Best Management Practices

STRIP-TILLAGE IN ONTARIO: MAKING IT WORK

Strip-tillage provides many benefits relative to other tillage systems, including soil conservation and efficiencies in nutrient application, fuel usage and labour. It also comes with a unique set of challenges that vary from farm-to-farm.

As with any change in a production system, it is critical to make adjustments in multiple areas to ensure optimal performance.

This factsheet draws upon Ontario farmer experiences and North American research to explain how to make strip-till work within a cropping system. Learn about residue management, soil sampling and fertility, weed control, GPS guidance and integrating cover crops in a strip-till system.

THE ROLE OF HEALTHY SOIL IN A CHANGING CLIMATE

Agriculture and climate are directly linked – anything that has a significant effect on our climate will influence farm production. Greenhouse gas (GHG) emissions and climate change are global concerns, and agriculture can be part of the solution.

BMPs that improve soil health can also help lower GHG emissions, reduce phosphorus loss from fields to surface water, and improve resilience to drought or excessively wet conditions. Healthy soil – an essential component of a healthy environment – is the foundation upon which a sustainable agriculture production system is built.

CANADIAN AGRICULTURAL PARTNERSHIP

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Residue management in strip-tillage systems

RESIDUE SPREAD

Integrating strip-tillage into a cropping system requires good residue management. Strip quality and crop performance can suffer when residue or chaff are excessive. Like no-till, residue management starts with uniform residue and chaff spreading while harvesting the preceding crop (Figure 1).

Figure 1. Strips made in thick, but evenly spread wheat residue.

When strip-tillage follows a cereal crop from which straw is windrowed, if possible, spread chaff separately. Other changes may be required, such as investing in combine residue management options, changing combines or switching custom harvest operators. Heavy chaff and dense volunteer cereal roots in the windrow area can reduce strip-tiller performance, even with more aggressive strip-tillers. These issues are made worse under damp soil conditions. In an extreme case, poor strips due to dense chaff and volunteer wheat windrows on a heavy clay soil in one Ontario field resulted in a 40 bu/ac yield loss relative to corn rows off the windrows (based on hand-harvest data; Figure 2).

Figure 2. Poor strips on old windrows with heavy chaff and volunteer wheat (left) and corn growing on poor strips on windrows the following season (right).

Consider the following to achieve uniform residue spread:

- cut the crop high to minimize volume of residue (if retaining straw/stover)
- add a chaff spreader to the combine
- maintain the stationary knives in good working condition
- upgrade the combine or custom operator to achieve residue management requirements

STRIP-TILL ROW CLEANERS

Most modern strip-tillers come equipped with some form of row cleaner (e.g., finger type, notched disk), which is crucial for making strips in high residue situations (Figure 3). Row cleaners remove residue from the row area to create a clean, tilled zone, which enhances soil warming and drying. It also prevents residue incorporation into the seed zone, improving seed to soil contact and uniformity of plant emergence and growth. Row cleaning alone may not be sufficient to manage high volumes of residue; uniform distribution of crop residue, chaff and volunteer cereals behind the combine are critical.

Figure 3. Toothed row cleaner (bottom left) on a strip-till unit.

PLANTER ROW CLEANERS

Spring strips

For planting into spring-made strips, planter row cleaners may not be required if the following conditions are met:

- strips are cleared during tillage;
- seedbed is finely aggregated;
- excess residue is kept off the strips, and
- planter follows the tillage pass relatively quickly

Row cleaners are beneficial if wind-blown residue between spring strip-tillage and planting is a concern or large, hard soil clods are formed during spring strip-tillage.

Fall strips

For fall strips, many farmers report planter row cleaners as necessary (Figure 4), while others use them rarely or only on an as-needed basis. Planter row cleaners are particularly beneficial when there is considerable residue movement over the winter (e.g., through wind-blown residue or cover crop top growth settling over strips). Removal of residue from the strip is critical to ensure good seed to soil contact and uniform emergence. Only adjust row cleaners to move residue and not soil from the strip.

