LNC09-312: Southwest North Dakota Soil Health Demonstration

2012 Final Report

Summary

2008-2012 Final Report
The SW ND Soil Health Project was a very successful project resulting from a unique combination of collaborative effort between Dakota West Resource, Conservation & Development Council, three Soil Conservation Districts, the NRCS, Dickinson State University and North Dakota State University's Dickinson Research Extension Center. The project was conducted from 2008 through November, 2012 on 160 acres divided into eight 20 acre plots that have high visibility along North Dakota highway 22.

The overarching objectives of the project to do the following: 1) Improve soil health awareness and knowledge of producers and resource people in southwestern North Dakota; 2) Motivate producers to implement practices on their operations that would improve soil health; and 3) To demonstrate an alternative rotational cropping system utilizing no-till and cover crops soil health improvement. Since soil, sun and water are central to the very existence of human kind, whether urban or rural dwellers, stewards of the soil are the first line of defense in controlling atmospheric carbon through organic matter management. Awareness of ways to reverse soil degradation by increasing soil organic matter was key to the objectives of this soil health demonstration that sought to inform producer and resource stakeholders of a cropping practice example in the field that could improve the soil quality aspect. The aspect of soil health education can be no better shown than to identify the number of people that attended various events presented to the consuming public. And not only did the project educate a broad cross section of interested public patrons, but the project engaged 12 individual producers that grew cover crops on their farms that reported results to the project coordinator. Interest in the project is best illustrated by the number of attendees at outreach events such as "Soil Health Field Days" and "Workshops". The total number of 599 interested stakeholders attended the various events that consisted of local and regional soil health professionals and experienced farmer cooperators that help train farmers who are new to the concept of improving soil health. In addition to the direct attendees at outreach events, project managers who had speaking engagements in which information from the demonstration was presented at conferences and seminars to include: Western RC&D conference in Missoula, MT; (200) Western RC and D Conference, Lewiston, ID (150), Dunn County Soil Conservation Field Days: (approx. 30 each year), Diversity, Direction and Dollars, Dickinson, ND (450), Stark and Dunn County Soil Conservation Banquets (54 -100/year). Other minor speaking engagements reached and estimated 80 people.

Youth are the future of agriculture. Students from Dickinson State University and regional high school vocational agriculture classes were invited to the field day events. We are pleased to report that Vo-Ag instructors from 6 to 20 high schools participated by bringing students; some as far as 100 miles away.

Crop rotations invoked in the demonstration were established to demonstrate the effect that increasing soil organic matter (OM) can have on various soil health measurements. Soil organic matter increased from 2.66 to 2.73% during the course of the project. Illustrating that improving soil quality is not a fast process, but one that requires considerable number of years. While that actual percent change in OM was not large, trends were established and encouraging. Water infiltration rate, is an important indicator of the effect that increased OM can have on soil quality. Especially, since western North Dakota is considered to be semi-arid, water conservation is critically important. The average water infiltration rate increased from 1.38 to 2.23 inches/hour, which is a significant increase. Soil armor and soil compaction were monitored with sequential pictures taken throughout each growing season from 2008 to 2012. The pictorial changes

in soil cover and compaction were dramatic resulting in reduced erosion and compaction. The farm manager was quoted as saying, “The fields are more mellow and easier to farm”.

Soil Foodweb, an analysis of soil biota, indicated that bacteria levels were high at the onset of the demonstration, but were declining by the end of the project. Moreover, while soil bacteria were on the decline, desirable soil protozoa were on the increase by the end of the demonstration. Soil protozoa facilitate nutrient cycling and by grazing on nitrogen rich organisms and serve an important role in nitrogen mineralization. Reduced tillage affordable through no-till seeding equipment eliminate soil disturbance that destroys soil structure and inhibits fungal development, which is beneficial for plant relationships and helps increase root contact with the soil. Fungal hyphae facilitate water and nutrient uptake by the plant. Although, total Foodweb fungal measurement was low, there was a trend for increased fungal activity, especially between the years 2011 and 2012.

Over the course of the demonstration, year-over-year precipitation, crop yields, and crop price varied widely. Ranking the field rotations according to average net return over variable costs, the rotation in Field 6 ($166.80) was the most profitable, which was followed by Fields 3, 5 and 8 ($114.87, $100.53, and $115.39, respectively). Wheat price and a greater number of forage crops in the rotation resulted in lower average return over variable costs for fields 4 and 7 ($74.26 and 96.83, respectively), and the lowest average return over variable costs occurred when all crops in the rotation were forages in fields 1 and 2 ($59.45 and $58.69, respectively).

An incentive program was offered to producers from the three participating soil conservation districts (SCD) at a compensation rate of $37.50/ac, if they would seed up to two 20 tracts of cropland to cover crops to improve soil health on their land. A total of 896 acres were seeded to cover crops with varied results. NRCS or SCD personnel verified the plantings in which the season long plantings were more successful. 2009 was the most successful year for plantings that followed spring crops and 2012 yielded very poor stands following spring seeded crops. Eighteen Soil Foodweb tests were conducted each year on the producer’s land as well. Subsequently several of these producers have hosted tours as part of an SCD Soil Health Tour. Five producers spoke at the 2011 Soil Health Workshop and four spoke at the 2012 Soil Health Workshop. These producers, especially two, continue to be very active in training other producers about soil health.

Improving the soil resource on farms is the most important single that pays huge dividends in return, but the process requires a time investment. As soil quality improves, fertilizer and chemical inputs can be reduced, because the Soil Foodweb is working for the farmer “growing nutrients”. In time, improved soil amenities provide higher productivity and yield stability during drought conditions. Stakeholders that took the time to attend field day and workshops gained a greater appreciation for the power of well managed soil and method for attaining improved soil quality.

In conclusion, there are producers that were not actively adopting practices that would build soil OM on their farms before this demonstration project started, but by the end of the project, they were and remain actively farming using sustainable soil management practices.

Introduction

Soil health (soil quality) is the capacity of a soil to function. These functions include; regulating the water cycle, sustaining plant and animal life, filtering and buffering organic and inorganic materials, cycling nutrients. It is these functions that this project highlighted and demonstrated improvement of. Adoption of strategies to improve soil health by producers also improves water quality, makes more efficient use of naturally occurring moisture, sequesters atmospheric carbon dioxide, reduces energy intensive inputs reduces costs and increases profitability. By reducing soil disturbance and increasing crop diversity, the soil will become more habitable by micro flora and fauna which make up the soil Foodweb. It is this Foodweb that builds soil organic matter, the heart of a healthy soil. Producers of crops and/or livestock in western North Dakota have benefited from this demonstration. Less soil disturbance, more crop diversity and the maintenance of a living root in the soil for the majority of the growing season will improve soil health. These principles of soil health are also compatible with alternative grazing systems. Currently many producers in western North Dakota are practicing, or switching to, no till cropping systems. Producers (regardless of tillage system) continue to struggle with crop rotation diversity, and are just being introduced to the use of cover crops to improve soil health. The demonstration exemplified how cropland management is critical to improving soil health.

Objectives/Performance Targets

1. The primary objective of the project was to improve the soil health knowledge of producers and resource people in southwestern North Dakota.
2. The project sought to motivate producers to implement practices on their operations that would improve soil health.
3. The project desired to demonstrate an alternative cropping system utilizing no-till, cropping rotations, and cover crops that will improve soil health.

Materials and Methods

A quarter section of land on the Dickinson Research Extension Center adjacent to a highly traveled Highway 22 was selected for the site. This parcel was previously split into eight approximately 20 acres plots. The land had been farmed conventionally for several years and exhibited potential for improvement in soil health parameters such as organic matter, infiltration, and productivity. A "Technical Advisory Group" (TAG) or managing group was developed which included a representative from each of three Soil Conservation Districts, the Dunn and Stark County NRCS District Conservationists, the NRCS Area Resource Soil Scientist, the Dickinson Research Extension Center (DREC) director, DREC's farm manager, and the Project Manager. This group recommended the managerial practices to be implemented including the crop rotation to be used. The basic crop rotation was; alfalfa > alfalfa > alfalfa > winter triticale/hairy vetch > corn > oats/peas followed by a multi-species cover crop > spring wheat > winter wheat. (see attached Map of Plots) All crops were seeded with a JD 1590 no-till drill and fertilized to recommended levels per soil test. The multi-specie cover crop mix included up to 10 varieties of warm and cool season grasses, legumes and brassicas. The intent was to improve soil quality, since soil armor was lacking, grazing was not incorporated with the exception of the corn in year one on Plot 4. In subsequent years the corn was harvested for grain with the stalks and leaves left for soil armor.

Soil samples were collected on each plot by Dunn County Soil Conservation personnel at 0 - 6" and 6 – 24" depths. Several sample sites were used in each plot with the locations documented by GPS and subsequent yearly samples obtained from the same locations. The samples were analyzed for NPK, pH, Cl, S, Cu, soluble salts and organic matter by a commercial laboratory.

Water infiltration tests for the first and second inch of water, were conducted in 2011 and 2012 utilizing a single 6" metal ring. The ring was lined with plastic, filled with one inch of water and the plastic removed at start of test time. The 2011 and 2012 tests were a single test per plot. In 2008 a student did three infiltration tests per plot on Plots 1 and 4, however he dropped the project due to the amount of time required.

Soil samples for Soil Foodweb analysis were collected from 0 – 3" with a hand probe in the fall of 2008 in the vicinity of once proposed sites along the central corridor of the plots. Foodweb samples were again collected randomly throughout the plots in 2011 and 2012. The 2011samples were collected in the fall after the cover crops had emerged whereas the 2012 samples were collected in June to take advantage of adequate moisture. Samples were refrigerated and sent to Earth Fort in Corvallis, OR for analysis.

Photos of each plot were taken on nearly a weekly basis for use in meeting presentations and also made available on the Manitoba-North Dakota Zero Tillage Farmers Association web site.

The project participants hosted annual Soil Health Field Days with additional entities touring the plots throughout the year. The project managers annually participated in five to seven other speaking engagements regarding soil health. Additionally, data and written articles were made available through a link on the Manitoba-North Dakota Zero Tillage Farmers Association web site. Information about the plots and soil health were also made available in a mailbox “kiosk” at the site.

Farmer participation in soil health improvement was encouraged by providing producers with an incentive payment of $37.50/ac to seed one or two 20 acre plots with cover crops. These incentives were available for the 2010, 2011, and 2012 crop years. The project also funded a Soil Foodweb analysis on each of the producer plots with the samples collected randomly in each field by NRCS or Soil Conservation District personnel.

