

# Optimizing Quality with Bale Density and Time of Wrapping

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## Silage Bales vs. Bunk

- Higher density
- Better fermentation due to immediately sealing
  - Higher quality of feed for cows, higher milk production and better health of the cows
- Less risk of spoilage due to less feed being exposed to air at a time (feeding one bale at a time vs. open face of a silage bunk)



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## Forage Quality Differences

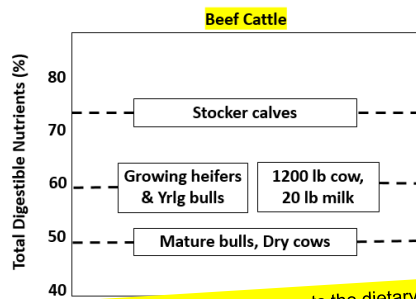
Measurement	Bermudagrass (Tifton 85) Dry Hay	Bermudagrass (Tifton 85) Silage Bales
% Moisture	18.5%	70.4%
RFQ	58.3	100.6
DMI	1.8%	2.3%
CP	8.4%	10.5%
TDN	39.9%	54.8%

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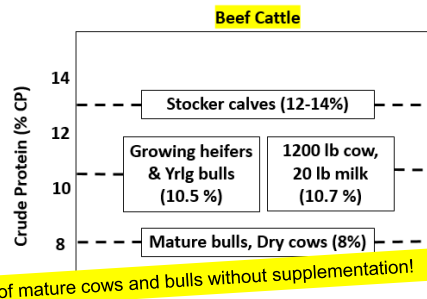


## What does the improvement in forage quality mean?

### TDN Requirements



### Crude Protein Requirements



Forage quality of silage bales meets the dietary needs of mature cows and bulls without supplementation!

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Data Source: D. Mayo, Univ. of Florida



## Proper Forage Moisture Content for Silage

Moisture (%)	Fermentation	Management Practice
< 30%	Possible, but not ideal for fermentation. Some mold growth could occur	Let hay dry down if possible to produce dry bales
30-45%	Possible, but not ideal for fermentation. Some mold growth could occur	Add at least 2 more layers of wrap to ensure oxygen exclusion; the addition of silage inoculant or acids can be beneficial to help fermentation
45-60%	Ideal for silage production and fermentation	Wrap bales with at least 6 layers of 1 mil polyethylene plastic film
60-70%	Possible, but the high levels of moisture can result in spoilage and low palatability	Add at least 2 more layers of wrap to ensure oxygen exclusion
> 70%	Too wet for proper fermentation; silage production is not recommended	Wait for the forage to dry down further before baling

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## Higher Yields than Dry Hay



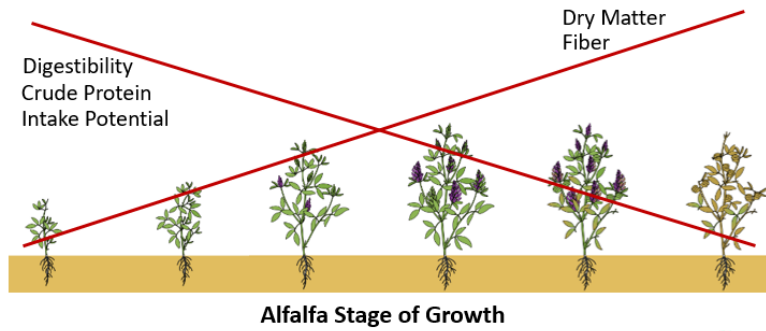
- **Less refusal rates than dry hay**
  - Dry hay could have a 10-50% refusal rate, depending on quality and forage species
- **Dry hay: every extra day of delay after mowing and before baling can result in a 5-6% yield loss**, depending on weather conditions
  - Waiting 5 days = 30% yield loss
- **Harvesting wet forage = less leaf loss**
  - Leaves are where the majority of highly digestible nutrients are present

