Cereal Silage Options for Western Canada

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Take Home Message

- Cereal crops provide producers with a lot of options that allow the producer to balance silage yield, quality, harvesting and storage.
- Producers must look at species, varieties and mixtures as ways of controlling silage quality.
- In monocrops, the stage of harvest should be at the soft-dough stage. In mixtures, the later maturing component at the soft-dough stage will give highest yield and energy and if harvested when the earliest component is at the soft-dough stage, protein content will increase.
- Disease factors are important considerations. Rotate your crops and varieties to guard against the build up of new diseases or disease races.

Introduction

The Alberta Agriculture Field Crop Development Centre had its beginnings in 1973 with its primary objective being the development of cereal crops for animal feed as grain and forage. We have developed 17 barley varieties, 2 spring triticale and 2 winter triticale varieties at the Centre. All of these varieties have been targeted to Alberta's livestock industry for feed as a grain or as forage. We have therefore put all of our varieties and breeding lines through tests to evaluate them not only for grain and biomass yield but also for nutritional and effective quality. This has been much easier for monogastric nutrition than for the ruminant. It has also been difficult to determine what the industry is looking for in quality. When it comes to silage production, we find that perception and agronomic factors often play a greater role than yield and quality when farmers make decisions regarding crop and variety. With this in mind we have seen the growth of silage as a crop from about 100,000 hectares to nearly 0.4 million hectares over the last 25 years. Silage production is expected to increase to over 0.6 million hectares in the next 5 years. Some estimates indicate that in 2001, 0.56 million hectares were used for forage.

This is probably indicative of the response to lower yields due to drought and included in this is crop that was pastured.

It is likely that there will be further growth in the production of silage crops to meet the needs of a growing cattle industry. Dairy producers are the leading edge when it comes to quality and we hope that we can provide you both the yield and quality you need for your operation.

■ Silage Quality

Silage making is less dependent upon good weather than haying, giving more control over quality. Producers have found over the years that barley provides on average a better quality product than other cereals. Barley makes up over 85% of the annual cereal silage production. However, from time to time we see pushes to grow other cereal crops or corn depending on the year and location. It is difficult to obtain good data to compare yield or quality due to the environmental differences from location to location and from year to year.

The data presented in this paper are the most recent data from our trials at Lacombe where we are able to obtain reliable data from tests grown under the same fertility and moisture conditions. We have tested primarily barley, spring triticale and winter triticale over the years with oat, spring wheat and fall rye as checks. This data shows the same trends as the studies by Khorasani et al. (1997) that examined the influence of stage of maturity on the chemical composition of alfalfa, oat, barley and triticale silage. Their results indicated that as the crop matured and dry matter increased, the protein content decreased. Acid detergent fiber (ADF) and neutral detergent fiber (NDF) increased until about 3 weeks after boot stage and then declined due to the increase of starch in the seed. Acid detergent lignin (ADL) steadily increased as the plant matured in all crops except barley, which peaked at approximately 2 to 3 weeks post-boot stage and then declined. This is most likely due to dilution effect from the grain but is not seen as dramatically in the other cereals.

Baron et al. (1999) evaluated the quality of forage taken at 10 days post anthesis and at early dough stages of growth for barley, oat and triticale (Table 1). These data show the same trends as that of Khorasani et al. (1997).

Table 1. Average silage quality for barley, triticale and oats grown at Lacombe in 1995-1996 (from Baron et al 1999).

Species	Date	ADF	NDF	LIGNIN	IVDOM[a]	PROTEIN
Barley	D1	34.6	59.0	4.1	69.9	13.2
Barley	D2	26.6	51.7	3.8	67.3	10.7
Oat	D1	36.5	61.5	5.0	67.3	10.5
Oat	D2	34.0	60.3	5.3	62.2	9.9
Triticale	D1	33.7	58.0	4.7	68.8	11.6
Triticale	D2	27.6	52.6	4.2	66.8	9.4

D1 – Ten days post anthesis
D2 – Early dough stage
a – in-vitro digestible organic matter

Juskiw et al. (2000b) reported on the components of the biomass relating to leaf, stem and spike for barley, oat and triticale (Figure 1). It is generally accepted that the leaf is important in the protein quality and the spike is important in the energy factor while the stem contains more of the fiber and lignin. Their data indicated that the winter cereals represented by 'Prima' rye and 'Pika' triticale had the highest percent of stem followed by 'Seebe' two-row barley. These cereals also had the lowest percent of spike. The six-row barley 'Kasota', 'AC Lacombe' and 'Noble' had the highest percent of spike. The oat 'AC Mustang', the spring triticale 'Wapiti' and the two-row barley 'Seebe' had the highest percent leaf.

