Craig Godbout – WSRA Application
Colorado Water Conservation Board
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Re: Final Report

Number: POGG1 PDAA 20150000000000000196
Date: 03/01/2018
Description: PDAA 2500 WSRA Ag Sustainability in the SLV in the RG Basin

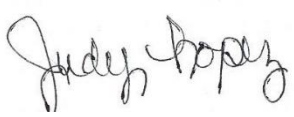
March 1, 2018

Dear Craig,

Please find the attached Final report for the Ag Sustainability in the San Luis Valley in the Rio Grande Basin project.

Please let me know if you have any questions.

Thank you!



Judy Lopez

Rio Grande Watershed Conservation and Education Initiative

Project Consultant

Project Title: Increasing the Water Holding Capacity of Soil for Agriculture Sustainability in the San Luis Valley

This project takes conventionally farmed fields and establishes a base line of their overall soil health and then in place of conventional nutrient management additives uses biotic based nutrient management additives and practices. These additives will be used throughout the rotation. There will beinitial soil health tests taken at the beginning of the project that will contribute the field portfolio; at the end of the three year trial a final analysis will be completed.

One of the many benefits of using this whole picture biotic approach in farming and ranching is that nature tends to create a balance that is far more complex and elegant than anything we could come up with on our own. The methodology Biotic farming means looking at all living things, not just the crop being grown. The success of farmers using this approach has been impressive. They have reduced their water use by 30 to 60 percent and maintained or increased pack out rates. This maintains farm income subsequently allowing for a decrease in production acres. If this type of farming were to replace the conventional standard we have gotten accustomed to, the result could be a win-win for everyone: Profitable farms , increased quality of the product produced, and reduced water consumption for all of us.

The study has looked at few basic tenant's:

1. Soil health through the use of biologic methods, such as compost, green manure cropping and biologic nutrient management, (ultimately replacing commercially produced compounds) will increase soil water holding capacity. How long does this take?

2. Will these biotic system changes increase pack out rates? If so, can productive land with increased pack-out be reduced thus preserving water and farm viability?

3. How long does field rebound from conventional chemical management take and what are the overall water saving through the course of a two/three year crop rotation?

With this in mind here is what we have found.

The study used fields that represent a cross section of the Valley. For each production field that will receive treatment, there is an adjacent control that will receive no treatment. The fields are as follows:

Sites and Treatment for Increasing the Water Holding Capacity of Soil for Agriculture Sustainability in the San Luis Valley

Site Number	Site Name	Treatment/Control	Type of Treatment 15	2015 Crop
1	Blue Sky Field #6 NW	Control	None	Potatoes
2	Blue Sky Field #8 NE	Treatment	Green Manure	Sorgham Sudan
3	Kester	Control	None	Alfalfa
4	Stroupe	Treatment	Compost/ Biologic Nutrient	Alfalfa
5	Trinchera Yoritomo West	Treatment	Compost/Interseeded legume	Barley/Legume
6	Trinchera Yoritomo East	Control	None	Barley/Legume
7	Coors Field 2 NE	Control	None	Barley
8	Coors Field 3 SE	Treatment	Interseeded legume mix	Barley/Legume
9	Worley Davison West	Control	None	Barley
10	Worley Worley East	Treatment	Green Manure	Potatoes
11	Jolly HomeLockwood North	Control	None	Barley
12	Jolly Home Locwood South	Treatment	Interseeded legume mix	Barley/Legume
13	Martinez Field 21 NE	Control	None	Barley
14	Martinez Field 21 SE	Treatment	Compost	Barley
15	Summit Field 1 Zone3	Control	None	Barley
16	Summit Field 31 Zone 1	Treatment	Green Manure	Sorgham Sudan
17	Conservation District Benton	Treatment	Compost/ Biologic Nutrient	Alfalfa

Soils were pulled from each of the sites in 2015, prior to cropping to provide a baseline of the chemical and biological characteristics of each field. Topsoil samples were taken from 0 to 6 inches and Sub soil samples were taken from 6 to 18 inch depths. A second set of samples were taken for the purpose of calculating available water soil holding capacity. A 4X4 meter plot was established at each site for soil sampling and magnetic makers were buried at the corners of each plot at depth of 5 feet, so the exact location could be used for future sample comparisons. Soil samples for the chemical and biological analysis were collected from a composite of locations: 1,10,16, and 25 in the grid plot. Soil samples for the water holding capacity analysis were collected from: 6,7 and 2 in the grid plot. See sample plot below.

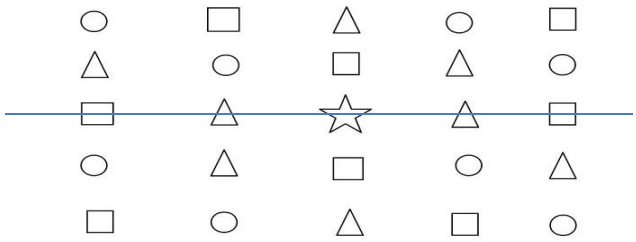
Grid Plot Design

= ○ Baseline Sampling Locations

= □ 1st Sampling Locations

= △ 2nd Sampling Locations

= ☆ Plot Center on Transect Tape



The following are the results of the study. Final sampling was completed in the fall of 2017. While the paired sites for control and treatment in each experiment do vary from each other slightly at the baseline, they are similar in most aspects. The results are significantly different from one experiment to the next based on the different parts of the San Luis Valley that the sites are located, soil types, and cropping histories. Table 3 and 4 show the measured organic matter at the beginning of the study in 2015 and at the end of the study in 2017. Organic matter is a measure of anything within the soil sample that contains carbon compounds that were formed by living organisms. It covers a wide range of things like previous crop residues, crop root matter and soil microbes.

The organic carbon to nitrogen ratio is a critical component of the nutrient cycle. Soil organic carbon and soil organic nitrogen are highly related to each other. The organic carbon to nitrogen ratio of the water extract provides a measure of the amount of carbon and nitrogen available to soil microbes. Again, The results are significantly different from one experiment to the next based on the different parts of the San Luis Valley that the sites are located, soil types, and cropping histories.

There was great variability in the results. All fields had increases in organic matter and fixed carbon/nitrogen components. Some fields had significant increases and others were marginal. The overall testing data was a result of soil type variability, cropping and practice implemented. The second parameters to consider came through the exit interview with growers. Growers in each case felt that even though they did not see significant water saving, they did feel that their overall soil health in the treated fields had improved. This is significant because this brought about the implementation of like practices in other farm circles. Most felt that the soil retained its moister longer and

when the 2017 rains came they watered less. Miller-Coors paid for the development of a soil-water holding capacity lab at Agro Engineering in Alamosa, CO. AGRO had residual soil samples from the test fields and used the pre and post samples to calibrate the lab. Those results will be finished in mid-July and will be a true reflection of the soils water holding capacity increase. It will be interesting to see if these results reflect what the growers feel they have gained. We will report these results to CWCB.

I would like to thank Agro Engineering, 0210 Road 2 South, Alamosa, CO 81101 for their excellent work on project design, implementation, testing and analysis. They have been instrumental in the process. I have attached the full analysis with this report.

AGRO ENGINEERING

"COMPREHENSIVE AGRICULTURAL AND WATER RESOURCE CONSULTING"

0210 ROAD 2 SOUTH ALAMOSA, CO 81101 PHONE (719) 852-4957 FAX 852-5146

February 5, 2018

Judy Lopez
Rio Grande Watershed Conservation & Education Initiative
101 South Craft Drive,
Alamosa, CO 81101

Re: Baseline Soil Results For "Increasing the Water Holding Capacity of Soil for Agricultural Sustainability in the San Luis Valley" Project

Dear Judy,

The Rio Grande Watershed Conservation & Education Initiative is undertaking a project to investigate whether biologic methods to improve soil health can result in positive changes to the soil system. The practices to improve soil health that are being studied include composting, green manure cover cropping and inter-seeding legume crops. Desired outcomes include: reducing water use, maintaining or increasing yields and product quality, and increasing farm profitability. The investigative process includes establishing a baseline of the soil chemical and biological profile, defining a nutrient management plan, developing a crop rotation, monitoring the crops and all amendments, and at the end of the three-year study re-evaluating the soil chemical and biological profiles. Desired soil improvements include an increase in organic matter, an increase in soil carbon, an increase in the organic carbon to nitrogen ratio, an increase in the soil respiration rate, an increase in the Haney soil health index, and an increase in the soil water holding capacity. Seventeen sites were chosen to participate in the study. This included eight paired experiments with a control and a soil health treatment.

Agro Engineering was asked to collect and analyze soil samples to provide the baseline soil profile and the onset of the study and similar samples and the end of the three-year study. Soil samples were sent to Servitech Labs for soil chemical analysis, Agvise Labs for soil carbon testing, and Ward Labs for soil microbiology testing. The purpose of this report is to provide the results from the final soil assay as compared to the baseline soil assay for the seventeen sites involved in the study.

Soil samples were pulled from each of the sites in the spring of 2015, prior to cropping, to provide a baseline of the chemical and biological characteristics at the beginning of the study. Samples were pulled again in August of 2017, while crops were still in the field, to provide a finish point at the end of the study. Top soil samples were taken from a 0 to 6-inch depth. Sub soil samples were taken from a 6 to 18-inch depth. A 4-meter x 4-meter grid plot was established at each site for soil sampling. Magnetic markers were buried 5 feet deep at each corner of the plot so that the exact soil location could be returned to for subsequent sampling.

Soil samples for the chemical and biologic assay were collected from a composite of locations 1, 10, 16, and 25 in the grid plot.

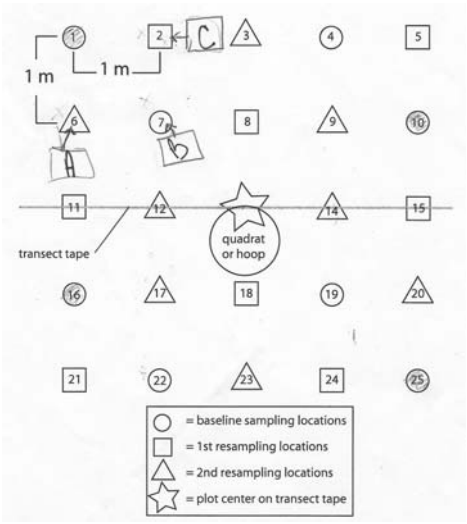


Figure 1. Grid Plot Design

The seventeen sites involved in the study are listed in Table 1.

