LEGACY Seeds

2024 FORAGE UNIVERSITY

AGENDA

- WELCOME / ALFALFA INDUSTRY UPDATE
  - JOHN HUBERS / DAVE ROBISON
- ALFALFA BREEDING/DISEASES
  - OLIVIA STEINMETZ
- ALFALFA ESTABLISHMENT/LATE SUMMER MANAGEMENT/WINTER INJURY/ROOT TYPES & BENEFITS
  - DAVE ROBISON / MARK TOMASZEWSKI
- ALFALFA AGRONOMICS / MANURE MANAGEMENT
  - MIKE SANKEY
- HARVEST MANAGEMENT
  - JUDD HODGEN
- ALFALFA ECONOMICS / ROTATION BENEFITS
  - DAVE ROBISON / MARK TOMASZEWSKI
- YIELD, QUALITY, & PERSISTENCE WITH DATA
  - JAMES FERRELL
- ALFALFA SEED PRODUCTION & PROCESSING
  - TYLER LEE
- TRITICALE
  - DRAKE FRIDERES
- RATION CHOICE
  - JUDD HODGEN / JIM WOLD

ALFALFA BREEDING & DISEASES

Forage University 2024

Olivia Steinmetz – Alfalfa Research Director

One of Three Alfalfa Breeding Programs Left!

- Our Alfalfa Breeding program started back in 2000
- Dave Huset, “father of highly digestible alfalfa,” had over 40 years of experience
- I was hired back in 2018
- James Ferrell hired in 2022
- We develop and test our own NEW varieties around the Midwest
- Focus on solutions to problems, and performance that brings profitability!

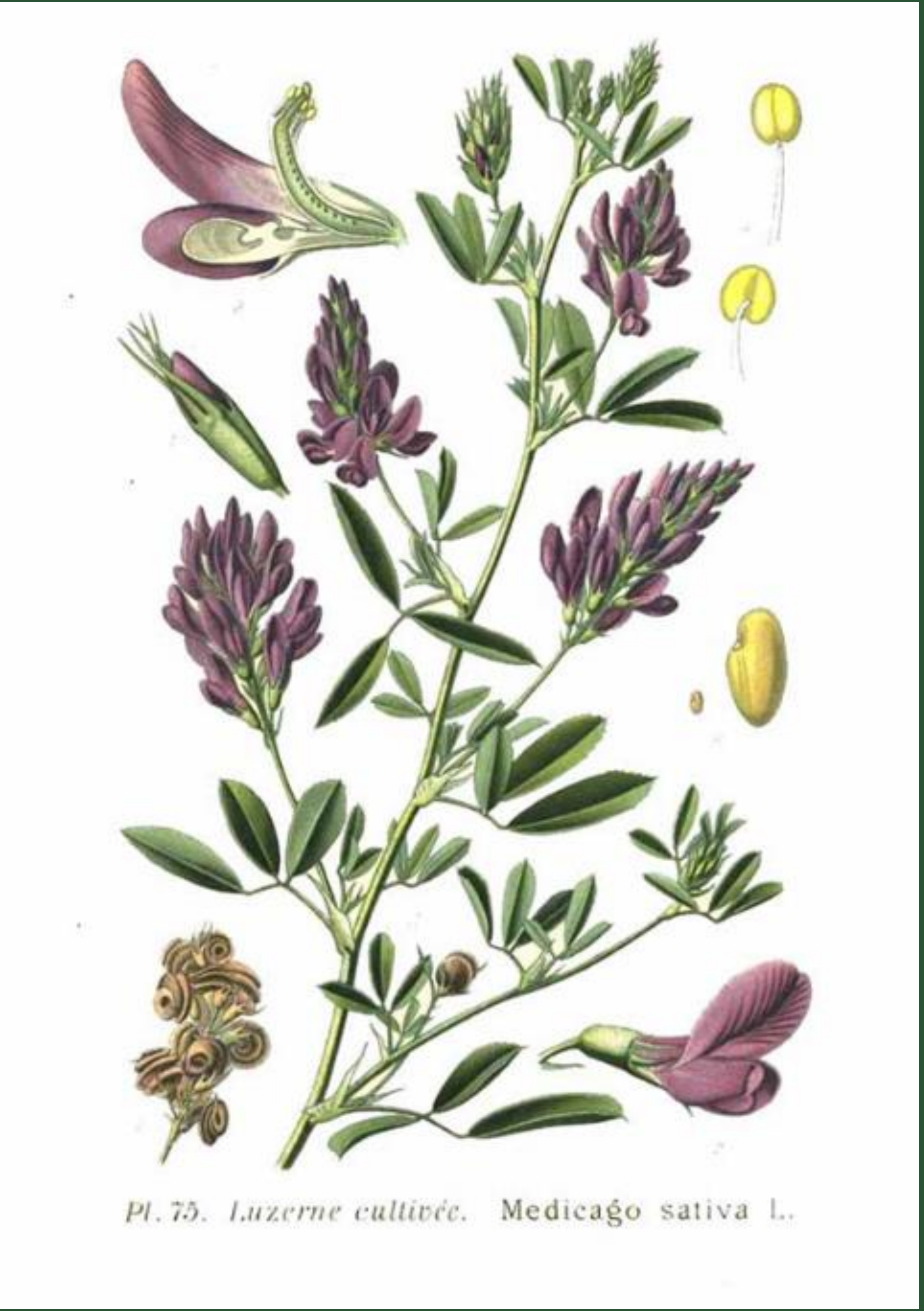
RLC Built in 2018 in Central WI

RLC Built in 2018 in Central WI

Data collection, product testing, and tours!

Alfalfa Breeding

- Outcrossing **Tetraploid** (2n=4x=32)
- Highly **heterozygous**; lots of genetic diversity
- Severe inbreeding depression
- Developed as a **synthetic variety**
- **Perennial**
- Improving multiple traits simultaneously
    - Genetic resistance to multiple diseases, yield, quality, persistence, root types, crown types, etc.



Yield

Quality

Persistence

Plant #	CP	ADF	aNDF	Lignin	Milk/Ton	RFV	RFQ
22	25.38	20.19	22.43	4.16	3634	303.46	323.01
49	24.31	20.24	23.4	3.85	3522	290.82	303.66
34	25.03	20.81	23.79	4.25	3500	284	298.95
36	24.6	21.12	24.45	4.24	3452	275.76	281.65
13	24.71	21.1	24.12	4.26	3447	279.73	282.09
36	24.78	21.53	23.94	4.34	3443	280.13	291.74
34	22.92	22.44	25.83	4.55	3437	257.44	262.82
15	25.2	21.14	24.86	4.45	3434	271.19	275.73
15	21.54	22.9	26.79	4.39	3431	246.78	255.1
28	23.4	21.51	24.48	4.24	3430	274.02	271.14
32	24.77	21.8	24.31	4.39	3426	275.41	272.62
13	26.05	20.99	23.6	4.31	3407	285.7	287.39
20	23.87	21.52	24.83	4.49	3405	270.11	275.57
28	23.53	21.67	25.34	4.33	3403	264.63	270.08
32	23.59	23.27	25.95	4.58	3397	253.46	260.6
14	26.87	22.06	24.64	4.59	3395	270.76	277.18
12	26.32	22.3	24.42	4.38	3393	272.26	278.92
13	26.35	21.52	24.53	4.74	3387	273.46	279.38
23	20.61	22.62	25.83	4.38	3385	256.94	251.71
30	25.56	21.02	25.07	3.97	3385	269.32	255.1
26	23.37	21.64	24.34	4.27	3384	275.32	278.88
32	25.21	21.84	24.85	4.61	3381	269.17	268.24
24	23.69	22.47	26.06	4.61	3375	254.6	266.23
20	24.56	21.96	24.81	4.59	3374	269.35	270.3
6	24.58	22.64	25.38	4.6	3373	261.29	268.09
44	25.74	21.82	25.01	4.29	3371	267.53	269.92
18	26.31	22.42	24.79	4.58	3369	268	275.15
49	22.61	22.9	26.57	4.63	3369	248.99	257.83
10	24.2	21.97	25.04	4.07	3365	266.57	263.4
38	24.51	22.19	24.78	4.53	3365	268.68	267.36
59	22.28	23.02	26.75	4.23	3360	247.02	252.6

Yield Quality Persistence

Complex traits, easy enough to measure but hard to select for. Ongoing process that takes years!

Plant #	CP	ADF	aNDF	Lignin	Milk/Ton	RFV	RFQ
22	25.38	20.19	22.43	4.16	3634	303.46	323.01
49	24.31	20.24	23.4	3.85	3522	290.82	303.66
34	25.03	20.81	23.79	4.25	3500	284	298.95
36	24.6	21.12	24.45	4.24	3452	275.76	281.65
13	24.71	21.1	24.12	4.26	3447	279.73	282.09
36	24.78	21.53	23.94	4.34	3443	280.13	291.74
34	22.92	22.44	25.83	4.55	3437	257.44	262.82
15	25.2	21.14	24.86	4.45	3434	271.19	275.73
15	21.54	22.9	26.79	4.39	3431	246.78	255.1
28	23.4	21.51	24.48	4.24	3430	274.02	271.14
32	24.77	21.8	24.31	4.39	3426	275.41	272.62
13	26.05	20.99	23.6	4.31	3407	285.7	287.39
20	23.87	21.52	24.83	4.49	3405	270.11	275.57
28	23.53	21.67	25.34	4.33	3403	264.63	270.08
32	23.59	23.27	25.95	4.58	3397	253.46	260.6
14	26.87	22.06	24.64	4.59	3395	270.76	277.18
12	26.32	22.3	24.42	4.38	3393	272.26	278.92
13	26.35	21.52	24.53	4.74	3387	273.46	279.38
23	20.61	22.62	25.83	4.38	3385	256.94	251.71
30	25.56	21.02	25.07	3.97	3385	269.32	255.1
26	23.37	21.64	24.34	4.27	3384	275.32	278.88
32	25.21	21.84	24.85	4.61	3381	269.17	268.24
24	23.69	22.47	26.06	4.61	3375	254.6	266.23
20	24.56	21.96	24.81	4.59	3374	269.35	270.3
6	24.58	22.64	25.38	4.6	3373	261.29	268.09
44	25.74	21.82	25.01	4.29	3371	267.53	269.92
18	26.31	22.42	24.79	4.58	3369	268	275.15
49	22.61	22.9	26.57	4.63	3369	248.99	257.83
10	24.2	21.97	25.04	4.07	3365	266.57	263.4
38	24.51	22.19	24.78	4.53	3365	268.68	267.36
59	22.28	23.02	26.75	4.23	3360	247.02	252.6

Product Development & Testing

- Product pipeline is “full”
- Takes ~5-8 years to release a new product
- Material at every stage of development and testing, able to ‘walk through time’ at the RLC
- Always testing against a high bar – we want relevant results

Selection Process

- Plant breeding is a numbers game
- Screening many individual plants for desired traits
  - Phenotype -> Genotype
- Process “starts” in the greenhouses every winter
- Only keep the best plants, transplanted into field every spring
- Years later, best plants are used in future product development
- Those potential products are tested, only the best go to market

Selection Process

- Aphanomyces (Races 1, 2, & “3”)
- Anthracnose (Races 1 & 5) – ***new!***
- Bacterial Wilt
- Fusarium Wilt
- Phytophthora Root Rot
- Verticillium Wilt
- Stem Nematode
- Pea Aphid
- Potato Leaf Hopper
- **Check out NAAIC.ORG for screening protocols!**

Selection Process

- Using standard pathogens and standard checks to test our unknown reactions
- Data AND Selection
- Mimicking field infection in a controlled setting
- Disease = Pathogen + Host + Environment
- Resistant response = R-gene for that disease
  (phenotype) = (genotype)

Selection Process

Selection Process

Selection Process

- Parents of future products are selected for:
  - High biomass **yield**
  - Improved **quality**
  - Improved **persistence**
  - High resistance to pests
  - Other traits like PLH hairs, branched root, sunken crown, etc.
- Seed produced becomes experimental varieties we can then test for all those traits

Green House Seed Production

- Process happens every fall/winter
  - *Check out our videos on Facebook!*
- Creating **NEW** experimental crosses
- Not a final product but a 'work in progress;' this seed is used in disease screens and put back into the nursery
- We harvest a few grams of seed from each

Breeder Seed Production "Cages"

- Process happens every spring/summer
- Creating **NEW** experimental varieties
- Each cage has its own pedigree
- We harvest a few pounds of seed from each

Variety Testing – Back in the Greenhouse!

- Aphanomyces (Races 1, 2, & "3")
- Anthracnose (Races 1 & 5) – ***new!***
- Bacterial Wilt
- Fusarium Wilt
- Phytophthora Root Rot
- Verticillium Wilt
- Stem Nematode
- Pea Aphid
- Potato Leaf Hopper
- **Check out NAAIC.ORG for screening protocols!**

Variety Testing – Fall Dormancy

- **Fall Dormancy** is a data point from a special nursery
- Measures plants' response to changing daylength
- Tall plant = less dormant = bigger number
- Standard checks to compare average variety response to

Variety Testing – Yield

Variety Testing – Quality

Variety Testing – Winter Survival/Persistence

Variety Testing – Winter Survival/Persistence

- **Winter survival** is a data point from a nursery that has gone through one winter
- Scale of 1-5
- Standard checks to compare to

Variety Testing – Winter Survival/Persistence

- Persistence takes **TIME** to show itself
- Stands are rated every fall and every spring
- The more years, harvests, and different environmental pressures we allow the bigger the differences can be
- We don't rush products to market

Variety Testing – Winter Survival/Persistence

- Management matters! All yield trials are managed the same way, so we only see **genetic differences**

- Persistence can **only be claimed with time –** so we leave our yield trials in for years!

- We try to beat up our nurseries so we're only selecting very persistent plants

Variety Testing – Other Traits!

Finally Ready to Sell!

- Plant breeding is a numbers game
- Only the best **plants** are used to make varieties, only the best **varieties** make it to market
- This is your time to shine ☺

LEGACY Seeds

L46-08 ALFALFA

Features

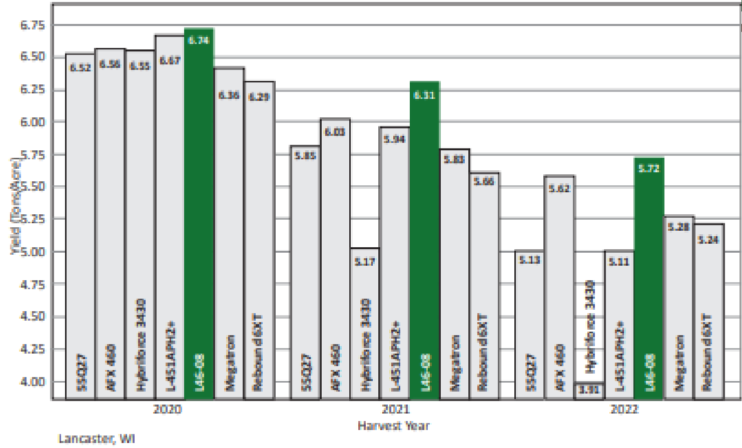
- Very high forage yield potential
- Resistance to Aphanomyces Race 1,2 and isolates of Race 3 Branch root with deep set crown

Agronomic Characteristics

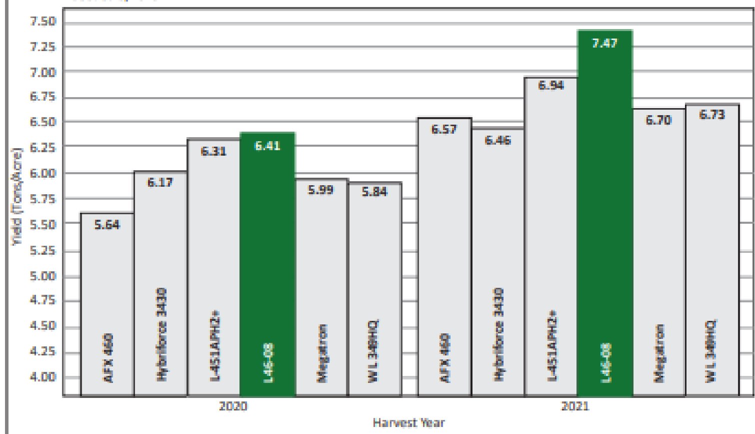
Bacterial Wilt	HR
Fusarium Wilt	HR
Verticillium Wilt	HR
Anthracnose *(Race 1)*	HR
Phytophthora Root Rot	HR
Aphanomyces Root Rot *(Race 1)*	HR
Aphanomyces Root Rot *(Race 2)*	HR
Aphanomyces Root Rot *(Race 3)*	MR
Stem Nematode	MR
DRI	35/35
Fall Dormancy	4.5
WSI Rating	1.6
Root type	Sunken/Branch
Recovery After Cutting	Fast
Multi-foliate Expression	Low
Forage Yield	Excellent
Forage Quality	Very Good
Color	Dark Green

L46-08 is an exciting new release from the Legacy Seeds Alfalfa breeding program. L46-08 is a very high forage yielding, disease resistant alfalfa variety. It carries resistance to Aphanomyces Races 1, 2 and disease isolates for Race 3. L46-08 expresses the branch root trait which allows it to be more productive in well and poorly drained soils.

Waupaca, WI Trial
Seeded 4/2019



Lancaster, WI
Seeded 5/2019



Legacy Seeds HD® Highly Digestible Alfalfa · StandLife GENETICS

HD® and StandLife Genetics® are Registered Trademarks of Legacy Seeds

QUESTIONS?

Olivia@legacyseeds.com

FORAGE UNIVERSITY

- Alfalfa Establishment
- Late Summer Management
- Winter Injury
- Root Types & Benefits

Dave Robison
Alfalfa Business Manager

Mark Tomaszewski
Regional Alfalfa Specialist

ALFALFA ESTABLISHMENT

- Field Selection / Soil Test
- Variety Selection
- Seedbed Preparation
- Planting
- Failure Scenarios

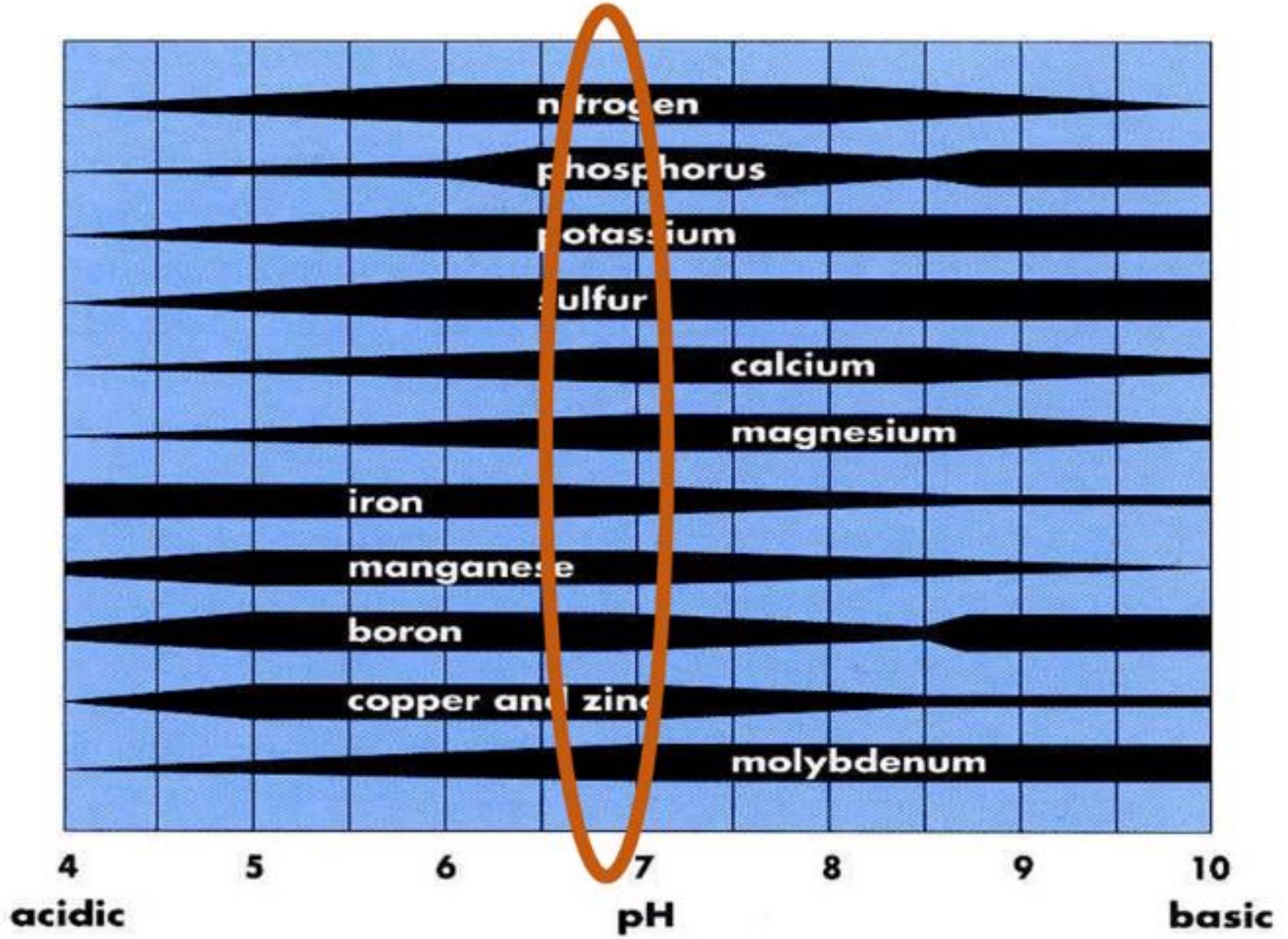
ESTABLISHMENT

- Most critical part of the alfalfa stand, is establishment.

FIELD SELECTION / SOIL TEST

- pH / Nutrient Needs
- Favorable Soil Type, Drainage, and Slope
- Perennial Weeds
- Autotoxicity Concern

Effect of Soil pH on Nutrient Availability



VARIETY SELECTION

- Positioning Alfalfa on Farm
  - Agronomically
    - Soil Type
    - Disease / Pest Pressure
  - Management Practice
    - Cutting Schedule
    - Harvest type
  - Quality Goals

PLANTING

- Seeding Time
- Field Preparation
- Seeding Equipment
- Seeding Depth / Rate
- Companion Crop

PLANTING DATE

- Central, WI / Central, MN
  - Spring
    - North – May 1st – May 30th
    - South – April 15th – May 15th
  - Fall
    - North – July 20th – August 1st
    - South – August 1st – August 15th

FIELD PREPARATION

Field should be smooth, firm, clod-free for optimum seed placement.

FIRM SOIL FOR PLANTING

PACKING CHOICES

PACKING CHOICES

PLANTING EQUIPMENT

- Grain Drill followed by cultipacker
- Double Corrugated roller seeders (Brillion)
  - Doesn't work as well in sandy or hard soils or with surface residues
- No-till Drill
  - Good for seeding into stubble
- Air broadcast followed by cultipacker

PLANTING EQUIPMENT

Drill with depth control packing wheels

Packing type of planter

PLANTING EQUIPMENT

NOT A GOOD ALFALFA PLANTER

SEED DEPTH AND RATES

- Alfalfa seed should be planted ¼ - ½ inch deep
- Seed rates
  - 16-25#+/acre soils with adequate moisture
  - Increased seeding rates results in better first year forage yields and likely less weed pressure.

University of Kentucky Study

COMPANION CROPS

- May be competitor to alfalfa
- Plant at a light rate
  - Italian Ryegrass – 2 LBS
  - Small grain – 1 bushel
- Do not take for grain
- Help with erosion control & weed pressure.
- Seeding depth of companion crop is deeper than alfalfa.

ALFALFA AND GRASS

- Determine forage ration to decide on alfalfa grass mixtures.
- Moderate amount of grass in mixture.
- Raise cutting height to 3-4 inches to not cut off the growing point of the grass.

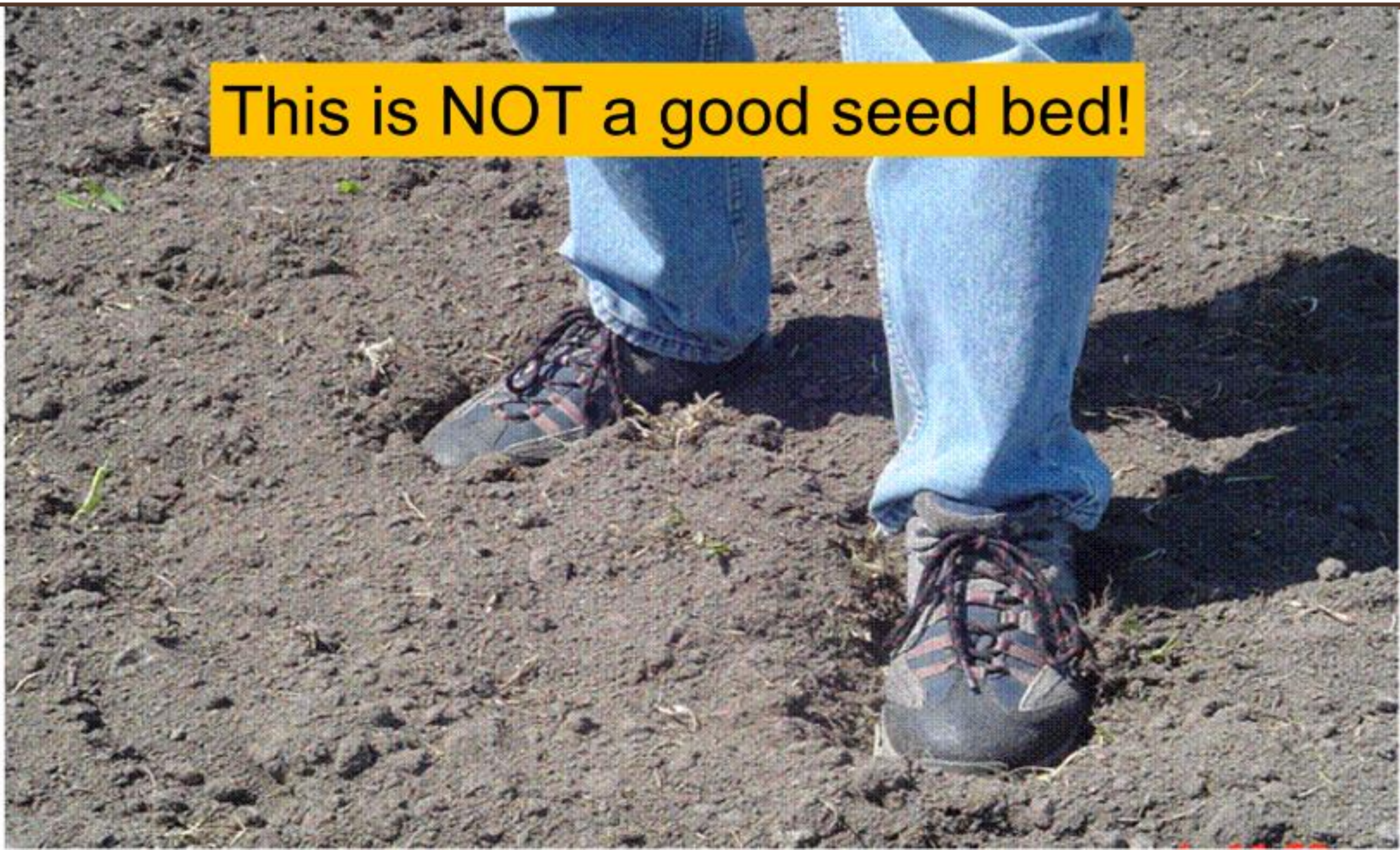
TOP REASONS FOR ALFALFA SEEDING FAILURE

- Low pH
- Poor seed to soil contact
- Seeding depth too deep
  - Soil too fluffy
- Herbicide carryover

SEED BED PREPARATION

Proper Seeding is Vital for Success

- Seed bed preparation
- Seeding depth
- Seeding rate
- Proper fertility!



FAILURE SCENARIOS

- Poor stand in angular pattern – likely soil related
- Poor stand in round patterns – likely disease
- Poor Stand in strips – equipment / operator error
- Uneven stand – poor field prep

LATE SUMMER MANAGEMENT

PREPARING FOR WINTER

- **Alfalfa is photoperiod sensitive**
  - As days become shorter, alfalfa plants begin to prepare for winter.
- When low temperatures drop below **40 degrees**, the plants begin to harden for cold temperatures

LATE SUMMER MANAGEMENT

- Alfalfa stores carbohydrates in the crown and roots.
- After 6-8 inches tall, alfalfa begins to replace carbohydrates in the roots.
- New growth draws upon the reserves to initiate regrowth.

ALFALFA PREPARING FOR WINTER

- Management is important!
- Low soil fertility reduces winter survival (low soil pH, potassium and sulfur)
  - Late summer fertilization should be done to replace nutrients removed by the alfalfa forage.
- More frequent cuttings requires more genetic winterhardiness because plants have less time between cutting to recharge root carbohydrates.
- Fall harvest puts additional stress on alfalfa and requires more winterhardiness.

MANAGEMENT FACTORS

- Alfalfa Variety
- Stand Age
- Soil Fertility
- Fall Cutting / Regrowth Height

CONSIDERATIONS

- Do I take this last cutting?
  - Do I need the feed?
- Is this stand worth keeping?
  - 55 stems per square foot for maximum forage yield, 25 stems on non-irrigated dryland production.
  - 40 stems in the fall with equate to a 25% forage yield reduction to next year
- Manage for high root carbohydrates going into the winter
  - Need more than 6-8 inches of regrowth entering the winter

WINTER INJURY

- Winter Kill
  - Causes/factors
- Winter Kill Management
- Reducing Risk of Winter Kill
- Stand Assessment

FACTORS THAT AFFECT WINTER INJURY

Sub-zero soil temps

- Exposed soil
- No snowfall

Ice sheets

- Prevent air exchange to the alfalfa crowns
- Alfalfa can tolerate up to 3 weeks of ice before killed.

FACTORS THAT AFFECT WINTER INJURY

Snow Cover.

- Snow is an excellent insulator. As little as four inches of can result in a 10-degree difference in soil temperatures.
- The more stubble left in the fall will increase levels of soil cover.

FACTORS THAT AFFECT WINTER INJURY

- **Soil fertility**. Stands with high fertility, especially potassium, are less likely to experience winter injury.
- **Soil moisture**. Well drained soils are less likely to have winter injury.
- **Fall moisture status**. Stands going into the winter with less soil moisture are better able tolerate winter damage.

FACTORS THAT AFFECT WINTER INJURY

- **Cutting Management**. In general, the short intervals between cuttings, the greater risk of winter injury.
- **Stands harvested** between September 5th and October 15th are at greater risk, as plants are unable to **replenish root carbohydrates** before winter.

FACTORS THAT AFFECT WINTER INJURY

- **Stand age**. Older stands are more likely to winterkill than younger ones.
- **Soil pH**. Stands growing on soils with a pH of ~ 6.8 are less likely to experience winter injury.
- **Variety**

DETERMINING WINTER KILL

- In the Fall
  - Weed infestation
  - Stand assessment
  - Crown and Root Ratings
- In the Spring
  - Slow to green up
  - Uneven growth
  - Root damage

STAND ASSESSMENT

- Alfalfa Squares
- Multiple areas throughout the field.

PLANT COUNT

- Count plants to estimate yield potential

- New Seeding – 20+ plants/sq.ft.
- Year 1 – 12-20 plants/sq.ft.
- Year 2 – 8-20 plants/sq.ft.
- Year 3 or older – 5 plants/sq.ft.