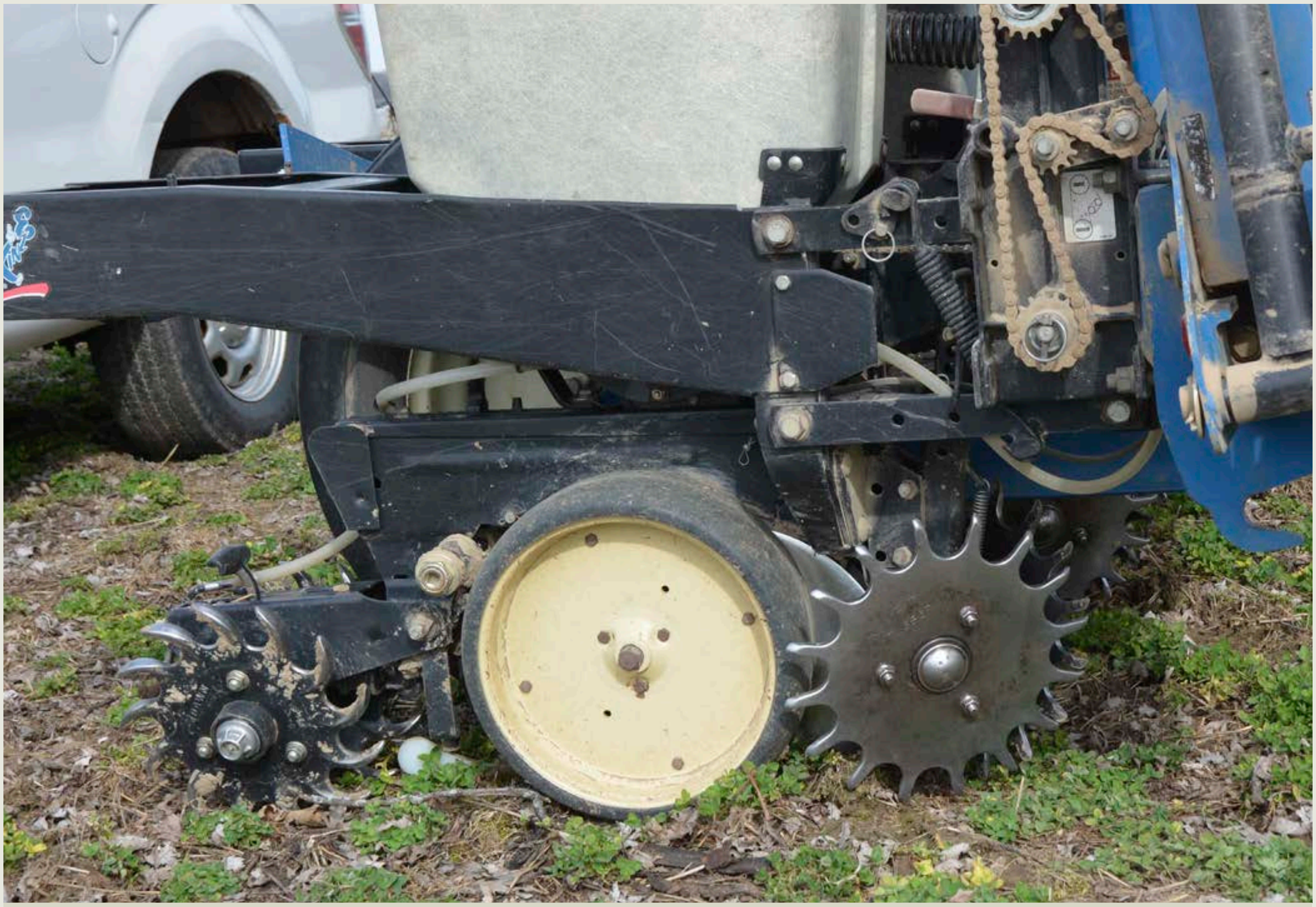

Figure 4. Planter row unit for an Ontario strip-till farmer who plants into one-pass fall strips. Row cleaners on planter remove any residue that accumulates on the strip over winter.

Nutrient management

PHOSPHORUS AND POTASSIUM

Strip-till equipment often provides an opportunity to apply phosphorus (P) and potassium (K) fertilizers. Depending on the strip-tillage unit and fertilizer delivery, nutrients can be blended throughout the strip, deep-banded (e.g., 15 cm (6 in.)), banded closer to seed depth (e.g. 10 cm (4 in.)), or a combination. Placement of nutrients in a zone closer to the seed can increase efficiency and reduce the need for starter fertilizer. Strip-till fertilizer application also lowers the risk of nutrient loss relative to surface application and reduces the number of field passes required to prepare for planting.

Like no-till, nutrient deficiencies appear to be made worse in strip-till on low fertility soils when compared to conventional till when no P or K fertilizer is applied. Fertilizer placement is critical in both no-till and strip-till. Most strip-tillers in Ontario use fertilizer carts as part of their strip-till systems (Figure 5). Broadcasting P and K fertilizer instead of strip placement is not a recommended practice.

Figure 5. A strip-till unit with an air cart attachment is used to apply fertilizer in strips.

