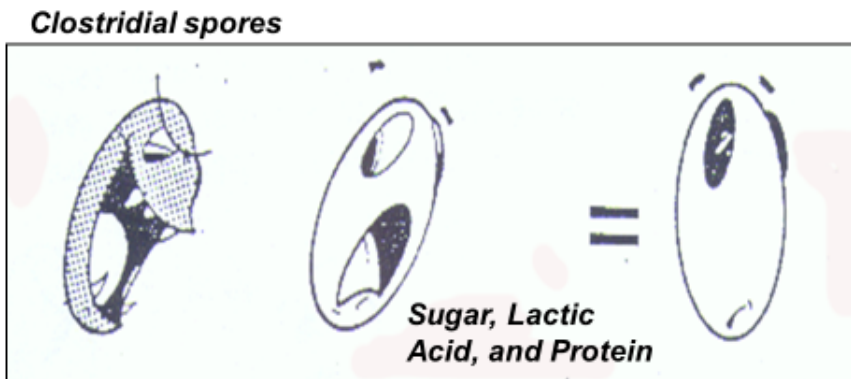
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So Why Not Bale Forage Wetter?

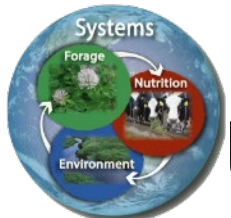
- **Safety**
 - *undersized tractors, 4 x 4-ft (1.2 x 1.2-m) bale can weigh 1500 lbs (680 kg)*
- **Equipment/Baler**
 - *most balers handle drier forages better than wet ones*
- **Clostridial Fermentation**



*Butyric Acid, Ammonia
"Bad, Evil-Smelling Silage"*



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Dry Silages



“An 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 is that producers are moving towards drier baled silages, placing emphasis on excluding air with plastic wrap, and less on fermentation.***

Question: What About Situations When Dry Hay Is Desired, But You Can't Get It Quite Dry Enough?

Pre-storage Characteristic	-- Preservative ¹ --		-- Plastic Wrap ² --		SEM
	Yes	No	Yes	No	
Diameter, ft	4.9	4.9	4.9	4.9	0.02
Volume, ft ³	73.9	73.2	73.6	73.6	0.54
Wet Weight, lbs	1184	1160	1166	1177	17.2
Moisture, %	26.2	25.4	25.9	25.8	0.41
Dry Weight, lbs	873	864	864	873	11.9
DM Density, lbs/ft ³	11.8	11.8	11.7	11.9	0.17
WSC, %	8.17	8.46	8.33	8.30	0.171

¹ Propionic-acid-based preservative applied at 0.27 ± 0.025% of wet bale weight.

² Bales wrapped individually in 7 layers of plastic film.

³ Project supported by the National Alfalfa Forage Alliance US Alfalfa Farmer Research Initiative.

Coblentz et al. (2021)



