

HarvXtra® Alfalfa with Roundup Ready® Technology

THE MARK OF PROGRESS



ALFALFA TODAY: Yield vs. Quality Tradeoff

Harvest Early

- Maximize Forage Quality
- **Sacrifice Yield**



Harvest Later

- Higher Forage Yield
- **Lower Forage Quality**



What is the HarvXtra® Alfalfa Trait?

THE GREAT TRAIT

HarvXtra® alfalfa trait reduces lignin content in alfalfa, giving growers the flexibility to produce higher quality forage or delay harvest to maximize yield potential.



Why is HarvXtra[®] Alfalfa The Great Trait?

THE FIRST GENETICALLY
ENHANCED ALFALFA TRAIT
DEVELOPED TO **MAXIMIZE
QUALITY** BY REDUCING LIGNIN

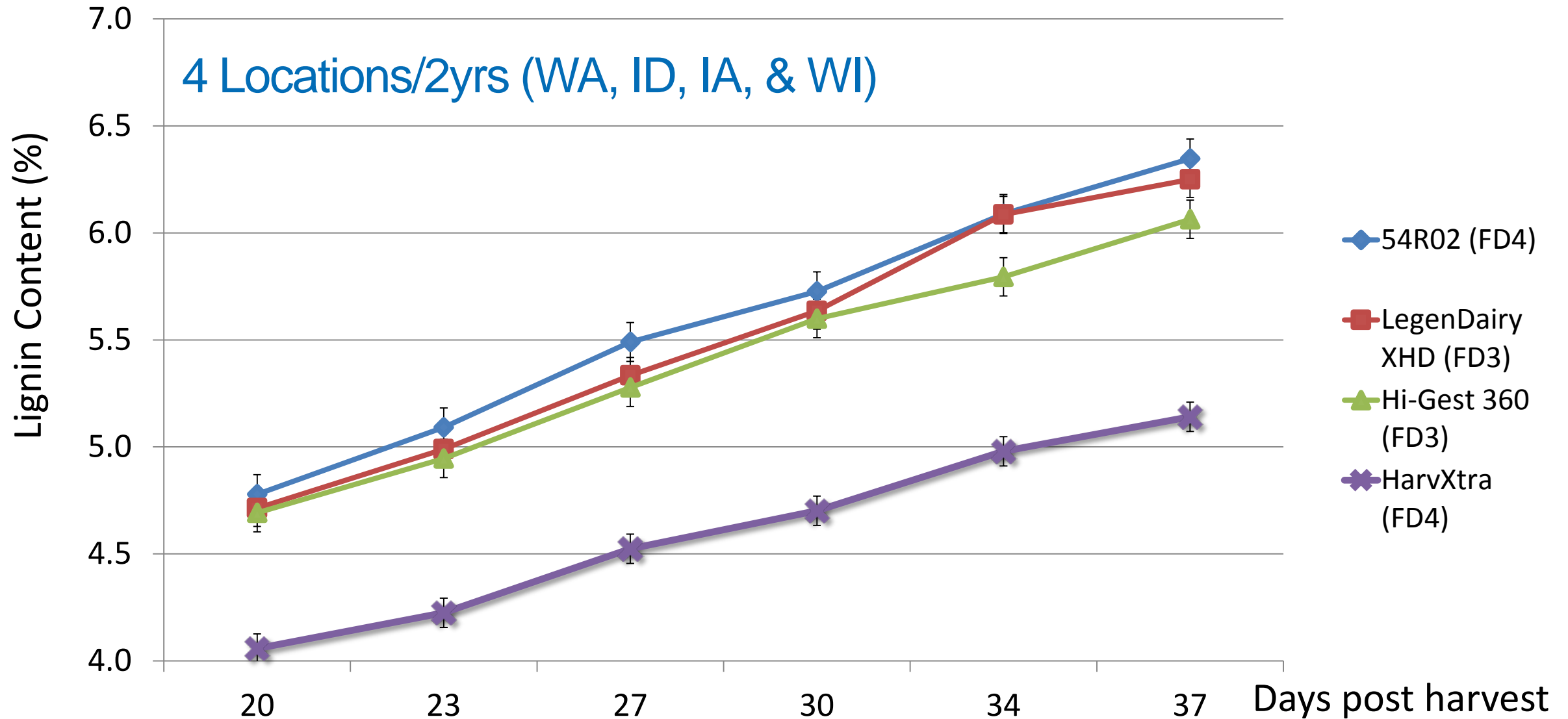
BY

12%-20%

Compared to conventional alfalfa at the same stage of maturity.

Includes Roundup Ready[®]
Technology

Change in ADL with Advancing Maturity



What will HarvXtra® Alfalfa do for growers?

Flexibility

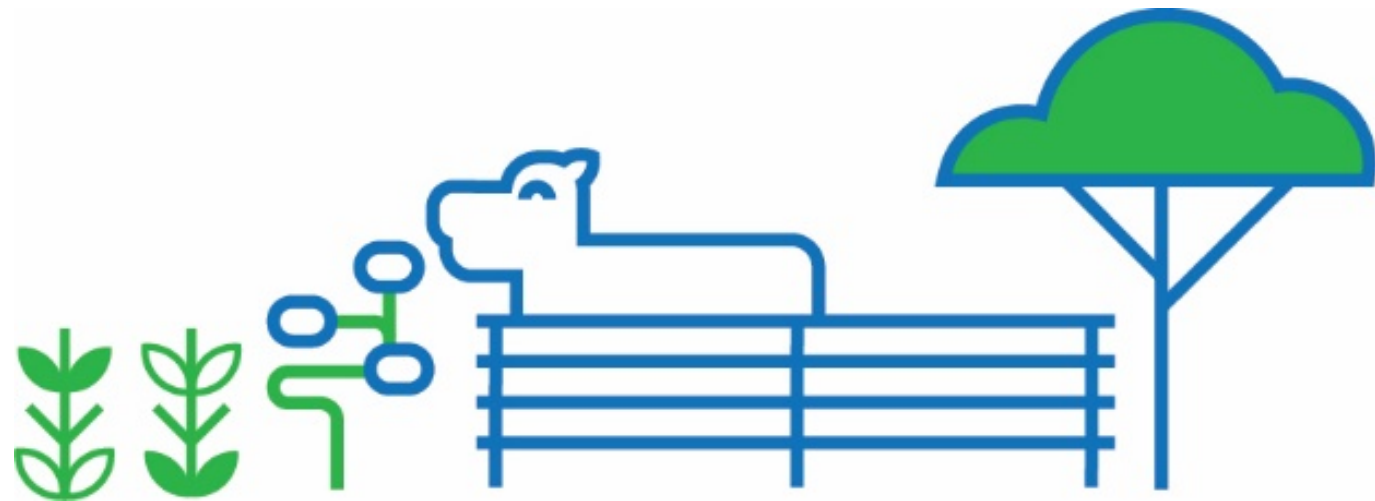
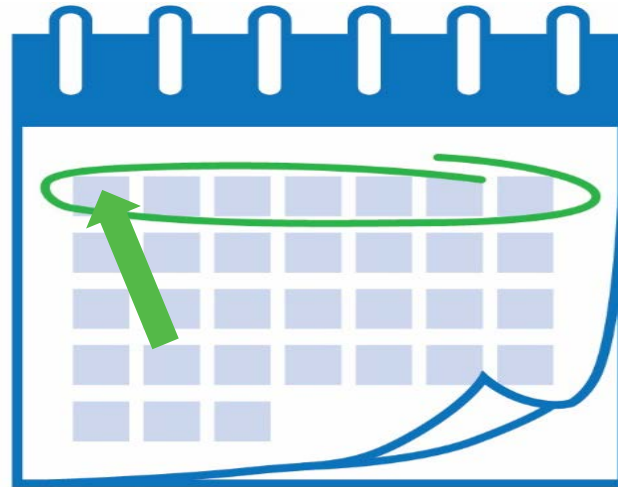
Maintain their
normal harvest schedules
for higher-quality forage,

or

Delay harvest 7-10 days for
increased yield potential, without
sacrificing
forage quality compared to
conventional alfalfa at
7-10 days earlier

