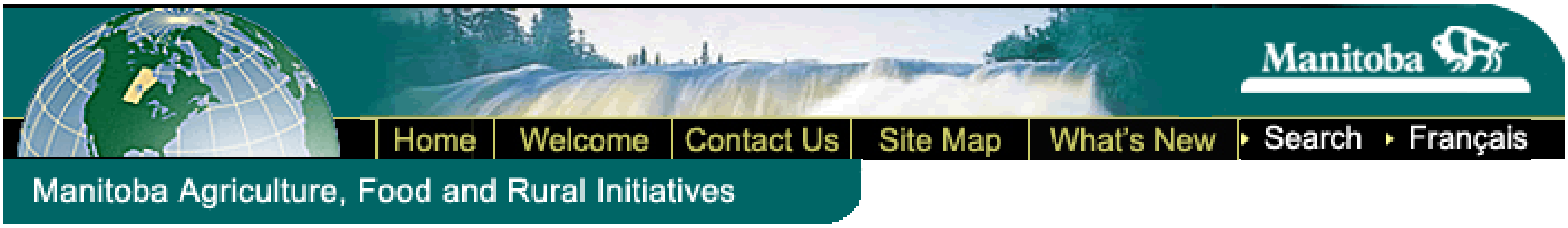

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Recommended Principles for Proper Hay Sampling

Nutrition Update
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Editor's Note: This is one of the best factsheets I have seen on this topic.

Proper sampling of hay and forage is of tremendous importance to assure an accurate forage test. Remember, a lab test is only as good as the sample provided to the lab. Here's the dilemma: Hundreds of thousands of pounds of highly variable plant material must be represented in a single, tiny, thumbnail-sized sample!! Often, the sample actually analyzed by the lab is often only ½ gram! This sample must not only represent the proper leaf-stem ratio and the legume/grass mix, but also reflect the spotty presence of weeds. Sampling variation is a significant problem in hay testing, and causes millions of dollars in lost revenue each year by either buyer, seller, or in animal performance. In practice, hay sampling produces more variation in results than does lab error. However, if sampling protocol is carefully followed, sampling variation can be reduced to an acceptable level, and the potential forage quality successfully predicted.

The following steps are widely considered to be the key elements of a standardized sampling protocol.

Identify a Single Lot of Hay

This is a key first step to proper hay sampling, and one frequently ignored. A hay lot should be identified which is a single cutting, a single field and variety, and generally be less than 200 tons. Combinations of different lots of hay cannot be represented adequately by a forage sampling method; different lots should be sampled separately. Don't mix cuttings, fields, or hay types.

When to Sample?

It is important to sample the hay either as close to feeding, or as close to point of sale as possible. Dry matter measurements are especially subject to changes after harvest and during storage, but other measurements may also change. Hay immediately after harvest normally goes through a process of further moisture lost known as a 'sweat'. During this period, hay may heat up due to the activities of microorganisms, driving residual moisture from the hay. Thus, moisture content is likely to be reduced in the days and weeks after harvest. If the hay has been baled at excess moisture, further biological activity may result in molding, or even (under very high moisture conditions) spontaneous combustion of hay. However, after hay has equilibrated to the range of 90% DM (10% moisture, depending upon humidity), it is typically quite stable. 'As received' dry matter measurements should be used to adjust quantity (tonnage, yield), not quality parameters, which should be compared on 100% DM basis.

