

# Cell Wall Characteristics Related to Alfalfa Digestibility

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# Forage Digestibility - In the eye of the beholder...



## INTERACTION

- ▶ Plants
- ▶ Animals
- ▶ Microbes



# Quality = Digestible Energy

## Measure Fiber

- Sequential Fiber digestion
- NDF & ADF

## Predict TDN/RFQ/RFV

- Multiple forage composition measurements
- NDF, CP, ADF & others

## Measuring Additional Energy Factors

- Measure the NFC components
- Sugar, starch, lipids

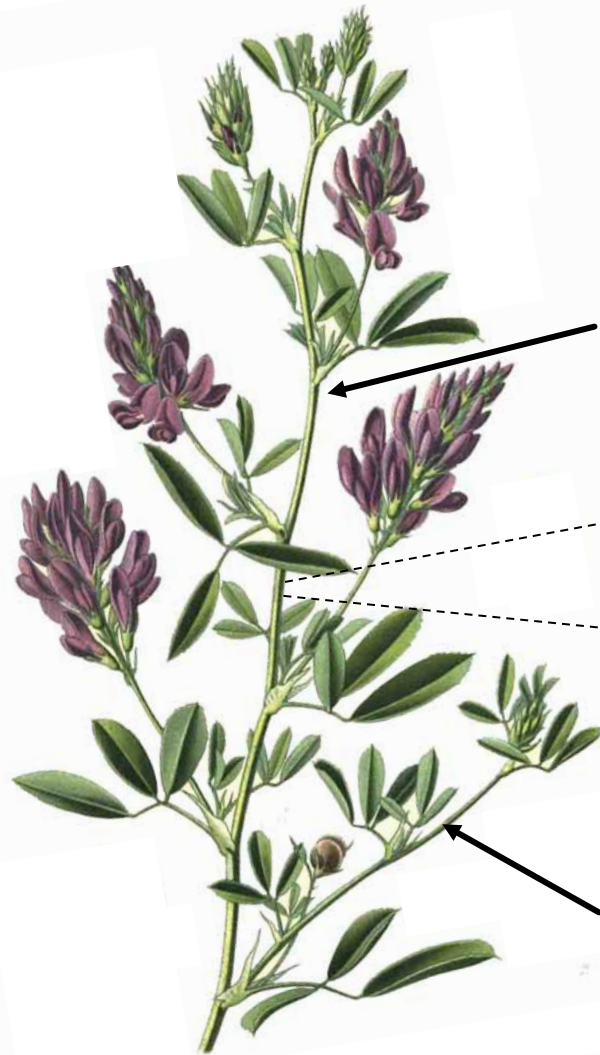
## *In vitro* / *in situ* Measurements

- Uses rumen fluid to determine
- Requires a fistulated cow.

Recommend method: using *in vitro* to measure dNDF

**Are there better plant traits for predicting Digestibility**

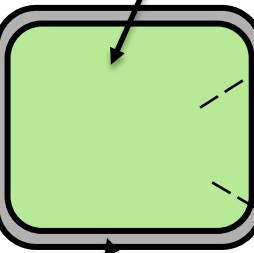
# Components



Stems  
30-55% ADF  
10-20% CP

Leaves  
12-20% ADF  
22-35% CP

Cell Solubles (NSC)  
100% digestible



Cell Wall (NDF)  
20-60% digestible



Non-Structural Carbohydrates  
\*Sugars, Pectin, Starch

Structural Carbohydrates (NDF & ADF)  
\*Hemi-cellulose, Cellulose, Lignin

Protein  
\*bound and soluble

Ash  
Lipids (2-3%)

