Fiber digestibility in cool season grasses

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All forage plants are composed of cells having fibrous cell walls for support and protection. Contained within the cells are several soluble compounds, most of which are highly digestible. Since cell wall material is the primary constituent of forages, one of the main objectives of forage analysis is to characterize the cell wall fiber.

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.

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. 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 or NDF. As the digestibility of the NDF fraction increases, the total net energy of the forage increases as well as total feed intake increases (Titel, 2000). In fact, researchers found that increasing NDF digestibility 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).

The variation in NDF digestibility between forages is significant. Though the average NDF digestibility of grass hay/silage samples submitted for fiber digestibility analysis to the Marshfield Soil and Forage Analysis Lab, Marshfield, WI, was 53%, individual samples ranged from 36 to 74% (Hoffman, 2003). For a typical dairy ration, this results in a 5 lb increase in milk per cow per day.

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.

The past several years we have conducted a trail looking at fiber digestibility of several cool season grasses. Grasses were planted in the fall and harvested for two consecutive years. Varieties were replicated three times, dry matter yield was recorded and samples were taken and analyzed in vitro for fiber digestibility. The following six figures illustrate the data and results observed.

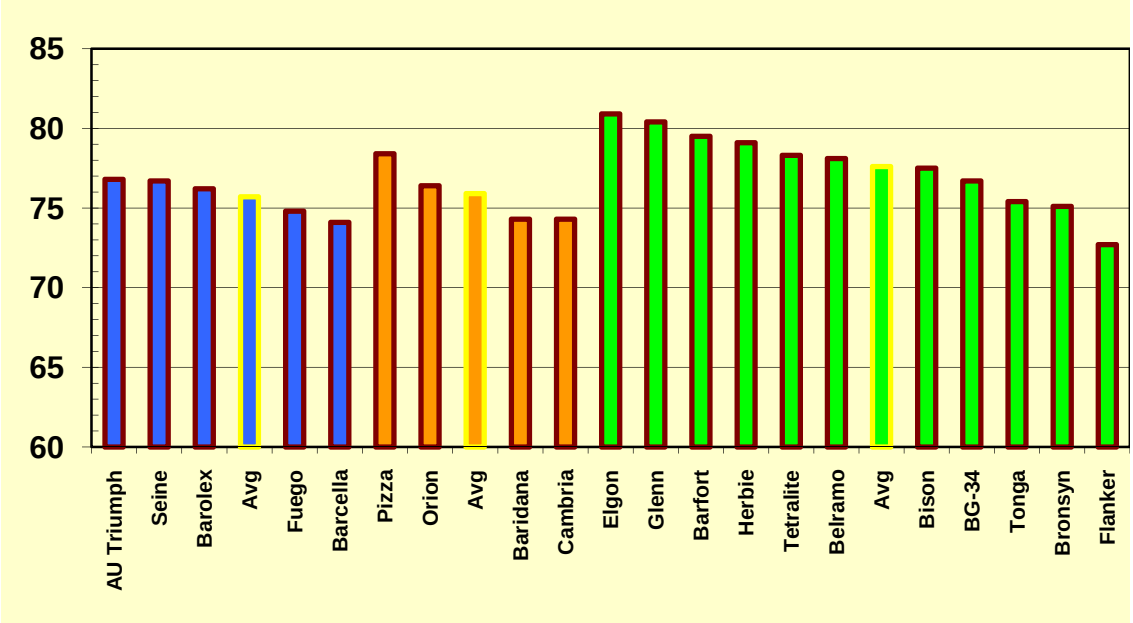

Figure 1 – NDF digestibility averages of individual varieties from ten cuttings over two years. Blue varieties are fescues, orange are orchard grasses and the green are ryegrasses.