Attach map of Plots with Crop Rotations

Results and Discussion/Milestones
The primary objective was to improve knowledge of soil quality which might be best gauged by the number of attendees at the “Soil Health Field Days” in addition to producer participation in seeding cover crops. The inaugural year of 2008 resulted in 371 people visiting the plots in five different groups namely: (attendance noted in parenthesis) Dunn County SCD tour (40), Area V SCD meeting (108), Kentucky SCD (50), Soil Health Field Day (150) and ND SWCS (23). The Soil Health Field Days continued with 110 attendees in 2010 and 32 in 2011. The project culmination was a Soil Health Workshop in November 2012 in which 86 people heard from 11 speakers ranging from scientists to producers. The project coordinators were very pleased with these numbers for this area where average attendance at producer events might not exceed 50. This interest has carried over to other field days regarding soil health and crop rotations. The project has had three project managers who had speaking engagements at various meetings such as: Western RC&D conference in Missoula, MT; (200) Western RC and D Conference, Lewiston, ID (150), Dunn County Soil Conservation Field Days: (approx. 30 each year), Diversity, Direction and Dollars, Dickinson, ND (approx.150), Stark and Dunn County Soil Conservation Banquets (54 -100/year). Other minor speaking engagements reached and estimated 80 people.

The NRCS Area Resource Soil Scientist, has used the plots and associated data for many of his soil health workshops and has presented the 2008 – 2011 data to “Cover Crops: The Science Behind” meeting in Bismarck with approximately 100 in attendance. Additionally, he has written several articles for NRCS and news media that included data from this project.

This project was designed to be a demonstration and consequently the field data collected was not designed to be “research quality” and results should be viewed as such. Data collected was more to “get people involved” than to provide research data. The raw data is attached in an Excel format titled “Soil Health Demo Raw Data. The following discussion and graphs were generated from this raw data. The average organic matter over the eight plots increased from 2.66% to 2.73% from 2008 to 2011. (see attached “Organic Matter and Infiltration Graphs”). However it should be noted that there is tremendous variability in the results as shown on the second graph. This variability was despite the sampling sites being GPS located to the same location each year. The variance in results makes a “teachable point” about the value and need for research quality testing.

The average water infiltration rate over the eight plots increased from 1.38 inches/hour to 2.23 inches per hour from 2011 to 2012. Again the subsequent graph shows the variability in results which is not surprising with one test per plot. It could be noted that both the 2011 and 2012 infiltration rates exceeded the replicated infiltration tests conducted on plots one and four in 2008. Slides 9-11 of the attached **"**Soil Health Demonstration 2012 Final" show photos of poor infiltration with runoff on plot 8 in 2008 and no runoff at the same location in 2012 with a very similar gentle rain event.

Soil armor or cover was not quantitatively measured but huge changes are evident in the weekly photographs taken by the project manager. Slides 12 - 16 of the **"**Soil Health Demonstration 2012 Final" clearly show drastic changes in the residue from 2008 to 2012. In 2008, the west end of plot 8 was bare and wind-blown with much of the A horizon missing. Plot 3 had wind and water erosion problems associated with it. Both plots reveal an astonishing improvement from 2008 to 2012.

Soil compaction and poor soil structure were dramatically evident in 2008 on Plot 1 as shown in slide 17 with some improvement shown in slide 18 taken in 2012. Slides 19 – 22 reveal some of the successful crops and comparisons from 2008 to 2012.

General comments about the plots include comments from the farm operator who states the land seems more mellow and easier to farm. Also, during the summative workshop in November 2012, the audience of 86 were asked if they had observed positive improvements on the plots. Approximately one-half of the audience were familiar with the plots and had noticed improvements, which supports the notion that the project did "demonstrate" soil health improvements.

The attached "Soil Foodweb Graphs" reveal that total bacteria is above the high level for all plots in 2008, 2011, and in 2012. However, all but plot 7 had a decrease in total bacteria from 2008 to 2012. The total fungal population is below the range recommended by Soil Foodweb personnel. There was not consistent trend noted from 2008 to 2012. Soil Foodweb suggests fungal food, inoculum, or fungal compost teas. Likewise the flagellate protozoa were low in all plots except plots 2 and 6 in 2008 and plot 8 in 2011. Similarly, the amoebae protozoa levels were low in several of the plots on different years. However, it was inconsistent which plot was low on what year. Soil Foodweb personnel suggest that a low protozoan level will limit nutrient cycling for plants and fertilization will be required until foodweb is improved. Their suggestion was an inoculant. The NRCS Area Resource Soil Scientist noted that if 12 or more species of plants had been grown in the plot since 2008, the amoebae protozoa increased by 25,994 per gram of soil and the flagellate protozoa increased an average of 3,378 per gram of soil.

The crop yields and growing season precipitation are reported in the attached "Yield and Precipitation Graphs." In the short span of this demonstration project, spring wheat (SW), winter wheat (WW), Corn (C), a field pea-oat cover crop (P-CC), and alfalfa yields were recorded. Alfalfa yield increased with each year of the demonstration; however, alfalfa weevil infestation in the last year of data collection (2012) reduced yield by 79% from a maximum of 3.6 ton in 2011 to 0.75 ton in 2012.

Grain and cover crop yields were variable and it was difficult to establish any sort of trend that followed the changes in the physical soil properties that were measured. Although the yields for SW and WW were variable, the yields measured were good for western North Dakota. Spring wheat averaged 34.3 bu/ac (range: 9 – 50 bu/ac) and WW averaged 52.8 bu/ac (range: 41 – 55 bu/ac). Corn, on the other hand, was somewhat of a disappointment. The 4-yr average corn yield was 56.3 bu/ac and ranged from a low of 40 bu/ac to a high of 85 bu/ac. Corn yield was highest in 2010 when the growing season precipitation was 110% of normal and lowest in 2012 when growing season precipitation was 98% of normal. Although the 2012 growing season precipitation was slightly below normal, heat during tasseling may have contributed to the reduced yield, because the cool season grain yields for SW and WW grown in adjacent fields were 42 and 55 bu/ac, respectively.

Attach Soil Health Demo Raw data
Attach Soil Health Demonstration 2012 Final.ppt
Attach Organic Matter and Infiltration Graphs
Attach Soil Foodweb Graphs
Attach Yield and Precipitation Graphs

Impact of Results/Outcomes

At the onset of this soil health demonstration, there were very few producers that were actively adopting practices that would build soil OM on their farms, but by the end of the project, there were many that were considering equipment changes, crop rotations, and cover crops that build soil quality. And there are several producers that are members of the three participating SCDs that are actively farming incorporating the principles of sustainable soil management practices. Those farmers that are actively incorporating principles are probably the smaller acreage farmers, but those farming 5,000 to 15,000 acres or more are looking at ways to utilize the principles on smaller tracts of land with the plans to expand on to larger tracts as the management protocol unfolds.

Economic Analysis

Since improving Soil Health was the primary objective of this project, the economics were a secondary, but important component of the project. The “Annual Yield, Income and Expense” for the 2010-2012 years is attached with the results by field and year being as variable as the market prices and weather.

The basis for the project focused on establishing a benchmark upon which soil health would be evaluated over time. Alfalfa is a deep rooted crop that served as the starting crop for the diverse rotation, which has the potential to increase the amount of residue. Since the crop was not rolled or left unharvested, but hayed, residue buildup was not as rapid as would have been the case with more residue being left on the soil surface. There were 8 fields used in the demonstration. The crop rotations were as follows: Field 1: Alf>Alf>Triticale H-Vetch; Field 2: Alf>Alf>Alf; Field 3: WWht>Alf>Alf; Field 4: SpWht>WWht>Alf; Field 5: OatPea>SpWht>WWht; Field 6: Corn>OatPea>SpWht; Field 7: Triticale H-Vetch>Corn>OatPea; Field 8: Alf>Triticale H-Vetch>Corn. Over the course of the demonstration, year-over-year precipitation, crop yields, crop price varied widely. The average return over variable costs for each field has been summarized in the table titled, “Annual Yield, Income and Expense.” Ranking the field rotations according to average net return over variable costs, the rotation in Field 6 ($166.80) was the most profitable, which was followed by Fields 3, 5 and 8 ($114.87, $100.53, and $115.39, respectively). Wheat price and a greater number of forage crops in the rotation resulted in lower average return over variable costs for fields 4 and 7 ($74.26 and 96.83, respectively), and the lowest average return over variable costs occurred when all crops in the rotation were forages in fields 1 and 2 ($59.45 and $58.69, respectively).

Publications/Outreach
Outreach and tours has been a major success of this project with specific details enumerated in the Results section since this is a primary objective. Using the numbers listed in the Results, it appears that approximately 599 people directly attended the field tours or soil health workshops that were part of the project. Another estimated 980 people were in attendance when a talk was given or information offered. However, it should be noted that many are likely the same individual attending an annual or similar event. The plot tours typically had handouts to accompany the tour. The booklet published for the 2012 Soil Health Workshop contained power points and reference material for the participants. (see attached "2012 Workshop Booklet") The tours and field days included news releases and advertisements along with articles in SCD newsletters. Additional articles on general soil health information were included in SCD newsletters as well.

Jon Stika, NRCS Area Resource Soil Scientist, was part of the project is also a national NRCS Soil Health Trainer. Jon has used this site for soil health training to approximately 20 new NRCS employees on several different occasions. In addition, Jon has conducted roughly a dozen other trainings in North Dakota and other states in which he references this project. Mr. Stika also wrote approximately six articles in a NRCS area newsletter with distribution outside of North Dakota. Finally, Jon has written articles for the Manitoba-North Dakota Zero Tillage Farmers Association which included information from this project. Photos and information on soil health was also included on their website.

Area colleges and high schools were invited to several of the Soil Health Field Days with participation ranging from 6 to 20 at a given field day. The initial and final project manager is an instructor at Dickinson State University so participation was increased during those years with information used in his courses.

The Soil Health Field Days brought in producer speakers from a 200-300 mile radius. Initially speakers came from locations east of the project site such as Bismarck, ND and Trail City, SD. The 2012 Workshop featured speakers from a drier climate to the west such as Beach, ND and Baker, MT to demonstrate improving soil health with less precipitation.