## Are there better plant traits for predicting Digestibility

# Experimental Setup

S0



High

X



Low

Cycle 1



High

X



High



Low

X



Low

Cycle 2



High

X



High



Low

X

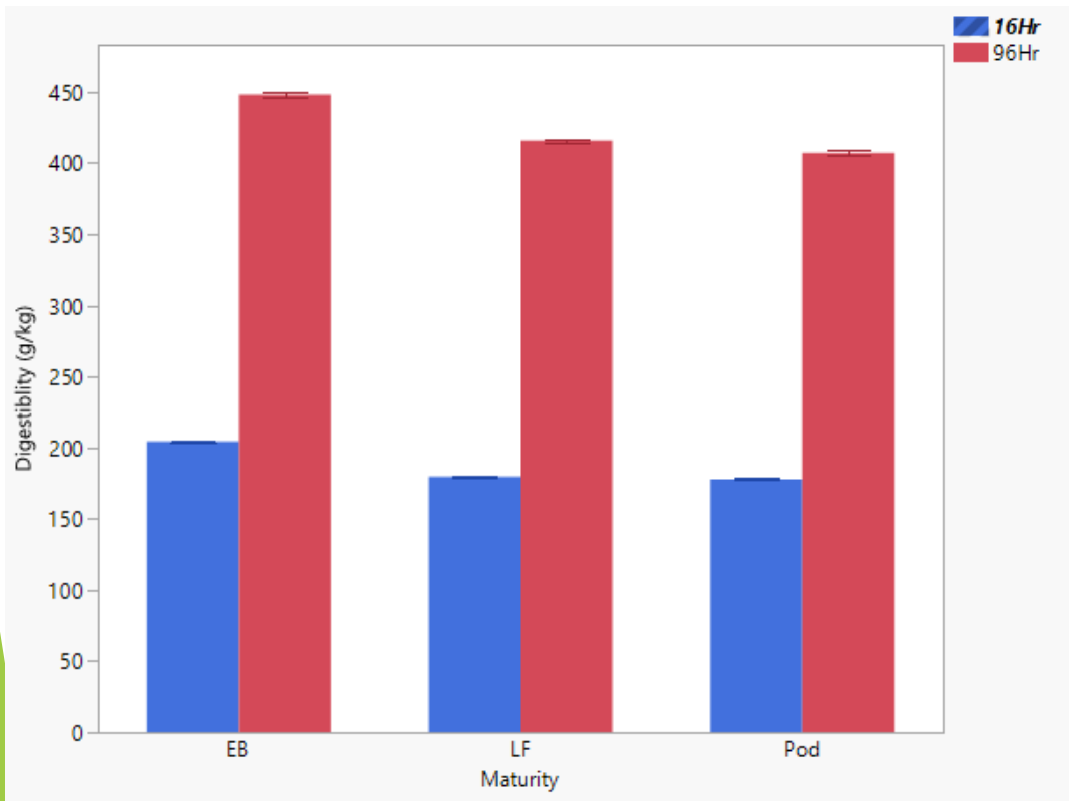


Low

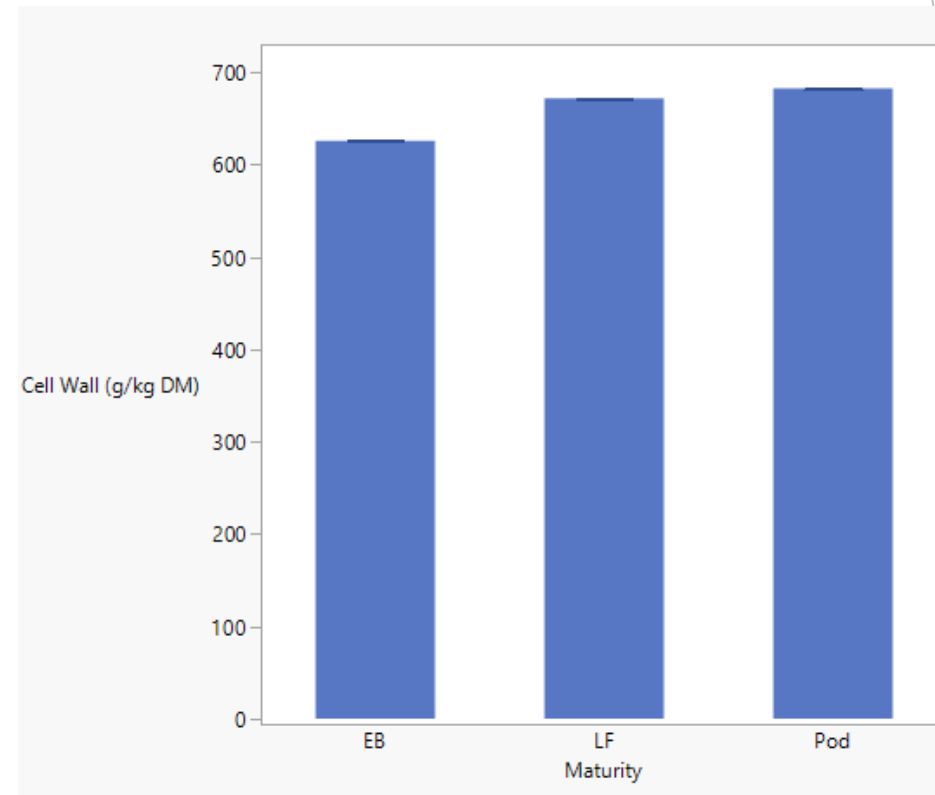
- 2 Years of Growth
- 3 Locations (MN)
- 1795 data points
- Analysis
  - 16 hr & 96 hr Digestibility
  - Sequential Fibers
    - NDF, ADF, ADL
  - Structural Carbohydrates
    - Cellulose, Hemicellulose, Lignin, Pectin