STEM COUNT

- Count stems to estimate yield potential

Figure 1. Alfalfa Stem Count and Yield Potential

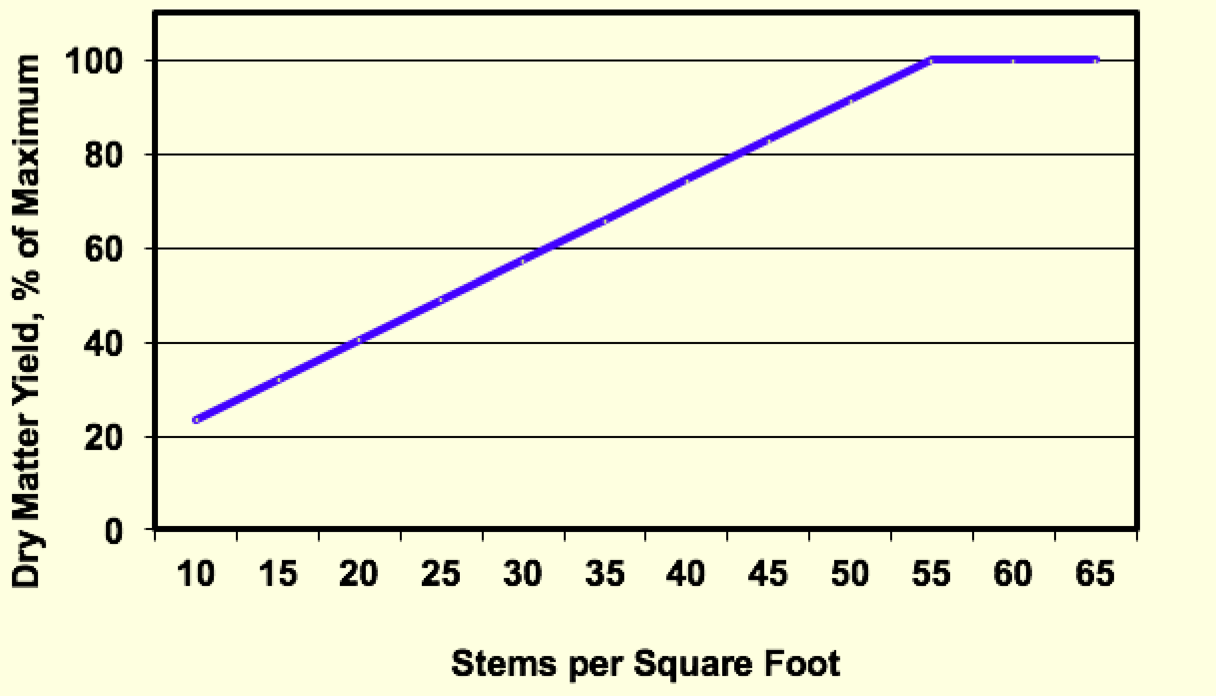


Table 2. Stand density recommendations

stand density (stems/sq ft)	action	predicted yield potential (assuming no winterkill)
>55	stem density not limiting yield	same as current year
40–55	some yield reduction expected	if good health, same as current year; if >30% in category 4, significantly less
<39	consider replacing stand	if good health, same as current year; if >30% in category 4, significantly less

CROWN AND ROOT HEALTH

- Evaluate crown and root health

Table 1. Rating alfalfa crown and roots rating condition winter survival

rating	condition	winter survivial
0	healthy	excellent
1	some discoloration	excellent
2	moderate discoloration/rot	good
3	significant discoloration/rot	good for mild winter; poor for hard winter
4	greater than 50% discoloration	poor
5	dead	—

ROOT RATINGS

Large crown, symmetrical, many shoots.

Off-white roots with few signs of discoloration. Excellent winter survival.

ROOT RATINGS

Large crown, less symmetry, many shoots.

Off-white roots beginning to show signs of discoloration. Excellent winter survival.

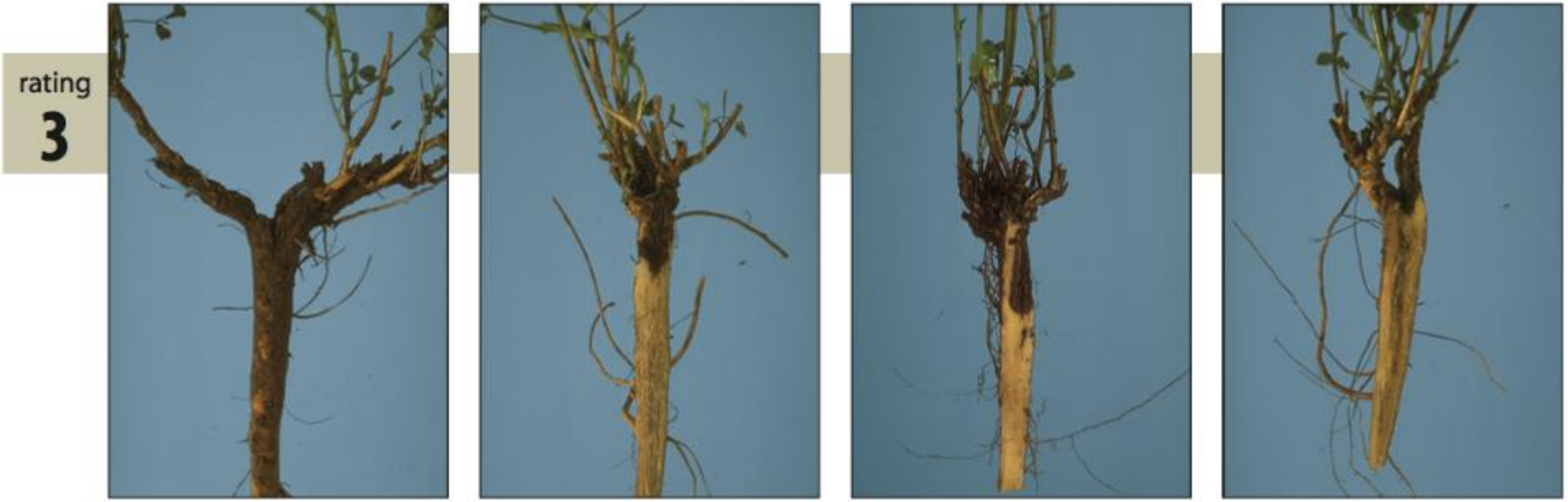
ROOT RATINGS

rating 2

Smaller crown, poor symmetry, fewer shoots.

Evidence of crown rot, vascular discoloration 3 to 4 inches deep. Roots may show one or both symptoms. Good winter survival.

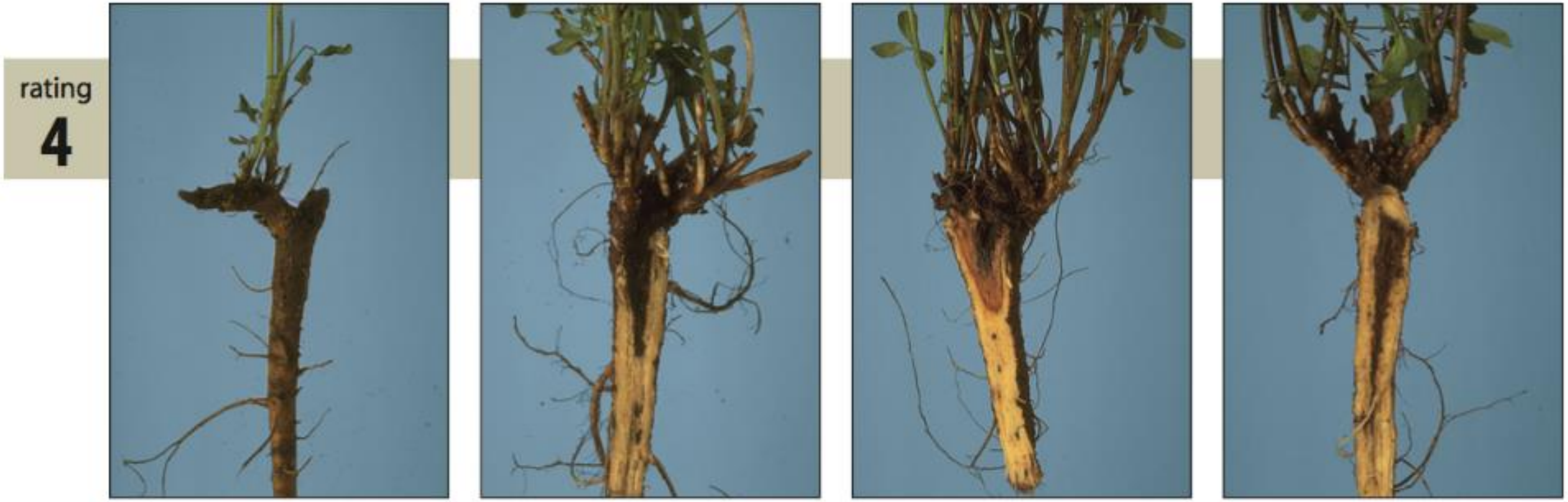
ROOT RATINGS



Weak crown, less symmetry, fewer shoots.

Significant crown rot and root discoloration. Good survival in mild winters; poor survival in hard winters.

ROOT RATINGS



Complete lack of symmetry, few shoots.

Root rot affects more than 50% of the root's diameter, significant vascular discoloration. Not likely to survive winter.

ROOT RATINGS

Dead plants.

IF I HAVE WINTER DAMAGE, WHAT CAN I DO?

- **Keep the stand <u>one more year?</u>**
- Interseed 7-10 LBS of Italian Ryegrass and 5-7 LBS of red clover into the stand.

IF I HAVE WINTER DAMAGE, WHAT CAN I DO?

- **Multiple Year Solution**
- Renovation Plus Mix
  - 25% Medium Red Clover
  - 25% Meadow Fescue
  - 25% Tall Fescue
  - 25 % Italian Rye Grass

12-15 LB Seeding Rate

- Long term forage - add 3-7#s of a combination of the following: Tall Fescue, Meadow Fescue, Perennial Ryegrass, Orchardgrass.

PLANT CORN

REDUCING RISK OF WINTER KILL

1. Variety Selection
2. Fertilization, plant health
3. Summer Cutting Management
4. Fall Cutting Management

ELITE GENETICS

- L46-08
- L-457 HD+
- L-470 HD

ROOT TYPES & BENEFITS

- Tap vs. Branch Root
- Tap with Branch Root expression
- Sunken / Recessed Crown
- Creeping Root

Tap Root

- Alfalfa roots grow deeper than many other crops.
  - 15+ feet is typical
  - Including Tap and Branch rooted alfalfa

BRANCH ROOT

- Heavy Soils
- Low spots in rolling fields
- Drought tolerance
  - Lateral roots close to surface

SUNKEN / RECESSED CROWN

- Wheel Traffic
- Animal Traffic
- No yield drag

BRANCH ROOT W/ SUNKEN CROWN

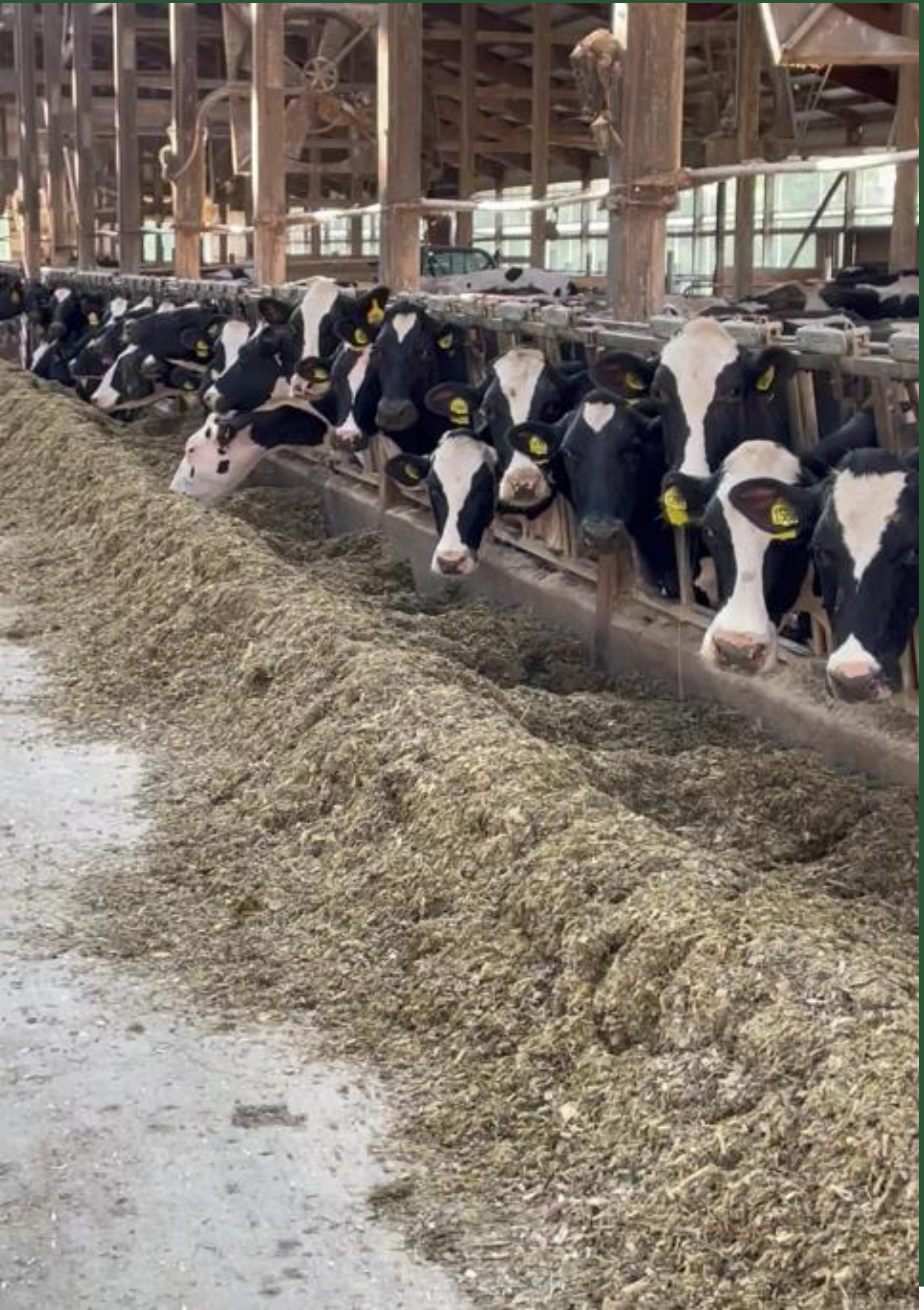
- Works on multiple soil types

CREEPING ROOT

- Pasture Mixes
- Long Rotations
- No Yield Drag

TRANSPLANTED ALFALFA PLANT

- Pulled from selection nursery
- Root grown from trimmed tap root.



THANK YOU!

QUESTIONS?

LEGACY Seeds

Alfalfa Management

Mike Sankey, CCA - Legacy Seeds Agronomist

February 2024

Herbicides

- Keep stands clean = Higher feed quality
- Most Important In Seeding Year

  - Pre-Plant Incorporated
    - Eptam & Treflan

- Post Emerge
    - Raptor, Buctril(Moxy 2E), 2,4-DB, Pursuit, Select, Poast
    - Warrant -> Only Residual Control
    - Round-Up -> Only on Tolerant Varieties

Always Read & Follow Each Products Label

Insecticides

- Insects can stress plants and make them more susceptible to disease and other unfavorable factors.

- Alfalfa Weevil, Alfalfa Caterpillar & Pea Aphids
  - Economic Thresholds
    - Alfalfa Weevil – 40% Stem Feeding
    - Alfalfa Caterpillar – 10/sweep
    - Pea Aphids – 100/sweep

Insecticides – Potato Leaf Hopper

- Most Important Alfalfa Insect Pest
- Cause Yield Losses
- Quality Losses, due t

g sugar instead of protein
- Reduction in plant vi arvest recovery, increased stand loss to winter kill

- Different Economic T
  - 3” Tall 2 in 10 sweeps
  - 6” Tall 5 in 10 sweeps
  - 8-11” Tall 10 in 10 sweeps

Always Read & Follow Each Products Label
Pay Attention to Harvest Restrictions or “PHI”

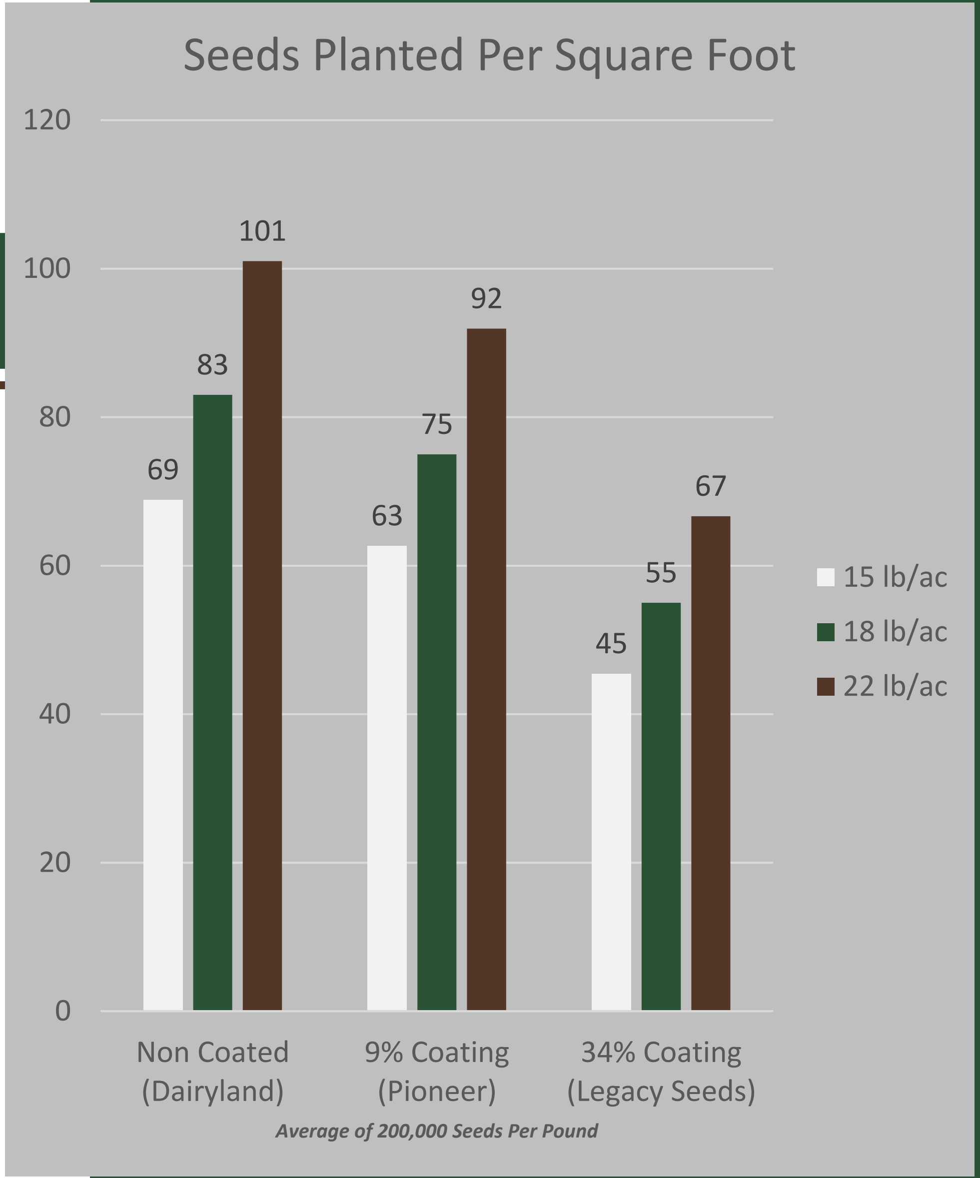
Fungicides

- In-Season Use
  - Headline, Priaxor, etc
  - Disease Control -> 1st Crop
  - Prevents Ethylene Production
    - Keep GREEN Leaves
  - Increased Yield Potential
  - Improved Forage Quality

- Some Seeds Have Fungicide Applied to Them(Apron)
  - Protects plants from Pythium, early-season Phytophthora, downy mildew, as well as damping-off and poor seed germination under ***cool and wet*** environmental conditions.

Seed Coatings

- Improves establishment success
- Provides a better microenvironment around the seed for germination and growth
- More uniform stands in variable acres
- The fungicide helps the alfalfa seedling when it is most vulnerable to pythium and phytophthora root rot
- Planting less seed but the same numbers of plants becoming established.



PLANT DENSITY

Period	Plants/sq. ft.
Within 30 days of seeding	25-30
Fall of seeding year	15-25
1st production year	10-15
2nd production year	6-10
3rd production year	4-6

Fertility

- Yield Goals – All Recommendations Based on Soil Type
  - Better Quality
  - Better Stand & Stand Life
- K2O -> Potassium
  - Potash 0-0-60
  - 50lbs K2O per Ton
- P2O5 -> Phosphorus
  - MAP, DAP, MicroEssentials S-10
  - 14lbs P2O5 per Ton
- Boron
  - Elemental or Aspire
- Sulfur
  - Elemental or Alternatives

6 Tons/Acre/Year

- 490# Potash (0-0-60)
- 150# MAP (11-48-0)
- 190# Cal-Sul(21Ca-17S)
- 7# Boron (14.5%)

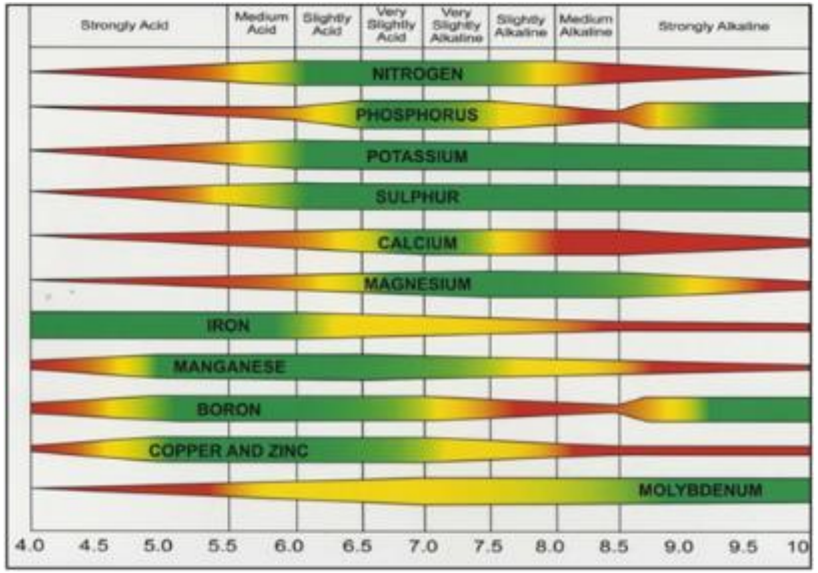
Fertility - Manure

- Valuable source of nutrients
- Lack of storage leads to the need of summer spreading
- Solid vs. Liquid Manure
  - +/- 5000 gallons
  - Spread IMMEDIATELY after harvest
  - N loss – unless there is grass inter-seeded

Liquid Manure Calculator - Book Value/1000 Gal				
		N	P_2O_5	K_2O
Gallons Spread	5500	7	6	17
		↓	↓	↓
Nutrients per Application		38.5	33	93.5
Frequency	3	115.5	99	280.5

pH - Liming

- Target 6.8
  - At lower pH, roots are less able to absorb nutrients from the soil
  - A low pH will prevent the rhizobia in the nodules from producing nitrogen
- Most crop insurance companies will not cover new seeding failures unless the pH is over 6.0
- Liming should be done 6 to 24 months prior to planting



Questions

HARVEST MANAGEMENT

WHAT WE USED TO DO

GETTING BETTER

WHAT WOULD YOU RATHER DO

WHAT'S ACTUALLY "BEST"

AMAZING HOW ADVANCED WE ARE

LONG DAY

NOT MANY OF THESE BEING USED

MAJORITY OF HAY HARVESTED THIS WAY

Alfalfa Harvest

1. Harvest forage as rapidly as possible to reduce the chance of rain damage.
2. Capture maximum forage yield at the optimum forage quality.
3. Reduce in harvest loss in putting up the forage.

HARVEST CONSIDERATIONS

- Cutting Height
  - Lower the cut
    - the more stem yield
    - Slows down drying time
    - Decreases stand life
    - Decreases forage quality
  - 2.5 – 4 inches
- Equipment
  - Mowers
  - Conditioners
  - Raking
  - Wheel Traffic

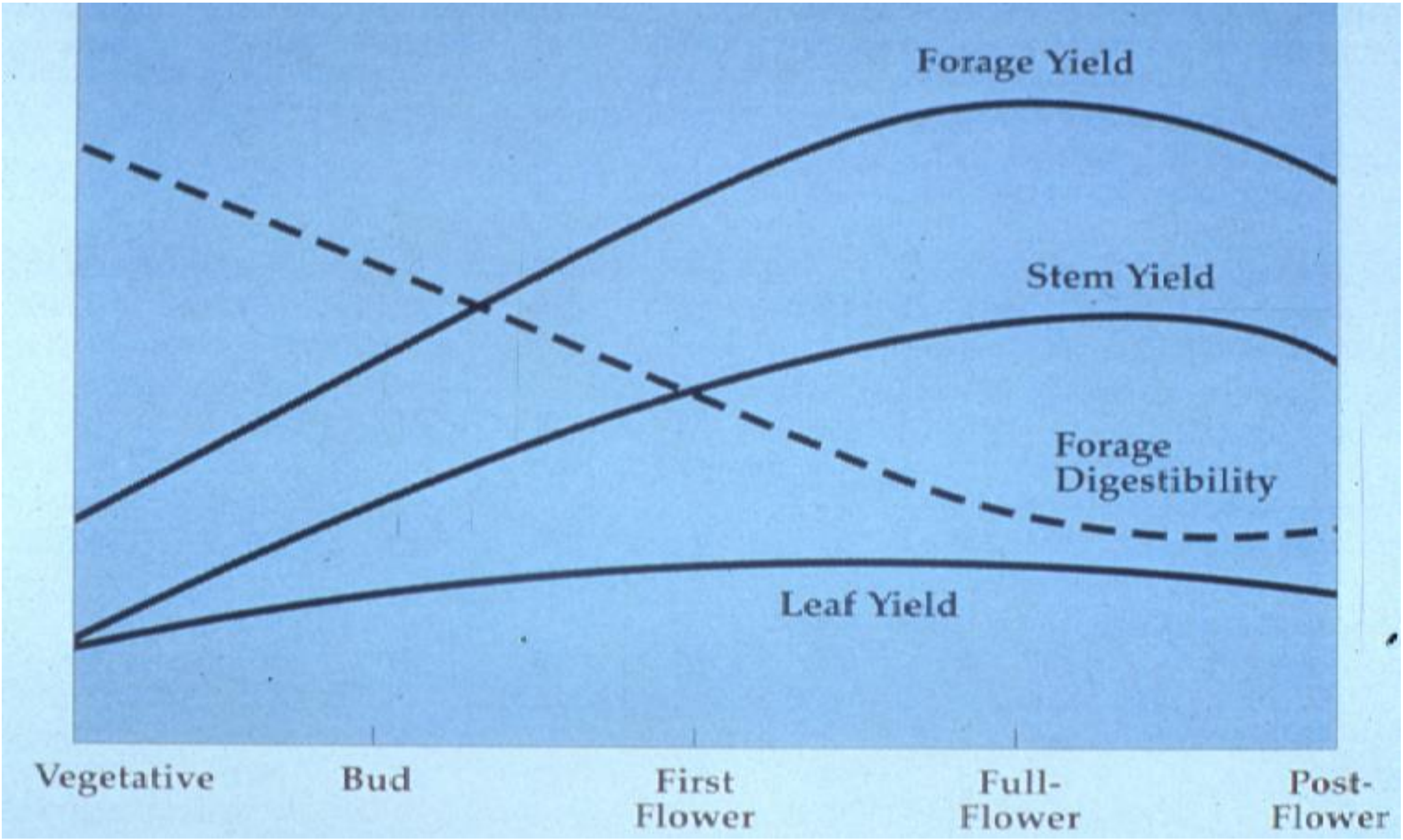
Wide swaths

- To maximize drying time, cut as wide as possible. At least 80% of cutter bar width. (only if it can be harvested efficiently enough to keep up with drying)
- Avoid big slugs of hay laying next to each other.
- Adjust cutter bar to keep hay off the ground. Need air flow under the windrow. Consider cutting at 3 inches instead of 2.
- Merge hay at 60% moisture to make haylage.

HARVEST MANAGEMENT

- Cutting Schedule
  - Aggressive Cutting
  - Extended Harvest
  - Flexible Harvest

- Forage Quality
  - Leaf : Stem
  - Rain Damage
  - Afternoon Harvest
  - Variety Differences



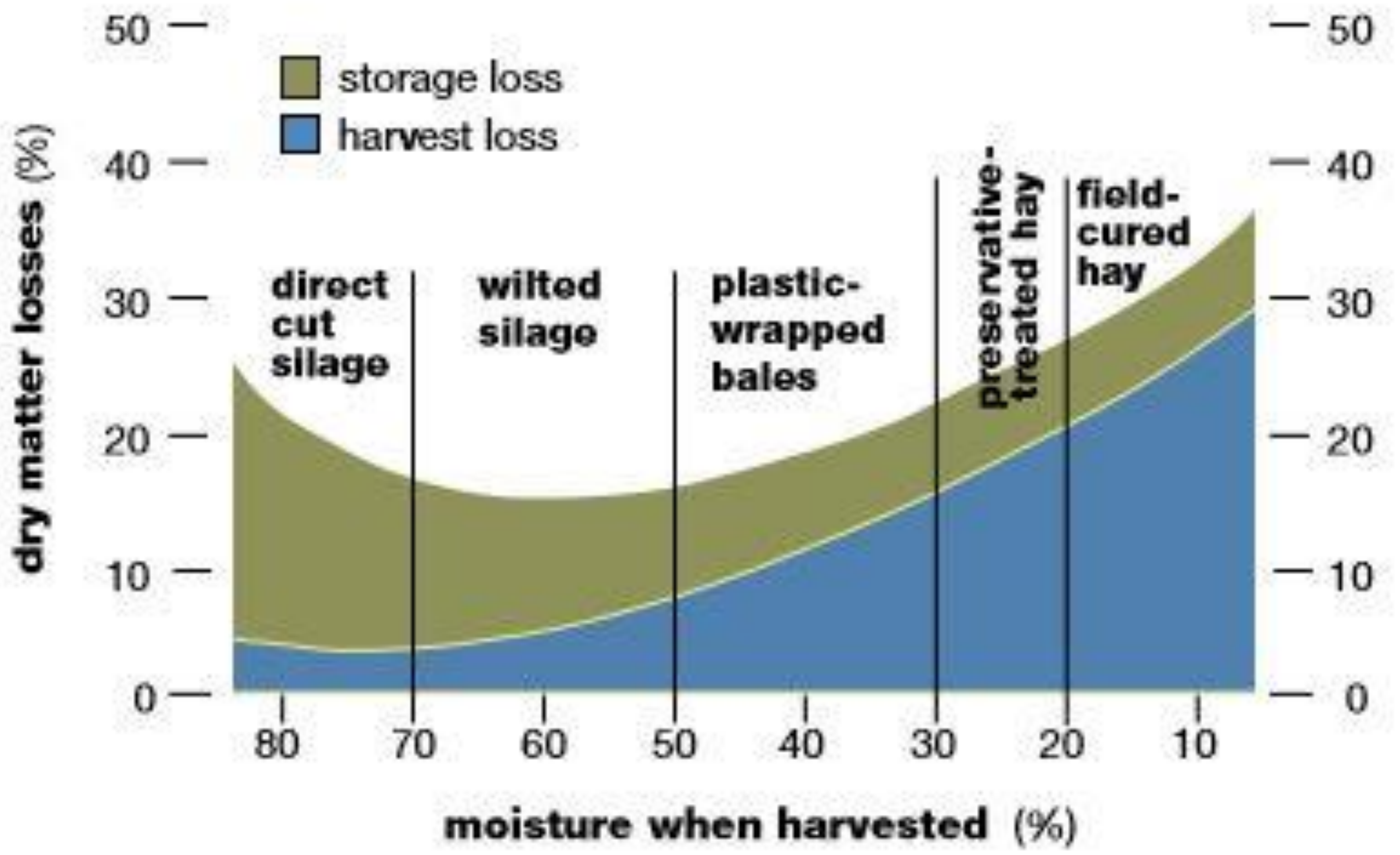
HARVESTING FOR YIELD AND QUALITY

- The first two harvests need to be timely.
- Calendar Date vs. Stage of Maturity vs. GDU's.
    - You should be able to feel the buds.
- Second cut taken in mid-bud around 28 or less days.
- Third and fourth cuts can be harvested on a longer interval.
- The industry has established that ideal timing for most efficient yield and quality is mid to late bud

Tedding Alfalfa

Rakes and Mergers

Figure 25. Dry matter losses during harvest and storage relative to forage moisture content at harvest.



Leaf Yield verses Stem Yield

- Once you get past bud stage, forage yield increases due to stem yield.
- Forage quality declines based on the ratio of stem to leaves.

