Harvest Management & Storage Planning

Making the Most of Advances in Forage Management

Joe Lawrence, Cornell PRO-DAIRY

Forage Quality & Milk Production

- Quality of home grown forages drives the composition of a ration.
- With quality forages, a high forage diet has shown to be quite profitable and good for the health of the cow.
  - Grain can never quite make up for poor forage quality.
- High production can be achieved with high forage rations, ***management is key***.

Harvest Quality and Silo Management Have Profound Effects on Silage Quality at Feeding

Poor quality forage→
Poor Silage Management→
= Poor quality silage

Poor quality forage→
Excellent Silage Management→
= Poor quality silage

High quality forage→
Poor Silage Management→
= Poor quality silage

High quality forage→
Excellent Silage Management→
= Excellent quality silage

Slide credit: Limin Kung, University of Delaware

Forage Production & Feeding Significant Investment

- Seed Selection
- Field Preparation
- Planting
- Soil Fertility/Plant Nutrition
- Harvest Equipment

Forage Production & Feeding
Significant Investment

- Forage Analysis
- Ration Balancing
- Feed Handling
- Feed Mixing

TMR Tracker

Forage Production & Feeding

Sometimes we miss
linking these together

The Right Quality Feed (Hall, 2015)

Every group of animals has differing nutritional requirements and to optimize forages, it is important to match feeds to animal group.

- Lactating Cows
- Young stock
  - Stage of Growth
- Dry Cows
- Roughage for Lactating Cows
- Bedding

Hall, Mary Beth. WCDS Advances in Dairy Technology (2015) Volume 27: 203-211

Core Acres

- **Pre-season planning**
  - Total acres by crop
  - Anticipated yields
  - Tons needed for each animal group
    - Don't forget carryover
- **Do these match or do acres need to be shifted**
- **Run this scenario with different yields to account for unknowns**

Cornell Cooperative Extension | Delaware County

Not an excuse to aim for mediocrity

- **Not all feed needs to be high quality.**
  We need the right quality feed for the right group of animals.

TRUE

- **Since I don't need all feed to be high quality I can plan to delay some fields**

FALSE

Logistical Reasons certain fields get assigned as "heifer hay"

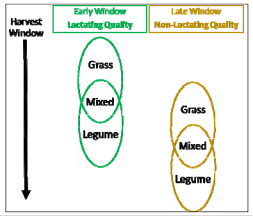
- **Soil Drainage**
  - **Timeliness of harvest**
- **Distance from Farm**
  - **Number of cuttings/trips per year**
- **Date of 1st cutting**

You *can't* base all decisions on what makes logistical sense when you are dealing with weather and with a crop where the quality changes by the day.

First Cutting

A lactating cows forage of choice

- Timely cut 1st cutting represents as much as ½ of total yield per acre with excellent milk making potential
- Highly digestible fiber
- Digestible Fiber/Acre
  - Need timely harvest to capitalize on digestible fiber
  - 2nd, 3rd, 4th cuttings often test better than the cows respond



Observations from 2018

- "If the first cutting was taken early then 2nd looks pretty good. Late first cutting hay fields are mostly brown or have no growth."

  - From Madison Co., USDA Crop Progress and Conditions, Week ending July 15, 2018

- This comment was true for many areas of the state
- In many areas 1st cutting yields were low regardless of cut date
  - Where 1st cut was taken **early**, subsequent yields were better and helped make up the difference
  - Where 1st cut was taken **late**, it dragged down a fields performance for remainder of season

Forage Growth & Development

Grass

- Yield gain: ~150 lbs DM/a/day*
  **leading up to maturity*
- NDFd decline: 1%/day
- Feeding trials: cows drop 0.5-1.0 lbs/cow/day with each 1% drop in NDFd

Once crop reaches maturity, DM yield increase/day slows way down

Source: JH Cherney, Cornell

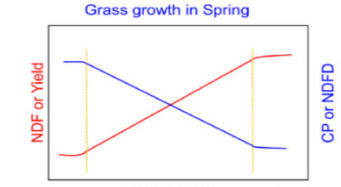


Figure 1. During mid to late May in a typical year, NDF and yield increase linearly, while CP and NDFD decrease linearly.