Choose a Sharp, Well-Designed Coring Device

Use a sharp coring device 3/8-3/4" diameter. Never send in flakes or grab samples, it is nearly impossible for these samples to represent a hay lot. "Hand-grab' samples have been shown to be significantly lower in quality than correctly sampled forage. The corer should have a tip 90o to shaft, not angled—studies have shown that angled shafts push aside some components of hay, providing a non-representative sample of the entire mix. Very small diameter tips (<3/8") do not adequately represent the leaf-stem ratio of the hay. Too-large diameter or too-long probes (e.g. > 24") provide good samples, but give too much forage in a 20 probe composite sample—thus the sampler may stop before 20 cores are completed or the lab may not grind the whole sample (see below). The length of probe should allow probing to a depth of 12"-24". Studies have shown this depth to successfully characterize the variation in hay, even in large (1 ton) bales, and no significant differences were seen between a 32" and 12" probe. A range of probe tip designs have been used successfully, from serrated to non-serrated tips—it is probably most important that the tip be sharp (and maintained sharp), and not create 'fines' during the cutting action, but cleanly cut across a cross-section of hay. Some probes are power, hand-brace, or auger driven, whereas others are push-type, both of which may work well. Many (not all) probes can be used to successfully represent a hay lot as long as they follow these principles: they easily penetrate the bale, fairly represent the leaf-stem ratio, can be easily sharpened, and produce approximately ½ lb (200 g) of sample in about 20 cores to a depth of 12"-24". (See a listing of probes at the NFTA website www.foragetesting.org.)

Sample at Random

The sampler should walk around the stack as much as possible, and sample bales at random. Both ends of bales should be sampled by walking around the stack. This is sometimes difficult since all of the bales are not available to the sampler (they may be against walls of a barn or up too high for practical sampling). However, the sampler should make every attempt to sample in a random fashion—this means not to bias either for or against any bales in the stack. For example, the sampler may walk 15 steps, sample, walk 20 steps, sample, walk 5 steps, sample, while walking around stack—trying to represent all areas of the stack. Don't avoid or choose bales because they look especially bad or good--If 20 cores are taken, they won't make much difference anyway. Avoiding or choosing bales introduces bias.

Take Enough Cores

We recommend a minimum of 20 cores for a composite sample to represent a hay lot. This is the same for large (e.g. 1 ton bales), or small 2-tie or 3-tie bales. This is because core-core (and bale-bale) variation in forage quality is tremendous (e.g. 5-7 % points ADF or CP). Sampling a large number of locations and bales throughout the stack to create a composite sample is a key aspect of representing the full variation contained in a hay lot. It is recommended to take more than 20 cores (e.g. up to 35) with very large lots (100-200 tons), or with highly variable lots (e.g. lots that may have non-attached leaves or are from very weedy fields). With small bales, sample 1 core per bale, >20 bales; with larger (e.g. 1 ton) bales, take 2-3 cores per bale in the center of the ends, sampling >10-12 bales. A larger number of core samples is generally better at characterizing variation in hay in more variable hay lots.

Use Proper Technique

Sample butt ends of hay bale, between strings or wires, not near the edge. Probe should be inserted at 90o angle, 12”-18” deep. Do not sample in the same exact spot twice. Do not use any technique which is likely to misrepresent the leaf-stem ratio. The sides or the top of the bale should not be sampled, since these cores will only represent one flake from a single area of the field, and additionally misrepresent the leaf-stem ratio. With round bales, sample towards middle of bale on an angle directly towards the center of the bale.

Sample Amount

Sampling should be done so that about ½ lb of sample is produced. Too-small samples don’t fairly represent the full range of variation in the hay lot. Very big samples (common with large length or diameter probes) are excellent at representing the hay but have practical disadvantages. Large samples cannot be easily ground by the labs—many labs will simply sub-sample such large samples before grinding, defeating the entire purpose of good sampling technique! The sampler should ensure that the entire sample is ground by the lab—this is important to check. If your lab is not grinding the whole sample, ask why—it could be that your sample is too large. Only work with labs that are willing to grind the entire sample (after a DM sample for field DM is taken). But you should also assure that you are providing a reasonable ½ lb sample, so that it can be practically handled by the lab. If a probe is too big or small to produce about ½ pound in 20 cores—get a different one! (see list of probes on NFTA website www.foragetesting.org.)

Handle Samples Correctly

Seal composite 20-core sample in a well-sealed plastic bag and protect from heat. Double bagging is beneficial, especially for DM measurements. Deliver to lab as soon as possible. Do not allow samples to be exposed to excess sun (e.g. in the cab of a pickup truck). Refrigeration of hay samples is helpful, however, dry hay samples (about 90% DM) are considered fairly stable.