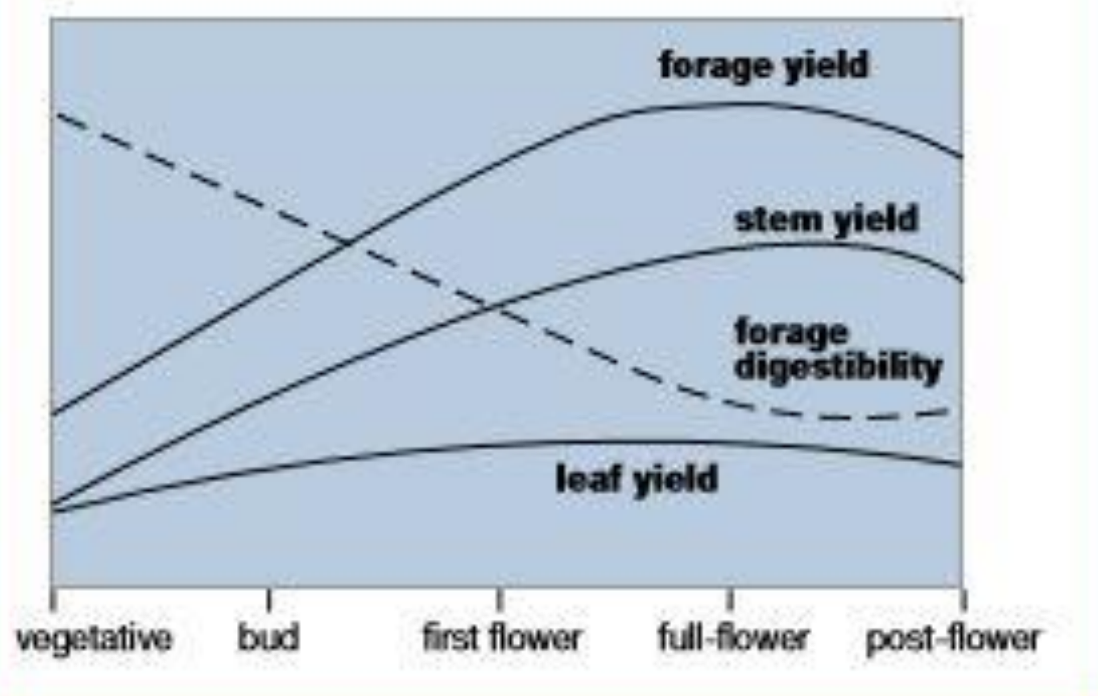


Figure 22. Forage yield relative to quality at different growth stages.

Harvesting for Yield and Quality

- The first two harvests need to be timely.
- First cut should be Mid to late May in upper Midwest. You should be able to feel the buds.
- Second cut taken in mid-bud around 28 or less days.
- Third and fourth cuts can be harvested on a longer interval.

Balers, Putting it in a package your customer wants.

Wrappers

Ash in Forages

Abby Neu
University of Minnesota

Goal ash content

- Goal should be 10% or less
- Grasses average 6% natural ash
- Alfalfa contains 8% natural ash
- Forage test adds natural ash and soil ash together

University of Wisconsin's Soil and Forage Analysis

Laboratory Results (1000 samples)

- Haylage samples averaged 12.% with a range of 5.7 to 18%.
- Hay samples averaged 10.3% with a range of 8.8 to 17.6%
- Both grass and alfalfa averages about 4% surface ash contamination

Consumption

Animals eating forage were consuming about 1# of dirt in each 5# of hay or silage.

Mergers

Mergers showed the least amount of soil contamination.

Wheel Rakes

Wheel Rakes tended to collect more ash because they are ground driven.

Rake forage off of the stubble instead for scraping the ground.

Pay attention to ground speed.

Sidebar Rakes

Keep teeth from scalping the soil.

Rotary Rake

Need to keep teeth from scalping the soil

Mower

- Raise cutter bar to 3+” to keep forage off of the ground.
- Lay in wide swath in a dense stubble to eliminate harvesting a layer of soil.
- We don’t need more ASH!

Tedding

- Reduce drying time by allowing sunlight to dry more of the forage.
- Do not scalp the soil.

Ash in storage

- Bags
  - Store bags on concreate or asphalt in reduce the risk of contamination.

Quality loss Plant sugars (Carbohydrate

Rainfall reduces soluble carbohydrates in two ways:

1. Direct leaching out of plant tissues depends on:
    - Moisture content of wilted hay
    - Amount of rain
    - Intensity of the rain
    - Duration of the rain

Quality loss

- Intensity and short duration is more damaging than same amount of rain over a longer period of time.
- Less leaching early in the wilting process when plant is at the high moisture rather than ready to bale.

Quality loss

2. Effect of rainfall on drying hay is simply that the forage is rewetted

- Rain on wilted hay is simply re-wetting the forage which can re-activate plant respiration. This will cause additional plant sugars to be lost.
- Respiration occurs in plants until moisture levels drop below 50%.

Results of rained on hay

1. Lost plant sugars from leaching or through respiration
2. Higher NDF
3. Lower NDFd
4. More ash
5. Lower RFQ
6. Higher protein ?

Fermentation

- When forage is chopped for high-moisture feed, rain during wilting will negate it potential fermentation qualities.

Yield Losses

- Leaf shatter decreases yield
- Need for additions windrow manipulation with equipment
- Yield losses range for minimal to 34% in research trials
- Rain damage also discolors or bleaches the hay.


Questions?
Alfalfa Management Guide
American Society of Agronomy
Crop Science Society of America
Soil Science Society of America
5585 Guilford Road
Madison, WI 53711-5801 USA

FORAGE UNIVERSITY

Outline

- Alfalfa Economics
- Alfalfa Rotation
    - Benefits
    - When to Rotate

Dave Robison
Alfalfa Business Manager

Mark Tomaszewski
Regional Alfalfa Specialist

Alfalfa is a Top Cash Crop!

ALFALFA ECONOMICS- Comparing the Top 3 Crops

Revenue per Acre	**Alfalfa**	**Corn**	**Soybeans**
Value of Crop (tons or bushels)*	$ 300.00	$ 4.50	$ 12.00
Expected Yield	6.0	210	75
Value of harvested crop per acre	$ 1,800.00	$ 945.00	$900.00
Expenses per acre	**Alfalfa**	**Corn**	**Soybeans**
Total Input Cost**	$ 650.00	$ 900.00	$683.00
NET PROFIT PER ACRE	$ 1,150.00	$ 45.00	$217.00
* 02-08-2024 Baldwin, WI			
** 2023 Iowa State estimates			

ROTATION BENEFITS

- Nitrogen fixation
- Breaks up pest cycles
- Soil improvement
- Erosion benefits
- Increased soil Phosphorus availability

NITROGEN CREDITS OF ALFALFA STANDS OF VARYING DENSITIES

	Medium/fine soils		Sandy Soils	
	Regrowth after last cutting			
Stand density	> 8 inches	< 8 inches	> 8 inches	< 8 inches
	# of nitrogen/acre			
Good, > 4 plts/ft	190	150	140	100
Fair, 1.5-4 plts/ft	160	120	110	60
Poor, < 1.5 plts/ft	130	90	80	40

FIRST-YEAR CORN SILAGE AND GRAIN YIELDS FOLLOWING ALFALFA AS AFFECTED BY NITROGEN FERTILIZER RATE.

Corn nitrogen fertilizer rate #N/Acre	Corn silage Yield T DM/Acre	Corn grain Yield Bu/Acre
0	9.77	228
20	9.75	226
40	9.81	228
80	9.78	229
160	9.88	229
LSD(.10)	NS	NS

Data are averages over 5 MN locations in 2009 and 5 potash rates applied to final-year alfalfa.

Authors: Jeff Coulter, Extension Corn Agronomist, Michael Russelle, USDA-ARS Soil Scientist; Craig Sheaffer, Professor of Forage Mgt.; and Dan Kaiser, Extension Nutrient Management Specialist.

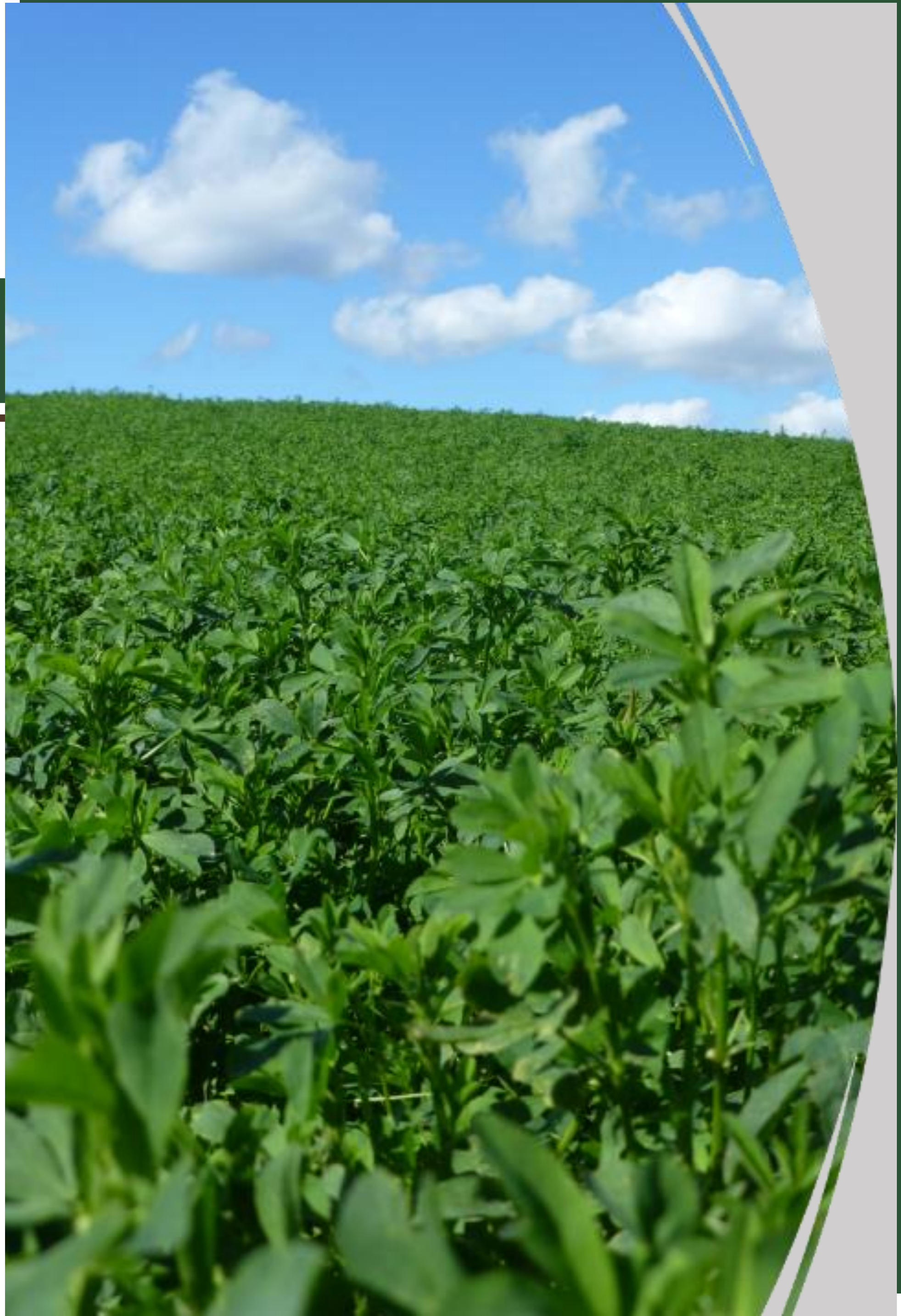
BREAK UP PEST CYCLES

- Corn Root Worm
    - Over winter in the soil

- Out compete herbicide resistance weeds

SOIL IMPROVEMENT / EROSION BENEFITS

- Alfalfa has deep roots to help mine minerals from deep in the soil
  - These minerals will be brought to the upper levels of the soil to benefit future grain crops
- Alfalfa + Grass provide excellent erosion control + soil improvement
  - Diverse root-types help *hold the soil* and *build the soil*



INCREASED SOIL PHOSPHORUS AVAILABILITY

- Alfalfa green manure, with higher N and P concentrations, as well as lower C/N and C/P ratios, significantly increased the soil available P through a high amount of organic P input and transformation into more available P.
- Alfalfa is an efficient user of Phosphorous

WHEN TO ROTATE

Stand Assessment

- In the Fall
  - Weed infestation
  - Stand assessment
  - Crown and Root Ratings
- In the Spring
  - Slow to green up
  - Uneven growth
- Alfalfa Stands
  - Alfalfa stands with four plants per square foot will often have 25% to 30% less forage yield compared to stands with good density.
  - Root damage

STAND COUNT

- Count plants to estimate yield potential

- New Seeding – 20+ plants/sq.ft.
- Year 1 – 12-20 plants/sq.ft.
- Year 2 – 8-20 plants/sq.ft.
- Year 3 or older – 5 plants/sq.ft.

STEM COUNT

- Count stems to estimate yield potential

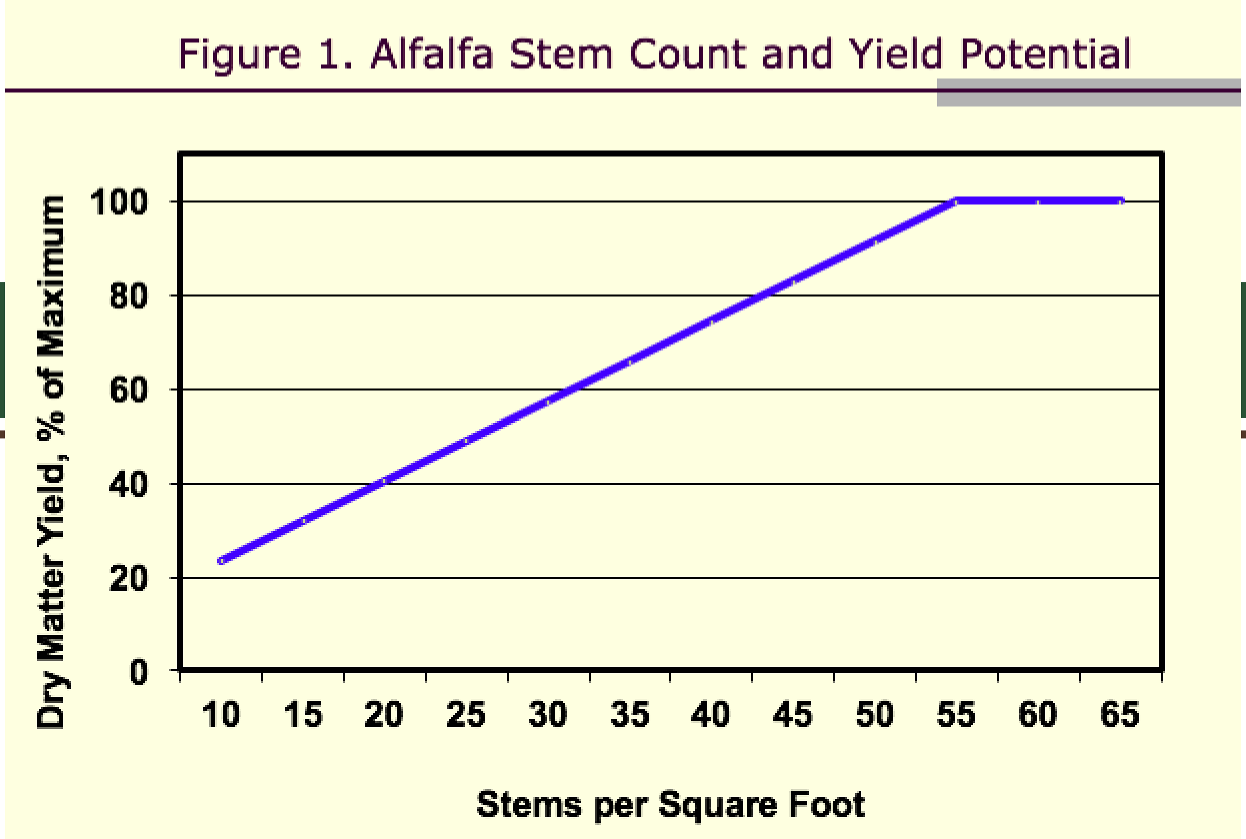
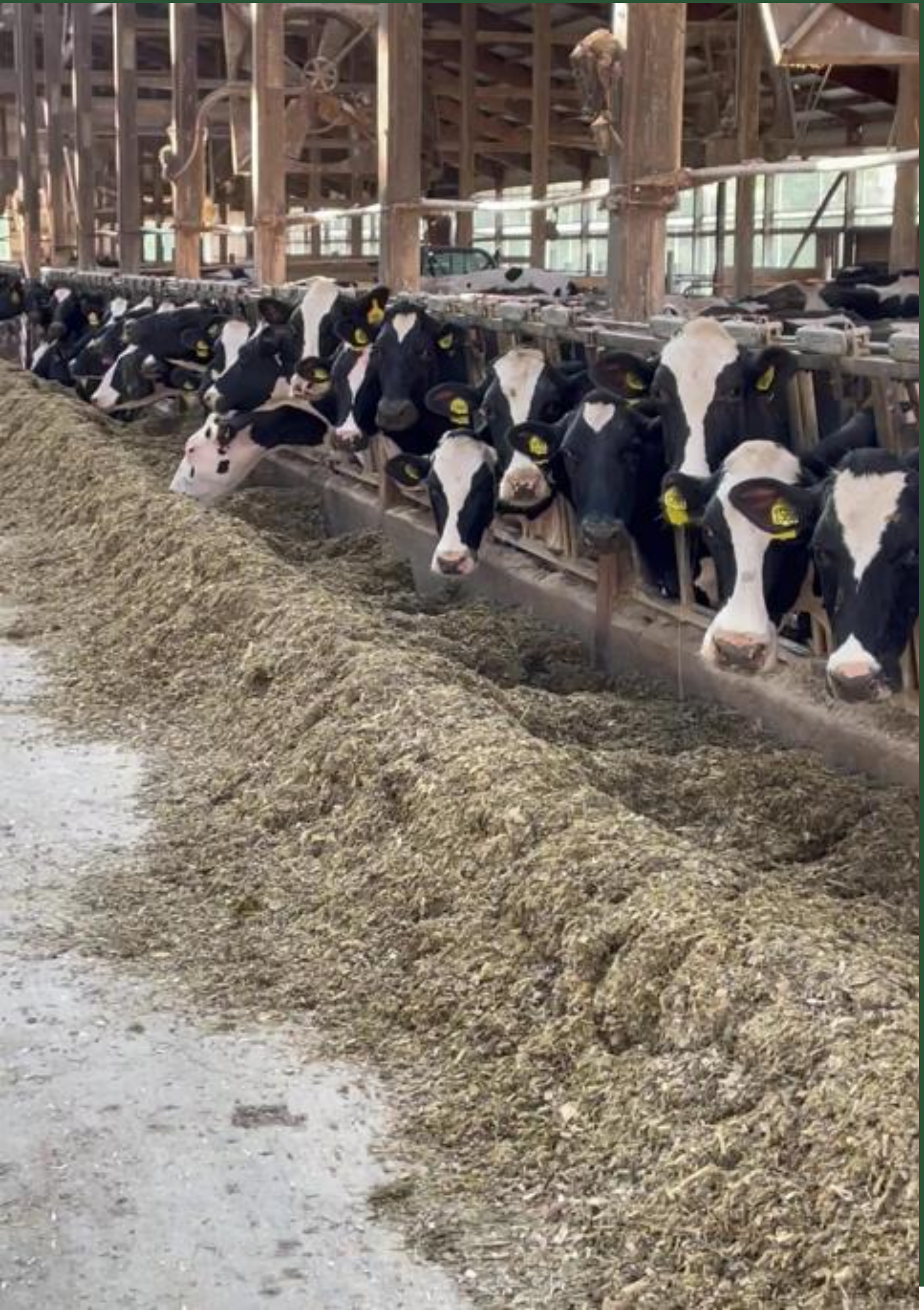


Table 2. Stand density recommendations

stand density (stems/sq ft)	action	predicted yield potential (assuming no winterkill)
>55	stem density not limiting yield	same as current year
40–55	some yield reduction expected	if good health, same as current year; if >30% in category 4, significantly less
<39	consider replacing stand	if good health, same as current year; if >30% in category 4, significantly less

UW Extension

College of Agricultural & Life Sciences, University of Wisconsin-Madison



THANK YOU!

QUESTIONS?

LEGACY Seeds

Data: Yield, Quality, and Persistence

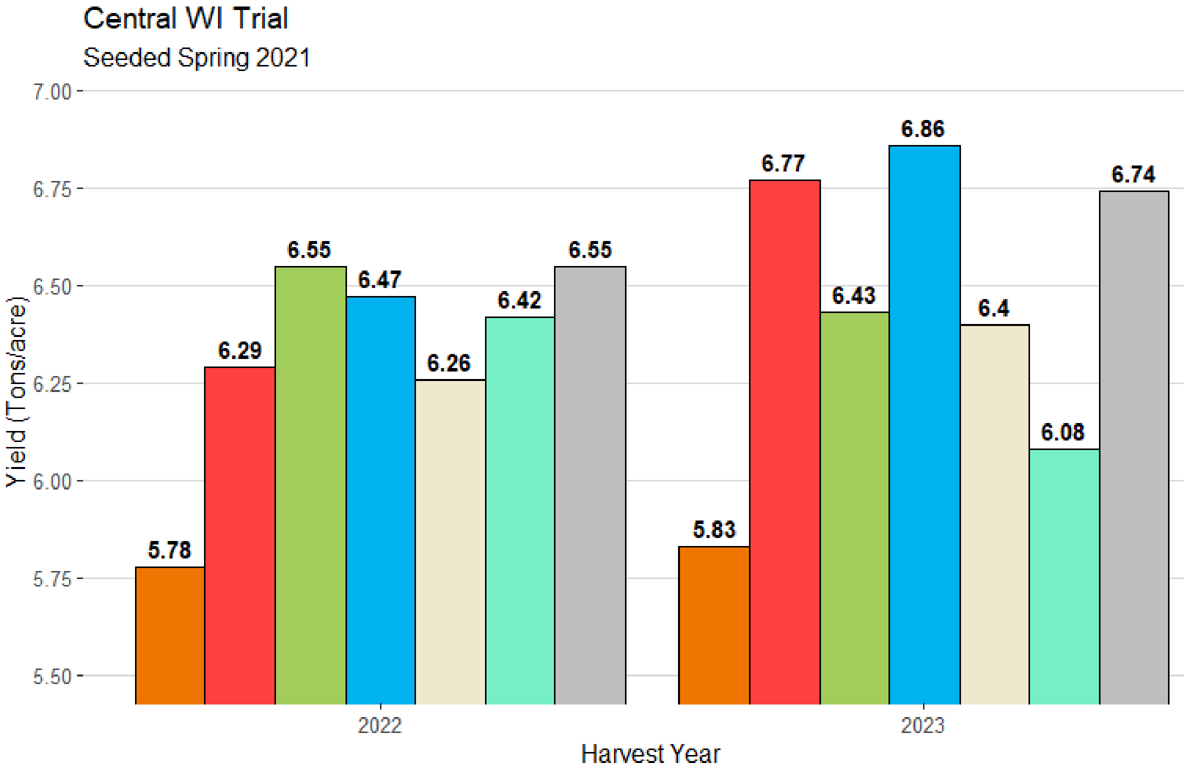
James Ferrell, Alfalfa Research Manager

February 22, 2024

The 3 Pillars

- **Yield**
- **Quality**
- **Persistence**

Yield

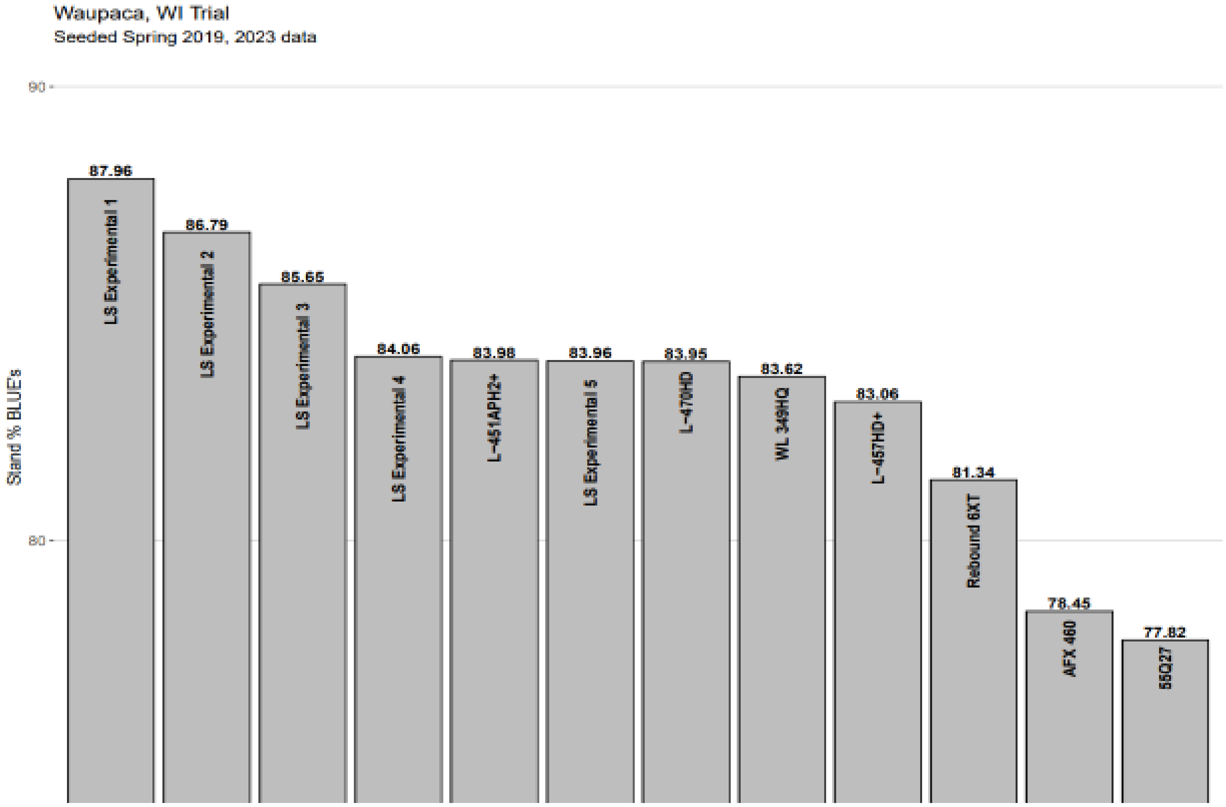


Central WI Trial
Seeded Spring 2021
Yield (Tons/acre)
7.00
6.75
6.50
6.25
6.00
5.75
5.50
5.78
6.29
6.55
6.47
6.26
6.42
6.55
5.83
6.77
6.43
6.86
6.4
6.08
6.74
2022
2023
Harvest Year

Quality

Entry	Yield (DM Tons)	Milk/Acre	Milk/Ton	RFQ	CP	Lignin	NDFD30	uNDFom240
L-457HD+	7.07	22,810	3226.33	228.62	24.08	5.23	58.99	10.96
Megatron	6.88	22,167	3222.00	228.57	24.35	5.10	59.63	11.09
L46-08	6.83	22,079	3232.67	227.67	24.02	5.47	59.66	10.90
Rebound AA	6.69	21,426	3202.67	222.73	23.57	5.32	57.28	11.28
Hybriforce 4400	6.54	21,292	3255.67	229.51	24.25	5.50	60.25	10.85
Pioneer 54Q14	6.46	20,386	3155.67	212.65	24.32	5.68	55.78	12.097

Persistence



Yield

- Cut
- Weigh
- Analyze

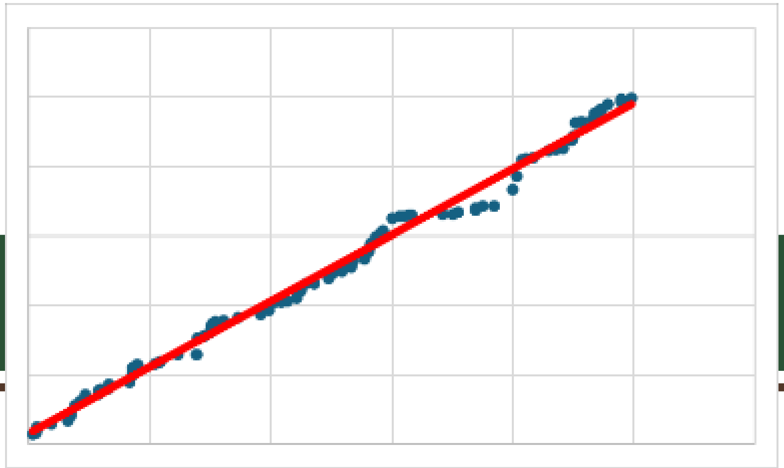
15.2	14.4	13.6	15	14.7	11	***9.7***	*9.8*
14	15.9	12.8	14	14.2	11.8	12.7	10
14.4	13.3	13.8	14.5	14	13	13	14
13.6	10	11.6	14.4	14.3	10.8	13.6	12.7
12.8	13.8	12.7	***12.2***	9.8	***9.7***	11.2	12.1
15.4	12.8	13	13.4	13.4	11.5	13	12.5
13.6	12.7	11.8	13.5	10.8	12.2	12.9	13
13.6	13	12.4	10.9	13.6	11.7	11	9.9

Experimental Design

- Rows, columns, and replications
- Modified randomized complete block (RCBD)

Variety 1	Variety 11	Variety 18	Variety 17
Variety 2	Variety 12	Variety 10	Variety 6
Variety 8	Variety 19	Variety 16	Variety 15
Variety 14	Variety 4	Variety 13	Variety 20
Variety 5	Variety 7	Variety 9	Variety 3
Variety 12	Variety 20	Variety 8	Variety 16
Variety 7	Variety 1	Variety 17	Variety 2
Variety 19	Variety 5	Variety 3	Variety 14
Variety 15	Variety 10	Variety 4	Variety 11
Variety 18	Variety 9	Variety 6	Variety 13
Variety 3	Variety 2	Variety 7	Variety 10
Variety 11	Variety 6	Variety 14	Variety 19
Variety 16	Variety 13	Variety 1	Variety 18
Variety 4	Variety 17	Variety 12	Variety 5
Variety 9	Variety 15	Variety 20	Variety 8
Variety 6	Variety 18	Variety 2	Variety 7
Variety 20	Variety 8	Variety 15	Variety 12
Variety 10	Variety 16	Variety 11	Variety 4
Variety 17	Variety 14	Variety 19	Variety 1
Variety 13	Variety 3	Variety 5	Variety 9

Multiple types of means



Observed Mean

- "Normal" average
- Add all values and divide by number of data points
- Simple but influenced by extreme values

Least Square Mean

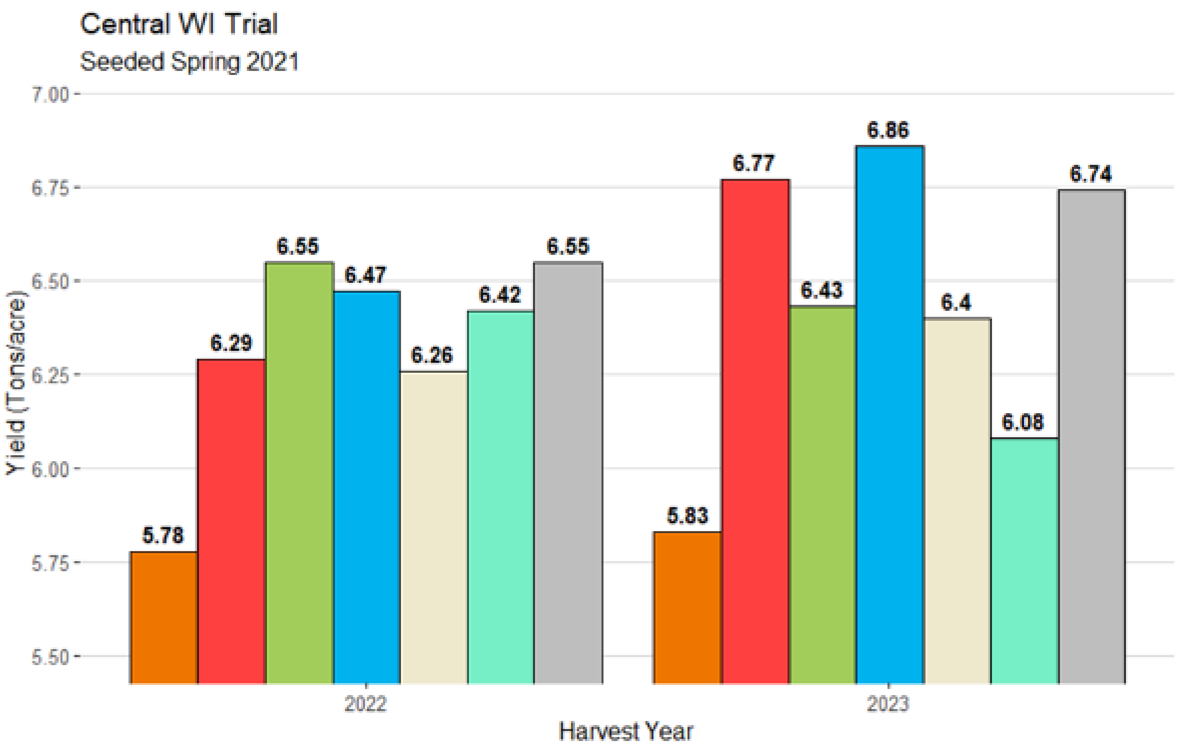
- Calculated using a statistical method called least squares
- This technique finds the best-fitting line or curve through a set of data points.
- Provide a more robust estimate, especially when there are imbalances in the data
- Can be used in the analysis of variance (ANOVA)

ANOVA

- Analysis of variance
- Simple linear model $yield = \mu + geno + rep + \varepsilon$
- Models can account for some affects (reps, treatments, etc.)
- Does a specific variable (reps, treatment, etc.) actually influence the yield?
  - Statistically significant difference
- Heritability

Yield

Entry	2021		2022		2023		TOTAL	
LS Exp.	1.40	1	5.40	2	7.43	1	14.24	1
LS Exp.	1.31	5	5.37	6	7.37	3	14.06	2
LS Exp.	1.23	11	5.38	5	7.41	2	14.02	3
LS Exp.	1.34	2	5.13	12	7.03	4	13.49	4
LS Exp.	1.32	4	5.39	3	6.78	10	13.48	5
LS Exp.	1.31	6	5.18	9	6.99	5	13.47	6
LS Variety	1.32	3	5.16	10	6.98	6	13.45	7
Competitor	1.20	13	5.38	4	6.80	9	13.38	8
LS Exp.	1.28	7	5.13	11	6.82	8	13.24	9
Competitor	1.22	12	5.49	1	6.52	14	13.22	10
LS Exp.	1.15	15	5.05	13	6.94	7	13.14	11
LS Exp.	1.26	9	5.25	8	6.58	12	13.09	12
LS Exp.	1.27	8	5.03	14	6.64	11	12.94	13
Competitor	1.13	16	5.36	7	6.41	15	12.90	14
Competitor	1.16	14	4.87	15	6.56	13	12.60	15
Competitor	1.24	10	4.83	16	5.65	16	11.72	16



Quality

- Harvest
- Send to lab
- Analyze results

Nurseries and Yield Trials

- Quality samples for selection
  - Single plant samples

- Quality samples for product verification and marketing
  - Multiple plant sample

What quality parameters are we interested in?

