FIBER DIGESTIBILITY IN RYEGRASSES

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Introduction

Plant fiber has three major components: cellulose, hemicellulose, and lignin. Cellulose and hemicellulose are digestible to some extent by ruminants. Ruminants can convert these fiber components to energy because the rumen provides the correct environment for bacteria and other microorganisms that actually break down the fiber. Lignin is indigestible, and thus cannot be used by ruminants for energy.

Most of the energy a cow receives in her diet comes from carbohydrates, which are a combination of non-fiber carbohydrates (grains) and fiber carbohydrates. As the digestibility of the fiber fraction increases, the total net energy of the forage increases as well as total feed intake increases (Titel, 2000). Increasing neutral detergent fiber digestibility (NDFD) by 1 percentage point resulted in a 0.37 lb increase in dry matter intake and boosted fat-corrected milk production by 0.55 pounds (Oba, 1999).

Several factors can affect forage's NDF digestibility, including the amount of lignin, hybrid or variety, soil fertility, weather conditions, and forage harvest and storage practices. In the past few years, several researchers have looked closely at NDF digestibility in corn and alfalfa; particularly the variation among varieties (Beckman, 2005). However, limited research has been done regarding the variation in NDF digestibility of cool-season grasses.

In one study in the Midwest, the average NDFD of grass hay/silage samples submitted for fiber digestibility analysis was 53%, individual samples ranged from 36 to 74% (Hoffman, 2003). For a typical dairy ration, this variation could result in 5 lb in milk per cow per day difference. Similar production responses and variation would be expected in growing sheep and cattle as well.

Dairy producers and dairy cattle nutritionists have known for years that forages with the exact same laboratory analysis could have significantly different performance in lactating cows. In the past few years, research has shown that the digestibility of neutral detergent fiber (NDF) may explain much of this variation. However, in Oregon very few nutritionist or dairymen have been accounting for fiber digestibility in grass while ration balancing. Part of the resistance for change has been the lack of understanding on the large variations seen in grasses compared to corn or alfalfa. This project was created to help highlight the large variation in grasses and persuade producers and nutritionist to change the way they balance rations.

Objectives

The objectives of this project were to:

- Determine fiber content and digestibility variability of eleven common ryegrasses
- Evaluate variation from cutting and season

- Determine annual energy differences due to NDF digestibility differences
- Use the information as part of an extension educational program aimed at both livestock producers and the grass seed industry.

Procedures

Eleven ryegrasses that were commonly grown in Oregon were selected and planted in September 2004 in Tillamook, OR. Plots were 5' x 20', replicated three times and all planted at the same time. Plots were fertilized in four separate applications of nitrogen annually of approximately 75 lbs/acre/year or 300 lbs N annually.

For two years, the plots were mechanically harvested six times at approximately 28 day intervals beginning in March and continuing through August. Yield data was recorded and samples were taken and dried in a 55^0C forced –air oven for 48 hour and analyzed for DM content. All samples were ground with a Wiley Mill (1mm screen; Arthur H. Thomas, Philadelphia, PA). Samples were analyzed for NDF and NDFD (VonSoest et al., 1991.) Fiber digestibility was determined in our lab using a Daisy II Incubator (Ankom Technology, Macedon, NY).

Digestibility and yield data were analyzed and developed into an Extension educational program. Extension educational programs were conducted across the state in two statewide workshops and six regional programs. Information was included in newsletters going to producers, nutritionist and grass seed industry as well as being presented at the Pacific Northwest Nutrition Conference.

Results

Total dry matter produced ranged from 6.5 tons down to 5.8 tons of dry matter per acre. Bronsyn was the highest yielding both years and Tonga was the lowest producing both years as well (Figure 1). Figure 2 illustrates the NDF digestibility seen by variety over the two years studied. Data indicated there was around a 10% difference between the highest variety Elgon and the lowest Flanker. If you compare Figure 1 to Figure 2 you will notice some varieties that yielded high like Bronsyn ended up having one of the lowest fiber digestibility values.

