Feeding the 2009 crop
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A cold and wet spring which delayed seeding and sprouting has resulted in a late harvest throughout most of the Western Canadian Prairies. The early September Saskatchewan crop report confirmed a harvest that is well behind the 5 year average. Although, a long, dry and sunny fall could significantly improve the outcome, it is reasonable to predict that the 2009 harvest will result in significant amounts of grain that is immature, frozen and or sprouted. Because these grains will be discounted, even relative to feed-grade grains, they represent an opportunity for lowering the overall cost of feed for swine producers.

Barley and Wheat

Grains are primarily incorporated into swine rations to provide energy; protein and amino acids can be supplemented with specific ingredients. The digestible energy (DE) content of a grain is due to the total amount of energy (gross energy, GE) in the kernel (derived from fat, starch and protein) and the digestibility of this energy by the animal. Unfortunately energy digestibility can't be measure directly in an analytical lab. The best we can do is to determine nutrient digestibility experimentally and correlate these measurements to the chemical composition. Prediction equations can then be developed. This has been done in a series of experiments with barley and wheat. An equation developed for barley samples collected in 2002 explained 86 % of the variability in DE. It requires the measurement of acid-detergent fibre (ADF) and crude protein (Clowes et al. 2003) while the best equation for wheat uses neutral detergent fibre (NDF) and crude protein (Zijlstra et al. 2003). The R^2 of 0.75 for the wheat equation indicates that 75 % of the variation in DE content can be explained using this equation, or conversely 25 % of the variation in DE content is unexplained (Table 1). This data set is particularly relevant for the current year because 14 of the 16 samples used in this data-set were frost damaged.

Table 1. Equations to predict DE (Kcal/kg) content of barley and wheat.[1]

		R^2
Barley[2] :	DE = 3,542 – 138.8 × ADF + 39.3 × CP	0.86
	DE = 4,054 – 135.2 × ADF	0.80
Wheat[3]	DE = 3,584 + 38.3 × CP – 16.0 × NDF	0.75

[1.] DE (kcal/kg DM), ADF, ADF and NDF (% DM)
[2.] Clowes et al. 2003
[3.] Zijlstra et al. 1999

Density or bushel weight is commonly used to estimate grain quality. Bushel weight is easy, low-cost and fast, ADF and NDF are none of these. Research over the past 20 years, however, has been unable to demonstrate a good relationship between bushel weight and feeding quality of grains for swine. Frost damaged grains often have a low bushel weight, primarily because of an increased fibre and lower starch content. The degree of damage depends on maturity of the crop and when the frost damage occurred. The following table (adapted from a 1980 Agriculture and Agri-Food publication) and graph (adapted from work conducted at the Prairie Swine Centre in 1993) demonstrate why there is some confusion regarding the use of bushel weight as an indication of grain quality.

Table 2. Relative feed value of damaged cereal grains.

Grain		Density kg/hL	Density (lbs/bushel)	Composition (%) Protein	Fat	Fibre	Ash	Feed value[2]
Wheat	Not damaged	78	(62)	14.8	1.8	2.6	1.5	105
Wheat	Slightly frozen	70	(56)	14.3	1.9	3.5	1.7	104
Wheat	Frozen or sprouted	63	(50)	14.7	2.1	4.0	1.9	102
Wheat	Frozen or sprouted	50	(40)	14.9	2.6	4.6	2.0	90
Wheat	Burnt (20% charred)	68	(54)	12.1	1.9	4.5	2.1	92
Barley	No damage	63	(50)	11.9	2.1	6.0	2.6	**100**
Barley	Frozen or sprouted	55	(44)	11.8	2.1	6.6	2.5	94
Barley	Frozen or sprouted	45	(36)	11.8	1.9	7.8	3.0	86
Oats	Frozen or sprouted	40	(32)	13.8	5.1	11.1	2.9	89
Oats	Frozen or sprouted	35	(28)	13.4	4.6	13.9	2.9	85

[1]Adapted from "Feeding Frost-Damaged and Sprouted Grain to Livestock" Fact Sheet, Sask. Ministry of Ag. (citing Ag and Agri-Food Canada publ # 1277; 1980)
[2]Relative to #1 Feed barley

