

**CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE  
ENVIRONMENTAL FARMING ACT SCIENCE ADVISORY PANEL (EFA SAP)**

**MEETING AGENDA**

**May 14, 2015**

**10 am to 4 pm**

**Auditorium**

**1220 N Street**

**California Department of Food and Agriculture (CDFA)**

**Sacramento, CA 95814**

**916-654-0433**

**WEBINAR INFORMATION**

**Webinar ID - 128-713-699**

**Please register at**

**<https://attendee.gotowebinar.com/register/678515588776947713>**

**EFA SAP MEMBERSHIP**

Don Cameron, Member and Chair

Mark Nechodom, PhD, Member

Jocelyn Bridson, MSc, Member

Mike Tollstrup, Member

Jeff Dlott, PhD, Member

Luana Kiger, MSc, Subject Matter Expert

Doug Parker, PhD, Subject Matter Expert

- |  |                                   |
|--|-----------------------------------|
| 1. Introductions (10 minutes)  | Don Cameron                       |
| 2. Welcome address – Secretary Ross  |                                   |
| 3. Updates (10 minutes)  | CDFA                              |
| • Minutes from previous meetings   |                                   |
| • State Water Efficiency and Enhancement Program (SWEEP)                         |                                   |
| 4. Soil Health   | Don Cameron                       |
| i. State Healthy Soils Initiative (20 minutes)                                   | CDFA                              |
| ii. Introduction to Soil Organic Matter and Soil Health (30 minutes)             | Dr. Dennis Chessman, USDA<br>NRCS |
| iii. Strategies to increase soil organic matter in California soils (20 minutes) | Dr. Jeff Mitchell, UC Davis       |
| iv. Questions and Discussion (30 minutes)  | Don Cameron                       |
| v. Working lunch (panel members and speakers only)                               | Don Cameron                       |
| vi. Panel Discussion (20 minutes each including questions)                       |                                   |
| - CalRecycle   | Howard Levenson                   |
| - CVRWQCB  | Adam Laputz                       |
| - Department of Conservation   | David Thesell                     |
| vii. Public Comment and Discussion (2 hours)                                     | Don Cameron                       |
| • Can we set soil organic matter goals?  |                                   |
| • What are good strategies to build soil organic matter?                         |                                   |
| • What are the scientific gaps?  |                                   |
| 5. Next meeting and location   | Don Cameron                       |

Amrith Gunasekara, PhD, CDFA Liaison to the Science Panel

All meeting facilities are accessible to persons with disabilities. If you require reasonable accommodation as defined by the American with Disabilities Act, or if you have questions regarding this public meeting, please contact Amrith Gunasekara at (916) 654-0433.

More information at: <http://cdfa.ca.gov/Meetings.html> and [http://www.cdfa.ca.gov/EnvironmentalStewardship/Meetings\\_Presentations.html](http://www.cdfa.ca.gov/EnvironmentalStewardship/Meetings_Presentations.html)

**CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE (CDFA)  
ENVIRONMENTAL FARMING ACT SCIENCE ADVISORY PANEL (EFA SAP)**

**Mendocino County Administrative Center  
501 Low Gap Road, Conference Room C  
Ukiah, CA 95482**

**March 4, 2015**

**MEETING MINUTES**

**Panel Members**

Don Cameron, Member and Chair  
Mike Tollstrup, Member  
Jocelyn Bridson, MSc, Member  
Jeff Dlott, PhD, Member

**Subject Matter Experts**

Luana Kiger, MSc, Subject Matter Expert

**State Agency Staff**

Amrith Gunasekara, PhD (CDFA)  
Nilan Watmore, MSc (CalEPA)

**AGENDA ITEM 1 and 2**

The meeting was called to order at 1:10 p.m. by the Chair, Mr. Don Cameron. Introductions were made and a quorum was established. Members present at the meeting included Mr. Cameron, Dr. Dlott (phone), Mr. Tollstrup and Ms. Bridson. Subject matter expert Ms. Kiger was also present. Introductions were made.

**PREVIOUS MEETING MINUTES**

There was a delay in producing the minutes from the December 19, 2014 meeting. Dr. Gunasekara noted the minutes would be presented at the next Science Panel meeting to be held in May or June, 2015.

**STATE WATER EFFICIENCY AND ENHANCEMENT PROGRAM (SWEEP)**

An update was provided on the implementation of the State Water Efficiency and Enhancement Program (SWEEP) by CDFA. Mr. Cameron noted that those projects involving the connection of pumps to utility lines (energy grid) might not be completed in time for the verification component to take place. Mr. Cameron noted that sending a letter out to the award recipients and highlighted the importance of completing the projects would be beneficial to CDFA and the growers. Dr. Gunasekara noted that CDFA will compile a letter to inform the award recipients of the importance of completing the projects by June 30, 2015 and explore other opportunities, such as contacting the utilities, to ensure interconnect issues do not delay project completion and the verification component.

**BIOCHAR**

Following the December 19, 2014 meeting which was focused on Biochar, Dr. Gunasekara noted that he is in discussions with the CDFA Fertilizer Research and Education Program (FREP) about potential funding to fund research on biochar use rate recommendations through

experimental field trials for different crops. The next solicitation for research will be released in September of 2015 and CDFA plans to include funding for biochar, a soil amendment, use rate research as one of several research priorities in the request for proposals.

### **HEALTHY SOIL INITIATIVE**

An update on the State Healthy Soils Initiative was provided by CDFA. This initiative to incentivize and build the organic matter content of our agricultural soils for climate change resiliency and other multiple benefits from healthy soils was included in the Governor's January budget. This initiative is timely because 2015 has been memorialized by the United Nations Food and Agriculture Organization after they recognized 2015 as the Year of the Soil. CDFA has been working closely with agency leaders and the administration to evaluate existing state agency efforts on healthy soils and will develop short and long term actions. Dr. Gunasekara noted that the Healthy Soil Initiative will be a primary topic of discussion at the next EFA SAP meeting to be held in May or June, 2015.

### **AGENDA ITEM 3. FARMED SMART CERTIFICATION**

The EFA SAP has been interested in learning more about a recent effort by the Pacific Northwest Direct Seed Association who is partnering with farmers to develop a new certification program called Farmed Smart. The certification would provide a "safe harbor" from regulatory agencies that support the program. CDFA had organized to have Ms. Kay Meyer, Executive Director of the program, to remotely call-in and present an overview of the program. Ms. Meyer was unavailable and therefore this agenda item will be revisited in a future EFA SAP meeting.

### **AGENDA ITEM 4. GEELA**

Mr. Watmore noted that the Governor's Environmental and Education Leadership Award (GEELA) categories were in the process of being reorganized. One of the goals of the reorganization would be to ensure that agricultural applications are submitted to one category rather than multiple categories as evident from the 2014 applications. Mr. Watmore was seeking input from EFA SAP members on the most effective way to organize and frame the agricultural category for the 2015 solicitation. Mr. Watmore also was seeking feedback on how to provide greater outreach to the agricultural community on GEELA to ensure more applications. Dr. Gunasekara noted that CDFA will distribute the announcement for applications (when released in May or June, 2015) via several internal email lists, University of California Cooperative Extension, the Ag Commissioners, Resource Conservation Districts, via the CDFA blog post and the EFA SAP members.

### **AGENDA ITEM 5. PUBLIC COMMENT AND OTHER ITEMS OF DISCUSSION**

Ms. Kiger noted that in the 2014 Farm Bill, farm insurance was relinked to conservation practices. She noted that some outreach by CDFA to growers would be helpful since not all California farmers might know about this change. Dr. Gunasekara noted that CDFA would assist in outreach efforts to farmers. The next EFA SAP meeting would be scheduled in May or June, 2015, with the location to be determined. The meeting was adjourned at 3:02 p.m.

Respectfully submitted by:



Amrith Gunasekara, Ph.D.

7/17/15

Date

## Healthy Soils Initiative Proposal

### Issue Statement:

California is the nation's leading agricultural production state in terms of both value and crop diversity. Soils are fundamental for crop growth and food production. The importance of soils has been memorialized by the United Nations Food and Agriculture Organization after they recognized 2015 as the Year of the Soil. With limited new arable land that is capable of growing food crops in California and an ongoing drought, it is critical to ensure the soil system is sustainable long into the future, resilient to potential climate change impacts such as variable temperatures and precipitation, and to be able to produce crop yields to sustain a growing local and global population. The term "healthy soils" refers to ensuring that our agricultural soils have adequate soil organic matter (SOM). Increasing the amount of SOM, from its current levels, in soils can provide multiple benefits such as:

- Source of nutrients for plants – SOM contains important nutrients that contribute to plant growth and yields (e.g., nitrogen and sulfur).
- Water retention – SOM has the ability to hold up to 20 times its weight in water.
- Contributes to the environmental fate of synthetic inputs – SOM affects persistence and biodegradability of pesticides and other soil inputs.
- Carbon sink – Stabilized carbon stored in soil serves as a carbon sink, preventing the escape of carbon dioxide and methane greenhouse gases to the atmosphere.
- Soil structure stability and reduced erosion – Soil carbon can combine with the inorganic clay mineral fraction to form structural units called aggregates. Aggregated soils have improved aeration, water infiltration and resistance to erosion, dust control, as well as numerous other benefits.
- At least a quarter of the world's biodiversity lives in the soil.

### Conceptual Proposal

Recently, the Brown administration recognized the importance of soil health in the Governor's 2015-16 proposed budget; "as the leading agricultural state in the nation, it is important for California's soils to be sustainable and resilient to climate change. Increased carbon in soils is responsible for numerous benefits including increased water holding capacity, increased crop yields and decreased sediment erosion. In the upcoming year, the Administration will work on several new initiatives to increase carbon in soil and establish long term goals for carbon levels in all California's agricultural soils. CDFA will coordinate this initiative under its existing authority provided by the Environmental Farming Act". Consistent with this initiative, several actions have been identified to:

- Protect and restore soil organic matter (soil carbon) in soils to ensure climate change mitigation and food and economic security
- Identify sustainable and integrated financing opportunities, including market development, to facilitate increased soil organic matter
- Provide for research, education and technical support to facilitate healthy soils
- Increase governmental efficiencies to enhance soil health on public and private lands
- Ensure interagency coordination and collaboration

### Short Term Actions (within a year)

- Establish a short- and long-term goal for building soil organic matter in California's agricultural and degraded soils by December 2015. These goals will be established through stakeholder meetings with scientific input (lead CDFA and CalRecycle).
- Establish a soil health initiative coordinator position to facilitate interagency activities including interagency communication, collaborations and to ensure resources optimization and permit streamlining to build soil carbon with carbon-based inputs (lead CDFA).
- Identify critical agronomic and economic research needed to fill knowledge gaps and build mapping tools for increasing soil organic matter throughout the state (lead CDFA).

## Administration/Department of Food and Agriculture Work Product

- Identify demonstration projects and contract with University of California Cooperative Extension (UCCE) to begin the cycle of management practice adoption to implement research objectives that meet soil carbon goals (lead CDFA).
- Integrate incentives for improved soil management practices into the Sustainable Agricultural Lands Conservation Program (lead Department of Conservation).
- Encourage organic diversions from landfills to more beneficial uses, including composting facilities, by a tiered tipping fee or complementary mechanism that incentivizes the diversion of organics. (lead CalRecycle).
- Provide healthy soils guidance in the Climate Change Handbook for Agricultural Water Management Planning as well as in public and outreach and education efforts (lead DWR).
- Facilitate discussion on the benefits of compost use when managing nitrogen and include as a separate component in the nitrogen management plans required by the Irrigated Lands Regulatory Program (lead Water Boards).
- Grow CDFA's State Water Efficiency and Enhancement Program to promote soil management practices that improve water retention (lead CDFA).
- Add healthy soils as an Efficient Water Management Practice (EWMP) in the guidebook to assist Agricultural Water Suppliers to Prepare an Agricultural Water Management Plan, and as a co-benefit in water efficiency grant programs (lead DWR).
- Explore opportunities to implement healthy soil management on construction, maintenance and operation plans in DWR (lead DWR).
- Explore with other Agencies opportunities for implementation of healthy soil management on public lands.

### **Long Term actions (1-5 years)**

#### **Identify sustainable and integrated financing opportunities, including market development, to facilitate increased soil organic matter**

Develop and fund incentive and demonstration programs with new and existing resources such as Resource Conservation Districts and UC Cooperative Extension, to promote GHG reductions, carbon sequestration, cover crops, crop rotation and organic amendments including compost to build soil carbon, increase water holding capacity and ensure crop yields for food production through on-farm management practices (lead CDFA).

#### **Provide for research, education and technical support to facilitate healthy soils**

Identify and secure resources to contract with the appropriate academic institution to develop a user-friendly soil management data base to incorporate research findings and practical applications.

Identify and secure short and long term funding sources to support a robust scientific research program that will fund research on topics such as carbon farming, subsidence reversal, wetland restoration, drainage issues, salt accumulation and multi-benefit farming to support and enhance healthy soils (lead CDFA).

#### **Increase governmental efficiencies to enhance soil health on public and private lands**

Increase the generation and use of compost in California to improve soil health, by permitting 100 new composting and anaerobic digestion facilities in California by 2020 (lead CalRecycle).

#### **Ensure interagency coordination and collaboration**

Include in the regular coordination between agencies the potential for broader discussions on soil health. Such as: include Healthy Soil Initiative practices to promote groundwater recharge and groundwater quality protection in DWR Sustainable Groundwater Management Program (lead DWR); with the ARB on dust mitigation as a key element in all Climate Change work across Cabinet.

# THE HEALTHY SOILS INITIATIVE

May 14, 2015

## Environmental Farming Act Science Advisory Panel

Jenny Lester Moffitt  
Deputy Secretary



CALIFORNIA DEPARTMENT OF  
FOOD & AGRICULTURE

# PRESENTATION OUTLINE

1. What is the Healthy Soils Initiative?
2. Why is this initiative important?
3. What work has been done on this initiative to date?



# GOVERNORS JANUARY BUDGET PROPOSAL

## “Healthy Soils

As the leading agricultural state in the nation, it is important for California’s soils to be sustainable and resilient to climate change. Increased carbon in soils is responsible for numerous benefits including increased water holding capacity, increased crop yields and decreased sediment erosion. In the upcoming year, the Administration will work on several new initiatives to increase carbon in soil and establish long term goals for carbon levels in all California’s agricultural soils. CDFA will coordinate this initiative under its existing authority provided by the Environmental Farming Act.”

Healthy soil = adequate soil organic matter or humus

## 2. Why is this Initiative Important

# INTERNATIONAL YEAR OF THE SOIL

## 2015

After two years of intensive work, **2015** has been declared the International Year of Soils by the 68th UN General Assembly (A/RES/68/232). The IYS aims to be a platform for raising awareness of the importance of soils for food security and essential eco-system functions.

**GSP: IYS 2015**

[www.fao.org/globalsoilpartnership/.../en...](http://www.fao.org/globalsoilpartnership/.../en...)

2015  
International  
Year of Soils

*healthy soils for a healthy life*

Home About News Events Resources Communications toolkit Blog FAQs

Life underground: digging deeper to learn more about soils

# FOOD SECURITY

- California is the nation's top agricultural state and has been for more than 50 years.
- More than 400 commodities
- California remained the No. 1 state in cash farm receipts in 2013, with \$46.4 billion in revenue from 77,900 farms and ranchers.
- The state accounted for 12 percent of national receipts.
- Over 1/3 (one third) of country's vegetables from California
- Over 2/3 (two thirds) of nation's fruits and nuts from California.
- Some of the most fertile and diverse agricultural soils.
- Some specialty crops only produced in California
- Leads the nation in the production of more than 80 crops

## 2. Why is this Initiative Important

### Crop and Livestock Commodities in which California Leads the Nation <sup>1/</sup>

<b>Almonds</b>	<b>Figs</b>	Melons, Cantaloupe	Pluots
Apricots	Flowers, Bulbs	Melons, Honeydew	<b>Pomegranates</b>
<b>Artichokes</b>	Flowers, Cut	Milk	Raspberries
Asparagus	Flowers, Potted Plants	Nectarines	<b>Rice, Sweet</b>
Avocados	Garlic	Nursery, Bedding Plants	Safflower
Beans, Dry Lima	<b>Grapes, Raisins</b>	Nursery Crops	Seed, Alfalfa
Beans, F.M. Snap	Grapes, Table	<b>Olives</b>	Seed, Bermuda Grass
Bedding/Garden Plants	Grapes, Wine	Onions, Dry	<b>Seed, Ladino Clover</b>
Broccoli	Greens, Mustard	Onions, Green	Seed, Vegetable and Flower
Brussels Sprouts	Hay, Alfalfa	Parsley	Spinach
Cabbage, Chinese	Herbs	<b>Peaches, Clingstone</b>	Squash
Carrots	Jojoba	Peaches, Freestone	Strawberries
Cauliflower	Kale	Pears, Bartlett	Tomatoes, F.M.
Celery	<b>Kiwifruit</b>	Peppers, Chile	Tomatoes, Processing
Chicory	Kumquats	Peppers, Bell	Triticale
Corn, Sweet	Lemons	Persimmons	Vegetables, Greenhouse
Cotton, American Pima	Lettuce, Head	Pigeons and Squabs	Vegetables, Oriental
Daikon	Lettuce, Leaf	<b>Pistachios</b>	<b>Walnuts</b>
<b>Dates</b>	Lettuce, Romaine	Plums	Watercress
Eggplant	Limes	<b>Plums, Dried</b>	Wild Rice
Escarole/Endive	Mandarins & Mandarin Hybrids		

<sup>1/</sup> California is the sole producer (99 percent or more) of the commodities in bold.

# FOOD SECURITY

## 2. Why is this Initiative Important

COTTON

ALFALFA

CORN

GRAPES

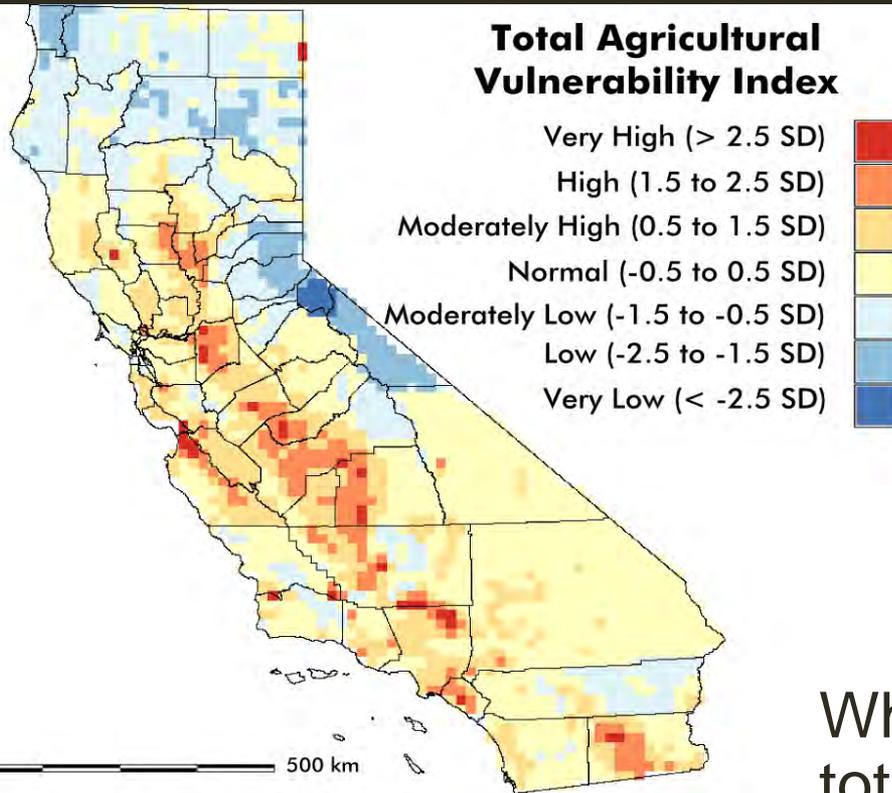
WINTER WHEAT

ALMONDS

PISTACHIOS



# CLIMATE CHANGE RESILIENCE



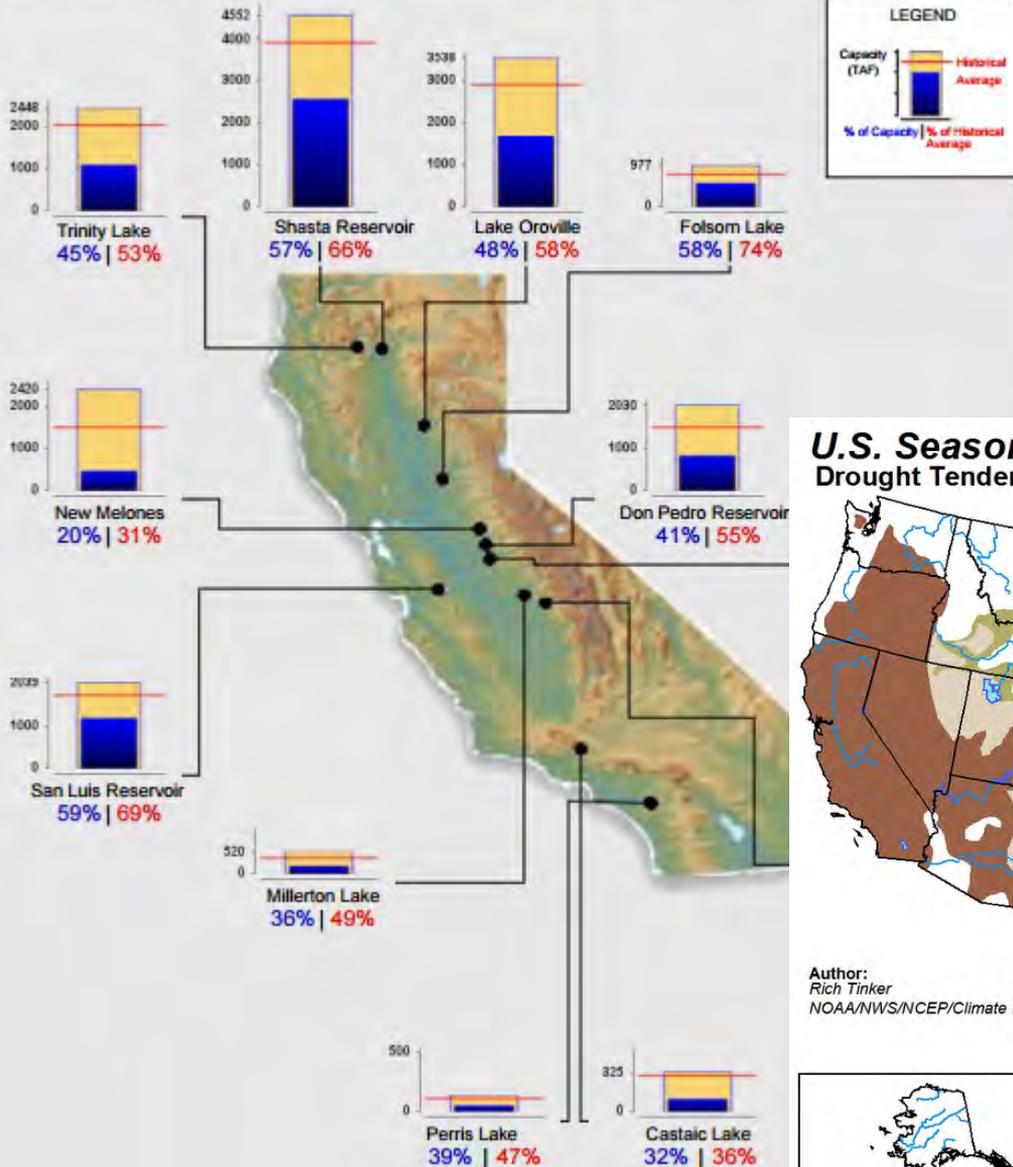
Vulnerability Index uses 4 sub indices:

