Soil Health Assessment Center

University of Missouri

Cover Crop Cost Share Program Soil Health Assessment Update

Service in the Land Grant Tradition

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Update Outline

- Overview and key points of cover crop program
- Overview and key points of Soil Health Assessment Center (SHAC)
- Outcome/results of the first year, 2015 (MO Fiscal Year 2016)
- Status of the second year, 2016 (MO Fiscal Year 2017)
- What is on the horizon?

Missouri Department of Natural Resources

Cover Crop Cost Share

Sheet and Rill/Gully Erosion Resource Concern

N340 Cover Crop

Purpose
Provide operators an incentive to encourage the adoption of cover crops for reducing soil erosion, improving water quality and soil health.

The definition of operator for the purpose of this practice is any individual farming the land, who has incurred the expenses for the cover crops. The operator's name should also be listed on file with FSA as the operator of such land.

Applicability
Applies to cropland acres where row crops are grown and soil erosion needs to be prevented or water quality and soil health improved.

Erosion Requirements
Practice has no erosion requirements to qualify. However, pre- and post-erosion rates need to be recorded in MoSWIMS to capture the erosion benefits of the practice.

Specifications
The completed components of the practice must meet the NRCS Standards and Specifications for Conservation Crop Rotation (328) and Cover Crop (340) contained in the Field Office Technical Guide.

Policies

Key Points

Encourage the adoption of cover crops to
1)decrease soil erosion,
2) improve water quality, and
3) improve soil health

Cover crops must be no-tilled or broadcast

Production crop following the cover crop must be no-tilled

Cover crop must include at least 25% cool season annual grass

Soil sample must be sent to the University of Missouri Soil Health Assessment Center

75% cost share on soil sample; $30-40/acre/yr. up to $20,000 total per operator

Soil Health Assessment Center

University of Missouri

- College of Agriculture, Food and Natural Resources
- South Farm

SHAC?

- Soil Health Assessment Center (SHAC) grew from the Soil Characterization Laboratory
  - Operational since funding in 1984
  - Soil analyses equipment
  - Experienced personnel
- Laboratory expanded for soil health evaluation
  - Additional space,
  - New equipment and analyses

Why send samples to the SHAC?

- History of DNR and the Soil Characterization Laboratory working together
- The Soil Health Laboratory had been running the analyses for a couple years
- Newer analyses do not have data for different climates and soils
- If samples were sent to one place (SHAC) at first, a database could be produced and used by other laboratories in the future

2015 (Fiscal Year 2016)

Soil Sampling for the Missouri Department of Natural Resources
Soil and Water Conservation Program (SWCP)
Cover Crops Cost-Share Program

Preface

This sampling protocol has been provided for the SWCP cost-share program. Because of the need for a rapid turn-around time for the development of the Soil Health Assessment Center Laboratory at the University of Missouri relative to the cover crops soil health cost share program, this sampling program is likely to become more detailed in the future but will assist in providing the initial assessment of soil health at the initiation of the cover crops program.

Soil Health Assessments

The following is a listing of the individual soil assessments that will be employed for soil health analysis for the MoDNR Soil and Water Program's cover crops cost share program:

Initial Standard Soil Health Package $90

- Simplified Particle Size
- Active Carbon
- Total Organic Carbon (also converted to Organic Matter)
- Mineralizable Nitrogen
- Wet Aggregate Stability
- pH (salt and water)
- Effective Cation Exchange Capacity plus exchangeable bases
- Effective Base Saturation
- Exchangeable Al
- Plant Available Phosphorus
- Bulk Density

Follow-Up Standard Soil Health Package $70

- Active Carbon
- Total Organic Carbon (also converted to Organic Matter)
- Mineralizable Nitrogen
- Wet Aggregate Stability
- pH (salt and water)
- Effective Cation Exchange Capacity
- Effective Base Saturation
- Exchangeable Al
- Plant Available Phosphorus
- Bulk Density

July 22, 2015

DNR – SWCP Cover Crop Cost Share Soil Health Information

Name(s)_____

Address_____

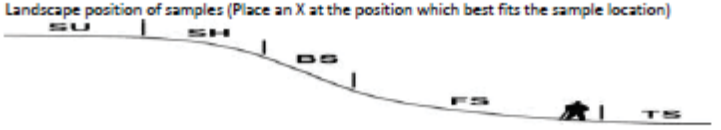
Telephone(s) _____

E-mail address(es) _____

County (where sample taken)_____

Tract and Field Number from Conservation Plan_____

Landscape position of samples (Place an X at the position which best fits the sample location)



Sampling Date_____

Soil series/soil mapping unit sampled (according to the current USDA-NRCS Soil Survey)

_____

Crop rotation over the past 5 years_____

_____

Tillage used over the past 5 years_____

_____

Planned crop rotation for next 5 years_____

_____

Planned tillage for next 5 years_____

_____

Has the field previous been planted with cover crops? Yes No

If yes, circle the years that cover crops were planted in the field. 2010 2011 2012 2013 2014 2015

If the field has been in continuous cover crops for more than five years, how many years has it had cover crops planted? _____

Sample Latitude, Longitude (Optional)(decimal degrees preferred)Lat._____Long._____

