UVM Extension 2021 Online Dairy Education Series, March 2021

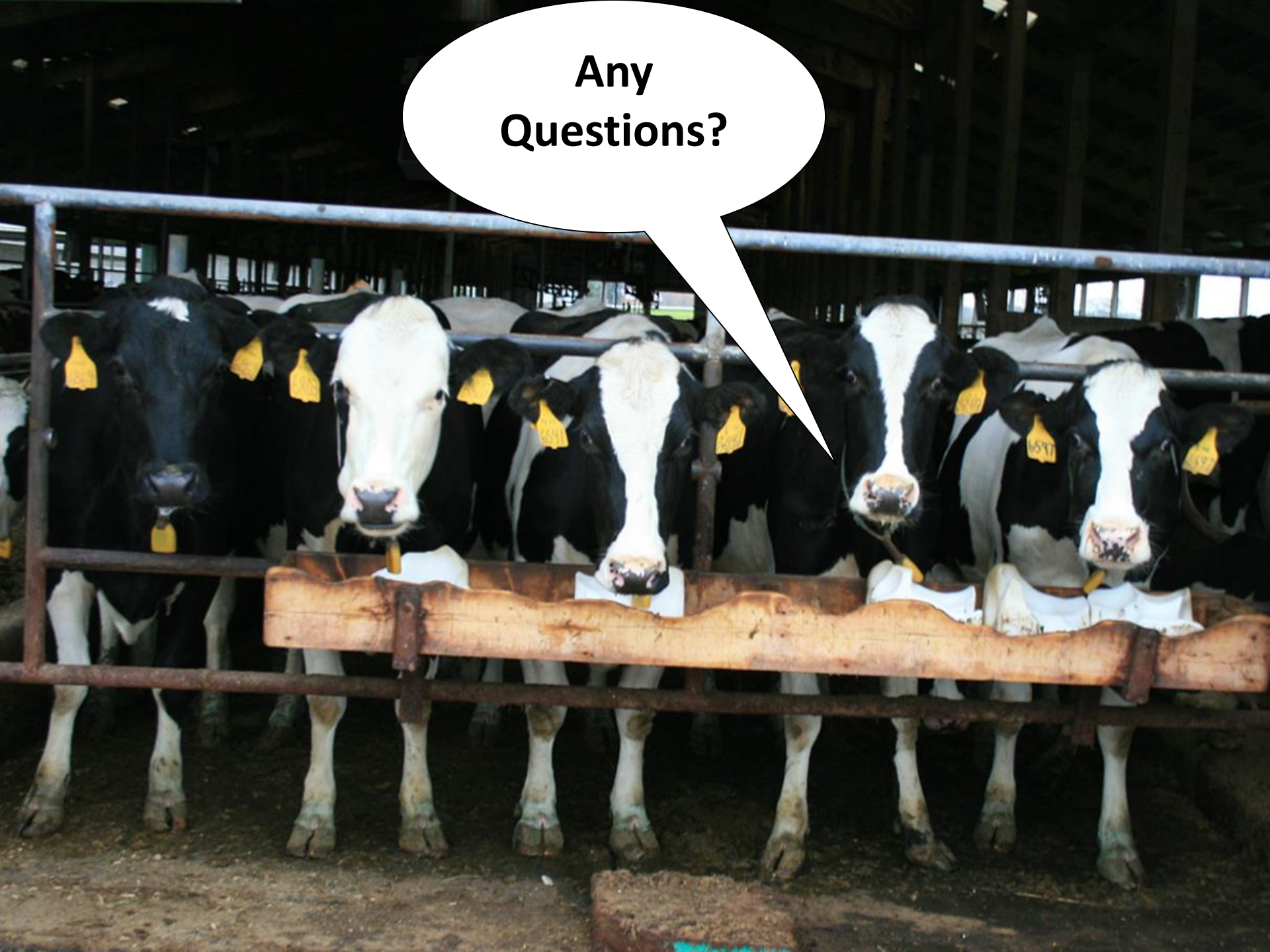
Forage Quality: How to Improve, Assess, and Feed More Forage

Managing Forage Crops for High Quality and Yield

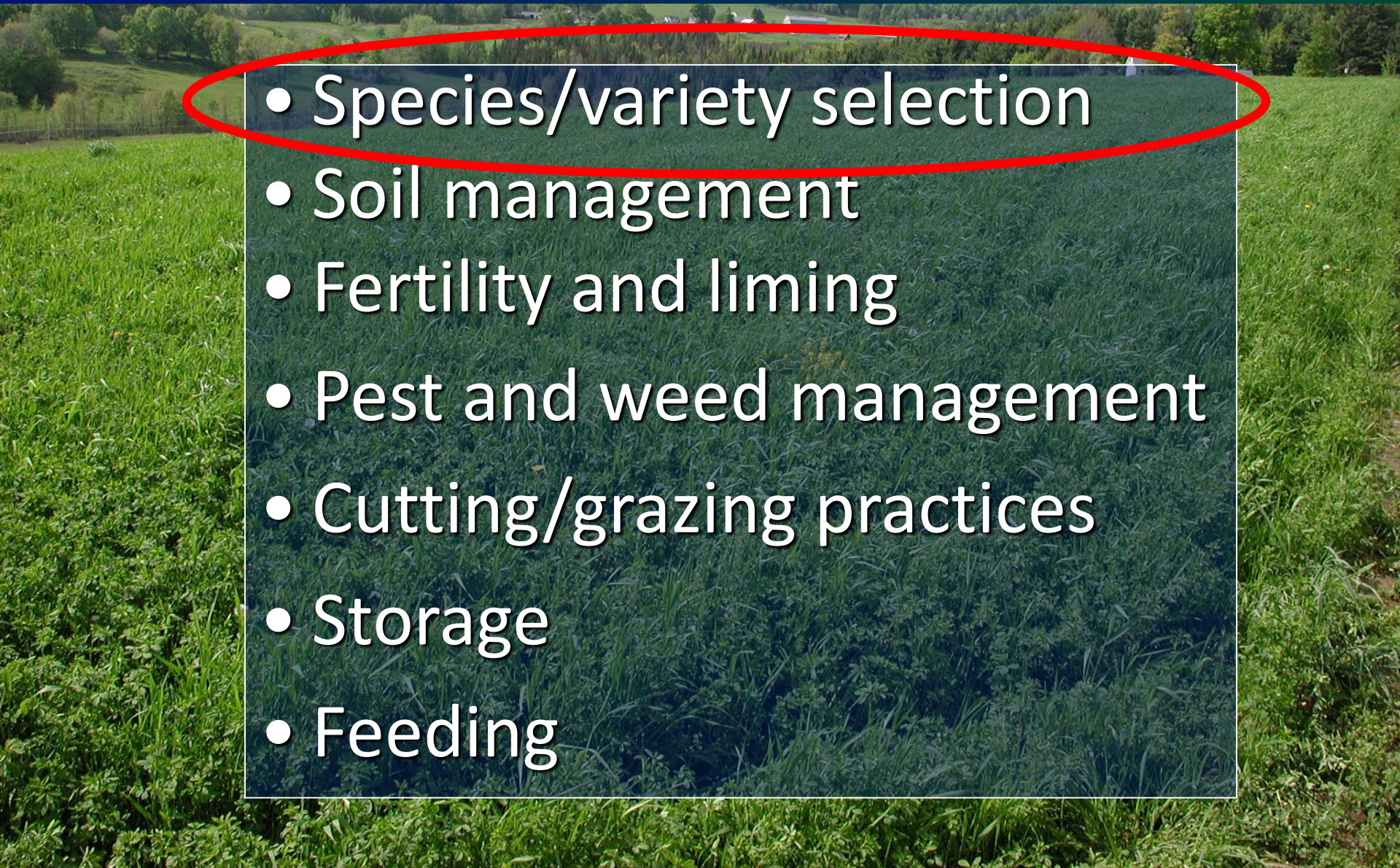
Sid Bosworth
Extension Agronomist (Retired)
University of Vermont

UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES

The UNIVERSITY of VERMONT
Plant and Soil Science


Any
Questions?

What can you control in your forage crop program to meet your yield and quality goals?



- Species/variety selection
- Soil management
- Fertility and liming
- Pest and weed management
- Cutting/grazing practices
- Storage
- Feeding

How Do You Choose Your Forages?

Considerations:

- Yield
- Quality
  - Crude protein?
  - Digestibility and energy
  - Tolerance of frequent harvests
  - Leaf texture*
- Time of flowering or heading (early to late)
- Disease resistance
- Winter hardiness
- Stand life (short term vs. long term rotation)
- Endophyte “free” or “enhanced”

Seed Costs

Are you growing the most adapted forage species on your farm?

Are you growing the most adapted forage species…

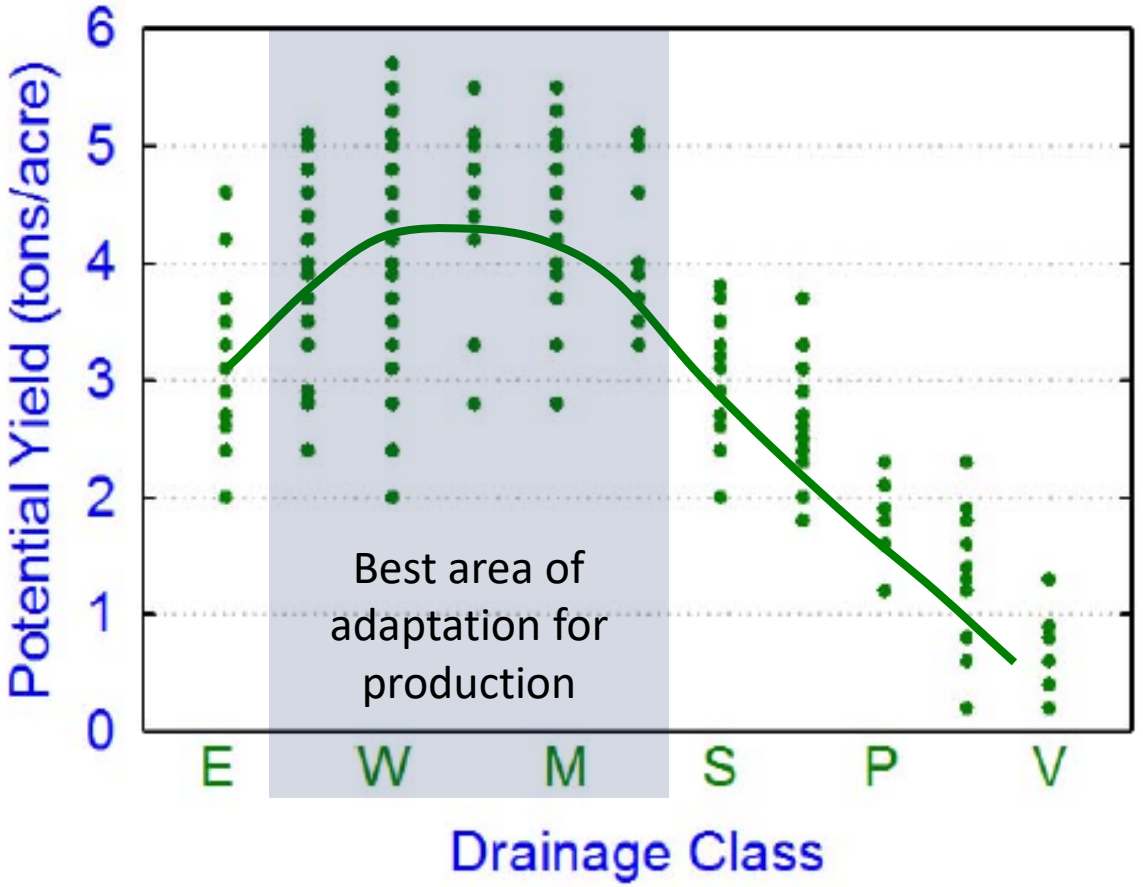


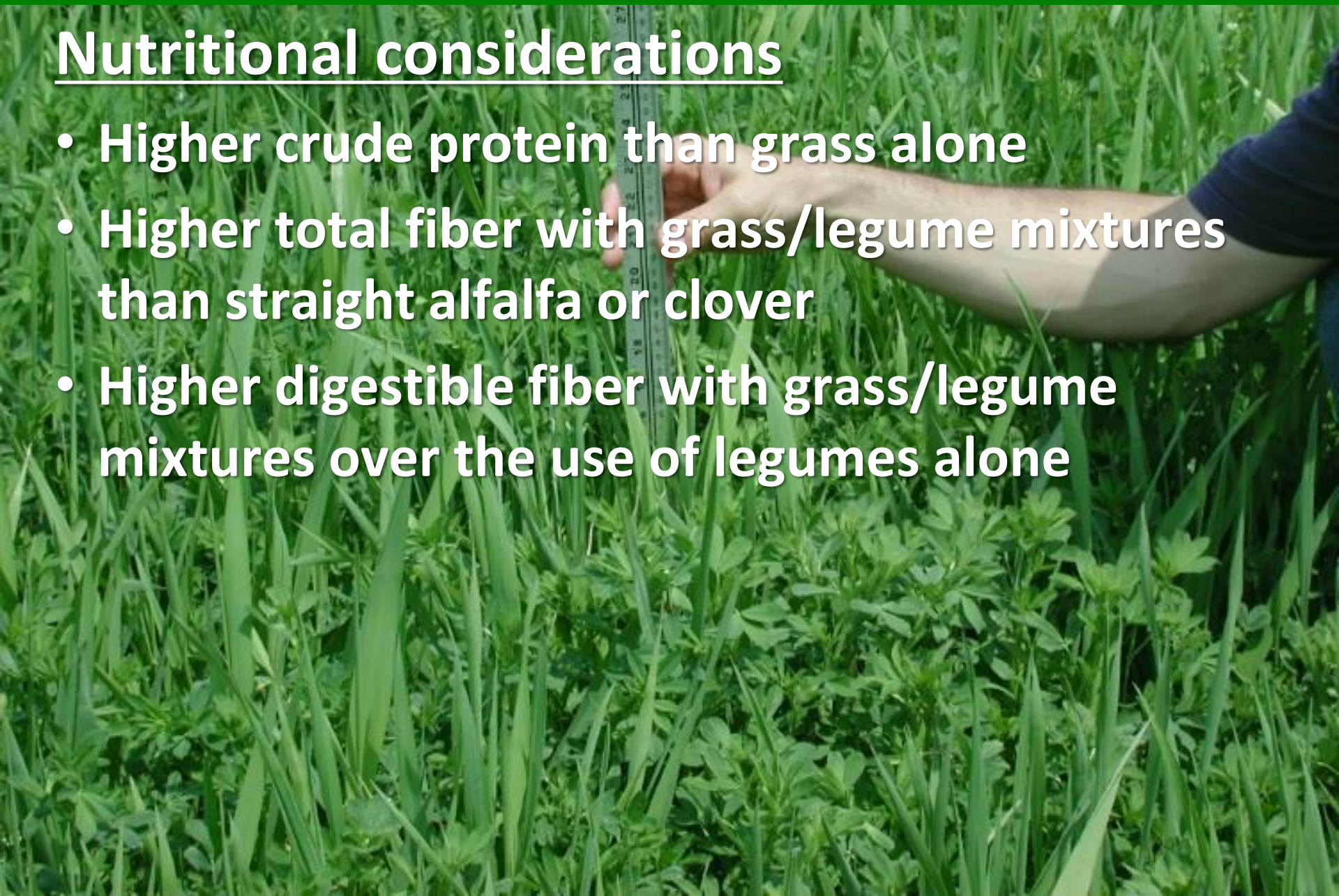
Figure 1. Orchardgrass yield potential on 640 NY soil types. Drainage classes are exceptionally well drained (E) to very poorly drained (V). Cherney, 2011, Cornell University

