Roots Not Iron: Evaluating Cover Crop Options and Planting Strategies

Interim Report 2
(OSCIA Tier 2 Grant-Thamesvalley)

Purpose:

A recent resurgence in cover crop interest has many producers wondering what options work best. The hashtag #RootsNotIron has become a popular Twitter category, with a focus on multi species cover crops and planting the grain crop into live green growing cover crops, with cover crop kill occurring following the planting operation. The impact on yield and any practical field implications has not been well researched. This project will attempt to evaluate these parameters across a range of cropping practices.

Algal blooms in Lake Erie have focused attention on the impact agricultural practices may have on the environment around us. This has put an even higher emphasis on soil conservation practices including cover crops and reduced tillage. It is beyond the scope of this project to measure the impact these practices have on reducing phosphorus losses: but this project will examine the effect that cover crops and reduced tillage have on soil health and crop yields.

In order to build long-term organic matter and not tie up nitrogen, it is important to have some high nitrogen residue (legumes or green leafy cereal plants) to go along with the high carbon residue left behind after corn and wheat harvest. This will help to balance the carbon to nitrogen (C:N) ratio and provide a variety of residue to feed a wide spectrum of soil microbes. The living roots of a cover crop also play a vital role in releasing carbon and other compounds into the soil to help feed the microorganisms for a longer period of time. The cover crop will increase plant biomass and carbon being returned to the soil, which will increase soil microbial activity. The increase in microbial activity will have numerous benefits on soil health including increased soil organic matter, soil structure and soil tilth

Methods:

Four wheat, three corn, and two soybean fields (9 total) carried through from 2015 across the Thames Valley and Heartland Regional Soil and Crop Improvement Association regions into the 2016 growing season. Each field will follow a corn, soybean, wheat rotation for the duration of this project. The three treatments to be replicated three times are:

1. Conventional Management (No cover crops)
2. Conventional Management (Clover after wheat, oat + peas if clover fails to establish)
3. RootsNotIron (Continuous cover crop, multi species if possible, strip till or notill)

The RootsNotIron cover crop treatment interseeded into the growing corn crop was changed from a cereal rye/annual ryegrass/crimson clover blend to an annual ryegrass/crimson clover blend, which will not be terminated until spring. The rye mixture was planted at a rate of 46 lbs/ac (40 lbs cereal rye, 4 lbs ryegrass, and 2 lbs crimson

clover) in 2015. However, the cereal rye simply did not withstand the competition, so in 2016 6 pounds/ac annual ryegrass plus 2 pounds/ac crimson clover was seeded at 6 leaf corn. Soybeans will be planted following a single spring strip till pass or no-tilled directly into the cover crop. Once the soybeans are harvested wheat will be no-tilled into the soybean stubble. After wheat harvest a multi-species cover crop will the planted in treatment 3. The multi-species cover crop will be planted at 110lbs/ac (30 lbs oats, 30 cereal rye, 20 sunflower, 20 peas, 4 ryegrass, 2 radish, 2 clover, 2 phacelia). The multi-species cover crop will be left till spring when corn will be planted directly into the cover crop or following a single strip till pass.

Tillage will be done on treatments 1 and 2 following the co-operators normal practice but treatment 3 will not receive any tillage for the duration of this project. All other variables (i.e. starter, nitrogen, manure) will be the same for all three treatments following the cooperators normal production practice.

Soil samples were taken from each location to determine baseline soil health levels. At the completion of this project each treatment will be soil sampled to determine the effect each treatment has on soil health.

Results:

The first two years of this study have been completed. During the initial year no cover treatments had been established prior to the corn being planted so the corn was planted following the co-operators normal practice. Rye was then interseeded into the corn at the 6 leaf stage. The yield results from the three corn sites, along with yield results from several other farmer conducted trials with the same treatments are shown in Table 1.

Table 1: Corn Yield Results from Inter-Seeded Rye (bu/ac)

Location	Check	Rye Interseeded	Difference
Arthur	192.3	193.1	+0.8
Glencoe	137.1	145.1	+8.0
Rodney	171.3	171.0	-0.3
Woodstock	194.5	195.3	+0.8
Strathroy #1	220.0	218.0	-2.0
Strathroy #2	220.0	202.0	-18.0
Average	**189.2**	**187.4**	

At four of the 6 sites there was no significant difference in yield whether rye was inter-seeded or not. Two locations really stand out in Table 1. There was an 8 bu/ac yield increase at the Glencoe site when rye was inter-seeded, while Strathroy #2 lost 18 bu/ac by inter-seeding rye. More research will need to be done to determine what conditions lead to an increase in corn yields at Glencoe, while there was a significant reduction in yield at Strathroy #2.

All three corn sites had good to excellent rye establishment during the 2015 and 2016 growing seasons. Image 1 shows the excellent rye growth that occurred at the Arthur location in 2015 and a modified seed drill used to interseed the rye at several locations.

Image 1: Rye after corn harvest (Nov 16, 2015) and modified drill

Clover stands were astounding following the 2015 wheat crop. Perfect stands and excellent growing conditions well into the fall resulted in lots of growth. The multi-species cover crop (Image 2) establishment was also excellent at two of the three wheat locations. Rough, uneven ground conditions resulted in variable seeding depth which combined with inadequate rainfall resulted in a variable stand which is shown in Image 3.

