Mitigating Climate Change with Organic Practices

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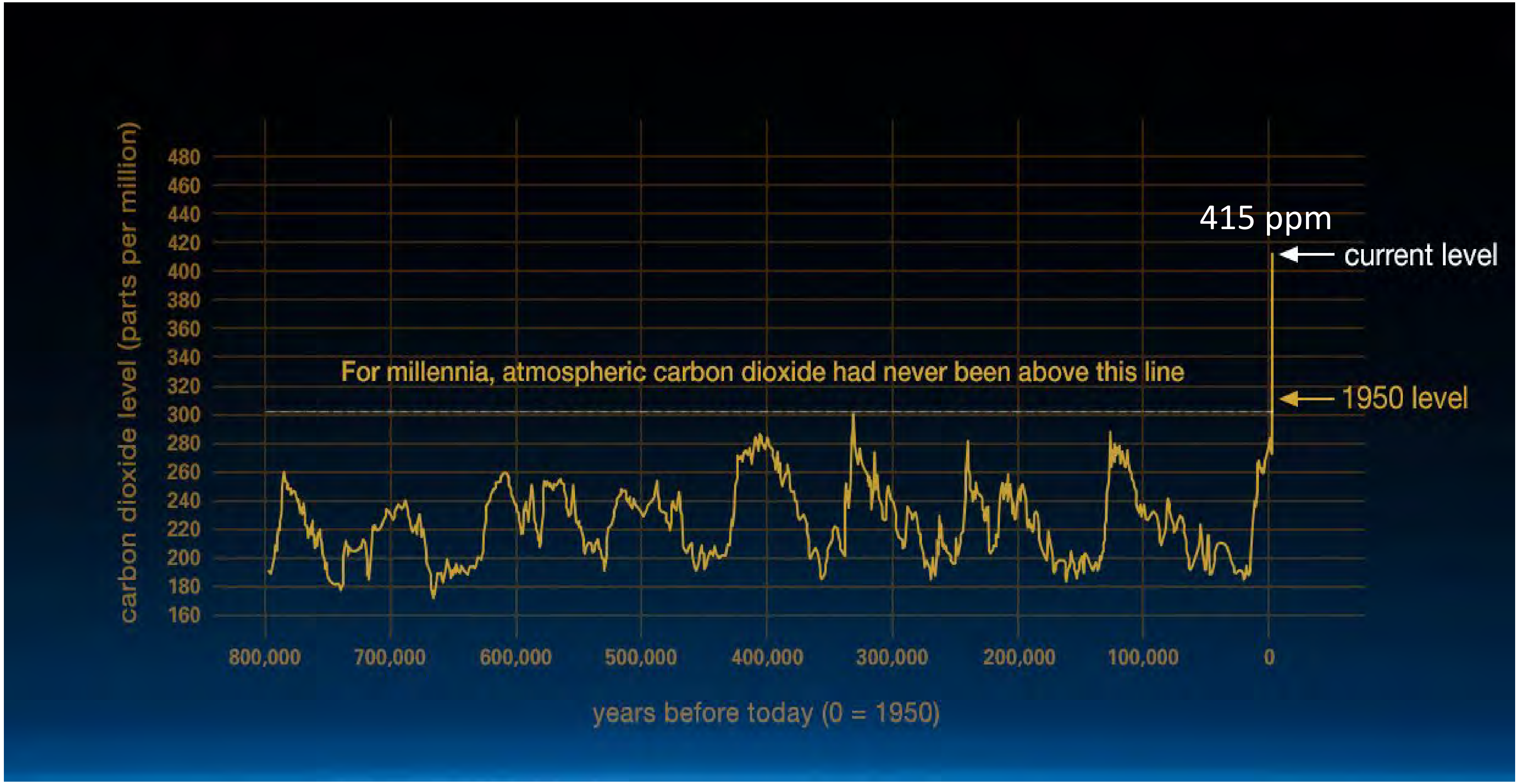
http://extension.agron.iastate.edu/organicag/

Greenhouse gases (GHG) can affect global warming



Majority of emissions from fossil-fuel burning; 60 percent of fossil-fuel emissions stay in the air. [Go ELECTRIC/SOLAR!]

https://climate.nasa.gov/

Federal level interest in carbon and climate

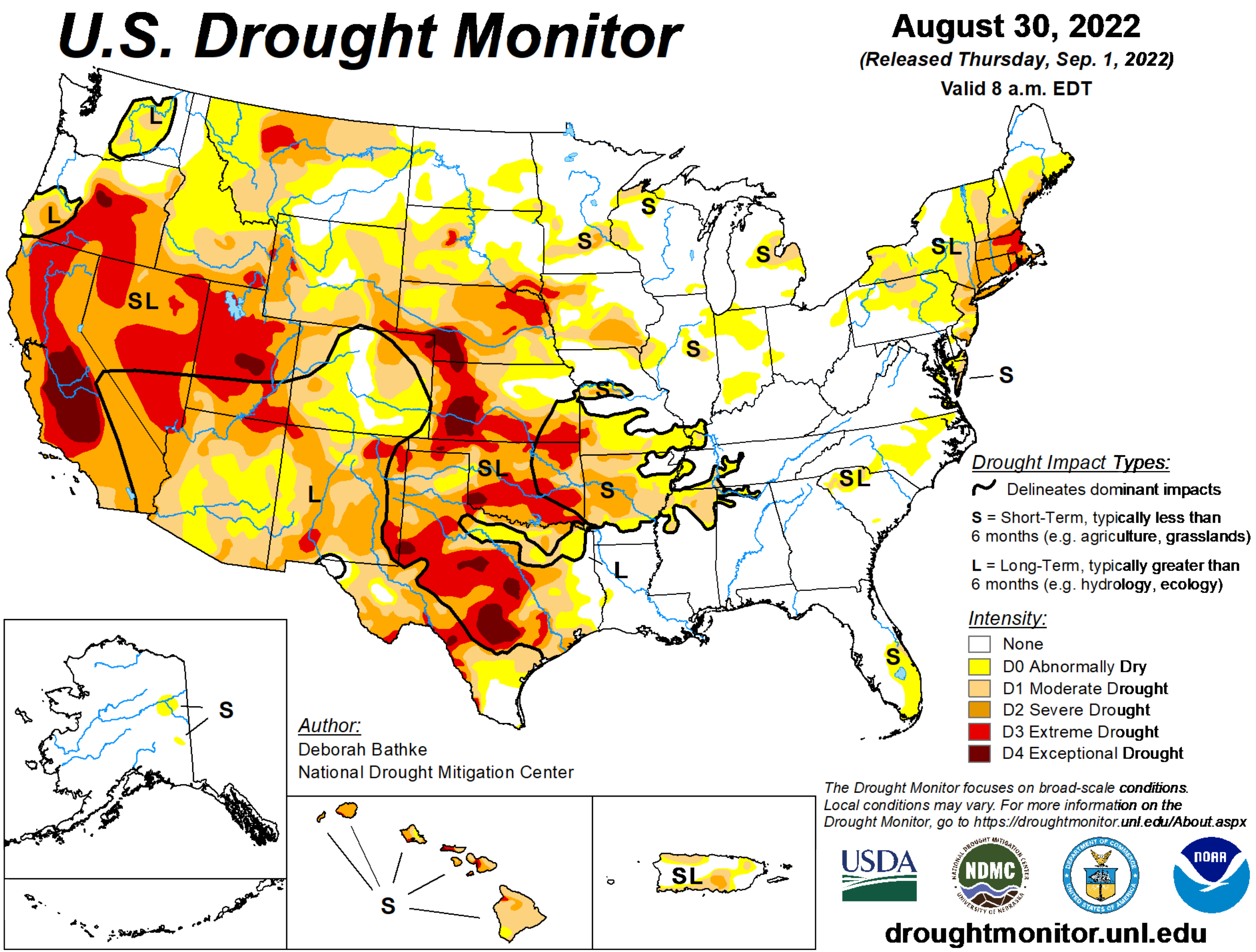
- Infrastructure Investment and Jobs Act: This Bipartisan Infrastructure Law will rebuild America's roads, bridges and rails, expand access to clean drinking water, ensure every American has access to high-speed internet, tackle the climate crisis, advance environmental justice, and invest in communities that have too often been left behind.

Floods in Fremont County, Iowa, March 29, 2019
-Tom Polansek / Reuters

Drought in June 2021
Photo credit: XtremeAg

Climate section of Inflation Reduction Act will provide direct assistance with climate-mitigating efforts (technical assistance, grants, carbon payments, etc.)