Forage Crop Mixtures

Agronomic considerations

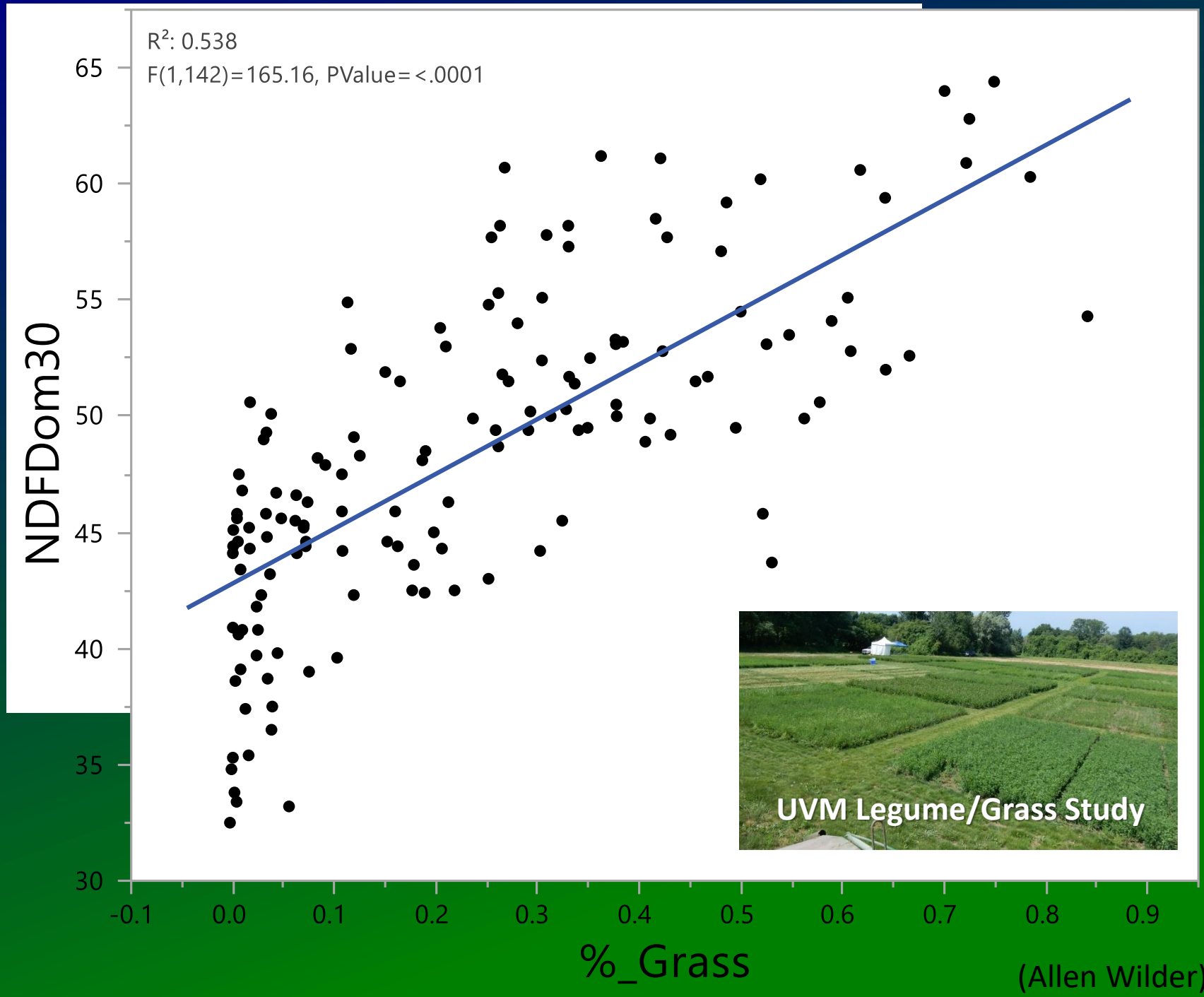
- Improve yields over wide range of soil conditions
- Less risk of thinned stands due to winterkill, pests, and diseases
- Challenge in getting desired mixture

Forage Crop Mixtures



Nutritional considerations

- Higher crude protein than grass alone
- Higher total fiber with grass/legume mixtures than straight alfalfa or clover
- Higher digestible fiber with grass/legume mixtures over the use of legumes alone



(Allen Wilder)

Forage Crop Mixtures

Challenge of mixtures – poor consistency

- Between fields
- Over the season
- Across years

Putting the Right Mixture Together

Which legumes for your mixture?

Which legumes for your mixture?

- Yield
- Quality
  - ✓NDF digestibility
  - ✓Non-structural carbohydrates
  - ✓Degradable protein

Variety Really Counts!

Allen Wilder – UVM MS. Candidate

Sid Bosworth – Extension Agronomist

Managing Legume-Grass Mixtures for High Forage Diets

UNIVERSITY OF VERMONT EXTENSION

University of New Hampshire

USDA NIFA

INTEGRATED RESEARCH, EDUCATION, AND EXTENSION COMPETITIVE GRANTS PROGRAM – ORGANIC TRANSITIONS

Legume/Grass Study

Located at the UVM Horticultural Research Farm,
Adams Sandy Loam Soil
Organically Managed

Legumes:

+

Grasses:

L/G Binary mixtures:

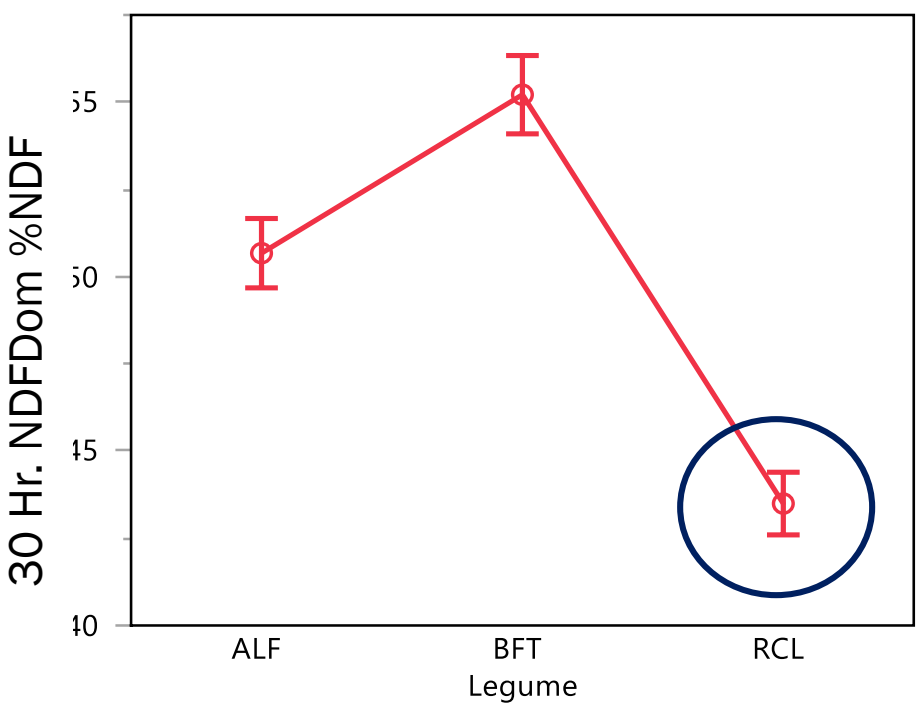
- Tall Fescue
- Meadow Fescue
- Perennial Ryegrass
- Timothy
- None (pure legume)

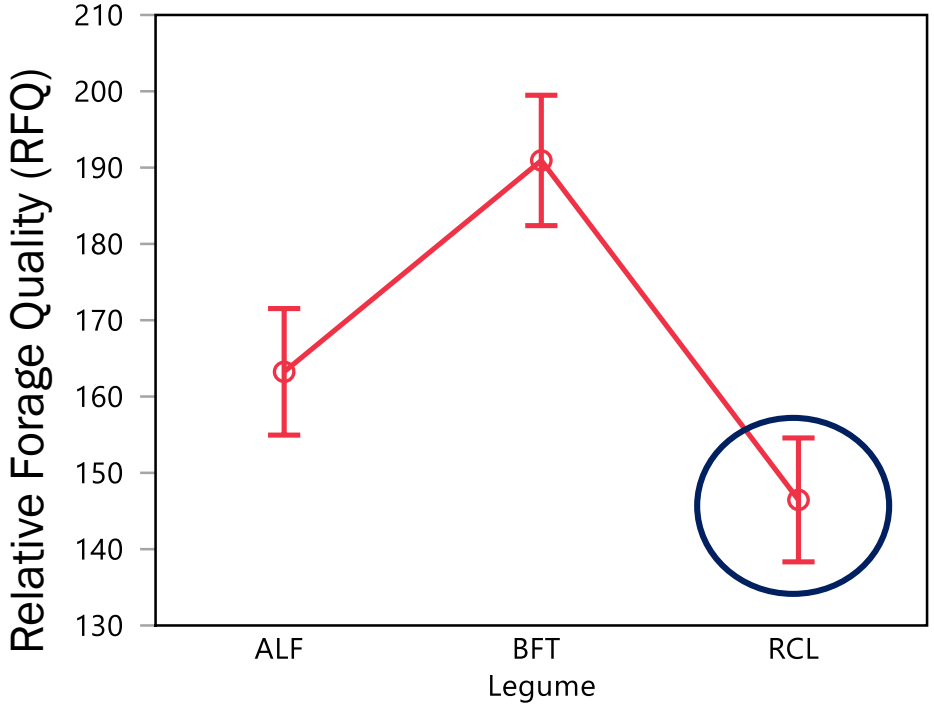
Management:

3 Cut (Delayed)
VS.
4 Cut (Intense)

Species	Cultivars
Alfalfa	KF 406 AP
Red Clover	Freedom
BFT	Bruce
Timothy	Summit
Meadow fescue	Preval
Tall fescue	Kora
PRG	Tivoli

Legume* Forage Quality 2018



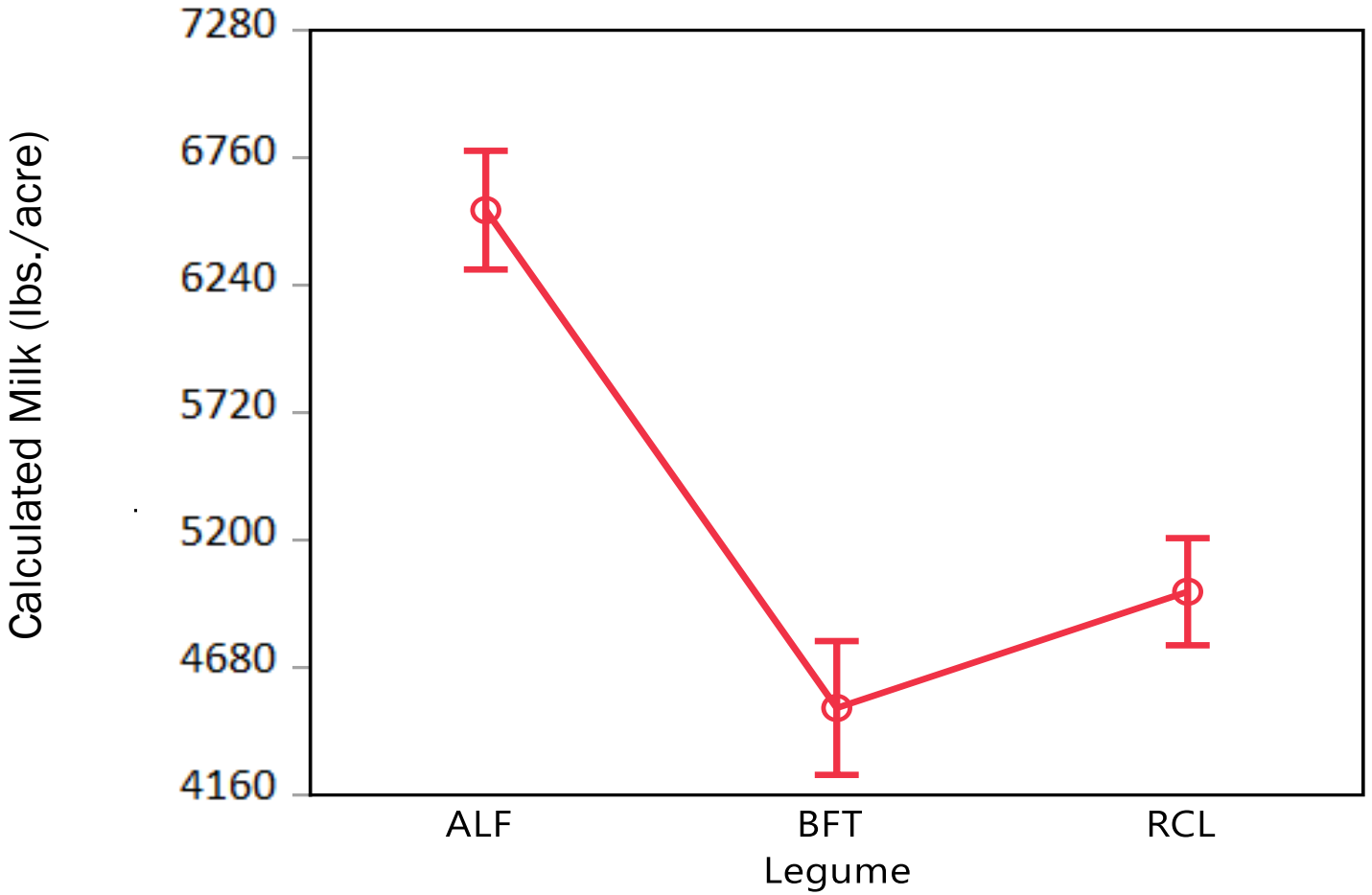


Similar results observed in 2019 with lower significance

* A weighted averaged across all cuttings and legume/grass treatments - adjusted for yield and the proportion of grass and legume in each mixture

