Prairie Steward

Farming For Your Future Environment

The Newsletter of the Saskatchewan Soil Conservation Association Inc. — Spring Issue No. 62, 2012

President`s Message – Let the Celebration Begin!!

By Tim Nerbas, PAg
SSCA President

What a year! 2012 marks 25 years since the SSCA was formed and next year's conference on January 9, 2013 will mark the 25th anniversary of the Association's first conference. Back on Feb 16 and 17, 1988, 150 producers arrived at the Wills Inn in Saskatoon for a conference entitled "A systems approach to Soil Conservation". The first president, Brett Meinert, made a bold statement: "The SSCA will be a voice for Soil Conservation in Saskatchewan". Over the last 25 years the Association has lead the most dramatic change ever seen in agriculture. Gone are the dust clouds, a common sight hovering over the prairie landscape and water erosion has been dramatically decreased. Instead of mining the soil for all its nutrients, producers have begun rebuilding the soil's organic matter.

In some ways the concept of soil conservation was a revolution not an evolution. It was a paradigm shift in agriculture. A few leaders saw the need for change and the cause was championed through the SSCA. The new methods were not easily adopted and most of those early adopters were ridiculed for their new practices. For many soil conservation naysayers this was just not how farming should be done. It was different and, human nature being what it is, many producers fought the idea of change. However through extension activities, Conservation Agriculture began to change a generation of thinking. Back in 1987, tillage was referred to as "conventional tillage", meaning something established by convention or the custom. Today Conservation Agriculture has become that custom. Tillage is now seen as unconventional or a method of last resort for repairing damage caused by equipment such as getting stuck in the field.

2012 SSCA Annual Conference

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In This Issue

Products and Practices to Target High Yield of Canola

Stewart Brandt, Northeast Agriculture Research Foundation (NARF) and Anne Kirk, Western Applied Research Corporation (WARC)

Most progressive growers attempt to optimize inputs and management practices to target high canola yield. With inputs like nitrogen and phosphate fertilizers or pesticides we have good tools to predict when, where and how much to use. Some other products and practices show potential but there is much less information on when and where growers could expect to see economic returns. With financial support from the Agricultural Demonstration Of Practices and Technologies (ADOPT) program and in-kind support from product developers, NARF and WARC undertook a project to investigate such products and practices.

The objective of this demonstration was to demonstrate whether economic yield benefits can be derived from adding inputs or management practices to a management system that already targets high canola yield.

In an attempt to provide better information to farmers upon which to make decisions we demonstrated a number of potential yield enhancing practices and products in standard four replicate field trials. Descriptions of these products or practices and the rationale for including them in the demonstration are as follows:

Micronutrients - Micronutrients are essential for plant growth but are only needed in small quantities. Most soils in the region are well equipped to meet crop micronutrient needs, but exceptions do exist. Where micronutrient deficiencies exist, adding them as fertilizers can be highly effective. Where fertilizer macronutrients are applied to target high yield there are suggestions that imbalances between some macro and micro nutrients are created; and that applying micronutrients as a foliar spray is an effective way of recreating an appropriate balance. To demonstrate whether this was beneficial, we applied Simplot BM86 at 1 L/ac in 10 gallons/ac of water at the start of flowering.

Avail Treated P - When phosphate fertilizer is applied to the soil a portion of the fertilizer becomes unavailable (fixed) due to reaction with iron, aluminum, calcium and magnesium in the soil solution. The proportion that is fixed in this way depends on the properties of the soil and can vary considerably in different soils. Avail is a chemical treatment that is applied to phosphate fertilizer to prevent this happening. This increases the amount that crops can use and in turn increases yield. Where high yields are targeted, phosphate may prevent yield responses to other yield enhancing technologies. To demonstrate this technology, we compared Avail treated and untreated triple super phosphate fertilizer at equal rates as recommended by soil tests.

Increased Nitrogen (N) - Recent research with high yielding canola cultivars indicated that higher rates of N are needed to optimize yield compared with older lower yielding cultivars. Since then yield potential of new cultivars continues to increase, raising questions about the need for even

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Marilyn Martens, Office Manager

SSCA's mission is "to promote conservation agriculture systems that improve the land and environment for future generations."

SSCA's Vision is "to be the recognised driver and facilitator of change that leads to conservation agriculture being practiced on prairie agricultural land.

Patience Pays Off with Winter Wheat

By Mark Akins, PAg, CCA
Conservation Program Specialist
Ducks Unlimited Canada

Spring is right around the corner and there are many new winter wheat growers wondering how their new crops are handling the odd winter conditions. Summer 2011 was very wet in many areas, but drying conditions allowed Saskatchewan producers to seed 580,000 acres of winter wheat in the fall. Many growers were hoping winter wheat would give them a chance to harvest a crop on previously flooded land.

Much of the 2012 crop was seeded to deal with this wet cycle, and seeding went well and large healthy plants were established. This is a mixed blessing as large strong plants mean the crown tissue developed in fall will be strong and able to withstand winter temperatures and recover vigorously in spring. Unfortunately, many fields lacked stubble to catch snow, reducing the ability to buffer the soil temperature from cold air temperatures. In many areas this winter snowfall has also been minimal increasing the worry of many new winter wheat growers. Back to the positive, we have had very little cold conditions to this point in the winter, still growers wonder what to expect in April and May.

Dr. Brian Fowler and Western Ag Labs have produced a model called the winter survival model. This model uses actual soil temperatures at select locations in the prairies and plots them against the projected winter wheat hardiness given variables like variety, seeding date, fertility and soil temperature. This model is only a guide but may help give growers a clue of what to expect. The model is available at http://www.usask.ca/agriculture/plantsci/winter_cereals/index.php.