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## Growth Stage at Harvest

Remember: As yield increases, forage quality declines



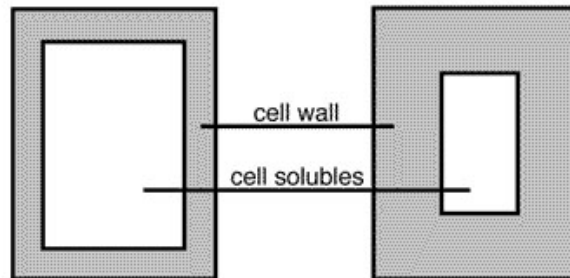
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## Growth Stage at Harvest

Early harvested forage

Late harvested forage



Thin cell wall:

low NDF (=high intake)

low ADF (=high energy)

Thick cell wall:

high NDF (=low intake)

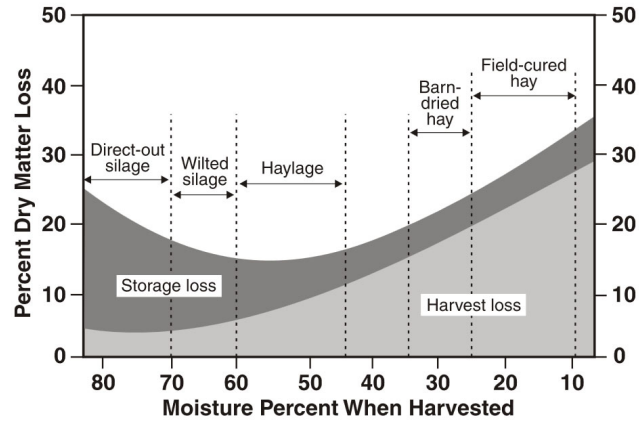
high ADF (=low energy)

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## Yield and Storage Advantage

Estimated dry matter loss during harvest and storage of forage crops at various moisture levels



Adapted from: Hoglund, 1964

Figure: Schroeder, NDSU Extension, 2013

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## Density Effects on Fermentation

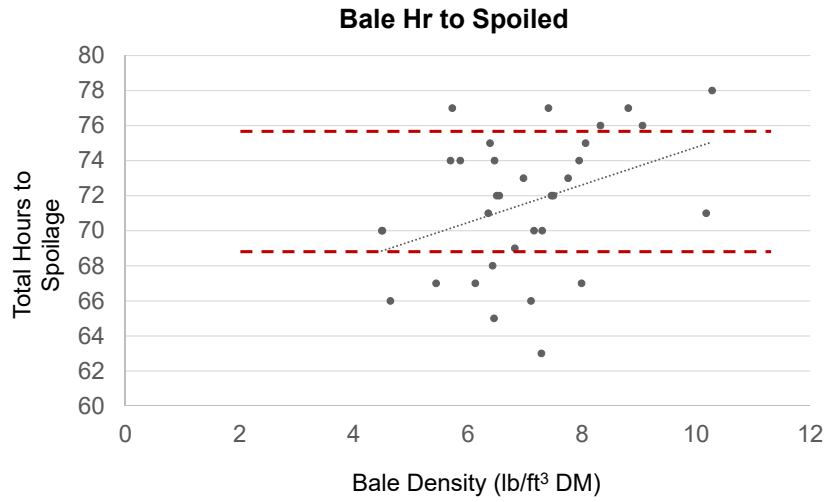
- **Greater bale density =**
  - Better fermentation
  - Higher forage value
  - Longer life of bale without spoilage



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## Density Effects on Whole Bale Bunk Life