Crude protein, AD-ICP, ND-ICP w/SS, Protein sol., Total amino acids, Lysine, Methionine, Isoleucine, Leucine, Histidine, ADF, aNDF, aNDFom, Lignin, Lignin (Sulferic Acid), NDFD12, NDFD 24, NDFD 30, NDFD 48, NDFD240, uNDFom12, uNDFom24, uNDFom30, uNDFom48, uNDFom240, Sugar (ESC), Sugar (WSC), Starch, Fat (EE), TFA (fat), 16:0 Palmitic, 18:0 Stearic, 18:1 Oleic, 18:2 Linoleic, 18:3 Linolenic, Ash, Calcium, Phosphorous, Magnesium, Potassium, Sulfur, Chloride, NFC, NSC, RFV, RFQ, NDF kd rate MIR_P1, Adjusted crude protein, TDN, Nel 3x, Neg, Nem, Milk per ton

- **54 different data points!**

What quality parameters are we interested in?

Crude protein, AD-ICP, ND-ICP w/SS, Protein sol., Total amino acids, Lysine, Methionine, Isoleucine, Leucine, Histidine, ADF, aNDF, aNDFom, **Lignin**, Lignin (Sulferic Acid), NDFD12, NDFD 24, **NDFD 30**, NDFD 48, NDFD240, uNDFom12, uNDFom24, uNDFom30, uNDFom48, **uNDFom240**, Sugar (ESC), Sugar (WSC), Starch, Fat (EE), TFA (fat), 16:0 Palmitic, 18:0 Stearic, 18:1 Oleic, 18:2 Linoleic, 18:3 Linolenic, Ash, Calcium, Phosphorous, Magnesium, Potassium, Sulfur, Chloride, NFC, NSC, RFV, **RFQ**, NDF kd rate MIR_P1, Adjusted crude protein, TDN, Nel 3x, Neg, Nem, **Milk per ton**

- **54 different data points!**

Can we take the observed average?

- Linear model $RFQ = \mu + geno + rep + \varepsilon$

Entry	Rep	NDFD24	NDFD30	MT	RFV	RFQ	CP
Variety 1	1	56.67	58.42	3616	258.42	289.16	24.63
Variety 2	1	60.9	62.4	3602	237.72	280.46	23.68
Variety 3	1	55.33	57.07	3484	255.69	280.18	25.64
Variety 1	2	56.05	57.72	3524	249.01	277.56	24.39
Variety 2	2	55.38	56.72	3567	247.56	277.31	22.8
Variety 3	2	57.65	59.47	3575	243.51	276.88	24.29

- Accounts for variable environment

Yield Trial Quality

- Product verification/classification
- Marketing

Entry	Yield (DM Tons)	Milk/Acre	Milk/Ton	RFQ	CP	Lignin	NDFD30	uNDFom240
L-457HD+	7.07	22,810	3226.33	228.62	24.08	5.23	58.99	10.96
Megatron	6.88	22,167	3222.00	228.57	24.35	5.10	59.63	11.09
L46-08	6.83	22,079	3232.67	227.67	24.02	5.47	59.66	10.90
Rebound AA	6.69	21,426	3202.67	222.73	23.57	5.32	57.28	11.28
Hybriforce 4400	6.54	21,292	3255.67	229.51	24.25	5.50	60.25	10.85
Pioneer 54Q14	6.46	20,386	3155.67	212.65	24.32	5.68	55.78	12.097

Can we use the raw numbers from nursery quality samples?

- Single plant sample
  - One genotype per sample

YES!

Nursery Quality - Index Selection

- **Multiple traits being selected at a time**

Fresh Garden Tomato

Trait	Index
Taste	1
Color	2
Texture	3
Size	4

Processing Tomato

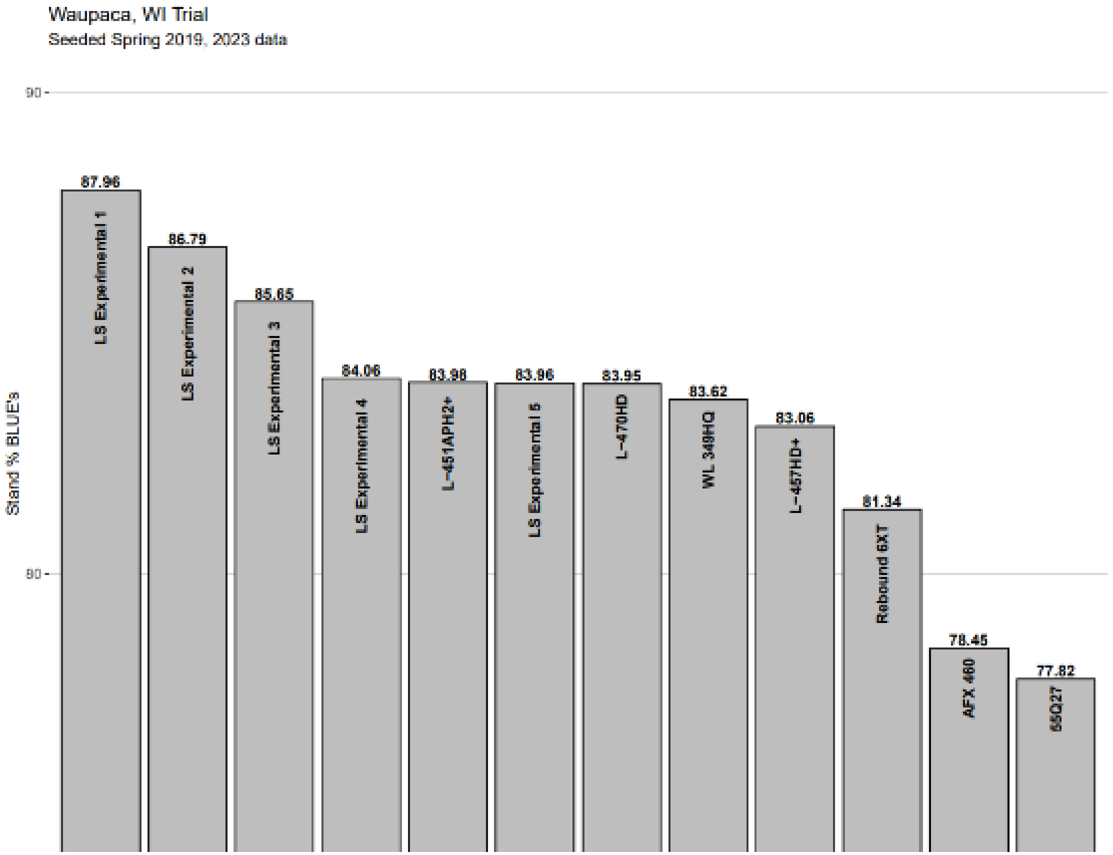
Trait	Index
Taste	4
Color	3
Texture	2
Size	1

Persistence

- Spring and fall ratings
- Winter survival vs. persistence
- Cumulative effect of harvesting <u>and</u> winter injury

Can we take the observed average?

- Linear model $Stand\ \% = \mu + geno + rep + row + column + \varepsilon$



85	80	85	50
92	80	85	90
45	85	85	85
85	85	85	80
85	85	80	75
85	90	85	80
80	80	85	75
85	85	80	85
90	45	85	80
85	80	80	80
85	80	80	85
80	70	35	75
50	80	80	75
80	80	85	80
85	85	55	70
92	30	80	70
85	90	80	75
90	85	80	85
90	75	85	75
80	80	70	85
85	85	85	85
85	80	85	15
85	80	85	80
85	75	90	80

Confidence in data

- Accuracy
- Clarity

- Data collection
  - Calibrated equipment
  - Consistent procedures
  - Site selection
  - Multiple locations
- Statistics
  - Experimental design
  - Linear models
  - ANOVA
  - Spatial Analysis

Questions

Triticale 101

Drake Frideres

What is Triticale

- Hybridization of tetraploid durum wheat (Triticum) and diploid Cereal Rye (Secale)
- Pronounced “Triti” and “cale”
- Myth: triticale is genetically stable and will not “Revert” back to wheat or Rye

No More Rye

- Cereal Rye tends to lodge when nitrogen levels are increased where triticale will continue to stand
- Triticale can produce 35% more forage than rye
- Triticale will hold nutritional value through later stages of maturity i.e. late boot better than cereal rye

Planting Method

HORTSCIENCE 49(4):441–447. 2014. A Comparison of Drill and Broadcast Methods for Establishing Cover Crops on Beds
Eric B. Brennan1 and Jim E. Leap
U.S. Department of Agriculture, Agricultural Research Service, U.S. Agricultural Research Station, 1636 E. Alisal Street, Salinas, CA 93905

- Drill vs Broadcast
- Tests show 35% less population density for broadcast + rototiller method than drilled
- Tests show 50% less population for broadcast + cultivator and broadcast + disc method than drilled

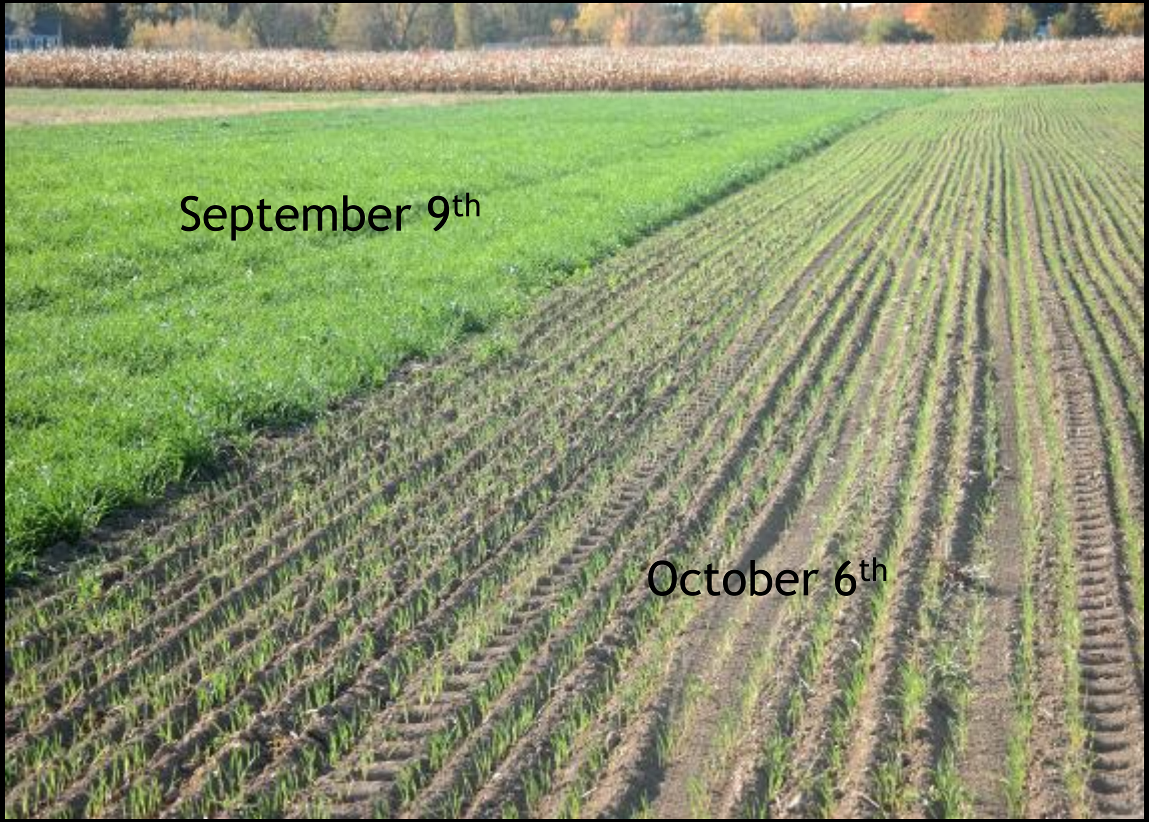
Planting Depth and Rate

Credit: Field Crop News, *Assessing winter wheat stands for winter survival*

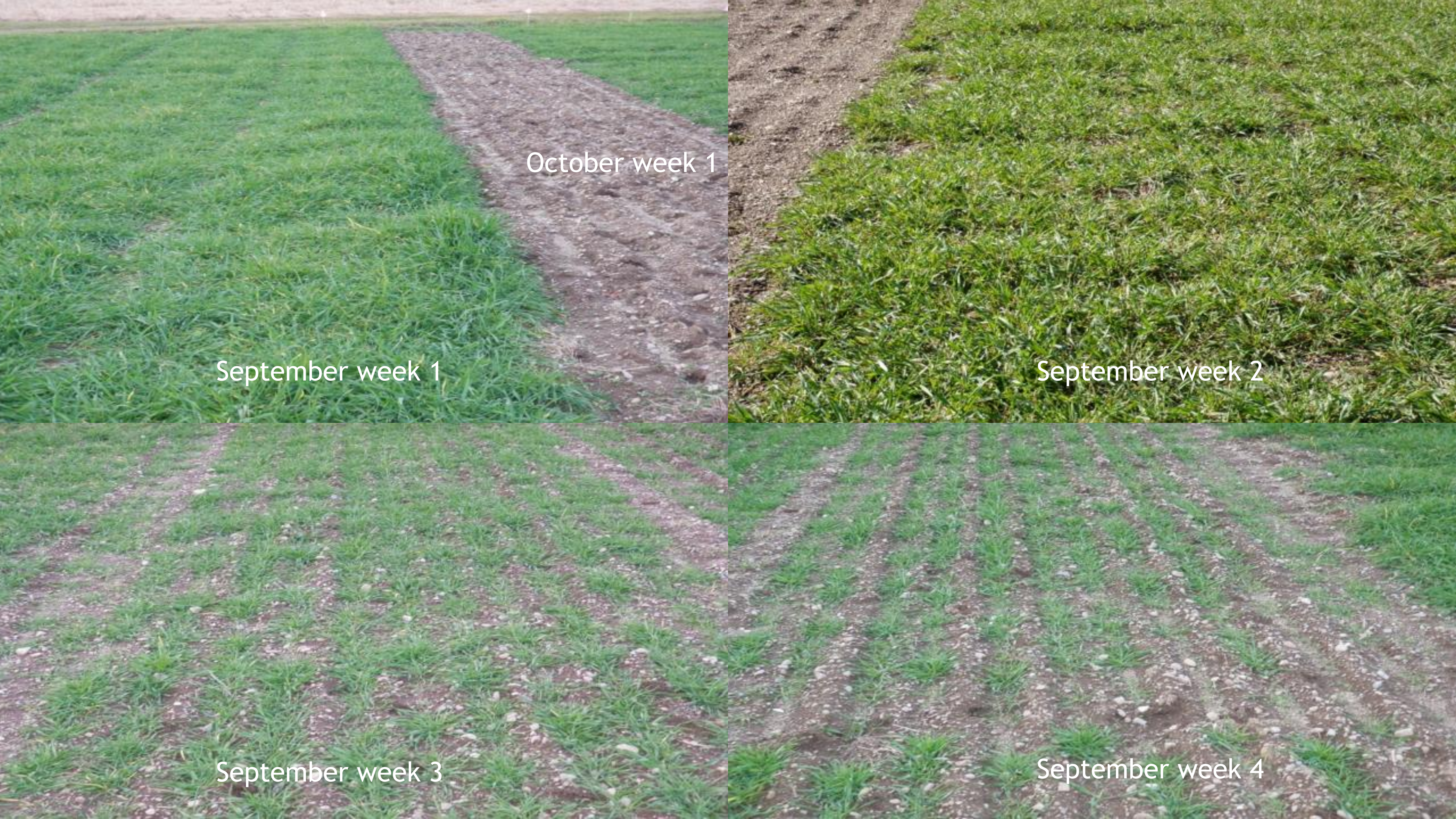
Population Comparison Among Cultivars					
Variety	Seeds/lb	lb/acre Planting Rate	Plants/acre Population	1.2 million % of Recommended	lbs/acre Correct rate
Trical Thor	8,997	100	899,700	75	133
Trical Surge	9,348	100	934,800	78	128
Trical Gainer 154	13,280	100	1,328,000	111	90
Trical 813	12,670	100	1,267,000	106	95
Trial Flex 719	11,540	100	1,154,000	96	104

- Plant between 1.25-2” in depth in a firm seed bed.
- It is important to allow the plant to develop a well-established root system and crown region to survive harsh winter months.
- Seeding rate: 1-1.2 million seeds per acre

Timely Planting



- Timing is everything!
- Planting date-first 2 weeks in September
- Or 10 days to 2 weeks before local grain wheat


October week 1
September week 1
September week 2
September week 3
September week 4

Nitrogen

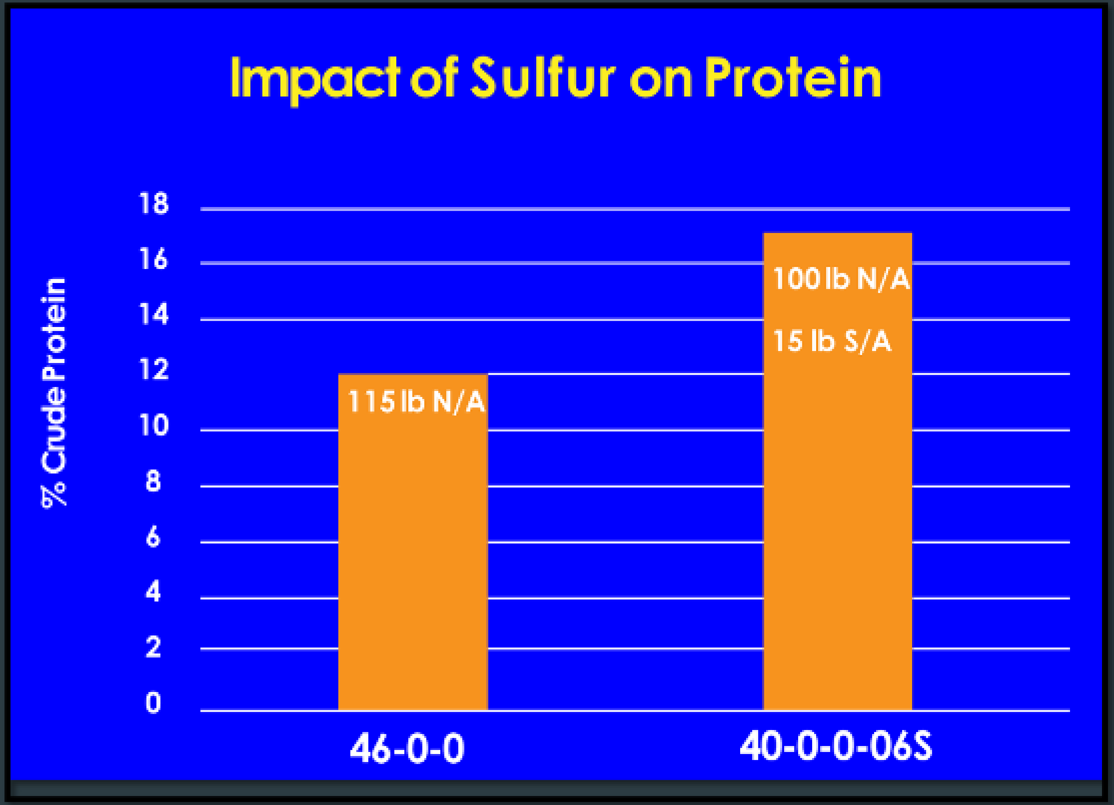
- Silage-120-150 lbs of N per acre
  - Applied 1/3 in fall and 2/3 in spring
- Triticale will use 50# N and 10 units of S per ton of DM at 16% CP.
- Example: Yield goal of 4 t/acre DM
  - 200 lbs of N
  - 40 lbs of S

Sulfur deficiency

Credit:Dorivar Ruiz Diaz, Nutrient Management Specialist Kansas State University

- Most commonly misdiagnosed as nitrogen deficiency
- Chlorosis of plant is exhibited in younger or uppermost leaves initially then yellowing will become uniform as the S deficiency persists.

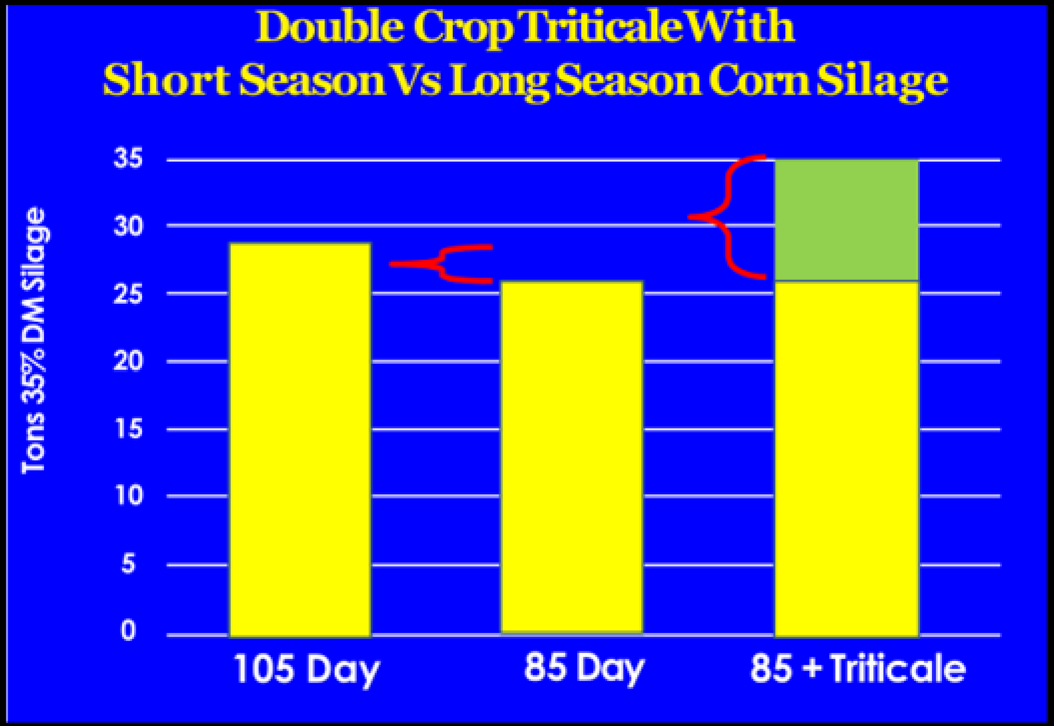
Impact of Sulfur on Protein



Double Cropping

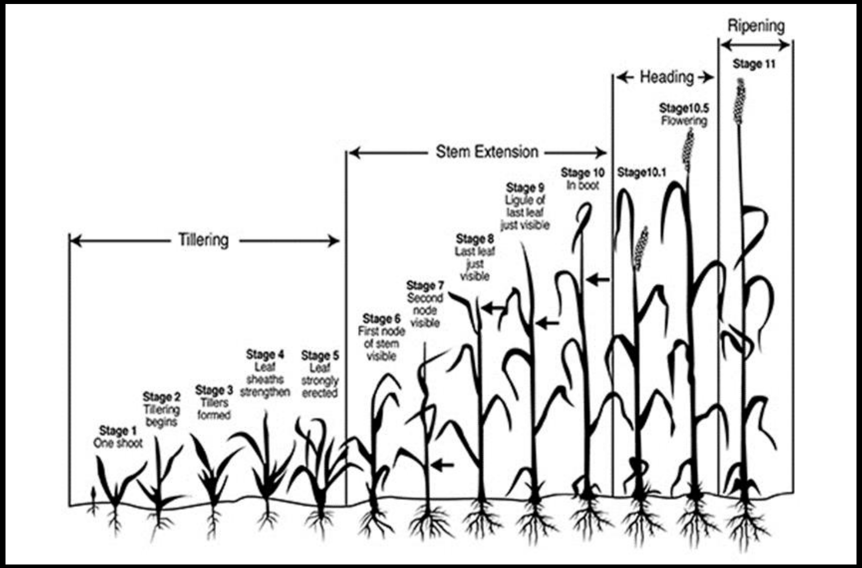
- Increase tons of DM harvested per acre by 25-35%
- Harvest 6-10 tons/acre of high-quality silage before spring grasses or legumes are ready

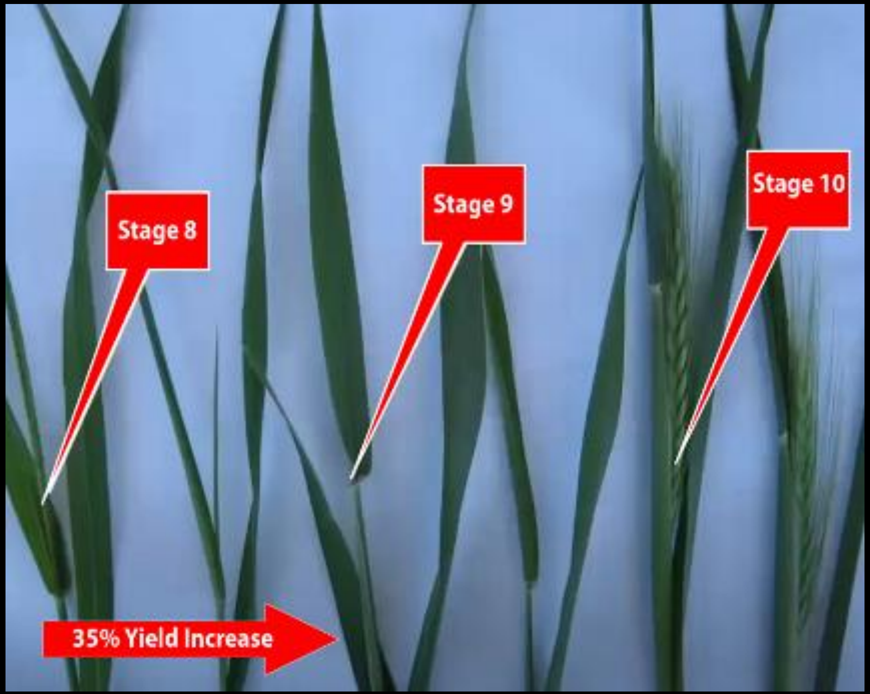
Maximizing the Double Crop



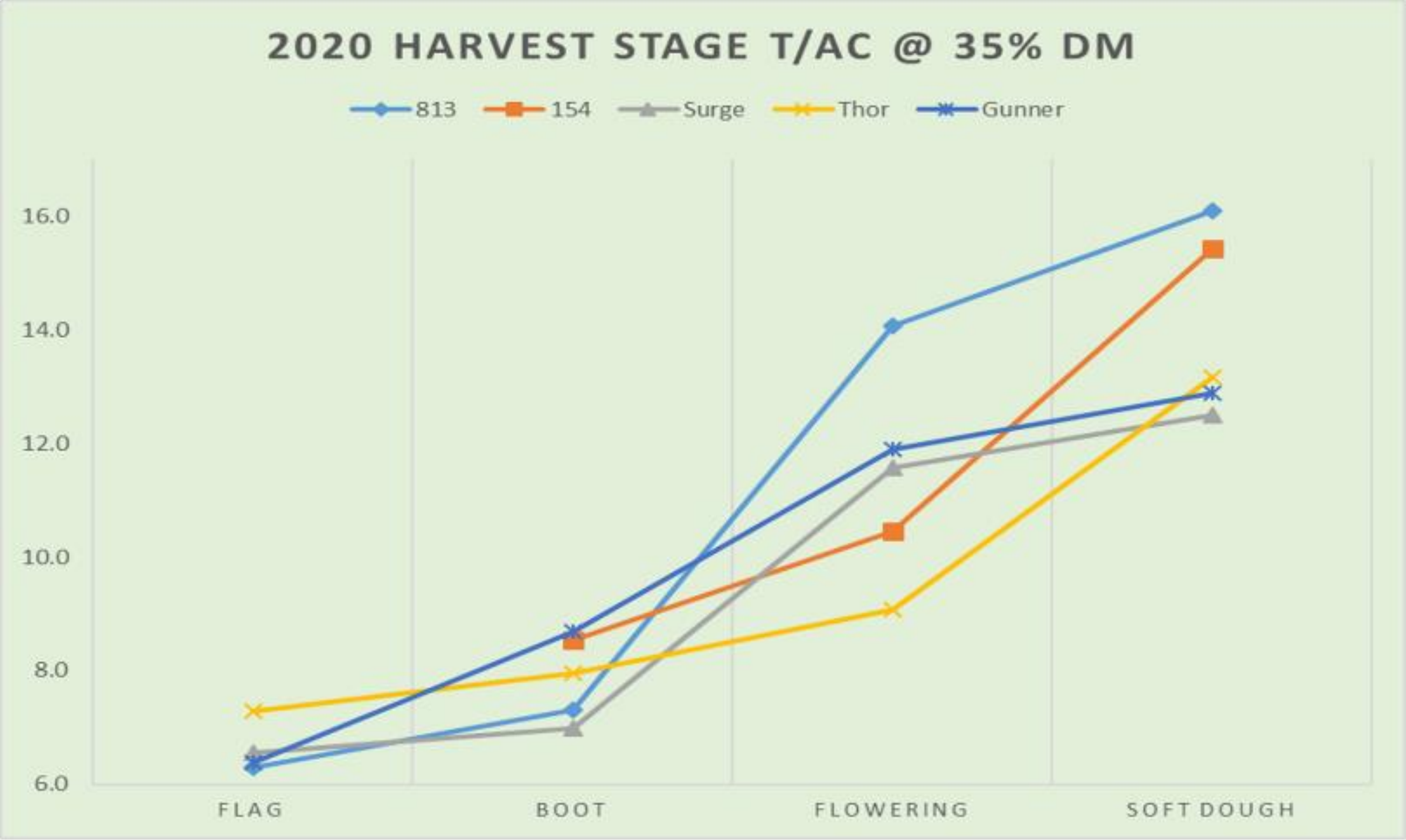
- Observed a ¾ ton silage lost for every 5 day shorter season corn
  - i.e. 105 day corn vs an 85 day corn=3 t/ac silage lost (1.05 t/ac DM)
- Addition of triticale-harvest
  - 5.7-12 t/ac silage (2-4.2 t/ac DM)
- Producing 8,000- 16,480 lbs of milk/ac

Harvest Timing





- Havest at Feekes 9 for maximum forage quality


2020 HARVEST STAGE T/AC @ 35% DM
813
154
Surge
Thor
Gunner
16.0
14.0
12.0
10.0
8.0
6.0
FLAG
BOOT
FLOWERING
SOFT DOUGH

Variety Selection

Purposes

- Crop purpose
  - Silage, Grazing, Hay
- Cropping system
  - Single or double cropping
- Growing Season
  - Winter or spring
- Awn length
  - Awned, Awnletted, Awnless

Facultative vs Winter

- Vernalization
  - The process of plant exposure to cold temps below 48 degrees which is required to move from vegetative to reproductive stages
- Facultative
  - Requires zero to almost zero vernalization
  - Allows fall and spring planting windows
- Winter
  - Possess a long vernalization requirement


RationChoice
SILAGE HYBRID
Forage University Ration Choice

Ration Choice

- Ration Choice Basics
- Understanding feed analysis
- Competitive Silage options

Silage

- End use/on-farm application
- Sales retention tool
- Product longevity
- Bigger data sets
- Absolutely 100% have to have it
- Almost immediate on-farm results
- Can sell at a premium(BMR is a example of this)
- Gain Loyalty

Grain Corn

- Price oriented sale
- Customers shop new products every year
- New grain product release annual or biannual
- Only company driven annual data sets
- Producer doesn’t control the market

