Meal Data for Conservation and Innovation Grant

1. Prices Received by Vermont Growers

Conventional growers of soybeans for livestock feed in Vermont typically command approximately $6 to $7 per bushel, or $200 to $230 per ton, for their beans. Organic farmers growing beans for the livestock market can expect to receive approximately $400 to $500 per ton. Soy food producers set high quality standards for the beans used to make soymilk, tofu, etc., and farmers growing for this market receive the highest price for their beans, ranging from $16 to $20 per bushel, or $550 to $700 per ton.

There are no current market data for Vermont canola due to the very small amount grown in the state. The situation is similar for much of the U.S., which is a net importer of canola. The USDA National Agricultural Statistics Service collects state-level canola price data only for Minnesota, Montana, and North Dakota. In 2006, prices received were $9.80, $11.70, and $11.10 per hundredweight, respectively, with all other states reported as $10.90 and the U.S. average equal to $11.10 per hundredweight.

There is a similar lack of Vermont-specific data for sunflower seed and oil prices because the crop is so new to the state. Nationally, the average prices received by farmers for the 2005/2006 marketing year were $12.10/cwt for sunflower seed, $0.385/lb for oil, and $77/short ton for meal (28 % protein). In general, the more the crop is processed and the more value added, the higher the price. Several Vermont farmers are currently growing sunflowers for oil. For high-quality, organic sunflower oil for human consumption, a farmer might expect to receive $8-12 per quart, equivalent to $50–$75 per bushel of seed (assumes 40% oil content per pound of seed).

Commercial feed dealers purchase the largest volumes of oilseed products in Vermont. Feed dealers purchase soybean and canola meal from out-of-state suppliers as well as whole soybeans directly from Vermont farmers. Most meal fed in the state is in mashed grain form, not pellets. The demand for this feed is driven by Vermont dairy farmers, who purchase oilseed meals to meet the protein requirements of lactating dairy cows. Some farmers purchase roasted soybeans directly from other farmer-growers who have their own roaster.

Secondary purchasers of oilseed products include emerging local food companies such as Vermont Soy, and could include other food processors, natural food co-ops and restaurants interested in the oil. Finally, oilseed crops could be used in crop digesters to generate electricity.

2. Sources and Shipment

Vermont imports the vast majority of its oilseeds and meal, in part because Vermont has no commercial seed crushing facility. Due to the relatively small amount of oilseeds grown in the state, there is an inadequate supply of seeds to warrant a commercial plant.

The seed-crushing facility closest to Vermont is Ag Pro, Ltd., in Maseena, New York, which produces conventional and certified organic and kosher products. Ag Pro uses a mechanical oil extraction process, and produces both a soybean meal—"Agrasoy Natural," formulated for the dairy industry—and fully refined soy oil. Ag Pro has the capacity to process 5,500 bushels or 150 tons of beans per day, or over 50,000 tons per year. It can refine over 16,000 tons of oil per year. In 2003, the plant was operating at approximately one third of its capacity, due to the decreased demand for high-quality feed resulting from high soybean prices and low milk prices.

There are two other crushing facilities in western New York, both of which also use mechanical extraction: Sheppard Grain in Phelps and Homer Oil Company in Homer. Archer Daniels Midland operates an oilseed processing plant in Windsor, Ontario, and Bunge Canada has a plant in Hamilton, Ontario.

A. Conventional Meal

Conventional soybean meal originates from crushing facilities in the Midwestern U.S. or Canada, whereas canola meal comes almost exclusively from Canada, especially Saskatchewan. The meals travel to Vermont by rail, and in some cases are transferred to truck for the last few miles to the mills. Vermont feed mills typically mix the meal with other components in preparing a grain ration that is delivered to the farmer. The price charged to the farmer includes the dealer's delivery cost. Alternatively, the feed dealer may sell bulk shipments of a single meal commodity to large farms that mix their own feed rations on-site.

