Horse Creek Area Watershed Cover Crop Test Plot

2021 Harvest Results

Another growing season has come and gone in the Horse Creek Area Watershed Council's cover crop test plot. 2021 marked the seventh year of the trial and the start of a fourth rotation in the corn-soybean system. The test plot continues to test five different trials looking for potential variations resulting from the implementation of different tillage practices and the use of cover crops. Soil mapped within the plot is Rosholt sandy loam with 2-6% slopes. The multi-species cover crop includes cereal rye, daikon radish, red clover, crimson clover, berseem clover, wheat, rapeseed/canola, and oats. All other agronomic practices are the same in each plot. These trials are randomly placed and triplicated in the plot and have remained the same each year of the trial. The five trials are as follows.

Trial 1. No-till without cover crop
Trial 2. No-till with a multispecies cover crop
Trial 3. No-till with cereal rye cover crop
Trial 4. Conventional till with cereal rye cover crop
Trial 5. Conventional till without cover crop

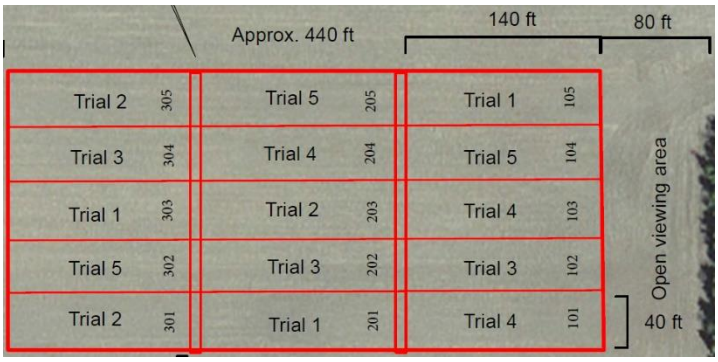

Figure 1: Plot Layout

Conventional tillage is simulated with a rotovator type attachment. The crop is planted with a no-till planter with 30-inch row spacing. Corn was planted on May 2nd. The herbicide program included two applications. The first herbicide application terminated the cover crop and any weeds prior to planting. The second herbicide application was June 1st (post-emergence) and included herbicides that provided contact and residual weed control. Surface residue cover was counted in each plot on June 7th. Differences in surface residue cover can be seen in Figures 2, and 3. Plant population counts were conducted on June 21st. Reside cover and plant population data can be seen later in this report.

Figure 2: No Till, No Cover Plot

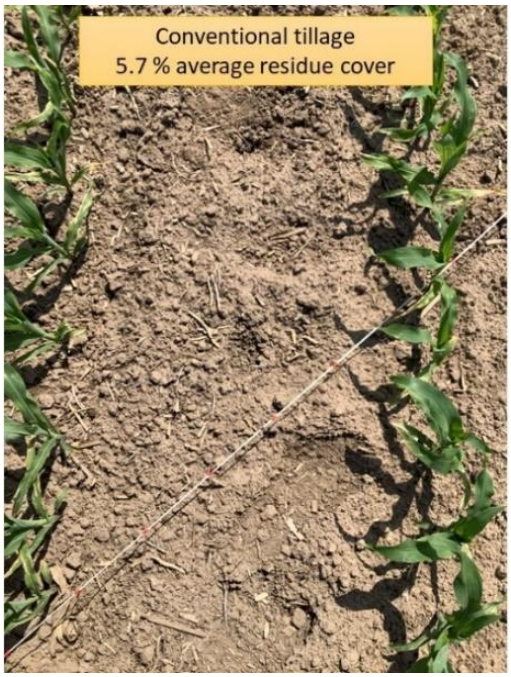

Figure 3: Conventional Plot

Differences in crop emergence and stage of plant development early in the growing season continued to be observed. On May 19th the plants in the conventional tilled plots were fully emerged while the plants in the no-till plots were just starting to poke through the soil. On June 7th the conventional plots were at the early V4 growth stage (4 leaf collars visible) while the no-till plots were at the V3 growth stage (3 leaf collars visible). These differences can be seen in Figures 4 and 5. During early vegetative growth stages a new leaf collar appears approximately every 84 growing degree days. Based on difference in vegetative stage and growing degree day accumulation, it is estimated that the conventional plots were emerged roughly 3 days before the no-till plots. On June 21st the conventional plots were at V7, and no-till plots were at V6. There was also a difference in plant height. Plants in the conventional plots were 29 inches tall and the no-till plants were 25 inches tall.

