Corn Silage and Whole Sunflowers – Energy from the Prairie Sun to Your Cows

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Take Home Message

- Modern high producing dairy cows face a potentially serious energy deficit in early lactation.
- There are several ways of addressing this deficit, one of the best being to increase the energy density of the ration.
- Corn silage has the potential to be a high energy forage, but grain development is important to maximize the energy content of corn silage.
- The best way to ensure grain development is to select hybrids with the correct maturity.
- Proper storage and feed-out are critical in ensuring that the cows get the full value from a silage crop.
- Feeding fat is an excellent way to increase the energy density of dairy rations.
- Oilseeds, especially whole sunflowers, are a safe, convenient and economical way of feeding fat to your dairy herd.
- There may be additional benefits down the road to feeding sunflower oil in terms of improved human health properties of animal products.

Why Talk About Energy?

There is an energy crisis on dairy farms across the country. As shown in Figure 1, milk production per cow has increased steadily over the past fifty years and this trend shows no tendency to slow down. We have almost tripled the amount of milk we expect a cow to produce while her body size has only increased modestly. The result is that high producing cows are always in an energy deficit situation in early lactation. Milk production peaks at around six weeks of

lactation while feed intake does not peak until about three months. The energy deficit is not too serious as long as it is managed and is not too great or too long. Otherwise a variety of other problems, especially poor breeding, can result.

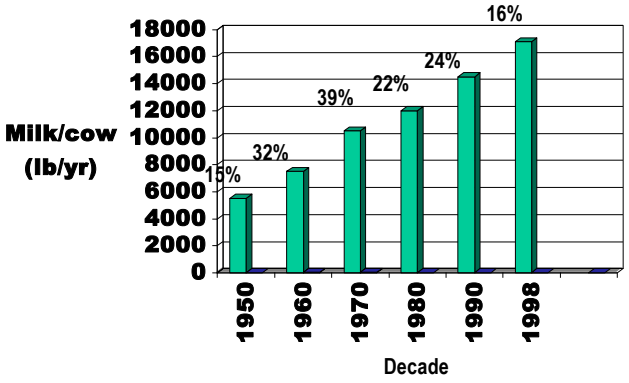

Figure 1. Change in Milk Production (lbs/cow/yr) by Decade (U.S., H.D. August/99)

The best method of monitoring the energy status of your herd is to monitor body condition. This could be the subject of an entire paper, but your goal should be to have your cows not lose more than one complete point of body condition score. In other words if cows freshen with a score of 3.5 (on a scale of 1 to 5), they should not drop below 2.5 in early lactation.

■ What Can You Do To Limit the Length and Extent of Your Cow's Energy Deficit?

There are basically three major approaches to increasing the energy available to a cow. We must, however, keep in mind that this cannot be done at the expense of fibre intake. In order to maintain a healthy, functioning rumen fibre intake must be maintained.

Three main ways to improve the cow's energy supply:

- Increase feed intake – This can be accomplished in three main ways, a good pre-calving program, correct feeding frequency and ensuring that feed is palatable. The pre-calving program gets the rumen microbes adapted to the feeds they will encounter during lactation and ensures that the cow gets off to a good start when she enters the milking herd. Cows will tend to eat

when they are fed or when feed is pushed in front of them. More frequent feeding also helps to maintain feed palatability.

- Increase energy density of the ration – This will be the main focus of this paper. By growing a forage crop like corn silage with a high-energy content the base energy level of the ration is increased, especially if the correct hybrid with good grain development is selected. Feeding supplemental fat also dramatically increases the energy level of the diet since fat contains at least 2.25 times more energy than starch while no acid is produced in the rumen when it is digested.
- Increase the digestibility of the ration – Some important ways that this can be achieved are by growing varieties of forages which have been selected for high digestibility, using a reputable silage inoculant when ensiling forages and possibly, processing corn silage at harvest.

Development and Evaluation of Hybrids for Silage

I want to digress a bit to discuss how silage hybrids are developed and how producers can evaluate the results of silage plots. Using Pioneer Hi-Bred Ltd as an example, there is a tremendous amount of resources required to bring a new silage hybrid to market. Pioneer has a research facility known as the Livestock Nutrition Center with extensive laboratory and animal feeding facilities where the nutritional evaluations are carried out. The process begins with the evaluation of up to 70,000 initial hybrid crosses, which may ultimately result in 20 – 25 hybrids, which are marketable.