MIDWEST RESEARCH

Researchers in the United States Midwest evaluated nutrient use efficiency, crop yield response and changes to soil test levels in strip-tillage versus no-till corn-soybean systems. In research conducted in Illinois from 2007 – 2015 across three commercial fields (with silty clay loam and silt loam soil textures), deep banding P and K in strip-till typically out-performed broadcast applications (in strip-till and no-till) in fields with low fertility [(1)]. Strip-tillage also resulted in 4-6% higher corn yields.

Broadcast applications significantly increased nutrient levels in surface soil layers over the study period, which increased the risk for environmental losses. Subsurface banding P and K elevated soil test P and K deeper in the soil profile.

(1) Fernandez, F.G. and C. White. 2012. No-till and strip-till corn production with broadcast and subsurface-band phosphorus and potassium. *Agronomy Journal.* 104:996-1005. doi: 10.2134/agronj2012.0064

ONTARIO RESEARCH

On-farm trials in the early 2000s in Ontario investigated deep banded (e.g., 15 cm (6 in.)), fall-applied P and K in strip-till compared to fall plow and no-till corn systems. The results are summarized in Table 1.

TABLE 1. CORN RESPONSE TO FERTILIZER PLACEMENT AND TILLAGE ACROSS A RANGE OF POTASSIUM SOIL TEST LEVELS

UNDER LOW POTASSIUM LEVELS (<75PPM K)	UNDER MODERATE POTASSIUM LEVELS (75-100PPM K)	UNDER HIGH POTASSIUM SOIL TEST LEVELS (>120PPM)
Fall-only P and K strip-till applications did not maximize yield response; planter-applied nutrients were still required Strong response to planter-applied P and K may have been due to deep (15 cm (6 in)) placement of fertilizer limiting early season crop uptake	Fall application of P and K fertilizer in plow and strip-till systems yielded similar to no-till soils with planter-banded P and K Phosphorus and potassium requirements for strip-till corn on such soils could possibly be met exclusively by fall banding	Corn yields were not affected by tillage or application of P and K

Ontario trials in 2019 and 2020 evaluated spring strip-till P and K applications banded for corn at a 10 cm (4 in.) depth (Figure 6). The research, conducted on low fertility soils across ten sites, found:

- higher corn yields in spring strip-till with P and K than where P and K was broadcast and incorporated by full width tillage (6.7 bu/ac average increase). Note that phosphorus and potassium were not applied at rates sufficient to maximize crop response in all cases.
- higher yields in spring strip-till with banded P and K than fall strip-till with banded P and K (5 bushels per acre); however, when half of the fall strip-till P and K was shifted to a 5 cm x 5 cm (2 in. x 2 in.) band the difference disappeared.

Where spring strip-tillage is a reliable option (soil texture, drainage and strip tiller are conducive to creating a good strip), P and K banding for early season uptake may be a viable substitute for planter-applied nutrients on low-testing soils.

Although no fertilizer burn was observed at fertilizer rates of 30 lb-N/ac, 60 lb-P_2O_5/ac and 60 lb-K_2O/ac in these trials, further work is required to determine crop safety implications across a range of soil types.

Figure 6. Strip-till fertilizer band placed 10 cm (4 ins.) below soil surface.

CAN STRIP-TILL FERTILIZER REPLACE THE NEED FOR STARTER FERTILIZER ON THE PLANTER?

In an ideal scenario – to improve planter speed and logistics – fertilizer applied in the strip would replace starter fertilizer (particularly P and K) on the planter. So far, research and on-farm results in Ontario have been variable. Key factors may include:

- **Soil test levels –** Is a response to starter fertilizer expected?
- **Strip-till timing –** Nutrient availability in spring strips is likely more advantageous than fall strips on low fertility soil.
- **Fertilizer placement in the strip –** Is fertilizer close enough to the seed for early uptake?
- **Strip placement relative to previously fertilized strips –** Corn planted in the same location as previously fertilized corn strip is likely to be less responsive.

NITROGEN

Broadcast nitrogen (N) applications are not recommended in strip-tillage systems. The inability to perform full width incorporation, presence of surface residue and likelihood for damper soil surfaces in spring increases the risk for losses relative to conventional tillage. As a result, many strip-till growers apply N in-crop. Often, enough nitrogen is applied when spring stripping (Figure 7) and/or planting to support plant growth until the balance of N can be applied as a traditional sidedress (injection) or high clearance, late vegetative N application.

Figure 7. Liquid nitrogen is subsurface applied during spring strip-tillage by this Ontario dairy farmer ahead of corn planting.

