No-till Cropping of Cabbage to Improve Soil Health

On-Farm Demonstration Research Manual

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Background

Non-soil-disturbance growing approaches (no-till) have many potential benefits, including the improvement of soil structure and biology leading to increased soil organic matter and balanced nutrient release (O'Hara 2020). A challenging aspect of no-till is the termination of the previous crop, with different approaches being used and trialled. Lounsbury *et al.* (2018) assessed the impact that solarization using black or clear tarps had on cabbage yield compared to using no tarp on cover crops in a no-till production system. While there was evidence that both clear and black tarps could effectively terminate the cover crop composed of hairy vetch and rye, black tarps increased cabbage weight by 58% compared to rolling and crimping alone. Christopher *et al.* (2009) paired no-till and conventional-till fields in 12 sites across seven U.S. States to assess any differences in carbon sequestration between the two production systems. In this study, they did not find an increase in soil organic carbon following no-till practices compared to conventional tillage. In a two year study by Halde *et al.* (2014) different cover crops and cover crop mixes were established over the course of one year, followed by mulching using a roller crimper, with a wheat crop directly seeded in the mulches. In this study, tillage occurred when planting the cover crops and in the fall after the wheat crop. Total above ground nitrogen uptake by wheat and weeds was the greatest when pure vetch, barley/vetch, and pure pea mulches had been planted. Wheat production with mulches containing hairy vetch were comparable to similar no-till organic wheat production in the region. Kornecki and Kichler (2022) assessed recurring rolling/crimping as a way to terminate a crimson clover/cereal rye cover crop mix before direct seeding bush beans. Crimping/rolling three times provided the highest cover crop termination rate and, when averaged across all three growing seasons, yield trended higher in rolling/crimping treatments compared to no rolling/crimping, although not statistically significant. There are many no-till approaches that farmers can adopt with a wide range of benefits. On-farm demonstration research is a way to evaluate which approach will work best for individual farmers. Demonstration research can be replicated over a few years to gain confidence in the results.

Objective & Research Questions

The objective of this on-farm demonstration research is to evaluate the effect of adopting no-till practices on cabbage yield and soil health, with an overarching goal of increasing carbon sequestration.

The research questions that this project will be addressing are:

1. Do no-till practices increase soil organic matter?
2. Do no-till practices provide comparable yield to conventional tillage in a cabbage crop?

Trial Design

In order to evaluate the effect of no-till, this demonstration trial will consist of one cabbage bed (Control) that will be farmed using normal tillage practices, compared with a cabbage bed (No-till) that will be grown using no-till practices (Fig. 1). Each bed will be 6 feet wide by 150 feet long including wheel tracks, with a bed top of 42 inches.

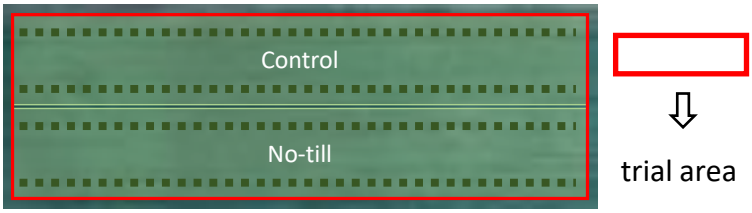

Figure 1. Trial layout consisting of two treatments- a control bed and a no-till bed.

Materials List

- Flail mower
- 75 lb. Kraft Paper Roll- 48 in. x 475', Uline Canada, Ontario
- Four tractor bucket loads of compost, Sea-to-Sky Soils, Whistler
- Marker
- Soil probe and bucket
- Plastic bags for soil samples
- Scale
- Datasheet
- Camera

Methodology

Year 1 (2022)

1. Establish fall rye/crimson clover cover crop in the trial area (Fig. 2a).

Year 2 (2023)

1. Flail mow the cover crop in spring in the no-till bed and till in the cover crop in the control bed.
2. Spread one bucket load of compost in each bed.
3. Layout one layer of the 48 inches wide paper over the no-till bed (Fig. 2b).
4. Spread one bucket load of compost again in each bed. Till the control bed prior to planting (Fig. 2c).
5. Set up irrigation in the trial area to wet the paper prior to planting.
6. Plant two rows of cabbage transplants in both the no-till and control beds.
7. All fertilizer and amendment inputs should be the same in both treatments.

Year 3 and 4 (2024 & 2025) - *activities not described in this manual*

1. Possible crop succession would be lettuce in 2024 and squash in 2025, continuing to observe no-till practices in the no-till bed and normal cultivation practices in control bed.

Figure 2. Established fall rye/crimson clover cover crop (a), layer of paper in no-till bed (b), the no-till bed (left) and the control bed (right) ready for planting (c).

Data Collection and Evaluation

Soil sampling

Soil samples will be taken in spring 2023 to establish a baseline. Soil samples will then be taken post-harvest on a yearly basis for the duration of the trial (2023, 2024, and 2025).

