

WHAT'S COMING DOWN THE PIKE IN CORN GENETICS? VALUE ADDED CORN SILAGE – BROWN MIDRIB, WAXY, HIGH-OIL AND OTHERS

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Corn is a versatile crop that can be planted from early to late spring. In the fall, producers have the option of harvesting corn for either silage or grain. Corn silage is an important source of forage, and many producers are reevaluating cropping systems and increasing use of corn silage.

Corn can produce high dry matter yields with one harvest. Corn is a good crop to recycle nutrients from manure and maintain water quality. Corn silage is easily ensiled and generally results in palatable forage with relatively consistent quality and higher energy content than other forages. Corn silage production requires less labor and machinery time than other harvested forages. Thus, the cost per ton of dry matter produced tends to be lower for corn silage than for other forages.

Offsetting these benefits of corn silage are some disadvantages relative to other forages. There are few established markets and transportation costs are high, so the crop must be fed on or near the farm where it is produced. In some locations, where corn is not well adapted, production costs may be too high to warrant silage production. On erodible soils, corn silage production may be limited because of soil residue requirements for conservation compliance.

CORN SILAGE QUALITY CHARACTERISTICS

Corn silage is primarily an energy supplying forage, and its nutritive value is related to digestibility and factors that affect digestibility. Any good forage crop should have high dry matter yield, high protein content, high-energy content (high digestibility), high intake potential (low fiber), and optimum dry matter content at harvest for acceptable fermentation and storage. With the exception of high protein level, corn silage exhibits these characteristics better than other forages. Both hybrid selection and agronomic management influence silage yield and quality.

HYBRID SELECTION

Corn hybrid selection is one of the most important management decisions in silage production. Selecting the correct hybrid can often mean the difference between profit and loss. Even selecting the "best" hybrid might not be enough if some aspect in agronomic management is lacking such as delaying harvest. Selecting hybrids for silage production depends somewhat on whether a field is planted specifically for

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silage or whether the field may be harvested for grain (dual purpose).

Many dairy producers grow corn for both grain and silage and they decide at harvest, which fields are to be used for each purpose. This flexibility is appreciated because at planting it is difficult to predict overall forage needs later in the year or know the condition of the corn crop at harvest. Acreage of silage production will increase in years when perennial forage legume production is reduced due to winterkill or drought or when moisture stress or early frost limits corn grain production. On the other hand when adequate forage from other crops is readily available and corn grain yields are adequate, producers may prefer the option of selling their grain production in the cash market.

HOW DIFFERENT ARE CORN HYBRIDS FOR SILAGE QUALITY?

Until recently there was little information about the extent of variation for nutritional quality of corn germplasm in the U.S. Most concepts about nutritive value of silage corn were the results of past studies of grain to stover ratios and genetic oddities such as the brown midrib mutants. It is generally agreed that most single gene mutants or germplasm stocks exhibiting radically altered morphology (profuse tillering, barren or "sugar" corn, dwarf, auto-tetraploid corn, teosinte-derived germplasm etc.) will not have much use as forage types due to their inherently poor productivity compared to adapted hybrids selected for grain production.

Although little information is available for U.S. germplasm, in regions of significant silage production such as Northern France, Germany and The Netherlands, corn germplasm has been undergoing selection for forage yield and quality for some time. After evaluating nearly 40 different corn hybrids that are typically grown in Wisconsin, our researchers reported that the highest yielding grain variety hybrids were not necessarily the highest yielding silage hybrids. Furthermore, whole plant digestibility and fiber ranges were rather narrow. Hybrid whole plant digestibility estimates by Michigan State researchers were slightly larger, while those from Idaho were even more significant. Data from around Canada, Netherlands and France indicate larger hybrid differences in stover and whole plant digestibility.