B. Organic Meal

Like conventional feed mills, organic feed mills in Vermont either mix their own feed using dry meal imported from out-of-state, purchase roasted soybeans, or roast soybeans purchased from local farmers on-site. In addition, a significant quantity of organic soybeans is coming to the United States from China (at $20-$30/ton lower price).

3. Pricing and Key Determinants of Value

Feed mills and farmers can choose from a variety of protein sources in preparing grain rations for livestock. Soybean and canola meals are the predominant meals sold by commercial feed mills, although animal protein sources, roasted soybeans, ureas, and distillers' grains are also available. Feed mills weigh the prices of these various inputs against the nutrient requirements of the livestock in order to develop a balanced feed ration.

The key determinants of the meal's value to feed dealers and farmers are quality and consistency. Commercial suppliers guarantee that the meal will meet a minimum set of criteria for moisture, protein, fat content, and other components. One Vermont feed dealer samples loads for quality irregularly, but reports that the commodity meals' quality usually exceeds the standard. The price a farmer can expect to receive for locally crushed meal depends to a great extent on its quality (protein, fat, and other nutrient content) and on the farmer's ability to guarantee consistency in that quality from batch to batch and from load to load. Dairy farmers feed their cows a ration carefully balanced to maximize milk production. Feed of questionable quality may cause milk production to suffer, a risk few farmers will be willing to take. The buyer of the meal will not pay a competitive price if he or she cannot be sure of the meal's quality. Therefore, the price of farm-processed meal is expected to be discounted significantly unless quality control can be established.

A. Conventional Meal

According to Vermont feed dealers, soybean meal is the benchmark price for protein feed sources. Local feed mills pay a commodity price (established by the Chicago Board of Trade and Winnipeg Commodity Exchange for soybeans and canola, respectively), plus transportation costs to Vermont. On March 30, 2007, Poulin Grain's market prices for soybean meals delivered to the farm ranged from $278 per ton for 48% protein, solvent-extracted meal, to $329 per ton for SoyPlus (heat-processed meal high in rumen-bypass protein). Whitman's Feed in North Bennington reported buying conventional, hexane-extracted canola meal for $170/ton delivered by rail car. Canola seed closed at approximately US$309 per ton on April 13, 2007. The price of canola meal is influenced by U.S. soy meal and oil prices, but also by world vegetable oil prices, since demand for canola is driven primarily by oil and secondarily by meal.

Local conventional feed dealers stated a willingness to purchase on-farm crushed meal from Vermont farmers, provided it met quality and consistency standards (e.g., free of pods and weeds, acceptable moisture content), and could be supplied reliably.

B. Organic Meal

Prices for organic soybeans and other grains are substantially higher than conventional feeds due to growing demand and limited availability. Green Mountain Feeds in Bethel reported that they cannot get enough organic canola or sunflower meal to use it in their organic rations on a consistent basis; and would expect to pay $400-$450/ton for these organic meals. Ag Pro, for example, sought to contract 15,000 acres of organic soybeans in

2005 at $450 per ton. The shortage is such that feed mills can be competing with buyers of food-grade beans for supply. Most organic mills stated they would pay more for domestic (U.S.) beans, seeds, or meal, with a premium (up to approximately $20 per ton) for Vermont-produced meal. Local sourcing would provide added purchasing flexibility if out-of-state shipments were off-schedule. Finally, the absence of genetically modified organisms (GMOs) is an important criterion for organic feed mills and farmers, and this could present additional opportunities for Vermont farmers interested in meeting this demand.

C. Volumes and Storage

The short-term volumes of soybean and canola meals purchased by feed mills depend in part on the prices of the commodities and their bases, but overall, the quantities imported by conventional feed mills are significant. The major feed mills in Vermont (Poulin Grain, Bourdeau Bros., and Blue Seal) together import over 650 tons of soybean meal and over 460 tons of canola meal each week. To meet this demand through in-state production, Vermont would have to plant approximately 39,000 acres of soybeans and approximately 48,000 acres of canola per year.