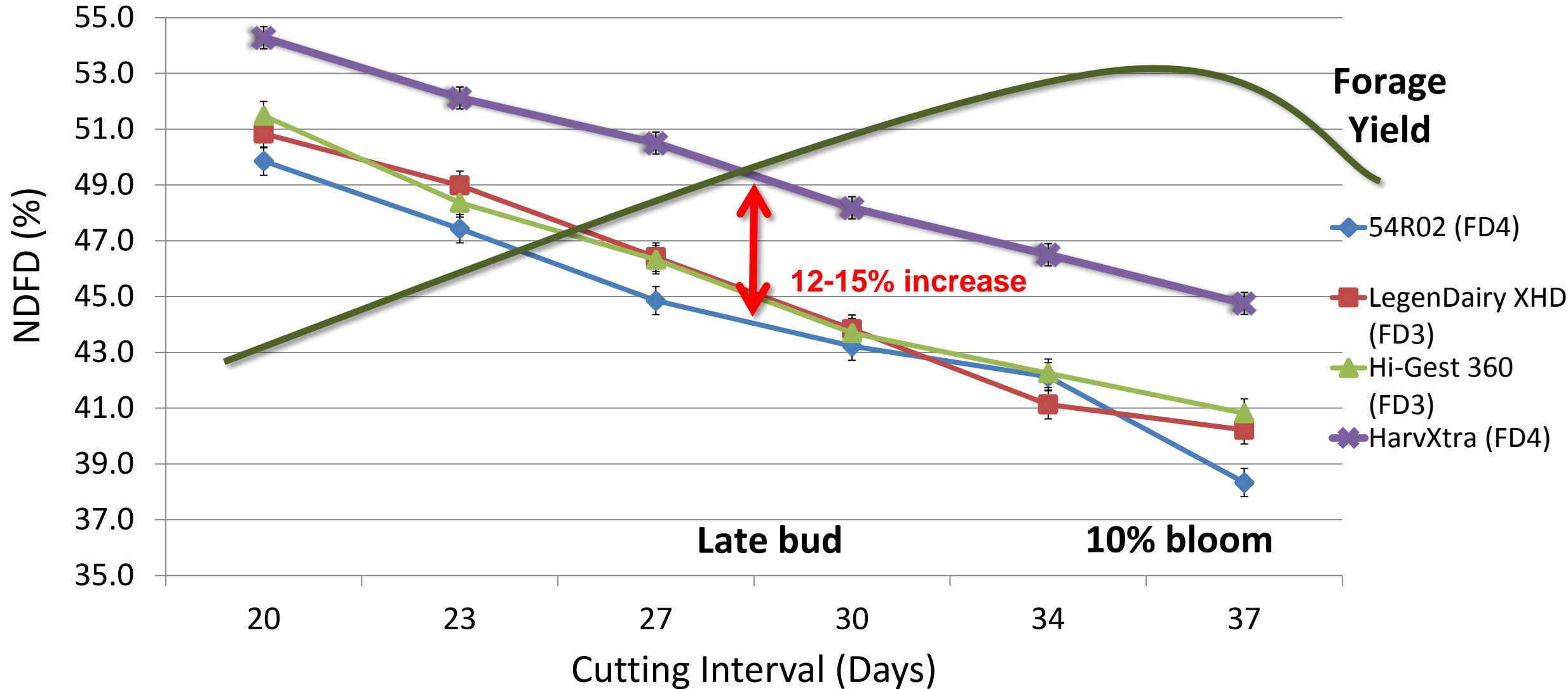
Option 1- Improved Quality

Farmers
can maintain
a **NORMAL**
HARVEST
SCHEDULE
and achieve
HIGHER
QUALITY

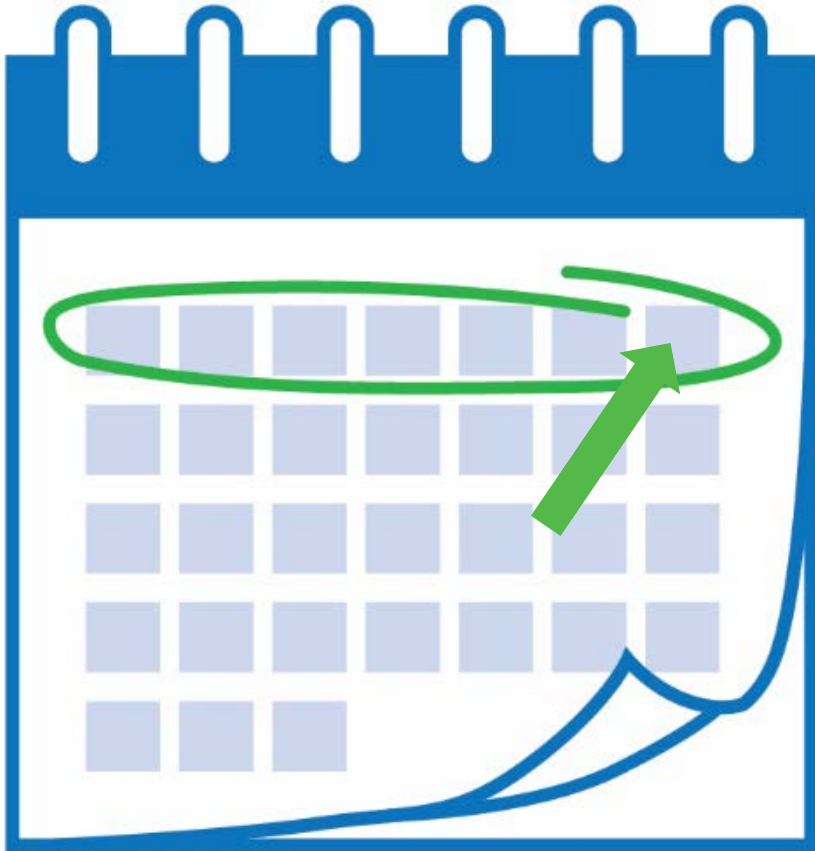


Harvest for Quality

NDFD - 4 Locations (WA, ID, IA, & WI)/2 yrs



Option 2- Delay Harvest

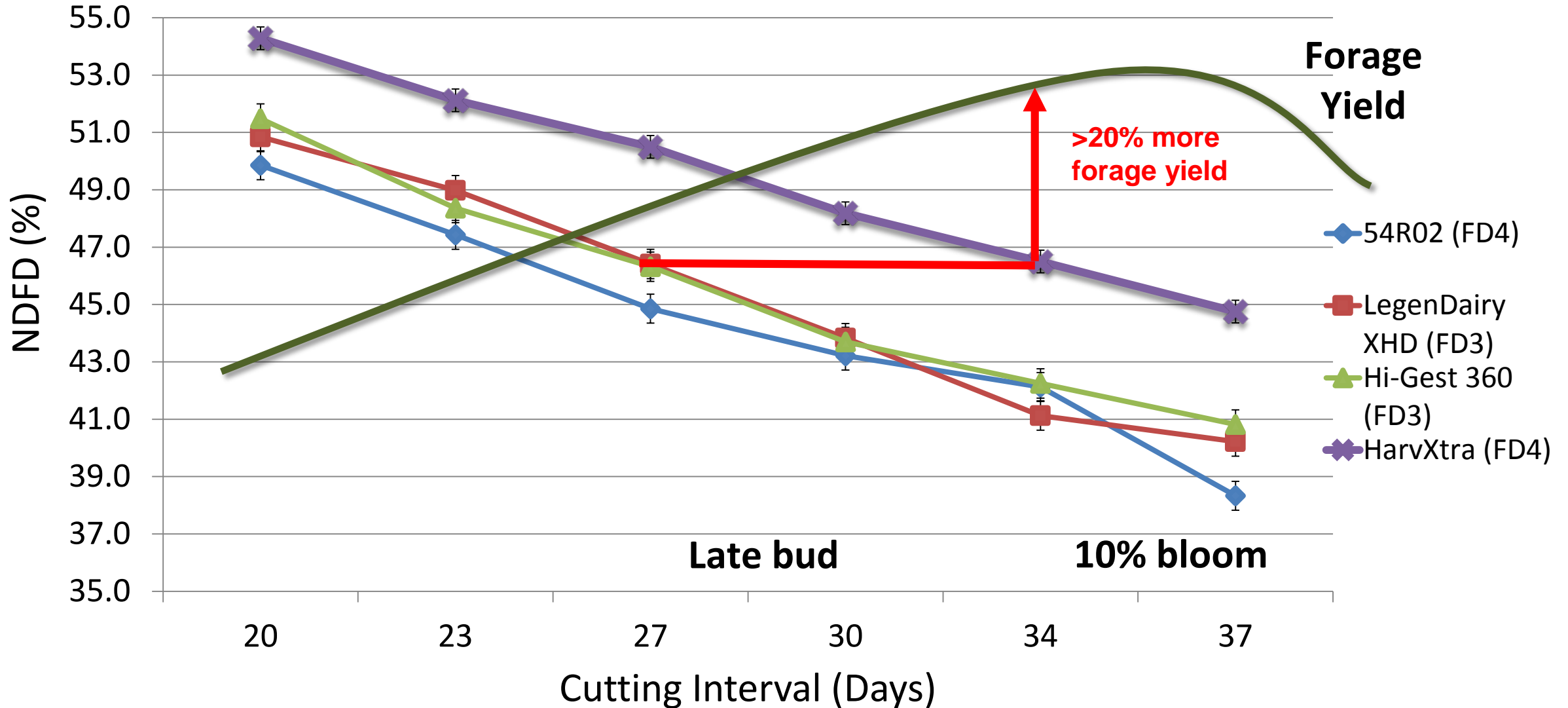


OR CHOOSE TO DELAY HARVEST FOR UP TO
7 DAYS FOR HIGHER
YIELD POTENTIAL