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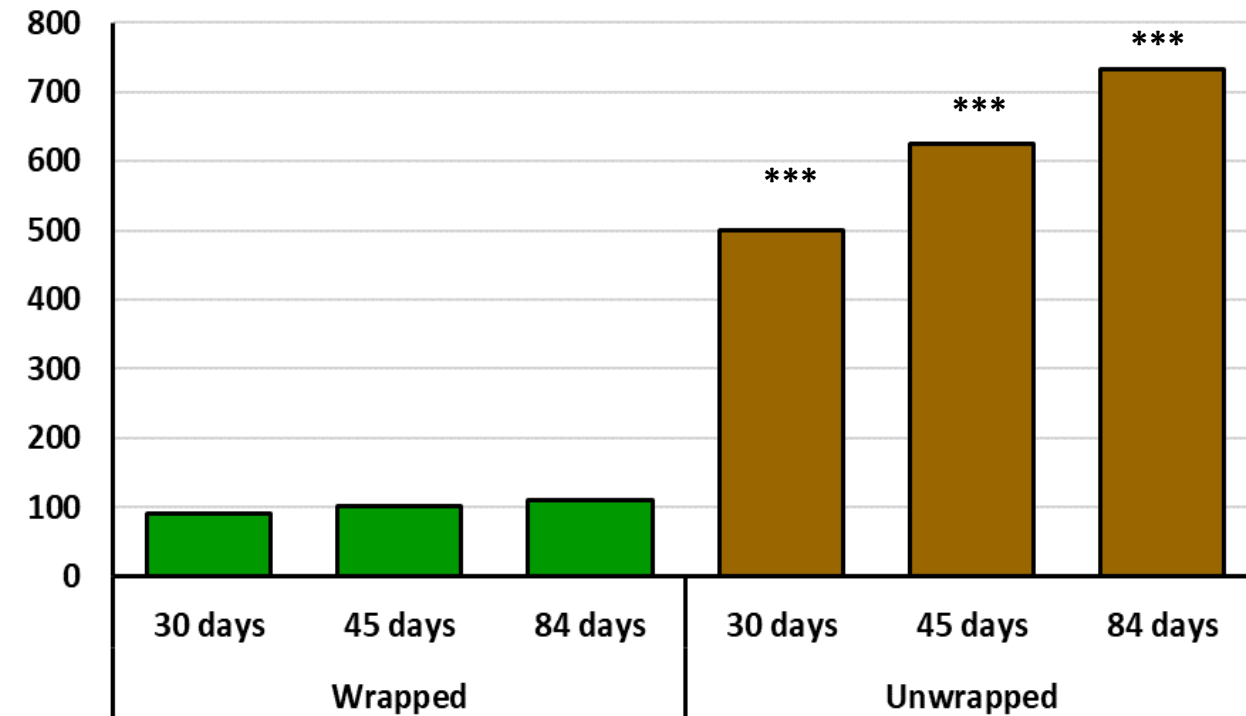


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Question: What About Situations When Dry Hay Is Desired, But You Can't Get It Quite Dry Enough?