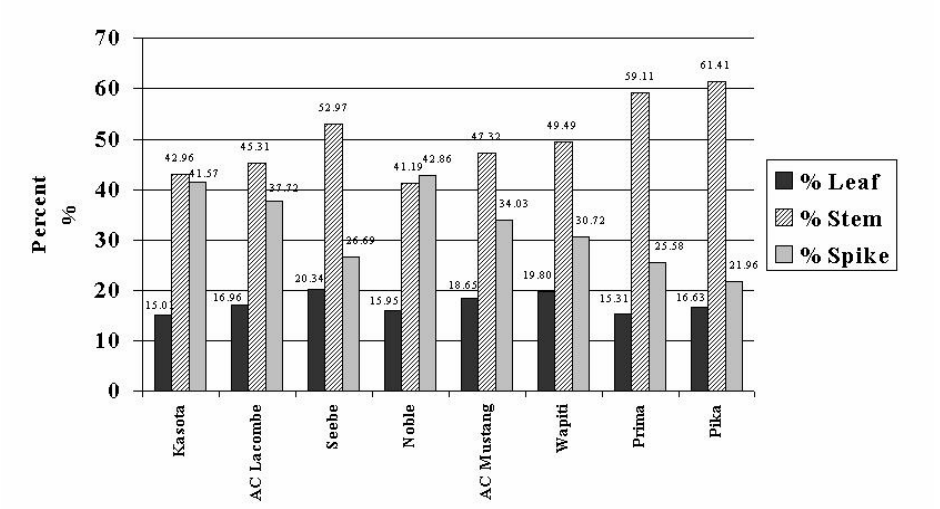

Figure 1. Component biomass of different cereals (from Juskiw et al.)

Figure 2 gives an indication of the range of quality that can be found between species when harvested at the soft-dough stage. This indicates that there is a great deal of range within the species and if you tie this to the stage of harvest one can expect to make high quality silage out of any of these crops provided they are properly handled and processed.

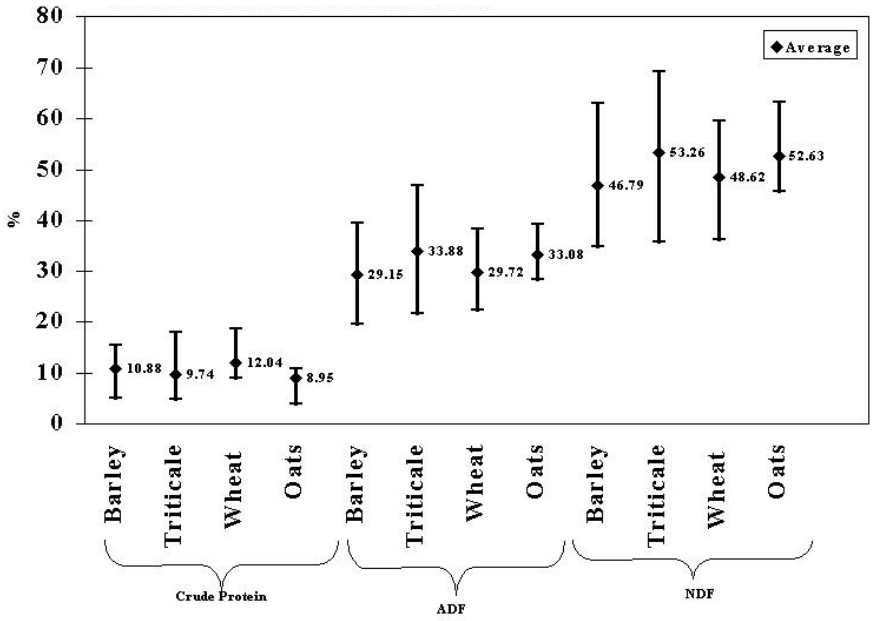

Figure 2. Range of quality (protein, ADF, NDF) for whole plant samples of barley, triticale and oat harvested at soft-dough stage and grown at Lacombe between 1998 and 2000.

■ Silage Yield and Agronomics

One of the primary factors that producers consider when selecting a species or a variety is yield, however as stated before, some agronomic factors are often considered as more important. One of these factors is lodging resistance or straw strength. Another is rough or smooth awn.