Image 2: Multi-Species mix (Oct 14, 2015);

Image 3: Uneven cover crop growth

In this second year of the project corn was planted directly into the multi species cover crop. At Bornholm the corn was no-tilled into the living cover crop while the other 2 conventional treatments received tillage prior to planting. At Elmira all treatments received a single pass with a strip till unit prior to planting. At Lucan all strips were planted no-till, and both neonic treated and fungicide only treated seed was utilized. The yield results from these locations are summarized in table 2.

Table 2: 2016 Corn Yields (bu/ac)

Location	No Cover	Clover	Plant Green
Bornholm	203.1	201.0	185.9
Elmira	218.0	198.8	199.6
Lucan (neonic)	225.8	223.2	202.4
Lucan (Fung)	223.0	224.6	196.9
Average	**217.5**	**211.9**	**196.2**
Average without Elmira	**217.3**	**216.3**	**195.1**

Substantial yield loss occurred at all three locations with the plant green treatment (Roots Not Iron). Yield loss ranged from 18 to 25 bu/ac. There was little yield difference between the no cover crop treatment and the red clover treatment at Bornholm and Lucan but there was a substantial yield loss with the red clover treatment at Elmira. At the Elmira location, red clover was not terminated in the fall, and control was not able to be applied until 3 days prior to planting. The yield loss can be further explained by looking at the greenness ratings which are summarized in Table 3. The greenness ratings were taken on the same day as the corn first emerged using the Canopeo app, developed by the Soil Physics Research Group at Oklahoma State University. The greenness ratings show that the clover was still green at Elmira when the corn emerged. Image 4 shows visually how much green cover remained in the clover strips at emergence. No Greenness ratings were taken at Lucan. This shows that any green material has the same impact on the corn crop. Table 1 shows that the yield impact of green clover at Elmira was exactly the same as the impact of the green multi species mix. Due to this impact, yield results for the three treatments should really be calculated without the clover data from Elmira. This average without Elmira is also available in Table 2.

Table 3: Greenness Ratings

Location	No Cover	Clover	Plant Green
Bornholm	0.3%	0.2%	32.0%
Elmira	0.3%	3.9%	0.6%
Lucan (neonic)	N/A	N/A	N/A
Lucan (Fung)	N/A	N/A	N/A

Image 4: Elmira Clover cover crop vs Multi Species Mix

In 2016 the soybeans were also planted into a living cover crop in the Roots Not Iron treatment. At the Rodney location the soybeans were no-tilled into both the rye and check strips while the soybeans were planted following a single pass with a strip till unit at Arthur. Image 5 shows soybeans being no-tilled into cereal rye at the Rodney location.

Difficulties maintaining good seed to soil contact plagued the plant green treatments wherever no tillage was done. At Rodney, soybean stands were reduced by 20% (Table 4) in the plant green strips. While this did not reduce yield at the Rodney location, it does indicate the problems associated with living roots holding tightly to soil, and the difficulties that this can present when attempting to get good seed to soil contact and close the slot. Yield results are seen in Table 5.

Image 5: Soybeans being no-tilled into Cereal Rye

Image 6: Slot closure issues in Plant Green soybeans

Table 4: Soybean stand counts

	Rye	No Cover	% Loss
Rep 1	13.1	15.3	14.4
Rep 2	12.7	16.9	24.9
Average	12.9	16.1	19.6

Table 5: Soybean yield Results

Location	Check	Rye
Arthur	61.6	58.9
Rodney	47.5	47.2
Average	**54.5**	**53.1**

Summary:

Inter-seeding rye into an existing corn crop had no significant impact on yield on average, but significant yield losses were seen at one location. Major losses were seen however when corn was planted into a green cover crop. Hypothesized reasoning is 2-fold: emerging corn plants sensing the presence of other green plants nearby which causes the corn plant to alter its growth pattern, and the difficulty in getting the sufficient required seed/soil contact through masses of living roots. The research showing that plants are able to sense other plants nearby has been well documented by Dr. Clarence Swanton at the University of Guelph. From yield numbers in this project, it appears soybeans may be able to handle the stress of plant green better than corn. Soybeans suffered only minor yield loss when planted into a green cover crop. More research is needed study the effect that planting green has on a soybean plant.

Cover crop establishment was excellent at most locations in 2016, which should provide excellent conditions to generate results from these sites in 2017.

Next Steps:

This trial will be continued for at least the next 2 years to complete the corn, soy, wheat rotation at all locations.

Acknowledgements:

Huge thanks to our co-operators. Thanks to summer assistant Alison Buckrell, technician Shane McClure, and administrator Marian Desjardine. Special thanks to Mel Luymes and Cathy Dibble for helping to coordinate sites and data. This project would not be possible without the support and funding of the Ontario Soil and Crop Improvement Association

Project Contact:

Peter Johnson, Agronomist, Real Agriculture, peter.johnson@bell.net
Shane McClure, Research Lead, shane_mcclure@hotmail.com
Cathy Dibble, Thames Valley SCIA cathy.dibble@ontariosoilcrop.org