Cherney et al. What's Cropping Up?. Vol.22, No.3

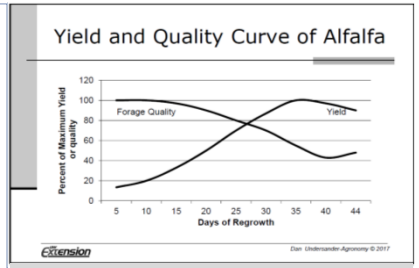
Forage Growth & Development

Alfalfa

Daily alfalfa forage change in yield and quality during the growing season

Cutting	Yield (lb/day)	RFV per day	RFQ per day
	-------Daily Change-------		
1	100	-5	-5
2	100	-2 to -3	-5
3	100	-2	-4
4	100	-1	-4

Dan Undersander, Wisconsin



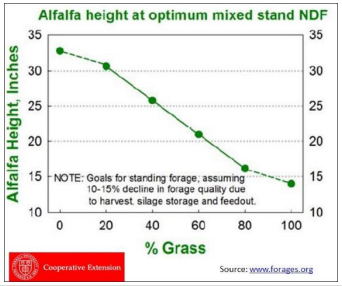
Dan Undersander. 2017 Herd Health & Nutrition Conf.

Forage Production & Handling Significant Investment

- Harvest Planning
  - Forage Stage at Harvest
  - Executing Harvest Plan
- Storage
  - Minimize Shrink
  - Optimize Access

Harvest Management: When to Start Harvest

1st cutting



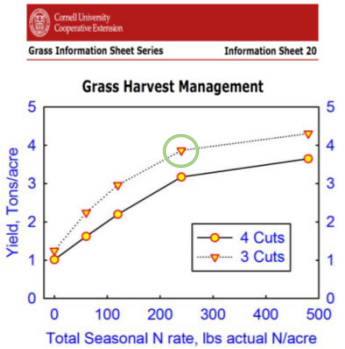
- Grass NDF is ~ 25 points ahead of alfalfa NDF
- 1st cutting sets the stage for all other cuttings
  - 28-35 day harvest interval
- Accurate Estimate of %Grass in stand is critical.

Forage Management
www.forages.org

CCE 1st Cutting Monitoring Programs
https://prodairy.cals.cornell.edu/sites/prodairy.cals.cornell.edu/files/shared/documents/FirstCutting_MonitoringPrograms_4.28.pdf

Intensive 3 Cut System Grass

- Harvest
  - Timely 1st cutting
  - 2nd cut 28-32 days later
  - 3rd cut *whenever convenient**
    *if 1st & 2nd achieved quality needs
- Nitrogen
  - ~200 units N (~400 lbs Urea) for season
    1. Spring Greenup
    2. After 1st cutting



http://www.forages.org/files/gis/GIS20_Grass_Harvest_Management.pdf

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Executing the plan

- Harvest Timing / Dynamic Harvest Scheduling
  - Alfalfa Grass - Understand Stand Composition (www.forages.org)
- Utilize Custom Services or Rented Equipment
- Minimize time from Mowing the Ensiling
  - Wide Swath/Haylage in a Day (http://advancedagsys.com/)
- Minimize Ash
- Minimize leaf loss in alfalfa

- Ability to Separate Feeds in Storage

Corn Silage

Key Considerations

- *Dry Matter at Harvest*
- *Kernel Processing*

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Harvest Planning

- Needs to be looked at *by acres*, *not by field*

- Needs to be looked at *by cutting*, *not by field*

Manage for the weather
instead of letting the weather manage you

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Harvest Windows

May 2016 — Saratoga Springs

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
0.12	0.76	0.02	0.38		0.03	0.44
0.1					0.77	★
0.07						
0.03	0.04	T	T			
T	0.83					

SUM 3.59"

May 2017 — Saratoga Springs

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		0.9	0.03		0.83	0.13
0.5						0.12
0.42	0.04				0.17	★
★	0.29	0.04	★	0.29	0.53	0.03
★	0.45	0.56	0.03			

SUM 5.36"

May 2018 — Saratoga Springs

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		0.04			0.07	0.46
0.03				T	★	0.1
★	★	0.12	0.08	★	★	0.71
0.08	★	0.23				
0.1	0.03					

SUM 2.05"

May 2016 — Lowville

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
0.02	0.28	0.02		T		0.13
0.03	T					0.01
0.03	0.13	T				
	T					
	T					

SUM 0.65"

May 2017 — Lowville

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	0.88	0.94	0.15	0.02	0.19	0.43
0.43	0.11	0.10	★	★	0.05	0.22
0.15				0.02	T	★
0.13	0.04	★	★	0.04	T	★
★	0.60	0.34	0.22			

SUM 5.43"

May 2018 — Lowville

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		0.01	T	T	0.2	0.33
					T	
		T	0.27			
0.14	T	★	0.2			

SUM 1.15"

May 2016 — Rochester

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
0.27	0.49		T	T	0.02	0.08
0.04				T	0.34	T
0.05	0.05					0.04
T				0.07	★	T
1.48						

SUM 2.93"

May 2017 — Rochester

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	1.24	0.01	T	0.31	0.84	0.69
0.08					T	0.01
0.14	★	0.01	★	0.04	★	★
0.13	0.01	★	★	1.59	0.05	★
★	0.11	0.03	T			

SUM 5.29"

May 2018 — Rochester

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			T	0.1	0.34	
T	T	★	★	0.03	★	0.03
★	★	0.34				0.25
0.05	★	0.56				
T				T		

SUM 1.70"

This is actual rainfall, what was the forecast for these days?