Yellow, tan, orange, red, and brown colors: abnormally dry to exceptional drought



U.S. Secretary of Ag Tom Vilsack

"We've embraced the concept of cover crops. We want to see 30 million acres by 2030."

–Feb. 7, 2022

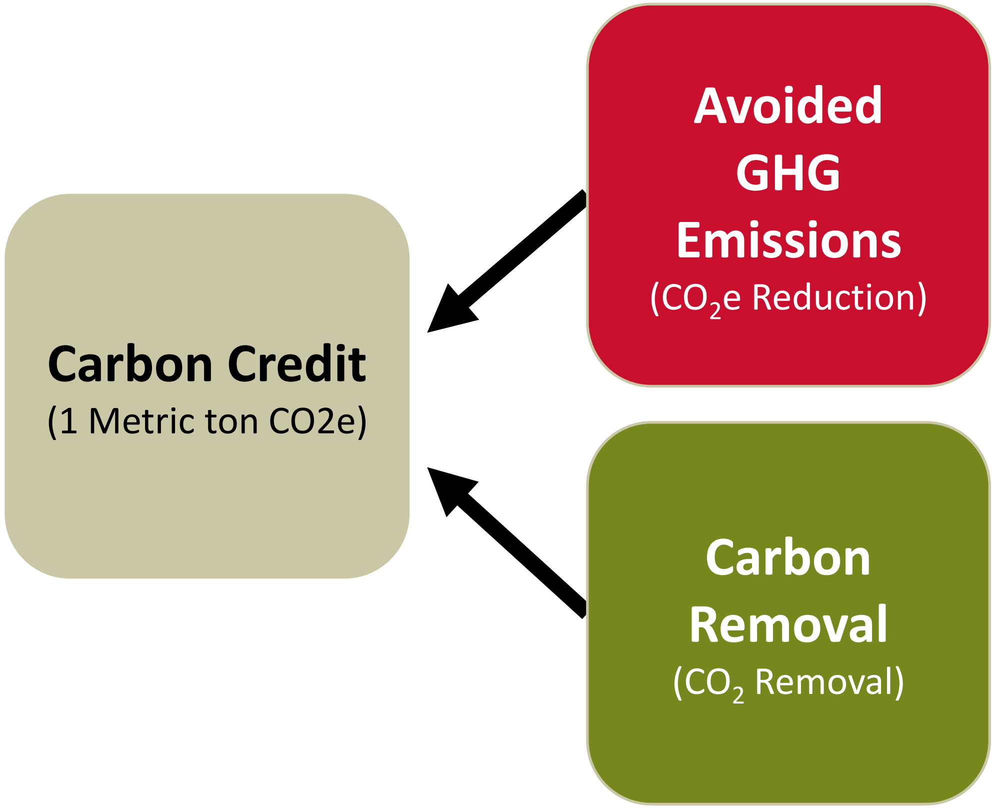
–New Transitioning to Organic Program
October 2022
Trainings, grants, cost-share

Winona LaDuke, White Earth Nation

"We don't need any CO_2 pipelines; sequester your carbon in your soil!"

–Feb. 9, 2022

Two ways to deal with GHGs



- Energy, materials conservation
- Switching to low CO_2e energy (wind, solar, renewable fuels), materials (electrochemical synthesis of ammonia, hydrogen)
- Avoided land use change

Avoid GHG-emitting fertilizers

- Carbon farming, soil storage
- Grassland, forest restoration
- Pyrolysis to biochar
- Capturing, using or sequestering waste streams
- Bioenergy with Carbon Capture, Sequestration (BECCS)
- Microbial carbonate precipitation
- Direct Air Capture

Slide courtesy of Jim Jordahl, Iowa State University

Soil carbon: let us sequester!

- ✓ Soil carbon is composed of inorganic carbonates and organic matter – living roots, insects and microorganisms as well as dead, dying and partially decayed organic matter

- ✓ Soil organic matter is composed of 50–58% carbon

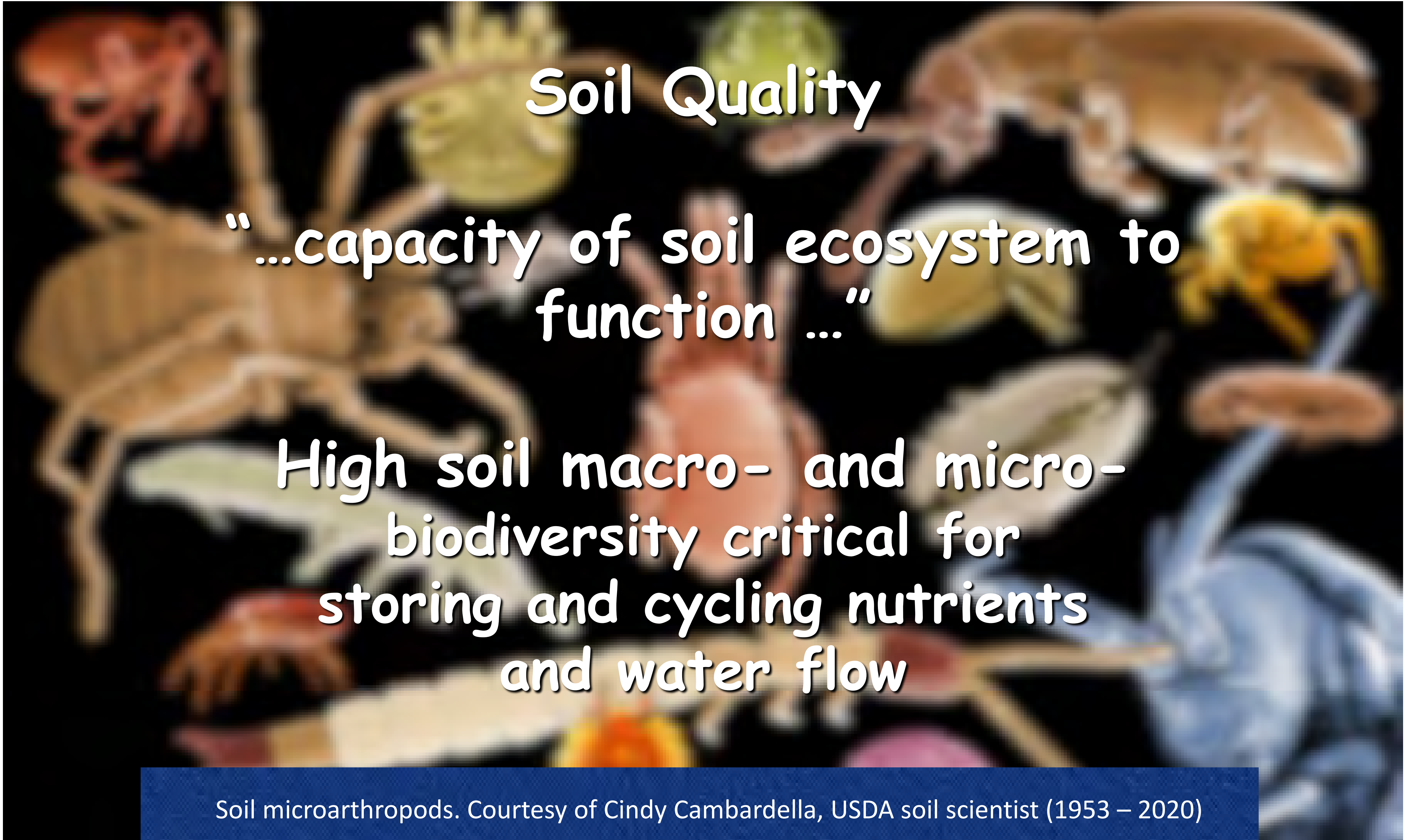
- ✓ Soil organic carbon is a critical driver for improving physical, chemical and biological processes and properties of soil quality; also, it controls landscape and global level processes of hydrologic function, nutrient cycling, and greenhouse gas emission and mitigation.

