PROJECT REPORT

Long-Term vs Short Term Effects of No-Till

2002 & 2003 & 2004

January, 2005

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Acknowledgement: This study was made possible with the cooperation of Jim Halford of Vale Farms Ltd, the Indian Head Agricultural Research Foundation, Saskatchewan Agriculture Food and Rural Revitalization, Agriculture and Agri-Food Canada, N.M Paterson Co, Taking Charge Greenhouse Gas Best Management Program, and the Potash and Phosphate Institute of Canada.

INTRODUCTION

Making changes in farming practises requires commitment, time and resources. Producers are interested in knowing the long-term benefits of these changes especially their economic impact. Most of the research work comparing no-till to conventional-till usually has a relatively short time frame of 2-6 years. This makes it very difficult to assess the long-term agronomic and economic benefits of no-till. In 2001, a unique opportunity presented itself. Jim Halford was able to lease a field adjacent to his long-term 23 year no-till field. The adjacent field had been managed using a conventional crop-fallow cropping system. This opportunity provided us with the ability to quantify the magnitude of the long-term agronomic and economic benefits of direct seeding. A description of the cropping sequences of the two adjacent fields is given in Table 1.

The close proximity of the two contrasting fields allowed the opportunity to answer more questions regarding the long-term effects of direct seeding and continuous cropping on overall crop production. The number of studies was expanded in 2003 to try and answer some of those questions. Each study listed below is being conducted on each one of the two fields.

The first study continues from 2002 using the same plots and treatments except that canola was seeded in 2003 instead of spring wheat. The study evaluates the effects of P placement (side-band vs seed-placed) and different rates of N.

The next two studies looks at the overall productivity of the major lentil types with and without fungicides and the effects of starter nitrogen.

The third study looks at the response of wheat and field pea to different levels of phosphorus fertilizer.

The fourth study looks at the response of canary seed, oat and flax to different rates of fertilizer nitrogen using urea in a mid-row banded situation. These crops tend to be less responsive to N fertilizer than spring wheat or canola.

The fifth study looks at alternate N management strategies in spring wheat. We are comparing putting 33% or 100% of the urea fertilizer down at seeding time vs using liquid (67% or 100%) in a surface dribble application at either the 1, 3 or 5 leaf stage.

Table 1. Cropping histories of long-term and short term fields used in this study.

Year	Long-Term No-Till Field	Year	Short-Term No-Till Field
1978-1983	No-Till Annual Cropping	**1984-1998**	Conventional Tillage Wheat/Fallow System
1984-90	Brome Grass Seed Production for 6 years and 2 years of hay		
1991	Chemical fallow	**1999**	Summerfallow
1992	Spring wheat	**2000**	Barley - Conventional Tillage
1993	Canola	**2001**	Canola (zero-till)
1994	Spring wheat	**2002**	Spring Wheat (zero-till)
1995	Canola	**2003**	Field Pea (zero-till)
1996	Spring wheat		
1997	Canola		
1998	Spring wheat		
1999	Lentil		
2000	Spring wheat		
2001	Canola		
2002	Spring wheat		
2003	Field pea		

2002 FIELD STUDY RESULTS

OBJECTIVE:

To determine the relative productivity of two adjacent fields with different cropping and tillage histories by comparing response of wheat to different rates of nitrogen and placement of phosphorus.

MATERIALS AND METHODS:

Two adjacent fields with very contrasting field histories in terms of tillage and crop rotations were used to compare the response of wheat to different rates of nitrogen and different placements of phosphorus. All fertilizer nitrogen (urea) was side-banded using rates of 0, 30, 60, 90 and 120 kg N /ha. One rate of mono-ammonium phosphate (23 kg/ha of P2O5) was used and either seed-placed or side-banded at time of seeding. When side-banded, it was placed with the urea nitrogen at 2.5 cm to the side and 7.5 cm below the seed. Refer to Table 2 for other pertinent information. The plots were 12' x 35', approximately 39 m^2. Plant and head counts were done on one meter of row in each plot and reported on a per square meter basis. Leaf nitrogen and phosphorus content was determined by collecting flag leaves at random throughout the plot after heading was complete, air drying them at 30°C , grinding and sending them for analysis for total N and P determination. Grain yield was determined by harvesting the entire plot and grain protein was done by keeping a sub-sample of 500 g from each plot and then having the protein concentration determined using a commercial infra-red analyser at the N.M. Paterson grain elevator in Indian Head on each plot sub-sample.

Table 2. Pertinent Agronomic Information for 2002.

Variable	Long-Term No-Till Field	Two Year No-Till Field
Crop Variety	CDC Teal	CDC Teal
Seeding Date	May 28th , 2002	May 28th , 2002
Harvest Date	September 16th, 2002	September 16th, 2002
Herbicide Use		
Pre-Seeding Burnoff	May 24th, 2002 Round-Up at 1.0 li/acre	May 24th, 2002 Round-Up at 1.0 li/acre
In-Crop Herbicide	Buctril M (1 li/ha) + 0.2l/ac MCPA Ester - June 24th	Buctril M (1 li/ha) + 0.2l/ac MCPA Ester - June 24th and Horizon 0.095 li/ac - July 5th.
Pre-Harvest Round-Up	September 6th Round-Up at 1.0 li/acre (applied by air)	September 4th Round-Up at 1.0 li/acre (applied by ground asplicator)

Seeding Implement	ConservaPak Seeder on 12" spacing	ConservaPak Seeder on 12" spacing
Soil Test NO3-N (kg/ha) 0-30cm	55	41
Soil Test PO4-P (kg/ha) 0-30 cm	60	25
Soil Test K (kg/ha) 0-30cm	895	1200
Soil Test SO4-S (kg/ha) 0-30 cm	73	69
Soil pH	7.9	8.0
Salinity Rating	Non-saline	Non-saline
Target N levels for 42 bus/ac assuming average growing season precipitation (kg/ha)	39 - 50	50 - 63
Soil Texture	Clay loam	Clay loam

RESULTS AND DISCUSSION

The results of the field study are presented in Tables 3, 4 and 5. The results clearly demonstrate the long term beneficial effects of continuous and diversified cropping when combined with conservation tillage. It is clear that adoption of these practises could lead to reduced input in terms of fertility or more innovative soil fertility practices and better grain quality as demonstrated by the higher grain protein values for the long-term zero tillage land. It also exemplifies the importance of maintaining the productivity of the land through proper management.

The results also show that placing the phosphorus with the nitrogen in a single band below and to the side of the seed does not alter the response to nitrogen. It is also apparent that placing the phosphorus with the seed is similar to placing it to the side and below the seed.

Above average growing conditions were observed for 2002. The grade of the wheat is estimated as a CW#2.

Table 3. The effects of nitrogen rates and phosphorus placement on selected variables under long-term (L-T) and short-term no-till (S-T) conditions in 2002.

Factor	Levels	Plants / m^2		Heads / m^2		Flag Leaf % N		Flag Leaf % P	
		L-T	S-T	L-T	S-T	L-T	S-T	L-T	S-T
P-Placement	**Seed-Placed**	415	366	497	561	3.97	3.46	0.28	0.25
	Side-Band	448	392	634	583	3.95	3.48	0.28	0.25
	s.e.	18	9	18	24	0.02	0.03	0.001	0.003
	p-level	ns	0.07	0.0001	ns	ns	ns	ns	ns
N-Rate kg/ha	**0**	437	395	520	658	3.64	2.96	0.27	0.24
	30	423	425	562	639	3.86	3.04	0.28	0.23
	60	430	389	578	514	3.96	3.51	0.28	0.25
	90	443	342	600	511	4.13	3.79	0.29	0.26
	120	423	342	569	536	4.19	4.04	0.29	0.26
	s.e.	28	15	29	38	0.04	0.05	0.036	0.004
	p-level	ns	0.004	ns	0.02	0.0001	0.0001	0.002	0.004
	Linear	ns	0.0009	ns	0.007	0.001	0.0001	0.0001	0.0003
	Quadratic	ns	ns	ns	ns	ns	ns	ns	ns
	N x P inter.	ns	ns	ns	ns	ns	ns	ns	ns

Table 4. The effects of nitrogen rates and phosphorus placement on selected variables under long-term (L-T)and short-term no-till (S-T) conditions in 2002.

Factor	Levels	Grain Protein %		Grain Yield kg/ha		Grain Yield bus/acre	
		L-T	S-T	L-T	S-T	L-T	S-T
P Placement	**Seed-Placed**	13.9	11.8	3095	2572	46.4	38.6
	Side-Band	13.9	11.7	3247	2630	48.7	39.4
	s.e.	0.09	0.08	99	79	1.5	1.2
	p-level	ns	ns	ns	ns	ns	ns
N rate (kg-N/ha)	**0**	13.3	10.9	2842	1748	42.6	26.2
	30	13.7	11.0	2988	2200	44.8	32.9
	60	14.0	11.6	3272	2679	49.1	40.2
	90	14.2	12.3	3436	3197	51.5	47.9
	120	14.4	13.1	3318	3181	49.8	47.7
	s.e.	0.14	0.13	157	125	2.3	1.9
	p-level	0.0003	0.0001	ns	0.0001	ns	0.0001
	Linear	0.001	0.0001	0.011	0.0001	0.011	0.0001
	Quadratic	ns	0.005	ns	ns	ns	ns
	N x P inter.	ns	ns	ns	ns	ns	ns

Table 5. Economic analysis of nitrogen rate response study as a function of zero tillage management.

Treatment	N Rate (kg/ha)	Yield (bu/A)	Protein (%)	Gross ($/A)[1]	N Fert cost ($/A) [2]	N Margin ($/A)	Other Var. & OH costs ($/A)[3]	Net ($/A)
LT - ZT	0	42.6	13.3	$169.55	$0.00	$169.55	$114.53	$55.02
	30	44.8	13.7	$183.68	$7.29	$176.39	$114.53	$61.86
	60	49.1	14.0	$205.73	$14.58	$191.15	$114.53	$76.62
	90	51.5	14.2	$219.91	$21.87	$198.04	$114.53	$83.51
	120	49.8	14.4	$216.63	$29.16	$187.47	$114.53	$72.94
ST - ZT	0	26.2	10.9	$87.77	$0.00	$87.77	$114.53	($26.76)
	30	32.9	11	$112.52	$7.29	$105.23	$114.53	($9.30)
	60	40.2	11.6	$141.50	$14.58	$126.92	$114.53	$12.39
	90	47.9	12.3	$175.79	$21.87	$153.92	$114.53	$39.39
	120	47.7	13.1	$186.51	$29.16	$157.35	$114.53	$42.82

1 Gross return = grain yield * price with protein premium – (freight + handling [1.47/bu])

2 Fertilizer cost = $277/mt urea ($0.273/lb N)

3 Variable and overhead costs, except for N fertilizer, according to SAF costs of production for direct seeded spring wheat Black soil zone

2003 Field Study Results

Study #1: The effects of phosphorus placement and rate of nitrogen on the grain yield of canola under a long-term and a short-term zero tillage field history.

The results obtained in 2003 follow the same pattern as in 2002 except that the low yields of 2003 resulted in overall net losses. Over the two years of the study the net returns from the long-term no-till field were impressive considering that this is a class 5 soil.

Table 6. Pertinent Agronomic Information for 2003.

Variable	Long-Term No-Till Field	Two Year No-Till Field
Crop Variety	InVigor 2663	InVigor 2663
Seeding Date	May 14	May 14
Harvest Date	Aug 19	Aug 19
Swathing Date	Aug 7	Aug 7
Herbicide Use		
Pre-Seeding Burnoff	Glyphos 900 gai/ha applied on May 8	
In-Crop Herbicide	Liberty and Select @506 & 15 gai/ha applied on June 5	
Pre-Harvest Round-Up	-	-
Seeding Implement	ConservaPak Seeder on 12" spacing	ConservaPak Seeder on 12" spacing
P_2O_5 kg/ha (12-51-0)	35	35
Soil pH	7.9	8.0
Salinity Rating	Non-saline	Non-saline
Soil Texture	Clay loam	Clay loam

Table 7. The effects on nitrogen rates in 2002 on the soil residual NO_3-N (kg/ha) levels from soil samples taken in the fall of 2002.

History	N rates (kg/ha)				
	0	**30**	**60**	**90**	**120**
L-T No-Till	18	21	40	30	42
S-T No-Till	12	11	11	12	17

Table 8. Agronomic and economic analysis of nitrogen rate response study as a function of zero tillage management in canola in 2003.

Treatment	N Rate (kg/ha)	Yield (bu/A)	Gross ($/A)[1]	N Fert cost ($/A)[2]	N Margin ($/A)	Other Var. & OH costs ($/A)[3]	Net ($/A)
LT - ZT	0	10.7	$75.86	$0.00	$75.86	$114.53	($38.67)
	30	13	$92.17	$11.60	$80.57	$114.53	($33.96)
	60	16.9	$119.82	$23.20	$96.62	$114.53	($17.91)
	90	18.4	$130.46	$34.76	$95.70	$114.53	($18.83)
	120	16.5	$116.99	$46.40	$70.58	$114.53	($43.95)
ST - ZT	0	4.2	$29.78	$0.00	$29.78	$114.53	($84.75)
	30	7.8	$55.30	$11.60	$43.70	$114.53	($70.83)
	60	11.4	$80.83	$23.20	$57.63	$114.53	($56.90)
	90	16.9	$119.82	$34.76	$85.06	$114.53	($29.47)
	120	14.7	$104.22	$46.40	$57.82	$114.53	($56.71)

1 Gross return = grain yield x price – (freight + handling [1.47/bu])

2 Fertilizer cost = $440/tonne for urea ($0.43/lb N)

3 Variable and overhead costs, except for N fertilizer, according to SAF costs of production for direct seeded spring wheat Black soil zone. Canola price $7.09/bus FOB Indian Head on Sept 7.

Study #2. The effects of starter N in lentils under long-term and short-term no-till management in 2003.

Producers are interested in the concept of starter nitrogen for pulse crops especially in lentil given their more indeterminant growth habit. Of interest as well is the observation that lentil grown on long-term continuously cropped no-till fields doesn't yield as well as on short term no-till fields. There is also concerns that fields with many cycles of lentil may also not yield as well, especially in the thin-black soil zone. Producers are interested in knowing if lentil grown on fields with low nitrogen fertility should be supplemented with fertilizer nitrogen. The present study permitted the investigation of some of those questions. A summary of pertinent agronomic information is given in Table 9.

A summary of the plant populations is given in Table 10. Although there was a slight drop in plant populations with the second rate of N, given that the N was mid-row banded, we feel that this is an artifact. Even though we tried to obtain better than 100 plants per square meter, our final plant population was only about 70 plants per square meter.

There was a significant length of No-Till x N rate interaction for grain yield (Table 11). The nature of the interaction is such that N rate had a greater effect on the short-term than the long-term no-till. Overall the yields tended to be greater on the short-term than the long-term. The N rate response was quadratic in nature.

We also did some spectral measurements with the GreenSeeker^{tm} instrument which provides measures of Normalized Difference Vegetation Index (NDVI). NDVI is calculated as the ratios of the infra-red and red bands using the relationship of (Infra-red - Red)/(Infra-red + Red). NDVI is an indirect measurement of the chlorophyll content of the crop canopy which in turn provides an indirect measurement of crop biomass. Chlorophyll absorbs radiation in the red band and reflects the infra-red radiation. This means that the higher the values for NDVI, the more the red band is being absorbed and consequently more chlorophyll is present hence more biomass. Measurements were conducted at two different times (Table 12). On the first date, which corresponded to 10-15 % bloom in the lentil, NDVI values were similar for the short term no-till and long-term no till but on the second date, the values were larger for the long-term no-till. We speculate that by the second seeding date, the larger amount of N being mineralized by the long-term no-till resulted in higher NDVI values. The values increased linearly with N rate on both dates and for both short term and long term no-till. NDVI was able to discriminate the different N rates on both dates.

Table 9. Other pertinent agronomic information.

Variable	Long-term No-Till	Short-term No-Till
Cultivar	CDC Sedley	CDC Sedley
Seeding Date	May 12	May 12
Seeding Rate	125 kg/ha	125 kg/ha
Inoculant Rate and Type	Granular @5.6 kg/ha	Granular @5.6 kg/ha

Harvest Date	Aug 12	Aug 12
Herbicide Use		
Pre-Seeding Burnoff	Glyphos 900 gai/ha applied on May 8	Glyphos 900 gai/ha applied on May 8
In-Crop Herbicide	Pursuit @16.2 gai/ha on May 14 pre-emergence Poast Ultra @214 gai/ha on June 5	Pursuit @16.2 gai/ha on May 14 pre-emergence Poast Ultra @214 gai/ha on June 5
Dessication	Reglone @ 420 gai/ha on Aug 8	Reglone @ 420 gai/ha on Aug 8
Fungicide Use		
In-Crop	Headline @100 gai/ha on July 4	Headline @ 100 gai/ha on July 4
Seeding Implement	Edwards Hoe Drill - 8" spacing	Edwards Hoe Drill - 8"spacing
Soil Test NO3-N (kg/ha) 0-30cm	24.1	19.5
Soil Test PO4-P (kg/ha) 0-30 cm	32.8	15.9
Potassium Sulfate Applied (kg/ha)	119 kg/ha on May 7	119 kg/ha on May 7
P_2O_5 fertilizer applied (kg/ha) 12-51-00	28 kg/ha	28 kg/ha
Nitrogen form and placement	Urea - Midrow band on 16" centers	Urea - Midrow band on 16" centers
Crop Stage for NDVI on July 2	10-15% flower bloom	10-15% flower bloom
Crop Stage for NDVI on July 17	30-35% flower bloom	30-35% flower bloom
Soil pH	7.9	8.0
Salinity Rating	Non-saline	Non-saline
Soil Texture	Clay loam	Clay loam

Table 10. The effects of years in no-till and nitrogen rate on plant populations (# m^{-2}) for lentil in 2003.