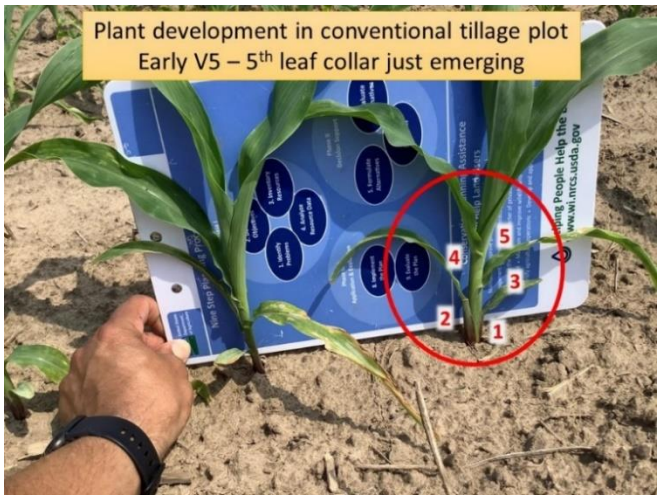

Figure 4: Conventional Plot 6/7/2021

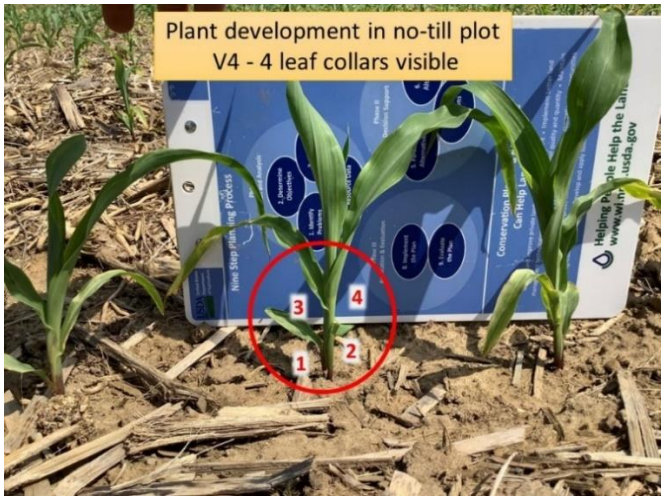

Figure 5: No-Till Plot 6/7/2021

The cover crop was seeded on August 30th. Figures 6 and 7 show differences in plant development late in the growing season. Corn plants in the conventional plots had started to show yellowing of the lower leaves and husks (Figure 6). The plants in the no-till plots were still green (Figure 7). The difference in plant maturity could be driven by a variety of factors including faster emergence due to warmer soil temperatures or slightly shallower seeding depth. Differences in plant development were also observed the previous 3 years. Differences in plant development during the tasseling, silking, or physiological maturity stages could not be confirmed due to lack of observation.

Figure 6: Plant development at cover crop planting 8/30/2021

Figure 7: Plant Development Conventional vs no-till 8/30/2021

The fall of 2021 provided optimal growing conditions for the cover crop. Temperatures stayed warm and the first frost wasn't until the middle of October. Figure 8 shows the growth of the cover crop at 14, 45, and 57 days after planting. All plots with cover crops showed exceptional above ground growth. The growth observed in the multi-species plots was by far the most above ground biomass observed out of all years of the study. An early planting date coupled with a prolonged warm fall provided the multi-species mix an extended window to grow.

Figure 8: Cover Crop Growth

The plots were harvested on October 26th. Each trial plot was harvested individually. Grain from each plot was offloaded and weighed in a weigh wagon. Grain moisture and test weight was also measured. During harvest it was noted that the outside rows of corn along the north end of the plot appeared to have some herbicide damage. The north end of the plot bordered a soybean field. It is unknown how any herbicide damage affected yield.

Infiltration and surface runoff testing was completed in the plots following corn harvest. Preliminary data shows better infiltration in the plots with no-till and/or cover crops. The full infiltration and surface runoff data will be analyzed and presented in a supplemental document.

2021 Data Analysis

Plant population, percent residue cover, and yield data are presented in the following 3 tables. Table 1 summarizes trial averages for plant population, residue cover, and yield. Individual plot harvest data is shown in Table 2. Individual plot data is displayed in Table 3 with each column of data color coded from highest value (green) to lowest value (red). The plots in Table 3 are grouped by trial with each trial sorted from highest yield to lowest yield. Finally, all seven years of yield data is highlighted in Table 4.

