Wide Swathing and Low Lignin Alfalfa

Technologies for Quality & Yield

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University of Wisconsin

Changes in U.S. Dairy Industry since 1935

Year	# Dairy Farms	# milk cows	Total Milk	Milk/ cow
	1000s	1,000 hd	billion lbs	lbs/hd/ year
1935	>4,100	24,187	100	4,184
1965	1,108	14,953	124	8,303
1995	140	9,466	155	16,405
2015	44	9,257	209	22,393

Source: USDA National Agricultural Statistical Service

National Milk Production Record

Produced a 365-day record of
- 72,170 pounds of milk, with
  - 2,787 pounds of fat
  - 2,142 pounds of protein.

Ever-Green-View My 1326-ET, owned by Thomas J. Kestell of Waldo, Wisc

Recipe for High Yield and Quality

- Cut at time when quality high
- Low respiratory losses
- Low leaf losses

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Rate of Alfalfa Forage Quality Change per Day

Component	Mean
Crude Protein, % DM	-0.25
Acid Detergent Fiber, % DM	0.36
Neutral Detergent Fiber, % DM	0.43
Neutral Detergent Fiber Digestibility, % NDF	-0.43
RFV, points	-2.9
RFQ, points	-3.6

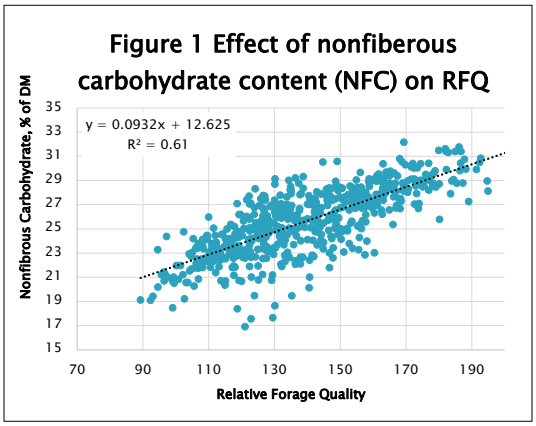
Source: Undersander, 2009 unpublished

Recipe for High Yield and Quality

- Cut at time when quality high
- Low respiratory losses
  - Respiration breakdowns starch and sugars gives off CO_2

Respiratory Losses

- Nonfiberous Carbohydrate (NFC) is starch and sugars



Wide swath benefits

- Faster drying
- Higher forage quality

Need to dry off first 15% moisture as quickly as possible

Narrow windrow

Wide Swath

Leaf Structure

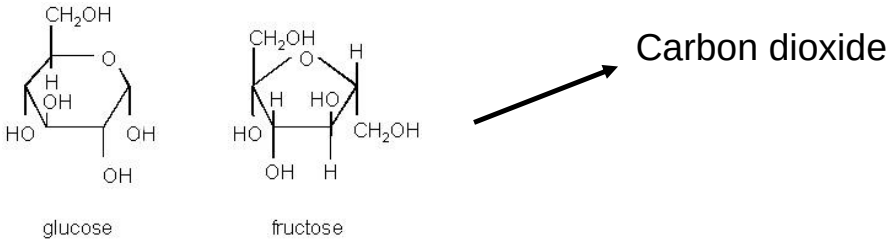
Legumes have 10 times more stomata than grasses

Upper and lower **epidermis** is heavily coated with wax

- ✓ conserves water
- ✓ protects surface cells

Respiration continues after cutting until plants dries below 60% water

Breakdown of starch and sugars



2 – 8% of Dry Matter loss

Table 1. Losses Due to Respiration			
Dry Matter Loss	2%	4%	8%
	Economic Loss ($/t)		
Hay value $181/t	$3.62	$7.24	$14.48

