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FLAX AS AN ALTERNATIVE GRAIN FOR MARITIME ORGANIC GROWERS

Final Research Report E2007-04

INTRODUCTION

Canada is the world leader in flax production with over 750,000 tonnes harvested annually in the prairie region (approximately 40% of global production). The agronomy of flax production is well understood as a result of extensive research and development conducted in Saskatchewan and Manitoba.

Despite the limited presence of flax in the Maritime Provinces, research has shown that the crop can be grown here with comparable results to that in Western Canada. Our study objective was to demonstrate the potential of organic flax production for the Maritimes.

SEEDING DATE AND INTERCROPPING (2004)

We selected two cultivars of flax, CDC Mons and Hanley, to investigate for organic flax production in Nova Scotia. Both varieties were sourced from Manitoba and were chosen for their above-average lodging resistance, high oil quality and disease resistance. Yield and weed competition in the two varieties were measured in response to planting date (early or late), and intercropping with wheat (AC Helena) or no intercropping. The early seeding date was May 13th; this included a disking operation on May 7th and s-tining on May 12th. The late seeding date was June 1st; this treatment was disked and s-tined on the day of seeding in addition to the earlier operations. Flax is known to be a difficult crop to finger weed and so the weeder was set to be less aggressive. We found that if finger-weeding was done too early the flax plants (2.5 – 3 cm tall) were buried and couldn't recover (34% losses, 57% weed control). Too late (flax 10 cm tall) and the weeds (at the 3 leaf pair stage) are too big to get effective control (7% flax loss, 34% weed control). We had the best luck finger-weeding when the flax was 5 cm tall (9% flax loss, 54% weed control).

Flax cultivar trial (A. Hammermeister)

Initial data indicated a higher flax and wheat density at the later planting date. Crop density of the Hanley cultivar was higher than CDC Mons, and Hanley matured at a slightly faster rate. The annual weed population was higher at the early seeding date. Flax yield of the individual plots without wheat intercrop ranged from 0.44 to 1.75 t ha^{-1} depending on treatment. Very low yields were observed in plots with high couch grass competition. Overall, the wheat intercrop reduced flax yields by approximately 40%, however total yield of flax and wheat was comparable to total flax yield in plots not intercropped. Late seeding of flax produced comparable yields to early seeded flax, which may be due to benefits of additional weed control. There were negligible differences in yield between the flax varieties overall.

CULTIVAR TRIALS (YEAR 1)

In 2005, cultivar trials were conducted at three locations in NS: the OACC research land in Brookside, and on two organic farms (Farm A and B). The cultivars selected for the trial were all developed in western Canada. Vimy and CDC Mons were bred at the Crop Development Centre for conditions in Saskatchewan, while the remaining varieties were bred in Manitoba. Cultivars for this trial were selected with consideration for disease resistance, yield potential, maturity and oil quality.

Table 1. Characteristics of flax cultivars from production in Western Canada

Cultivar	Year released	Maturity	Height	Lodging resistance	Seed size
Vimy[a]	1986	Medium	Med-tall	Poor	Med-large
CDC Mons[b]	2002	Med-late	Medium	Good	Small-med
NorLin[a]	1982	Medium	Medium	Good	Medium
AC Emerson[a]	1994	Medium	Medium	Fair	Med-large
AC Watson[a]	1995	Medium	Medium	Good	Med-large
AC Carnduff[a]	1996	Med-late	Med-tall	Good	Large
Hanley[c]	2002	Med-early	Medium	Very good	Medium

[a] Flax Council of Canada 2006; [b] Rowland et al. 2003; [c] Duguid et al. 2003

Replicated flax plots were planted in late April at Brookside with medium fertility, early May at Farm A with low fertility and some couchgrass problems, and early June at Farm B, with very low fertility and very dry conditions through the summer. After harvest, a subsample of three varieties from each farm (plus a sample of the original seed) was analysed to determine oil quality.

Due to major differences between farms, the yields are discussed for each site individually. There were few differences to report among the flax cultivars aside from poorer performance from the cultivar NorLin. Yields were slightly lower than in exploratory trials in the previous year, with AC Emerson producing the highest yields across 2 sites (Brookside and Farm A) (Table 1). NorLin was significantly later in emerging, flowering and maturity resulting in much lower yields. Fingerweeding at Brookside and Farm A resulted in a thinning of the stand at both locations, especially at Farm A where weeding was done too early. Lower yields at Farm A were also related to lower soil fertility, and higher weed competition, especially from couchgrass.

The flax was mature and ready for harvest in early September at both Brookside and Farm A, with the exception of NorLin. At Farm B, an even stand of all cultivars established, but drought and low soil fertility produced a short crop with obviously low grain quality. Late season rains also stimulated extended flowering and kept stems green resulting in a delay in harvest to October 5th. Even then, the flax was still somewhat green which posed problems with harvest as the knives would jam on the header, and the sample was difficult to clean. Cylinder speeds must be reduced on the combine to avoid damaging the seed. Late harvest reduces crop quality significantly, and flax becomes miserable to harvest. Swathing may be necessary to take this crop off successfully.

Flax quality was influenced by cultivar and by site (Table 3). Oil content and alpha-linolenic (ALA) fatty acid content are important attributes of flax sought after by processors and the health food industry. Alpha-linolenic acid is the major omega-3 fatty acid in flax to which many health benefits are attributed. Oil content and ALA content were was high at the Brookside location where fertility and moisture were adequate and the crop was planted early. In contrast, low fertility, late planting, drought and resulting late harvest all contributed to relatively low flax oil yield and quality at Farm B. Average ALA content was lowest for the Vimy cultivar. Compared to 10-year averages for conventional flax produced in western Canada (DeClercq 2005), our mean oil content of 40.6% was slightly lower than western flax (44.3%), but ALA levels were comparable (Maritime 58.6% vs. western 58.0%).

