Organic On-Farm Trials and Demonstrations Report

Thank you for your participation in our 2018 season of Organic On-Farm Trials and Demonstrations. As we begin to wrap up the program we are excited to hear your story! Please fill in the final report below and include pictures. Note that we will be posting the information from these reports on our website, as a way share with other farmers. Please have all reports in by November 30th, 2018. If you have any questions, please feel free to give me a call (Tierra Stokes (587) 521 2400). Thank you again!

1. What was your research question?

“What are the impacts of crimped versus tilled green manure termination methods?”

a) Is there a difference in soil moisture between roller crimping yellow clover and incorporating it into the ground with tillage?

b) Is total organic carbon affected by roller crimping versus disking?

c) Are available nutrients affected by roller crimping versus disking?

2. Why was this trial or demonstration important to your farm?

We are in an especially dry region of the prairies where our average rainfall is between 300 and 355 mm. In the last few years this has drastically decreased and in 2017 we received less than 40 mm of moisture during the growing season. Our farm is very focused on improving our soil quality which will also improve our ability to capture and retain moisture for use when needed during the drier years. We have learned how tillage affects this process by breaking up soil aggregates and reducing water infiltration and consequently we have started to reduce the type and frequency of tillage on our farm. Part of this effort includes using a roller crimper to terminate our green manure crops instead of a disk. Recently we have been asked if allowing the green manure crop to remain on the surface of the soil instead of incorporating it into the soil would in fact, impact the amount of moisture available for next years crop. The reasoning behind this
is that the green manure crop (in this case is yellow clover) has a long taproot which would be pulling the moisture up to the surface and would be lost as the crimped clover dried down. We wanted to look into the effects of crimping versus disking on the soil moisture of the following crop year in order to determine the best way to conserve this precious resource and produce a better crop in dry conditions.

3. How did you set up your trial or demonstration?

A 93-acre field which was seeded in 2016 to sweet yellow clover was selected in 2017 for this trial. We divided the field into eight different plots for four replicates of two different treatment types (disked and crimped). The treatments were alternated across all the plots in an effort to reduce the influence of different soil type and quality between the treatments. Four of the plots were disked using a Salford disk and the other four of the plots were crimped with a Rite-Way roller crimper. The treatments were applied on the same day after the clover had reached the full flowering stage. Each of the treatments was applied using two passes (of the disk or roller crimper) to ensure adequate termination of the yellow clover. No other operations were done on these plots for the rest of 2017.

In 2018 the disked plots were cultivated in the middle of May. Then, due to perennial weed pressure all of the disked plots and two of the roller crimped plots were disked a week later prior to seeding a cash crop. Spelt was seeded (70lbs/acre) across all plots in the end of May. In August, the disked plots were swathed prior to combining in the beginning of September. The remaining plots (only roller crimped, and roller crimped in 2017 but disked in 2018) did not have any spelt present and so were not harvested. In October 2018 the entire field was disked to terminate all the weeds that were still growing in preparation for the 2019 growing season.
Soil samples were taken before the treatments were applied in 2017 and just prior to seeding in 2018 to observe any potential differences between plots prior to growing the cash crop. Soil samples were taken from the top 12 inches from 5 different areas within each plot and combined to make a composite sample. Samples were sent away and analyzed for % moisture, total organic carbon and available nutrients (nitrate, phosphate, sulfate) as well as general chemistry parameters (conductivity, pH, particle size). In addition, samples were taken in Fall of 2018 for an in-house assessment of the soil biology between the different treatments.
4. What were some challenges you experienced?

The most significant challenge we experienced during this project was weather. Although we had sufficient moisture in 2016, this was followed by two exceptionally dry years. The total precipitation in 2016, 2017 and 2018 was 469.8 mm, 181.6 mm and 248.9 mm respectively. The total precipitation during each month is graphed for each of these years and shown to the left.

The total amount of precipitation in 2017 was less than 40% of the amount we received in 2016. This lack of overall precipitation in had a severe impact on the ability of the clover to produce enough biomass during 2017. This in turn didn’t allow for an adequate mulch layer to be produced in the roller crimped plots which contributed to the increased presence of weeds in these plots in 2018.

The total amount of precipitation we received in 2018 was more than what we had received in 2017, however it was still well below average and what we had received in 2016. The timing of the precipitation also was different in 2018 as it occurred mostly later in the growing season. This shift in the timing and amount of the precipitation we received in 2018 likely had a negative impact on the growth of the cash crop planted across all of the plots that year.
5. What did you learn?

**Soil Moisture**

We found that overall the % moisture did not change between plots within the same sampling year. The plots that had been roller crimped in 2017 and disked in 2018 did see the least amount of % soil moisture increase in 2018. However it should be stated that this difference is less than 1% and is likely did not have a significant impact on the yields of the cash crop.

Percent moisture was almost double in 2018 vs 2017. This is likely due to the time of the year these plots were sampled. The 2017 samples were taken in July which is typically the driest time of the year for our area, while the 2018 samples were taken in May which is when we typically get most of our moisture. This coupled with the fact that 2017 was an exceptionally dry year with next to no moisture in our area likely explains this drastic increase in soil moisture between 2017 and 2018. It is also possible that sampling further down (i.e. Below the standard 12 inches that were taken), we might have seen a bit more of a difference between treatments due to the potential presence of any retained moisture.