A 30 lb-N/ac application at planting is recommended where sidedressing is used in conventional tillage. Under no-till, placement in a 5 cm x 5 cm (2 in. x 2 in.) band or application of a slightly higher rate assists with early season uptake. This approach applies to strip-till as well. Higher up-front N rates are likely required when the majority of N is applied at later vegetative stages, though optimal rates have not been determined for this application timing.

NITROGEN RATES IN THE STRIP

Although the maximum safe rate for corn with a 5 cm x 5 cm (2 in. x 2 in.) planter band is 36 lb-N/ac (for blends containing urea), Ontario growers often report blending or deep banding higher rates than this in their strips. For growers wishing to increase starter N rates beyond typical starter fertilizer amounts, avoid at all costs shallow fertilizer bands especially if the distance between band and planter cannot be guaranteed. Though data is limited, applying a full nitrogen program – blended or deep banded – in a spring strip poses too much risk of burn in most cases.

The following approaches may increase crop safety with nitrogen in a fertilizer blend:

- Apply N portion of fertilizer in a deep band, or in a manner that would allow consistent placement to the bottom of the strip.
    - For example, place urea ammonium nitrate (UAN) at the bottom of the shank at least 15 cm (6 in.) deep. If a multi-bin setup is available (Figure 8), one approach is to place urea to the bottom of the shank or strip with a safer "starter" blend mixed throughout the strip.
- Apply a portion of N as a physically protected, slow release N product such as polymer-coated urea. Delayed solubilization of such products has been shown to improve fertilizer safety in Ontario spring strip-till research.

Figure 8. Multi-bin air carts could enable crop-safe, deeper placement of nitrogen and separate placement of other nutrients mixed throughout the strip.

CROP SAFETY

Currently, no safe fertilizer rates are established for strip-till. The wide range of application methods used within strip-tillage systems present challenges in developing general recommendations.

Safe 5 cm x 5 cm (2 in. x 2 in.) banding guidelines for ammonium and salt fertilizers (N+K+S) are provided in Table 2. Shallow banding poses the greatest risk. Banding fertilizer at 10 cm (4 in.) in the strip provides 5 cm (2 in.) of separation between seed planted 5 cm (2 in.) deep. This is less than the 7 cm (2.75 in.) of separation for seed planted at 5 cm (2 in.) and a 5 cm x 5 cm (2 in. x 2 in.) band. Mixing fertilizer throughout the strip may reduce risk relative to shallow banding. Deep banding (e.g., 15 cm (6in.)) likely provides the greatest safety, though early nutrient uptake and starter response potential is limited.

Safety can also be impacted by other factors, including timing (fall vs. spring), soil texture and seedbed moisture. Some growers report the ability to apply fertilizer rates much higher than 5 cm x 5 cm (2 in. x 2 in.) banding guidelines without issue. In the absence of safe rate guidelines, on-farm rate tests may be required to evaluate crop-safe blends and rates for local conditions.

TABLE 2. MAXIMUM SAFE RATES OF NUTRIENTS IN FERTILIZER FOR 5 CM X 5 CM (2 IN. X 2 IN.) (BELOW SEED) PLACEMENT AT 76 CM (30 IN.) ROW SPACING FOR CORN, SOYBEANS AND DRY BEANS.

CROP	FERTILIZER	NITROGEN (LB/AC)	NITROGEN + POTASH + SULPHUR (LB/AC)
Corn	Urea	36	71
	Other fertilizers	47	105
Soybeans and dry beans	Ammonium sulphate	27	Not recommended
	Other fertilizers	Not recommended	81

90 lb/ac = 100 kg/ha
Adapted from OMAFRA Publication 811, *Agronomy Guide for Field Crops.*

MANURE APPLICATION

Strip-tillage can work well on farms using manure. Growers typically handle manure similar to other tillage systems: manure is broadcast after harvest (e.g., after wheat or soybeans) and strips are created after the manure application. Another approach is to inject liquid manure at 76 cm (30 in.) spacing and follow with strip-tillage directly over each row.

Some livestock producers perform simultaneous manure application and tillage. Setups used by Ontario growers have typically been strip-tillers mounted to the rear of manure tankers (Figure 9). Growers report being able to successfully incorporate manure in strips with little “bubbling out” of manure at standard application rates and speeds required to produce proper strips.

One challenge of this system is when making fall manure applications in conditions that are also suitable for strip-till. Strip-tillage is not as reliable an option as other tillage tools under marginal soil conditions. When the strip-till operation is tied to manure application after soybean or corn harvest, it can be more difficult to complete it under ideal conditions.

Figure 9. A strip-tiller-manure tanker combination used by an Ontario farmer to incorporate liquid manure.

