Harvesting Soybeans for Silage:
A possible risk management tool for short season areas

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The production of soybeans in non-traditional areas (ie: areas with less than 2400 CHU's) is increasing. Approximately 1000 acres of soybeans were grown in the Temiskaming District (New Liskeard to Englehart) in 1998. The soils of this area are well suited to soybeans and experienced cash-crop producers are plentiful, however, long-term climatic data would suggest that soybeans are a risky crop due to the short growing season. There is a danger that soybeans may not reach physiological maturity or that they would not dry down sufficiently for proper harvesting. In a situation where cool conditions result in a soybean crop that is clearly not going to mature in time, harvesting the crop as whole plant silage may be an option. This practice was investigated at NLARS during 1998.

Methods:

Two short-season, commercially available soybean varieties, Alta (First Line Seeds) and Corona (Hyland Seeds) were sown at 120 kg/ha in 18 cm rows (approx. 10 seeds per meter of row) on May 12, 1998. The seed was not inoculated but 50 kg/ha of N fertilizer was applied pre-plant. Phosphorus and potash levels were sufficient based on the OMAFRA soil test. In addition to the small plots, a larger area (about 3 acres) was sown to soybeans to make round bale silage.

Whole plant soybeans were harvested with a flail-type forage plot harvester on August 24, September 01, September 08 and September 15. A final set of soybean plots was combined for grain on October 06. Prior to each forage harvest, a subsample (2 sections of row 1 metre long per plot) were hand clipped at ground level and separated into leaves, stems and pods (including seeds). Moisture samples were collected on each plot and a subsample of the harvested material was submitted for forage quality analysis. The 3 acre block of soybeans was cut with a swather on August 31 and round baled on September 01. The bales were line wrapped shortly after baling was completed.

Results:

i) Corn Heat Unit Accumulation:

Corn heat unit accumulation up to our predetermined harvest dates was about 300 CHU's (14%) above the previous 5 year average (Table 1). Therefore the soybeans in our plots were more mature at harvest than we had expected (see discussion below).

Table 1. Corn heat unit accumulation at NLARS for 1998 and 1993-1997.

Date	1998 CHU's	5 Year Average (1993-1997)
August 24	2292	2007
September 01	2466	2148
September 08	2573	2258
September 15	2672	2352

ii) Yield of Whole Plant Soybeans:

Whole plant soybeans were harvested weekly starting on August 24. There was no significant difference in whole plant forage yield or grain yield between the two varieties (Table 2). Dry matter yield peaked on the September 01 harvest dates for both varieties. By September 15, whole plant yields had decreased by about 30% relative to the maximum yield. Soybean grain yield was about 15% of maximum whole plant yield. This is lower than expected. The grain yield may have been restricted by low nitrogen and dry weather in August. Maximum whole plant soybean yield appears to be about 75 to 100% of two cuttings of alfalfa at this site.

Table 2. Whole plant soybean yield of two varieties at four dates and grain yield in fall.

Date	Alta (kg/ha)	Corona (kg/ha)
August 24 (whole plant)	7447	7972
September 01 (whole plant)	8623	9211
September 08 (whole plant)	7365	7628
September 15 (whole plant)	6145	6035
October 06 (grain only)	1355	1507
Overall Average	6329 kg/ha	
Significance: Varieties	Not significant	
Significance: Harvest Dates	Highly significant (***)	
Significance: Variety x Date	Not significant	
Coefficient of Variation	15.4%	

iii) Components of Harvested Material

At each harvest date, soybean plants were hand-separated into leaf, stem, and pod (including seed) components. In general, stem content was constant over the four harvest dates, while leaf content decreased and pod content increased (Table 3). At the first harvest date, about 23% of the harvested material was leaf. This dropped to zero by the fourth harvest date. During the same period, pod and seed content increased from about 45% to almost 70% of the total dry matter harvested. As mentioned above, the heat unit accumulation was much higher than normal in 1998. This resulted in soybeans being more mature at the pre-determined harvest dates than we expected. We had anticipated the leaf content being higher at the earlier harvest dates. Since we would expect forage quality to be higher in leaves than stems, harvesting prior to leaf drop would be desirable.

Table 3. Composition of whole-plant soybean forage (component as a % of dry matter)..

Harvest Date	Pods (incl. seed)	Leaves	Stems
August 24	45.9 %	22.5 %	31.6 %
September 01	56.3 %	16.1 %	27.5 %
September 08	69.1 %	4.5 %	26.4 %
September 15	73.4 %	0.0 %	26.6 %

iv) Forage Quality:

Forage quality results of wrapped round bale soybean silage are shown in Table 4. The forage sample was taken 5 weeks after the round bales were wrapped, so we assume that the silage mass had reached stability. Crude protein levels were similar to mixed hay, while fibre levels were similar to high quality legume hay. The estimated energy was higher than top quality alfalfa hay. The calcium to phosphorus ratio was relatively high. About 15 round bales of soybean silage are available and will be used to assess its palatability to livestock this winter. Quality analysis of the small plot soybean forage is not yet available.

Summary:

This project was undertaken to assess the potential to salvage immature grain-type soybeans for forage instead of grain. Since our heat unit accumulation was significantly above normal, the soybeans were more mature at the predetermined harvest dates than we had expected. Dry matter yields were quite acceptable, approaching those of two-cut alfalfa. Leaf drop was earlier than expected and as such only about 15 to 20% of the harvested forage was leaf material at maximum yield. While full quality analysis is not yet complete, quality analysis of round bale soybean silage revealed moderate protein levels and relatively high energy content.

Table 4. Quality analysis of whole-plant soybean silage cut 110 days after planting and sampled 5 weeks after wrapping (all values are dry basis).

Dry Matter	33.0%
Crude Protein (%)	13.5
Acid Detergent Fibre (%)	28.1
Neutral Detergent Fibre (%)	40.0
Calcium (%)	1.77
Phosphorus (%)	0.28
Potassium (%)	1.65
Magnesium (%)	0.51
Sodium (%)	0.03
Estimated Total Digestible Nutrients	70.6
Ca:P ratio	6.4:1

The key management decision involved in salvaging immature soybeans as silage will be when to concede that the crop will not make grain (and hence to cut it as forage). It is apparent that if one wants any significant leaf content in the silage, the decision to harvest the whole plant will have to be made in late August or early September. At that time, growers may not be prepared to harvest as forage, but rather wait and hope the crop matures sufficiently for grain.

The other concern will be the end use of the silage. Dairy farmers will likely be able to find a use for soybean silage by blending with haylage to form a heifer or milking ration. Producers who are strictly cash-cropping would have to make arrangements to sell the crop for silage standing or harvest and store it and try to market the silage in the winter.

This trial will be repeated in 1999 to further evaluate soybean silage production from short-season grain varieties.