Silage quality of regular dent corn has been reported in the literature to range from 54 to 86 percent dry matter digestibility, 7 to 11 percent crude protein, 23 to 43 percent acid detergent fiber, and 40 to 68 percent neutral detergent fiber. Whole plant dry matter yields in Wisconsin have been as high as 11 ton per acre. The large range in digestibility and other silage quality parameters reported in the literature can be attributed to differences in hybrid maturity, grain-to-stover ratio, grain composition, stover composition, and methods of forage analysis. The range in silage quality parameters may be smaller than the ranges in whole plant and grain yield for corn hybrids developed for specific environments. Bures (data not published) analyzed 15 early maturing commercial hybrids in three northern Wisconsin environments. Averaged over environments, whole plant quality of these hybrids ranged from 40 to 44 percent for NDF, 20 to 23 percent for ADF, and 80 to 83 percent for dry matter digestibility. Whole plant yields ranged from 5.9 to 7.4 tons per acre. Grain yields ranged from 2.9 to 4.0 tons per acre.

Several types of corn are available from corn breeders that differ in their genetic makeup and may affect silage characteristics (Table 1). These include brown-midrib, waxy, sugar or grainless, sweet corn and

high-oil corn. Usually these types of corn are agronomically poor performers compared to regular dent corn because of yield or lodging deficiencies.

Table 1. Range in relative dry matter yield and forage quality characteristics of dent corn and other corn germplasms. Derived from references listed in Literature Cited.

	Dry Matter Yield	Digestibility	Crude Protein	ADF	NDF
	percent relative to dent corn	----- percent of dry matter -----			
Dent corn	100	54-86	7-11	23-43	40-68
Brown mid-rib	81-90	56-69	7-10	21-39	37-65
Sweet corn	39-100	65-69	7-9	---	45-50
Pop corn	39-69	66	7	---	51
Opaque-2 hybrids	93	63-68	7	20-26	---
Waxy hybrids	96-114	69	8-11	22-37	41-57
High-oil hybrids	---	71	9	---	40
Tillering hybrids	62-161	60-66	6-9	29-37	---
Dwarf genotypes	83-100	60-70	9	---	65
Autotetraploids	100-113	62-73	7-8	---	---
Teosinte	82-145	---	8-9	---	---

Brown-midrib corn has reduced lignin levels in stalks and leaves compared to lignin levels in normal corn plants. Since lignin is undigestible, brown-midrib corn plants should be more digestible than normal corn plants. Increased digestibility is usually found in the stover of brown-midrib types. However, animal performance in feeding trials is inconsistent. Agronomic evaluations have shown slower growth rates, poor early season vigor, increased lodging, delayed flowering, and poor grain yields.

Normal cornstarch contains about 75 percent amylopectin starch and 25 percent amylose starch. Waxy grain contains 100 percent amylopectin starch. Limited feeding trial data suggest that waxy corn could equal, but not exceed, normal corn for forage quality. Waxy corn is very similar to normal corn for agronomic characteristics.

Sweet corn is often available for ensiling as canning factory waste, stover, and as whole plants. Canning factory waste consists of husks, cobs, and some ears. This silage is usually lower in protein and energy than silage made from eared field corn. On a dry matter basis, its nutritive value equals that of immature field corn. Sweet corn stover left after removing the ears for the factory has more nutritive value than stover from ripe field corn due to greater leafiness, and greener leaves and stalks. Whole plant corn silage is made by allowing the plant to mature before ensiling, and its feed value equals that of field corn with similar ear-stalk ratios. A disadvantage of sweet corn is its slow grain dry down rate, which means it must be harvested later than field corn. This not only delays harvest and increases the risk of spoilage, but also reduces stover quality due to increased lignin and fiber concentrations.

High-oil corn has greater energy than normal corn because the calorie content of oil is approximately

2.5 times as great as that of carbohydrates. Feeding trials show greater dry matter intake, but lower digestibility when compared to silage of normal dent corn. Field yield losses have been associated with elevated oil levels. Recently much interest has been generated with new high-oil corn hybrids being marketed under the "top-cross" brand. This method involves using between 3 to 8 percent of the plants as pollinators, while the remaining 92 to 97 percent of the plants are high performing male-sterile hybrids. Testing of the top-cross high-oil hybrids is difficult due to isolation requirements. No university tests have been published on agronomic performance of these new top-cross high oil corn hybrids.