Name of person taking sample _____Soil Scientist? Yes No

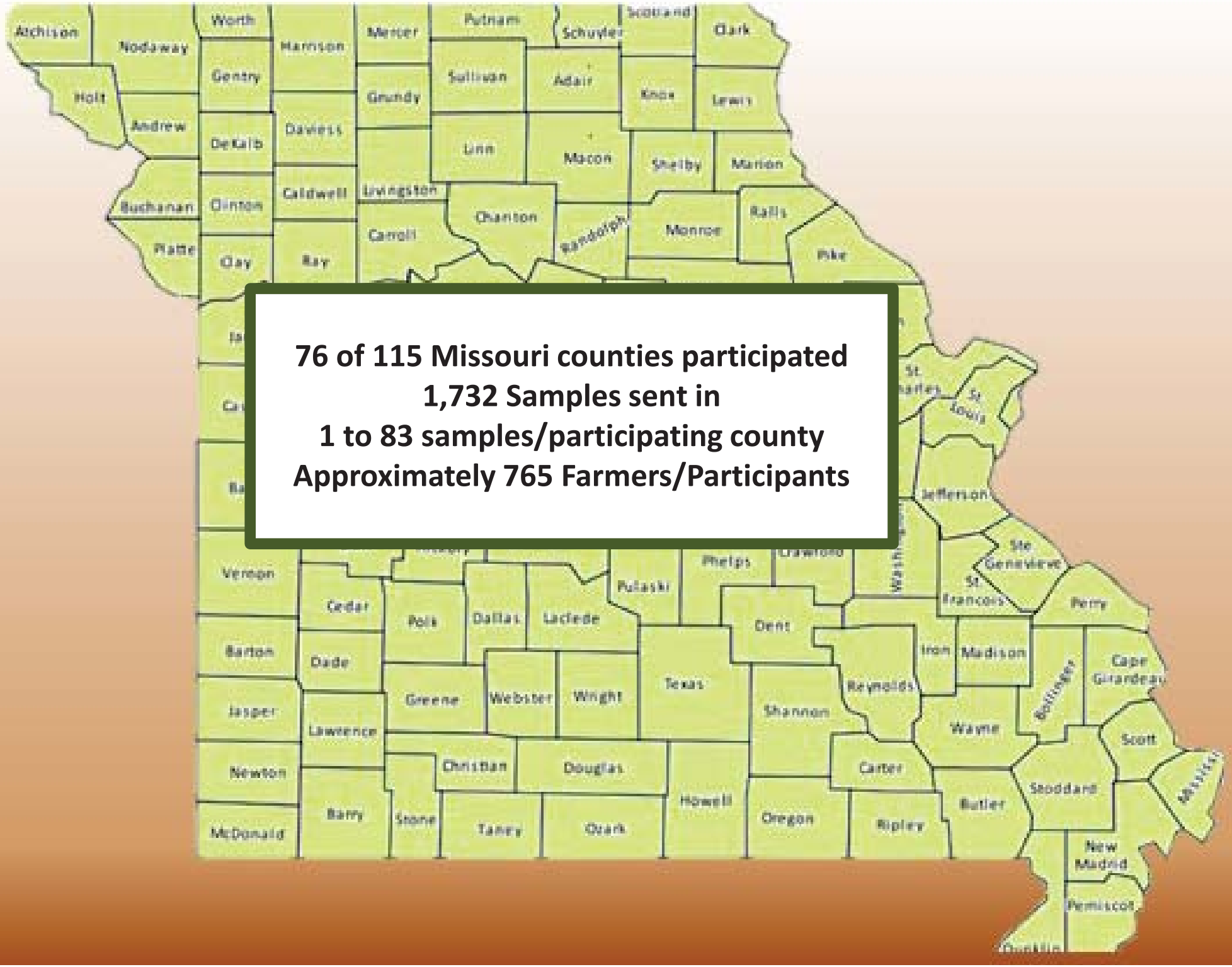
July 22, 2015

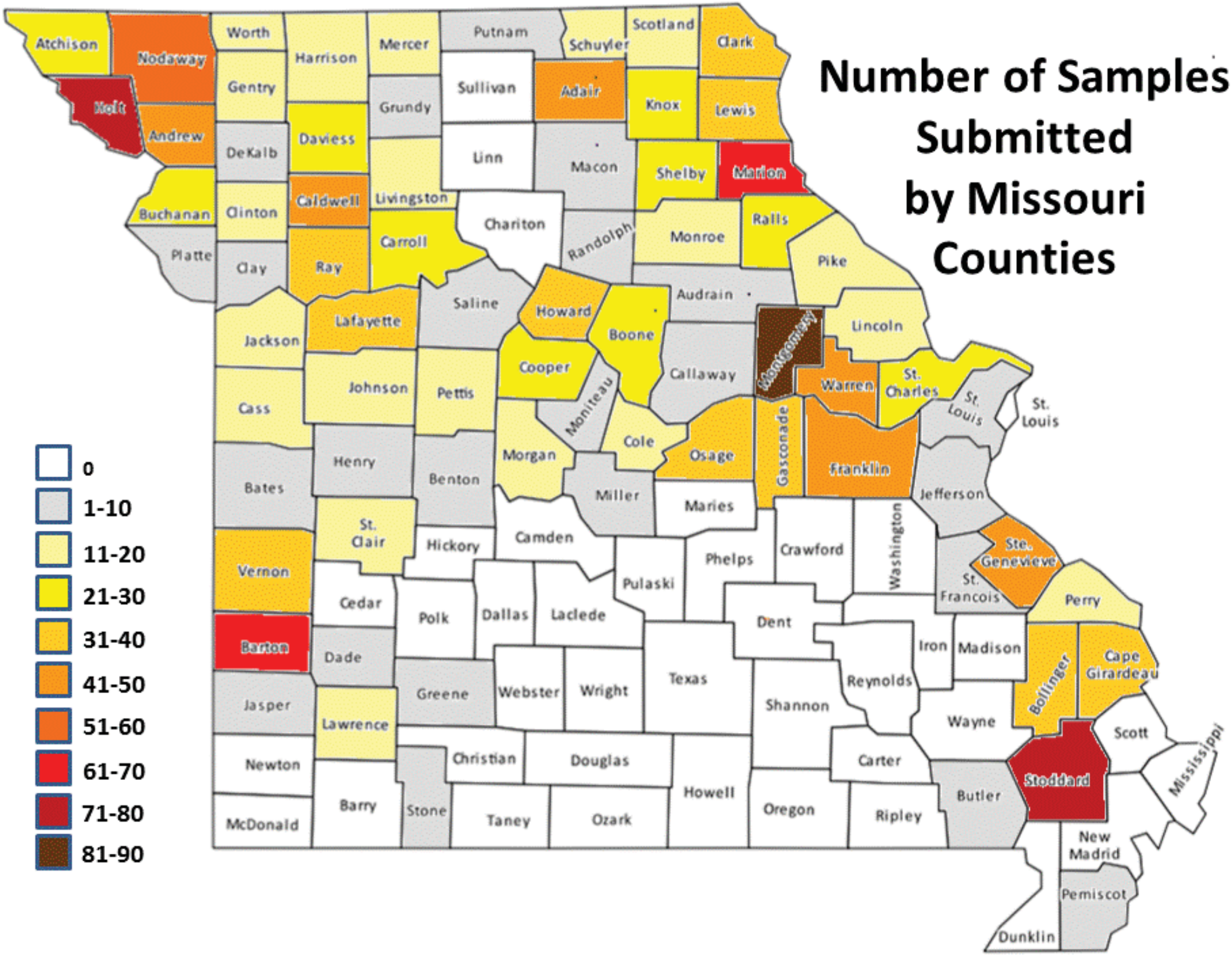
Outcome/results of the first year, 2015 (MO Fiscal Year 2016)

Resulted in 83,863 acres planted to cover crops in Missouri in 2015 (Fiscal Year 2016)

Favorable Comments/ Outcomes due to Cover Crop Plantings

- Protected soil from erosion during early winter rains
- Improved weed control
- Possibly reduced fallow syndrome
- Softened surface soils


76 of 115 Missouri counties participated
1,732 Samples sent in
1 to 83 samples/participating county
Approximately 765 Farmers/Participants
Atchison
Nodaway
Worth
Harrison
Mercer
Putnam
Schuyler
Scotland
Clark
Holt
Gentry
Grundy
Sullivan
Adair
Knox
Lewis
Andrew
DeKalb
Daviess
Linn
Macon
Shelby
Marion
Buchanan
Clinton
Caldwell
Livingston
Chariton
Randolph
Monroe
Ralls
Pike
Platte
Clay
Ray
Carroll
St Charles
St Louis
Jefferson
Ste Genevieve
St Francois
Perry
Vernon
Cedar
Polk
Dallas
Laclede
Pulaski
Phelps
Crawford
Dent
Iron
Madison
Barton
Dade
Greene
Webster
Wright
Texas
Reynolds
Shannon
Wayne
Bollinger
Cape Girardeau
Jasper
Lawrence
Christian
Douglas
Howell
Carter
Scott
Newton
Barry
Stone
Taney
Ozark
Oregon
Ripley
Butler
Stoddard
New Madrid
McDonald
Pemiscot