Data for 2021 shows statistical differences in plant population between several of the trials. This was the first year there has been a statistical difference in corn plant population. Trials 2 (no-till, multi species) & 4 (conventional, cereal rye) had plant population that were statistically higher than Trial 1 (no-till, no cover). Trials 2 and 4 were also statistically higher than Trial 5 (conventional, no cover).

	Plant Population (Plants/Acre)	Residue Cover (%)	Yield Average (Adjusted to 15.5% Moisture)
Trial 1 – no till, no cover	30,778	72.3	219.6
Trial 2 – no till, multi species cover	31,944	75.4	225.9
Trial 3 – no till, cereal rye cover	31,389	77.7	229.0
Trial 4 – conventional, cereal rye cover	32,167	5.6	236.8
Trial 5 – conventional, no cover	31,111	5.8	209.8

Table 1: Trial Data

Tillage practice continues to drive the stark difference in surface residue observed in the test plot (Figures 2 and 3). No-till plots averaged 75.1% surface reside cover while the conventional plots had an average of 5.7%. The conventional plots (trial 4 and 5) had statistically similar residue cover and there was only a 0.2% difference between the averages of the two trials. The no-till plots had residue cover of 72.3% (no cover), 75.4% (multi species), and 77.7% (cereal rye). The residue cover in the three no-till plots were statistically the same. For the third year in a row the presence of a cover crop is adding residue in the no-till plots. The multi species cover crop added 3.1% residue cover. The cereal rye cover crop added 5.4% residue cover.

Data collected during crop harvest is presented in Table 2. Grain moisture ranged from 15.4% to 18.1%. Test weight ranged from 58 to 59 pounds per bushel. Plot yield is adjusted to a standard moisture of 15.5%. Individual plot yields ranged from a low of 198.0 bu/ac. to a high of 249.9 bu/ac. Based on the trial averages, conventional tillage with a cereal rye cover crop resulted in the highest yield. Conventional tillage without cover crops resulted in the lowest yield. Statistically there was no difference between the five trials suggesting that the treatments did not influence the differences in yield.

Plot #	Tillage	Cover Crop	Moisture (%)	Test Weight	Yield (Wet)	Adjusted Yield (15.5 % moisture)
101	Conventional	Cereal Rye	15.4	58	249.6	249.9
102	No-Till	Cereal Rye	17.3	58.5	240.1	235.0
103	Conventional	Cereal Rye	16.3	59	239.9	237.6
104	Conventional	No Cover	17.8	58.5	219.0	213.0
105	No-Till	No Cover	18.3	58	204.8	198.0
201	No-Till	No Cover	16.9	58	246.0	241.9
202	No-Till	Cereal Rye	18.1	59	242.9	235.4
203	No-Till	Multi-species	16.3	58.5	237.1	234.8
204	Conventional	Cereal Rye	16.9	59	226.8	223.0
205	Conventional	No Cover	17.5	58.5	209.6	204.6
301	No-Till	Multi-species	17.6	58	237.9	232.0
302	Conventional	No Cover	17.7	58.5	217.3	211.7
303	No-Till	No Cover	17.4	59	224.0	219.0
304	No-Till	Cereal Rye	17.5	59	221.8	216.5
305	No-Till	Multi-species	16.2	58	212.6	210.9

Table 2: Individual Plot Harvest Data

Even though the data does not show a statistical difference in yield, there was a large deviation, 51.8 bu/acre, between the fifteen plots. This was the widest range in corn yield observed during the study. There was also a wide range in yield between plots with the same treatment. For example, the three plots utilizing no-till and no cover crop had yields of 198.0, 219.0 and 241.9 bushel. When yield is plotted spatially (Figure 9), the highest yields were in the southeast part of the plot. This part of the plot has the lowest elevation. In 2021 the plot received approximately 11.7 inches of rain during the growing season (May 19th to September 20). Only 3.6 inches of rain fell from May 19 to July 19. It is possible that the plots lower on the landscape were able to collect and infiltrate more water than the other plots. Of the five trials, the three with cover crops had the highest average yield. Looking at the plots individually shows the majority of plots with cover crops ranked high in yield.

Summary

The cover crop test plot continues to offer producers a local source of data testing the use of different agricultural practices. After seven growing seasons the data may be showing some trends. However, factors outside of the study control like weather also play a role. Continuing the trial, collecting more data, and analyzing the data will be key to showing outcomes of the trial.