Nutrition Terms

- **NDFD 30:** % of NDF (Fiber) that is digestible at 30 hours
- **uNDF240:** % of un-digestible fiber at 240 hours
- **Starch % Dry Matter:** Amount of starch in the silage
- **7-hour Starch Digestibility:** % of starch digestible at 7 hours
- **Fast Pool Starch:** Starch available for digestion before 7 hours
- **TTNDFD:** Total Tract Neutral Detergent Fiber Digestibility
- **MPT (Milk Per Ton):** Estimation of the amount of milk per ton of dry matter
- **MPA(Milk Per Acre):** MPA is calculated MPT x Dry Matter Yield
- **KP:** Digestion rate of feedstuffs in the rumen
- **KD:** Digestion rate of feedstuffs passing from the rumen

3 Types of Corn Silage

01	**Standard Corn**	• Ration Choice • Dual Purpose • TMFs/Leafys
02	**BMRs**	• Mycogen(Corteva) BM3s • Dows(Corteva) BM1
03	**Transgenic**	• Enogen(Syngenta)

Corn Silage Product Genes & Categories

- Leafy
- Leafy Floury(Opaque 1)
- Floury
- BM1
- BM3
- BM3 + Floury
- Standard Corn
- High Oil
- Opaque
- High Lysine

Standard Corn

Ration Choice

Pros

- Every producer knows how to grow it
- Easily managed
- With proper agronomics can compete with BMR
- More usable starch
- Better standability
- With correct management can be used to eliminate fall slump

Standard Corn

Cons

- Generally less usable fiber than BMR unless managed correctly
- Perceived as less quality feed
- Fully-traited packages can cost as much as BMR

Ration Choice Hybrids

Key Selection Categories

Yield | Fiber Digestibility | Starch Digestibility | Crude Protein | Residual Sugars

- Ration Choice products are top performers in multiple categories
- These components are all critical to milk production
- There is no single test or selection criteria that can determine how silage will perform in a ration
- It is important to weigh out a number of these factors to select the best products

Fiber Digestibility

- There are several commercially available fiber tests
- These tests are all indicators of digestibility in ruminants
- It is important to look at multiple fiber tests to get a complete analysis of digestibility

NDFd30 | uNDF240 | TTNDFD

- NDFd30 is commonly used in the industry
- TTDFD and uNDF240 give a more complete picture of digestion when combined with NDFd30

Starch % and Digestibility

- Starch % is a critical number that will be used by nutritionists to build rations, as starch drives much of the energy in silage
- Starch % is an indicator of how well the hybrid produces grain in the silage
- Starch digestibility has been overlooked by corn hybrid developers
- Most standard silage analysis treats starch as if digested the same
- There are huge differences in the digestibility of starch in silage
- Fast pool starch digestibility is the best indicator of starch digestibility

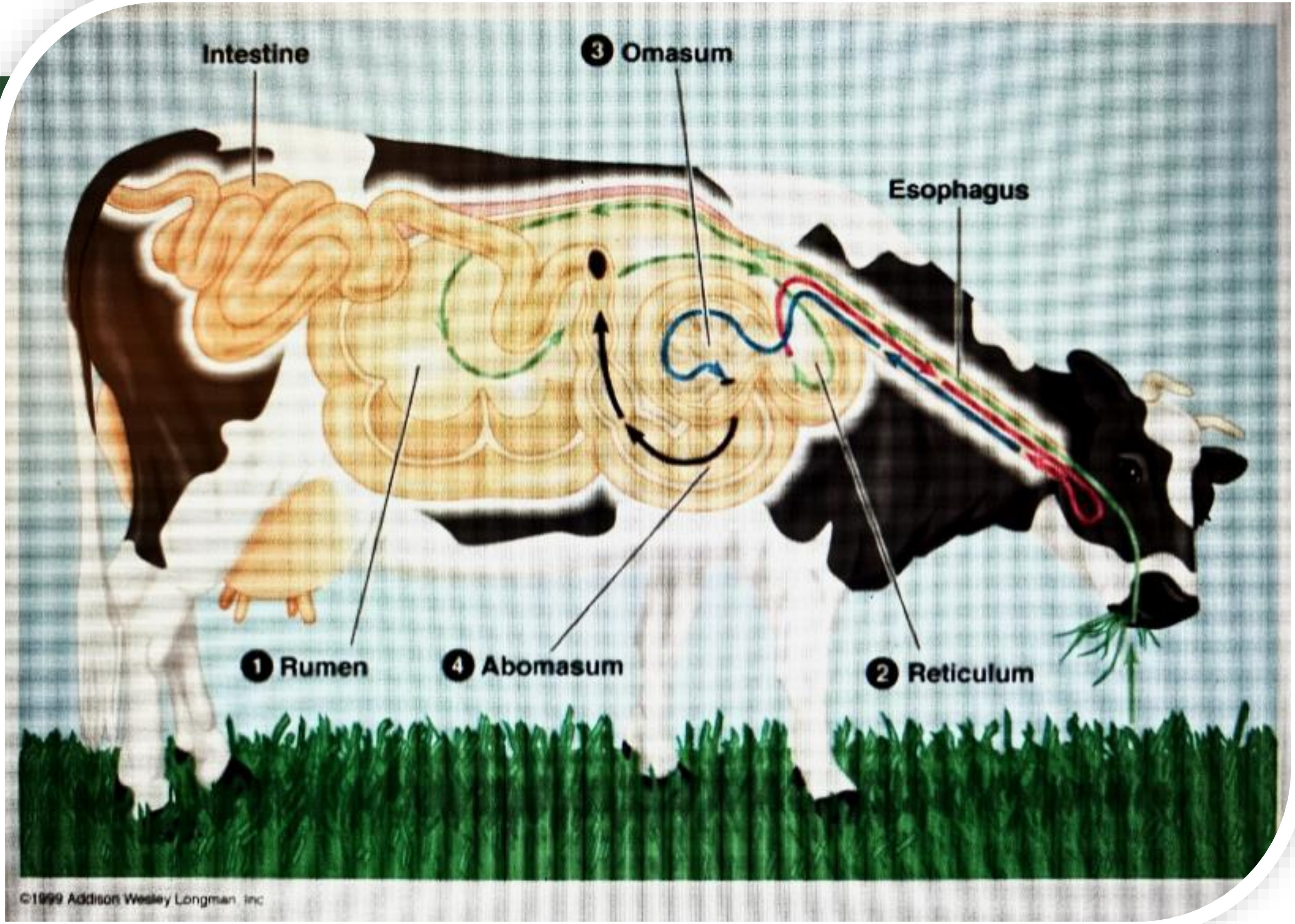
Residual Sugars

- Residual sugars are indicators of digestibility that are often overlooked
- The residual sugars are another source of energy
- Some hybrids tend to produce more sugars in the field, and this can lead to more residual sugars after fermentation
- These sugars play a factor in building a product portfolio
- These sugars also help in the fermentation process

Ration Choice

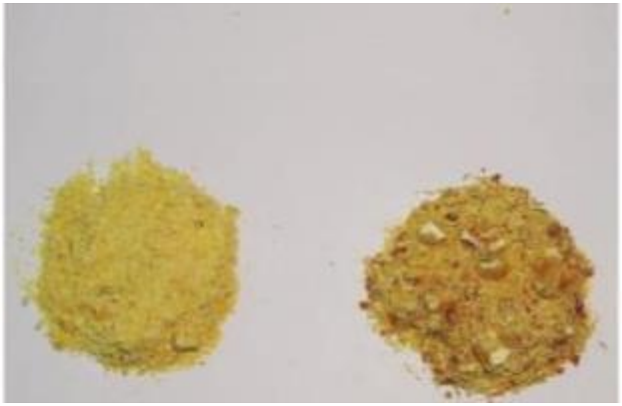
Combining all data and factoring the importance of each piece of data allows Ration Choice to assemble the best possible product portfolio from available sources.

Cotract Silage Trials	Hybrid	RM	Wet Tons/ A	% H20	DM	DM T/A	% of Mean DM Tons/A	Tons/A 65%	CP	% of Mean CP	NDFd30	% of Mean NDFd30	uNDF 240	% of Mean uNDF240	Starch	% of Mean Starch	InSitu 0 hr Starch	% of Mean InSitu 0 hr Starch	M/Ton	% of Mean M/Ton	M/Acre	% of Mean M/Acre	IVSD7	% of Mean IVSD7	Beef/ Ton	% of Mean Beef/Ton	WSC (Sugar)	% of Mean WSC (Sugar)	TTNDFD	% of Mean TTNDFD	Reps
CST 1		83	18.8	57.6	42.4	7.9	98%	22.7	7.8	98%	56.0	98%	8.9	102%	37.4	103%	11.3	85%	3,392	98%	27,014	95%	70.8	96%	242.7	100%	4.0	90%	39.2	96%	6
		85	22.9	60.1	39.9	9.0	111%	25.8	7.7	98%	56.8	100%	8.8	101%	37.0	102%	13.2	99%	3,424	99%	31,199	110%	73.0	99%	249.2	102%	4.1	93%	40.5	100%	6
		85	21.6	60.9	39.1	8.4	105%	24.0	7.9	100%	56.1	98%	9.4	108%	35.9	99%	14.0	109%	3,453	100%	29,339	106%	73.8	100%	241.5	99%	4.7	108%	40.5	100%	6
		87	22.4	63.7	36.3	8.1	101%	23.2	8.0	100%	56.7	100%	8.5	97%	36.3	100%	16.6	126%	3,496	101%	28,682	102%	73.1	100%	221.0	91%	3.9	89%	37.8	93%	6
		85	24.6	63.6	36.4	8.9	110%	25.5	7.9	100%	57.4	101%	8.5	97%	35.8	99%	13.3	100%	3,499	101%	31,366	111%	73.9	101%	244.0	100%	3.9	89%	40.6	100%	6
		88	19.6	63.0	37.0	7.3	89%	20.9	8.1	102%	59.1	104%	8.2	94%	35.1	97%	12.5	95%	3,505	101%	25,647	90%	74.7	102%	262.7	108%	5.1	117%	44.3	109%	6
		88	20.3	62.7	37.3	7.6	94%	21.6	8.1	102%	57.1	100%	9.3	106%	35.1	97%	12.0	91%	3,485	101%	26,362	94%	73.8	100%	239.0	98%	4.4	100%	40.8	100%	6
		88	18.6	59.1	40.9	7.5	93%	21.4	7.9	99%	56.1	98%	8.9	101%	36.4	101%	11.9	90%	3,392	98%	25,512	90%	74.7	102%	246.5	101%	5.0	114%	41.4	102%	6


Intestine
3 Omasum
Esophagus
1 Rumen
4 Abomasum
2 Reticulum
©1999 Addison Wesley Longman, Inc

Soft Grain

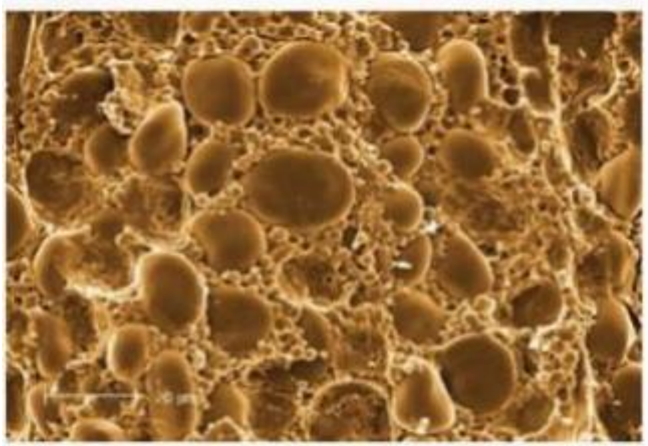
Vitreous Grain

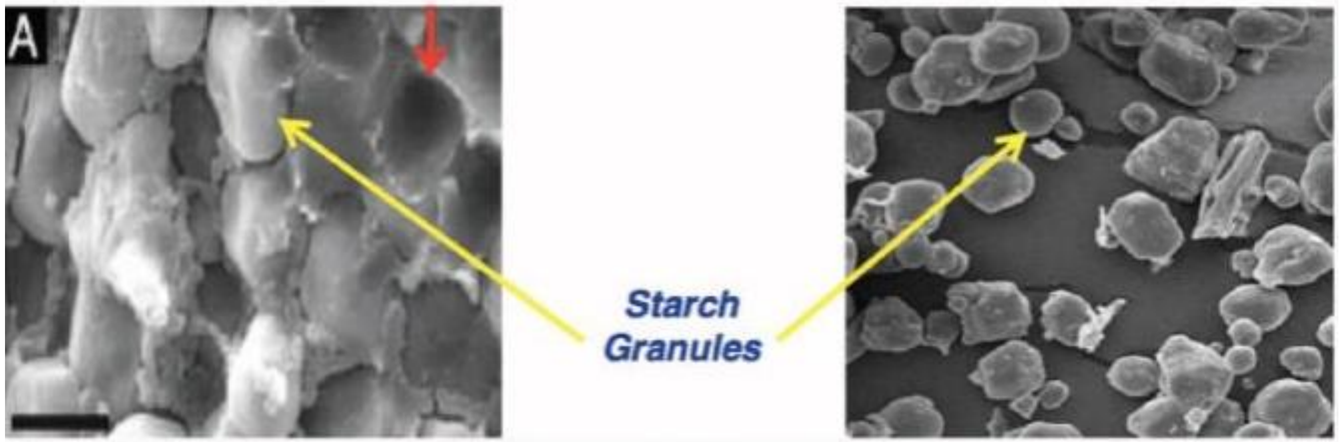


Chemical Characteristics

Zein Prolamin

- Alpha
- Beta
- Gamma
- Delta





CVAS 3 Week Averages

STORAGE WEEK	DM	CP	Sol P	NDF	NDF30	STARCH	IVSD7
0	36.7	8.30	2.30	36.90	59.12	37.12	62.56
3	35.2	8.36	3.26	38.82	61.45	33.80	65.89
6	36.2	8.22	3.35	38.30	61.11	35.09	70.57
9	36.4	8.15	3.61	38.50	60.76	35.28	72.42
12	36.4	8.13	3.89	39.05	60.89	34.84	74.41
15	37.3	8.20	4.09	39.54	59.75	33.59	75.22
18	36.0	8.23	4,31	39.39	60.32	34.31	76.88
21	36.4	8.15	4.33	38.96	60.85	34.54	76.32
24	36.5	8.14	4.42	38.52	60.00	35.08	76.83
27	36.5	8.08	4.39	38.50	61.48	35.02	76.58

CVAS 3 Week Averages

STORAGE WEEK	DM	CP	Sol P	NDF	NDF30	STARCH	IVSD7
0	36.7	8.30	2.30	36.90	59.12	37.12	62.56
3	35.2	8.36	3.26	38.82	61.45	33.80	65.89
Ration Choice/Soft endosperm products							
6	36.2	8.22	3.35	38.30	61.11	35.09	70.57
9	36.4	8.15	3.61	38.50	60.76	35.28	72.42
12	36.4	8.13	3.89	39.05	60.89	34.84	74.41
TMF/Industry Grain Corn							
15	37.3	8.20	4.09	39.54	59.75	33.59	75.22
18	36.0	8.23	4,31	39.39	60.32	34.31	76.88
21	36.4	8.15	4.33	38.96	60.85	34.54	76.32
BMR							
24	36.5	8.14	4.42	38.52	60.00	35.08	76.83
27	36.5	8.08	4.39	38.50	61.48	35.02	76.58

Microbial Yield Advantage

HYBRID	Ration Choice	Industry
Hardness scale 1-10	6	9
RR in-situ 7rhr	49%	33%
Microbial Yield Grams	1928	1794

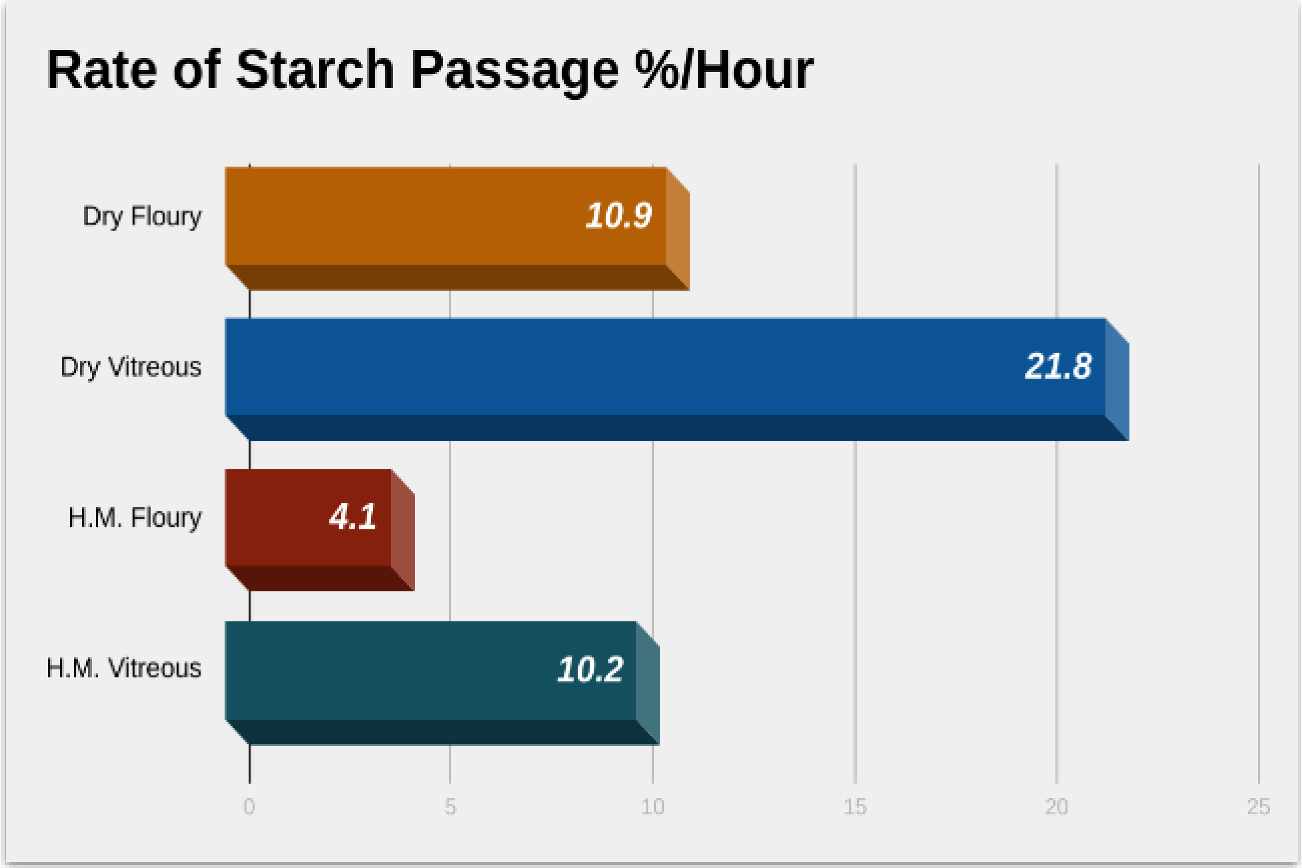
Difference of 134 grams

The nutrition model tells us that moving the starch digestion model just 8 points from 68% to 76% can increase microbial yield protein 41 grams. This can be a real-world improvement of up to 5# of milk. - Mark Kirk RRL

Effect of Passage Rate

Notice in the graph that dry floury grain passes 2X as slowly as dry vitreous grain

What's interesting is that when tested, both high moisture vitreous and floury grain, the floury grain maintained its advantage over vitreous as its ruminal passage rate was less than half that of the high moisture vitreous grain



RationChoice™

Corn Silage Population Study

Planting Population vs Silage Quality

- Identify goals on the farm
- These goals will help us with product selection and management
- Is the farm more focused on yield or quality?
- Ideally farms should be focused on maximizing both yield and quality to maximize their efficiency

Planting Population vs Silage Quality

- Increased planting populations can increase yield, assuming moisture and fertility can support the increase
- Planting population directly impacts the quality of silage
- As planting populations increase, forage quality decreases
- Increased planting population can impact both fiber and starch digestibility
- Reduced stalk diameter and kernel size are key factors in this reduction in digestibility

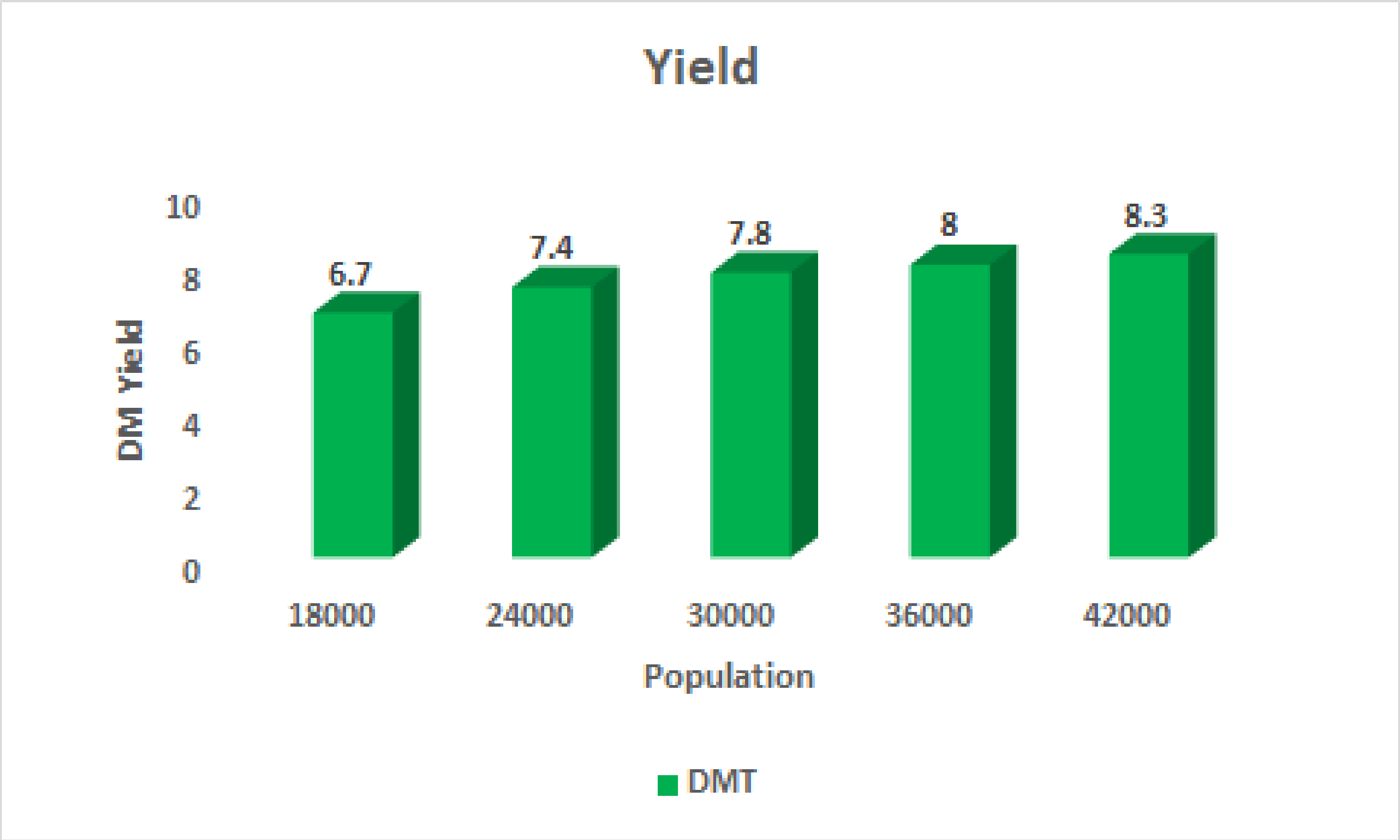
Virginia Tech Population Study

Effect of corn planting rate on silage yield and forage quality

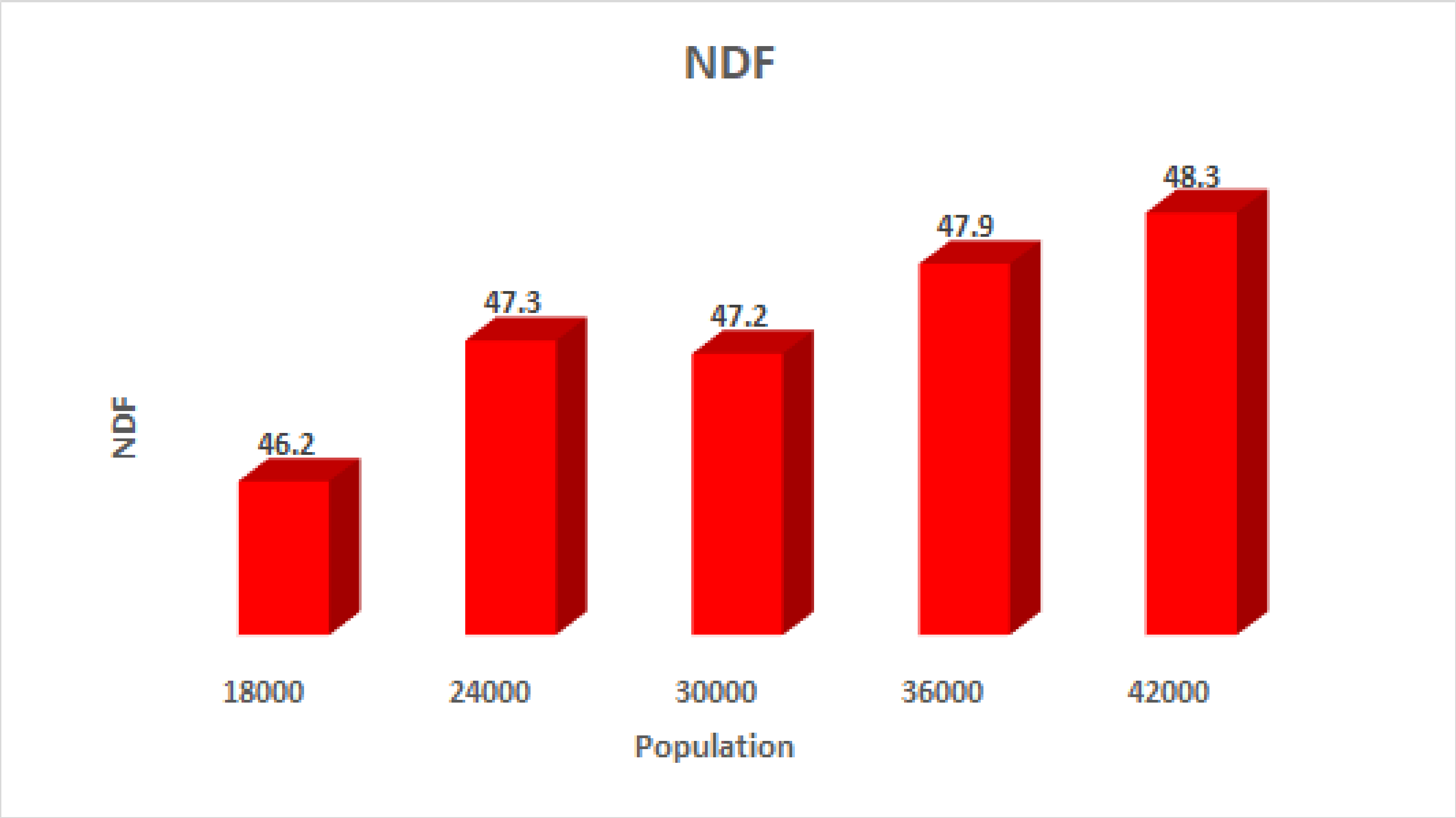
	Planting rate			
	22,000	28,000	34,000	40,000
Final plant density, 1,000 plants/acre	22.3	26.7	32.6	39.2
Plant dry weight, lbs./plant	0.83	0.74	0.63	0.56
Dry matter yield, tons/acre	8.8	9.5	10.4	11.5
Kernels per ear, count	720	641	570	553
Silage pH	3.77	3.77	3.78	3.80
Ash, %	4.3	4.2	4.2	4.3
Crude protein, %	10.2	10.6	10.5	10.3
Neutral detergent fiber (NDF), %	39.9	40.3	41.6	41.4
Acid detergent lignin, %	2.1	2.1	2.2	2.4
Starch, %	29.7	31.2	30.1	29.2
30-h in vitro NDF digestibility, % of NDF	45.3	43.3	43.8	42.8

Source: Ferreira and Teets (2017). Professional Animal Scientist 33:420-425

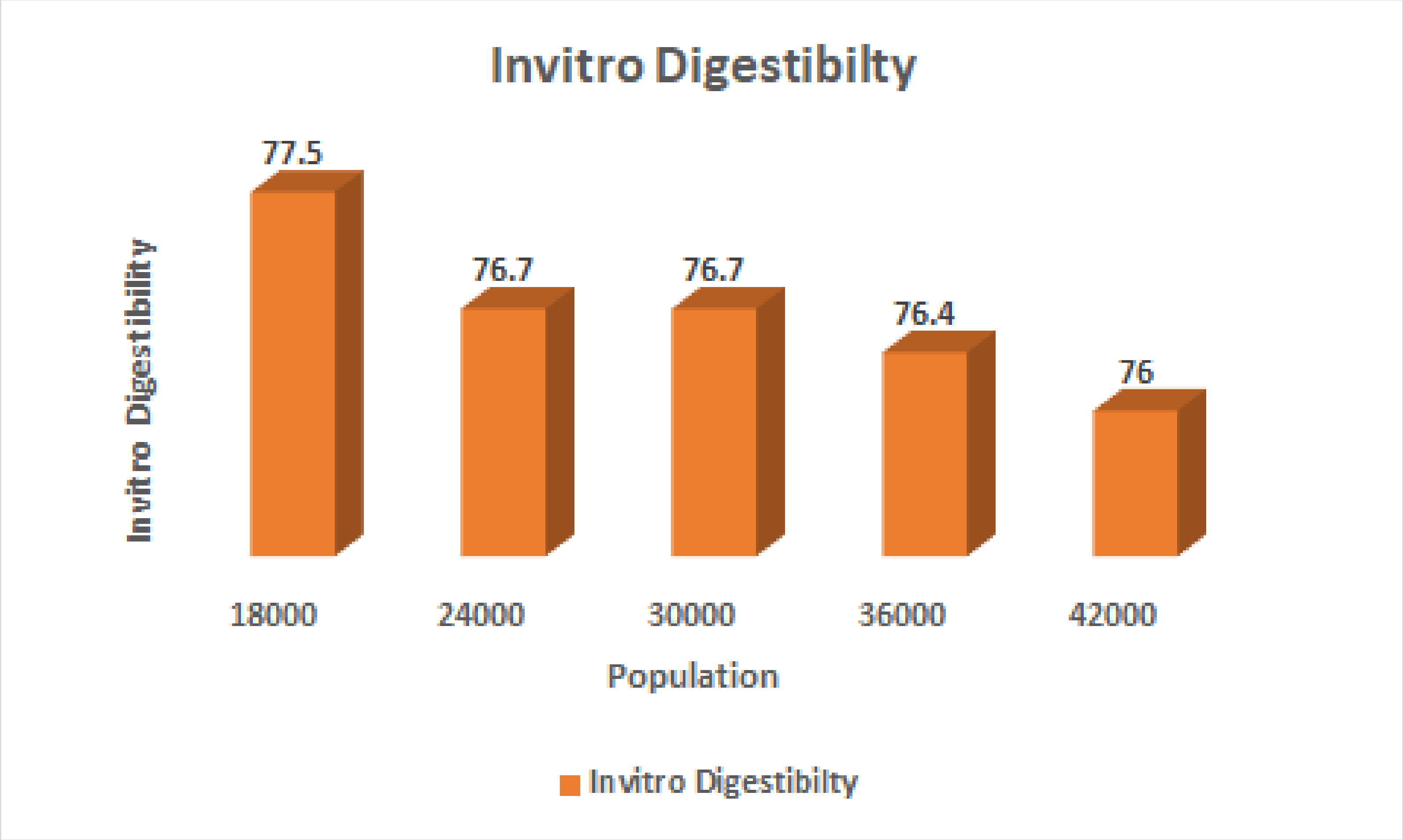
Population Study-University of WI



Population Study-University of WI



Population Study-University of WI



Product Selection

- Focus on stress tolerant hybrids in yield driven systems
- Flex hybrids maximize yield and quality in lower population systems
- Lower planting populations will increase
  - starch %
  - starch digestibility
  - fiber digestibility
- Lower planting populations of standard corn can rival fiber digestibility of BMR products

Maximizing Yield and Quality

- Typically yield and quality can be maximized at moderate populations (28,000-34,000 ppa)
- Focus on choosing the right population and product for the soil and management system
  - correct agronomic placement adds nutritional value
  - healthy corn plants make quality silage

RationChoice

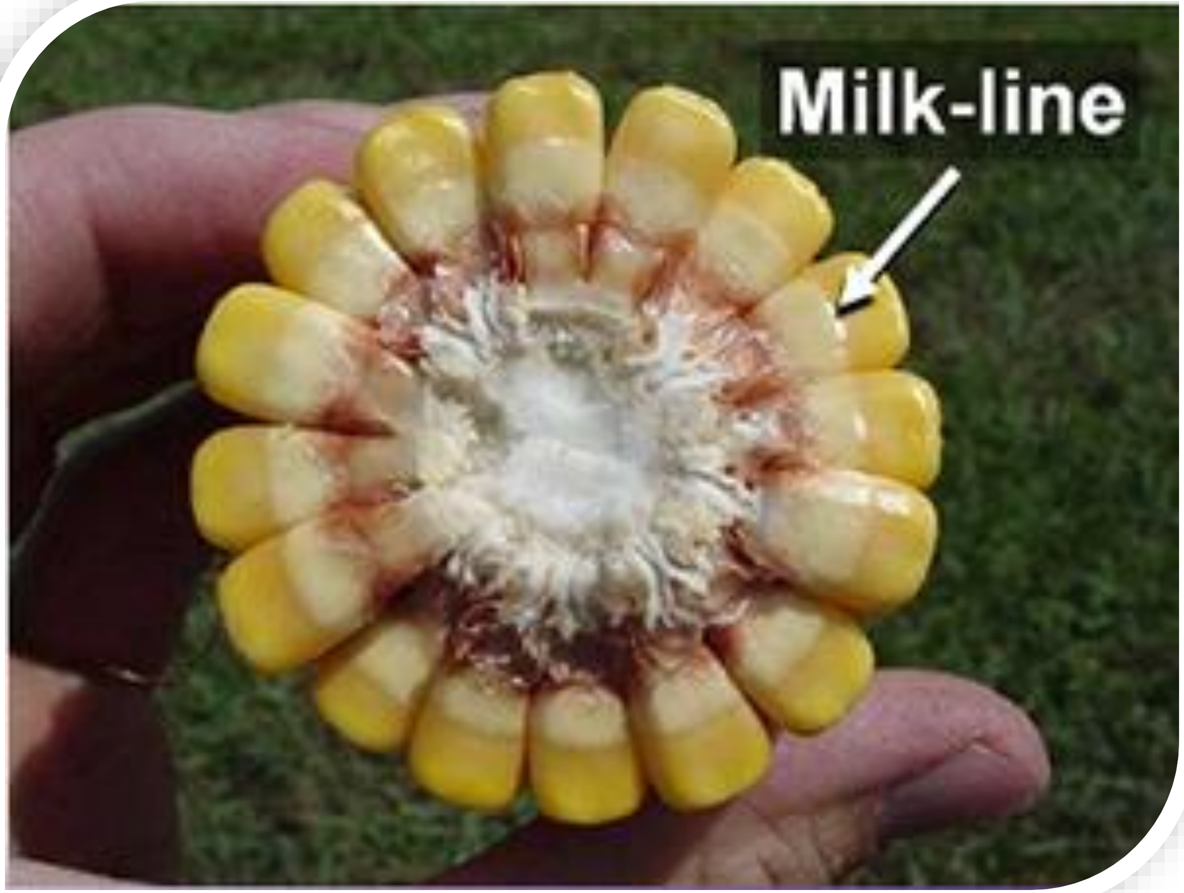
Harvest Management

INTEGRITY. PERFORMANCE. SOLUTIONS.

