

# IDENTIFYING MOLECULAR MARKERS ASSOCIATED WITH QUALITY & QUANTIFYING THEIR POTENTIAL TO INCREASE ALFALFA VALUE

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# Objectives

- 1) Determine quality at first harvest of 150 alfalfa plant introductions and 50 varieties at three locations in the PNW
- 2) Quantify the genetic diversity of alfalfa that is related to forage quality
- 3) Identify genetic areas associated with forage quality
- 4) Extend the knowledge gained

# Breakdown of the 200 entries in this study

Region	Country	N
North America	Canada (21), United States (121)	138
Turkey	Turkey	21
Central Asia	Afghanistan, Armenia, Georgia, Kazakhstan, Turkmenistan	14
Eastern Europe	Belarus (1), Russian Federation (8)	9
China	China	8
Central_Europe	Czech Republic, Denmark, France, Germany	4
Mediterranean	Greece, Morocco, Romania, Spain	4
Other	Australia, Japan	2



Salish Sea Strait of Juan de Fuca

Washington

Cascade Range

Prosser

Elevation 203 m (665 ft)

Union

Elevation 851 m (2,791 ft)

Oregon

Bitterroot Range Rocky Mountains

Salmon River Mountains

Idaho

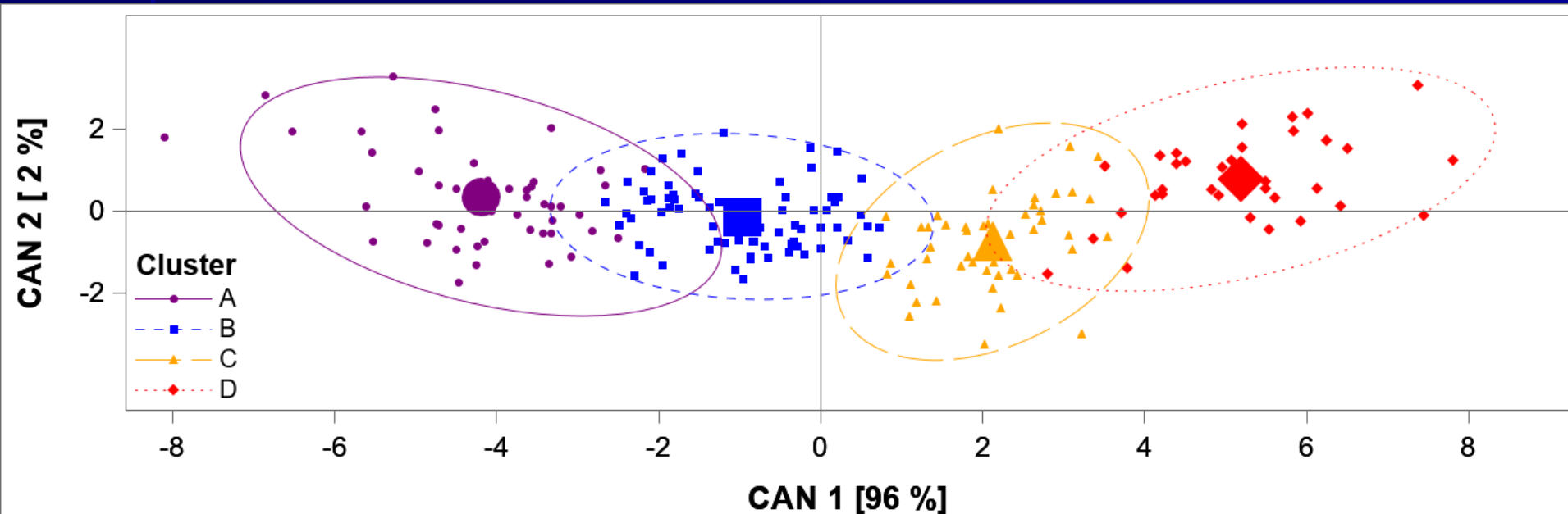
Kimberly Kimberly

Elevation of 1,196 m; (3,924 ft.)

