GRAIN PRODUCTION IN NEWFOUNDLAND 97/98

Creating The Competitive Edge

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SUMMARY

The average grain yields for Chapais and AC Sterling barley in 1997 were 5.3 tonnes/ha (2.4 tons/ac) and 4.5 tonnes/ha (2.0 tons/ac) respectively. Chapais barley yielded more total digestible nutrient (TDN) and crude protein (CP) than AC Sterling at all locations except Deer Lake and Lethbridge where the CP yields were higher in AC Sterling. The average TDN content for Chapais and AC Sterling were 75.5% and 76.5% respectively. The average CP content for Chapais and AC Sterling were 10.1% and 10.6% respectively. In a small plot experiment in which Chapais barley received 316 kg/ha (283 lbs/ac) 19-19-19, the CP content increased with additional N-topdress (30 and 60kg/ha) when seeded May 30th and June 13th but did not increase with additional N-Topdress when seeded June 28th.

Wheat grain yields were higher in Borden and Fundulea winter wheats than in the Belvedere spring wheat. Belvedere spring wheat yields averaged 3.9 tonnes/ha (1.8 tons/ac) while Borden and Fundulea yields were 5.3 tonnes/ha (2.4 tons/ac) and 5.4 tonnes/ha (2.4 tons/ac). Borden and Fundulea winter wheat CP contents were 14.7% and 15.9% and their TDN contents were 77.4% and 78.1% respectively. The CP and TDN content for Belvedere spring wheat grown at Robinsons were 15.6% and 81.2%. The TDN content was 79.1% for Belvedere at Lethbridge but it is unknown why the CP content was low at 9.4%. The highest straw yields were obtained from Borden Winter Wheat grown at the ACCCRC in St. John's. However, strawberry producer, K. C. Robertson, uses oat straw with the grain attached as a mulching material.

AC Baton hulless oat and AC Rigodon covered oat yields were 4.2 tonnes/ha (1.9 tons/ac) and 3.4 tonnes/ha (1.5 tons/ac) respectively. The CP and TDN content of AC Baton hulless oats were 15.0% and 78.1% respectively. The nutrient analysis of the AC Rigodon was not available at the time of this report.

Silage corn was grown successfully in 1997 in Maidstone and St. David's by dairy farmer Brent Chaffey. The moisture content of his silage however was high at 74%. Silage corn was harvested late in October after all the forage harvest was completed. The small grain can successfully mature in areas which receive at least 1200 Growing Degree Days (GDDs). Areas such as Cormack which do not receive 1200 GDDs may be limited to high moisture grain production.

The electrical costs to condition and store grain at Wooddale and Reidville were $0.17 and $0.30 per tonne. The grain was stored at 16.0 - 20.0% moisture content for 10 months from September to July with little spoilage. According to the Ontario Ministry of Agriculture and Food Publication, "Natural Air Drying of Barley", barley with 18.3% moisture content can be safely stored for 50 weeks at 10^{o}C.

During the feeding trials at Reidville and Wooddale, barley and wheat were incorporated at 31% and 48% of the total grain ration. The farmers saved $1,532.47 and $1,754.04 per month. The reduction in the dairy cost of production (COP) was $3.24/hL and $3.73/hL for Reidville and Wooddale respectively. There was no decrease in mean milk yields during the trial period.

Introduction

Grain crops such as barley, wheat, and oats are among the most important feed components to the Newfoundland livestock industry. The potential for production of these crops has been investigated since 1993 with most of the research concentrated in the dairy, beef and sheep sectors. Farmers within these sectors and those within the poultry sectors may wish to grow grain in order to obtain the competitive edge in an increasingly competitive market.

Since the initiation of the grain project, a viable grain industry has been developing in Newfoundland at a conservative pace with a core group of farms demonstrating most of the research. These research results have proven instrumental to farmers in making sound business decisions concerning on-farm production and handling of small grains. Farm industry participation in research has proven to be invaluable as we strive towards the establishment of a viable local grain production industry. Grain production can provide Newfoundland farms with the competitive edge necessary to compete successfully in the next millennium.

The objectives for the 1997 grain project were:

1. to collect grain yields and climatic data,
2. to perform two dairy feeding trials and grain storage trials and,
3. to investigate seeding dates & N-topdress rates for barley and winter wheat.

On Farm Field Plot Statistics

Soil samples were collected from each of the five on-farm field plot sites in 1997 in conjunction with the Soils and Lands Management Division of the Department of Forest Resources and Agrifoods. A detailed report, “Soil Profiles on Barley and Wheat Fields Throughout the Island of Newfoundland, Report No. 97-3" has been published and is available upon request. The information from this report provided much needed insight into soil type, texture, drainage and topography for successful grain fields on the island of Newfoundland. The following are the statistical outlines for each farm site in Newfoundland for 1997 as identified in the report.

HillTop Farm, Robinsons, NF.

Planting Date:	May 30th
Seeding Rate:	Chapais Barley (120lbs/ac) AC Sterling Barley (120lbs/ac) Belvedere S. Wheat (135 lbs/ac)
Soil pH:	5.6
Soil Topography:	Orthic Humo-Ferric Podzol, undulating to gently sloping (3% slope)
Drainage:	Moderately Well
Tillage:	Spring tillage - plowing, discing
Soil Type:	Codroy Soil (coy)
Soil Texture:	Loam to Very Fine Sandy Loam (10% gravel)
Elevation:	200ft
Herbicides:	Round-up (1.5L/ac) prior to tillage
Fertilization:	Broadcast 19-19-19 (268lbs/ac)
Harvest Date:	October 26th

Headline Holsteins Ltd., Goose Arm, NF.

Planting Date:	June 7th
Seeding Rate:	Chapais Barley (120lbs/ac) AC Sterling Barley (120lbs/ac)
Soil pH:	6.5
Soil Topography:	Ortstein Humo-Ferric Podzol, moderately sloping terrace disserted by drainage channels (2% slope)
Drainage:	Well
Tillage:	Spring tillage - plowing, discing
Soil Type:	Coal Brook Soil (cbk)
Soil Texture:	Loamy Fine Sandy (15% gravel)
Elevation:	150ft
Herbicides:	Round-up (1.5L/ac) prior to tillage
Fertilization:	Broadcast 19-19-19 (268lbs/ac)
Harvest Date:	October 10th

Glenfair Farm, Wooddale, NF.

Planting Date:	May 31st
Seeding Rate:	Chapais Barley (120lbs/ac) AC Sterling Barley (120lbs/ac)
Soil pH:	6.5

Soil Topography:	Orthic Humo-Ferric Podzol, moderately sloping terrace (3% slope)
Drainage:	Well
Tillage:	Fall plowing, spring discing
Soil Type:	Peter's Arm Soil (ptr)
Soil Texture:	Loam (20% gravel)
Elevation:	100ft
Herbicides:	Round-up (1.5L/ac) prior to tillage
Fertilization:	Broadcast 19-19-19 (268lbs/ac)
Harvest Date:	September 16th

Glenview Farm, Kilbride, NF.