Table 1. Sites Involved in the Study and Treatment Types

Experiment	Site	Farm, Field and Location	Treatment	Type of Treatment
1	1	Blue Sky Farms Field #8 - NW	Control	None
1	2	Blue Sky Farms Field #8 - NE	Treatment	Green Manure
2	3	Kester	Control	None
2	4	Trinchera Stroupe	Treatment	Compost
3	6	Trinchera Yoritomo 3 - East	Control	None
3	5	Trinchera Yoritomo 3 - West	Treatment	Interseeded Legume mix
4	7	Coors Field 2 - NE	Control	None
4	8	Coors Field 3 - SE	Treatment	Interseeded Legume mix
5	9	Worley Davison - West	Control	None
5	10	Worley Worley - East	Treatment	Green Manure
6	12	Jolly, Home Lockwood - North	Control	None
6	11	Jolly, Home Lockwood - South	Treatment	Interseeded Legume mix
7	13	Martinez Field 21 - NE	Control	None
7	14	Martinez Field 21 - SE	Treatment	Compost
8	15	Summit Field 1 - NE (zone 3)	Control	None
8	16	Summit Field 31 - NE (zone 1)	Treatment	Green Manure
9	17	NRCS Benton Field - North	Control	None

The cropping practices in the first and last year of the study are shown in Table 2.

Table 2. Sites Cropping Practices

Experiment	Site	Farm and Field	2015 Crop	2017 Crop
1	1	BSF #8 NW	Potatoes	Potatoes
1	2	BSF #8 NE	Sorghum Sudan	Canola
2	3	Kester (west of Stroupe)	Alfalfa	Alfalfa
2	4	Trinchera Stroupe	Alfalfa	Alfalfa
3	6	Trinchera Y3 East	Barley	Alfalfa
3	5	Trinchera Y3 West	Barley/legume mix	Alfalfa
4	7	Coors 2 NE	Barley	Barley
4	8	Coors 3 SE	Barley/legume mix	Barley
5	9	Worley Davison West	Barley	Barley
5	10	Worley Worley East	Potatoes	Hemp
6	12	Don Jolly, Home Lockwood, North (control plot)	Barley	Barley
6	11	Don Jolly, Home Lockwood South	Barley/legume mix	Barley
7	13	Martinez 21 NNE	Barley	Barley
7	14	Martinez 21 SE	Barley	Barley
8	15	Summit 1 NE corner (zone 3)	Barley	Barley
8	16	Summit 31 NNE (zone 1)	Sorghum Sudan	Barley
9	17	NRCS Field NE (no 5yr fert monitor area)	Alfalfa	Alfalfa

The following several tables provide a summary of the results of the key indicators measured by the three labs to provide indicators of soil microbiological activity and soil health. While the paired sites for control and treatment in each experiment do vary from each other slightly at the baseline, they are similar in most aspects. The results are significantly different from one experiment to the next based on the different parts of the San Luis Valley that the sites are located, soil types, and cropping histories. Table 3 and 4 show the measured organic matter at the beginning of the study in 2015 and at the end of the study in 2017. Organic matter is a measure of anything within the soil sample that contains carbon compounds that were formed by living organisms. It covers a wide range of things like previous crop residues, crop root matter, and soil microbes.

Table 3. Measures of Organic Matter at the Beginning of the Study in 2015

Experiment	Site	Farm, Field and Location	Treatment	Servitech Top Soil Organic Matter (%)	Servitech Sub Soil Organic Matter (%)	Ward Labs Top Soil Organic Matter (%)
1	1	Blue Sky Farms Field #8 - NW	Control	0.6	0.3	1.1
1	2	Blue Sky Farms Field #8 - NE	Treatment	0.7	0.6	0.7
2	3	Kester	Control	1.3	0.9	1.9
2	4	Trinchera Stroupe	Treatment	1.7	1.2	2
3	6	Trinchera Yoritomo 3 - East	Control	0.6	0.3	1
3	5	Trinchera Yoritomo 3 - West	Treatment	0.8	0.2	0.9
4	7	Coors Field 2 - NE	Control	0.9	0.6	1.5
4	8	Coors Field 3 - SE	Treatment	1.2	0.7	1.7
5	9	Worley Davison - West	Control	0.8	0.5	1.2
5	10	Worley Worley - East	Treatment	0.9	0.3	1.1
6	12	Jolly, Home Lockwood - North	Control	1.3	2.2	3
6	11	Jolly, Home Lockwood - South	Treatment	2.5	1.0	3.3
7	13	Martinez Field 21 - NE	Control	0.8	0.4	1.2
7	14	Martinez Field 21 - SE	Treatment	0.7	0.5	1.1
8	15	Summit Field 1 - NE (zone 3)	Control	0.8	0.4	1.1
8	16	Summit Field 31 - NE (zone 1)	Treatment	1.1	0.8	1.5
9	17	NRCS Benton Field - North	Control	0.9	0.9	1.2

Table 4. Measures of Organic Matter at the End of the Study in 2017

Experiment	Site	Farm, Field, and Location	Treatment	Servitech Top Soil Organic Matter (%)	Servitech Sub Soil Organic Matter (%)	Ward Labs Top Soil Organic Matter (%)
1	1	Blue Sky Farms Field #8 - NW	Control	0.8	0.7	0.9
1	2	Blue Sky Farms Field #8 - NE	Treatment	0.8	0.8	1
2	3	Kester	Control	1.6	1.6	2.1
2	4	Trinchera Stroupe	Treatment	2.2	1.7	2.6
3	6	Trinchera Yoritomo 3 - East	Control	0.9	0.5	1.2
3	5	Trinchera Yoritomo 3 - West	Treatment	0.8	0.6	1.1
4	7	Coors Field 2 - NE	Control	1.2	1	1.5
4	8	Coors Field 3 - SE	Treatment	0.9	1.1	1.6
5	9	Worley Davison - West	Control	0.9	1	1.4
5	10	Worley Worley - East	Treatment	1	0.9	1.3
6	12	Jolly, Home Lockwood - North	Control	2.4	2.3	3.1
6	11	Jolly, Home Lockwood - South	Treatment	2.5	2.2	3.2
7	13	Martinez Field 21 - NE	Control	1.1	1	1.4
7	14	Martinez Field 21 - SE	Treatment	0.9	0.9	1.2
8	15	Summit Field 1 - NE (zone 3)	Control	0.9	0.6	1
8	16	Summit Field 31 - NE (zone 1)	Treatment	1.2	1	1.5
9	17	NRCS Benton Field - North	Control	1	1	1.4

The following graphs provide a visual summary of the organic matter results. In order to accept the hypothesis that a soil health treatment is effective at increasing a soil characteristic, we would like to see the treatment at the end of the study jump higher than the control at the end of the study and the treatment and control at the beginning of the study. If both the treatment and control at the end of the study bump up as compared to the beginning of the study, then some other variable other than the soil health treatment is likely responsible for the change.

The compost treatment in Experiment 2 showed a significant increase in organic matter in the top soil. The interseeded legumes in Experiment 3 and 6 showed an increase in the sub soil organic matter.

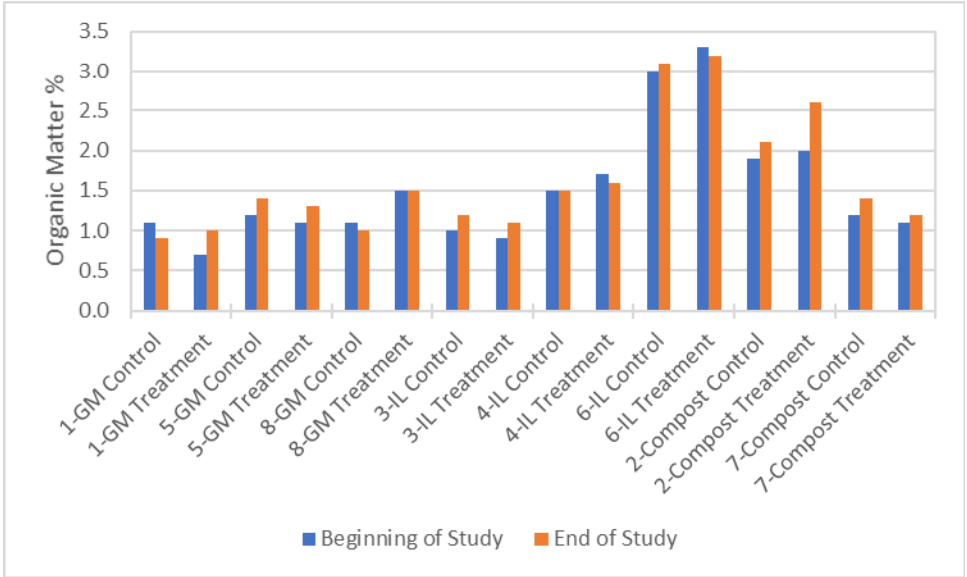


Figure 2. Comparison of Top Soil Organic Matter (Ward)

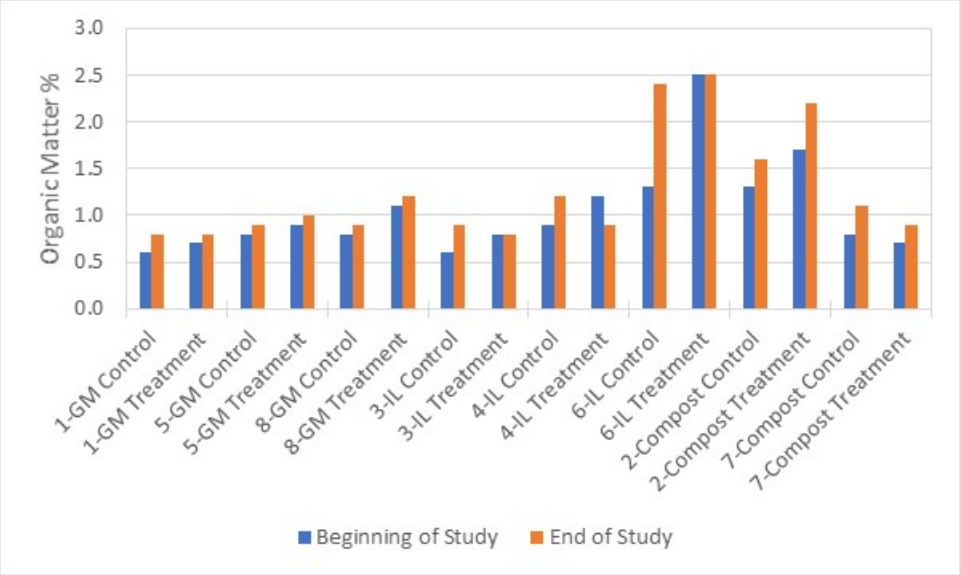


Figure 3. Comparison of Top Soil Organic Matter (Servitech)