Number of Samples Submitted by Missouri Counties
0
1-10
11-20
21-30
31-40
41-50
51-60
61-70
71-80
81-90
Atchison
Nodaway
Worth
Harrison
Mercer
Putnam
Schuyler
Scotland
Clark
Holt
Gentry
Grundy
Sullivan
Adair
Knox
Lewis
Andrew
DeKalb
Daviess
Linn
Macon
Shelby
Marion
Buchanan
Clinton
Caldwell
Livingston
Chariton
Randolph
Monroe
Ralls
Platte
Clay
Ray
Carroll
Saline
Howard
Boone
Audrain
Pike
Jackson
Lafayette
Cooper
Callaway
Montgomery
Lincoln
Cass
Johnson
Pettis
Moniteau
Warren
St. Charles
St. Louis
St. Louis
Bates
Henry
Benton
Morgan
Cole
Osage
Gasconade
Franklin
Jefferson
St. Clair
Hickory
Camden
Miller
Maries
Washington
Ste. Genevieve
Vernon
Cedar
Polk
Dallas
Laclede
Pulaski
Phelps
Crawford
St. Francois
Perry
Barton
Dade
Dent
Iron
Madison
Bollinger
Cape Girardeau
Jasper
Greene
Webster
Wright
Texas
Shannon
Reynolds
Lawrence
Wayne
Scott
Newton
Christian
Douglas
Howell
Carter
Stoddard
Mississippi
Barry
Stone
Oregon
Butler
McDonald
Taney
Ozark
Ripley
New Madrid
Pemiscot
Dunklin

Soil Health Assessme
University

Approximately 769 Reports Sent Out

Health Assessment Results Report

N340 Cover Crops

Thank you!

The data provided by your submitted samples will provide baseline data for the newer soil health analyses in Missouri.

This report provides you with :

- Data helpful in determining the relative strengths and weaknesses of your soils' health and function, plus lists of benefits to you as you maximize aspects of your soils' health.
- General recommendations and management options to consider in optimizing long-term soil health.
- One report (in most cases) for all related farms samples. Graphs show individual field results for easy comparison among fields for all properties measured.
- State and county averages for each analysis to help put your results into perspective. After further analysis, regional averages will be provided at https://cafnr.missouri.edu/soil-health/.

This report will not directly provide:

Fertilizer or liming recommendations because samples were not taken to the standard 6-inch depth and taken at multiple locations in the field. Results can indicate possible nutrient deficiencies or surpluses. For fertilizer recommendations submit samples to an independent soil fertility laboratory according to recommended protocol. Analytical methods used are described at https://cafnr.missouri.edu/soil-health/.

Contents

Sample Results Summary

The tables below summarize the soil health test results. Pages following this summary provide information about the analyses and their importance, management considerations, and graphs comparing results. You may want to look over the summary, read the rest of the document, and then return to the summary. The Table of Contents on page 1 can direct you to specific analyses.

Sample Field	% Total Organic Carbon	* % Soil Organic Matter	Active Carbon (mg/Kg)	**PMN (ppm)	pH (Salt)	pH (Water)	Bray 1 Phosphorus (ppm)	Bray 1 Phosphorus ***(lbs/acre)	Bulk Density (g/cm3)	% Water Stable Aggregates
Field 1	3.2	5.5	725.0	92.0	6.5	7.1	18.6	37	0.89	66
Field 2	1.1	1.9	318.0	24.0	6.7	7.2	12.6	25	1.19	29
Field 3	3.0	5.2	752.0	107.5	6.4	6.9	14.5	29	0.88	67
Field 4	2.4	4.1	578.0	82.0	7.1	7.6	17.3	35	0.76	35
Field 5	2.4	4.1	565.0	70.0	6.3	6.8	27.7	55	1.00	29
Field 6	1.0	1.7	191.0	8.0	5.7	6.3	8.8	18	1.05	36
County Average	2.2	3.8	521.5	63.9	6.5	7.0	16.6	33	1.00	44
State Average	1.8	3.1	522.6	71.6	6.7	7.1	48.3	97	1.10	32

Sample Field	Calcium	Magnesium	Sodium	Potassium	Aluminum	****CEC	% Base Saturation	% Clay	% Silt	% Sand	Soil Textural Class
	(Milliequivalents per 100 g soil)										
Field 1	24.6	2.6	0.0	0.8	0.0	25.8	>100	28.1	58.6	13.3	Silty Clay Loam
Field 2	16.9	2.8	0.0	0.4	0.0	18.9	>100	28.2	59.1	12.7	Silty Clay Loam
Field 3	21.8	2.4	0.0	0.7	0.0	26.0	96	27.5	59.9	12.6	Silty Clay Loam
Field 4	26.7	1.4	0.0	0.9	0.0	22.8	>100	27.9	68.5	3.6	Silty Clay Loam
Field 5	18.4	2.4	0.0	1.7	0.0	22.4	100	28.1	68.3	3.6	Silty Clay Loam
Field 6	15.9	4.5	0.1	0.3	0.0	21.9	95	33.3	63.6	3.1	Silty Clay Loam
County Average	20.7	2.7	0.0	0.8	0.0	23.0	>100				
State Average	16.3	2.6	0.0	0.6	0.0	18.7	>100				

* Estimated by multiplying Total Organic Carbon values by 1.72
** Potentially Mineralizable Nitrogen
*** Estimated by multiplying Bray P1 values by 2
**** Cation Exchange Capacity

Soil test ratings and interpretations within this document were made according to:
Buchholz, D. D., Brown, J. R., Garret, J. D., Hanson, R. G., & Wheaton, H. N. (2004). *Soil test interpretations and recommendations handbook*. University of Missouri-College of Agriculture, Division of Plant Sciences.

Total Organic Carbon (TOC)

What is it? Why is it Important?

Soil TOC levels are highly correlated with soil nutrient cycling, pore space, water holding capacity, soil microbial activity, and nearly all aspects of soil health and soil functions.

Percent Total Organic Carbon Versus Percent Soil Organic Matter

Measurements of TOC may be roughly compared to measurements of soil organic matter (SOM) by multiplying TOC by 1.72.

Soil organic matter includes elements such as hydrogen, nitrogen, and oxygen in addition to carbon and is found in various forms in the soil. Soil organic matter is usually determined using (soil weight) loss on ignitions methods. Some weight loss is due to loss of water associated with clays. Different laboratories use different drying and ignition temperatures producing varied results.