Planting Date:	June 2nd
Seeding Rate:	Chapais Barley (120lbs/ac) AC Sterling Barley (120lbs/ac)
Soil pH:	6.3
Soil Topography:	Orthic Humo-Ferric Podzol, undulating to moderately sloping terrain (7% slope)
Drainage:	Moderately Well
Tillage:	Spring tillage - plowing, discing
Soil Type:	Cochrane Soil (coh)
Soil Texture:	Gravelly Loam (20-25% gravel)
Elevation:	200ft
Herbicides:	Round-up (1.5L/ac) prior to tillage
Fertilization:	Broadcast 19-19-19 (268lbs/ac)
Harvest Date:	October 23rd

Robertson Farm Ltd., Lethbridge, NF.

Planting Date:	June 9th
Seeding Rate:	Chapais Barley (120lbs/ac) AC Sterling Barley (120lbs/ac) Belvedere S. Wheat AC Baton Hulless Oats
Soil pH:	4.8
Soil Topography:	Orthic Humo-Ferric Podzol, strongly sloping hummocky terrain (0.5 - 11% slope)
Drainage:	
Tillage:	Fall tillage - plowing, discing
Soil Type:	Lethbridge Soil (leg)
Soil Texture:	Very Gravelly, Silty Clay Loam (55-60% gravel)
Elevation:	150ft
Herbicides:	Round-up (1.5L/ac) prior to tillage
Fertilization:	Broadcast 19-19-19 (268lbs/ac)
Harvest Date:	October 4th

Atlantic Cool Climate Crop Research Centre, St. John's, NF.

Winter Wheat - Borden & Fundulea

Planting Date:	September 14
Seeding Rate:	150 kg/ha

Soil pH:	6.2
Soil Topography:	Undulating to moderately sloping terrain
Drainage:	Moderately well to poorly
Tillage:	Fall plowed, spring disced and harrowed
Soil Type:	Cochrane (Ortho Humo-Ferric Podzol)
Soil Texture:	Medium textured gravelly loam, dark olive gray glacial till derived mainly from gray slate and siltstone
Herbicide:	Target @ 1.5 L/ha
Fertilization:	5-20-20@200 kg/ha (banded)
Topdress:	1st - June 2, 34-0-0@ 140 kg/ha 2nd -June 17, 34-0-0 @ 265 kg/ha
Harvest Date:	September 29th

Spring Grain - Belvedere Wheat and AC Sterling & Chapais Barley

Planting Date:	May 23rd - 29th
Seeding Rate:	Belvedere - 150 kg/ha AC Sterling & Chapais - 135 lbs/ha
Soil pH:	5.5
Soil Topography:	Undulating to moderately sloping terrain
Drainage:	Moderately well
Tillage:	Fall plowed, spring disced and harrowed
Soil Type:	Cochrane (Ortho Humo-Ferric Podzol)
Soil Texture:	Medium textured gravelly loam, dark olive gray glacial till derived mainly from gray slate and siltstone
Herbicide:	Target @ 1.5 L/ha
Fertilization:	17-17-17@135 kg/ha (banded)
Topdress:	34-0-0@ 90 kg/ha
Harvest Date:	September 29th - October 7th

AC Rigodon Oats

Planting Date:	June 10th
Seeding Rate:	135 kg/ha
Soil pH:	6.1
Soil Topography:	Undulating to moderately sloping terrain
Drainage:	Moderately well
Tillage:	Fall plowed, spring disced and harrowed
Soil Type:	Cochrane (Ortho Humo-Ferric Podzol)
Soil Texture:	Medium textured gravelly loam, dark olive gray glacial till derived mainly from gray slate and siltstone
Herbicide:	Target @ 1.5 L/ha
Fertilization:	17-17-17@135 kg/ha (banded)
Topdress:	34-0-0@ 90 kg/ha
Harvest Date:	October 16th

Results & Discussion

Barley

Grain Yield

Six and two row barley have been grown in Newfoundland since the initiation of the grain project in 1993. Most of the research was conducted as on-farm demonstration plots in various environments and on many soil types. The experience attained over the years and through cooperation among farmers, the

Department of Forest Resources and Agrifoods and Agriculture and Agri-Food Canada have contributed to improved grain yields. With increased emphasis on improving seeding date and soil pH, barley grain yields in 1997 such as Chapais averaged 5.3 tonnes/ha (2.4 tons/ac), an increase of 0.9 tonnes/ha (0.4 tons/ac) over 1996. The newly introduced two row barley AC Sterling, which has replaced Morrison, averaged 4.5 tonnes/ha (2.0 tons/ac) of grain this year.

Chapais barley grain yields were higher than AC Sterling's at all locations with the exception of St. John's at the Atlantic Cool Climate Crop Research Centre (ACCCRC). The average grain yields were 4.8 tonnes/ha (2.2 tons/ac) for AC Sterling and 4.7 tonnes/ha (2.1 tons/ac) for Chapais. The highest grain yields for both Chapais and AC Sterling were 6.3 tonnes/ha (2.9 tons/ac) and 5.8 tonnes/ha (2.6 tons/ac) respectively at Deer Lake (Figure 1). Lowest grain yields were recorded at Kilbride for Chapais and AC Sterling at 3.5 tonnes/ha (1.6 tons/ac) and 2.7 tonnes/ha (1.2 tons/ac) (Table 1).

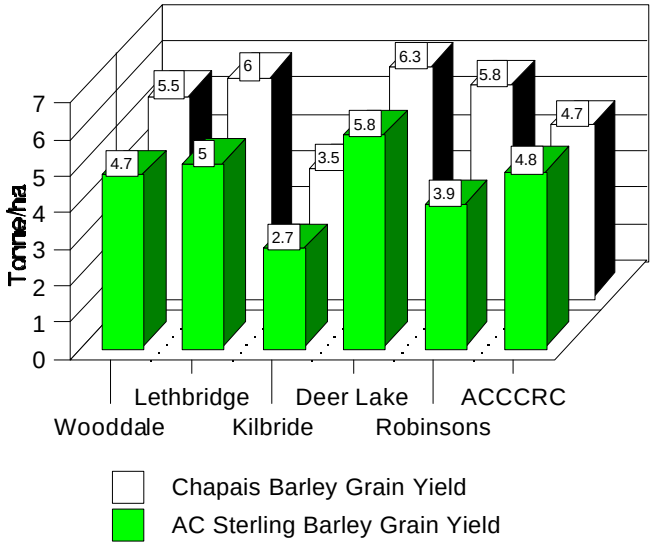


Figure 1. Chapais Barley vs AC Sterling, Grain Yields (86%DM), 1997

Table 1. Chapais & AC Sterling Barley, Grain Yields (86%DM), 1997

Location	Grain	Grain Yield	
		tonnes/ha	tons/ac
Wooddale	Chapais Barley	5.5	2.5
	AC Sterling Barley	4.7	2.1
Lethbridge	Chapais Barley	6.0	2.7
	AC Sterling Barley	5.0	2.2
Kilbride	Chapais Barley	3.5	1.6
	AC Sterling Barley	2.7	1.2