Figure 3. SOM will be evaluated from soil testing.

Samples will be collected using a soil core (2.5 cm diameter) from 15 random locations in each treatment (Fig. 3). Samples will be taken and separated into two depth categories, which will be 0-15 cm and 15-30 cm. For each treatment and depth categories, soil from all cores will be mixed together to obtain one composite sample. Laboratory analysis of soil samples will be completed by the Terralink Plant Science Lab in Abbotsford, BC.

The specific parameter that will be evaluated will be soil organic matter (SOM) level build-up over time (3 years) in the no-till treatment compared to the control.

Yield

Total yield (lbs.) per bed and total number of heads for both the control and the no-till treatment will be recorded at harvest. Total yield per head will be compared between treatments.

Record-keeping:

The following information should be recorded for future referral (see attached datasheet):

Dates: mowing of cover crop, laying paper, applying compost, watering prior to planting, planting, harvest, soil samples (spring 2023, fall of each year).

Data collected: SOM, yield, extra time spent on no-till bed. General observations such as differences in pest pressure should also be noted.

Photos: Cover crop prior to mowing, beds at planting, beds mid-summer, beds at row closure, harvest.

Potential Funding Options

1. BC Climate Agri-Solutions Fund (BCCAF) – Cover Cropping & Nitrogen Management.
2. Environmental Farm Plan/Best Management Practices (EFP/BMP) funding – Cover Cropping (Practice Code 1304) and Reduced Tillage (Practice Code 3305).

Trial Schedule	
Date	**Description of Activities**
Spring 2023	Take baseline soil samples
May-June 2023	Flail mow cover crop, apply paper, compost, and water
Early June 2023	Plant cabbage transplants
Mid September 2023	Host a field day before harvest
Early October 2023	Harvest cabbage and collect yield data
October 2023	Take post-harvest soil test
Fall 2023	Analyse data and prepare a trial summary
2024 & 2025	Repeat trial with lettuce and squash in same trial area

Budget for Supplies (new)		
Item	**Description**	**Cost**
Paper	75 lb. Kraft Paper Roll- 48 in. x 475', Uline Canada, Ontario	$110
Compost	Four tractor buckets @ $45/bucket of Organic Boost Compost, Sea-to-Sky Soils, Whistler	$180
2023 soil tests	Terralink Plant Science Lab fees: $92.50 per sample, 8 samples	$740
Plastic bags	Large plastic bags for soil sampling	$10

Labour (outside of normal farm practices)		
Item	**Description**	**Hours**
Soil sampling	Two samplings	4
Flair mowing	Initial flail mowing of the cover crop	0.5
Paper	Laying out paper	0.5
Compost	Moving and spreading compost	2.25
Irrigation	Extra irrigation to wet paper down prior to planting	0.5
Planting	Extra time planting transplants	0.5
Weeding	Extra weeding time	2
Mowing	Three extra mowing of walkways using a lawnmower	1
Field day	Promo and hosting	8
Summary	Analyse data and prepare a trial summary	8

Datasheet Template

2023 Activities	**Date**		
Mowing of cover crop			
Laying paper			
Applying compost			
Watering paper			
Planting of cabbage			
Harvest			
Soil sample #1 (spring 2023)			
Soil sample #2 (fall 2023)			

Soil sampling

Treatment	Timing	SOM 0-15 cm	SOM 15-30 cm
Control	Spring 2023		
No-till	Spring 2023		
Control	Fall 2023		
No-till	Fall 2023		

Yield assessment

Treatment	Head #	Total Lbs	Lbs/head
Control			
No-till			

General observations

Treatment	Notes
Control	
No-till	

Extra activities/time spent on no-till bed compared to control bed

Activity	Date	Control Time	No-till Time

References

Christopher, S. F., Lal, R., and Mishra, U. 2009. Regional study of no-till effects on carbon sequestration in the midwestern United States. *Soil Science Society of America Journal*. **73**:207-216.

Halde, C., Gulden, R. H., and Entz, M. H. 2014. Selecting cover crop mulches for organic rotational no-till systems in Manitoba, Canada. *Organic Agriculture and Agroecology*. **106**: 1193-1204.

Kornecki, T. S., and Kichler, C. M. 2022. Influence of recurrent rolling/crimping of a cereal rye/crimson clover cover crop on no-till bush bean yield. *Agri Engineering*. **4**: 855-870.

Lounsbury, N. P., Warren, N. D., Wolfe, S. D., and Smith, R. G. 2018. Investigating tarps to facilitate organic no-till cabbage production with high-residue cover crops. *Renewable Agriculture and Food Systems*. **35**: 227-233.

O'Hara, B. 2020. No-till intensive vegetable culture. Chelsea Green Publishing, White River Junction, Vermont.