1. Climate
2. Crop
3. Land use
4. Socioeconomic

When indices are combined, total agricultural vulnerability in some areas of the state is very high

Ending At Midnight - May 11, 2015

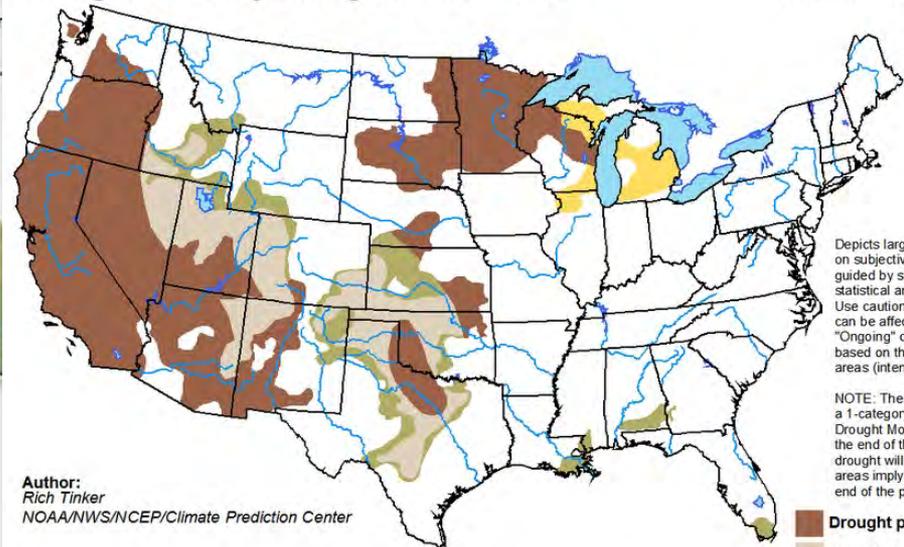
# CURRENT RESERVOIR CONDITIONS



# Fourth year of a historic drought in California

## U.S. Seasonal Drought Outlook Drought Tendency During the Valid Period

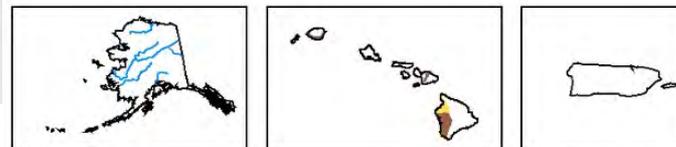
Valid for April 16 - July 31, 2015  
Released April 16, 2015



Depicts large-scale trends based on subjectively derived probabilities guided by short- and long-range statistical and dynamical forecasts. Use caution for applications that can be affected by short lived events. "Ongoing" drought areas are based on the U.S. Drought Monitor areas (intensities of D1 to D4).

NOTE: The tan areas imply at least a 1-category improvement in the Drought Monitor intensity levels by the end of the period, although drought will remain. The green areas imply drought removal by the end of the period (D0 or none).

- Drought persists/intensifies
- Drought remains but improves
- Drought removal likely
- Drought development likely



<http://go.usa.gov/hH7e>

# BENEFITS FROM SOIL ORGANIC MATTER

- Source of nutrients for plants – SOM contains important nutrients that contribute to plant growth and yields (e.g., nitrogen and sulfur)
- Water retention – SOM has the ability to hold up to 20 times its weight in water
- Contributes to the environmental fate of synthetic inputs – SOM affects persistence and biodegradability of pesticides and other soil inputs
- Carbon sink – Stabilized carbon stored in soil serves as a carbon sink, preventing the escape of carbon dioxide and methane greenhouse gases to the atmosphere
- Soil structure stability and reduced erosion – Soil carbon can combine with the inorganic clay mineral fraction to form structural units called aggregates. Aggregated soils have improved aeration, water infiltration and resistance to erosion, as well as numerous other benefits
- At least a quarter of the world's biodiversity lives in the soil.

# ACTIVITIES TO DATE

- Meeting with Governor's Office and administration on initiative
- Interagency meetings with several other agencies and departments
  - CalEPA
    - DPR
    - CalRecycle
    - State Water Resources Control Board
    - Central Valley Regional Water Quality Control Board (ILRP)
  - Natural Resources Agency
    - Department of Conservation
- CDFA worked to develop actions document (handout today)
- Set up webpage for California Healthy Soils Initiative
- Initiate this preliminary workshop to discuss and take public comment on the Healthy Soils Initiative
- Additional meetings to gather feedback and actions related to healthy soils including co-hosting meeting with other agencies (e.g., CalRecycle)

# ACTIONS

- Protect and restore soil organic matter (soil carbon) in soils to ensure climate change mitigation and food and economic security
- Identify sustainable and integrated financing opportunities, including market development, to facilitate increased soil organic matter
- Provide for research, education and technical support to facilitate healthy soils
- Increase governmental efficiencies to enhance soil health on public and private lands
- Ensure interagency coordination and collaboration

More specific short term and long term actions (see handout)

<http://www.cdfa.ca.gov/EnvironmentalStewardship/HealthySoils.html>

# WEBSITE AND BLOG POST



## environmental stewardship

[CDFA Home](#) > [Environmental Stewardship](#) > [Healthy Soil Initiative](#)

### HEALTHY SOIL INITIATIVE

Join the Healthy Soils Discussion on May 14th at CDFA  
Next Environmental Farming Act Science Advisory Panel to discuss healthy soils

#### Agenda

To receive e-mail news updates on the Healthy Soils Initiative: [subscribe here](#).

California is the nation's leading agricultural production state in terms of both value and crop diversity (<http://www.cdfa.ca.gov/Statistics/>). Soils are fundamental medium for crop growth and food production (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/soils/health/>). The importance of soils has been memorialized by the United Nations Food and Agriculture Organization after they recognized 2015 as the Year of the Soil (<http://www.fao.org/soils-2015/en/>). The term "healthy soils" refers to ensuring that our agricultural soils have adequate soil organic matter (SOM) or soil carbon content. Increasing the amount of SOM, from its current levels, in soils can provide multiple benefits. These benefits include (among others):

## Planting Seeds

FOOD & FARMING NEWS FROM CDFA

← [USDA announces \\$30 Million for food entrepreneurs and agricultural producers to develop new products](#)

### Healthy Soils Initiative: A foundation for agricultural sustainability and climate change resilience

Posted on May 13, 2015 by [Office of Public Affairs](#)

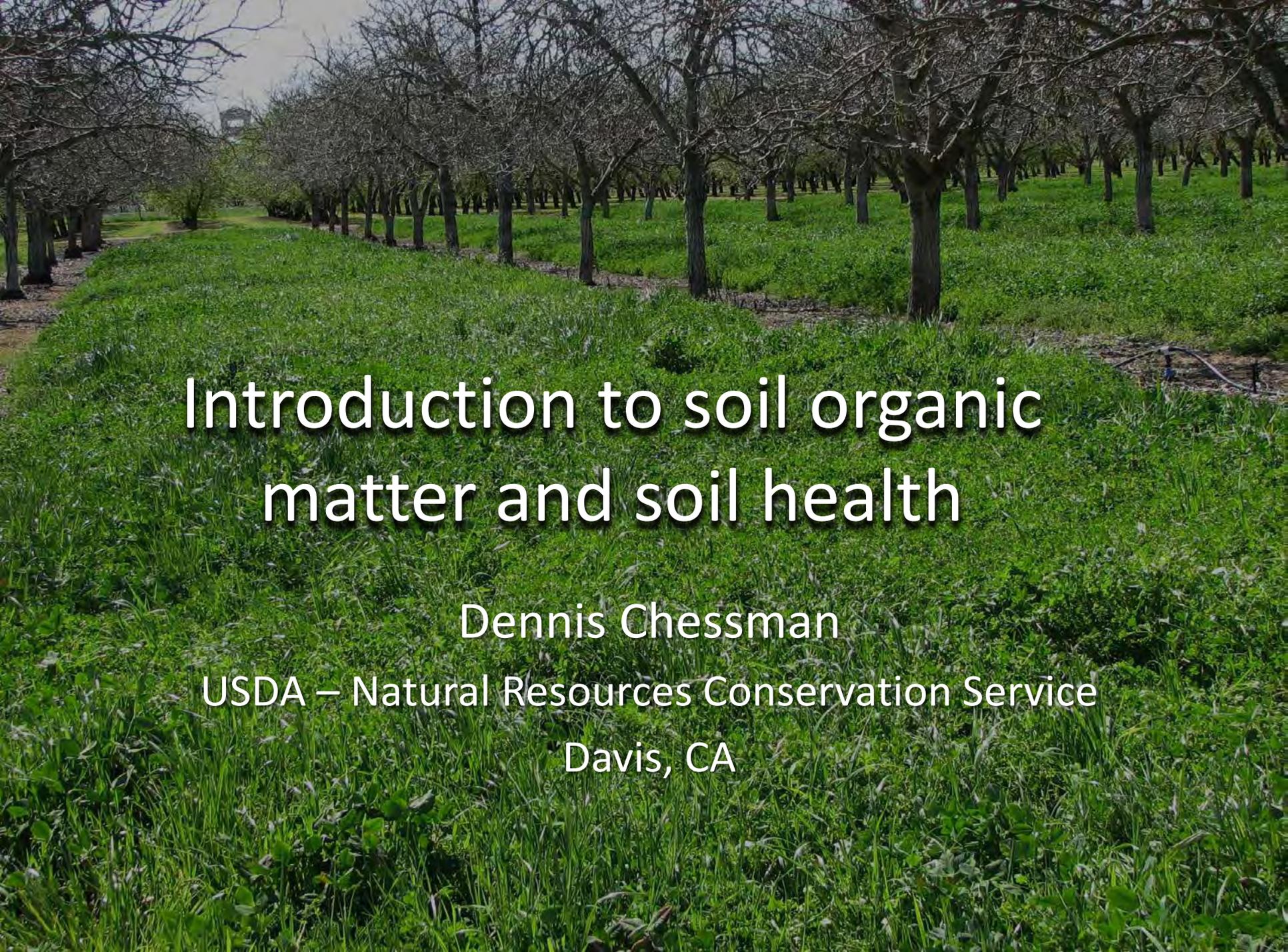
Ask a shopper where their food comes from, and the answer might be "the supermarket" or "the farmers' market," or maybe even "a farm" or "a farmer." Those are all true, but of course they aren't the whole story. Ask a *farmer* the same question, and you're likely to hear "the soil." Ah, now we're getting somewhere...

In his recent budget proposal, Governor Brown included a [Healthy Soils Initiative](#), saying: "Increased carbon in soils is responsible for numerous benefits including increased water-holding capacity, increased crop yields and decreased sediment erosion. In the upcoming year, the Administration will work on several new initiatives to increase carbon in soil and establish long term goals for carbon levels in all of California's agricultural soils. CDFA will coordinate this initiative under its existing authority provided by the Environmental Farming Act."



# SHORT VIDEO...

<http://www.fao.org/soils-2015/blog/building-humus-watch-the-time-lapse-video-here/en/>

A photograph of a large orchard with rows of trees and a field of green cover crops in the foreground. The trees are mostly bare, suggesting a dormant season. The ground is covered with a dense layer of green plants, likely cover crops. The text is overlaid on the image.

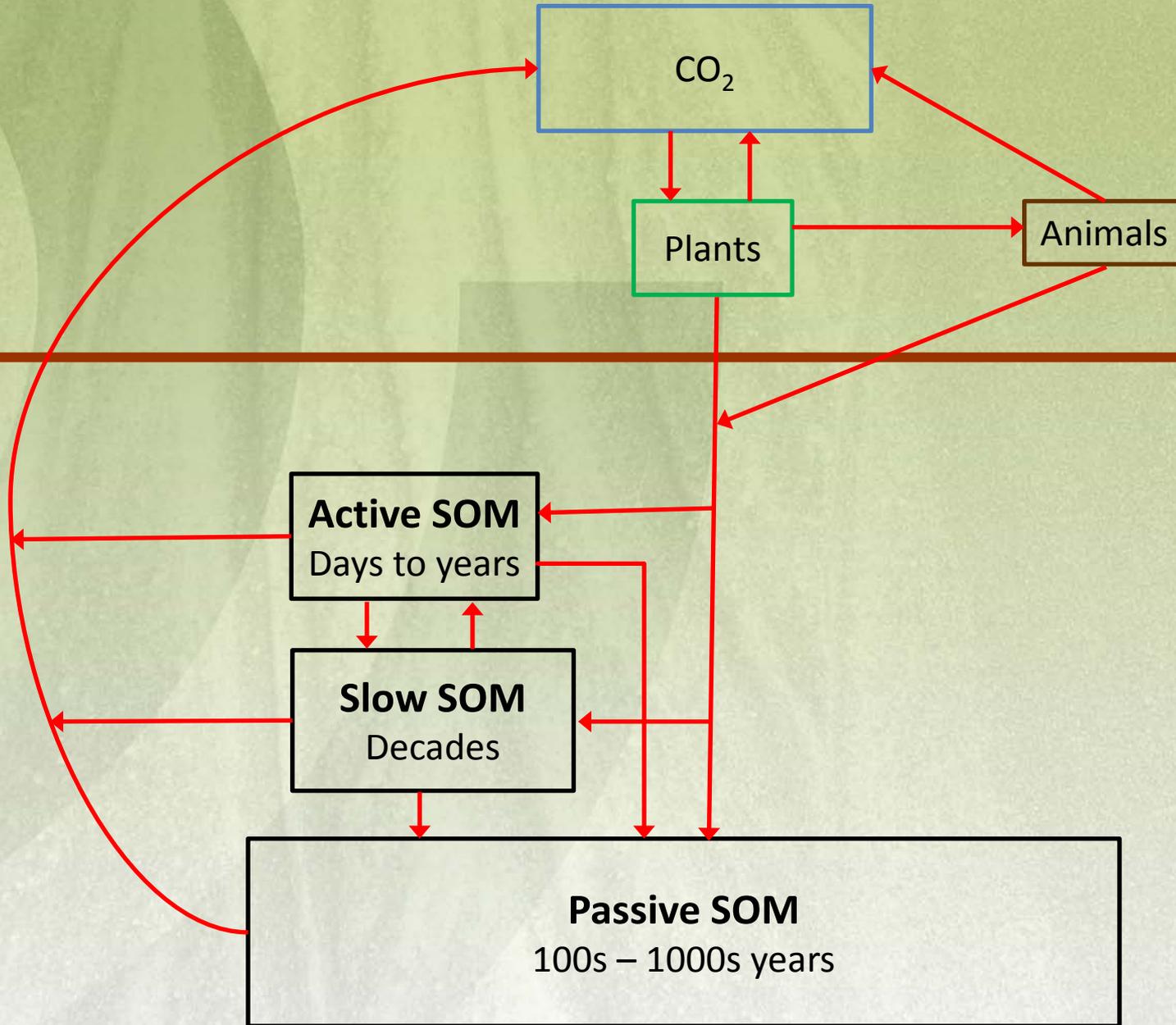
# Introduction to soil organic matter and soil health

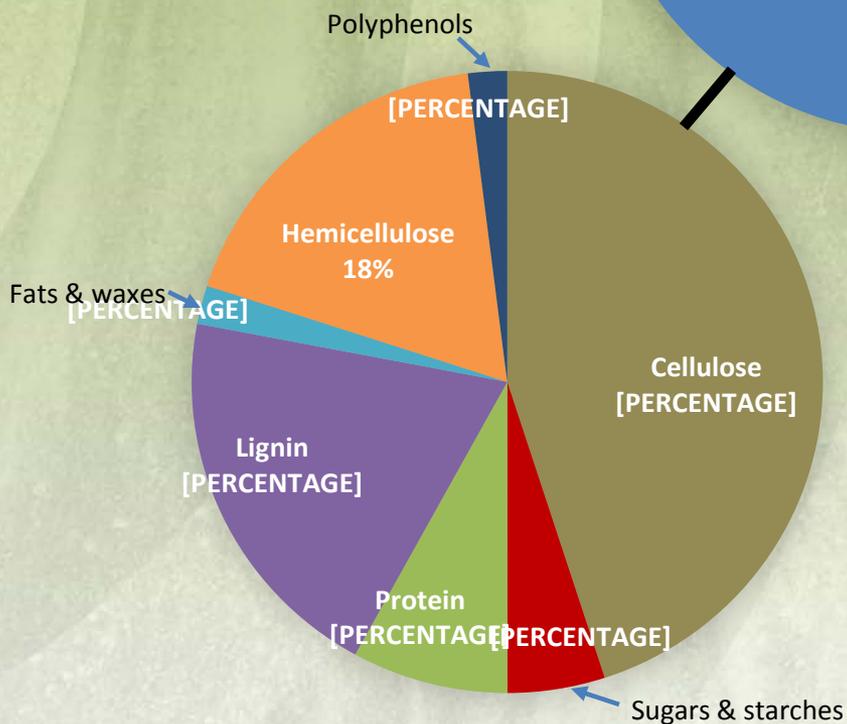
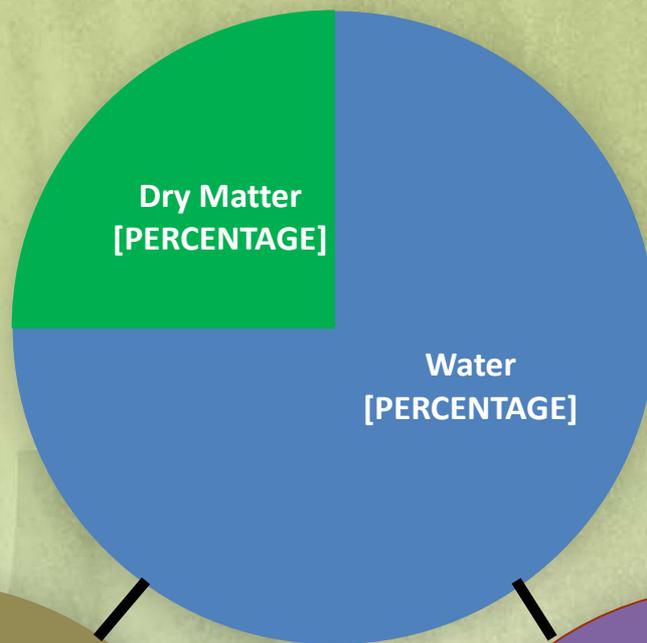
Dennis Chessman