Nitrogen-N rate (kg/ha)	Long Term No-Till	Short Term No-Till	Mean
0	94	70	82
15	45	43	44
30	70	67	68
60	76	76	73
Mean	**71**	**62**	
CV=22.3%; Significant quadratic response to nitrogen rate (p=0.016).			

Table 11. The effects of years in no-till and nitrogen rate on grain yield (kg/ha) for lentil in 2003.

Nitrogen-N rate (kg/ha)	Long Term No-Till	Short Term No-Till	Mean
0	1773	2016	**1895**
15	1822	1752	**1787**
30	1879	2226	**2053**
60	1988	2367	**2177**
Mean	**1865**	**2091**	
cv=6.3%; nrate effect (p=0.008); linear N rate effect (p=0.0001); time in no-till x n rate interaction (p=0.03);			

Table 12. The effects of years in no-till and nitrogen rate on NDVI for lentil in 2003 at two different times.

Nitrogen-N rate (kg/ha)	July 2			July 17		
	Long Term No-Till	Short Term No-Till	Mean	Long-term No-till	Short-term No-till	Mean
0	0.442	0.449	0.446	0.713	0.616	0.665
15	0.467	0.520	0.493	0.732	0.679	0.705
30	0.577	0.597	0.587	0.710	0.718	0.714
60	0.615	0.672	0.644	0.758	0.773	0.765
Mean	0.525	0.560		0.728	0.696	
cv=6.4%; nrate effect (p=0.001); linear nrate effect (p=0.001).				**cv=8.0%; nrate effect (p=0.640); limear nrate effect (p=0.003)**		

Study #3: The effects of long-term and short-term no-till and fungicides on the production of different classes of lentil in 2003.

The study examined three types of green lentils and two types of red lentil. We were interested in determining if there were interactions between lentil type, fungicide application and length of time under no-till. Relevant agronomic information is presented in Table 13.

The recommended target plant population for lentil is 130 plants per meter square. Table 14 lists the treatment effects on plant populations. Although seeding rates were adjusted for seed size and germination percentage, we were not able to obtain the target plant populations. An interaction between cultivar and length of no-till was observed.

The grain yields were affected by time in no-till and cultivars and there was a cultivar x time interaction (Table 15). The interaction was due to smaller differences between the highest and lowest cultivars under long-term no-till than short term no-till. The overall yields were greater under the short-term no-till. The green lentils as a group yield higher than the red lentils. CDC Robin yielded the least under both systems while CDC Vantage yielded the highest under both systems. The large green cultivar CDC Sedley yielded less that the other two green cultivars and its yield was similar to CDC Robin and CDC Recap.

The effect of time in no-till did not have an effect on seed weight (Table 16). The various lentil classes used in the study behave similarly in terms of seed weight, regardless of the length of time in no-till.

Table 13. Other pertinent agronomic information.

Variable	Long-term No-Till	Short-term No-Till
Seeding Date	May 8	May 8
Seeding Rate		
CDC Milestone (small green)	46 kg/ha	46 kg/ha
CDC Sedley (large green)	125 kg/ha	125 kg/ha
CDC Vantage (medium green)	73 kg/ha	73 kg/ha
CDC Redcap (large red)	54 kg/ha	54 kg/ha
CDC Robin (small red)	34 kg/ha	34 kg/ha
Inoculant Rate and Type	Granular @ 5.6 kg/ha with the seed	Granular @ 5.6 kg/ha with the seed
Harvest Date	August 12	August 12
Herbicide Use		
Pre-Seeding Burnoff	Glyphos @ 900 gai/ha on May 8	Glyphos @ 900 gai/ha on May 8

In-Crop Herbicide	Pursuit @ 16.2 gai/ha on May 14 pre-emergence Poast Ultra @ 214 gai/ha on June 5	Pursuit @16.2 gai/ha on May 14 pre-emergence Poast Ultra @ 214 gai/ha on June 5
Dessication	Reglone @ 420 gai/ha on Aug 8	Reglone @ 420 gai/ha on Aug 8
Fungicide Use		
In-Crop	Headline @100 gai/ha on July 4	Headline @ 100 gai/ha on July 4
Seeding Implement	Edwards Hoe Drill - 8" spacing	Edwards Hoe Drill - 8"spacing
Soil Test NO3-N (kg/ha) 0-30cm	24.0	15.2
Soil Test PO4-P (kg/ha) 0-30 cm	29.7	11.9
Potassium Sulfate Applied (kg/ha)	119 kg/ha on May 7 broadcast applied	119 kg/ha on May 7 broadcast applied
P_2O_5 fertilizer applied (kg/ha) 12-51-00	28 kg/ha	28 kg/ha
Soil pH	7.9	8.0
Salinity Rating	Non-saline	Non-saline
Soil Texture	Clay loam	Clay loam

Table 14. The effects of time under no-till on plant populations (#/^{2}) in 2003.

Lentil Cultivar	Long-term No-till	Short-term No-Till
CDC Milestone	69	100
CDC Sedley	68	73
CDC Vantage	90	80
CDC Redcap	100	75
CDC Robin	114	101
Mean	**88**	**86**
cv=22.2%; Significant cultivar effect and cultivar x length of no-till effect. The recommended seeding rate is 130 plants per square meter.		

Table 15. The effects of time under no-till on grain yield (kg/ha) in 2003.

Lentil Cultivar	Long-term No-till	Short-term No-Till	Mean
CDC Milestone	1520	2186	**1853a**
CDC Sedley	1236	1870	**1553bc**
CDC Vantage	1599	2284	**1941a**
CDC Redcap	1348	1976	**1661b**
CDC Robin	1147	1841	**1493c**
Mean	**1370b**	**2031a**	**1701**
cv=10.6%; Significant cultivar effect (LSD05=150); time in no-till and cultivar x time in no-till interaction.			

Table 16. The effects of time under no-till on 1000 seed weight (g) in 2003.

Lentil Cultivar	Long-term No-till	Short-term No-Till	Mean
CDC Milestone	37	35	**36c**
CDC Sedley	74	74	**74a**
CDC Vantage	53	53	**53b**
CDC Redcap	36	36	**36c**
CDC Robin	28	28	**28d**
Mean	**45**	**45**	
cv=2.3%; Significant cultivar effect (LSD05=0.9)			

Study #4: The effects of long-term and short-term no-till on the response of flax, canary seed and oat to nitrogen fertilizer in 2003.

It is well known that crops like flax and canary seed unlike oat are not very responsive to nitrogen fertilizer. The objective of the study was quantify the N response of these three crops on the long-term and short-tem no-till fields. A summary of pertinent agronomic information is provided in Table 17. In order to test out as many rates as possible, 11 rates of N (from 0-100 kg N /ha in 10 kg increments) were employed with only one replicate. NDVI measurements were collected with a Green Seeker[tm] instrument on two separate occasions to try and establish a relationship between NDVI and grain yield. The summary of grain yield results is provided in Table 18. Overall with oat, a significant response to N was observed and the yield was greater for the long-term than the short-term no-till site. As well, we showed very strong relationships between NDVI and grain yield on both seeding dates (Table 19). With flax, the overall response to N was weak and the differences between the two field histories were not obvious like in oat (Table 18). The relationship between NDVI and grain yield was weak on the long-term site and very strong on the short-term site (Table 19). The yield results for canary seed are suspect because of problems with volunteer wheat on the long-term site. Nonetheless, there was a very strong relationship between NDVI and grain yield for the short-term but not the long-term no-till site. Given the data collected to date with the GreenSeeker[tm], it would appear that this technology has the potential of helping us make better decisions regarding N management on a field scale basis.

Table 17. Other pertinent agronomic information.

Variable	Long-term No-Till	Short-term No-Till
	Flax	
Cultivar	CDC Bethune	CDC Bethune
Seeding Date	May 12	May 12
Seeding Rate	56 kg/ha	56 kg/ha
Harvest Date	Sept 3	Sept 3
Herbicide Use		
Pre-Seeding Burnoff	Glyphos @ 900 gai/ha on May 8	Glyphos @ 900 gai/ha on May 8
In-Crop Herbicide	Curtail M @ 660 gai/ha on June 5 Poast Ultra @ 214 gai/ha on June 5	Curtail M @ 660 gai/ha on June 5 Poast Ultra @ 214 gai/ha on June 5
Post Harvest	-	-
GreenSeeker (July 2) Crop Stage	Start of flowering	Start of flowering
GreenSeeker (July 17) Crop Stage	End of flowering	End of flowering
Seeding Implement	Edwards Hoe Drill - 8" spacing	Edwards Hoe Drill - 8"spacing

Soil Test NO3-N (kg/ha) 0-30cm	14	14
Soil Test PO4-P (kg/ha) 0-30 cm	22	5
Potassium Sulfate Applied (kg/ha)	119 kg/ha on May 7 broadcast applied	119 kg/ha on May 7 broadcast applied
P_2O_5 fertilizer applied (kg/ha) 12-51-00	24 kg/ha seed placed	24 kg/ha seed placed
Soil pH	7.9	8.0
Salinity Rating	Non-saline	Non-saline
Soil Texture	Clay loam	Clay loam
	Canaryseed	
Cultivar	CDC Maria	CDC Maria
Seeding Date	May 12	May 12
Seeding Rate	35 kg/ha	35 kg/ha
Harvest Date	Aug 15	Aug 15
Herbicide Use		
Pre-Seeding Burnoff	Glyphos @ 900 gai/ha on May 8	Glyphos @ 900 gai/ha on May 8
In-Crop Herbicide	Curtail M @660 gai/ha on June 5	Curtail M @660 gai/ha on June 5
Post Harvest	-	-
GreenSeeker (July 2) Crop Stage	10% of spikes emerged	10% of spikes emerged
GreenSeeker (July 17) Crop Stage	Early grain fill	Early grain fill
Seeding Implement	Edwards Hoe Drill - 8" spacing	Edwards Hoe Drill - 8"spacing
Soil Test NO3-N (kg/ha) 0-30cm	16	16
Soil Test PO4-P (kg/ha) 0-30 cm	51	11

Potassium Sulfate Applied (kg/ha)	119 kg/ha on May 7 broadcast applied	119 kg/ha on May 7 broadcast applied
P_2O_5 fertilizer applied (kg/ha) 12-51-00	24 kg/ha seed placed	24 kg/ha seed placed
Soil pH	7.9	8.0
Salinity Rating	Non-saline	Non-saline
Soil Texture	Clay loam	Clay loam
	OAT	
Cultivar	AC Morgan	AC Morgan
Seeding Date	May 12	May 12
Seeding Rate	156 kg/ha	156 kg/ha
Harvest Date	August 15	August 15
Herbicide Use		
Pre-Seeding Burnoff	Glyphos @ 900 gai/ha on May 8	Glyphos @ 900 gai/ha on May 8
In-Crop Herbicide	Curtail M @660 gai/ha on June 5	Curtail M @660 gai/ha on June 5
Post Harvest	-	-
GreenSeeker (July 2) Crop Stage	Flag leaf emergence	Flag leaf emergence
GreenSeeker (July 17) Crop Stage	Early grain fill	Early grain fill
Seeding Implement	Edwards Hoe Drill - 8" spacing	Edwards Hoe Drill - 8"spacing
Soil Test NO3-N (kg/ha) 0-30cm	15	11
Soil Test PO4-P (kg/ha) 0-30 cm	42	11
Potassium Sulfate Applied (kg/ha)	119 kg /ha surface broadcast on May 7	119 kg/ha on May 7 broadcast applied
P_2O_5 fertilizer applied (kg/ha) 12-51-00	24 kg/ha seed placed	24 kg/ha seed placed

Soil pH	7.9	8.0
Salinity Rating	Non-saline	Non-saline
Soil Texture	Clay loam	Clay loam

Table 18. The effects of nitrogen fertilizer on the yield (kg/ha) of flax, canary seed and oat under long-term and short-term no-till in 2003.

N rate kg/ha	Flax		Canaryseed		Oat	
	L-T	S-T	L-T	S-T	L-T	S-T
0	954	657	108	215	2326	1726
10	428	602	210	360	3230	1686
20	978	894	123	708	3453	2336
30	514	818	127	579	3052	2759
40	596	1008	218	649	3722	2967
50	1133	1171	201	855	3321	3375
60	842	1120	175	785	3545	3538
70	1190	1145	223	1055	3691	3935
80	1089	1011	150	852	3713	3376
90	984	1105	370	831	3961	3755
100	880	1095	174	922	3811	4099
Mean	**872**	**966**	**189****	**710**	**3439**	**3050**

****Problems with volunteer wheat**

Table 19. Linear regression equations between grain yield and NDVI measurements in 2003.

Field History	NDVI Measurement	# of Observations	Linear Equation	R^2 (%)	Significance
			Flax		
Long-Term	**July 2nd**	**11**	kg/ha = -434 + 3015 [NDVIJy2]	36	0.049
	July 17th	**11**	kg/ha = -224 + 2236[NDVIJy17]	42	0.031
Short-Term	**July 2nd**	**11**	kg/ha = -298 + 3262[NDVIJy2]	82	0.0001
	July 17th	**11**	kg/ha = -35 + 2293 [NDVIJy17]	90	0.0001
			Canaryseed		
Long-Term	**July 2nd**	**11**	kg/ha = 17.8 + 327[NDVIJy2]	17	ns
	July 17th	**11**	kg/ha = -6.1 + 362[NDVIJy17]	25	ns
Short-Term	**July 2nd**	**11**	kg/ha = -500 + 2090 [NDVIJy2]	86	0.0001
	July 17th	**11**	kg/ha = -276 + 1838[ndviJy17]	86	0.0001
			Oat		
Long-Term	**July 2nd**	**11**	kg/ha = 760 + 4206[NDVIJy2]	71	0.001
	July 17th	**11**	kg/ha = 763 + 4172[NDVIJy17]	83	0.0001
Short-Term	**July 2nd**	**11**	kg/ha = -683 + 5742[NDVIJy2]	90	0.0001
	July 17th	**11**	kg/ha = -397 + 5542[NDVIJy17]	92	0.0001

Study #5: The effects of long-term and short-term no-till on the response of field pea and spring wheat phosphorus fertilizer in 2003.

As with the other studies, the proximity of the two fields with very contrasting cropping histories permitted an evaluation on phosphorus response. The effects were investigated in field pea and spring wheat by using different rates of P_2O_5 (ranging from 0 - 45 lbs P_2O_5 /ac in 5 lb increments) and only one replicate for each crop. A summary of the pertinent agronomic information in provided in Table 20. Field history had no effect on phosphorus response in field pea (Table 21) and spring wheat (Table 22). Although the long-term site yielded more than the short term site, there was still no P response. No relationship was found between grain yield and NDVI for both crops reflecting the lack of P response.

Table 20. Other pertinent agronomic information.

Variable	Long-term No-Till	Short-term No-Till
	Field Pea	
Cultivar	Eclipse	Eclipse
Seeding Date	May 12	May 12
Seeding Rate	210 kg/ha	210 kg/ha
Inoculant Rate and Type	Granular @5.6 kg/ha seed-placed	Granular @5.6 kg/ha seed-placed
Harvest Date	Aug 12	Aug 12
Herbicide Use		
Pre-Seeding Burnoff	Glyphos @900 gai/ha on May 8	Glyphos @900 gai/ha on May 8
In-Crop Herbicide	Odyssey @30 gai/ha on June 5	Odyssey @30 gai/ha on June 5
Post Harvest	Reglone @420 gai/ha on August 3	Reglone @420 gai/ha on August 3
GreenSeeker (July 2) Crop Stage	Start of flowering	Start of flowering
GreenSeeker (July 17) Crop Stage	Flat pod stage	Flat pod stage
Seeding Implement	Edwards Hoe Drill - 8" spacing	Edwards Hoe Drill - 8"spacing
Soil Test NO3-N (kg/ha) 0-30cm	25	19
Soil Test PO4-P (kg/ha) 0-30 cm	28	6
Potassium Sulfate Applied (kg/ha)	119 kg/ha surface broadcast on May 7	119 kg/ha surface broadcast on May 7
Soil pH	7.9	8.0

Salinity Rating	Non-saline	Non-saline
Soil Texture	Clay loam	Clay loam
	Spring wheat	
Cultivar	Prodigy	Prodigy
Seeding Date	May 12	May 12
Seeding Rate	134 kg/ha	134 kg/ha
Harvest Date	Aug 13	Aug 13
Herbicide Use		
Pre-Seeding Burnoff	Glyphos @ 900 gai/ha	Glyphos @ 900 gai/ha
In-Crop Herbicide	Curtail M @ 660 gai/ha on June 5	Curtail M @ 660 gai/ha on June 5
Post Harvest	-	-
GreenSeeker (July 2) Crop Stage	Flag leag 90% emerged	Flag leaf 90% emerged
GreenSeeker (July 17) Crop Stage	Early grain fill	Early grain fill
Seeding Implement	Edwards Hoe Drill - 8" spacing	Edwards Hoe Drill - 8"spacing
Soil Test NO3-N (kg/ha) 0-30cm	22	12
Soil Test PO4-P (kg/ha) 0-30 cm	36	8
Potassium Sulfate Applied (kg/ha)	119 kg/ha surface applied on May 7	119 kg/ha surface applied on May 7
Urea -N fertilizer applied (kg/ha)	90 kg/ha mid-row band at seeding	90 kg/ha mid-row band at seeding
Soil pH	7.9	8.0
Salinity Rating	Non-saline	Non-saline
Soil Texture	Clay loam	Clay loam

Table 21. The effects of phosphorus fertilizer rate on the yield (kg/ha) and NDVI on field pea under long-term and short-term no-till in 2003.