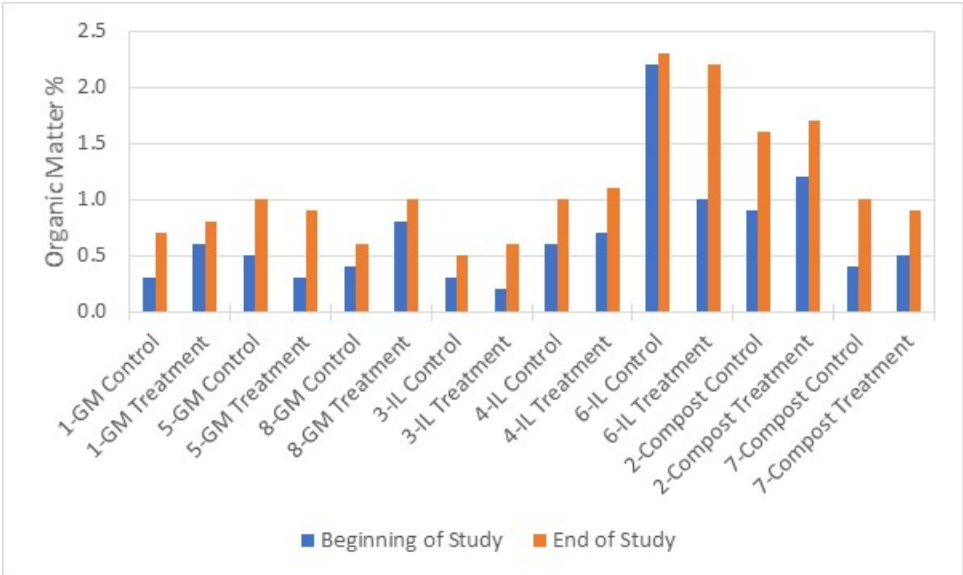


Figure 4. Comparison of Sub Soil Organic Matter (Servitech)

Soil carbon was evaluated for the total carbon (TC) in the soil and also the active carbon. Active soil carbon (TOC) represents the amount of biologically active carbon contained within the soil microbial organisms within the aerobic zone of the soil.

Table 5. Measures of Total Carbon and Active Carbon at the Beginning of the Study in 2015

Experiment	Site	Farm, Field, and Location	Treatment	Agvise Labs Top Soil TC	Agvise Labs Top Soil CCE	Agvise Labs Top Soil TOC	Agvise Labs Sub Soil TC	Agvise Labs Sub Soil CCE	Agvise Labs Sub Soil TOC
				(%)	(%)	(%)	(%)	(%)	(%)
1	1	Blue Sky Farms Field #8 - NW	Control	0.60	2.20	0.30	0.50	2.30	0.20
1	2	Blue Sky Farms Field #8 - NE	Treatment	0.60	1.20	0.40	0.70	2.80	0.30
2	3	Kester	Control	0.80	0.20	0.80	0.60	0.10	0.60
2	4	Trinchera Stroupe	Treatment	1.10	0.10	1.10	0.80	0.00	0.80
3	6	Trinchera Yoritomo 3 - East	Control	0.60	0.20	0.60	0.30	0.00	0.30
3	5	Trinchera Yoritomo 3 - West	Treatment	0.50	0.20	0.40	0.30	0.00	0.30
4	7	Coors Field 2 - NE	Control	0.80	0.80	0.70	0.50	1.20	0.30
4	8	Coors Field 3 - SE	Treatment	0.90	1.00	0.80	0.60	1.00	0.50
5	9	Worley Davison - West	Control	0.60	0.00	0.60	0.30	0.20	0.30
5	10	Worley Worley - East	Treatment	0.60	0.00	0.60	0.20	0.20	0.20
6	12	Jolly, Home Lockwood - North	Control	1.40	0.30	1.30	0.80	0.30	0.80
6	11	Jolly, Home Lockwood - South	Treatment	1.80	0.10	1.80	0.60	0.10	0.60
7	13	Martinez Field 21 - NE	Control	0.80	2.70	0.50	0.60	3.20	0.20
7	14	Martinez Field 21 - SE	Treatment	0.50	0.10	0.40	0.30	0.50	0.30
8	15	Summit Field 1 - NE (zone 3)	Control	0.80	1.60	0.60	0.80	6.20	0.00
8	16	Summit Field 31 - NE (zone 1)	Treatment	1.10	2.20	0.80	0.80	2.30	0.50
9	17	NRCS Benton Field - North	Control	0.60	0.20	0.60	0.60	0.20	0.60

Table 6. Measures of Total Carbon and Active Carbon at the End of the Study in 2017

Experiment	Site	Farm, Field, and Location	Treatment	Agvise Labs Top Soil TC	Agvise Labs Top Soil CCE	Agvise Labs Top Soil TOC	Agvise Labs Sub Soil TC	Agvise Labs Sub Soil CCE	Agvise Labs Sub Soil TOC
				(%)	(%)	(%)	(%)	(%)	(%)
1	1	Blue Sky Farms Field #8 - NW	Control	0.60	0.90	0.50	0.60	1.50	0.40
1	2	Blue Sky Farms Field #8 - NE	Treatment	0.70	1.20	0.60	0.60	1.60	0.40
2	3	Kester	Control	1.10	0.10	1.10	1.10	0.20	1.10
2	4	Trinchera Stroupe	Treatment	1.40	0.20	1.40	1.30	0.10	1.30
3	6	Trinchera Yoritomo 3 - East	Control	0.60	0.10	0.60	0.50	0.10	0.50
3	5	Trinchera Yoritomo 3 - West	Treatment	0.70	0.00	0.70	0.50	0.00	0.50
4	7	Coors Field 2 - NE	Control	0.80	0.70	0.80	0.90	0.60	0.80
4	8	Coors Field 3 - SE	Treatment	0.90	0.60	0.90	1.00	0.90	0.90
5	9	Worley Davison - West	Control	0.70	0.10	0.70	0.40	0.10	0.40
5	10	Worley Worley - East	Treatment	0.70	0.10	0.70	0.60	0.00	0.60
6	12	Jolly, Home Lockwood - North	Control	1.50	0.10	1.50	1.50	0.10	1.40
6	11	Jolly, Home Lockwood - South	Treatment	1.50	0.20	1.40	0.50	0.10	0.50
7	13	Martinez Field 21 - NE	Control	1.20	3.10	0.80	1.20	3.50	0.80
7	14	Martinez Field 21 - SE	Treatment	0.60	0.20	0.60	0.50	0.20	0.50
8	15	Summit Field 1 - NE (zone 3)	Control	0.60	0.90	0.50	0.70	1.00	0.50
8	16	Summit Field 31 - NE (zone 1)	Treatment	0.90	1.30	0.80	1.00	1.30	0.90
9	17	NRCS Benton Field - North	Control	0.70	0.00	0.70	0.70	0.10	0.70

The following graphs provide a visual summary of the soil carbon results. The green manure treatment in Experiment 1 and the interseeded-legume treatment in Experiment 3 showed a slight increase in top soil total carbon and top soil active carbon. None of the other treatments showed a significant change in top soil carbon.

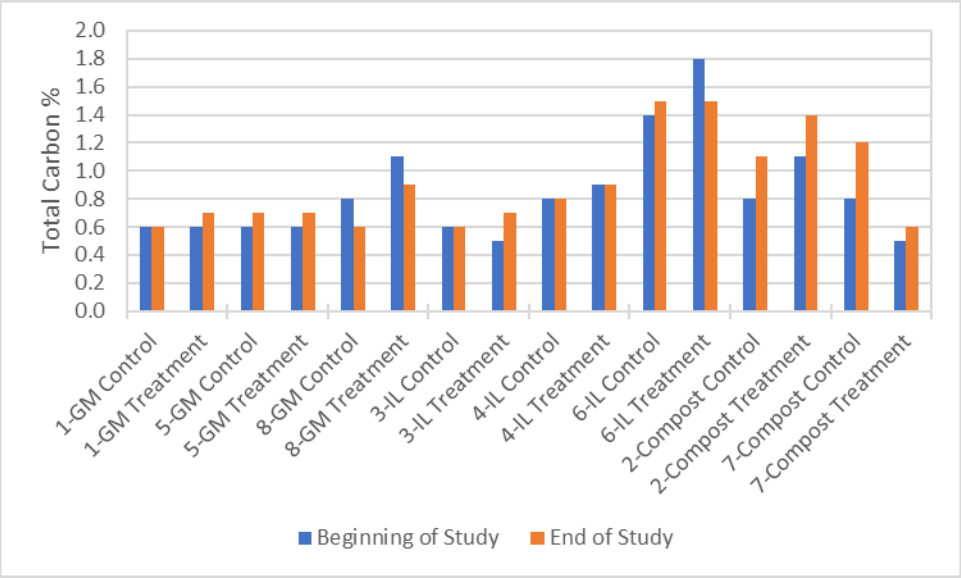


Figure 5. Comparison of Top Soil Total Carbon

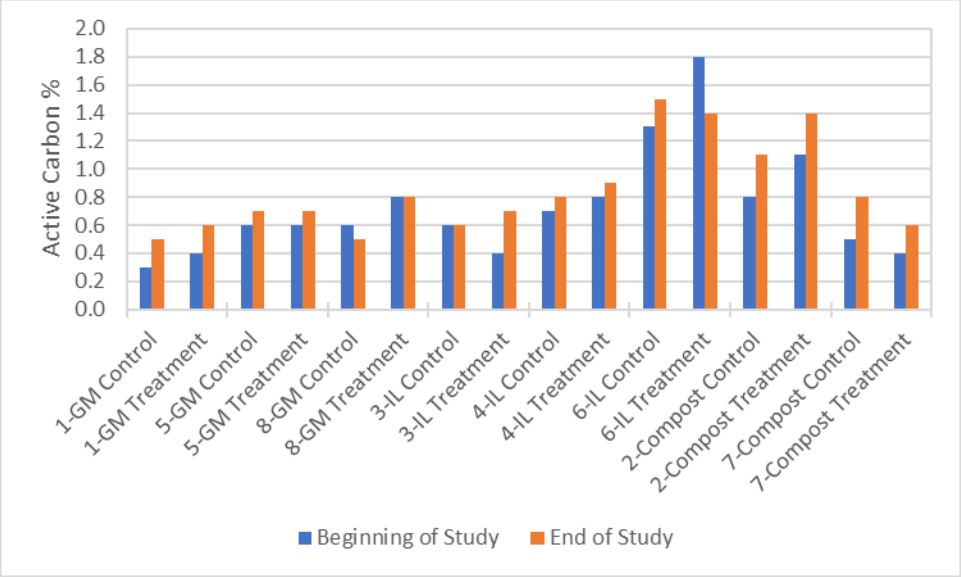


Figure 6. Comparison of Top Soil Active Carbon

The green manure treatment in Experiment 5 and 8 showed a slight increase in sub soil total carbon and sub soil active carbon. None of the other treatments showed a significant change in sub soil carbon.

