Trial Four

Cover Cropping Demonstration

Summit Acre Farms

Seeding Date: June 20, 2023

Previous Crop: LL Canola

Cover Crop Mixture: Field Peas with Red Clover, Turnip, Radish and Hairy Vetch

Trial Area: Pineview, BC

PEACE REGION
LIVING LAB

Cover Cropping Demonstration

Summit Acre Farms – Pineview, BC

Project Goal: To utilize cover crops in an annual cropping system to help break up soil compaction and improve soil health.

Background: This field is part of the 5 year living lab project that will compare this field (BMP) with and adjacent field (Check) where a continues cropping system will be done over the same time period. The producer wanted to compare these two fields and determine if by planting a cover crop there will be an improvement to reduce compaction, increase water infiltration and increase yield.

Previous Crop: LL Canola

Seeding Date: June 20, 2023

Cover Crop Mixture: Field Peas, Red Clover, Turnip, Radish, and Hairy Vetch.

Fertility: No additional fertility was added.

Soil Moisture: Within 4 days of finishing seeding the cover crop there was 26.15mm (1.028 inches) of rain, which created optimum moisture conditions for germination and establishment. It should be noted that prior to this rainfall, soil moisture conditions had been depleted due to lack of precipitation. The producer did note that as the field had no disturbance since fall 2022, the previous crop trash layer assisted with moisture retention.

Soil Temperature: Although no temperature was taken at the time of seeding, there has been two months of warm dry conditions, making the soil temp warm.

Seeding Rate: Peas: 1.5 bu/ac (seeded at deeper depth); and

Custom Blend: Red Clover 10lbs/ac, Radish 2lbs/ac, Turnip 1lb/ac, and Hairy Vetch 1lb/ac. (custom blended together, and seeded out the same shoot).

Seed Cost: $44.38/ac (Custom blend $3.17/lb * 14lbs/ac) Peas seed $20/ac = $65/ac

Equipment costs: Custom seeding rate $30/ac (includes Seeding equipment + operator + support equipment)

TOTAL Cost: **$95/ac**

Weed Control: Pre seed glyphosate application at a rate of .67l/ac of 540gm prior to seeding was completed.

2024 Cropping Plan: Allowing of Red clover regrowth creating an additional cover crop year.

Spring Conditions at time of baseline measurements

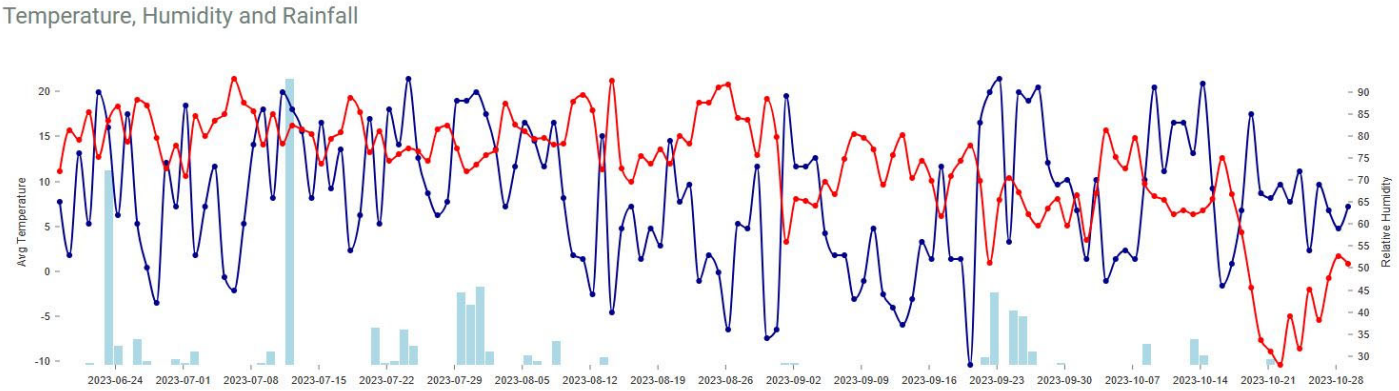
Weather Data: Nearest Weather Station located (@ Bickford Farms) approximately 5 miles north west across the Montney Creek. According to producer weather pattern in 2023 were quite unpredictable with intermittent rainfall events that rainfall information to be slightly more than weather station data indicated.

Using the data collected from the local BC Peace weather monitoring station, the Growing Degree Days can be determined for this trial location. Growing Degree Days (GDD) are determined by calculating the accumulated heat units above a base temperature threshold, typically 10 degrees Celsius, during the growing season. The formula is: GDD = (Max Temperature + Min Temperature) / 2 - Base Temperature.