Never Split Samples Without Grinding

It is important to occasionally double check the performance of your lab by comparing with another (or several other) labs. However, never split un-ground samples and send them to two different labs—the samples are likely to be genuinely different! To test two labs, either grind and carefully split the sample, or better yet, ask for your ground sample back to send to another lab. Use several samples to test average potential bias between labs. Don’t work with labs that are unwilling to do this—good labs should be willing to test their performance and answer questions with regards to consistency of lab results.

Sources:

D. H. Putnam. 2002. University of California, Davis.

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If It's Spoiled, Throw It Out

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Manitoba cattle producers generally do an excellent job of putting up good quality silage. Silage is chopped to the recommended length, silos are well packed and covered when full, and feed-out is managed well. All these things are done with an eye towards minimizing the spoilage which we know can significantly decrease dry matter and nutrient recovery from a silo. Despite the best of intentions, occasionally some silage does become spoiled and research from Kansas State University (KSU) shows that spoiled silage should be discarded as it can have a big negative impact on performance.

Corn was harvested and placed in a bunker silo. The top 3 feet of the corn silage was allowed to spoil. The top 18” of the spoilage was black, with a mud-like texture and a foul odour – typical signs of silage which had not been sealed. The bottom 18” was yellow-orange in color and had a strong acetic acid smell. The spoiled silage was incorporated into steer diets consisting of 90% silage and 10% supplement. Of the 90% silage, treatment groups consisted of 100% good silage, 75% good silage: 25% spoiled silage; 50% good : 50% spoiled and 25% normal : 75% spoiled. Steers were fitted with ruminal cannulas which allowed samples of digesta to be taken directly from the rumen.

The addition of spoiled silage to the diet resulted in drops in feed intake and digestibility.

Item	**Ration**			
	A	B	C	D
DMI, lbs/day	17.5a	16.2b	15.3b,c	14.7c
	Digestibility (%)			
Organic Matter	75.6a	70.6b	69.0b	67.8b
CP	74.6a	70.5b	68.0b	62.8c
NDF	63.2a	56.0b	52.5b	52.3b
ADF	56.1a	46.2b	41.3b	40.5b

a,b,c - within a row with no common superscript differ (P<.05)

Decreases in organic matter, protein and NDF digestibilities meant the steers were not able to utilize the available nutrients as efficiently. The addition of the first 25% spoilage caused the largest drop. When samples of rumen digesta were examined, it was found that the spoiled silage had destroyed or partially destroyed the forage mat in the rumen.

Using this information, KSU researchers went on to determine the effects that spoiled silage might have on milk production. Using a software program called Milk 2000, which calculates milk production based on various aspects of forage quality, they estimated a loss of 7.5 lbs of milk/cow/day when feeding 25% spoilage. If we use a more moderate loss of 4 lbs/cow/day and Manitoba milk prices, this equals close to 6 hectolitres of milk per lactation and $360 of lost profit.

Most dairy producers will not feed spoiled silage to milk cows and the above information shows why this is a good management practice. However, does this discarded material make its way into the diets of heifers or dry cows?? The KSU work showed a drop in feed intake of almost 10% when 25% spoiled silage was incorporated into the diets of the steers. This could have negative impacts on heifer and dry cow productivity.

Reference:

Kansas State University Silage Team. 2002. www.oznet.ksu.edu/pr_silage.

