

# Trial One

## Plowing Vs Minimum Tillage

### Wide Spread Farms



Plow

Minimum Tillage

**Seeding Date:** May 5, 2023

**Harvest Date:** September 11, 2023

**Variety:** Metcalfe Barley

**Trial Area:** Buick, BC



**PEACE REGION**  
LIVING LAB

# Effects of Plowing on Long-Term Minimum Tillage Soil Management System

## Wide Spread Farms – Buick, BC

**Project Goal:** To compare the effect of plowing in a long-term minimal tillage field on infiltration, compaction and yield. .

**Project Description:** A tillage trial contrasting the effects of: an annual fall plowing tillage pass (BMP) to long term one pass minimal tillage (CHECK), in the same field.

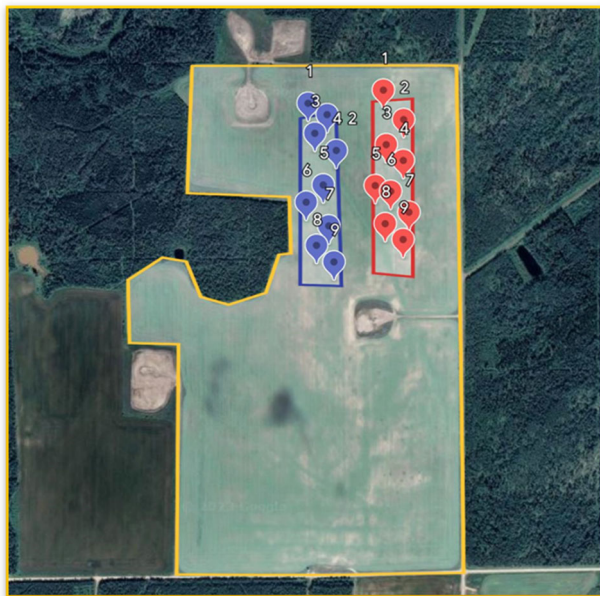
After the fall harvest of 2022, in a 212 acre long-term minimal tillage field, the producer plowed a 45 acre area (BMP) to compare with the remaining 167 acres of long-term minimum tillage (check). In 2023, both the plowed and minimal tillage areas were planted using direct seeding by hoe type opener in an annual cropping situation (barley). Both the BMP and check areas were managed with the same practices throughout the 2023 growing season. This project site is part of the 5 year living lab project (2022-2026) Plowing will continue each fall in the BMP area for the duration of the 5 year project.

**Project Background:** Minimum tillage / zero tillage systems have been widely adopted in grain and oilseed production across the BC Peace Region.

Zero tillage, while offering several benefits such as: reduced soil erosion, improved moisture retention, and reduced fuel usage; can also have some negative effects on the soil. These may include: increased soil compaction, reduced organic matter decomposition, and potential for increased weed pressure. Additionally, in some cases zero tillage can lead to the accumulation of crop residues at the soil surface, which may affect soil warming and seedling emergence.

Along with the above challenges, in recent years grain & oil seed producers in the region have been noticing a decline in yield, and water infiltration leading to increased runoff causing erosion. Compaction of the soil can significantly hinder root penetration, reduce pore space, limit air and water movement, and make it difficult for roots to grow and spread. This can lead to stunted root development, decreased nutrient uptake, and contribute to overall reduced plant growth. Producers have begun to add more high disturbance tillage into their operations to determine if a one-time tillage pass can counteract the side effects of long-term minimum tillage. This involves using a plow to turn over the top layer of the soil, which is typically rich in organic matter and nutrients. Doing so helps aerate the soil, control weeds, break compaction layers and prepare the ground for planting crops.

**Monitoring & Data Collection:** This project is part of the 5-year long term monitoring project, but there were visual and data differences recorded already during the 2023 monitoring season. Ten acre polygons were laid out on both the plowed (BMP) and minimum tillage (check) areas, and 9 data points (following a “W” pattern) were marked to ensure data collection was collected from same spot each time. This is shown in the aerial photo below, with the **BMP in red** and **check in blue** .