P_2O_5 rate lbs/ac	Yield (kg/ha)		NDVI (July 2)		NDVI (July 17)	
	L-T	S-T	L-T	S-T	L-T	S-T
0	3121	2474	0.527	0.425	0.679	0.504
5	3201	2530	0.499	0.392	0.629	0.507
10	3234	2520	0.533	0.411	0.682	0.574
15	3251	2867	0.492	0.457	0.654	0.612
20	3351	2395	0.549	0.392	0.696	0.509
25	3378	2619	0.544	0.421	0.684	0.590
30	3075	2309	0.491	0.391	0.674	0.510
35	3223	2782	0.498	0.403	0.655	0.587
40	3046	2494	0.506	0.390	0.607	0.529
45	3445	2193	0.489	0.370	0.651	0.516
P level	ns	ns	ns	ns	ns	ns

Table 22. The effects of phosphorus fertilizer rate on the yield (kg/ha) and NDVI on spring wheat under long-term and short-term no-till in 2003.

P_2O_5 rate lbs/ac	Yield (kg/ha)		NDVI (July 2)		NDVI (July 17)	
	L-T	S-T	L-T	S-T	L-T	S-T
0	2388	1637	0.698	0.691	0.739	0.704
5	2450	1945	0.744	0.647	0.777	0.629
10	2338	1723	0.779	0.663	0.785	0.660
15	2478	2000	0.754	0.661	0.784	0.703
20	2377	1715	0.754	0.682	0.777	0.690
25	2282	1991	0.750	0.701	0.779	0.688
30	2519	1990	0.756	0.665	0.765	0.698
35	2389	1900	0.765	0.710	0.777	0.710
40	2260	2035	0.760	0.710	0.775	0.702
45	2330	1647	0.800	0.661	0.767	0.690
P level	ns	ns	ns	ns	ns	ns

Study #6: The effects of long-term and short-term no-till on the response of spring wheat to post emergent applications of liquid nitrogen fertilizer in 2003.

There is a lot of interest in looking at other nitrogen management strategies in order to manage more effectively crop production risks. Currently there is research looking at post emergent applications of liquid nitrogen as a surface band at different times in wheat and canola. The present field study offered the opportunity of testing the concept more fully and determining if the risks of this nitrogen management approach are lower in long-term than short-term no-till fields. A summary of pertinent agronomic information is given in Table 9. The soil test results, averaged over the three samples taken from each replicate of the study, and the amount of N used in the study is given in Table 10. It was assumed that the soil test levels would be very low on the short-term area and higher on the long-term area but the soil test results indicated very little difference in residual N between the two sites. However we used more N on the short-term than the long-term site.

The treatments of the study were chosen to compare putting all the nitrogen (urea) down at seeding time in a mid-row band on 16" spacing vs putting 33% down at seeding in a mid-row band using urea and the remainder at the 1, 3 or 5 leaf stage using liquid UAN as a surface band or putting 100% down after seeding at the 1, 3 or 5 leaf stage as a surface band using liquid UAN. We were interested in overall crop production and grain protein content. We also did some spectral measurements with the GreenSeeker^{tm} instrument which provides measures of Normalized Difference Vegetation Index (NDVI). NDVI is calculated as the ratio of the infra-red and red bands using the relationship of (Infra-red - Red)/(Infra-red + Red). NDVI is an indirect measurement of the chlorophyll content of the crop canopy which in turn also provides an indirect measurement of crop biomass. Chlorophyll absorbs radiation in the red band and reflects in the infra-red band. This means that the higher the values for NDVI, the more the red band is being absorbed and consequently more chlorophyll is present hence more biomass. Measurements were conducted at two different times, July 2 (flag leaf just emerged) and on July 17 (early grain fill).

Due to the confounding effects of using different rates of N for each field history, a separate analysis was done for each field history ie long-term no-till vs short-term no-till. The grain yield results are given in Table 11 for both field histories. With the long-term site, an overall response to nitrogen was observed and the highest yield was obtained when all the nitrogen was applied at seeding time. Overall, the post-emergent N applications yielded less than when all the N was applied at seeding time. This was also the case for the short-term no-till field. The difference between the highest yielding treatment and the check was greater for the short-term than the long-term field history. In both cases, applying all the nitrogen fertilizer after seeding as opposed to putting 33% down at seeding and the remainder after seeding yielded less. This would mean that from a risk management perspective, some starter N is required at seeding. The question is how much N should be put down at seeding without minimizing the ability to manage N risk with post-emergent N applications. It has been suggested that a target yield be established based on soil moisture levels in the spring and if weather conditions permit, more N could be applied at a later date.

A different picture emerged for grain protein (Table 12). For the long-term site, an overall N response was observed for grain yield but not for grain protein except when the N was applied at the 1-1.5 leaf stage. In that case, the grain protein was lower than the treatment where all the nitrogen was applied at seeding time. With the short-term no-till site, there was no protein response to N. Although the soil nitrate levels were low in both fields, a different picture emerged for grain

protein reflecting the ability of the long-term field to mineralize more nitrogen during the growing season. The information for the number of spikes per unit area is given in Table 13.

The study also looked at the potential of the GreenSeeker[tm] in helping us to manage nitrogen more effectively. The results for the two sites are given in Tables 14 and 15. This was the first year collecting data with this unit. A summary of correlation coefficients between grain yield and NDVI and grain protein and NDVI is provided in Table 16. The correlations were better for grain yield than grain protein. Overall, the measurements collected on July 2nd and 17th were able to explain a significant portion of the overall variability in final grain yield (Table 17). Based on these results there is merit in pursuing the investigation of this technology as a way to manage N more effectively at a field scale level.

Table 23. Other pertinent agronomic information.

Variable	Long-term No-Till	Short-term No-Till
Cultivar	Prodigy	Prodigy
Seeding Date	May 13	May 13
Seeding Rate	134 kg/ha	134 kg/ha
Harvest Date	August 13	August 13
1-1.5 Leaf Stage	May 27	May 27
3-3.5 Leaf Stage	June 5	June 5
5-5.5 Leaf Stage	June 16	June 16
Crop Stage July 2 (First Reading with GeenSeeker)	Flag leaf emerged and erect	Flag leaf emerged and erect
Crop Stage July 17 (Second Reading with GeenSeeker)	early grain fill	early grain fill
Herbicide Use		
Pre-Seeding Burnoff	Glyphos @900 gai /ha on May 8.	Glyphos @900 gai /ha on May 8.
In-Crop Herbicide	Curtail M @ 660 gai/ha and Horizon @ 69 gai/ha on June 5	Curtail M @ 660 gai/ha and Horizon @ 69 gai/ha on June 5
Post Harvest	-	-
Seeding Implement	Edwards Hoe Drill - 8" spacing	Edwards Hoe Drill - 8"spacing

Soil Test NO3-N (kg/ha) 0-30cm	16	10
Soil Test PO4-P (kg/ha) 0-30 cm	27	9
Potassium Sulfate Applied (kg/ha)	119 kg/ha surface broadcast on May 7	119 kg/ha surface broadcast on May 7
Total Urea-N Applied (kg/ha)	65 kg/ha mid-row band at seeding	75 kg/ha mid-row band at seeding
P_2O_5 fertilizer applied (kg/ha) 12-51-00	24 kg/ha seed-placed	30 kg/ha seed placed
Soil pH	7.9	8.0
Salinity Rating	Non-saline	Non-saline
Soil Texture	Clay loam	Clay loam

Table 10. Soil test levels for NO_3-N and PO_4 (kg/ha) long-term and short-term no-till in 2003 and amount of N used in the study..

Length of No-Till	NO_3-N (0-24") kg/ha	PO_4 (0-6") kg/ha	Total N Applied kg/ha
Short-term	10	9	83
Long-term	16	27	70

Table 11. The effects of length of no-till and nitrogen management on the grain yield (kg/ha) of spring wheat in 2003.

Long-Term No-Till							
N Placement	**% Amount of N Applied**	**Check**	**Crop Leaf Stage**				
			At Seeding	**1-1.5**	**3-3.5**	**5-5.5**	**Mean**
Check	**0**	1078	-	-	-	-	1078
Mid-row band	**100**	-	1875	-	-	-	1875
Mid-row band	**33**	-	-	1645	1276	1654	1525
Mid-row band	**0**	-	-	1281	1242	1681	1401
	Mean	1078	1875	1463	1259	1668	

cv=9.6%
CONTRAST Check vs Rest: 0.0002
CONTRAST MidRow band vs REST of N treatments: 0.0003
CONTRAST MidRow band vs ALL Surface Dribble Treatments: 0.0002
CONTRAST Mid-Row band vs ALL Surface Dribble Treatments and Starter N: 0.0002
CONTRAST Surface Dribble Treatments VS Surface Dribble and Starter N Treatments: 0.08
CONTRAST Mid-Row Band vs N at the 1-1.5 Leaf Stage: 0.001
CONTRAST Mid-Row Band vs N at the 3-3.5 Leaf Stage: 0.0001
CONTRAST Mid-Row Band vs N at the 5-5.5 Leaf Stage: 0.06

Short-Term No-Till							
N Placement	**% Amount of N Applied**	**Check**	**Crop Leaf Stage**				
			At Seeding	**1-1.5**	**3-3.5**	**5-5.5**	**Mean**
Check	**0**	647	-	-	-	-	647
Mid-row band	**100**	-	2202	-	-	-	2202
Mid-row band	**33**	-	-	1732	1676	1770	1726
Mid-row band	**0**	-	-	1343	1190	1704	1412
	Mean	647	2202	1538	1433	1737	

cv=8.3%
CONTRAST Check vs Rest: 0.0001
CONTRAST MidRow band vs REST of N treatments; 0.0001
CONTRAST MidRow band vs ALL Surface Dribble Treatments: 0.0001
CONTRAST Mid-Row band vs ALL Surface Dribble Treatments and Starter N: 0.0001
CONTRAST Surface Dribble Treatments VS Surface Dribble and Starter N Treatments: 0.0001
CONTRAST Mid-Row Band vs N at the 1-1.5 Leaf Stage: 0.0001
CONTRAST Mid-Row Band vs N at the 3-3.5 Leaf Stage: 0.0001
CONTRAST Mid-Row Band vs N at the 5-5.5 Leaf Stage: 0.0001

Table 12. The effects of length of no-till and nitrogen management on the grain protein (%) spring wheat in 2003.

Long-Term No-Till							
N Placement	**% Amount of N Applied**	**Check**	**Crop Leaf Stage**				
			At Seeding	**1-1.5**	**3-3.5**	**5-5.5**	**Mean**
Check	**0**	13.2	-	-	-	-	13.2
Mid-row band	**100**	-	14.2	-	-	-	14.2
Mid-row band	**33**	-	-	13.4	13.5	14.4	13.8
Mid-row band	**0**	-	-	13.7	14.0	14.5	14.1
	Mean	13.2	14.2	13.5	13.8	14.4	

cv= 2.8%
CONTRAST Check vs Rest: 0.005
CONTRAST MidRow band vs REST of N treatments: ns
CONTRAST MidRow band vs ALL Surface Dribble Treatments: ns
CONTRAST Mid-Row band vs ALL Surface Dribble Treatments and Starter N: ns
CONTRAST Surface Dribble Treatments VS Surface Dribble and Starter N Treatments: ns
CONTRAST Mid-Row Band vs N at the 1-1.5 Leaf Stage: 0.02
CONTRAST Mid-Row Band vs N at the 3-3.5 Leaf Stage: ns
CONTRAST Mid-Row Band vs N at the 5-5.5 Leaf Stage: ns

Short-Term No-Till							
N Placement	**% Amount of N Applied**	**Check**	**Crop Leaf Stage**				
			At Seeding	**1-1.5**	**3-3.5**	**5-5.5**	**Mean**
Check	0	11.7	-	-	-	-	**11.7**
Mid-row band	100	-	12.4	-	-	-	**12.4**
Mid-row band	33	-	-	11.9	11.9	12.1	**12.0**
Mid-row band	0	-	-	11.8	12.2	12.4	**12.1**
	Mean	**11.7**	**12.4**	**11.8**	**12.1**	**12.2**	

cv=3.4%
CONTRAST Check vs Rest: ns
CONTRAST MidRow band vs REST of N treatments: ns
CONTRAST MidRow band vs ALL Surface Dribble Treatments: ns
CONTRAST Mid-Row band vs ALL Surface Dribble Treatments and Starter N:ns
CONTRAST Surface Dribble Treatments VS Surface Dribble and Starter N Treatments: ns
CONTRAST Mid-Row Band vs N at the 1-1.5 Leaf Stage: 0.07
CONTRAST Mid-Row Band vs N at the 3-3.5 Leaf Stage: ns
CONTRAST Mid-Row Band vs N at the 5-5.5 Leaf Stage: ns

Table 13. The effects of length of no-till and nitrogen management on the number of head per meter square in spring wheat in 2003.

Long-Term No-Till							
N Placement	**% Amount of N Applied**	**Check**	**Crop Leaf Stage**				
			At Seeding	**1-1.5**	**3-3.5**	**5-5.5**	**Mean**
Check	**0**	280	-	-	-	-	280
Mid-row band	**100**	-	371	-	-	-	371
Mid-row band	**33**	-	-	318	248	294	287
Mid-row band	**0**	-	-	258	293	290	280
	Mean	280	371	288	271	292	

cv=10.4
CONTRAST Check vs Rest: ns
CONTRAST MidRow band vs REST of N treatments: 0.0004
CONTRAST MidRow band vs ALL Surface Dribble Treatments: 0.0006
CONTRAST Mid-Row band vs ALL Surface Dribble Treatments and Starter N: 0.001
CONTRAST Surface Dribble Treatments VS Surface Dribble and Starter N Treatments: ns
CONTRAST Mid-Row Band vs N at the 1-1.5 Leaf Stage: 0.002
CONTRAST Mid-Row Band vs N at the 3-3.5 Leaf Stage: 0.0004
CONTRAST Mid-Row Band vs N at the 5-5.5 Leaf Stage: 0.003

Short-Term No-Till							
N Placement	**% Amount of N Applied**	**Check**	**Crop Leaf Stage**				
			At Seeding	**1-1.5**	**3-3.5**	**5-5.5**	**Mean**
Check	0	208	-	-	-	-	208
Mid-row band	100	-	361	-	-	-	361
Mid-row band	33	-	-	313	303	327	314
Mid-row band	0	-	-	281	238	268	262
	Mean	**208**	**361**	**297**	**271**	**298**	

cv=14.6
CONTRAST Check vs Rest: 0.004
CONTRAST MidRow band vs REST of N treatments: 0.015
CONTRAST MidRow band vs ALL Surface Dribble Treatments: 0.003
CONTRAST Mid-Row band vs ALL Surface Dribble Treatments and Starter N: ns
CONTRAST Surface Dribble Treatments VS Surface Dribble and Starter N Treatments: 0.019
CONTRAST Mid-Row Band vs N at the 1-1.5 Leaf Stage: 0.049
CONTRAST Mid-Row Band vs N at the 3-3.5 Leaf Stage: 0.009
CONTRAST Mid-Row Band vs N at the 5-5.5 Leaf Stage: 0.051

Table 14. The effects of length of no-till and nitrogen management on NDVI taken on July 2 in spring wheat in 2003.

Long-Term No-Till							
N Placement	**% Amount of N Applied**	**Check**	**Crop Leaf Stage**				
			At Seeding	**1-1.5**	**3-3.5**	**5-5.5**	**Mean**
Check	**0**	0.330	-	-	-	-	0.330
Mid-row band	**100**	-	0.652	-	-	-	0.652
Mid-row band	**33**	-	-	0.508	0.390	0.554	0.484
Mid-row band	**0**	-	-	0.480	0.411	0.604	0.485
	Mean	0.330	0.652	0.474	0.401	0.579	

cv=6.4%
CONTRAST Check vs Rest: 0.0001
CONTRAST MidRow band vs REST of N treatments: 0.0001
CONTRAST MidRow band vs ALL Surface Dribble Treatments: 0.0001
CONTRAST Mid-Row band vs ALL Surface Dribble Treatments and Starter N: 0.0001
CONTRAST Surface Dribble Treatments VS Surface Dribble and Starter N Treatments: ns
CONTRAST Mid-Row Band vs N at the 1-1.5 Leaf Stage: 0.0001
CONTRAST Mid-Row Band vs N at the 3-3.5 Leaf Stage: 0.0001
CONTRAST Mid-Row Band vs N at the 5-5.5 Leaf Stage: 0.005

Short-Term No-Till							
N Placement	**% Amount of N Applied**	**Check**	**Crop Leaf Stage**				
			At Seeding	**1-1.5**	**3-3.5**	**5-5.5**	**Mean**
Check	0	0.316	-	-	-	-	0.316
Mid-row band	100	-	0.713	-	-	-	0.713
Mid-row band	33	-	-	0.581	0.543	0.593	0.572
Mid-row band	0	-	-	0.485	0.412	0.446	0.448
	Mean	**0.316**	**0.713**	**0.533**	**0.478**	**0.520**	

```
cv=5.8%
CONTRAST   Check vs Rest: 0.0001
CONTRAST   MidRow band vs  REST of N treatments: 0.0001
CONTRAST   MidRow band vs ALL Surface Dribble Treatments: 0.0001
CONTRAST   Mid-Row band vs ALL Surface Dribble Treatments and Starter N: 0.0001
CONTRAST   Surface Dribble Treatments VS Surface Dribble and Starter N Treatments: 0.0001
CONTRAST   Mid-Row Band vs N at the 1-1.5 Leaf Stage: 0.0001
CONTRAST   Mid-Row Band vs N at the 3-3.5 Leaf Stage: 0.0001
CONTRAST   Mid-Row Band vs N at the 5-5.5 Leaf Stage: 0.0001
```

Table 15. The effects of length of no-till and nitrogen management on NDVI taken on July 17 in spring wheat in 2003.