Opaque-2 mutants of corn have elevated levels of lysine and tryptophan. General nutritional value of this silage was similar to normal corn silage. Feeding trials have shown no advantage for these genotypes over normal corn.

ANIMAL PERFORMANCE

Approximately 80% of corn whole plant dry matter is digestible by the dairy cow. Typical corn silage contains 1/2 grain and 1/2 stover. The grain portion is 95% digestible. The stover portion consists of 1/3 cell contents that are 95% digestible, and 2/3 cell walls (fiber) that is 50% digestible.

Predicting animal performance and relating it to improvements in corn silage quality 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 isogenic normal counterpart shown recently by Michigan State workers. The optimum silage composition can vary depending on the type of cow (growing heifer versus milking cow, production level, stage of lactation, etc.) it's fed to 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. The milk per ton index of Undersander et al. (1993) has now been modified (Schwab and Shaver, 2001), and an easy to use Excel 5.0 spreadsheet called Milk2000 has been developed (<http://www.uwex.edu/ces/forage/pubs/milk2000.xls>). Beginning with the 2000 Wisconsin Corn Hybrid Performance Trial Results, ranking of corn hybrid quality was estimated using Milk2000. Previously, Milk1991 and Milk1995 estimated dry matter intake using NDF, and estimated NE_L (Mcal/lb) using acid detergent fiber or *in vitro* true digestibility. Milk2000 uses forage analyses (crude protein, NDF, *in vitro* NDF digestibility, starch, and non-fiber carbohydrate) to estimate energy content using a modification of the NRC (2001) summative approach and dry matter intake from NDF (Mertens, 1987) and *in vitro* NDF digestibility (Oba and Allen, 1999) to predict milk production per ton of forage dry matter. In Milk2000, the intake of energy from forage for a 1350 lb. milking cow consuming a 30% NDF diet is calculated and the cow's maintenance energy requirement (proportioned according to the percentage of forage in the diet) is then subtracted from energy intake to provide an estimate of the energy available from forage for conversion to milk (NRC, 2001). Forage dry matter yield multiplied by the milk produced per ton of forage dry matter provides an estimate of the milk

produced per acre and combines yield and quality into a single term. Because the cows maintenance energy requirements were partitioned against the total diet in Milk2000 rather than against only corn silage as was done in Milk1995, there was a base increase in our new estimate of milk per ton which was of equal value across all samples that did not influence ranking of hybrids.

A dairy producer who buys his feed off-farm would be interested in feeding the best quality silage he could purchase and would be most interested in milk produced per ton of silage (maximize milk per ton). A dairy producer who grows his own feed on-farm would be interested in producing both quality silage as well as high yields from the land base (maximize milk per acre).

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. Repeatable differences for whole plant fiber and digestibility were observed in the "high" and "low" quality checks. Previously identified high quality hybrids were above average for milk per acre and milk per ton, while low quality hybrids were average to below average in these trials.

CRITERIA FOR SELECTING CORN HYBRIDS

Much debate is currently taking place regarding important traits in grain versus silage hybrids (Table 2). 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.

Table 2. Summary of hybrid selection and management considerations and adjustments depending upon grain or silage use of corn.

Decision	Grain	Silage
	<u>Hybrid Selection</u>	
Grain yield potential	High	Adequate
Forage yield potential	Adequate	High
Range among hybrids	60 bu/A	8,000 lb Milk/A
Maturity	“Full-season”	5-10 days longer
Stalks	Unknown	Low NDF, high digestibility
Leaves	Unknown	Low NDF, high digestibility
Kernel hardness	Hard	Soft
Standability	High	High (Allows flexibility)
Pest resistance	High	High (Allows flexibility)
Plant drydown	“Stay-green”	Synchronous
Specialty traits	Bt, RR, LL	Bt, Leafy, BMR
	<u>Management Considerations</u>	
Planting date	May 1 - 7	May 1 - 20
Row spacing	15 to 30 inches	15 inches
Plant population	28,000 to 32,000 plants/A	32,000 to 36,000 plants/A
Pest economic thresholds	Higher	Lower
Fertilizer inputs	High	Greater nutrient removal
Harvesting and storage	Expensive	Expensive
Use and Market	On-farm, local and export market	On-farm or local market

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.