WITHOUT SACRIFICING QUALITY

Compared to conventional alfalfa at the same stage of maturity.

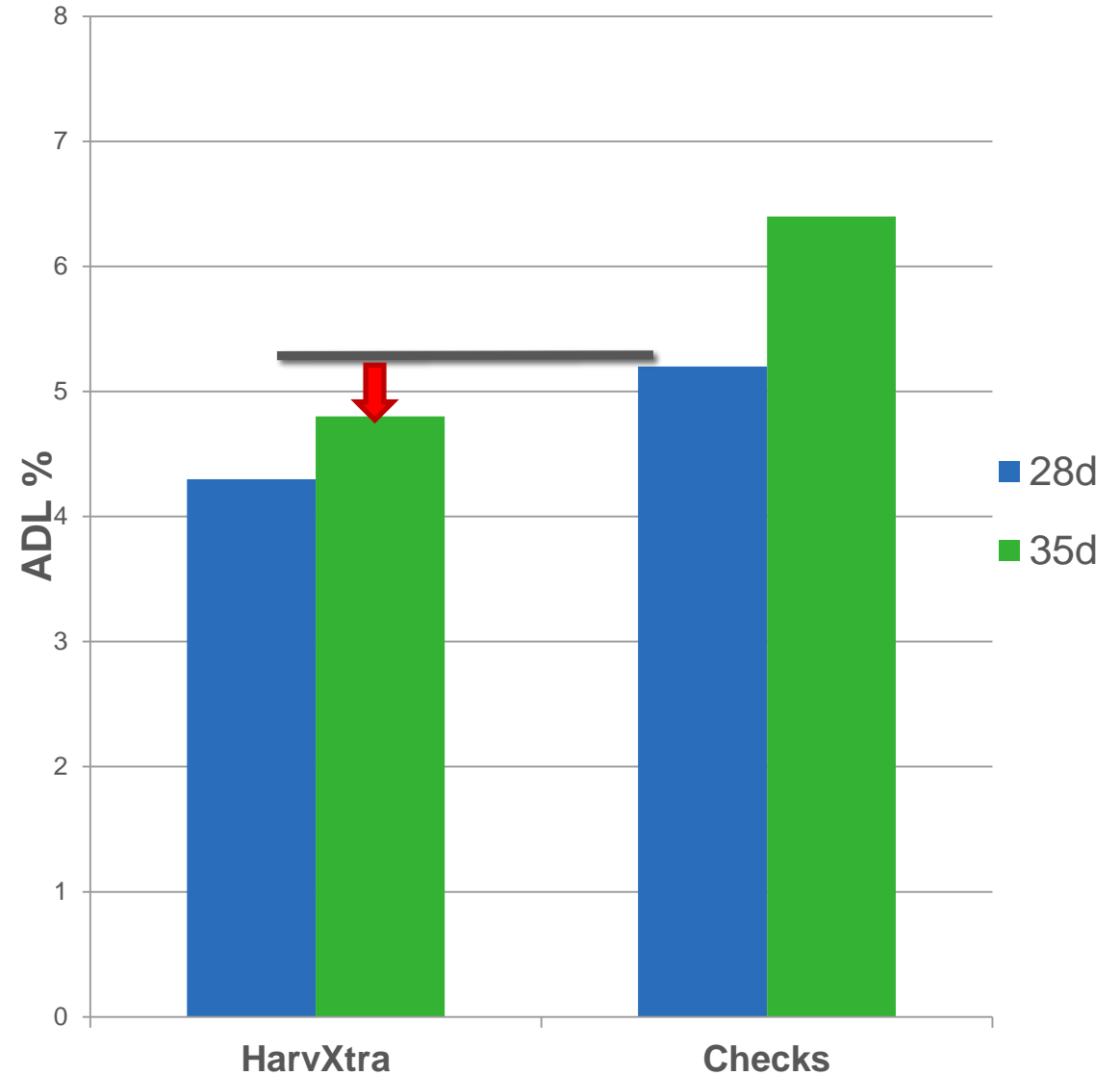
Delay Harvest for Yield

NDFD - 4 Locations (WA, ID, IA, & WI)/2 yrs



Comparing ADL in 3 vs 4 Cut Management: 2014 FGI Trials

The FGI trial demonstrates that ADL of the HarvXtra® alfalfa varieties harvested at 35 days is slightly less than the checks harvested at 28 days.