Klamath Mountains

Data LDEO-COULRCA-0117AA  
Image Landsat/Copernicus

# Canonical Analysis Analysis for Forage Quality based on RFQ

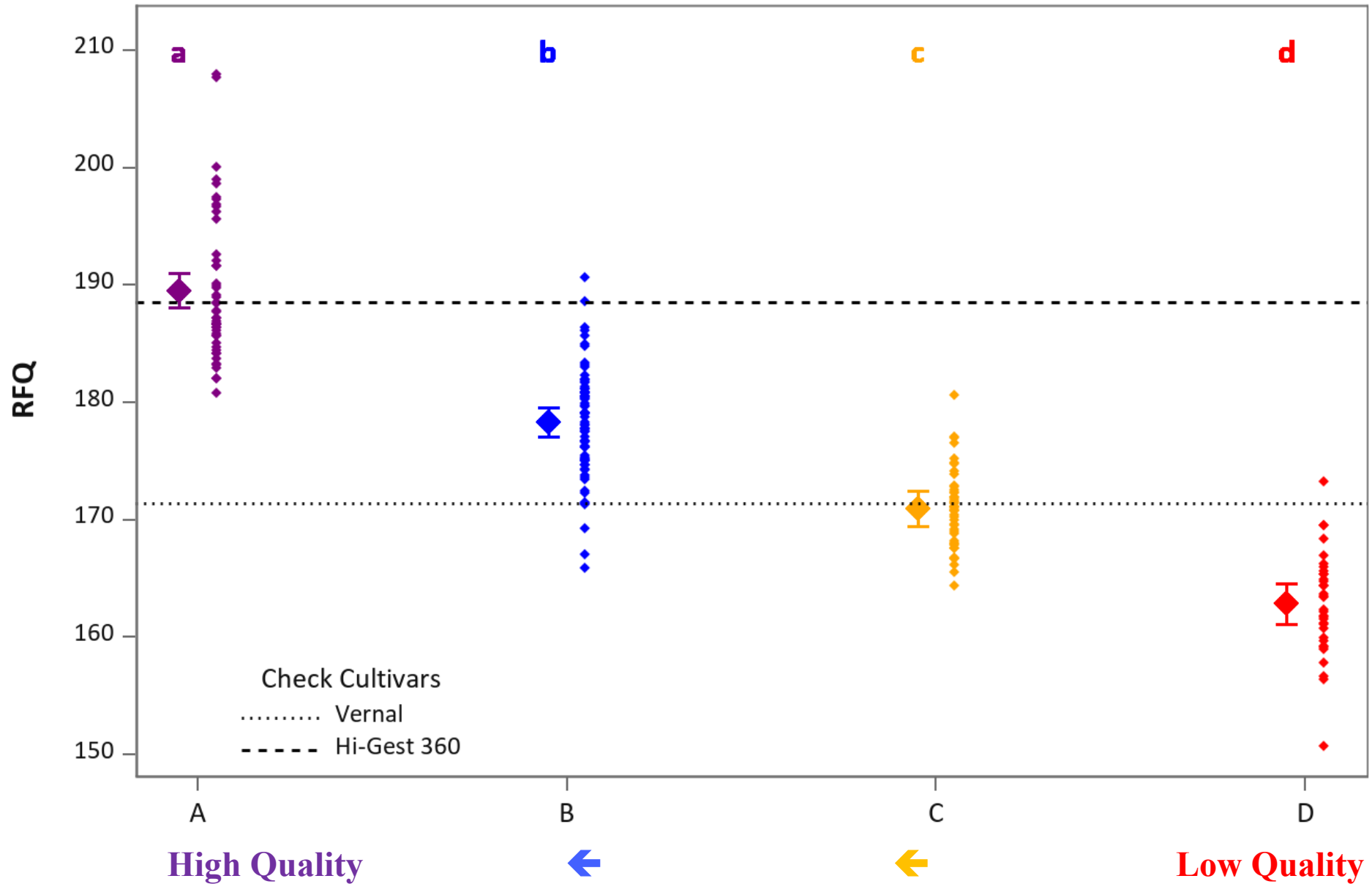


High Quality

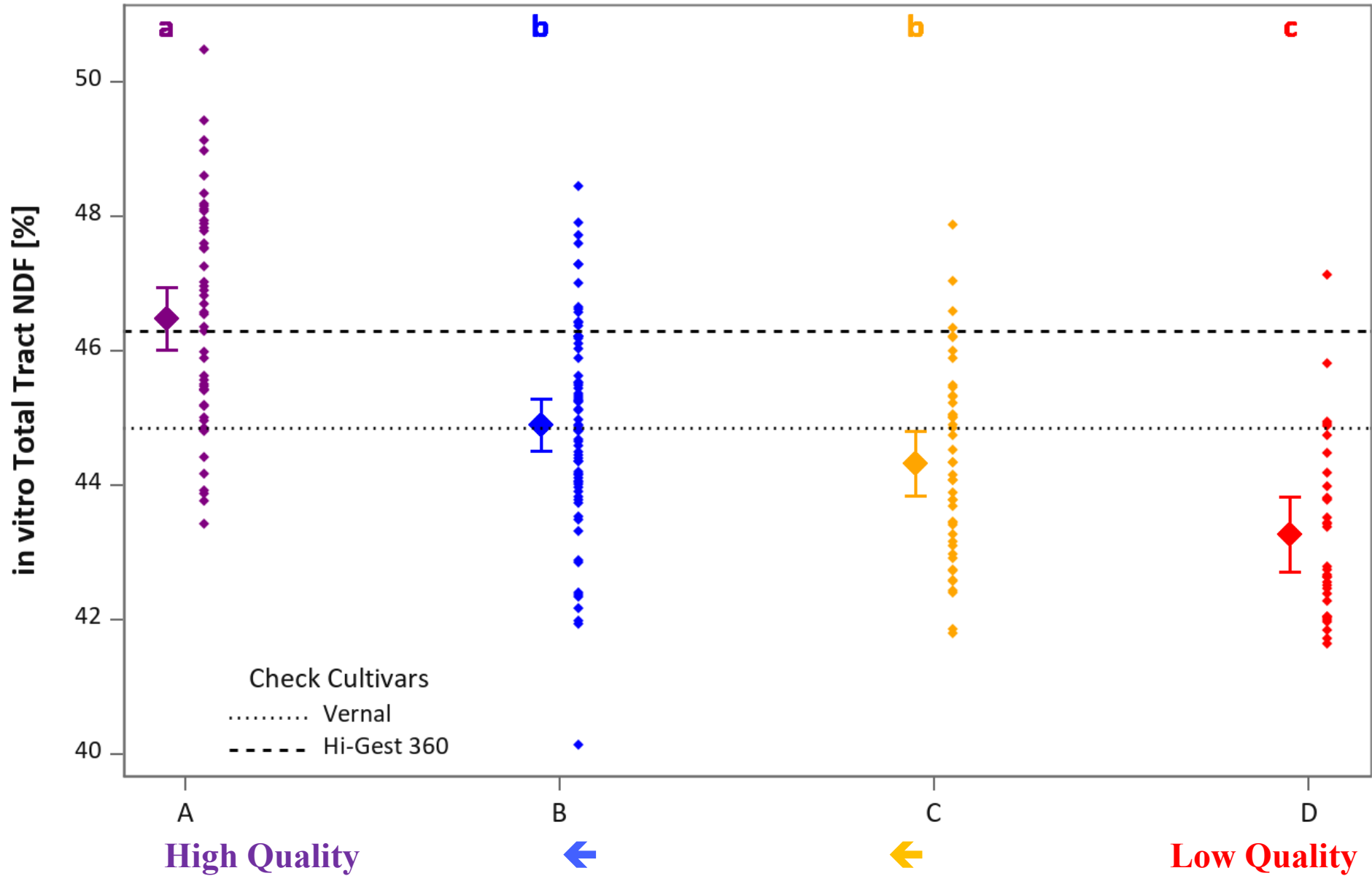


Low Quality

# RFQ



# TTNDFD





# Avg. over Locations, Value of Hay for Protein, Energy, Fiber, Fiber Fill and Total \$ ton<sup>-1</sup> of for First Cutting 2018 and 2019.

Statistic	Protein Value	Energy Value	Net Fiber Value	Quality Adjustment	Dollar Value ton
Maximum	\$83.25	\$135.60	\$61.48	\$103.33	\$372.91
Minimum	\$68.89	\$113.75	\$50.72	\$3.60	\$247.73
Hi-Gest - 360	\$75.83	\$127.38	\$54.42	\$82.51	\$340.14
Vernal	\$74.53	\$122.52	\$57.55	\$71.05	\$325.66

Assuming \$0.35 /lb MP, \$0.11/lb Mcal, \$0.07/lb eNDF and \$5/ton increase or decrease from 47% NDFD. Currently prices have increased by 86% for metabolizable protein, 62% for energy, and 74% for effective fiber (Progressive Dairyman, April Fry, May 7<sup>th</sup>, 2022).