Attach 2012 Workshop booklet

Farmer Adoption
Twelve producers from the three Soil conservation districts participated in the $37.50/ac. incentive program to seed cover crops with the goal of improving soil health on their land. Producers were allowed a maximum of two 20 acre contracts each of the three years between 2010 -2012. A total of 896 acres were seeded to cover crops with varied results. NRCS or SCD personnel verified the plantings in which the season long plantings were more successful with cover crops following a spring crop resulting in limited success. 2009 was the most successful year for plantings that followed spring crops and 2012 yielded very poor stands following spring seeded crops. Eighteen Soil Foodweb tests were conducted each year for these 12 producers as well. Subsequently, several of these producers have hosted tours as part of an SCD Soil Health Tour. Five producers spoke at the 2011 Soil Health Workshop and four spoke at the 2012 Soil Health Workshop. These producers, especially two, continue to be very active in training other producers about soil health.

The twelve producers were also asked to complete a questionnaire about changes they might have observed regarding soil health such as infiltration, soil cover, earthworms, moisture, aggregates, yields, and ease of tillage. (see Producer Survey and Producer Survey Results) It is noteworthy that observations were made over a limited time period of three years. Consequently it is not surprising that "No Change Observed" was the most common response. However four of the five respondents observed an improvement in one or more categories. Two producers (40%) reported observing an improvement in soil cover and yields. The questionnaire also asked about producer's opinion of soil health and knowledge by ranking their response 1-5 with the 5 being strongly agree. All responses except one, ranked either a 4 or 5 in agreement to the statements about the importance of Soil Health. Four (80%) of the producers ranked "Soil Health has become more important to me" as 5. Four of the producers (80%) ranked "I have observed the benefits of soil health" as a 4. With the item labeled "I have become more knowledgeable about soil health", three (60%) responded 4, and one response was 5, strongly agree. The final question was "I intend to improve soil health on my operation in which two (40%) responded 4, and three responded 5, strongly agree.

Attach producer survey

Areas Needing Additional Study

This project was tremendously successful in providing a stimulus for soil health awareness and knowledge in Western North Dakota. However, there remains much work and information to be gathered and distributed. One such aspect is how to incorporate soil building crop rotations into large scale operations that cover thousands of acres. How do these alternative crops fit the land area, existing crop sequencing and economic returns?

Another area that beckons additional research is the role of grazing animal on soil health and techniques for a traditional crop farmer to incorporate livestock into his operation to obtain the financial returns of soil improving crops. What is the role of livestock on the microbial community? Cooperative grazing agreements with livestock producers could be demonstrated along with temporary fencing and water supply.

Managing and manipulating the soil biota seems to be an area where distribution of knowledge needs to be improved. Many farmers have seen the Soil Food Web analysis or a similar report but are uncertain of what the appropriate microbial balance is. Secondly, producers need to know how to devise a practical plan to manipulate the microbial balance with different crops. This information is out there, but implementation could be improved.

Southwest ND

SOIL HEALTH DEMONSTRATION

www.swndsoilhealth.mandakzerotill.org

NRCS

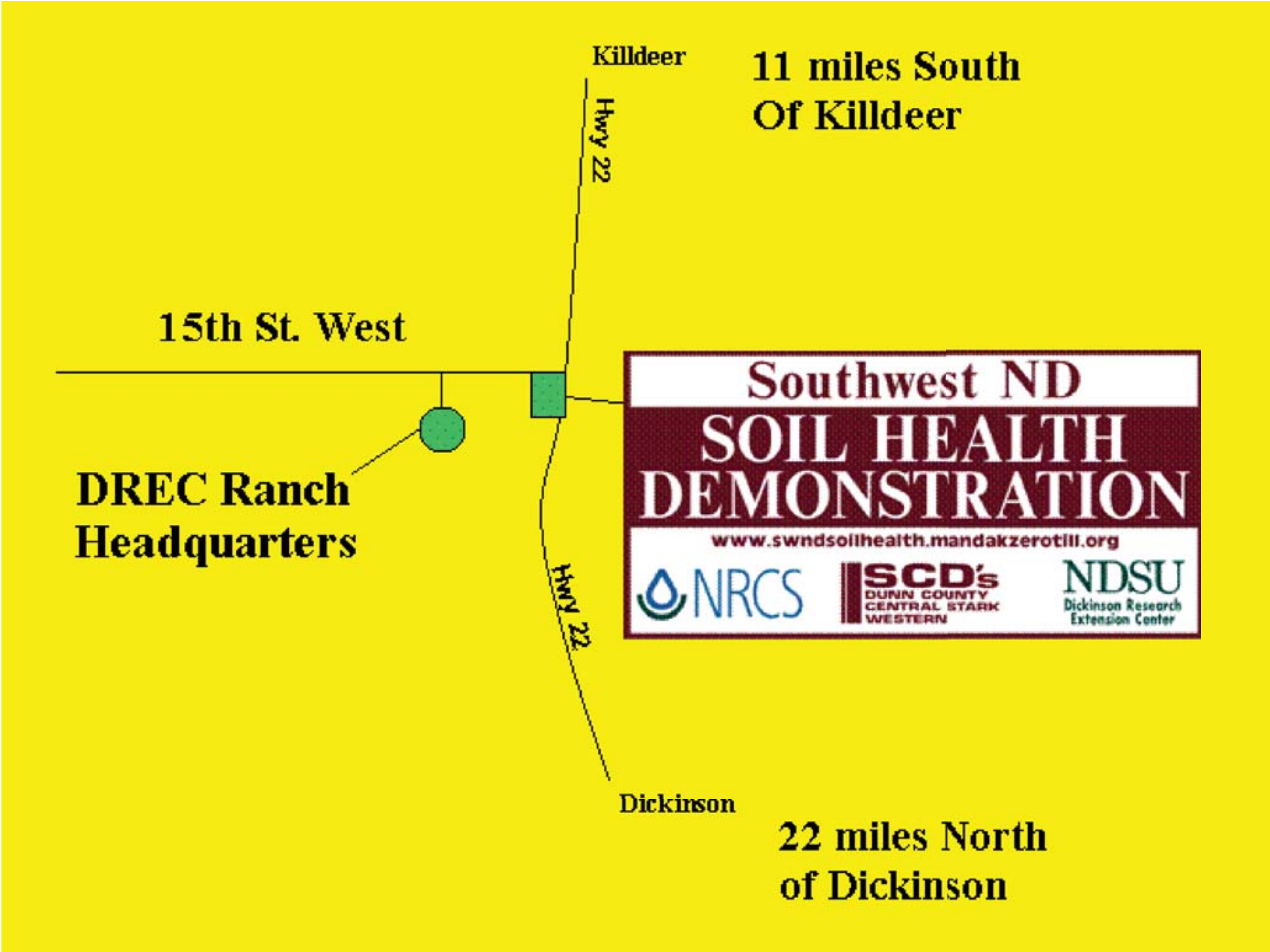
Dunn County S
Central Stark C
Western D

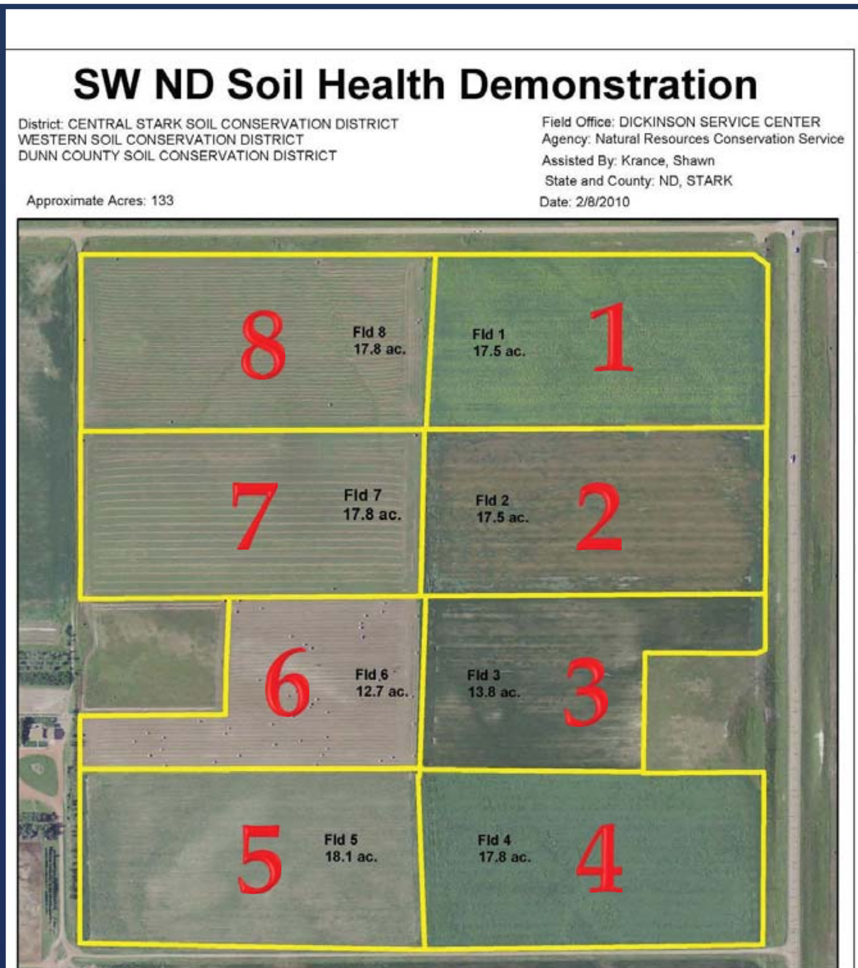
NDSU
Dickinson Research
Extension Center

Objectives:

A. How is Soil Health effected by:
   - no tillage
   - a diverse crop rotation with cover crops

B. Enhance awareness of Soil Health





NE ¼ Sec. 24
T143N R96 W

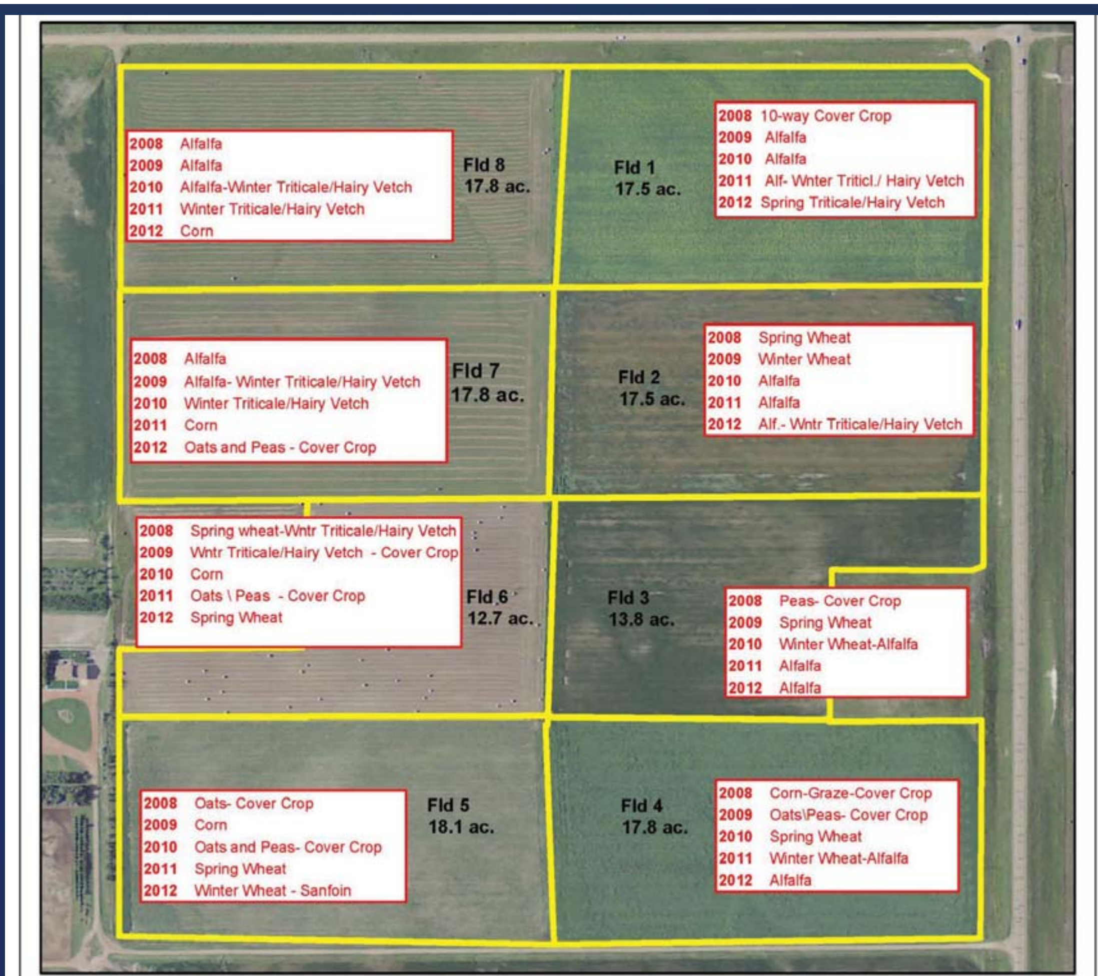
Dunn County, ND
8 Fields
Approx. 12 – 18 ac.

Diverse Crop Rotation

Alfalfa
Alfalfa
Alfalfa
Winter Triticale / Hairy Vetch 7 - 10 Cover Crop
Corn
Oats/Peas 7 – 10 Cover Crop
Spring Wheat
Winter Wheat

2012 Cover Crop Mix

	lb/ac
Millet	**5**
Sorghum	**7**
Sunflower	**.6**
Safflower	**4.5**
Hunter Brassica	**.5**
Graza Brassica	**1.5**
Soybeans	**4.5**
Total	**23.6 lb/ac**


2008 Alfalfa
2009 Alfalfa
2010 Alfalfa-Winter Triticale/Hairy Vetch
2011 Winter Triticale/Hairy Vetch
2012 Corn
Fld 8
17.8 ac.
Fld 1
17.5 ac.
2008 10-way Cover Crop
2009 Alfalfa
2010 Alfalfa
2011 Alf- Wnter Triticl./ Hairy Vetch
2012 Spring Triticale/Hairy Vetch
2008 Alfalfa
2009 Alfalfa- Winter Triticale/Hairy Vetch
2010 Winter Triticale/Hairy Vetch
2011 Corn
2012 Oats and Peas - Cover Crop
Fld 7
17.8 ac.
Fld 2
17.5 ac.
2008 Spring Wheat
2009 Winter Wheat
2010 Alfalfa
2011 Alfalfa
2012 Alf.- Wntr Triticale/Hairy Vetch
2008 Spring wheat-Wntr Triticale/Hairy Vetch
2009 Wntr Triticale/Hairy Vetch - Cover Crop
2010 Corn
2011 Oats \ Peas - Cover Crop
2012 Spring Wheat
Fld 6
12.7 ac.
Fld 3
13.8 ac.
2008 Peas- Cover Crop
2009 Spring Wheat
2010 Winter Wheat-Alfalfa
2011 Alfalfa
2012 Alfalfa
2008 Oats- Cover Crop
2009 Corn
2010 Oats and Peas- Cover Crop
2011 Spring Wheat
2012 Winter Wheat - Sanfoin
Fld 5
18.1 ac.
Fld 4
17.8 ac.
2008 Corn-Graze-Cover Crop
2009 Oats\Peas- Cover Crop
2010 Spring Wheat
2011 Winter Wheat-Alfalfa
2012 Alfalfa