HarvXtra® Alfalfa checks: Consistency 4.0RR and WL355RR

2011 HarvXtra® Alfalfa Cutting Management Trial

Touchet, WA

1st cut 5/9 = 3.60 T/A

1st cut 5/15 = 4.55 T/A

Six Harvests

Five Harvests

Spring Regrowth: 03-05-2013
Touchet, WA FGI Research Site



2011 HarvXtra® Alfalfa Cutting Management Trial

Boone, IA



4 Harvests/35 Day Schedule

Five Harvests/28 Day Schedule

Photo Taken: 05-07-2013
Boone, IA FGI Research Site

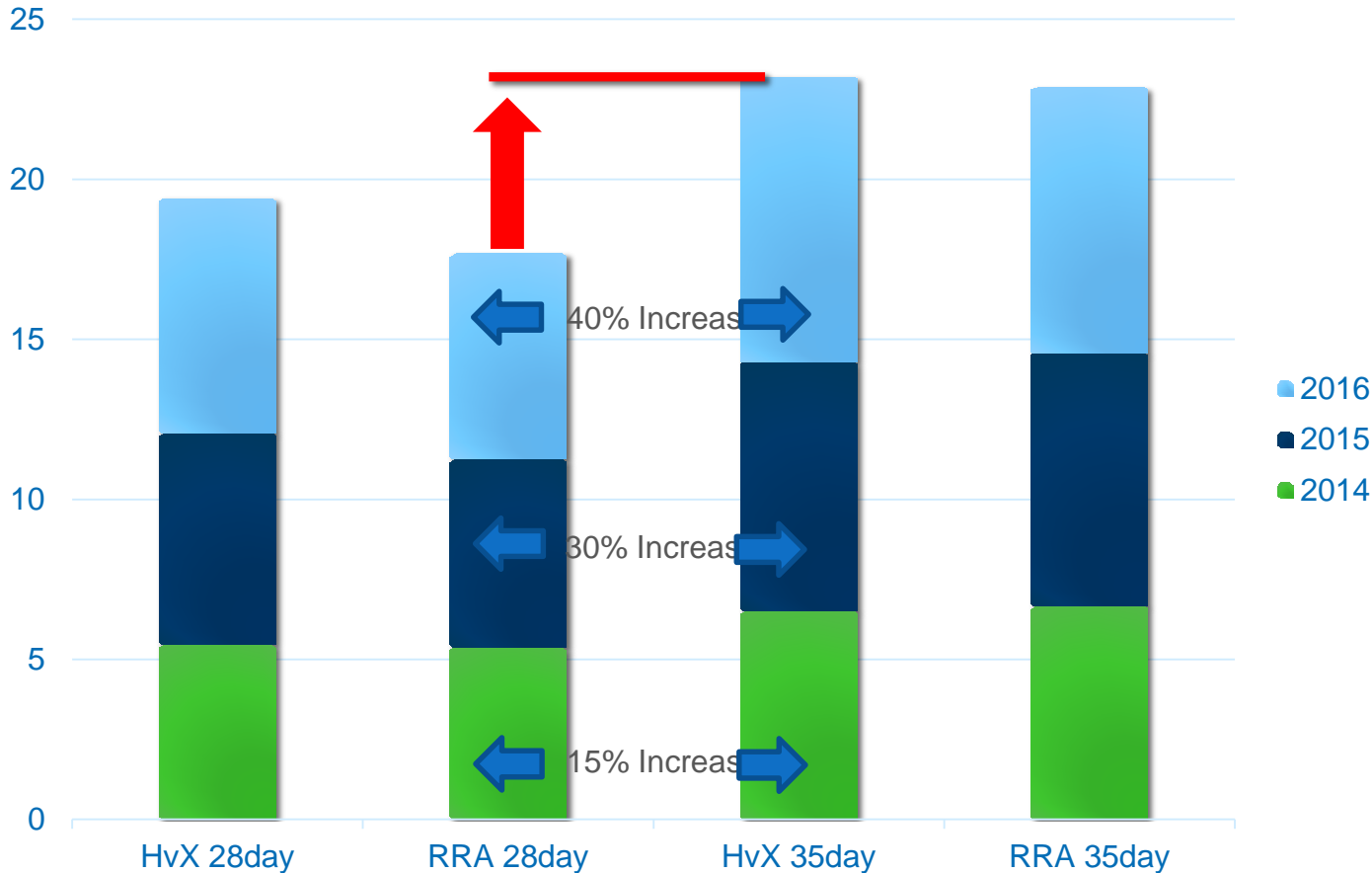
3 vs 4 cutting by Sept 1

Effect on Alfalfa Yield, Arlington, WI

		1 st cutting	2 nd cutting	3 rd cutting	4 th cutting	Season Total	
2 nd year	3 cut	2.97	2.43	2.15	----	7.55	
	4 cut	1.66	1.48	1.71	1.68	6.53	17%
3 rd year	3 cut	2.32	1.53	1.24	----	5.09	
	4 cut	1.31	1.18	0.75	0.83	4.07	25%

Multiple trials conducted at the University of Wisconsin (UW) have shown a 15-20% forage yield advantage for a three cut verse four cut management system over a four year rotation.

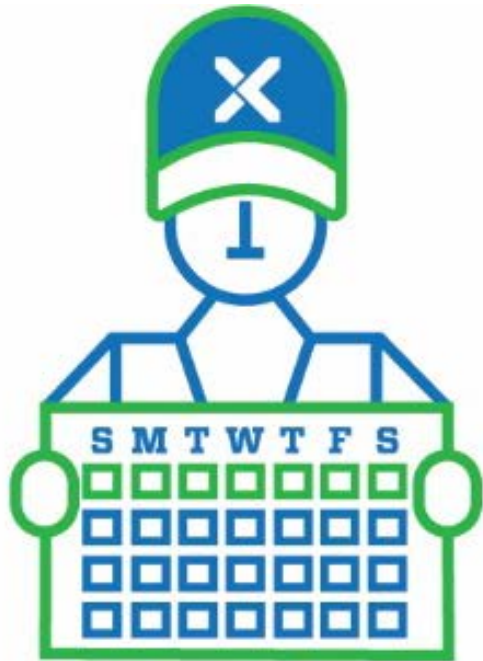
28d vs 35d Forage Yield – 3yr Summary



Seeded Fall 2013 at West Salem, WI

- HarvXtra® Alfalfa (HvX) cut at 35 days averaged **30% yield increase** over 3 years compared to Roundup Ready® Alfalfa (RRA) cut at 28 day
 - 2016 40% increase
 - 2015 30% increase
 - 2014 15% increase
- NDFD for HvX cut at 35 days was greater than RRA at 28d

What will HarvXtra® Alfalfa do for growers?