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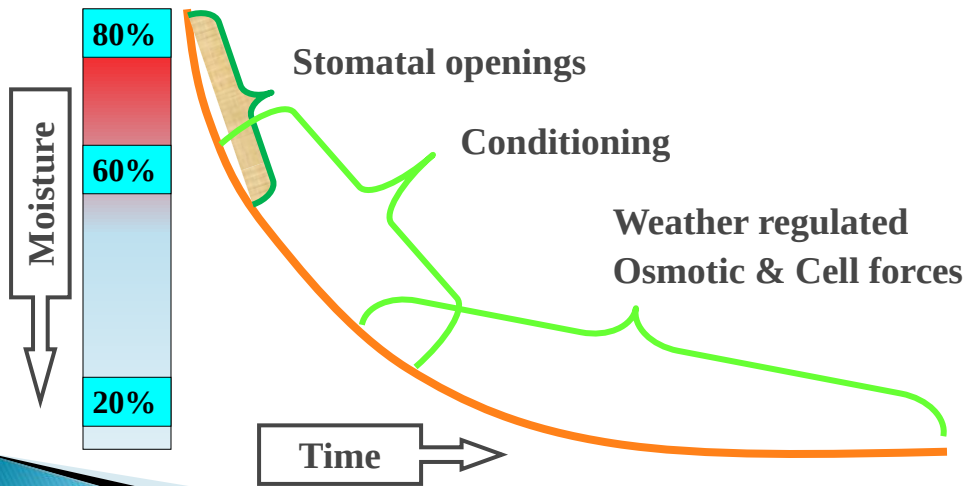
Table 1. Losses Due to Respiration			
Dry Matter Loss	2%	4%	8%
	Economic Loss ($/t)		
Hay value $181/t	$3.62	$7.24	$14.48
Forage Quality Loss from 4% sugar/starch loss			
ADF, %	NDF, %	RFQ	Value, $/t
30.0	40.0	153	$181.00
--Forage quality if lose 4% dry matter of starch/sugars--			
33.0	43.4	134	$116.00
Prices from Midwest Hay Market Report, Feb 13, 2017			

$-65

Sequence of Drying Forages



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Benefits of Wide Swath

- Higher forage quality
- Increased yield – Need to cut 3 to 5 days earlier to make up for increased fiber due to NFC loss
  - Lose 150 to 200 lb/acre/day

Benefits of Wide Swath

- Higher forage quality
- Increased yield - cut need to cut earlier for NFC loss
- Increased yield of next cutting
  - Less wheel traffic damage
  - Quicker irrigation

Traffic No Traffic

Wide Swath

Summary

- Begin with wide swath (>70% of cut area).
- Conditioning necessary for hay not haylage.
- Condition alfalfa & alfalfa/grass mixtures with roller conditioner.
- Rake/merge with minimal ground contact to reduce dirt in forage.
- Additional tedding often necessary for grasses