Used JD 1590 drill

2008 Plot 1

Poor cover

Poor structure

Poor infiltration

2008 Plot 1

Poor cover

Poor structure

Poor infiltration

2012 Plot 8

cover with triticale residue

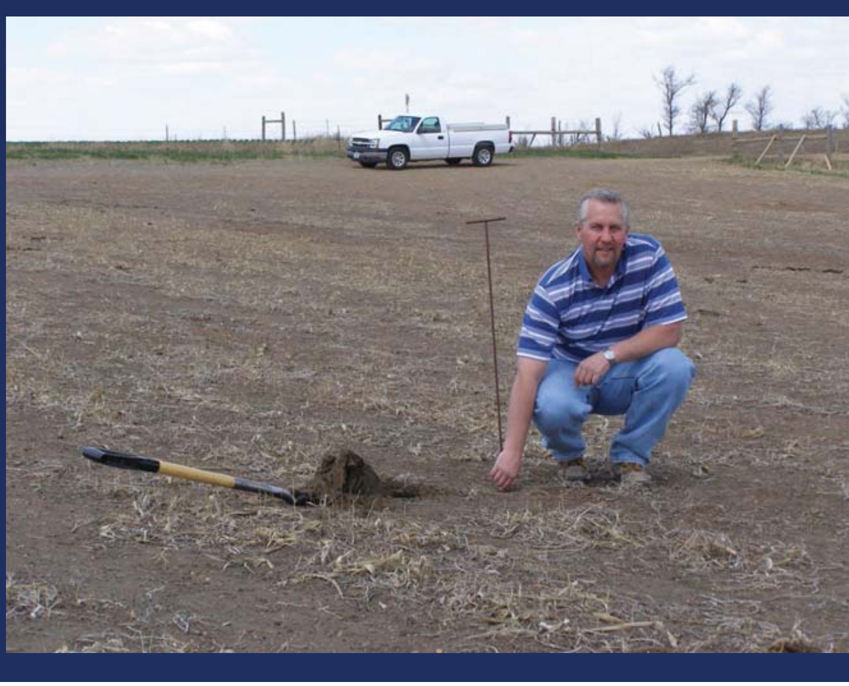
similar rain event to 2008

2008 Plot 1

Poor cover

Poor structure

Poor infiltration



2008

2012 Corn planted in triticale residue

Residue after corn

2008

2012

2008

No cover

cover crop attempted after Pea/Oat

2012

Second year alfalfa

Winter wheat residue

Sanfoin seeded 8-21-12

2008 Field 1
plow pan
poor aggregation

2012 Field 1
after 1 year 10 way cover crop and
3 years of alfalfa
more improvement needed

2009 Plot 8 Alfalfa - poor stand in 2008

2012 Field 1
Spring Triticale

July 29, 2009   Plot 5
2008 oats (hayed) cover crop - poor

Cover crops

Oct. 2008
after oat/pea

Sept. 2009
after winter triticale

Cover crops

Sept. 2012
after oat/pea

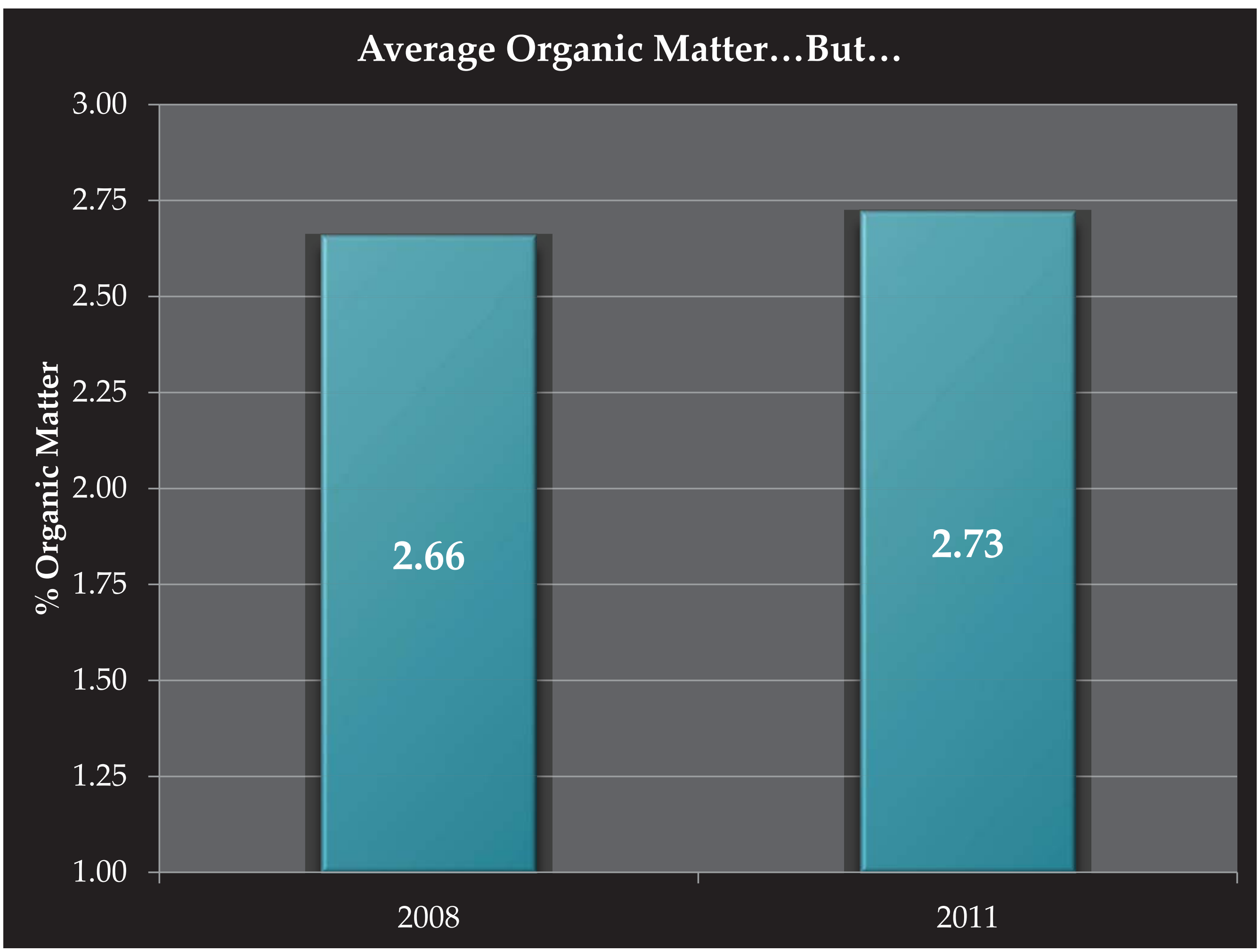
Seeded 7-20-12

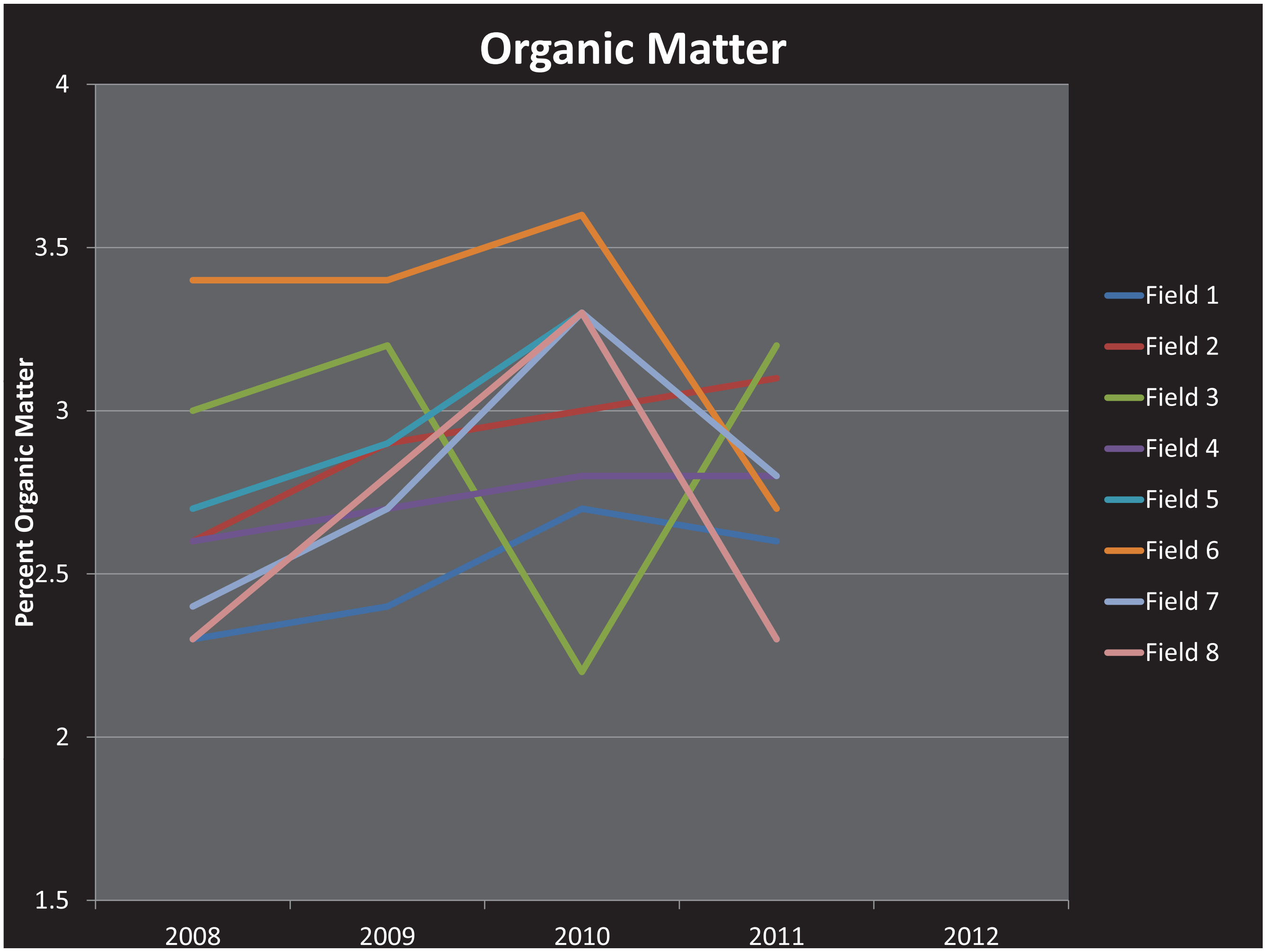
Sept. 2012
after winter triticale
DREC 6 miles west of demo.
Seeded 6-30-12