Deer Lake	Chapais Barley	6.3	2.9
	AC Sterling Barley	5.8	2.6
Robinsons	Chapais Barley	5.8	2.6
	AC Sterling Barley	3.9	1.8
St. John's	Chapais Barley	4.7	2.1
	AC Sterling B.	4.8	2.2

Protein and TDN

Generally considered important as an energy source in livestock nutrition, a desirable feed barley should have 15% protein content and high digestible energy (Bhatty, 1993) The average CP content for AC Sterling and Chapais grown on-farms were 10.6% and 9.5% respectively and the average TDN content were 76.5% and 75.9%. Although barley grain yields were high for both AC Sterling and Chapais barley the CP was less than the desired 15%. Their respective CP contents ranged from 10.0 - 11.2% and 8.0 - 10.8%. However, the CP content in Chapais grown at the ACCCRC was 13.1% (Table 2). The TDN content was low for Chapais grown at the ACCCRC at 74.0%. There were no nutrient analysis available for AC Sterling grown at the ACCCRC.

Higher CP contents in Chapais barley grown at the ACCCRC may be the result of differing production management practices from the on-farm plots. The on-farm barley plots received one spring time application of nitrogen, phosphate and potassium (NPK) at 57 kg/ha (51 lbs/ac) while the ACCCRC's barley received 23 kg/ha (21 lbs/ac) of NPK and a topdress of 31 kg/ha (27 lbs/ac) of N at the start of tillering. Although there was less NPK applied on the barley at the ACCCRC, the Chapais CP was higher possibly due to the timing of topdress N.

In light of the response to topdress N at the ACCCRC, it may be necessary for local producers of barley to apply additional N-topdress to their present cultural practices in order to increase protein content. Kong et al. (1995) recommended that in addition to developing high protein cultivars, a management production package may be developed to increase protein content in Maritime grown barley and eliminate the need for protein supplements in ration formulation.

Table 2. Chapais & AC Sterling Barley, Percent C P and TDN (100%DM), 1997

Farmer	Chapais		AC Sterling	
	%CP	%TDN	%CP	%TDN
Wooddale	10.8	75.2	11.2	76.5
Lethbridge	8.0	75.8	10.6	77.0
Kilbride	11.1	76.5	10.0	76.4
Deer Lake	8.6	75.1	10.7	75.8
Robinsons	9.2	76.7	10.3	77.0
St. John's	13.1	74.0	NA	NA

Barley Plot: effect of seeding date & N-topdress rate on CP content for Chapais barley

Barley grain yields in Newfoundland are among the highest in the country but protein content remains below the desired 15%. Improved crop production management such as seeding dates and N-topdressing may increase protein in barley and reduce the cost of expensive protein feed supplements. A joint investigation between the Agriculture and Agri-Food Canada (ACCCRC) and the Department of Forest Resources and Agrifoods studied the effects of seeding date and N topdress rates on CP content of Chapais barley.

All plots in the experiment received 316 kg/ha (283 lbs/ac) 19 -19 -19 and the three Chapais barley seeding dates (May 30th, June 13th & June 28th) were split with three N-topdress treatments (0 kg/ha, 30 kg/ha & 60 kg/ha). The CP content was highest (12.40%) at the earliest seeding date with a topdress of 60 kg/ha of N (Table 3). The data analysis (*t*-test) revealed that Chapais barley seeded May 30th had significantly more CP with 60 kg/ha of N topdress than no N-topdress (12.40 and 11.45% respectively; $P < 0.05$).

The effect of N-topdress rates were most evident in the June 13th seeding date when Chapais barley CP increased significantly ($P < 0.05$) at 30 and 60 kg/ha of N (Table 3). The respective CP contents were 10.00, 11.33 and 12.15%. There were no significant differences ($P < 0.05$) in Chapais barley CP content among N-topdress treatments at the June 28th seeding date.

Table 3. Mean Percent CP Contents (100%DM basis) in Chapais Barley Between Three N-Topdress Treatments at Three Seeding Dates.

N-topdress	May 30th	June 13th	June 28th
0 kg/ha	11.45a	10.00a	10.38a
30 kg/ha	12.00ab	11.33b	10.90a
60 kg/ha	12.40b	12.15c	10.70a

a,b,c Means followed by different letters are significantly different within a column ($P<0.05$) based on the *t*-Test.

Wheat

Grain Yield

Although most of the grain research conducted in Newfoundland has concentrated on barley, some wheat cultivars show promise. The winter wheat varieties, Borden and Fundulea, produced high yields, energy and protein. They have great potential to reach maturity here but overwintering damage has caused much concern. Despite these concerns, Borden and Fundulea, performed well in 1997 at the ACCCRC with grain yields of 5.3 tonnes/ha (2.4 tons/ac) and 5.4 tonnes/ha (2.4 tons/ac) respectively (Table 6). Research into winter wheat seeding dates and plant recovery should be investigated in 1998.

The spring wheat variety, Belvedere, required a longer growing season to mature than Borden and Fundulea and may be more suited to be harvested as a high moisture grain in some locations. Belvedere grain yields averaged 3.9 tonnes/ha (1.8 tons/ac) in 1997 with highest yields of 4.9 tonnes/ha (2.2 tons/ac) at St. John's (Table 6).

Table 4. Belvedere Spring Wheat and Borden and Fundulea Winter Wheat, Grain Yields (86%DM), 1997

Farmer	Grain	Grain Yield	
		tonnes/ha	tons/ac
Lethbridge	Belvedere S. Wheat	3.2	1.4
St. John's	Belvedere S. Wheat	4.9	2.2
	Borden W. Wheat	5.3	2.4
	Fundulea W. Wheat	5.4	2.4
Robinsons	Belvedere S. Wheat	3.6	1.6

Protein and TDN

Wheat is a valuable component in many livestock rations. It should not however, exceed more than one-half of a ruminant or swine grain ration formulation (Sub-committee of the Atlantic Provinces Livestock Committee, 1988). Borden and Fundulea had CP contents of 14.7% and 15.9% respectively and TDN contents of 77.4% and 78.1% (Table 7). Although Belvedere spring wheat had a lower grain yield, the CP and TDN content at Robinsons were comparable to winter wheat at 15.6% and 81.2% respectively (Table 7). The Belvedere CP content in Lethbridge was low at 9.4%.