USDA – Natural Resources Conservation Service

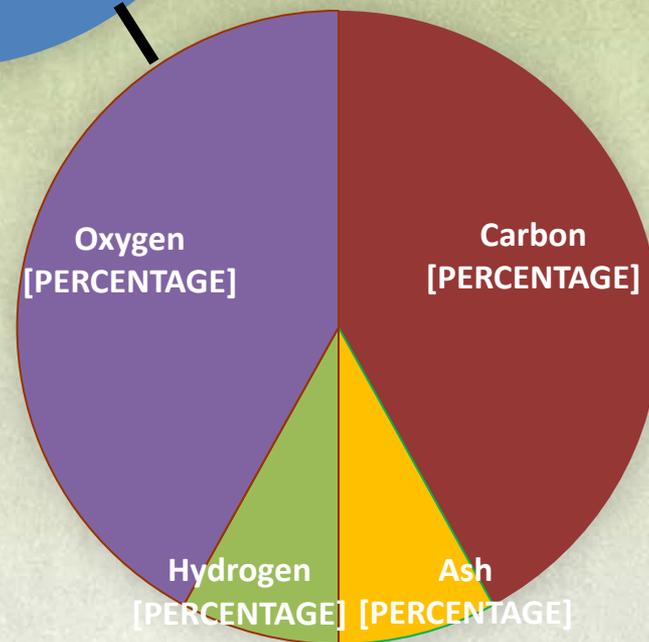
Davis, CA

# Carbon and soil organic matter





Types of compounds



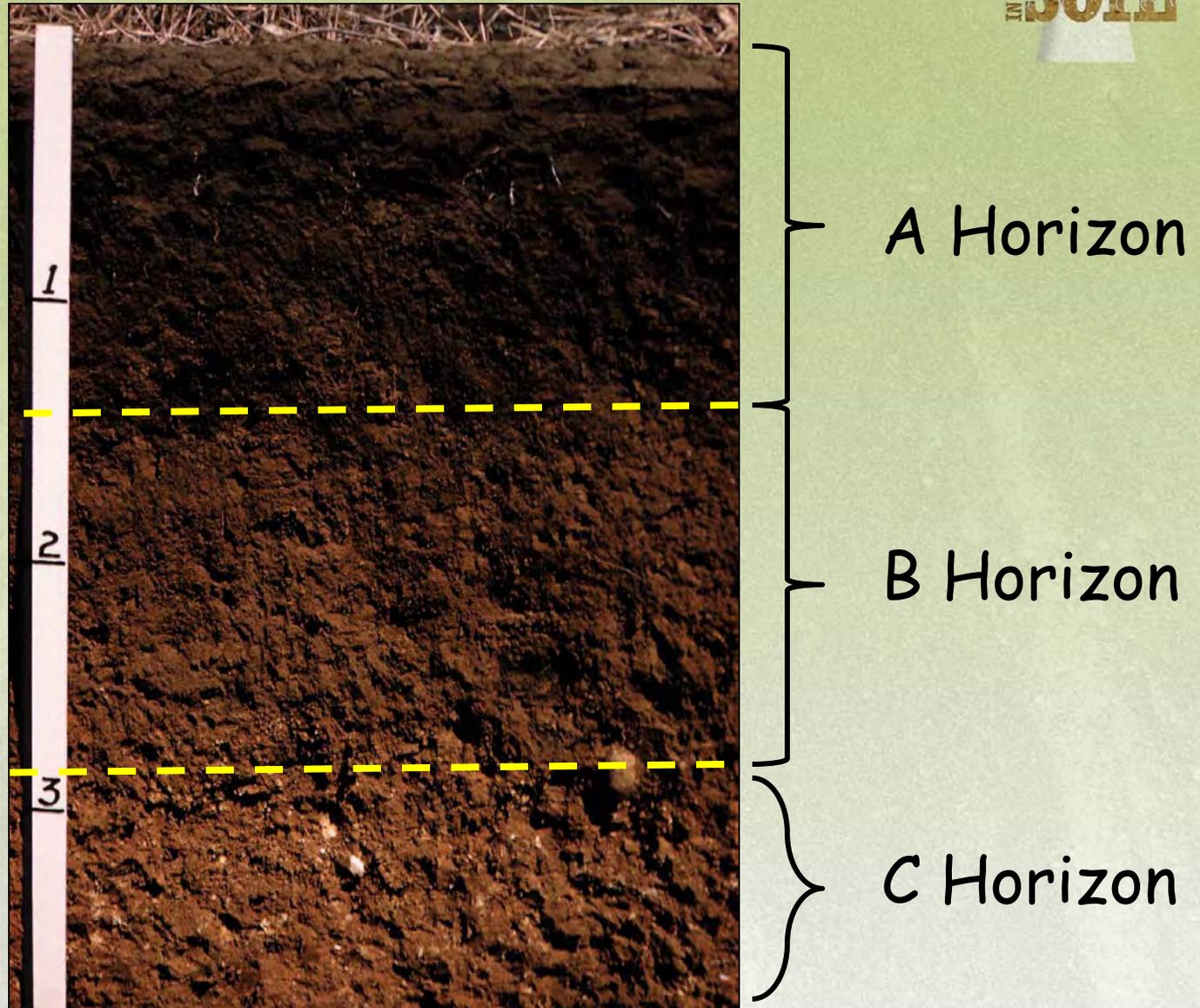
Elemental composition

# Factors affecting SOM levels

- Climate
- Soil texture
- Drainage
- Vegetation
- Management



# Soil Profile

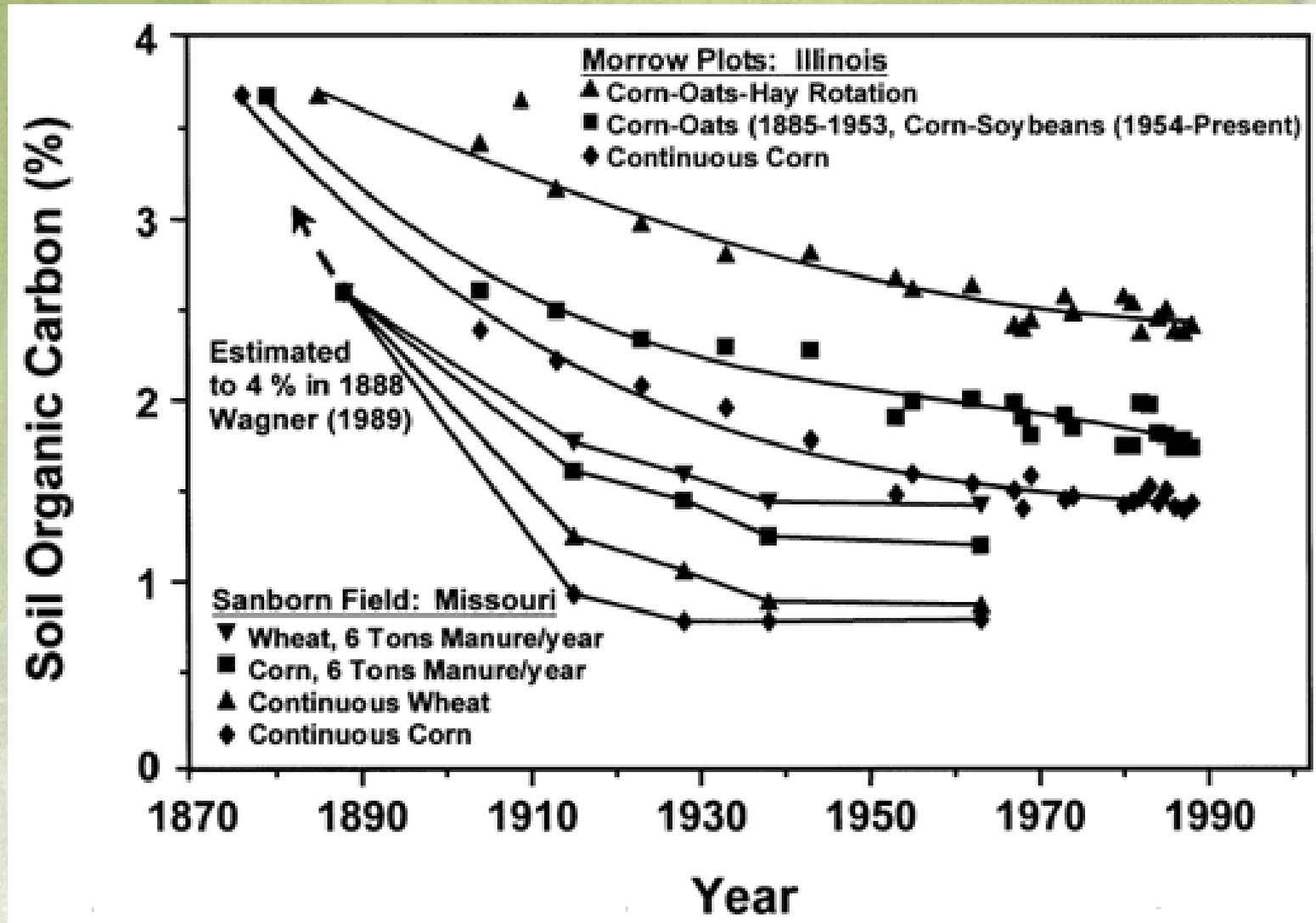




# Benefits of SOM

- Improves water infiltration, water holding capacity, and available water at field capacity
- Source of the major aggregate forming cements (ex. polysaccharides)
- Mineralization of organic nitrogen
- Accounts for 30 – 90% of CEC
- Can be a major source of plant-available P & S
- Chelates metals keeping them available
- Improves plant root environment
- **Contributes to favorable habitat**

# Cropping and organic matter





# What is Soil Health?

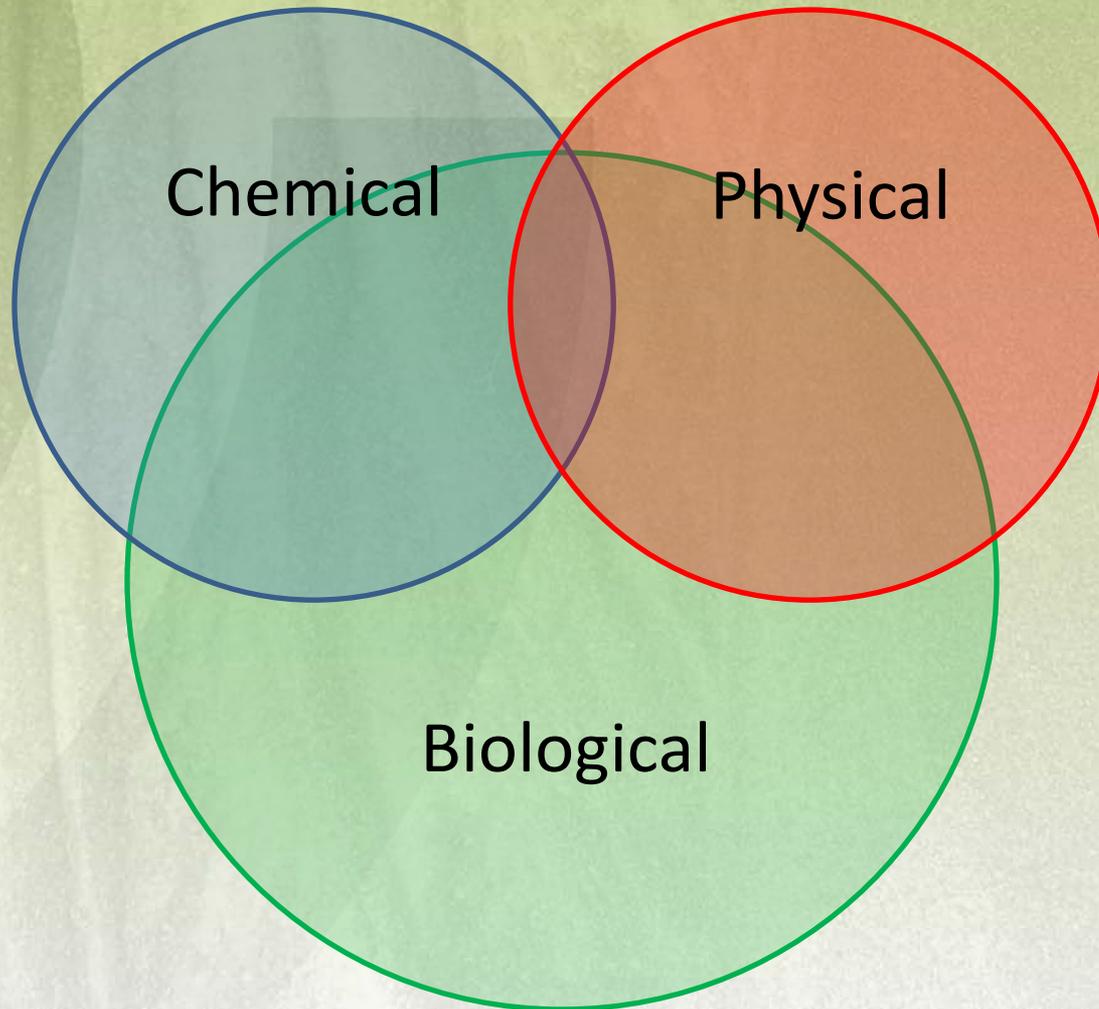
- ...self-regulation, stability, resilience, and lack of stress symptoms in a soil as an ecosystem... the biological integrity of the soil community—the balance among organisms within a soil and between soil organisms and their environment. (Brady & Weil, 2008)
- ...the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans. (NRCS)

# Adjusting our thinking about soil

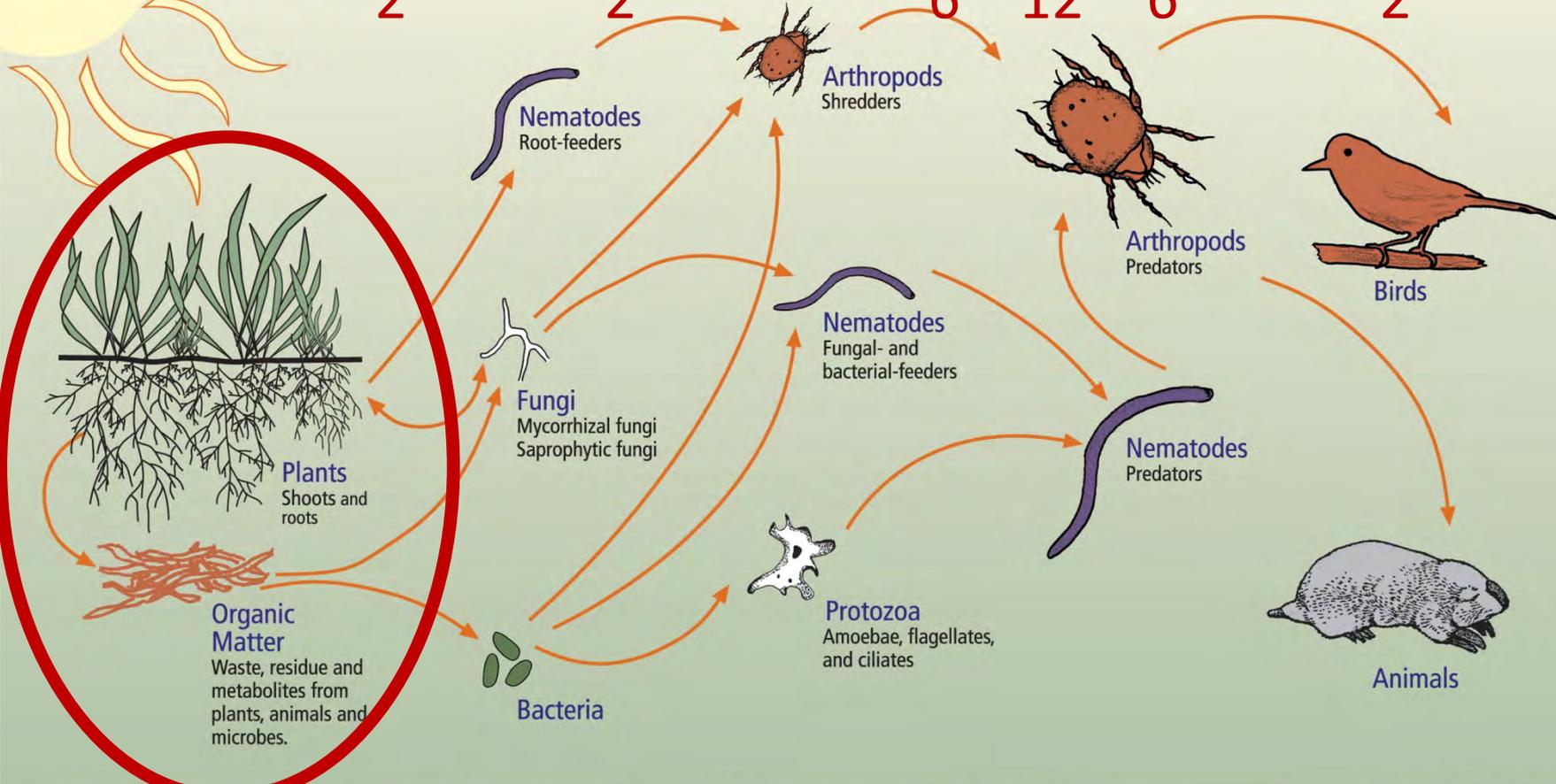


- Soil as an ecosystem
- Giving appropriate attention to the biotic component
- Ecosystems function
  - The collective intraspecific and interspecific interactions of the biota, such as primary and secondary production, mutualistic and antagonistic relationships.
- Functioning can be described

# Interrelated soil systems



# The Soil Food Web



**First trophic level:**  
Photosynthesizers

**Second trophic level:**  
Decomposers  
Mutualists  
Pathogens, Parasites  
Root-feeders

**Third trophic level:**  
Shredders  
Predators  
Grazers

**Fourth trophic level:**  
Higher level predators

**Fifth and higher trophic levels:**  
Higher level predators



# Why SOM is important to the soil ecosystem

- Contributes to a favorable environment for organisms
- Carbon in the labile fraction provides the energy upon which the system is built

Agricultural goods	Soil-based delivery processes
Food and fibre	Nutrient capture and cycling
	OM input decomposition
	SOM dynamics
	Soil structure maintenance
	Biological population regulation

Non-agricultural services	Soil-based delivery processes
Water quality and supply	Soil structure maintenance
	Nutrient cycling
Erosion control	Soil structure maintenance
Atmospheric composition and climate regulation	SOM dynamics
Pollutant attenuation and degradation	Decomposition
	Nutrient cycling
Non-agricultural pest and disease control	Biological population regulation
Biodiversity conservation	Habitat provision
	Biological population regulation

Aggregate Ecosystem functions	Functional Assemblages
1. C transformations	Decomposers <ul style="list-style-type: none"> <li>• fungi</li> <li>• bacteria</li> <li>• microbivores</li> <li>• detritivores</li> </ul>
2. Nutrient cycling	Nutrient transformers <ul style="list-style-type: none"> <li>• decomposers</li> <li>• element transformers</li> <li>• N-fixers</li> <li>• mycorrhizae</li> </ul>
3. Soil structure maintenance	Ecosystem engineers <ul style="list-style-type: none"> <li>• megafauna</li> <li>• macrofauna</li> <li>• fungi</li> <li>• bacteria</li> </ul>
4. Biological population regulation	Biocontrollers <ul style="list-style-type: none"> <li>• predators</li> <li>• microbivores</li> <li>• hyperparasites</li> </ul>

# How do natural systems differ from crop systems?



- Disturbance
- Diversity
- Cover
- Roots



- Water cycling
- Nutrient cycling
- Soil temperature
- C sequestered
- Plant health and susceptibility to pests
- System resistance and resilience

# Management affects soil properties & function



63% decrease in soil organic matter after 17 years of conventionally-tilled monoculture



20 cm layer

Forest  
SOM = 4.3 %

CT Soybean monoculture – 17 yr  
SOM = 1.6 %

# Decreased SOM, structure and water

- Water that cannot enter the soil leaves the field.
- It carries soil, nutrients and pesticides.
- Water that leaves the field is not available to crops.
- Structurally poor soils hold little water for plants.