Figure 3 shows the total pounds of digestible fiber harvested on an annual basis by variety. This value is generated by multiplying the yield times the percentage of digestible fiber. This analysis showed a 32% variation in digestible fiber per acre from the highest (Elgon) to the lowest (Tonga). Figure 4 shows the NDF digestibility of each variety studied for each year. While there was some variation from year to year, most varieties were very consistent from one year to another.

One major goal of this project was to understand seasonally changes in fiber and fiber digestibility. Figure 5 illustrates NDF and NDFD values throughout the season. Neutral detergent fiber values started in March averaging 45% of the total dry matter and ended up at 51% by August. Conversely, NDF digestibility started up at 83% in March and declined to around 65% in August.

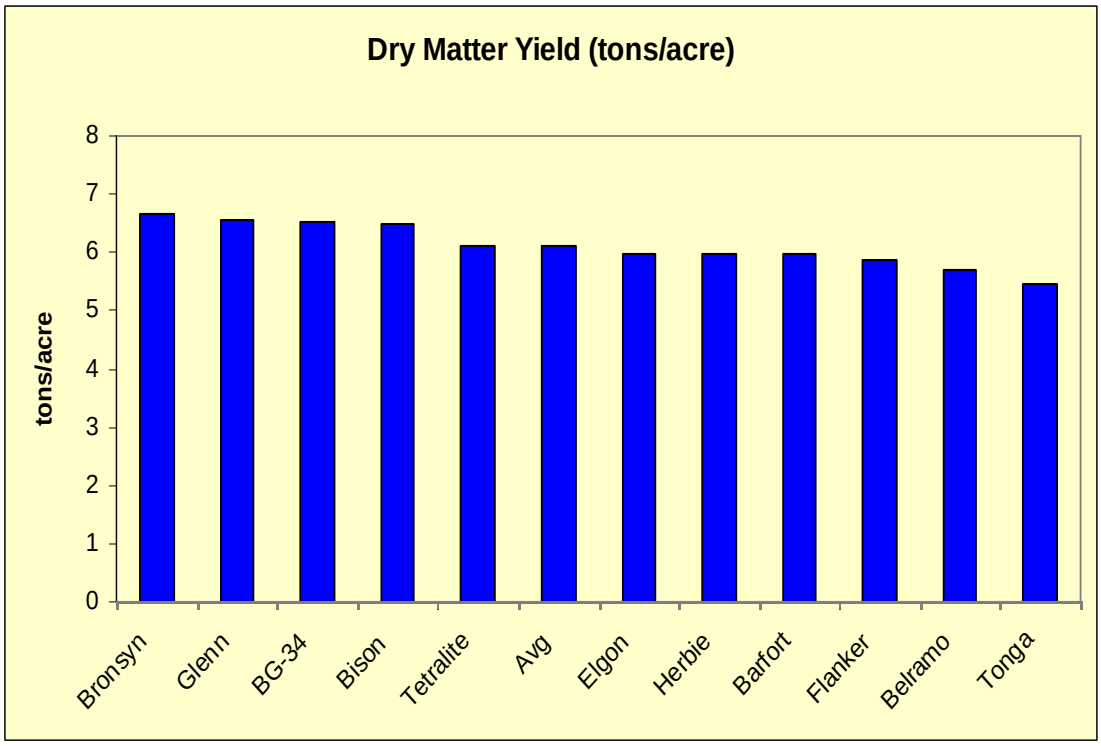

Figure 1 – Tons of dry matter produced by variety per year (two years averaged)