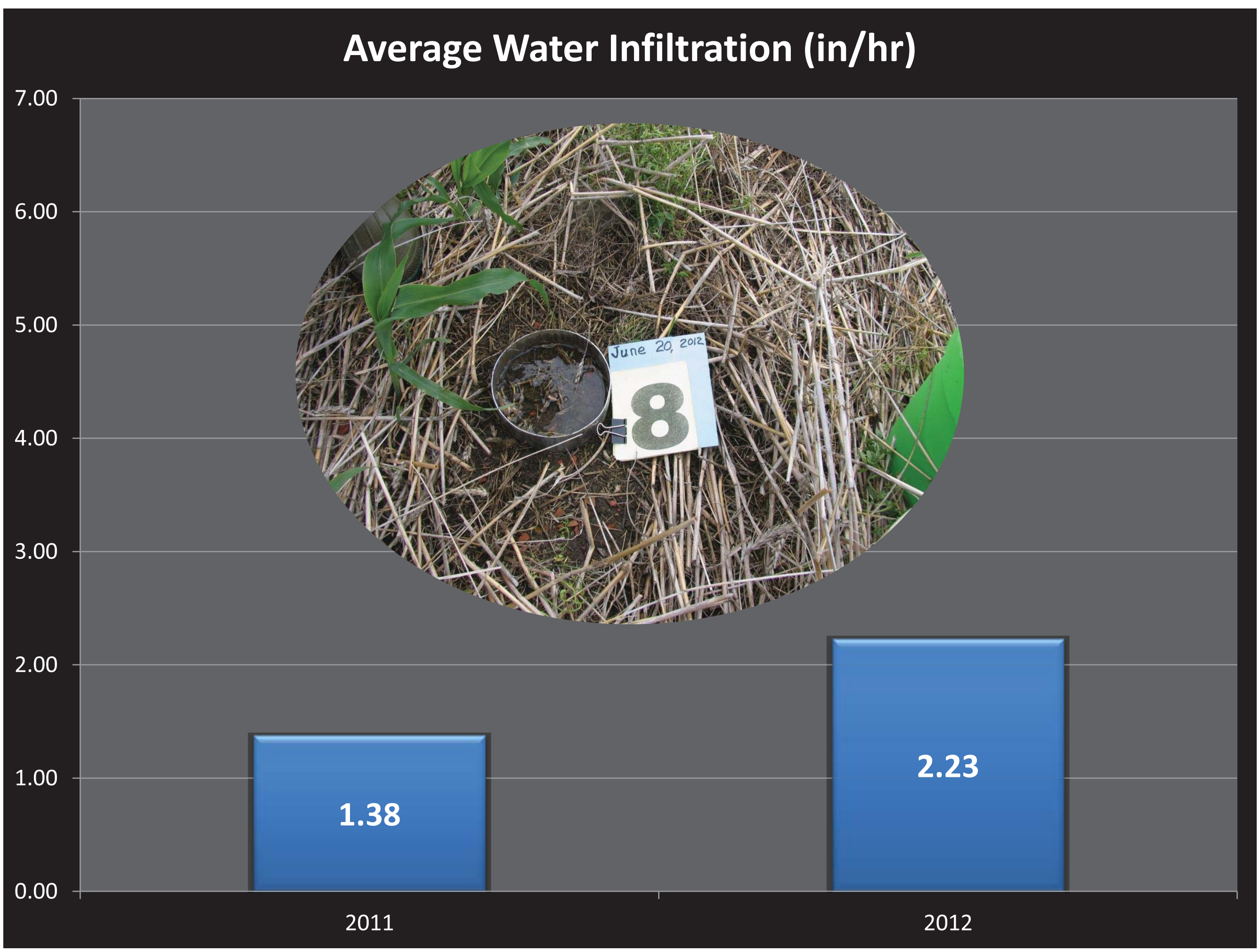
Cover crops

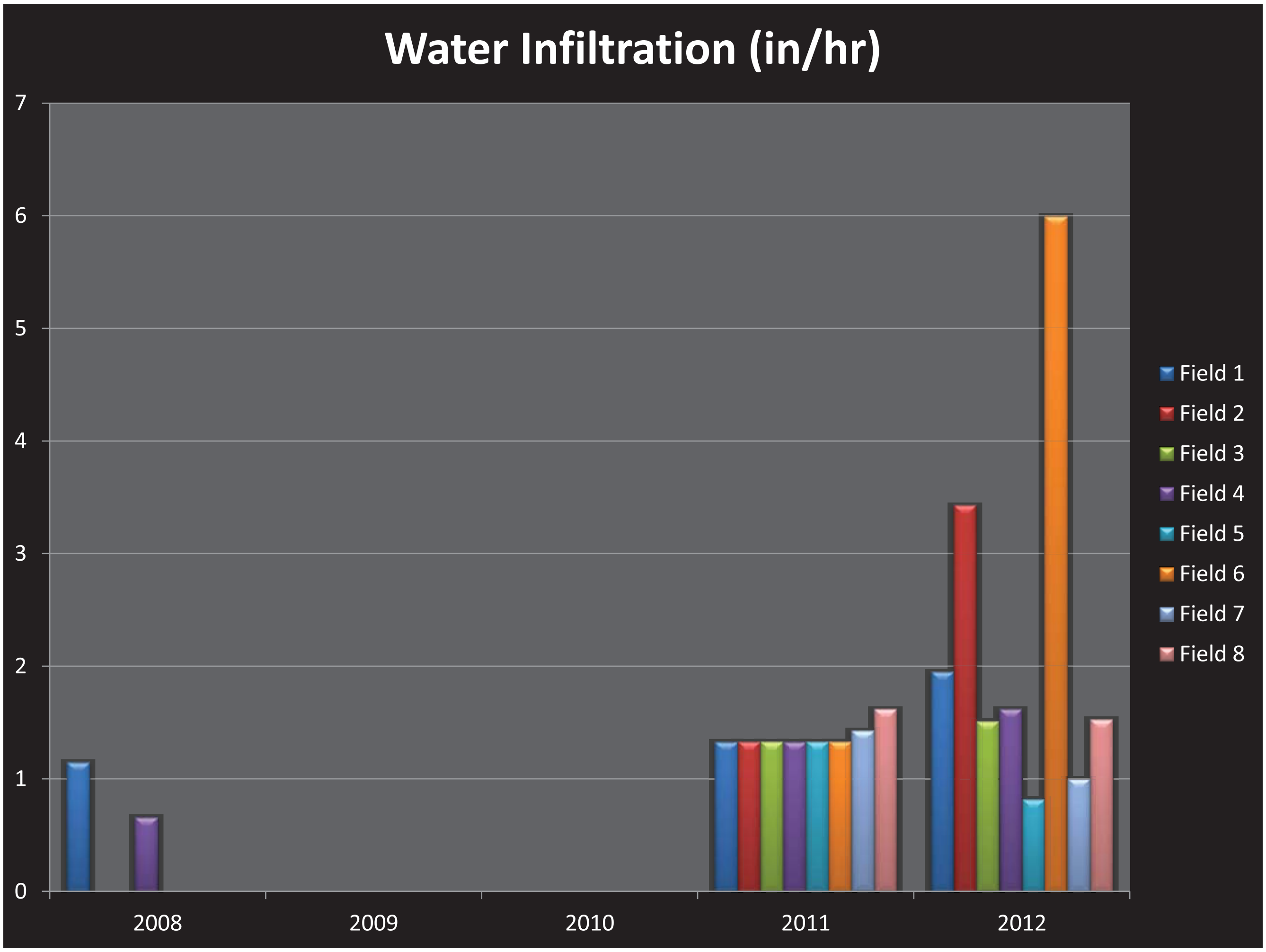
Nov. 8, 2012
after oat/pea

Nov. 8 2012
after winter triticale
DREC 6 miles west of demo.

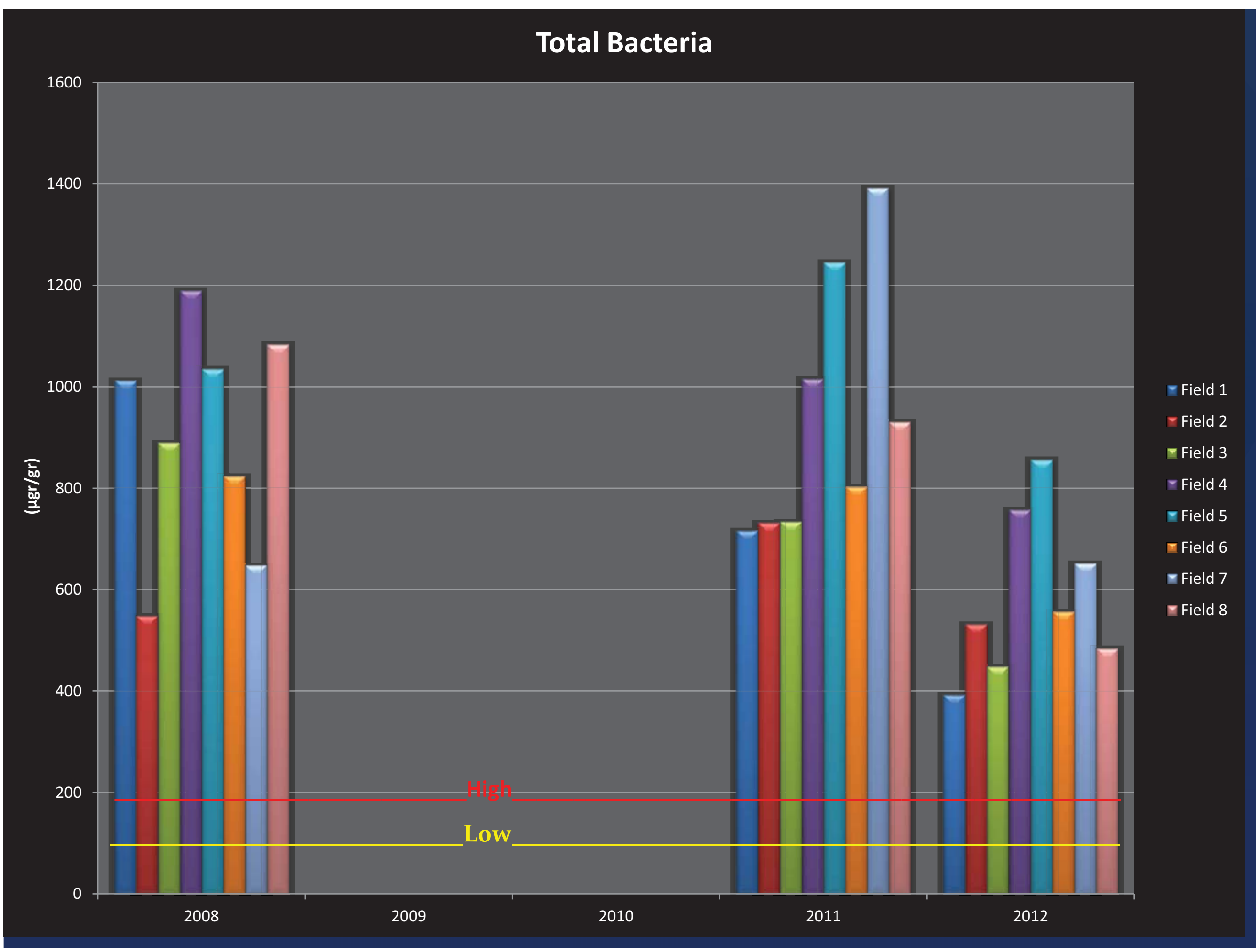



Organic Matter
Percent Organic Matter
4
3.5
3
2.5
2
1.5
2008
2009
2010
2011
2012
Field 1
Field 2
Field 3
Field 4
Field 5
Field 6
Field 7
Field 8

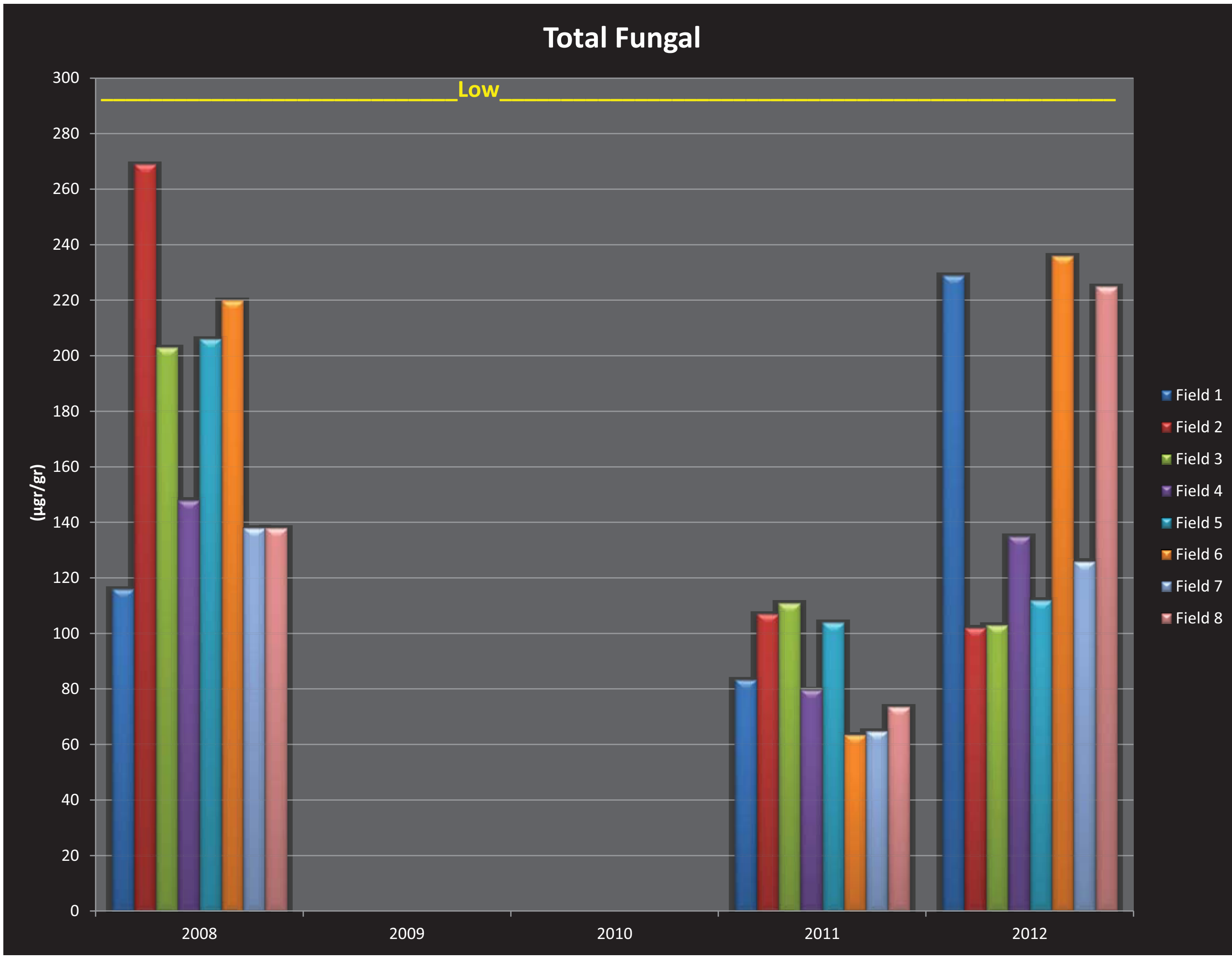

Average Water Infiltration (in/hr)
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
June 20, 2012
8
1.38
2.23
2011
2012