FLEXIBLE CUTTING WINDOW

Anyone who's worked on a farm knows stuff happens. Rain. Equipment maintenance. Whatever comes your way, HarvXtra® alfalfa trait provides the flexibility you need.



What does that mean for me?



FIELD-PROVEN BENEFITS

OF VARIETIES AVAILABLE IN 2017

20%

**LESS
LIGNIN**

(acid detergent lignin)
across cuttings and locations

16%

**HIGHER
RFQ**

(relative forage quality)
across cuttings

16%

**HIGHER
NDFD**

(neutral detergent fiber digestibility)
across cuttings

Up to
26%

**HIGHER
YIELD**

WITH DELAYED HARVEST
AT 35-DAY
CUTTING INTERVALS*

**Three cuttings at 35-day intervals compared to four cuttings at 28-day intervals, with the three-cut system yielding 26% more over the life of the stand.*

Stacked with Roundup Ready® Technology

Broad
spectrum
weed
control

Excellent
crop
safety

Alfalfa
yield
advantage
over the
life of the
stand

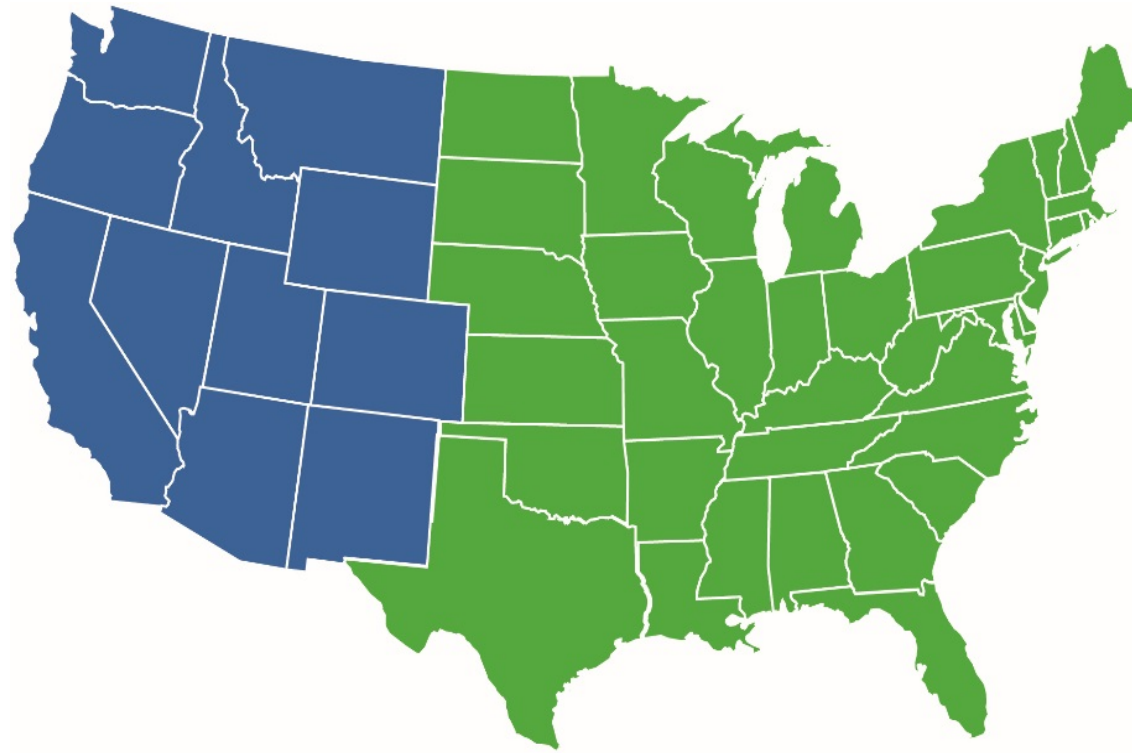
Higher
quality
feed in
every ton

Flexible
application
timing

Where is HarvXtra® Alfalfa Available?

Starting January 1, 2017, HarvXtra® Alfalfa with Roundup Ready® Technology will be available for sale and planting in the Eastern states (green geography) and also the following states (blue geography, “Western states”) subject to a Seed and Feed Use Agreement: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington and Wyoming.

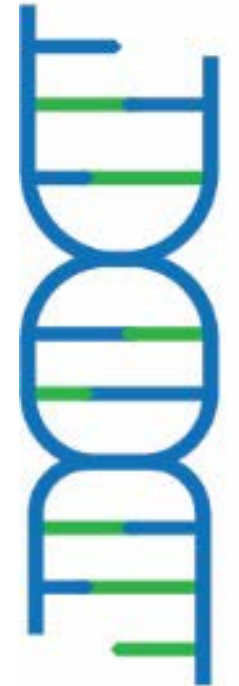
Growers must direct any product produced from HarvXtra® Alfalfa with Roundup Ready® Technology seed or crops (including hay and hay products) to US domestic use only.