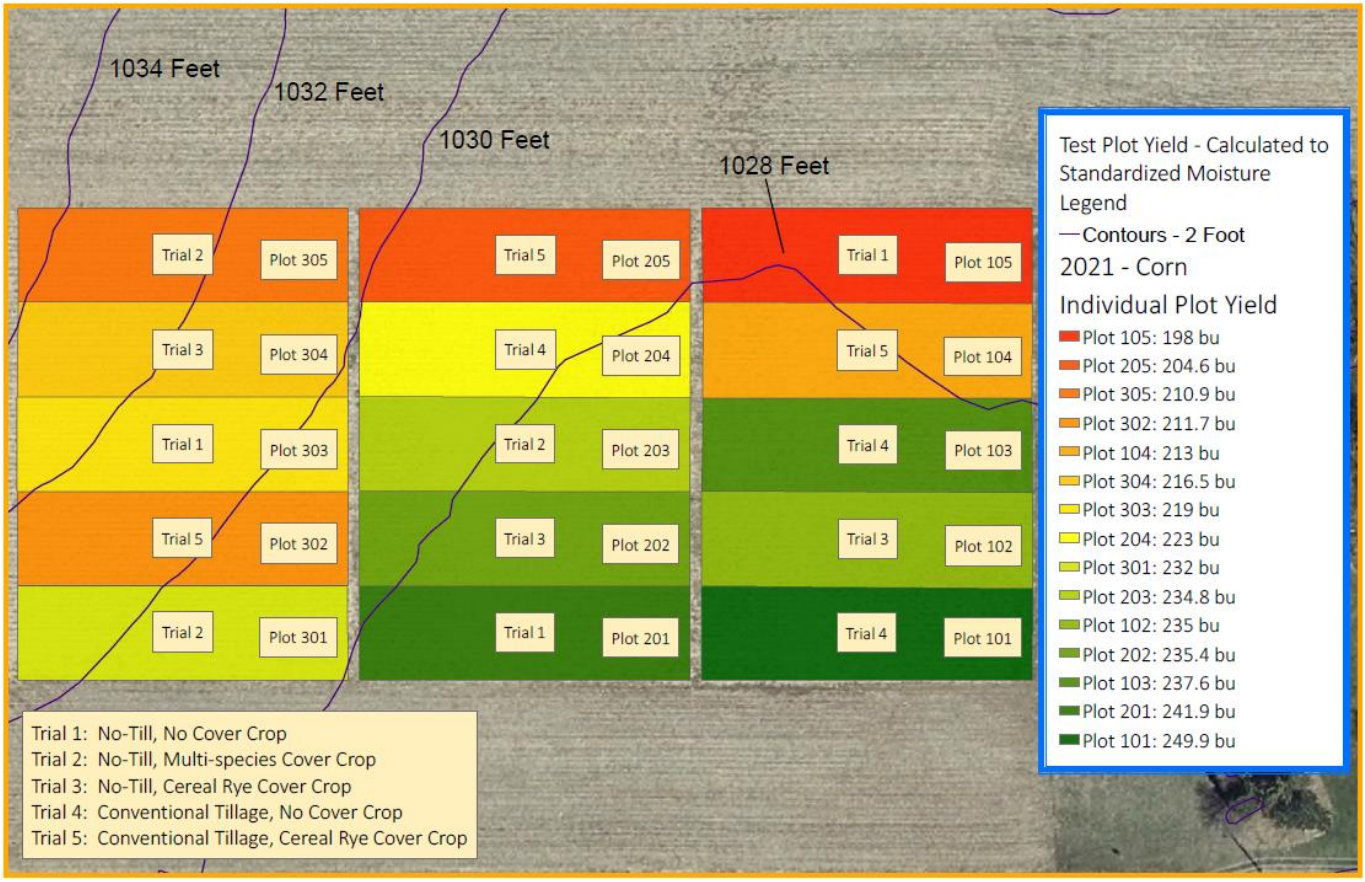

Figure 9: Individual Plot Yield

2021 was the first year where there was a statistical difference in plant population for corn. In 2021 the trials with higher average plant population tended to have higher average yield. This suggests that plant population may have had some numeric effect on yield but didn't result in a significant yield difference. The data continues to show that adding cover crops is adding surface residue. The cover crop and its residue help protect the soil from erosion and is eventually incorporated into the soil by tillage or organisms like earthworms. This adds organic matter into the soil profile. One of the benefits of cover crops is they improve soil health by improving soil structure and adding organic matter which can increase the soil's ability to infiltrate water and hold moisture. It is possible that the plots with cover crops were able to infiltrate and store more water early in the growing season to help sustain the developing corn plant during drought conditions. When rain was received during the summer the plots with cover crops may have infiltrated more water than the plots without cover crops. This potential increase in water infiltration and water availability in the soil profile may have led to increased yields. Preliminary infiltration data collected after harvest suggests that in general, the no-till and plots with cereal rye were able to infiltrate more water which helps support this hypothesis. Repeating the infiltration and runoff testing in the spring will provide additional data to help accept or reject this hypothesis.