All Bales

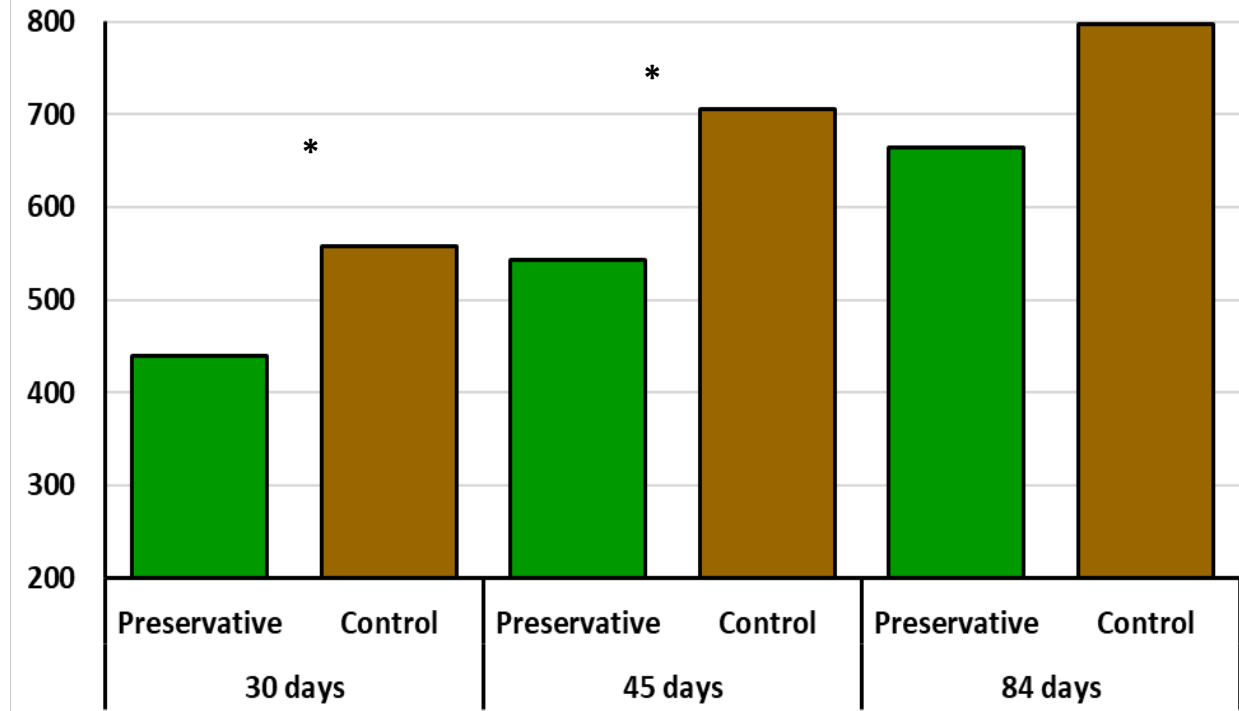
Heating Degree Days > 30°C



Unwrapped Bales Only

Heating Degree Days > 30°C

$P = 0.15$



* $P < 0.05$

*** $P < 0.001$

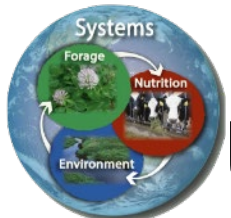
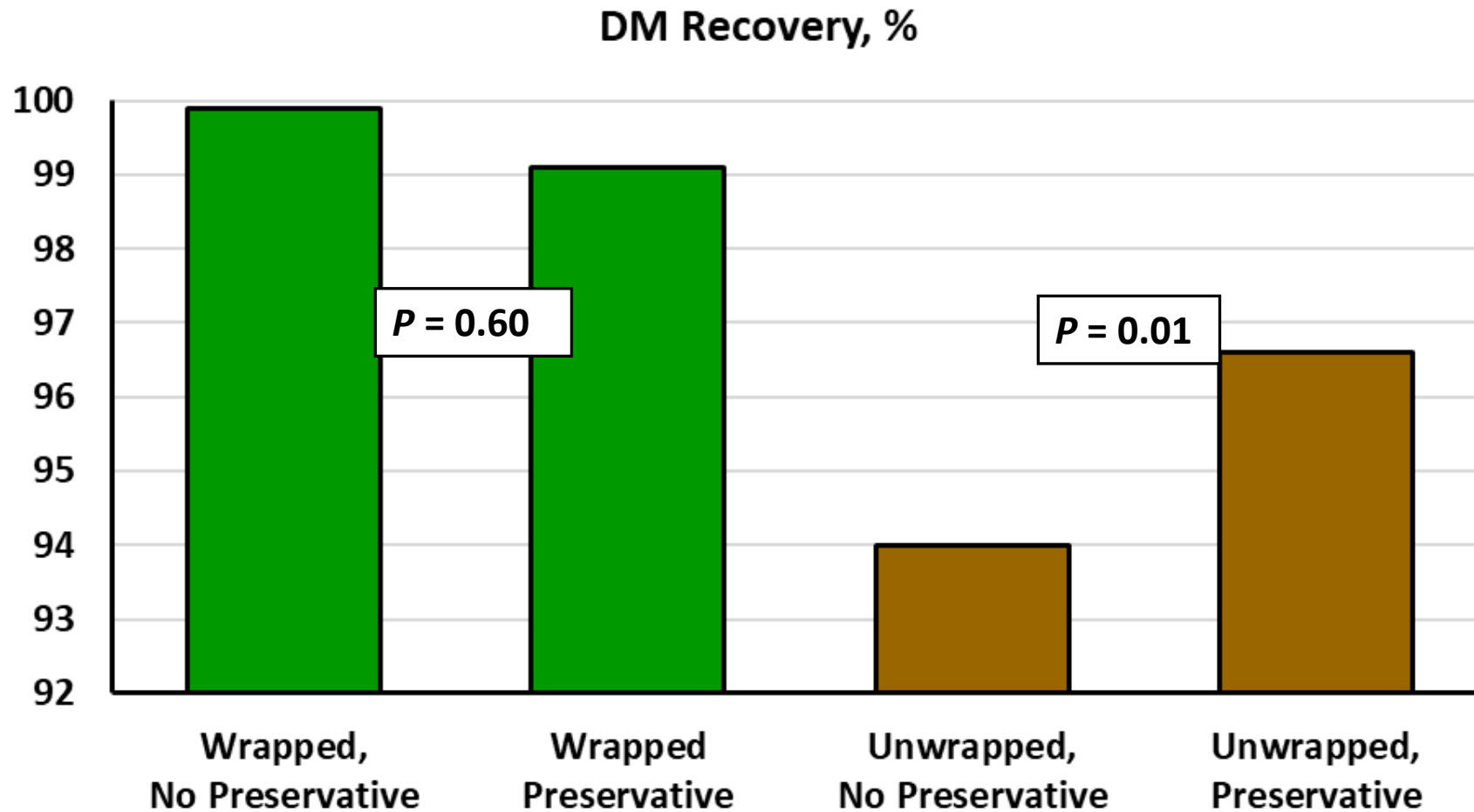
Coblentz et al. (2021)



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Question: What About Situations When Dry Hay Is Desired, But You Can't Get It Quite Dry Enough?



