Integrating Technologies to Enhance Conservation Cropping Strip Tillage Systems

Purpose:

The majority of Ontario corn is produced through conventional tillage which results in unprotected soil surfaces which are highly vulnerable to erosion. While the call for a shift towards more reduced-tillage corn production has been made for decades, adoption has been limited due to productivity and logistical issues. Predictions for an increase in the intensity and duration of rainfall events in the future due to climate change are expected to exacerbate soil erosion losses from conventional tillage systems, and reinforce the requirement to develop simple and effective methods of reduced-tillage in corn. Strip tillage is one reduced tillage system which has demonstrated a capability to achieve corn yields similar to conventional tillage while still providing meaningful protection against soil erosion. Unfortunately, the economic and environmental incentives of strip tillage have not been enough to convince corn producers to overcome the logistical hurdles associated with the conversion from a conventional-till system. This research project is aiming to develop a simple one-pass spring strip-tillage system which integrates various technologies to help simplify the transition from conventional-till systems, and promote its adoption to produce a more environmentally resilient corn production model.

Methods:

A one-pass spring strip tillage system is being compared for its economic and environmental performance relative to a conventional-till system. A few key elements for this system to be investigated include:

1. evaluation of strip-till equipment which can perform well under spring soil conditions (maximize soil conservation and provide “one-pass” simplicity by creating tillage strips in spring instead of previous fall, identify equipment which will provide sufficient performance with spring operation)
2. evaluation of the performance of applying a full fertility program (NPK) including a slow-release nitrogen component with the strip-till pass to mitigate fertilizer safety issues in the seed zone (provide the opportunity to address all fertility requirements, particularly N, prior to planting as currently exists with broadcast and incorporation in conventional-till systems)
3. evaluate the simplicity of setting up and operating contour strip-tillage and planting operations through GPS autoguidance with implement steering guidance (further reduce the potential for erosion losses relative to non-contour cropping methods)

Results:

Four trials were conducted at Paris, Woodstock, Bornholm and Arthur where strip tillage systems were compared to other tillage or planting options. A 5^{th} site explored the integration of contour steering and implement guidance with the strip tillage and fertilizer banding approach, and was located at Lucan.

Figure 1. Strip Tillage Equipment used in this project. Gandy Fertilizer distributor, DAWN Pluribus 6 row strip tiller and ProTrakker Implement Guidance.

Figure 2. Spring Strip Tillage on the contour at Lucan, 2014.

Applying all of the N, P and K for the 2014 corn crop via the strip tiller was shown to be quite feasible and eliminated the need to apply fertilizer either through the planter or to sidedress nitrogen. However, it was also clear that if urea was the sole source of nitrogen applied in the strip tillage band then fertilizer burn was evident and reduced stands and yields were observed. The use of 50% ESN in the strip tillage zone eliminated this problem. Soil loosening and residue removal from the row zone by the spring strip tillage unit did not appear to significantly improve corn yields compared to a no tillage system at most locations. Using the contour path option on the tractors GPS guidance system combined with implement GPS steering allowed for the successful implementation of strip tillage on the contour. US research has shown that running the strips on the contour is an excellent way to reduce soil erosion risks.

Table 1. Results from strip tillage research and demonstration at the Paris site in 2014.

Tillage	Strip N	Planter N	Side N	Yield (bu/ac)
Spring Strip	0	30	115	183
Spring Strip	107 ESN	0	38	179
No-till	0	30	115	178
Spring Strip	107 Urea	0	38	175

"ESN" implies that 50% of the N supplied was from ESN and 50% form urea.
"Urea" implies that 100% of the N supplied was form urea.

Table 2. Results from strip tillage research and demonstration at the Arthur site in 2014.

Tillage	Strip N	Planter N	Side N	Yield (bu/ac)
Spring Strip	0	30	106	144
Fall Plow	0	30	106	141
Spring Strip	136 ESN	0	0	140
Fall Strip	0	30	106	140
Fall Disc Ripper	0	30	106	138

"ESN" implies that 50% of the N supplied was from ESN and 50% form urea.

Table 3. Results from strip tillage research and demonstration at the Bornholm site in 2014.

Tillage	Strip N	Planter N	Side N	Yield (bu/ac)
No-till	0	30	130	152
Spring Strip	134 ESN	0	26	150
Spring Strip	0	30	130	150
Spring Strip	160 ESN	0	0	147
Spring Strip	134 Urea	0	26	132
Spring Strip	160 Urea	0	0	126

"ESN" implies that 50% of the N supplied was from ESN and 50% form urea.
"Urea" implies that 100% of the N supplied was form urea.

Farmers will be able to evaluate the potential field passes eliminated by this type of integrated strip tillage. For consideration one might argue that the elimination of other tillage practices is made possible ($35/acre); one broadcast application of fertilizer is eliminated ($12/acre), and a sidedress application of N may also be eliminated ($15/acre). In addition the planter does not require any special conservation tillage modifications and does not need to apply fertilizer this could represent a savings of $5/acre. The strip tillage operation if applying fertilizer can be estimated at $25/acre.

Potential cost reduction is estimated at 35+12+15+5-25 = $42 /acre. These values will be further examined over the remainder of the project.

Table 4. Results from strip tillage research and demonstration at the Woodstock site in 2014.

Tillage	Strip N	Planter N	Side N	Yield (bu/ac)
Spring Strip	165 ESN	0	0	191
Spring Strip	0	30	135	192
No-till	0	165	0	192

"ESN" implies that 50% of the N supplied was from ESN and 50% form urea.
In this trial Planter N was applied as UAN 15" rom the row unit.

Summary:

A one-pass, full-fertility spring strip-till system was compared to conventional and no-tillage practices at four locations in 2014. Applying all N, P and K for the 2014 corn crop via strip tiller was shown to be quite feasible and eliminated the need to apply fertilizer either through the planter or to sidedress nitrogen. If urea was the sole source of nitrogen applied in the strip tillage band then fertilizer burn was evident and reduced stands and yields were observed, but using 50% ESN in the strip tillage zone eliminated this problem. Strip tillage yields did not appear to significantly improve corn yields compared to no-till at most locations. Using the contour path option on the tractors GPS guidance system combined with implement GPS steering allowed for the successful implementation of strip tillage on the contour

Next Steps:

This project will be repeated for one more growing season in 2015.

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