Long-Term No-till							
N Placement	**% Amount of N Applied**	**Check**	**Crop Leaf Stage**				
			At Seeding	**1-1.5**	**3-3.5**	**5-5.5**	**Mean**
Check	**0**	0.389	-	-	-	-	0.389
Mid-row band	**100**	-	0.680	-	-	-	0.680
Mid-row band	**33**	-	-	0.537	0.416	0.602	0.518
Mid-row band	**0**	-	-	0.496	0.457	0.626	0.526
	Mean	0.389	0.680	0.517	0.437	0.614	

cv=6.3%
CONTRAST Check vs Rest: 0.0001
CONTRAST MidRow band vs REST of N treatments: 0.0001
CONTRAST MidRow band vs ALL Surface Dribble Treatments: 0.0001
CONTRAST Mid-Row band vs ALL Surface Dribble Treatments and Starter N: 0.0001
CONTRAST Surface Dribble Treatments VS Surface Dribble and Starter N Treatments: ns
CONTRAST Mid-Row Band vs N at the 1-1.5 Leaf Stage: 0.0001
CONTRAST Mid-Row Band vs N at the 3-3.5 Leaf Stage: 0.0001
CONTRAST Mid-Row Band vs N at the 5-5.5 Leaf Stage: 0.014

Short-Term No-Till							
N Placement	**% Amount of N Applied**	**Check**	**Crop Leaf Stage**				
			At Seeding	**1-1.5**	**3-3.5**	**5-5.5**	**Mean**
Check	0	0.274	-	-	-	-	0.274
Mid-row band	100	-	0.658	-	-	-	0.658
Mid-row band	33	-	-	0.509	0.475	0.526	0.503
Mid-row band	0	-	-	0.441	0.366	0.451	0.419
	Mean	**0.274**	**0.658**	**0.475**	**0.421**	**0.489**	

cv=8.1%	
CONTRAST	Check vs Rest: 0.0001
CONTRAST	MidRow band vs REST of N treatments: 0.0001
CONTRAST	MidRow band vs ALL Surface Dribble Treatments: 0.0001
CONTRAST	Mid-Row band vs ALL Surface Dribble Treatments and Starter N: 0.0001
CONTRAST	Surface Dribble Treatments VS Surface Dribble and Starter N Treatments: 0.0001
CONTRAST	Mid-Row Band vs N at the 1-1.5 Leaf Stage: 0.0001
CONTRAST	Mid-Row Band vs N at the 3-3.5 Leaf Stage: 0.0001
CONTRAST	Mid-Row Band vs N at the 5-5.5 Leaf Stage: 0.0001

Table 16. Correlation coefficients between NDVI values and grain protein and grain yield for both field histories and combined.

GreenSeeker	Grain Yield			Grain Protein		
	All	L-T N-T	S-T N-T	All	L-T N-T	S-T N-T
# of Observations	48	24	24	48	24	24
NDVI-July2nd	0.87**	0.87**	0.88**	0.09ns	0.64**	0.11ns
NDVI-July 17th	0.85**	0.90**	0.94**	0.44*	0.68**	0.14ns
**, * and ns refers to significant at the 1% level, 5% level and not significant						

Table 17. Linear regression equations between grain yield and NDVI measurements on two separate dates in 2003.

Field History	NDVI Measurement	# of Observations	Linear Equation	R^2 (%)	Significance
Long-Term	**July 2nd**	**24**	kg/ha = 270 + 2463 [NDVIJy2]	76	***
	July 17th	**24**	kg/ha = 61+2676 [NDVIJy17]	81	***
Short-Term	**July 2nd**	**24**	kg/ha = -229 + 3447 [NDVIJy2]	78	***
	July 17th	**24**	kg/ha = -285 + 3933 [NDVIJy17]	89	***
Combined	**July 2nd**	**48**	kg/ha = 5.3 + 2997 [NDVIJy2]	75	***
	July 17th	**48**	kg/ha = 15 + 3003 [ndviJy17]	73	***

2004 Field Study Results

Study #1: The effects of phosphorus placement and rate of nitrogen on the grain yield of spring wheat under a long-term and a short-term zero tillage field history.

A description of some of the pertinent agronomic information is provided in Table 1. The effects of P placement and N rates on the variables measured are provided in Table 2 and 3. P placement had no effect on plant numbers, head numbers, flag leaf N or P content, grain yield and grain protein. N rate reduced plant numbers linearly under short-term no-till (STNT) but not under long-term no-till (LTNT). There was a nitrogen by P placement interaction for flag leaf N content under STNT. P placement had no effect on grain protein and grain yield. N rate had an effect on grain N and grain yield but no interactions. Yields were higher for the STNT because frost had less of an effect but the grain protein levels were lower for the STNT than the LTNT (Table 8).

A summary of the fall residual NO3-N values is provided in Table 4. Overall, residual N levels were slightly higher for the LTNT than the STNT site but well within acceptable levels.

A economic evaluation using margin analysis is provided in Table 5. The economic performance was poorer due to the effects of the frost being harder on the LTNT than the STNT site. The effects on grade are provided in Table 7 which was included in the analysis.

Table 1. Pertinent Agronomic Information for 2004.

Variable	Long-Term No-Till Field	Three Year No-Till Field
Crop Variety	AC Abbey	AC Abbey
Seeding Date	May 5	May 5
Harvest Date	Sept 7	Sept 7
Herbicide Use		
Pre-Seeding Burnoff	Glyphos @ 667 gai/ha applied on May 7	
In-Crop Herbicide	Lontrel @ 98.9 gai/ha on June 16 MCPA ester @ 553.5 gai/ha on June 16 Achieve @ 197.7 gai/ha on June 16 Attain @ 142.3 gai/ha on June 16	Lontrel @ 98.9 gai/ha on June 16 MCPA ester @ 553.5 gai/ha on June 16 Achieve @ 197.7 gai/ha on June 16 Attain @ 142.3 gai/ha on June 16
Pre-Harvest Round-Up	Glyphos @ 890 gai/ha on Aug 25	Glyphos @ 890 gai/ha on Aug 25
Seeding Implement	ConservaPak Seeder on 12" spacing	ConservaPak Seeder on 12" spacing
Greenseeker Crop Stage (June 15)	3.5 - 4 leaves	3.4 - 3.8 leaves

Greenseeker Crop Stage (June 23)	4 - 4.5 leaves	4 leaves
Greenseeker Crop Stage (June 30)	5.5 - 5.7 leaves	5.3 leaves
Greenseeker Crop Stage (July 7)	6 - 7 leaves / early flag	6 - 7 leaves / early flag
Greenseeker Crop Stage (July 14)	head out of booth	late booth / head emergence
Greenseeker Crop Stage (July 30)	late milk stage	late milk stage
P_2O_5 kg/ha (11-52-0)	65	65
Soil pH	7.9	8.0
Salinity Rating	Non-saline	Non-saline
Soil Texture	Clay loam	Clay loam

Table 2. The effects of nitrogen rates and phosphorus placement on selected variables under long-term (L-T) and short-term no-till (S-T) conditions in 2004.

Factor	Levels	Plants / m^2		Heads / m^2		Flag Leaf % N		Flag Leaf % P	
		L-T	S-T	L-T	S-T	L-T	S-T	L-T	S-T
P-Placement	**Seed-Placed**	372	417	499	493	3.56	3.33	0.25	0.22
	Side-Band	398	389	506	495	3.61	3.39	0.26	0.23
	s.e.	13.7	13.1	7.6	19.1	0.04	0.05	0.003	0.002
	p-level	ns	ns	ns	ns	ns	ns	ns	ns
N-Rate (kg/ha)	**0**	396	444	465	496	3.05	2.77	0.24	0.21
	30	398	425	471	512	3.13	2.68	0.25	0.22
	60	385	392	511	430	3.58	3.29	0.26	0.22
	90	368	391	530	494	3.94	3.92	0.26	0.24
	120	379	362	535	536	4.22	4.14	0.27	0.24
	s.e.	7.9	21.2	20.8	25.7	0.3	0.4	0.007	0.008
	p-level	ns	ns	0.0006	ns	0.0001	0.0001	0.0148	0.0011
	linear	ns	0.006	ns	ns	0.0001	0.0001	0.0007	0.0001
	quadratic	ns	ns	ns	ns	ns	0.02	ns	ns
	N X P	ns	ns	ns	ns	ns	0.0223	ns	ns

Table 3. The effects of nitrogen rates and phosphorus placement on selected variables under long-term (L-T) and short-term no-till (S-T) conditions in 2004.

Factor	Levels	Grain Protein %		Grain Yield kg/ha		Grain Yield bus/acre	
		L-T	S-T	L-T	S-T	L-T	S-T
P Placement	**Seed-Placed**	13.3	12.7	1531	1639	23	25
	Side-Band	13.2	12.5	1624	1652	24	25
	s.e.	0.0	0.0	58.0	57.3	0.9	0.9
	p-level	ns	ns	ns	ns	ns	ns
N rate (kg-N/ha)	**0**	12.9	11.8	1103	1102	17	17
	30	13.2	12.0	1032	1062	15	16
	60	13.0	12.1	1530	1568	23	24
	90	13.4	12.8	2011	2162	30	32
	120	13.9	13.7	2211	2334	33	35
	s.e.	0.2	0.5	333.7	364.8	5.0	5.5
	p-level	0.0032	0.0001	0.0001	0.0001	0.0001	0.0001
	linear	0.0006	0.0001	0.0001	0.0001	0.0001	0.0001
	quadratic	ns	0.0064	ns	ns	ns	ns
	N X P	ns	ns	ns	ns	ns	ns

Table 4. The effects on nitrogen rates in 2004 on the soil residual NO_3-N (kg/ha) levels from soil samples taken in the fall of 2004.

History	N rates (kg/ha)				
	0*	**30**	**60**	**90**	**120**
L-T	23	21	28	27	62
S-T	20	17	19	21	41

* note these plots were accidentally fertilized at rate of 30 kg/ha in 2004

Table 5. Agronomic and economic analysis of nitrogen rate response study as a function of zero tillage management in in 2004.

Treatment	N Rate (kg/ha)	Yield (bu/A)	Gross ($/A)[1]	N Fert cost ($/A) [2]	N Margin ($/A)	Other Var. & OH costs ($/A)[3]	Net ($/A)
LT - ZT	0*	14.88	$30.65	$7.48	$23.17	$114.53	($91.36)
	30	15.48	$31.89	$7.48	$24.41	$114.53	($90.12)
	60	22.95	$47.28	$14.95	$32.33	$114.53	($82.20)
	90	30.17	$62.15	$22.43	$39.72	$114.53	($74.81)
	120	33.16	$68.31	$29.90	$38.41	$114.53	($76.12)
ST - ZT	0*	16.54	$49.79	$7.48	$42.31	$114.53	($72.22)
	30	15.92	$47.92	$7.48	$40.44	$114.53	($74.09)
	60	23.52	$70.80	$14.95	$55.85	$114.53	($58.68)
	90	32.42	$97.58	$22.43	$75.15	$114.53	($39.38)
	120	35.02	$105.41	$29.90	$75.51	$114.53	($39.02)

1 Gross return = grain yield x price – (freight + handling [1.48/bu]) CWB PRO as of Jan 27, 2005 based on grade - $3.01 for 3 CWRS - $2.06 for 4 CWRS-

2 Fertilizer cost = $420/tonne for urea ($0.28/lb N) Agri-Core United Bulk Price in Spring 2004

3 Variable and overhead costs, except for N fertilizer, according to SAF costs of production for direct seeded spring wheat Black soil zone are $7.09/bu.

* these plots were fertilized at a rate of 30 kg/ha by accident in 2004

Table 6. The effect of N rate and length of No-Till on the NDVI values in spring wheat.

N rate	NDVI (June 15)		NDVI (June 23)		NDVI (June 30)	
	L-T	S-T	L-T	S-T	L-T	S-T
0*	0.4775	0.4891	0.4914	0.4518	0.5291	0.5196
30	0.4851	0.4725	0.4622	0.4420	0.4995	0.5028
60	0.4536	0.4276	0.5175	0.4683	0.6098	0.5863
90	0.4610	0.4561	0.5726	0.4659	0.7223	0.6329
120	0.4745	0.4189	0.5604	0.4707	0.6922	0.6274
N rate	**NDVI (July 7)**		**NDVI (July 14)**		**NDVI (July 30)**	
	L-T	**S-T**	**L-T**	**S-T**	**L-T**	**S-T**
0*	0.6301	0.6183	0.6627	0.5645	0.5082	0.4500
30	0.6245	0.5825	0.6562	0.5401	0.5015	0.4267
60	0.7262	0.6955	0.7470	0.6537	0.5805	0.5003
90	0.8103	0.7549	0.8008	0.7150	0.6521	0.6220
120	0.8049	0.7583	0.8056	0.7135	0.6965	0.6415

*2004 plots for 0kg/ha rate of fertilizer were fertilized to 30 kg/ha by accident

Table 7. The effect of N fertilizer and P placement (side band and seed-placed) on grade of spring wheat in zero till management.

	N rate (kg/ha)									
	0*		**30**		**60**		**90**		**120**	
Length of No-Till	**seed**	**side**	**seed**	**side**	**seed**	**side**	**seed**	**side**	**seed**	**side**
LT	4	4	good 3	4	poor 3	poor 3	feed	feed	poor 4	feed
ST	good 3	good 3	2	3	poor 2	2	3	3	4	feed

*2004 plots for 0kg/ha rate of fertilizer were fertilized to 30 kg/ha by accident

Table 8. The effect of N fertilizer and P placement on % protein of spring wheat in zero till management.

N rate (kg/ha)										
	0*		30		60		90		120	
Length of No-Till	**seed**	**side**	**seed**	**side**	**seed**	**side**	**seed**	**side**	**seed**	**side**
LT	12.9	12.9	13.2	13.2	13.0	12.9	13.4	13.3	13.9	13.8
ST	11.8	11.7	11.8	12.1	12.2	11.9	12.8	12.8	13.9	13.5

*2004 plots for 0kg/ha rate of fertilizer were fertilized to 30 kg/ha by accident

Study #2. The effects of starter N in lentils under long-term and short-term no-till management in 2004.

Producers are interested in the concept of starter nitrogen for pulse crops especially in lentil given their more indeterminate growth habit. Of interest as well is the observation that lentil grown on long-term continuously cropped no-till fields doesn't yield as well as on short term no-till fields. There is also concerns that fields with many cycles of lentil may also not yield as well, especially in the thin-black soil zone. Producers are interested in knowing if lentil grown on fields with low nitrogen fertility should be supplemented with fertilizer nitrogen. The present study permitted the investigation of some of those questions. A summary of pertinent agronomic information is given in Table 9.

A summary of the plant populations is given in Table 10. The plant populations were greater for long-term than short-term no-till and a reduction due to N was observed even though the nitrogen was mid-row banded.

There was a significant length of No-Till x N rate interaction for grain yield (Table 11). The nature of the interaction is such that N rate had a greater yield reducing effect on the short-term than the long-term no-till. Overall the yields tended to be greater on the short-term than the long-term no-till.

We also did some spectral measurements with the GreenSeeker^{tm} instrument which provides measures of Normalized Difference Vegetation Index (NDVI). NDVI is calculated as the ratios of the infra-red and red bands using the relationship of (Infra-red - Red)/(Infra-red + Red). NDVI is an indirect measurement of the chlorophyll content of the crop canopy which in turn provides an indirect measurement of crop biomass. Chlorophyll absorbs radiation in the red band and reflects the infra-red radiation. This means that the higher the values for NDVI, the more the red band is being absorbed and consequently more chlorophyll is present hence more biomass. Measurements were conducted at six different times (Table 12). Actual biomass results are provided in Table 13. The overall biomass results were similar between long-term and short-term no-till as well as the N content (Table 14). The yield differences between long-term and short-term no-till cannot be attributed to these two factors. Results from the grading show that overall, the grades were lower for the long-term than the short term no-till.

Table 9. Other pertinent agronomic information for 2004.

Variable	Long-term No-Till	Short-term No-Till
Cultivar	CDC Sedley	CDC Sedley
Seeding Date	May 4	May 4
Seeding Rate	120 kg/ha	120 kg/ha
Inoculant Rate and Type	Granular @5.6 kg/ha	Granular @5.6 kg/ha
Harvest Date	Sept 23	Sept 23
Herbicide Use		
Pre-Seeding Burnoff	Glyphos 667 gai/ha applied on May 7	Glyphos 667 gai/ha applied on May 7

In-Crop Herbicide	Sencor @ 204 g ai/ha on June 3 Poast Ultra @ 211.3 g ai/ha on June 16th Glyphos @ 890 g ai/ha on Aug 25	Sencor @ 204 g ai/ha on June 3 Poast Ultra @ 211.3 g ai/ha on June 16th Glyphos @ 890 g ai/ha on Aug 25
Dessication	-	-
Fungicide Use		
In-Crop	Headline EC@ 98.8 gai/ha on July 12	Headline @ 98.8 gai/ha on July 12
Seeding Implement	Edwards Hoe Drill - 8" spacing	Edwards Hoe Drill - 8"spacing
Soil Test NO3-N (kg/ha) 0-30cm	10.39 kg/ha	9.75 kg/ha
Soil Test PO4-P (kg/ha) 0-30 cm	30.72 kg/ha	9.14 kg/ha
Potassium Sulfate Applied (kg/ha)	20 kg/ha on May	20 kg/ha on May
P_2O_5 fertilizer applied (kg/ha) 12-51-00	54 kg/ha	54 kg/ha
Nitrogen form and placement	Urea - Midrow band on 16" centers	Urea - Midrow band on 16" centers
Crop Stage for NDVI on Jun 15	7 - 9 nodes	7 - 9 nodes
Crop Stage for NDVI on Jun 23	9 - 10 nodes	9 - 10 nodes
Crop Stage for NDVI on Jun 30	12 - 13 nodes	11 - 13 nodes
Crop Stage for NDVI on Jul 7	13 - 16 nodes	13 - 16 nodes
Crop Stage for NDVI on Jul 16	full flower	full flower
Crop Stage for NDVI on Jul 30	late flower 5% remaining	late flower 5% remaining
Soil pH	7.9	8.0
Salinity Rating	Non-saline	Non-saline
Soil Texture	Clay loam	Clay loam

Table 10. The effects of years in no-till and nitrogen rate on plant populations (# m^{-2}) for lentil in 2004.