Oilseed meals are stored in grain bins, and must have a moisture content of no more than 8% to 10% to prevent rot and molding. Dry meal also moves through augers, mixers, and other processing equipment more easily, and does not stick to the sides of bins as readily. Long-term storage is not a problem for most feed mills, however, since the meal turns over quickly. Farmers with their own grain bins may store meal for a season or two at most.

4. Estimated Vermont Demand

Vermont's agriculture sector is dominated by milk production, and dairy cows are the major livestock type by number of head. Although Vermont farmers also raise sheep, emus, ostriches, alpacas, llamas, and other animals, only cows, hogs, chickens, and turkeys are raised in sufficient numbers to create meaningful demand for protein meal. Table 1 shows the estimated numbers of the major livestock types in Vermont.

Table 1. Estimated Number Of Livestock Fed Protein Meal In Vermont

Dairy cows – conventional	137,500
Dairy cows – organic	3,500
Beef cattle (cows, calves, yearlings)	18,000
Hogs and pigs	2,500
Laying chickens 20 weeks old and older	211,968
Pullets for laying flock replacement	30,956
Broilers and other meat-type chickens	134,529
Turkeys	55,865

Source: Conventional dairy cow, beef cattle, and swine data from National Agricultural Statistics Service, Agricultural Statistics Database. Poultry data from National Agricultural Statistics Service, 2002 Census of Agriculture. Organic dairy cow data from Economic Research Service, USDA, Data Sets: Organic Production, Table 5: Certified Organic Livestock.

Different types of oilseed meal have different characteristics. Overall, soybean meal is the most desirable for livestock feeding in terms of protein content and amino acid profile. Soybean meal contains several factors that reduce its digestibility to poultry and swine, however. The most important such anti-nutritional factors are trypsin inhibitors, which interfere with the trypsin enzyme that breaks down proteins in the animal's intestinal tract. If the trypsin enzyme is inactivated, the animal will not be able to absorb all of the protein nutrients in the meal, and the animal's pancreas may enlarge in order to produce more enzymes. The presence of urease in soybeans is also a concern for ruminants. Uresase can react with urea in the cow's diet to produce ammonia. Heating the meal to at least 140–150ºF or roasting whole beans at approximately 220–245ºF both deactivates the trypsin inhibitors and urease, however. Heating also decreases the amount of rumen-degradable protein in the meal, making it more attractive as a feed for dairy cows.

Relative to soybean meal, canola and sunflower meal have higher amounts of rumen-degradable protein, which can limit the amount fed per day to dairy cows. Canola also cannot be fed in large amounts (maximum 3% of diet by weight) to brown egg–laying chickens.

In estimating protein meal demand by Vermont livestock, it was assumed that cows on a conventional dairy farm are fed 5 to 8 pounds of protein meal per day, and that organic dairy cows are fed one-third less, or 1.5 to 3 pounds of protein meal per day. Compared to dairy cows, other livestock are fed relatively small amounts of grain per day. It was assumed that grain-finished beef cattle are fed 5 pounds per day for 90 days, and that beef calves and heifer replacements are fed 2 pounds per day for 180 days. Hogs, turkeys, and broiler and laying chickens are fed less than a pound per day on average. The lower consumption and smaller numbers of beef cattle, swine, and poultry in Vermont means that approximately 97% of the state demand for protein meal is estimated to come from dairy cows.

A. Conventional Meal

Table 2 gives a rounded estimate of the annual demand for conventional oilseed meals. Tables 3 through 5 detail the estimated annual demand for conventional soybean, canola, and sunflower meal in Vermont, respectively, based on typical livestock diets and rations. These estimates were derived to calculate the maximum potential in-state demand for each oilseed meal by taking each meal singly and assuming it as the only protein source. They do not, therefore, account for the blending of meals that could and does occur.