Until mid may growers may not know for sure whether their winter wheat is ok but the must keep a few things in mind. First is winterkill not very common with crops being re seeded only about 5% of the time. Secondly they should always have a "plan B" crop in mind in case the winter wheat doesn't meet expectations just so they aren't caught off guard.

Fall growth under snow.

Winter wheat requires time to recover and resume growth after dormancy so growers should be patient and continue to execute their fertility and weed control plans. Stands that are slow to recover should not be starved of nutrients or exposed to excessive weed competition. As a general rule, delay spring assessment until 2/3 of spring seeding is complete. This may mean assessing the winter wheat crop between May 15 and May 25, giving enough time to reseed if necessary. Assessing the crop condition means looking for new root growth from the crown tissue as early in spring, brown leaf material may not be a sign of winterkill and green leaves may not mean the crop has survived.

Spring winter wheat regrowth from crown.

The optimum winter wheat plant stand is 20 to 30 plants per square foot. Winter wheat has the ability to tiller relatively aggressively, therefore stands between eight to 10 plants per square foot can still produce an adequate crop.

The challenge when assessing stand establishment is often the variability in the plant stand across the whole field. In situations where the stand is thin or weak, a more intense management strategy is required.

Only when the stand has been properly assessed and deemed unacceptable should a producer terminate the winter wheat crop and reseed. If this occurs, consider the following management practices:

- Spray out the winter wheat as the crop will draw on moisture and nutrient reserves.
- Avoid replanting to cereals, especially wheat. The wheat streak mosaic may carryover from infected winter wheat into spring-seeded cereals. If replanting wheat, a 10- to 14-day window should be left before reseeding to avoid problems.
- Remember to credit any spring applied nitrogen to the following crop.

As spring approaches planning for all outcomes but being patient with winter wheat crops will pay dividends in fall of 2012. For more information on spring assessment, contact your local Ducks Unlimited Canada agronomist or visit wintercereals.ca.

The Ups and Downs of Spray Pressure

By Thomas M. Wolf
Agriculture and Agri-Food Canada, Saskatoon Research Centre

Automatic rate controllers are standard equipment on almost all new sprayers. A rate controller allows the applicator to enter a desired application volume and the controller sets the spray pressure that gives the necessary flow for the application volume and sprayer travel speed being used. In practice, this means that higher travel speeds result in higher spray pressure, and vice versa.

But it's not that simple. Rate controllers aren't smart enough to know how pressure affects nozzle performance. Some nozzles don't work well at low pressures. Others do a poor job at high pressures. Some sprayer pumps may even have a problem generating some of the higher pressures a rate controller calls for. What does that mean for the available travel speed range that's possible with any given nozzle? To answer that question, we first have to have a closer look at how pressure affects nozzle performance.

Spray Pressure and Nozzle Performance

Nozzle performance depends on a number of factors. Of these, the most critical is spray pressure. Pressure affects the spray pattern (fan angle) and the spray quality (droplet size range). Both of these affect coverage, overlap, and spray drift, so it's important to get them right. Each nozzle type has a unique spray pressure range and unique spray qualities within that range, so one must obtain information that is specific to the nozzles on the spray boom.

	PSI										
	15	20	25	30	35	40	50	60	70	80	90
TT11001	C	M	M	M	M	M	F	F	F	F	F
TT110015	C	C	M	M	M	M	M	M	F	F	F
TT11002	C	C	C	M	M	M	M	M	M	M	F
TT110025	VC	C	C	C	M	M	M	M	M	M	F
TT11003	VC	VC	C	C	C	C	M	M	M	M	M
TT11004	XC	VC	VC	C	C	C	C	C	M	M	M
TT11005	XC	VC	VC	VC	VC	C	C	C	C	M	M
TT11006	XC	XC	VC	VC	VC	C	C	C	C	C	M
TT11008	XC	XC	VC	VC	VC	VC	C	C	C	C	M

Figure 1: Manufacturer's tables show how spray pressure and nozzle flow rate affects Spray Quality (reproduced from TeeJet catalogue).

Catalogues Contain Important Information

Nozzle manufacturer catalogues identify the pressure range over which the nozzle should be operated. At low pressures, engineers look for a uniform pattern that meets the advertised fan angle. High pressures are kept low enough to prevent the formation of excessively fine sprays. Manufacturers now publish tables containing "Spray Quality", a broad categorization of droplet size, for their various nozzles and spray pressures in their product line. Common spray qualities for agricultural nozzles are Fine (orange), Medium (yellow), Coarse (blue), Very Coarse (green), and Extremely Coarse (white). An example table from a catalogue is shown in Figure 1. Note that for any given nozzle flow rate (left column), the spray quality changes with spray pressure. For example, the TT110025 nozzle can produce a Very Coarse or a Fine spray, depending on the pressure. Also note that for any given pressure, higher flow rate nozzles produce coarser sprays. At 40 psi, the TT nozzle can produce a Medium, Coarse, or Very Coarse spray. Both of these relationships depend on the nozzle model and manufacturer.

Speed-Pressure-Spray Quality Relationship

As we increase spray pressure, flow rate increases with a square-root relationship.

This means that in order to double the flow rate, we need to increase spray pressure by a factor of four. See Figure 2 to show what would happen if an operator uses a TT11006 to apply 10 US gpa at 18 mph and 40 psi. If the sprayer slows down to 9 mph to initiate a turn, spray pressure will drop to one quarter of 40, or 10 psi. Using the above chart as an example, spray quality would change from Coarse to Extremely Coarse (we

$$\frac{GPM_1}{GPM_2} = \frac{\sqrt{PSI_1}}{\sqrt{PSI_2}}$$

don't know for sure because it's outside the lower limit of the chart, which also means that the nozzle would not be guaranteed to produce a wide-enough or uniform spray pattern). Poor pest control performance is likely in this situation.