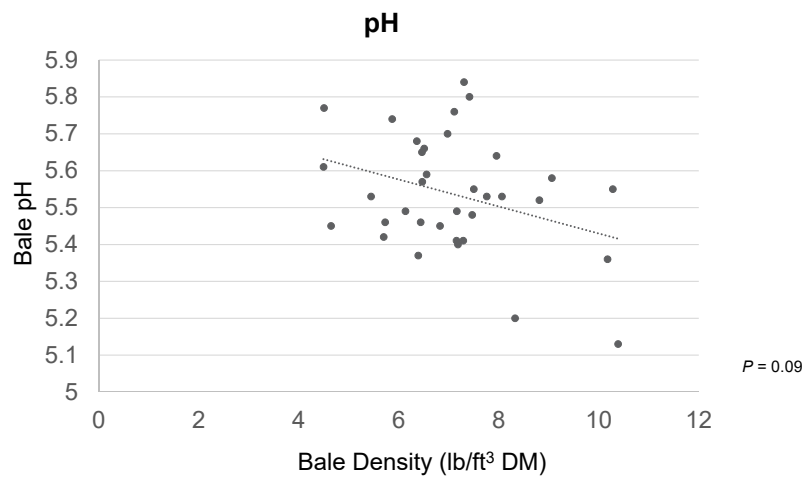


Source: Williamson and Hall, Penn State Extension, 2019

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## Density Effects on Bale pH

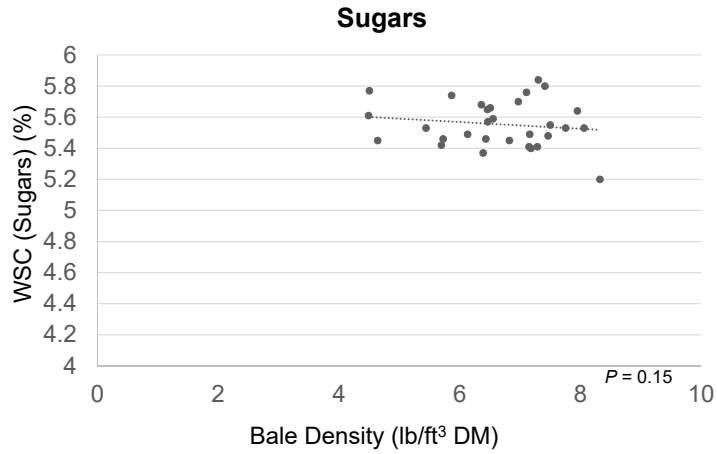


Source: Williamson and Hall, Penn State Extension, 2019

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### Density Effects on Water Soluble Carbohydrates (Sugars)

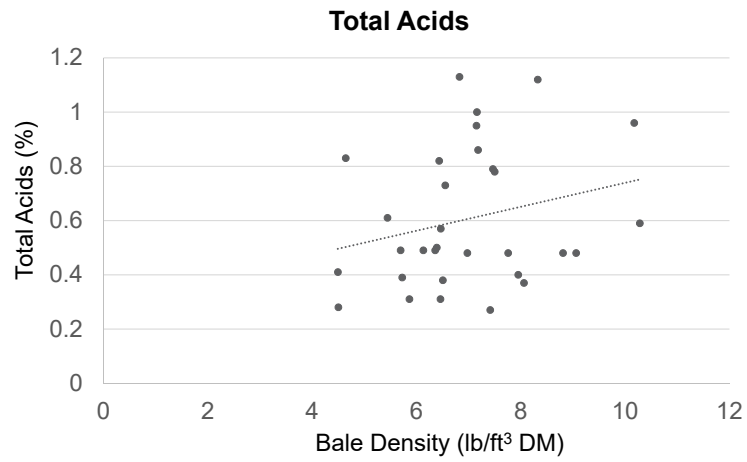


Source: Williamson and Hall, Penn State Extension, 2019

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### Density Effects on Total Acid Production



Source: Williamson and Hall, Penn State Extension, 2019

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## How can I tell if I have a dense bale?