When evaluating the results of silage plots, it is important to understand the nature of field trials and the need for adequate numbers of comparisons in order to come to a valid conclusion. For example if 2 silage hybrids are really different by 3 tonnes per acre, there needs to be 6 trials run to reliably show the difference. If the difference is only 1.4 tonnes, you need 23 trials to make sure that the difference is real. While a plot done on your farm can give you valuable information, it is important to compare the results to a larger set of data.

Growing, Storing and Feeding a High-Energy Corn Silage Crop

Growing – What Hybrid to Grow

The first thing to keep in mind about corn is that it is a member of the grass family and until you have a cob of corn on the plant it is just tall grass. Figure 2 helps to picture how the corn plant changes with maturity. The moisture content declines as expected. The proportion of the plant made up by the stalk and

leaves declines as that made up by the cob increases. This is reflected in the increasing amount of starch and the declining amount of sugar as the plant stores as much energy as possible into the corn grain. Another way of looking at this is to consider the ratio of corn grain to stover, which is the main factor influencing the energy content of corn silage. Since corn grain has 80% more net energy than stover on a weight basis, to get high energy corn silage there must be ear development.

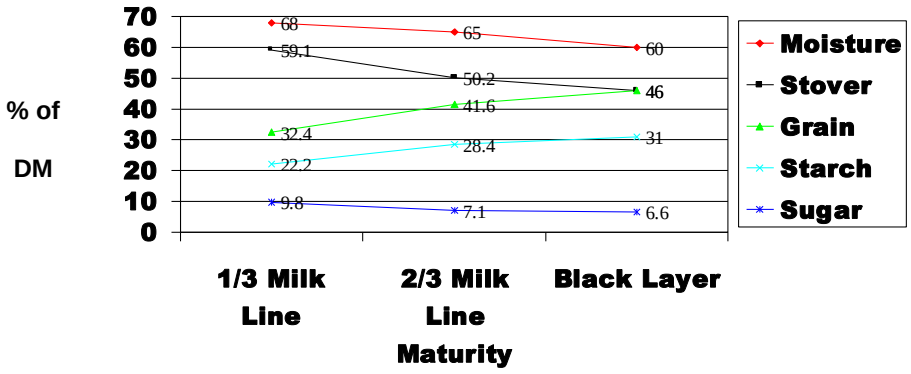

Figure 2: Change in Corn Plant Components with Advancing Maturity

Another way of looking at the corn plant is to note the fibre content and digestibility of the various parts of the plant at silage maturity as shown in Table 1. The green parts of the corn plant range in fibre content from 66 to 89% with digestibilities from 31 to 73%. Corn grain is only 11% fibre and is 90% digestible. These figures clearly indicate the superiority of corn grain as an energy source.

Table 1. Quality of Corn Plant Parts

			Digestibility %	
Part	**% of DM**	**NDF (%)**	**NDF**	**DM**
Tassel	<1	78.4	53.4	63.5
Leaf sheath	6.1	78.1	60.3	69.0
Husk	5.8	80.5	69.5	75.4
Leaf blades	8.5	66.7	73.2	82.1
Cobs	12.1	89.3	31.9	39.2
Stalk	18.3	66.5	61.5	74.4
Grain	48.5	11.8	89.7	90.0

How do you maximize the energy yield of corn as silage? It is through growing hybrids that have a good chance of developing to the point where they have a reasonable grain content before the first expected frost.

There is a silage evaluation program being run here in Alberta by Dr. Vern Baron of Agriculture and Agri-Food Canada out of Lacombe. Plots are grown at Lacombe, Brooks and Bow Island to represent the range of maturities found in central and southern Alberta. There are now results available for four years comparing different corn silage hybrids and comparing different crops for silage. In Table 2, I have shown selected data on two different hybrids of differing maturities to illustrate the importance of matching hybrids with their correct growing area. Hybrid A is rated as 2000 corn heat units (CHU) while Hybrid B is 2250. You can see from the data in the table that Hybrid A is well adapted to the shorter growing season at Lacombe as it produced reasonable yield and developed a good percentage of ear. Hybrid B on the other hand is too long a season corn for Lacombe and did not develop ears. As the season got longer at Brooks, Hybrid A still outperformed Hybrid B but both performed acceptably. At Bow Island, Hybrid B is in its more optimum zone and it clearly outperforms Hybrid A, which is too short seasoned for that area.