The lesson from this exercise is three-fold: (a) operate the nozzle at a slightly higher pressure at 18 mph (to avoid dropping the pressure too low at 9 mph), (b) avoid going as slow as 9 mph to prevent the pressure from dropping below 15 psi (some operators compromise by setting a minimum spray pressure on their rate controller, in which case they'd over-apply if their speed dropped too low), and (c) consider slower travel speeds. At 14 mph it's easier to maintain a reasonable pressure when you need to slow down. According to Figure 2, perhaps a

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higher N rates. To demonstrate this we added a treatment where an additional 40 lb/ac of fertilizer N was applied over that recommended by soil tests.

Increased Seeding Rate - Other recent research indicated that higher plant densities were needed where high yields are targeted with high fertility and high yielding cultivars. To test whether current seed rate recommendations were adequate to optimize yield we added a treatment where the seed rate was increased by 1-2 lb/ac depending on location.

Foliar Fungicides - Environments that support high canola yields are often environments that are conducive to increased foliar disease. In such environments, it is sometimes suggested that additional fungicide treatments are beneficial. To demonstrate this we made two applications of Lance at both locations, with the second application at 7-10 days after the first application.

Bioboost - Recently plant growth promoting rhizobacteria (PGPR) strains have been identified that play a role in improving crop stress tolerance and ultimately yield. Bioboost is a PGPR that was developed for use on canola. It acts by colonizing the zone surrounding canola roots, improving crop vigor and enhancing yield potential of the crop. To demonstrate effects of Bioboost we applied this product to the crop at 0.25 l/ac at the 2-4 leaf stage of crop development.

Fracturing - In north-eastern Saskatchewan, the 2010 growing season was unusually wet and growers were concerned about soil compaction limiting crop yield. Added to this is the widespread use of direct seeding that limits soil disturbance that might otherwise correct soil compaction. Coulter type tillage is suggested as a remedy to fracture surface soil an alleviate compaction. To demonstrate any benefit from this practice we obtained a prototype coulter machine and used it to fracture soil before seeding at the Melfort location only.

Combined Application - Combining yield enhancing practices typically has an additive effect on yield and sometimes even a synergistic effect. Additive effects reflect each input adding to the response from others, while synergistic responses exceed the sum of individual responses. Because some of these responses were expected to be relatively small we added a combined treatment to look for additive or synergistic effects.

As a check we used an input/management package (Normal Inputs) that targeted optimum yield based on consensus from NARF and WARC farmer board members. At Melfort, Roundup Ready 9557 hybrid canola was sown at 5 lb/ac with fertilizer nitrogen pre seed banded at 85 lb/ac and phosphate applied at seeding at 44 lb/ac. At Scott the same cultivar was seeded at 4.5 lb/ac with N side banded at 92 lb/ac and P2O5 applied at 25 lb/ac. Planting was done May 16 at both locations with medium size No-Till equipment on stubble land. Fertilizer potassium (K) and sulfur (S) were applied at both locations at rates adequate to ensure that these nutrients were not yield-limiting. Glyphosate was applied prior to seeding and again as near as possible to the 2-3 leaf stage (180 g active/ac) of the crop, and Lance was applied (142 g/ac) at 20-50% bloom at both locations.

We did note some treatment effects during the growing season. At Melfort the coulter treatment cut through the heavy crop residue

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Table 1: Yield and economic impact of adding inputs to canola where high yield is being targeted.

Treatment	Yield (bu/ac)			Average cost increase* ($/ac)	Average impact** ($/ac)
	Melfort	Scott	average		
Normal Inputs	63.2	52.8	58.0 0	0	
Add Micros	63.7	52.5	58.1	5.50(8.36)	-4.30(-7.16)
Add Avail	64.0	50.0	57.0	3.50	-15.50
Add Nitrogen	66.7	53.6	60.1	26.80	-1.60
Increase seed rate	68.6	50.0	59.3	17.94	-2.34
Add Fungicides	65.7	52.2	59.0	24.08(26.94)	-12.80(-14.94)
Add Bioboost	66.8	50.1	58.5	5.00(6.43)	1.00(-0.43)
Fracturing	61.8	n/a	n/a	4.85	-21.65
Combined application	63.3	56.6	60.0	87.67(93.39)	-63.67(-69.39)

*Costs based on N @$0.67/lb; RR canola seed @ $10.25/lb; and our best estimate for Avail treatment of $0.10/lb of phosphate; Bioboost @ $5/ac. Numbers in brackets include application costs.