Recipe for High Yield and Quality

- Cut at time when quality high
- Low respiratory losses
- Low leaf losses

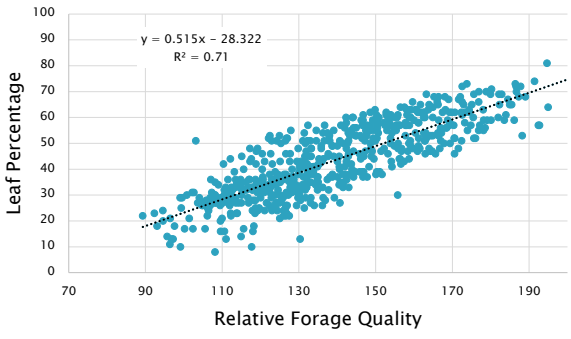
Leaf Losses

- Leaves higher in quality than stems

Leaves 15 to 20% NDF

Stems 60 to 70% NDF

Figure 2 Effect of leaf percentage on RFQ



Leaf loss

Machine adjustments and operating speed have largest effect

~~Tedding~~, Raking, Merging

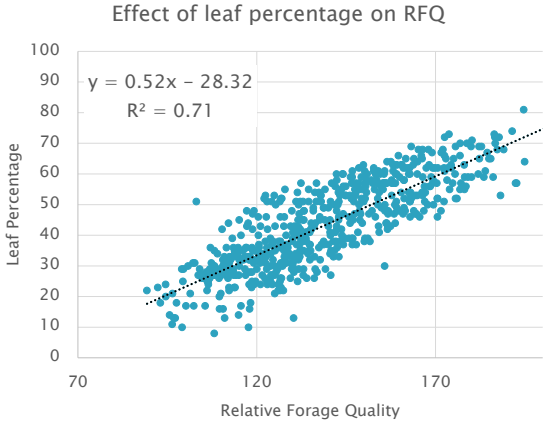
Tedding, Raking, Merging

Alfalfa Leaf Loss Effect on Forage Quality

- Leaves higher in quality than stems

Leaves 15 to 20% NDF

Stems 60 to 70% NDF



Recipe for High Yield and Quality

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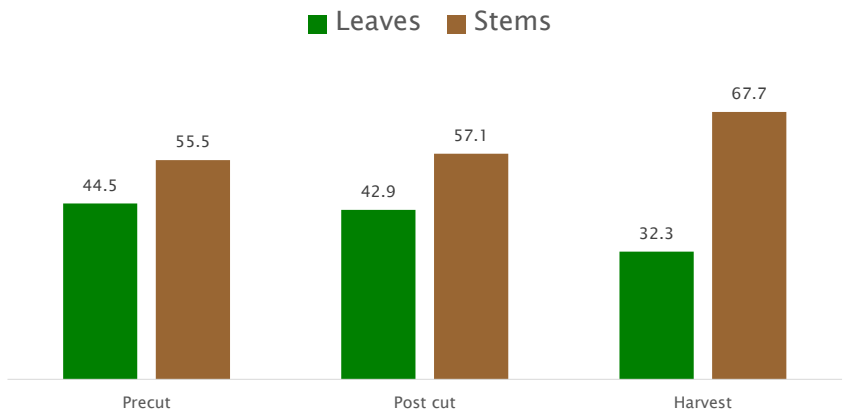
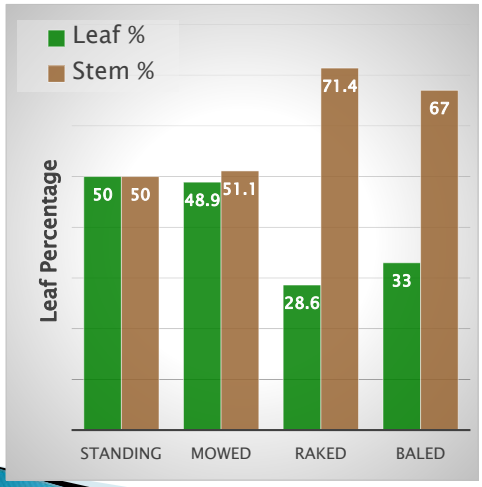
- Low respiratory losses
- Low leaf losses

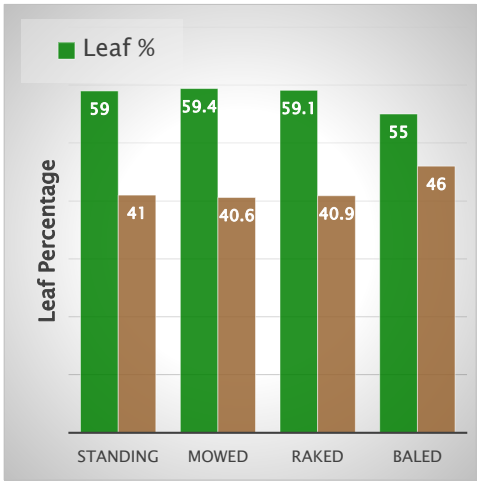
Leaf Content at Harvesting Stages



Data from Winfield, 2016

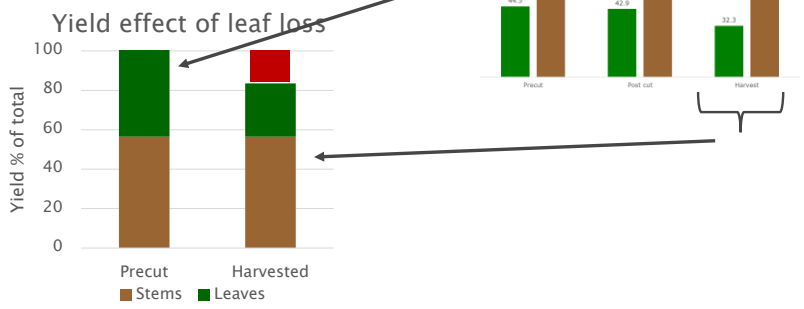
Three-state rake/merger trial, 2015





Retaining leaves increases yield

- Reduced leaf loss
  - 5 to 20% yield reduction



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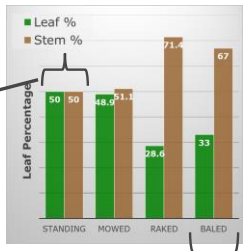
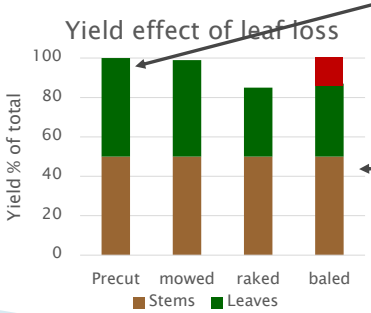