University Data

HarvXtra® Alfalfa vs Conventional Alfalfa Varieties University Trials

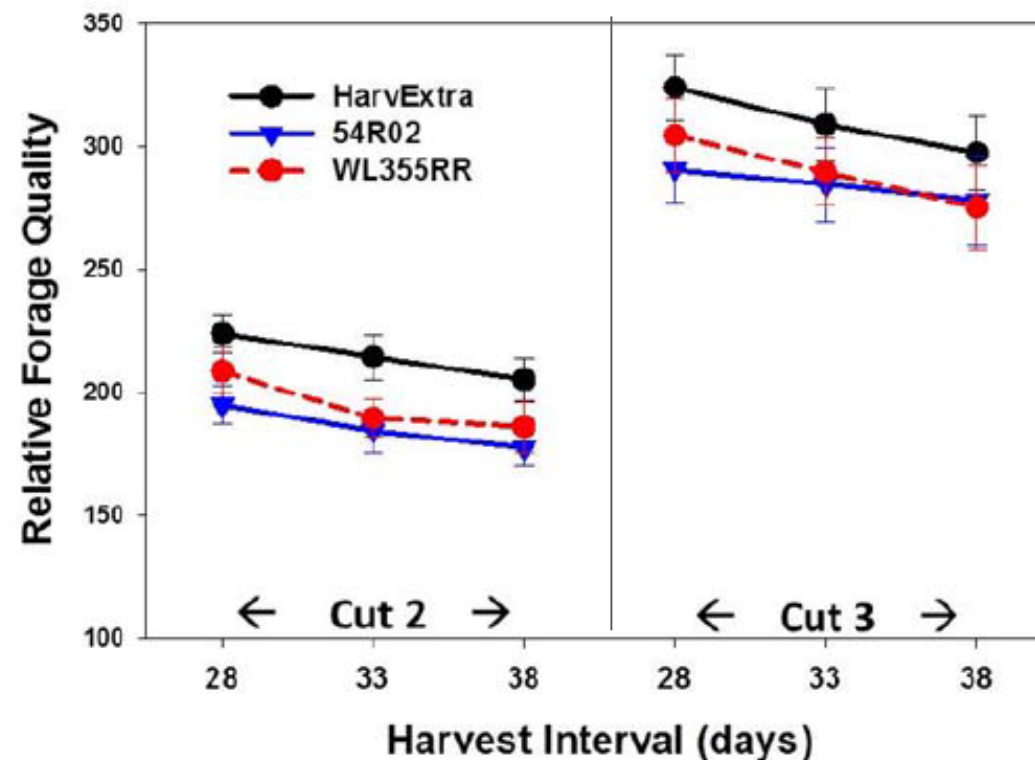
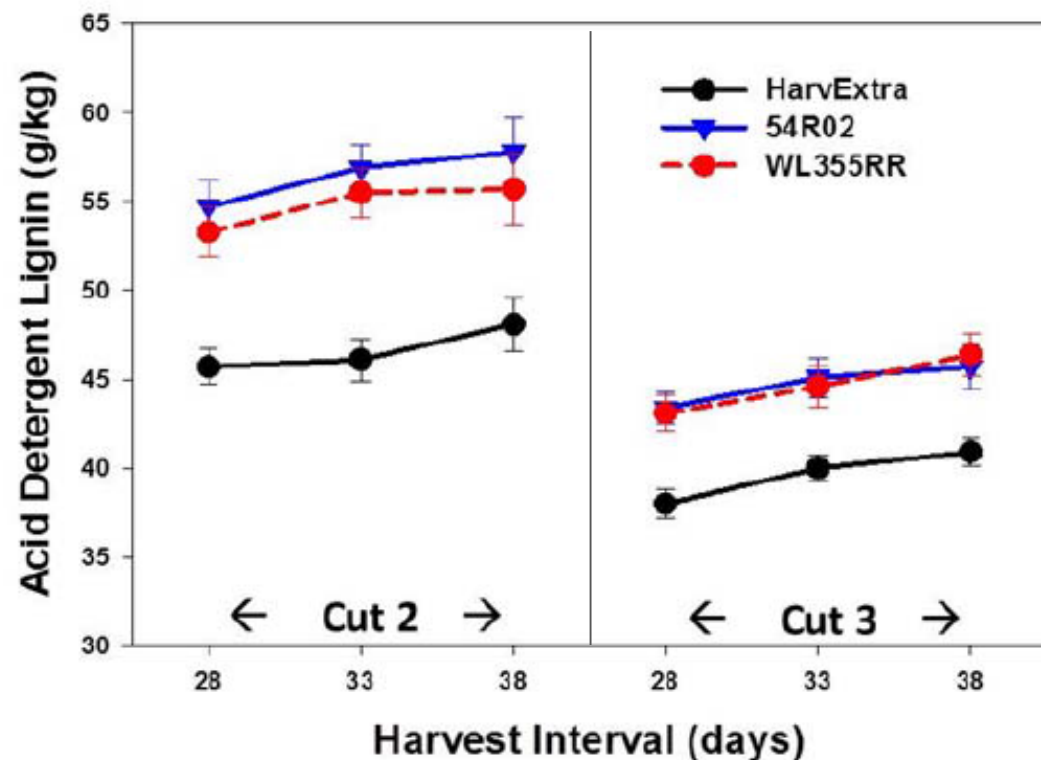
- Field trials were established in six states (CA, KS, MI, OH, PA, WI) in spring 2015
- Three alfalfa varieties
 - HarvXtra-008 with the reduced lignin trait
 - 54R02 with high yield
 - WL 355RR selected for high forage quality
- Hi-Gest 360 variety was only included in CA and PA trials



LOW LIGNIN ALFALFA: WIDE AREA FIELD TEST RESULTS
R. Mark Sulc, Angela Parker, Kenneth Albrecht, Kim Cassida, Marvin Hall, Doo-Hong Min, Steve Orloff, Dan Undersander, and Xuan Xu

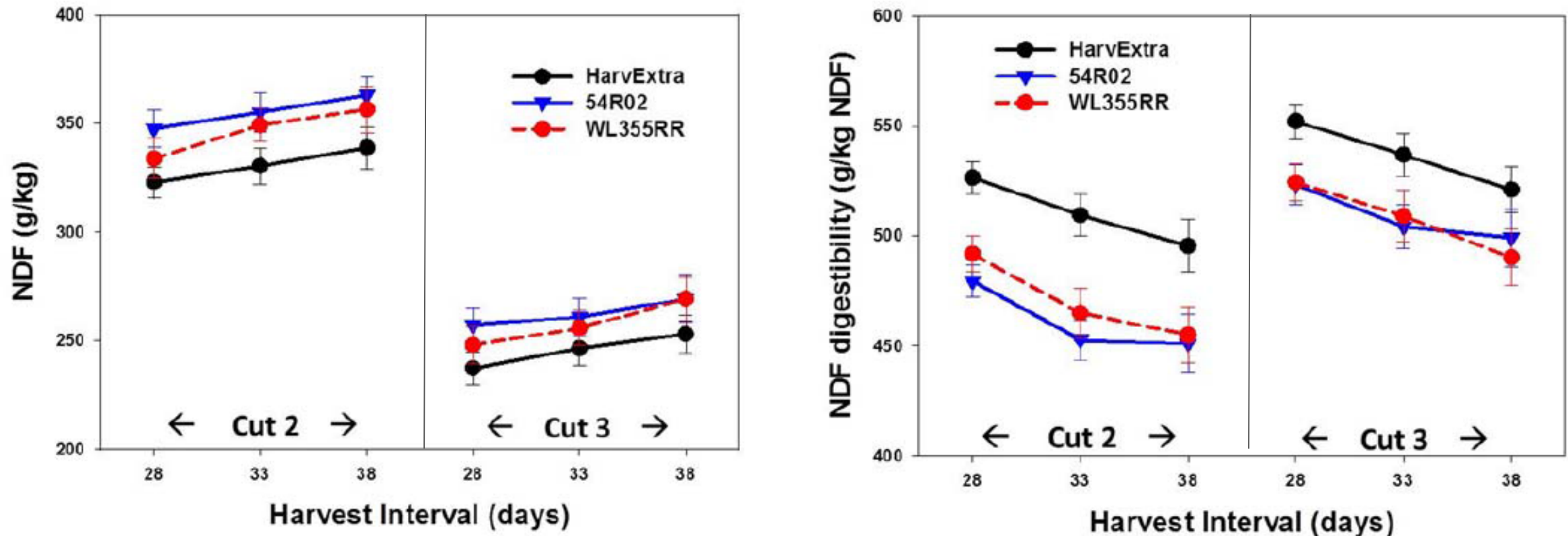
The Results- ADL & RFQ

Figure 3. Average ADL, NDF, NDFD, and RFQ of three alfalfa cultivars grown in six locations and harvested twice in the seeding year at 28- 33-, and 38-day intervals.
 (Note, % values for ADL, NDF, and NDFD are obtained by dividing values by 10).



The Results- NDF & NDFd

Figure 3. Average ADL, NDF, NDFD, and RFQ of three alfalfa cultivars grown in six locations and harvested twice in the seeding year at 28- 33-, and 38-day intervals.
 (Note, % values for ADL, NDF, and NDFD are obtained by dividing values by 10).