Silage Harvest Management

- Harvest timing is critical to maximize digestibility
- Ensures rapid fermentation and preservation of high-quality forage
- 65 to 68 percent moisture is ideal
- It is important to observe the progression of the milk line leading up to harvest
- A milk line of approximately 50-70% is a good indicator of ideal harvest moisture
- Typically, harvest will be 42-47 days after silking
- Begin testing total plant moisture when the milkline hits the 80% mark
- As the crop nears harvest, it will dry down about ½% per day

Harvest Management

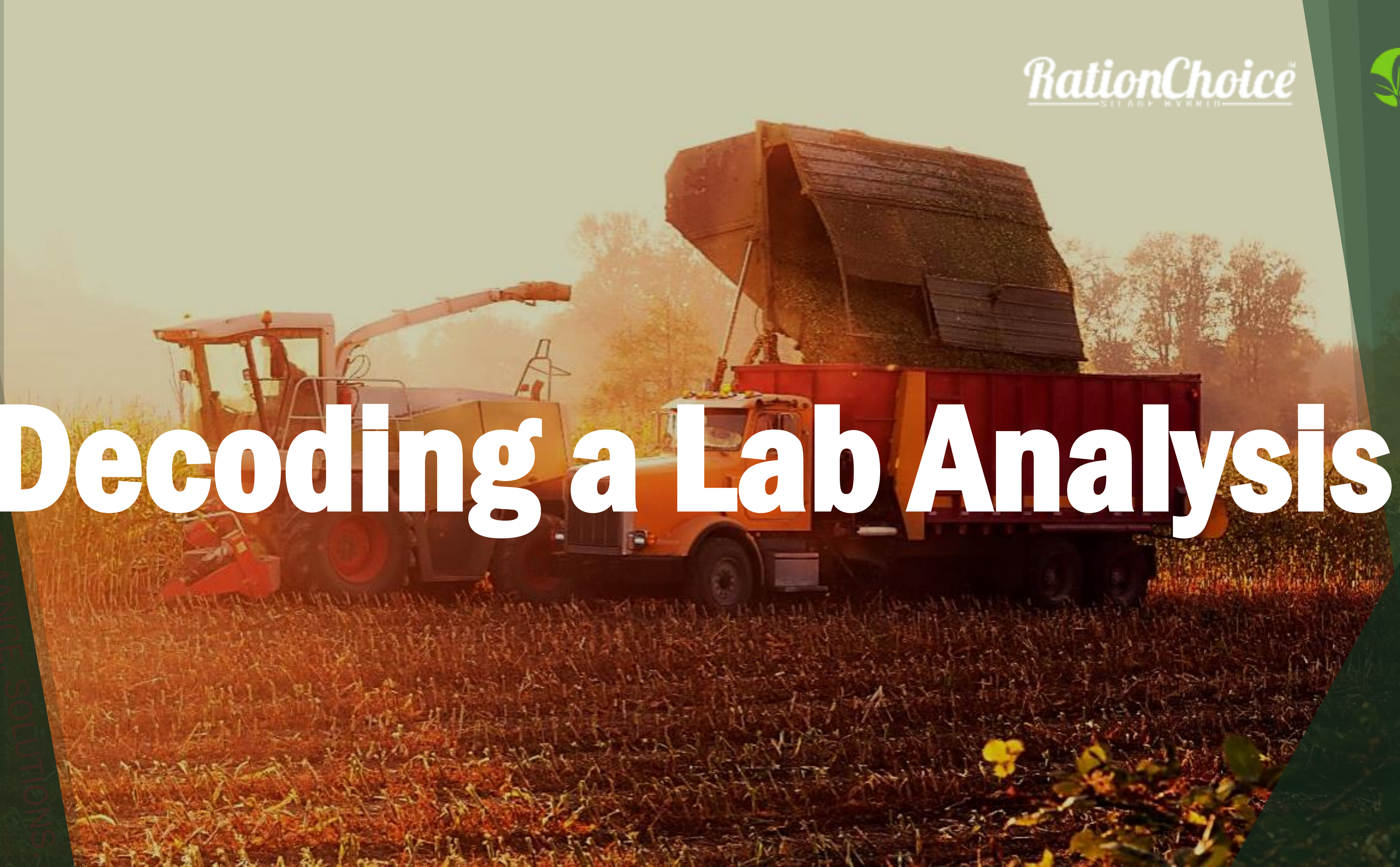


Harvest Management

Silage Bags	Upright Silo	Bunkers/Drive Over Piles
62-65% Moisture	60-65% Moisture	62-68% Moisture

RationChoice

Decoding a Lab Analysis



INTEGRITY. PERFORMANCE. SOLUTIONS.

Decoding a lab analysis

Received: 1/12/2021 **Sampled:** 1/11/2021
Rep: [redacted]

Moisture: 63.98
Dry Matter: 36.02 (Feed Avg = 36.19)

ROCK RIVER LABORATORY, INC.
920-261-0446

Protein & Amino Acid	**%DM**	**N=3**	**4 yr**
Crude Protein	7.39	7.29	7.61
Total Amino Acid	7.22	6.96	7.06
Sol. CP, % of CP	66.43	68.18	54.29
NH3-N CP Equivalent	0.86	0.89	0.60
NH3-N, % of CP	11.67	12.26	7.69
ADICP	0.79	0.77	0.64
NDICP	0.90	1.02	1.05
ADICP, % of CP	10.67	10.59	8.36
Available CP	6.60	6.52	6.97
Nitrate-N			
Non-Protein Nitrogen			
Calculated Amino Acids			
Lysine, % of CP	3.12	3.05	2.98
Methionine, % of CP	1.96	1.92	1.88
Histidine, % of CP	2.30	2.24	2.19
Minerals & Ash			
Ash	5.45	5.53	4.20
Calcium	0.21	0.22	0.16
Phosphorus	0.22	0.21	0.22
Magnesium	0.14	0.14	0.13
Potassium	1.04	1.04	0.93
Sodium			
Sulfur	0.09	0.09	0.08
Chloride			
Aluminum			
Boron			
Copper			
Iron			
Manganese			
Molybdenum			
Zinc			

Carbohydrates	**%DM**	**N=3**	**4 yr**
ADF	23.76	24.27	22.11
aNDF	39.93	40.26	38.34
aNDFom	38.35	38.58	36.43
Lignin	4.08	4.20	3.94
Starch	32.81	31.93	34.64
Sugar (ESC)	0.31	0.62	1.63
Sugar (WSC)	4.54	4.52	4.46
Glucose			
Fructose			
Sucrose			
Lactose			
Mannitol			
Total Sugar			
Crude Fiber			
Fermentation Products			
pH	3.77	3.72	3.97
Lactic Acid	6.10	6.43	3.56
Acetic Acid	2.39	2.40	1.51
Butyric Acid	0.00	0.00	0.13
Propionic Acid			
Succinic			
Formic			
Ethanol			
1,2 Propanediol			
1 Propanol			
2,3 Butanediol			
2 Butanol			
2 Propanol			
Total Acids			
Total Alcohols			
Fermentation DM Loss	1.78	1.68	2.13

Fat	**%DM**	**N=3**	**4 yr**
Ether Extract	2.37	2.48	2.59
Total Fatty Acid	1.63	1.71	1.79
Acid Hydrolysis			
	% of FA		
Myristic (C14:0)	0.42	0.40	0.41
Palmitic (C16:0)	15.60	16.00	14.71
Stearic (C18:0)	1.90	1.85	1.87
Oleic (C18:1 c9)	20.21	20.47	20.91
Linoleic (C18:2 c9,12)	47.95	48.23	47.60
Linolenic (C18:3 c9,12,15)	6.81	6.50	6.30
RUFAL	74.97	75.20	74.81
Nutrient Digestion, % of nutrient			
tNDFD12	24.42	24.31	19.73
tNDFD30	61.83	62.88	57.64
tNDFD48	69.11	69.20	66.86
tNDFD72			
tNDFD120	70.78	70.44	69.93
tNDFD240	73.84	72.14	74.30
tNDFD30om	64.85	65.79	60.70
tNDFD120om	73.43	73.05	72.44
tNDFD240om	76.36	74.68	76.62
sNDFD24	23.04	23.54	22.55
sNDFD30	28.54	28.35	27.64
sNDFD48	50.30	50.89	47.19
uNDF30, % DM	15.24	14.98	16.03
uNDF240, % DM	10.45	11.27	9.83
isSD0	40.17	37.79	23.83
isSD3	85.60	84.64	67.28
isSD7	89.69	89.04	79.76
isSD16	99.00	297.00	89.45
isSD24	99.00		
in situ RUP 16h			
RUP intest. dig., % RUP			

Powered by Rock River Laboratory **Bold results by wet chemistry** **Page 1 of 3 (Lab No: 1306695)**

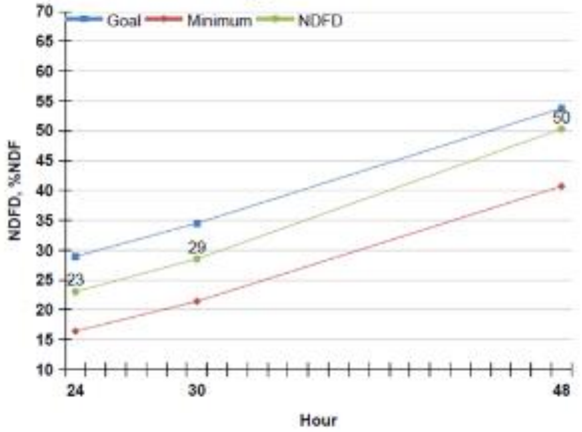
Comprehensive Nutrition Analysis Report

Calculations	**%DM**	**N=3**	**4 yr**
Dynamic NDF kd, %/h	4.50	4.76	4.16
Dynamic Starch Kd, %/h	31.16	30.36	22.46
RFV			
RFQ			
TTNDFD, % of NDF	43.44	43.77	41.05
Total Tract Starch Dig			
NFC	45.76	45.46	48.29
DCAD			
Salt			
RDP %CP			

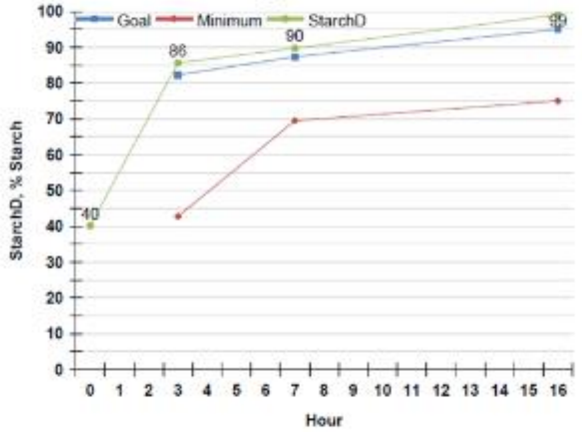
Energy Calculations	**N=3**	**NEL**	**NEG**	**NEM**
ADF (PA)				
OARDC Dairy				
NRC2001 Dairy				
Milk2006 Dairy	72.30	0.703	0.548	0.834
NRC2016 Beef				
Milk lb/Ton, Milk2006	3336			
Beef lb/Ton, NRC2016				

Anti-Nutrients
Mold
Yeast
DON, ppm
Aflatoxin, ppb
Zearalenone, ppb
Fumonisin, ppm
T-2, ppb
Ochratoxin-A, ppb
Clostridium perfringens
Enterobacteria

NDF Digestion Curve



Starch Digestion Curve



This Feed Avg lab numbers: 1306498,1305966

Powered by Rock River Laboratory **Bold results by wet chemistry** **Page 2 of 3 (Lab No: 1306695)**

Decoding a lab analysis

- Valuable sales tool
- Helps you speak their language
- Moves you beyond salesman

Categories on an analysis

- **Moisture/Dry Matter**
- Protein
- Minerals and Ash
- **Carbohydrates**
- Fermentation Products
- Fat
- **Nutrient Digestion % of Nutrient**
- **Calculations**

Moisture Matters

- First place to start
- Amount of water in the sample
- Effects almost all aspects of quality
- Corn Silage: 62-68%
- Haylage: 60-65%
- Baleage: 45-55%
- High moisture corn: 24-33%

Received: 1/12/2021 **Sampled:** 1/11/2021

Rep: [redacted]

[redacted]

Moisture: 63.98

Dry Matter: 36.02 (Feed Avg = 36.19)

ROCK RIVER LABORATORY, INC.
AGRICULTURAL ANALYSIS
920-261-0446

Protein & Amino Acid	**%DM**	**N=3**	**4 yr**
Crude Protein	7.39	7.29	7.61
Total Amino Acid	7.22	6.96	7.06
Sol. CP, % of CP	66.43	68.18	54.29
NH3-N CP Equivalent	0.86	0.89	0.60
NH3-N, % of CP	11.67	12.26	7.69
ADICP	0.79	0.77	0.64
NDICP	0.90	1.02	1.05
ADICP, % of CP	10.67	10.59	8.36
Available CP	6.60	6.52	6.97
Nitrate-N			
Non-Protein Nitrogen			

Calculated Amino Acids			
Lysine, % of CP	3.12	3.05	2.98
Methionine, % of CP	1.96	1.92	1.88
Histidine, % of CP	2.30	2.24	2.19

Minerals & Ash			
Ash	5.45	5.53	4.20
Calcium	0.21	0.22	0.16
Phosphorus	0.22	0.21	0.22
Magnesium	0.14	0.14	0.13
Potassium	1.04	1.04	0.93
Sodium			
Sulfur	0.09	0.09	0.08
Chloride			
Aluminum			
Boron			
Copper			
Iron			
Manganese			
Molybdenum			
Zinc			

Carbohydrates	**%DM**	**N=3**	**4 yr**
ADF	23.76	24.27	22.11
aNDF	39.93	40.26	38.34
aNDFom	38.35	38.58	36.43
Lignin	4.08	4.20	3.94
Starch	32.81	31.93	34.64
Sugar (ESC)	0.31	0.62	1.63
Sugar (WSC)	4.54	4.52	4.46
Glucose			
Fructose			
Sucrose			
Lactose			
Mannitol			
Total Sugar			
Crude Fiber			

Fermentation Products			
pH	3.77	3.72	3.97
Lactic Acid	6.10	6.43	3.56
Acetic Acid	2.39	2.40	1.51
Butyric Acid	0.00	0.00	0.13
Propionic Acid			
Succinic			
Formic			
Ethanol			
1,2 Propanediol			
1 Propanol			
2,3 Butanediol			
2 Butanol			
2 Propanol			
Total Acids			
Total Alcohols			
Fermentation DM Loss	1.78	1.68	2.13

Fat	**%DM**	**N=3**	**4 yr**
Ether Extract	2.37	2.48	2.59
Total Fatty Acid	1.63	1.71	1.79
Acid Hydrolysis			
	% of FA		
Myristic (C14:0)	0.42	0.40	0.41
Palmitic (C16:0)	15.60	16.00	14.71
Stearic (C18:0)	1.90	1.85	1.87
Oleic (C18:1 c9)	20.21	20.47	20.91
Linoleic (C18:2 c9,12)	47.95	48.23	47.60
Linolenic (C18:3 c9,12,15)	6.81	6.50	6.30
RUFAL	74.97	75.20	74.81

Nutrient Digestion, % of nutrient			
tNDFD12	24.42	24.31	19.73
tNDFD30	61.83	62.88	57.64
tNDFD48	69.11	69.20	66.86
tNDFD72			
tNDFD120	70.78	70.44	69.93
tNDFD240	73.84	72.14	74.30
tNDFD30om	64.85	65.79	60.70
tNDFD120om	73.43	73.05	72.44
tNDFD240om	76.36	74.68	76.62
sNDFD24	23.04	23.54	22.55
sNDFD30	28.54	28.35	27.64
sNDFD48	50.30	50.89	47.19
uNDF30, % DM	15.24	14.98	16.03
uNDF240, % DM	10.45	11.27	9.83
isSD0	40.17	37.79	23.83
isSD3	85.60	84.64	67.28
isSD7	89.69	89.04	79.76
isSD16	99.00	297.00	89.45
isSD24	99.00		
in situ RUP 16h			
RUP intest. dig., % RUP			

Moisture Matters - Wet 68% or greater

- Corn should be harvested for silage at a moisture content of 62 to 68. If too wet - above 68 percent - yield potential is reduced and seepage will occur, resulting in the undesirable presence of clostridia bacteria fermentation.
- Clostridia bacteria are very inefficient, converting forage sugars and organic acids into butyric acid, carbon dioxide and ammonia. Silage with these bacteria loses dry matter, creates a foul smell due to the butyric acid, and has a higher pH, and poor forage quality and palatability.
- Will freeze in the winter making it extremely difficult to load.

Dry 62% or less

- Silage harvested too dry is difficult to pack sufficiently to force out the air. Trapped oxygen allows extended respiration by plant cells that will consume digestible nutrients. The silage often heats as yeasts and molds grow, which reduces silage yield and lowers energy and protein digestibility. Silage spoils quickly when re-exposed to air, shortening bunk life.
- Low-moisture corn silage also has lower starch and fiber digestibility. Kernels that are too dry will become hard and pass through the cow undigested.
- Fiber digestibility has been found to decrease by over 10% as moisture decreases from 70% to 58%.

Carbohydrates

- ADF
- NDFom
- Lignin
- **Starch**
- **Sugars (WSC and ESC)**

Received: 1/12/2021 **Sampled:** 1/11/2021
Rep: [redacted]
[redacted]

Moisture: 63.98
Dry Matter: 36.02 (Feed Avg = 36.19)

ROCK RIVER LABORATORY, INC.
920-261-0446

Protein & Amino Acid	%DM	N=3	4 yr
Crude Protein	7.39	7.29	7.61
Total Amino Acid	7.22	6.96	7.06
Sol. CP, % of CP	66.43		
NH3-N CP Equivalent	0.86		
NH3-N, % of CP	11.67		
ADICP	0.79		
NDICP	0.90		
ADICP, % of CP	10.67		
Available CP	6.60		
Nitrate-N			
Non-Protein Nitrogen			

Calculated Amino Acids	%DM
Lysine, % of CP	3.12
Methionine, % of CP	1.96
Histidine, % of CP	2.30

Minerals & Ash	%DM
Ash	5.45
Calcium	0.21
Phosphorus	0.22
Magnesium	0.14
Potassium	1.04
Sodium	
Sulfur	0.09
Chloride	
Aluminum	
Boron	
Copper	
Iron	
Manganese	
Molybdenum	
Zinc	

Carbohydrates	%DM	N=3	4 yr
ADF	23.76	24.27	22.11
aNDF	39.93	40.26	38.34

Carbohydrates	%DM	N=3	4 yr
ADF	23.76	24.27	22.11
aNDF	39.93	40.26	38.34
aNDFom	38.35	38.58	36.43
Lignin	4.08	4.20	3.94
Starch	32.81	31.93	34.64
Sugar (ESC)	0.31	0.62	1.63
Sugar (WSC)	4.54	4.52	4.46
Glucose			
Fructose			
Sucrose			
Lactose			
Mannitol			
Total Sugar			
Crude Fiber			

	%DM	N=3	4 yr
Total Alcohols			
Fermentation DM Loss	1.78	1.68	2.13

Fat	%DM	N=3	4 yr
Ether Extract	2.37	2.48	2.59
Total Fatty Acid	1.63	1.71	1.79
		0.40	0.41
		16.00	14.71
		1.85	1.87
		20.47	20.91
		48.23	47.60
		6.50	6.30
		75.20	74.81
		24.31	19.73
		62.88	57.64
		69.20	66.86
		70.44	69.93
		72.14	74.30
		65.79	60.70
		73.05	72.44
		74.68	76.62
		23.54	22.55
		28.35	27.64
		50.89	47.19
		14.98	16.03
		11.27	9.83
		37.79	23.83
		84.64	67.28
		89.04	79.76
isSD16	99.00	297.00	89.45
isSD24	99.00		
in situ RUP 16h			
RUP intest. dig., % RUP			

Starch %

- Amount of grain in silage
- Most dense energy, more energy per pound
- 30’s is where you want to see them
- Dependent on:
  - Maturity/Moisture
  - Chop height

Carbohydrates	%DM	N=3	4 yr
ADF	23.76	24.27	22.11
aNDF	39.93	40.26	38.34
aNDFom	38.35	38.58	36.43
Lignin	4.08	4.20	3.94
Starch	32.81	31.93	34.64
Sugar (ESC)	0.31	0.62	1.63
Sugar (WSC)	4.54	4.52	4.46
Glucose			
Fructose			
Sucrose			
Lactose			
Mannitol			
Total Sugar			
Crude Fiber			

Sugars WSC

- Water Soluble Carbohydrates
- Captures more true sugars then ESC
- Quickly available energy source to the cow
- Higher the better 4.5 and higher

Carbohydrates	%DM	N=3	4 yr
ADF	23.76	24.27	22.11
aNDF	39.93	40.26	38.34
aNDFom	38.35	38.58	36.43
Lignin	4.08	4.20	3.94
Starch	32.81	31.93	34.64
Sugar (ESC)	0.31	0.62	1.63
Sugar (WSC)	4.54	4.52	4.46
Glucose			
Fructose			
Sucrose			
Lactose			
Mannitol			
Total Sugar			
Crude Fiber			

Nutrient Digestion % of Nutrient

- Fiber Digestion
- Starch Digestion

Received: 1/12/2021 **Sampled:** 1/11/2021
Rep: [redacted]
[redacted]

Moisture: 63.98
Dry Matter: 36.02 (Feed Avg = 36.19)

ROCK RIVER LABORATORY, INC.
AGRICULTURAL ANALYSIS
920-261-0446

Protein & Amino Acid	**%DM**	**N=3**	**4 yr**
Crude Protein	7.39	7.29	7.61
Total Amino Acid	7.22	6.96	7.06
Sol. CP, % of CP	66.43	68.18	54.29
NH3-N CP Equivalent	0.86	0.89	0.60
NH3-N, % of CP	11.67	12.26	7.69
ADICP	0.79	0.77	0.64
NDICP	0.90	1.02	1.05
ADICP, % of CP	10.67	10.59	8.36
Available CP	6.60	6.52	6.97
Nitrate-N			
Non-Protein Nitrogen			

Calculated Amino Acids			
Lysine, % of CP	3.12	3.05	2.98
Methionine, % of CP	1.96	1.92	1.88
Histidine, % of CP	2.30	2.24	2.19

Minerals & Ash			
Ash	5.45	5.53	4.20
Calcium	0.21	0.22	0.16
Phosphorus	0.22	0.21	0.22
Magnesium	0.14	0.14	0.13
Potassium	1.04	1.04	0.93
Sodium			
Sulfur	0.09	0.09	0.08
Chloride			
Aluminum			
Boron			
Copper			
Iron			
Manganese			
Molybdenum			
Zinc			

Carbohydrates	**%DM**	**N=3**	**4 yr**
ADF	23.76	24.27	22.11
aNDF	39.93	40.26	38.34
aNDFom	38.35	38.58	36.43
Lignin	4.08	4.20	3.94
Starch	32.81	31.93	34.64
Sugar (ESC)	0.31	0.62	1.63
Sugar (WSC)	4.54	4.52	4.46
Glucose			
Fructose			
Sucrose			
Lactose			
Mannitol			
Total Sugar			
Crude Fiber			

Fermentation Products			
pH	3.77	3.72	3.97
Lactic Acid	6.10	6.43	3.56
Acetic Acid	2.39	2.40	1.51
Butyric Acid	0.00	0.00	0.13
Propionic Acid			
Succinic			
Formic			
Ethanol			
1,2 Propanediol			
1 Propanol			
2,3 Butanediol			
2 Butanol			
2 Propanol			
Total Acids			
Total Alcohols			
Fermentation DM Loss	1.78	1.68	2.13

Fat	**%DM**	**N=3**	**4 yr**
Ether Extract	2.37	2.48	2.59
Total Fatty Acid	1.63	1.71	1.79
Acid Hydrolysis			
	% of FA		
Myristic (C14:0)	0.42	0.40	0.41
Palmitic (C16:0)	15.60	16.00	14.71
Stearic (C18:0)	1.90	1.85	1.87
Oleic (C18:1 c9)	20.21	20.47	20.91
Linoleic (C18:2 c9,12)	47.95	48.23	47.60
Linolenic (C18:3 c9,12,15)	6.81	6.50	6.30
RUFAL	74.97	75.20	74.81

Nutrient Digestion, % of nutrient			
tNDFD12	24.42	24.31	19.73
tNDFD30	61.83	62.88	57.64
tNDFD48	69.11	69.20	66.86
tNDFD72			
tNDFD120	70.78	70.44	69.93
tNDFD240	73.84	72.14	74.30
tNDFD30om	64.85	65.79	60.70
tNDFD120om	73.43	73.05	72.44
tNDFD240om	76.36	74.68	76.62
sNDFD24	23.04	23.54	22.55
sNDFD30	28.54	28.35	27.64
sNDFD48	50.30	50.89	47.19
uNDF30, % DM	15.24	14.98	16.03
uNDF240, % DM	10.45	11.27	9.83
isSD0	40.17	37.79	23.83
isSD3	85.60	84.64	67.28
isSD7	89.69	89.04	79.76
isSD16	99.00	297.00	89.45
isSD24	99.00		
in situ RUP 16h			
RUP intest. dig., % RUP			

Fiber Digestion

- tNDFD- traditional NDF Digestion-
  - Amount of NDF digested at certain time points
  - 30 hr is industry standard
- UNDF 240- undigested NDF at 240 hr
  - Lower the better
  - Affects dry matter intake
  - 5-6 lbs/ day

Received: 1/12/2021 **Sampled:** 1/11/2021

Rep: [redacted]

Moisture: 63.98

Dry Matter: 36.02 (Feed Avg = 36.19)

ROCK RIVER LABORATORY, INC.
AGRICULTURAL ANALYSIS
920-261-0446

Protein & Amino Acid	**%DM**
Crude Protein	7.39
Total Amino Acid	7.22
Sol. CP, % of CP	66.43
NH3-N CP Equivalent	0.86
NH3-N, % of CP	11.67
ADICP	0.79
NDICP	0.90
ADICP, % of CP	10.67
Available CP	6.60
Nitrate-N	
Non-Protein Nitrogen	

Calculated Amino Acids	
Lysine, % of CP	3.12
Methionine, % of CP	1.96
Histidine, % of CP	2.30

Minerals & Ash	
Ash	5.45
Calcium	0.21
Phosphorus	0.22
Magnesium	0.14
Potassium	1.04
Sodium	
Sulfur	0.09
Chloride	
Aluminum	
Boron	
Copper	
Iron	
Manganese	
Molybdenum	
Zinc	

Nutrient Digestion, % of nutrient

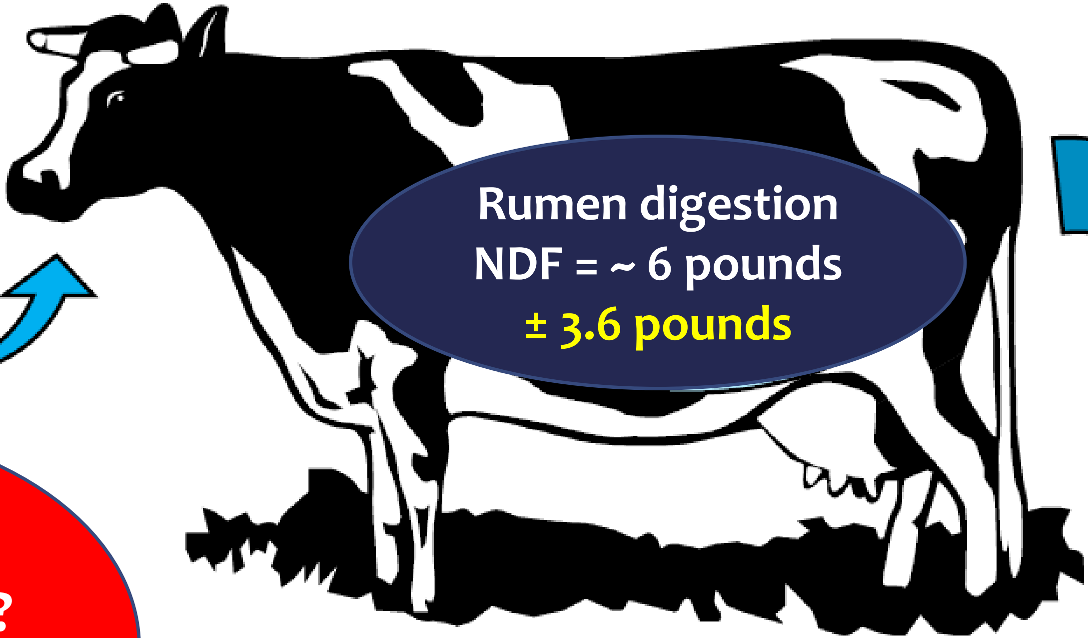
tNDFD12	24.42	24.31	19.73
tNDFD30	61.83	62.88	57.64
tNDFD48	69.11	69.20	66.86
tNDFD72			
tNDFD120	70.78	70.44	69.93
tNDFD240	73.84	72.14	74.30
tNDFD30om	64.85	65.79	60.70
tNDFD120om	73.43	73.05	72.44
tNDFD240om	76.36	74.68	76.62
sNDFD24	23.04	23.54	22.55
sNDFD30	28.54	28.35	27.64
sNDFD48	50.30	50.89	47.19
uNDF30, % DM	15.24	14.98	16.03
uNDF240, % DM	10.45	11.27	9.83
isSD0	40.17	37.79	23.83
isSD3	85.60	84.64	67.28
isSD7	89.69	89.04	79.76
isSD16	99.00	297.00	89.45
isSD24	99.00		

%DM	N=3	4 yr
2.37	2.48	2.59
1.63	1.71	1.79
% of FA		
0.42	0.40	0.41
15.60	16.00	14.71
1.90	1.85	1.87
20.21	20.47	20.91
47.95	48.23	47.60
6.81	6.50	6.30
74.97	75.20	74.81
nutrient		
24.42	24.31	19.73
61.83	62.88	57.64
69.11	69.20	66.86
70.78	70.44	69.93
73.84	72.14	74.30
64.85	65.79	60.70
73.43	73.05	72.44
76.36	74.68	76.62
23.04	23.54	22.55
28.54	28.35	27.64
50.30	50.89	47.19
15.24	14.98	16.03
10.45	11.27	9.83
40.17	37.79	23.83
85.60	84.64	67.28
89.69	89.04	79.76
99.00	297.00	89.45
99.00		

Powered by Rock River Laboratory **Bold results by wet chemistry**

Speaking "fiber"

~ 15 pounds fiber intake (DM)



Rumen digestion
NDF = ~ 6 pounds
± 3.6 pounds

1 pound digestible fiber?
± 3.5 pounds milk!

oeser, 2014)

Total Tract *digestion*
NDF = 7.3 pounds
+/- 3.4 pounds

NDFD means something to cows

NDFD 30 (% of aNDF): 55 vs 65?