# Can management increase SOM in California?



- Sierra Foothills
  - 40 acres of orchard with some annual crops
  - Increased SOM at 0 – 12 inches from avg. of **2.2 to 5.1%** in 30 years
- Sacramento Valley
  - ~2000 acres of annual vegetables
  - Increased SOM from avg. of **2.0 to 3.8%** in 19 years

# Can management increase SOM in California?



San Joaquin Valley, fine sandy loam after 18 y



0.9% SOM



4.0% SOM

# Help for unhealthy agricultural soil

- Reduce tillage and other disturbance
- Keep the soil surface continually covered
- Have growing plants present at all times
- Increase plant diversity
- Properly manage nutrients and pesticides



# Soil Health Field Assessment Worksheet

Location: \_\_\_\_\_ Field: \_\_\_\_\_ Test: \_\_\_\_ of \_\_\_\_

Name: \_\_\_\_\_ Assessor: \_\_\_\_\_ Date: \_\_\_\_\_

Soil Map Unit: \_\_\_\_\_ Soil Moisture: \_\_\_\_\_ Topsoil Texture: \_\_\_\_\_

Indicator	Avg. Rating	Potential Practices
<b>Compaction</b> (3 = No evidence of compaction; 2 = Some penetration resistance; 1 = Clear evidence of a compacted layer)		329, 340, 345 Location 1____, 2____, 3____
<b>Structure</b> (3 = Strong; 2 = Moderate; 1 = Weak or structure-less)		328, 329, 340, 345 Location 1____, 2____, 3____
<b>Surface crusts</b> (3 = No evidence of surface crust; 2 = Surface crust in places; 1 = Surface crust throughout the field)		329, 340, 345, 484 Location 1____, 2____, 3____
<b>Residue cover</b> (Plant residue cover: 3 = 75% or more; 2 = from 25 to 75%; 1 = less than 25%)		329, 340, 345, 484 Location 1____, 2____, 3____
<b>Roots and Pores</b> (3 = Many roots or pores; 2 = Common roots or pores; 1 = Few to no roots or pores)	ROOTS	328, 329, 340
	PORES	Location 1____, 2____, 3____
<b>Earthworms</b> (Number of worms or worm sign/cubic foot of soil: 3 = abundant (at least 10); 2 = few (1 to 9); 1 = None)		329, 340, 345, 484 Location 1____, 2____, 3____
<b>Biological activity</b> (The presence of fungal hyphae, macro-invertebrates, etc.: 3 = Clearly evident; 2 = Few evident upon close examination; 1 = No biological activity visible)		328, 329, 340, 345, 484, 528, 590, 595 Location 1____, 2____, 3____
<b>Smell</b> (3 = Earthy, sweet, and rich; 2 = Earthy, fresh, not unpleasant; 1 = Sour, putrid, or chemical-like)		328, 329, 340, 345, 484, 595 Location 1____, 2____, 3____
<b>Aggregate stability</b> (3 = Clods remain intact; 2 = Clods exhibit moderate stability; 1 = Clods disintegrate)		329, 340, 345, 484 Location 1____, 2____, 3____

(328) Conservation Crop Rotation, (329) Residue and Tillage Management, No-Till, (340) Cover Crop, (345) Residue and Tillage Management, Reduced-Till, (484) Mulching, (528) Prescribed Grazing, (590) Nutrient Management, (595) Integrated Pest Management

The above indicators are related to the Resource Concerns/Planning Criteria: SOIL QUALITY DEGRADATION – Compaction and/or Organic Matter Depletion.

**Useful assessment materials:** shovel, wire flag, clear plastic cups or similar, water, small hand lens, texture by feel guide



# Soil health is not just an annual cropland concern



Nor are certified organic  
producers immune



# Summary

- Soils are ecosystems
- Soil systems are C-dependent
- Carbon cycles
- Regular C inputs are necessary to retain SOM
- Disturbance decreases SOM
- Most agricultural soils are organic matter-poor
- Management can increase SOM and achieve associated soil health benefits



[dennis.chessman@ca.usda.gov](mailto:dennis.chessman@ca.usda.gov)



# Strategies to increase soil organic matter in California soils

## **Jeff Mitchell**

Department of Plant Sciences, University of California, Davis

## **Garrison Sposito and Gil Eshel**

University of California, Berkeley

## **Randy Southard, Will Horwath, and Kate Scow**

Department of Land, Air and Water Resources, University of California, Davis

## **Howard Ferris**

Department of Nematology, University of California, Davis

## **Ron Harben**

California Association of Resource Conservation Districts

## **Eric Kueneman and Judee Fisher**

Kueneman Consultancy

## **Dennis Chessman and Margaret Smither-Kopperl**

United States Department of Agriculture NRCS, Fresno, CA

## **John Diener**

Five Points, CA

## **Anil Shrestha**

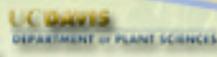
California State University, Fresno

**Environmental Farming Act  
Science Advisory Panel  
Public Comment Meeting**

Sacramento, CA

May 14, 2015

**My thanks to Amrith Gunasekara for  
the wonderful opportunity to be with  
you this morning.**



I thank you for this opportunity to provide information and ideas.

I very much support and applaud your consideration of the importance of goal-setting and long-term planning for cropping system improvement and sustainability.

I encourage additional partnerships and innovations going forward.





You replied on 5/13/2015 6:35 AM.

From: Beck, Dwayne [Dwayne.Beck@SDSTATE.EDU]  
To: Jeffrey Mitchell  
Cc:  
Subject: RE: Environmental Farming Act Science Advisory Panel

Thirty minutes to explain soil organic matter. No problem. I am not sure what you will do with the extra time.

Good luck,  
Dwayne

**From:** Jeffrey Mitchell [<mailto:jpmitchell@ucdavis.edu>]  
**Sent:** Wednesday, May 13, 2015 8:03 AM  
**To:** Beck, Dwayne  
**Subject:** FW: Environmental Farming Act Science Advisory Panel

LONG-TERM and TRANSFORMATIONAL thinking. There is not time for baby steps.



**Five Points, CA  
1982**



Don Cameron  
Terra Nova Farms  
Helm, CA  
Hosting UC Davis PLS110A Class  
October 18, 2014



# Main points

- There are benefits to be achieved by encouraging farming practices that address the core goals and principles of soil health
- I will share science and experiences related to how intensive soil health management systems
  - lower costs
  - are more efficient in inputs, water and energy, and
  - have other benefits with respect to soil function, water conservation and competitiveness
- I acknowledge a measure of uncertainty, but also a tremendous experience base related to why these systems make sense
- That long-term planning and goal-setting are extremely important,
- Finally, I encourage your consideration of additional partnerships moving forward





# Crop and Livestock Commodities in which California Leads the Nation

## **Almonds**

Apricots

## **Artichokes**

Asparagus

Avocados

Beans, Dry Lima

Bedding/Garden Plants

Broccoli

Brussels Sprouts

Cabbage, Chinese

Cabbage, F.M.

Carrots

Cauliflower

Celery

Chicory

Cotton, Am. Pima

Daikon

## **Dates**

Eggplant

Escarole/Endive

## **Figs**

Flowers, Bulbs

Flowers, Cut

Flowers, Potted Plants

Garlic

## **Grapes, Raisins**

Grapes, Table

Grapes, Wine

Greens, Mustard

Hay, Alfalfa

Herbs

Kale

## **Kiwifruit**

Kumquats

Lemons

Lettuce, Head

Lettuce, Leaf

Lettuce, Romaine

Limes

Mandarins & Mandarin Hybrids

Melons, Cantaloupe

Melons, Honeydew

Milk

Milk goats

Nectarines

Nursery, Bedding Plants

Nursery, Crops

## **Olives**

Onions, Dry

Onions, Green

Parsley

## **Peaches, Clingstone**

Peaches, Freestone

Pears, Barlett

Peppers, Chile

Peppers, Bell

Persimmons

Pigeons and Squabs

## **Pistachios**

Plums

Plums, Dried

Pluots

Pomegranates

Raspberries

Rice, Sweet

Safflower

Seed, Alfalfa

Seed, Bermuda Grass

Seed, Ladino Clover

Seed, Vegetable and Flower

Spinach

Strawberries

Tomatoes, Processing

Vegetables, Oriental

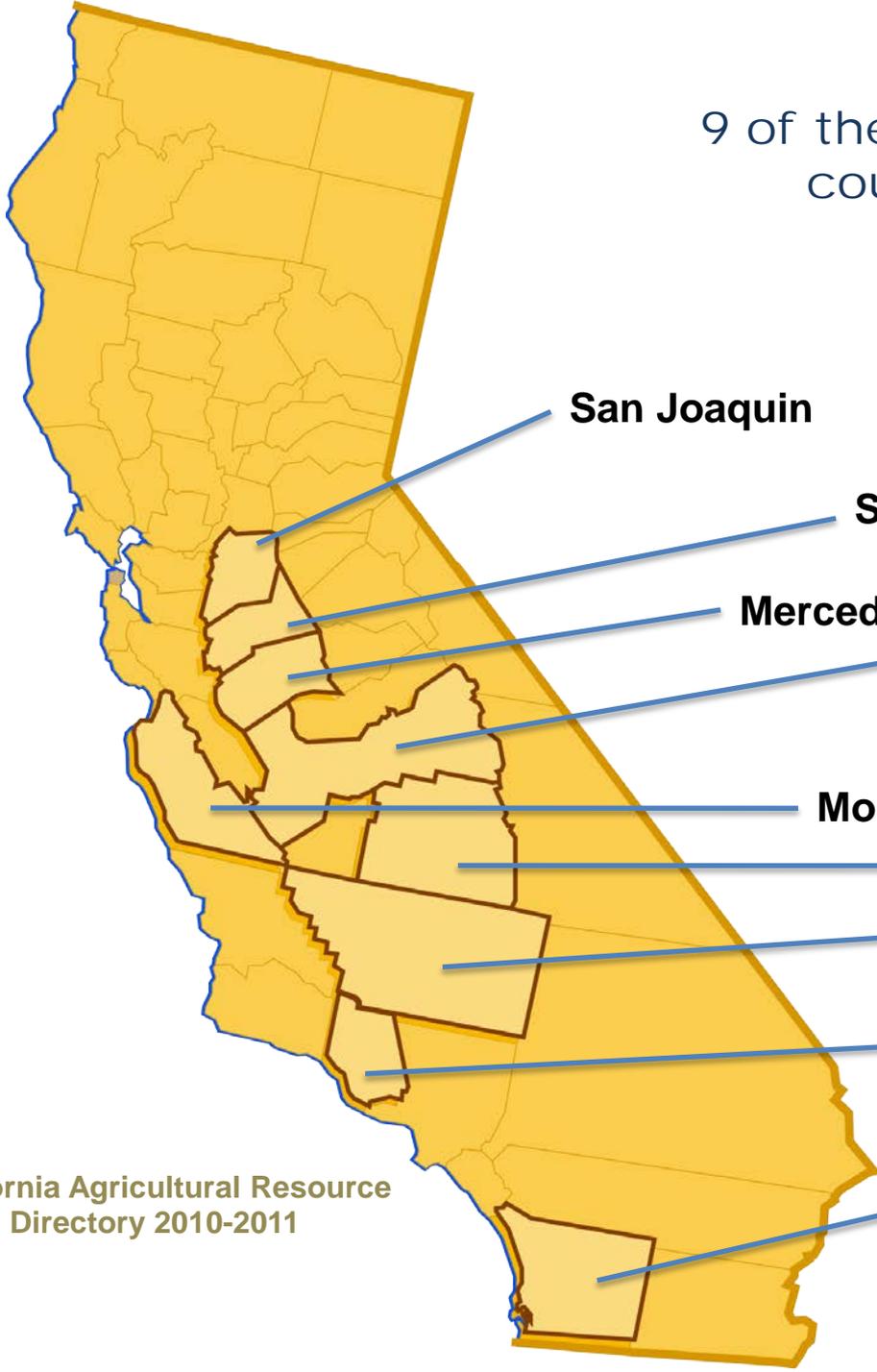
## **Walnuts**

Wild Rice



USDA, National Agricultural Statistics Service, California Field Office  
California Agricultural Statistics, Crop Year 2010 (October 28, 2011)

9 of the nation's top 10 producing counties are in California



**San Joaquin**

**Stanislaus**

**Merced**

**Fresno**

**Monterey**

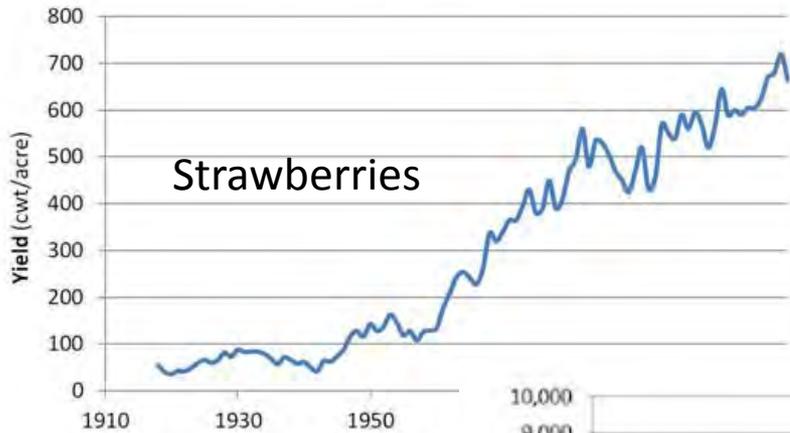
**Tulare**

**Kern**

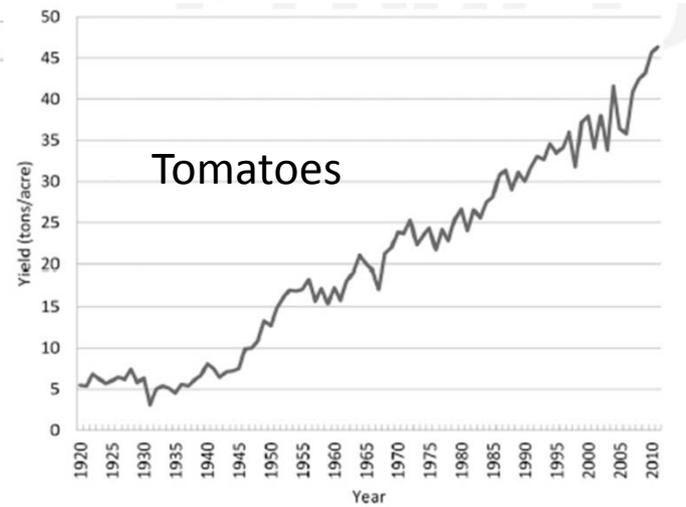
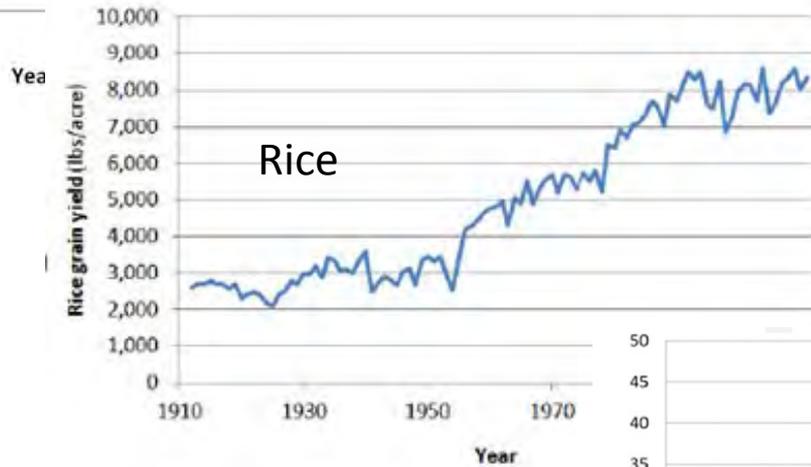
**Ventura**

**San Diego**





With historical trends of yield increases for California crop production, are there legitimate indications that soil function, soil quality, or soil health is declining?



Are there indications that soil function, soil quality, or soil health is declining in California?

A legitimate, reasonable question that can be answered by testable hypotheses

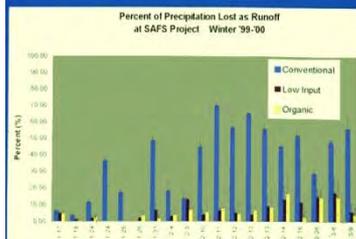
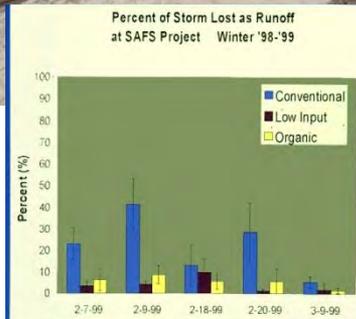


Is there evidence that water intake and storage characteristics of soils might be improved?

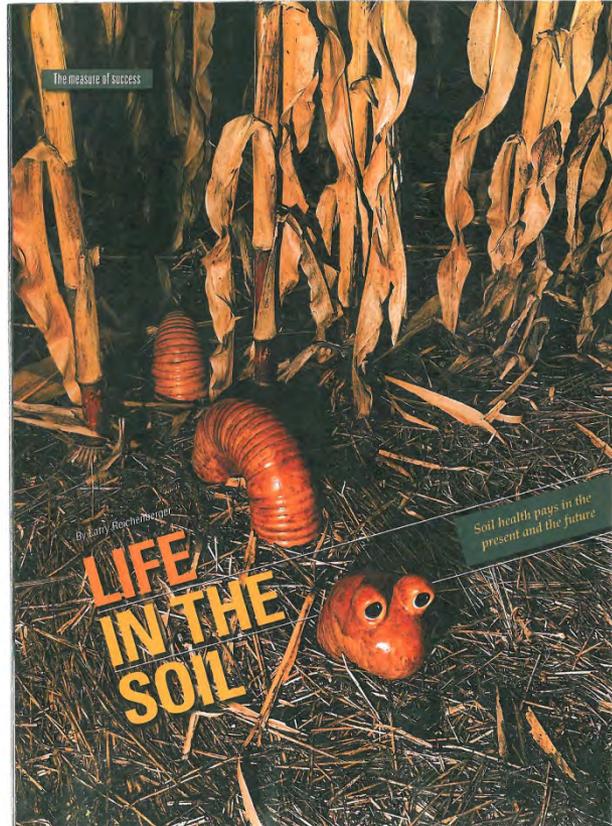
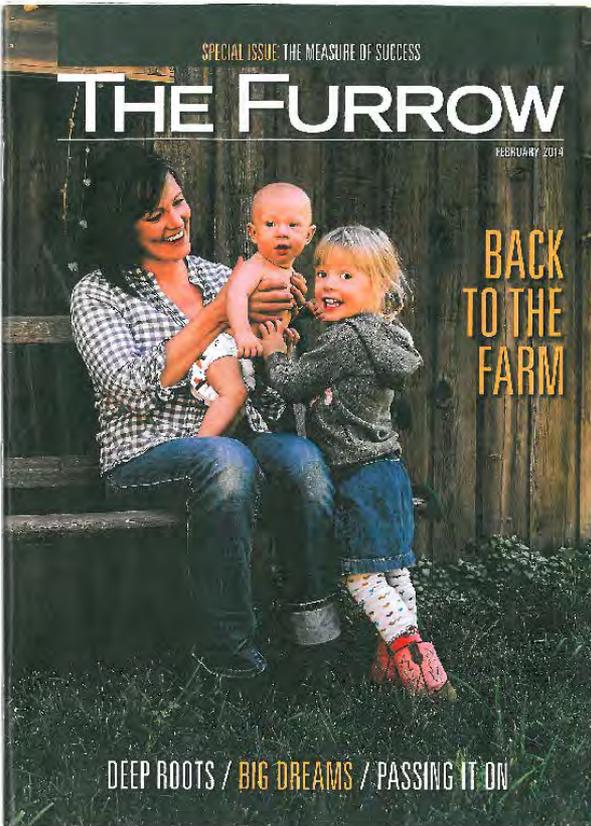
CONVENTIONAL = Winter Fallowed



ALTERNATIVE = Winter Cover Cropped



Is there evidence that the value of soil biodiversity may not be expressed or realized to some sort of optimal extent?



**H**ealthy soils are the ultimate measure of success for Rick Bieber. With the zeal of an evangelist, this Trail City, S.D., farmer promotes methods that enhance soil quality. He swears by the old adage, "If you take care of your soil, your soil will take care of you."

"The soil is the greatest source of wealth in the world, but most farmers squander its potential," says Bieber, who farms with his son, Ben. "The soil isn't just a tool, it's a full partner in a farming operation and deserves to be treated with respect. Learn to protect the soil and to manage it like it's really alive—because it is—and you will see an unbelievable response."

**Diversity in crops.** Bieber's recipe for a healthy soil includes long-term no-till, intensive crop rotation, and cover crops. "We started no-tilling in 1987 and soon learned we needed to diversify and intensify our crop rotation to utilize the moisture we were saving and to boost microbial activity in the soil. From wheat/fallow, we changed to rotations that also include chickpeas, millet, flax, sunflowers, and alfalfa. More recently, we've added cover

► **Left:** Rick Bieber says healthy soil makes farming fun—a point emphasized by this giant earthworm he poses for frequent visitors to his farm.

crops that are planted after wheat and interseeded into growing corn."

"Now, our yields are higher with fewer inputs so profitability has increased. And, the impact of drought, heat, and other stress is less. Our 10-year proven corn yields are 408% of the county average, and wheat yields are 338% of the norm," adds Bieber.

**Credit the soil.** Bieber is quick to deflect credit for this performance. "It's totally due to the soil—all I've done is provide what the soil tells me it needs to do its job," he says.

What Bieber provides is a steady supply of carbon—in the form of crop residue and living plant roots—that feeds soil microbes, moderates soil temperatures to protect the microbes, shields the soil surface from erosion, and builds soil organic matter levels.

Bieber measures performance of his system is various ways. "We used to apply 90 pounds per acre of nitrogen and produce 90-bushel corn, but now the same amount of nitrogen produces 160 bushels. That's due mainly to our soil organic matter levels, which are 4-5% in our long-term no-till."