Slide courtesy of Alan Franzluebbers, USDA-ARS

Soil Quality

"…capacity of soil ecosystem to function …"

High soil macro- and micro-biodiversity critical for storing and cycling nutrients and water flow



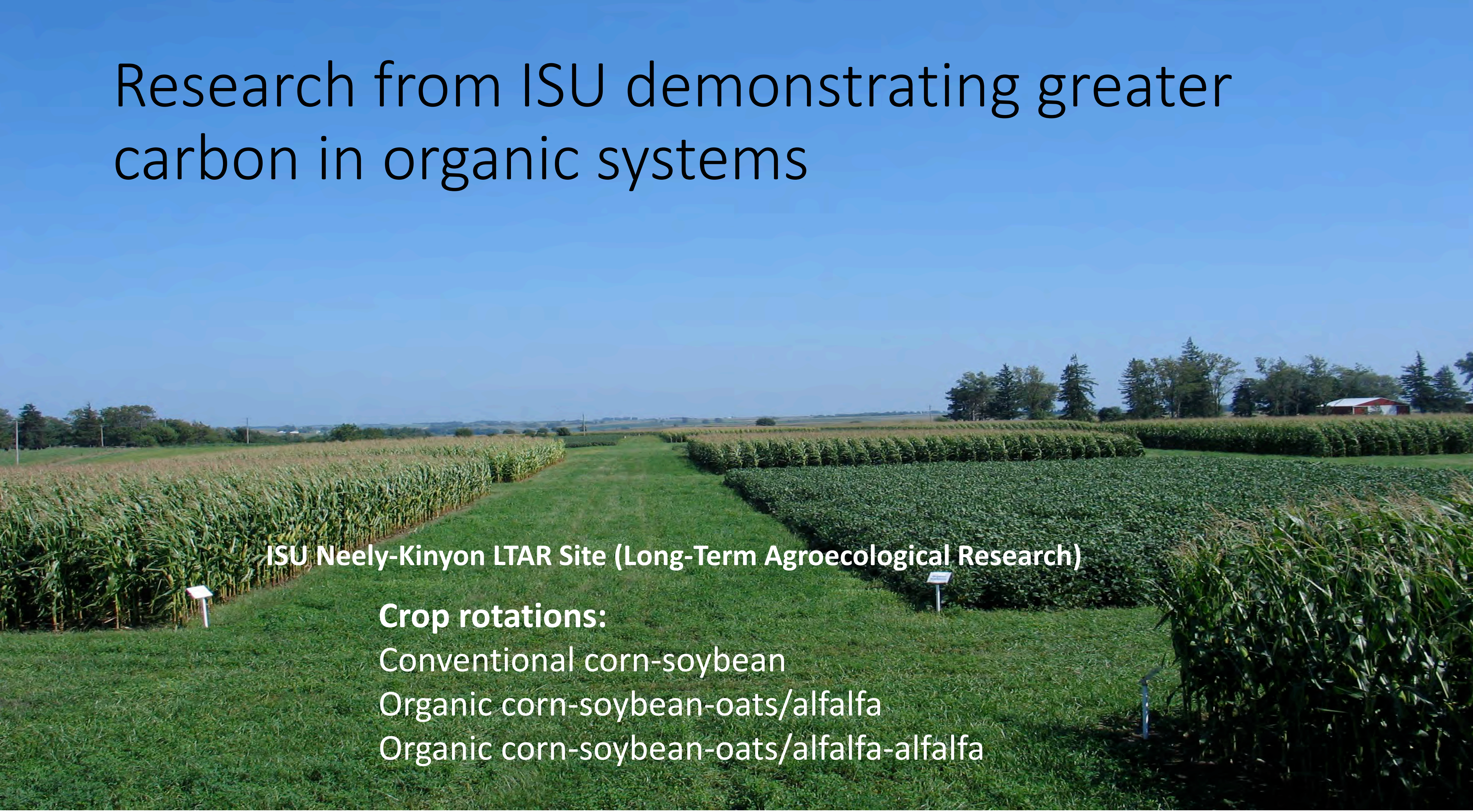
Soil microarthropods. Courtesy of Cindy Cambardella, USDA soil scientist (1953 – 2020)

Which management increase the stock of soil carbon?

- ✓ Adoption of conservation agricultural systems will sequester soil carbon at observed rates of 0.25 to 1.0 Mg C ha^{-1} yr^{-1}
- ✓ Conservation agricultural management may include conservation tillage, diverse crop rotations, cover cropping, manure application, and integration of perennial forages and animal grazing with cropping systems

Slide courtesy of Alan Franzluebbers, USDA-ARS

Research from ISU demonstrating greater carbon in organic systems

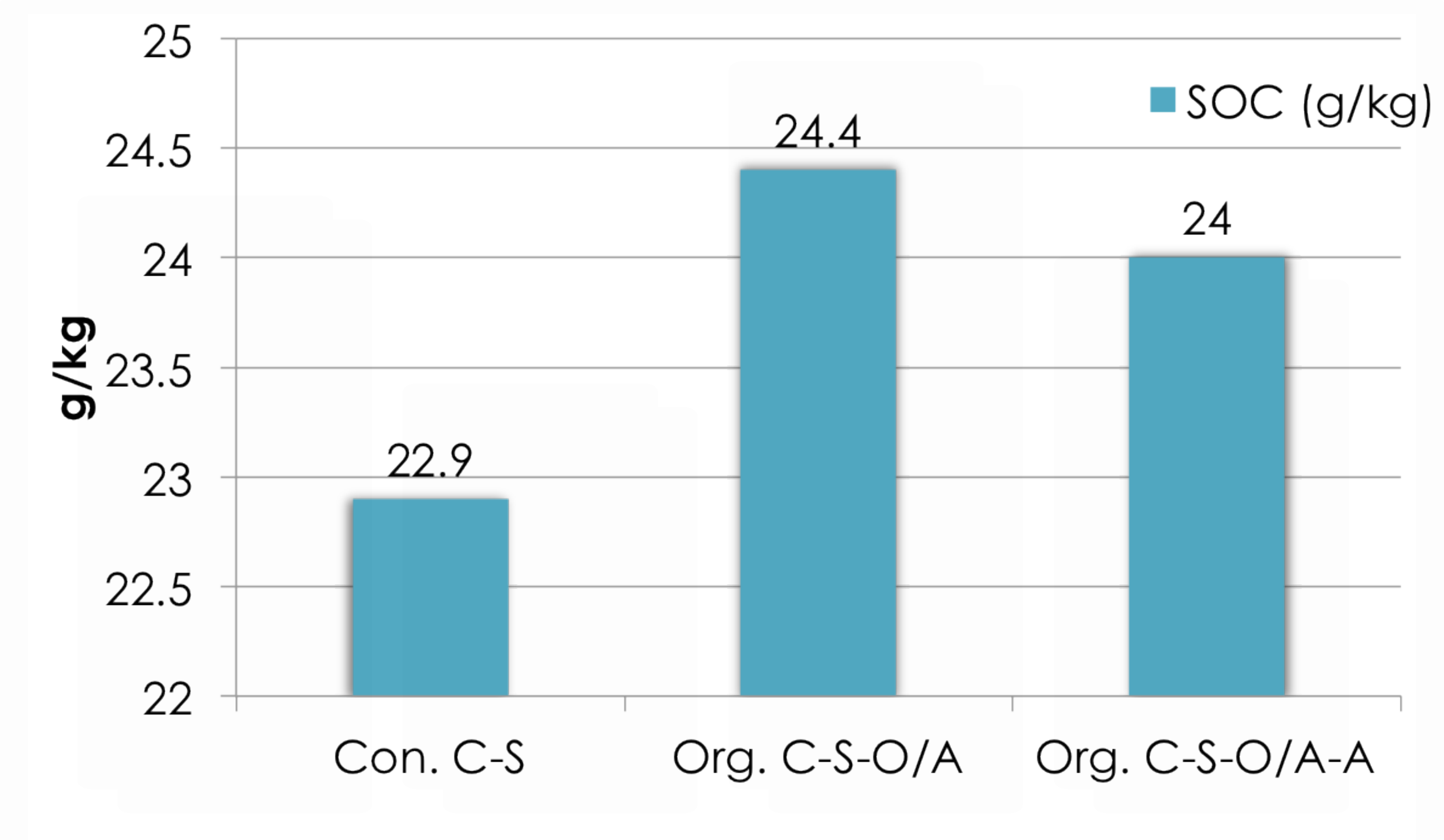


ISU Neely-Kinyon LTAR Site (Long-Term Agroecological Research)

Crop rotations:

Conventional corn-soybean
Organic corn-soybean-oats/alfalfa
Organic corn-soybean-oats/alfalfa-alfalfa

Soil SOC (g/kg) at LTAR
(depth: 0-6 in)



Carbon sequestration greater in organic plots.