SOIL SAMPLING IN STRIP-TILL SYSTEMS

When fertilizer is applied to strips kept in the same location year after year using real-time kinematic (RTK) navigation, it is recommended to collect one soil sample from the in-row position for every 3 collected between rows (Figure 10). According to United States Midwest research[2] this method best reflects whole-field fertility (e.g., would produce a similar soil test to where an equivalent amount of fertilizer had been uniformly broadcast). The study found no need to adjust fertilizer rate based on banded placement in a strip-till system. While strip-tillage can improve nutrient use efficiency, evidence does not suggest that fertilizer rates can be reduced relative to conventional tillage systems.

Samples collected from an Ontario strip-till farm with strips maintained in the same locations across several crop rotations showed elevated soil test levels in-strip vs. between strip, highlighting the importance of proper soil sampling (Figure 11).

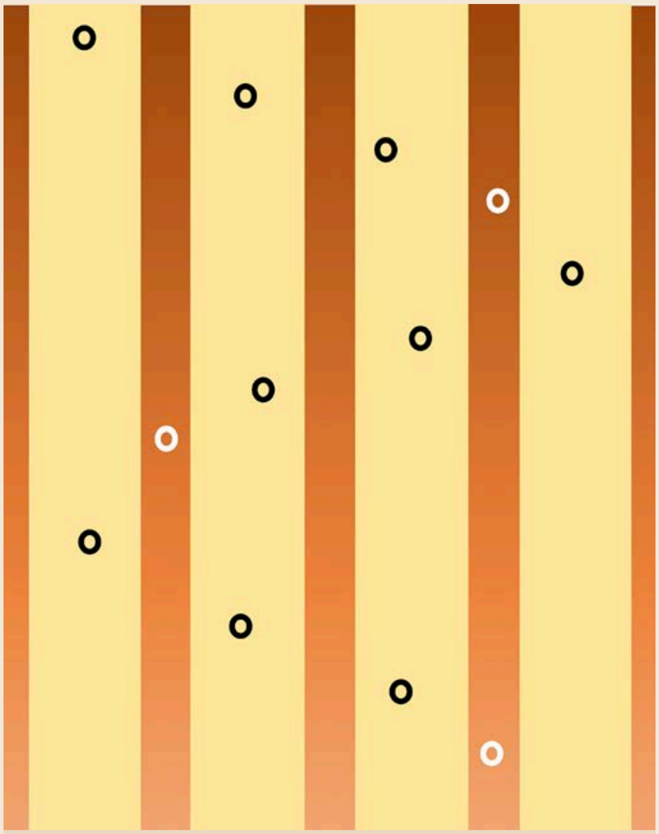

Figure 10. Collect 1 sample in-strip for every 3 outside the strip.

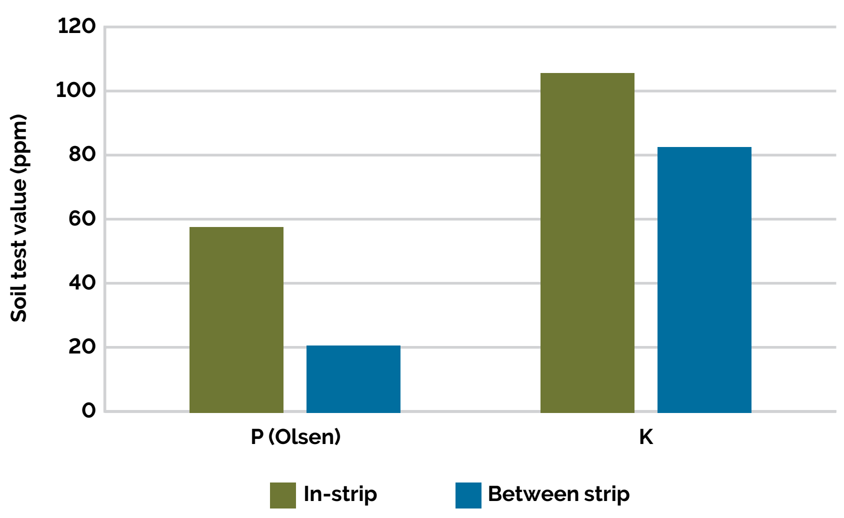

Figure 11. Differences in soil test P and K in-strip vs. between strip for an Ontario farm.

(2) Fernandez, F.G. and D. Schaefer. 2012. Assessment of soil phosphorus and potassium following real time kinematic-guided broadcast and deep-band placement in strip-till and no-till. *Soil Science Society of America Journal.* 76:1090-1099. doi: 10.2136/sssaj2011.0352

Weed management in strip-tillage

A transition to strip-tillage from full-width tillage is typically accompanied by a shift in weed species. This is especially true if the other crops in rotation are managed without tillage.