- 80 vs 89 lbs/ cow (ECM)
- 1.48 vs 1.54 (ECM FCE)

Received: 1/12/2021 **Sampled:** 1/11/2021
Rep: [redacted]
[redacted]

Moisture: 63.98
Dry Matter: 36.02 (Feed Avg = 36.19)

ROCK RIVER LABORATORY, INC.
AGRICULTURAL ANALYSIS
920-261-0446

Protein & Amino Acid	%DM	N
Crude Protein	7.39	7.
Total Amino Acid	7.22	6.
Sol. CP, % of CP	66.43	68.
NH3-N CP Equivalent	0.86	0.
NH3-N, % of CP	11.67	12.
ADICP	0.79	0.
NDICP	0.90	1.
ADICP, % of CP	10.67	10.
Available CP	6.60	6.
Nitrate-N		
Non-Protein Nitrogen		
Calculated Amino Acids		
Lysine, % of CP	3.12	3.
Methionine, % of CP	1.96	1.
Histidine, % of CP	2.30	2.
Minerals & Ash		
Ash	5.45	5.
Calcium	0.21	0.
Phosphorus	0.22	0.
Magnesium	0.14	0.
Potassium	1.04	1.
Sodium		
Sulfur	0.09	0.
Chloride		
Aluminum		
Boron		
Copper		
Iron		
Manganese		
Molybdenum		
Zinc		

Nutrient Digestion, % of nutrient

tNDFD12	24.42	24.31	19.73
tNDFD30	61.83	62.88	57.64
tNDFD48	69.11	69.20	66.86
tNDFD72			
tNDFD120	70.78	70.44	69.93
tNDFD240	73.84	72.14	74.30
tNDFD30om	64.85	65.79	60.70
tNDFD120om	73.43	73.05	72.44
tNDFD240om	76.36	74.68	76.62
sNDFD24	23.04	23.54	22.55
sNDFD30	28.54	28.35	27.64
sNDFD48	50.30	50.89	47.19
uNDF30, % DM	15.24	14.98	16.03
uNDF240, % DM	10.45	11.27	9.83
isSD0	40.17	37.79	23.83
isSD3	85.60	84.64	67.28
isSD7	89.69	89.04	79.76
isSD16	99.00	297.00	89.45
isSD24	99.00		

.DM	N=3	4 yr
2.37	2.48	2.59
1.63	1.71	1.79
FA		
0.42	0.40	0.41
5.60	16.00	14.71
1.90	1.85	1.87
0.21	20.47	20.91
7.95	48.23	47.60
6.81	6.50	6.30
4.97	75.20	74.81
nt		
4.42	24.31	19.73
1.83	62.88	57.64
9.11	69.20	66.86
0.78	70.44	69.93
3.84	72.14	74.30
4.85	65.79	60.70
3.43	73.05	72.44
6.36	74.68	76.62
3.04	23.54	22.55
8.54	28.35	27.64
0.30	50.89	47.19
5.24	14.98	16.03
0.45	11.27	9.83
0.17	37.79	23.83
5.60	84.64	67.28
9.69	89.04	79.76
9.00	297.00	89.45
9.00		

Starch Digestibility

- Starch digestion is the amount of starch digested at certain time points
- Starch digestibility has been overlooked by corn hybrid developers
- Most standard silage analysis treats starch as if digested the same
- There are huge differences in the digestibility of starch in silage
- Fast pool (0 hr) starch digestibility is the best indicator of starch digestibility
- 7 hr starch digestion is most work in the industry has been done
- Increases with ensiling time.

Received: 1/12/2021 **Sampled:** 1/11/2021

Rep: [redacted]

[redacted]

Moisture: 63.98

Dry Matter: 36.02 (Feed Avg = 36.19)

ROCK RIVER LABORATORY, INC.
AGRICULTURAL ANALYSIS
920-261-0446

Protein & Amino Acid	**%DM**	**N=3**	**4 yr**
Crude Protein	7.39	7.29	7.61
Total Amino Acid	7.22	6.96	7.06
Sol. CP, % of CP	66.43	68.18	54.29
NH3-N CP Equivalent	0.86	0.89	0.60
NH3-N, % of CP	11.67	12.26	7.69
ADICP	0.79	0.77	0.64
NDICP	0.90	1.02	1.05
ADICP, % of CP	10.67	10.59	8.36
Available CP	6.60	6.52	6.97
Nitrate-N			
Non-Protein Nitrogen			
Calculated Amino Acids			
Lysine, % of CP	3.12	3.05	2.98
Methionine, % of CP	1.96	1.92	1.88
Histidine, % of CP	2.30	2.24	2.19
Minerals & Ash			
Ash	5.45	5.53	4.20
Calcium	0.21	0.22	0.16
Phosphorus	0.22	0.21	0.22
Magnesium	0.14	0.14	0.13
Potassium	1.04	1.04	0.93
Sodium			
Sulfur	0.09	0.09	0.08
Chloride			
Aluminum			
Boron			
Copper			
Iron			
Manganese			
Molybdenum			
Zinc			

Carbohydrates	**%DM**	**N=3**	**4 yr**
ADF	23.76	24.27	22.11
aNDF	39.93	40.26	38.34
aNDFom	38.35	38.58	36.43
Lignin	4.08	4.20	3.94
Starch	32.81	31.93	34.64
Sugar (ESC)	0.31	0.62	1.63
Sugar (WSC)	4.54	4.52	4.46
Glucose			
Fructose			
Sucrose			
Lactose			
Mannitol			
Total Sugar			
Crude Fiber			
Fermentation Products			
pH	3.77	3.72	3.97
Lactic Acid	6.10	6.43	3.56
Acetic Acid	2.39	2.40	1.51
Butyric Acid	0.00	0.00	0.13
Propionic Acid			
Succinic			
Formic			
Ethanol			
1,2 Propanediol			
1 Propanol			
2,3 Butanediol			
2 Butanol			
2 Propanol			
Total Acids			
Total Alcohols			
Fermentation DM Loss	1.78	1.68	2.13

Fat	**%DM**	**N=3**	**4 yr**
Ether Extract	2.37	2.48	2.59
Total Fatty Acid	1.63	1.71	1.79
Acid Hydrolysis			
	% of FA		
Myristic (C14:0)	0.42	0.40	0.41
Palmitic (C16:0)	15.60	16.00	14.71
Stearic (C18:0)	1.90	1.85	1.87
Oleic (C18:1 c9)	20.21	20.47	20.91
Linoleic (C18:2 c9,12)	47.95	48.23	47.60
Linolenic (C18:3 c9,12,15)	6.81	6.50	6.30
RUFAL	74.97	75.20	74.81
Nutrient Digestion, % of nutrient			
tNDFD12	24.42	24.31	19.73
tNDFD30	61.83	62.88	57.64
tNDFD48	69.11	69.20	66.86
tNDFD72			
tNDFD120	70.78	70.44	69.93
tNDFD240	73.84	72.14	74.30
tNDFD30om	64.85	65.79	60.70
tNDFD120om	73.43	73.05	72.44
tNDFD240om	76.36	74.68	76.62
sNDFD24	23.04	23.54	22.55
sNDFD30	28.54	28.35	27.64
sNDFD48	50.30	50.89	47.19
uNDF30, % DM	15.24	14.98	16.03
[illegible]	[illegible]	[illegible]	[illegible]
isSD0	40.17	37.79	23.83
isSD3	85.60	84.64	67.28
isSD7	89.69	89.04	79.76
isSD16	[illegible]	[illegible]	89.45
isSD24	99.00		
in situ RUP 16h			
RUP intest. dig., % RUP			

Received: 1/12/2021 **Sampled:** 1/11/2021

Rep: [redacted]

[redacted]

Moisture: 63.98

Dry Matter: 36.02 (Feed Avg = 36.19)

ROCK RIVER LABORATORY, INC.
AGRICULTURAL ANALYSIS
920-261-0446

Protein & Amino Acid	**%DM**	**N=3**
Crude Protein	7.39	7.29
Total Amino Acid	7.22	6.96
Sol. CP, % of CP	66.43	68.18
NH3-N CP Equivalent	0.86	0.89
NH3-N, % of CP	11.67	12.26
ADICP	0.79	0.77
NDICP	0.90	1.02
ADICP, % of CP	10.67	10.59
Available CP	6.60	6.52
Nitrate-N		
Non-Protein Nitrogen		

Calculated Amino Acids		
Lysine, % of CP	3.12	3.05
Methionine, % of CP	1.96	1.92
Histidine, % of CP	2.30	2.24

Minerals & Ash		
Ash	5.45	5.53
Calcium	0.21	0.22
Phosphorus	0.22	0.21
Magnesium	0.14	0.14
Potassium	1.04	1.04
Sodium		
Sulfur	0.09	0.09
Chloride		
Aluminum		
Boron		
Copper		
Iron		
Manganese		
Molybdenum		
Zinc		

Nutrient Digestion, % of nutrient

tNDFD12	24.42	24.31	19.73
tNDFD30	61.83	62.88	57.64
tNDFD48	69.11	69.20	66.86
tNDFD72			
tNDFD120	70.78	70.44	69.93
tNDFD240	73.84	72.14	74.30
tNDFD30om	64.85	65.79	60.70
tNDFD120om	73.43	73.05	72.44
tNDFD240om	76.36	74.68	76.62
sNDFD24	23.04	23.54	22.55
sNDFD30	28.54	28.35	27.64
sNDFD48	50.30	50.89	47.19
uNDF30, % DM	15.24	14.98	16.03
uNDF240, % DM	10.45	11.27	9.83
isSD0	40.17	37.79	23.83
isSD3	85.60	84.64	67.28
isSD7	89.69	89.04	79.76
isSD16	99.00	297.00	89.45
isSD24	99.00		

%DM	N=3	4 yr
2.37	2.48	2.59
1.63	1.71	1.79
of FA		
0.42	0.40	0.41
15.60	16.00	14.71
1.90	1.85	1.87
20.21	20.47	20.91
47.95	48.23	47.60
6.81	6.50	6.30
74.97	75.20	74.81
ient		
24.42	24.31	19.73
61.83	62.88	57.64
69.11	69.20	66.86
70.78	70.44	69.93
73.84	72.14	74.30
64.85	65.79	60.70
73.43	73.05	72.44
76.36	74.68	76.62
23.04	23.54	22.55
28.54	28.35	27.64
50.30	50.89	47.19
15.24	14.98	16.03
10.45	11.27	9.83
40.17	37.79	23.83
85.60	84.64	67.28
89.69	89.04	79.76
99.00	297.00	89.45
99.00		

Starch Digestion Sales Key

- You may have a silage that has a lower starch % but a higher starch digestion, making the lower starch silage a better milk producer
- Example:
  - 35% Starch at 72% digestible = 25.2% is available to the cow
  - 30% Starch at 85% digestible = 25.5% is available to the cow

Energy Calculations

- TTNDFD- Total Tract NDF Digestion 42+
- MPT- Milk Per Ton (DM) 3200 is average

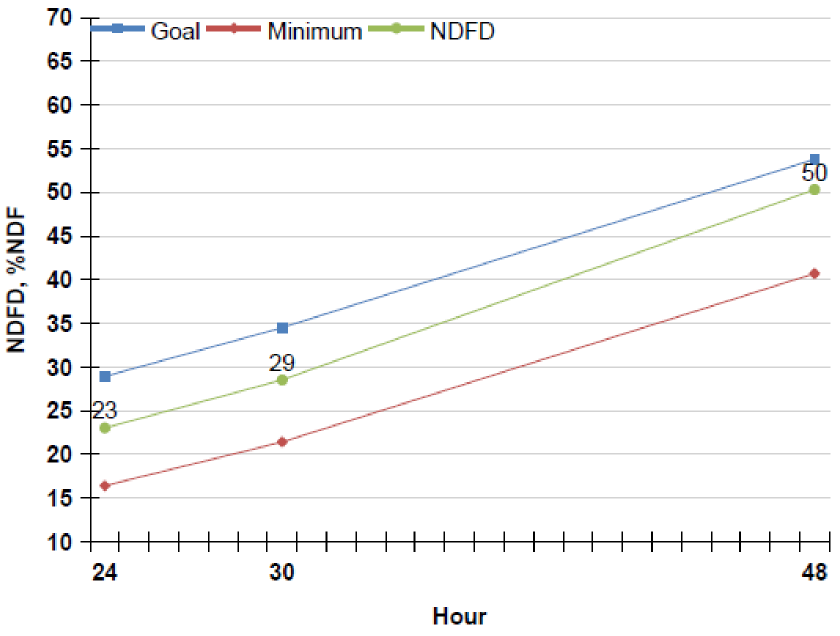
Comprehensive Nutrition Analysis Report

Calculations	%DM	N=3	4 yr
Dynamic NDF kd, %/h	4.50	4.76	4.16
Dynamic Starch Kd, %/h	31.16	30.36	22.46
RFV			
RFQ			
TTNDFD, % of NDF	43.44	43.77	41.05
Total Tract Starch Dig			
NFC	45.76	45.46	48.29
DCAD			
Salt			
RDP %CP			

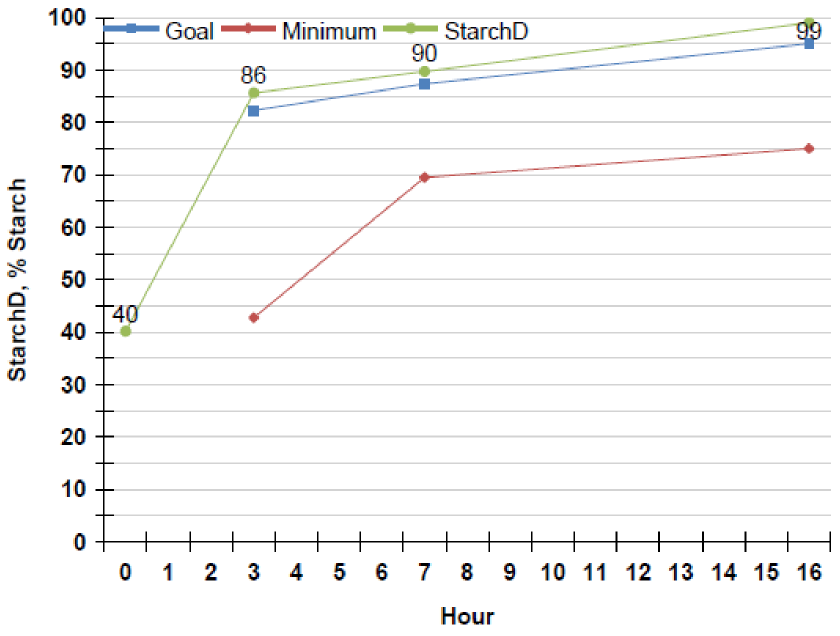
Energy Calculations	N=3	NEL	NEG	NEM
ADF (PA)				
OARDC Dairy				
NRC2001 Dairy				
Milk2006 Dairy	72.30	0.703	0.548	0.834
NRC2016 Beef				
Milk lb/Ton, Milk2006	3336			
Beef lb/Ton, NRC2016				

Anti-Nutrients
Mold
Yeast
DON, ppm
Aflatoxin, ppb
Zearalenone, ppb
Fumonisin, ppm
T-2, ppb
Ochratoxin-A, ppb
Clostridium perfringens
Enterobacteria

NDF Digestion Curve



Starch Digestion Curve



This Feed Avg lab numbers: 1306498,1305966

TTNDFD
Total Tract NDF Digestion

- NDFD 30 is a “snapshot picture” at a the 30hr time point
- TTNDFD is a “movie” of how the fiber will perform
- It is more complete analysis than a single time point

Calculations	%DM	N=3	4 yr
Dynamic NDF kd, %/h	4.50	4.76	4.16
Dynamic Starch Kd, %/h	31.16	30.36	22.46
RFV			
RFQ			
TTNDFD, % of NDF	43.44	43.77	41.05
Total Tract Starch Dig			
NFC	45.76	45.46	48.29
DCAD			
Salt			
RDP %CP			

Energy Calculations	N=3	NEL	NEG	NEM
ADF (PA)				
OARDC Dairy				
NRC2001 Dairy				
Milk2006 Dairy	72.30	0.703	0.548	0.834
NRC2016 Beef				
Milk lb/Ton, Milk2006	3336			
Beef lb/Ton, NRC2016				

Fiber Digestibility

- These tests are all indicators of digestibility in ruminants
- It is important to look at multiple fiber tests to get a complete analysis of digestibility:

NDFd30	uNDF240	TTNDFD

- NDFd30 is commonly used in the industry
- TTDFD and uNDF240 give a more complete picture of digestion when combined with NDFd30

Fiber Digestion Sales Key

- Use all three parameters to help growers understand the benefits of your hybrids.
- If you lose at NDFD30 its ok as long as you don’t lose at uNDF240 and TTNDFD

Milk Per Ton

- MPT, Milk lb/Ton
- ESTIMATED pounds of milk produced per ton of dry matter
- Older calculation
- It is often the language of producers

Calculations	%DM	N=3	4 yr
Dynamic NDF kd, %/h	4.50	4.76	4.16
Dynamic Starch Kd, %/h	31.16	30.36	22.46
RFV			
RFQ			
TTNDFD, % of NDF	43.44	43.77	41.05
Total Tract Starch Dig			
NFC	45.76	45.46	48.29
DCAD			
Salt			
RDP %CP			

Energy Calculations	N=3	NEL	NEG	NEM
ADF (PA)				
OARDC Dairy				
NRC2001 Dairy				
Milk2006 Dairy	72.30	0.703	0.548	0.834
NRC2016 Beef				
Milk lb/Ton, Milk2006	3336			
Beef lb/Ton, NRC2016				

Don’t get caught in the battle of samples!

- Each year is different
- Lots of things affect forage quality
- Win Some and lose some
- Can’t emphasize this enough.

Final Thoughts

- Fiber amount and digestion does not change with ensiling time
- Starch digestion will increase as ensiling time increases
  - Can’t always compare a one-year ensiled sample with fresh
- Can not compare samples from different labs
- Lab analysis are a tool not the whole toolbox

Competitive Silage Products

BMR

BMR Pros

- Improved digestibility
  - Lower lignin
  - Increased crude protein
- Great for milk quality
- Commonly regarded as the pinnacle of dairy silage quality
- 3 to 5.5 lbs increase in daily milk production

BMR Cons

- Higher seed prices
- Yield drag
  - Agronomic hurdles
  - More feed is needed to maximize milk production
- Hard grain can lead to fall slump
- Lower starch percentage in silage

Enogen

<u>Pros</u>

- Contains alpha amylase
- Highly digestible
  - Digestible starch
  - Digestible fiber
- No yield drag

<u>Cons</u>

- Added stewardship requirements
- Negative perception of Syngenta stewardship
- Negative perception surrounding Syngenta genetic base

TMFs

Pros

- Visual appeal
- High tonnage potential

Cons

- Inconsistent agronomic performance
- Low starch percentage
- Hybrids with floury gene can be more susceptible to ear rots/molds

Enogen

INTEGRITY. PERFORMANCE. SOLUTIONS.

What is Enogen?

- Enogen is a GMO trait
- The trait is inserted into #2 yellow dent hybrids
- Originally developed for ethanol production
- Alpha amylase is present in the grain
- The amylase requires heat for activation
- The heat of fermentation in the silage pile activates the amylase
- Amylase aids in the breakdown of starches and sugars

Enogen Market Movement

- Syngenta field staff is making a strong marketing push for feed
- Syngenta's goal is 90% of Enogen sales will be in the animal feed sector in a few years
- More of the Enogen marketing is geared to feedlots than dairy
- Syngenta has released very little public data and has paid to keep all the university trails private
- There is far less material being used than has been marketed

GROW AND FEED SILAGE THAT DELIVERS **MORE AVAILABLE ENERGY**

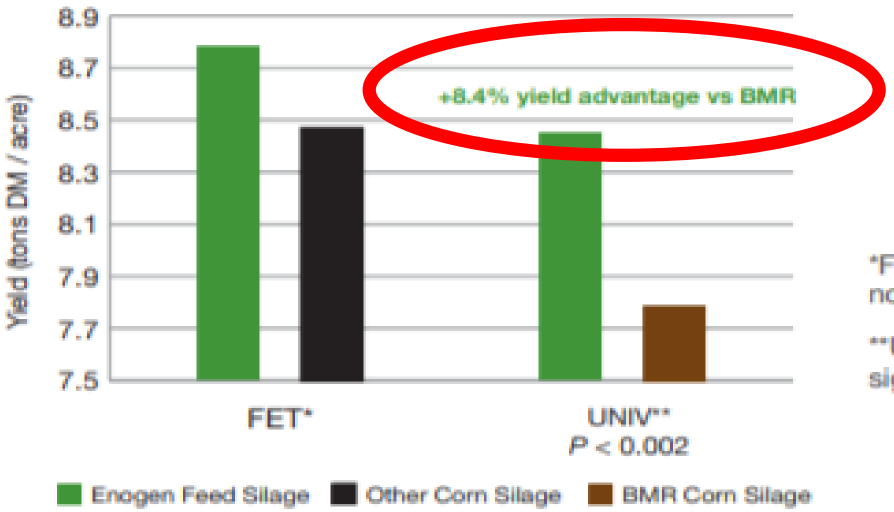
Enogen® Feed hybrids: Improved profit potential for dairy producers.

If you are a dairy producer growing your own feed, **a simple switch in your corn hybrid**[1] can help increase the feed value of the silage in your ration.

Enogen Feed hybrids are **proven, high-yielding hybrids** — backed by on-farm research[2] — with the traits you need to protect yield potential. And, there are **no additional management challenges,** unlike some silage-specific hybrids.[3]

Enogen Feed silage has been shown to provide excellent yield potential, performing equal too or better than non-Enogen hybrids.[4] **High yield potential and increased silage quality with Enogen Feed hybrids can help you get more out of your ration.**

2017 silage yield data

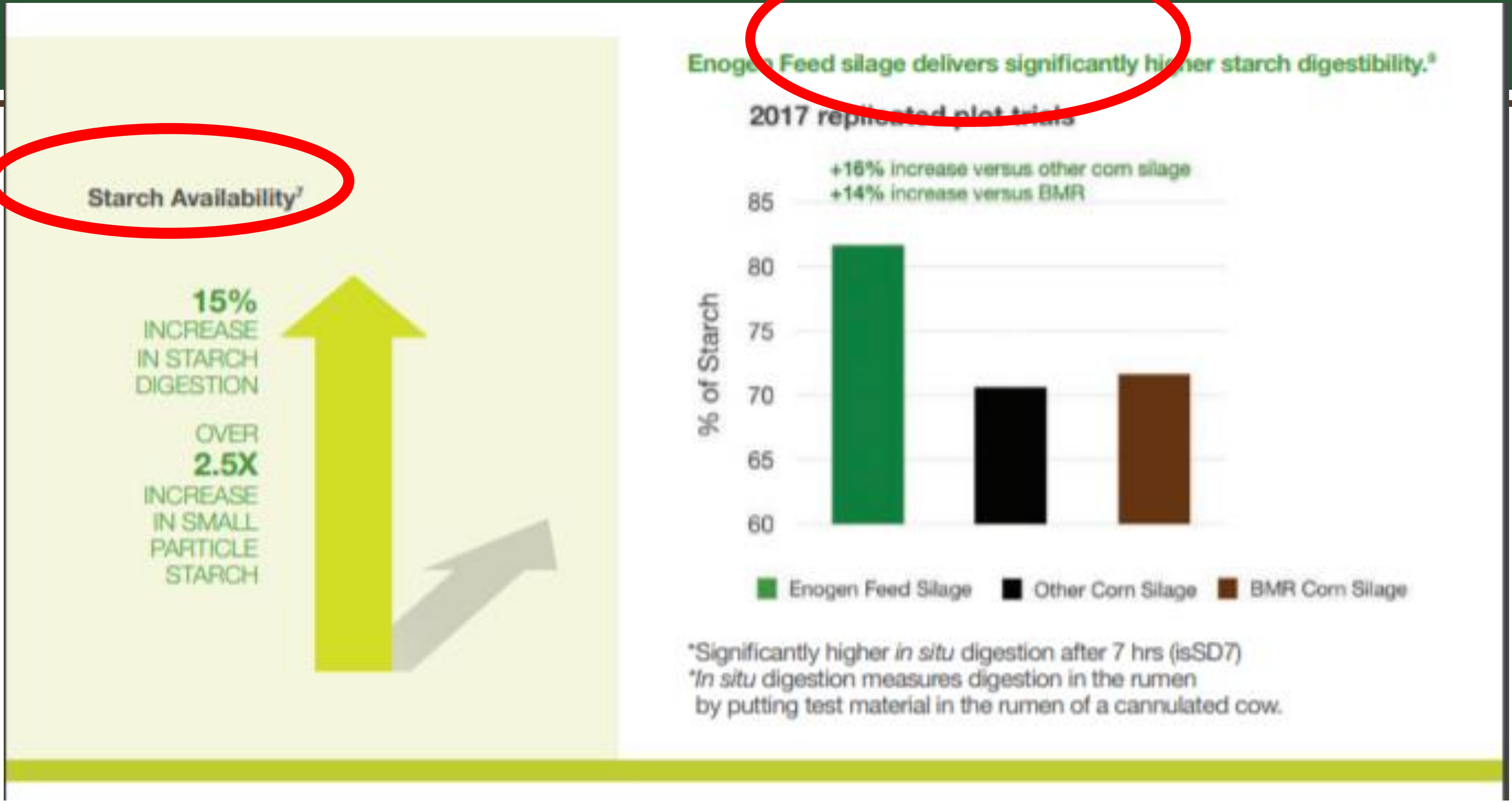


*FET = Field Evaluation Trials, no significant difference

**UNIV = University Trials, significant yield advantage vs BMR[5]

Syngenta Marketing

- Syngenta claims an 8.7% yield advantage over BMR and 1.5% advantage over standard corn
- This is a genetic advantage and is null and void if your company has access to Greenleaf products
- Syngenta claims a 2.5 x holistic starch advantage when compared to standard corn and higher when compared to BMR. To understand this, we need to remember that industry standard is hard vitreous corn kernels that have low early hour starch digestibility. We are really comparing apples to oranges.



Starch Availability[7]
15%
INCREASE
IN STARCH
DIGESTION
OVER
2.5X
INCREASE
IN SMALL
PARTICLE
STARCH
Enogen Feed silage delivers significantly higher starch digestibility.[8]
2017 replicated plot trials
+16% increase versus other corn silage
+14% increase versus BMR
85
80
75
70
65
60
% of Starch
Enogen Feed Silage
Other Corn Silage
BMR Corn Silage
*Significantly higher *in situ* digestion after 7 hrs (isSD7)
In situ digestion measures digestion in the rumen
by putting test material in the rumen of a cannulated cow.

Syngenta Marketing…*continued*

- Syngenta claims a 15-16% ISD7 advantage
- remember the industry standard is hard grain that doesn't test well in ISD7
- Soft Endo Ration Choice hybrids on average show a 15% increase in ISD7 over industry grain hybrids and would in turn be a direct competitor for Enogen's ISD7 advantage at the same potential price point
- Enogen's only real advantage over properly selected RC Hybrids is greatly varying seed costs
- Ration Choices advantage is very little stewardship

BMR

RationChoice
SILAGE HYBRID

INTEGRITY. PERFORMANCE. SOLUTIONS.

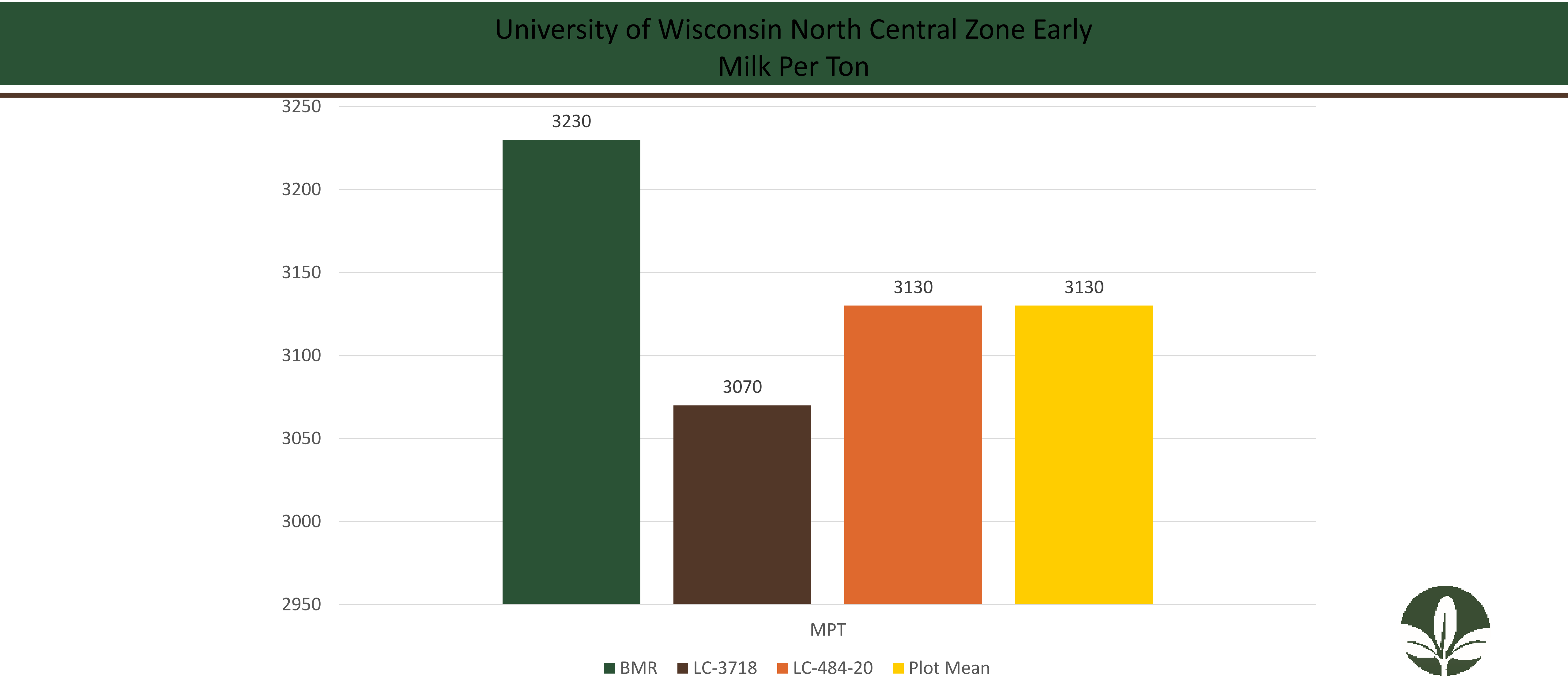
What is BMR?