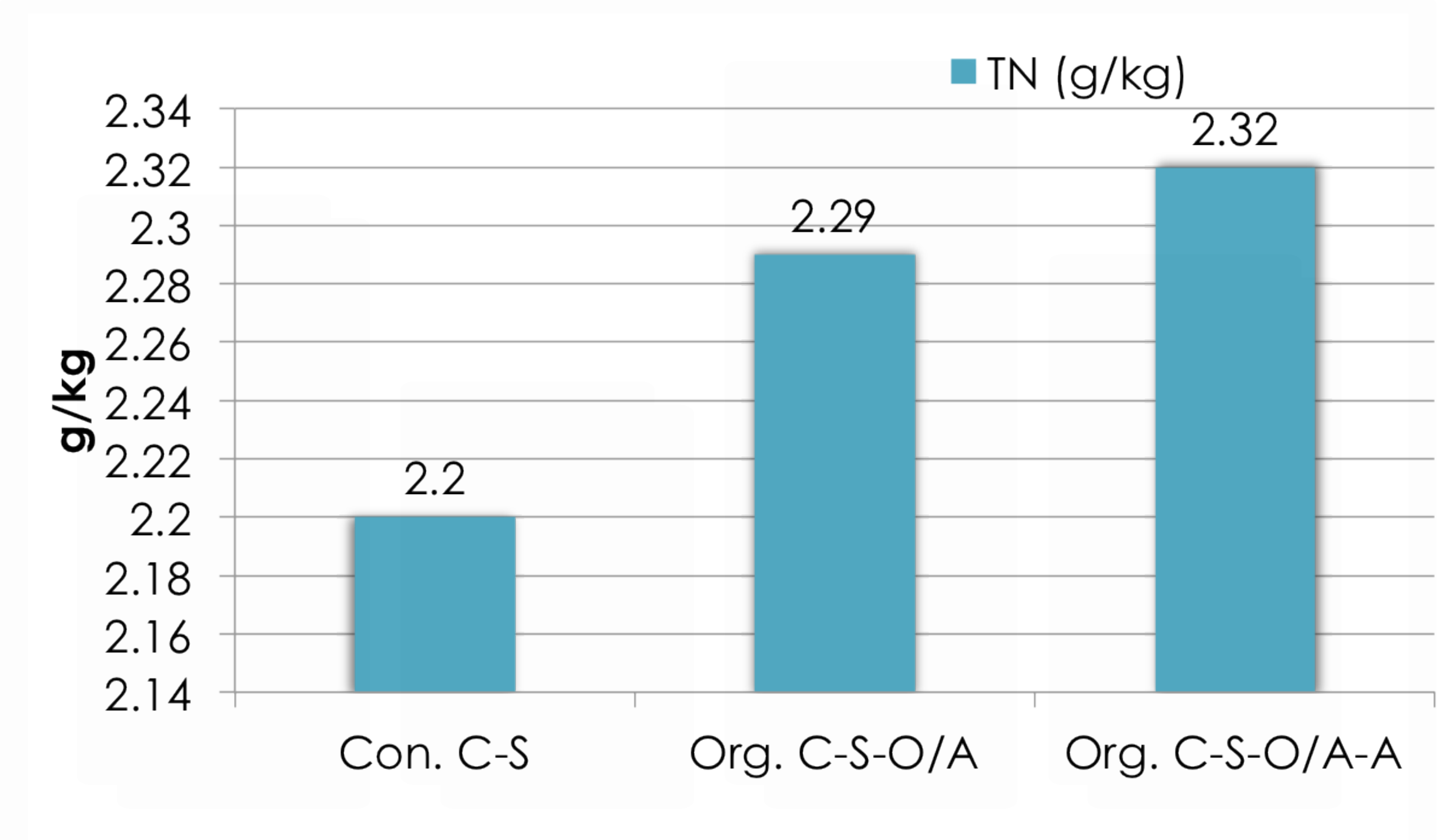
-C.Cambardella, USDA-ARS
National Lab for Ag & the Environment

Carbon Change over 10 years in the LTAR

Rotation	C-S-O/A	C-S-O/A-A	C-S
Residue C	41.5 Mg C ha^{-1}	41.1	58.5
Compost C	17.5	17.5	0
Total C inputs	59.0	58.6	58.5
SOC 1998	40.9	40.9	40.9
SOC 2007	43.6	46.2	40.7
ΔSOC 98-07	2.7	5.3	0
ΔSOC/10 y	0.27	**0.53**	0

- Cumulative carbon inputs over 10 years ~equal for conventional and organic
    - **More carbon is retained in the organic systems**
- Carbon change over 10 years for C-S-O/A-A rotation is similar to estimates of C sequestration potential converting CT to NT (0.57 Mg ha^{-1} West and Post,2002)

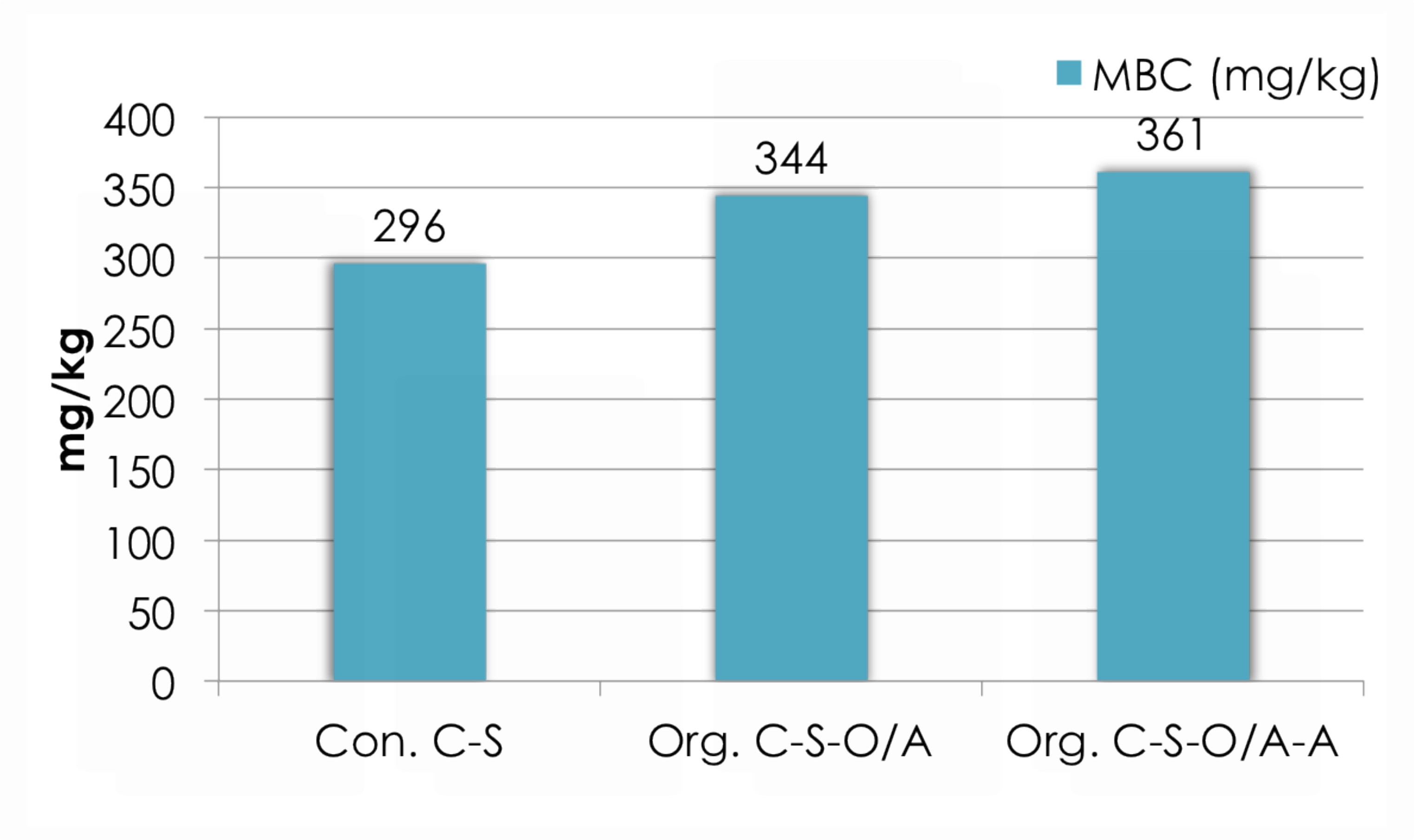
Soil TN (g/kg) at LTAR
(depth: 0-6 in)



Nitrogen storage in the soil for the next crop greater in organic plots.

