



U.S. Dairy Forage Research Center

Greener Horizons for Crops, Cows, and Communities

USDA-Agricultural Research Service



Zero in on harvest and feeding decisions with forage moisture

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**Link to U.S.
DFRC Home**

Presentation format

- ★ Why moisture is so important
- ★ How to measure forage moisture
- ★ Importance of sampling



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Why is moisture so important?

★ Proper fermentation:

- ◆ Higher quality feed
- ◆ Minimize storage losses
- ◆ Increased bunk life

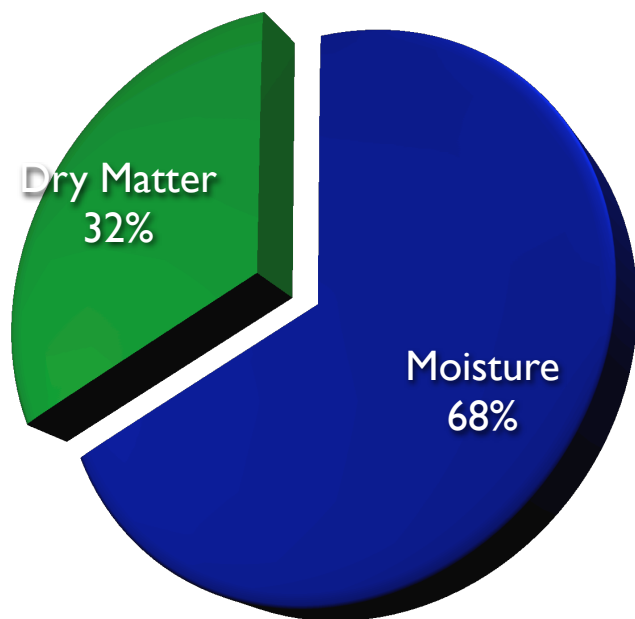
★ Increased intake

★ Reduced sorting by cows

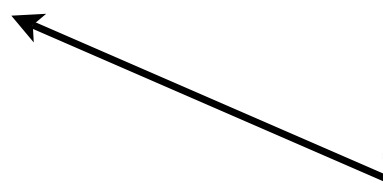
★ Source of water for cows



What is forage moisture content?



68% moisture



A cow's diet is based on **dry matter**.

Basic Dairy Ration

	DM%	Dry Matter, lb	Moisture, lb	As fed lb
Alfalfa Silage	40	11	17	28
Corn Silage	35	17	31	47
Concentrate+	90	23	3	25

* Assuming 50lb of dry matter intake



We feed based on weight !

10,335 lb water

2,915 lb DM

78%

9,673 lb water

3,577 lb DM

73%

9,010 lb water

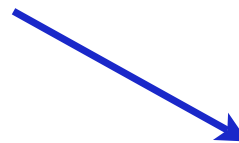
4,240 lb DM

68%



Dry Matter (DM) = Energy = Milk !

1lb DM corn silage = .73 Mcal (energy)



1lb milk requires .34 Mcal



Simplified loss calculation

	As fed (68% MC)	As fed (off 5%)	As fed (off 10%)
Wet	5313	5313	5313
DM	1700	1434	1169
Difference	0	266	531
Milk loss lb	0	570	1141
MAX \$ lost/day	0	70	140

* 50 lb DM intake, 100 cow herd

* Milk price 12.50 (\$/cwt)