In contrast, typical conventionally tilled fields in Bieber's area have soil organic matter levels around 2%. Soil with higher organic matter not only mineralizes more nitrogen, it also holds more water, and that's the

farm's major benchmark of success.

"We judge our management skills by the amount of grain we produce per inch of rainfall, and we've seen this water-use efficiency increase as our soil health has improved. In 1998 we produced just over 4 bushels of corn per inch of rainfall. By 2011, the first year corn in our rotation grew on cover crops grown in 1998, that had increased to 54 bushels per inch. By 2007, that efficiency had increased to 623 bushels per inch of rainfall!"

**Best combination.** Bieber worked with agronomist Cheryl Reese from South Dakota State University on an intensive cover crop study from 2009 through 2011. "There were 96 trials, and they showed that the best combination of cover crops and fertilizer rates resulted in 12.6 bushels of corn per inch of rainfall. Then in 2012, with a severe drought, corn on our long-term, no-till ground produced 9.54 bushels per inch of rainfall while the same new ground—in its first year of no-till—produced only 4 bushels per inch. That was amazingly similar to what we saw in 1998," says Bieber.

**Hungry soil.** His water use efficiency data has convinced Bieber that his soils are hungry for live roots, even in dry years. "Living plants sequester carbon from the atmosphere and deposit it in the soil through their root system, so we want to have something growing every moment that the season allows," he says.

Cover crops allow Bieber to put this conclusion into practice. "We hire an extra man so we can plant cover crops right behind the combine during wheat harvest. And, the cover crops we interseed at the V-6 stage of our corn stay alive well after the corn matures in the fall," he says.

"We're protecting soil not just for the next generation, but for those 100 and 1,000 years from now," he adds. ■

► **Left center:** High organic matter levels have turned Bieber's soils black and fostered a thriving population of earthworms. ► **Left:** Cover crops, including radishes and turnips, are broadcast into corn at the V-6 stage to extend the growing season and improve winter grazing.



“Soil care’ is what we’re doing.”

Rick Bieber  
Trail City, SD  
January 28, 2014



Is there evidence that soil water storage and movement are not what they might be for optimal water use efficiency and benefit?



Is there evidence that the soil management practices that are commonly used in California cropping systems as water use efficient as they might be?

## REVIEW SUMMARY

## SOIL SCIENCE

## Soil and human security in the 21st century

Ronald Amundson,\* Asmeret Asefaw Berhe, Jan W. Hopmans, Carolyn Olson, A. Ester Szein, Donald L. Sparks

**BACKGROUND:** Earth's soil has formed by processes that have maintained a persistent and expansive global soil mantle, one that in turn provided the stage for the evolution of the vast diversity of life on land. The underlying stability of soil systems is controlled by their inherent balance between inputs and losses of nutrients and carbon. Human exploitation of these soil resources, beginning a few thousand years ago, allowed agriculture to become an enormous success. The vastness of the planet and its soil resources allowed agriculture to expand, with growing populations, or to move, when soil resources were depleted. However, the practice of farming greatly accelerated rates of erosion relative to soil production, and soil has been and continues to be lost at rates that are orders of magnitude greater than mechanisms that replenish soil. Additionally, agricultural practices greatly altered natural soil carbon balances and feedbacks. Cultivation thus began an ongoing slow ignition of Earth's largest superficial reservoir of carbon—one that, when com-

bined with the anthropogenic warming of many biomes, is capable of driving large positive feedbacks that will further increase the accumulation of atmospheric greenhouse gases and exacerbate associated climate change.

**ADVANCES:** The study of soil is now the domain of diverse schools of physical and biological science. Rapid advances in empirical and theoretical understanding of soil processes are occurring. These advances have brought an international, and global, perspective to the study of soil processes and focused the implications of soil stewardship for societal well being. Major advances in the past decade include our first quantitative understanding of the natural rates of soil production, derived from isotopic methods developed by collaboration of geochemists and geomorphologists. Proliferation of research by soil and ecological scientists in the northern latitudes continues to illuminate and improve estimates of the magnitude of soil carbon storage in these regions and its sensitivity and

response to warming. The role of soil processes in global carbon and climate models is entering a period of growing attention and increasing maturity. These activities in turn reveal the severity of soil related issues at stake for the remainder of this century—the need to rapidly regain a balance to the physical and biological processes that drive and maintain soil properties, and the societal implications that will result if we do not.

**OUTLOOK:** Both great challenges and opportunities exist in regards to maintaining soil's role in food, climate, and human security. Erosion continues to exceed natural rates of soil renewal even in highly developed countries. The recent focus by economists and natural scientists on potential future shortages of phosphorus fertilizer offers opportunities for novel partnerships to develop efficient methods of nutrient recycling and redistribution systems

## ON OUR WEB SITE

Read the full article at <http://dx.doi.org/10.1126/science.1261071>

in urban settings. Possibly the most challenging issues will be to better understand the magnitude of global soil carbon feedbacks to climate change and to mitigating climate change in a timely fashion. The net results of human impacts on soil resources this century will be global in scale and will have direct impacts on human security for centuries to come. ■

The list of author affiliations is available in the full article online.  
\*Corresponding author. E-mail: [earthly@berkeley.edu](mailto:earthly@berkeley.edu)  
Cite this article as R. Amundson et al., *Science* 348, 1261071 (2015). DOI:10.1126/science.1261071



Large-scale erosion forming a gully system in the watershed of Lake Bogoria, Kenya. Accelerated soil erosion here is due to both overgrazing and improper agricultural management, which are partially due to political-social impacts of past colonization and inadequate resources and infrastructure. The erosion additionally affects the long-term future of Lake Bogoria because of rapid sedimentation. This example illustrates the disruption of the natural balance of soil production and erosion over geological time scales by human activity and the rapidity of the consequences of this imbalance.

OSRO T. SIGHTS FROM ACSTTY. JACES



**Aref Abdul-Baki**  
USDA ARS  
Beltsville, MD



**Dwayne Beck**  
SDSU  
Pierre, SD



**Ron Morse**  
Virginia Tech  
Blacksburg, VA



**Andy McGuire**  
Moses Lake, WA



**Dick and Sharon Thompson**  
Boone, IA



**Suat Irmak**  
Lincoln, NE



**Steve Groff**  
Lancaster County  
Pennsylvania



**John Landers**  
Cerrado Region  
Brazil



**John Luna**  
Oregon State  
University  
Corvallis, OR



**Karl Kupers**  
Rearden, WA



**Mike Peterson**  
Greeley, CO



**Don Reicosky**  
USDA ARS  
Morris, MN

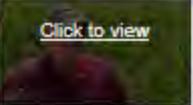
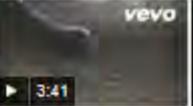
## Soil health summary profiles of experienced practitioners

	David Brandt Ohio	Gabe Browne North Dakota	Gail Fuller Kansas	Leon Moses North Carolina	Lawrence Sanchez New Mexico
Acres farmed	1100	5400 (crops+pasture)	2000	492	300
Years in soil health system	30	20	8	6	12
Primary crops	Corn, wheat, soybeans	Corn, wheat, sunflowers, alfalfa, oats, triticale, hairy vetch, red clover, peas	Corn, grain sorghum, triticale, winter barley, winter wheat, soybeans	Corn, soybeans, hay	Grass, alfalfa, corn, winter wheat, oats
Primary cover crops	All mixes, some 8- and 14-way blend; most used: peas, radishes, hairy vetch, crimson clover, ryegrass	Cocktail mixes with 20 to 25 different plant species	All mixes, some 8- and 14-way blend; most used: peas, radishes, hairy vetch, crimson clover, ryegrass	Ryegrass, hairy vetch, clover	Fescue, orchardgrass, clovers
Yields	7- to 10- bushel/Ac increase in corn, 8% increase in soybeans	20% higher than county average	Increased	Doubled	Increased
Commercial fertilizer use	\$100-per-acre annual savings in nitrogen	No synthetic fertilizer used	Cut by 25% overall, up to 60% in some instances	Commercial nitrogen use cut by 100lbs/Ac	Reduced; but often uses manure in heavy does on newly rented land
Insecticide use	None	None used for past 10yrs.	None used for past 4yrs.	Better control with reduced use	None
Herbicide use	Very little	Cut by 75%	Dropped at least 1 herbicide pass in every field	Reduced; johnsongrass nearly eradicated	Reduced
Other benefits	Virtually no soil erosion; nutrients stay on the farm; less soil compaction; greener, healthier crops; reduced soil compaction; better water filtration; less worry about drought	Organic matter rose from 2% to more than 5%; water holding capacity and infiltration at highest levels; wildlife populations and diversity increased exponentially.	Higher-quality, more nutritious grains; no live called for in nearly 15 years; much better bottom line	Reduced soil compaction; much better water infiltration; better soil structure; 35% return on investment	Superior, more nutritious crops; less irrigation water needed; stronger soil structure; protection from wind and water erosion

(Source: Lynn Betts, 'Put the Soil First,' Dakota Farmer, January 2013, Farm Progress (permission granted))

## [Videos of gabe brown](#)

[bing.com/videos](#)

 <p>▶ 1:09</p>	 <p>Click to view</p>	 <p>▶ 44:52</p>	 <p>▶ 1:16:32</p>
<b>Gabe Brown: 2012 Growing</b> YouTube	<b>Gabe Brown - SARE National</b> YouTube	<b>2012 Quivira Coalition</b> YouTube	<b>Gabe Brown Talks on the Valley</b> YouTube
 <p>▶ 2:26 HD</p>	 <p>▶ 3:24</p>	 <p>▶ 3:41</p>	 <p>▶ 58:53   HD</p>
<b>Gabe Brown - Bismarck, ND</b> YouTube	<b>Gabe Brown - Chicago Audition</b> Dailymotion	<b>Gabriel Brown: American Dream</b> Yahoo Screens	<b>Gabe Brown: Keys To Building</b> YouTube

[See more videos of gabe brown](#)

## [Gabe Brown on Cover Crops, No-Till Farming and Livestock](#)

[agriculturalinsights.com/episode-035-gabe-brown-on-cover-crops-no...](#)

Gabe Brown is using No-Till Farming, Cover Crops and Livestock to enhance his farming resources.

## [Brown's Ranch - Home](#)

[brownsranch.us](#)

Brown's Ranch: Home; Soil Health; Cropping; Grazing; Livestock; Food; Learning Resources; Talk Forum; Events; Visit us on Facebook; Contact Us; Home; ...

## [Cedar Meadow Farm](#)

[www.cedarmeadowfarm.com](#)

Looking for Tillage Radish? You can find out. all you need at: [www.TillageRadish.com](#). Steve Groff and his family, farm 200 acres of vegetables and crops on hilly land ...

## [Cedar Meadow Farm • Our Equipment](#)

[www.cedarmeadowfarm.com/OurEquipment](#)

Steve & Cheri Groff • Cedar Meadow Farm 679 Hilldale Road • Holtwood, PA 17532  
Phone: (717) 284-5152 • Fax: (717) 284-5987 ...

## [Images of steve groff](#)

[bing.com/images](#)



[See more images of steve groff](#)

## [steve groff profiles | LinkedIn](#)

<https://www.linkedin.com/pub/dir/steve/groff>

50+ items - View the profiles of professionals named **steve groff** on LinkedIn. There ...

Stephen Groff	Vice-President for East Asia, Southes...	Philippines
Steve Groff	Director, Technology Infrastructure a...	Greater Boston Area

## [Steve Groff Profiles | Facebook](#)

<https://www.facebook.com/public/Steve-Groff>

View the profiles of people named **Steve Groff** on Facebook. Join Facebook to connect with **Steve Groff** and others you may know. Facebook gives people the...



## New Company Aims To Help No-Tillers Expand

Fall Line Farms will lease farm ground to top no-tillers or buy it from farmers wanting to see good soil stewardship practiced.



as good of a job, even, the very best farmers who are

Mitchell says he'll offer spending extra acre to be a no-till, only to raise no-tillers and no-till. Farmers pay more than he have much trouble

and degradation isn't and economics, and away in the farmland

many of reasons why tillage causes soil erosion, while no-till able. He says erosion will be retained with organic

"People in Iowa still buy farmland off of the Corn Suitability Rating (CSR), and in other states the ratings are based of decades-old soil surveys that are used as a proxy for farmland value," Mitchell says.

Mitchell adds he's done a lot of soil depth soil sampling and sees that soils with the same CSR ratings can have vastly different amounts of topsoil and vastly different productive capacities. The most important factor is producing this is tillage history.

"My analysis has shown that investing in no-till farmland is a huge savings," he says. "It will take a time for the marketplace to

Recent declines in crop prices have cooled the enthusiasm a bit, but few experts see the farmland value bubble bursting anytime soon. Unlike the 1980s, buyers are paying cash rather than relying on credit, and farmers are paying down their debt loads.

Demand for U.S. grains by China, India and other countries drives up signs of subsiding as the world's population ages 7 billion. And there is growing demand for biofuel, which uses about 40% of the U.S. corn supply.

**Most Landlords Not Farmers.** Although production has shifted dramatically to larger farms over the past 25 years, 97% of all farms remain family farms, generating 82% of the total value of U.S. agricultural production, the USDA says.

And most of the farmland owned by farmers is leased from people who are not currently farm operators themselves.

In 2007, 277,000 farm operators reported owning 62 million acres of farmland to others, which accounted for only 14% of the 395 million acres of owned farmland, the USDA says. Non-operator landlords provided the rest of the owned land.

Mitchell believes high farmland prices are being driven by a combination of factors — including low interest rates, high grain prices and poor recent returns in other asset classes.

But he also sees a new appreciation emerging for farmland security. It's estimated that only 18% of the world's arable land is not being farmed, and 37,000 square miles per year is being lost to soil erosion.

"The harvest industry says we can double yields to meet new demand, but we'll have to produce more grain in the next 40 years than the previous 500," he says. "The U.S. is losing soil 10 times faster than the replacement rate, and China and India are losing soil 30 to 40 times faster than the replacement rate."

"Owning farmland that still has great productive potential is the best investment in the world."

*We want to have long-term relationships with farmers, so farmers that keep the farmer strong are important to us...*



Clay Mitchell

- **Obtivation By Technology:** Breeding and production gains have increased yields in most farm sectors that erosion has reduced them.
- **Farmland Mobility:** Investors believe that land has agricultural value because of signs of agricultural identity, such as location within agricultural landscape, barns, fences, proximity to markets or green hedgerows.
- **Yield:** In the short-term, tillage might increase yields on compacted or poorly drained ground. During the early years of intensive farming of fertile but erosion-prone steep slopes, "farmers and policymakers may be lulled into a false sense of security by strong growth in yields in spite of heavy erosion," he says.
- **Time Lag:** Because of the extensivity of yield response to topsoil depth, large amounts of soil are lost before yield loss begins, creating a large time lag between the action and consequence.

**No-Till Value.** No-till farm acres will be far more valuable in the future as world demand for food begins to outstrip resources, Mitchell says, noting that tilled farmland loses one to two orders of magnitude more soil than no-till land.

Because returns in soil are mostly in the form of topsoil, no-till will, over time, have more topsoil and nutrients than tilled soil, he says.

with a current inventory of soil productivity, but as it begins to happen, I think we can make a lot of money."

**Strong Gains.** In the last five years, holding costs over productive farmland have eroded across the Plains and Midwest Corn Belt, helping to push farmland prices to historic highs.

In the past year, prices of farmland in Iowa, Illinois and Indiana have skyrocketed by 20% or more, and by 12% and 1% in Michigan and Wisconsin, respectively.

The USDA reported last August that the average price of farm real estate nationwide had been \$2,140 an acre as of Jan. 1, 2010, up 1.4% from the level a year earlier, but 86.1% above the level a decade before.

Original values in the Plains States rose more than 25% over the past year to a record high, the Federal Reserve Bank of Kansas City said in a quarterly survey of 243 banks in the region.

Nebraska posted the strongest gains, with irrigated and non-irrigated land values rising approximately 40% above year-ago levels, says the Kansas City Fed. Oklahoma, aimed in one of its worst droughts ever, saw a gain of just over 10%.

The price of farmland in the Corn Belt rose 20% in the third quarter, the report says. The Federal Reserve Bank of Kansas City said in its survey of 243 banks in the region.

**To contact Fall Line Farms:**  
 • Clay Mitchell — (315) 464-5870 or  
 • (800) 888-8888  
 • Lawrence T. Smith — (315) 470-4227  
 • (800) 888-8888  
 • (315) 464-5870

University of California  
[www.no-tillfarmer.com](http://www.no-tillfarmer.com) Natural Resources

Making a Difference for California

[Home](#) / [News](#) / [News](#) / [Cut nitrogen by 50 lb. zero-till farmers told](#)

## Cut nitrogen by 50 lb. zero-till farmers told

Avid supporter

No Comments Posted Jan. 24th, 2014 by [Robert Amason](#)



Wheat and durum only | Research was carried out in North Dakota and is not recommended for the Canadian Prairies

MINOT, N.D. — Dave Franzen of North Dakota State University believes in following the data.

So when North Dakota field data indicated that long-term, no-till fields require less nitrogen than conventionally tilled soils, the extension soil specialist told no tillage farmers to cut their nitrogen rates by 50 pounds per acre.

“That’s the just way it worked out in the data. The data said 50 (lbs. per acre), so I used 50,” Franzen said.

The recommendations apply to only wheat and durum.

“I only put out recommendations on things that I test,” he said.

“I don’t have any numbers to support (this) for sunflowers or anything else.... Unless I have any numbers, I’m not going to pull anything out of my back pocket. I’ve done the wheat and durum (research), so that’s out there.”

NDSU has said for the last several years that farmers growing wheat on fields with continuous no-till for more than five years require 50 lb. less nitrogen per acre than conventionally tilled fields.

Franzen is also developing nitrogen guidelines for corn grown on long-term zero-till fields.

He devised the wheat recommendation after studying North Dakota zero-tillage data



# We Will Feed the World in 2050

Lalit Verma

**A**gricultural and biological engineers (ABEs) will be critically important in feeding an additional three billion people by 2050. Our profession's past contributions to safe, affordable, and abundant food are proof of that.

Ensuring food security for the projected global population is a daunting challenge. However, a bright spot is that major contributions toward food security can be achieved without increasing production—for example, by reducing post-harvest losses. My confidence stems from my international experience as a post-harvest agricultural engineer.

In fact, because we need to produce more food with fewer inputs per unit of land, and then deliver this food to the people who need it most, production increases—by themselves—won't be enough. In addition to reducing post-harvest losses, we must also increase the efficiency of our production systems. We have started to do this by combining our engineering expertise—including precision farming, micro-irrigation, sensor networks, robotics, and other technologies—with expertise from other professionals, including agronomists, soil scientists, geneticists, entomologists, agricultural economists, and many others.

To do the most good, these collaborations need to be global, to match our combined expertise with local needs around the world. This is especially important for the developing world, as the large-scale strategies that work in developed countries must be adapted, using technologies that are appropriate for different cultures and different climates with even greater resource constraints. Fortunately, our recent successful collaborations with scientists in other fields have so far demonstrated that we can solve the complex problems of food production with constrained resources of land, water, and energy.

At the 2014 ASABE/CSBE Annual International Meeting in Montreal, we mapped out the global challenges and opportunities for ABEs as part of the Global Engagement Day activities. To further our ABE Global Initiative, we are developing a strategic position paper that identifies ABEs' importance and responsibility in sustainably feeding the world in 2050.



This paper outlines the challenges before us, highlights the specific needs of three “security” themes (food security, energy security, and water security) in the context of sustainability and climate change, and specifies how ASABE, its members, and its partners will address the grand challenges. Our strategy is expressed in the following goals:

1. Improve food productivity.
2. Reduce food losses and waste.
3. Enhance energy conservation and efficiency.
4. Develop adaptable renewable energy systems.
5. Improve water availability, conservation, and efficient use.
6. Provide clean water for multiple uses (human consumption, agriculture, recreation, ecosystem services, biodiversity, etc.).

These goals may sound familiar to you—in a way, they summarize the long-standing efforts of the ABE profession. We can be proud of what we've accomplished, so our strategy also involves showing the world who we are, what we do, and how our work has improved the quality of life for everyone. In particular, we must ensure that policy-makers are aware of the proven strengths and expertise of our profession.

Despite the challenges facing us, I believe that our future is bright, that all problems have solutions, and that our profession will be profoundly important in the global effort to feed the world in 2050.

ASABE Fellow and Past President Lalit Verma, Professor and Head, Department of Biological and Agricultural Engineering, University of Arkansas, Fayetteville, USA; lverma@uark.edu.

## A New Paradigm for Feeding the World in 2050 The Sustainable Intensification of Crop Production

Theodor Friedrich

**W**hen the Food and Agricultural Organization (FAO) of the United Nations was founded in 1945, it was with the objective to fight hunger in the world. Since then, some progress has been made. The first of the Millennium Development Goals—to halve the proportion of hungry people in the world by 2015—appears within reach. At present, hunger along with poverty is more a problem of access to food than of availability. Therefore, hunger is being successfully addressed in many countries by political will and social programs. However, for the expected population of 9.2 billion in 2050, global food production will have to increase by about 70%, a conservative estimate considering the increased demand for animal products and bioenergy and the threats from climate change. Despite this challenge, FAO has revised its overall goal from reducing hunger to eradicating hunger. We can assume that FAO member countries, in accepting this change, are not pursuing an impossible target.