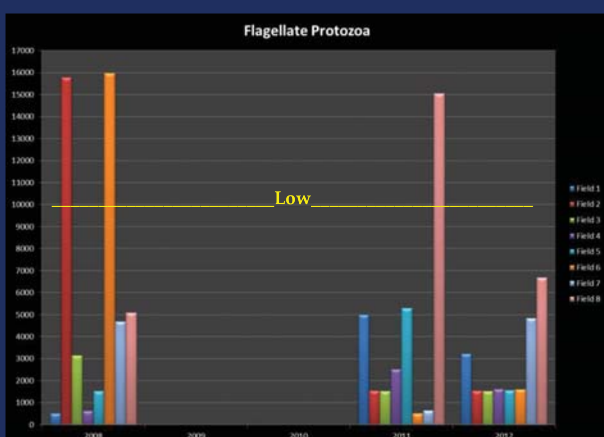


Water Infiltration (in/hr)
7
6
5
4
3
2
1
0
2008
2009
2010
2011
2012
Field 1
Field 2
Field 3
Field 4
Field 5
Field 6
Field 7
Field 8



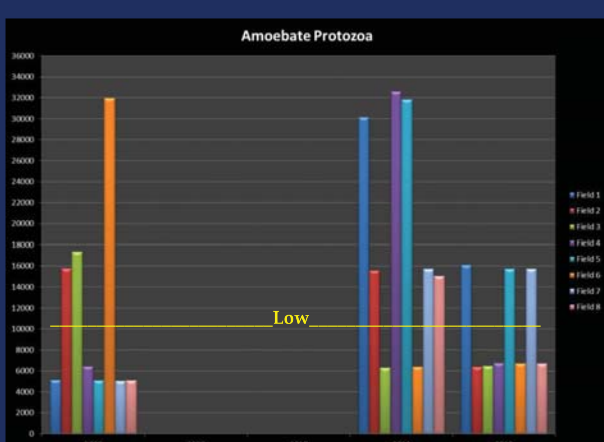
Total Bacteria
1600
1400
1200
1000
800
600
400
200
0
(µgr/gr)
High
Low
2008
2009
2010
2011
2012
Field 1
Field 2
Field 3
Field 4
Field 5
Field 6
Field 7
Field 8

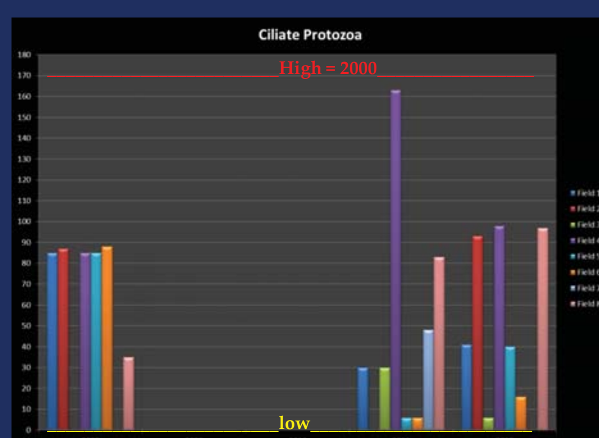


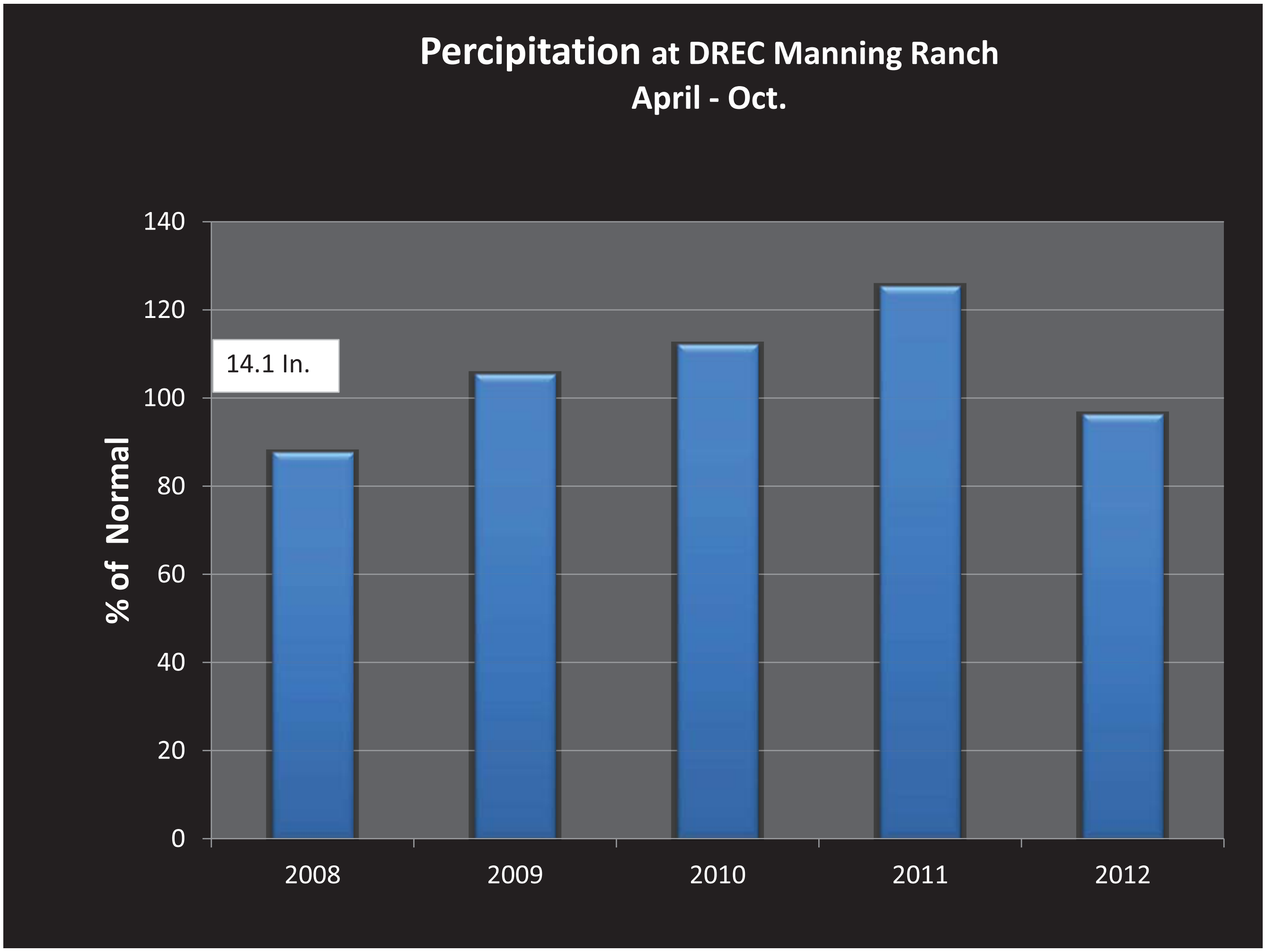


Protozoa

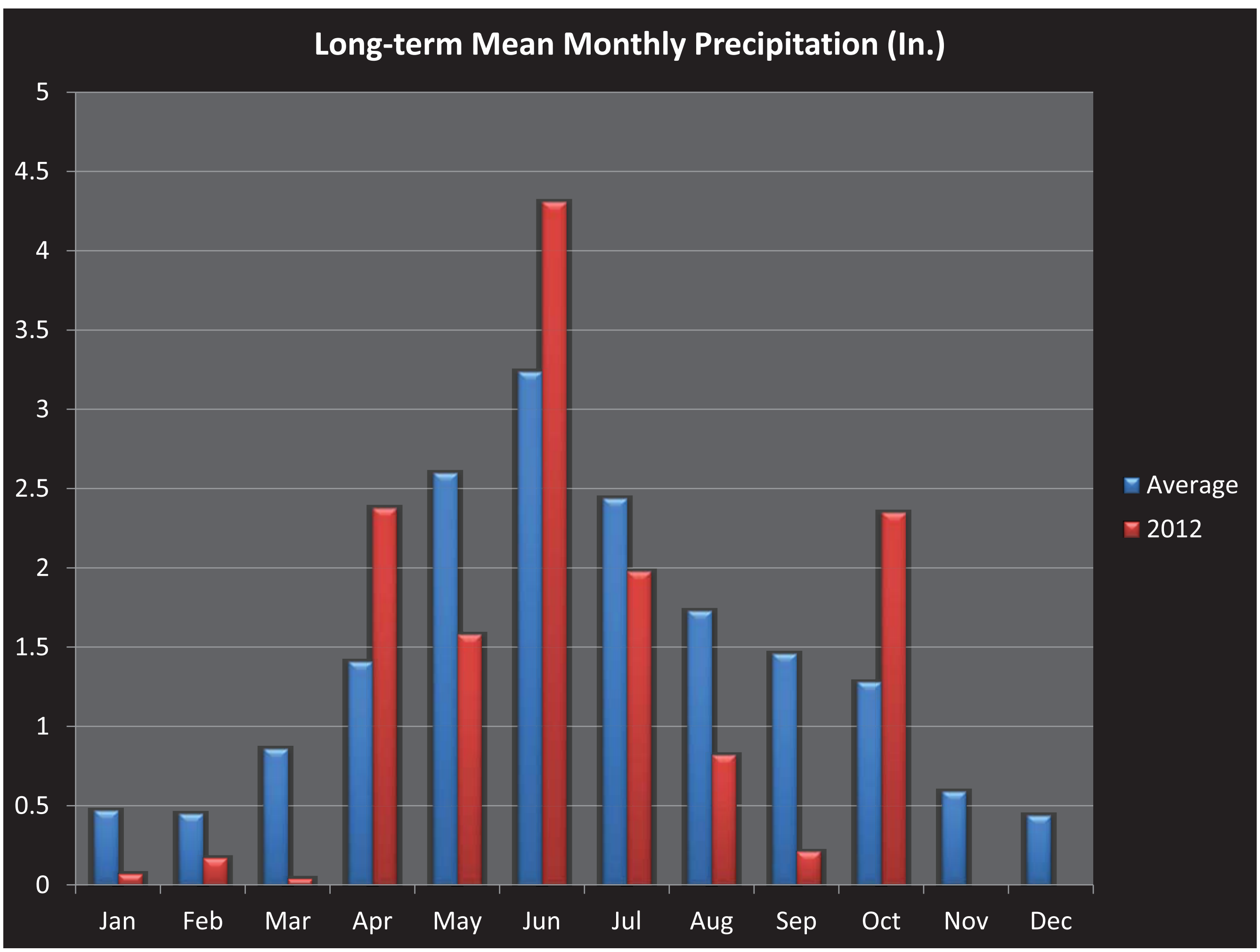
(numbers/g)