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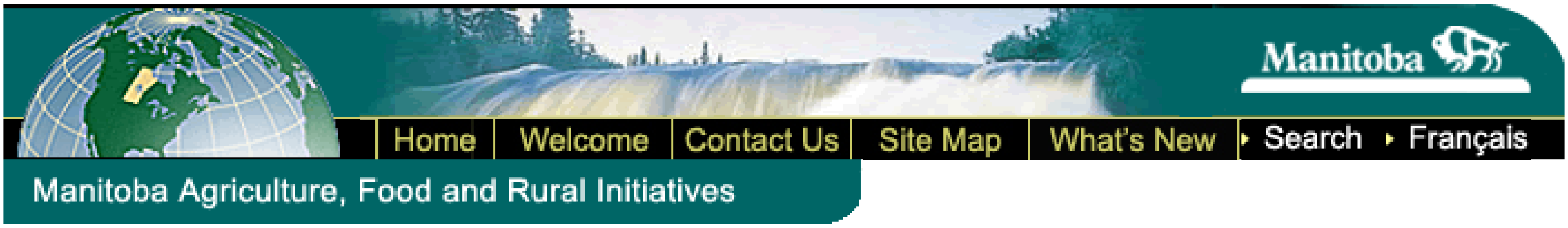

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Pricing Protein and Energy Supplements for November 2005

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The following tables break down the price of the various feed ingredients. Although there may be significant changes in prices as the winter feeding period progresses, the following can be used as a basis for discussion. There may also be some difference in price between feed sources. The first table shows the price/tonne and price/kg of actual protein. The second table shows the price/tonne and price/kg of TDN for various energy supplements. Products marked by * contain added minerals and vitamins and this will have a small effect on overall cost.

Protein Costs

Product	$/Tonne	$/kg Protein
46% SBM	243	0.53
34% Canola Meal	138	0.41
41:20 Block*	1157	2.82
32% Pellets*	333	1.04
25% Distillers Grain (corn)	115	0.46
35% Distillers Grains (wheat)	155	0.44
16% Alfalfa	80	0.50

Energy Costs

Feed (% TDN, as fed)	$/Tonne	$/kg TDN
Alfalfa Grass (50% TDN)	60	0.12
Alfalfa (56% TDN)	80	0.14
Barley (73% TDN)	92	0.13
Wheat (79% TDN)	102	0.13
Oats (67% TDN)	126	0.19
Corn (79% TDN)	93	0.12
41:20 Block (67% TDN)*	1157	1.73

$/kg TDN = $ per tonne / (%TDN x 10)

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Using Whole Canola Seed in Livestock Diets

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Nutrient Behavior and Composition of Damaged Canola Seed

It is the protein and oil content of whole canola seed that gives it value. Analysis shows protein content is less affected by frost or weathering in the whole seed but oil content varies more. The oil of oilseeds such as canola, like the starch of cereal grains, is the last major component to develop in the maturing process. Canola seed damaged by frost is prevented from maturing; hence the oil content of the seed is reduced. This is different from seeds that have matured or almost matured, and have a high content of green chlorophyll, with oil content closer to normal. Sample frozen canola on a dry matter basis has an average composition ranging from 21 to 24% crude protein and 31 to 42% oil depending on stage of maturity at time of frost damage. Recent feed analysis of a sample of more mature canola, having greater than 65% green seed had an analysis of 27.7% crude protein and 44.9% oil. Average analysis of #1 canola approximates 22 to 23% protein and 44 to 46% oil.

The presence of green chlorophyll in the oil is not considered a problem as practical experience in use and research with chickens has shown no negative effects. What is of concern is the processing of the seed to obtain full use and value. Significant improvements have been shown to occur with processing.

Table 1.

	Digestibility Coefficients (%)			
	Unprocessed		Processed	
	Protein	Energy	Protein	Energy
20% frozen canola: pigs (Bell: 1984)	20	34	66	60
5% frozen canola: pigs (Bell: 1984)	12	32	62	61
Canola screenings: steers (Pylot: 1999)	57.08	51.51	68.16	61.53

Work supported by Saskatchewan Canola Development Commission

The canola seed being hard, small and round must be cracked to allow access by digestive enzymes. Grinding, pelleting and extruding are all processes to do this by. For on farm processing, grinding through a 1/8" or smaller hammermill screen along with 30 to 50% grain to avoid plugging should be done.