Table 2. Mean flax yields by cultivar at three locations, 2005

	Mean Yield (kg ha^{-1})		
Cultivar	**Brookside**	**Farm A**	**Farm B**
CDC Mons	1187	565	110
AC Carnduff	1312	461	47
AC Watson	1183	596	130
Hanley	1157	614	**166**
Vimy	1227	563	132
NorLin	473	265	134
AC Emerson	**1320**	**630**	54

Table 3. Oil quality assessment for three flax cultivars in 2005

		Hanley	Vimy	AC Emerson
Oil Content (%)	Original[a]	39.9	40.7	41.9
	Brookside	41.9	42.4	42.8
	Farm A	41.0	41.9	41.9
	Farm B	38.2	38.4	37.1
ALA (% of all FA)	Original[a]	62.3	56.8	62.8
	Brookside	62.2	59.1	63.1
	Farm A	59.8	56.7	61.5
	Farm B	56.0	53.2	56.0
Free Fatty Acid[b]	Original[a]	0.40	0.62	0.39
	Brookside	0.72	0.85	0.57
	Farm A	2.75	0.83	1.42
	Farm B	1.17	0.83	1.26

[a] Original refers to the original registered seed

Free fatty acid content results from the breakdown of triglycerides. High FFA means that the oil quality is lower and rancidity may be of concern. For good quality oil, FFA should be no greater than 2%. The average FFA content of western Canadian No. 1 flax is very low, with a 10-yr average of 0.28 (DeClercq 2005). In the Maritime trial, the mean FFA over all sites was 1.2. For the cultivars Hanley and AC Emerson, the FFA was over 3x greater than the original sample at Farm A and B. FFA was lowest for the cultivar Vimy (Table 3).

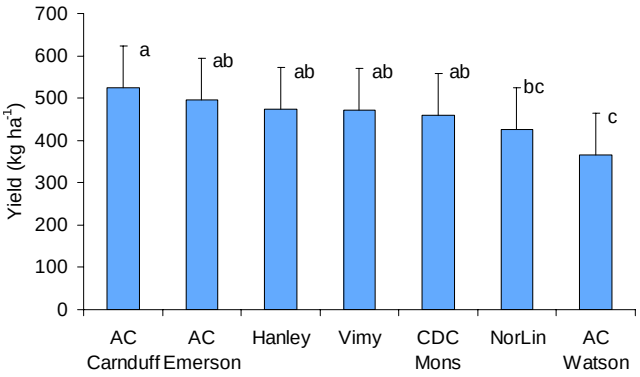

Figure 1. Mean flax yields averaged over five sites in 2006. Yields for varieties with the same letter are not significantly different.

CULTIVAR TRIALS (YEAR 2)

The same seven flax cultivars were tested in 2006 at five sites: Brookside, Farm A and additional organic farms in PEI, NS and NB. In general, yield was lower than expected, with the mean yield over all sites under 0.5 t ha^{-1}. Few statistically significant differences were observed between varieties (Figure 1). In the analysis of all 2006 sites together, yield for AC Carnduff was higher than NorLin and AC Watson. Yields of AC Emerson, Hanley, Vimy and CDC Mons were all intermediate and similar. When we looked at each farm separately, differences between varieties were only seen at two sites (Table 4). The cultivars AC Carnduff and AC Emerson both performed well at Brookside and Farm B.

Table 4. Mean flax yields in 2006 at the Brookside research station and four organic farms

Cultivar	ID	Yield (kg ha^{-1})				
		Brookside	Farm A	Farm B2	Farm C	Farm D
CDC Mons	F1	628c	471	599	178c	418
AC Carnduff	F2	912a	390	658	282a	377
AC Watson	F3	616c	284	478	229b	221
Hanley	F4	715bc	422	616	220bc	392
Vimy	F5	865ab	440	562	224bc	206
NorLin	F6	611c	279	641	261ab	337
AC Emerson	F7	790abc	434	676	280a	299
Overall Mean		*734*	*388*	*604*	*239*	*321*
SEM		77	66	140	26	68*
F =		2.6	1.5	0.25	3.59	2.2
P>F		**0.07**	0.27	0.95	**0.03**	0.12

a-c Means in each column with the same letter are not significantly different (P < 0.10, LS Means comparison).
*SEM for F5 is 79 kg ha^{-1}

When considering both study years, few varieties stood out over others. The cultivars AC Carnduff and AC Emerson tended to yield better than others, while NorLin and to some extent AC Watson both were poorer yielding. However, the performance of cultivars was variable depending on site and weather conditions in each year. If seedbed preparation and weed control are performed well and soil fertility and moisture is adequate, then a decent crop could result from most of the varieties tested here. However, in years of excess moisture or late planting, producers may not be able to achieve high yields, and oil content and quality may suffer.

Flax is a high profile crop due to its health benefits. It is sold as a whole seed to consumers, bakers and processors. The interest in flax as a value added feed supplement and a product for the health food industry plus interest in local flax oil production, are positive developments for the organic flax market. However, good management, timely harvest, and proper cleaning and storage are necessary.

Flowering flax (A. Hammermeister)

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THE BOTTOM LINE...

Of the varieties tested, AC Carnduff and AC Emerson performed best under Maritime conditions. Flax can be grown in the Maritimes, but must be well managed and handled. Planting early in a clean field with moderate fertility will produce reasonable yields and quality. Late planting can allow additional weed control, however, may cause problems with delayed harvest. Timely harvest is very important for achieving high quality.

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