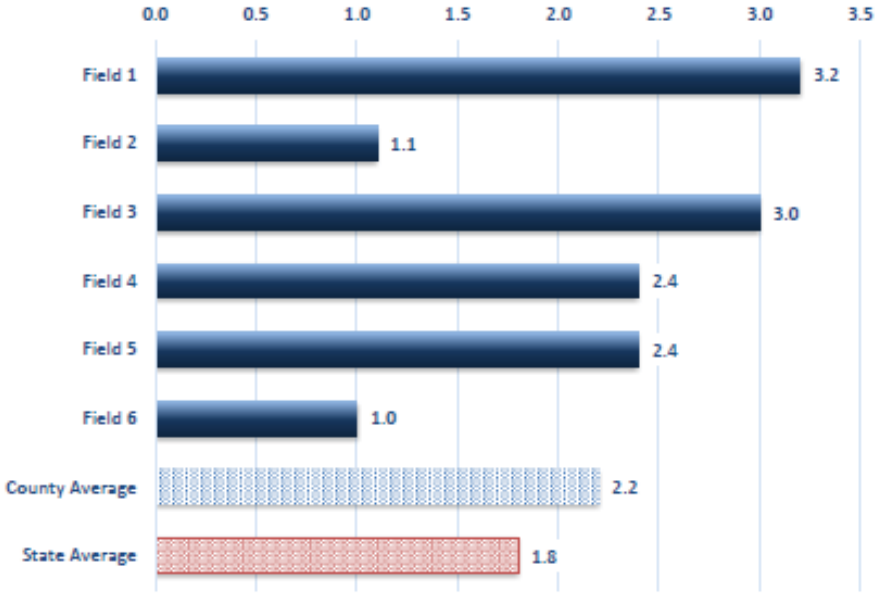
Soil TOC can be measured more accurately and precisely than can soil organic matter.

What are the benefits to having a large amount of soil total organic carbon?

Soil TOC affects biological, chemical, and physical soil properties. Larger amounts of TOC cycle more nutrients, hold more water, and house more microbial biomass than lesser amounts. The TOC and the microbes help the soil filter, buffer, and transform inputs such as herbicides.

Management options to increase soil Total Organic Carbon:

- Decrease tillage/disturbance
- Add manure, compost, or mulch
- Keep vegetation growing year-round
- Use double cropping
- Plant cover crops
- Plant high biomass crops
- Add perennial crops or grasses to the rotation
- Avoid burning or otherwise removing crop residues
- Keep soil covered year-round
- Reduce soil erosion



Why does the report only give “management options” rather than straight out recommendations?

The MU Soil and Plant Testing Laboratory provides fertilizer recommendations

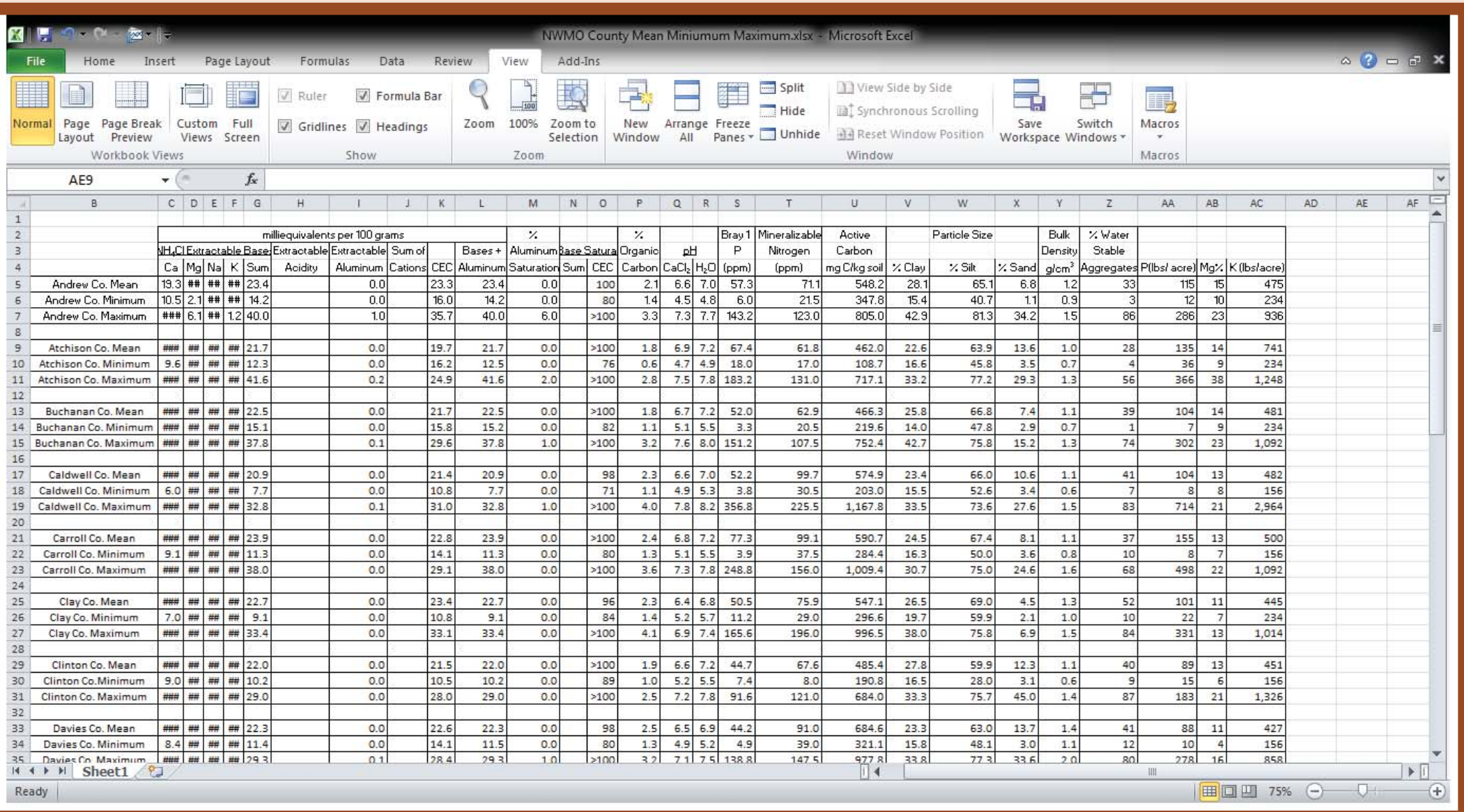
You can’t just add 5 tons of water stable aggregates per acre to your fields

There is more than one way to accomplish goals

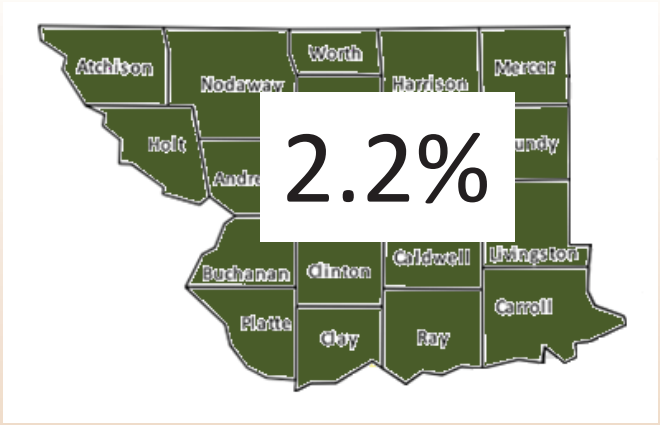
Laboratory personnel don’t know the individual farmers, their goals, their equipment, their preferences…