Use of Whole Canola Seed in Livestock and Poultry Diets

Cattle and Sheep: For ruminants the amount of whole canola seed used in diets for beef and dairy cattle and sheep is dependent upon the total fat or oil level in the diet. At higher concentrations usually above 5.5 to 6% of total diet dry matter fat interferes with fibre digestion and may reduce feed intake. However fat at lower levels if properly formulated into the diet becomes a safe and efficient manner in which to add energy. (One unit of fat contains 2.25 times the energy of one unit of starch). Most diets based on prairie feedstuffs usually do not contain more than 1.5 to 2.5% fat in total.

Feeding Beef Cows

Whole canola seed can be used to advantage for growing and finishing animals and also for wintering beef cows. In feedlot diets levels up to 20% of total diet dry matter have been successfully fed providing total dietary fat dry matter % is below 6%. This could be 10% of whole canola if the oil content is 40% or 15% whole canola at 27% oil.

For Wintering Beef Cows

It can be fed mixed with grain at a level that will provide a maximum of 300 to 350 grams of oil per cow per day. In both growing and wintering beef cow diets, the added protein provided will also provide added value and may negate and/or reduce the need for protein supplementation.

Dairy Cattle

High production dairy diets may use some added fat in the diet to provide additional energy in a form other than starch. Similar rules apply to dairy with whole canola seed as for beef cattle. Added dietary oil levels of up to 400 grams per cow per day can be used. Because of the unsaturated fat and interference with fibre digestibility much higher levels are not well tolerated without lowering butterfat levels or reducing feed intake. It is unusual though to require much more than 300 grams of added oil per cow per day in most diets.

Sheep Diets

Use similarly as for growing finishing beef cattle.

Swine Diets

Damaged whole canola seed can provide valuable additions of protein (amino acids) and energy to swine diets. Total dietary fat levels should not exceed 5.5% for grower finishing pigs to avoid too soft a fat in the carcasses. In sow diets whole canola seed can be used to provide the added fat commonly added up to 12% of the sow feed. In swine diets processed canola seed also provides the added advantage of reducing dust in the diet. Experience with pork producers has indicated that whole canola seed is best fed to pigs greater than 25 kg of weight and that is it readily accepted at levels up to 12 -14% of the diet.

Poultry Diets

Added energy beyond barley with pigs and wheat with poultry is necessary to get added performance. With poultry this typically means oil or fat addition. For broilers levels of up to 10% of regular canola seed were found to be satisfactory in feeding trials at the University of Guelph (1977). Poultry have limited capability to handle fibre and better quality offgrade canola seed should be used. However, value in poultry diets is higher than other animals and can be a bargain. In general for poultry, whole canola should not exceed 10 to 12% of the total diet.

Valuing Whole Canola Seed

If you have not guessed it by now, a feed analysis is a must to not only feed whole seed canola, but also place a value on it. Both protein and energy in whole canola seed give it value. The more oil the more energy and at 20 to 22% protein it is much higher than most feeds. In a strict definition whole canola seed just qualifies as a protein supplement.

The value of whole canola seed for different species depends upon the demands of the diet. As an example, with poultry, high production dairy diets and sow diets, where oil or fat is added to increase energy level, whole canola seed has the greatest value. While in swine grower and finisher diets it can be used to supplement barley in place of wheat to provide greater energy, its value is intermediate. The following table shows the value of a whole canola seed containing 20.5% crude protein and 41% oil on an as fed basis. Feed prices per tonne for barley $102, wheat $125, corn $165, canola meal $180, soybean meal $335, barley silage $32, alfalfa hay $105 and tallow $510 were used.

Table 2. August 2004 opportunity value of whole canola seed (20.5% CP and 41% oil) in various feeding programs

Feeding Program	Value ($/tonne)
Broiler grower	$405 to 415
Layer	$380
Hog grower	$307
Sow lactation	$340
Dairy lactation	$390
Beef grower	$253 to 275

While these values are maximum opportunity values, a simple deduction for processing and transport can be used to determine a more realistic value.

Sources:

V. Racz; D.A. Christensen. 2004. Whole Canola Seed Use and Value.

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