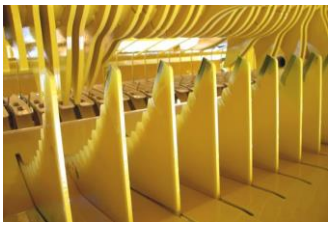


Leaf Loss during harvesting

Baling

Cutting forage for hay/haylage

- Higher initial machinery cost
- Higher energy requirement
- Stones cause knife damage

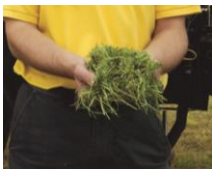


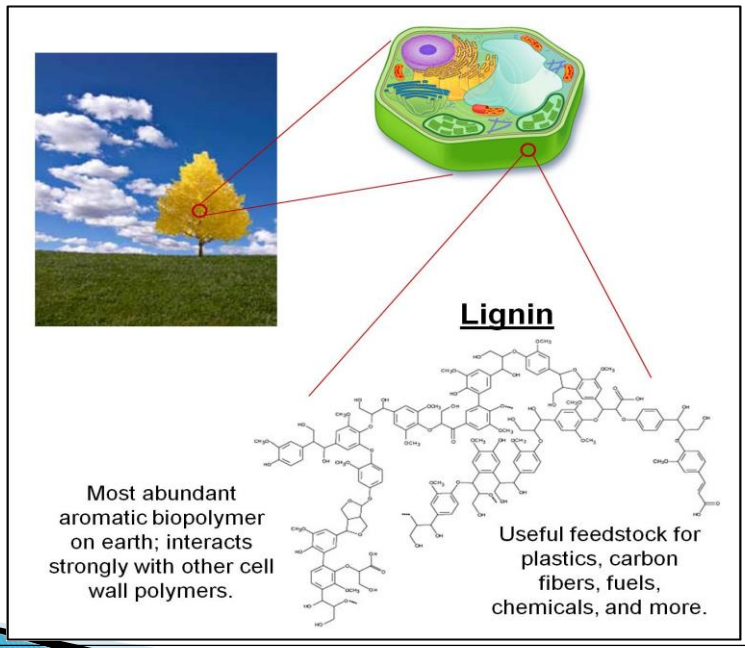
Baling

Cutting forage for hay/haylage

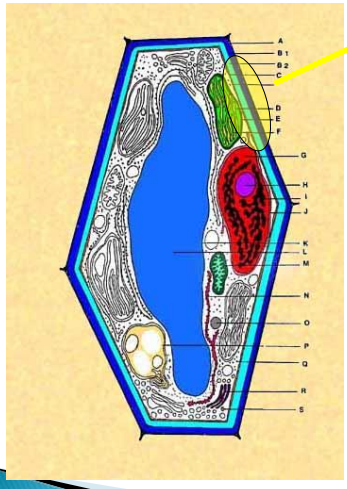
- Higher initial cost
- Higher energy requirement
- Stones cause knife damage

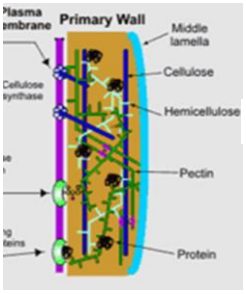
✓ Greater bale density
✓ Better feed intake
✓ Better animal gain
✓ Less feeding loss