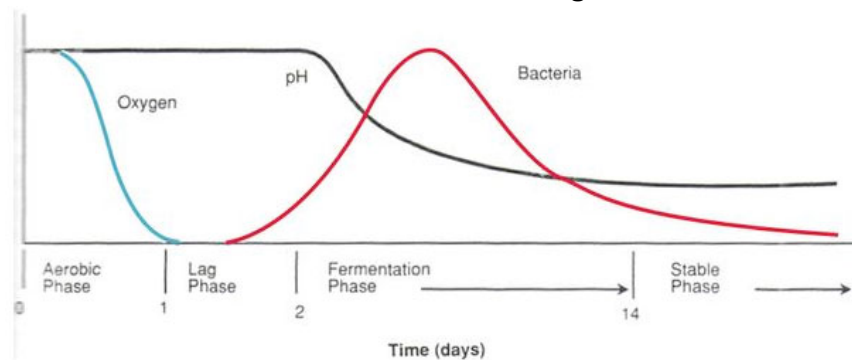


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## Fermentation Process

### Fermentation: conversion of sugars to acids



Adapted from Collins and Owens, 2003.

Image: NC State Extension

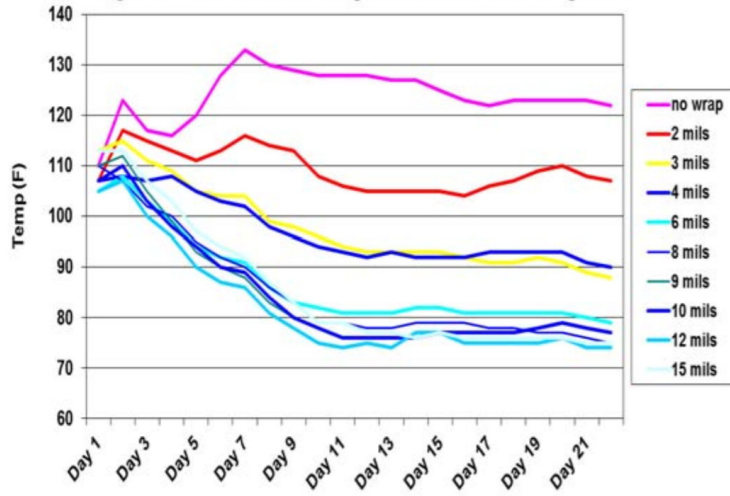
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## Wrapping Bales – Film Thickness

Figure 2 Effect of Plastic Wrap Thickness on Bale Temperature



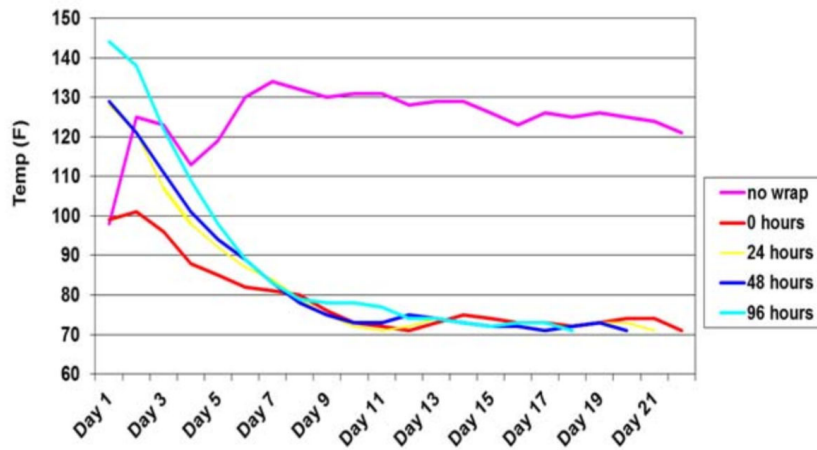
Source: D. Undersander, Univ. of Wisconsin

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## Wrapping Bales – Time of Wrapping after Baling

Figure 1. Effect of Timing of Bale Wrapping on Bale Temperature



Source: D. Undersander, Univ. of Wisconsin

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## Hesston by Massey Ferguson® | RB Series Silage Baler

- RB 4160V – 4x5 bale; 35.5-63” in diameter
- RB 4180V – 4x6 bale; 35.5-71” in diameter
- Cutter baler with up to 17 knives optional
- Variable density chamber
- Cam-less pickup
  - Fewer moving parts, quieter, less sensitive to wear, more reliable
  - Uniform, well-shaped bales that optimize baling, transporting and storage efficiency
- HydroFlex™ Control,
  - Two-stage anti-plugging system with its flexing, mechanical floor reduces the potential for plugging the baler and makes it easier to clear out excess material from the tractor cab if plugging occurs.