-C. Cambardella, USDA-ARS

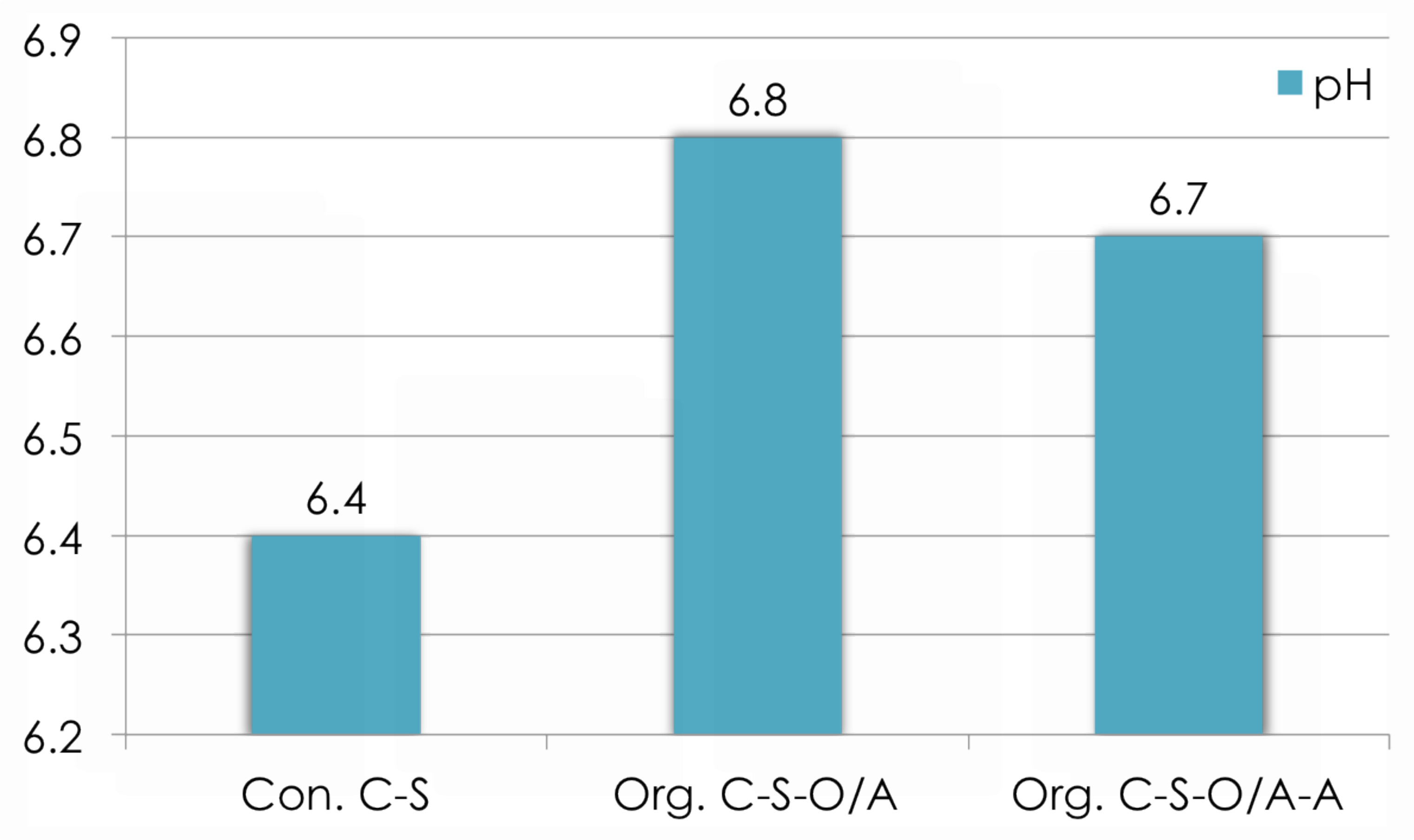
Soil MBC (mg/kg) at LTAR (depth: 0-6 in)



Beneficial soil microbial populations greater in organic plots

-C. Cambardella, USDA-ARS

Soil pH at LTAR (depth: 0-6 in)

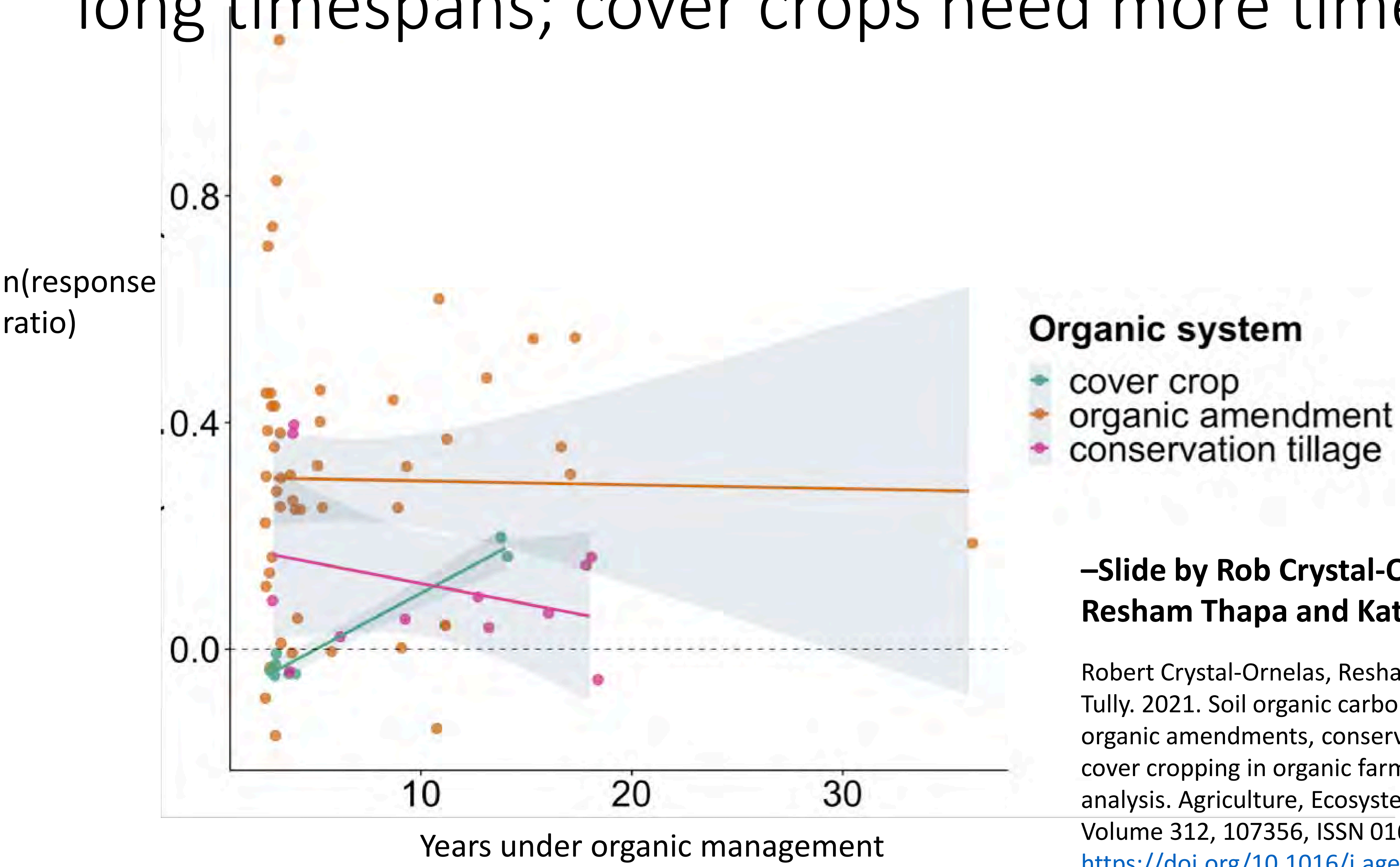


-C. Cambardella, USDA-ARS

Soil quality enhancement seen in cation concentrations related to CEC which controls nutrient availability

Parameter	Organic	Conventional
pH	6.9a	6.3b
Bray P (mg/kg)	69a	22b
K (mg/kg)	266a	217b
Mg (mg/kg)	400a	338b
Ca (mg/kg)	3702a	3105b
EC (µS/cm)	186a	143b
BD (g/cm3)	1.22a	1.26a

Organic amendments increase SOC over short and long timespans; cover crops need more time



