

CURRENT AGRONOMIC RESEARCH RELATED TO CORN SILAGE

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Predicting animal performance and relating it to improvements in corn silage quality whether from breeding or management is complex. In numerous studies, differences in fiber and digestibility translate into differences in animal performance. For example, researchers in Idaho have found that high quality corn silage (low fiber and high digestibility) produced \$315 more beef per acre than low quality silage. Another example is the significantly higher milk production for brown midrib corn silage compared to its normal counterpart shown recently by Michigan and Wisconsin workers. The optimum silage composition can vary depending on the type of cow it's fed to (growing heifer versus milking cow, production level, stage of lactation, etc.) and the other components of the ration.

Estimates of animal performance responses can be obtained through forage analysis. The University of Wisconsin, along with many other universities, evaluates corn hybrids for silage yield and quality characteristics. Relatively small differences in corn silage fiber and digestibility translate into large differences in predicted animal performance. In Wisconsin, the ranges among hybrid entries for crude protein, ADF, NDF and *in vitro* digestibility were relatively narrow. However, the range among hybrids within a trial for milk per acre was 6,000 - 8,000 pounds, while the range among hybrids for milk per ton was 300 - 500 pounds.

Consistent performance regardless of environment is important for making hybrid selection decisions for silage quality. "High" and "low" quality corn hybrid checks were included in the UW Hybrid Performance trials. For trials conducted between 1995 and 1997, checks were selected on the basis of previous work conducted by the UW Corn Silage Consortium. Between 1998 and 2000, new check hybrids were selected every year on the basis of above average dry matter yield and then sorted on NDF. Low NDF and high NDF hybrids were further scrutinized for Milk per ton characteristics using Milk1995. A total of 61 trials contained hybrids with low and high NDF check hybrids. The high and low quality checks were compared to the trial average.

Repeatable differences for whole plant fiber and digestibility were observed in the high and low quality checks. Dry matter yield differences between hybrids tested in 61 environments and selected for low and high NDF were nonsignificant (Table 1). Maturity differences as measured by forage moisture content and kernel milkline were significant, but biologically small. Fiber concentrations were lower for hybrids selected for low NDF. *In vitro* true digestibility was greater for low NDF hybrids. NDF digestibility (CWD) and crude protein content was not different between low and high NDF hybrids. In general, the "average" hybrid was intermediate in yield and quality measurements.

Previously identified high quality hybrids were above average for milk per acre and milk per ton, while low quality hybrids were below average in these trials. Milk1995 indices were greater for low NDF hybrid checks than high NDF checks. Likewise using Milk2000, milk per ton was greater for the low NDF check hybrids.

All of the corn hybrid checks were selected using concepts developed for Milk1995. Using Milk1995 as an index to predict repeatability of hybrid performance, 74 % ($P=0.0002$) of the time the low NDF hybrid would have greater milk per ton than the high NDF hybrid, and 90 % ($P=0.0001$) of

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the time the low NDF hybrid would be either greater or within ± 1 standard deviation for milk ton of the high NDF check hybrid. Using Milk2000, the low NDF check hybrid would have numerically greater milk ton than the high NDF check hybrid in 62% ($P=0.05$) of the trials, and for 93% ($P=0.0001$) of the trials the low NDF hybrid produced either more or was within ± 1 standard deviation for milk per ton of the high NDF check. Using NDF and the milk indices gave good results for predicting future milk per ton performance of corn silage hybrids.

Table 1. Relative performance of corn hybrid checks pre-selected for low and high NDF tested in 61 Wisconsin environments conducted between 1995 and 2000 at six locations.