Firstly, consider silage yield. Triticale outyields both oat and barley silage harvested at early and late stages of growth (Figure 3). Silage yield of barley and oat is equal at the early dough stage but oat outyields barley when harvested 10 days post-anthesis (Baron et al. 1999). What this data does not explain is that the barley is ready for harvest two to three weeks earlier than the oat and triticale.

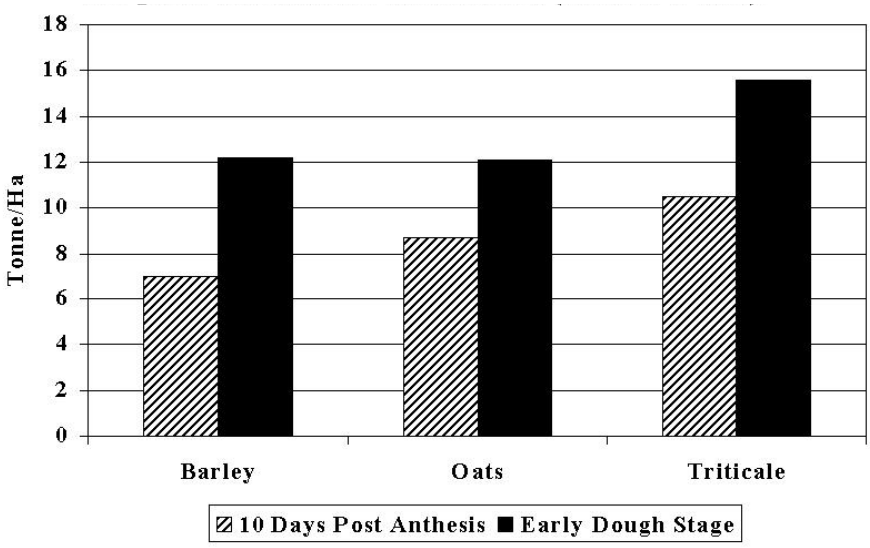

Figure 3. Average silage yield of barley, triticale and oat grown at Lacombe in 1995 and 1996 (Baron et al. 1999).

Our research indicates that there is considerable range in silage dry matter yield and the grain yield of both barley and triticale (Table 2). While the average triticale yield is greater than barley there is considerable overlap in the range (Figure 4).

Table 2. Dry silage yield and grain yield for different lines* of triticale and barley grown at Lacombe, AB in 1998-2001.

Triticale **			Barley		
Variety	**Dry Silage Yield (kg/ha)**	**Dry Grain Yield (kg/ha)**	**Variety**	**Dry Silage Yield (kg/ha)**	**Dry Grain Yield (kg/ha)**
AC Alta	16137	8789	AC Lacombe	14490	8226
Pronghorn	15910	9658	CDC Dolly	13685	7227
Sandro	15395	9062	Falcon	12221	6888
AC Ultima	12938	9427	Harrington	13451	5866
94L039007	12858	9061	Vivar	14675	8617
94L044006	13066	8354	H89012001	14008	8543
94L044009	13220	9630	H89020001	12960	6963
97O019	13856	8299	H90009012	12945	5500
98P015	12812	9100	H90013004	14537	8827
88L012053	15271	8413	H91010014	14337	7147
88L012114	14719	8419	H92020115	12922	6201
92L012010	14428	7582	H92031021	13625	6992
93L016002	14853	8802	H93003006	14046	6783
94L037009	14722	9433	H93040038	10943	6607
94L043014	14335	8574	H93040116	11754	6712
94L043015	14615	8646	H93167228	13808	6398
94L043017	14666	8402	H93170006	13187	6908
94L043019	15124	9012	T89037005	14056	7770
94S001008	14149	7879	T89047103	12859	7153
89L003006	13408	8111	W91201005	12418	6290
Minimum	12812	7582	Minimum	10943	5500
Maximum	16137	9658	Maximum	14675	8827
Average	14324	8733	Average	13346	7081

* Numbered lines are breeding lines from advanced trials and give an indication of genetic variability.