(Wilder, UVM)

2018 Calculated Milk of Legume Mixtures*



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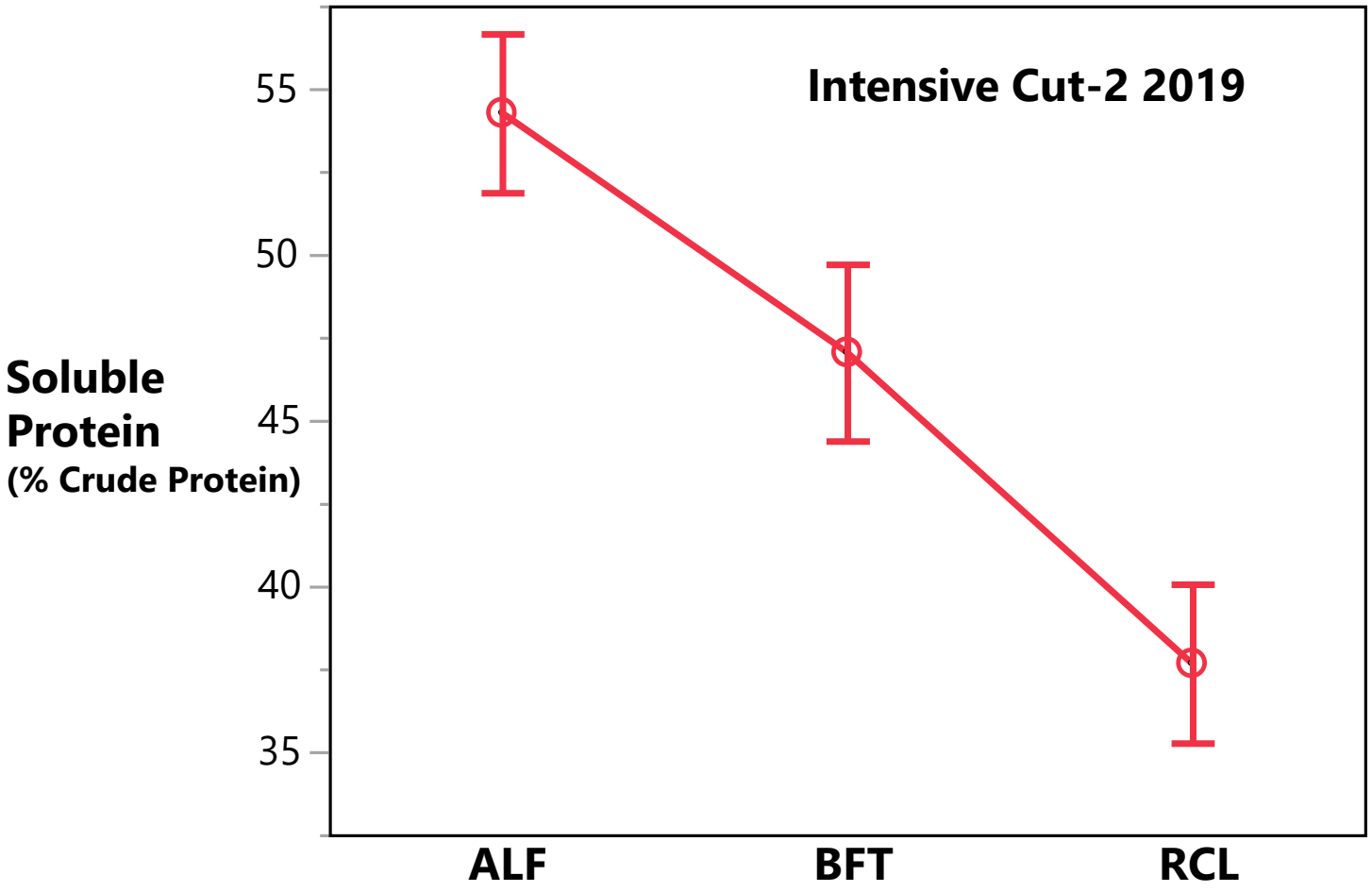
(Wilder, UVM)

Legume /Grass Study

Soluble Protein* of Legumes



Got the same trend in six out of six harvests

* A weighted averaged across all legume/grass treatments - adjusted for yield and the proportion of grass and legume in each mixture

(Wilder, UVM)

UVM Legume Trial (2018/19)

Table 5. Forage quality characteristics by species, 1st cut, 2018.

Species	DM	CP	ADF	NDF	48-hr NDFD
	%		% DM		% NDF
Alfalfa	26.7	20.5*	24.9	35.9	51.9
Birdsfoot Trefoil	23.1*	19.7	23.9*	32.9*	55.8
Red Clover	**21.9**	21.0*	26.2	37.0	49.5
White Clover	22.2*	**21.5**	**22.1**	**32.1**	**61.5**
p-value	<0.0001	<0.05	<0.0001	<0.05	<0.0001
Cut Mean	24.0	20.8	24.4	34.9	54.1

Table 6. Forage quality characteristics by species, 2nd cut, 2018.

Species	Dry matter	CP	ADF	NDF	48-hr NDFD
	%		% DM		% NDF
Alfalfa	28.0	22.7*	25.9	36.2	49.1
Birdsfoot Trefoil	**24.5**	22.2*	**25.1**	**33.3**	51.9
Red Clover	25.0*	**22.8**	26.2	36.8	49.1
White Clover	26.3*	21.8	26.3	35.8	**57.3**
p-value	<0.05	<0.05	NS	<0.05	<0.0001
Cut Mean	26.5	22.4	26.0	36.0	51.4

Treatments with an asterisk* performed statistically similar to the top performer in **bold.**
NS – Not significant.

Darby et. al. 2018
(https://www.uvm.edu/sites/default/files/media/2018_Legume_VT_Report.pdf)

UVM Legume Trial (2018/19)

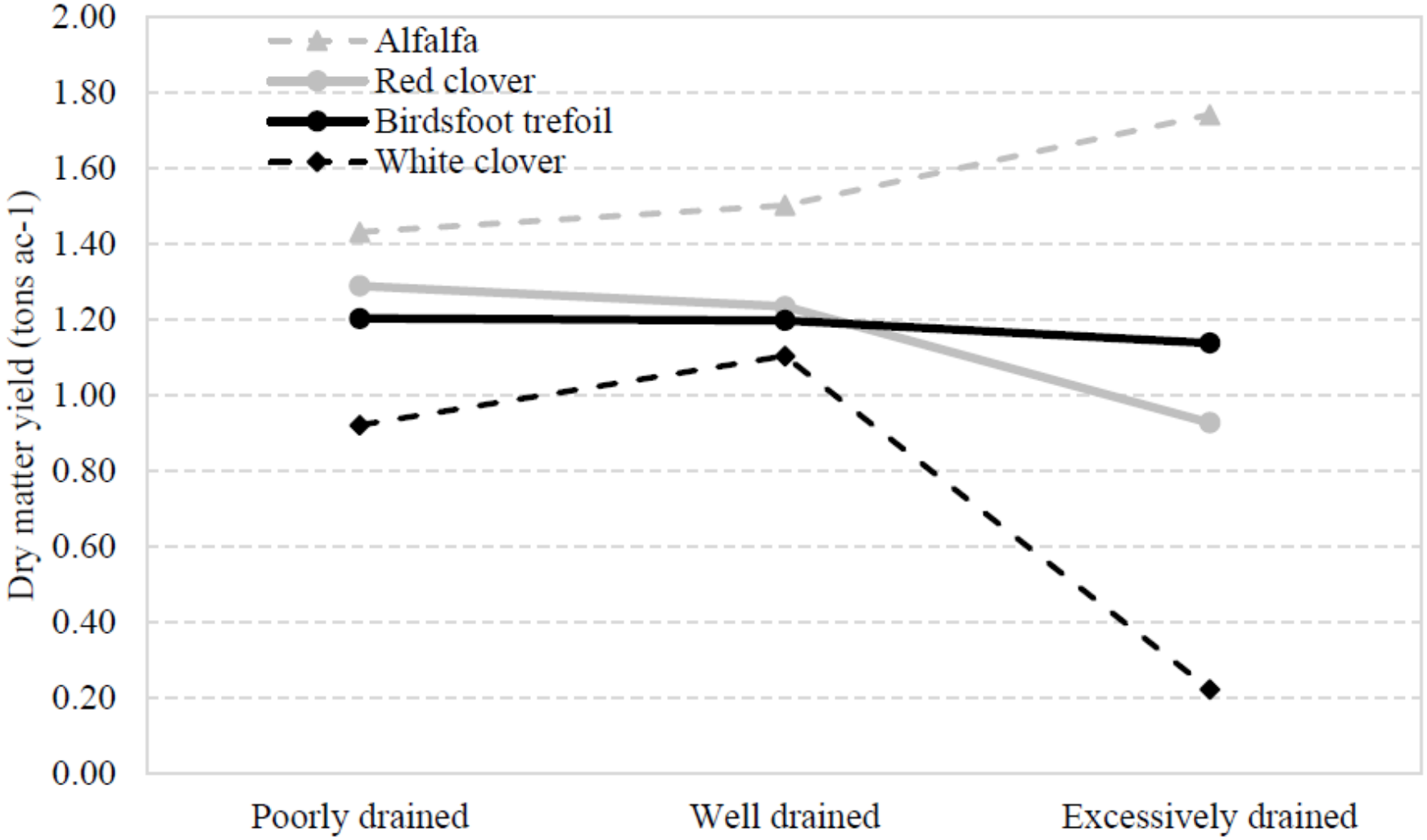


Figure 5. 2nd cut dry matter yield by legume species across soil drainage class, 2019.

Darby et. al. 2019 (https://www.uvm.edu/sites/default/files/Northwest-Crops-and-Soils-Program/2019_Legume_VT_Report.pdf)

Selecting Grasses for Quality

- Want grasses that tolerate intensive cutting

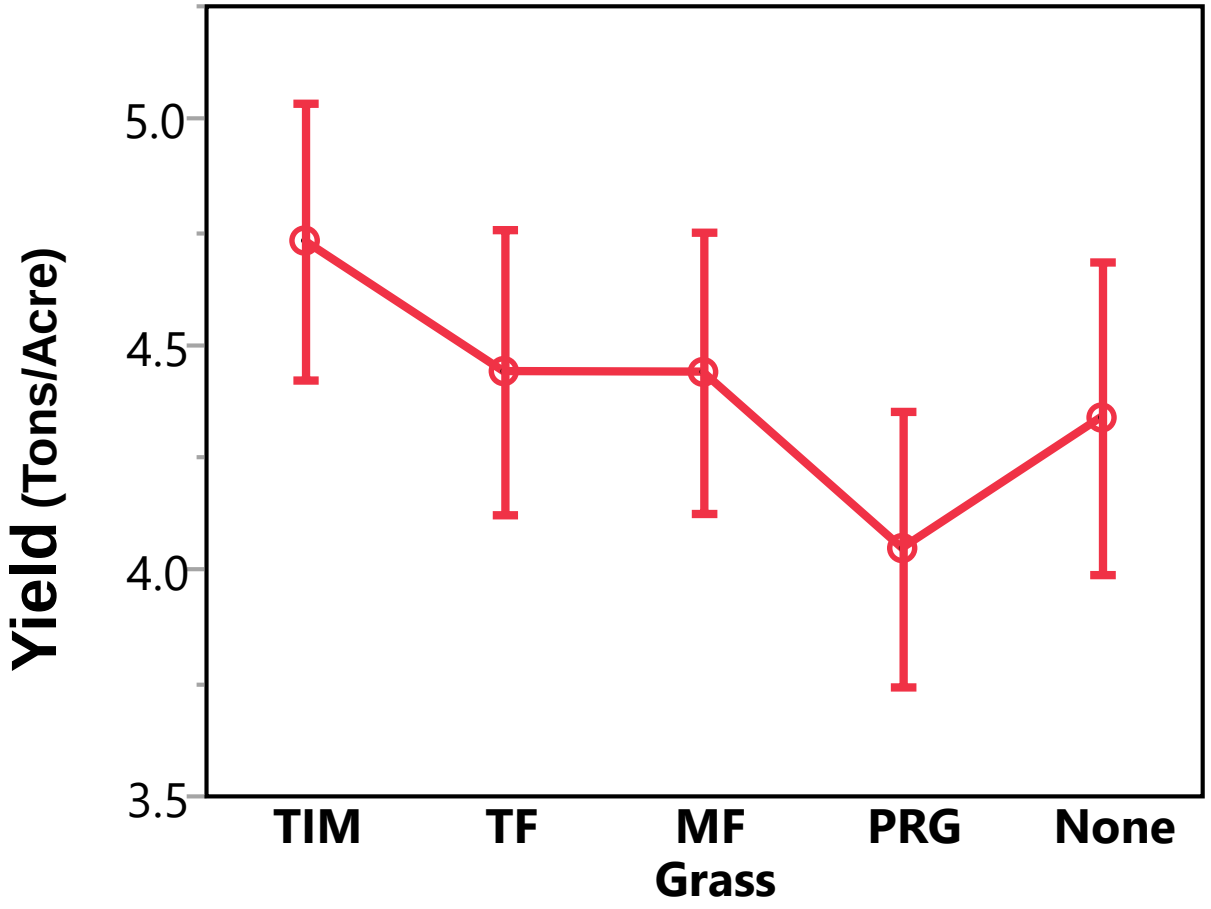
What About Timothy?