Table 2. Estimated Annual Vermont Demand For Conventional Oilseed Meals

Oilseed Meal	Estimated Annual Vermont Demand (rounded)
Soybean meal	166,000 tons
Canola meal	90,000 tons
Sunflower meal	140,000 tons

Table 3. Estimated Annual Vermont Conventional Soybean Meal Demand

	Soy Meal Demand (lbs)		Total Meal Demand
Livestock Type	Min	Max	
Dairy cows (conventional only)	646,900	1,035,040	97%
Beef cattle, swine, chickens, and turkeys	0	29,825	3%
Range total meal demand (lbs/day)	646,900	1,064,865	

Range total meal demand (lbs/year)	236,118,500	388,675,545	
Range total meal demand (tons/year)	118,059	194,338	
Midpoint total meal demand (lbs/day)	855,882		
Midpoint total meal demand (lbs/year)	312,397,022		
Midpoint total meal demand (tons/year)	**156,199**		

Table 4. Estimated Annual Vermont Canola Meal Demand

	Canola Meal Demand (lbs)		Total Meal Demand
Livestock Type	**Min**	**Max**	
Dairy cows (conventional only)	388,140	517,520	95%
Beef cattle, swine, chickens, and turkeys	0	25,285	5%
Range total meal demand (lbs/day)	388,140	542,805	
Range total meal demand (lbs/year)	141,671,100	198,124,002	
Range total meal demand (tons/year)	70,836	99,062	
Midpoint total meal demand (lbs/day)	465,473		
Midpoint total meal demand (lbs/year)	169,897,551		
Midpoint total meal demand (tons/year)	**84,949**		

Source: Canola Council of Canada, Canola Meal Feed Industry Guide, (Accessed from http://www.canola-council.org/meal5.html on February 24, 2007.

Table 5. Estimated Annual Vermont Sunflower Meal Demand

Livestock Type	Sunflower Meal Demand (lbs) Min	Max	Total Meal Demand
Dairy cows (conventional only)	388,140	1,035,040	98%
Beef cattle, swine, chickens, and turkeys	0	25,575	2%
Range total meal demand (lbs/day)	388,140	1,060,615	
Range total meal demand (lbs/year)	141,671,100	387,124,349	
Range total meal demand (tons/year)	70,836	99,062	
Midpoint total meal demand (lbs/day)	724,377		
Midpoint total meal demand (lbs/year)	264,397,725		
Midpoint total meal demand (tons/year)	**132,199**		

Source: National Sunflower Association, Meal/Wholeseed Feeding, Accessed from http://www.sunflowernsa.com/wholeseed/default.asp?contentID=253 on April 7, 2007.

B. Organic Meal

Of Vermont's approximately 1,180 dairy farms, about 200 are expected to be certified organic by end of 2007, with the remaining 980 using conventional methods. Organic dairies typically work to increase the quality of their forage and many emphasize grazing/forage feeding practices over grain feeding practices in order to improve animal health and control (or decrease) grain purchases, which can run twice the cost per cow compared to conventional meal. As a result, organic dairies contacted for this study report protein feedings of one-third less, on average. Furthermore, organic dairy herds tend to be smaller then conventional herds. In the long run, a continued shift to organic production could decrease the *overall* need for protein meal in the state as a result of smaller herd size and feeding practices that focus on forages, not grain. In the short term, however, the shift toward organic milk production is increasing demand for *organic* protein meal in Vermont. Table 6 summarizes the estimated demand for organic oilseed meals in Vermont, estimated based on an organic dairy herd population of approximately 11,600 cows.

Table 8. Estimated Vermont Organic Oilseed Meal Demand

	Meal Demand (lbs)	
Organic Dairy Cows	**Min**	**Max**
Range total meal demand (lbs/day)	5,250	10,500
Range total meal demand (lbs/year)	1,916,250	3,832,500
Range total meal demand (tons/year)	958	1,916
Midpoint total meal demand (lbs/day)	7,875	
Midpoint total meal demand (lbs/year)	2,874,375	
Midpoint total meal demand (tons/year)	**1,437**	

5. Quality

Samples of meal from 2006 soybean, canola, and sunflower seed pressed at State Line Farm and 2007 sunflower, canola, and moldy canola from Borderview Farm were sent to the UVM Agricultural Testing Lab in October 2006 and to the DairyOne lab in Ithaca, New York, for a comprehensive analysis of their components. Table 20 shows the results of these analyses.