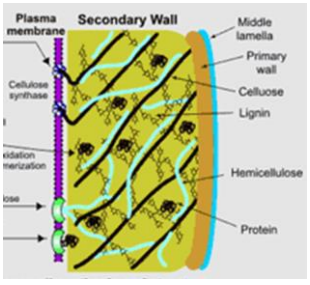


Cell Wall





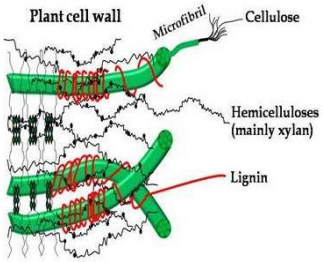
Developing cell wall

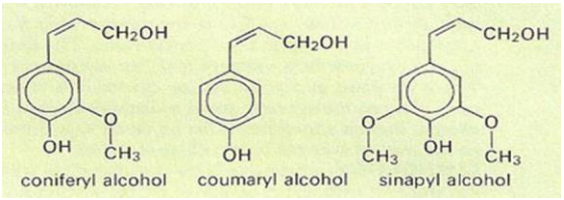


Mature cell wall

Lignin

- Is a polymer of aromatic alcohols





Importance of Lignin in Alfalfa

- ✓Provides strength to plants
- ✓Allows the plant vascular system to transport water in the plant without leakage.
- ✓Sequesters atmospheric carbon into vegetation
- ✓Is one of the most slowly decomposing components of dead vegetation, contributing a major fraction of soil organic matter.

Plant lignins can be broadly divided into three classes

- 1) softwood (gymnosperm) composed principally of coniferyl alcohol units

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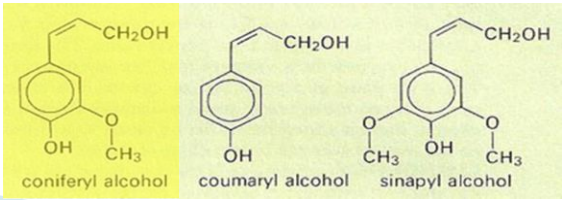

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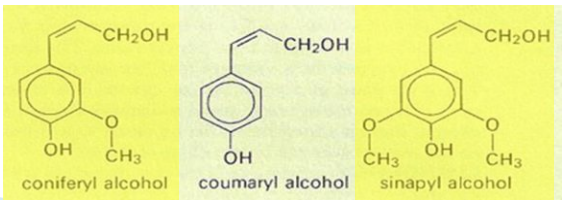
- 1) softwood (gymnosperm) composed principally of coniferyl alcohol units
- 2) hardwood (angiosperm) composed of coniferyl and sinapyl alcohol units.



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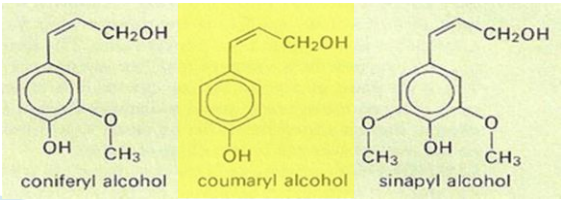
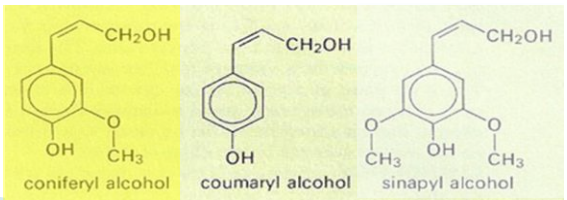
- 1) softwood (gymnosperm) composed principally of coniferyl alcohol units
- 2) hardwood (angiosperm) composed of coniferyl and sinapyl alcohol units.
- 3) grass or annual plant (graminaceous) lignin composed mainly of p-coumaryl alcohol units.



Plant lignins can be broadly divided into three classes

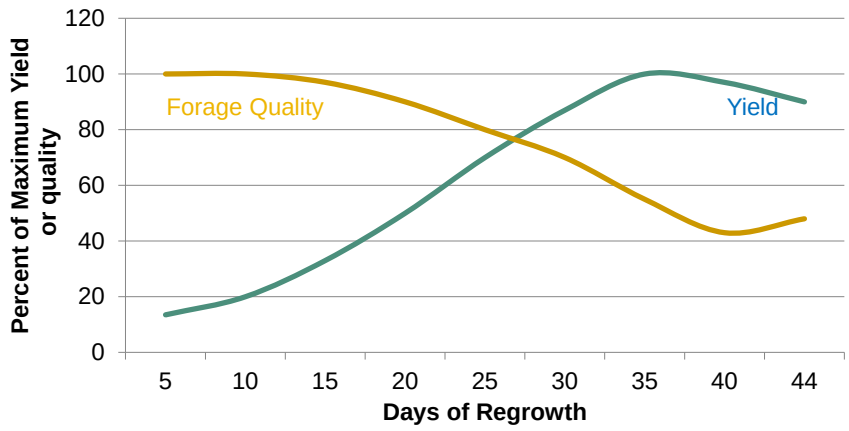
- Alfalfa is composed principally of coniferyl alcohol units (like softwoods).