**Total Organic Carbon**

The amount of total organic carbon increased in the plots that were roller crimped in 2017 versus those that were disked. The amount that increased however was very small (<0.2%). Nevertheless, it is possible that over time, these small incremental increases will accumulate and translate into a larger difference between termination methods.

The retention of carbon within an annual cropping system is vitally important to its long-term viability. This carbon provides the vital building blocks to a healthy soil ecosystem which then increases the amount of nutrients available to grow a nutrient dense cash crop.
Available Nutrients

There was a substantial increase in available nitrate in 2018 compared with 2017 across all treatments. In contrast, the amount of available phosphate decreased across all treatments in 2018. The amount of available sulfate did not change between 2017 and 2018.

Using yellow clover as a green manure is quite common in organic agriculture. It is a biannual and if it is seeded with the previous year’s cash crop it will produce a large amount of biomass in the second year of its growth. However its use as a green manure in organic agriculture is primarily due to that it is such an excellent nitrogen fixer. It has been noted to produce between 100 and 200 lbs of N/acre ([www.sare.org](http://www.sare.org)). It is therefore not surprising to see this increase in nitrate between 2017 and 2018.

Soil Biology Assessment

Average length of fungal strands increased proportionally with a decrease in tillage. The longest strands were seen in the two plots that were never disked or cultivated, and the shortest strands were seen in the plots that were disked in 2017 and then both cultivated and disked in 2018. Fungal strand length in the two plots that were roller crimped in 2017 but then disked in 2018 was lower than the roller crimp only plots but higher than the plots that didn’t receive any roller crimping. We know that tillage can disrupt the soil biology in our systems. Fungi play a very important role in the ability of a soil to aggregate and thereby infiltrate and store moisture. The evidence of tillage decreasing the ability of the fungi to perform this important function means that less water may be available for use in future years.
Pictures showing the visual differences in an eroded knoll between the roller crimped and disked plots.
Left: During the growing season in 2018. Right: After disking both plots in the Fall of 2018.

This decrease in soil aggregation could also be seen visually. The above left picture is an overhead shot of an eroded knoll between a roller crimped plot (left) and a disked plot (right). The line between the two treatments can easily be distinguished as the white colour of the bare, eroded soil ends exactly at the border between the two plots. After the field was disked in the Fall of 2018 there was an even greater visual distinction between the two treatments (picture above right). This second picture has the roller crimped plot in the foreground (darker coloured soil) and the disked plot in the background (lighter coloured soil).

Picture showing the results of the slake test comparing a disked plot to a 3-year organic no-till field.

These visual observations were then tested using a slake test. The slake test is a qualitative assessment of a soil’s stability when exposed to rapid wetting. Slaking occurs when aggregates are not strong enough to withstand internal stresses caused by the rapid water uptake (www.soilquality.org). We had the opportunity to perform a slake test at the recent Soil and Weeds workshop held at Organic Connections in Regina, SK on November 1st, 2018. We submitted a sample from the disked plot with the eroded knoll
and compared it to another field that we have had not tilled for 3 years. When the sample from the disked plot was put into the water it completely disintegrated within minutes. However, the sample from our 3-year organic no-till field was still intact after more than 6 hours in the water. This showed the presence of good soil aggregate formation in the no-till sample.

In summary although we didn’t see any difference in the soil moisture content, we did observe positive changes in both the physical (total organic carbon) and biological quality (fungal strand length) of the soil in the roller crimped treatments. This demonstrated to us the importance of implementing practices, such as roller crimping, that protect and promote the biology of our soils. We look forward to seeing how these changes benefit yields in 2019.

6. What will you do differently on your farm now?

We have shown that roller crimping green manure crops has the ability to increase soil carbon and biology in organic systems. Leaving the soil undisturbed during the green manure year allowed for the soil biology to work at breaking down the crimped crop and store this carbon for future use. It also allowed the biology to establish and start to repopulate which will also prove to be very important in future crop years. However, the pressure of perennial weeds proved to be a major factor in the establishment of a cash crop in a roller crimped system. It is vitally important that enough moisture is present to ensure that there is enough top growth available in order to provide a mulch layer to compete with weeds in the following crop year. Due to extremely dry conditions in 2017 we were not able to produce enough of a green manure crop to provide an effective mulch layer.

We see real potential in using the roller crimper to terminate green manure crops and our next challenge is to successfully grow a green manure crop under extremely dry conditions to provide good weed competition. Even with some tillage occurring in the early spring the year after the roller crimper was used, we still observed a substantial increase in total organic carbon. This shows that if the soil is left undisturbed in the green manure year, benefits will be seen in the following crop year.

7. Anything else you would like to share with us?

We wish to express our gratitude and appreciation to the Prairie Organic Grain Initiative for providing the funding for this project.

Please submit report to Tierra Stokes
Email: tierra.stokes@organicalberta.org
Fax: 1-780-989-2488
Mail: Attn: Tierra Stokes Unit #1 10329 61 ave, Edmonton, AB T6H 1K9