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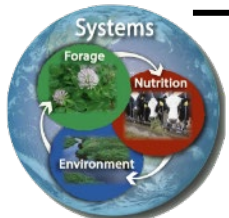
Coblentz et al. (2021)



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Question: What About Situations When Dry Hay Is Desired, But You Can't Get It Quite Dry Enough?

Item	Preservative	No Preservative	SEM	<i>P</i> > <i>F</i>
Number Wrapped Bales	8	8	...	...
Moisture, %	26.0	24.6	0.78	0.170
pH	5.84	5.95	0.020	0.007
WSC, %	7.74	7.66	0.233	0.793
Lactic Acid, %	0.34	0.30	0.023	0.124
Acetic Acid, %	0.32	0.29	0.021	0.336
Total Acids, %	1.01	0.94	0.051	0.231
2,3 butanediol	0.41	0.25	0.009	<0.001
Total Alcohols, %	0.71	0.50	0.019	< 0.001



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Coblentz et al. (2021)



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Aerobic Stability/Preservatives



Common Question:

Silage is perishable. If I want to sell exposed bales, or feed them at some distance from the storage site where individual bale transport is inefficient, how long are they stable in air?

Use of Propionic-Acid Based Preservatives to Improve Aerobic Stability of Alfalfa-Grass Silages¹

Treatment	pH	WSC, %	Lactic Acid, %	Acetic Acid, %	Total Acids, %
Application Rate, % of wet bale weight					
Control	5.54	5.13	1.25	0.25	1.84
0.13	5.58	6.25	0.91	0.19	1.24
0.44	5.49	6.19	1.00	0.20	1.34
0.80	5.45	6.42	0.85	0.15	1.09
Linear (P > F)	0.107	0.010	0.245	0.156	0.107
Moisture					
Ideal	5.36 b	5.38 b	1.49 a	0.29 a	2.04 a
Dry	5.68 a	6.62 a	0.52 b	0.11 b	0.71 b