Implementing no-till and cover crops have many different goals and outcomes. Implementing no-till can reduce inputs, reduce erosion, and improve soil structure. Implementing cover crops can reduce compaction, scavenge nutrients, improve soil health, reduce erosion, and suppress weeds. Some changes like reducing fuel and equipment cost by parking the tillage equipment are immediate. Other changes like improving soil structure and soil health take time to show benefits. After seven years of using no-till and cover crops these benefits may be starting to show, especially in a year with reduced precipitation. Conditions during any given year are unique and place different stresses on agricultural systems. These stresses affect overall crop production and can impact yield. Different agricultural practices will perform better or worse depending on a given year's stresses. Table 4 shows average yield for each year in the study. Yield for each year is color coded with highest yield in green and

lowest in red. Based on seven years of yield data, no trial has consistently had the highest or lowest yields. Each year seems to produce different results. As weather patterns and other stresses change, building a soil that is resistant to these stresses is important to ensure the resiliency of agricultural systems and ensure long term success. Systems that reduce soil erosion, improve water use efficiency, and provide an overall stable system will lead to a more resilient system. Continuing the test plot study will help show how over time the use of different management practices effect crop productivity. Looking at factors other than yield may also show how changes in management can improve agricultural systems.

Plot #	Trail #	Treatments		Plant Population*	Residue*	Yield*
105	Trail 1	No-Till	No Cover	31,500	65.2	198.0
303	Trial 1	No-Till	No Cover	31,500	80.3	219.0
201	Trial 1	No-Till	No Cover	29,333	71.5	241.9
305	Trial 2	No-Till	Multi-species Blend	31,833	73.5	210.9
301	Trial 2	No-Till	Multi-species Blend	31,833	84.2	232.0
203	Trial 2	No-Till	Multi-species Blend	32,167	68.5	234.8
304	Trial 3	No-Till	Cereal Rye	31,500	84.2	216.5
102	Trial 3	No-Till	Cereal Rye	31,167	72.7	235.0
202	Trial 3	No-Till	Cereal Rye	31,500	76.3	235.4
204	Trial 4	Conventional	Cereal Rye	31,500	6.3	223.0
103	Trial 4	Conventional	Cereal Rye	33,167	4.2	237.6
101	Trial 4	Conventional	Cereal Rye	31,833	6.2	249.9
205	Trial 5	Conventional	No Cover	31,000	4.2	204.6
302	Trial 5	Conventional	No Cover	31,000	9.5	211.7
104	Trial 5	Conventional	No Cover	31,333	3.8	213.0

* Each column above is color coded from highest value (green) to lowest value (red)

Table 3: Individual Plot Data

		Harvest Year	2015	2016	2017	2018	2019	2020	2021
		Crop	Corn	Soybean	Corn	Soybean	Corn	Soybean	Corn
Trial #	Treatment		Yield Average (Bu/Acre)						
Trial 1	No-Till	No Cover	187.2	66.5	194.0	45.2	188.0	55.7	219.6
Trial 2	No-Till	Multi-species Blend	184.3	66.3	186.1	45.8	190.9	55.0	225.9
Trial 3	No-Till	Cereal Rye	184.6	66.3	189.9	45.7	187.8	57.1	229.0
Trial 4	Conventional	Cereal Rye	191.8	65.3	194.5	43.5	182.1	59.1	236.8
Trial 5	Conventional	No Cover	194.8	66.5	191.8	41.9	186.8	62.1	209.8

	2015	2016	2017	2018	2019	2020	2021
High (Individual Plot)	197.7	67.9	205.0	49.1	196.6	64.8	249.9
Low (Individual Plot)	165.5	64.6	181.0	41.1	177.3	52.4	198.0
Mean (average)	188.5	66.2	191.3	44.4	187.1	57.8	224.2
Standard Deviation	10.6	0.9	7.8	2.6	5.5	3.3	15.1
Median	191.7	66.0	188.4	44.2	186.2	57.8	223.0
Range	32.3	3.4	24.0	8.1	19.3	12.4	51.8

Table 4: Yearly Trial Average Yield and Statistics