** Impact based on canola @$12/bu so impact = change in yield x $12 - cost increase.

THE UPS AND DOWNS OF SPRAY PRESSURE...CONTINUED FROM PAGE 4

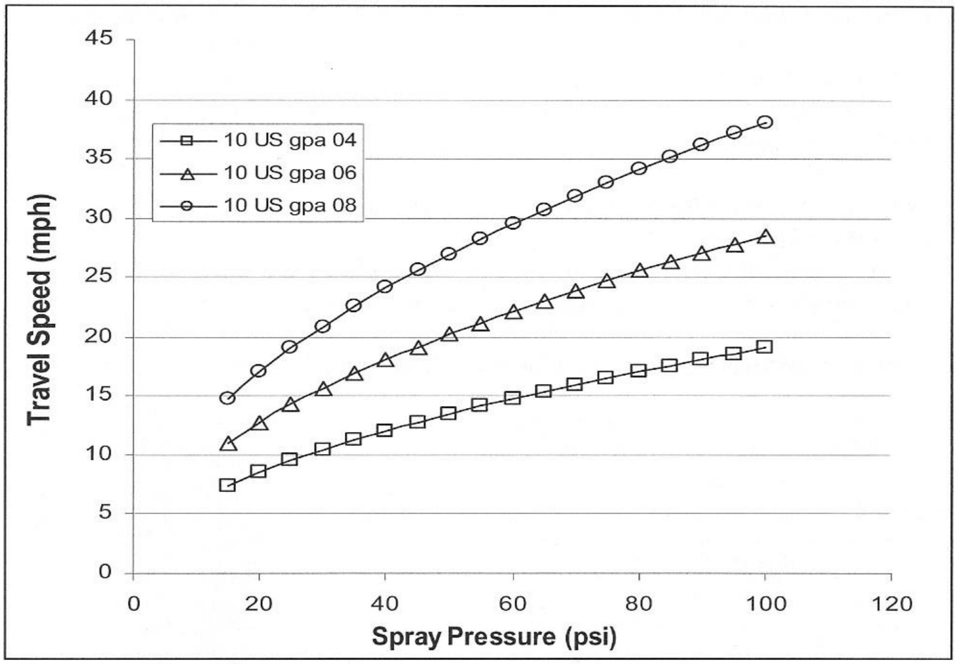

Figure 2: Relationship between spray pressure and travel speed for three tips

TT11004 operated at 50 to 55 psi would provide the right pressure flexibility. A Coarse spray is maintained down to 30 psi, which allows a travel speed as low as 10 mph. Even lower speeds (pressures) can be used temporarily without the spray's pattern becoming too narrow or too coarse. Faster speeds than 14 mph are possible as long as spray drift can be managed - if wind conditions or proximity to sensitive areas allows.

Spray Pattern Overlap

Flat fan nozzle patterns need the correct overlap in order to achieve a uniform spray pattern under the boom. Research has shown that the amount of overlap for low-drift nozzles needs to be at least 100% to achieve optimum nozzle performance. In other words, the edge of a fan should reach into the centre of the adjacent fan (Figure 3). This amount of overlap assures that not only the spray volume is uniformly distributed, but that the droplet density is equally uniform. Less overlap may result in fewer droplets depositing in the overlap region, resulting in poor coverage and reduced pesticide performance.

Adjust the boom height so that at the lowest expected spray pressure (slowest planned travel speed), the nozzles still achieve 100% overlap. There is no disadvantage with greater than 100% overlap, except that higher booms will lead to greater drift. When a choice exists, choose 110º fan angle nozzles. Most air-induced nozzles are produced at one (usually wide) fan angle only, but actual angles usually differ from those advertised. It is important to visually check the overlap before spraying.

Recommendations

What does this mean in practice? Spray operators need to know the right spray quality for the job at hand. They also need to use manufacturers' charts to identify the spray quality their nozzle will likely produce at their expected application volume and travel speed. If it's a poor match, a different nozzle may need to be found. Here are some rules of thumb:

1. Choose a nozzle that produces a Coarse spray over most of the operating pressures you expect to use. Although Very Coarse sprays can work in most situations, avoid them when using lower water volumes, controlling grassy weeds, or using contact modes of action.

2. Minimize spray drift by avoiding pressures that produce Medium or Fine spray qualities.

3. Choose a pressure that is in the middle of the nozzle's recommended operating range. If the range is 15 to 90 psi, select 50 psi. If it's 40 to 100 psi, select 70 psi. This allows you slow down or speed up somewhat without breaching the nozzle's capabilities.

4. Identify the travel speeds that are possible without creating spray qualities that could compromise your application goals.

5. Visually inspect the spray pattern at the pressure extremes you expect to spray at. At the lowest pressure, your nozzle should still produce 100% overlap (the edge of the spray fan should come to the middle of the next nozzle at target height). If it doesn't, choose a wider fan angle nozzle, increase spray pressure or elevate the boom.

6. Make sure your pump can produce the higher spray pressures you expect to need. Pressure limitations are greatest at high flow rates (fast travel speeds applying large water volumes).

7. Be prepared to compromise. It's rarely possible to travel at the exact speed, obtain the perfect pressure, and apply the desired water volume that's been worked out in the office or using manufacturer's charts. If in doubt, choose slower speeds or higher water volumes to make things work out.

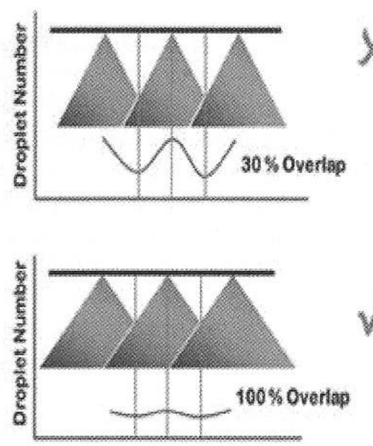

Figure 3: Spray pattern overlaps

Nozzle manufacturers are getting much better at producing information that helps applicators produce good spraying outcomes. Learning how to use this information is the first step.

LONG TERM NO-TILL: What it means to the production bottom line...

By Guy P. Lafond
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INTRODUCTION

Approximately 93-99% of the food consumed by humans comes from the land. On a global basis, the estimated land area available for annual crop production is 3.338 billion acres which amounts to 0.48 acres per person based on a population of 7 billion people. However, 45% of global arable soils are affected by degradation. As well, 0.3-0.8% of the world's arable land is rendered unsuitable yearly for agricultural production owing to excessive soil degradation, with wind and water erosion accounting for 84% of the degradation. The world population is supposed to increase to 9 billion people by 2050. This means only 0.37 acres per person but in actual fact it will be much less because an extra 2 billion people will require a lot of infra-structure which further consumes arable land.