Table 5. Belvedere Spring Wheat & Borden & Fundulea Winter, Wheat Percent Crude Protein and TDN (100%DM), 1997

Location	Grain	CP (%)	TDN (%)
Lethbridge	Belvedere Wheat	9.4	79.1
Robinsons	Belvedere Wheat	15.6	81.2
St. John's	Belvedere Wheat	NA	NA
	Borden W. Wheat	14.7	77.4
	Fundulea W. Wheat	15.9	78.1

Oats

Grain Yield

Oats have been grown for many years in Newfoundland as a cover crop for clover, timothy and alfalfa or in combination with peas and vetch. It is more tolerant of acidic soil conditions than wheat and barley but it requires a longer growing season to mature. The hulless and covered varieties AC Baton and AC Rigodon grain yields for 1997 were 4.2 tonnes/ha (1.9 tons/ac) and 3.4 tonnes/ha (1.5 tons/ac) respectively (Table 8).

Table 6. AC Baton Hulless and AC Rigodon Covered Oat, Grain Yields (86%DM), 1997

Farmer	Grain	Grain Yield tonnes/ha	tons/ac
Lethbridge	AC Baton Hulless Oats	4.2	1.9
St. John's	AC Rigodon Oats	3.4	1.5

Protein and TDN

Burrows et al. (1993) suggested that the feeding value of oats (covered oats) are generally variable due to the wide range of hull content in the grain. However, with the development of newer breeds of oats having membrane like hulls that separate from the groat at harvest (covered oats) this problem has largely been overcome (Burrows et al., 1993). Some sheep farmers in Newfoundland have adapted oat production as part of their operation management. With the development of the highly nutritious hulless oats, it is likely oats may now be used as a major ingredient in swine and poultry diets as well.

The feed value of covered oats is lower than hulless oats because of the hull content. The hull is low in protein and high in fibre, which reduces the TDN and protein contents of the kernel (Burrows et al., 1993). The CP and TDN contents were not available for AC Rigodon hulled oats but were 15.0% and 78.1% for AC Baton (Table 7).

Table 7. AC Baton Hulless & AC Rigodon Covered Oat, Percent Crude Protein and TDN (100%DM), 1997

Location	Grain	CP (%)	TDN (%)
Lethbridge	AC Baton Oats	15.0	78.1
St. John's	AC Rigodon Oats	NA	NA

Straw

Straw Yield

Many strawberry producers in Newfoundland require mulching material to over-winter their strawberry plants. Lethbridge strawberry producer, K. C. Robertson, stated that wheat straw has the best mulching qualities for strawberries simply because it holds structural strength during winter longer than barley and oats. Average Belvedere spring wheat straw yield for 1997 was 3.7 tonnes/ha (1.7 tons/ac) with the highest yields of 3.9 tonnes/ha (1.8 tons/ac) recorded at Lethbridge (Table 4). Borden and Fundulea winter wheat grown at the ACCCRC in St. John's showed great potential for straw production with yields of 6.2 tonnes/ha (2.8 tons/ac) and 4.7 tonnes/ha (2.1 tons/ac) respectively (Table 4).

Barley straw is poor mulching material for strawberries because it loses structural strength quickly during the winter. The average straw yields for Chapais and AC Sterling barley in 1997 were 2.7 tonnes/ha (1.2 tons/ac) and 3.3 tonnes/ha (1.5 tons/ac) respectively. Highest straw yields for Chapais and AC Sterling barley were 3.8 tonnes/ha (1.7 tons/ac) and 4.6 tonnes/ha (2.1 tons/ac) at Lethbridge respectively (Table 1).

Mr. Robertson presently uses oat straw for mulching his strawberries and is interested in winter wheat straw production. Straw yields for AC Baton Hulless oats at

Lethbridge and AC Rigodon oats at St. John's were 4.7 tonnes/ha (2.1 tons/ac) and 3.0 tonnes/ha (1.4 tons/ac) respectively (Table 5). The AC Baton Hulless oat straw yields were higher than AC Rigodon oats during 1997 and could potentially replace the covered oat for production of mulching material.

Table 8. Belvedere Spring Wheat and Borden and Fundulea Winter Wheat, Straw Yields (86%DM), 1997

Farmer	Grain	Straw Yield tonnes/ha	tons/ac
Lethbridge	Belvedere S. Wheat	3.9	1.8
St. John's	Belvedere S. Wheat	3.2	1.5
	Borden W. Wheat	6.2	2.8
	Fundulea W. Wheat	4.7	2.1
Robinsons	Belvedere S. Wheat	3.9	1.7

Table 9. AC Baton Hulless and AC Rigodon Covered Oats, Straw Yields (86%DM), 1997

Farmer	Grain	Straw Yield tonnes/ha	tons/ac
Lethbridge	AC Baton Hulless Oats	4.7	2.1
St. John's	AC Rigodon Oats	3.0	1.3

Table 10. Chapais & AC Sterling Barley, Straw Yields (86%DM), 1997

Location	Grain	Straw Yield tonnes/ha	tons/ac
Wooddale	Chapais Barley	3.1	1.4
	AC Sterling B.	3.6	1.6
Lethbridge	Chapais Barley	3.8	1.7
	AC Sterling B.	4.6	2.1
Kilbride	Chapais Barley	2.1	1.0
	AC Sterling B.	2.2	1.0
Deer Lake	Chapais Barley	2.5	1.1
	AC Sterling B.	4.1	1.8
Robinsons	Chapais Barley	2.8	1.3
	AC Sterling B.	2.9	1.3
St. John's	Chapais Barley	1.9	0.8
	AC Sterling B.	2.2	1.0

Economics

According to the Department of Forest Resources and Agrifoods (1997) the cost to produce one acre of winter wheat, spring wheat, barley and covered oats and hulless oats was $327.46, $251.43, $242.58, $243.73 and $242.51 respectively (Appendix A). The cost to produce one tonne of straw was $133.11 for winter wheat, $152.38 for spring wheat, $179.69 for barley, $180.54 for oats and $115.48 for hulless oats (Appendix A). These figures are based on production management practices designed for grain. Further research into production practices for straw must be evaluated to determine optimal straw yields and the lowest cost per tonne of straw. The value of straw purchased in Newfoundland presently ranges from $100.00 - $200.00/tonne.