Weather Data — Bickford Station		
	May 1- Sept 30	June 20- Oct 28
Total Rainfall	205.99mm	156.46mm
Average Temperature	13.2C	11.8C
Highest Temperature	31.8C	31.8C
Normal Rainfall	270.61mm	215.09mm
% Normal Rainfall	70%	73%

Growing Degree Days	**June 20, 2023**	**To**	**October 28, 2023**
# Days of Growth	131		
	Actual	**Normal**	**% of Normal**
GDD Base 0C	1836	1496	123%
GDD Base 5C	1221	897	136%
GDD Base 10C	649	400	163%

Weather Chart June 20th (Seeding) to Oct 28th



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Baseline Sampling Summary

Dr. Sahel Miladi Lari

BC Grain Chief Scientific Officer Dr. Sahel Miladi Lari provided a summary of the sampling that was completed comparing this field (BMP) and Adjacent field (Check) these samples were taken as a baseline to be utilized over the duration of the Living Labs project. These measurements were taken May 12, 2023 prior to the seeding of the cover crop on June 20, 2023.

Soil Compaction

One of the main goals of this Cover cropping BMP is to utilize a non mechanical control to mange compaction. Soil compaction is a process that reduces the pore space between soil particles, making it harder for water, air, and plant roots to move through the soil. Soil compaction can be caused by various factors, such as heavy machinery, tillage, animal traffic, and rainfall. Soil compaction can have negative impacts on crop growth, soil health, and environmental quality. The producer has noted that compaction on this field appears to be higher than on the adjacent check field.

Effects of Soil Compaction

Some of the effects of soil compaction are:

- Decreased water infiltration and drainage, leading to more runoff and erosion.
- Reduced soil aeration and oxygen availability, affecting soil microbial activity and nutrient cycling.
- Increased soil strength and bulk density, limiting root penetration and exploration.

Altered soil temperature and moisture regimes, affecting seed germination and plant development.

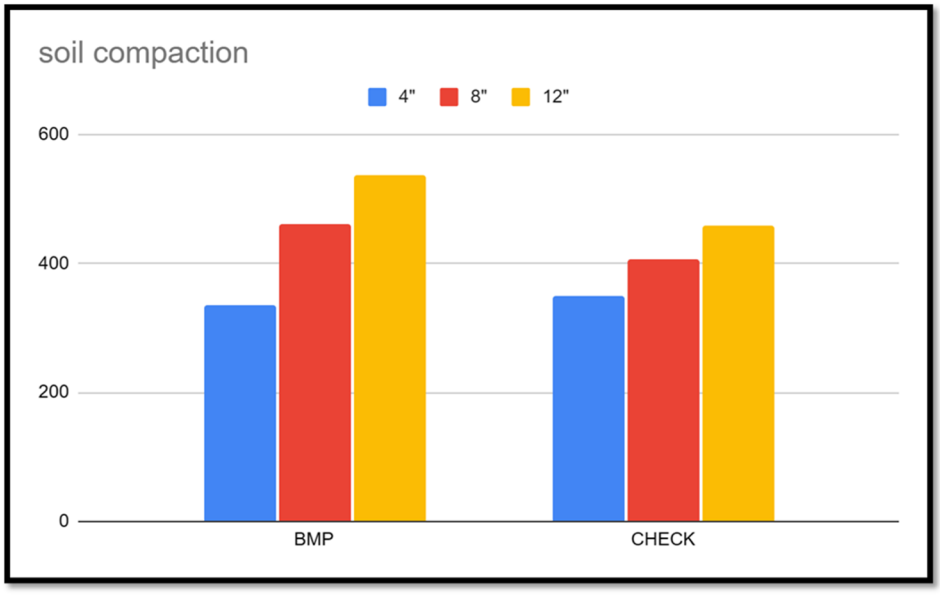
Management Practices to Prevent or Reduce Soil Compaction

To prevent or reduce soil compaction, some of the management practices are:

- Avoiding field operations when the soil is wet or moist.
- Reducing the weight and frequency of machinery and equipment on the soil surface.
- Using controlled traffic or tramline systems to confine wheel traffic to specific paths.
- Increasing soil organic matter and biological activity to improve soil structure and aggregation.
- Applying cover crops, crop rotations, and reduced tillage to enhance soil diversity and resilience.

Soil Compaction Measurement

For this project, the SpotOn Digital Soil Compaction Meter was used to measure the soil compaction. The chart below shows the average soil compaction of BMP and check at different depths (4”, 8”, and 12”). The data indicate that the soil compaction in check was lower than in BMP at all depths except at 4” depth, where BMP was lower than check.



Increased Water Infiltration: Compacted soil can hinder water infiltration, leading to runoff and erosion. Cover crops with deep-rooting systems can break up compaction, allowing water to penetrate the soil more effectively. This helps improve soil moisture retention and reduces the risk of waterlogging. In recent years, the BC Peace Region has experienced many instances of significant rainfall in a short time frame followed by prolonged dry periods. Ability for water to infiltrate rather than drain off can improve moisture availability to plants throughout the growing season while decreasing erosion damage. Dr. Sahel Miladi Lari was able to provide the following summary detailing the baseline water filtration results from sample that was completed prior to seeding of cover crop.