Although research on the topic is limited, there are some general differences in weed dynamics between strip-till and conventional tillage[3][4]:

- weed emergence tends to be faster in conventional tillage system vs. strip-tillage
- weed seeds that remain at the soil surface in strip-tillage are more vulnerable to predation, which may lower weed densities over time
- strip-tillage tends to result in more winter annual, biennial and perennial weeds – species commonly associated with no-till

Within a strip-till system, differences in soil moisture, temperature and other properties between the in-row and between-row zones can make weed population dynamics more complex. For example, maximum weed emergence was found to be greater in the tilled zone as compared to the between-row zone in a Wisconsin trial[5]. Figure 12 shows an example of this in an Ontario strip-till field. The same study found no difference in diversity or density of weeds between a strip-till and a chisel-plow tillage system. Although weed management differs, production risks are not necessarily higher in strip-till than conventional systems.

Figure 12. Greater weed density (witchgrass and green foxtail) in-strip versus between-strip. Tilled strips provided a more conducive environment for seedling emergence despite field receiving a soil-applied herbicide.

(3) Brainard, D.C., R.E. Peachey, E.R. Haramoto, J.M. Luna, A. Rangarajan. 2013. Weed ecology and nonchemical management under strip-tillage: implications for northern U.S. vegetable cropping systems. *Weed Technology.* 27:218-230. doi: 10.1614/WT-D-12-00068.1

(4) Hendrix, B.J., B.G. Young, S-K Chong. 2004. Weed management in strip tillage corn. *Agronomy Journal.* 96:229-235

(5) Drewitz, N.M. and D.E. Stoltenberg. 2018. Weed communities in strip-tillage corn/no-tillage soybean rotation and chisel-plow corn systems after 10 years of variable management. *Weed Science.* 66:651-661. doi: 10.1017/wsc.2018.40

Planting on the strips and GPS guidance

STAYING CENTRED ON STRIPS

Based on research and grower experience, keeping the planter centred on the strips is critical for success. One dataset from Indiana demonstrated a 5-8 bu/ac yield loss for corn rows not centred on strips with GPS(6). Drifting off strips creates many challenges, including:

- planting into cooler, wetter, residue-covered soil, especially if the planter is not properly equipped (e.g., no row cleaners or starter fertilizer)
- stunted crop growth due to smeared or poorly closed furrows
- slug feeding in high residue environments
- lack of starter fertilizer if fertilizer is delivered exclusively through the strip tiller

Widespread adoption of RTK-GPS has reduced this barrier to strip-till.

Strip condition can also influence how well planters stay centred. Taller, narrower strips – more common with some shank style strip tillers – may be more challenging to keep planters centred on than on wide, flat strips. More rigid, ground-engaging equipment on the planter (e.g., fertilizer openers) may help the planter to stay within softer strips (Figure 13).

Figure 13. An Ontario planter set up for strip-till conditions. Fertilizer openers help planters stay within the soft strip.

(6) (T. Vyn, unpublished)

GPS GUIDANCE

Grower reports for GPS guidance are mixed. In most cases, high quality GPS for strip-tilling is considered a must. If strips are made with GPS, some growers report little need for GPS guidance while planting. Many growers still use tractor GPS guidance for planting, while some use active implement guidance to keep passes lined up (e.g., tractor compensation to keep equipment centred on guidance lines or hydraulic hitch to shift implement to centre (Figure 14)). Field topography, differences in equipment widths and draft will determine guidance requirements.