On the Canadian Prairies, early estimates suggest that from the start of cultivation to the 1940s, soils lost 15-40% of their organic N content. Several later studies reported similar impacts of cultivation on soil organic matter on the Prairies, typically attributing losses to enhanced decomposition or increased erosivity. This loss of SOC is also associated with an overall loss in soil fertility and productivity.

Research from the past decade or so has shown that diversified continuous cropping systems combined with proper fertilization, in the absence of wind or water erosion, can sustain and even increase overall soil fertility and productivity. The ability of standing stubble and surface residues to enhance water conservation and reduce wind erosion has been well documented and no-till also has

Table 1. Means of selected variables for the main effects land management (native vs long-term no-till vs short-term no-till) and landscape position (convex-area shedding water vs concave-area receiving the water from the corresponding convex area). Each sampling depth is reported separately.

	Soil Bulk Density	Soil Residual NH_4-N	Soil Residual NO_3-N	Total N (NO_3+NH_4)	Hot KCl NH_4-N	Hot KCl NO_3-N	Amino Sugar-N	Soil Organic Carbon
Land Management				**Soil Depth (0-15 cm)**				
	g cm-3	kg ha-1	kg ha-1	kg ha-1	kg ha-1	kg ha-1	kg ha-1	t ha-1
Native	0.98	2	4	6	60	12	558	48.2
LTNT	1.46	3	9	12	38	20	462	44.4
STNT	1.47	1	5	6	22	14	370	36.7
LSD(0.10)	**0.13**	**6.5**	**2.0**	**7.3**	**17.9**	**7.3**	**99**	**10.3**
				Soil Depth (15-30 cm)				
Native	1.35	1	1	2	33	4	394	27.5
LTNT	1.34	<0	4	5	15	8	248	19.6
STNT	1.38	<0	3	3	12	5	210	18.3
LSD (0.10)	**0.2**	**0.8**	**2.1**	**2.3**	**10**	**2.3**	**116**	**13.1**
Landscape Position				**Soil Depth (0-15 cm)**				
Convex	1.32	2	4	6	28	14	379	35.6
Concave	1.29	2	7	9	51	16	545	50.6
LSD(0.10)	**0.07**	**3.9**	**2.2**	**5.1**	**9.2**	**10.8**	**54**	**6.5**
				Soil Depth (15-30 cm)				
Convex	1.33	<1	2	3	12	5	235	17.3
Concave	1.38	<1	3	3	28	6	333	26.3
LSD(0.10)	**0.13**	**0.3**	**1.2**	**1.1**	**7.1**	**1.8**	**68**	**7.7**

[z]SED represents standard error of difference with corresponding denominator degrees of freedom (df) immediately below.

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YIELD OF CANOLA...CONTINUED FROM PAGE 5

cover and appeared to improve crop emergence. At Scott the increased N rate appeared to prolong flowering, increase podding and delay maturity while increased seed rate hastened maturity.

High yield which was a pre-requisite for testing value of additional inputs under high yield conditions was achieved at both locations. Yield varied between treatments, but when subjected to statistical analysis yield differences between treatments were not significant at either location (Table 1). At Melfort, there were weak indications of yield responses to increased seed rate or adding N, fungicides or Bioboost. Taken alone this might suggest some potential for these inputs to enhance yield. However at Scott, these same treatments either had minimal impact or tended to decrease yield. This would suggest that yield responses would be expected to be small and variable.

Because yield responses were not significant, economic responses should be viewed with some caution. We estimated the economic impact of the treatments based on average yield responses across the two locations and our best estimates of the costs of the inputs, plus applicable application costs (Table 1). None of the added treatments provided sufficient yield benefit to cover added costs when application costs were factored in. In general, the greater the cost of the input added, the larger the economic loss. There were a couple of departures from these trends. Increasing the N rate increased costs substantially, but had only a small impact on economic returns. Applying Bioboost provided sufficient return to more than offset the cost of the product, but not both the product plus application cost. Finally, where all the added inputs were applied together, economic losses were very substantial.

"Results of this demonstration suggest that growers wishing to target high yields should first ensure that their practices optimize 'tried and true technologies' like recommended rates of seed, fertilizer and pesticides combined with optimal application methods."

From this trial we conclude that we were unable to demonstrate yield responses to added inputs where high yield is targeted with a 'normal' input package that growers would typically use to target high yields. This is not to suggest that these inputs never have value; however it does indicate that growers will need improved tools to target specific conditions where such added inputs have consistent potential to provide economic returns.

Results of this demonstration suggest that growers wishing to target high yields should first ensure that their practices optimize 'tried and true technologies' like recommended rates of seed, fertilizer and pesticides combined with optimal application methods. Where growers have done this, they should be cautious about using many added inputs such as used in this study unless they have very good information that they will enhance yield sufficiently to offset costs plus provide a return on the extra money invested.

Acknowledgements : We would like to express our gratitude to the Saskatchewan Ministry of Agriculture and Agriculture Canada for ADOPT funding support for this project, and to Brett Young, Simplot, BASF and Pioneer Hybrid for supplying some of the inputs used. •

TOPsoil, the SSCA e-newsletter

The SSCA has been sending out a one-page e-newsletter this winter to update members on coming events and activities related to conservation agriculture. Marilyn Martens, our office manager has 80% of the e-mail addresses for SSCA members. We encourage members, who would like to receive TOPsoil to send your e-mail address to Marilyn at info@ssca.ca.