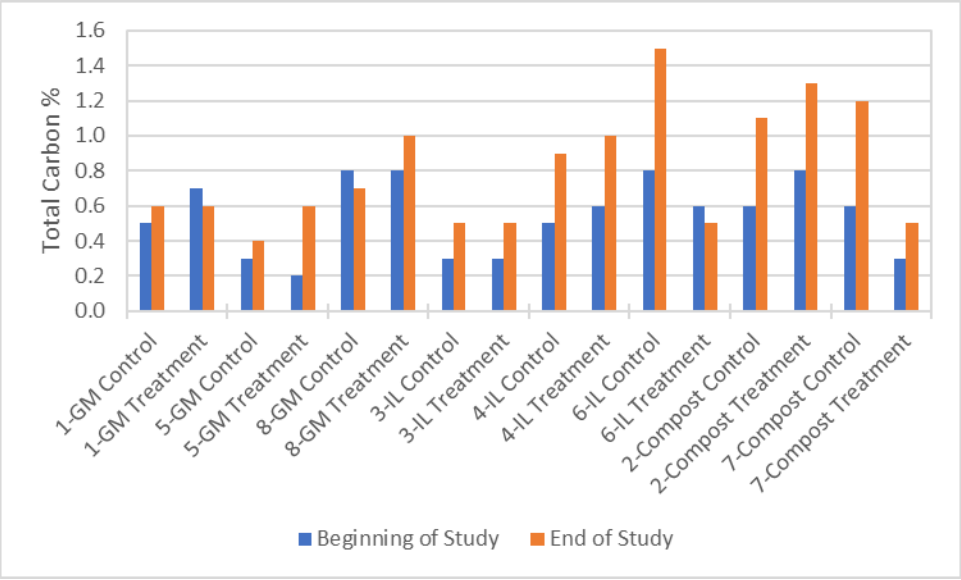


Figure 7. Comparison of Sub Soil Total Carbon

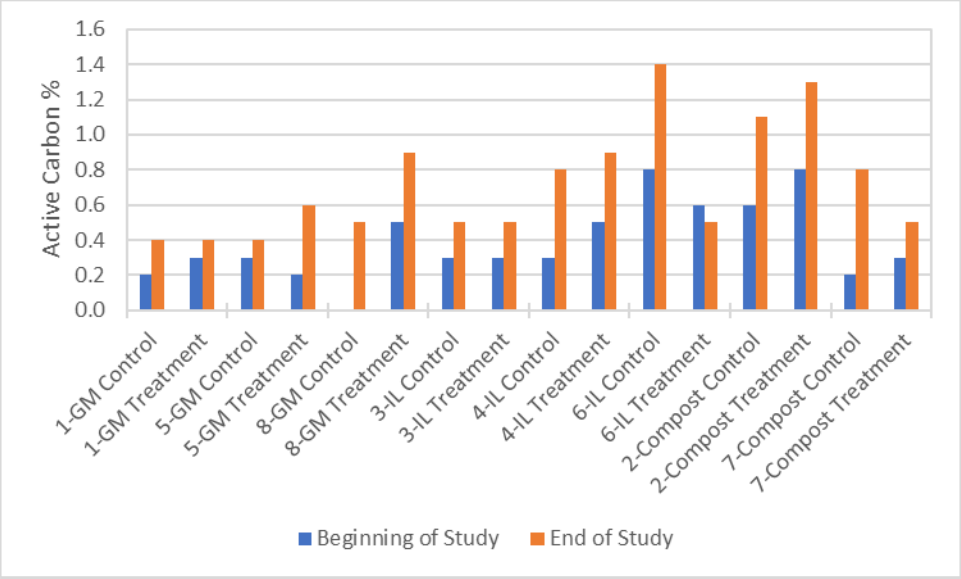


Figure 8. Comparison of Sub Soil Active Carbon

The organic carbon to nitrogen ratio is a critical component of the nutrient cycle. Soil organic carbon and soil organic nitrogen are highly related to each other. The organic carbon to nitrogen ratio of the water extract provides a measure of the amount of carbon and nitrogen available to soil microbes. A C:N ratio above 20:1 generally indicates that no net N and P mineralization will occur, meaning the N and P are "tied up" within the microbial cells. As the ratio decreases, more N and P are released to the soil solution and become plant available. A higher organic carbon to nitrogen ratio indicates more soil microbes.

The Solvita test quantifies the amount of respired carbon dioxide after rewetting a dry soil sample. The amount of carbon dioxide measured over a 24-hour period represents "active carbon" or "respirable carbon" that was acted upon by the microbes and may also be used to estimate potential mineralizeable nitrogen and phosphorus from the soil organic matter. Soil microbial biomass plays a critical role in controlling the supply of nitrogen and phosphorus to crops. The rate of soil biological activity serves as an index of a soil's capacity to supply nitrogen and perhaps other nutrients such as phosphorus to crops. In general, soils that exhibit a higher CO2 flush are considered to contain greater microbial biomass due to a more favorable food supply, leading to an increased potential for activity and nutrient turnover/mineralization.

The Haney soil health index is calculated as the 1-day CO2-C divided by the organic carbon to nitrogen ratio plus the weighted contribution of water extractable organic carbon and organic nitrogen. It represents the overall health of the soil. It combines five independent measures of the soil's biological properties. The calculation looks at the balance of soil carbon and nitrogen and their relationship to microbial activity. This soil health calculation number can vary from 0 to more than 50. In general, good soil health is measured by numbers greater than 7.

The Haney Test of available N is an integrated and comprehensive index for measuring soil health. It includes many different chemical and biologic factors including, nitrogen, phosphate, the Solvita test, the organic carbon to nitrogen ration, and the soil health calculation. The Haney Test of available N represents the amount of nitrogen available to the crop.

Table 7. Measures of Soil Microbiology and Soil Health at the Beginning of the Study in 2015

Experiment	Site	Farm, Field, and Location	Treatment	Ward Labs Organic C:N Ratio	Ward Labs Solvita CO2-C (0 to 120)	Ward Labs Soil Health Calculation (0 to over 50)	Ward Labs Haney Test N
1	1	Blue Sky Farms Field #8 - NW	Control	13	15.4	6.04	48.6
1	2	Blue Sky Farms Field #8 - NE	Treatment	11.4	7.5	5.35	74.3
2	3	Kester	Control	15.9	38.1	6.28	17.7
2	4	Trinchera Stroupe	Treatment	11.7	33.1	8.05	42.7
3	6	Trinchera Yoritomo 3 - East	Control	7.7	19.2	7.43	129
3	5	Trinchera Yoritomo 3 - West	Treatment	10.1	22.1	6.21	54.8
4	7	Coors Field 2 - NE	Control	17.8	17.5	4.82	11.8
4	8	Coors Field 3 - SE	Treatment	14.6	19.2	5.91	16.7
5	9	Worley Davison - West	Control	17	27.7	4.91	211.5
5	10	Worley Worley - East	Treatment	9.8	47.8	8.95	106.3
6	12	Jolly, Home Lockwood - North	Control	11.6	94.1	14.19	142.1
6	11	Jolly, Home Lockwood - South	Treatment	11.8	94.1	16.16	148.4
7	13	Martinez Field 21 - NE	Control	28.4	14	3.88	201.9
7	14	Martinez Field 21 - SE	Treatment	8.2	12.8	5.44	137.5
8	15	Summit Field 1 - NE (zone 3)	Control	13.1	26.4	6.56	149.9
8	16	Summit Field 31 - NE (zone 1)	Treatment	13	21.1	6.93	110.9
9	17	NRCS Benton Field - North	Control	12.9	71.6	9.91	42.4

Table 8. Measures of Soil Microbiology and Soil Health at the End of the Study in 2017

Experiment	Site	Farm, Field, and Location	Treatment	Ward Labs Organic C:N Ratio	Ward Labs Solvita CO2-C (0 to 120)	Ward Labs Soil Health Calculation (0 to over 50)	Ward Labs Haney Test N
1	1	Blue Sky Farms Field #8 - NW	Control	12.5	6.2	6	21
1	2	Blue Sky Farms Field #8 - NE	Treatment	15.3	4.5	5.7	6
2	3	Kester	Control	9.7	31.6	8.4	34.3
2	4	Trinchera Stroupe	Treatment	9.3	123	16.6	61.8
3	6	Trinchera Yoritomo 3 - East	Control	8.9	25.2	8	30.4
3	5	Trinchera Yoritomo 3 - West	Treatment	8.9	20.2	7.4	23.2
4	7	Coors Field 2 - NE	Control	12.2	11.1	7.4	20.1
4	8	Coors Field 3 - SE	Treatment	10.9	7.8	7	17.6
5	9	Worley Davison - West	Control	8.4	43.5	10.3	51.5
5	10	Worley Worley - East	Treatment	9.5	20.2	7.3	24.1
6	12	Jolly, Home Lockwood - North	Control	9.8	204	21.6	71.8
6	11	Jolly, Home Lockwood - South	Treatment	10.8	134	17.4	57.3
7	13	Martinez Field 21 - NE	Control	15.9	8.5	7.9	15.7
7	14	Martinez Field 21 - SE	Treatment	10.9	6.8	4.5	11.4
8	15	Summit Field 1 - NE (zone 3)	Control	12.7	5.4	5.4	17.7
8	16	Summit Field 31 - NE (zone 1)	Treatment	13	5.9	6.2	18.4
9	17	NRCS Benton Field - North	Control	9.4	52.3	11	49.7

Figure 9 provides a visual summary of the organic carbon to organic nitrogen ratio. The green manure treatment in Experiment 1, the interseeded-legume treatment in Experiment 6 and the compost treatment in Experiment 7 all showed a slight increase in the organic carbon to nitrogen ratio. None of the other treatments showed a significant response in improving the organic carbon to nitrogen ratio.