Robertson Farm Ltd. uses higher seed and fertilizer rates when growing oats for straw mulch. As a result they claim that their straw yields are higher. In addition to higher straw yields, Robertson Farm Ltd. leaves the grain on the straw when they mulch. The average combined straw and grain yields for 1997 were 4.9 tons/ac (10.9 tonnes/ha) for winter wheat, 3.5 tons/ac (7.8 tonnes/ha) for spring wheat, 3.6 tons/ac (8.0 tonnes/ha) for barley, 2.9 tons/ac (6.4 tonnes/ha) for oats and 4.0 tons/ac (8.9 tonnes/ha) for hulless oats. For both straw and grain used for mulching strawberries, the cost to produce one tonne was $67.38 for winter wheat, $73.73 for spring wheat, $68.14 for barley, $84.63 for oats and $60.93 for hulless oats.

These figures represent the economic potential using management practices designed for grain production. Further research should include management practices suitable for straw production such as seeding rates and nitrogen application. It should be noted that the practice of using straw containing grain as mulching material may cause weed problems in strawberries.

Heat Requirements for Alternative Feed Crops

The environmental criteria for any new crop introduced to Newfoundland should be carefully considered for any potential growth limiting factors. There are many growth limiting factors which may be controlled such as variety selection, crop rotation, soil fertility, tillage, seeding date, seeding rate and N-fertilization. Other factors which can not be controlled are soil type, soil moisture holding capacity, frequency and distribution of rain, intensity of sunlight and temperature extremes. This section will look at heat requirements for the proper development of small grains and silage corn.

Climatic data obtained from Environment Canada's Atlantic Climate Centre and the Department of Forest Resources and Agrifoods climate stations were used to calculate the growing degree days (GDD) and corn heat units (CHU) for thirteen sites across Newfoundland (Figure 2).

Small Grains (GDD)

GDDs were calculated using normal maximum and minimum temperatures from May 1st to Oct 31st. The GDD provides a reference for the relationship between

temperature and crop development. It is calculated from daily maximum and minimum air temperatures and a base temperature, which for small grains is $5^{o}C$:

$$GDD = \frac{T(max) + T(min)}{2} - 5^{o}C$$

Where, T(max) is the maximum daily air temperature
T(min) is the minimum daily air temperature

The minimum required GDDs (base $5^{0}C$) for cereal grains such as spring wheat, barley and oats to reach maturity is 1200 (Corn Heat Units, 1998). With the exception of Cormack and some upland areas of South Branch, all of the 13 climate monitored sites satisfied these GDD requirements (Tables 11 & 12). Small grains such as barley and winter wheat have grown successfully at all the locations identified in Figure 2. In the areas which so not receive 1200 GDDs, such as Cormack, the grain was harvested with a high moisture content. The high moisture grain (HMG) is grain that does not completely mature and has a moisture content of 20 - 30%. According to "Corn Heat Units" (1998), areas receiving 1250 GDDs will likely mature small grains 9 years out of 10. Additional drying practices such as drying storage bins and grain dryers may be necessary in these areas.

Early maturing grains such as barley and winter wheat can be harvested as dry grain, in most locations, during late August and early September. Later maturing species of small grains such as oats and spring wheat require an additional 10 to 14 days to mature. In areas such as Cormack, high moisture barley and winter wheat have the most potential to reach physiological maturity, but may not reach 14% moisture content. These grains, however, make excellent high moisture feeds.

Figure 2. Map of Newfoundland With Climatic Data Sites For 1997

Silage Corn (CHU)

Corn Heat Units (CHUs) are calculated using maximum and minimum temperatures from June 1st until the minimum temperature reached 0^0C when corn growth was halted. The CHU is a specific reference for the relationship between temperature and corn development. Corn is a heat loving plant and maturity will be accelerated or slowed depending on the temperature. The CHUs were calculated from daytime maximums and nighttime minimum air temperatures and a base temperature: daytime base is 10.0^oC and nighttime base is 4.4^oC.

$$CHU = \frac{Y(max) + Y(min)}{2}$$

where, $Y(max) = 3.33(T(max) - 10.0^oC) - 0.084(T(max) - 10.0^oC)^2$

$Y(min) = 1.8(T(min) - 4.44^oC)$

Table 11. Growing Degree Days (GDD) and Corn Heat Units (CHU) From Environment Canada's Atlantic Climate Centre Accumulated Over 15 Years.

Location	GDD (May - Nov.)	CHU (June - 1st. Frost)
St. John's	1242.85	1965.49
Lethbridge	1260.20	1968.72
Wooddale	1326.50	1853.15
Cormack	1115.40	1748.49
Deer Lake	1282.95	2010.43
Deer Lake Airport	1223.30	1905.02
Pasadena	1303.85	2046.72
Loch Leven	1340.45	2079.73
South Branch	1189.90	1856.42
Doyles	1339.30	2105.32

Table 12. Growing Degree Days (GDD) and Corn Heat Units (CHU) From the Department of Forest Resources and Agrifoods Climate Stations 1997.

Location	GDD (May - Nov.)	CHU (June - 1st. Frost)
Robinson's	1281.75	2027.05
St. David's	1205.45	2034.85
South Branch	1255.50	2155.90

The Environment Canada's climate data revealed that the highest normal CHUs were accumulated at Doyles with 2105.32 and the lowest normal CHUs were accumulated at Cormack with 1748.49 and Loch Leven received 2079.75 normal CHUs (Table 11). The climate data obtained by the Department of Forest Resources and Agrifoods showed that Robinsons, St. Davids and South Branch all received above 2000 CHUs at the on-farm plot sites in 1997 (Table 12).

According to Dube (1984), early hybrid corn can be grown for silage in areas receiving at least 1900 - 2000 CHU and a frost free period of 130 - 140 days. The Manitoba Agriculture publication, "Corn Heat Units" (1998), stated that on the eastern prairies corn hybrids grown for silage require 2,000 to 2,100 CHU annually and that in an average year areas which receive less than 2,000 CHU are not suited for silage corn production. The Nova Scotia Agriculture and Marketing publication, "Corn Guide to Hybrid and Pesticide Selection" (1997), stated that corn production is very risky in areas receiving less than 2,100 CHU and that "corn will usually freeze before becoming sufficiently mature for acceptable silage".

The average CHU provides an estimated value that is exceeded or not reached in 50% of years. The Ontario Ministry of Agriculture, Food and Rural Affairs publication, "Crop Heat Units for Corn and Other Warm-Season Crops in Ontario" (1997), stated that it is impossible to estimate the CHU ratings for a specific area closer than 50 heat units.

There are many factors which can influence temperature in a given area such as slope and soil type. For example, a south facing slope will receive more heat than a north facing slope and sandy soils

will heat up faster than loam or clay soils (Crop Heat Units for Corn and Other Warm-Season Crops in Ontario, 1997). Also, uplands are seem to accumulate less CHUs than lowlands. For example, the normal CHU accumulation at South Branch is 1856.42 at the Environment Canada's Climate Station but CHUs accumulated in 1997 recorded 2155.90 CHUs on river-flat soils in that same area. Other environmental factors which influence corn rate of growth include photo period (daily period from sunrise to sunset), soil fertility and availability of soil water (Crop Heat Units for Corn and Other Warm-Season Crops in Ontario, 1997).