A total of six issues of TOPsoil have been published to date in September, November, December, January, late-January and March. We hope to send one more e-newsletter in April, before seeding. The e-newsletter is timely and has no printing or postage costs for the SSCA. However the Board has received no feedback from members about TOPsoil. Your comments on the content, frequency and format of TOPsoil e-newsletter would be most welcome. We would like to publish more stories from SSCA members in TOPsoil and the Prairie Steward. Many of our members would benefit from your experiences and if you are not comfortable writing your own story, please contact our office as we can help. Please send any feedback or ideas for articles to Marilyn at info@ssca.ca.

proven effective in protecting soils against water erosion.

The positive benefits of no-till production systems on crop production, economic performance and energy use efficiency are well recognized. No-till increases macro-aggregation (>0.25 mm) and mean weight diameter of soil aggregates, even in coarse textured soils, indicating the potential for no-till soils to sequester carbon. No-till has also shown that water retention and infiltration can be increased due to a redistribution of pore size classes into more small pores and fewer large pores having the potential to improve crop water use and crop production. Because of their positive impact on soil carbon, no-till production systems are seen as a necessary component to sustaining and enhancing the global soil resource.

The soil chemical constituents of greatest interest are soil organic carbon (SOC) and soil organic nitrogen (SON). In the semi-arid and sub-humid prairies, increases in SOC and SON are closely related to the amount of crop residue returned to the soil, cropping frequency, the N content of the residues and the requirements for positive nutrient balances, especially for N and phosphorus (P). The combination of no-till, tall stubble and proper fertility can increase the potential of no-till to further increase SOC and SON as a result of higher grain yields due to increased snow retention, reduced surface evaporation and improved water use efficiency, especially in the semi-arid areas. Other studies in the semi-arid areas have strongly suggested that continuous cropping combined with no-till would increase SOC and SON over time. In the sub-humid areas of the prairies, the maintenance of SOC and SON to ensure optimum crop growth is dependent on continuous cropping and adequate fertility from either the addition of manures or inorganic fertilizers or the inclusion of forage crops in rotations.

Table 2. Analysis of Variance of the parameters derived from fitting a nitrogen rate response curves for grain yield, grain N accumulation and grain protein content in spring wheat and canola.

Coefficient[z] / Treatment[y]	Grain Yield kg ha^{-1}	Grain N kg ha^{-1}	Grain Protein g kg^{-1}
	Estimate		
Maximum Response			
Wheat - LTNT	3283	87.4	157
Wheat - STNT	2877	73.7	158
Canola - LTNT	1996	70.7	-
Canola - STNT	1716	65.4	-
Optimum N rate	(kg N ha^{-1})		
Wheat - LTNT	108	119	170
Wheat - STNT	106	116	166
Canola - LTNT	106	118	-
Canola - STNT	116	135	-
	p-value[x]		
Maximum Response			
Crop (C) x Land Management (L)	0.037	0.003	
Wheat	< 0.001	< 0.001	ns
Canola	< 0.001	0.014	-
Optimum N rate			
C x L	0.050	0.012	
Wheat	ns	ns	ns
Canola	0.041	0.010	-

[z] Coefficients from non-linear regression were the maximum predicted response and N fertilizer rate to achieve the maximum predicted response (optimum N rate).

[y] Abbreviations for levels of history are as follows: LTNT = long-term no-till and STNT = short-term no-till.

[x] The statistical significance of the variance estimates are indicated by the actual p-values from the statistical analysis when the p-value is less than 0.05 and by ns when the p-value is greater than 0.05.

Soil organic matter (SOM) also plays a key role in soil quality. The size of the microbial community is directly proportional to SOM content and soil microbes are the principal mediators of nutrient cycling. Although soil microbial biomass represents only a small proportion of overall SOM, it is more dynamic than total SOM and a better indicator of how tillage and cropping systems impact soil health and productive capacity. Soil organic carbon and SON, microbial biomass carbon (MBC), light fraction carbon (LFC), light fraction organic nitrogen (LFN) and wet aggregate stability were enhanced with increased cropping frequency, fertilization and also with the inclusion of annual green manure crops and forage-legume hay crops but LFC, LFN, MBC and potentially mineralizable N were more sensitive to changes in cropping practices than simple measures of total SOC and SON. When no-till is included as an additional factor, it was noted that microbial biomass was increased further along with the functional diversity and activity of microbes. In turn, these increases have a positive effect on the decomposition processes of crop residues and therefore nutrient cycling. Higher N mineralization has also been observed with no-till.

Given the many reported benefits of no-till on soil health, soil fertility, crop production, economic and energy

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performance in the short to medium term and the protection afforded against tillage, wind and water erosion, what can be expected from 20-30 years of no-till continuous cropping practices? Can the SOM content be brought back to, or even exceed, its original native level? Can no-till continuous cropping systems provide the productivity required to meet the future challenges of a burgeoning world population, the increasing demands for food, feed and fibre and a decrease in arable land per capita? The objectives of this study were 1) to compare two adjacent fields with different no-till and cropping histories for their SOC content and their ability to mineralize SON based on indirect measurements of potentially mineralizable N and 2) to relate these measures to the responses of canola and spring wheat to different rates of N fertilizer with respect to grain yield, grain protein, soil residual N and N balance over an eight-year period. The soil quality of these two contrasting fields was also compared to that of an adjacent native prairie soil to estimate the progress made with no-till after more than 23 years of no-till.

GENERAL DISCUSSION

The study attempted to quantify the long-term benefits of no-till on soil quality and consequent grain yield and grain protein concentration. To our knowledge, no previous studies have evaluated how the average performance of a field with 9 years of no-till and continuous cropping compares to that of an adjacent field with 31 years of no-till and continuous cropping. In this case the two adjacent fields had a similar soil type and experienced similar climatic conditions.