** 20 lines from a larger study representing the advanced material with the best grain yields.

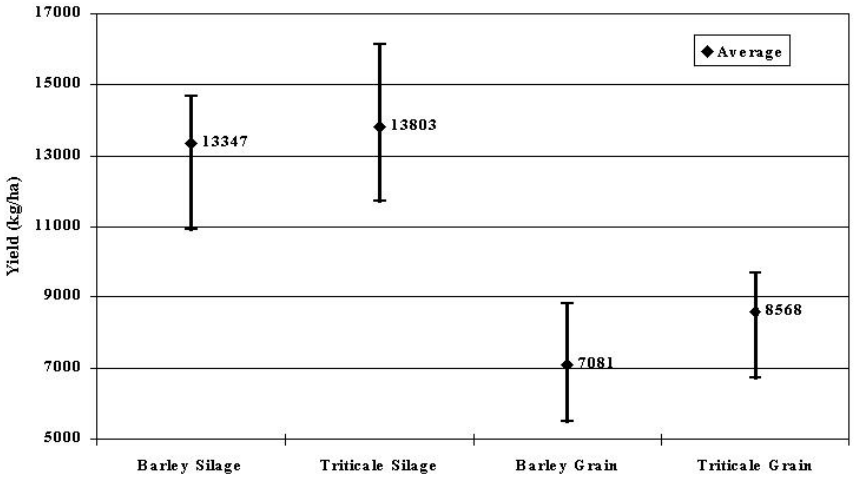

Figure 4. Range of grain and forage yield for barley and triticale grown at Lacombe, AB between 1998 and 2001.

Grain yield and silage yield is correlated (Figures 5 and 6) for both barley and triticale. It has often been said that the highest yielding grain varieties are also the best silage varieties. This is generally true, but when it is not true we can usually determine a genetic or morphological factor that changes this relationship. Some of these factors are maturity, plant height, leaf area, and straw strength.

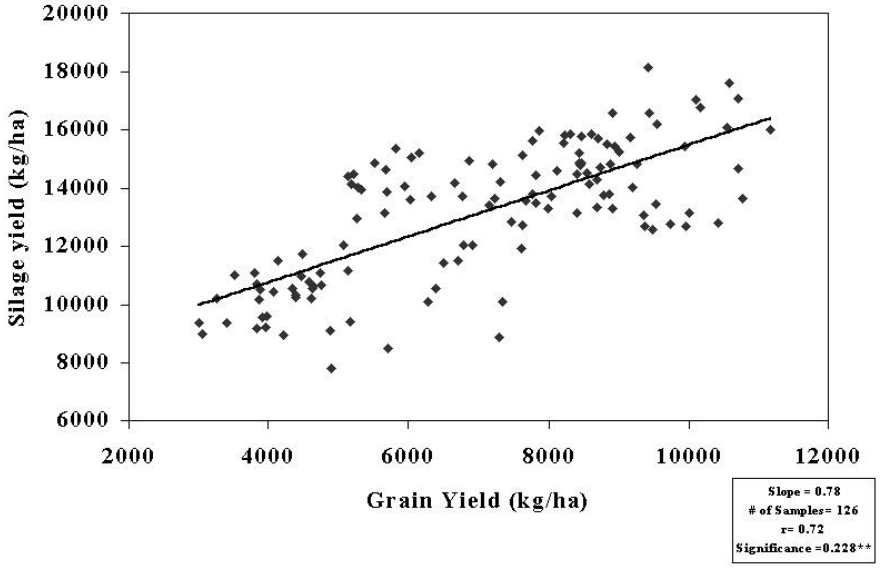

Figure 5. Silage yield vs. grain yield in barley grown at Lacombe, AB between 1998 and 2001.

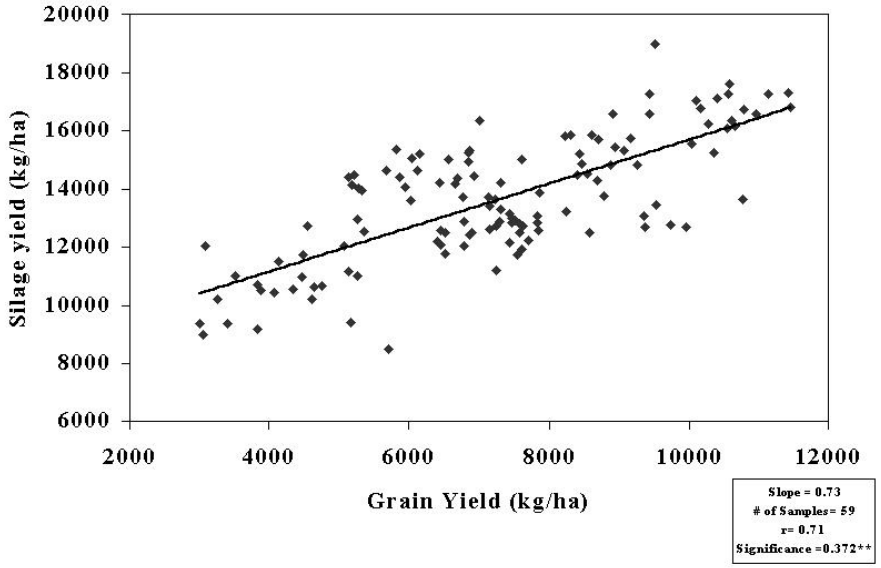

Figure 6. Silage yield vs. grain yield in triticale grown at Lacombe, AB between 1998 and 2001.