- Tolerates wet sites
- Winter hardy
- Easy to establish

But…

- Less tolerate of early, frequent cuts but variety dependent
- Poor seasonal distribution with low summer yield
- Lower in CP than other grasses

2018 Yields* of Grass/Legume Mixtures



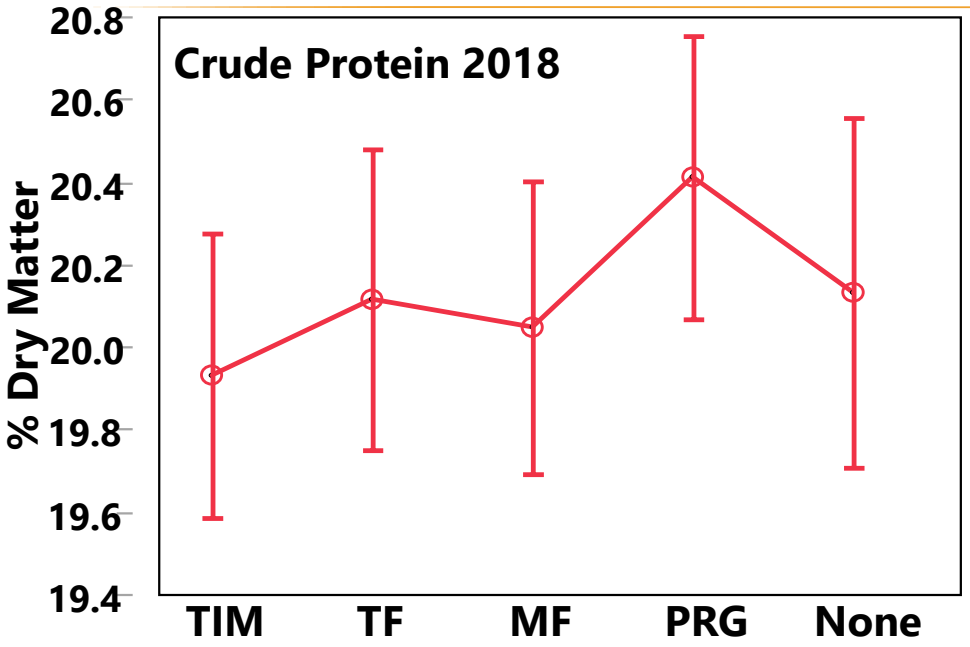
Similar results observed in 2019

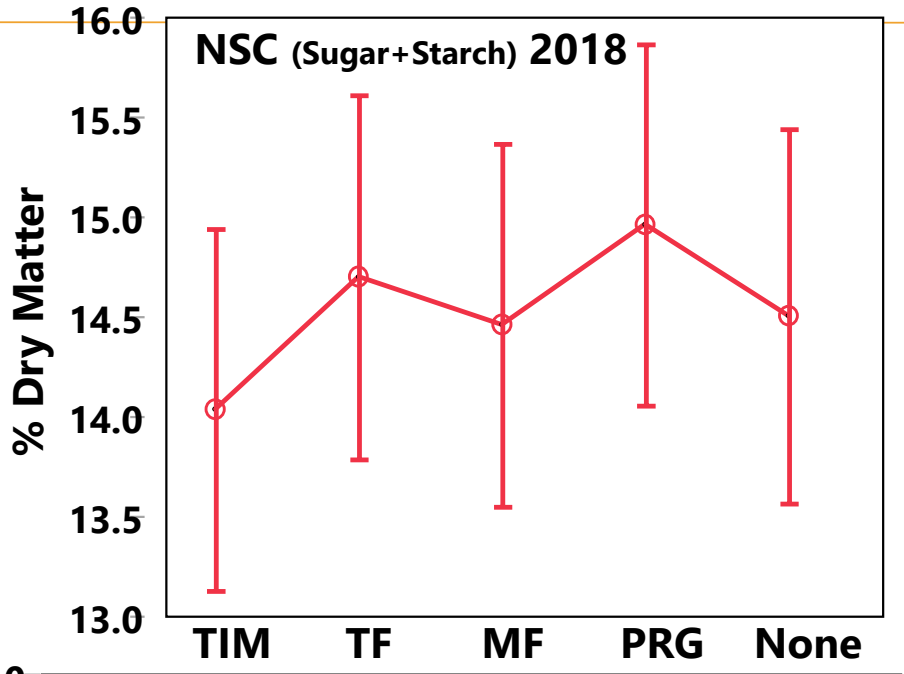
* A weighted averaged across all cuttings and legume/grass treatments - adjusted for yield and the proportion of grass and legume in each mixture

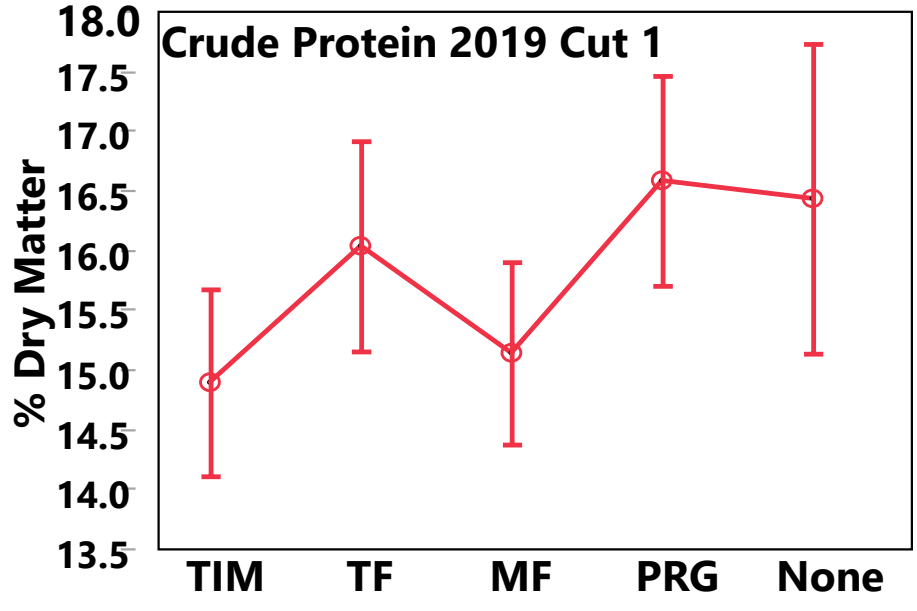
(Wilder, UVM)

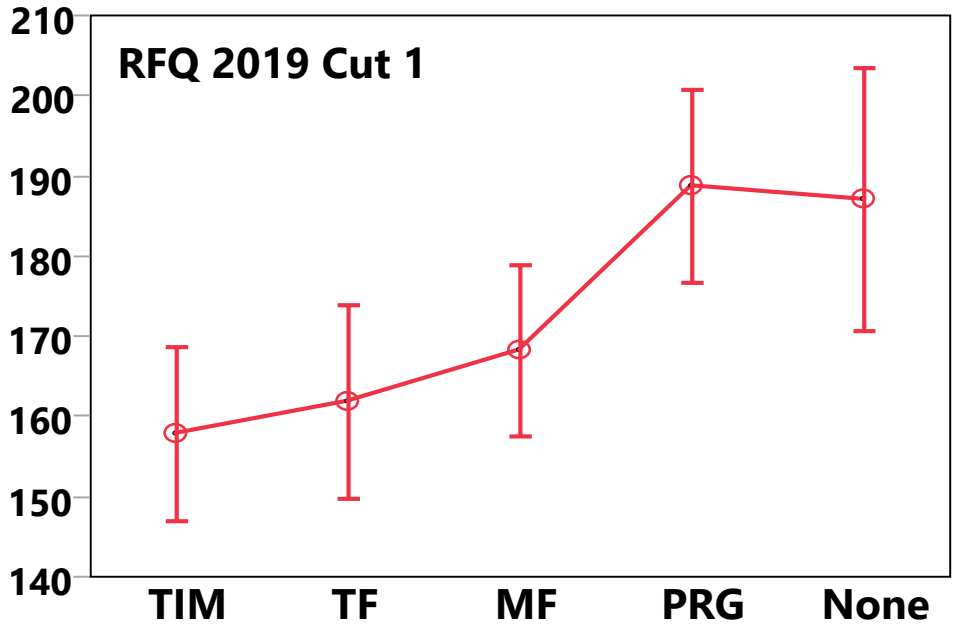
Quality * of Grass/Legume Mixtures

(Wilder, UVM)