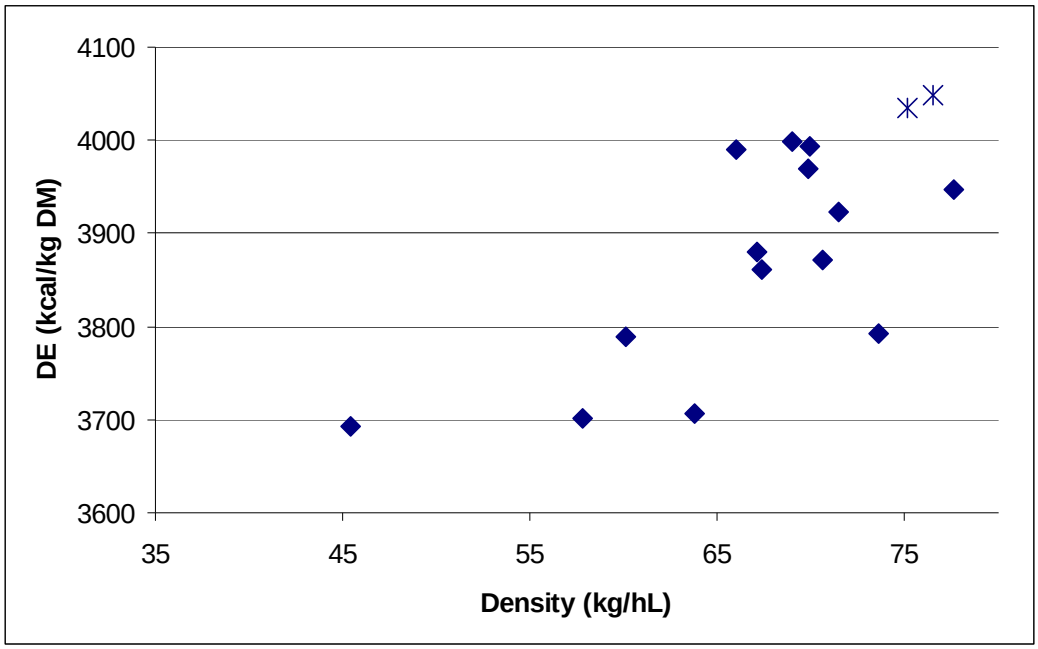
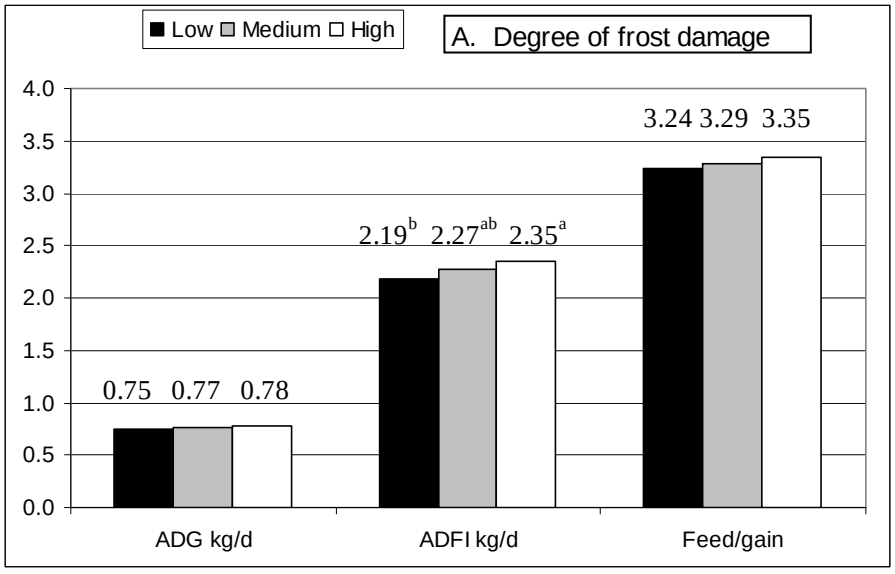


Figure 1. Correlation of grain density with digestible energy content in 16 wheat samples. Samples indicated by ✳had optimal growing and harvesting conditions while ◆ samples had some degree of frost damage. Note (To convert kg/hL to lbs per bushel, divide by 1.25 or for example a density of 60 kg/hL is a bushel weight of 48).

It is clear from both of these data sets that a decline in density due to frost –damage correlates with decreased DE content of the grain. However, upon closer examination we can see that this relationship is only valid when comparing extremes, for example when comparing undamaged wheat with a bushel weight of 62 to damaged wheat with a bushel weight of 40 (Table 2) but above a bushel weight of about 40 for wheat or 45 for barley, bushel weight does a poor job of predicting DE.

Canola. Similar to what is observed with barley and wheat, an early autumn frost may prevent the maturation of canola, resulting in reduced yield, lower oil content and increased dockage.