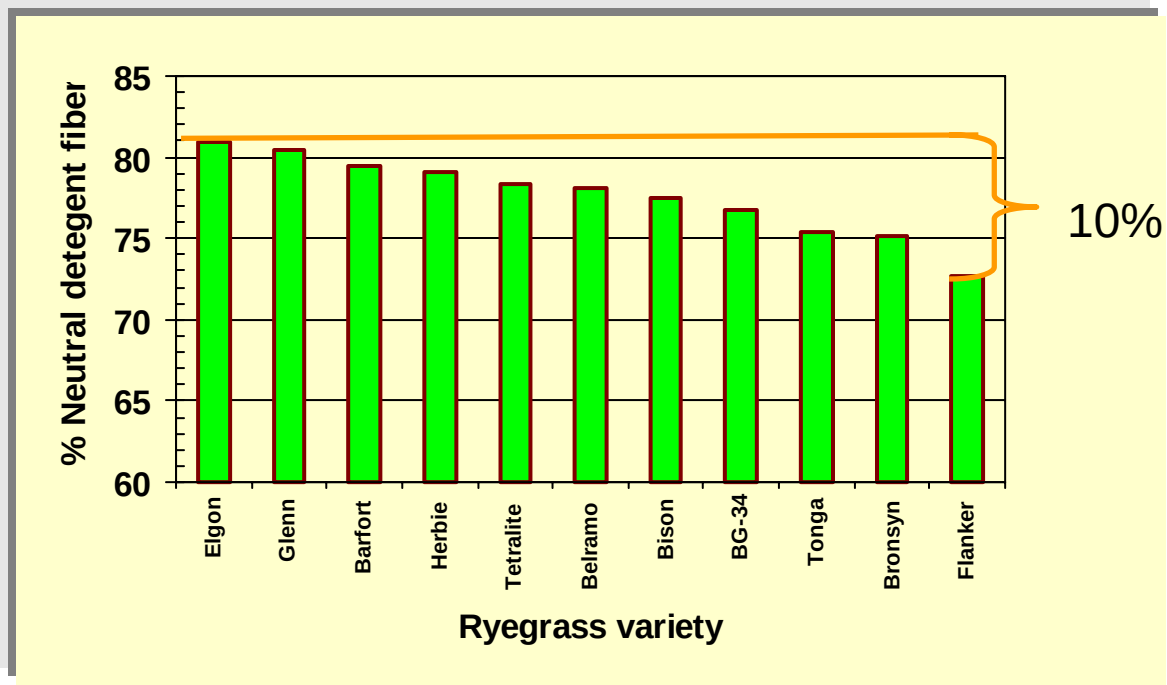

Figure 2 - Fiber digestibility of the ryegrasses studied highlighting that there is a 10% difference from the highest to the lowest.