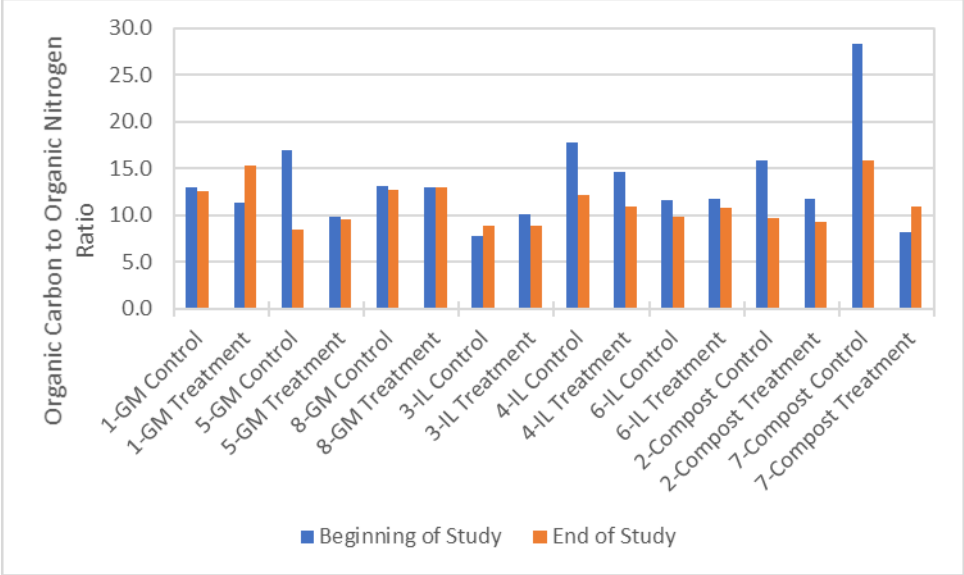


Figure 9. Comparison of Organic Carbon to Organic Nitrogen Ratio

Figure 10 provides a visual summary of the change in the Solvita soil carbon dioxide respiration rate. The compost treatment in Experiment 2 showed a large increase in the soil respiration rate. None of the other treatments showed a significant response in improving the soil respiration rate.

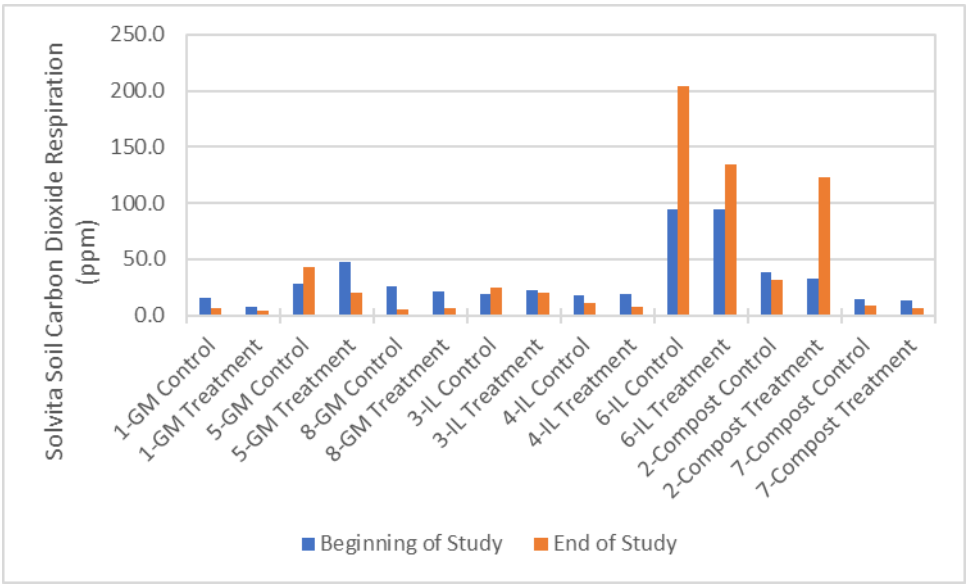


Figure 10. Comparison of Solvita CO2 Respiration (Ward)

Figure 11 provides a visual summary of the change in the Haney soil health index. The compost treatment in Experiment 2 showed a large increase in the soil health index. None of the other treatments showed a significant response in changing the Haney soil health index.

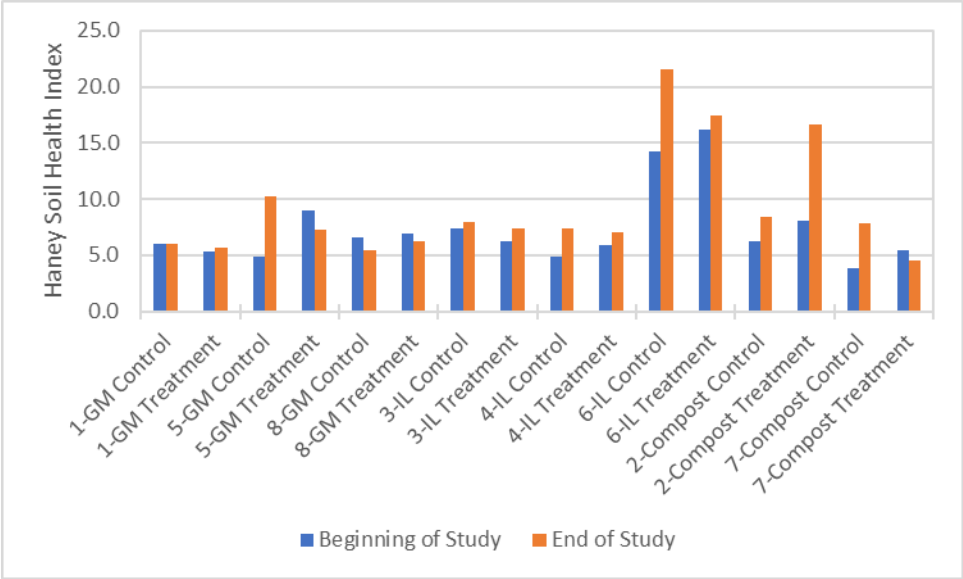


Figure 11. Comparison of Haney Soil Health Index

Figure 12 provides a visual summary of the change in the Haney available nitrogen. The compost treatment in Experiment 2 showed a slight increase in the Haney available nitrogen. None of the other treatments showed a significant response in changing the Haney available nitrogen.

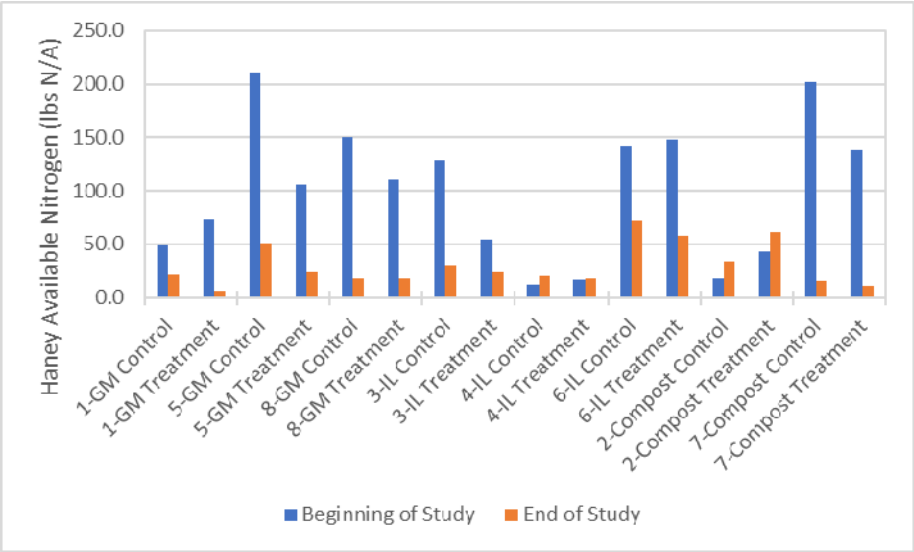


Figure 12. Comparison of Sub Soil Active Carbon (Agvise)

In conclusion, none of the soil health treatment types showed dramatic and consistent results at increasing the soil physical and biological characteristics that are indicative of improved soil health. One of the three green manure treatments had a slight increase in soil organic matter, top soil total carbon, sub soil total carbon, and sub soil active carbon. This may indicate the positive benefit of the deep roots that the green manure provides. However, the other two green manure trials did not show this response.

Two of the three interseeded-legume treatments had an increase in the sub soil organic matter. However, the third trial did not show this response. One of the interseeded-legume treatments did have a slight increase in the amount of top soil total and active carbon, however this response was not seen in the other two treatments.

Compost seemed to have the largest effect on the greatest number of soil health indicators. In one of the experiments, the compost seemed to improve the organic matter, organic carbon to nitrogen ratio, soil respiration rate, Haney soil health index, and Haney available nitrogen. However, this effect was not seen in the second compost trial. This may indicate an issue with compost batch consistency, or there may be other variables associated with differing soil types and differing farm practices that influence these effects.

The complete soil analysis from the soil samples sent to Servitech Labs, Agvise Labs, and Ward Labs are contained in Appendix A. The tables in the appendix include all of the chemical analytes that were measured. I hope this information is insightful. I will provide a similar analysis of the change in water holding capacities once all of that lab work is complete.

Sincerely,

Kirk Thompson, P.E. C.C.A.