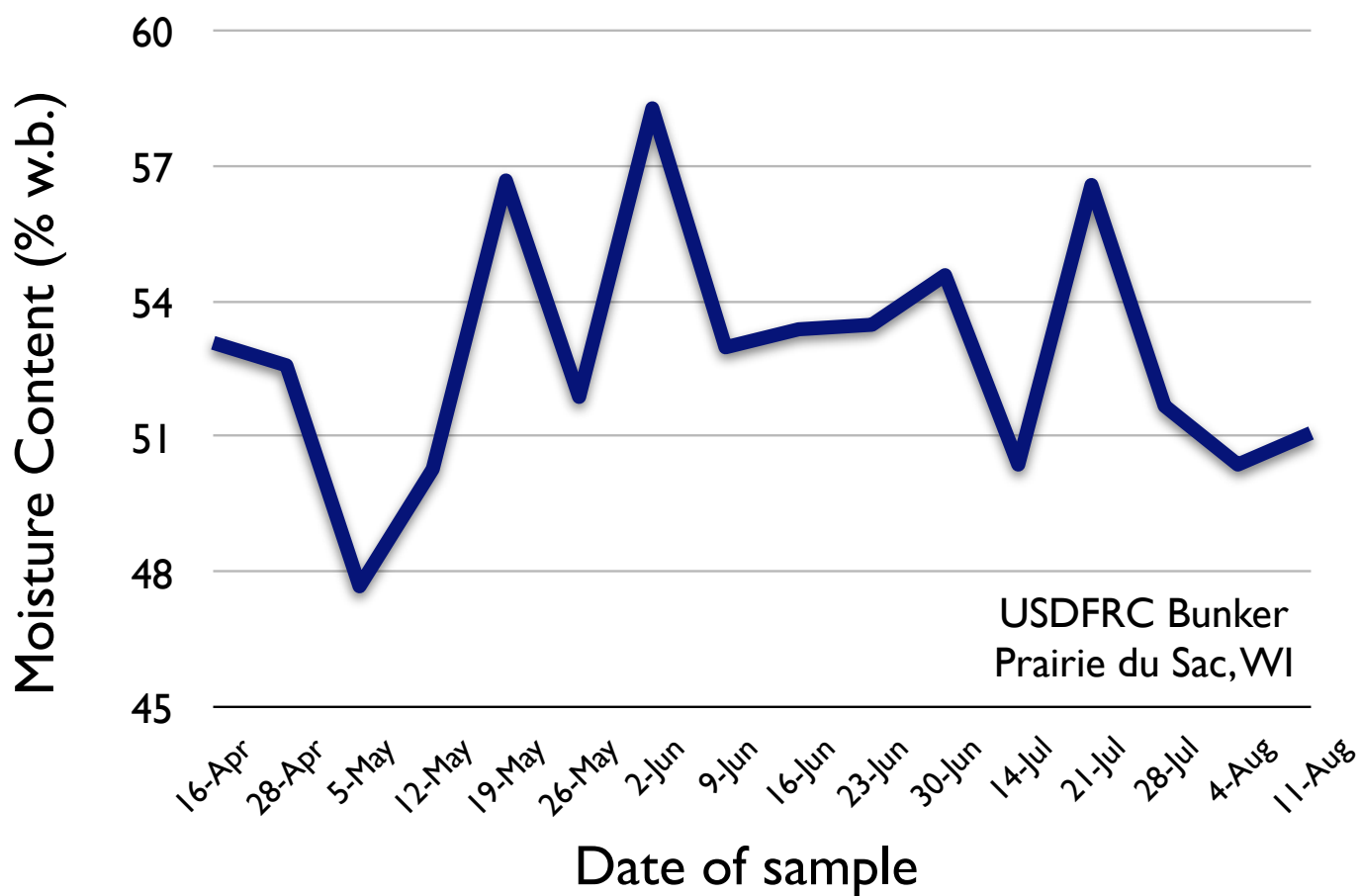


What did we leave out?

- ★ Actual loss less:
 - ◆ Cows mobilize energy reserves
 - ◆ Cows will consume built-in refusal feed
- ★ Off-feed issues
- ★ Over feeding DM:
 - ◆ Dilution of concentrates



How much does my feed actually vary?



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Measuring forage moisture

★ Gravimetric systems (difference in weight)

