Growing Conditions Dictate Corn Silage Quality

By Matt Laubach, Pioneer Dairy Specialist

Environment is King

The tremendous influence of growing environments on corn silage yield and quality is depicted in Figure 1, which shows relative silage yields, starch content and 24-hour NDFD (neutral detergent fiber digestibility) of the same hybrid grown in 14 locations in Michigan in 2009. This clearly demonstrates why it is not valid for nutritionists to attribute hybrid genetics as the primary cause of nutritional differences when comparing hybrids grown on different farms. This is also why seed companies and university plots only compare hybrids grown in the same location (side by side). Therefore, seed companies have to compare hybrids grown next to each other, across multiple plots (so they all receive the same environment). It is also important to compare hybrids within the same maturity, seed treatments, technology segment, and planting populations (e.g., low populations will result in higher NDF digestibility).

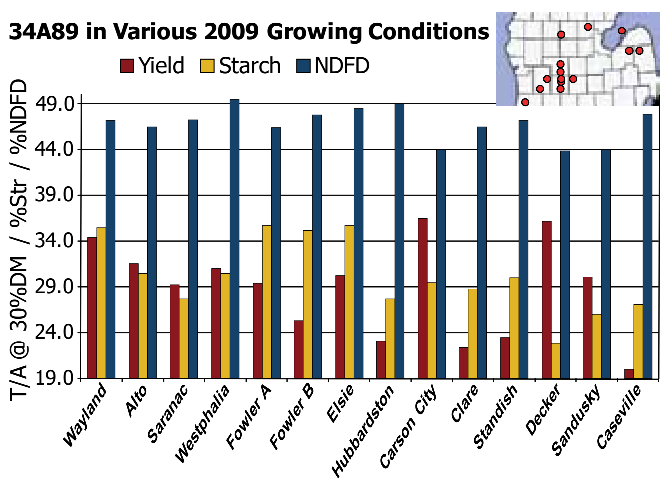

Figure 1. Yield, starch content and 24-hr NDFD of the same hybrid grown in multiple Michigan locations in 2009.

The influence of growing conditions (especially moisture) is a major source of the nutritional variability seen within hybrids across years and locations. Dr. Fred Below (2009), professor of plant physiology from the University of Illinois, attributes 19% of the grain yield performance to hybrid genetics, with the remaining influence the result of weather (27%), nitrogen (26%), previous crop (10%), plant population (8%), tillage (6%) and growth regulators (4%).

Dry, Moderate Heat Best for NDFD

Van Soest (1996) and Van Soest and Hall (1998) suggest that cool, dry years are best for corn silage quality and that slight moisture stress might stimulate seed (grain) production. Cool temperature (especially at night) may inhibit secondary cell wall development. These studies suggest that accumulated growing degree days after silking may be most important in affecting corn silage nutritive value because of the nutritional value of enhanced grain yield.

The specific timing of environmental stress during the development of the corn plant also appears important. Research by Mertens (2002) indicates the weather before and after silking may interact to affect final corn silage nutritive value. Mertens analyzed unfermented whole plant corn samples from various genetics grown in multiple locations, with each location geo-referenced to allow for weather station data to be included in the analysis. Growing conditions prior to silking affected corn plant height (and yield) and fiber digestibility. Growing conditions after silking appeared to exert more effect on corn grain yield and total dry matter digestibility (Mertens, 2002).

It has been proposed that with irrigated crops, silage growers might stress the crop for water during pre-tasseling to increase NDFD; applying the conserved water more liberally during kernel starch filling periods of plant growth. However, excessive moisture stress during vegetative growth can reduce whole plant yields by reducing stalk internode length and possibly reduce grain yield during 6th leaf and tasseling growth stages by reducing the number of kernels around the ear (ear girth) and number of kernels per row (ear length), respectively.

Figure 2 shows how five hybrids differed in 24-hour NDFD when grouped by the average growing conditions in Michigan during stalk development. Moisture accumulation and heat exerted an effect on the NDFD of all hybrids, but moisture had a greater influence. Some hybrids (C) appear to be more susceptible to environmental influences.