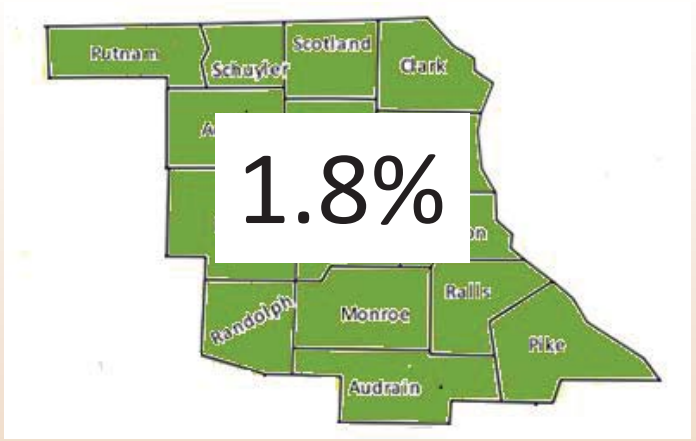
Little prescriptive research for very specific recommendations

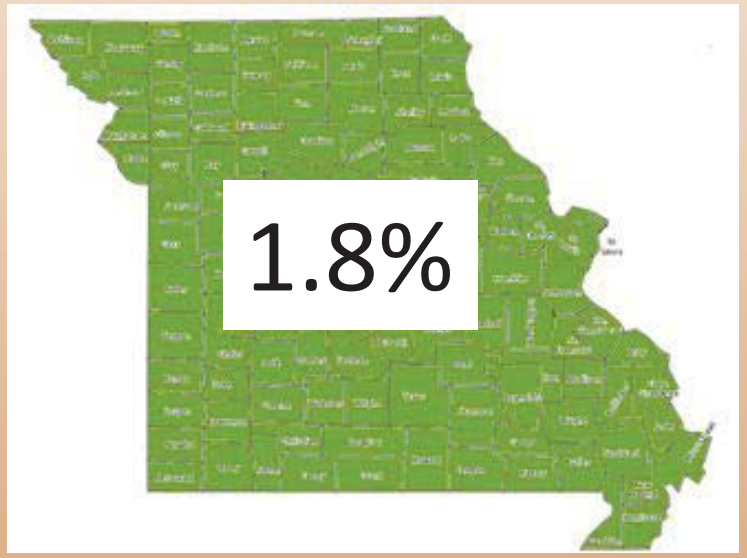
County Means, Minimums and Maximums

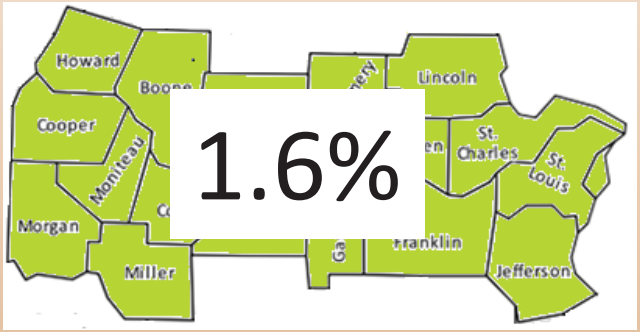


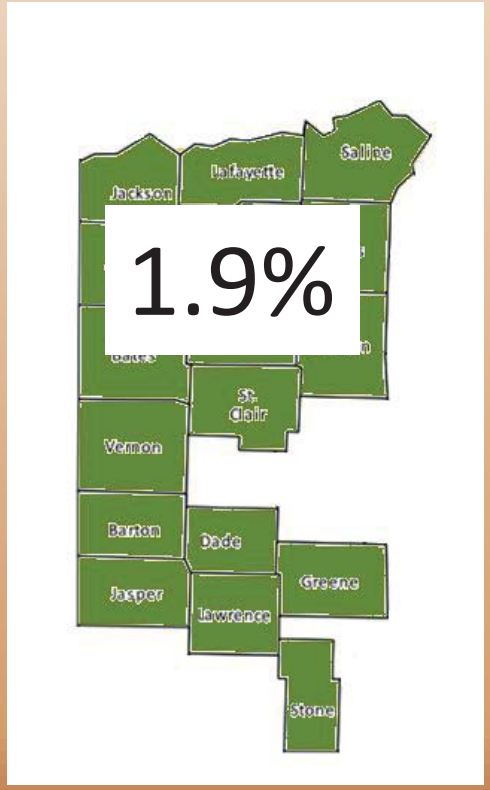
	milliequivalents per 100 grams										%			%			Bray 1	Mineralizable	Active	Particle Size			Bulk	% Water			
	NH_4Cl Extractable Bases					Extractable	Extractable	Sum of		Bases +	Aluminum	Base Saturation		Organic	pH		P	Nitrogen	Carbon				Density	Stable			
	Ca	Mg	Na	K	Sum	Acidity	Aluminum	Cations	CEC	Aluminum	Saturation	Sum	CEC	Carbon	$CaCl_2$	H_2O	(ppm)	(ppm)	mg C/kg soil	% Clay	% Silt	% Sand	g/cm^3	Aggregates	P(lbs/ acre)	Mg%	K (lbs/acre)
Andrew Co. Mean	19.3	##	##	##	23.4		0.0		23.3	23.4	0.0		100	2.1	6.6	7.0	57.3	71.1	548.2	28.1	65.1	6.8	1.2	33	115	15	475
Andrew Co. Minimum	10.5	2.1	##	##	14.2		0.0		16.0	14.2	0.0		80	1.4	4.5	4.8	6.0	21.5	347.8	15.4	40.7	1.1	0.9	3	12	10	234
Andrew Co. Maximum	###	6.1	##	1.2	40.0		1.0		35.7	40.0	6.0		>100	3.3	7.3	7.7	143.2	123.0	805.0	42.9	81.3	34.2	1.5	86	286	23	936
Atchison Co. Mean	###	##	##	##	21.7		0.0		19.7	21.7	0.0		>100	1.8	6.9	7.2	67.4	61.8	462.0	22.6	63.9	13.6	1.0	28	135	14	741
Atchison Co. Minimum	9.6	##	##	##	12.3		0.0		16.2	12.5	0.0		76	0.6	4.7	4.9	18.0	17.0	108.7	16.6	45.8	3.5	0.7	4	36	9	234
Atchison Co. Maximum	###	##	##	##	41.6		0.2		24.9	41.6	2.0		>100	2.8	7.5	7.8	183.2	131.0	717.1	33.2	77.2	29.3	1.3	56	366	38	1,248
Buchanan Co. Mean	###	##	##	##	22.5		0.0		21.7	22.5	0.0		>100	1.8	6.7	7.2	52.0	62.9	466.3	25.8	66.8	7.4	1.1	39	104	14	481
Buchanan Co. Minimum	###	##	##	##	15.1		0.0		15.8	15.2	0.0		82	1.1	5.1	5.5	3.3	20.5	219.6	14.0	47.8	2.9	0.7	1	7	9	234
Buchanan Co. Maximum	###	##	##	##	37.8		0.1		29.6	37.8	1.0		>100	3.2	7.6	8.0	151.2	107.5	752.4	42.7	75.8	15.2	1.3	74	302	23	1,092
Caldwell Co. Mean	###	##	##	##	20.9		0.0		21.4	20.9	0.0		98	2.3	6.6	7.0	52.2	99.7	574.9	23.4	66.0	10.6	1.1	41	104	13	482
Caldwell Co. Minimum	6.0	##	##	##	7.7		0.0		10.8	7.7	0.0		71	1.1	4.9	5.3	3.8	30.5	203.0	15.5	52.6	3.4	0.6	7	8	8	156
Caldwell Co. Maximum	###	##	##	##	32.8		0.1		31.0	32.8	1.0		>100	4.0	7.8	8.2	356.8	225.5	1,167.8	33.5	73.6	27.6	1.5	83	714	21	2,964
Carroll Co. Mean	###	##	##	##	23.9		0.0		22.8	23.9	0.0		>100	2.4	6.8	7.2	77.3	99.1	590.7	24.5	67.4	8.1	1.1	37	155	13	500
Carroll Co. Minimum	9.1	##	##	##	11.3		0.0		14.1	11.3	0.0		80	1.3	5.1	5.5	3.9	37.5	284.4	16.3	50.0	3.6	0.8	10	8	7	156
Carroll Co. Maximum	###	##	##	##	38.0		0.0		29.1	38.0	0.0		>100	3.6	7.3	7.8	248.8	156.0	1,009.4	30.7	75.0	24.6	1.6	68	498	22	1,092
Clay Co. Mean	###	##	##	##	22.7		0.0		23.4	22.7	0.0		96	2.3	6.4	6.8	50.5	75.9	547.1	26.5	69.0	4.5	1.3	52	101	11	445
Clay Co. Minimum	7.0	##	##	##	9.1		0.0		10.8	9.1	0.0		84	1.4	5.2	5.7	11.2	29.0	296.6	19.7	59.9	2.1	1.0	10	22	7	234
Clay Co. Maximum	###	##	##	##	33.4		0.0		33.1	33.4	0.0		>100	4.1	6.9	7.4	165.6	196.0	996.5	38.0	75.8	6.9	1.5	84	331	13	1,014
Clinton Co. Mean	###	##	##	##	22.0		0.0		21.5	22.0	0.0		>100	1.9	6.6	7.2	44.7	67.6	485.4	27.8	59.9	12.3	1.1	40	89	13	451
Clinton Co.Minimum	9.0	##	##	##	10.2		0.0		10.5	10.2	0.0		89	1.0	5.2	5.5	7.4	8.0	190.8	16.5	28.0	3.1	0.6	9	15	6	156
Clinton Co. Maximum	###	##	##	##	29.0		0.0		28.0	29.0	0.0		>100	2.5	7.2	7.8	91.6	121.0	684.0	33.3	75.7	45.0	1.4	87	183	21	1,326
Davies Co. Mean	###	##	##	##	22.3		0.0		22.6	22.3	0.0		98	2.5	6.5	6.9	44.2	91.0	684.6	23.3	63.0	13.7	1.4	41	88	11	427
Davies Co. Minimum	8.4	##	##	##	11.4		0.0		14.1	11.5	0.0		80	1.3	4.9	5.2	4.9	39.0	321.1	15.8	48.1	3.0	1.1	12	10	4	156
Davies Co. Maximum	###	##	##	##	29.3		0.1		28.4	29.3	1.0		>100	3.2	7.1	7.5	138.8	147.5	977.8	33.8	77.3	33.6	2.0	80	278	16	858