Single Ring Infiltration Results[1].

To calculate the infiltration rate, used the following formula.

$$I = \frac{V}{A \times t}$$

where I is the infiltration rate (cm/min), V is the volume of water is the cross-sectional area of the pipe and t is the time (min). Using this formula, we can calculate the infiltration rate for each sample point in both BMP and CHECK methods. (See charts below)

To compare the two methods, we can calculate the average infiltration rate for each method and see which one is higher. The average infiltration rate is the sum of the infiltration rates divided by the number of sample points. Here are the results:

BMP: Average infiltration rate = 0.3651 cm/min
CHECK: Average infiltration rate = 1.9186 cm/min

Therefore, we can conclude that the CHECK method has a higher average infiltration rate than the BMP method, which means that the soil in the CHECK area is more permeable and allows more water to infiltrate. This could be due to different soil types, compaction, vegetation, or other factors that affect the soil structure and porosity.

Infiltration Rates for BMP

Sample Point #	GPS Coordinates	Time (min)	Infiltration Rate (cm/min)
1	56 41.311 -121 05.582	0.5	0.6283
2	56 41.295 -121 05.535	0.4333333333	0.7264
3	56 41.269 -121 05.565	0.6833333333	0.4608
4	56 41.245 -121 05.511	0.7333333333	0.4296
5	56 41.197 -121 05.544	4.15	0.0759
6	56 41.173 -121 05.587	0.9666666667	0.3256
7	56 41.140 -121 05.530	12.3	0.0256
8	56 41.113 -121 05.561	0.5	0.6283
9	56 41.090 -121 05.517	3.766666667	0.0836

Infiltration Rates for Check

Sample Point #	GPS Coordinates	Time (min)	Infiltration Rate (cm/min)
C1	56 41.329 - 121 05.392	0.08333333333	3.7699
C2	56 41.288 - 121 05.341	0.1	3.14
C3	56 41.253 - 121 05.385	0.1666666667	1.8849
C4	56 41.231 - 121 05.342	0.1833333333	1.7136
C5	56 41.196 - 121 05.413	0.15	2.0933
C6	56 41.188 - 121 05.374	0.06666666667	4.7100
C7	56 41.159 - 121 05.328	0.3833333333	0.6519
C8	56 41.143 - 121 05.388	0.5166666667	0.4833
C9	56 41.121 - 121 05.343	0.2833333333	0.8816

Benefits & Challenges of Introducing Cover Crops

Benefits

Nutrient Cycling and Retention: Cover crops take up excess nutrients from the soil, preventing leaching and nutrient runoff. When cover crops decompose, they release these nutrients back into the soil, improving nutrient availability for subsequent crops. This cycling of nutrients reduces the need for synthetic fertilizers. The addition of nitrogen fixating species such as peas and clovers utilizes natural processes to build nitrogen within soils. Continued monitoring will be done to access the nutrient benefits of this cover crop in the future.

Weed Suppression: Cover crops can act as a natural weed suppressant by competing for resources such as light, water, and nutrients. By reducing weed pressure therefore also reducing herbicide usage, promoting an integrated weed management approach.

Soil Erosion Control: Compacted soil is more prone to erosion, especially during heavy rainfall events. Cover crops help protect the soil surface from erosion by intercepting raindrops, reducing runoff, and improving soil structure. Infiltration & compaction testing will be completed on this field for the duration of the project to access how these changes over time.

Biodiversity and Habitat: Cover crops provide habitat and food sources for beneficial insects and microorganisms. This promotes biodiversity in agricultural landscapes and supports natural pest control, reducing the reliance on pesticides.

Challenges

Timing and logistics: Choosing the right time to plant was challenging especially given the drought conditions prior to seeding, and the need to fit within the existing crop rotation and management practices. As the seeding of this cover crop is also at the same time that spraying operations are taking place there were additional labour allocation challenges.

Competition with cash crops: As cover cropping essentially take a year out of revenue generating crops there is a revenue loss that is created, for smaller farms or farms with reduced ability to withstand reduction in cash flow there are significant financial risks. Unless farm has ability to take additional yield & soils information following cover crop implementation there can be challenges in determining the direct cost & soil health benefits.

Challenges Continued ...

Species Selection: Selecting the appropriate cover crop species and varieties that are well adapted for the unique Peace Region climate can be difficult, as the growing season is generally shorter. Factors such as climate, soil type, and desired outcomes need to be considered. Different cover crops have varying growth habits, nutrient requirements, and disease susceptibility which can impact their effectiveness.