# Value of Optimizing Constituents

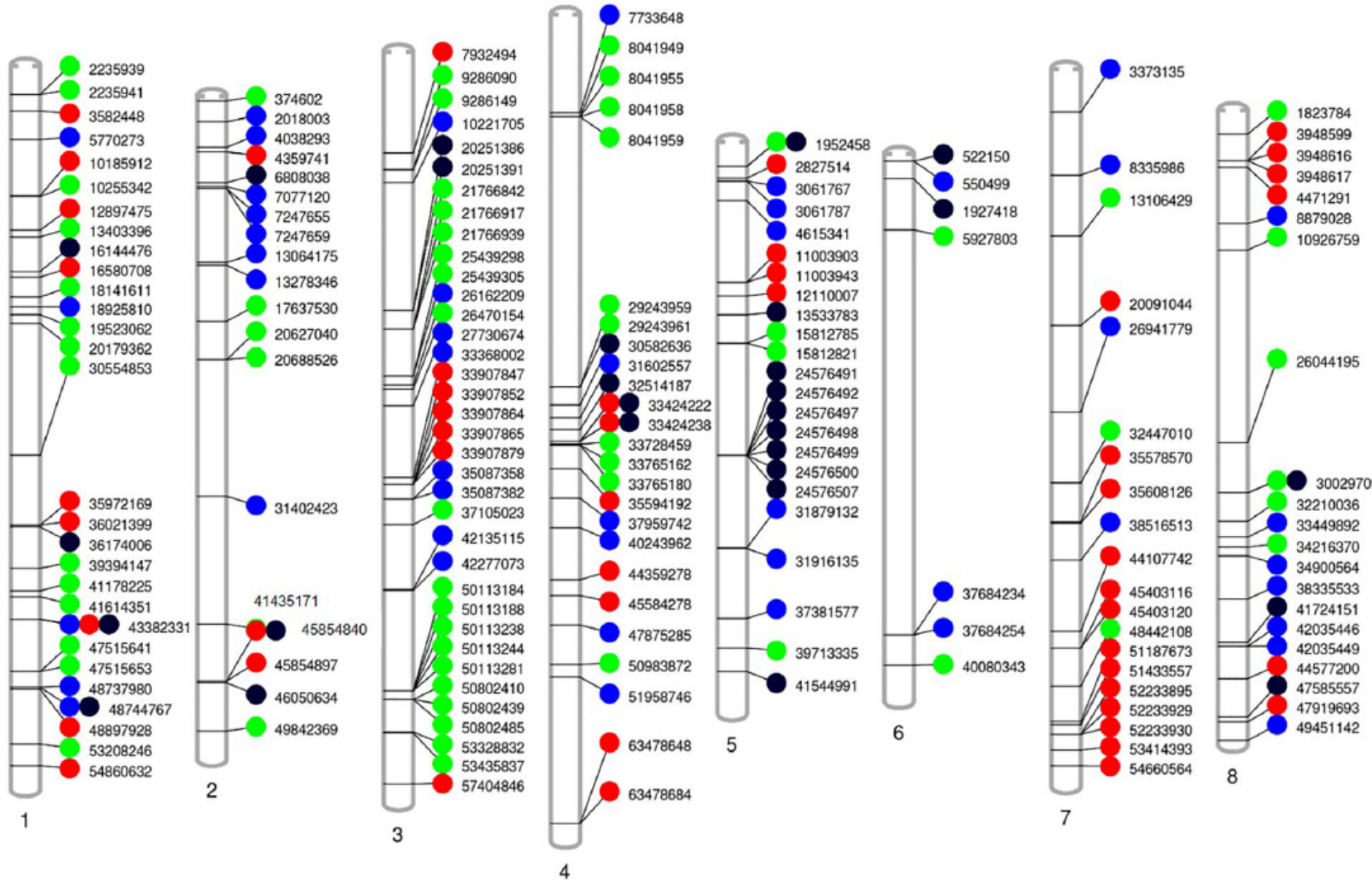
Constituent	Hi-Gest 360 Response (% of plant)	Optimum Response Received (% of plant)	Added Value (\$ Ton <sup>-1</sup> )
NDFD 48 hr	63.5	67.7	20.82
Crude Protein	23.9	25.4	5.79
Ash	10.0	9.2	2.24
Lignin	6.2	5.8	1.48
Fats	2.0	2.2	0.56
NDICP	1.0	1.3	0.24
ADICP	0.56	0.5	0.26
All constituents optimized			29.85