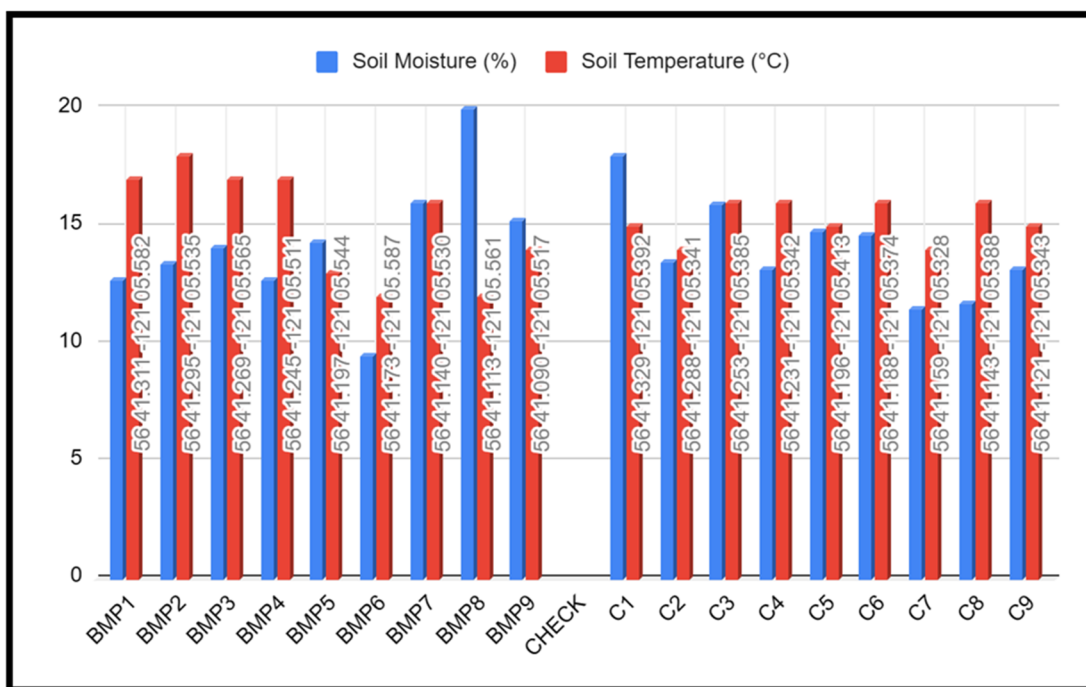


Data that was collected from each of these points, for both the BMP and check areas, included:

- Soil temperature & moisture
- Soil compaction
- Crop residue
- Infiltration
- Visual observations
- Yield

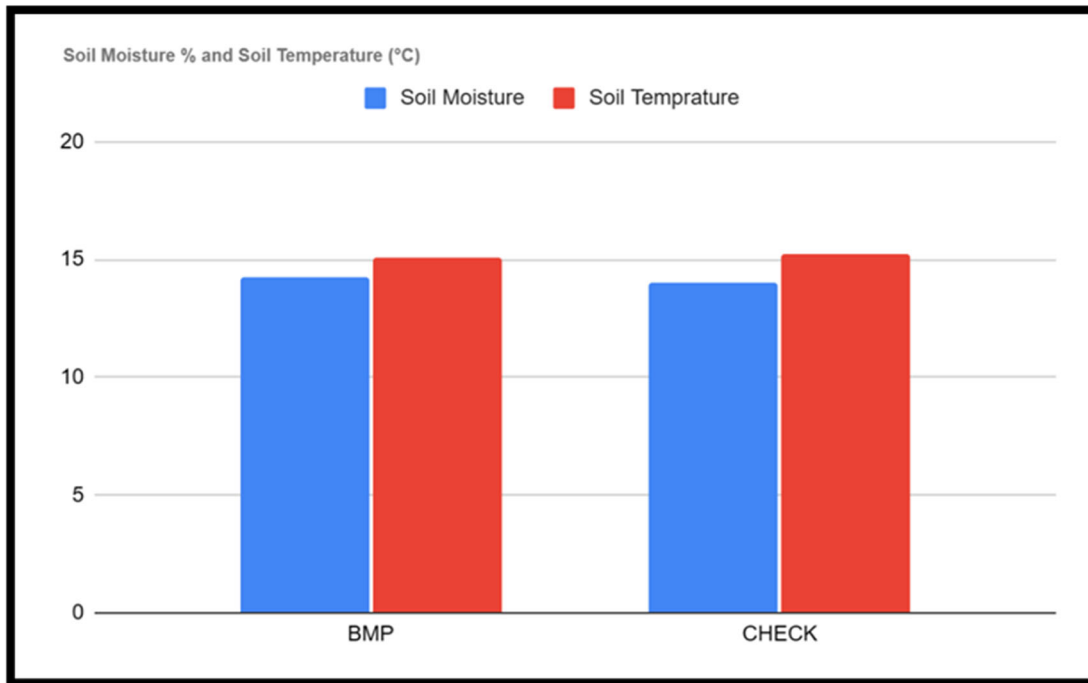
BC Grains Chief Scientific Officer Dr. Sahel Miladi Lari provided the following summary of the information collected from the 9 data points within a 10 acres polygon of each treatment:

*Soil Temperature & Moisture:* This was measured using a digital thermometer on the surface soil (0-15 cm or 0-6”), while soil moisture was measured using a soil moisture probe. The chart reveals that the highest temperature and moisture levels in BMP were recorded at point 2 and point 8, respectively. The lowest temperature and moisture levels in BMP were both observed at point 6. In check, the highest moisture level was found at point 1, while the highest temperature levels were shared by points 3, 4, 6, and 8. The lowest temperature level in check was recorded at point 7.



The chart above shows the soil temperature and moisture levels at the nine different points within the 10 acre polygons for both the plowing (BMP) and minimum tillage (check).

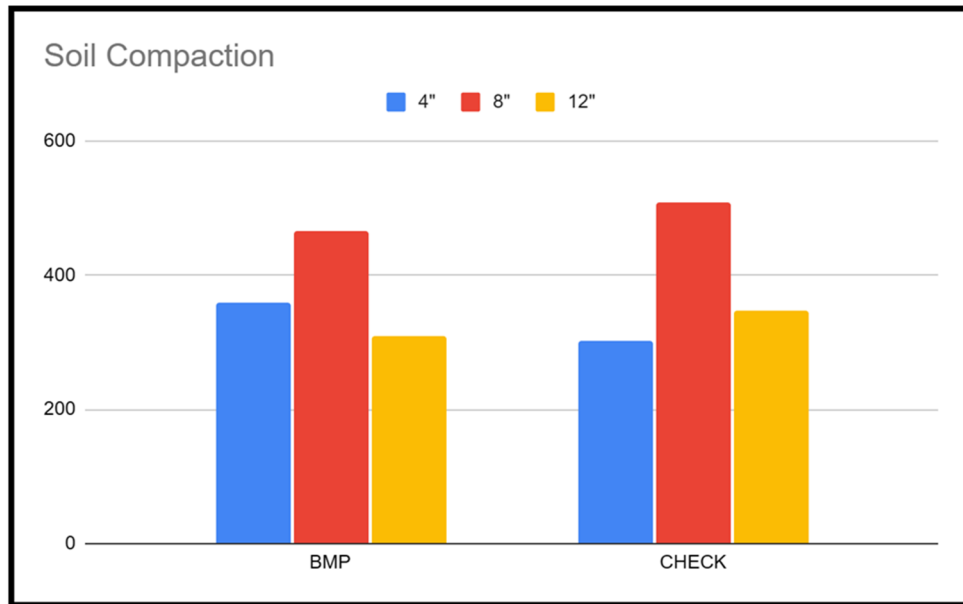
The chart below compares the average soil moisture and temperature in BMP and check. The percentage moisture in BMP was higher than check, and the temperature was lower than check.