There is little hope of achieving the necessary production increase from expanding the cultivated land area. More than 80% of the necessary production increase will have to come from yield increases. Yet, the yield increases for all major food crops are declining. Therefore, this challenge will not be met by continuing with a concept of farming that caused the problem in the first place. The problem is not in the genetic potential of crops or the lack of production inputs. Instead, the problem lies in the degradation of natural resources and their yield-related functions, which do not allow closing the yield gap anymore.

Therefore, FAO has proposed a different paradigm for agricultural production: **sustainable intensification, as described in the book *Save and Grow* ([www.fao.org/ag/save-and-grow](http://www.fao.org/ag/save-and-grow)). Sustainable intensification means achieving the highest possible production, applying all necessary technologies, while keeping the environmental impact below the threshold of natural recovery.**

FAO would not propose this paradigm change if it did not have “proof of application” that it actually works for farmers. Agricultural production can only be considered sustainable if the soil health and productive capacity are main-

tained in an optimal condition. Over the past millennia, agricultural land use globally has led to physical, chemical, biological, and hydrological degradation of the soil, and this process continues unabated on most farm lands. This is true for farms of all sizes, climatic regions, and economic development levels.

The dominant global farming paradigm is based on mechanical tillage. In this paradigm, the “best practices” for crop, soil, nutrient, water, and pest management are the technical state of the art and are presumed to be suitable for obtaining high production with limited environmental damage. However, in many cases, soil degradation and environmental damage can only be controlled, not avoided, and this damage is generally accepted as an inevitable side effect of farming. This view is now being challenged, and it is increasingly considered outdated. Tillage-based farming practices cannot meet the combined objectives of production intensification with ecosystem services that are now being demanded by society. In the case of the soil, the degradation and erosion caused by tillage are always greater, by orders of magnitude, than the natural formation of soil. Hence, tillage systems cannot be sustainable. A long list of literature explores this problem, from Edward Faulkner's *Ploughman's Folly* (1943) to the more recent *Dirt: The Erosion of Civilizations* by David Montgomery (2007).

The logical response to this challenge is a farming system that does not mechanically disturb the soil and maintains the soil in a healthy state—a no-till system with biologically and ecologically active soil. Analyzing farmers' experiences with no-till around the world, FAO has come up with a definition for such a system, commonly known as conservation agriculture (CA), based on three interlinked principles for any land-based production system:

- Minimum or no mechanical soil disturbance (permanently).
- Permanent organic soil cover.
- Diversification of species.

When implemented correctly, CA delivers on multiple objectives: it increases yield and production in a sustainable way, closing the



By reducing the turnover time between harvest and seeding of the subsequent crop, conservation agriculture enables farmers in climates with restricted growing periods to grow an additional crop in the same season.

yield gap with reduced inputs over time, while enhancing ecosystem services. It is environmentally, economically, and socially sustainable and highly productive, and it responds to the demand for climate change adaptation and mitigation. I have seen many farmers on all continents improve their livelihoods and happiness after adopting CA on their farms. With CA, FAO had a sound basis for sustainable intensification, and hence FAO has been promoting CA around the world along with a growing number of organizations and institutions. Globally, CA is growing exponentially at 10 million ha per year, having reached 155 million ha in 2013, which represents 11% of global cropland. In some countries, CA is now the dominant farming system, and the oldest CA farms date back over 50 years.

Obviously, despite CA's many advantages, such a complex paradigm change in farming requires continued policy and institutional support for it to spread fast enough to help meet the challenge of feeding the world in 2050. This challenge is still facing us, and it is a question of political will, as is the eradication of hunger at the present time. Given that political will, there is no question that the challenge to feed the world in 2050 can be met with conservation agriculture, without the need of technological miracles that are yet to be invented.

ASABE Member Theodor Friedrich is co-founder of FAO's conservation agriculture initiative and for more than a decade has led FAO's global work on CA. He currently serves as FAO's representative in Cuba; theodor.friedrich@fao.org.

Top photo © Matthew Collingwood | Dreamstime. Mid-page photo by the author.



### Launch of the 2015 International Year of Soils

The launch of the IYS will take place during the celebration of the first official UN World Soil Day 2014 on 5 December 2014

#### INFOGRAPHIC



International Year of Soils 2015

#### WEBSITE



FAO Soils Portal

#### IN FOCUS



Download the IYS 2015 logo

#### Tweets

**Bacoban UK** @BacobanUK 1h  
@BacobanUK cares by reduce disinfctn in2 drains RT @UN #WorldSoilDay Soil hosts 1/4 of planet biodiversity j.mp/1w0U6RW #IYS2015

**Footprint to Wings** @Footprint2Wings 2h  
Heads up! 2015 is the International year of Soils #IYS2015 fao.org/soils-2015/en/

**Sue Carlson** @susanmcarlson 2h  
#IYS2015 A free video to view this week 5-12 Dec. svmhonvofthesoil.com Beautiful moving

Compose new Tweet...

The 68th UN General Assembly declared 2015 the International Year of Soils (IYS) (A/RES/68/232).

The Food and Agriculture Organization of the United Nations has been nominated to implement the IYS 2015, within the framework of the Global Soil Partnership and in collaboration with Governments and the secretariat of the United Nations Convention to Combat Desertification.

***“The International Year of Soils will help us pave the road towards sustainable development for all and by all.”***

José Graziano da Silva, FAO Director-General

#### Related Links

- Global Soil Partnership

## Soil Health Profile, David Brandt



On October 11, 2012, at the Carroll, OH farm of long-time no-till and cover crop farmer, David Brandt, USDA's Natural Resources Conservation Service (NRCS) launched "*Unlock the Secrets in the Soil*," a major, national education and awareness campaign about soil health.

### Ohio soil health pioneer forges new frontier in farming

While David and Kendra Brandt like what they see from the soil health system they're using on their central Ohio farm, everything they do still has to pass muster through the combine's yield monitor.

They've used no-till on their corn, wheat, and soybean operation since 1971, but when David saw a drop in corn yields in 1978, he added hairy vetch and winter peas to the system to get more nitrogen.

"We were using commercial nitrogen then, and I wasn't really thinking about the health of the soil," Brandt says. "We saw some improvement in water infiltration at the time, but we didn't reduce nitrogen inputs until we learned our soils were changing and we didn't really need it," he says.

### Reducing Crop Inputs

"Cutting back on commercial inputs has been a tough one for me, because we've always been taught we need so many pounds of nitrogen, phosphorus and potash to grow a decent corn crop," Brandt says. "We're learning now with cover crops that we don't need to buy those additional nutrients because we can bring them up from deeper in the soil. They just weren't available to the crop before."

"In fact, we've learned in the last two years that we can go to using almost no purchased commercial fertilizer or herbicide and still produce a great crop of corn and beans."



April 15, 2015

A quantifiable assessment of the capacity of our oceans to deliver benefits and resources sustainably.

Scores range from 0 to 100 for 10 goals for a healthy ocean.

Global

67

Ocean Region Rankings



New Score Releases

Antarctica and the Southern Ocean region scored 72 while the average score of the high seas was 67 out of 100.

[Antarctica Scores](#) 

[High Seas Overview](#) 

[2014 Key Findings](#) 

How was this score calculated?



See how overall region scores rank



# An Index Organized by 10 Public Goals

Each goal has an optimum reference point determined by a team of experts. The target is considered attainable and is more sustainable than the current conditions. A score of 100 meets the target. The Ocean Health Index was started in 2012 and reports new scores annually. Roll over the chart to learn more about each goal.

Visit the [Annual Change](#) page to view the Index over time



67

Food Provision

51

Artisanal Fishing Opportunities

68

Natural Products

42

Carbon Storage

74

Coastal Protection

76

Coastal Livelihoods & Economies

82

Tourism & Recreation

44

Sense of Place

67

Clean Waters

78

Biodiversity

83

## Using the Best Available Science

Using data from the best available scientific resources, the Index calculates an annual global score for ocean health in 221 coastal regions and 15 sectors of the high seas.

The framework for the Ocean Health Index was first published in [Marine Policy](#) in 2012.

## Watch and Learn

Want to see conservation in action? Check out these videos for more information on how to choose and plant cover crops, how to judge soil texture by feel, how to adjust a no-till planter, and more.

## A Soil Health Approach

*Maximize profits and increase production while protecting your land*



### Indiana's Innovative Soil Health Hubs

The hubs will provide regionally centralized locations for training opportunities and will also be coordinating with local farmers and ICP staff dedicated to the project.



### On Farm Network

CCSI is a partner in Indiana's On Farm Network, a group of crop producers interested in economics, stewardship, and reducing their environmental footprint.



### Watch and Learn

Want to see conservation in action? Check out these videos for more information on how to choose and plant cover crops, how to judge soil texture by feel, how to adjust a no-till planter, and more.



A PROJECT TO MAKE AGRICULTURE MORE  
PRODUCTIVE AND SUSTAINABLE THROUGH  
**IMPROVED SOIL HEALTH**

## **A FIVE-YEAR INITIATIVE**

Over the next five years, we plan to **identify, test and measure management practices that improve soil health and benefit farmers' operations**. Right now, many farmers across the country are implementing innovative management practices that result in economic and environmental benefits. We plan to build upon the work of these farmers to **provide connections between on-farm practices and improving soil health**.

We believe the results of this farmer-led project will provide a platform for sharing information from farmers to farmers, with the support and resources to benefit farmers' bottom lines and agricultural sustainability. **We want to help provide the spark for greater understanding and more broadly implementing agricultural practices that work best.**



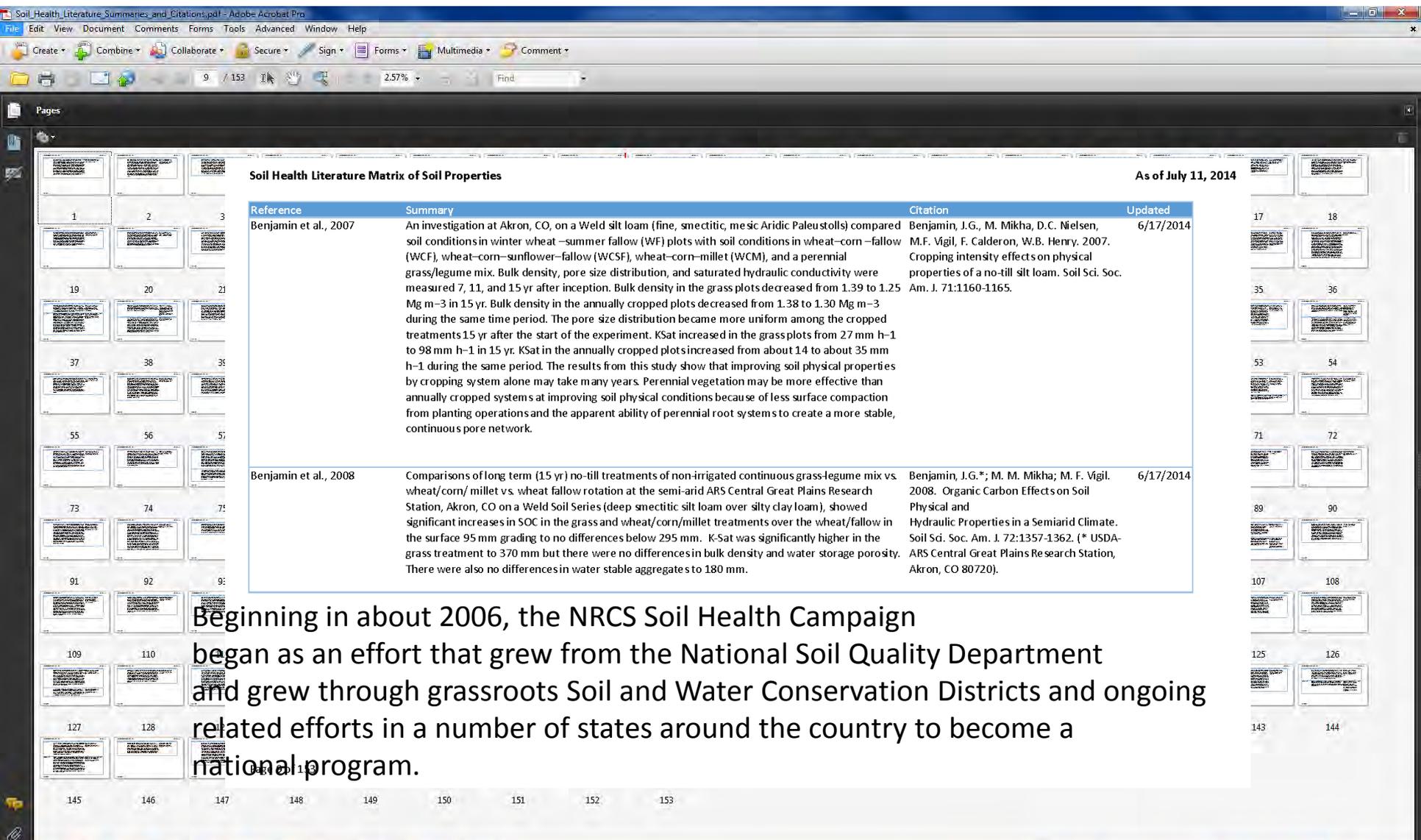
**An NCGA Initiative**

## **Managing for soil health ...**

- **Minimizing soil disturbance**
- **Maximizing the diversity of plants in rotation / cover crops**
- **Keeping living roots in the soil as much as possible, and**
- **Keeping the soil covered with plants and plant residues at all times**

**Unlock the Secrets in the Soil**

<http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/soils/health/>



**Soil Health Literature Matrix of Soil Properties**

As of July 11, 2014

Reference	Summary	Citation	Updated
Benjamin et al., 2007	An investigation at Akron, CO, on a Weld silt loam (fine, smectitic, mesic Aridic Paleustolls) compared soil conditions in winter wheat–summer fallow (WF) plots with soil conditions in wheat–corn–fallow (WCF), wheat–corn–sunflower–fallow (WCSF), wheat–corn–millet (WCM), and a perennial grass/legume mix. Bulk density, pore size distribution, and saturated hydraulic conductivity were measured 7, 11, and 15 yr after inception. Bulk density in the grass plots decreased from 1.39 to 1.25 Mg m <sup>-3</sup> in 15 yr. Bulk density in the annually cropped plots decreased from 1.38 to 1.30 Mg m <sup>-3</sup> during the same time period. The pore size distribution became more uniform among the cropped treatments 15 yr after the start of the experiment. K <sub>Sat</sub> increased in the grass plots from 27 mm h <sup>-1</sup> to 98 mm h <sup>-1</sup> in 15 yr. K <sub>Sat</sub> in the annually cropped plots increased from about 14 to about 35 mm h <sup>-1</sup> during the same period. The results from this study show that improving soil physical properties by cropping system alone may take many years. Perennial vegetation may be more effective than annually cropped systems at improving soil physical conditions because of less surface compaction from planting operations and the apparent ability of perennial root systems to create a more stable, continuous pore network.	Benjamin, J.G., M. Mikha, D.C. Nielsen, M.F. Vigil, F. Calderon, W.B. Henry. 2007. Cropping intensity effects on physical properties of a no-till silt loam. Soil Sci. Soc. Am. J. 71:1160-1165.	6/17/2014
Benjamin et al., 2008	Comparisons of long term (15 yr) no-till treatments of non-irrigated continuous grass-legume mix vs. wheat/corn/ millet vs. wheat fallow rotation at the semi-arid ARS Central Great Plains Research Station, Akron, CO on a Weld Soil Series (deep smectitic silt loam over silty clay loam), showed significant increases in SOC in the grass and wheat/corn/millet treatments over the wheat/fallow in the surface 95 mm grading to no differences below 295 mm. K-Sat was significantly higher in the grass treatment to 370 mm but there were no differences in bulk density and water storage porosity. There were also no differences in water stable aggregates to 180 mm.	Benjamin, J.G.*; M. M. Mikha; M. F. Vigil. 2008. Organic Carbon Effects on Soil Physical and Hydraulic Properties in a Semiarid Climate. Soil Sci. Soc. Am. J. 72:1357-1362. (* USDA-ARS Central Great Plains Research Station, Akron, CO 80720).	6/17/2014

Beginning in about 2006, the NRCS Soil Health Campaign began as an effort that grew from the National Soil Quality Department and grew through grassroots Soil and Water Conservation Districts and ongoing related efforts in a number of states around the country to become a national program.

## Natural systems ...

- harvest the maximum amount of sunlight
- leak very few nutrients including CO<sub>2</sub>
- have diversity
- tend not to export nutrients
- make maximum use of water and nutrients by having highly developed porosity and VAM webs
- do not do tillage

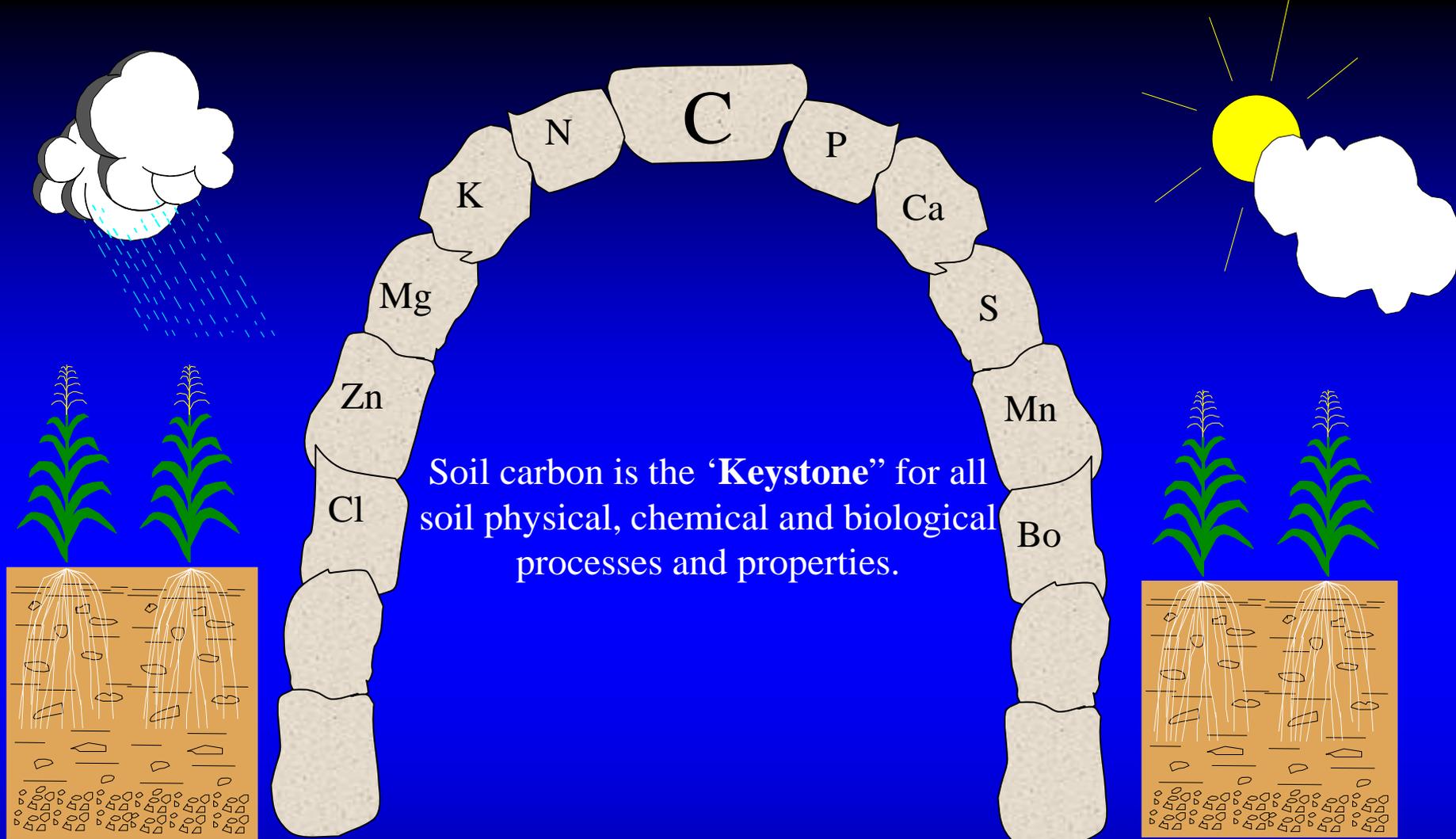
Summary of comments made by Dr. Dwayne Beck, SDSU,  
at 2014 Winter Conference of No-till on the Plains, Salina, KS

# Soil improving practices

1. Feed the soil (OM) (not take away everything, not mine the soil)
2. Reduced soil disturbance (physical, chemical, and biological)
3. Increase diversity (biodiversity)
4. Keep the soil covered
5. Minimize diversity-reducing inputs
6. Promote optimal soil structure
7. Reduce extremes in temperature
8. Build soil carbon
9. Use diverse cover crops
10. Rotate crops
11. Manage salinity
12. Manage nitrogen
13. Precision irrigation
14. Decrease soil-borne pests
15. Reduce compaction
16. Monitor soil conditions (lab analyses)



This list was developed in a meeting with farmers, NRCS conservationists, private sector consultants, and university researchers held at the UC West Side Research and Extension Center in Five Points, CA, April 23, 2013.