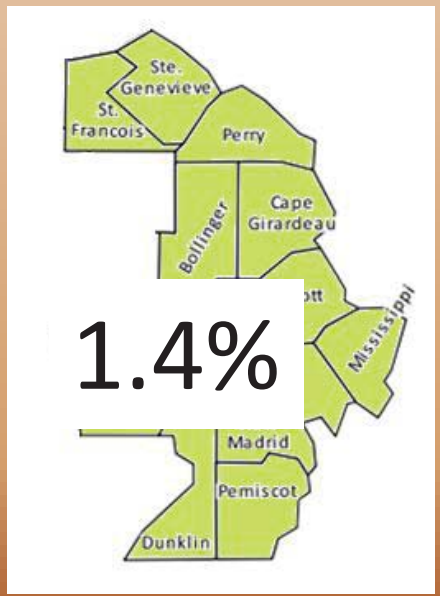


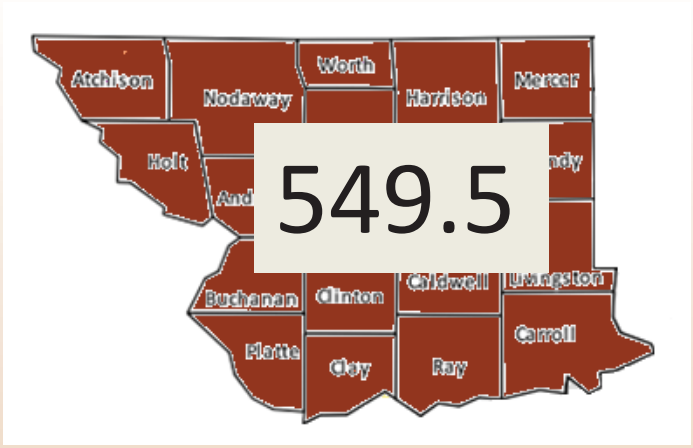


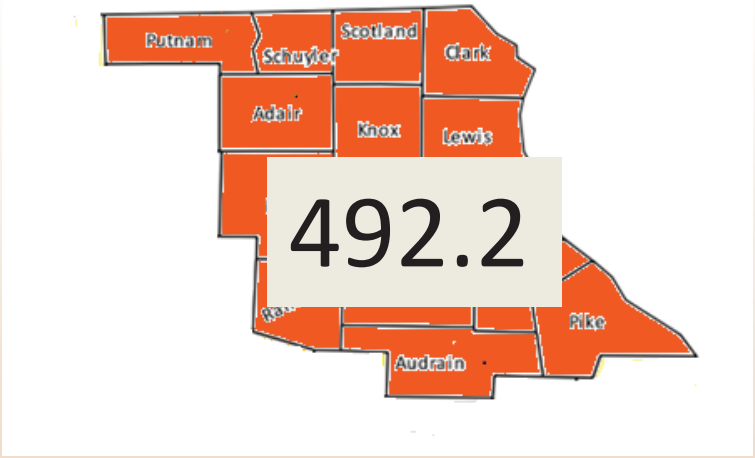


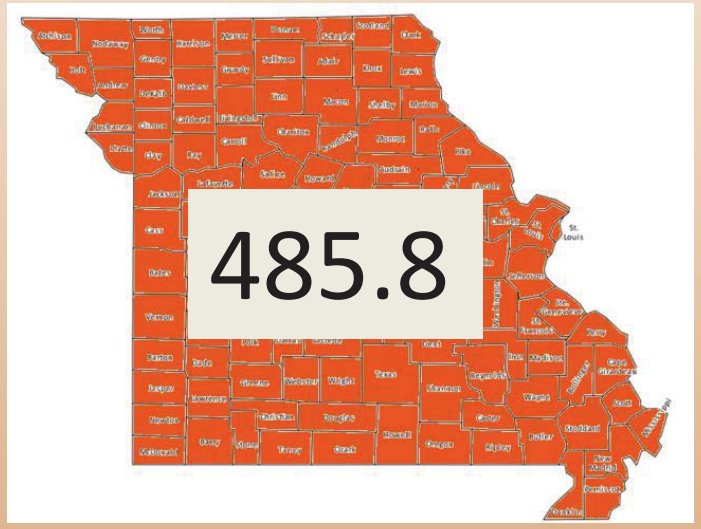


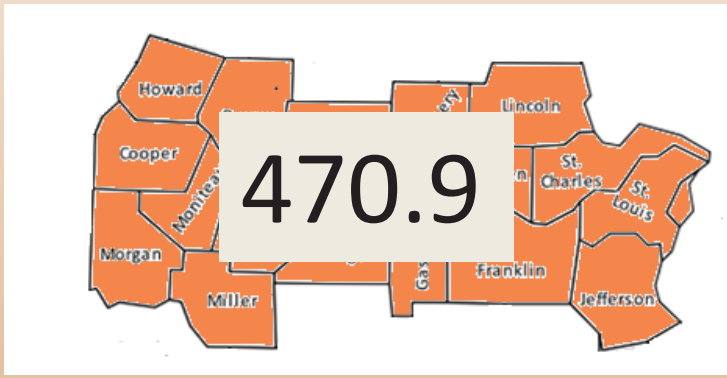
Total Organic Carbon

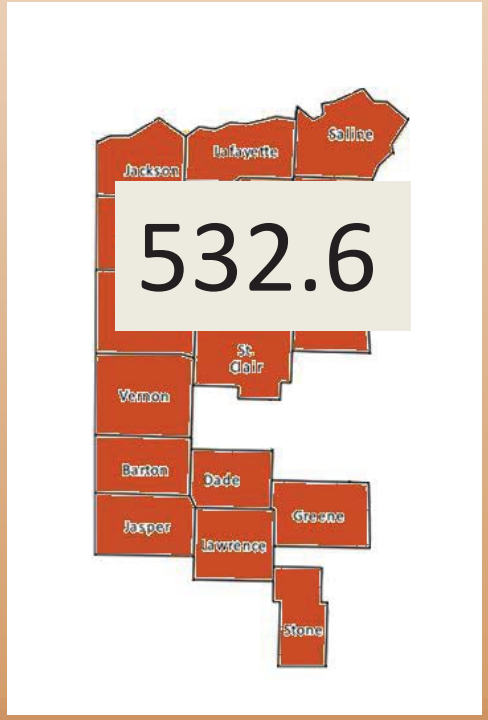