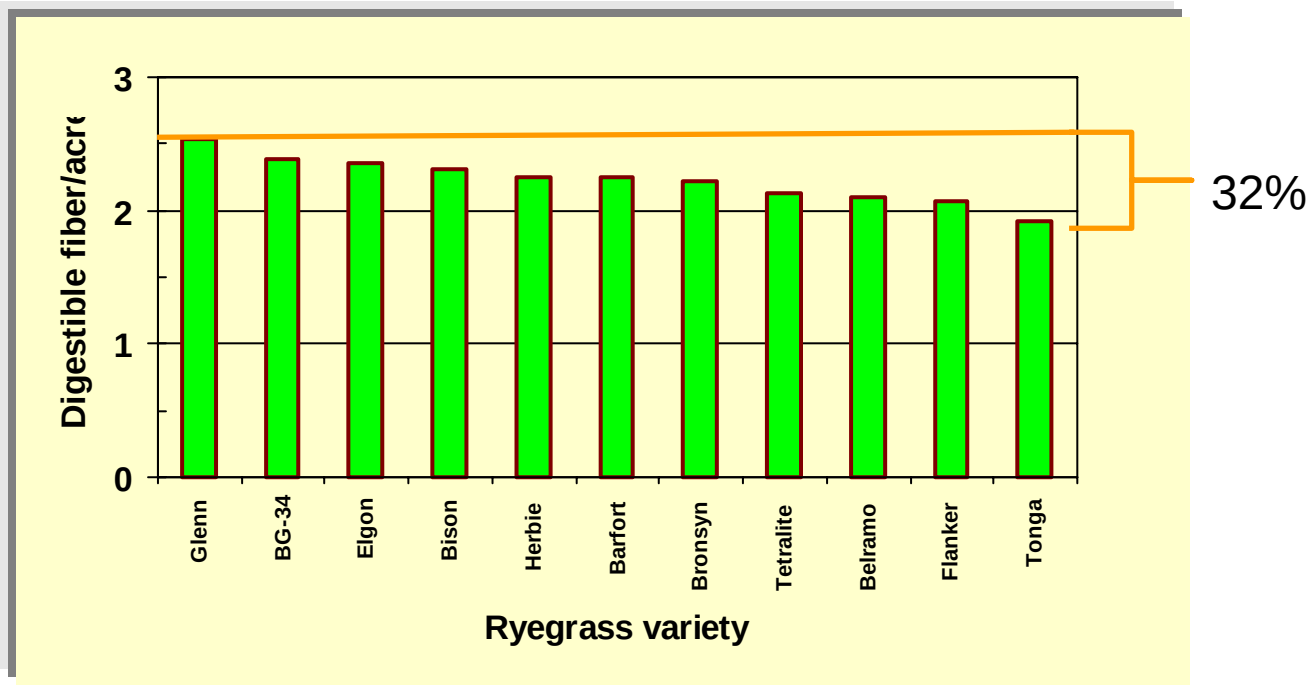

Figure 3 - Ryegrass digestible fiber yield in tons per acre. When you multiply total yield times the percent digestible, the difference becomes very significant.

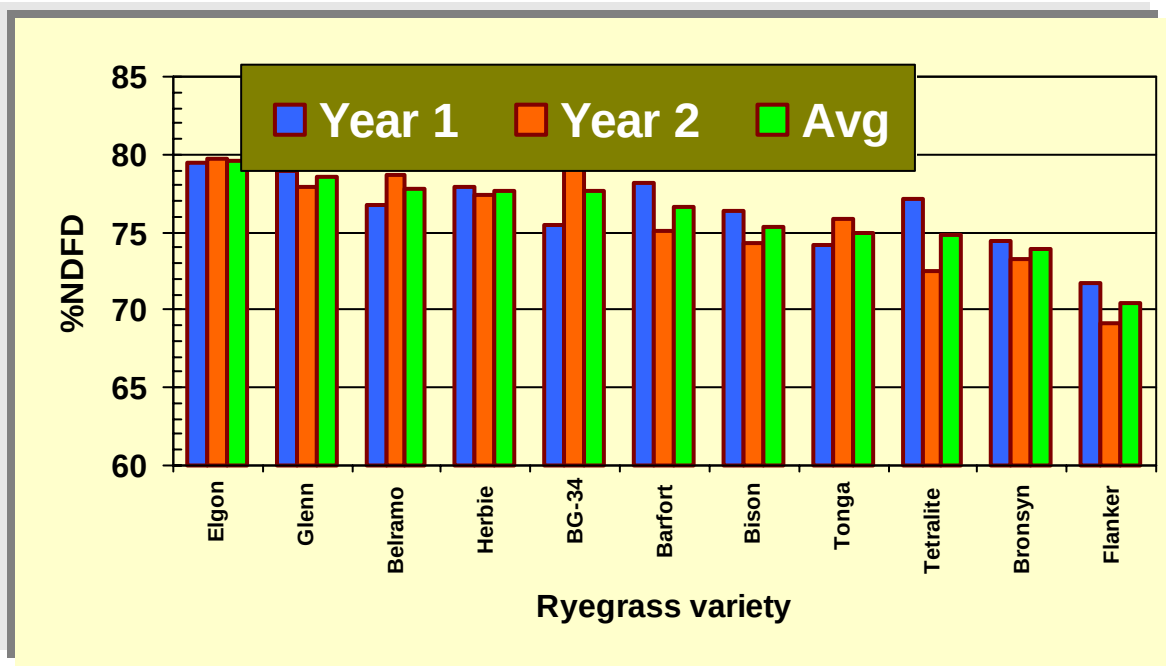

Figure 4 – NDF digestibility of ryegrasses for each year studied.