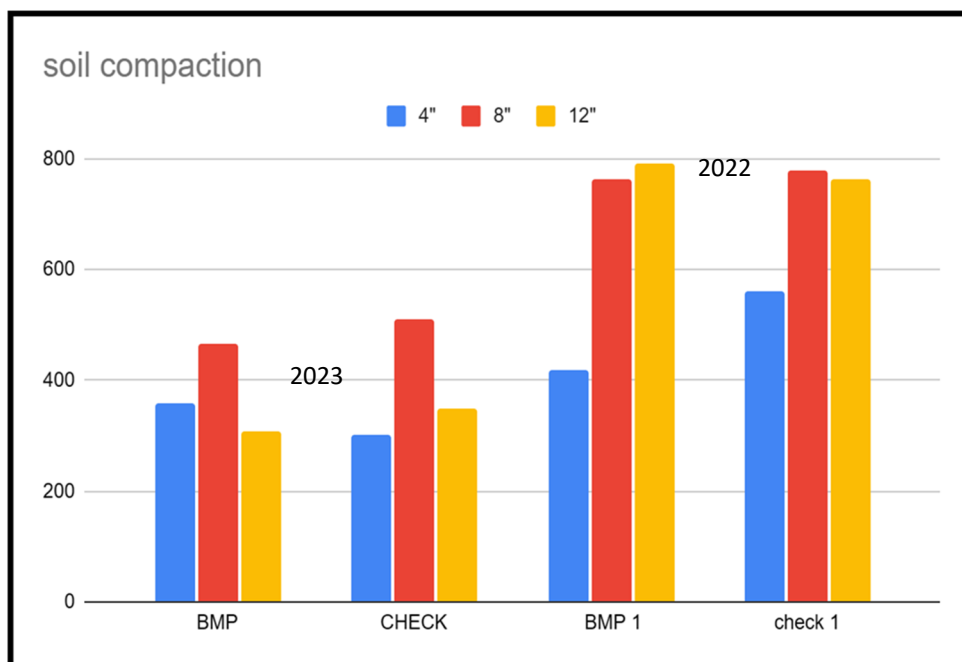
Soil moisture and temperature are two important factors that affect the carbon sequestration potential of different cropping systems. Carbon sequestration is the process of storing carbon in the soil and preventing it from entering the atmosphere as greenhouse gases. This can help mitigate climate change and improve soil quality. Soil moisture and temperature influence the decomposition and stabilization of soil organic matter, the activity and diversity of soil microorganisms, the rates of photosynthesis and respiration, and the growth and yield of crops. Plowing enhances soil moisture relative to minimum tillage due to several factors. First, plowing generates a finer soil texture that retains more water than the coarser texture of minimum tillage. Second, plowing conceals the crop residues or mulch that otherwise diminish water loss from the soil surface by evaporation and transpiration. Third, plowing facilitates water infiltration and storage in the soil by eliminating the compacted or crusted layers that obstruct water movement.

## Soil Compaction:

**Soil compaction** is the reduction of soil pore space due to external pressure, such as from machinery, animals, or human activities. It can reduce **water infiltration**, **aeration**, **drainage**, and **root growth**, leading to lower crop yields and higher susceptibility to drought and erosion. The SpotOn Digital Soil Compaction Meter was used to measure the soil compaction.



The chart below shows the change in soil compaction from 2022 to 2023. Soil compaction is the process of increasing the density of soil by reducing the air spaces between the soil particles. Soil compaction can have negative effects on plant growth, water infiltration, and soil biodiversity. According to the chart, soil compaction decreased in 2023, indicating an improvement in soil quality. The data for 2022 were obtained from BMP-1 and check 1 methods.



### Single Ring Infiltration:

The infiltration rate depends on the soil type, moisture content, and compaction. Nine sample points were tested using this method at the site A6 on June 16th, 2023.