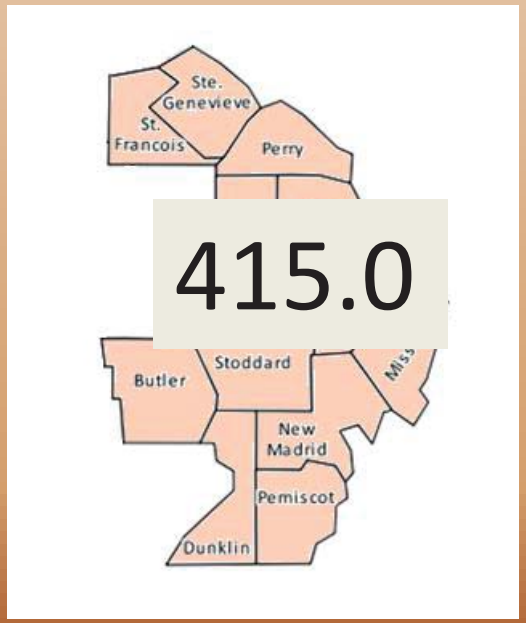


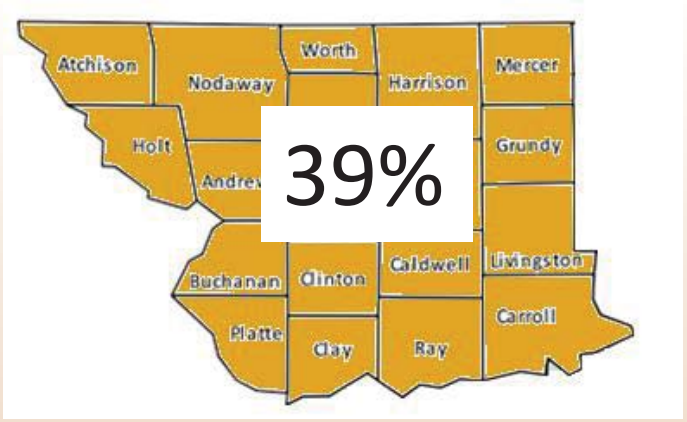


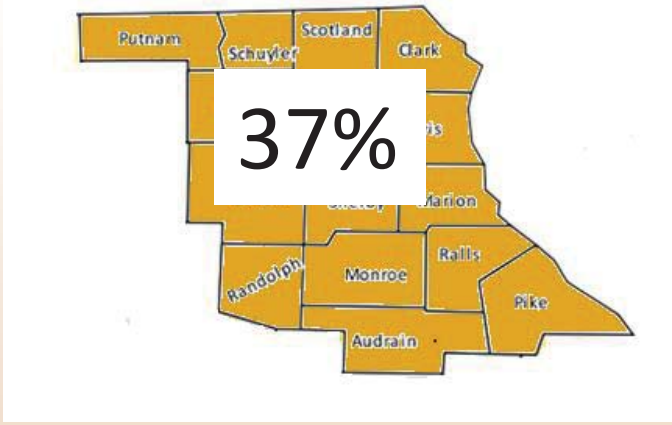


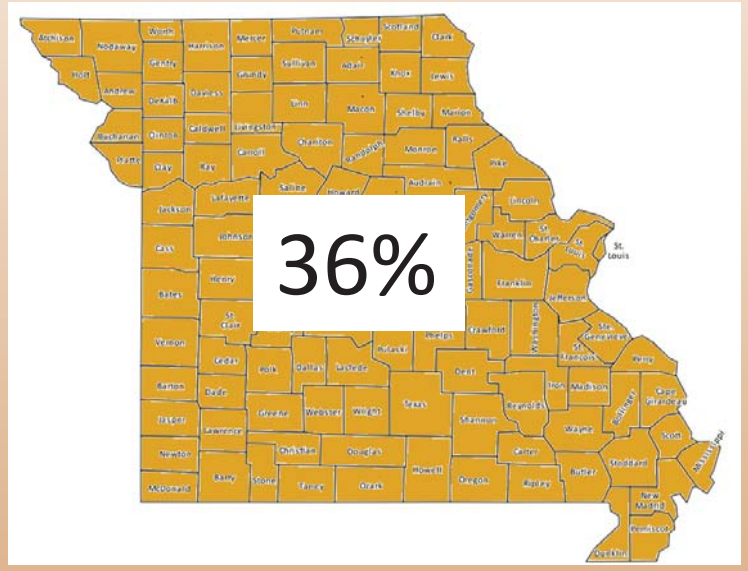


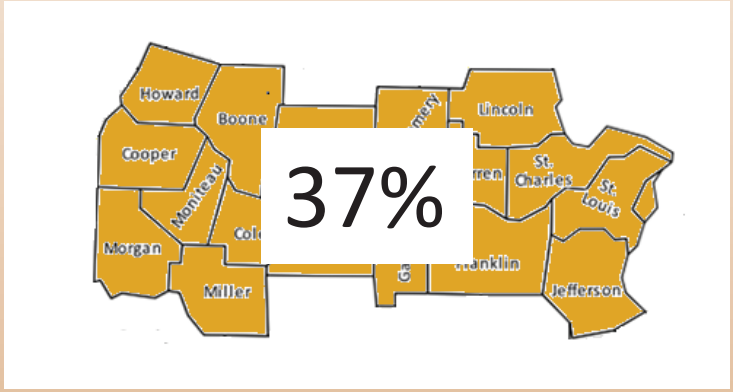
Active Carbon (mg/Kg)