USING RESULTS FROM A CORN SILAGE EVALUATION PROGRAM

In 1995 a new program was initiated at the University of Wisconsin in Madison to evaluate corn hybrids for silage yield and quality characteristics. Silage performance trials are established at seven locations in Wisconsin. The cultural practices used to establish these trials are similar to practices and management of growers in surrounding areas with the exception that slightly higher plant populations are used, i.e. 32,000 plants/acre. At harvest whole plant silage plots are harvested using a tractor driven three point mounted one-row chopper. Kernel milk percent, plot weight and moisture content were measured and yields are adjusted to tons per acre of dry matter.

A subsample is collected and analyzed using near infrared spectroscopy by the UW Forage Marshfield Analysis Laboratory. Plot samples were dried, ground and analyzed for crude protein acid detergent fiber, neutral detergent fiber and in vitro digestibility.

Hybrid dry matter yield averages range between 4.0 and 12.0 tons dry matter per acre between the top and bottom hybrids in the trial. As previously reported by other workers whole plant digestibility and fiber ranges have been rather narrow. ADF concentration ranged between 19 and 27 percent, while NDF ranged between 37 and 51 percent depending upon the trial. Digestibility ranged from 73 to 83 percent. Relatively small changes in silage quality can result in rather large differences in milk per acre and milk per ton. The optimum silage composition can vary depending on the type of cattle fed to and the other components of the ration.

The results can be used to provide producers with an independent objective evaluation of performance of unfamiliar hybrids promoted by seed companies and sales representatives. The following are some suggested steps to use when selecting top performing hybrids for use next year on your farm.

- 1) Use multi-location average data. Consider single location results with extreme caution.
- 2) Begin with trials nearest you.

- 3) Compare hybrids with similar maturities within a trial. You will need to divide most trials into at least two and sometimes three groups with similar average harvest moisture within about 2% range in moisture.
- 4) Make a list of 5 to 10 hybrids with the highest milk per acre and milk per ton indices within each maturity group of a trial.
- 5) Evaluate consistency of performance of the hybrids on your lists over years in other trials.
- 6) Observe relative performance of the hybrids you have chosen based on these trial results and several other reliable unbiased trials and be wary of any with inconsistent performance.
- 7) Consider including the hybrids you have chosen in your own test plot primarily to evaluate agronomic traits.
- 8) Remember you don't know what weather conditions (rainfall, temperature) will be like year, therefore the most reliable way to choose hybrids with greatest chance to perform best next year on your farm is to consider performance over a wide range of locations and climatic conditions.

You are taking a tremendous gamble if you make hybrid selection decisions based on last year's yield comparisons in only one or two local test plots.

MANAGEMENT CONSIDERATIONS

Different management decisions must be sometimes made when growing corn for silage use rather than for grain use (Table 2). 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.

RANKING HYBRIDS

Consistency and repeatability of rankings is important for selecting hybrids. “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 (Coors, unpublished). Between 1998 and 2000, new check hybrids were selected every year on the basis of above average dry matter yield and then sorted on the basis of 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.

Dry matter yield differences between hybrids tested in 61 environments and selected for low and high NDF were nonsignificant (Table 3). Maturity differences as measured by forage moisture content and kernel milkline were significant, but biologically small. As expected, fiber concentrations were lower for hybrids selected for low NDF. *In vitro* true digestibility was greater for low NDF hybrids. NDF digestibility and crude protein content was not different between low and high NDF hybrids. 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. But, no difference was observed for per acre between low and high NDF hybrids. In general, the “average” hybrid was intermediate in yield and quality measurements.