Nitrogen rate (kg/ha)	Long Term No-Till	Short Term No-Till	Mean
0	247	164	**206**
15	243	145	**194**
30	213	147	**180**
60	231	151	**191**
Mean	**234**	**152**	
CV=22.3%; Significant quadratic response to nitrogen rate (p=0.016).			

Table 11. The effects of years in no-till and nitrogen rate on grain yield (kg/ha) for lentil in 2004.

Nitrogen rate (kg/ha)	Long Term No-Till	Short Term No-Till	Mean
0	450	1063	**757**
15	610	595	**603**
30	558	829	**694**
60	495	685	**591**
Mean	**528**	**794**	
cv=6.3%; nrate effect (p=0.008); linear N rate effect (p=0.0001); time in no-till x n rate interaction (p=0.03);			

Table 12. The effects of years in no-till and nitrogen rate on NDVI for lentil in 2004 at two different times.

Nitrogen rate (kg/ha)	Jul 7			July 30		
	Long Term No-Till	Short Term No-Till	Mean	Long-term No-till	Short-term No-till	Mean
0	0.5084	0.5465	0.5275	0.8578	0.8529	0.8554
15	0.5791	0.5964	0.5878	0.8595	0.8559	0.8577
30	0.6055	0.6193	0.6124	0.8563	0.8492	0.8528
60	0.4940	0.5512	0.5226	0.8579	0.8469	0.8524
Mean	0.5468	0.5784		0.8579	0.8512	
cv=6.4%; nrate effect (p=0.001); linear nrate effect (p=0.001).				**cv=8.0%; nrate effect (p=0.640); limear nrate effect (p=0.003)**		

Table 13. The effects of years no-till and nitrogen rate on biomass production at flowering for lentil in 2004.

Nitrogen rate (kg/ha)	Long Term No-Till	Short Term No-Till	Mean
0	2379	1903	**2141**
15	2395	2543	**2469**
30	2034	2822	**2428**
60	2461	2362	**2412**
Mean	**2317**	**2408**	

Table 14. The effects of years no-till and nitrogen rate on nitrogen uptake of biomass at flowering for lentil in 2004.

Nitrogen rate (kg/ha)	Long Term No-Till	Short Term No-Till	Mean
0	67	59	**63**
15	75	93	**84**
30	71	94	**83**
60	80	79	**80**
Mean	**73**	**81**	

Table 15. The effects of years no-till and nitrogen rate on grade of lentil in 2004.

Nitrogen rate (kg/ha)	Long Term No-Till		Short Term No-Till	
	Company #1	Company #2	Company #1	Company #2
0	Feed	Feed	Feed	#3
15	Feed	Feed	Feed	#3
30	Feed	Feed	Feed	#3
60	Feed	Feed	Feed	#3
Mean	Feed	Feed	Feed	#3

Study #3: The effects of long-term and short-term no-till and fungicides on the production of different classes of lentil in 2004.

The study examined three varieties of green lentils and two varieties of red lentil. We were interested in determining if there were interactions between fungicide application and length of time under no-till. Relevant agronomic information is presented in Table 16.

The recommended target plant population for lentil is 130 plants per meter square. Table 17 lists the treatment effects on plant populations. An interaction between cultivar and length of no-till was observed. The target plant population was obtained on the LTNT site but exceeded on the STNT site.

The grain yields were affected by time in no-till and cultivars effect and also a cultivar x lenght of no-till interaction (Table 18). As in 2003, the yields were greater on the STNT site than the LTNT site. The interaction is due to differences among varities between the LTNT and STNT sites. There was no fungicide effect.

The effect of time in no-till did have an effect on seed weight (Table 19). STNT had a higher average 1000 kernel seed weight than LTNT. There was no effect due to fungicide.

The overall grades were slightly better for the STNT than the LTNT site (Table 20).

Table 16. Other pertinent agronomic information for 2004.

Variable	Long-term No-Till	Short-term No-Till
Seeding Date	May 4	May 4
Seeding Rate	130 kg/ha	130 kg/ha
CDC Milestone (small green)	46 kg/ha	46 kg/ha
CDC Sedley (large green)	125 kg/ha	125 kg/ha
CDC Vantage (medium green)	73 kg/ha	73 kg/ha
CDC Redcap (large red)	54 kg/ha	54 kg/ha
CDC Robin (small red)	34 kg/ha	34 kg/ha
Inoculant Rate and Type	Granular @ 5.6 kg/ha with the seed	Granular @ 5.6 kg/ha with the seed
Harvest Date	Sept 23	Sept 23
Herbicide Use		
Pre-Seeding Burnoff	Glyphos @ 667 gai/ha on May 7	Glyphos @ 667 gai/ha on May 7
In-Crop Herbicide	Sencor @204 gai/ha on June 3 Poast Ultra @211.3 g ai/ha on June 16th Glyphos @890 gai/ha on Aug 25	Sencor @204 gai/ha on June 3 Poast Ultra @211.3 g ai/ha on June 16th Glyphos @890 gai/ha on Aug 25

Dessication	-	-
Fungicide Use		
In-Crop	Headline EC@ 98.8 gai/ha on July 12	Headline @ 98.8 gai/ha on July 12
Seeding Implement	Edwards Hoe Drill - 8" spacing	Edwards Hoe Drill - 8"spacing
Soil Test NO3-N (kg/ha) 0-30cm	21	15
Soil Test PO4-P (kg/ha) 0-30 cm	18	48
Potassium Sulfate Applied (kg/ha)	20 kg/ha on May 4	20 kg/ha on May 4
P_2O_5 fertilizer applied (kg/ha) 11-52-00	25 kg/ha	25 kg/ha
Soil pH	7.9	8.0
Salinity Rating	Non-saline	Non-saline
Soil Texture	Clay loam	Clay loam

Table 17. The effects of time under no-till on plant populations (#/^{2}) in 2004.

Lentil Cultivar	Long-term No-till	Short-term No-Till
CDC Milestone	181	163
CDC Sedley	140	151
CDC Vantage	106	151
CDC Redcap	126	135
CDC Robin	136	166
Mean	**138**	**153**

cv=22.2%; Significant cultivar effect and cultivar x length of no-till effect.
The recommended seeding rate is 130 plants per square meter.

Table 18. The effects of time under no-till on grain yield (kg/ha) in 2004.

Lentil Cultivar	Long-term No-till	Short-term No-Till	Mean
CDC Milestone	434	988	**711**
CDC Sedley	315	750	**533**
CDC Vantage	349	885	**617**
CDC Redcap	544	1268	**906**
CDC Robin	369	923	**646**
Mean	**402**	**963**	
cv=10.6%; Significant cultivar effect (LSD05=150); time in no-till and cultivar x time in no-till interaction.			

Table 19. The effects of time under no-till on 1000 seed weight (g) in 2004.

Lentil Cultivar	Long-term No-till	Short-term No-Till	Mean
CDC Milestone	21.73	24.05	**22.89**
CDC Sedley	36.29	51.02	**43.66**
CDC Vantage	24.86	35.01	**29.94**
CDC Redcap	22.83	22.32	**22.58**
CDC Robin	18.99	17.83	**18.41**
Mean	**24.94**	**30.05**	
cv=2.3%; Significant cultivar effect (LSD05=0.9)			

Table 20. The effects of length of no-till and fungicide on grade of lentil in 2004.

Lentil Cultivar	TMT	Long Term No-Till			Short Term No-Till	
		Company #1	Company #2		Company #1	Company #2
CDC Milestone	**Fungicide**	Feed	Feed		Feed	Feed
	No Fungicide	Feed	Feed		Feed	Feed
CDC Sedley	**Fungicide**	Feed	Feed		#3	#3
	No Fungicide	Feed	Feed		Feed	#3
CDC Vantage	**Fungicide**	Feed	Feed		Feed	Feed
	No Fungicide	Feed	Feed		Feed	Feed
CDC Redcap	**Fungicide**	Feed	Feed		#3	#3
	No Fungicide	Feed	Feed		#3	#3
CDC Robin	**Fungicide**	Feed	Feed		Feed	#3
	No Fungicide	Feed	Feed		#3	Feed

Study #4: The effects of long-term and short-term no-till on the response of flax, canary seed and oat to nitrogen fertilizer in 2004.

It is well known that crops like flax, canary seed and oat are not as responsive to nitrogen fertilizer as crops like wheat and canola. The objective of the study was quantify the N response of these three crops on the long-term and short-tem no-till fields. A summary of pertinent agronomic information is provided in Table 21. In order to test out as many rates as possible, 11 rates of N (from 0-100 kg N /ha in 10 kg increments) were employed with only one replicate. NDVI measurements were collected with a Green Seeker[tm] instrument on six separate occasions to try and establish a relationship between NDVI and grain yield. The summary of grain yield results is provided in Table 22.

Overall with oat, a significant response to N was observed and the yield was greater for the long-term than the short-term no-till site, especially at the lower N rates. As well, we showed very strong relationships between NDVI and grain yield on both seeding dates (Table 23).

With flax, the overall response to N was weak and the differences between the two field histories were not obvious like in oat (Table 22). The yields were lower for the LTNT than the STNT due to the frost received on August 20th, 2004. The effects of the frost were greatest at the higher N rates. There was a good response to N on the short term site. The relationship between NDVI and grain yield was weak on the long-term site and very strong on the short-term site (Table 23).

The yield results for canary seed are suspect because of problems with frost and the influence of aphids. Nonetheless, there was a very strong relationship between NDVI and grain yield for the short-term but not the long-term no-till site.

Table 21. Other pertinent agronomic information in 2004.

Variable	Long-term No-Till	Short-term No-Till
	Flax	
Cultivar	CDC Bethune	CDC Bethune
Seeding Date	May 4	May 4
Seeding Rate	56 kg/ha	56 kg/ha
Harvest Date	Oct 7	Oct 7
Herbicide Use		
Pre-Seeding Burnoff	Glyphos @ 667 gai/ha on May 7	Glyphos @ 667 gai/ha on May 7
In-Crop Herbicide	Poast Ultra @ 211.3 gai/ha on June 16 Lontrel @ 98.9 gai/ha on June 16 MCPA Ester @ 553.5 gai/ha on June 16	Poast Ultra @ 211.3 gai/ha on June 16 Lontrel @ 98.9 gai/ha on June 16 MCPA Ester @ 553.5 gai/ha on June 16
Post Harvest	-	-
GreenSeeker (Jun 15) Crop Stage	2 - 3 inches	2 - 4 inches

GreenSeeker (Jun 23) Crop Stage	3.5 - 4 inches	4 - 6 inches
GreenSeeker (Jun 30) Crop Stage	6 - 8 inches	8 - 12 inches
GreenSeeker (July 7) Crop Stage	10 - 14 inches	10 - 13 inches
GreenSeeker (July 14) Crop Stage	20 % flowering	10% flowering
GreenSeeker (July 30) Crop Stage	30% bloom	30% bloom
Seeding Implement	Edwards Hoe Drill - 8" spacing	Edwards Hoe Drill - 8"spacing
Soil Test NO3-N (kg/ha) 0-30cm	27	26
Soil Test PO4-P (kg/ha) 0-30 cm	68	26
Potassium Sulfate Applied (kg/ha)	20 kg/ha on broadcast applied	20 kg/ha on broadcast applied
P_2O_5 fertilizer applied (kg/ha) 11-52-00	48 kg/ha seed placed	48 kg/ha seed placed
Soil pH	7.9	8.0
Salinity Rating	Non-saline	Non-saline
Soil Texture	Clay loam	Clay loam
	Canaryseed	
Cultivar	CDC Maria	CDC Maria
Seeding Date	May 4	May 4
Seeding Rate	35 kg/ha	35 kg/ha
Harvest Date	Sept 23	Sept 23
Herbicide Use		
Pre-Seeding Burnoff	Glyphos @ 667 gai/ha on May 7	Glyphos @ 667 gai/ha on May 7

In-Crop Herbicide	Lontrel @ 98.9 gai/ha on June 16 MCPA ester @ 553.5 gai/ha on June 16 Attain @ 142.3 gai/ha on June 16 Glyphos @ 890 gai/ha on Aug 25	Lontrel @ 98.9 gai/ha on June 16 MCPA ester @ 553.3 gai/ha on June 16 Attain @ 142.3 gai/ha on June 16 Glyphos @ 890 gai/ha on Aug 25
Post Harvest	-	-
Seeding Implement	Edwards Hoe Drill - 8" spacing	Edwards Hoe Drill - 8"spacing
GreenSeeker (Jun 15) Crop Stage	2 - 3 inches	2 - 4 inches
GreenSeeker (Jun 23) Crop Stage	3.5 - 4 inches	4 - 6 inches
GreenSeeker (Jun 30) Crop Stage	6 - 8 inches	8 - 12 inches
GreenSeeker (July 7) Crop Stage	10 - 14 inches	10 - 13 inches
GreenSeeker (July 14) Crop Stage	20 % flowering	10% flowering
GreenSeeker (July 30) Crop Stage	milk stage	milk stage
Soil Test NO3-N (kg/ha) 0-30cm	15	19
Soil Test PO4-P (kg/ha) 0-30 cm	33	25
Potassium Sulfate Applied (kg/ha)	30 kg/ha broadcast applied	30 kg/ha broadcast applied
P_2O_5 fertilizer applied (kg/ha) 11-52-00	48 kg/ha seed placed	48 kg/ha seed placed
Soil pH	7.9	8.0
Salinity Rating	Non-saline	Non-saline
Soil Texture	Clay loam	Clay loam
	OAT	
Cultivar	AC Morgan	AC Morgan
Seeding Date	May 4	May 4
Seeding Rate	156 kg/ha	156 kg/ha

Harvest Date	Sept 7	Sept 7
Herbicide Use		
Pre-Seeding Burnoff	Glyphos @ 667 gai/ha on May 7	Glyphos @ 667 gai/ha on May 7
In-Crop Herbicide	Lontrel @ 98.9 gai/ha on June 16 MCPA ester @ 553.5 gai/ha on June 16 Attain @ 142.3 gai/ha on June 16 Glyphos @ 890 gai/ha on Aug 25	Lontrel @ 98.9 gai/ha on June 16 MCPA ester @ 553.5 gai/ha on June 16 Attain @ 142.3 gai/ha on June 16 Glyphos @ 890 gai/ha on Aug 25
Post Harvest	-	-
GreenSeeker (Jun 15) Crop Stage	2 - 3 inches	2 - 4 inches
GreenSeeker (Jun 23) Crop Stage	3.5 - 4 inches	4 - 6 inches
GreenSeeker (Jun 30) Crop Stage	6 - 8 inches	8 - 12 inches
GreenSeeker (July 7) Crop Stage	10 - 14 inches	10 - 13 inches
GreenSeeker (July 14) Crop Stage	20 % flowering	10% flowering
GreenSeeker (July 30) Crop Stage	Late milk stage	Late milk stage
Seeding Implement	Edwards Hoe Drill - 8" spacing	Edwards Hoe Drill - 8"spacing
Soil Test NO3-N (kg/ha) 0-30cm	39	70
Soil Test PO4-P (kg/ha) 0-30 cm	29	5
Potassium Sulfate Applied (kg/ha)	20 kg /ha surface broadcast on	20 kg/ha on broadcast applied
P_2O_5 fertilizer applied (kg/ha) 11-52-00	48 kg/ha seed placed	48 kg/ha seed placed
Soil pH	7.9	8.0
Salinity Rating	Non-saline	Non-saline
Soil Texture	Clay loam	Clay loam

Table 22. The effects of nitrogen fertilizer on the yield (kg/ha) of flax, canary seed and oat under long-term and short-term no-till in 2004.

N rate (kg/ha)	Flax		Canaryseed		Oat	
	L-T	S-T	L-T	S-T	L-T	S-T
0	359	755	8	254	1712	826
10	611	705	13	137	1626	926
20	511	1015	16	246	2127	1781
30	1024	940	10	399	1887	2031
40	728	1280	12	403	2244	2465
50	563	1239	7	842	3884	3298
60	953	1374	15	514	3743	4320
70	1045	1485	23	829	3705	3809
80	986	1124	13	726	4679	2952
90	1226	1501	42	700	2973	3878
100	1038	1731	55	652	3476	5181
Mean	**822**	**1195**	**19**	**518**	**2914**	**2861**

Table 23. Linear regression equations between grain yield and NDVI measurements in 2004.