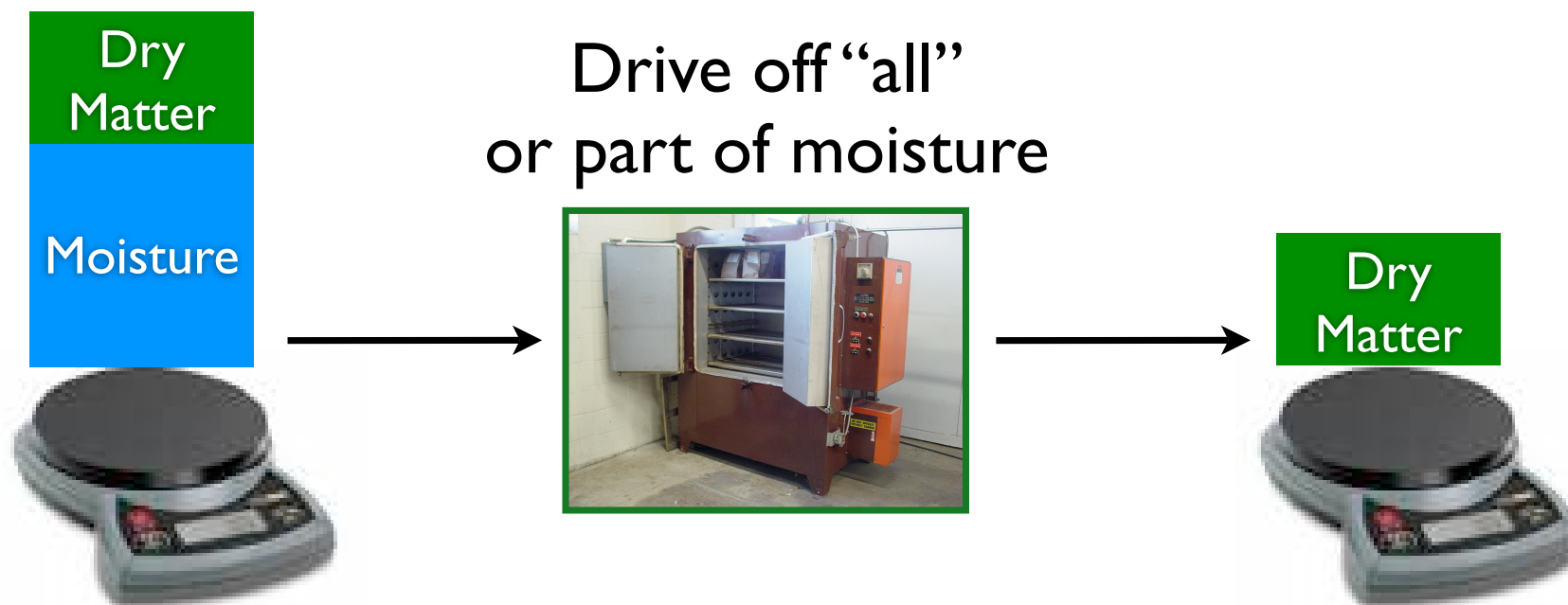
- ◆ Oven
- ◆ Microwave
- ◆ Koster/Food dehydrator/Vortex dryer

★ Electronic systems

- ◆ Capacitance
- ◆ Conductance
- ◆ NIRS



Gravimetric principle of operation



Determining moisture content

$$MC(\%) = \frac{\text{DM} - \text{Moisture}}{\text{DM}} \times 100$$

The equation is annotated with colored boxes: a green box labeled 'DM' is positioned above the 'Initial' term in the numerator; a blue box labeled 'Moisture' is positioned below the 'Initial' term in the numerator; a green box labeled 'DM' is positioned above the 'Final' term in the numerator; and a blue box labeled 'Moisture' is positioned below the 'Initial' term in the denominator.



Example

$$MC(\%) = \frac{\begin{array}{c} \text{DM} \\ \text{Moisture} \end{array} 200 - \begin{array}{c} \text{DM} \\ \end{array} 100}{\begin{array}{c} \text{DM} \\ \text{Moisture} \end{array} 200} \times 100 = 50\%$$



Gravimetric systems



Drying Oven



Microwave



Koster



Food Dehydrator



PSU Vortex Dryer

Time	24-72 hours	5-10 minutes	30 minutes	2-24 hours	20-60 minutes
Accuracy	reference	± 2%	± 1-2%	± 2-1%	± 1%
Cost	\$2000+	\$50	\$285*	\$250	\$40
Comments	Most accurate	Quickest	Easy to use	Dries multiple samples	Portable, inexpensive

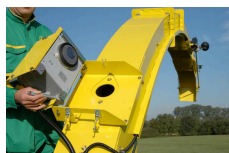
*Price includes scale.