Table 3. 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	Moisture	C P	AD F	ND F	IV D	CW D	Starch	Milk per Ton		Milk per Acre	
									1995	2000	1995	2000
	T/A	%	%	%	%	%	%	%	lb/T	lb/T	lb/A	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.	23.	46.	77.	51.5	29.5	196	15000	309	23800
LSD (0.05)	NS	0.9	N	0.4	0.6	0.4	NS	0.8	40	600	30	NS
			S									

All of the corn hybrid checks were selected using concepts developed for Milk1995. Using Milk1995 as an index to predict repeatability of hybrid performance in the 61 trials, we found that 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 the time the low NDF hybrid would be either greater or be 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.

Significant differences were observed for yield and quality of different hybrid types (Tables 4 and 5). Significant changes in ranking occurred when comparing Milk1995 and Milk2000. As expected, more mature (drier) hybrids tended to produce lower milk per ton and milk per Acre when calculated using Milk2000 (Table 5). The shorter-season hybrid (D1297) that was significantly drier was ranked significantly greater for Milk per ton and Milk per acre using Milk1995, but using Milk2000 were only average for Milk per ton and below average for Milk per acre. This was due largely to the negative impact of advanced maturity on starch digestibility (Bal et al., 1997), being accounted for in Milk2000 but not in Milk1995. Likewise, the full-season hybrid (P33A14) was not as affected by use of Milk2000 versus Milk1995, because maturity was not as advanced for this hybrid.

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 (Tables 4 and 5). The brown midrib hybrid (CF657) increased higher above the mean for Milk per ton with Milk2000 compared to Milk1995, but had significantly lower Milk per acre due to low yield. The increase in Milk per ton above the mean for the brown midrib hybrid with Milk2000 versus Milk1995 reflects its higher cell wall digestibility accounted for in Milk2000, but ignored in Milk1995.

The leafy and mid-season hybrids (NK48V8 and P35R58) did not change appreciably in relative hybrid rankings for Milk2000 versus Milk1995. From these comparisons, it is apparent that maturity at harvest and NDF digestibility strongly influence the relative hybrid rankings with Milk2000 versus Milk1995.

Table 4. Relative Performance of Corn Hybrid Types Tested in the UW Silage Trials (1999-2000).

Hybrid	Yield	Moistur e	C P	AD F	ND F	IVD	CW D	Star ch	Milk per Ton		Milk per Acre	
									1995	2000	1995	2000
	T/A	%	%	%	%	%	%	%	lb/T		lb/A	
Bt	8.5	62.2	7	24	47	74	46	31	1750	2910	1490	2470
											0	0
HOC	8.2	66.8	8	24	48	75	48	30	1730	3050	1420	2510
											0	0
leafy	8.4	63.0	7	24	48	74	46	29	1670	2900	1400	2420
											0	0
average hybrid	8.4	62.5	7	24	48	74	46	31	1700	2890	1440	2430
											0	0

Table 5. Relative Performance of Corn Hybrids Tested in Six locations (Coors, 2000).

Hybrid	Yield	Moistur e	C P	AD F	ND F	IV D	CW D	Star ch	Milk per Ton		Milk per Acre	
									1995	2000	1995	2000
	T/A	%	%	%	%	%	%	%	lb/T		lb/A	
Dairyland 1297	6.4	53	7	24	49	73	45	30	1630	2630	1040	1680
											0	0
Pioneer 35R58	8.2	64	7	27	53	70	44	25	1250	2630	1030	2160
											0	0
NK 48V8 (4687)	8.1	65	7	27	53	70	44	22	1280	2680	1030	2160
											0	0
Cargill F657	5.7	68	7	25	50	75	50	27	1690	3110	9650	1780
											0	0
Pioneer 33A14A	8.1	69	7	29	55	69	43	20	1090	2590	8800	2100
											0	0
LSD (0.05)	0.4	3	N	1	2	1	1	2	30	20	1400	1400
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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.

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