- A mutation that has been isolated in Maize, Sorghum, and Millet through spontaneous or chemical mutation
- It has a physical representation of a brown mid vein
- The brown mid vein has a direct association to lower lignin content
- The gene is useful to improve forage digestibility

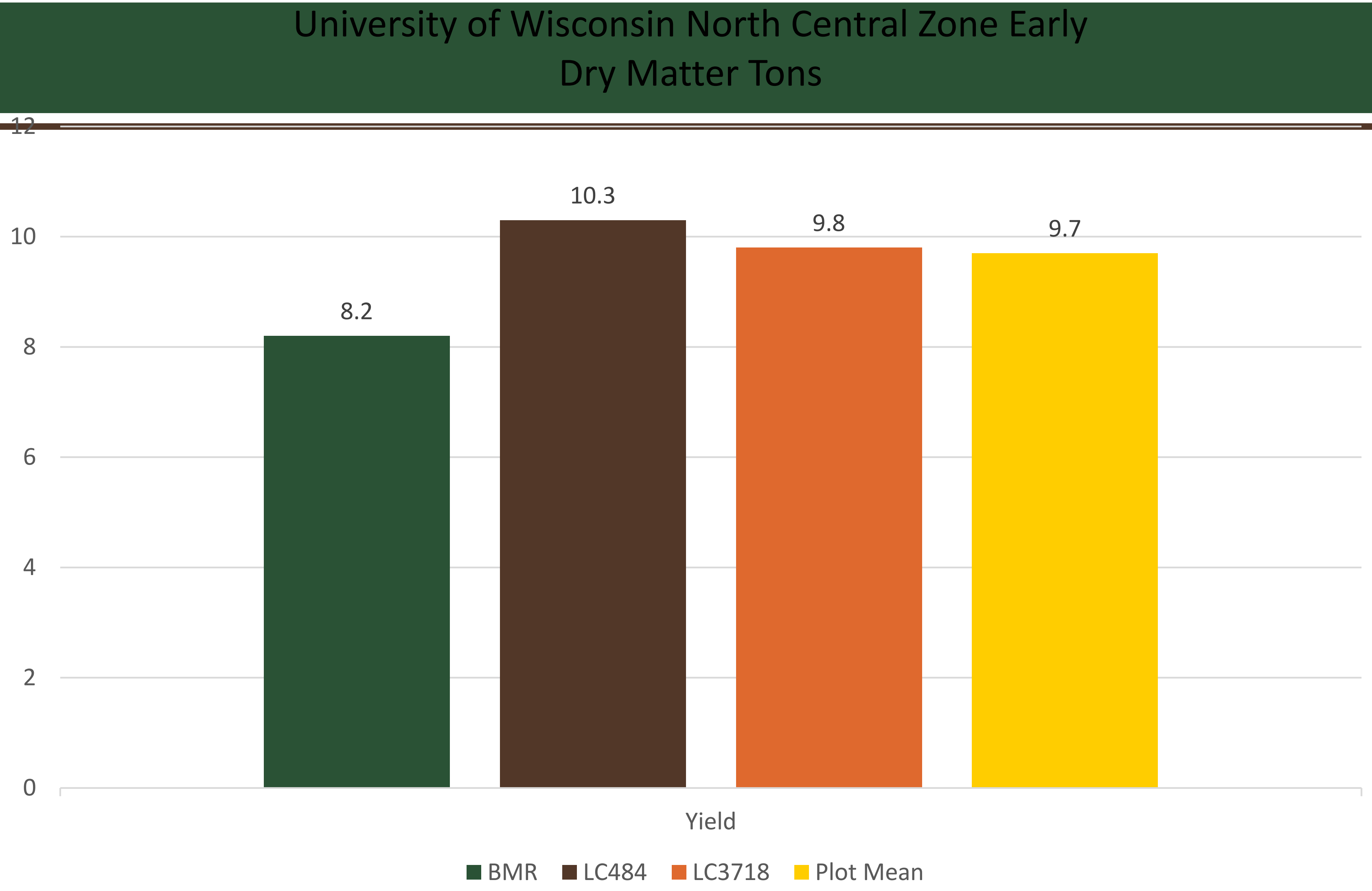
BMR Market Movement

- The BMR gene 1 and 3 now owned by the same company, BMR Gene 1 is being used for new seed production
- Very little marketing is being done. It has been pulled out of numerous independent trails and testing has consolidated.
- The company is applying resource to other segments and is letting BMR coast. They believe this portion of the industry is secured.
- Retail agreements have distanced relationships with nutrition groups. It has a smaller sales footprint than it did 24 months ago.

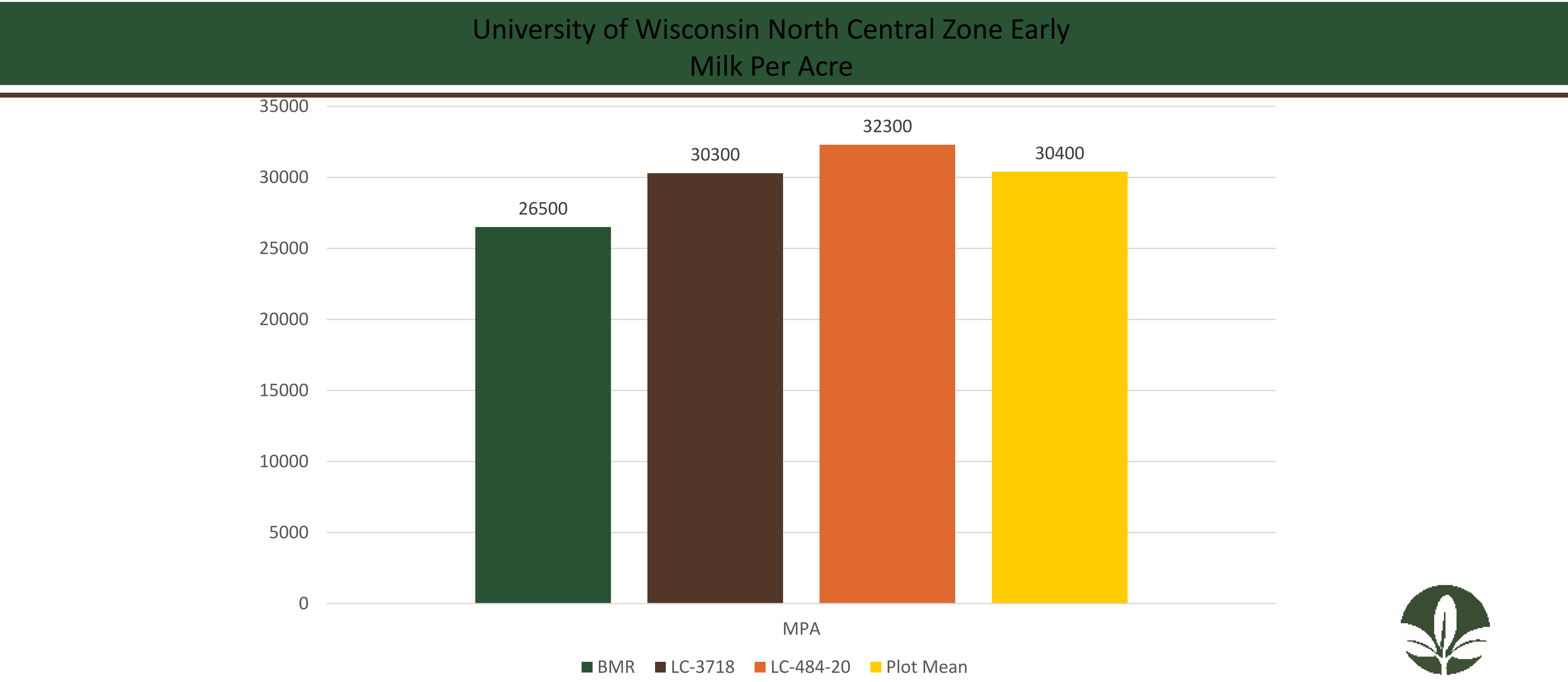
BMR vs. Legacy Products and Plot Mean



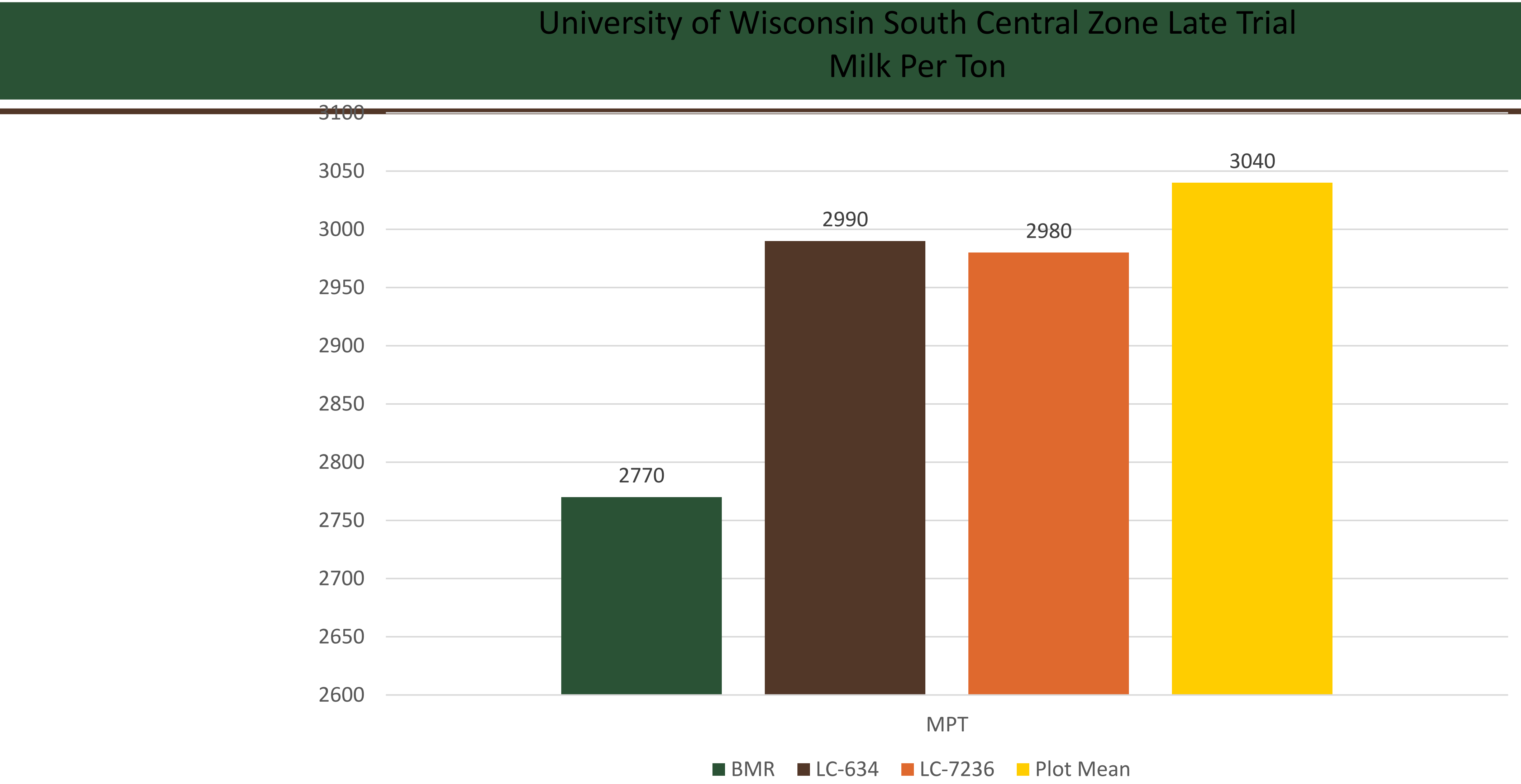
BMR vs. Legacy Products and Plot Mean



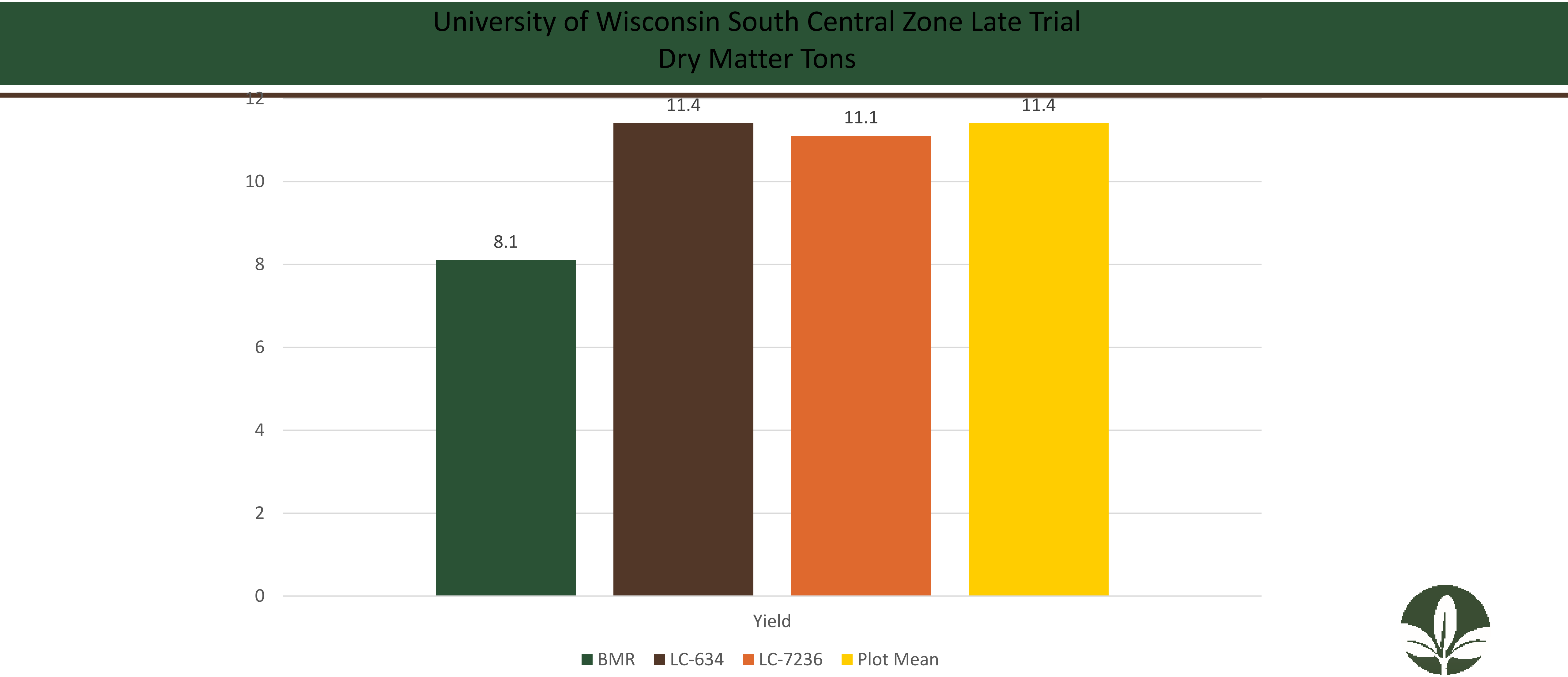
BMR vs. Legacy Products and Plot Mean



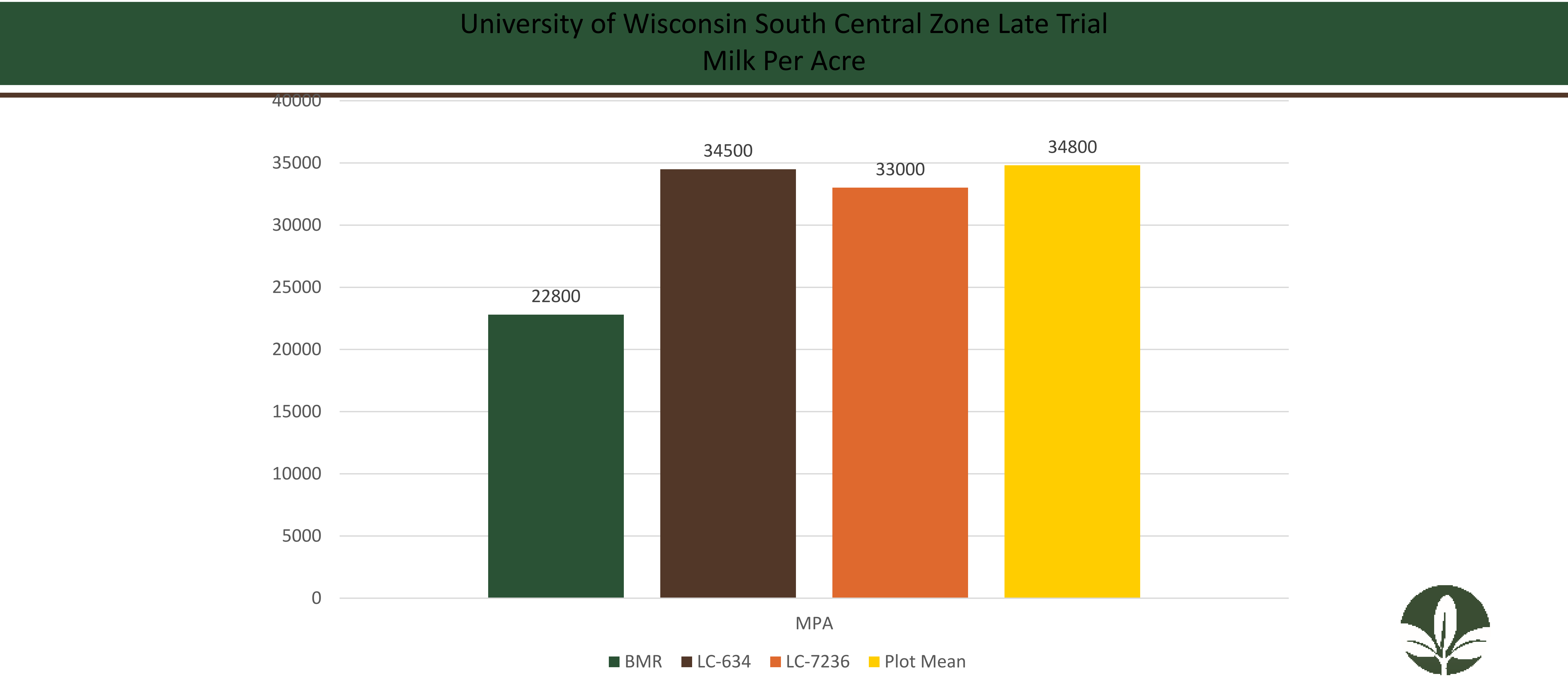
BMR vs. Legacy Products and Plot Mean



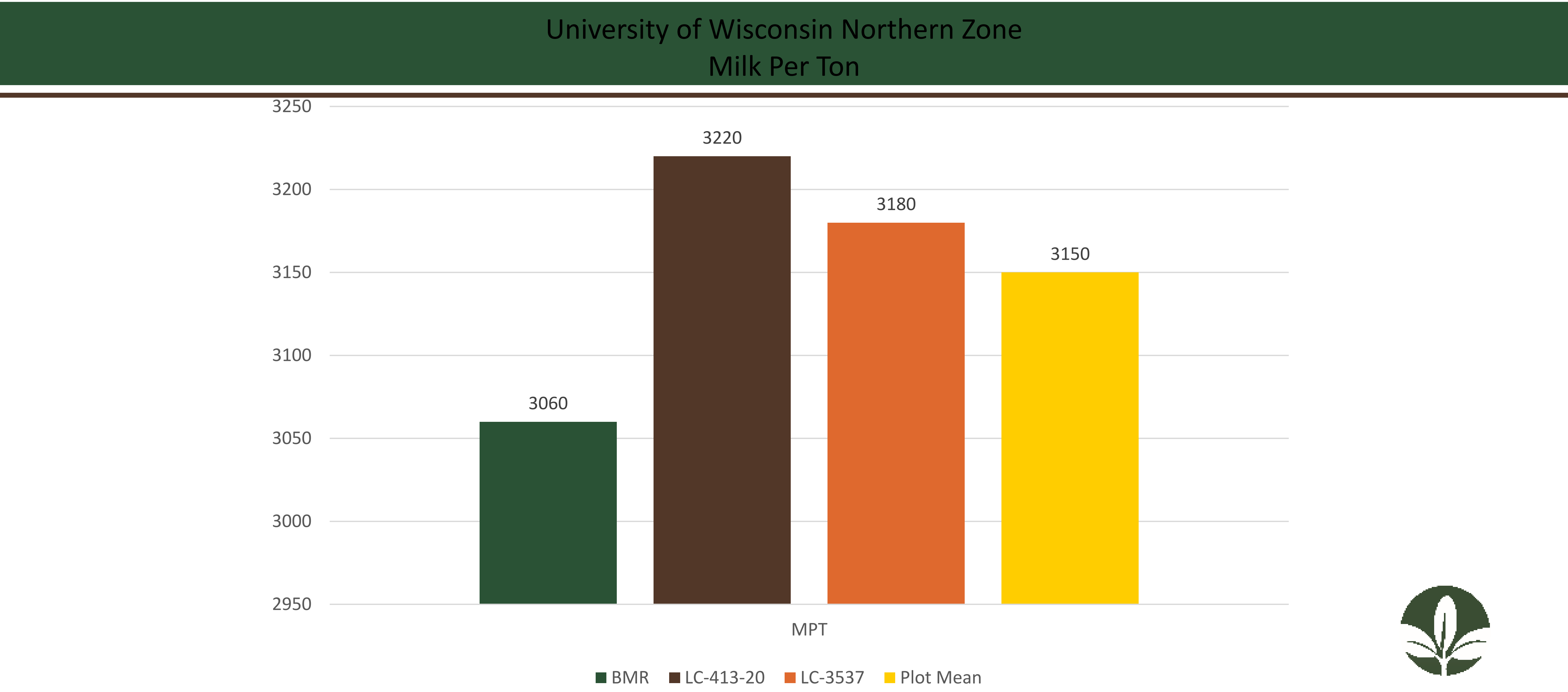
BMR vs. Legacy Products and Plot Mean



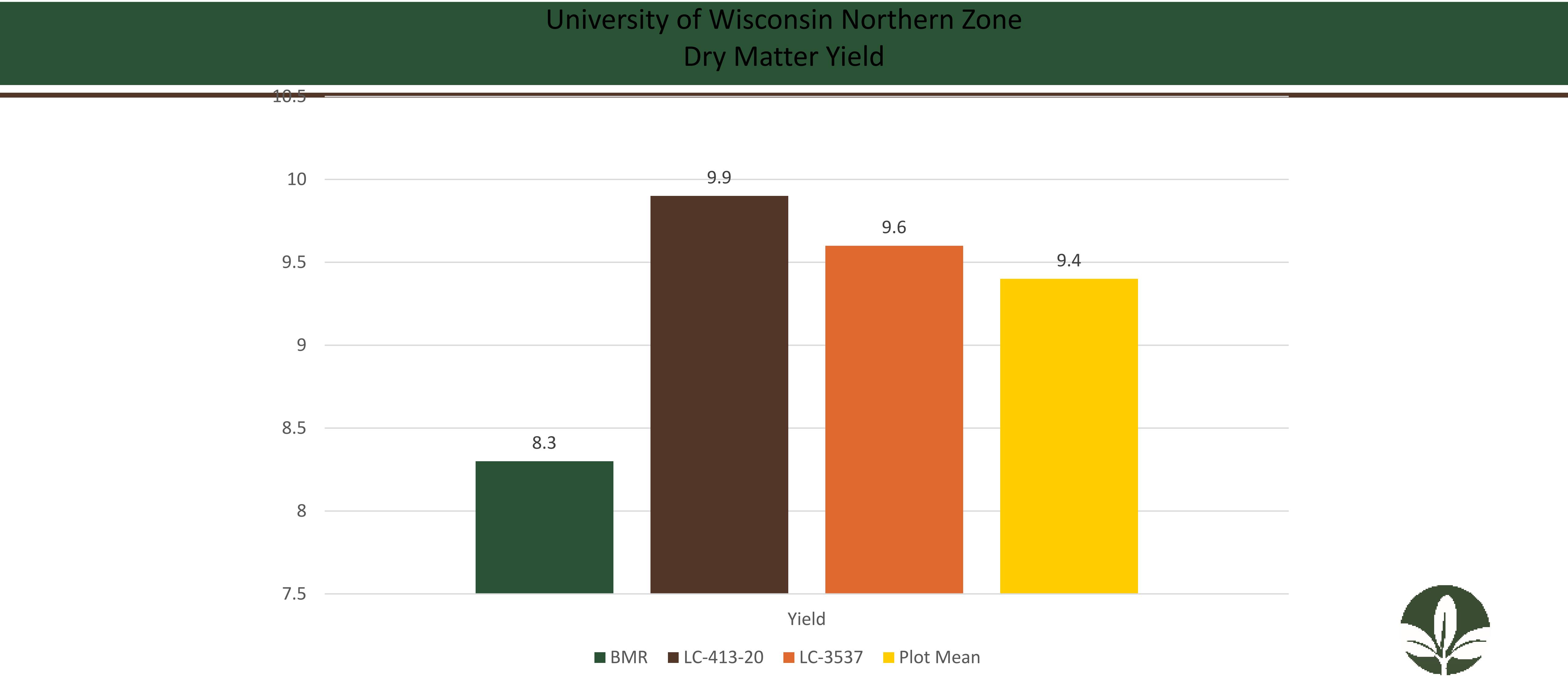
BMR vs. Legacy Products and Plot Mean



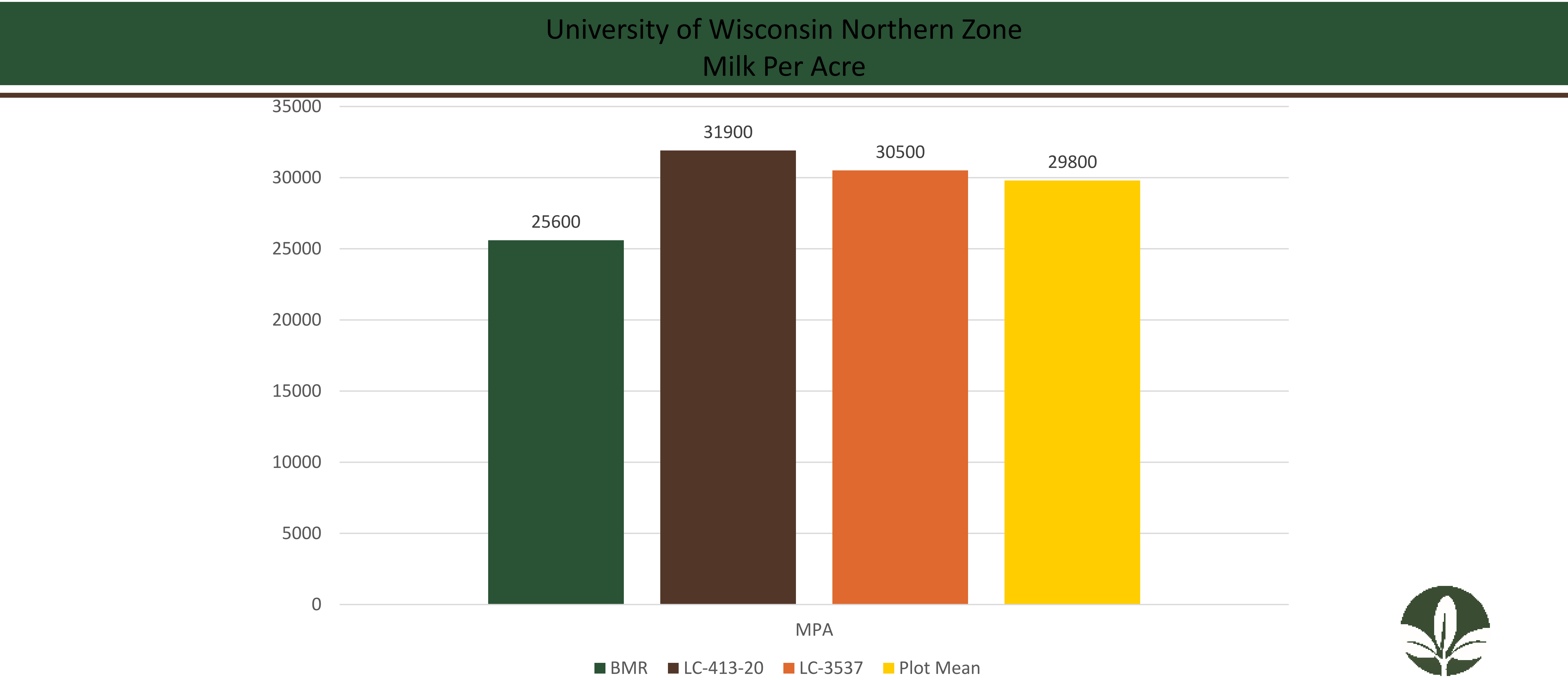
BMR vs. Legacy Products and Plot Mean



BMR vs. Legacy Products and Plot Mean



BMR vs. Legacy Products and Plot Mean



Another University's look at BMR vs Standard Corn

University of Illinois did a study where they fed BMR vs Standard corn

- the data was collected over 4 isolated herds
- BMR showed a 17% yield drag
- 3% lower undf
- 8% higher NDF30
- resulting in a 3.75# milk advantage

What does that mean is dollars and cents over a 500 cow herd?

Many research reports have concluded that BMR corn silage increases milk production in cows. Our data consistently shows higher Milk per Ton, but lower Milk per Acre yield due to lower forage yield primarily due to grain yield. Since there is typically no premium paid for higher quality corn silage, I have often said, “Buy all of the BMR corn silage you can buy but be careful about growing it on your farm.”

Dr. Joe Lauer – University of Wisconsin

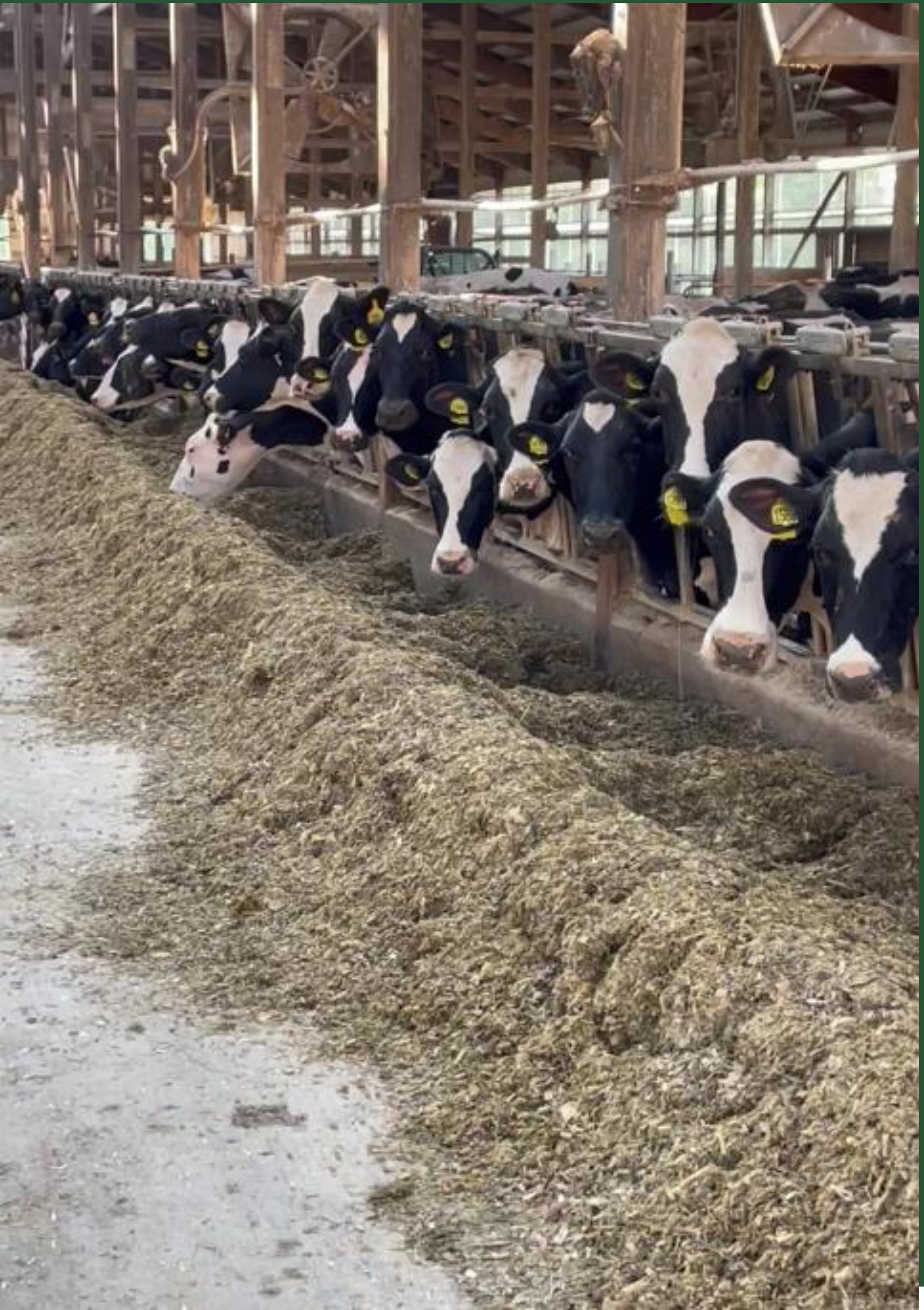
Pioneer Standard Corn

- MPA is a Pioneer number, it was created to combat Mycogens MPT scores and showed that profitability matters…(ironic)
- Selection program with a yield focus versus quality
- Genetic program that needs environmental effects for increased starch and fiber digestibility
- Less focus on true silage genetics...still use "dual purpose" style of selection
- Markets for whole acre solutions
- Sells packages to offset quality deficits…inoculants, proteins, forages, soybeans

Conclusion

- BMR is expensive, has a yield disadvantage, and has hard grain
- Enogen has stewardship restrictions, no genetic yield advantage, and with proper selections no early hour starch advantage
- TMFs looked good with generally poor early starch digestibility
- Pioneer has to give seed away...

DON'T BE AFRAID - YOU HAVE GOOD STUFF



THANK YOU!

QUESTIONS?