Table 2: Importance of Correct Maturity (Alberta)*

	Site		
	Lacombe	**Brooks**	**Bow Island**
CHU to harvest	1795	2073	2239
Hybrid A			
Height cm	183	227	230
Yield (DM, t/ha)	10.9	13.5	13.2
Dry Matter, %	25.4	27.6	38.5
% Ear	32	43	56
Hybrid B			
Height cm	186	215	249
Yield (DM, t/ha)	7.2	13.9	14.6
Dry Matter, %	17.6	25.1	31
% Ear	11	32	44

*Adapted from V. Baron, 2002

There is similar data available from Saskatchewan, where corn is being evaluated by the Irrigation Crop Diversification Corporation under the direction of Les Bohrson. Their data from 2002 shows that shorter season hybrids produced almost twice as much grain as the longer season corn that did not have a chance to mature.

Since barley silage is the standard to which other silages must be compared on the Prairies, it is interesting to look at the results of four years of data from the

Lacombe study mentioned previously. In Table 3 you will see the comparison of dry matter and energy yields. Using a very conservative estimate of the energy difference between barley and corn silage, the barley silage only produced an average of 77%of the energy of corn silage.

Table 3: Comparison of Barley and Corn Silage*

Silage Type	Yield (DM,T/ac)	Protein %	ADF %	TDN (T/ac)	% of Corn
Corn	4.58	8.1	26.3	3.21	
Barley	3.44	11.3	27.1	2.48	77

*Adapted from V. Baron, 1999 – 2002

Storing

After you have spent the money to grow and harvest a crop of corn silage, it is essential to store it and feed it out properly to ensure that your cows maximize their energy intake. While a comprehensive discussion of silage management is beyond the scope of this paper, it is important to highlight a couple of issues.

The first is to ensure that the silage is covered with an appropriate type of plastic immediately after filling. Research shows that up to 33% of the dry matter in the top four feet of the silage can be lost to respiration if silage is not covered. To make this ever more serious, the dry matter that is lost is the most digestible nutrients: the sugars and fermentable carbohydrates that the high producing cow needs to overcome her energy shortage.

Feeding

It is important, if at all possible, to let the silage ferment before feeding. It takes a minimum of two weeks for corn silage to go through its initial fermentation and it will continue to change for up to six weeks. During this time the silage is changing on a daily basis and it is impossible to properly balance the ration. The other issue is that some of the corn grain may go through the cows, again wasting precious energy that the cow needs.

The final point on feeding is to ensure that the face of the bunk silo is managed properly and that silage is not allowed to spoil. This not only reduces the value of the spoiled silage, but also can reduce the intake of the entire TMR. Even if you have grown and stored high quality silage, much of the benefit can be lost with poor bunk management.

Agronomic Issues

One issue that cannot be overlooked when considering whether to grow corn for silage is the ability of corn to utilize a lot of nitrogen and potassium. As shown in Figure 3, corn removes much more of these nutrients than cereal silages. This issue will become more important as proper utilization of manure nutrients comes under more scrutiny.

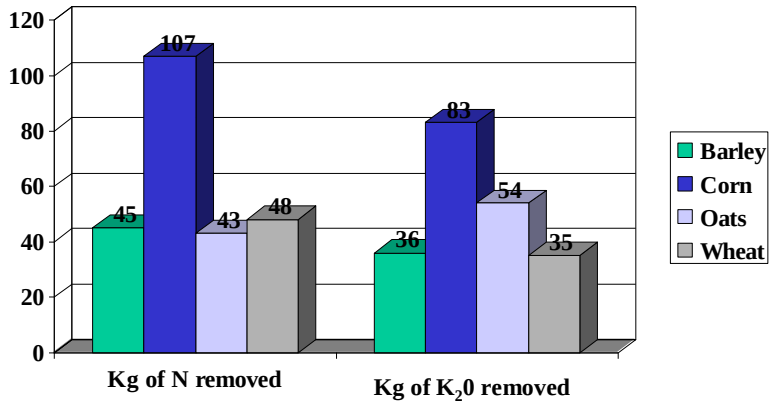

Figure 3: Nutrients removed per acre by different crops

■ Sunflowers

Issues in Feeding Fat

In the initial part of this paper it was pointed out that fat was an important potential energy source for the high producing cow. The fact that fat is at least 2.25 times higher in energy than starch means that the cow can get more energy without having to eat more feed.