# Overall Comparisons

▶ dNDF (g/kg)



▶ Total Cell Wall Content (g/kg DM)



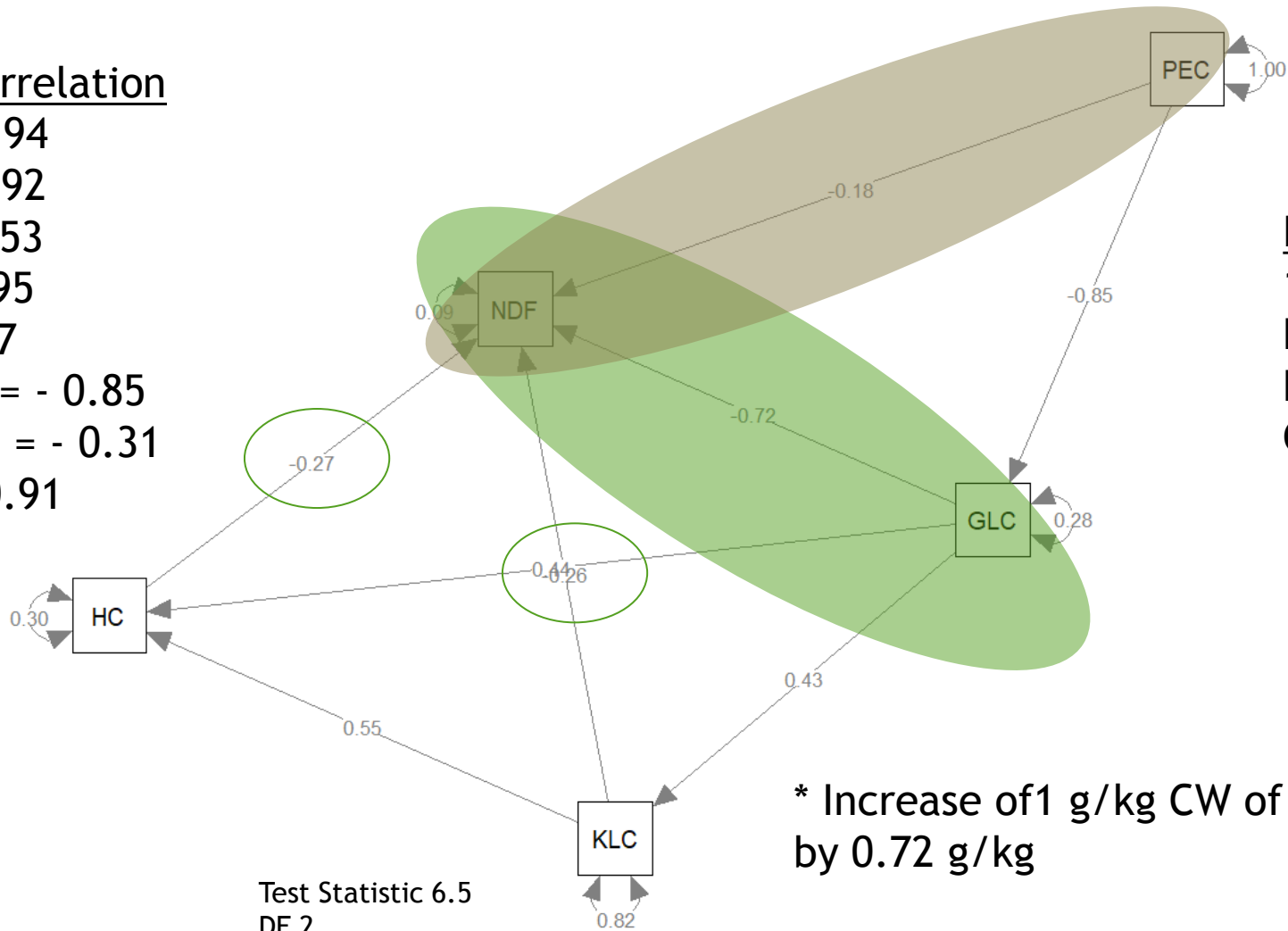
\*No difference in between populations except means

# Relationships :16 Hr Digestibility

↔ Correlation = R2 value  
 → Causation = regression

## Person Correlation

NDF = - 0.94  
 ADF = - 0.92  
 ADL = - 0.53  
 CW = - 0.95  
 KL = - 0.37  
 Cellulose = - 0.85  
 Hemi-Cell = - 0.31  
 Pectin = 0.91