The Results- HarvXtra-008

Maintained lower lignin content than conventionally bred varieties

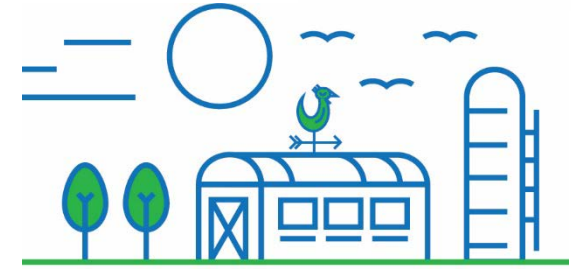
Consistently higher in nutritive value when harvested on a normal harvest frequency

Maintained high nutritive value for up to 10 days longer than conventional high quality alfalfa varieties

Produced greater yields to conventional varieties when delayed 10 days longer

FAQs

Will there be on-farm feeding data?



- Yes, ~20 on farm trials of HarvXtra® alfalfa planted and harvested in 2016
- SD to PA, dairy herds from <100 to >1000
- Segregated harvest and storage of HarvXtra® alfalfa hay or haylage
- Forage intake and milk production data to be collected at end of two week feeding period
- Final data pending

Initial results show HarvXtra® is feeding like it's supposed to!

Are there other improved quality alfalfa products on the market?

NO!

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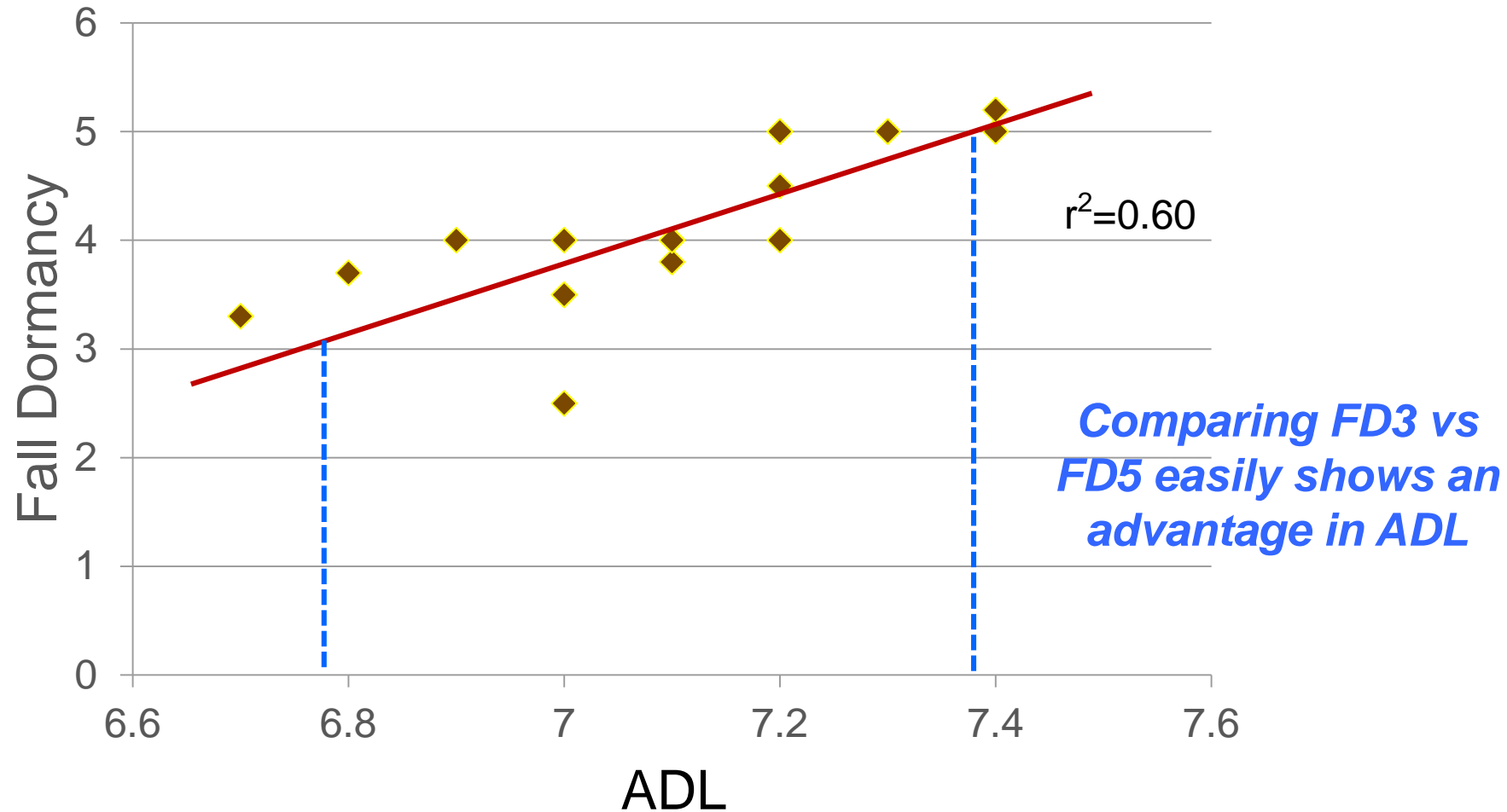


The HarvXtra[®] alfalfa trait allows lignin modifications not possible with conventional approaches

It is a true break-through in alfalfa forage quality for alfalfa growers and dairy producers.