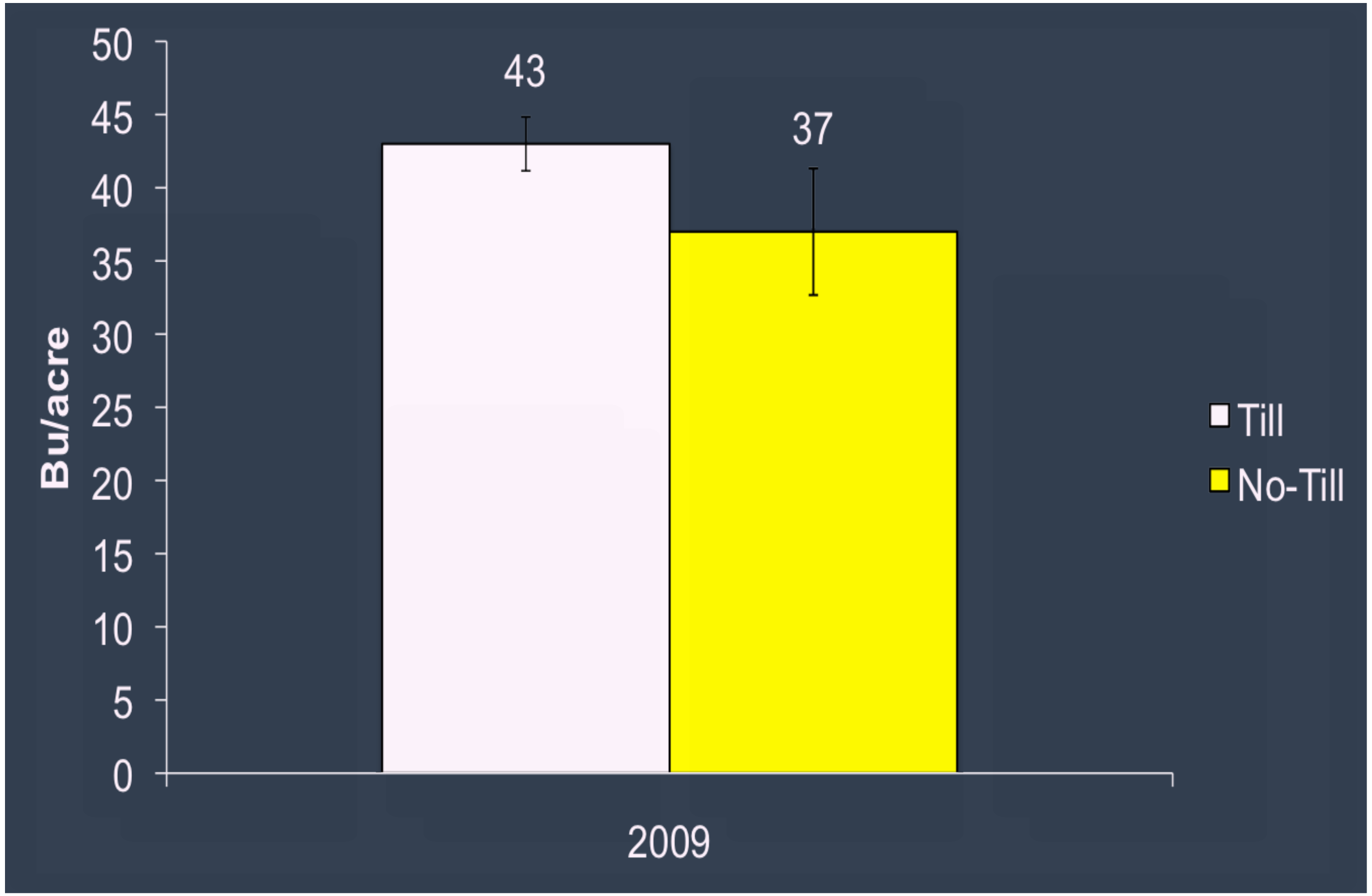
–Slide by Rob Crystal-Ornelas, Resham Thapa and Kate Tully

Robert Crystal-Ornelas, Resham Thapa, Katherine L. Tully. 2021. Soil organic carbon is affected by organic amendments, conservation tillage, and cover cropping in organic farming systems: A meta-analysis. Agriculture, Ecosystems & Environment, Volume 312, 107356, ISSN 0167-8809, https://doi.org/10.1016/j.agee.2021.107356

Organic No-Till Soybean Research

Front-mounted **roller crushing fall-planted rye cover crop; planter on rear**

Fluted coulters cut through crushed hairy vetch cover crop residue



ISU Research Farm results:
Organic soy following rye successful
Organic no-till corn-challenging due to hairy vetch re-growth and need for additional nitrogen

Conservation Innovation Grant: USDA-NRCS

- Current project with UW-Madison and Rodale Institute
- On-Farm Demonstration
- Weed Zapper™ with organic no-till soybeans: less weeds; higher yields
- Propane flamer with no-till corn: vetch controlled too severely

Treatment	Broadleaf weeds (plants/m²)	Grass weeds (plants/m²)	Yields (bu/acre)
ZRX Non-Zapped	17.00d	19.33d	Non-Zapped: 33.37
Rodale Non-Zapped	9.67c	12.33c	
ZRX Zapped	3.67b	8.67b	Zapped: 55.63
Rodale Zapped	2.33a	4.67a	
P value =0.05	0.0014	0.0194	

Microbial biomass carbon and nitrogen higher in organic NT

Site	MBC NT	MBC CT	MBN NT	MBN CT
Iowa	194	185	48	35
Minnesota	218	191	69	65
Pennsylvania	190	170	66	51
Wisconsin	174	162	49	47
Michigan	173	166	36	36
North Dakota	273	264	42	38

-Values in mg/g
-CT = Organic tilled

-Sharon Weyers, USDA-ARS, Morris, MN
-Soil samples after 3 years of organic reduced tillage

USDA-NIFA-ORG experiment examined straw mulch vs. no-till vs. tilled vegetables

Tomato yields:

25 tons/acre in Tilled system

24 tons/acre in No-Tilled system

Delate, K., D. Cwach, and C. Chase. 2012. Organic no–till system effects on soybean, corn and irrigated tomato production and economic performance in Iowa, USA. Renewable Agriculture and Food Systems 27(1):49–59. doi: 10.1017/S1742170511000524.

Cover crops and organic no-till: best combination for soil quality

Parameter	NCC_T	CC_NT	CC_T
SOC (g/kg)*	26.8c	30.7a	29.0ab
TN (g/kg)	2.7bc	3.0a	2.9ab
POMC (g/kg)	3.8b	5.7a	6.0a
MBC (mg/kg)	220b	283a	286a
PotMinN (mg/kg)	54.3b	70.4a	70.2a
Macroaggs (%)	15.0c	27.0a	21.4b

NCC_T = No Cover Crop, Till
CC_NT = Cover Crop, No-Till
CC_T = Cover Crop, Till

No Till > Till
Cover crop > No Cover Crop
Cover crops reduce negative impacts of tillage for all properties

-C. Cambardella, USDA-ARS

Integrating livestock with crops

- ✓ Enhances nutrient cycling
- ✓ Preserves soil carbon with year-round plant cover
- ✓ Grazed wheat and rye pastures having a greater amount of the soil enzyme, glucosidase, and greater soil nitrate levels.

–Galindo, F.S., Delate, K., Heins, B., Phillips, H., Smith, A., and Pagliari, P.H. 2020. Cropping System and Rotational Grazing Effects on Soil Fertility and Enzymatic Activity in an Integrated Organic Crop-Livestock System. Agronomy 10: 803: https://www.mdpi.com/2073-4395/10/6/803

Full-time job understanding everything out there!

