by John Goeser

Less hardwood in your forage

TREE bark and wood are robust analogies for the impact that lignin has within plant cell walls. Lignin is a structural component of plant cell walls, nested within both acid detergent (ADF) and neutral detergent fiber (NDF). (You can learn more about these fiber groups in the March 10, 2018, *Hoard's Dairyman* article, "Dairy nutrition's tribal language: Speaking fiber.")

To give you an idea of what the compound is, understand that lignin is not soluble in concentrated sulfuric acid (strong enough to burn through clothing) and in the 1930s was described as "cement" within plant tissue. Lignin maintains several unique functions within plants.

Lignin contributes to plant strength and rigidity. For example, to hold a 250 bushel-type ear in the air, the plant lignifies and builds strength. Plant breeders have also solidified plants while breeding for improved standability (or reduced lodging). While standability is great and cement is strong, the aim with dairy forage is to reduce lignin and capture more energy from the fiber fraction that lignin zippers together.

Lignin is also important for plant defense or healing, which I learned recently while co-teaching a graduate student ruminant nutrition course with Ron Hatfield.

When plants are wounded, one healing response is to further lignify in that region much like how our bodies scab after a cut or scrape. Consider this fact relative to plant health as the season progresses. Theoretically, crop protection may be further warranted with reduced-lignin forages.

Focusing back on lignin's negative impact on fiber digestion and energy contribution to the diet, our aim needs to be lessening lignin content in the plant. There are two general paths to lessen lignin content:

1) Dilute lignin by harvesting forage with more sugar, protein, or starch.

2) Curtail the plant's ability to lignify via plant breeding and genetics.

The latter path is where we'll focus with several seed genetics products now available commercially via mutations (such as brown midrib or bm3), a transgenic trait (such as single gene transfers into alfalfa genetics) and traditional breeding (nontransgenic alfalfa).

To my knowledge, only bm3 mutants have substantial research documenting both the lignin reduction and corresponding impact on digestibility and performance. This hasn't stopped the questions and excitement though regarding how these technologies may improve forage quality and farm profitability.

Both on-farm plots and proprietary research are beginning to shed some light on other lignin reduction technologies. Rather than hypothesize about reduced-lignin technology potential, I'll focus on helping you interpret results from your on-farm or nearby plots and/or projecting profitability impact potential associated with lignin reductions.

Compare your crop

As I eluded to previously, there are two ways to reduce lignin — dilution or reducing the plant's ability to lignify within fiber. With the latter being the focus with advanced seed genetics, we need to assess lignin as a percent of total fiber (percent of aNDF). To do so, with your forage analyses in hand, take the lignin (percent of dry matter) and divide it by aNDF (percent of dry matter) and then multiply by 100.

For example, using lignin with 8 percent of dry matter and aNDF of 42 percent of dry matter:

Lignin percent of NDF = (8.0/42.0) x 100 = 19 percent.

With this value, you can compare your alfalfa or corn silage against thousands of other hay or silages analyzed by Rock River Laboratory (for the East, Midwest, or western U.S.) over the past 18 months, using Figures 1 and 2. How do your numbers stack up?

Reduced lignin impacts the potentially digestible fiber fraction in feeds. Consult with your nutritionist as to what this means in more detail.

Figure 1: Lignin in 2016 and 2017 Rock River Lab hay & silage samples

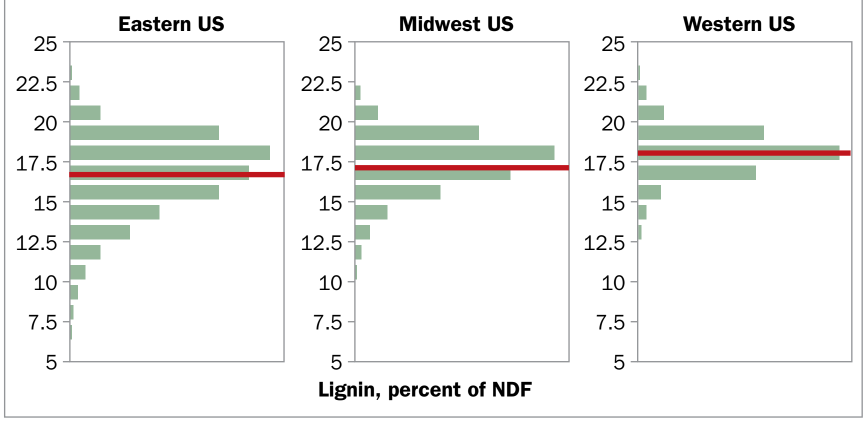
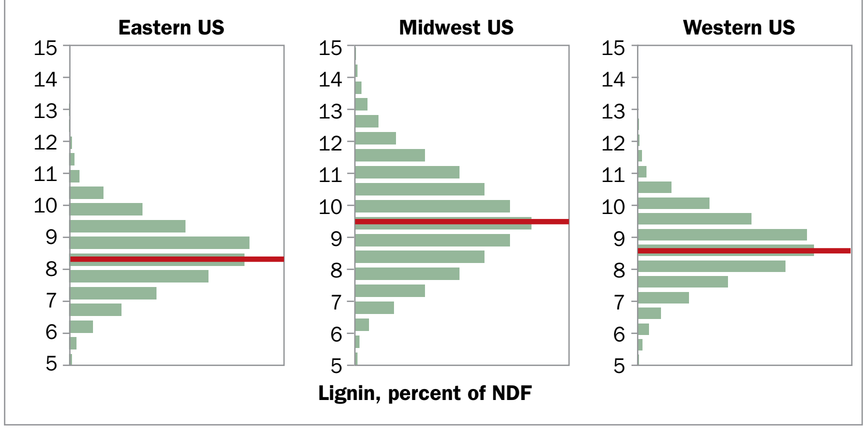


Figure 2: Lignin in 2016 and 2017 Rock River Lab corn silage samples



Practically speaking, having less lignin is like having more wood in a fire pit. There's more fiber fuel for the rumen to digest because there's less cement in the fiber fraction.

Less lignin does not mean that the fiber will digest faster. Assuming a 10 percent lignin reduction, and assuming a lignin to uNDF ratio of 3:1, we can project uNDF240 levels for a normal and reduced-lignin alfalfa. At 44 NDF (percent of dry matter) and 7.5 lignin (percent of dry matter), a realistic NDFD240 (percent of NDF) to use in comparison could be 49 and 54, for normal and 10 percent lignin reduction, respectively.

Next with NDFD240 levels for normal and low-lignin alfalfa, we can make milk projections. I've run several scenarios over the past few months with numbers such as those shown here. Typically I've projected about 0.5 pound milk gain (assuming 8 to 10 pounds dry matter alfalfa fed within a 50 to 55 pound dry matter intake, high forage diet).

Learning recently from Agriculture Modeling and Training System's Sam Fessenden, one could also bump up dry matter intake if one assumes uNDF240 is limiting intakes in high production cows. With greater intakes, milk projections would be greater than 0.5 pounds per cow. To round out the economic exercise, balance milk gains against yield and seed costs differences to assess a return on investment (ROI).

In summary, there are many speculative ideas, suggestions, and debates circling around low-lignin forage, yield, value, and ROI. Experience and future research will add new chapters to this continually unfolding story.

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