Given the numerous benefits of no-till on soil quality and fertility, how does 31 years of no-till continuous cropping practices impact crop production relative to a shorter time frame of 9 years? The detailed field characterizations established that LTNT had more SOC and higher levels of potentially mineralizable-N than STNT after 2 and 24 years, respectively (Table 1). Moreover, the maximum spring wheat grain yield recorded for LTNT was 14% higher than on STNT (Table 2). Importantly, higher maximum grain yields in spring wheat under LTNT were obtained with similar rates of N as those for STNT. Maximum grain protein concentration was similar between LTNT and STNT despite LTNT having higher grain yields with similar nitrogen (N) rates. These results imply that LTNT soils provide more N to support crop growth during the growing season than STNT soils. This assertion is supported by the differences in potentially mineralizable-N. We postulate that STNT may be in a "soil building" phase, thus limiting soil N supply to the growing crop relative to LTNT. The observation that higher rates of N cycling are occurring with LTNT are further supported by higher recorded N concentrations in the flag leaf in LTNT than in STNT, regardless of N rate used (Table 3). The higher flag leaf N concentrations in LTNT at all N rates provides further evidence that LTNT soils are cycling more SON during the growing season than STNT soils.

Table 3. The effects of nitrogen fertilizer rates on flag leaf N concentration (g kg-1) for the two land management histories.

Nitrogen Rate kg ha^{-1}	LTNT	STNT
0	33.0	29.0
30	35.2	29.9
60	38.3	34.7
90	41.0	38.1
120	42.8	40.6
	se=0.6[z]	

[z] se = standard error of mean

With canola, the highest maximum grain yield recorded was 16% higher on LTNT than STNT and more N fertilizer was required under STNT than LTNT (116 vs 106 kg N ha-1) to achieve the maximum seed yield. Again, the evidence points to more soil N cycling under LTNT than STNT.

Also of interest is the lack of convergence of grain yield responses to N between LTNT and STNT. Even after 9 years of no-till continuous cropping in STNT and with N rates in excess of grain N removal, the yield differences between LTNT and STNT were still apparent (Figure 1a,b,c). This would imply that the LTNT soils are possibly still improving (i.e. still in a soil building phase), even after 31 years.

It has been suggested that soil organic matter is most useful biologically when it decays, leading to the dilemma of whether we can continue to sequester soil organic matter and simultaneously profit from its decay (Janzen 2006). The ability of no-till continuous cropping systems to sequester carbon has been well documented. Increases in the quantity and diversity of the microbial community and increases in N mineralization are also observed with no-till. Increases in potentially mineralizable N with LTNT were demonstrated in this study. Janzen (2006) asked the challenging question of whether we should hoard SOC or use it. Using SOC implies changes in soil and crop management (i.e, resorting to tillage) to accelerate SOC decay via microbial activity or else adding less nutrients than what is removed in the grain. However, loss of SOC with time will also negatively impact crop production because of the beneficial effects of soil organic matter on the chemical, physical and biological properties of soils. Given that tillage has to be done either before seeding or after harvest, tilling the soil for SOC decay may not necessarily result in nutrients being released at the most opportune time for crop uptake. Furthermore, tillage increases the potential for rapid loss of nutrients that could result from erosion or leaching. Janzen (2006) suggests that one solution to this dilemma is to increase the inflow of carbon into the soil. The results from this study showed higher productivity with LTNT than STNT in the form of higher grain yields. Given that the amount of carbon removed in the grain is less than

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half of the total carbon produced (i.e. harvest index is usually less than 0.5), LTNT is still adding carbon to the soil while simultaneously mineralizing SON. This is evident in that we observed higher grain N uptake in LTNT than STNT at all N rates used. Carbon inputs in no-till could be further increased with simple changes to stubble management involving tall stubble which has been shown to increase water use efficiency and grain yields in a number of crops. Given the results from this study, we would argue that using the carbon is not an option and hoarding C confers benefits beyond the potential nutrient release. We have no effective means to use the SOC effectively and the potential negative risks appear to be higher than the possible rewards; thus, at the present time, the benefits of hoarding SOC outweigh the benefits of using it. We would also argue that after 31 years of no-till, the soils are still improving and that it may be possible to attain or even exceed SOC and SON levels observed prior to the start of cultivation.

CONCLUSIONS

Because of the positive impact on soil carbon, the results of this study support the currently held view that no-till production systems combined with continuous cropping and proper fertility management are a necessary component to sustaining and enhancing the global soil resource. The higher cycling rates of N from the stored SON also provide important evidence that, under favourable climatic conditions, LTNT will make more N available for crop growth and support higher grain yields and grain protein levels. Higher grain yields will be achieved without necessarily having to add additional crop inputs like fertilizer. This will add the necessary resiliency to cropping systems while at the same time lowering the production risks for producers. No-till production systems will increase soil productivity over time and help feed a growing human population.

Note: The complete results from this study have been recently published. The information can be obtained from Lafond et al. (2011).