Having said that, dairy farmer Brent Chaffey planted 90 acres of silage corn in 1997 on river-flat soils in St. David's and upland soils in Maidstone, near Loch Leven. He was pleased with the crop although the moisture content was high at approximately 74%. Mr. Chaffey said that silage corn was good for his operation because of the late harvest date. The corn was harvested in late October after all his regular forages were harvested.

The harvest window for most of these locations is late August and early September when day-time temperatures are warm enough to dry the grain for harvest. Spring wheat and oats may be harvested 1 - 2 weeks later than barley and winter wheat.

Grain Storage

Grain storage and drying have been investigated by the Department of Forest Resources and Agrifoods in 1997 at Reidville and Wooddale. Both locations harvested Chapais and Morrison barley at about 18% moisture content (M.C.) and stored the grain for 10 months in an 80 tonne capacity drying and storage bin. According to Lenehan (1986) barley with moisture content of 16%, 17% and 18% can be stored without mold growth for 50, 28 and 9 weeks respectively at 10^{o}C and 120, 80 and 22 weeks respectively at 5^{o}C.

During the harvest season as the bins were being filled with grain, the 5 h.p. electric fan was turned on to condition the grain and remove the field heat which may cause the grain to spoil. The fan was turned off after the bin was filled and the grain quality remained good during the storage period with moderate spoilage observed at both locations. The electric heater was not used in 1997 during the conditioning of the grain since daytime temperatures reached above 10^{o}C and was sufficiently high to dry the grain.

There was approximately 35 tonnes of grain stored at Wooddale and 80 tonnes stored at Reidville. The total number of aeration fan operating hours at Wooddale and Reidville were 24 and 96 hours respectively. The overall electrical cost to operate the aeration fan was approximately $6.07 and $24.29 at Wooddale and Reidville respectively (Table 11). The electrical costs of conditioning the grain for safe storage at Wooddale and Reidville were $0.17 and $0.30 per tonne respectively. Glenfair Dairy Farm in Wooddale and Headline Holsteins Too Farm in Reidville are expected to start feeding the barley to their dairy herd in 1998.

Table 13. Grain Moisture Contents and Electrical Costs During Storage, 1997 (Barley)

Location	Date	Moisture (%)	Fan Hours	Total Cost of Electricity	Electricity per tonne ($)
Wooddale	Sept. 16th	16.0 - 20.0	24	$6.07	$0.17
Reidville	Oct. 10th	16.0 - 20.0	96	$24.29	$0.30

Dairy Feeding Trial Economics and Production

Feed grains such as barley, wheat and oats are an important part of livestock nutrition and if produced and fed right can save farmers plenty. In a study conducted by the Department of Forest Resources and Agrifoods in 1995, the weight gains of beef calves fed locally produced grains were comparable with beef calves fed Western grains. Pungtilan (1995) stated that the benefits of feeding locally produced grain to beef were:

1. reduced production costs,
2. lower feed costs per unit weight gain, and
3. value of the straw by-product.

In 1997, the Department of Forest Resources and Agrifoods conducted a study to determine the impact of locally produced grain on profitability and milk production when fed to multiparous Holstein dairy herds. Two dairy farms were used, 1) Glenfair Farm at Wooddale and 2) Headline Holsteins Too Ltd at Reidville. Milk yields and costs of production (COP) during the feeding trial were compared to milk yields and COP for the three month period prior to and following the feeding trial. The feed ration and cost analysis for Glenfair Farm and Headline Holsteins Too are outlined in Appendices B and C.

The Headline Holsteins Too dairy herd was fed 450 kg of local barley per day supplemented with Grain Stretcher and the Glenfair Farm dairy herd was fed 350 kg of local barley plus 130 kg of local wheat supplemented with Pre-Mix (Appendices B and C). The proportions of local grains within the total grain ration were 30 - 50% at Headline Holsteins Too and at Glenfair Farm. The savings per day during the trial were $51.08 at Headline Holsteins Too Ltd and $63.10 at Glenfair Farm. The reduction in the dairy COP was $3.24/hL at Headline Holsteins Too Ltd and $3.73/hL at Glenfair farm. The feeding trial duration at Headline Holsteins Too was 4 months with a total savings of $6,129.86 or approximately $1,532.47 per month. The duration of the feeding trial at Glenfair Farm was 10 months with a total savings of $17,540.41 or approximately $1,754.04 per month.

The monthly mean adjusted milk yields for the periods prior to, during and following the feeding trial were analyzed (*t*-test). There were no differences ($P<0.05$) among adjusted milk yields between the periods prior to, during and after the feeding trial at Headline Holsteins Too Ltd (Figure 3). The adjusted milk yields for the periods during and following the feeding trial at Glenfair Farm were significantly higher ($P<0.05$) than adjusted milk yields during the pre-trial period (Figure 4). This increase in milk production during and after the feeding trial can likely be attributed to the addition of a TMR machine on the farm at the start of the feeding trial.

Figure 3. **Monthly Adjusted Milk Yields for Headline Holsteins Too Ltd. (Feeding Trial Period are Dark Bars**).