Partnerships for Climate-Smart Commodities

Growing Climate Solutions Act

NORI

REGEN NETWORK

indigo

CLIMATE ACTION RESERVE — 2001-2021 —

American Carbon Registry at WINROCK INTERNATIONAL

PLAN VIVO For nature, climate and communities

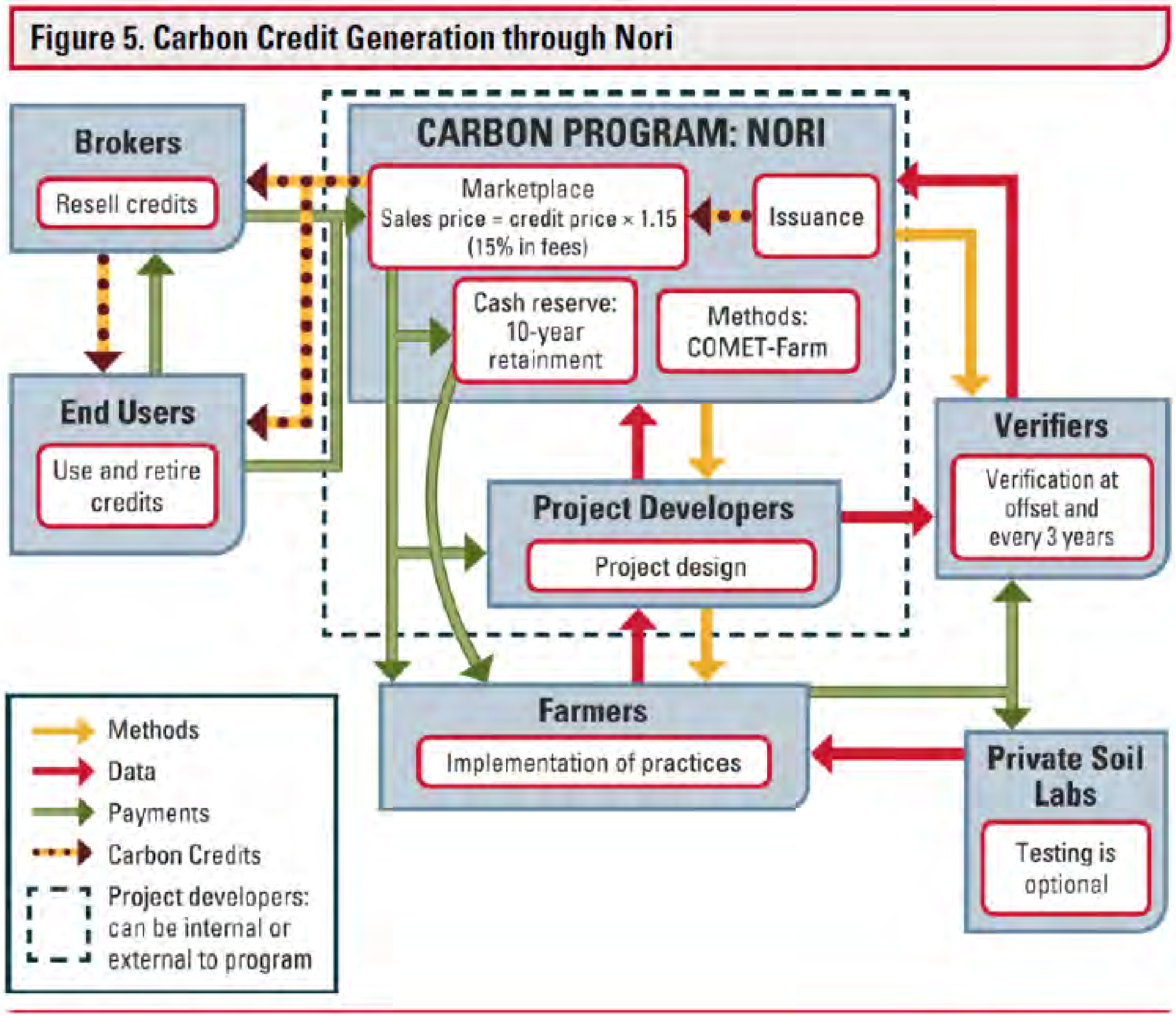
Gold Standard

Verified Carbon Standard

The Regional Greenhouse Gas Initiative
an initiative of Eastern States of the US

Slide courtesy of Alan Franzluebbers, USDA-ARS

Many programs available: some very complex!



- Most carbon credit opportunities establish the baseline for the credit as the current farm practices
- So if you moved to cover-cropping several years ago, you may not qualify for carbon programs-most contracts are seeking changes from your current practices
- If practices are discontinued ("Reversal"), carbon programs will penalize the farmer.

Source: Plastina, A. 2021. How do data and payments flow through ag carbon programs? File A1-77. Ag Decision Maker, Iowa State University Extension and Outreach, Ames, Iowa.

United States Department of Agriculture
Natural Resources Conservation Service

NRCS EQIP/ CSP
Payments for Organic Practices

- **Conservation Activity Plan (CAP) – 138 - Conservation Plan Supporting Organic Transition**
- Common Organic Practices – Certified Organic
  - 328 Conservation Crop Rotation
  - 329 Residue and Tillage Management, No-Till
  - 340 Cover Crops
  - Grazing Practices
  - 590 Nutrient Management
- Since FY2013 Iowa has allocated $400,000 to Organic Initiative annually.
- CSP – Conservation Stewardship Program

https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/organic/

-Dave Brommel, NRCS-Iowa

Exciting new Practice Standard: Organic Management!

-Some criteria:
"Include at least one cover crop every two years in the rotation with cc biomass of ≥ 1 ton/acre"

USDA

United States Department of Agriculture

823-CPS-1

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

ORGANIC MANAGEMENT

CODE 823

(ac)

DEFINITION

Managing and improving natural resources on land in and adjacent to organic production using methods which integrate cultural, biological, and mechanical practices that foster cycling of resources, promote ecological balance, and conserve biodiversity.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Improve soil health
- Reduce soil erosion
- Reduce emissions of greenhouse gases (GHG)
- Reduce transport of pesticides and nutrients transported to surface water, groundwater and air
- Improve moisture management
- Improve plant productivity and health
- Reduce plant pest pressure
- Enhance habitat for wildlife, pollinators, and other beneficial invertebrates
- Improve livestock feed and forage imbalance
- Improve or maintain quantity and/or quality of forage for grazing, browsing and productivity

CONDITIONS WHERE PRACTICE APPLIES

This practices applies to all lands where organic management methods are used.

CRITERIA

General Criteria Applicable to All Purposes

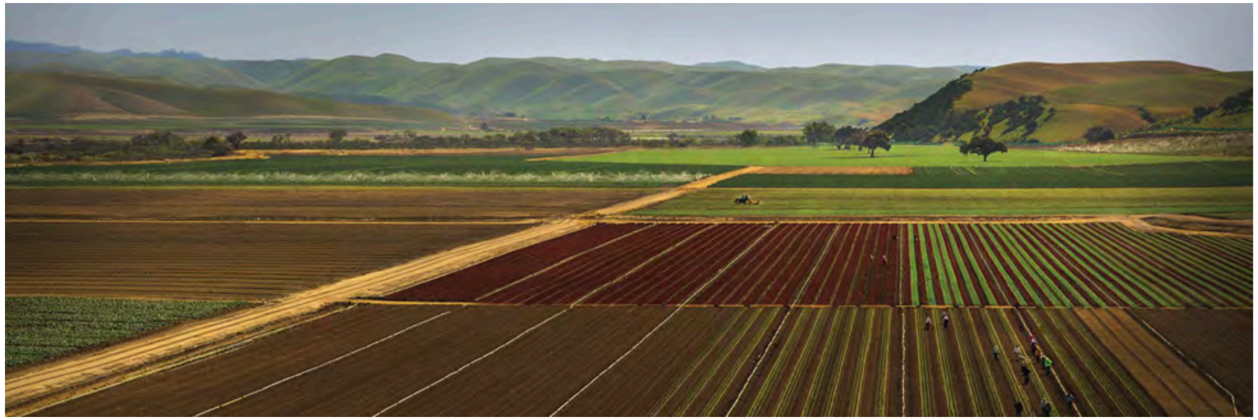
Must adhere to the USDA's National Organic Program (NOP) Standards.

Producers must coordinate all activities/inputs with NOP approved Organic Certifiers.

Protect organic production areas from unintended introduction of prohibited substances through defined boundaries, buffer zones or diversions. Establish or maintain at least one perennial conservation buffer planting to address specific concerns and follow the appropriate NRCS Conservation Practice Standard (CPS) such as Conservation Cover (Code 327), Hedgerow Planting (Code 422) etc., to protect production areas, enhance biodiversity, and/or provide habitat for wildlife and beneficials.

All inputs and other materials must follow the National List of allowed and prohibited substances, methods, and ingredients. .Within annual production fields, implement a diverse crop rotation to maintain

California leads the way in climate-smart agriculture



INVESTING IN CALIFORNIA AGRICULTURE'S CLIMATE SOLUTIONS: CLIMATE SMART AG PROGRAMS

The state of California launched its innovative Climate Smart Agriculture programs starting in 2014, funding them with proceeds from the state's cap-and-trade program. The grant programs—the first of their kind in the country—provide unique resources for farmers and ranchers to adopt transformative management practices that reduce potent greenhouse gas (GHG) emissions, increase carbon storage in soils and woody plants, and protect at risk agricultural lands, all while providing multiple benefits that improve the health and resiliency of our farms, ecosystems and communities.

https://calclimateag.org

Farm Carbon Calculator (UK)

Carbon Sequestration — This section calculates the carbon sequestered (absorbed) by the plants and soils on your farm

Carbon sink

Soil Organic Matter (SOM)

If you have SOM results from at least two different years on any of your fields please enter the details below. The more years' worth of data you have the better!