Adjusting By Cutting

- It all starts with 1st cutting but doesn't end there
- Each cutting offers a unique opportunity and unique challenges
- Approaching strategy for high quality feed by acres and cuttings instead of by fields
- If needs for high quality forage are meant early in the season adjust future cuttings for needs of other animal groups
  - Cutting schedule
  - Cuttings / year

Dynamic Harvest Scheduling

- Target high quality feed ***from every acre***
- Do not pre-determine what fields will be harvested at a lower quality
- Let unforeseen challenges (*weather, equipment breakdowns*) determine what feed will fit the needs of non-lactating animals

				Rigid Harvest Schedule				Dynamic Harvest Schedule			
				Planned		Actual		Planned		Actual	
Acres	Proposed Harvest Order	Species	Conditions when High Quality	Harvest for Lactating Animals	Delayed Harvest for Non-Lactating Animals	Harvest for Lactating Animals	Delayed Harvest for Non-Lactating Animals	Harvest for Lactating Animals	Delayed Harvest for Non-Lactating Animals	Harvest for Lactating Animals	Delayed Harvest for Non-Lactating Animals
12	1	100% Orchardgrass	Favorable for Harvest		*		*	*		*	
20	2	100% Tall Fescue	Rain Delay		*		*	*			*
16	3	70% Grass, 30% Alfalfa	Favorable for Harvest		*		*	*		*	
8	4	70% Grass, 30% Alfalfa	Favorable for Harvest		*		*	*		*	
9	5	50% Grass, 50% Alfalfa	Favorable for Harvest	*		*		*		*	
8	6	40% Grass, 60% Alfalfa	Rain Delay	*		x		*			*
25	7	30% Grass, 70% Alfalfa	Favorable for Harvest	*		*		*		*	
16	8	20% Grass, 80% Alfalfa	Rain Delay	*		x		*			*
21	9	100% Alfalfa	Favorable for Harvest	*		*		*		*	
12	10	100% Alfalfa	Equipment Breakdown	*		x		*			*

California Alfalfa Study

Sequential
- Habit
- field's proximity to the headquarters
- dryness of a field
- Once an order is established, the same harvest sequence is followed for each subsequent cutting
- It is very easy to just miss producing 'dairy quality' and end up harvesting much of the alfalfa in one of the least profitable time periods

Staggered
- targets some harvests for quality and others for yield and improved stand life

- The number of 'dairy-quality' cuttings was increased using a staggered cutting order.

Orloff and Putnam, 2006

Silage Storage - Preservation of Dry Matter

- Minimize Respiration (DM) Losses
  - Density
  - Inoculants
  - Face Management
- Consistency of Feed in Ration
  - Carry over
- Maximize feed stored in a given footprint
  - Economics
  - Environment
- Optimize usage of feed for targeted classes of animals
  - Is feed accessible when needed for target group of animals
  - Mix & Match Storage System

Harvest & Storage Management

Guidelines for Success:

- ***Send all employees home to their families safe everyday***
- Harvest at correct Maturity & Moisture
- Retention of Dry Matter (DM)
- Proper Siting & Construction of Storage area.
- Segregate feed by Quality & Intended Use (class of animal)
- Storage Management – *Particularly Critical in Horizontal Silos*
- Feedout Management

Shrink

Losses

- Loss of dry matter (DM)
  - Not available to feed or sell
- Loss of Quality
  - Nutrients
    - Animal health & Performance
  - Palatability

Manageable

- Harvest
- Transport
- Weathering in storage
- Re-introduction of moisture and oxygen
- In proper fermentation

Un-avoidable (but can minimize)

- Natural Fermentation Processes

Value of Silage Management

	Losses w/ Good Management		Losses w/ Poor Management	
	Hay	Corn	Hay	Corn
Value Lost	$11,204	$8,572	$18,649	$14,992
Total		$19,776		$33,571

Difference: $13,795

- 100 cow herd with replacements
- Hay Silage Value = $125/TDM Corn Silage Value = $100/TDM

Source U. of Wisconsin Team Forage

Forage Needs / Acreage Needs

Annual Yield (tons/acre, DM)	4.5
% DM	38%
Annual Yield (tons/acre, as fed)	12
Feed needs (tons, as fed)	4500
Acres Needed (without shrink)	380

Shrink	10%	15%	20%	25%	30%	35%	40%
Yield after shrink (tons/acre)	10.7	10.1	9.5	8.9	8.3	7.7	7.1
Total Available Feed (after shrink)	4050	3825	3600	3375	3150	2925	2700
Feed Shortfall (tons)	450	675	900	1125	1350	1575	1800
Total Acres Needed (with Shrink)	409.4	456.6	510.0	570.8	640.7	721.7	816.7
Extra acres (to account for shrink)	29.4	76.6	130.0	190.8	260.7	341.7	436.7