Seed Availability and Cost: Local availability and affordability of cover crop seeds can be a challenge, especially for less common or region-specific species. Seed supply for many cover crops may be limited in the Peace Region and producers may have to source seeds from other regions, which can increase the risk of importing invasive weeds or diseases that can have long-term impacts to farming operation. Seed costs are also high for custom mixtures and with no cash revenue generation from expense.

Weed Management: While cover crops can help suppress weeds, they can also introduce weed species if not managed properly. Timing of cover crop termination and ensuring effective weed control during the transition from cover crop to cash crop is important. In this cover cropping project volunteer canola from the previous year became a particular challenge as pre seed glyphosate herbicide application was unable to control LL volunteer canola and in some areas of the field the volunteer canola outcompeted the cover crop.

Integration with Existing Equipment and Practices: Modifying or adapting machinery and equipment to accommodate cover crops can be a hurdle. For example, planting or terminating cover crops may require adjustments to seeding or tillage equipment. The producer was able to utilize a double shoot seeding implement to seed the peas deeper (fertilizer band) and the cover crop seed mixture in a shallower seeding depth improving the seed to soil contact for germination and establishment. The producer also identified that challenges with surface plant growth may be difficult to manage with their current equipment.

Wildlife Damage: As cover crops are late season, they are at peak vegetative growth after most annual crops have been harvested making cover crops very attractive to wildlife species such as deer, moose, water fowl, and bears. Producer noted significant wild life during later fall period: at one point 20 moose and approx. 100 deer were grazing on this cover crop area.

Knowledge and expertise: Implementing cover crops effectively requires knowledge of their benefits, management techniques, and potential challenges.

Changes to Scope of Project

Livestock Integration: Although the original intention of this cover cropping project was to grow the cover crop and have it terminated by environmental conditions (frost) or through herbicide. Drought conditions in the Peace Region during the 2023 growing season made this cover crop a valuable feed source. The producer made the decision to install temporary fencing and graze this cover crop. Although not intentional, this operation created an additional scope to this project.

Grazing Information: 80 cow calf pairs (born May 2023) grazed for 22 days starting October 28, on the north 96 acres. Additional grazing may be added. The producer did not graze the remaining portion of field as he wanted to compare grazing vs no grazing. It should be noted the part of the field that was left as check, was the worst part for soil health and drainage.

Benefits of Livestock Integration into Annual Cropping System:

Enhanced soil health: Cattle grazing can help improve soil structure and fertility by trampling plant residues, incorporating organic matter into the soil, and stimulating nutrient cycling through their manure.

Weed and pest control: Grazing animals can help control weeds by consuming and trampling them. Additionally, they can reduce pest pressure by breaking up pest life cycles and disturbing habitats.

Nutrient cycling: Cattle grazing on cover crops or crop residues can recycle nutrients by consuming plant material and returning it to the soil through their manure. This can reduce the need for synthetic fertilizers and improve nutrient availability for subsequent crops.

Diversification and risk management: Integrating livestock into cropping systems provides an additional income stream. It can help spread financial risks by reducing dependence on a single commodity.

Improved forage utilization: Grazing cattle on cover crops or crop residues can help utilize plant material that would otherwise go to waste. This maximizes the use of available resources and reduces feed costs

Challenges of Livestock Integration into Annual Cropping System:

Compaction: Cattle integration can cause soil compaction especially as livestock tend to follow same pathways and concentrate in areas or increased feed, water, or shelter. This soil compaction can negatively affect soil health and water infiltration.

Inc*reased labour:* To effectively graze a cover crop and ensure even distribution of manure additional labour and infrastructure many need to be put in place. For example: installing of fencing, more labour to move temporary fencing, creating water sources, and hauling of water.

Future Challenges

2024 Identified Challenges / Benefits:

Vegetative growth management: In traditional annual cropping systems, straw management is done via combines through a straw chopper. The producer has identified that the surface growth of this cover crop is significant, and although this will be a great long-term addition of soil organic matter there will management strategies to be considered in the interim. The hoe type openers on their existing drill may not be able to seed effectively into the increased debris levels of trash that may be on the surface. This increased vegetative debris may cause hair pinning, plugging, and poor seed placement for future crops. Producer is seeking out options such as: mowing or different tillage equipment; aim to not continue to graze any livestock past June 2024; and remove any growth by aggressive tillage that could impede the root pathway water infiltration created by the decaying turnip/ radish root structure.

Reduced Revenue: An additional year of lost cash revenue may be a challenge especially with increased cost of production. Integration of livestock may an additional cash value.

Timing and Logistic: As an additional seeding pass is required for 2024 because the red clover is already seeded there is a decrease in spring /harvest work load.

Weed Control: As there are limited herbicides that can control weeds in a red clover stand additional weed control practices may need to be implemented, should a challenging weed species emerge.