Lignin effect on digestibility

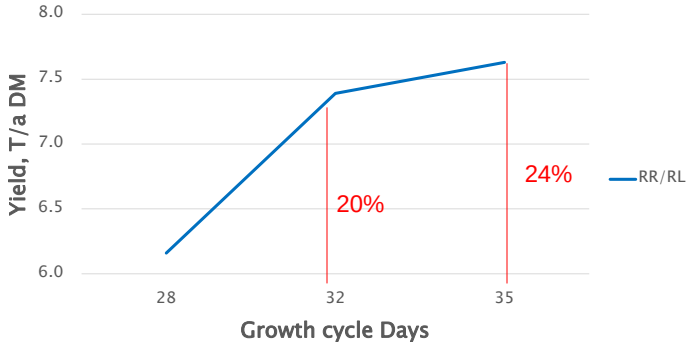
- Depends on:
  - Type of lignin
  - Amount of lignin
  - Location of Lignin

Yield and Quality Curve of Alfalfa



Effect of harvest delay on alfalfa yield, total of 4 cuttings, Wisconsin 2015

Alfalfa adds about 150 lbs dm/a/day near harvest



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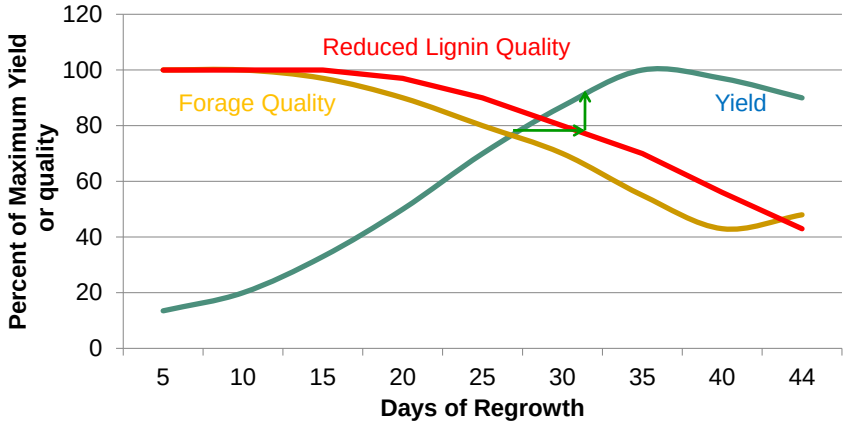


How does lignin/digestibility of forage change?

- Less and/or different lignin in stem
  - Genetic effect
  - Environmental effect
    - Less sunlight (cloudy days) reduces lignin content
    - Cooler temperature reduces lignin content
- More leaves
  - Favorable leaf growth environment
  - Less leaf disease
  - Reduce harvesting leaf loss

Value of reduced lignin

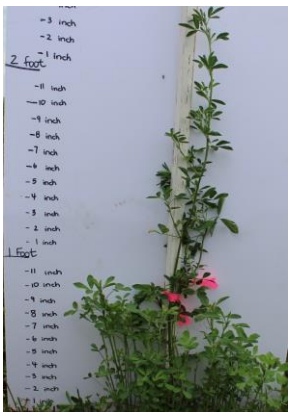
- Improved forage quality
- Wider harvest window?
- Later harvest
  - Greater tonnage per cutting
  - Make use of full growing season
  - Reduce number of cuttings
    - 15 to 18% lignin reduction harvest 8 to 10 days later

Make better use of full growing season

- Cutting schedule
  - May 20
  - June 20
  - July 20
  - August 20

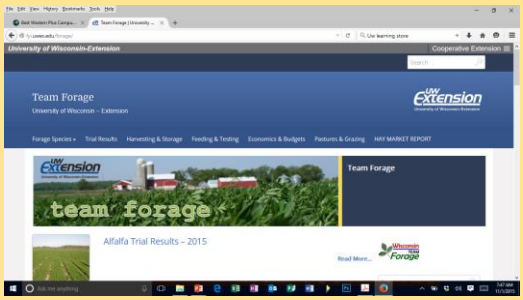
  - Could grow until September 5
    - 16 days * 150 lb/a = 2.4 t/a

Cut above regrowth



For Additional Information

fyi.uwex.edu/forage



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