APPENDIX A. COMPLETE SOIL ANALYSIS

Agvise Labs Soil Carbon Testing

Spring 2015

Top Soil Samples

Experiment	Site	Farm and Field	TC	CCE	TOC
			(%)	(%)	(%)
1	1	BSF #8 NW	0.60	2.20	0.30
1	2	BSF #8 NE	0.60	1.20	0.40
2	3	Kester (west of Stroupe)	0.80	0.20	0.80
2	4	Trinchera Stroupe	1.10	0.10	1.10
3	6	Trinchera Y3 East	0.60	0.20	0.60
3	5	Trinchera Y3 West	0.50	0.20	0.40
4	7	Coors 2 NE	0.80	0.80	0.70
4	8	Coors 3 SE	0.90	1.00	0.80
5	9	Worley Davison West	0.60	0.00	0.60
5	10	Worley Worley East	0.60	0.00	0.60
6	12	Don Jolly, Home Lockwood, North (control plot)	1.40	0.30	1.30
6	11	Don Jolly, Home Lockwood South	1.80	0.10	1.80
7	13	Martinez 21 NNE	0.80	2.70	0.50
7	14	Martinez 21 SE	0.50	0.10	0.40
8	15	Summit 1 NE corner (zone 3)	0.80	1.60	0.60
8	16	Summit 31 NNE (zone 1)	1.10	2.20	0.80
9	17	NRCS Field NE (no 5yr fert monitor area)	0.60	0.20	0.60

Sub Soil Samples

Experiment	Site	Farm and Field	TC	CCE	TOC
			(%)	(%)	(%)
1	1	BSF #8 NW	0.50	2.30	0.20
1	2	BSF #8 NE	0.70	2.80	0.30
2	3	Kester (west of Stroupe)	0.60	0.10	0.60
2	4	Trinchera Stroupe	0.80	0.00	0.80
3	6	Trinchera Y3 East	0.30	0.00	0.30
3	5	Trinchera Y3 West	0.30	0.00	0.30
4	7	Coors 2 NE	0.50	1.20	0.30
4	8	Coors 3 SE	0.60	1.00	0.50
5	9	Worley Davison West	0.30	0.20	0.30
5	10	Worley Worley East	0.20	0.20	0.20
6	12	Don Jolly, Home Lockwood, North (control plot)	0.80	0.30	0.80
6	11	Don Jolly, Home Lockwood South	0.60	0.10	0.60
7	13	Martinez 21 NNE	0.60	3.20	0.20
7	14	Martinez 21 SE	0.30	0.50	0.30
8	15	Summit 1 NE corner (zone 3)	0.80	6.20	0.00
8	16	Summit 31 NNE (zone 1)	0.80	2.30	0.50
9	17	NRCS Field NE (no 5yr fert monitor area)	0.60	0.20	0.60

Agvise Labs Soil Carbon Testing

Fall 2017

Top Soil Samples

Experiment	Site	Farm and Field	TC	CCE	TOC
			(%)	(%)	(%)
1	1	BSF #8 NW	0.60	0.90	0.50
1	2	BSF #8 NE	0.70	1.20	0.60
2	3	Kester (west of Stroupe)	1.10	0.10	1.10
2	4	Trinchera Stroupe	1.40	0.20	1.40
3	6	Trinchera Y3 East	0.60	0.10	0.60
3	5	Trinchera Y3 West	0.70	0.00	0.70
4	7	Coors 2 NE	0.80	0.70	0.80
4	8	Coors 3 SE	0.90	0.60	0.90
5	9	Worley Davison West	0.70	0.10	0.70
5	10	Worley Worley East	0.70	0.10	0.70
6	12	Don Jolly, Home Lockwood, North (control plot)	1.50	0.10	1.50
6	11	Don Jolly, Home Lockwood South	1.50	0.20	1.40
7	13	Martinez 21 NNE	1.20	3.10	0.80
7	14	Martinez 21 SE	0.60	0.20	0.60
8	15	Summit 1 NE corner (zone 3)	0.60	0.90	0.50
8	16	Summit 31 NNE (zone 1)	0.90	1.30	0.80
9	17	NRCS Field NE (no 5yr fert monitor area)	0.70	0.00	0.70

Sub Soil Samples

Experiment	Site	Farm and Field	TC	CCE	TOC
			(%)	(%)	(%)
1	1	BSF #8 NW	0.60	1.50	0.40
1	2	BSF #8 NE	0.60	1.60	0.40
2	3	Kester (west of Stroupe)	1.10	0.20	1.10
2	4	Trinchera Stroupe	1.30	0.10	1.30
3	6	Trinchera Y3 East	0.50	0.10	0.50
3	5	Trinchera Y3 West	0.50	0.00	0.50
4	7	Coors 2 NE	0.90	0.60	0.80
4	8	Coors 3 SE	1.00	0.90	0.90
5	9	Worley Davison West	0.40	0.10	0.40
5	10	Worley Worley East	0.60	0.00	0.60
6	12	Don Jolly, Home Lockwood, North (control plot)	1.50	0.10	1.40
6	11	Don Jolly, Home Lockwood South	0.50	0.10	0.50
7	13	Martinez 21 NNE	1.20	3.50	0.80
7	14	Martinez 21 SE	0.50	0.20	0.50
8	15	Summit 1 NE corner (zone 3)	0.70	1.00	0.50
8	16	Summit 31 NNE (zone 1)	1.00	1.30	0.90
9	17	NRCS Field NE (no 5yr fert monitor area)	0.70	0.10	0.70

Ward Labs Soil Chemical and Microbial Testing

Spring 2015

Experiment	Site	Farm and Field	Date Recd	Date Rept	Lab No	1:1 Soil pH	WDRF Buffer	1:1 Soluble Salt	Excess Lime	Organic Matter	Solvita CO2-C	H2O Total N	H2O Organic N	H2O Total Organic C	H3A Nitrate	H3A Ammonium	H3A Inorganic Nitrogen	H3A Inorganic Phosphorus	H3A Total Phosphorus	H3A Organic Phosphorus	H3A ICAP Potassium	H3A ICAP Calcium
1	1	BSF #8 NW	1/6/2016	1/8/2016	18	6.9	7.2	0.56	3	1.1	15.4	43.9	21.1	274	20.2	0.9	21.2	86	108	21.7	236	3180
1	2	BSF #8 NE	1/6/2016	1/8/2016	17	7.3	7.2	0.98	3	0.7	7.5	60.4	21.9	249	34.5	0.7	35.3	68.4	86	17.2	287	4024
2	3	Kester (west of Stroupe)	1/6/2016	1/8/2016	31	7.4	7.2	0.34	1	1.9	38.1	18.5	15	238	2.9	0.9	3.9	21.2	29	8.1	68	509
2	4	Trinchera Stroupe	1/6/2016	1/8/2016	30	7.5	7.2	0.64	1	2	33.1	35.6	24.1	282	9.7	1.3	11	29.5	39	9.1	82	622
3	6	Trinchera Y3 East	1/6/2016	1/8/2016	29	7.2	7.2	0.61	1	1	19.2	80.4	27.9	214	52.4	2	54.4	63.4	80	16.6	212	354
3	5	Trinchera Y3 West	1/6/2016	1/8/2016	28	7.3	7.2	0.39	1	0.9	22.1	41.4	20	202	19.1	1.6	20.8	51.9	67	15.5	168	333
4	7	Coors 2 NE	1/6/2016	1/8/2016	20	8.1	7.2	0.46	3	1.5	17.5	17.6	13.8	245	3.5	0.9	4.4	129.5	162	32.2	126	2168
4	8	Coors 3 SE	1/6/2016	1/8/2016	21	8	7.2	0.34	3	1.7	19.2	23.9	18.7	272	4.7	0.6	5.3	122.5	151	28.3	220	2580
5	9	Worley Davison West	1/6/2016	1/8/2016	32	6	6.1	1.03	1	1.2	27.7	117.2	12.1	206	82.8	20.1	102.9	93.3	116	22.6	232	327
5	10	Worley Worley East	1/6/2016	1/8/2016	33	6.7	7.2	1.44	1	1.1	47.8	55.7	20.6	202	19.9	15.9	35.8	136.5	167	30.1	354	439
6	12	Don Jolly, Home Lockwood, North (control plot)	1/6/2016	1/8/2016	23	6.8	7.2	0.82	1	3	94.1	72.7	28.2	328	39.9	2.9	42.8	63.5	79	15.5	188	766
6	11	Don Jolly, Home Lockwood South	1/6/2016	1/8/2016	22	7.6	7.2	0.88	1	3.3	94.1	77.2	37.5	443	35.5	1.2	36.7	87.1	111	23.9	379	1001
7	13	Martinez 21 NNE	1/6/2016	1/8/2016	24	7.7	7.2	1.56	3	1.2	14	107.7	8.8	251	99.1	1.3	100.4	47.2	56	9.3	222	4771
7	14	Martinez 21 SE	1/6/2016	1/8/2016	25	7.4	7.2	0.82	1	1.1	12.8	82.9	21.3	175	62.7	1.4	64.1	168.5	210	41.9	121	826
8	15	Summit 1 NE corner (zone 3)	1/6/2016	1/8/2016	27	7.8	7.2	0.66	3	1.1	26.4	90.2	19.7	258	67.6	1.6	69.3	77.7	94	16.2	192	4001
8	16	Summit 31 NNE (zone 1)	1/6/2016	1/8/2016	26	8	7.2	0.75	3	1.5	21.1	73.5	23.1	299	49.3	0.9	50.2	59.3	72	12.3	312	4180
9	17	NRCS Field NE (no 5yr fert monitor area)	1/6/2016	1/8/2016	19	6.2	6.8	0.27	1	1.2	71.6	22.7	19.1	247	3.2	0.9	4.1	76.2	99	22.6	135	400