There are many potential fat sources available for feeding. Oilseed crops have several benefits over liquid fat sources such as tallow. One of the most important, in light of recent problems in other countries is that the fat is of a known origin and there would be no negative reaction from consumers to it being fed. There are also benefits in terms of convenience and cost savings. Feeding fat in the form of oilseeds eliminates the need for a fat tank, which would need to be kept heated in the winter time. Cows do not like feeds with a

fatty taste or texture, so liquid fats can result in reduced feed intake at the very time that the cow needs to maximize energy intake. There are also reports of flies being attracted to liquid fat products in the summertime.

Oilseed Fat Sources

One of the more common oilseeds currently fed on the Prairies is whole cottonseed. As shown in Table 4, sunflowers are over twice as high in fat as cottonseed with similar amounts of protein and fibre. Sunflowers have the additional benefit of being easy to handle and store using conventional grain handling equipment. They are also, of course a crop that can be grown locally in most areas of the Prairies.

Table 4: Comparison of Sunflower and Cotton Seeds

	Sunflower	Cottonseed
Protein %	19.6	23
Fat %	44	20
Crude Fibre %	22.5	24

Another potential oilseed is whole roasted soybeans. Sunflowers are lower in protein but higher in fat and fibre than soybeans, with similar digestibility. The most common oilseed in the west is of course canola. Canola has enormous potential as an energy source for livestock, but there is no practical way of feeding it on farm. The seed is too hard and indigestible to feed whole and once it is processed in any way the high fat content makes it very difficult to store and feed.

It was mentioned earlier how important it is to maintain fibre intake in high producing cows. One additional benefit of whole sunflowers is that because they are light, they float in the rumen and can act like a fibre source.

Sunflower Production Feeding Studies

There have been many feeding studies done with whole sunflowers for lactating cows. A study done in Saskatchewan in the early 1990's showed an improvement of over two kilos of milk per cow per day when sunflowers were added to the ration. Recent renewed interest in feeding sunflowers prompted Dr. Christiansen at Saskatoon to run a dairy study in the University of Saskatchewan herd. The results of this study are shown in Table 5. Feeding whole sunflowers increased fat corrected milk by 2.4 kilos per day while milk protein was unchanged. Some seed was roasted to see if there would be any further improvement in performance, and there was not.

Table 5: One kg sunflower seed (WSFS) replacing TMR dry matter

	Pre Trial	Roasted WSFS	Raw WSFS	Post Trial
Actual Milk, kg/day	37.0	38.7	39.8	39.1
Milk fat, %	3.43	3.62	3.46	3.27
3.5% FCM Milk, kg/day	35.6	38.9	39.0	37.1
Protein, %	3.21	3.23	3.22	3.16
Milk Value, $/day	19.29	21.96	22.21	21.33

University of Saskatchewan Herd Trial, Christensen, 2001

Other Possible Benefits

One of the most exciting areas of nutrition research is looking at the potential of improving human health by enhancing the levels of naturally occurring compounds with known health benefits. One such group of compounds is a type of fatty acid known as Conjugated Linoleic Acid or CLA. There have been a number of health benefits ascribed to this type of fatty acid as outlined in Table 6.

Table 6: Health effects of CLA: implications for humans

• Anti-carcinogenic (Vanden Heuvel *et al.,* 1999)
• Anti-atherosclerotic (Kritchevsky 2000)
• Battles obesity (Delaney *et al.,* 1999)
• Anti-diabetic (Houseknecht *et al.,* 1998)
• Improves immunity (Hayek *et al.,* 1999)
• Combats allergies and asthma (Cook *et al.,* 2000)
• Decreases cholesterol (Nicolosi *et al.,* 1997)

The reason for bringing this up in this discussion is that feeding whole sunflowers has been shown as a possible way of increasing the CLA content of ruminant products. Studies with beef cattle have shown that sunflowers can significantly increase the CLA content of beef. This could have enormous positive marketing possibilities for meat and milk products down the road.

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Also see Pioneer Hi-Bred Ltd. Website: www.Pioneer.com for more details on corn silage and sunflower growing, harvesting and feeding.