RB 4160V

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## Hesston by Massey Ferguson® | RB Series Silage Baler – ProTec



RB 4160V ProTec



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## Time of Wrapping Effects on Forage Quality

Kennett Square, PA

Conducted  
2020

**OBJECTIVES:** Determine if time after wrapping has an effect on forage quality

**HYPOTHESIS:** Time of wrapping after baling, environmental temperature and humidity, and forage moisture at baling affects forage quality.

**TREATMENTS:**

Hrs After Baling to Wrap
0h
2h
4h
8h
24h



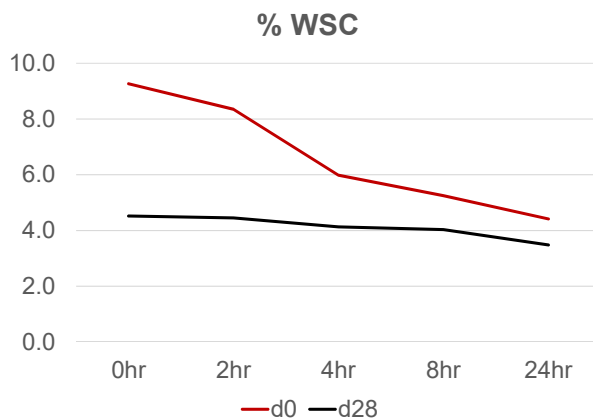
5 treatments x 6 reps (bales)/trt = 30 total bales

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## Time of Wrapping Effects on Forage Quality

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The fermentation process converts sugars (water soluble carbohydrates) to acids and pH starts to drop when sugars begin to convert to acids.

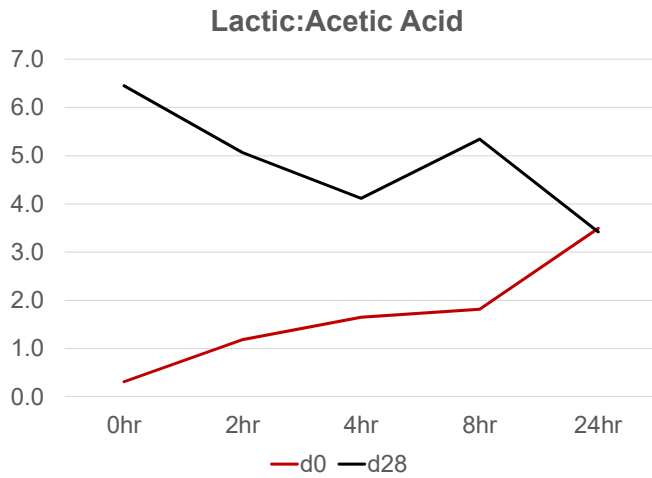
**% WSC – LOWER INDICATES CONVERSION TO ACIDS**

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## Time of Wrapping Effects on Forage Quality

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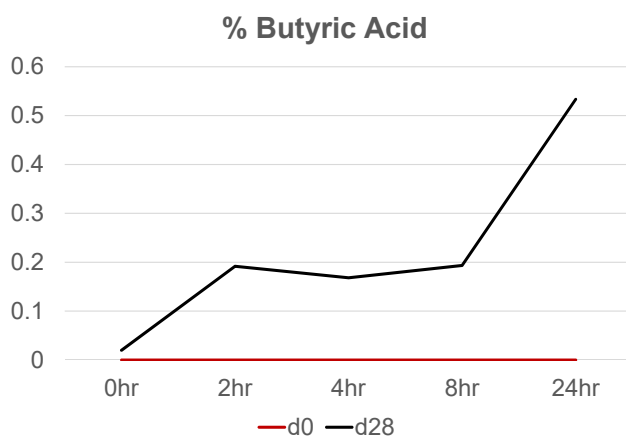
**Lactic acid** – has the greatest preservative effect. It should make up at least 65-70% of the total silage acids in a good silage.