Field History	NDVI Measurement	# of Observations	Linear Equation	R^2 (%)	Significance
			Flax		
Long-Term	**June 15**	**11**	kg/ha = 350 + 1297[NDVIJn15]	0.6	ns
	June 23	**11**	kg/ha =-1520 + 6468[NDVIJn23]	36	0.0501
	June 30	**11**	kg/ha = -468 + 2778[NDVIJn30]	56	0.0078
	July 7	**11**	kg/ha = -407 + 2066[NDVIJy7]	54	0.0105
	July 14	**11**	kg/ha = -642 +2290[NDVIJy14]	67	0.0022
	July 30	**11**	kg/ha = -1548 + 3104[NDVIJy30]	60	0.0052
Short-Term	**June 15**	**11**	kg/ha = 174 + 2793[NDVIJn15]	3	ns
	June 23	**11**	kg/ha =-1639+ 6821[NDVIJn23]	64	0.0032
	June 30	**11**	kg/ha = -898 + 4211[NDVIJn30]	81	0.0002
	July 7	**11**	kg/ha = -840 + 3154[NDVIJy7]	83	0.0001
	July 14	**11**	kg/ha = -608 +2859[NDVIJy14]	81	0.0002
	July 30	**11**	kg/ha = -1956 + 4171[NDVIJy30]	77	0.0004
			Canaryseed		
Long-Term	**June 15**	**11**	kg/ha = -4 + 70[NDVIJn15]	2	ns
	June 23	**11**	kg/ha = -32 + 131[NDVIJn23]	46	0.0216
	June 30	**11**	kg/ha = -21 +75[NDVIJn30]	50	0.0150
	July 7	**11**	kg/ha = -21 + 67[NDVIJy7]	45	0.0237
	July 14	**11**	kg/ha = -28 +77[NDVIJy14]	55	0.0088
	July 30	**11**	kg/ha = -56 +109[NDVIJy30]	44	0.0268
Short-Term	**June 15**	**11**	kg/ha = 9 + 1527[NDVIJn15]	44	0.0260
	June 23	**11**	kg/ha =-830 +3519[NDVIJn23]	84	0.0001
	June 30	**11**	kg/ha = 649 - 365[NDVIJn30]	5	ns
	July 7	**11**	kg/ha = -430 +1441[NDVIJy7]	85	0.0001
	July 14	**11**	kg/ha = -472 1521[NDVIJy14]	83	0.0001

	July 30	**11**	kg/ha = -805 + 1898[NDVIJy30]	80	0.0002
Oat					
Long-Term	**June 15**	**11**	kg/ha = -3020+ 12554[NDVIJn15]	77	0.0004
	June 23	**11**	kg/ha =-1226 + 7141[NDVIJn23]	81	0.0002
	June 30	**11**	kg/ha = -1128 + 6313[NDVIJn30]	76	0.0004
	July 7	**11**	kg/ha = -1443+ 6417[NDVIJy7]	76	0.0005
	July 14	**11**	kg/ha = -983 +5581[NDVIJy14]	59	0.0060
	July 30	**11**	kg/ha = -3608 +9123[NDVIJy30]	80	0.0002
Short-Term	**June 15**	**11**	kg/ha =-4257 + 14655[NDVIJn15]	89	0.0001
	June 23	**11**	kg/ha =-2757 + 9675[NDVIJn23]	85	0.0001
	June 30	**11**	kg/ha = -2210+ 8180[NDVIJn30]	85	0.0001
	July 7	**11**	kg/ha = -2214 + 7689[NDVIJy7]	86	0.0001
	July 14	**11**	kg/ha = -2169 +7750[NDVIJy14]	82	0.0001
	July 30	**11**	kg/ha = -3225 + 8922[NDVIJy30]	82	0.0001

Study #5: The effects of long-term and short-term no-till on the response of field pea and spring wheat phosphorus fertilizer in 2004.

As with the other studies, the proximity of the two fields with very contrasting cropping histories permitted an evaluation on phosphorus response. The effects were investigated in field pea and spring wheat by using different rates of P_2O_5 (ranging from 0 - 45 lbs P_2O_5 /ac in 5 lb increments) and only one replicate for each crop. The plots alternate between field pea and spring wheat on the same group of plots and the same rates of P are used on the plots year after year.

A summary of the pertinent agronomic information for spring wheat and field pea is provided in Table 24. Field history had no effect on phosphorus response in field pea (Table 25). The yields in 2004 favored the STNT site versus the LTNT site which is opposite to 2003. Based on our observation, the frost damage appeared worst on the LTNT than the STNT site explaining somewhat the discrepancy between the two years. We observed lower plant numbers on the STNT than the LTNT plots and the effects of seed-placed P appeared to have a larger effect on the STNT than the LTNT site. This will need to be investigated more fully over time.

Plant numbers were greater for the LTNT than the STNT site and the effects of seed-placed P on plant numbers tended to be greater on the STNT site (Table 26). The grain yields were slightly higher for the STNT than the LTNT site. Their appeared to be a P response on the STNT but not the LTNT site. If that is the case, it may be possible to skip the expense of P fertilizer in some years and invest it in N fertilizer. It also warrants more studies to examine more closely the cycling of P in no-till systems.

Table 24. Other pertinent agronomic information.

Variable	Long-term No-Till	Short-term No-Till
	Field Pea	
Cultivar	Eclipse	Eclipse
Seeding Date	May 4	May 4
Seeding Rate	210 kg/ha	210 kg/ha
Inoculant Rate and Type	Granular @5.6 kg/ha seed-placed	Granular @5.6 kg/ha seed-placed
Harvest Date	Sept 23	Sept 23
Herbicide Use		
Pre-Seeding Burnoff	Glyphos @667 gai/ha on May 7	Glyphos @667 gai/ha on May 7
In-Crop Herbicide	Odyssey @14.8 gai/ha on June 16 Glyphos @890 gai/ha on Aug 25	Odyssey @14.8 gai/ha on June 16 Glyphos @890 gai/ha on Aug 25
Post Harvest	-	-
Greenseeker June 15 Crop Stage	5 nodes	5 nodes
Greenseeker June 23 Crop Stage	7 - 9 nodes	7 - 9 nodes

Greenseeker June 30 Crop Stage	9 - 10 nodes	9 - 10 nodes
Greenseeker July 7 Crop Stage	12 - 14 nodes	11 - 13 nodes
Greenseeker July 14 Crop Stage	50 - 60 % flowering	50 - 60 % flowering
Greenseeker July 30 Crop Stage	30 % still flowering	30 % still flowering
Seeding Implement	Edwards Hoe Drill - 8" spacing	Edwards Hoe Drill - 8"spacing
Soil Test NO3-N (kg/ha) 0-30cm	23	28
Soil Test PO4-P (kg/ha) 0-30 cm	39	15
Potassium Sulfate Applied (kg/ha)	20 kg/ha surface broadcast on May 4	20 kg/ha surface broadcast on May 4
Soil pH	7.9	8.0
Salinity Rating	Non-saline	Non-saline
Soil Texture	Clay loam	Clay loam
	Spring wheat	
Cultivar	Prodigy	Prodigy
Seeding Date	May 4	May 4
Seeding Rate	134 kg/ha	134 kg/ha
Harvest Date	Sept 7	Sept 7
Herbicide Use		
Pre-Seeding Burnoff	Glyphos @ 667 gai/ha on May 7	Glyphos @ 667 gai/ha on May 7
In-Crop Herbicide	Lontrel @ 98.9 gai/ha on June 16 MCPA ester @ 553.5 gai/ha on June 16 Attain @ 142.3 gai/ha on June 16 Achieve @ 197.7 gai/ha on June 16 Glyphos @ 890 gai/ha on Aug 25	Lontrel @ 98.9 gai/ha on June 16 MCPA ester @ 553.5 gai/ha on June 16 Attain @ 142.3 gai/ha on June 16 Achieve @ 197.7 gai/ha on June 16 Glyphos @ 890 gai/ha on Aug 25
Post Harvest	-	-

GreenSeeker June 15 Crop Stage	3.5 leaves	3.5 leaves
GreenSeekerJune 23 Crop Stage	3.8 - 4.3 leaves	3.8 - 4.3 leaves
GreenSeekerJune 30 Crop Stage	5.7 - 5.9 leaves	5.7 - 5.9 leaves
GreenSeekerJuly 7 Crop Stage	7 leaves to early flag	7 leaves to early flag
GreenSeekerJuly 14 Crop Stage	Head just emerging	late booth / early head emerging
GreenSeekerJuly 30 Crop Stage	late milk	late milk
Seeding Implement	Edwards Hoe Drill - 8" spacing	Edwards Hoe Drill - 8"spacing
Soil Test NO3-N (kg/ha) 0-30cm	23	39
Soil Test PO4-P (kg/ha) 0-15 cm	28	15
Potassium Sulfate Applied (kg/ha)	20 kg/ha surface applied on May 4	20 kg/ha surface applied on May 4
Urea -N fertilizer applied (kg/ha)	90 kg/ha mid-row band at seeding	90 kg/ha mid-row band at seeding
Soil pH	7.9	8.0
Salinity Rating	Non-saline	Non-saline
Soil Texture	Clay loam	Clay loam

Table 25. The effects of phosphorus fertilizer rate on the yield (kg/ha) and NDVI on field pea under long-term and short-term no-till in 2004.

P_2O_5 rate (kg/ha)	PPMS		YIELD (kg/ha)		NDVI (June 15)		NDVI (June 23)	
	L-T	S-T	L-T	S-T	L-T	S-T	L-T	S-T
0	59	41	3387	4066	0.3363	0.2741	0.3153	0.2875
5	53	43	2764	3663	0.3339	0.2789	0.3141	0.3020
10	57	46	2970	3609	0.3115	0.2544	0.3138	0.2546
15	63	34	2939	3847	0.3132	0.2529	0.2982	0.2659
20	53	49	2918	3922	0.3224	0.2505	0.3005	0.2660
25	45	55	1928	4043	0.3042	0.2655	0.2908	0.2793
30	46	43	3481	4089	0.3188	0.2733	0.2911	0.2762
35	54	34	2918	4404	0.3072	0.2642	0.3866	0.2825
40	40	33	3070	3836	0.3073	0.2507	0.2832	0.2591
45	49	31	3122	3384	0.3130	0.2574	0.2853	0.2669
MEAN	**52**	**41**	**2950**	**3886**	**ns**	**ns**	**ns**	**ns**

P_2O_5 rate (kg/ha)	NDVI(June 30)		NDVI (July 7)		NDVI (July 14)		NDVI (July 30)	
	L-T	S-T	L-T	S-T	L-T	S-T	L-T	S-T
0	**0.4127**	**0.3865**	**0.5746**	**0.4850**	**0.6848**	**0.6448**	**0.7732**	**0.7498**
5	**0.4220**	**0.3989**	**0.5506**	**0.5424**	**0.6729**	**0.7065**	**0.7732**	**0.7621**
10	**0.3961**	**0.3261**	**0.5328**	**0.4519**	**0.6942**	**0.6288**	**0.7659**	**0.7474**
15	**0.4162**	**0.3436**	**0.5579**	**0.4627**	**0.6872**	**0.6741**	**0.7729**	**0.7681**
20	**0.3845**	**0.3512**	**0.5458**	**0.4746**	**0.6695**	**0.6217**	**0.7723**	**0.7548**
25	**0.3748**	**0.3484**	**0.4801**	**0.4870**	**0.6275**	**0.6420**	**0.7605**	**0.7629**
30	**0.3861**	**0.3539**	**0.5093**	**0.4959**	**0.6487**	**0.6679**	**0.7557**	**0.7681**
35	**0.3866**	**0.3751**	**0.5161**	**0.5131**	**0.6620**	**0.6621**	**0.7701**	**0.7620**
40	**0.3625**	**0.2959**	**0.4806**	**0.4175**	**0.6107**	**0.5754**	**0.7549**	**0.7417**
45	**0.3764**	**0.3250**	**0.4814**	**0.4500**	**0.6107**	**0.6428**	**0.7527**	**0.7602**

Table 26. The effects of phosphorus fertilizer rate on the yield (kg/ha) and NDVI on spring wheat under long-term and short-term no-till in 2004.

P_2O_5 rate (kg/ha)	PPMS		YIELD (kg/ha)		NDVI (June 15)		NDVI (June 23)	
	L-T	S-T	L-T	S-T	L-T	S-T	L-T	S-T
0	411	362	2403	2045	0.4963	0.3562	0.6436	0.4625
5	320	317	2480	2291	0.4487	0.3772	0.5827	0.4229
10	352	308	2305	2281	0.3740	0.3947	0.4969	0.5368
15	313	295	2532	2538	0.44555	0.4997	0.5792	0.6058
20	359	367	2055	2611	0.4929	0.4399	0.6186	0.5724
25	325	313	2261	2700	0.4328	0.4854	0.5465	0.6335
30	381	349	2320	2542	0.4750	0.4742	0.6402	0.6112
35	362	332	2670	3178	0.3460	0.4960	0.4162	0.6651
40	399	330	2359	2650	0.3339	0.4912	0.6416	0.6467
45	615	369	2434	2619	0.5511	0.4316	0.7192	0.6016
MEAN	**384**	**334**	**2382**	**2546**	**ns**	**ns**	**ns**	**ns**

P_2O_5 rate (kg/ha)	NDVI(June 30)		NDVI (July 7)		NDVI (July 14)		NDVI (July 30)	
	L-T	S-T	L-T	S-T	L-T	S-T	L-T	S-T
0	**0.7899**	**0.6490**	**0.8513**	**0.7978**	**0.8096**	**0.7838**	**0.7378**	**0.7055**
5	**0.7592**	**0.6256**	**0.8551**	**0.7890**	**0.8043**	**0.7825**	**0.7789**	**0.7233**
10	**0.7418**	**0.7566**	**0.8331**	**0.8354**	**0.7958**	**0.8400**	**0.7281**	**0.7358**
15	**0.7476**	**0.7738**	**0.8488**	**0.8561**	**0.7911**	**0.8486**	**0.7245**	**0.7480**
20	**0.7770**	**0.7651**	**0.8395**	**0.8416**	**0.7998**	**0.8353**	**0.7211**	**0.7434**
25	**0.7641**	**0.7925**	**0.8340**	**0.8570**	**0.7786**	**0.8479**	**0.7473**	**0.7561**
30	**0.7697**	**0.7714**	**0.8427**	**0.8473**	**0.7787**	**0.8296**	**0.7520**	**0.7332**
35	**0.6652**	**0.8100**	**0.8049**	**0.8500**	**0.8025**	**0.8321**	**0.7288**	**0.7748**
40	**0.7846**	**0.8085**	**0.8546**	**0.8625**	**0.7739**	**0.8441**	**0.6525**	**0.7581**
45	**0.8277**	**0.7933**	**0.8714**	**0.8641**	**0.8028**	**0.8485**	**0.7538**	**0.7563**

Study #6: The effects of long-term and short-term no-till on the response of spring wheat to post emergent applications of liquid nitrogen fertilizer in 2004.

There is a lot of interest in looking at other nitrogen management strategies in order to manage more effectively crop production risks. Currently there is research looking at post emergent applications of liquid nitrogen as a surface band at different times post seeding in wheat and canola. The present field study offered the opportunity of testing the concept more fully and determining if the risks of this nitrogen management approach are lower in long-term than short-term no-till fields. A summary of pertinent agronomic information is given in Table 27. The soil test results, averaged over the three samples taken from each replicate of the study, and the amount of N used in the study is given in Table 28. It was assumed that the soil test levels would be very low on the short-term area and higher on the long-term area but the soil test results indicated very little difference in residual N between the two sites.

The treatments of the study were chosen to compare putting all the nitrogen (urea) down at seeding time in a mid-row band on 16" spacing vs putting 33% down at seeding in a mid-row band using urea and the remainder at the 1, 3 or 5 leaf stage using liquid UAN as a surface band or putting 100% down after seeding at the 1, 3 or 5 leaf stage as a surface band using liquid UAN. We were interested in overall crop production and grain protein content. We also did some spectral measurements with the GreenSeeker^{tm} instrument which provides measures of Normalized Difference Vegetation Index (NDVI). NDVI is calculated as the ratio of the infra-red and red bands using the relationship of (Infra-red - Red)/(Infra-red + Red). NDVI is an indirect measurement of crop biomass. Chlorophyll absorbs radiation in the red band and as biomass accumulates, more of the near-infra-red is being reflected. This means that the higher the values for NDVI, the more the red band is being absorbed and consequently more chlorophyll is present hence more biomass. Measurements were conducted at two different times, July 2 (flag leaf just emerged) and on July 17 (early grain fill). A summary of the GreenSeeker measurements is provided in Tables 31-34.

A separate analysis was done for each field history ie LTNT and STNT. The study also collected data with the GreenSeeker^{tm} sensor in order to allow us to build an application algorithm. The pertinent agronomic information for the two sites is given in Tables 27 and 28.

For the long-term no-till site, there was an effect of nitrogen on grain protein level but no effect from placement and timing even though the nitrogen applied at the 1-1.5 leaf stage tended to have lower protein levels (Table 29).With the short-term site, there was no effect of N on grain protein and the timing and placement also had no effect as well (Table 29). The difference in results between the two sites reflects the differences in the nitrogen supplying power of the two soils due to differences in management history.

With the yield data, there was an overall response to N for the LTNT site and overall the N applied at seeding tended to produce higher grain yields than the later post-emergent N applications (Table 30). However, when 33% of the N was applied at time of seeding, the yield differences between all N applied at seeding vs N applied post-emergent, were not existent. Also the post-emergent N applications with 33% of the N upfront and the balance at different leaf stages produced better yields than when all N was applied in a post-emergent fashion. These differences were not present at the 1-1.5 leaf stage but were present at the 3 and 5 leaf stages.

With the short-term no-till site, we observed an overall response to nitrogen and overall the yields with the N all applied at time of seeding was better than when applied in a post-emergent fashion (Table 30). We also observed that unlike the LTNT site, putting 33% of the fertilizer at seeding and the balance pot-emergent did not alleviate the better yields of all the N put down at time of seeding. If fact there was no difference between 33% of the fertilizer at seeding vs none at seeding with the balance of N in both cases applied in a post-emergent fashion. The grain yields when the post-emergent N was applied at the 1-1.5 leaf stage were not different than when N was all applied at seeding. The reduction in grain yields increased as the post emergent N application was applied at the 3 and 5 leaf stage.