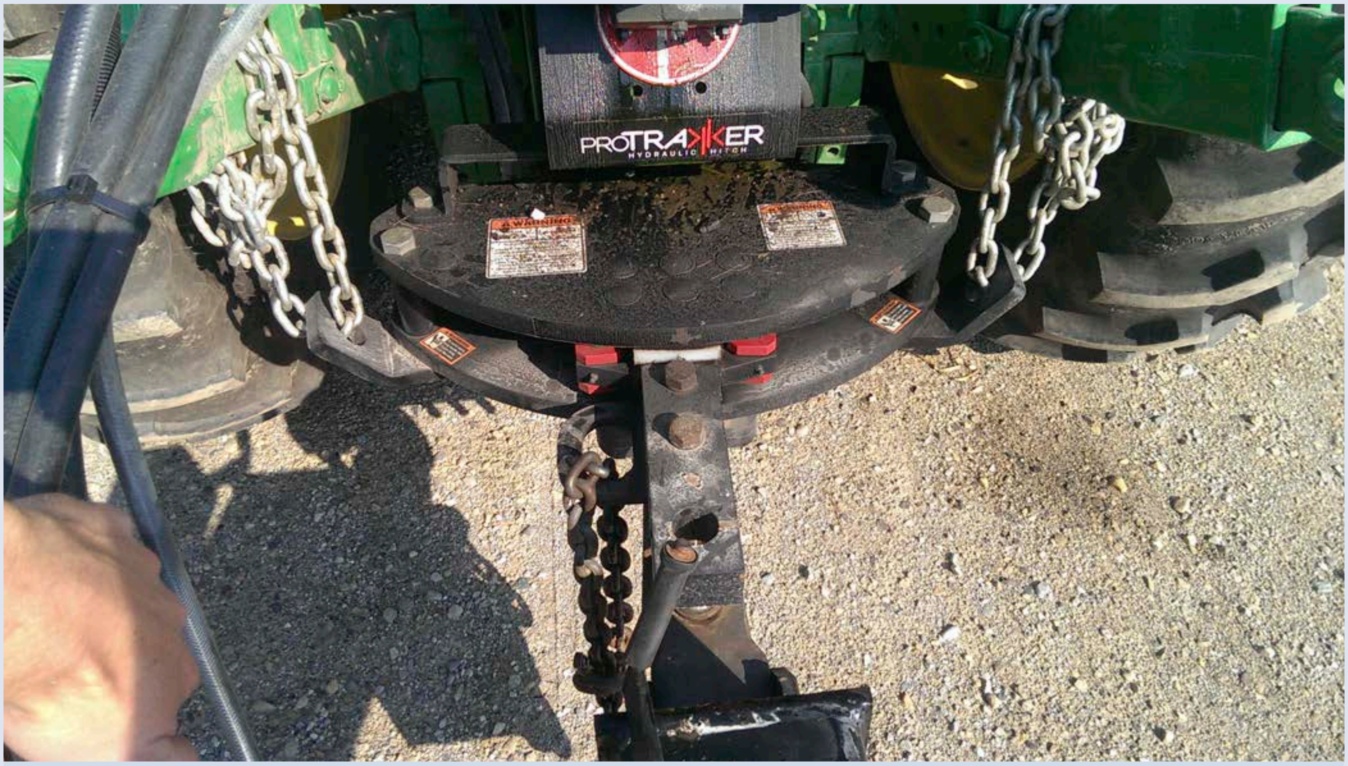

Figure 14. An example of a hydraulic hitch.

Cover crops and strip-tillage

Many Ontario strip-tillers successfully integrate cover crops which support the soil health and conservation focus of a strip-till system. Success with cover crops in strip-till depends on cover crop type and growth, strip-tillage equipment and timing of tillage. Many growers report success even with basic strip-tillers when tilling earlier in simple cover crops, before above- or below-ground growth become excessive. Earlier tillage ensures good residue flow and minimizes soil clumping or ribboning.

One low-risk approach is to seed light stands and create strips in spring cereals before stem elongation. Even when tillage is performed early, cover crop growth between strips often provides excellent overall cover. Other growers report success using more aggressive units even in very heavy, tall cover crop mixtures. Figure 15 shows fall strips created by a shank-based strip tiller in a moderate stand of oats.

Figure 15. Fresh fall strips in a modestly thick and tall stand of an oat cover crop.

Like with chaff rows, thick cover crop stands and root systems can cause issues for some strip-tillers. It can be a challenge to make good strips in red clover where it has produced a large root system – either in the late fall or if allowed to grow until spring. Under these conditions, it can be difficult to achieve a high-quality strip (Figure 16).

One solution is to make strips early, before aggressive clover growth. Another approach is to shift cover crop seeding later or plant separate cover crop species in the stripped zones that are easier to manage. Some growers will seed a quickly degradable, low carbon-to-nitrogen species in row (e.g., radish), with a more competitive, fibrous-rooted species between rows (e.g., cereal rye).

Start simple when integrating cover crops into a strip-tillage system. For example, select a single cover crop species that winterkills, such as oats, use a modest seeding rate and perform tillage early before growth becomes excessive. Fine-tune seeding dates and strip-till timing to achieve additional cover crop benefits over time.

Figure 16. Less-than-ideal strips created in the fall in thick stand of red clover.

Strip-tillage operating costs

Partial budgets for operating costs of various tillage systems are compared to strip-tillage for corn production in Table 3. This economic comparison is meant as a general guide only. It uses average values from the 2018 Ontario Custom Rate survey and assumes an average corn price of $5/bu (approximate 2010-2020 average). Some assumptions for various systems are made:

- strip-tillage includes a dry fertilizer application and replaces the need for a broadcast application
- strip-till incurs extra herbicide costs through an additional application, product or higher product rate

This comparison assumes all other practices (nitrogen application methods, other crop protectants, harvest) remain the same.