Hybrid	Yield T/A	Moisture %	CP %	ADF %	NDF %	IVD %	CWD %	Starch %	Milk per Ton		Milk per Acre	
									1995 lb/T	2000 lb/T	1995 lb/A	2000 lb/A
Low NDF hybrid	7.63	61.0	7.3	22.4	44.4	78.4	51.6	32.0	2110	15800	3150	23900
Average hybrid	7.63	62.0	7.3	23.2	45.7	77.8	51.5	30.2	2020	15300	3110	23700
High NDF hybrid	7.75	61.7	7.3	23.7	46.5	77.4	51.5	29.5	1960	15000	3090	23800
LSD (0.05)	NS	0.9	NS	0.4	0.6	0.4	NS	0.8	40	600	30	NS

Higher stover digestibility hybrids like brown midrib hybrids had greater milk per ton using Milk2000, but still did not yield as much milk per acre as other hybrids in the test due to poor yield (Figure 1). On average leafy type hybrids tend to be below average for quality and above average for

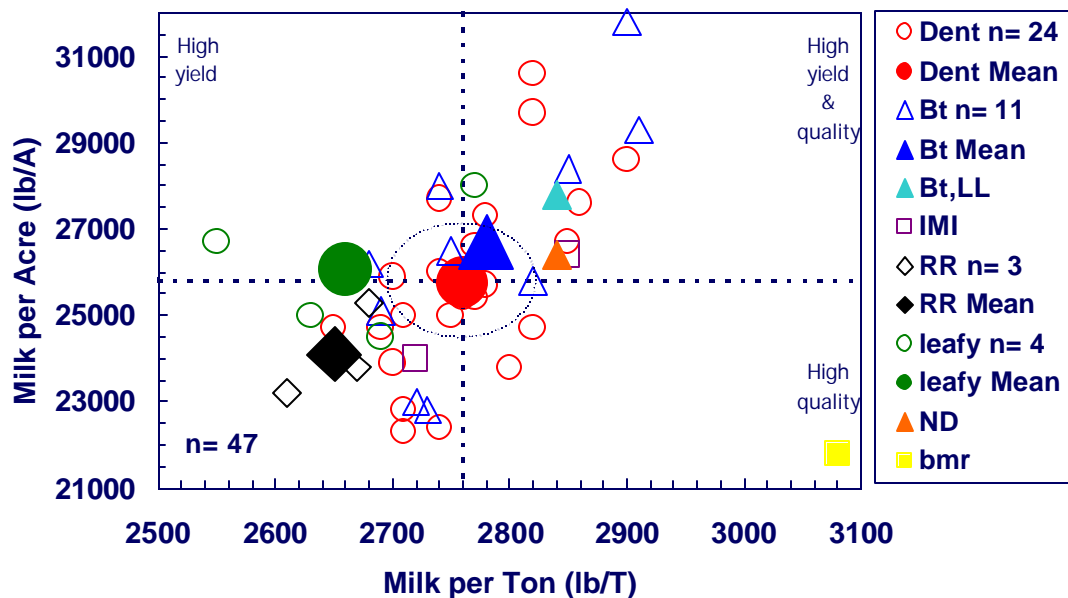


Figure 1. 2001 Wisconsin Corn Hybrid Performance Trial Results – Table 12 Southern Zone, Late Maturity Trial at Arlington and Lancaster. Dashed lines are trial averages for milk per acre and milk per ton. The dashed oval is ± 1 standard deviation

dry matter yield.

Much debate is currently taking place regarding important traits in grain versus silage hybrids. Selecting hybrids for silage production depends on whether a field is planted specifically for silage or whether the field might be harvested for grain (dual purpose). Silage hybrids should have high forage yield, high digestibility, low fiber levels and highly digestible stover. The best silage hybrids usually have high grain yields because grain is highly digestible. However, ranking for top yielding hybrids used for silage may vary based on differences in fiber digestibility and grain to stover ratio. A dual-purpose hybrid should have both high grain and forage yields.

For both scenarios hybrid selection should start with identifying a group of hybrids that are adapted to the area in terms of maturity, drought tolerance, disease and insect resistance. In a silage field, full-season hybrids can be 5 to 10 days longer season than what would normally be grown for grain because concern for getting the field to black layer is not as great as it is with grain. The greater expected yield potential with longer season hybrids often makes it worth the greater risk. This means that the range of hybrids planted on a farm should be greater if both corn grain and silage is being produced. This will also help minimize the risk of weather problems during a particular growth stage (particularly pollination/silking) and improves the workload during harvest. Growers should plant 50% of their corn acreage in the full-season maturity range and 25% in the mid-season range and 25% in shorter-season range.