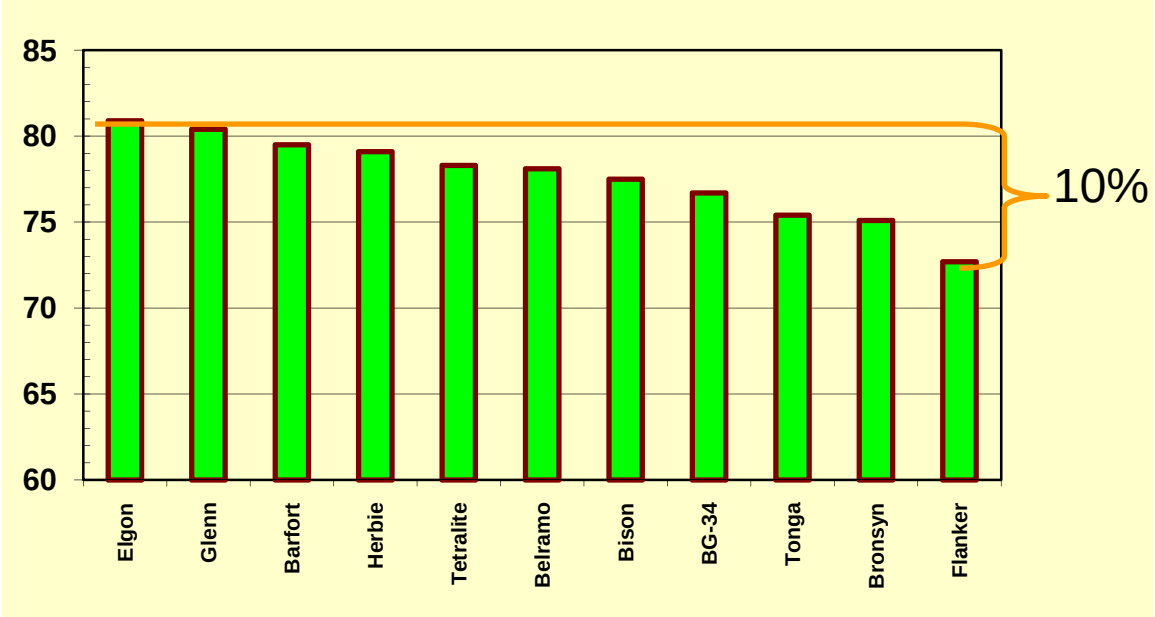

Figure 2 - Fiber digestibility of the ryegrasses studied highlighting that there is a 10% difference from the highest to the lowest.

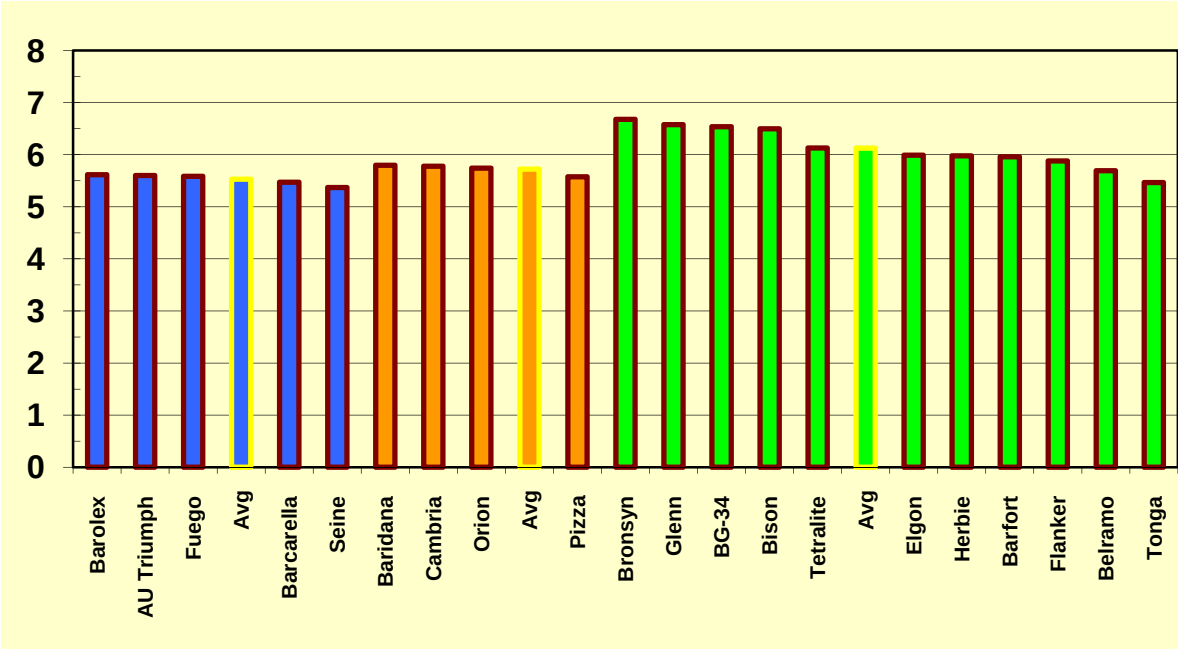

Figure 3 - Dry matter yield averaged over all cuttings for two consecutive years.