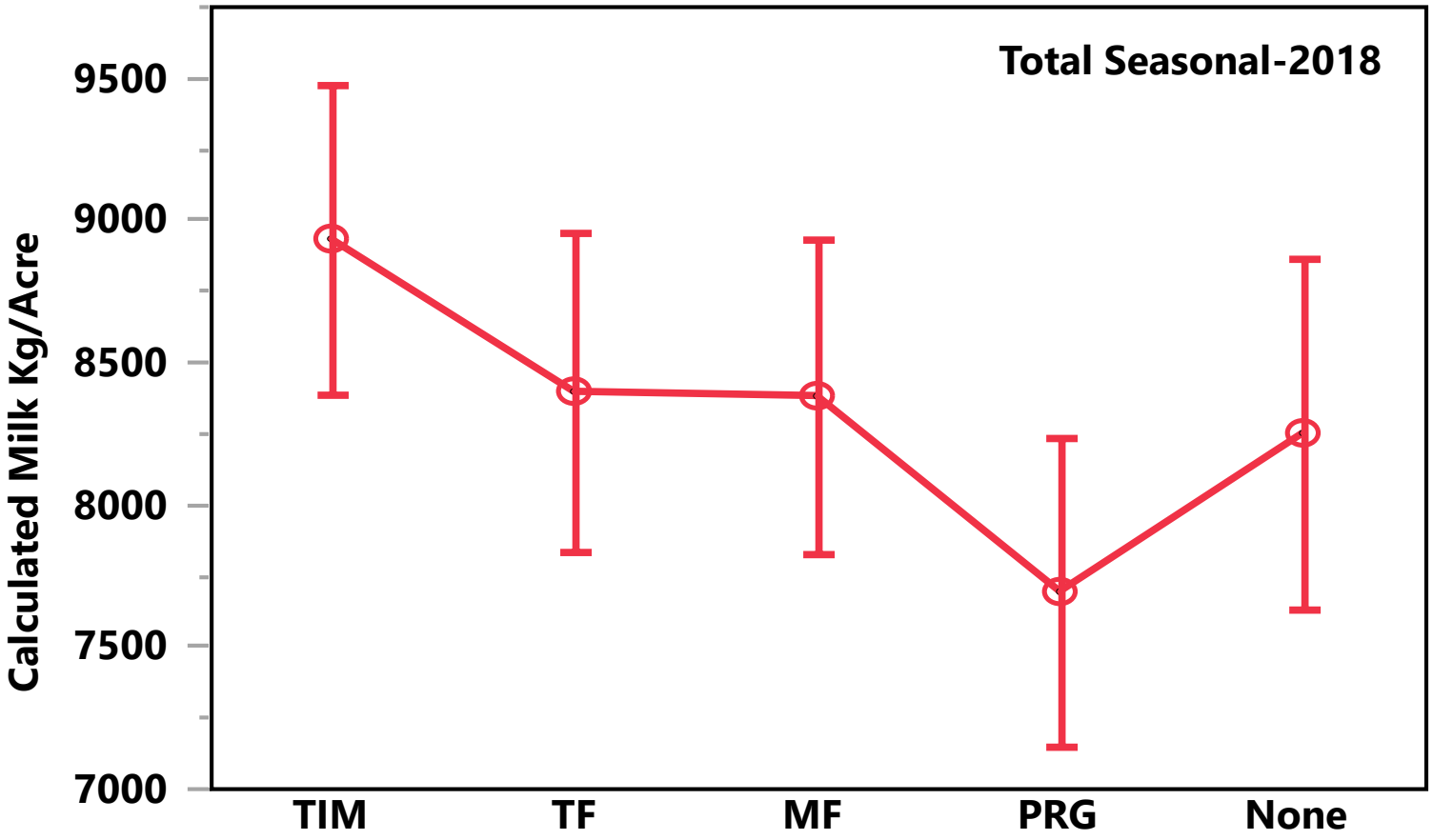






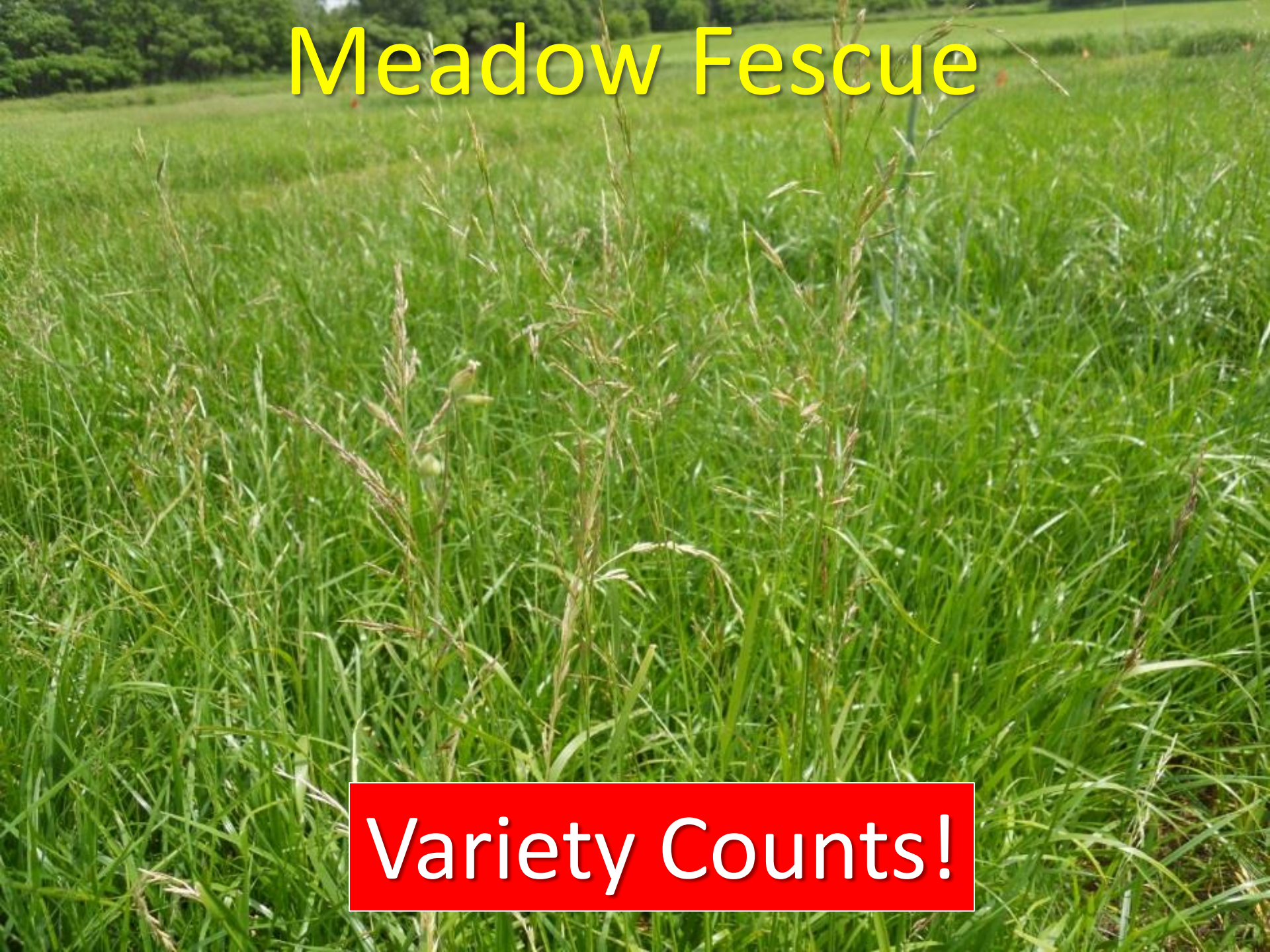
Estimated Milk* of Grass/Legume Mixtures

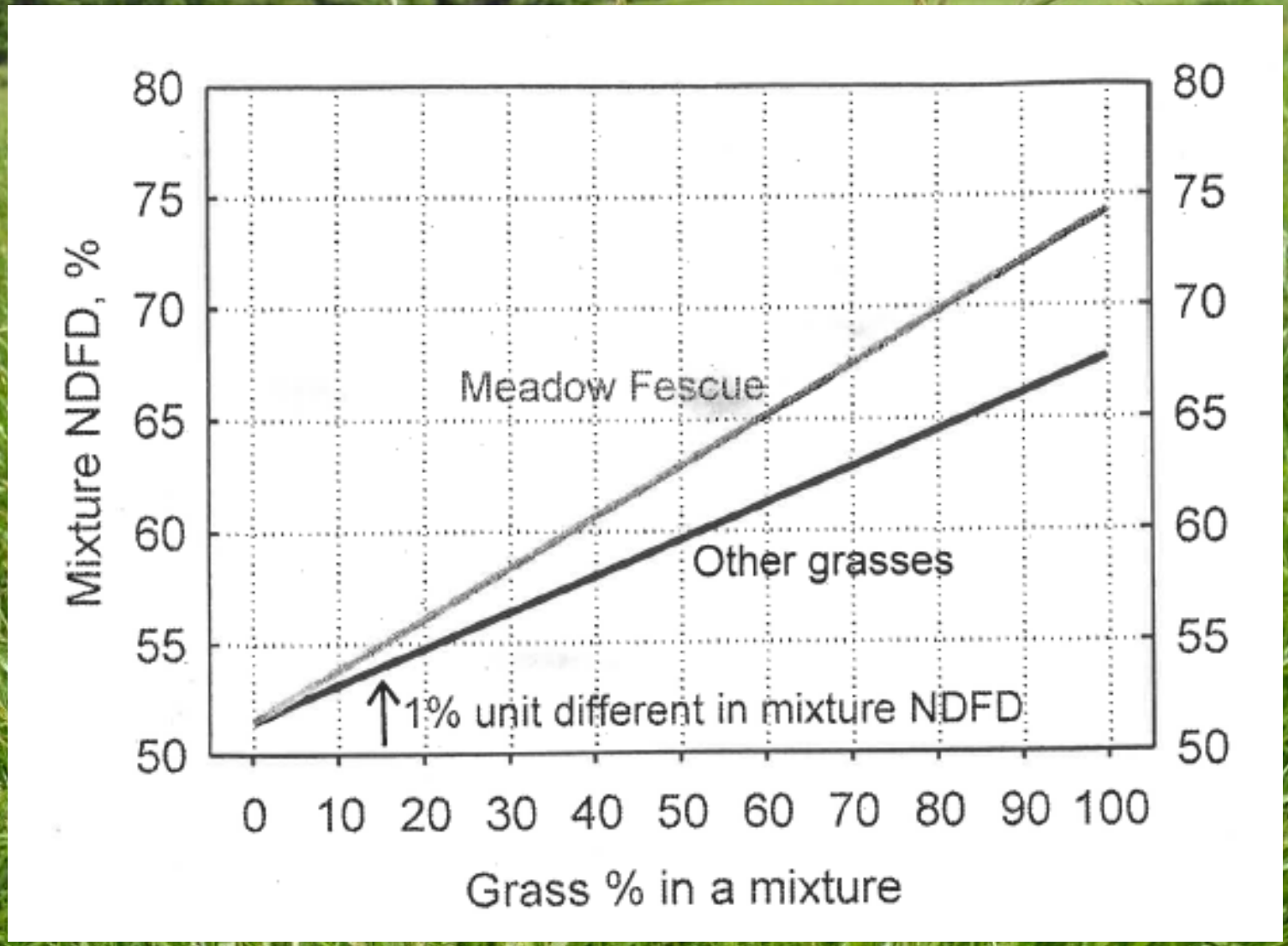
- Quality differences did not counteract predicted milk yield



(Wilder, UVM)

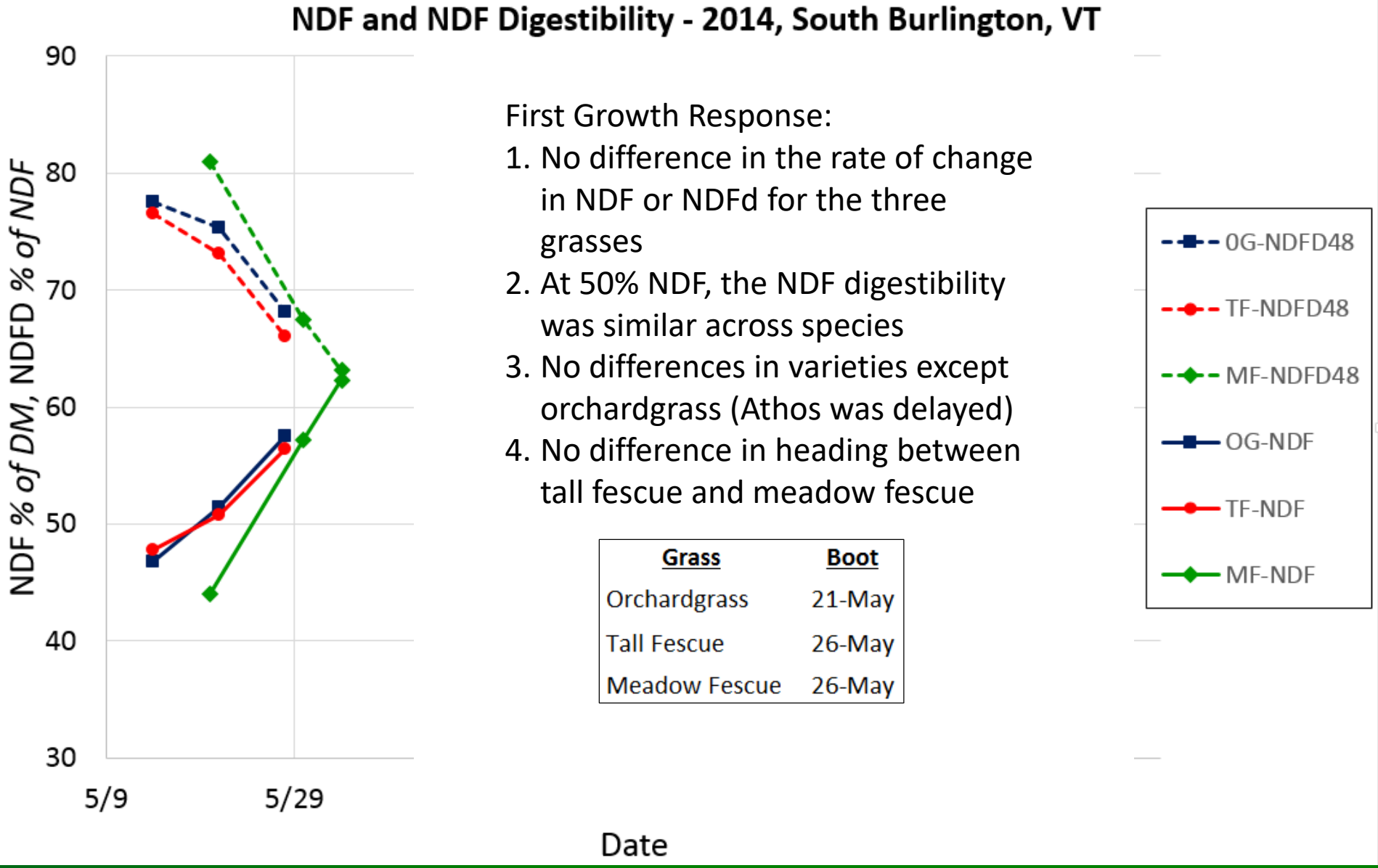
* A weighted averaged across all cuttings and legume/grass treatments - adjusted for yield and the proportion of grass and legume in each mixture


Meadow Fescue
Variety Counts!



Jerry Cherney, Cornell 2017

Orchardgrass, Tall Fescue and Meadow Fescue Quality in Vermont



First Growth Response:

1. No difference in the rate of change in NDF or NDFd for the three grasses
2. At 50% NDF, the NDF digestibility was similar across species
3. No differences in varieties except orchardgrass (Athos was delayed)
4. No difference in heading between tall fescue and meadow fescue

Grass	Boot
Orchardgrass	21-May
Tall Fescue	26-May
Meadow Fescue	26-May

Source: Bosworth and Darby, Un. of Vermont

The Fescues

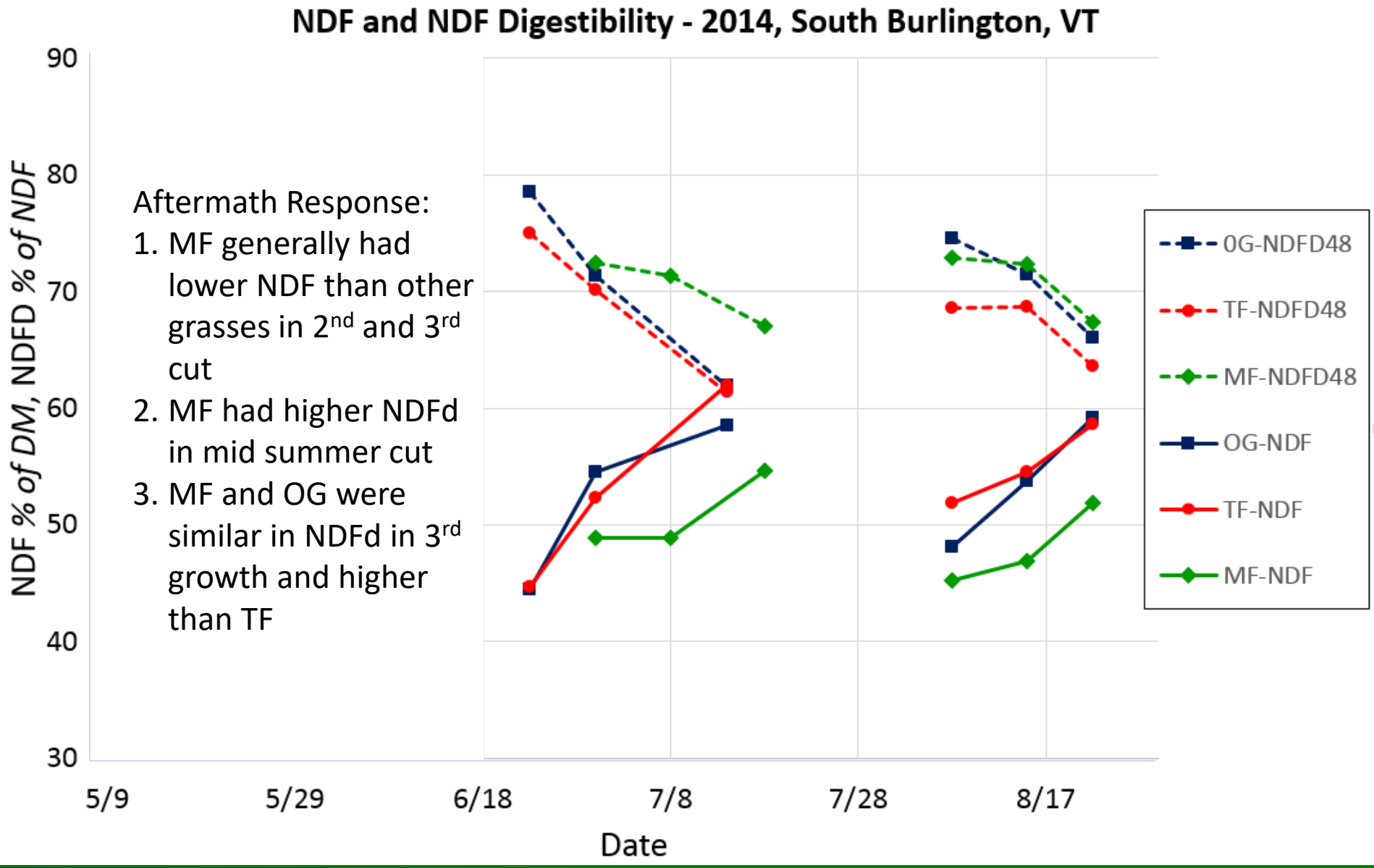
UVM Hort Farm 5/21/2014

The Fescues

Tall Fescue

Meadow Fescue

Orchardgrass, Tall Fescue and Meadow Fescue Quality in Vermont – South Burlington, VT