Experiment	Site	Farm and Field	H3A ICAP Aluminum	H3A ICAP Iron	Organic C:N	N Min	Organic N Release	Organic N Reserve	P Min	Organic P Reserve	P Saturation Al/Fe	P Saturation Ca	Soil Health Calculation	Available N	Available P	Available K	Nutrient Value	Traditional N	Haney Test N	Lbs N Difference	N savings
1	1	BSF #8 NW	127.4	82.8	13	1.9	3.1	18	1.4	20.3	51.2	3.4	6.04	48.6	200.9	282.8	250.88	40.5	48.6	8.1	5.2
1	2	BSF #8 NE	86.59	63.2	11.4	1.2	1.9	20.1	0.9	16.3	57.1	2.1	5.35	74.3	159.3	344.9	282.12	69.1	74.3	5.2	3.33
2	3	Kester (west of Stroupe)	342.3	277.5	15.9	2.5	5	10	1.2	6.9	4.7	5.8	6.28	17.7	51.5	81.6	72.23	5.9	17.7	11.8	7.58
2	4	Trinchera Stroupe	292.2	208.2	11.7	5	10.3	13.8	3.8	5.3	7.7	6.2	8.05	42.7	76.6	98.5	106.47	19.5	42.7	23.3	14.89
3	6	Trinchera Y3 East	375.8	209	7.7	4.8	10.1	17.8	3.8	12.8	13.7	22.6	7.43	129	154.4	254.4	270.01	104.9	129	24.2	15.48
3	5	Trinchera Y3 West	393.5	219.1	10.1	4.2	6.6	13.4	3.3	12.2	11	20.2	6.21	54.8	126.8	201.2	185.17	38.3	54.8	16.6	10.6
4	7	Coors 2 NE	211.9	86.4	17.8	0.5	1.5	12.3	< 0.1	32.2	54.2	7.5	4.82	11.8	297.8	150.8	199.1	6.9	11.8	4.9	3.14
4	8	Coors 3 SE	180.5	82.5	14.6	1.7	3	15.6	1.1	27.2	57.3	5.8	5.91	16.7	284.2	264.2	253.68	9.5	16.7	7.2	4.64
5	9	Worley Davison West	350.3	213.4	17	1.2	2.8	9.3	0.3	22.4	20.6	35.4	4.91	211.5	215.1	278.3	358.39	165.7	211.5	45.8	29.33
5	10	Worley Worley East	294	168.3	9.8	9.4	17.4	3.3	7.3	22.8	36	38	8.95	106.3	330.8	425.3	409.68	39.9	106.3	66.5	42.53
6	12	Don Jolly, Home Lockwood, North (control plot)	332.9	140.4	11.6	14.5	28.2	0	11.1	4.5	16.7	10.3	14.19	142.1	171.4	226.1	270.81	79.9	142.1	62.2	39.81
6	11	Don Jolly, Home Lockwood South	308.2	123	11.8	14.1	37.5	0	10.7	13.2	25.7	11.1	16.16	148.4	224.9	454.4	409.94	71.1	148.4	77.4	49.52
7	13	Martinez 21 NNE	72.42	54.1	28.4	< 0.1	0.5	8.3	< 0.1	9.3	44.8	1.2	3.88	201.9	108.5	266.4	304.71	198.3	201.9	3.6	2.31
7	14	Martinez 21 SE	226.2	105.5	8.2	3	4.6	16.7	2.4	39.6	63.4	25.5	5.44	137.5	392.9	144.7	313.57	125.5	137.5	12	7.67
8	15	Summit 1 NE corner (zone 3)	128.7	71.3	13.1	3.2	5.7	14	2.3	13.9	46.9	2.3	6.56	149.9	184	230.2	282.77	135.3	149.9	14.7	9.38
8	16	Summit 31 NNE (zone 1)	97.45	58.8	13	2.6	5.2	17.8	1.9	10.4	45.8	1.7	6.93	110.9	140.7	374.2	312.96	98.7	110.9	12.3	7.86
9	17	NRCS Field NE (no 5yr fert monitor area)	523.5	290.5	12.9	8.9	17.1	2	6.5	16.1	12.1	24.7	9.91	42.4	190.2	161.6	182.15	6.4	42.4	36	23.05

Ward Labs Soil Chemical and Microbial Testing

Fall 2017

Experiment	Site	Farm and Field	Date Recd	Date Rept	Lab No	1:1 Soil pH	WDRF Buffer	1:1 Soluble Salt	Excess Lime	Organic Matter	Solvita CO2-C	H2O Total N	H2O Organic N	H2O Total Organic C	H3A Nitrate	H3A Ammonium	H3A Inorganic Nitrogen	H3A Inorganic Phosphorus	H3A Total Phosphorus	H3A Organic Phosphorus	H3A ICAP Potassium	H3A ICAP Zinc	H3A ICAP Iron	H3A ICAP Manganese
1	1	BSF #8 NW	8/15/2017	8/17/2017	116633	8.1	7.2	0.18	1	0.9	6.2	29.4	15.4	193	7.9	1.7	9.7	106	88.3	17.8	153	2.3	97.4	12.1
1	2	BSF #8 NE	8/15/2017	8/17/2017	116634	8.2	7.2	0.22	1	1	4.5	15.6	13.1	200	1.2	0.9	2.1	101	85.4	15.1	148	1.6	99	11.3
2	3	Kester (west of Stroupe)	8/15/2017	8/17/2017	116635	7.5	7.2	0.16	0	2.1	31.6	25.7	17.7	172	4.9	1.1	6.1	25	16.4	8.5	78	1.2	432	10.1
2	4	Trinchera Stroupe	8/15/2017	8/17/2017	116636	7.5	7.2	0.19	0	2.6	123	37.3	22.1	205	10.5	1.8	12.2	38	28.7	10.4	76	1.3	297.7	9
3	6	Trinchera Y3 East	8/15/2017	8/17/2017	116638	7.1	7.2	0.1	0	1.2	25.2	26.2	19.8	176	4	1.6	5.6	78	62.6	15.8	198	1.7	355	30.7
3	5	Trinchera Y3 West	8/15/2017	8/17/2017	116537	6.9	7.2	0.09	0	1.1	20.2	23.2	19.5	173	2.5	1.3	3.8	63	49.1	13.9	146	1.4	321.9	26.5
4	7	Coors 2 NE	8/15/2017	8/17/2017	116539	8.2	7.2	0.27	1	1.5	11.1	27.1	18.4	224	5.5	2	7.5	189	161.2	27.7	155	1.8	139.4	24.7
4	8	Coors 3 SE	8/15/2017	8/17/2017	116540	8.2	7.2	0.22	0	1.8	7.8	27.5	19.6	213	5.4	1.5	6.9	161	138.2	22.3	124	1.9	141.8	20.8
5	9	Worley Davison West	8/15/2017	8/17/2017	116541	6.2	6.9	0.16	0	1.4	43.5	30.7	22.1	187	5.7	2.4	8	136	108.2	28.1	230	5.6	470.9	51.8
5	10	Worley Worley East	8/15/2017	8/17/2017	116542	6.6	7.2	0.13	0	1.3	20.2	23.7	18.1	172	3.3	1.6	4.9	139	117.2	21.6	204	3.9	316.5	54.1
6	12	Don Jolly, Home Lockwood, North (control plot)	8/15/2017	8/17/2017	116544	6.9	7.2	0.26	0	3.1	204	39.4	23.8	234	14.3	1.8	16.1	133	112.2	20.8	256	1.4	209.7	27.5
6	11	Don Jolly, Home Lockwood South	8/15/2017	8/17/2017	116543	7.3	7.2	0.3	0	3.2	134	37.6	19.8	215	10.7	1.3	12	134	114.2	19.3	210	1.8	198	32
7	13	Martinez 21 NNE	8/15/2017	8/17/2017	116545	8.2	7.2	0.25	3	1.4	8.5	23.9	16.9	270	5.5	1.1	6.6	42	31.6	10.5	179	0.2	63.8	4.9
7	14	Martinez 21 SE	8/15/2017	8/17/2017	116546	7.9	7.2	0.13	0	1.2	6.8	15.5	11.9	130	3	0.9	3.8	181	153.2	28.1	105	3.1	167.2	57.5
8	15	Summit 1 NE corner (zone 3)	8/15/2017	8/17/2017	116547	8.2	7.2	0.25	1	1	5.4	23.5	13.6	173	7.3	0.9	8.1	131	111.2	19.3	89	1.7	84.2	12.5
8	16	Summit 31 NNE (zone 1)	8/15/2017	8/17/2017	116548	8.3	7.2	0.3	1	1.5	5.9	25.6	15.6	203	7.3	1.1	8.4	72	61.6	10.7	182	0.9	84.9	9.9
9	17	NRCS Field NE (no 5yr fert monitor area)	8/15/2017	8/17/2017	116549	6.6	7.2	0.13	0	1.4	52.3	29.1	20	188	5.9	1.8	7.6	113	89.4	23.4	164	3.2	520.2	26.9

Experiment	Site	Farm and Field	H3A ICAP Copper	H3A ICAP Sulfur	H3A ICAP Calcium	H3A ICAP Mangnesium	H3A ICAP Sodium	H3A ICAP Aluminum	Microbially Active Carbon	Organic C: Organic N	Organic N- Inorganic N	Organic N Release	Organic N Reserve	Organic P Release	Organic P Reserve	Soil Health Calculation	Available N	Available P	Available K	Nutrient Value	Traditional N	Haney Test N	Lbs N Difference	N savings
1	1	BSF #8 NW	0.4	27.6	2738	186.9	44.6	139.2	3.2	12.5	1.6	2	13.5	1.7	16.1	6	21	207	183.2	185.8	14.3	21	6.7	4.29
1	2	BSF #8 NE	0.4	45.8	2407	178.5	60.3	132.3	2.3	15.3	6.1	1.2	11.8	1	14.1	5.7	6	198.7	177.2	169.9	2.2	6	3.8	2.42
2	3	Kester (west of Stroupe)	0.7	6.7	392.7	169.3	30.7	462.2	18.3	9.7	2.9	13	4.7	4.7	3.8	8.4	34.3	48.4	93.3	87.5	8.8	34.3	25.4	16.28
2	4	Trinchera Stroupe	0.6	10.2	444.3	163	33.2	342	60.1	9.3	1.8	22.1	0.1	10.4	0.1	16.6	61.8	89.9	90.6	119.9	18.9	61.8	42.9	27.45
3	6	Trinchera Y3 East	0.7	6.9	238.4	131.4	28.9	543.5	14.3	8.9	3.5	11.3	8.4	6.8	9	8	30.4	159.5	238.1	200.7	7.2	30.4	23.2	14.84
3	5	Trinchera Y3 West	0.6	6	220	122.9	26.9	484.5	11.7	8.9	5.2	9.1	10.4	4.9	9.1	7.4	23.2	124.1	175.1	150.7	4.4	23.2	18.7	11.98
4	7	Coors 2 NE	0.5	41	1979	251.3	59.3	273.5	4.9	12.2	2.5	3.6	14.8	4.1	23.6	7.4	20.1	380.1	185.8	254	9.9	20.1	10.1	6.48
4	8	Coors 3 SE	0.3	35.2	2260	275.1	66.2	251.3	3.7	10.9	2.8	2.9	16.7	2.5	19.9	7	17.6	323.4	148.8	211.8	9.7	17.6	7.9	5.05
5	9	Worley Davison West	1.5	17.5	269.7	131.4	41.9	682.8	23.3	8.4	2.8	20.6	1.5	19.7	8.5	10.3	51.5	294	275.8	285.5	10.2	51.5	41.3	26.46
5	10	Worley Worley East	0.8	13.4	248.2	103.2	51.3	473.1	11.7	9.5	3.7	8.5	9.6	7.6	14	7.3	24.1	287	244.3	249.5	5.9	24.1	18.2	11.66
6	12	Don Jolly, Home Lockwood, North (control plot)	0.6	17	568.3	181.7	33.3	351.9	87.2	9.8	1.5	23.8	0.1	20.8	0.1	21.6	71.8	305.9	306.6	318.6	25.7	71.8	46.1	29.51
6	11	Don Jolly, Home Lockwood South	0.5	13	550	179.2	31.2	348.7	62.4	10.8	1.6	19.8	0.1	19.3	0.1	17.4	57.3	307	252	282.4	19.2	57.3	38.1	24.39
7	13	Martinez 21 NNE	0.1	49.2	3760	169.5	48.7	76.8	3.2	15.9	2.6	2.1	14.8	1	9.5	7.9	15.7	74.9	215	146.8	10	15.7	5.8	3.68
7	14	Martinez 21 SE	0.4	13.4	424.3	102.4	50.1	281	5.2	10.9	3.1	2.5	9.4	4.4	23.7	4.5	11.4	362.4	126	211.6	5.4	11.4	6	3.85
8	15	Summit 1 NE corner (zone 3)	0.4	37.7	2279	167.2	54.7	146.8	3.1	12.7	1.7	1.7	11.9	1.8	17.5	5.4	17.7	259.8	107.2	166.3	13.1	17.7	4.6	2.97
8	16	Summit 31 NNE (zone 1)	0.2	53.6	3113	213.3	72	126.3	2.9	13	1.9	1.8	13.8	0.9	9.8	6.2	18.4	143.7	218.6	177.2	13.2	18.4	5.2	3.33
9	17	NRCS Field NE (no 5yr fert monitor area)	0.7	9.3	345	164.8	44.8	849.5	27.9	9.4	2.6	20	0.1	19.6	3.8	11	49.7	250.6	196.6	227.8	10.6	49.7	39.1	25.05