Good standability and pest resistance should be present in the hybrid selected. This allows flexibility for harvesting the field as either corn for grain or silage in the fall. Corn hybrids with poor standability must be harvested as silage, because if lodged they will not be able to be picked up with a corn head.

Recent evidence suggests that softer kernel texture provides greater digestibility and energy in the silage. This may be managed by using kernel processors. Kernel processors can also extend the harvest season by breaking kernels that might be too hard in typical grain hybrids.

Certain hybrids with specialty traits may be appropriate for fields grown specifically for silage. The decision to grow specialty silage corn decreases flexibility in the fall at harvest due to lower grain and forage yield potential. Brown midrib corn has greater digestibility of the stover portion of corn silage and can be an advantage in dairy systems where digestible fiber is limiting. Leafy type hybrids produce very high tonnage. Recent evidence from Iowa suggests that the incidence of mycotoxin development is lower in Bt hybrids, which are also typically high grain producers.

Stover quality in silage hybrids should include low NDF and high digestibility traits. These traits maximize feed intake and energy potential of the forage. These traits are not as important in grain hybrids.

Once a group of adapted hybrids is identified evaluate them on the basis of yield potential. For those fields that are planted for silage production, evaluate hybrids based on silage yield performance. Many studies have shown that grain yield is a good general indicator of whole plant yield. However, within high grain yielding hybrids there can be differences in whole plant yield and fiber digestibility, reinforcing the need to have silage data available on these hybrids. For the dual-purpose strategy select hybrids with good grain and silage yields.

The final consideration for hybrid selection should be quality. Differences exist among commercial corn hybrids for digestibility, NDF digestibility and protein. Most studies have shown

that within a group of commercial hybrids there will be a few with superior quality; most with average quality and a few with significantly less than average quality. Many seed companies are developing forage quality profiles of existing corn hybrids.

Management Considerations

Different management decisions must be sometimes made when growing corn for silage use rather than for grain use. Some decisions depend upon the amount of flexibility a producer wants to have at harvest. Some decisions must be made in the spring, which thereby locks a field into silage harvest in the fall. For example, high plant populations will require that the field be harvested for silage because leaving it for grain harvest would be more risky due to lodging potential.

In Wisconsin, relatively few cornfields planted in the spring are managed for silage harvest in the fall. In most years, the decision to harvest a field for grain or silage is made in the fall. Should cornfields be managed differently if they are planned for fall silage harvest? Does it make any difference economically?

The optimum planting date for corn grown for grain is May 1 in southern and May 7 in northern Wisconsin. Since we are not as concerned about black layer formation in the fall with corn silage, a slightly later planting date can be used without detrimental effects. However, significantly late planting dates will affect silage yield and quality potential as it does grain yield potential. June planting dates produce dry matter yields only about 1/3 to 1/2 of early May planting dates.

In Wisconsin significant responses to row spacing are more often seen with corn grown for silage than for grain. Silage yield increases have averaged 9% with no changes in quality, while grain yield increases have averaged 4 %. With the new chopper heads currently available, narrow row corn production is not difficult for corn silage.

Optimum plant populations for grain production range between 28,000 and 32,000 plants/A. Corn silage optimum plant populations are similar, but yield has been observed to continue increasing through the range of 42,000 plants/A. Significant quality changes occur at higher plant populations.

Corn silage is a more valuable crop when marketed, as beef or milk and thus economic thresholds for pests are lower than corn grown for grain. Greater nutrient removal occurs with corn silage because both grain and stover are removed from the field.

Harvesting corn silage requires great care in the timing of harvest. Once the crop is ready, it usually requires more equipment to chop, transport fill and pack the silos for safe storage. Markets are usually more local than the corn grain markets. Due to high water content, it is usually not economical to transport corn silage more than 100 miles from where it is grown and eventually stored and fed to livestock.

The debate will continue as to which corn hybrid type is best for the dairy cow. Much recent progress has occurred and a divergence in types and approach to developing the ideal type is occurring in the seed and dairy industries. However, dent corn hybrids will continue to be used for both silage and grain and will be the predominant germplasm for many years to come.