Aftermath Response:

1. MF generally had lower NDF than other grasses in 2nd and 3rd cut
2. MF had higher NDFd in mid summer cut
3. MF and OG were similar in NDFd in 3rd growth and higher than TF

Source: Bosworth and Darby, Un. of Vermont

Orchardgrass

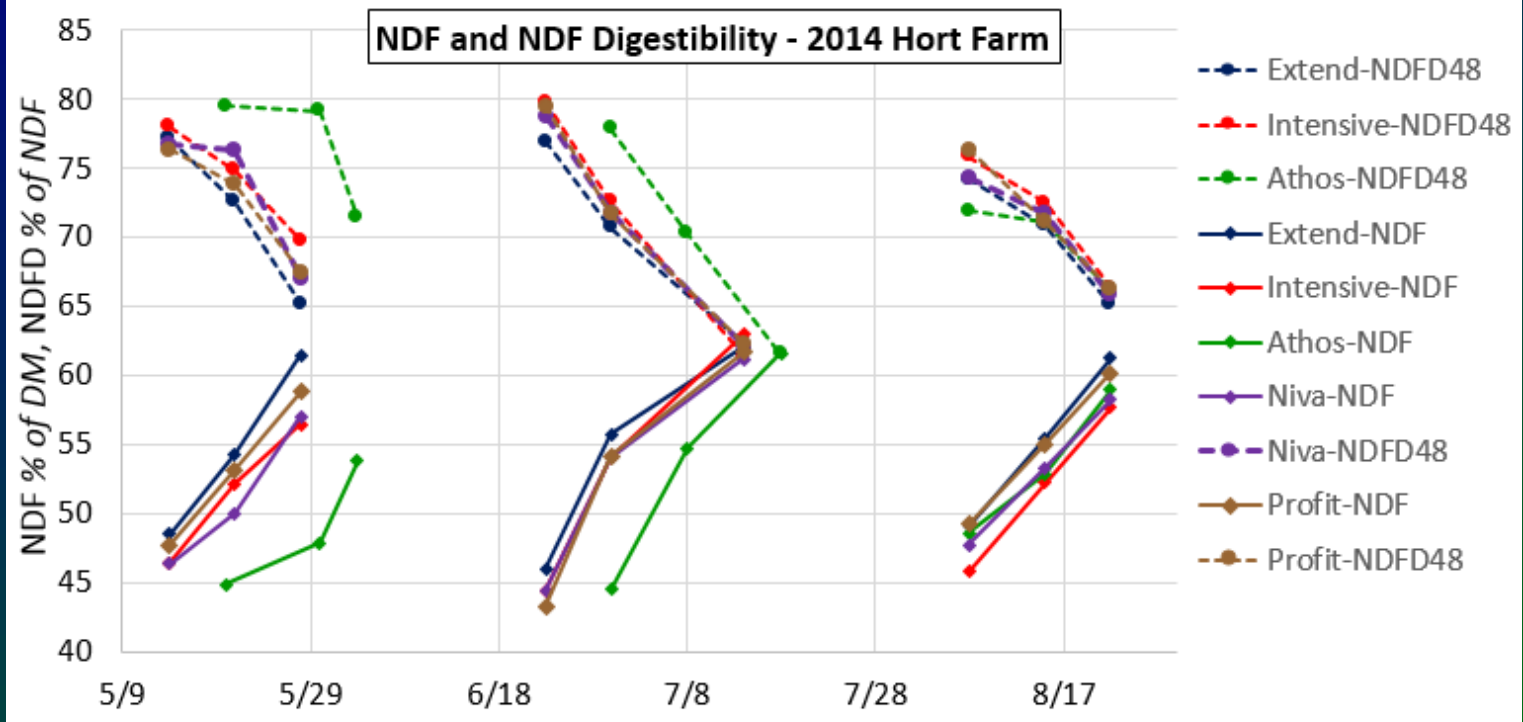
- Late maturing varieties
- Culmless varieties

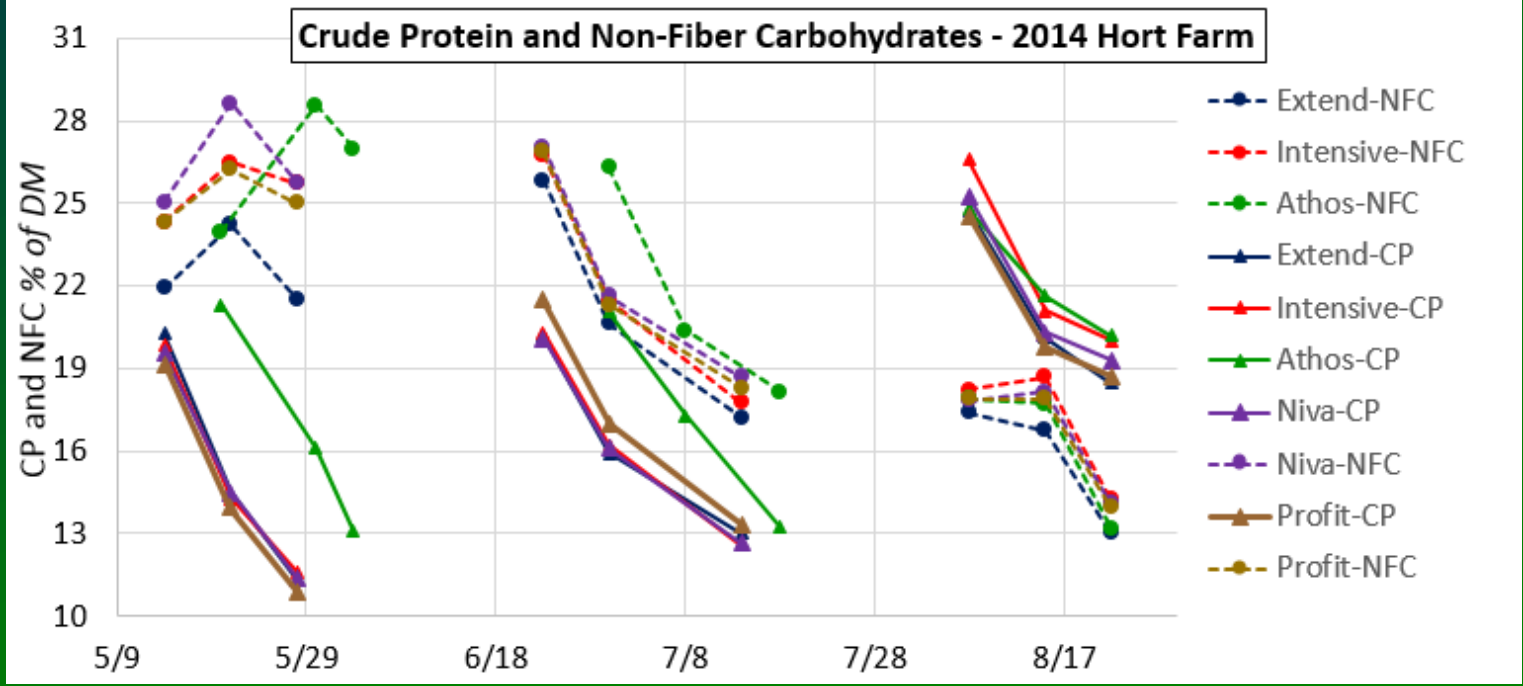
Change in Quality of Five Cultivars of Orchardgrass

South Burlington Vermont

Cultivar	Early Head*
Extend	21-May
Profit	24-May
Niva	25-May
Intensive	28-May
Athos	30-May

*Collected in 2015





Source:
Bosworth and Darby
Un. of Vermont

Choosing Forage Varieties

- Study results from your local university trials
- Ask lots of questions of your seed dealer
- Ask for documentation
  (look for data from unbiased evaluations)
- Be wary of wildly optimistic claims
- Check blends or mixtures for variety names
- When possible, avoid ‘Common’ seed or ‘Variety Not Stated’ seed
- Purchase seed of high quality

High Quality Forage

Focus on your first two harvests

- The first two cuttings have the highest potential for having the most digestible forage
  - ✓ During May and June, cool temperatures as well as increasing daylength enhances sugar content and higher NDF digestibility
  - ✓ Later in the season, high temperatures and decreasing daylength of mid to late summer reduces sugar content and enhances lignification, thus, reducing NDF digestibility.

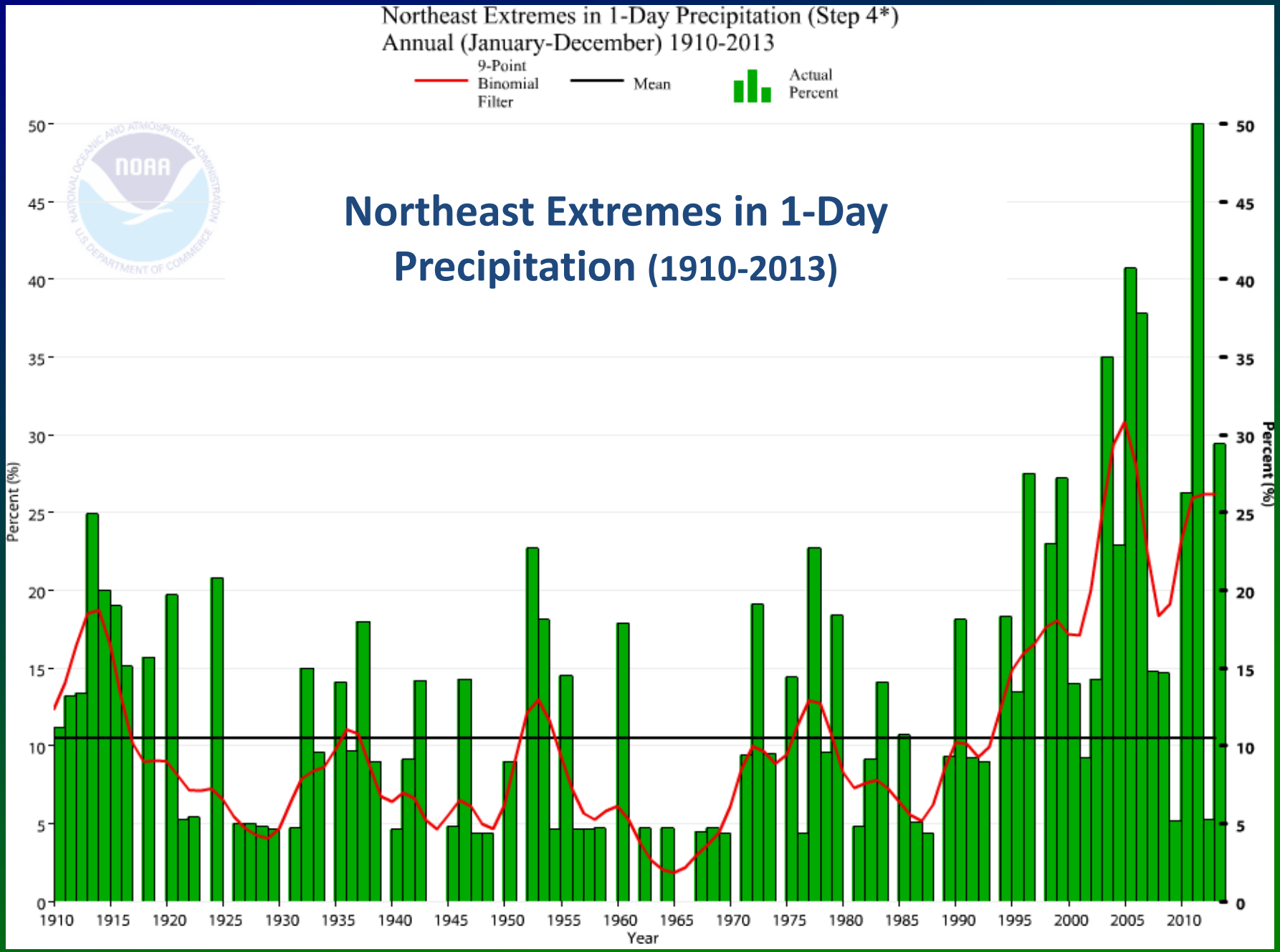
Impact of Cutting Time

- Delaying first cutting by 10 days and each interval about 5 days (from 34 to 39)
  - Reduced seasonal yield by 7%
  - 5.5 % reduction in crude protein
  - 7.4% reduction in 30 hr. NDFD
  - 16.4% reduction in NSC (Sugar + Starch)
  - 22.5% reduction in RFQ
  - 14.9% reduction in Milk/Acre
  - $519/acre loss at $17.60/CWT
- What do you save?
  - Harvest cost, ↑ **persistence?**