The old rule of thumb on maturity was that one-day difference in maturity was worth 2% yield. However, 'Kasota' which is 5 to 10 days earlier than 'AC Lacombe', is equal in grain yield but much lower in silage yield. In Figure 1 we see that at the silage stage, both 'Kasota' and 'Noble' had a high % spike. At maturity, 'Kasota' would have a larger percentage grain (50 to 55 % spike) compared to 'Noble' and 'AC Lacombe' (45 to 50% spike).

Plant height is often considered important in silage varieties. But in actual fact a semi-dwarf variety that has more tillers and spikes has the same or higher leaf and equal or lower stem. If high levels of manure are factored in and lodging becomes a problem, then harvested yield of the standing crop is often better for semi-dwarf varieties than the tall varieties. Often semi-dwarf varieties end up with higher protein content. This is due to the fact that on a shorter stem there are still the same numbers of leaves. This is somewhat offset by the thicker stems on the semi-dwarfs. We can increase the amount of leaf in the silage by cutting early but we do it at the expense of yield and energy. In addition, some varieties have been observed to keep green leaves longer and seem to ripen from the top down while others senesce from the bottom up so that the bottom leaves are gone before the soft-dough stage is reached.

Another factor to consider is disease resistance. 'Seebe' may have a higher percent leaf due to its extremely high level of leaf disease resistance. As disease reduces the photosynthetic area of the plant it also reduces yield. What the feed value differences are between diseased leaves with high levels of fungi compared to healthy leaves is not known.

■ Varieties for Silage – a Grain and Bio-mass Comparison

It is evident that any cereal species or variety can be used for quality silage. However, if the aim is high protein and low fiber the crop must be taken at the proper stage of growth. We recommend harvest at the soft-dough stage to get maximum yield and quality. Ranking the cereals at this growth stage for silage quality, barley is the highest, followed by triticale, then wheat, and oat has the lowest quality.

Depending on moisture and fertility, a semi-dwarf with strong straw will outperform a tall type under high yielding conditions. Smooth awned varieties may have an advantage over rough awned types if the crop is too dry or the chop length is not appropriate to allow adequate fermentation.

Producers should try to rotate varieties that have different disease resistance to ensure the crop is protected. One of the diseases that is now threatening cereal production on the prairies is Fusarium Head Blight. The disease can be severe on crops following an infected crop. Corn is especially susceptible and

growing wheat or barley after a corn crop could be the formula for seeing this disease increase across western Canada.

Use of Crop and Varietal Mixtures

The use of mixtures for silage production should be considered. This is often done for a number of reasons. The best reasons are for increasing the window of quality, for disease control and for lodging control. Juskiw et al. (2000a) concluded, "species mixtures could be a means for producers to extend their window of harvest for silage, while improving the quality of that harvest. The interspecific mixture of oat and barley, when harvested at the soft-dough stage of the barley, gave higher yields and quality than the barley or oat monocrops." The intraspecific mixture of 'Kasota' (early maturing) and 'Seebe' (late maturing) barley, when harvested at the soft-dough stage of 'Seebe' tended to have higher yields than the monocrops (Juskiw et al. 2000a).

The planting of triticale and pea blends is a popular option in some areas for dairy silage. As well, the blend of barley and triticale can work to produce high quality silage. Blends of varieties with different genes for disease resistance can also lessen the impact of diseases on yield and quality.

Conclusion

Cereal crops give the producer a range of choices, allowing the producer to balance yield, quality, harvesting and storage. Producers must look at species, varieties and mixtures as ways of controlling silage quality. In monocrops the stage of harvest should be at the soft-dough stage. In mixtures the later maturing component at the soft-dough stage will give highest yield and energy and if harvested when the earliest component is at the soft-dough stage, protein content will increase. Disease factors are important considerations. Rotate your crops and varieties to guard against the build up of new diseases or disease races.

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