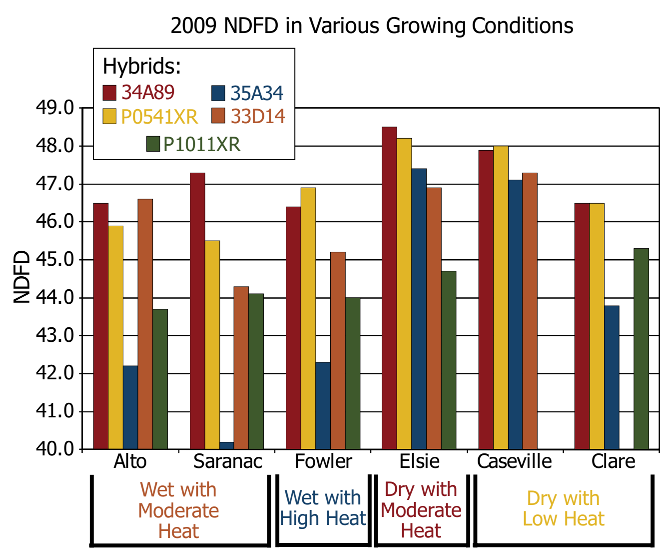

Figure 2. NDFD (24-hour) of hybrids in 2009 Michigan silage plot locations grouped by growing environment during stalk development, June 1 to July 15.

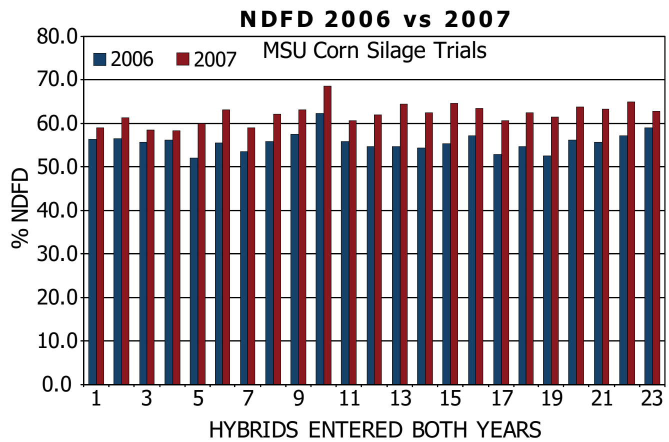

Figure 3. Impact of growing environment on NDFD shown by the drought-stress effect of the same hybrids grown in 2006 (wet year) versus 2007 (drought year).

Figure 3 shows more data from Michigan State University silage plots harvested in a relatively wet growing season (2006) compared to the same hybrids harvested from the same plot in a relatively dry growing season (2007). Hybrids averaged 6.5 points higher in 24-hour NDFD in the drought year. It was interesting to note that, as expected, the highest NDFD in both seasons was a BMR hybrid, but that nearly half of the conventional hybrids grown in the drought year were higher in NDFD than the BMR grown in the wet year.

Corn breeders are very interested in the interaction between genetics and environment (GxE). If GxE (in a statistical sense) is significant, it means hybrids grown in different environments could rank differently for any particular trait. Contrast this to environmental influence on genetics. Hybrids will rank similar across environments, but the relative magnitude of difference will be smaller or bigger depending upon the particular environment. It could also mean the absolute values will change with no change in the hybrid differences between environments. While GxE is a very real effect experienced by hybrids (explaining why seed companies do so much testing to determine the area of adaptation of hybrids), there is no indication that nutritional characteristics are any more susceptible to environmental interactions than either grain or whole plant yield (Coors, 1996).

Research by corn breeders suggest that to be 95% confident in selecting the best hybrid for silage yield or nutritional traits, approximately 20 direct, side-by-side comparisons (in the same plots), are required, preferably across multiple years to account for unique yearly environmental effects. Data from a single plot is almost meaningless due to variability caused by factors including soil compaction, previous crop history, fertility/manure history, soil type, water availability, tillage, and insect damage. To put one plot in perspective, on average ground with 150 bushel/acre yield potential, a hybrid with a 2-ton per acre (30%DM) advantage has only a 60% chance of being the superior silage yielding hybrid. The odds of selecting the superior yielding silage hybrid increases to 95% with a 2-ton yield advantage demonstrated across 30 individual silage plots.

The Bottom Line

When it comes to selecting corn silage genetics, university and seed company plots prove there are minimal genetic differences (3-4% points) between (non-BMR) hybrids for NDF digestibility. The large variation in NDFD observed by nutritionists from farm-to-farm and season-to-season are more the result of environmental factors such as growing conditions and harvest timing. This is why nutritionists working in the Midwest and East, with fewer irrigated acres and more weather variability, struggle with quantifying and managing corn silage digestibility.

In general, dry conditions during stalk development enhance fiber digestibility and wet conditions, while improving whole plant yield (taller plants) tend to reduce fiber digestibility. Most seed companies encourage the nutritionist to be part of the silage hybrid selection process; but to be an informed participant, a clear understanding of the role of genetics versus growing environment is an important pre-requisite.

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