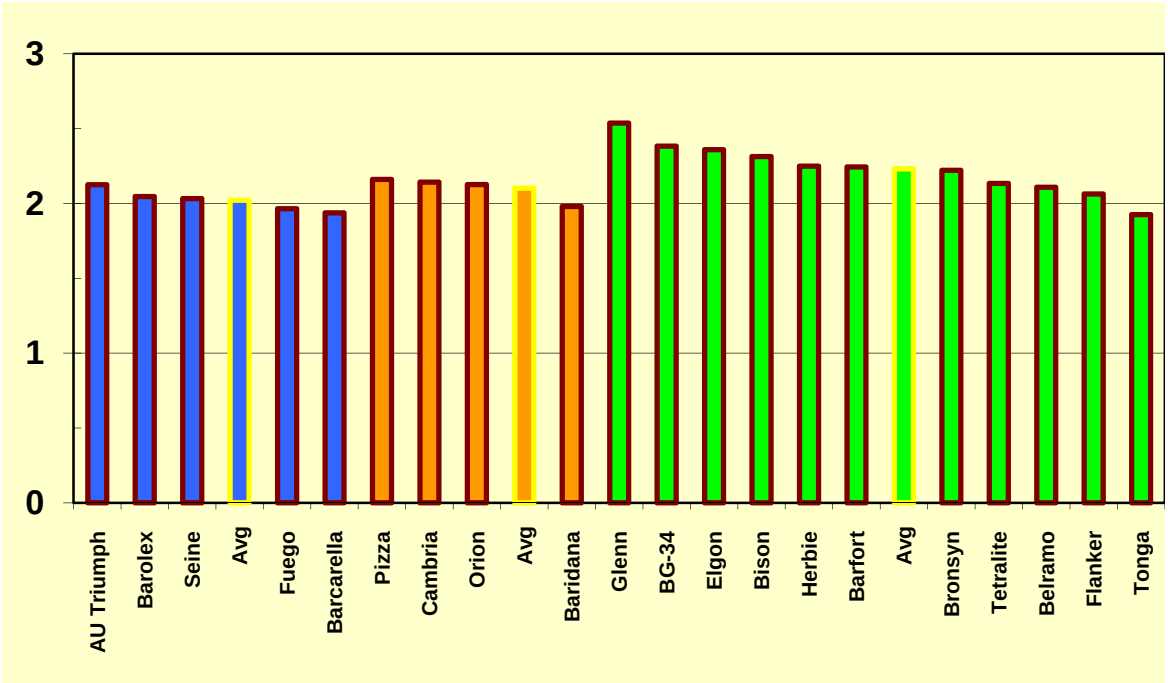

Figure 4 - Tons of digestible fiber per acre by varieties averaged over 2 years

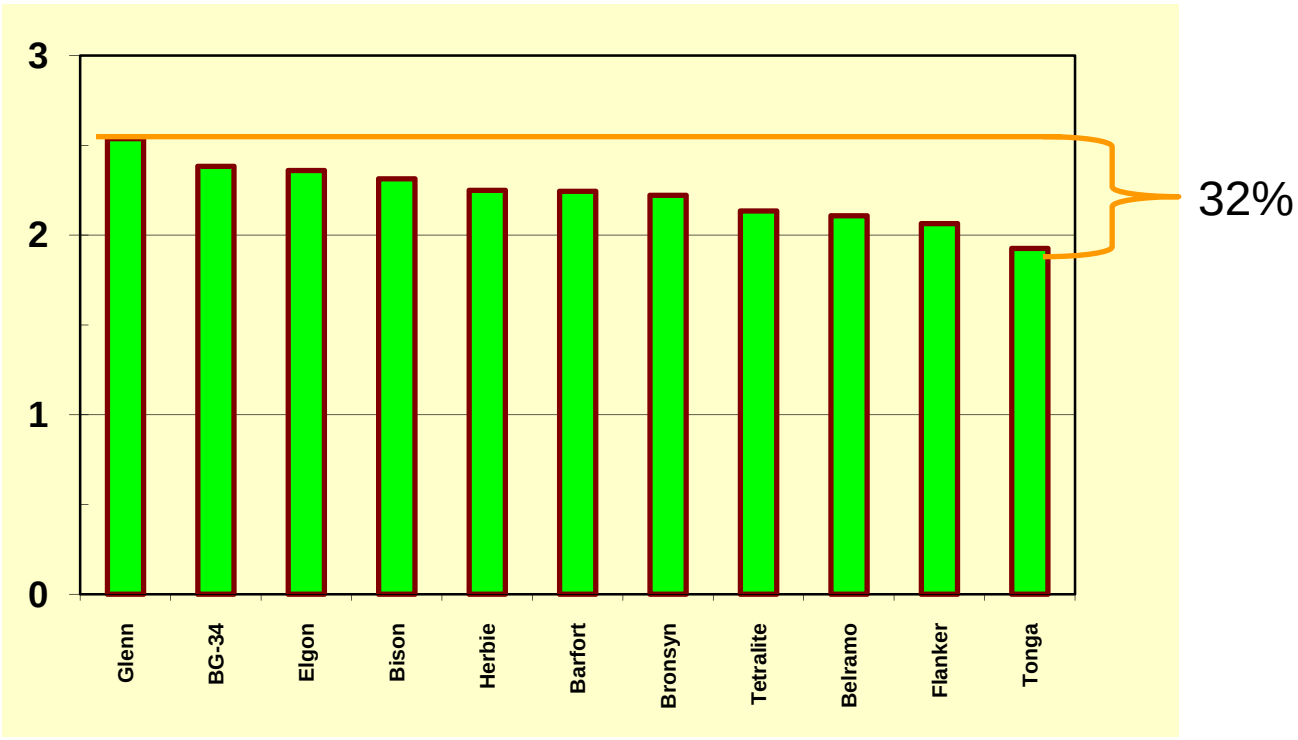

Figure 5 - Ryegrass digestible fiber yield in tons per acre. When you multiply total yield times the percent digestible, the difference becomes very significant.

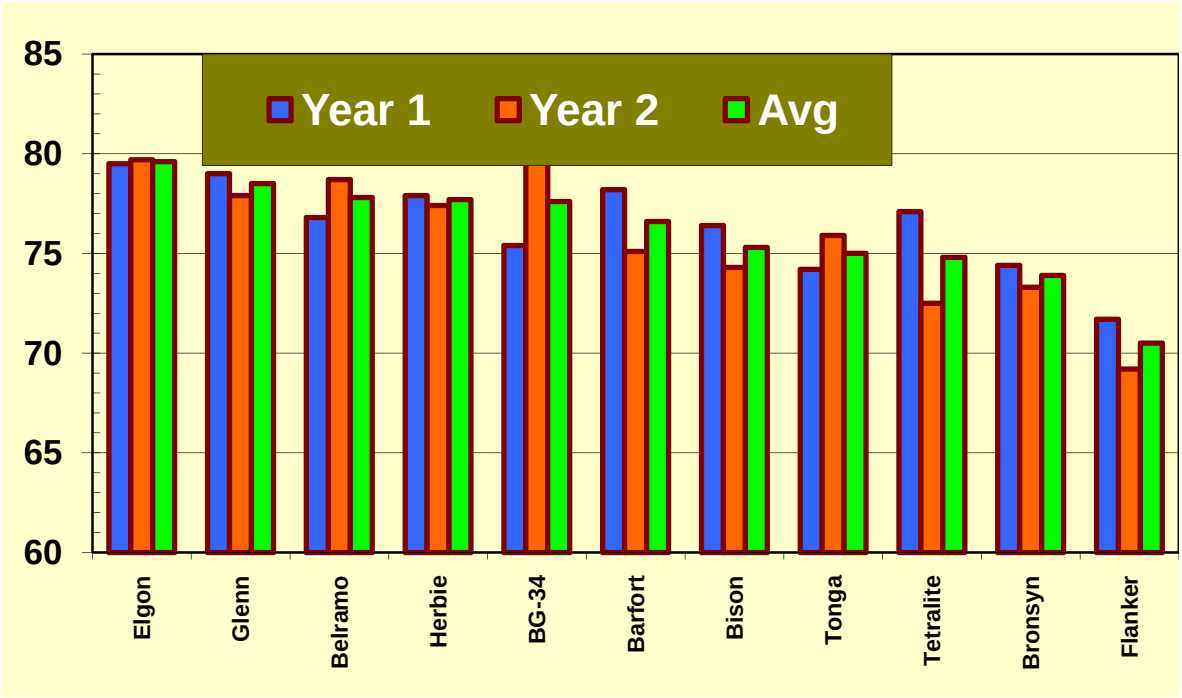

Figure 6 – NDF digestibility of ryegrasses for each year studied.

The difference seen from the best ryegrass to the worst is significant for several reasons. First, this 32% 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 drives additional milk production or animal growth.

Bottom Line:

1) Neutral detergent fiber digestibility is more variable in grasses than corn or alfalfa.

2) Initial trials indicate significant differences in ryegrasses in total digestible fiber grown per acre.

3) Talk with your nutritionist about NDF digestibility and how using new information can improve your bottom line.

References:

Beckman, J.L. and W.P. Weiss. 2005. Nutrient digestibility of diets with different fiber and starch ratios when fed to lactating dairy cows. J Dairy Sci. 88:1015.

Hoffman, P. C. 2003. New developments in analytical evaluation of total mixed rations. In: Proc. Pacific NW Anim. Nutr. Conf., Vancouver, B.C., Canada. p 120-133.

Oba, M and M.S. Allen. 1999. Evaluation of the important of the digestibility of neutral detergent fiber from forage: Effects on dry matter intake and milk yield of dairy cows. J Dairy Sci. 82:589.

Titel, R. 2000. "NDF-digestibility." 4-4-05. <www.agrinutrition.com>