TABLE 3. PARTIAL BUDGET OF VARIOUS TILLAGE SYSTEMS COMPARED TO STRIP-TILL FOR CORN PRODUCTION

EXPENSE	MOLDBOARD PLOW, 2X SPRING SECONDARY	CHISEL PLOW, 2X SPRING SECONDARY	FALL DISK, 2X SPRING SECONDARY	FALL DISK, 1X SPRING SECONDARY	2X SPRING SECONDARY	STRIP-TILL	1X SPRING SECONDARY	NO-TILL
	$/ac							
Fall Moldboard	$33	–	–	–	–	–	–	–
Fall Chisel Plow	–	$26	–	–	–	–	–	–
Fall Disk	–	–	$21	$21	–	–	–	–
Fall or Spring Strip-Till	–	–	–	–	–	$28	–	–
Spring Secondary Tillage	$32	$32	$32	$16	$32	–	$16	–
Dry Fertilizer Application	$10	$10	$10	$10	$10	–	$10	$10
Additional Herbicide or Pass	–	–	–	–	–	$10	–	$10
Total	**$75**	**$68**	**$63**	**$47**	**$42**	**$38**	**$26**	**$20**
Total vs. Strip-Till	**$37**	**$30**	**$25**	**$9**	**$4**	**–**	**-$12**	**-$18**
Bu/ac to Breakeven with Strip-Till*	**+7**	**+6**	**+5**	**+2**	**+1**	**–**	**-2**	**-4**

* assumes a corn price of $5/bu

KEY TAKE-AWAYS:

- Compared to systems where full width primary tillage (e.g., moldboard plow, chisel plow, disk) and multiple passes of secondary tillage are required (e.g., following high residue crops (Figure 17) on medium to heavier textured soils), strip-till can provide a savings of $25-37/ac.
- Relative to systems where only one or two passes of secondary tillage may be required (e.g., following low residue crops such as soybeans or edible beans), strip-till would result in small or negative cost savings ($4/ac savings to $12/ac more expense).
- No-till is a lower cost system than strip-till ($18/ac savings) and may be more beneficial on soils that do not respond to tillage (e.g., sands, loamy sands, sandy loams) or require fertilizer capabilities of strip-till.

OTHER POTENTIAL COST SAVINGS OF STRIP-TILL INCLUDE:

- The opportunity to shift labour and logistical demands for tillage and fertilizer application from spring to summer/fall, following cereal/soybean harvest. This enables more timely, simplified planting for sole operators and frees labour for soybean planting or other spring activities.
- Improved corn planter efficiency if the strip-till fertility program can replace some or all starter fertilizer.
- Ability to place larger amounts of fertilizer in the seed zone for low fertility soils.
- Reduced labour and equipment requirements for secondary tillage and stone picking.

Figure 17. A moldboard plow set to perform primary tillage following a high residue crop. Strip-tillage provides cost savings in such situations.

Advice for growers considering strip-till

If you are thinking about starting into strip-tillage, consider the following common suggestions from Ontario strip-tillers:

- **Evaluate equipment on-farm first –** Many experienced Ontario growers have changed strip-till equipment at some point. Before making the jump, demo equipment on-farm to be sure it meets the needs of your system and the soils on your farm (Figure 18).
- **Think about the whole system –** Strip-tillage is not a drop-in replacement for conventional tillage. Modifications to residue management, planters or other equipment may be needed to get the best results. Talk to other strip-tillers to find out how they integrated strip-till into their operations.
- **Do not opt for the cheapest option –** If you are making the investment into strip-till, you won't be happy making sub-par strips. Find a machine that performs in your system and have the horsepower to operate at the speeds needed to make good strips.
- **Strip-till operator should have planter experience –** The strip-till operator must think like a planter operator to layout the field and judge seedbed conditions being made. This is a more demanding skillset than that required of a typical primary or secondary tillage operator (Figure 18).

Figure 18. Corn crop growing in a strip-till field.

For more information

ONTARIO MINISTRY OF AGRICULTURE, FOOD AND RURAL AFFAIRS

Many sources of supplementary information are available. Most can be found online at ontario.ca/omafra or ordered through Service Ontario.

- *Agronomy Guide for Field Crops*, Publication 811
- Soil Erosion – Causes and Effects, OMAFRA Factsheet
- fieldcropnews.com

Best Management Practices Series

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