The infiltration rate was calculated for each sample point in both BMP and CHECK methods. Here are the results:

#### BMP – Plow Infiltration Rates

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

#### Check – Minimum Tillage Infiltration Rates

Sample Point #	GPS Coordinates	Time (min)	Infiltration Rate (cm/min)
C1	56 41.329 -121 05.392	0.0833333333	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	0.0666666667	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

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 (Plow): Average infiltration rate = 0.3651 cm/min

CHECK (Minimum Tillage): Average infiltration rate = 1.9186 cm/min

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

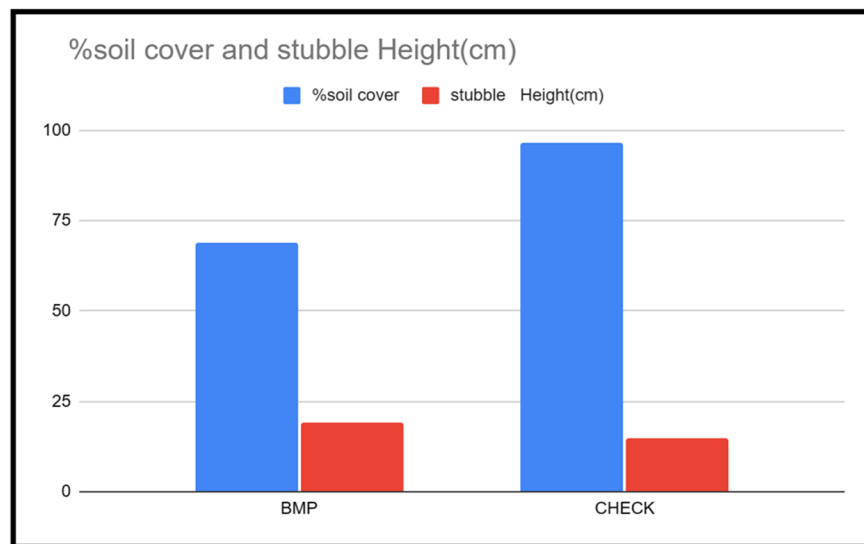


## Crop Residue:

Crop residues are the plant materials that remain in the field after harvesting the crop. They have various roles in agriculture and the environment, such as:

- Improving soil health by adding organic matter, nutrients, and biological activity.
- Reducing soil erosion by protecting the soil surface from wind and water.
- Enhancing water conservation by increasing infiltration and reducing evaporation.
- Mitigating climate change by sequestering carbon and reducing greenhouse gas emissions.

Measurement of crop residue was taken by using a meter stick marked into 25 equal segments and counting crop residue coverage in the 25 segments.



## Crop Residue Visual Assessment



Minimum Tillage—CHECK



Plow—BMP

**In Crop Observations:** Field inspections were completed at three different time periods throughout the growing season.

June 16, 2023: Soil moisture, temperature, compaction, and infiltration measurements were taken.

August 4, 2023: Soil compaction measurements taken, and visual root observations were made.

September 26, 2023: Crop residue assessments were made.