**Acetic acid** – elevated levels may be the result of a prolonged aerobic phase if silage is put up too dry, too slowly and/or not packed or covered adequately. (Dairy One)

**LACTIC:ACETIC ACID – GREATER IS BETTER**

## Time of Wrapping Effects on Forage Quality

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2020

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**Butyric acid** – high moisture content at harvest and/or lack of adequate sugars may result in a clostridial fermentation and the production of butyric acid. High butyric acid silage is often low in feed value and may have a negative impact on animal performance and health.

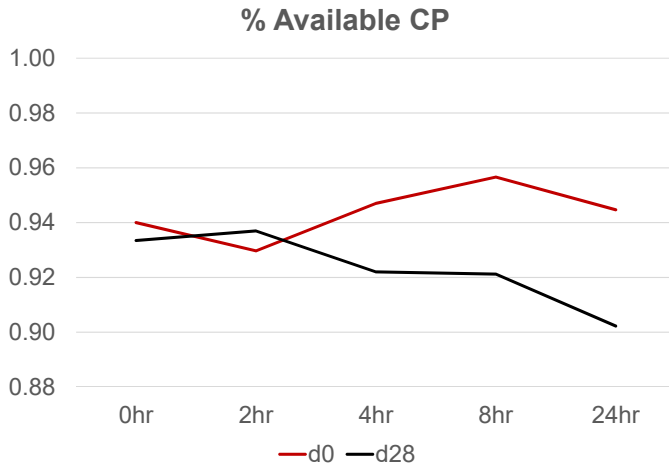
**% BUTYRIC ACID – LOWER IS BETTER**

*This silage (24hr) is still suitable feed quality and not harmful to livestock.*

**Time of Wrapping Effects on Forage Quality**

Kennett Square, PA

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**2020**



**Available Crude Protein:** The fraction of crude protein that is available for digestion and utilization within the animal. This can be reduced by proteins being denatured with increased levels of heating.

**Avail. CP – GREATER IS BETTER**

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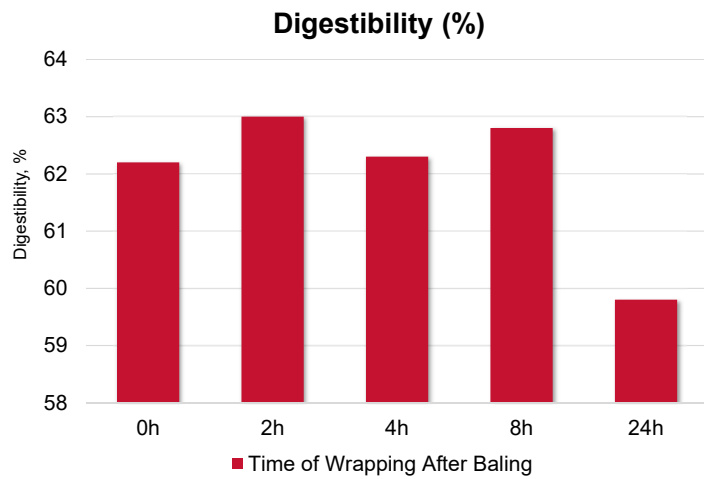


**Time of Wrapping Effects on Forage Quality**

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**2020**

Treatments (Hours After Baling Before Wrapping)
0h
2h
4h
8h
24h



- Concentrate feed requirements for dairy cows increase by 4% for each 1% decline in silage DMD