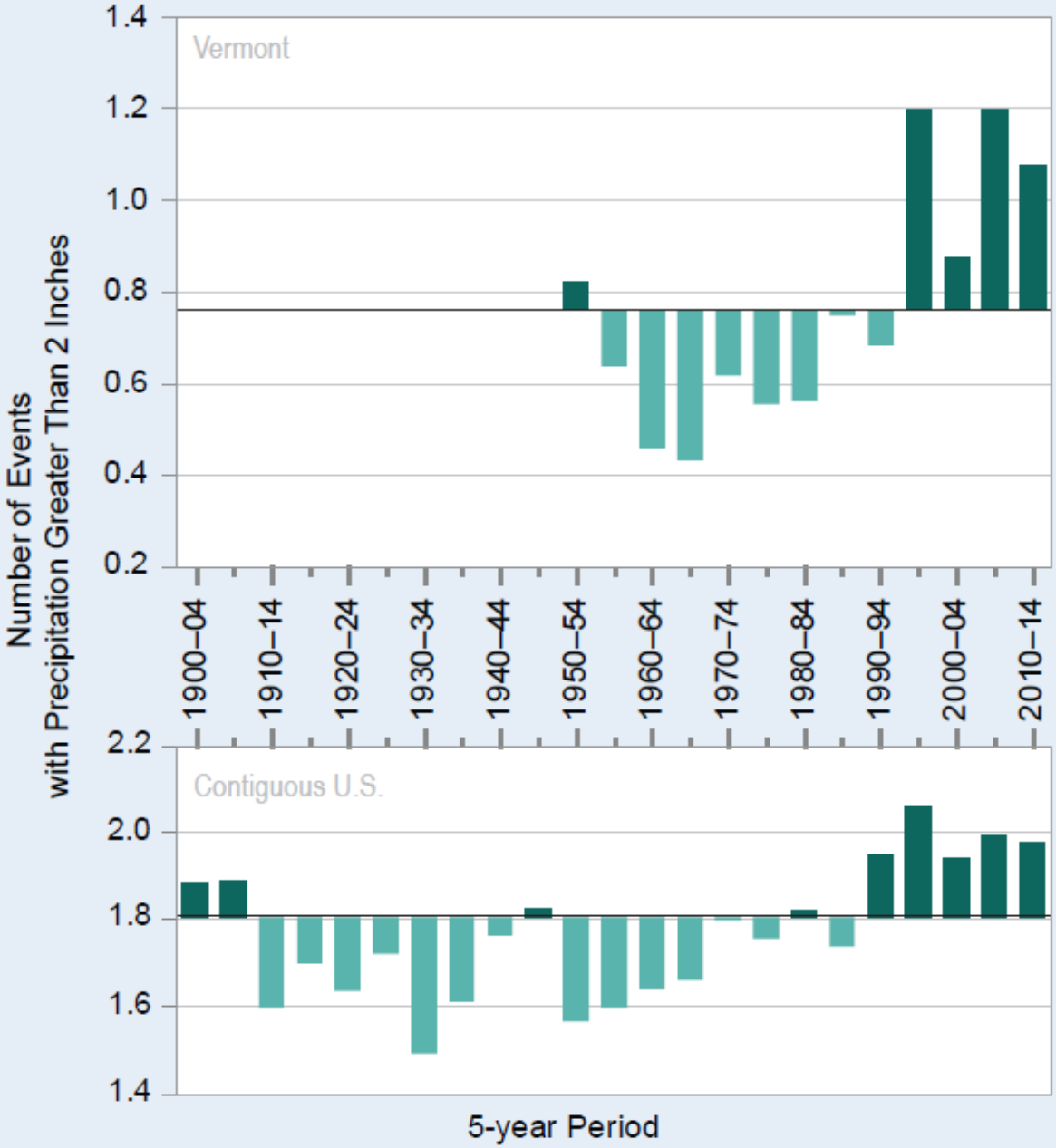
(Wilder, UVM)

What's Your Harvest Strategy for Producing High Quality Forage?


What is of less control in your forage program?


Northeast Extremes in 1-Day Precipitation (Step 4*)
Annual (January-December) 1910-2013
9-Point Binomial Filter
Mean
Actual Percent
Northeast Extremes in 1-Day Precipitation (1910-2013)
Percent (%)
Year
0
5
10
15
20
25
30
35
40
45
50
1910
1915
1920
1925
1930
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010

Observed Number of Extreme Precipitation Events



*NOAA

Weather Extremes and Forages

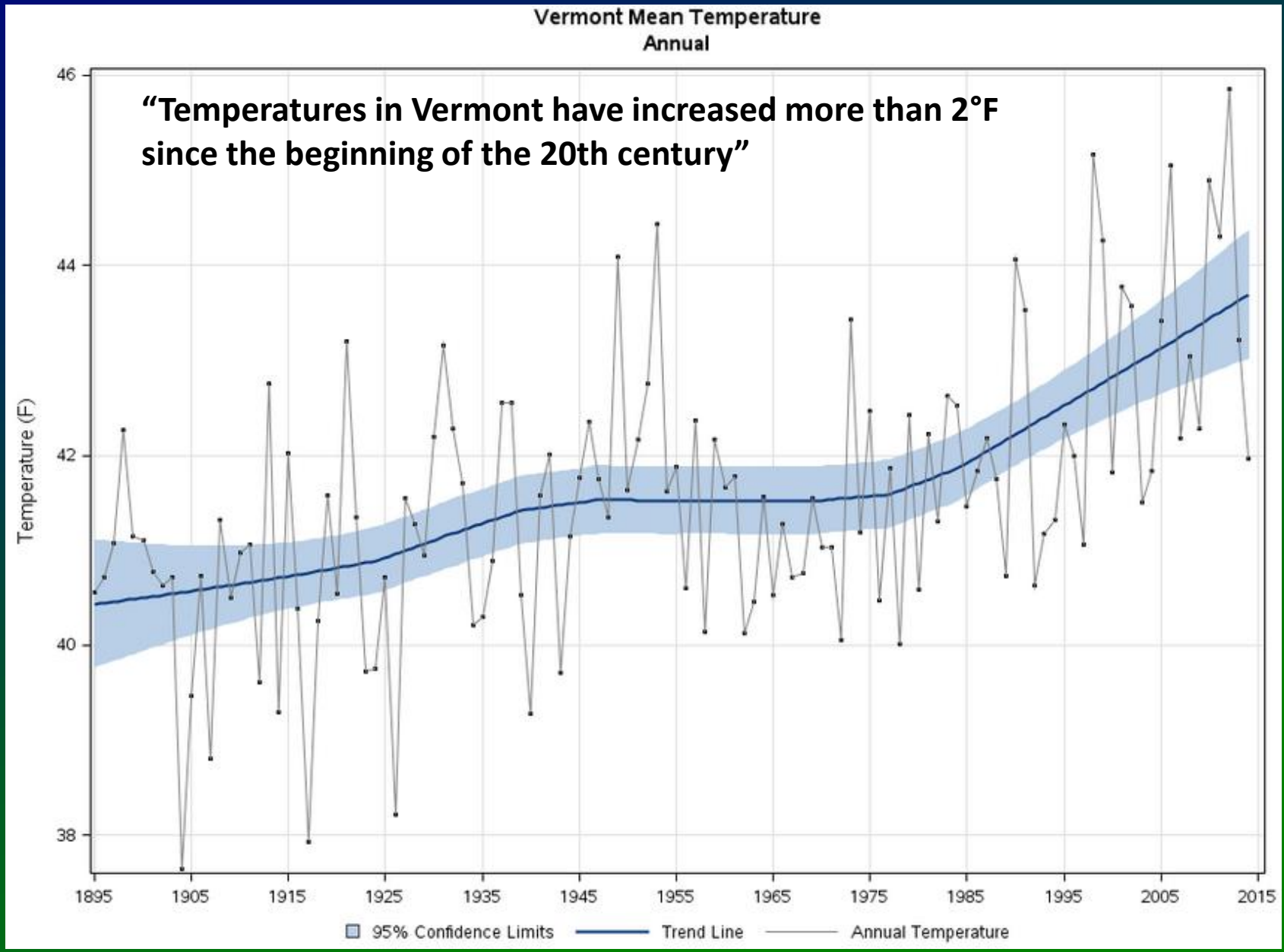
Prolonged rainy periods

- Delayed harvest
- Plant stress
- Reduced protein
  - Soil N losses
  - Poor N fixation
- Reduced energy
  - Low sugar content

Are you adapting your farm to grow the most desirable forage species?

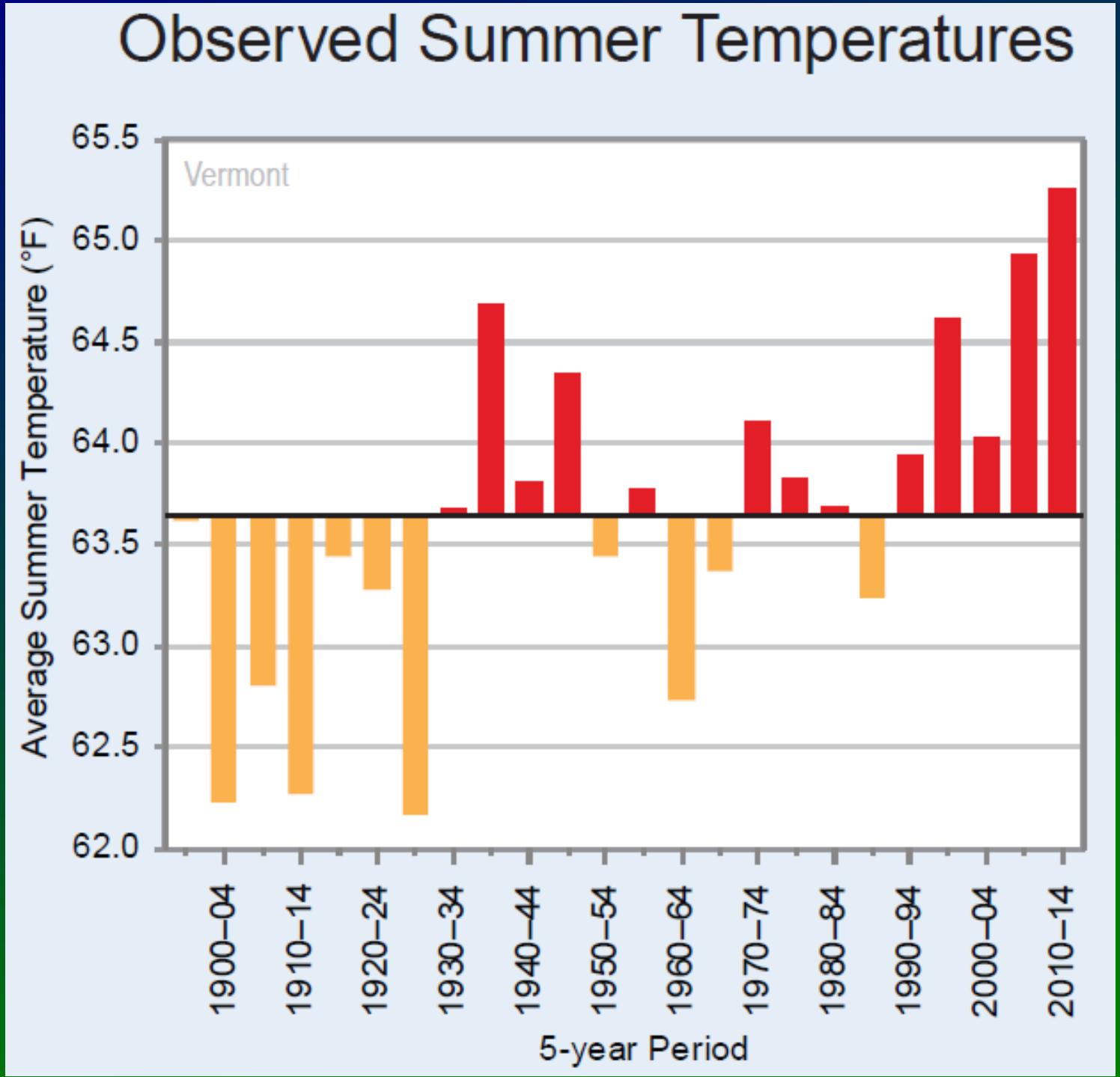
https://brownfieldagnews.com/news/drain-tile-demonstration-popular-at-farm-technology-days/