Several aspects of the nutrient analyses are particularly important to understanding the potential value of these oilseed meals. The first crucial component is protein. Oilseed meals are used in livestock diets primarily to supply protein. All but one sample of the farm-pressed meals had an available protein level of 30-50%, which is comparable with commercial feeds. (The 23% protein level on the January tested sunflower is below the normal range.

As or more important than the level of protein, however, are the quality and characteristics of the protein supplied. Different oilseeds contain different amino acids, and each species of livestock requires these amino acids in differing proportions. Further analysis is needed to determine the amino acid profile and true protein content of these meals, and therefore to establish the suitability of these meals for various animal species. University of Vermont Animal Science professor Matthew Waldron recommends conducting an in situ protein degradability test on several samples of meal. These tests involve placing meal in a nylon bag, incubating the meal in a cow's rumen for a period of time, and then analyzing the meal to see which components were used by the cow. These tests cost approximately $100 per sample and can establish the percentage of rumen bypass protein and the amino acid levels of the feeds.

The second component of interest is fat. As discussed previously, commercial feed meals contain only 1% to 6% fat. As Table 21 shows, the fat content of these samples is quite high, ranging from 13% to 29%. The high fat content is undesirable for two reasons. First, it indicates that a substantial amount of oil is not being recovered from the seed, and is being left in the meal. Second, according to Dr. Waldron, although "in some species (such as swine or poultry), the fat in the meal may be a welcome source of energy, in other species we must be more careful about how much fat we feed." Too many unsaturated fatty acids, for example, can inhibit pregastric digestion in ruminants (cows, goats, and sheep) and are therefore typically limited to 2–4% of dietary fat in these diets.[77]

Heat treating of the meal is another consideration. As discussed previously, "controlled heating of the meal is beneficial because it neutralizes anti-nutritional factors such as trypsin inhibitors." Trypsin inhibitors reduce digestibility of the meal, impairing animal performance and allowing more nutrients to pass through the animal, increasing potential environmental impacts (such as higher amounts of nitrogen excreted). An analysis of one State Line Farm soybean meal sent to Midwest Laboratories showed urease activity limited to 0.05 pH unit rise, indicating that adequate heat was applied to deactivate trypsin inhibitors. This sample indicates that the State Line press is capable of adequately heating the meal, but the test did not note the temperature or length of time that heat was applied. Further testing is required to establish the optimal time and temperature settings the press in order to deactivate the trypsin inhibitors.

In general, using farm-pressed meal reduces daily feed costs only if the local meal is priced at a discount. These savings would produce a net gain for the farm only if milk production (and therefore revenues) does not suffer as a result of the change in the cows' diet. If the switch to farm-pressed feed were to cause a drop in milk production and farm revenue, the farmer would be no better or even worse off.

For these reasons, the importance of establishing consistency and quality of farm-produced meals cannot be overstated. If the local meal is not of guaranteed quality and consistency, it represents a major risk to the farmer in terms of its potential to reduce milk production and decrease revenues. Without quality assurance, farmers' only incentive to buy locally produced meal would be if it is available at a significant discount, reducing revenue potential for the oilseed grower/meal producer. If the meal's quality can be assured and it can be priced more competitively, the CNCPS software shows that as the price of farm-pressed meal approaches that of commercial meals, the feed cost per day approaches that of the base ration, and the savings to the farmer of using local meal is reduced. In other words, when the price differential is removed, the two meals are competing solely on quality. Quality must therefore be assured to make locally produced meal competitive with commercially produced feed meals.

In sum, beyond simple cost savings, a farmer's decision to include the meal in a feed ration will also depend on several other logistical factors, such as the amount of meal processed, the consistency and reliability of supply, the need for feed analyses for each batch to ensure quality and consistency, and the effort needed to mix the meal. These factors will vary from farm to farm.

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