## Path analysis

16hr = 0.91  
 KL = 0.18  
 Hemi-cell = 0.7  
 Cellulose = 0.72

\* Increase of 1 g/kg CW of Cellulose decreases the dNDFD by 0.72 g/kg

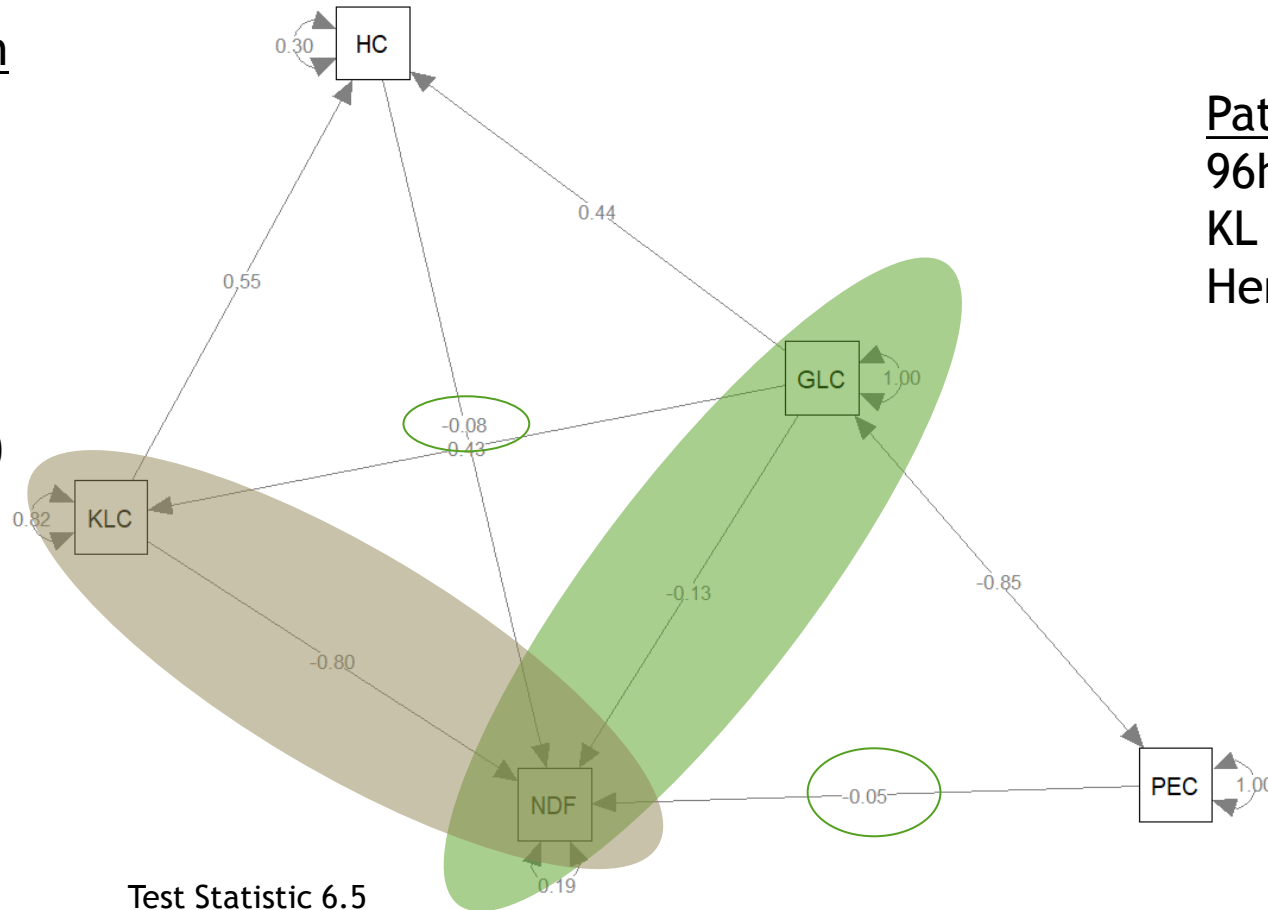
Test Statistic 6.5  
 DF 2  
 Chi-square P = 0.039

# Relationships :96 Hr Digestibility

↔ Correlation = R2 value  
 → Causation = regression

## Person Correlation

NDF = - 0.73  
 ADF = - 0.67  
 ADL = - 0.82  
 CW = - 0.78  
 KL = - 0.76  
 Cellulose = - 0.48  
 Hemi-Cell = - 0.30  
 Pectin = 0.66



## Path analysis

96hr = 0.81  
 KL = 0.18  
 Hemi-cell = 0.71

Test Statistic 6.5  
 DF 2  
 Chi-square P = 0.039



# Summary

Large populations of high & low digestible lines suggest that:

- ▶ No difference in relationships between populations (High & Low)
- ▶ Changes in cellulose could increase the rate of digestibility
- ▶ Changes in Lignin increase the potential digestibility

## Future Work

- ▶ Genes for targeting digestibility in cellulose pathway
- ▶ Validation of the model