Servitech Soil Fertility Testing of Chemical Analytes

Spring 2015

Experiment	Site	Lab Number	Producer	Field ID	pH	Soluble Salts	Top Organic Matter	Sub Organic Matter	NO3-N (ppm)	P (ppm)	K (ppm)	S (ppm)	S (lb/A)	Ca (ppm)	Mg (ppm)	Na (ppm)
1	1	17957	BLUE SKY FARMS	1368/8W/1	7.9	0.46	0.6	0.3	22	113	487	66	119	3348	180	61
1	2	17955	BLUE SKY FARMS	1368/8E/1	7.9	0.79	0.7	0.6	38	135	569	127	229	3467	179	65
2	3	17981	KESTER	KESTER DUE/WS1E/1	7.5	0.30	1.3	0.9	1	26	120	5	9	2539	409	24
2	4	17979	TRINCHERA RANCH	1750/S1/1	7.4	0.69	1.7	1.2	13	35	160	50	90	2743	437	63
3	6	17977	TRINCHERA RANCH	1750/1Y3/1	7.3	0.34	0.6	0.3	21	62	213	14	25	1470	187	25
3	5	17987	TRINCHERA RANCH	1750/1Y3/1	7.1	0.69	0.8	0.2	57	83	291	39	70	1380	180	19
4	7	17961	COORS FARM	1068/7/2NE/1	8.1	0.37	0.9	0.6	4	117	251	22	40	3185	339	78
4	8	17963	COORS FARM	1066/7/3SE/1	8.0	0.34	1.2	0.7	5	133	432	24	43	3122	306	50
5	9	17983	WORLEY	1130/1NW/1	5.9	1.21	0.8	0.5	74	127	339	60	108	1375	179	39
5	10	17985	WORLEY	1130/0/NE/1	6.7	1.33	0.9	0.3	21	163	553	141	254	1481	176	54
6	12	17967	JOLLY, DON	CONTROL/FIELD/1	7.2	0.57	1.3	2.2	29	34	350	25	45	3347	535	37
6	11	17965	JOLLY, DON	TREAT/FIELD/1	7.5	0.84	2.5	1.0	40	102	929	35	63	3410	530	66
7	13	17969	MARTINEZ FARMS	1210/21NE/1	7.7	1.82	0.8	0.4	89	113	399	424	763	4240	229	67
7	14	17971	MARTINEZ FARMS	1210/2SE/1	7.4	0.87	0.7	0.5	59	189	208	116	209	2082	177	59
8	15	17975	SUMMIT FARMS	1032/6/E/1	7.7	0.69	0.8	0.4	66	142	410	42	76	3688	198	48
8	16	17973	SUMMIT FARMS	1032/31W/1	8.0	0.84	1.1	0.8	51	151	710	68	122	2237	216	69
9	17	17959	CONS DIST	CONS DIST/FIELD/1	6.3	0.22	0.9	0.9	3	135	213	12	22	1922	248	46

Experiment	Site	Lab Number	Producer	Field ID	Zn (ppm)	Fe (ppm)	Mn (ppm)	Cu (ppm)	CEC	%H	%K	%Ca	%Mg	%Na	Boron (ppm)
1	1	17957	BLUE SKY FARMS	1368/8W/1	1.9	5	9	1.0	20	0	6	85	8	1	0.53
1	2	17955	BLUE SKY FARMS	1368/8E/1	2.4	6	10	1.0	21	0	7	84	7	1	0.64
2	3	17981	KESTER	KESTER DUE/WS1E/1	0.9	31	16	2.0	17	0	2	77	21	1	0.17
2	4	17979	TRINCHERA RANCH	1750/S1/1	2.4	22	14	1.8	18	0	2	76	20	2	0.44
3	6	17977	TRINCHERA RANCH	1750/1Y3/1	0.9	12	17	0.8	10	0	6	77	16	1	0.37
3	5	17987	TRINCHERA RANCH	1750/1Y3/1	1.1	12	18	0.8	9	0	8	75	16	1	0.34
4	7	17961	COORS FARM	1068/7/2NE/1	2.2	8	16	1.3	20	0	3	81	14	2	0.81
4	8	17963	COORS FARM	1066/7/3SE/1	2.7	9	19	0.7	19	0	6	80	13	1	0.64
5	9	17983	WORLEY	1130/1NW/1	6.2	27	44	3.0	9	0	9	73	16	2	2.64
5	10	17985	WORLEY	1130/0/NE/1	5.5	17	38	1.6	11	0	13	70	14	2	1.01
6	12	17967	JOLLY, DON	CONTROL/FIELD/1	1.9	15	24	2.2	22	0	4	75	20	1	0.28
6	11	17965	JOLLY, DON	TREAT/FIELD/1	4.9	17	36	1.8	24	0	10	71	18	1	0.62
7	13	17969	MARTINEZ FARMS	1210/21NE/1	1.8	6	16	1.8	24	0	4	87	8	1	0.54
7	14	17971	MARTINEZ FARMS	1210/2SE/1	2.7	9	17	1.2	13	0	4	82	12	2	0.56
8	15	17975	SUMMIT FARMS	1032/6/E/1	3.8	7	17	1.4	21	0	5	86	8	1	0.73
8	16	17973	SUMMIT FARMS	1032/31W/1	3.7	7	18	1.0	23	0	7	83	9	1	0.89
9	17	17959	CONS DIST	CONS DIST/FIELD/1	2.6	39	37	1.4	12	0	4	77	17	2	0.45

Servitech Soil Fertility Testing of Chemical Analytes

Fall 2017

Experiment	Site	Lab Number	pH	Soluble Salts	Free Lime	Top Organic Matter	Sub Organic Matter	NO3-N (ppm)	P (ppm)	K (ppm)	S (ppm)	Ca (ppm)	Mg (ppm)	Na (ppm)
1	1	40163	8.2	0.37	3	0.8	0.7	10	129	407	27	3660	171	40
1	2	40177	8.5	0.26	3	0.8	0.8	1	115	450	49	3764	189	73
2	3	40176	7.7	0.16	0	1.6	1.6	5	14	109	4	2290	370	19
2	4	40175	7.3	0.19	0	2.2	1.7	12	23	136	5	2346	369	21
3	6	40173	7	0.1	0	0.9	0.5	3	68	197	4	914	164	14
3	5	40174	6.9	0.09	0	0.8	0.6	3	48	149	2	863	149	12
4	7	40172	8.2	0.26	1	1.2	1	4	105	314	31	3183	292	49
4	8	40162	8.4	0.28	3	0.9	1.1	5	107	273	35	3677	325	61
5	9	40170	6.1	0.15	0	0.9	1	4	169	279	14	911	149	21
5	10	40178	6.9	0.13	0	1	0.9	2	135	340	11	929	142	44
6	12	40167	7.2	0.37	0	2.4	2.3	15	65	698	13	3213	481	28
6	11	40168	7.1	0.36	0	2.5	2.2	14	76	686	12	3356	500	25
7	13	40166	8.3	0.25	3	1.1	1	5	128	503	53	4576	186	47
7	14	40165	8	0.15	0	0.9	0.9	2	170	226	11	1855	176	47
8	15	40164	8.2	0.41	3	0.9	0.6	9	97	240	39	3609	187	57
8	16	40186	8.1	0.31	3	1.2	1	8	120	512	49	3887	230	71
9	17	40169	6.8	0.16	0	1	1	10	122	175	4	1715	220	32

Experiment	Site	Lab Number	Zn (ppm)	Fe (ppm)	Mn (ppm)	Cu (ppm)	Boron (ppm)	CEC	%H	%K	%Ca	%Mg	%Na
1	1	40163	5.4	5	9	1.9	1.88	21	0	5	87	7	1
1	2	40177	3.1	6	8	1.8	2	22	0	5	86	7	1
2	3	40176	0.7	23	8	1.7	0.69	15	0	2	77	21	1
2	4	40175	1.6	21	8	1.5	1.26	15	0	2	77	20	1
3	6	40173	1.2	14	9	0.9	0.86	7	0	8	70	21	1
3	5	40174	1	15	11	0.9	0.66	6	0	6	72	21	1
4	7	40172	2.2	7	10	1.3	1.82	19	0	4	82	13	1
4	8	40162	2.6	7	10	0.7	2.29	22	0	3	83	12	1
5	9	40170	4.9	41	27	2.6	2.31	7	0	11	68	19	2
5	10	40178	4.4	20	19	1.6	1.8	7	0	13	67	17	3
6	12	40167	2.9	26	18	2.1	1.53	22	0	8	73	18	1
6	11	40168	3.7	19	16	1.9	2.02	23	0	8	74	18	0
7	13	40166	2.4	8	8	1.1	1.58	26	0	5	88	6	1
7	14	40165	3.6	11	10	1.4	1.71	12	0	5	81	13	2
8	15	40164	2.8	5	8	1.4	1.81	20	0	3	88	8	1
8	16	40186	3.6	7	9	0.9	1.82	23	0	6	85	8	1
9	17	40169	2.1	37	20	1.3	1.69	11	0	4	78	17	1