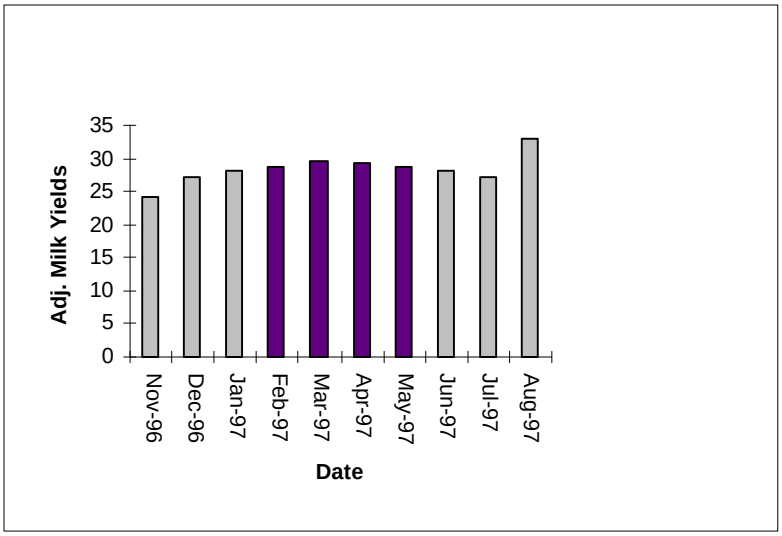
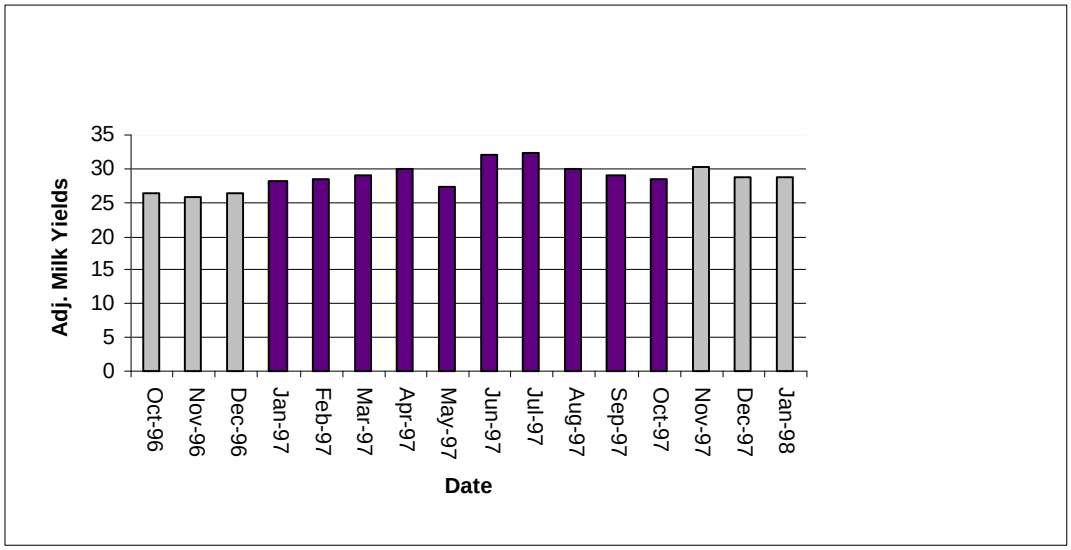


Figure 4. Monthly Adjusted Milk Yields for Glenfair Farm (Feeding Trial Period are Dark Bars).



The mean adjusted milk yields for the period prior to, during and following the feeding trial at Headline Holsteins Too Ltd were 26.37L/day, 29.15L/day and 29.4L/day respectively. The mean adjusted milk yields for the period prior to, during and following the feeding trial at Glenfair Farm were 26.17L/day, 29.53L/day and 29.3L/day respectively. There was no net reduction in milk yields during the feeding trial which indicated that local barley and wheat does not negatively affect milk production when fed to multiparous Holstein cows.

CONCLUSION

Barley grain yields were higher in 1997 than any year previous, demonstrating that growing grain in partnership with farmers can benefit both the Department and the farming sector. Small grains, such as barley and winter wheat, are best suited for production in Newfoundland because they require a relatively short growing season as compared to oats and spring wheat. Much work is needed, however, to increase barley protein content and reduce the need for expensive supplements. Winter wheat is a high

quality crop in Newfoundland with average CP and TDN contents of 15.3% and 77.8% respectively, yet more work is needed to increase winter survival and plant recovery.

The straw component of grain has a value of $100.00 to $200.00 per tonne and is used as bedding and mulching material by strawberry growers. The production of grain crops for straw has been undertaken by strawberry producer, K. C. Robertson. He grows covered oats for straw and the production practices that he uses differs from conventional grain production recommendations as it requires higher fertilizer and seeding rates. Under conventional grain production practices, winter wheat and hulless oats produced the highest straw yields at 5.5 tonnes/ha (2.5 tons/ac) and 4.7 tonnes/ha (2.1 tons/ac) respectively. Covered oats, spring wheat and barley yields were 3.0 tonnes/ha (1.3 tons/ac), 3.7 tonnes/ha (1.7 tons/ac) and 3.0 tonnes/ha (1.3 tons/ac). Research into straw production practices and species selection is required to make sound recommendations to straw producers.

The research work performed in 1997 showed that Newfoundland's diverse environment can successfully produce a wide range of alternative crops such as silage corn, dry grain and high moisture grain. Some areas, such as Cormack, which accumulated low CHUs and GDDs (1750 and 1115 respectively) are more suited for high moisture grains; and, areas such as Doyles, in the Codroy Valley, have high enough CHUs and GDDs (2105 and 1339 respectively) to grow silage corn or dry grain.

The two dairy feeding trials in 1997 revealed:

1. locally produced barley and wheat did not reduce milk yields during the feeding period; and,

2. locally produced grain incorporated in a dairy ration at 31% and 48% reduced the respective farmer's COP by $3.24/hL and $3.73/hL per day. The total cost to dry and store the barley in bulk grain bins were $0.17/tonne and $0.30/tonne.

In 1997 over 200 acres of grains were produced with at least 90 acres in silage corn. These grains were utilized on the farm and directly lowered the producers' COP. The establishment of grain production in Newfoundland depends largely on this type of grain utilization on the farm. The Department of Forest Resources and Agrifoods has maintained a good working relationship with the farming industry investigating alternative feed crops. Nevertheless, an investigative survey could determine:

a) how farmers, such as dairy, foresee the development of a local grain industry; and,

b) the opportunities and constraints that may or may not exist.

RECOMMENDATIONS

Supported by the findings and conclusions of this report, the following recommendations are offered in an effort to develop a local grain industry.

1) Continue soil profiles of successful grain fields. This is a cooperative effort between the Soil and Land Management and Production and Marketing divisions of the Department of Forest Resources and Agrifoods.

2) Continue on-farm field plot trials. The relationship between the Department of Forest Resources and Agrifoods is strong and needs to be maintained to further improve farm production management practices.

3) Experimental plots to increase CP content in barley. The feed value of barley can be increased through cultivar selection and management practices. Increased protein content in locally produced barley can lessen producers dependence on expensive feed supplements.

4) Experimental plots to increase winter wheat plant recovery and winter survival. Winter wheat is a high quality feed but concerns needs to be addressed especially winter survival and plant recovery.

5) Investigate hulless oat potential for yield. Hulless oats is a high quality feed but yield performance in Newfoundland has been irregular and further investigation is necessary.

6) Experimental plots to increase straw production in oats and winter wheat. Presently, Newfoundland does not have any recommendations for straw production. This information is essential for straw growers for production management practices especially for strawberry producers.

7) Continue to collect climate data from on-farm plots. Environmental data varies greatly from one area to the next in Newfoundland and farmers need this data to make informative decisions on crop management practices.

8) Production management trials for silage corn. On-farm silage corn production management and variety trials can determine the most economical production methods and which silage corn varieties to grow. Farmers can then make informative decisions based on a) yield, b) CP and TDN content, c) cob content, and d) moisture content.

9) High moisture grain production, storage and feeding trials. High moisture grain is a high quality feed and as a result, growing, storing and feeding practices need to be investigated.