In order to make post-emergent N applications work, we will need to work with more than 33% of the fertilizer N applied at time of seeding in order to reduce the potential risks associated with this practise. This will be necessary if we are to make the GreenSeeker sensor work to our advantage in terms of assisting in making more accurate predictions of crop needs for nitrogen.

Table 27. Other pertinent agronomic information in 2004.

Variable	Long-term No-Till	Short-term No-Till
Cultivar	Prodigy	Prodigy
Seeding Date	May 4	May 4
Seeding Rate	134 kg/ha	134 kg/ha
Harvest Date	Sept 4	Sept 4
1-1.5 Leaf Stage	May 27	May 27
3-3.5 Leaf Stage	June 5	June 5
5-5.5 Leaf Stage	June 16	June 16
Crop Stage July 2 (First Reading with GeenSeeker)	Flag leaf emerged and erect	Flag leaf emerged and erect
Crop Stage July 17 (Second Reading with GeenSeeker)	early grain fill	early grain fill
Herbicide Use		
Pre-Seeding Burnoff	Glyphos @667 gai /ha on May 7	Glyphos @667 gai /ha on May 7
In-Crop Herbicide	Lontrel @98.9 gai/ha on June 16 MCPA ester @553.5 gai/ha on June 16 Attain @ 142.3 gai/ha on June 16 Achieve @ 197.7 gai/ha on June 16 Glyphos @ 890 gai/ha on Aug 25	Lontrel @98.9 gai/ha on June 16 MCPA ester @553.5 gai/ha on June 16 Attain @ 142.3 gai/ha on June 16 Achieve @ 197.7 gai/ha on June 16 Glyphos @ 890 gai/ha on Aug 25
Post Harvest	-	-
Seeding Implement	Edwards Hoe Drill - 8" spacing	Edwards Hoe Drill - 8"spacing

Soil Test NO3-N (kg/ha) 0-30cm	23	28
Soil Test PO4-P (kg/ha) 0-30 cm	39	15
Potassium Sulfate Applied (kg/ha)	119 kg/ha surface broadcast on May 7	119 kg/ha surface broadcast on May 7
Total Urea-N Applied (kg/ha)	70 kg/ha mid-row band at seeding	70 kg/ha mid-row band at seeding
P_2O_5 fertilizer applied (kg/ha) 11-52-00	58 kg/ha seed-placed	58 kg/ha seed placed
Soil pH	7.9	8.0
Salinity Rating	Non-saline	Non-saline
Soil Texture	Clay loam	Clay loam

Table 28. Soil test levels for NO_3-N and PO_4 (kg/ha) long-term and short-term no-till in 2004 and amount of N used in the study.

Length of No-Till	NO_3-N (0-24") kg/ha	PO_4 (0-6") kg/ha	Total N Applied kg/ha
Short-term	28	15	108
Long-term	23	39	108

Table 29. The effects of length of no-till and nitrogen management on the grain protein (%) spring wheat in 2004.

Long-Term No-Till							
N Placement	**% Amount of N Applied**	**Check**	**Crop Leaf Stage**				
			At Seeding	**1-1.5**	**3-3.5**	**5-5.5**	**Mean**
Check	**0**	13.1	-	-	-	-	13.1
Mid-row band	**100**	-	13.7	-	-	-	13.7
Mid-row band	**33**	-	-	13.4	14.0	14.0	13.8
Mid-row band	**0**	-	-	13.3	13.9	14.1	13.8
	Mean	13.1	13.7	13.4	14.0	14.1	

cv= 2.4%
CONTRAST Check vs Rest: 0.0044
CONTRAST MidRow band vs REST of N treatments: ns
CONTRAST MidRow band vs ALL Surface Dribble Treatments: ns
CONTRAST Mid-Row band vs ALL Surface Dribble Treatments and Starter N: ns
CONTRAST Surface Dribble Treatments VS Surface Dribble and Starter N Treatments: ns
CONTRAST Mid-Row Band vs N at the 1-1.5 Leaf Stage: ns
CONTRAST Mid-Row Band vs N at the 3-3.5 Leaf Stage: ns
CONTRAST Mid-Row Band vs N at the 5-5.5 Leaf Stage: ns

Short-Term No-Till							
N Placement	**% Amount of N Applied**	**Check**	**Crop Leaf Stage**				
			At Seeding	**1-1.5**	**3-3.5**	**5-5.5**	**Mean**
Check	0	12.6	-	-	-	-	**12.6**
Mid-row band	100	-	12.1	-	-	-	**12.1**
Mid-row band	33	-	-	12.0	12.7	12.6	**12.4**
Mid-row band	0	-	-	12.2	12.9	12.8	**12.6**
	Mean	**12.6**	**12.1**	**12.1**	**12.8**	**12.7**	

cv=4.4%
CONTRAST Check vs Rest:ns
CONTRAST MidRow band vs REST of N treatments: ns
CONTRAST MidRow band vs ALL Surface Dribble Treatments: ns
CONTRAST Mid-Row band vs ALL Surface Dribble Treatments and Starter N:ns
CONTRAST Surface Dribble Treatments VS Surface Dribble and Starter N Treatments: ns
CONTRAST Mid-Row Band vs N at the 1-1.5 Leaf Stage: ns
CONTRAST Mid-Row Band vs N at the 3-3.5 Leaf Stage: ns
CONTRAST Mid-Row Band vs N at the 5-5.5 Leaf Stage: ns

Table 30. The effects of length of no-till and nitrogen management on the grain yield (kg/ha) spring wheat in 2004.

Long-Term No-Till							
N Placement	**% Amount of N Applied**	**Check**	**Crop Leaf Stage**				
			At Seeding	**1-1.5**	**3-3.5**	**5-5.5**	**Mean**
Check	**0**	1024	-	-	-	-	1024
Mid-row band	**100**	-	2068	-	-	-	2068
Mid-row band	**33**	-	-	2003	1841	1833	1892
Mid-row band	**0**	-	-	1865	1428	1571	1621
	Mean	1024	2068	1934	1635	1702	

cv=12.0%
CONTRAST Check vs Rest: 0.0001
CONTRAST MidRow band vs REST of N treatments: 0.0287
CONTRAST MidRow band vs ALL Surface Dribble Treatments: 0.0055
CONTRAST Mid-Row band vs ALL Surface Dribble Treatments and Starter N: ns
CONTRAST Surface Dribble Treatments VS Surface Dribble and Starter N Treatments: 0.0139
CONTRAST Mid-Row Band vs N at the 1-1.5 Leaf Stage: ns
CONTRAST Mid-Row Band vs N at the 3-3.5 Leaf Stage: 0.0096
CONTRAST Mid-Row Band vs N at the 5-5.5 Leaf Stage: 0.0240

Short-Term No-Till							
N Placement	**% Amount of N Applied**	**Check**	**Crop Leaf Stage**				
			At Seeding	**1-1.5**	**3-3.5**	**5-5.5**	**Mean**
Check	0	1531	-	-	-	-	**1531**
Mid-row band	100	-	2612	-	-	-	**2612**
Mid-row band	33	-	-	2347	2111	2184	**2214**
Mid-row band	0	-	-	2375	1840	2073	**2096**
	Mean	**1531**	**2612**	**2361**	**1976**	**2129**	

cv=8.9%
CONTRAST Check vs Rest: 0.0001
CONTRAST MidRow band vs REST of N treatments: 0.0018
CONTRAST MidRow band vs ALL Surface Dribble Treatments: 0.0012
CONTRAST Mid-Row band vs ALL Surface Dribble Treatments and Starter N:0.0076
CONTRAST Surface Dribble Treatments VS Surface Dribble and Starter N Treatments: ns
CONTRAST Mid-Row Band vs N at the 1-1.5 Leaf Stage: ns
CONTRAST Mid-Row Band vs N at the 3-3.5 Leaf Stage: 0.0003
CONTRAST Mid-Row Band vs N at the 5-5.5 Leaf Stage: 0.0031

Table 31. The effects of zero-till and nitrogen management on plants per metre squared, grain yield and NDVI readings in Abbey Spring Wheat 2004.

N Placement	PPMS		NDVI (June 15)		NDVI (June 23)	
	L-T	S-T	L-T	S-T	L-T	S-T
Check	390	410	0.4052	0.4351	0.3642	0.4675
MR @ Seeding	398	411	0.4869	0.5334	0.5963	0.6825
1-1.5 leaf stage	366	359	0.5159	0.5130	0.6229	0.6505
3-3.5 leaf stage	448	381	0.4086	0.4275	0.4215	0.4394
5-5.5 leaf stage	444	419	0.4259	0.4351	0.3970	0.5060
Start + 1-1.5	397	352	0.5055	0.5420	0.6525	0.6770
Start + 3-3.5	377	342	0.4621	0.4911	0.4531	0.4939
Start + 5-5.5	364	374	0.4508	0.4763	0.4497	0.5504

Table 32. The effects of zero-till and nitrogen management on NDVI readings on different dates in Abbey Spring Wheat 2004.

N Placement	NDVI(June 30)		NDVI (July 7)		NDVI (July 14)		NDVI (July 30)	
	L-T	S-T	L-T	S-T	L-T	S-T	L-T	S-T
Check	0.4285	0.5367	0.5289	0.6486	0.5098	0.6189	0.4800	0.5215
MR @ Seeding	0.7231	0.7781	0.7980	0.8303	0.7443	0.8161	0.6126	0.6759
1-1.5 leaf stage	0.7011	0.7364	0.7793	0.8078	0.7353	0.7526	0.6102	0.6206
3-3.5 leaf stage	0.4829	0.5393	0.6091	0.6663	0.5886	0.6353	0.5775	0.5973
5-5.5 leaf stage	0.4496	0.5650	0.5773	0.6998	0.5378	0.6723	0.6052	0.6439
Start + 1-1.5	0.7188	0.7328	0.7943	0.7999	0.7347	0.7542	0.6409	0.6365
Start + 3-3.5	0.5515	0.5930	0.7049	0.7216	0.6497	0.6779	0.6330	0.5815
Start + 5-5.5	0.5433	0.6363	0.6749	0.7350	0.6223	0.6988	0.6284	0.6287

Table 33. Correlation coefficients (90) between NDVI values and grain protein and grain yield for both field histories and combined in 2004.

GreenSeeker	Grain Yield			Grain Protein		
	All	L-T N-T	S-T N-T	All	L-T N-T	S-T N-T
# of Observations	48	24	24	48	24	24
NDVI - June 15	16.3	0.1	12.0	5.7	3.7	3.7
NDVI - June 23	14.4	16.5	11.0	5.5	3.6	3.9
NDVI - June 30	12.6	15.6	8.7	5.5	3.6	3.8
NDVI - July 7	11.1	13.5	7.4	5.6	3.7	4.0
NDVI - July 14	10.7	11.0	6.9	5.4	3.6	4.0
NDVI - July 30	13.4	12.2	10.2	6.1	3.5	4.4

Table 34. Linear regression equations between grain yield and NDVI measurements on various dates during the 2004 growing season.

Field History	NDVI Measurement	# of Observations	Linear Equation	R^2 (%)	Significance
Abbey Spring Wheat					
Long-Term	**June 15**	**24**	kg/ha = 1.19 + 66.62[NDVI]	-	0.0001
	June 23	**24**	kg/ha = -787.01 + 5443.34[NDVI]	48	0.0002
	June 30	**24**	kg/ha = 480.18 + 2473.94[NDVI]	53	0.0001
	July 7	**24**	kg/ha = 246.62 + 2535.15[NDVI]	65	0.0001
	July 14	**24**	kg/ha = -466.88 + 3176.83[NDVI]	77	0.0001
	July 30	**24**	kg/ha = -490.12 + 3426.41[NDVI]	71	0.0001
Short-Term	**June 15**	**24**	kg/ha = 174.96 + 4067.31[NDVI]	63	0.0001
	June 23	**24**	kg/ha = 405.81 + 3095.13[NDVI]	69	0.0001
	June 30	**24**	kg/ha = -113.40 +3513.34[NDVI]	81	0.0001
	July 7	**24**	kg/ha =-1310.80 +4663.57[NDVI]	86	0.0001
	July 14	**24**	kg/ha =-1189.43 +4727.93[NDVI]	88	0.0001
	July 30	**24**	kg/ha =-1311.93 +5619.48[NDVI]	74	0.0001

Study #7 - To determine the effects of long-term and short-term no-till production on fertilized and unfertilized malting barley production in 2004.

This study was undertaken to determine the implications of LTNT and STNT on nutrient uptake and nitrous oxide emissions, a potent greenhouse gas. This project is part of a larger GAPS project under the direction of Dr Cindy Grant.

Only the results related to nutrient uptake, biomass accumulation and grain yield will be discussed. A summary of the pertinent agronomic information is presented in Table 35. Fertilizer reduced plant populations but increased head numbers and grain yield. The overall grain yield was better on the STNT than the LTNT. This is a reflection of the areas that we chose to do the studies. The topsoil was visually better and deeper on the STNT site thereby skewing the results (Table 36). We also conducted NDVI measurements in order to start building an algorithm for barley to go with the GreenSeeker sensor. The results can be viewed in Tables 37-39.

The data for dry matter accumulation is provided in Tables 40 and 41.

The data for nutrient uptake is provided in Table 42 for the fertilizer plot and the LTNT and STNT site and Table 43 for the unfertilized plots and the LTNT and STNT sites.

A series of figures were drafted in order to graphically represent the information on dry matter and nutrient uptake (Figures 1-4).

Table 35. Other pertinent agronomic information in 2004.

Variable	Long-Term No-Till Field	Short-Term No-Till Field
Crop Variety	AC Metcalfe	AC Metcalfe
Seeding Date	May 5	May 5
Harvest Date	Sept 7	Sept 7
Herbicide Use		
Pre-Seeding Burnoff	Glyphos 667 gai/ha applied on May 7	
In-Crop Herbicide	Lontrel @98.9 gai/ha on June 16 MCPA ester @553.5 gai/ha on June 16 Achieve @197.7 gai/ha on June 16 Attain @142.3 gai/ha on June 16	Lontrel @98.9 gai/ha on June 16 MCPA ester @553.5 gai/ha on June 16 Achieve @197.7 gai/ha on June 16 Attain @142.3 gai/ha on June 16
Pre-Harvest Round-Up	Glyphos @890 gai/ha on Aug 25	Glyphos @890 gai/ha on Aug 25
Seeding Implement	ConservaPak Seeder on 12" spacing	ConservaPak Seeder on 12" spacing
Total urea N fertilized kg/ha (46-00-00)	97	97
P_2O_5 kg/ha (11-52-00)	48	48

Soil Test NO3-N (kg/ha) 0-30cm	22	18
Soil Test PO4-P (kg/ha) 0-30 cm	29	7
Soil pH	7.9	8.0
Salinity Rating	Non-saline	Non-saline
Soil Texture	Clay loam	Clay loam

Table 36. Effects of nitrogen management on plants per metre squared, heads per metre squared , grain yield and bushels per acre in malting barley production in 2004.

N rate	PPMS			HDMS			YIELD (kg/ha)			Bus/Acre	
	L-T	S-T		L-T	S-T		L-T	S-T		L-T	S-T
fertilized	135	170		546	563		5668	6582		108	125
unfertilized	164	187		415	360		3202	4508		61	86
MEAN	**150**	**179**		**481**	**462**		**4435**	**5545**		**85**	**106**
p - level	**0.06**	**0.18**		**0.02**	**0.02**		**0.005**	**0.002**		**0.005**	**0.002**

Table 37. The effects of nitrogen management on grain protein and NDVI in malting barley production in 2004.

N rate	Grain Protein (%)			NDVI (June 10)			NDVI (June 15)			NDVI (June 18)	
	L-T	S-T		L-T	S-T		L-T	S-T		L-T	S-T
fertilized	-	-		0.2978	0.3058		0.3830	0.4353		0.3303	0.4538
unfertilized	-	-		0.2750	0.2885		0.3313	0.3565		0.2950	0.3470
MEAN	**-**	**-**		**0.2864**	**0.2972**		**0.3572**	**0.3959**		**0.3127**	**0.4004**

Table 38. The effects of nitrogen management on NDVI readings on different dates in malting barley production in 2004.

N rate	NDVI (June 25)		NDVI (July 2)		NDVI (July 9)		NDVI (July 16)	
	L-T	S-T	L-T	S-T	L-T	S-T	L-T	S-T
fertilized	0.4358	0.5780	0.6158	0.7290	0.7328	0.7858	0.7348	0.7775
unfertilized	0.3390	0.4005	0.4013	0.5313	0.4898	0.6373	0.5475	0.6293
MEAN	**0.3874**	**0.4893**	**0.5086**	**0.6302**	**0.6113**	**0.7116**	**0.6412**	**0.7034**

Table 39. The effects of nitrogen management on NDVI readings and dry matter (kg/ha) on different dates in malting barley production in 2004.

N rate	NDVI (July 23)		NDVI (July 30)		DMAT(June 10)		DMAT (June18)	
	L-T	S-T	L-T	S-T	L-T	S-T	L-T	S-T
fertilized	0.7783	0.799	0.6758	0.7105	189	303	328	615
unfertilized	0.6188	0.7098	0.5425	0.5610	123	205	180	361
MEAN	**0.6986**	**0.7544**	**0.6092**	**0.6358**	**156**	**254**	**254**	**488**
p - level	**-**	**-**	**-**	**-**	**0.01**	**0.009**	**0.005**	**ns**

Table 40. The effects of nitrogen management on dry matter (kg/ha) for different dates in malting barley production in 2004.