Silage Preservation

DENSITY "Rule of 800"

MINIMUM 800 lbs of packing weight per ton of forage per hour

ex. 45 tons/hr * 800 lbs = 36,000 lbs

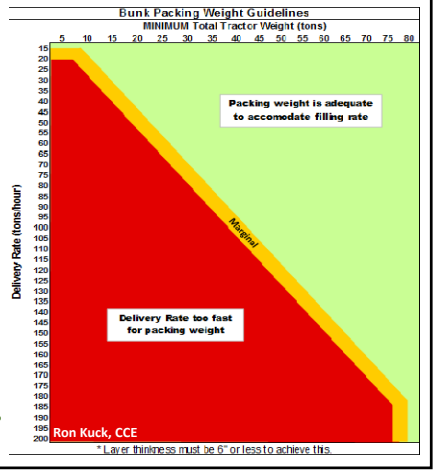
Notes: pushing tractor is only packing ~60% of time.

A *28,000 lb* pushing tractor (x 0.60) contributes ***16,800 lbs*** of packing weight

Dry Matter Density

15 lbs DM/ cu. Ft. MINIMUM

18+ lbs DM / cu. Ft. Desirable & *Achievable*



Matching Feed to Animal Needs

- Determine total tons of feed needed for each animal group
- Store feeds in separate (***and accessible***) locations to utilize each forage for the right group of animals.

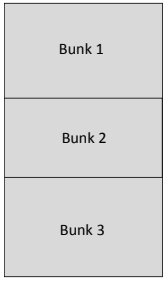
- Lactating Cows
- Young stock
  - Stage of Growth
- Dry Cows
- Roughage for Lactating Cows
- Bedding

Mapping Your Storage

- **Focus in on Forage Storage areas**
- **Have a plan**
  - **Plan A**
  - **Plan B**
  - **Plan C**

- **What happens with a surplus of quality feed?**
- **What happens with a cutting of garbage?**

- **Don't bury one feed behind another.**



Storage Systems

Minimal Flexibility	Somewhat Flexible	Greater Flexibility
Upright Silo	Drive Over Plies	Silo Bags
Large Bunk	Many Smaller Bunks	Drive Over Plies
Too few bunks		Baleage
		Dry Hay

Baleage

Strengths

- Minimal storage losses
- Minimal runoff concerns
- Segregate Forages
- Good Quality can be achieved even with limited equipment and labor
- Custom Hire for certain feeds

Weaknesses

- Cost
- Large changes in forage through tube
- Site selection
- Recycling of plastic
- More time at feed out

Silo Bags

Strengths

- Minimal storage losses
- Minimal runoff concerns
- Handles wide range of forage delivery rates
- Segregate Forages
- Good Quality can be achieved even with limited equipment and labor
- Custom Hire for certain feeds

Weaknesses

- Cost
- Matching bagger to herd size
- Large changes in forage through bag
- Site selection
- Recycling of plastic
- More time at feed out

Upright Silos

Strengths

- Contained Footprint
- Segregate Forages
- Freshness of “face”

Weaknesses

- Bury older forage
- Fixed Cost
- Inflexible if repurposing of space is needed

Drive Over Pile

Strengths	Weaknesses
• Segregate Forages • Flexibility • Adapt space to Ag Bag pad or bunk with walls	• Large footprint • Packing weight and labor requirements to achieve adequate density • Runoff Collection - CAFO • Exposed Face • Managing varying delivery rate

Bunk with Walls

Strengths	Weaknesses
• Contained Footprint • Segregate Forages • Control Face Size	• Bury older forage • Cost of Walls • Matching width and tractors needed for packing weight • Runoff Collection - CAFO • OSHA • Managing varying delivery rate • Packing weight and labor requirements to achieve adequate density • Inflexible if repurposing of space is needed

Mix & Match Storage Systems

Silo Bags
- Very flexible options
  - Year to year
  - Cutting to cutting
  - Forage to forage
- Custom service options
  - Like any other custom service communication with custom operator is critical.
- Achieve good density with less people

Mix & Match Storage Systems

Drive over piles
- Similar Flexibility

- NOT WORTH IT IF IMPROPERLY SETUP
  - Good Base
  - Packing Density
  - Covering

Final Thought

Many exciting developments, including

- improved forage varieties
- precision equipment
- advances in the understanding of fiber digestibility,

continue to enhance the value of forages in feeding programs.

Harvest and storage strategies are important pieces of the puzzle to capitalize on these others advances.

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PRODAIRY

Thank You!

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Education & Applied Research

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