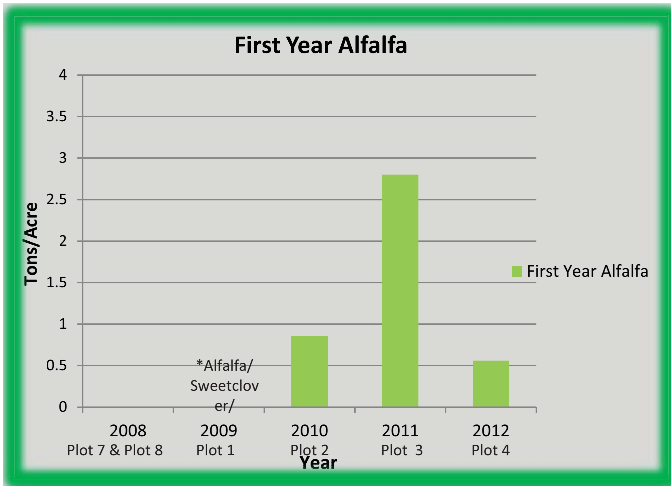


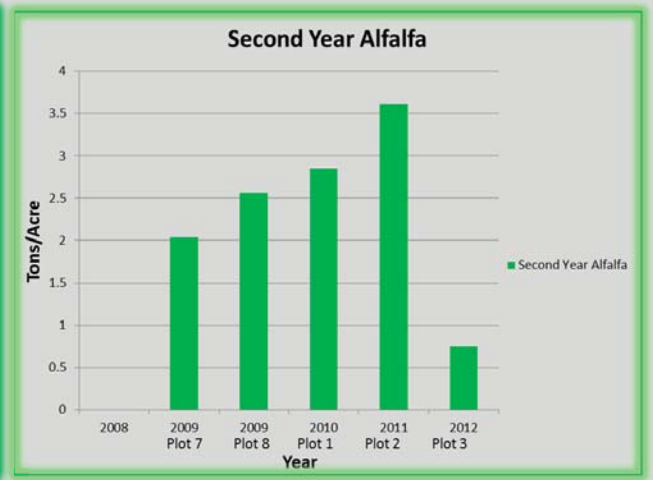


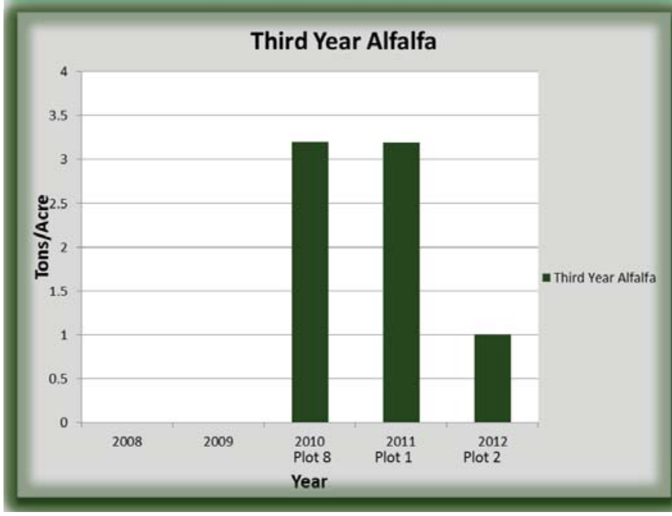
Percipitation at DREC Manning Ranch
April - Oct.
% of Normal
14.1 In.
140
120
100
80
60
40
20
0
2008
2009
2010
2011
2012

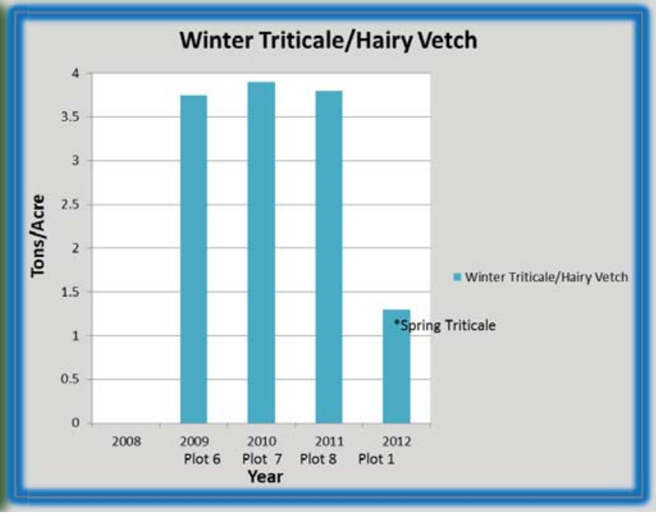


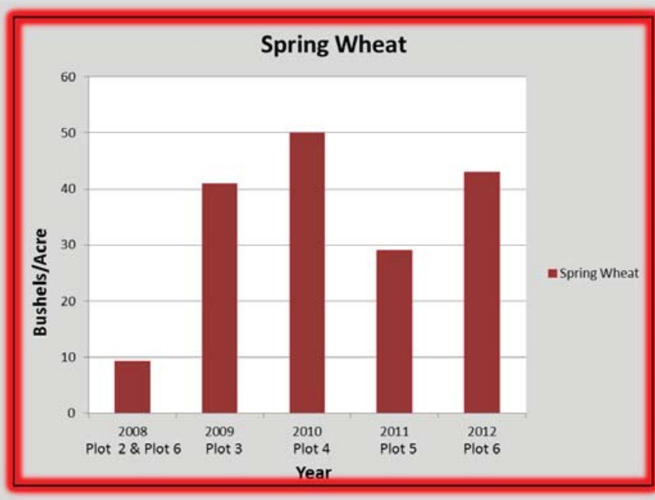
Long-term Mean Monthly Precipitation (In.)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Average
2012

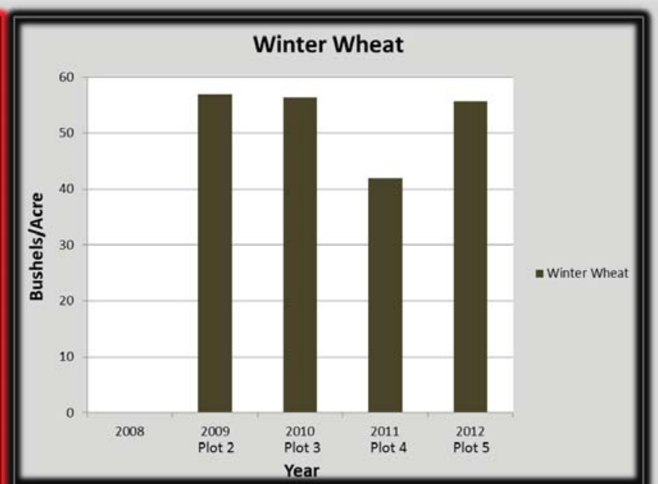

First Year Alfalfa
Tons/Acre
First Year Alfalfa
*Alfalfa/
Sweetclov
er/
2008
Plot 7 & Plot 8
2009
Plot 1
2010
Plot 2
2011
Plot 3
2012
Plot 4
Year

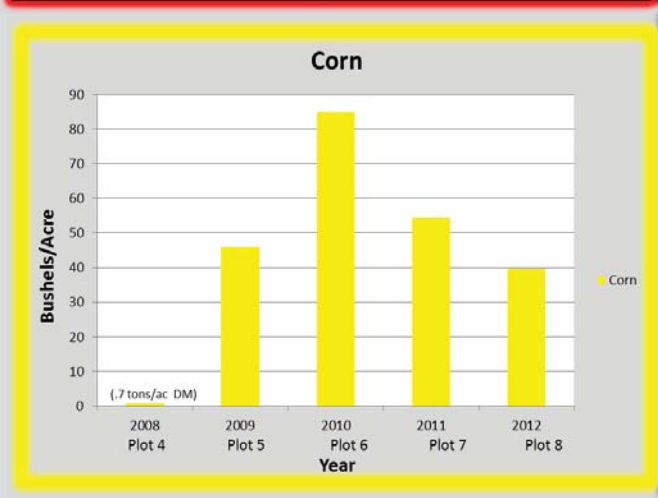

Second Year Alfalfa
Tons/Acre
Second Year Alfalfa
2008
2009
Plot 7
2009
Plot 8
2010
Plot 1
2011
Plot 2
2012
Plot 3
Year

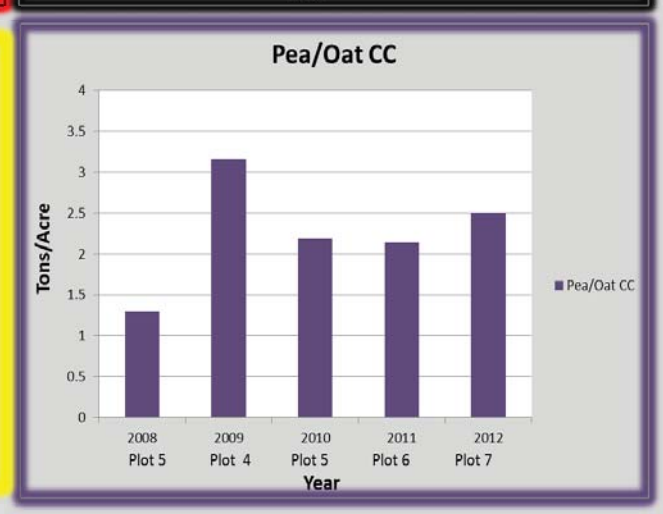

Third Year Alfalfa
Tons/Acre
Third Year Alfalfa
2008
2009
2010
Plot 8
2011
Plot 1
2012
Plot 2
Year


Winter Triticale/Hairy Vetch
Tons/Acre
Winter Triticale/Hairy Vetch
*Spring Triticale
2008
2009
Plot 6
2010
Plot 7
2011
Plot 8
2012
Plot 1
Year


Spring Wheat
Bushels/Acre
Spring Wheat
2008
Plot 2 & Plot 6
2009
Plot 3
2010
Plot 4
2011
Plot 5
2012
Plot 6
Year


Winter Wheat
Bushels/Acre
Winter Wheat
2008
2009
Plot 2
2010
Plot 3
2011
Plot 4
2012
Plot 5
Year


Corn
Bushels/Acre
Corn
(.7 tons/ac DM)
2008
Plot 4
2009
Plot 5
2010
Plot 6
2011
Plot 7
2012
Plot 8
Year


Pea/Oat CC
Tons/Acre
Pea/Oat CC
2008
Plot 5
2009
Plot 4
2010
Plot 5
2011
Plot 6
2012
Plot 7
Year

Thoughts:

-Demonstration was successful

-Armor Up….cover, cover, cover – 1st thing

-Seeding cover crop after winter annual harvested or grazed in June

-Results are variable – research would help