N rate	DMAT (June 25)		DMAT (July 2)		DMAT(July 9)		DMAT (July 16)	
	L-T	S-T	L-T	S-T	L-T	S-T	L-T	S-T
fertilized	804	1312	1911	1870	2321	3019	3839	5856
unfertilized	336	583	746	1132	886	1714	1649	2592
MEAN	**570**	**948**	**1329**	**1501**	**1604**	**2367**	**2744**	**4224**
p - level	**0.01**	**0.02**	**0.001**	**ns**	**0.0009**	**ns**	**0.0008**	**0.001**

Table 41. The effects of nitrogen management on dry matter (kg/ha) for different dates in malting barley production in 2004.

N rate	DMAT (July 23)			DMAT (July 30)			DMAT (Aug 27)	
	L-T	S-T		L-T	S-T		L-T	S-T
fertilized	6767	8161		7784	10236		9293	12697
unfertilized	3429	5479		3535	5258		5693	8202
MEAN	**5098**	**6820**		**5660**	**7747**		**7493**	**10450**
p - level	**0.008**	**0.06**		**0.001**	**0.01**		**0.05**	**0.008**

Table 42 - Fertilized Plots of Malting Barley in 2004

	Dry Matter (kg/ha)		Total N Uptake (kg/ha)		Total PUptake (kg/ha)		Total K Uptake (kg/ha)		Total S Uptake (kg/ha)	
Julian Date	**LT**	**ST**	**LT**	**ST**	**LT**	**ST**	**LT**	**ST**	**LT**	**ST**
162	189	303	9	15	1	1	7	13	0	1
170	328	615	14	26	1	3	14	26	1	2
177	804	1312	35	51	4	5	32	56	2	5
184	1911	1870	61	56	7	6	71	67	5	5
191	2321	3018	55	63	7	8	70	87	5	6
198	3839	5856	68	97	9	13	87	146	6	11
205	6767	8161	115	118	18	19	134	154	10	13
212	7784	10236	115	126	19	19	109	153	11	14
240	9293	12697	51	52	8	7	119	165	9	12
250 (straw only)	3625	6116	-	-	-	-	-	-	-	-
grain only	4435	5545								

Table 43 - Unfertilized Plots of Malting Barley in 2004

	Dry Matter (kg/ha)		Total N Uptake (kg/ha)		Total PUptake (kg/ha)		Total K Uptake (kg/ha)		Total S Uptake (kg/ha)	
Julian Date	**LT**	**ST**	**LT**	**ST**	**LT**	**ST**	**LT**	**ST**	**LT**	**ST**
162	123	205	4	8	0	1	5	8	0	1
170	180	361	6	13	1	1	8	13	1	1
177	336	582	12	22	2	3	13	22	1	2
184	746	1132	20	33	3	4	28	40	2	3
191	886	1714	22	40	4	6	28	54	2	5
198	1649	2592	33	41	6	7	38	59	3	5
205	3428	5479	54	85	11	14	64	110	5	9
212	3535	5258	56	63	11	12	54	67	6	8
240	5692	8202	42	38	9	8	82	106	8	8
250 (straw only)	2491	3694	-	-	-	-	-	-	-	-
grain only	4435	5545								

Figure 1- The relationship between Nitrogen Uptake in barley and Julian Date in Short Term No-Till Production in 2004.

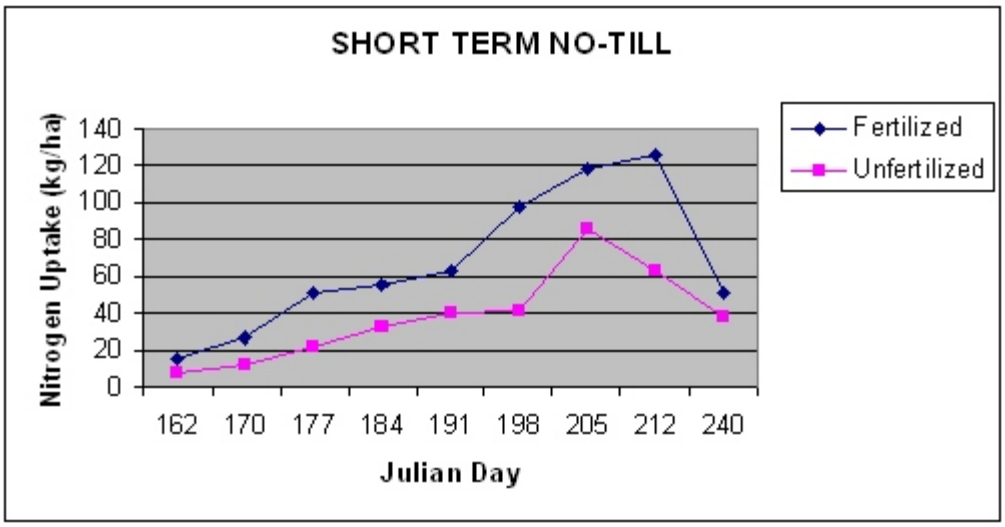


Figure 2- The relationship between Dry Matter in barley by Julian Date in Short Term No-Till Production in 2004.

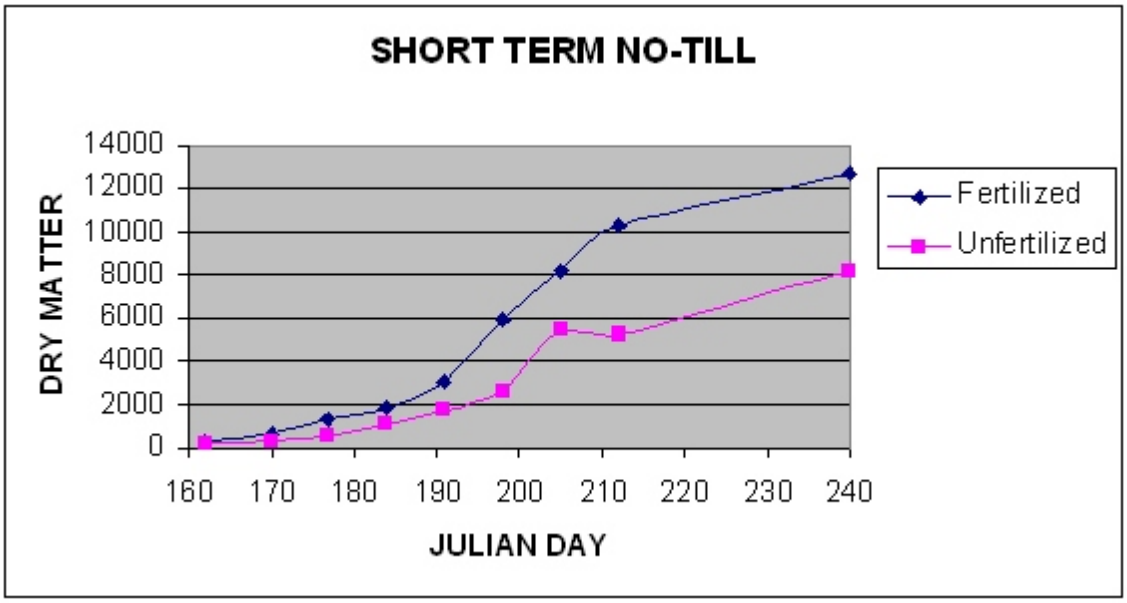


Figure 3 - The relationship between nitrogen uptake by julian date in long term no-till production in 2004.

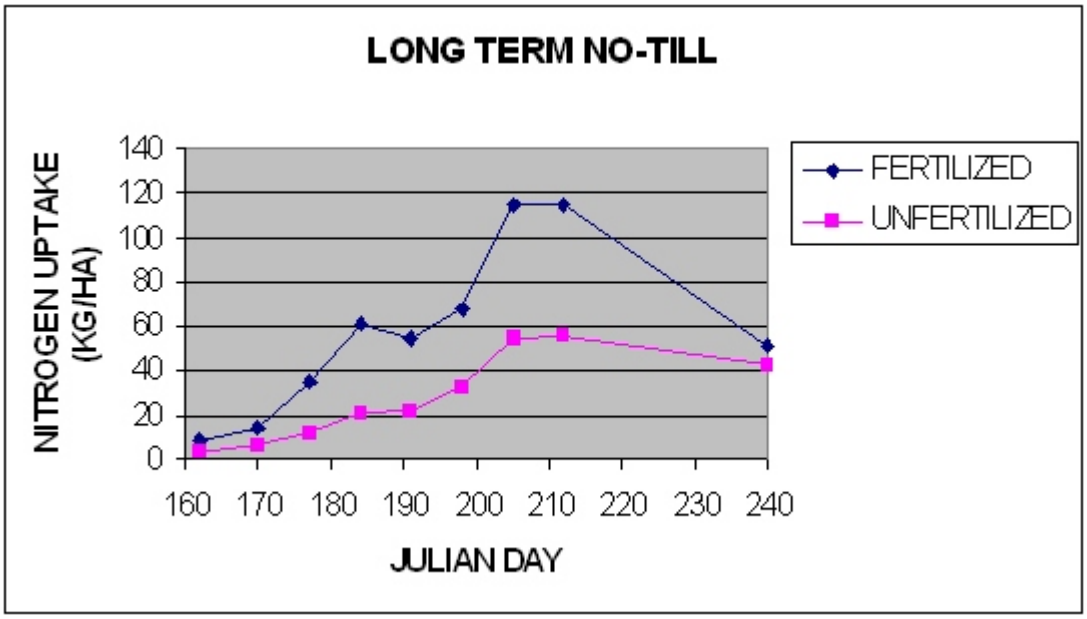
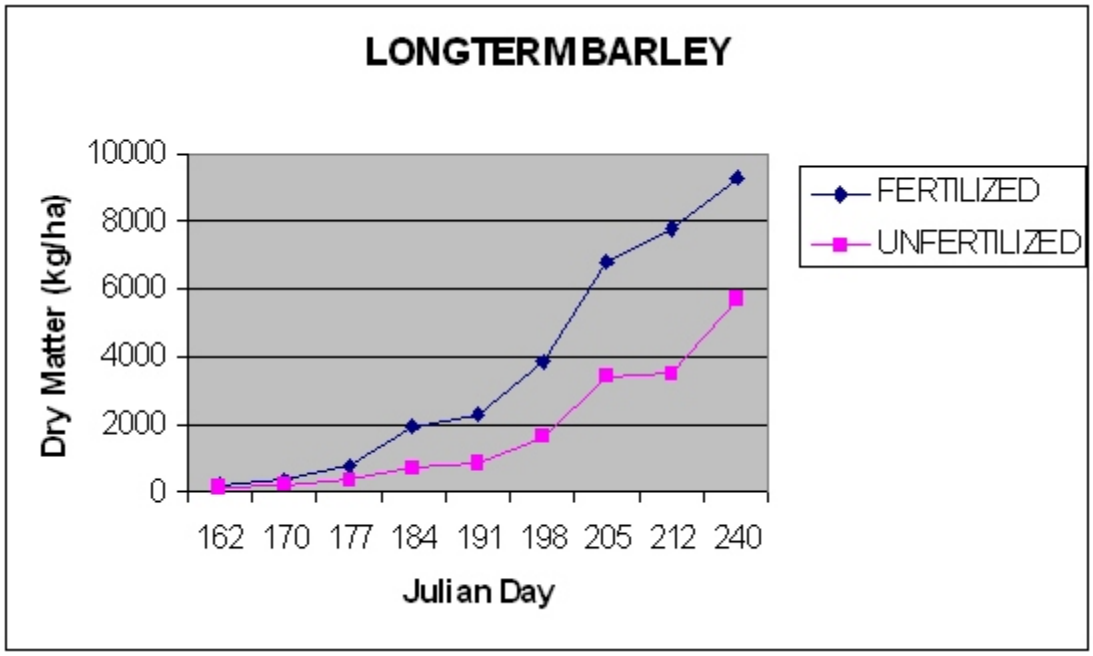


Figure 4 - The relationship between dry matter in barley by julian date in long term no-till production in 2004.



Study #8 - To determine the effects of long-term and short-term no-till production on malt barley production at different rates of nitrogen in 2004.

This was study was added on in order to do a nitrogen rate response in barley to complement the previous study and to get additional information about malting barley production on long-term no-till sites. A summary of the pertinent agronomic information is provided in Table 44. A summary of the agronomic information is provided in Table 44 and 45. The corresponding NDVI's are also provided in Tables 45, 46 and 47. In this study, we observed higher grain yields on the LTNT than the STNT site which is opposite to the previous study showing how variables soils are (Table 44). What is most interesting are the larger grain yields of LTNT than STNT for nitrogen fertilizer rates in the range of 0-60 kg/ha. This shows the differences in nitrogen supplying power of the soil with LTNT.

Table 44. Other pertinent agronomic information in 2004.

Variable	Long-Term No-Till Field	Two Year No-Till Field
Crop Variety	AC Metcalfe	AC Metcalfe
Seeding Date	May 4	May 4
Harvest Date	Sept 7	Sept 7
Herbicide Use		
Pre-Seeding Burnoff	Glyphos 667 gai/ha applied on May 7	
In-Crop Herbicide	Lontrel @98.9 gai/ha on June 16 MCPA ester @553.5 gai/ha on June 16 Achieve @197.7 gai/ha on June 16 Attain @142.3 gai/ha on June 16	Lontrel @98.9 gai/ha on June 16 MCPA ester @553.5 gai/ha on June 16 Achieve @197.7 gai/ha on June 16 Attain @142.3 gai/ha on June 16
Pre-Harvest Round-Up	Glyphos @890 gai/ha on Aug 25	Glyphos @890 gai/ha on Aug 25
Seeding Implement	ConservaPak Seeder on 12" spacing	ConservaPak Seeder on 12" spacing
P_2O_5 kg/ha (11-52-00)	48	48
Soil Test NO3-N (kg/ha) 0-30cm	22	18
Soil Test PO4-P (kg/ha) 0-30 cm	29	7
Soil pH	7.9	8.0
Salinity Rating	Non-saline	Non-saline
Soil Texture	Clay loam	Clay loam

Table 45. Effects of nitrogen management on plants per metre squared, heads per metre squared , grain yield and bushels per acre in malting barley production in 2004.

N rate	PPMS		HDMS		YIELD (kg/ha)		Bus/Acre	
	L-T	S-T	L-T	S-T	L-T	S-T	L-T	S-T
0 kg/ha	159	160	505	322	2024	1434	38	27
20 kg/ha	162	172	550	416	3529	1720	67	33
40 kg/ha	165	176	640	539	4582	2212	87	42
60 kg/ha	193	208	569	637	4553	3775	87	72
80 kg/ha	209	193	772	615	4342	4186	83	80
100 kg/ha	206	180	576	671	4822	4796	92	91
120 kg/ha	208	213	767	713	5272	4855	100	92
140 kg/ha	138	177	1061	630	5958	6364	113	121
MEAN	**180**	**185**	**680**	**568**	**4385**	**3668**	**83**	**70**

Table 46. The effects of nitrogen management on grain protein and NDVI in malting barley production in 2004.

N rate	Grain Protein (%)		NDVI (June 10)		NDVI (June 15)		NDVI (June 18)	
	L-T	S-T	L-T	S-T	L-T	S-T	L-T	S-T
0			0.3019	0.2897	0.3792	0.3559	0.3395	0.3573
20			0.3059	0.2937	0.3978	0.3836	0.3795	0.3954
40			0.3024	0.3050	0.4148	0.4483	0.3968	0.4750
60			0.2943	0.3430	0.3788	0.4583	0.3760	0.5117
80			0.2996	0.3148	0.4088	0.4415	0.3991	0.4891
100			0.3081	0.3323	0.4262	0.4735	0.4112	0.5307
120			0.3094	0.3142	0.4345	0.4118	0.4417	0.4892
140			0.3108	0.3128	0.4266	0.4068	0.4217	0.4409
MEAN			**0.3041**	**0.3132**	**0.4083**	**0.4225**	**0.3957**	**0.4612**

Table 47. The effects of nitrogen management on NDVI readings on different dates in malting barley production in 2004.

N rate	NDVI (June 25)		NDVI (July 2)		NDVI (July 9)		NDVI (July 16)	
	L-T	S-T	L-T	S-T	L-T	S-T	L-T	S-T
0	0.3679	0.3933	0.4682	0.4504	0.5909	0.5314	0.6216	0.5391
20	0.4505	0.4605	0.5792	0.5395	0.6537	0.6406	0.6948	0.6070
40	0.5057	0.5609	0.6708	0.6936	0.7501	0.7552	0.7529	0.7231
60	0.5010	0.6326	0.6748	0.7688	0.7535	0.8005	0.7651	0.7680
80	0.5396	0.6275	0.7433	0.7880	0.8143	0.8230	0.8017	0.8141
100	0.5574	0.6525	0.7450	0.7965	0.8081	0.8395	0.7938	0.8144
120	0.5798	0.6479	0.7655	0.8054	0.8178	0.8417	0.8152	0.8259
140	0.6068	0.5987	0.7701	0.7862	0.8390	0.8408	0.8235	0.8318
MEAN	**0.5136**	**0.5717**	**0.6771**	**0.7036**	**0.7534**	**0.7591**	**0.7586**	**0.7404**

Table 48. The effects of nitrogen management on NDVI readings and dry matter samples on different dates in malting barley production in 2004.

N rate	NDVI (July 23)		NDVI (July 30)	
	L-T	S-T	L-T	S-T
0	0.6641	0.6170	0.5984	0.4661
20	0.7743	0.6675	0.6718	0.4997
40	0.7860	0.7688	0.7019	0.6101
60	0.8151	0.8275	0.7428	0.6661
80	0.8293	0.8560	0.7794	0.7395
100	0.8504	0.8547	0.7979	0.7541
120	0.8577	0.8155	0.7979	0.7774
140	0.8716	0.8713	0.8147	0.7959
MEAN	**0.8061**	**0.7848**	**0.7381**	**0.6636**