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APPENDIX A

(Estimated Cost of Production of Various Grain on a Per Acre Basis - 1996/97)

Estimated Cost of Production on a Per Acre Basis - 1996/97

Variable Costs	H. Oat	Oat	Barley	S. Wheat		W. Wheat
Seed (120 lbs/ac)	$ 26.52	$ 27.74	$ 26.59	$ 38.18	(130 lbs/ac)	$ 56.88
Fertilizer (19-19-19; 268 lbs/ac)	$ 50.92	$ 50.92	$ 50.92	$ 50.92	(12-24-24; 450 lbs/ac)	$ 88.36
Fertilizer					(34-0-0; 73 lbs/ac)	$ 14.93
Limestone (2200 lbs/ac)	$ 25.00	$ 25.00	$ 25.00	$ 25.00		$ 25.00
Herbicide (1.5 litres/ac)	$ 14.70	$ 14.70	$ 14.70	$ 14.70		$ 14.70
Interest on Operating Capital	$ 16.04	$ 16.04	$ 16.04	$ 16.04		$ 16.04
Machinery and Equipment						
Fuel and Lube	$ 14.84	$ 14.84	$ 14.84	$ 14.84		$ 14.84
Repairs and Maint.	$ 18.38	$ 18.38	$ 18.38	$ 18.38		$ 18.38
Total Variable Costs	**$ 166.40**	**$ 167.62**	**$ 166.47**	**$ 178.06**		**$ 249.13**
Labour Inputs						
Plowing	$ 4.08	$ 4.08	$ 4.08	$ 4.08		$ 4.08
Limestone Application	$ 1.63	$ 1.63	$ 1.63	$ 1.63		$ 1.63
Fertilizer Application	$ 1.63	$ 1.63	$ 1.63	$ 1.63		$ 1.63
Discing	$ 1.96	$ 1.96	$ 1.96	$ 1.96		$ 1.96
Spray Herbicide	$ 0.98	$ 0.98	$ 0.98	$ 0.98		$ 0.98
Cultivate, harrow and pack	$ 0.82	$ 0.82	$ 0.82	$ 0.82		$ 0.82
Hauling Seed	$ 0.49	$ 0.49	$ 0.49	$ 0.49		$ 0.49
Planting	$ 1.96	$ 1.96	$ 1.96	$ 1.96		$ 1.96
Combining	$ 2.45	$ 2.45	$ 2.45	$ 2.45		$ 2.45
Processing	$ 9.22	$ 9.22	$ 9.22	$ 6.48		$ 11.44
Hauling to Storage	$ 2.45	$ 2.45	$ 2.45	$ 2.45		$ 2.45
Total Labour Inputs	**$ 27.67**	**$ 27.67**	**$ 27.67**	**$ 24.93**		**$ 29.89**
Fixed Costs						
Machinery and Equipment						
Insurance	$ 1.87	$ 1.87	$ 1.87	$ 1.87		$ 1.87
Storage	$ 3.60	$ 3.60	$ 3.60	$ 3.60		$ 3.60
Depreciation	$ 12.71	$ 12.71	$ 12.71	$ 12.71		$ 12.71
Interest on Investment	$ 8.36	$ 8.36	$ 8.36	$ 8.36		$ 8.36
Building						
Insurance	$ 3.09	$ 3.09	$ 3.09	$ 3.09		$ 3.09
Depreciation	$ 14.85	$ 14.85	$ 14.85	$ 14.85		$ 14.85
Other Overhead	$ 3.96	$ 3.96	$ 3.96	$ 3.96		$ 3.96
Total Fixed Costs	**$ 48.44**	**$ 48.44**	**$ 48.44**	**$ 48.44**		**$ 48.44**
Production Costs per Acre	**$ 242.51**	**$ 243.73**	**$ 242.58**	**$ 251.43**		**$ 327.46**
Grain Yields (tons/ac)	**1.9**	**1.5**	**2.2**	**1.8**		**2.4**
Production Costs Per tonne	**$ 128.99**	**$ 159.30**	**$ 109.76**	**$ 142.86**		**$ 136.44**
Straw Yields (tonne/ac)	**2.1**	**1.4**	**1.4**	**1.7**		**2.5**
Production Costs Per tonne	**$ 115.48**	**$ 180.54**	**$ 179.69**	**$ 152.38**		**$ 133.11**

Grain and Straw (mulch) Production Costs Per tonne	**$ 60.93**	**$ 84.63**	**$ 68.14**	**$ 73.73**	**$ 67.38**

APPENDIX B

(Feeding Trial Economics at Glenfair Farm)

Feeding Trial Economics at Glenfair Farm in Wooddale

	Ration	kg	Cost/tonne	Total Cost
TMR with Producer's Grain	Barley	350	$159.30	$55.76
	Wheat	130	$189.00	$24.57
	Pre-Mix	120	$681.00	$81.72
	Labour	0.88hrs	$8.00hrs	$7.04
	Total	600		$169.09
Haylage (60%DM)		390	$85.33	$33.28
Silage (40%DM)		2,800	$56.89	$159.29
Dairy Ration		Confidential		Confidential
Depreciation of equipment not included in other COP's - Roller (10 year useful life)				$12.02
TMR (10 year useful life)				
Cost of Feed using producer's grain				$536.48
Cost of Feed without using producer's grain				$599.57
Saving per day				$63.10
Total Savings over trial				$17,540.41
Percentage decline in dairy COP** during trial				4.0%
Decline in dairy COP** during trial				$3.73 /hL

Assumptions: ** Industry Average COP of $92.64/hL was used.
All forages are produced on farm.

APPENDIX C

(Feeding Trial Economics at Headline Holsteins Too Ltd)

Feeding Trial Economics at Headline Holsteins Too Ltd. at Reidville

	Ration	kg	Cost/tonne	Total Cost
TMR with Producer's Grain	Barley	450	$159.30	$71.69
	Grain Stretcher	150	$506.00	$75.90
	Ca++ (per bag)	4	$7.95 / bg.	$1.27
	Mineral	4	$858.20	$3.43
	Bicarb	8	$0.552 /kg	$4.42
	Combo	40	$804.00	$32.16
	Labour	1.03hrs	$8.00hrs	$8.27
	Total	656		$197.14
Forage (45%DM)		2,094	$85.33	$135.99
Dairy Ration		Confidential		Confidential
Depreciation of equipment not used in other COP's - Roller (10 year useful life)				$1.06
Cost of Feed using producer's grain				$638.19
Cost of Feed without using producer's grain				$689.27
Saving per day				$51.08
Total Savings over trial				$6,129.86
Percentage decline in dairy COP** during trial				3.5%
Decline in dairy COP** during trial				$3.24 / hL

Assumptions: ** Industry Average COP of $92.64/hL was used.
All forages are produced on farm.