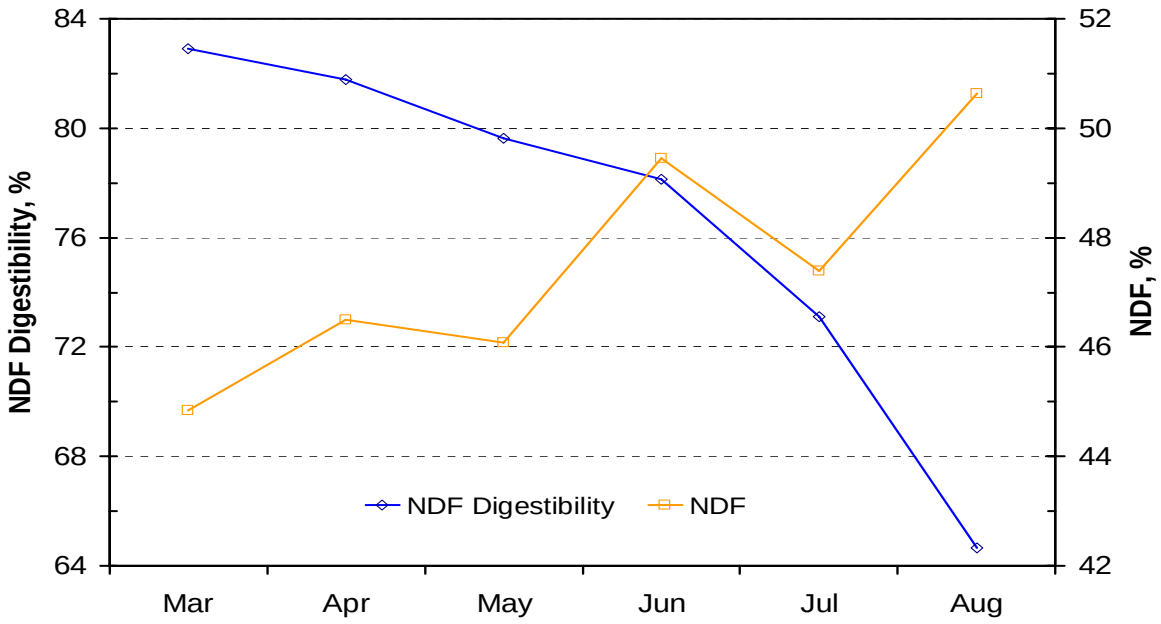

Figure 5- Neutral detergent fiber (NDF) and NDFD.

Summary

This project had a major impact on the way nutritionists and livestock producers consider the digestibility of grasses when balancing rations. Before this project, very little attention was given to the variability seen between grass varieties or season of harvest. This project has helped emphasize the importance of using feed analysis instead of book values for digestibility.

As we continue to learn more about NDF digestibility in grasses it becomes apparent there are significant variations that have large financial impacts on producers and alter animal performance. The difference seen from the best ryegrass to the worst is significant for several reasons. First, a 10% increase in digestible fiber means there is more energy available in the rumen for microbial growth and ultimately milk production. This increased energy actually increases nitrogen efficiency allowing the ruminant to make better utilization of the protein of nitrogen in the forage. This reduces losses in the form of ammonia gas and excretions in the urine. Additionally, this increased energy is available for growth and milk prodcution.

When looking at the impacts on grass or farm productivity, the 32% difference from the best to the worst ryegrass becomes the important difference. It is estimated the amount of extra energy produced in the form of digestible fiber from our highest ryegrass over our lowest is enough to produce an extra 28 cwt of milk per acre per year. Even at $15.00 per cwt., this is a difference of

$420 extra digestible fiber per acre. We would expect to see additional growth and productivity from grazing livestock as well.

Accounting for NDFD in grasses is turning out to be critical for the livestock industry. It is probably more important as a producer to understand the NDFD of grasses than even corn silage or alfalfa because we are learning there are more variations seen in the grass population. This educational program has demonstrated how fiber digestibility impacts animal performance and farm profits. It also helps us understand the large variations seen in grasses and the need to research variety performance before re-establishing new pastures. This project has already changed the way we balance rations in Oregon. It's still too early to tell, but we hope this also changes the varieties available from seed companies to more digestible ones in the future.

References

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