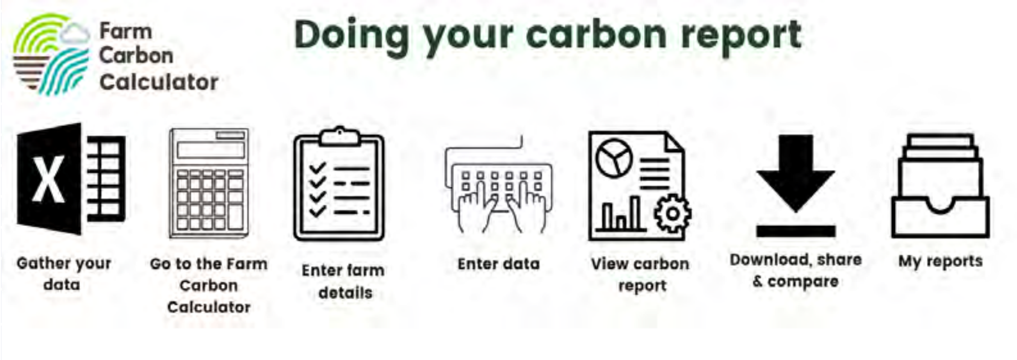
If necessary copy and paste more boxes to accommodate more results

Field reference	average	(name)	acres	Field reference	(name)	Field reference	(name)
Area of field	202.3	ha	500	Area of field	ha	Area of field	ha
Soil Bulk density	1.6	g/cm3		Soil Bulk density	g/cm3	Soil Bulk density	g/cm3
Depth of measurements	0.3	m		Depth of measurements	0.3m	Depth of measurements	0.3m
	%	Year		%	Year	%	Year
SOM	3.36	2021		SOM		SOM	
SOM	3.45	2020		SOM		SOM	
SOM	3.38	2019		SOM		SOM	
SOM	3.43	2018		SOM			
SOM	3.24	2017		SOM			

Soil Organic Carbon — Stocks — tonnes CO2/ha

Field reference

Hectares



Cultivated Peat Soils (soils with a SOM content above 20%)

Cultivating peat soils increases emissions of CO2, CH4 and N2O. Enter area of peat soils cultivated on your farm. Ignore if you are on any other soil type

No SOM results	ha	Note: peat soils defined as those above 20% organic matter
SOM measurements carried out	ha	If you've already entered data for the farm in SOM above, use this function.

Woodland

Record any woodland you have on the farm, or even large individual trees. If possible use the species and age specific options – it's more accurate; if not possible use the average options.

		Area (ha)	Species	Age	
Species and age specific	Woodland: detailed analysis				Use drop down options for species and age
					Note: use farm maps to assist

Sample Data Sheet by Dean Dickel: ddickel5066@gmail.com

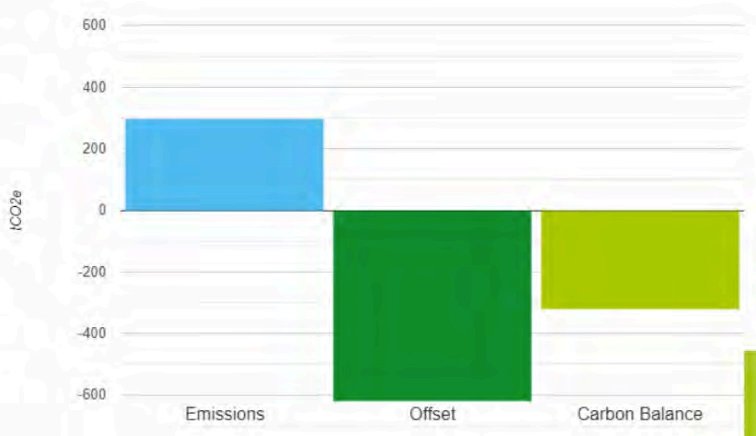
https://farmcarbontoolkit.org.uk

Farm Carbon Calculator

Hypothetical farm: 500 acre conventional corn/soybean operation. Corn planted no-till into bean stubble. Expected yields: 170 bushels corn and 49 bu/acre for soybeans.

Midwest farm 28 Dec 2021

Summary



-321.71

tonnes CO_2e per year

Sequestered

Emissions	tonnes CO_2e	%
Fuels	60.45	20.36%
Crops	177.38	59.74%
Inputs	59.08	19.90%
Total	**296.91**	**100%**

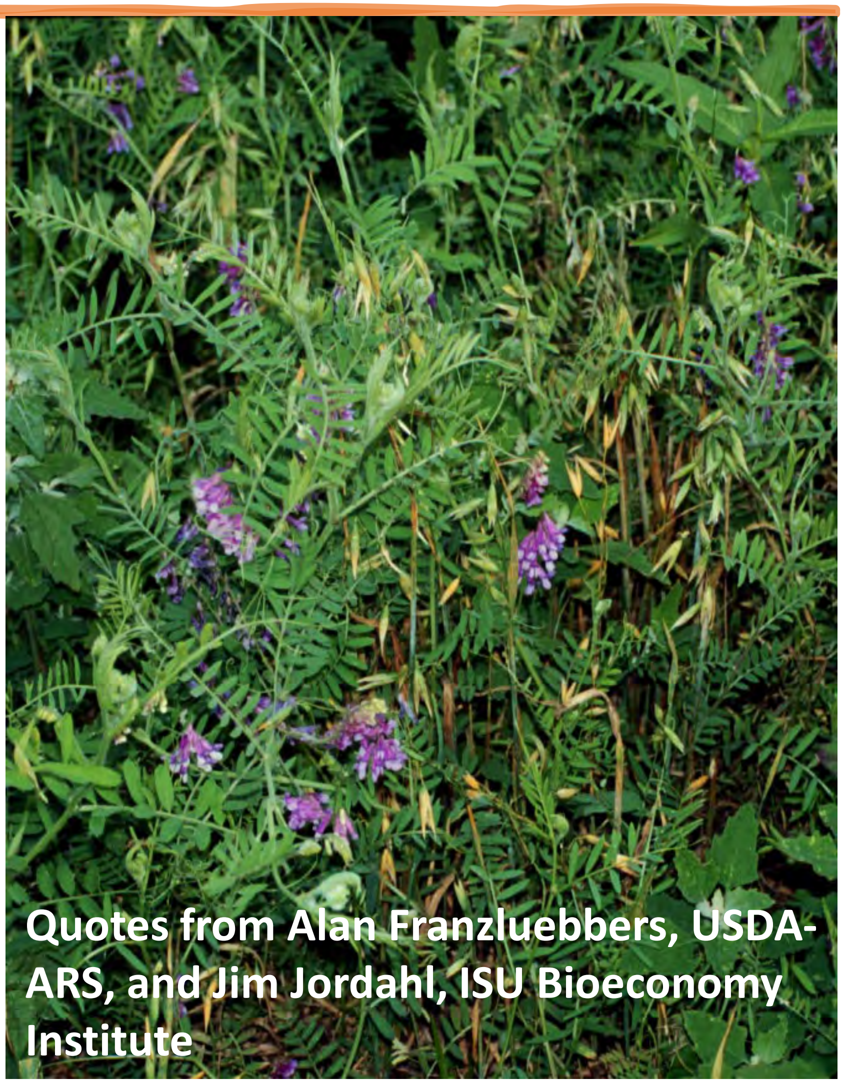
Offset	tonnes CO_2e	%
Soil Organic Matter	-618.61	100.00%
Total	**-618.61**	**100%**

Carbon offset determined through Organic Matter content (618.61 MT CO_2e);
Total emissions (fuels, crops, inputs) = 296.91 MT CO_2e
Total sequestered: 321.71 CO_2e

Sample Summary Sheet by Dean Dickel: ddickel5066@gmail.com

Overall benefits from organic practices related to reducing GHGs/mitigating climate change

- **Increasing soil organic carbon rewards farmers and landowners with better tilth, higher nutrient-supplying capacity, improved resilience to perturbations and weather extremes, and abundant biological diversity to support vigorous plants and sustained ecosystem services**
- **Carbon trading seems to be a marketing tool that helps broaden society's appreciation for the inherent value of soil carbon as a fundamental basis for sustainability**
- **The health of our soils is improved through farm management that increases soil organic matter and reduces reliance on fossil fuel-based inputs.**
- **Improved management of N_2O emissions from cropland will have greatest impacts on CO_2e**
- **Organic does BOTH: reduces N_2O emissions by avoiding synthetic N and sequestering carbon through required organic practices**



Thank you for your interest in Organic Agriculture!

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