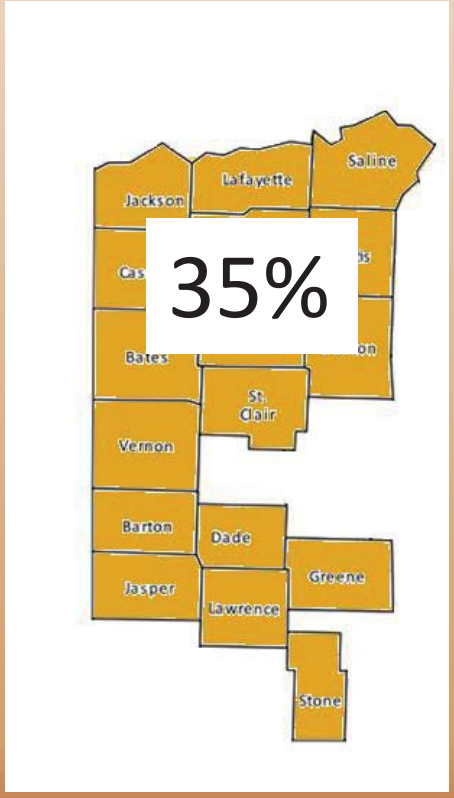




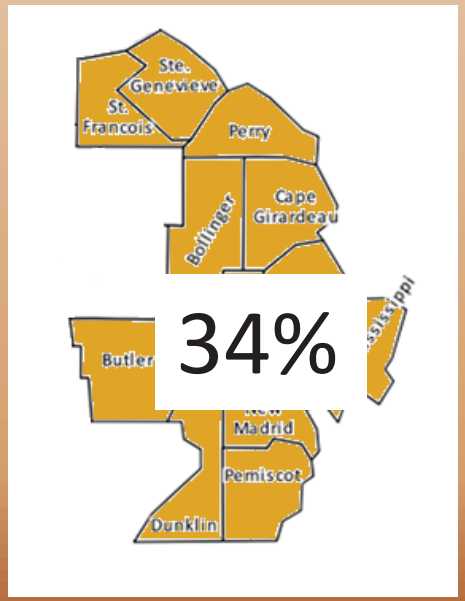








Water Stable Aggregates



Outreach

- 6 Train-the-Trainer Workshops on the reports
  - 2 in NWMO
  - 1 each in NEMO, ECMO, SEMO, and ECMO
  - About 160 Participants in Workshops

- University of Missouri Research Center Field Days
- Produced traveling displays with region-specific panels
- Missouri State Fair
- Laboratory Tours

Progress on the second year, 2015 (MO Fiscal Year 2016)

2015 (MO Fiscal Year 2016)

Soil Sampling for the Missouri Department of Natural Resources
Soil and Water Conservation Program (SWCP)
Cover Crops Cost-Share Program

Soil Health Assessments

The following is a listing of the individual soil assessments that will be employed for soil health analysis for the MoDNR Soil and Water Program's cover crops cost share program:

Initial Standard Soil Health Package $90

- Simplified Particle Size
- Active Carbon
- Total Organic Carbon (also converted to Organic Matter)
- Mineralizable Nitrogen
- Wet Aggregate Stability
- pH (salt and water)
- Effective Cation Exchange Capacity plus exchangeable bases
- Effective Base Saturation
- Exchangeable Al
- Plant Available Phosphorus
- Bulk Density

Follow-Up Standard Soil Health Package $70

- Active Carbon
- Total Organic Carbon (also converted to Organic Matter)
- Mineralizable Nitrogen
- Wet Aggregate Stability
- pH (salt and water)
- Effective Cation Exchange Capacity
- Effective Base Saturation
- Exchangeable Al
- Plant Available Phosphorus
- Bulk Density

The initial standard package will be initiated before seeding cover crops in year 1. If the landowner will be receiving cost-share on the same field where the initial standard test was sampled at least 3 years after the initial test, and the field contained cover crops in all the previous years, then samples for the follow-up standard package test will need to be taken from the field. The follow-up sampling site must be taken in the same location of the field as the original sampling site.

July 14, 2016

2016 DNR – SWCP Cover Crop Cost Share Soil Health Information

Name(s)_____

Address_____

Telephone(s) _____

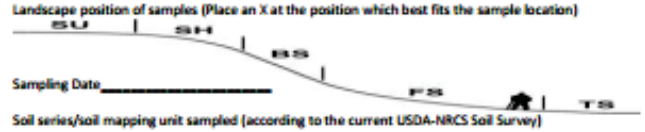
E-mail address(es) _____

County (where sample taken)_____

Farm, Tract, and Field Numbers from Conservation Plan_____

Farmer's name for the field_____

Landscape position of samples (Place an X at the position which best fits the sample location)



Sampling Date_____

Soil series/soil mapping unit sampled (according to the current USDA-NRCS Soil Survey)

_____

Sample Latitude, Longitude (Optional)(decimal degrees preferred) Lat._____Long._____

Crop rotation over the past 5 years_____

_____

Tillage used over the past 5 years_____

_____

Planned crop rotation for next 5 years_____

_____

Planned tillage for next 5 years

_____

Any prior covers crops in this field? Yes No If yes, which years? 2010 2011 2012 2013 2014 2015

If in continuous cover crops > 5 years, how many total years in cover crops? _____

etc.)?_____How many tons per acre? _____

How was it applied? _____

Name of person taking sample _____Soil Scientist? Yes No

July 7, 2016

Year Two

- The bulk of the samples came later in the year
- Approximately 950 samples
- 67 counties
- 3 new counties—Dunklin, Hickory, and Scot
- Have begun sending out reports
- Will attempt to further automate reports and send them out as they came in
- Second year of cover crops does not require a sample
- Have applied for a minigrant to look at the affects of manure on soil health

On the Horizon…

- Presenting at the Missouri Natural Resource Conference
- Plan to present Posters at Iowa Soil Health Conference
- Will continue to analyze data collected during the first year and add in second year data
- Looking at landscape position soil texture MLRAs
- Histograms what management produced best outcomes
- Training TGA
- “Mop Up” Soil Health Assessment Training in Central Missouri

Big Picture

- Graziers have expressed interest in soil health parameters in pastures and hay land
- Interest has been expressed in soil health parameters in vegetable cropping
- Continue working with NRCS looking at native soils
- Working with Sanborn Field >125 of cropping systems
- Possibly look at nutrition as soil health increases

Questions or Comments?