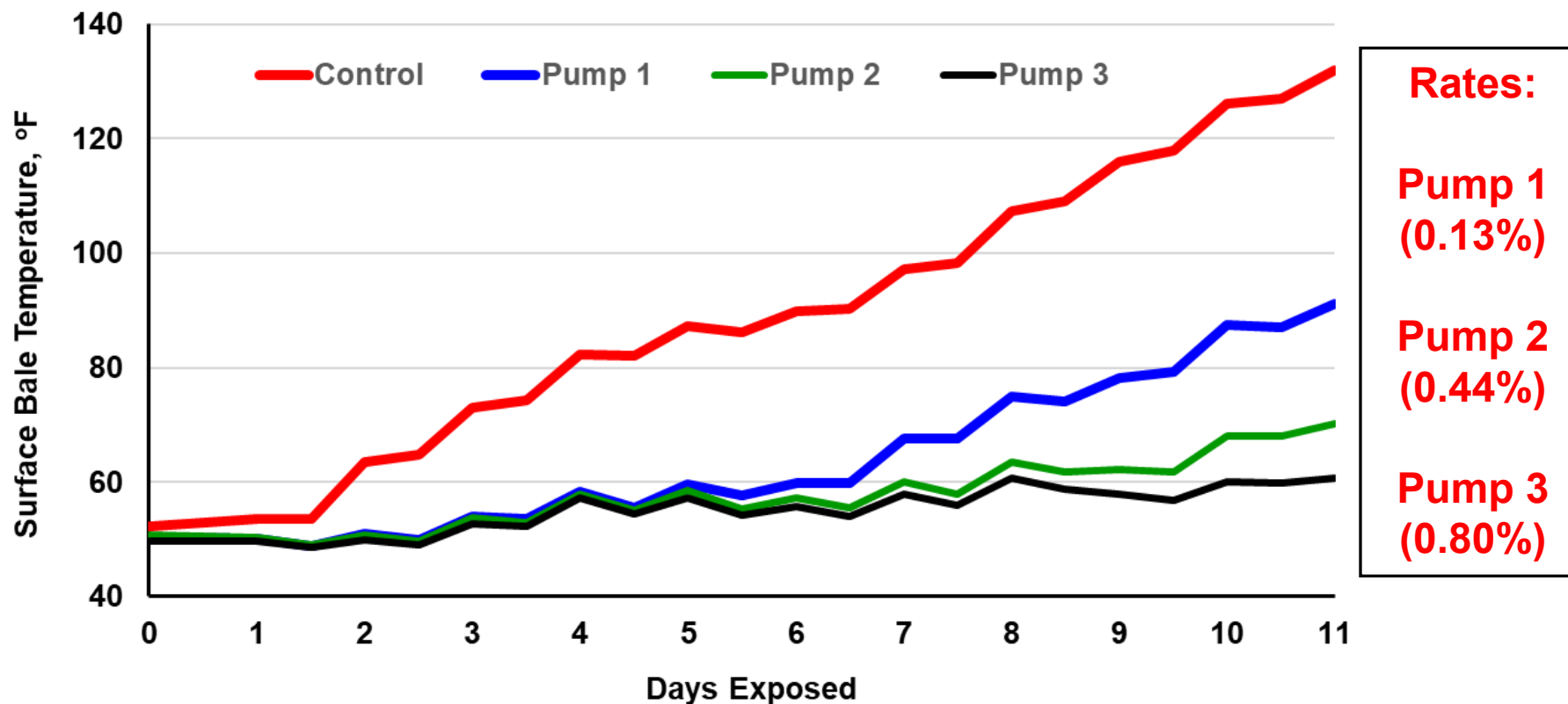
¹ ***Alfalfa/grass forages were ensiled at 52 or 44% moisture and stored for 242 days.***

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Use of Propionic-Acid Based Preservatives to Improve Aerobic Stability of Alfalfa-Grass Silages¹