# Management platform

Don Reicosky,  
 (Retired Soil Scientist  
 USDA ARS)

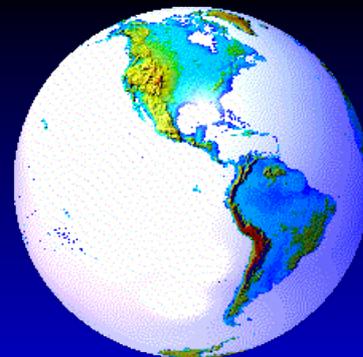
fertility, variety, irrigation, species, cover crop, manure, rotations, tillage, soil type, erosion, timing,



“Tillage-induced carbon dioxide loss” information and data from Reicosky used in commercial advertising  
Tulare, CA  
2015

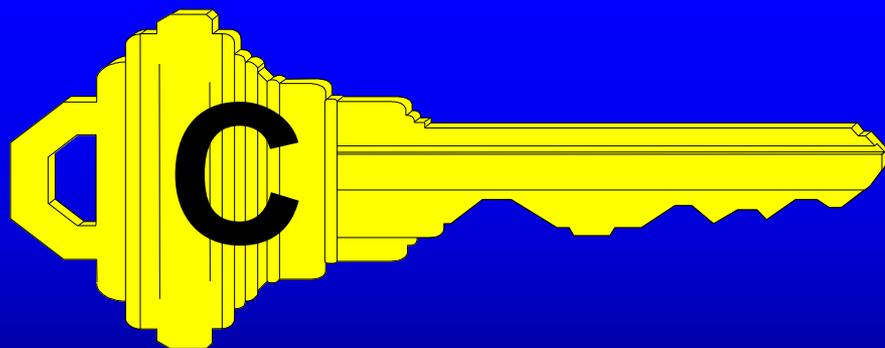


**OUR HUNGRY WORLD  
OUR THREATENED PLANET  
OUR CHILDREN'S FUTURE**



**OUR ONE CHANCE... Conservation Agriculture  
All rest on "OUR LIVING SOIL" that depends on  
soil carbon!**

**The "key" component is:**



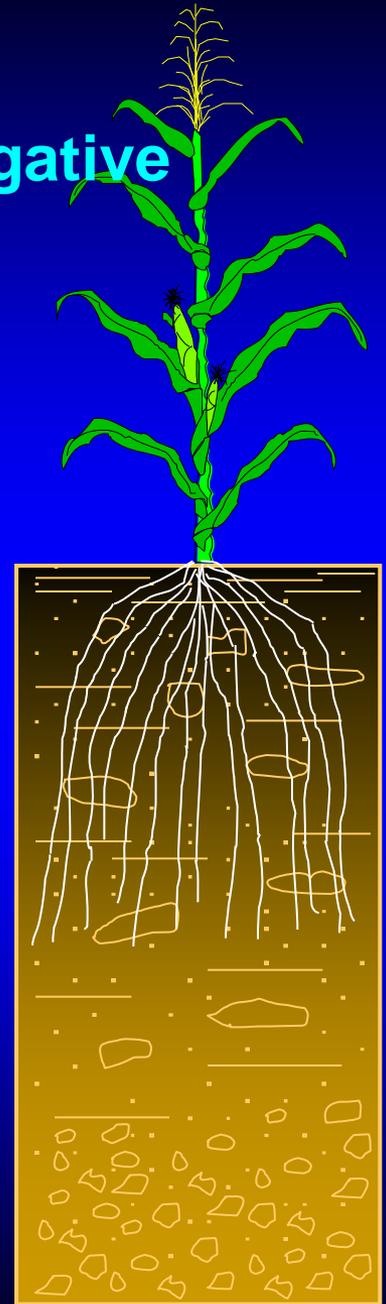
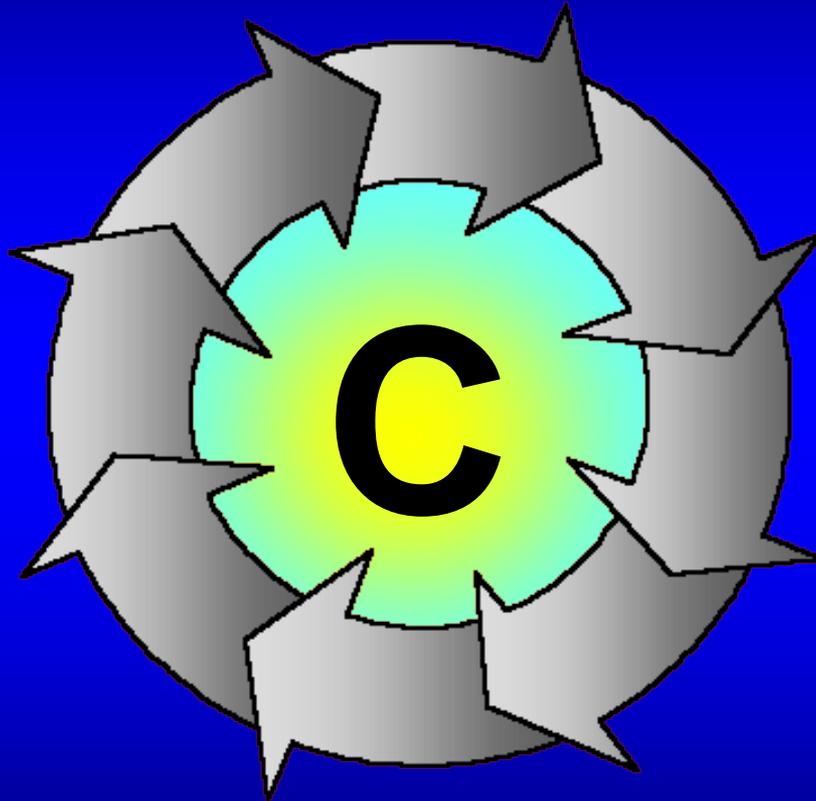
**c a r b o n !**



**Don Reicosky,  
(Retired Soil Scientist USDA ARS)**

# Why Soil Carbon Management?

Agriculture, through better management of the “biological C” cycle, can help society offset negative environmental impacts of the “fossil C” cycle.



**Soil carbon is an important link between sustainability and productivity within our agricultural systems.**





# 30 Years Continuous Corn + Plow

Total Carbon (Mg/ha)

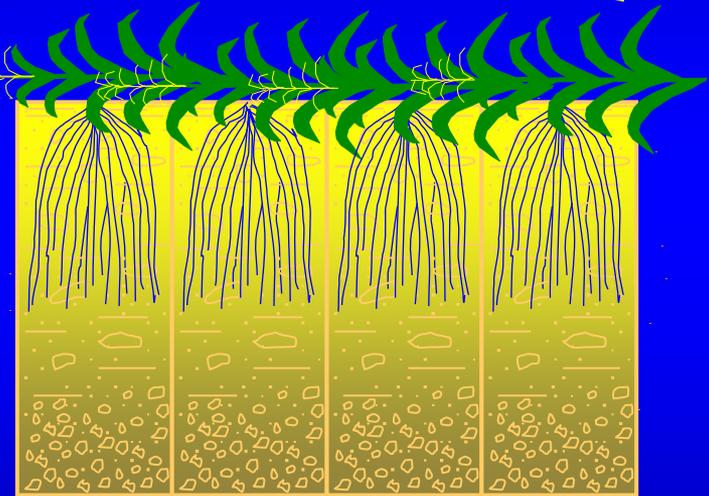
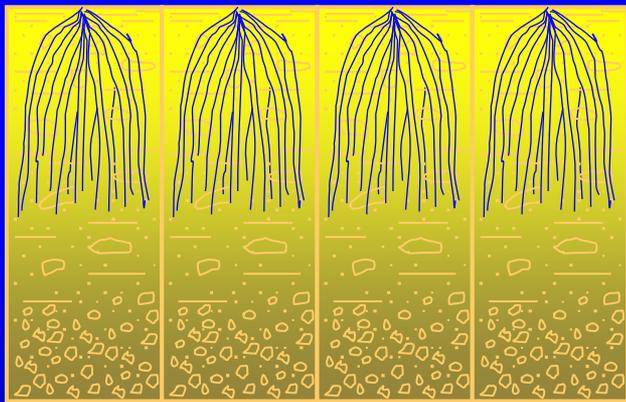
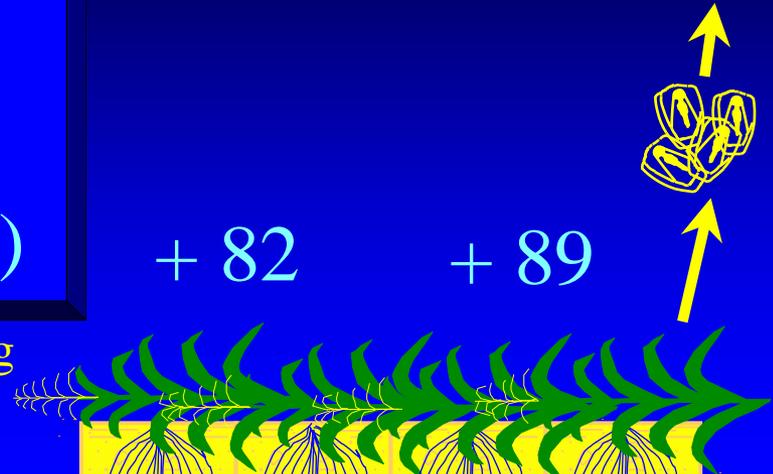
@ 410 g C/kg

- 150

- 162

+ 82

+ 89



Fertility

low

high

low

high

Silage removed  
(grain and stover removed)

Grain removed  
(stover returned)

# 30 Years Continuous Corn + Plow

Silage removed  
(grain and stover  
removed)

Grain removed  
(stover returned)

Total Carbon  
(Mg/ha)

- 150

- 162

+ 82

+ 89

Fertility low

high

(0-15 cm)  
Soil  
Carbon

low

high

21.3

21.4

(g C/kg)

21.3

21.7

Results suggest intensive tillage (moldboard plow) common to all treatments overshadowed stover carbon removal or addition.

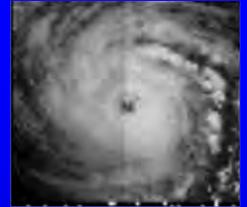
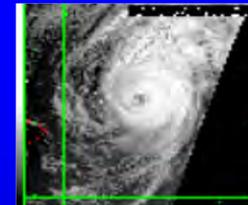
# "Turmoil of Tillage"

The soil is a natural biological system that contains a lot of life and when tilled intensively is dramatically changed. It can be considered analogous to human reaction to a combination of:

- earthquake



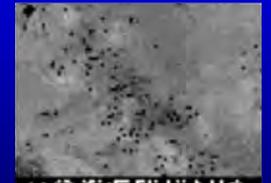
- hurricane



- tornado



- forest fire

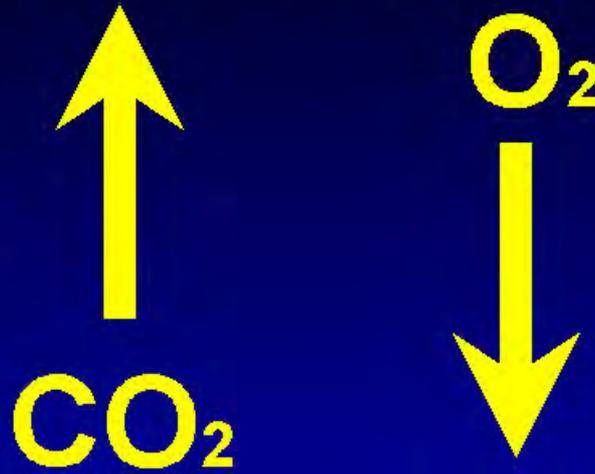
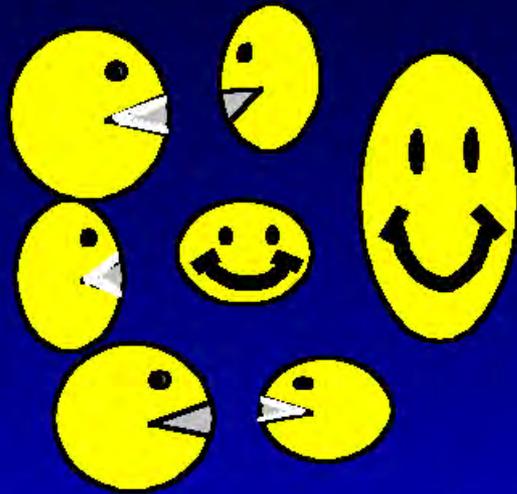


all rolled into one perturbation event.

Natural  
Pace

Feeding  
Frenzy

Gas Exchange



**MMM**

**Mild  
Mannered  
Microbes**

**Intensive  
Tillage**

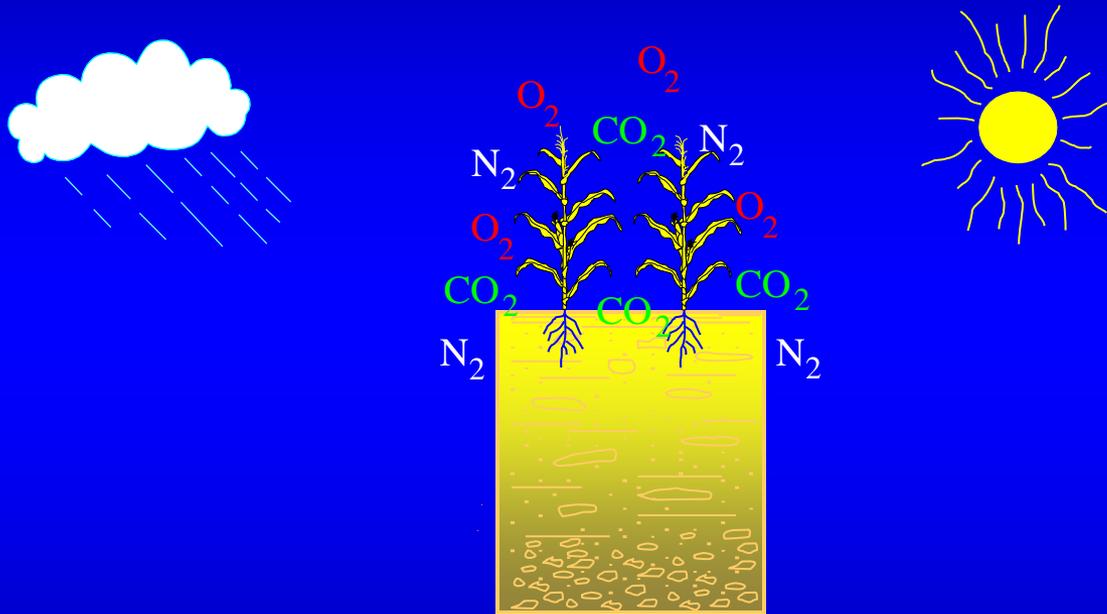


**"P"MM**

**"Piranha"  
Mannered  
Microbes**

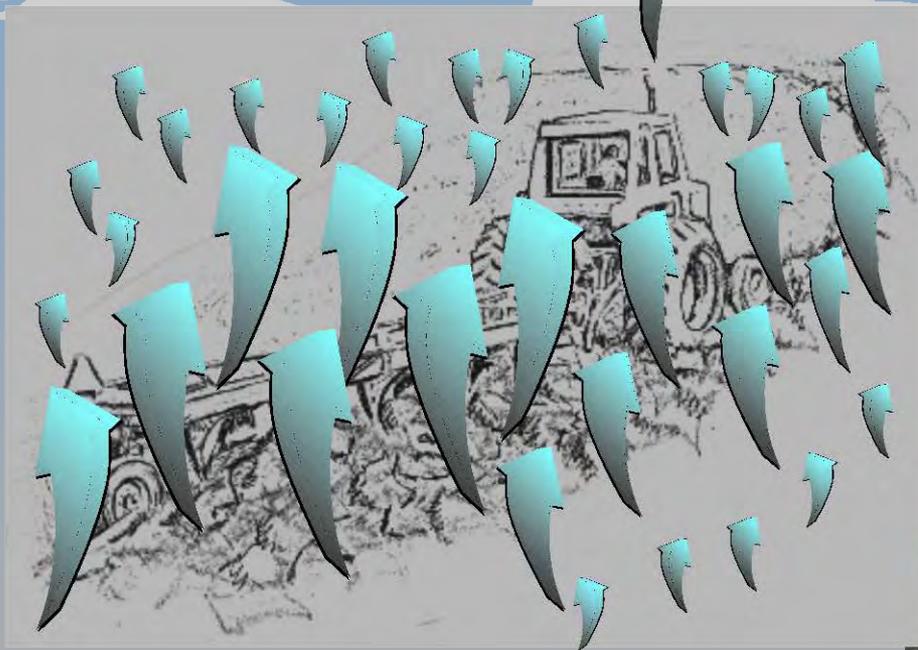
# Soil Quality is everyone's business!

Anyone who eats should be concerned about soil quality.

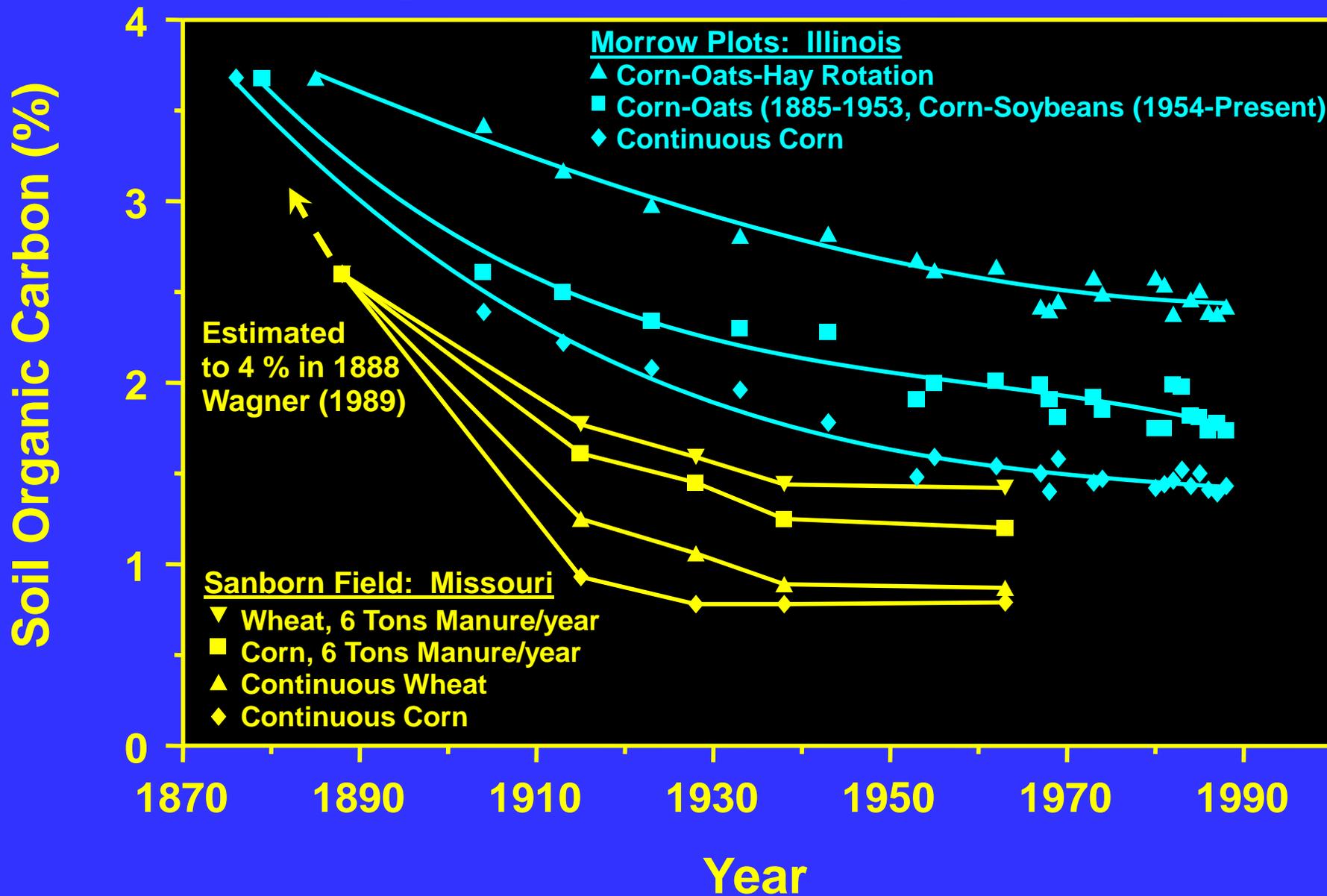


Our soils are the fundamental foundation of our life and our economy. Our soils, water, air and sun are the major resources that sustain our food production. We are the stewards of those resources and must manage soil carbon to maintain sustainable production.