# Correlation of Constituents NDFD 48 hr. & C. Protein

Constituent	Correlation with NDFD48 hr.	Correlation with Crude Protein
NDFD 48 hr.	1.000	0.66
aNDF	-0.57	-0.87
Crude Protein	0.66	1.00
Ash	0.26	0.48
Lignin	-0.79	-0.76
Fats	0.61	0.68
NDICP	0.06	0.23
ADICP	-0.31	0.04

# Genetic Results

- Genome-wide association studies (GWAS) identified 126 SNP markers associated with 24 quality traits. Among them, most of the markers were associated with fiber digestibility and protein content.



● WA

● ID

● OR

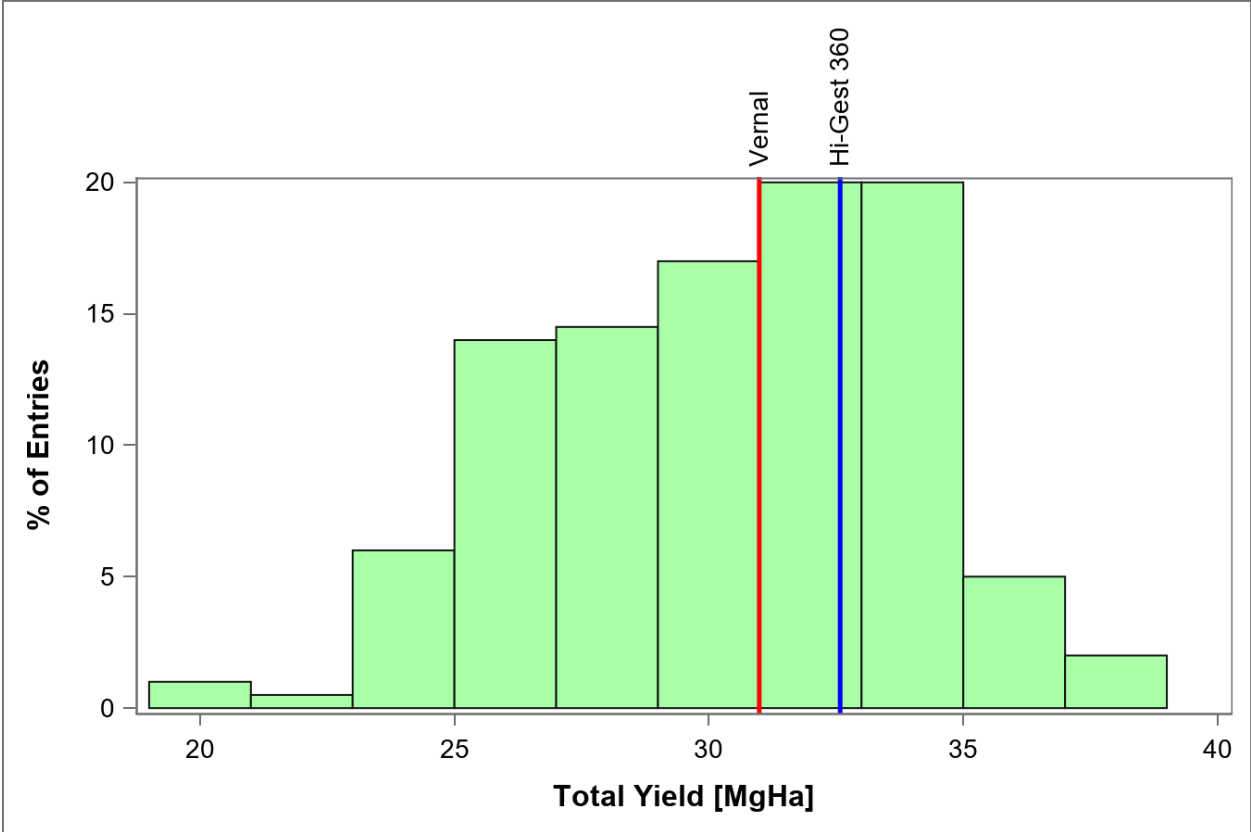
● Mean

# Frontiers in Plant Science Journal Article

- Genome-Wide Association Studies Identifying Multiple Loci Associated With Alfalfa Forage Quality. *Front. Plant Sci.* 12:648192.
- Lin S, Medina CA, Norberg OS, Combs D, Wang G, Shewmaker G, Fransen S, Llewellyn D and Yu L-X (2021)
- doi: 10.3389/fpls.2021.648192