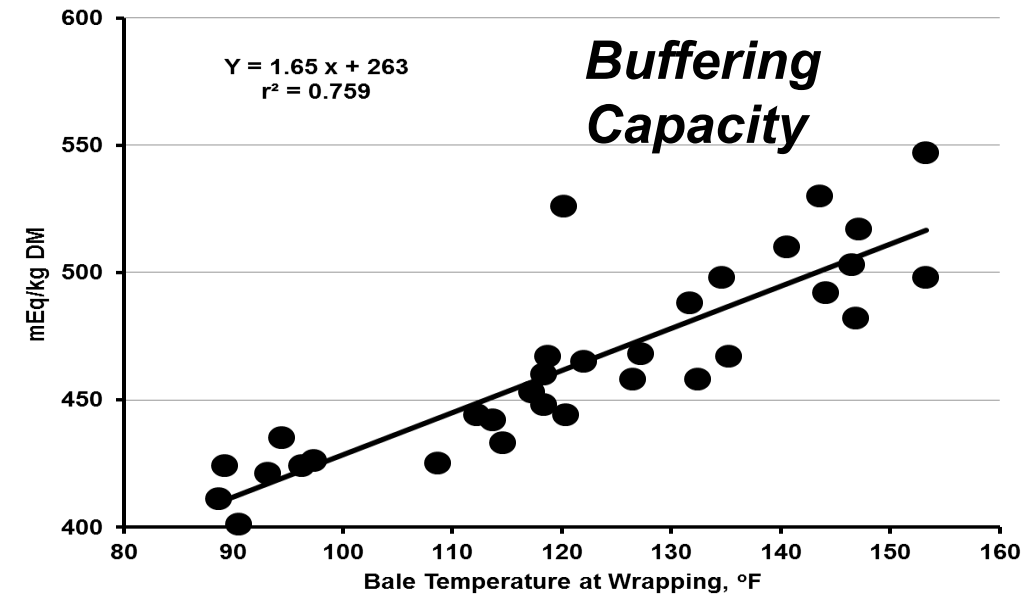
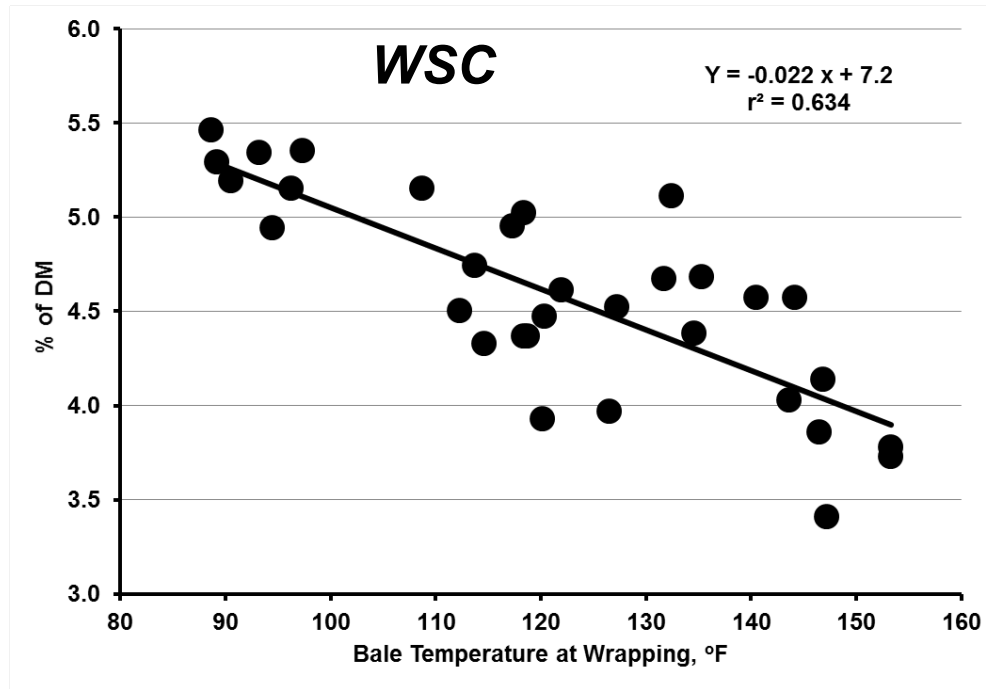
¹ Alfalfa/grass forages were ensiled at 52 or 44% moisture and stored for 242 days. Bales were then exposed for 11 days (May) when the mean maximum air temperature was 57.6°F.



Wrapping Delays

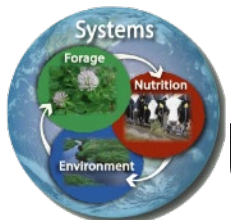
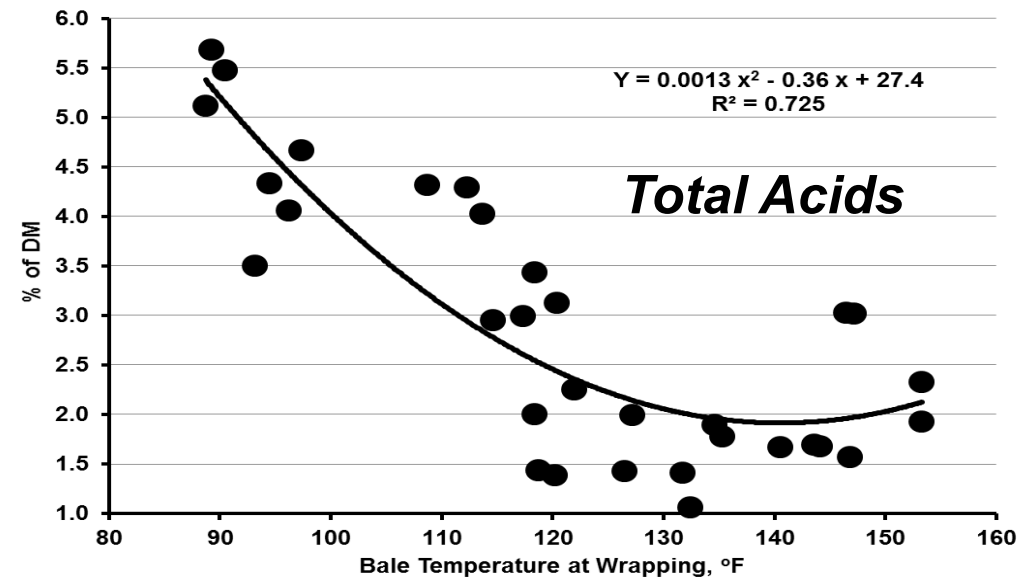