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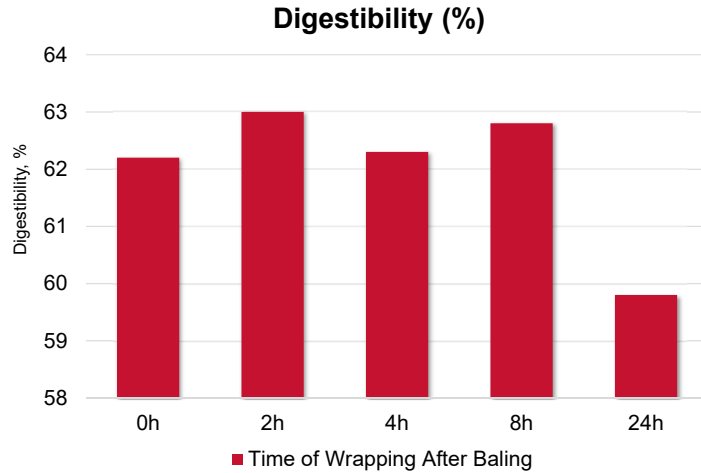
## Time of Wrapping Effects on Forage Quality

Kennett Square, PA

Conducted  
2020

### ANIMAL NUTRITION BENEFITS (Milk Yield):

- A 2% improvement in TDN would yield an additional 600 lb milk per acre
- At \$18/cwt,  $6 * \$18 = \$108/ac = 240$  EUR/ha in increased revenue per acre based on more milk production



- Concentrate feed requirements for dairy cows increase by 4% for each 1% decline in silage DMD

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## Time of Wrapping Effects on Forage Quality

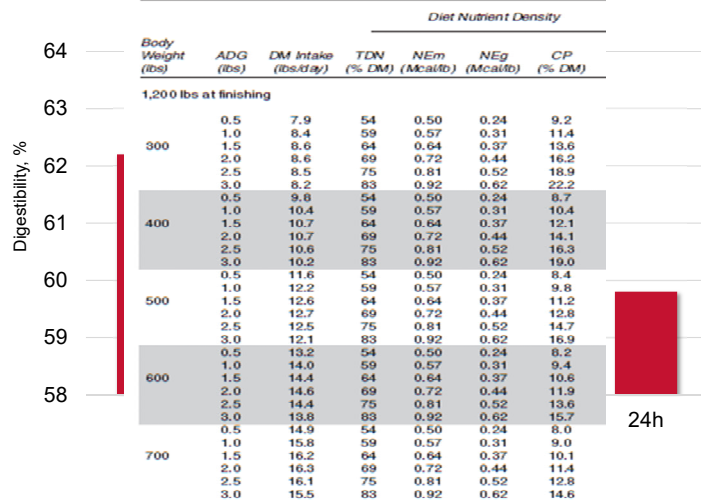
Kennett Square, PA

Conducted  
2020

### ANIMAL NUTRITION BENEFITS (Cattle Gains):

- A 2% improvement in TDN would yield an additional .1 lb/d of gain on a 600 lb growing steer.
- At a 3.5% BW DMI, forage from one acre and will cause gains of an additional 50 lb total across all head.
- At the average cattle price of \$140 cwt = \$70/ac = 155,68 EUR/ha in improved animal daily gains

Table 4. Nutrient requirements of growing steer and heifer calves.



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## Time of Wrapping Effects on Forage Quality

Beauvais, FR

Conducted  
**2021**

**Project Scope**

**Objective**

- Does delayed wrapping after baling of silage bales reduce forage quality?
- Year 2 – Beauvais, FR

**Treatments**

- 0hr
- 2hr
- 4hr
- 8hr
- 24hr
- 48hr

**Special thanks for your support!** Nicolas Gapon, Benoit Poinsignon, and La Salle University (Beauvais, FR)

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## Time of Wrapping Effects on Forage Quality

Beauvais, FR

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**2021**

### Digestibility (%)

Time of Wrapping after Baling	Digestibility (%)
0h	~87.0
2h	~86.0
4h	~87.0
8h	~83.0
24h	~83.0
48h	~81.5