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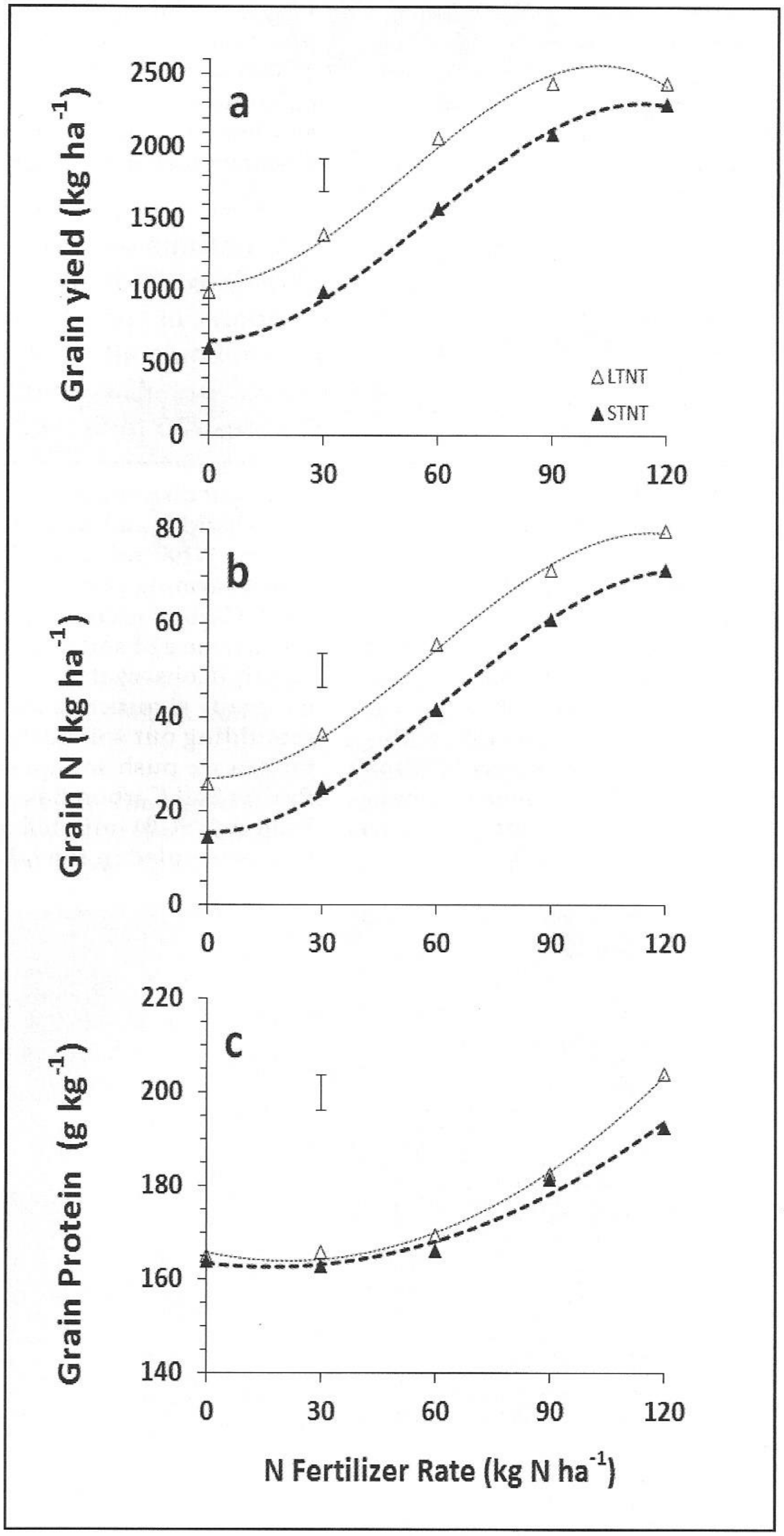

Figure 1. The response of (a) grain yield, (b) grain N and (c) grain protein concentration to nitrogen rates for canola grown under long-term no-till (LTNT) and short-term no-till (STNT). Each line on the graphs quantifies the response observed in 2009 which is the 8th year of the study and represents the 9th year of no-till and continuous cropping for STNT and 31 years for LTNT.

PRESIDENT'S MESSAGE – LET THE CELEBRATION BEGIN!! ...CONTINUED FROM PAGE 1

So after 25 years, what is left? I believe that now Conservation Agriculture is evolving. We have now entered an era where we are fine tuning our craft. However this is not the time for complacency. There is still significant work to do. A good deal of tillage is still occurring across the province; not everyone has accepted the paradigm shift. Higher grain prices have caused many producers to move away from sustainable rotations. Does this mean we will see short term gain for long term pain? Only time will tell. Technological advances are allowing growers to both minimize overlap and alter seeding rates, pesticide rates and fertilizer rates across the field. For the first time we have the power to be wrong or right with our agronomic decisions 100% of the time. With the development of glyphosate resistant kochia, we must ask ourselves, have we relied on glyphosate too much? We must continue searching for new tools to stock our toolbox. This could be new herbicide combinations, or sound crop rotations that allow us to not only alter our seeding date on a given field, but also change our timing of herbicides and their modes of action. What role does controlled traffic farming play?

"We must continue searching for new tools to stock our toolbox. This could be new herbicide combinations, or sound crop rotations that allow us to not only alter our seeding date on a given field, but also change our timing of herbicides and their modes of action."

Soil Carbon is considered to be the measure of soil quality or health. Conservation Agriculture has made significant strides in rebuilding our soil health. How far can we push soil quality? The Prairie Soil Carbon Balance Project (PSCB) initiated in 1996 was resampled in the fall of 2011. The results from this study, which includes samples from approximately 90 sites should be out later this year.

Do you use a smart phone? Are you looking for Apps to help you with your farming decisions? The SSCA has received funding through the Canadian Agricultural Adaptation Program (CAAP). We are currently working on the first two phases of this project and we hope to have a number of Apps out for testing early in 2013 to be ready for the 2013 growing season.

Finally, I want to say what a privilege it is to be President of such a storied organization. After spending ten years as an employee with the SSCA and the last two years as a director, my passion for soil conservation is still very much alive. Yes, we have made significant changes to farming in Saskatchewan, but there is still so much left to accomplish.

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