Temperature and Forage Quality



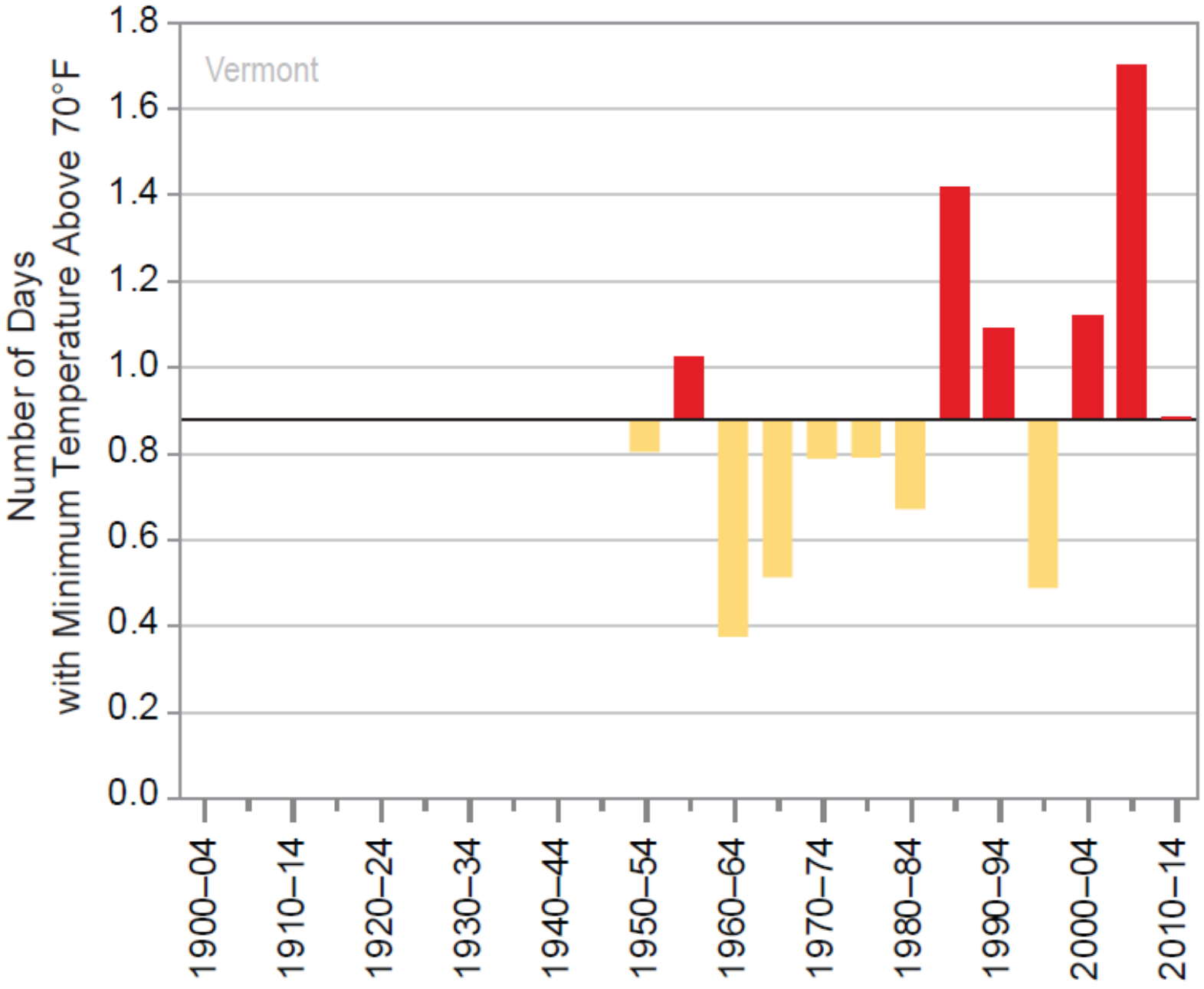
*NOAA National Climatic Data Center

Observed Summer Temperatures



*NOAA

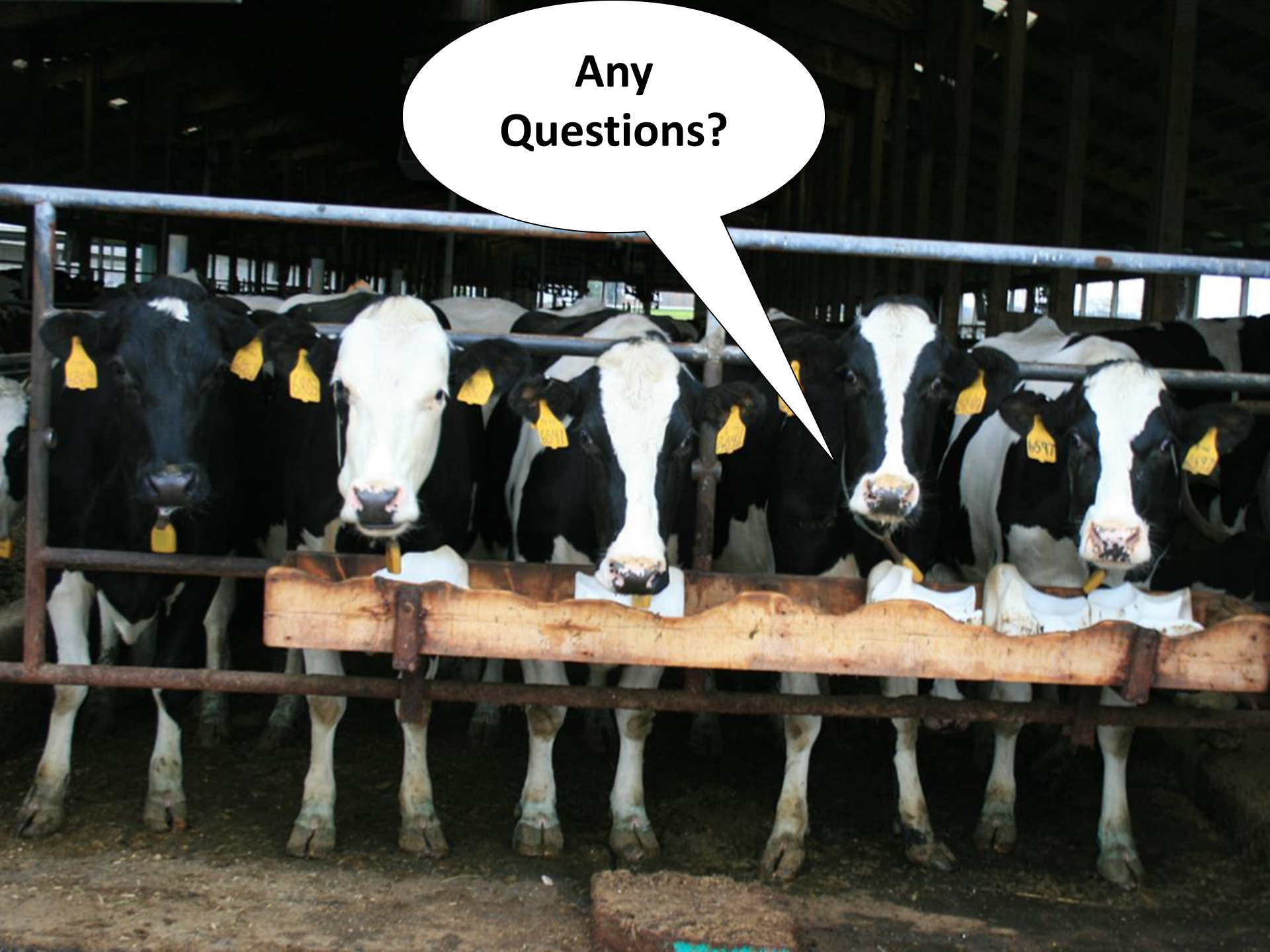
Observed Number of Warm Nights



*NOAA

Elevated Temperature and Forage Quality

- Earlier reproductive development
- Plant stress
- Lignification
  - Lower NDFD
- Reduced energy
  - Low sugar content


Any
Questions?

Low Lignin Alfalfa Mixed with Grass?

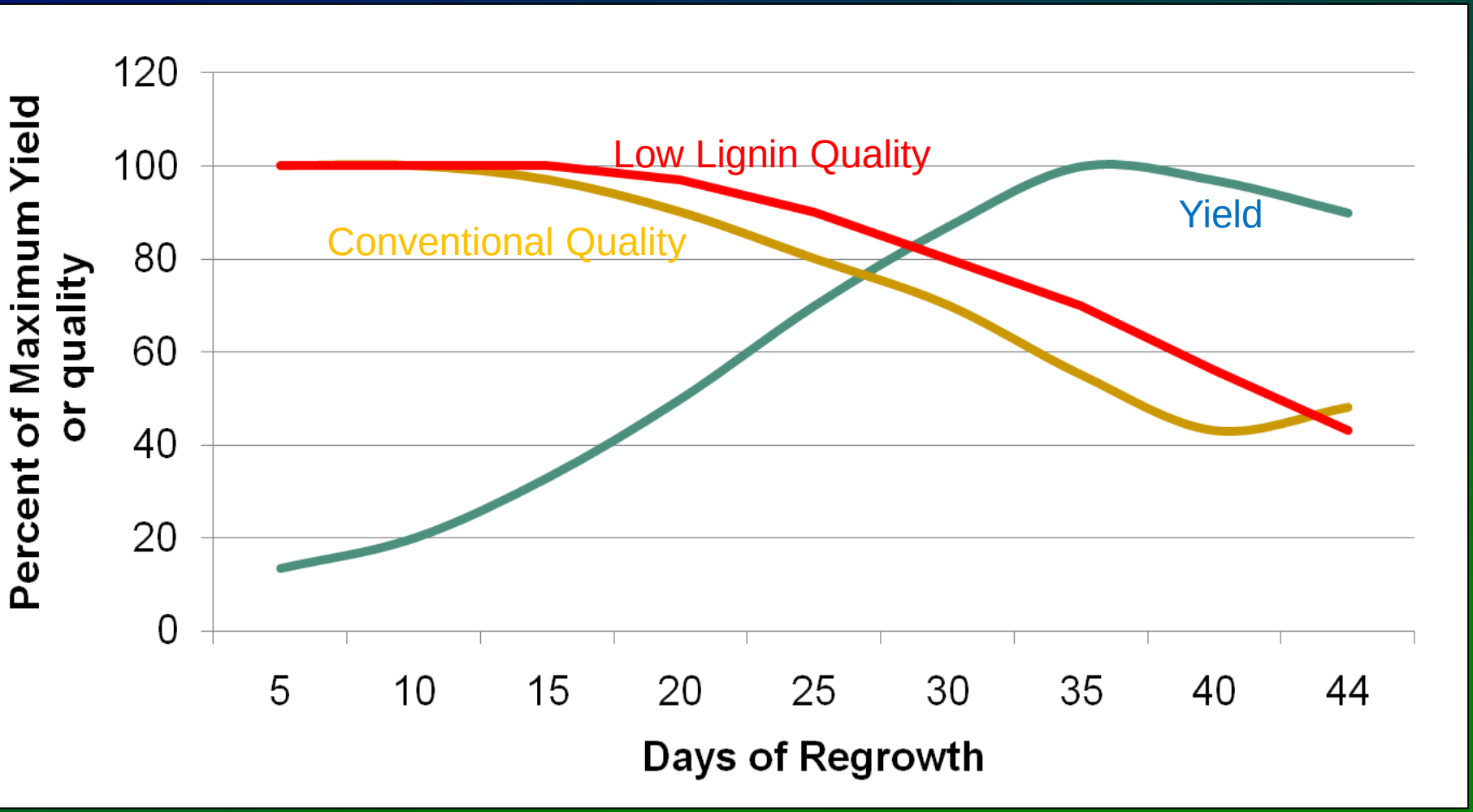
Does it make sense?

7 to 10 percent less lignin than conventional alfalfa varieties

10 to 15 percent less lignin than conventional alfalfa varieties

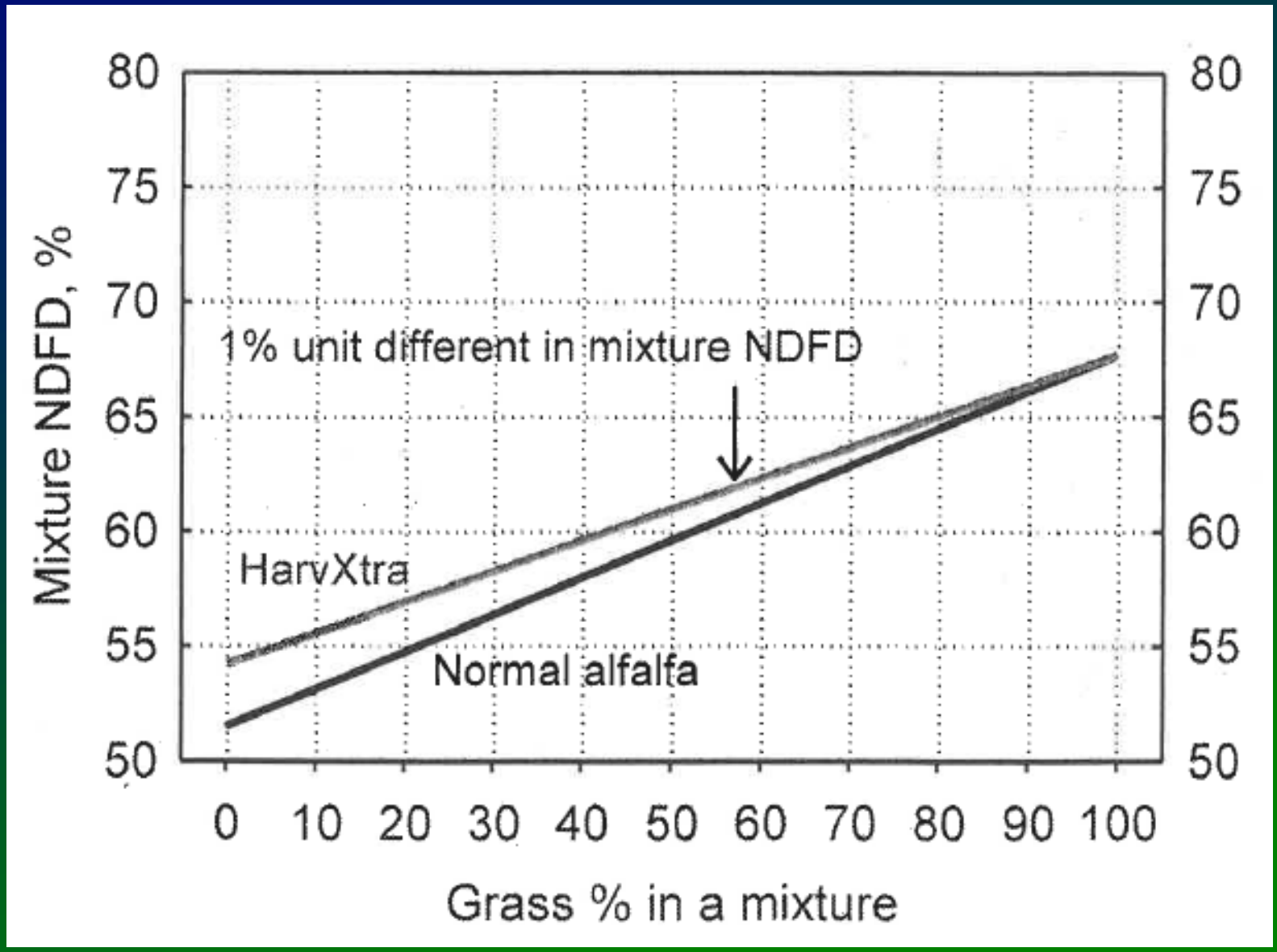
Low Lignin Alfalfa

Does it fit in New England?



Source: Dan Undersander, Un. Wisconsin

Low Lignin Alfalfa With Grasses?



Jerry Cherney, Cornell 2017