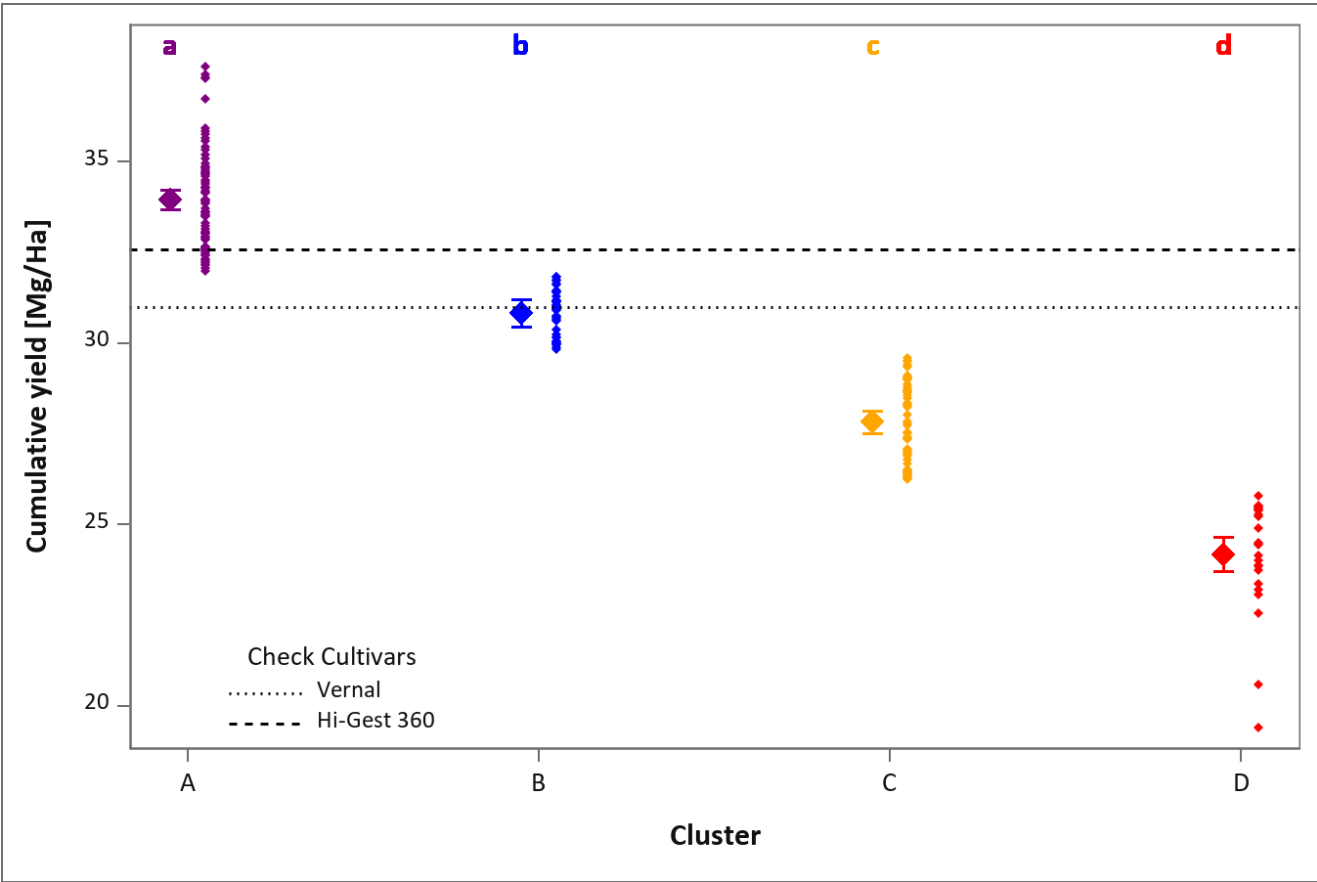
**Yield**

# Yield Distribution in General





# Yield Distribution in Clusters



# Conclusions

- There is room for genetic improvement especially with digestibility and protein.
- Energy and Protein carry the majority of the value of hay
- Digestibility genes have been located on the chromosomes
- Yield and quality appear not to be as closely linked and improvement is possible.



**Questions?**