Gravimetric systems

- + Very accurate
- + Cost effective
- Many require significant operator time
- Many not practical for harvesting
 - ◆ lack timeliness
 - ◆ lack portability



Electronic systems



NIR



Capacitance



Conductance

	NIR	Capacitance	Conductance
Time	5 seconds	1 minute	1 minute
Accuracy	± 2-2.5%	± N/A	± 3%
Cost	\$??	\$300	\$200
Comments	Density independent	Easy to use	



Electronic systems

- ± Can be accurate if used properly
- + May be used in harvesting situations
 - ◆ Quick measurements
 - ◆ Portable
- Few low cost options
- Performance dependent on calibration



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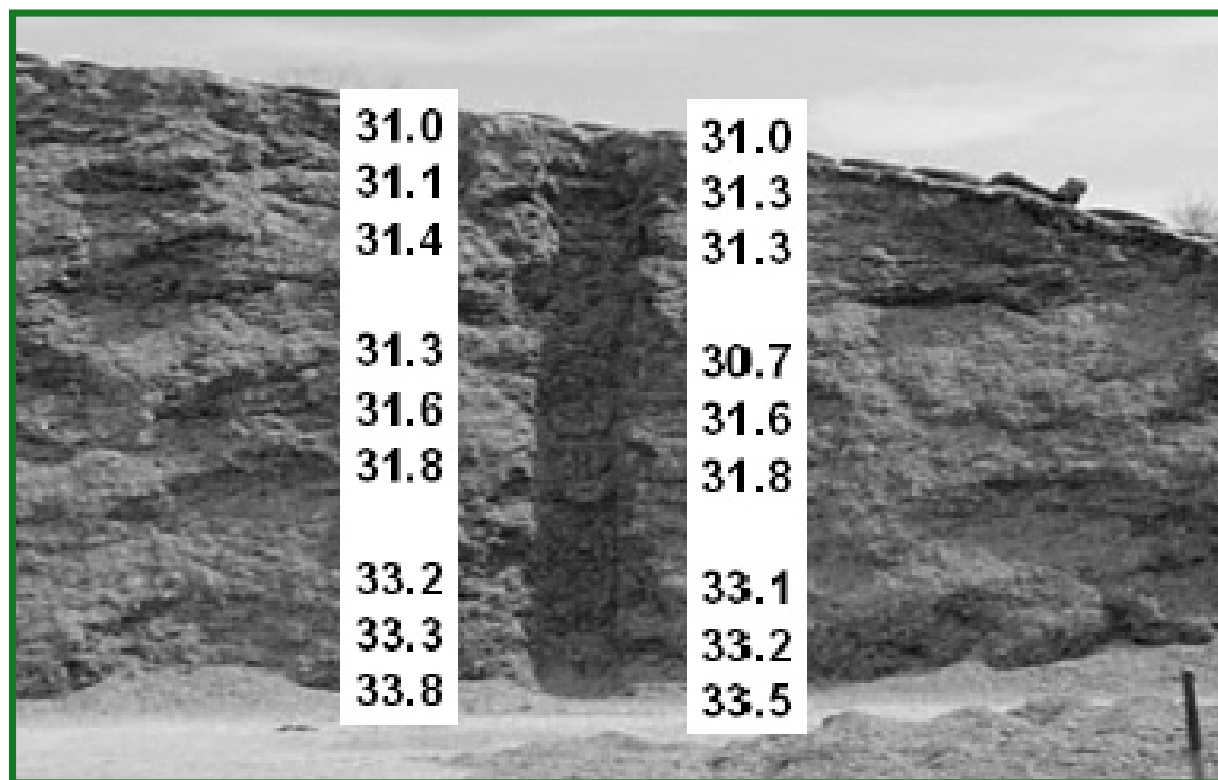


Sampling

- ★ More important than your selection of measurement method !!!
- ★ Sample must represent entire batch/day/week



Sampling



Source: Stone, 2004

Take home message

- ★ Rations are balanced using dry matter
- ★ Rations are fed by weight (moisture + dry matter)
- ★ Forage moisture is variable
- ★ Sample often
- ★ Representative sample is key



Questions?



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<http://www.ars.usda.gov/mwa/madison/dfrc>