Fermentation Characteristics of Alfalfa Ensiled in Large-Round Bales as Affected by Wrapping Delays



*** Round bales of alfalfa forage wrapped in plastic immediately after baling, or after 1-, 2-, or 3-day delays.**

Coblentz et al. (2016)



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Sealing the Bale



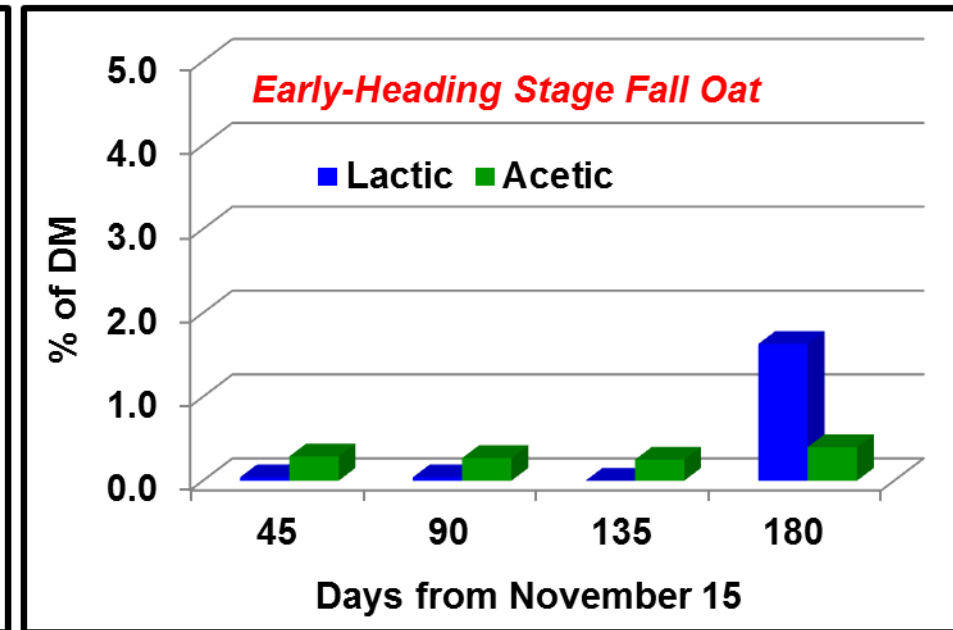
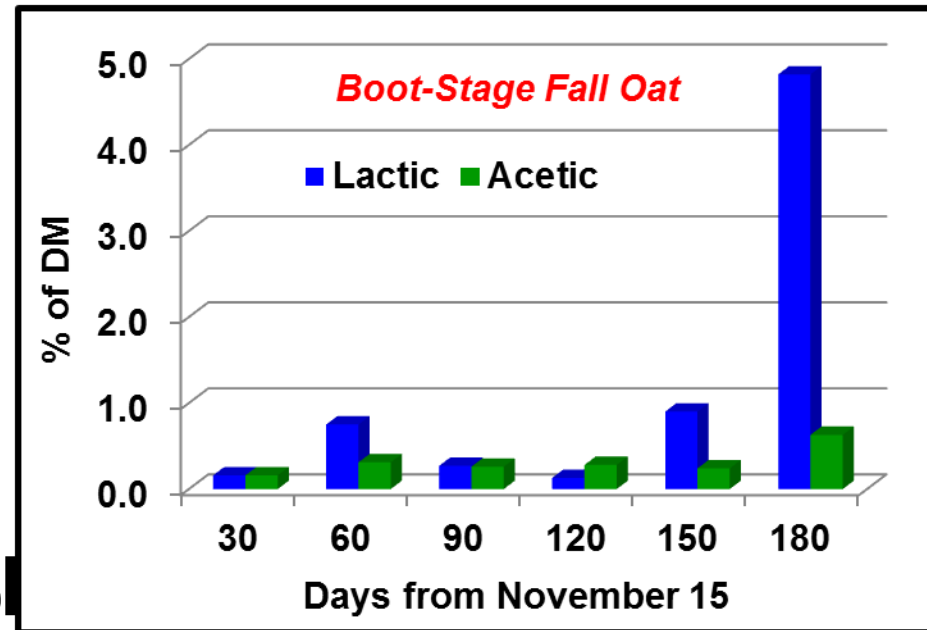
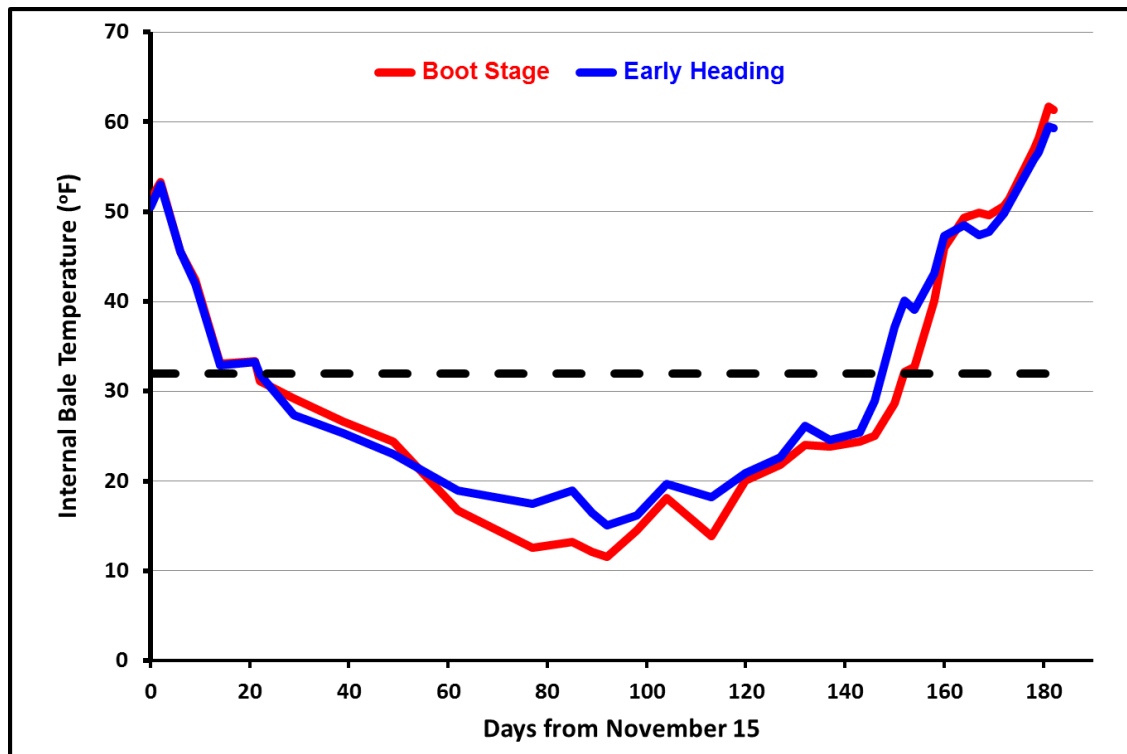
- *wrap as quickly as possible after baling (within 24 hours)*
- *use 6-8 layers (1 mil or 25 microns) of stretched plastic for long term storage*
- *storage site selection/maintenance is important*
- *do not puncture plastic - isolate from cattle, pets, and vermin*
- *patch holes with appropriate tape*

Silage Fermentation in Cold Weather

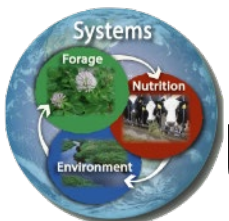


Effects of Cold Weather on Fermentation of Fall-Grown Oat

Coblentz et al. (2015)



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Summary

- 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.
- Producers should diligently address these management details:
 - **maximize bale density (> 162 kg DM/m³ or 10 lbs DM/ft³)**
 - **consider an inoculant (LAB), 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 (within 24 hrs)**
 - **protect the product (6 - 8 plastic wrap layers)**
 - **a preservative may improve stability at ideal moisture but had less effect on dry silage**
 - **dry baled silages should place additional emphasis on exclusion of air**





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Questions?

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