The increased dockage may down-grade the canola sufficiently that its use as an animal feed becomes a consideration. The following graph (figure 2) and table 4 shows that ground frozen canola seed can successfully be incorporated into swine rations. In this experiment canola with either a low (20 % frost damaged seeds), medium (45 % frost-damaged seeds) or high (65 % frost-damaged seeds) degree of frost-damage were incorporated into swine diets at 10, 20 or 30 %. There were no interactions of frost-damage by level of incorporation. There is some evidence that frost-damage actually improved the palatability of the canola seed. The improvement in feed intake with degree of frost damage was observed even in the early grower period (23 to 57 kg). At current prices, frost damaged ground canola is worth about 1.3 × that of barley (Table 4)



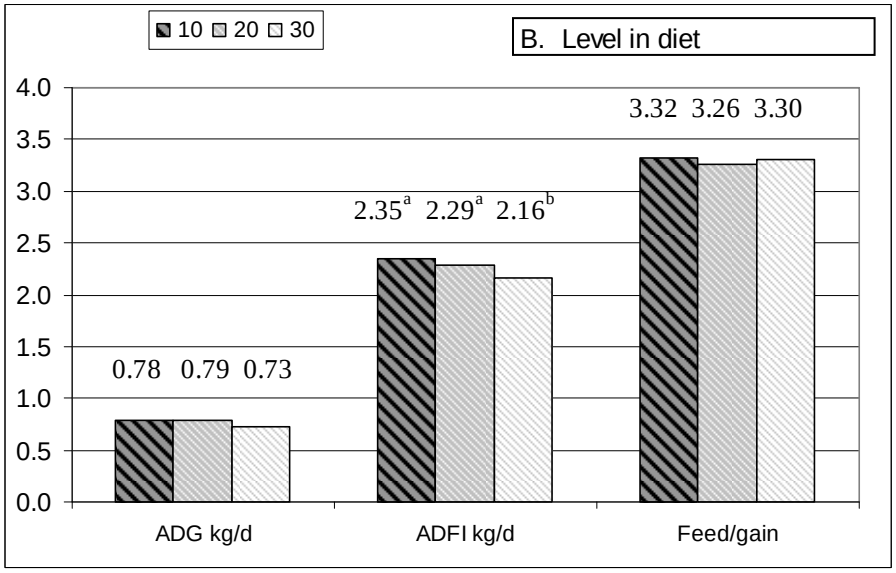


Figure 2. The response of growing pigs (23 to 100 kg BW) to the incorporation of ground frozen canola into their diets. A. Degree of frost damage (low, medium or high refers to 20, 45 or 65 % frost damaged seeds). B. Level of incorporation of the frost-damaged seed into the diet. 10, 20 30 refers to 10, 20 or 30 % incorporation)

Table 4. Value of frozen canola seed relative to barley at different price ratios. Barley price equals 100.[1]

		Barley:canola meal price ratio	
Frost Damage	Seed Form	**1:1.50**	**1:2.00**
Low	Whole	61	55
Medium	Whole	50	40
High	Whole	60	52
Low	Ground	132	142
Medium	Ground	121	127
High	Ground	128	135

[1]Bell et al. 1985.

Ergot

A cool, wet spring is ideal for the development of ergot contamination. Ergot is a fungal disease which primarily affects rye and triticale, but may also affect barley and wheat. Ergot was a problem in 2008 in Western Manitoba, Saskatchewan and into Central Alberta. Carry-over from the 2008 infestation puts the 2009 crop at higher risk. Ergot contains numerous poisonous substances (alkaloids) which, if consumed, lead to poor growth rate, decreased feed consumption and poor feed efficiency. The effect of impairment depends upon the age or physiological stage of the animal, amount consumed, and the form of alkaloid present. Research conducted at PSCI with weanling pigs showed severe reduction in growth performance with 0.10 % ergot in the ration when fed for 14 or 28 days. A drop in serum prolactin was observed with even the smallest dose of ergot (0.05%) indicating that no level should be fed to the breeding herd.

Moulds and mycotoxins

Grain harvested immature or damp will be more prone to mould during storage. The toxins produced by molds, notably vomitoxin (DON) and zearalenone negatively affect performance, similar to ergot. The recommended maximum amount of DON in diets for nursery, grow/finish or the breeding herd is 0.5, 1.0 and 1.0 ppm respectively. The recommended maximum amounts of zearalenone are 0.5, 2.0 and 0.5 ppm for nursery, grow/finish or the breeding herd, respectively. A ppm is parts per million (1 part per 1,000,000!). Some labs may report this as mg/kg or ug/g.

There are several feed additives on the market which claim to reduce the detrimental effects of feeding mould contaminated grain. In an experiment conducted at PSCI these were not effective against DON (Centred on Swine, Spring 2008). A producer faced with feeding a large amount of contaminated grain may however, want to consider one of these feed additives as they may show some efficacy against different toxins or if the toxin is at a lower concentrations.

What to do- The Bottom Line

Discounted, frost damaged wheat, canola or barley can represent an opportunity for pork producers. Producers should have the grain tested for fibre content (ADF and NDF) and use appropriate equations to adjust the DE content. However, these equations are not accurate if the damage is severe (bushel weight of 40 or below for wheat or 45 for barley). The energy content of severely damaged grain should be discounted by 10% and/or it should be diluted with undamaged grain.

If ergot or mould is suspected, again the grain should be tested. It should then be mixed with "clean" grain to ensure the toxin does not exceed the recommended levels. None of this grain should be included in rations destined for the breeding herd.