#### Visual Observations—June 16, 2023



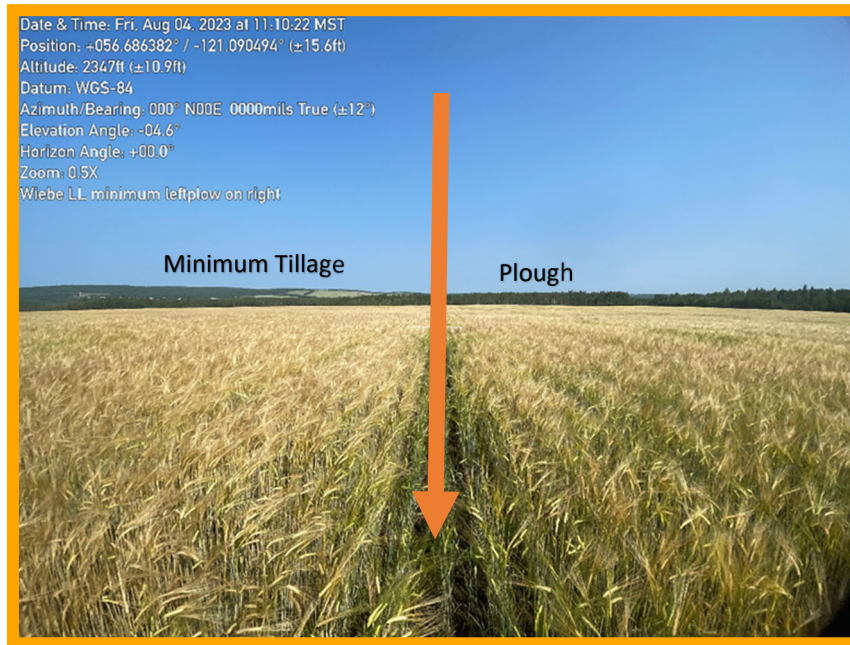
**Minimum Tillage (Check)**



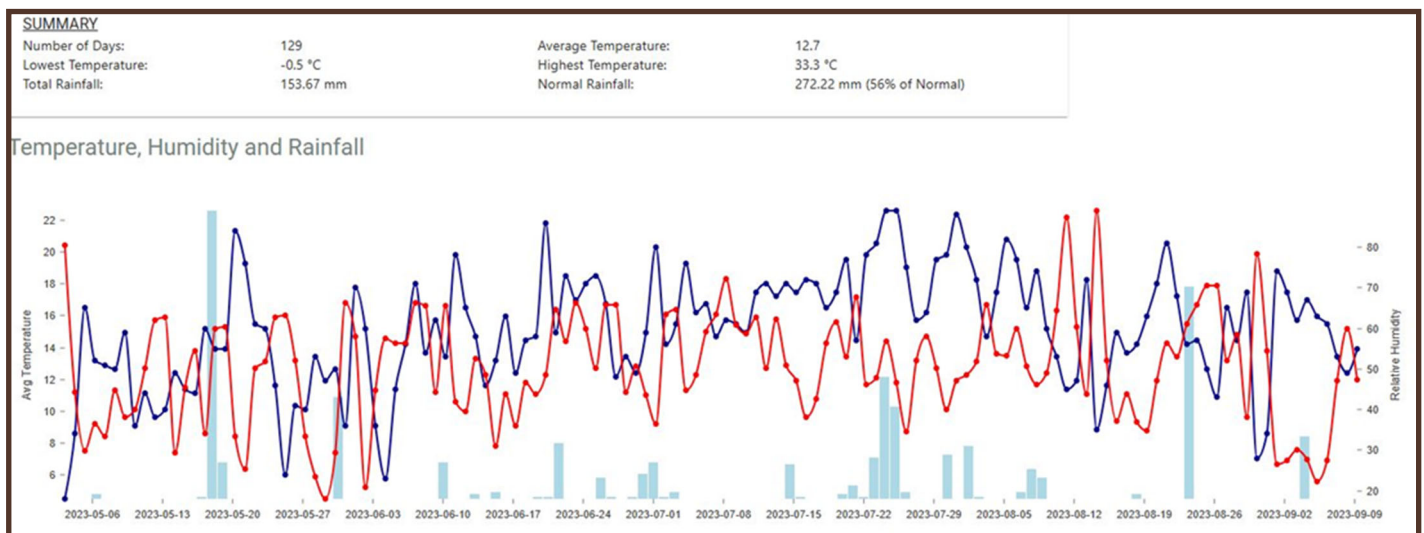
**Plow- (BMP)**



## Visual Observations Aug 3, 2023



## Weather Summary



## Crop Yield:

Yield Measurements were taken from both the BMP (Plowing) and Check (Minimum tillage) using producers combine GPS for area measurement and weigh scales on grain cart BMP (east side of field) Plow 27.5 acres @ 33,900 kgs = 33.90mt = 1.233 mt/ac **56bu/ac** Minimum till (west side) 36.5 ac @ 42,000 kg = 42.00mt = 1.17mt/ac **53bu/ac**. Giving the plowing side a **3 bushel/ ac yield advantage**. Grain samples from each the BMP and Check were sent away to the grain commission. Protein for both samples was comparable BMP= 12.7% and Check = 12.5% and Moisture was 12.2% moisture for Check and 13.5% moisture for BMP. Both samples graded a 1CW.

## Cost Comparison:

The producers cost of plowing per acre is \$48/ac including equipment, fuel and operator. (Cost may vary depending on farm and area) with the yield increase of 3bu/ac @ \$6.00 = \$18.00/ac which is 37.5% of the plowing costs the producer did not see a return on investment in the first year. This project will be monitored for 3 more years.