■ Time of Wrapping after Baling

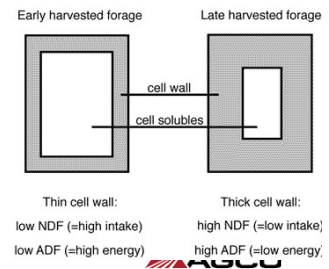
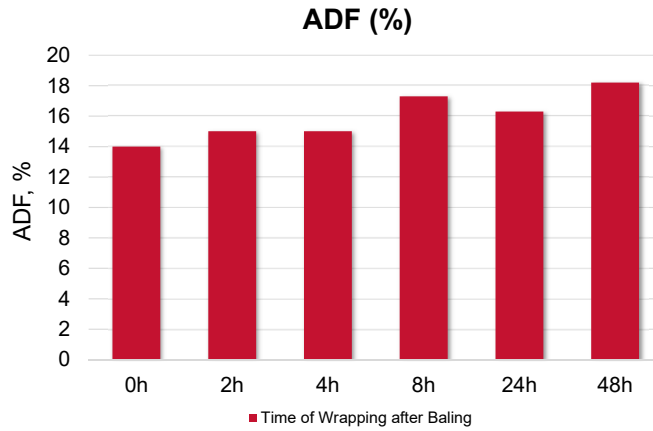
- Concentrate feed requirements for dairy cows increase by 4% for each 1% decline in silage DMD
- A 2% improvement in TDN would yield an additional 600 lb milk per acre

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## Time of Wrapping Effects on Forage Quality

Beauvais, FR

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2021



**Acid Detergent Fiber (ADF)** – cell wall contents (cellulose + lignin)

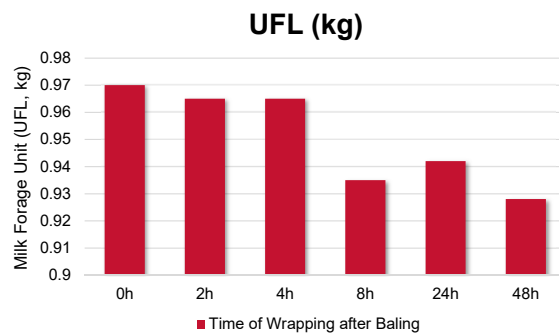
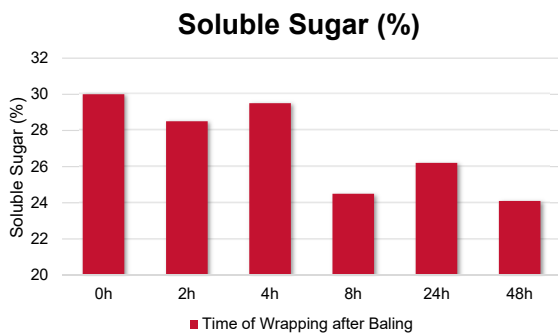
- Inversely correlated with digestibility
- As ADF increases, digestibility decreases

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## Time of Wrapping Effects on Forage Quality

Beauvais, FR

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2021



UFL – (milk forage unit) which represents the net energy value of one kg of forage, used as reference forage, distributed to dairy cows

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## Labor savings using Protec vs Wrapping off-site

- For this field trial, bales that were manually wrapped (2, 4, 8, and 24h treatments) took approximately 2.5-2min per bale to wrap.
  - Bales that were 0h treatment were wrapped on the back of the baler while the next bale was entering the chamber of the baler, eliminating excess time and labor needed for manually wrapping individual bales.
- In order for an operation not utilizing the Protec baler to realize the forage quality benefits of wrapping the bales within 8hr after baling, labor would need to consist of:
  - Baler operator
  - Loader operator (to load bales on to trailer in field)
  - Loader operator (to load bales on to and off of the wrapper)
  - Wrapper operator
- Running Protec saves 45 USD/hr = 37 EUR/hr in labor

Operator	Protec	Other Baler
Baler	✓	✓
Loader (in field)	N/A	✓
Loader (at wrapper)	N/A	✓
Wrapper	N/A	✓
TOTAL @ 15/hour USD	15 USD/hour	60 USD/hour
TOTAL @ 12/hour EUR	12 EUR/hour	48 EUR/hour

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# THANK YOU!

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