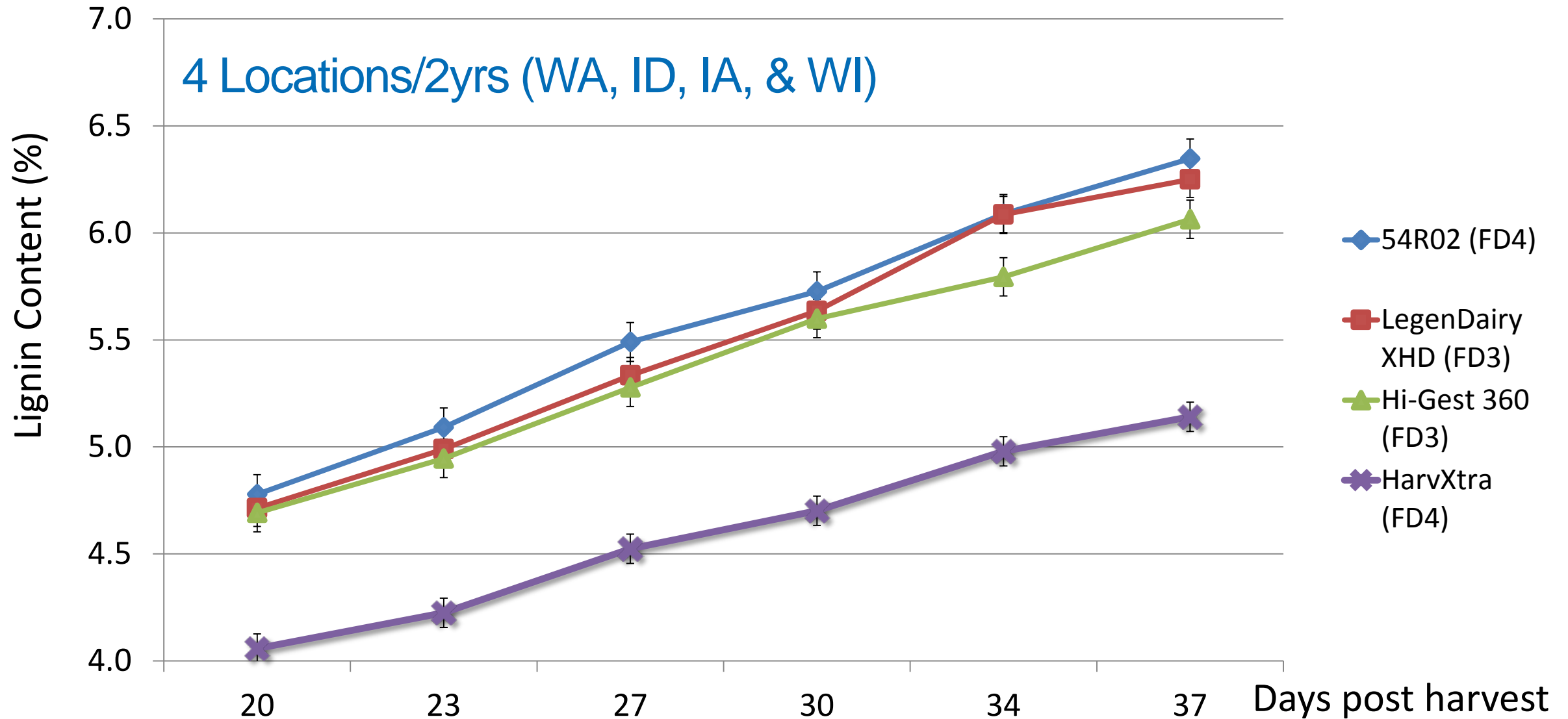
2014 FD/ADL Relationship

(mean of four cuts in 2013 West Salem, WI Demo)



NOTE: ADL is Acid Detergent Lignin or indigestible plant component, giving the plant cell wall its strength and water impermeability.

Change in ADL with Advancing Maturity



Are there any agronomic differences with HarvXtra[®] Alfalfa?

No, HarvXtra[®] alfalfa plants look and feel like conventional alfalfa, delivering competitive levels of forage yield, persistence, and pest resistance while showing no increase in lodging risk. And whether ensiled or fed as dry hay, its quality remains the same.

Is HarvXtra[®] alfalfa similar to BMR corn silage?

Both benefit from a genetic modification in the lignin pathway that improves fiber digestibility and the magnitude of the NDFD improvement is similar.

HarvXtra[®] alfalfa involves a more precise suppression of a key gene in the lignin pathway, which allows capturing a very significant quality advantage without sacrificing forage yield or standability.

HarvXtra[®] alfalfa has shown no yield lag or lodging issues that BMR corn has shown

Potential Benefits of HarvXtra® Alfalfa with Roundup Ready® Technology

Forage quality advantage

- Maintain current harvest schedule
- Higher likelihood of harvesting premium quality hay



Delayed harvest

- Fewer harvests/lower harvest costs
- Higher forage yield
- Improved persistence



Flexibility

- Increased harvest timing flexibility
- Manage around weather issues at harvest



Roundup Ready® Technology

- Proven performance
- Superior weed control during establishment
- Simple and flexible application



Value of HarvXtra® Alfalfa with Roundup Ready® Technology



Value of Improved Quality with HarvXtra® Alfalfa

Assumptions – Traditional Cutting System

Seeding Rate (Acres/Bag): 3

Normal Cuttings Per Year: 4

Normal Tons Per Acre: 5

Normal Life of Stand (In Years): 4

RFQ: Improvement of 15% over checks (1pt RFQ = \$1)

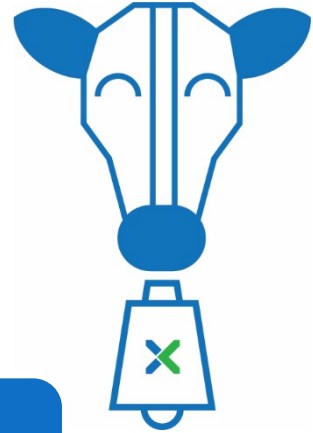
- This moves you at least one category higher on the hay test guidelines
- Example - "Good to Premium" or "Premium to Supreme"

Stacked with the Roundup Ready® Technology

Value of Improved Quality with HarvXtra® Alfalfa

RFQ Improvement of 15%

- RFQ 150 x 15% = 22.5 point improvement = \$22.5 premium/ton
- 5 tons/acre x \$22.5 premium x 4 years x 3 acres/bag = \$1,350/bag



Roundup Ready® Technology

- \$175 value/acre x 3 acres/bag = \$525

Total Value

- \$1,350 + \$525 = \$1,875 per bag

Value of Delayed Harvest with HarvXtra[®] Alfalfa

Assumptions – Traditional Cutting System



Seeding Rate (Acres/Bag): 3

Normal Tons Per Acre: 5

Cost to Harvest One Cutting of Alfalfa (Dollars/Acre): \$50

Current Hay Market (Dollars/Ton): \$150.00

Normal Life of Stand (In Years): 4

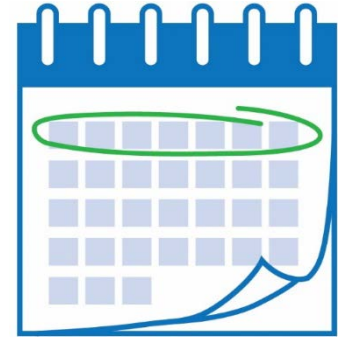
Moving to 3 cuts from 4 cuts per year

Stacked with the Roundup Ready[®] Technology

Value of Delayed Harvest with HarvXtra® Alfalfa

Reduced one cutting per year

- \$50/acre harvest costs x 4 years x 3 acres/bag = \$600/bag



Improved yield of 10% over life of stand

- 5 tons/year x 10% = .5 tons/year x \$150/ton x 4 years x 3 acres/bag = \$900/bag

Roundup Ready® Technology

- \$175 value/acre x 3 acres/bag = \$525/bag

Total Value

- \$600 + \$900 + \$525 = \$2,025 per bag

Legal Statement

For the 2017 growing season, growers must direct any product produced from HarvXtra® Alfalfa with Roundup Ready® Technology seed or crops (including hay and hay products) only to United States domestic use. In addition, due to the unique cropping practices do not plant HarvXtra® Alfalfa with Roundup Ready® Technology in Imperial County, California, pending import approval in China and until Forage Genetics International, LLC (FGI) grants express permission for such planting. It is a violation of national and international law to move material containing biotech traits across boundaries into nations where import is not permitted. Growers should talk to their product purchaser to confirm their buying position for this product.

Do not export Genuity® Roundup Ready® Alfalfa seed or crop, including hay or hay products, to China pending import approval. In addition, due to the unique cropping practices do not plant Genuity® Roundup Ready® Alfalfa in Imperial County, California, pending import approvals and until Monsanto grants express permission for such planting.

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