# TILLAGE-INDUCED CARBON DIOXIDE LOSS



# Long Term Effects of Crop Rotations



## REVIEW

## SOIL SCIENCE

## Soil and human security in the 21st century

Ronald Amundson,<sup>1,2\*</sup> Asmeret Asefaw Berhe,<sup>2</sup> Jan W. Hopmans,<sup>3</sup> Carolyn Olson,<sup>4</sup> A. Ester Sztein,<sup>5</sup> Donald L. Sparks<sup>6</sup>

Human security has and will continue to rely on Earth's diverse soil resources. Yet we have now exploited the planet's most productive soils. Soil erosion greatly exceeds rates of production in many agricultural regions. Nitrogen produced by fossil fuel and geological reservoirs of other fertilizers are headed toward possible scarcity, increased cost, and/or geopolitical conflict. Climate change is accelerating the microbial release of greenhouse gases from soil organic matter and will likely play a large role in our near-term climate future. In this Review, we highlight challenges facing Earth's soil resources in the coming century. The direct and indirect response of soils to past and future human activities will play a major role in human prosperity and survival.

Soil is the living epidermis of the planet (1). Globally, soil is the medium through which a number of atmospheric gases are biologically cycled and through which waters are filtered and stored as they pass through the global hydrological cycle (2). Soil is a large and dynamic reservoir of carbon and the physical substrate for most of our food production. Profound changes are on the horizon for these interconnected functions particularly sparked by changes to climate and food production that will likely reverberate through society this century. Ultimately, the way in which we directly and indirectly manage our planet's soil will be intertwined within our future success as a species.

Soil is commonly thought of as the ~1-m-thick layer of biogeochemically altered rock or sediment at Earth's surface that has acquired numerous qualities during its exposure to the atmosphere that greatly distinguish it from its geological sources (3). Soil-forming chemical reactions create micrometer-sized electrically negative clay minerals that impart soil with plant nutrient retention capabilities (4). The electrical charge characteristics of soil, combined with its small particle size and high surface area, allow it to temporarily store rain and snow melt for plant use and provide sufficient residence time for a multitude of chemical reactions to occur that may remove or reduce the

toxicity of contaminants. The water stored in soil termed green water (5) serves as the source for 90% of the world's agricultural production and represents ~65% of global fresh water (6). Last, the intimate intermingling of life—plant, animal, and microbial—within the soil matrix drives redox reactions that control many elemental cycles (6) and creates a reservoir of organic C that greatly exceeds the C in the global atmosphere and biosphere (7). The microbial communities that mediate these redox reactions are now believed to represent much of Earth's total biodiversity (8), but the nature, function, and economic potential of this soil biosphere is only beginning to be probed (6).

Soil, due to global variations in climate, geology, and biota (3), has tremendous spatial diversity. More than 20,000 soil types (or soil series) have been identified and mapped in the United States alone (9), and the number identified increases as land area investigated increases. If the soil series to land area relationship (10) is extrapolated to global ice-free land area, the results suggest that there are more than 300,000 series on the planet. The response of these soils to perturbations can be extremely varied because of their diverse chemical, physical, and biological characteristics, suggesting the importance, as a simple precautionary principle, of maintaining segments of this diversity for the stability and resilience of global biogeochemical systems in the face of anthropogenic disturbances.

#### Human Imprint on Soil

Humans altered the ecosystems they encountered as they began their spread across the globe. However, the most momentous development in human landscape change occurred with the invention and adoption of agriculture (11). Most agricultural practices involve the removal of the natural flora, the simplification of biodiversity to favor monocultures, and the physical disruption

of the soil. Since the Industrial Revolution, expanding populations have relied on the exploitation of more and more soil for a corresponding growth in food production. Today, ~12% of ice-free land is in cropland, and 38% is used for combined cropping and grazing (12), an area roughly equivalent to the land area covered by ice and scoured or otherwise disturbed during the last glacial maximum (Fig. 1A). In addition to the similarity in area, the agricultural impact on soil processes rivals or exceeds the effect of those ice sheets in both rapidity and magnitude.

Undisturbed soils have the characteristic, as result of a number of feedback mechanisms, of being able to retain many of their features indefinitely over time—their thickness, C content, and nutrients, for example—a condition that is equatable to sustainability (Fig. 2). Cultivated soils are highly modified forms of their wild predecessors and may thus be viewed as domesticated soils (9). One key characteristic is that domesticated soils seldom are able to maintain the qualities of their original conditions, and these changes greatly affect their productivity and their impact on surrounding geochemical cycles. The efforts to improve the management and conservation of these domesticated soils, and the preservation of portions of their remaining wild ancestral stock, will be among the most important challenges this century (9, 13). Analyses of the combined agricultural and urban impact on soil series in the United States, for example, revealed large areas in the agricultural heartland where more than 50% of the soil series had been domesticated. Soil diversity, like biodiversity (14), provides an array of human-valued goods and services. Among the most apparent issues is the ability of soil to provide sustained agricultural production.

The domesticated soil landscape is one of Earth's most valuable commodities. For example, nearly \$3816 billion (U.S. dollars) in agricultural products were produced globally in 2012 (15). However, agriculture is competing with increasing urban and suburban soil demands. The conversion of soil to urban land is largely irreversible on human time scales. There is uncertainty both in the present and the future distribution of urban land on Earth (Fig. 1B). A recent meta-analysis suggests that between 1970 and 2000, an area greater than the size of Denmark was urbanized, and that in the next 20 years, 1.5 million km<sup>2</sup> of land (the size of Mongolia) will be urbanized (16). The conversion of farmland to urban areas must be weighed against the fact that our most productive soils have already been exploited and that demand for food production will continue to increase.

#### Soil and Climate Security

A relatively stable climate has been the stage on which the great human inventions of agriculture and industrialization have evolved, and direct or indirect human impacts on soil C cycling processes will have much to do with atmospheric greenhouse gas concentrations and the associated climate implications by the end of this century.

Is there evidence that soil carbon levels are not what they might be in California soils?

“During the first few decades that soil is cultivated, up to 50% of the carbon pool is oxidized to CO<sub>2</sub>; eventually, a quasi-steady-state soil C pool is achieved. Based on the global agricultural land area, cultivation has likely released between 50 and 70 Gt of C to the atmosphere over the course of human history, and the combined cultivation and biomass burning contributions to atmospheric CO<sub>2</sub> exceeded that of fossil fuel emissions well into the 20<sup>th</sup> century.”

<sup>1</sup>Department of Environmental Science, Policy, and Management, University of California, Berkeley, CA 94720, USA. <sup>2</sup>Life and Environmental Sciences Unit, University of California, Merced, CA 95343, USA. <sup>3</sup>Land, Air, and Water Resources, One Shields Avenue, Davis, CA 95616, USA. <sup>4</sup>Climate Change Program Office, Office of the Chief Economist, U.S. Department of Agriculture (USDA), 14th and Independence SW, Washington, DC 20013, USA. <sup>5</sup>Board on International Scientific Organizations, National Academy of Sciences, 500 Fifth Street NW, Washington, DC 20001, USA. <sup>6</sup>Plant and Soil Science, Chemistry and Biochemistry, Civil and Environmental Engineering, and Marine Science and Policy, University of Delaware, Newark, DE 19716, USA. \*Corresponding author. E-mail: earth@berkeley.edu

## REVIEW

## SOIL SCIENCE

# Soil and human security in the 21st century

Ronald Amundson,<sup>1,\*</sup> Asmeret Asefaw Berhe,<sup>2</sup> Jan W. Hopmans,<sup>3</sup> Carolyn Olson,<sup>4</sup> A. Ester Sztein,<sup>5</sup> Donald L. Sparks<sup>6</sup>

Human security has and will continue to rely on Earth's diverse soil resources. Yet we have now exploited the planet's most productive soils. Soil erosion greatly exceeds rates of production in many agricultural regions. Nitrogen produced by fossil fuel and geological reservoirs of other fertilizers are headed toward possible scarcity, increased cost, and/or geopolitical conflict. Climate change is accelerating the microbial release of greenhouse gases from soil organic matter and will likely play a large role in our near-term climate future. In this Review, we highlight challenges facing Earth's soil resources in the coming century. The direct and indirect response of soils to past and future human activities will play a major role in human prosperity and survival.

Soil is the living epidermis of the planet (1). Globally, soil is the medium through which a number of atmospheric gases are biologically cycled and through which waters are filtered and stored as they pass through the global hydrological cycle (2). Soil is a large and dynamic reservoir of carbon and the physical substrate for most of our food production. Profound changes are on the horizon for these interconnected functions particularly sparked by changes to climate and food production that will likely reverberate through society this century. Ultimately, the way in which we directly and indirectly manage our planet's soil will be interwoven within our future success as a species.

Soil is commonly thought of as the ~1-m-thick layer of biogeochemically altered rock or sediment at Earth's surface that has acquired numerous qualities during its exposure to the atmosphere that greatly distinguish it from its geological sources (3). Soil-forming chemical reactions create micrometer-sized electrically negative clay minerals that impart soil with plant nutrient retention capabilities (4). The electrical charge characteristics of soil, combined with its small particle size and high surface area, allow it to temporarily store rain and snow melt for plant use and provide sufficient residence time for a multitude of chemical reactions to occur that may remove or reduce the

toxicity of contaminants. The water stored in soil termed green water (5) serves as the source for 90% of the world's agricultural production and represents ~65% of global fresh water (6). Last, the intimate intermingling of life—plant, animal, and microbial—within the soil matrix drives redox reactions that control many elemental cycles (6) and creates a reservoir of organic C that greatly exceeds the C in the global atmosphere and biosphere (7). The microbial communities that mediate these redox reactions are now believed to represent much of Earth's total biodiversity (8), but the nature, function, and economic potential of this soil biosphere is only beginning to be probed (6).

Soil, due to global variations in climate, geology, and biota (3), has tremendous spatial diversity. More than 20,000 soil types (or soil series) have been identified and mapped in the United States alone (9), and the number identified increases as land area investigated increases. If the soil series to land area relationship (10) is extrapolated to global ice-free land area, the results suggest that there are more than 300,000 series on the planet. The response of these soils to perturbations can be extremely varied because of their diverse chemical, physical, and biological characteristics, suggesting the importance, as a simple precautionary principle, of maintaining segments of this diversity for the stability and resilience of global biogeochemical systems in the face of anthropogenic disturbances.

## Human Imprint on Soil

Humans altered the ecosystems they encountered as they began their spread across the globe. However, the most momentous development in human landscape change occurred with the invention and adoption of agriculture (11). Most agricultural practices involve the removal of the natural flora, the simplification of biodiversity to favor monocultures, and the physical disruption

of the soil. Since the Industrial Revolution, expanding populations have relied on the exploitation of more and more soil for a corresponding growth in food production. Today, ~12% of ice-free land is in cropland, and 38% is used for combined cropping and grazing (12), an area roughly equivalent to the land area covered by ice and scoured or otherwise disturbed during the last glacial maximum (Fig. 1A). In addition to the similarity in area, the agricultural impact on soil processes rivals or exceeds the effect of those ice sheets in both rapidity and magnitude.

Undisturbed soils have the characteristic, as result of a number of feedback mechanisms, of being able to retain many of their features indefinitely over time—their thickness, C content, and nutrients, for example—a condition that is equatable to sustainability (Fig. 2). Cultivated soils are highly modified forms of their wild predecessors and may thus be viewed as domesticated soils (9). One key characteristic is that domesticated soils seldom are able to maintain the qualities of their original conditions, and these changes greatly affect their productivity and their impact on surrounding geochemical cycles. The efforts to improve the management and conservation of these domesticated soils, and the preservation of portions of their remaining wild ancestral stock, will be among the most important challenges this century (9, 13). Analyses of the combined agricultural and urban impact on soil series in the United States, for example, revealed large areas in the agricultural heartland where more than 50% of the soil series had been domesticated. Soil diversity, like biodiversity (14), provides an array of human-valued goods and services. Among the most apparent issues is the ability of soil to provide sustained agricultural production.

The domesticated soil landscape is one of Earth's most valuable commodities. For example, nearly \$3816 billion (U.S. dollars) in agricultural products were produced globally in 2012 (15). However, agriculture is competing with increasing urban and suburban soil demands. The conversion of soil to urban land is largely irreversible on human time scales. There is uncertainty both in the present and the future distribution of urban land on Earth (Fig. 1B). A recent meta-analysis suggests that between 1970 and 2000, an area greater than the size of Denmark was urbanized, and that in the next 20 years, 1.5 million km<sup>2</sup> of land (the size of Mongolia) will be urbanized (16). The conversion of farmland to urban areas must be weighed against the fact that our most productive soils have already been exploited and that demand for food production will continue to increase.

## Soil and Climate Security

A relatively stable climate has been the stage on which the great human inventions of agriculture and industrialization have evolved, and direct or indirect human impacts on soil C cycling processes will have much to do with atmospheric greenhouse gas concentrations and the associated climate implications by the end of this century.

“Better stewardship of domesticated soils that leads to higher organic matter contents is a valuable practice from an ecological perspective and from an agronomic point of view.”

“These strategies should focus on regaining a balance in (i) organic C inputs and losses, (ii) soil erosion and production, and (iii) release and loss of nutrients.”

<sup>1</sup>Department of Environmental Science, Policy, and Management, University of California, Berkeley, CA 94720, USA. <sup>2</sup>Life and Environmental Sciences Unit, University of California, Merced, CA 95343, USA. <sup>3</sup>Land, Air, and Water Resources, One Shields Avenue, Davis, CA 95616, USA. <sup>4</sup>Climate Change Program Office, Office of the Chief Economist, U.S. Department of Agriculture (USDA), 14th and Independence SW, Washington, DC 20013, USA. <sup>5</sup>Board on International Scientific Organizations, National Academy of Sciences, 500 Fifth Street NW, Washington, DC 20001, USA. <sup>6</sup>Plant and Soil Science, Chemistry and Biochemistry, Civil and Environmental Engineering, and Marine Science and Policy, University of Delaware, Newark, DE 19716, USA. \*Corresponding author. E-mail: earth@berkeley.edu

# CONSERVATION AGRICULTURE

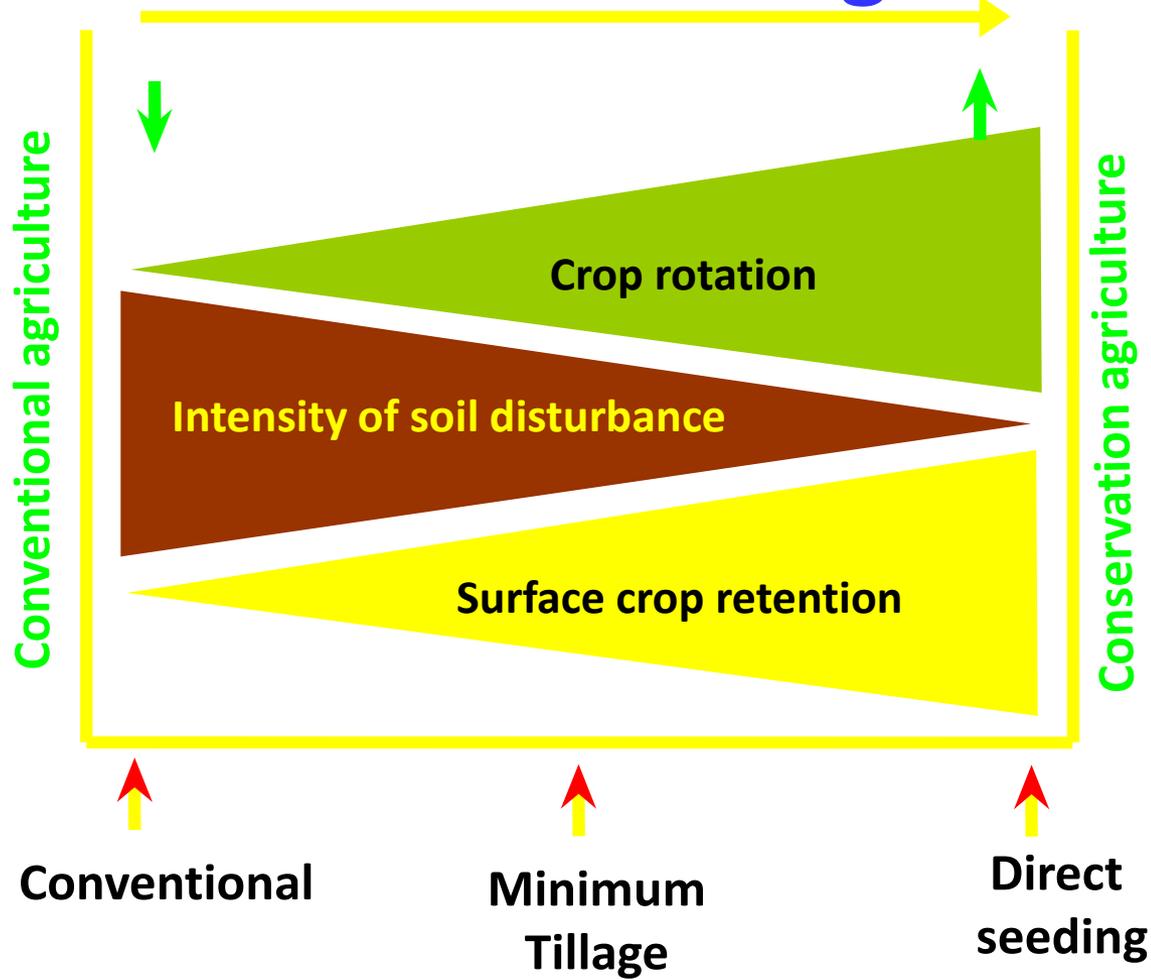
- ... has developed to be a technically viable, sustainable, and economic alternative to current crop production practices,
- ... is gaining acceptance in many parts of the world as an alternative to both conventional agriculture and organic agriculture
- ... is the integration of ecological management with modern, scientific, agricultural production

# CONSERVATION AGRICULTURE

- ... is not 'business as usual,' based primarily or solely on maximizing yields,
- ... rather, it is based on optimizing yields and profits to achieve a balance of agricultural, economic and environmental benefits,
- ...it advocates that the combined economic and social benefits gained from combining production and protecting the environment, including reduced input and labor costs, are greater than those from production alone.

Past approaches are not going to be sufficient.

# Toward conservation agriculture



# CONSERVATION AGRICULTURE

- ★ Minimal soil disturbance
- ★ Preservation of residues that provide permanent soil cover
- ★ Diverse crop rotations
- ★ Use of cover crops
- ★ Integrated pest management
- ★ Reliance on precision, highly efficient irrigation
- ★ Controlled or limited mechanical traffic over agricultural soils

# More Profit With Less Tillage

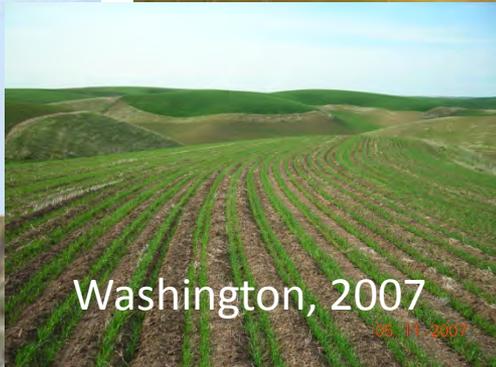
Ernest E. Behn



Iowa, 2001



Alabama, 2001



Washington, 2007



Iowa, 2001



Georgia, 2001



Brazil, 2007



Nebraska, 2007



Brazil, 2004



Strip-till cotton into rolled rye cover crop  
Tifton, GA 2005



Ron and Robert Rayner  
No-till cotton  
Goodyear, AZ

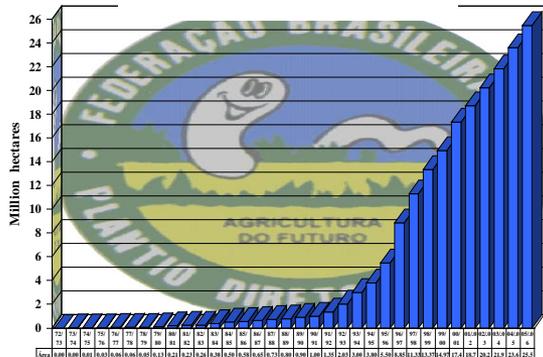




**Strip-till seeded onions in wheat cover crop  
Moses Lake, WA  
2010**

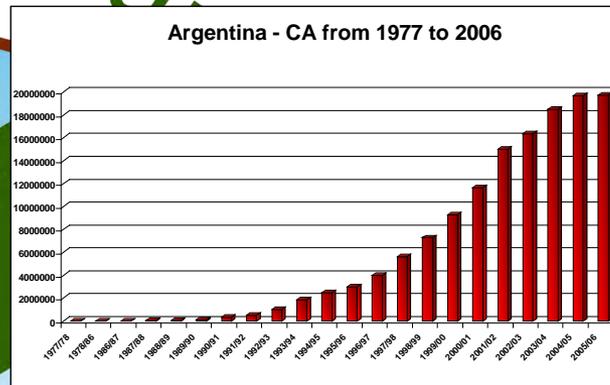
# Agriculture

Brazil - Area under CA from 1972 to 2006



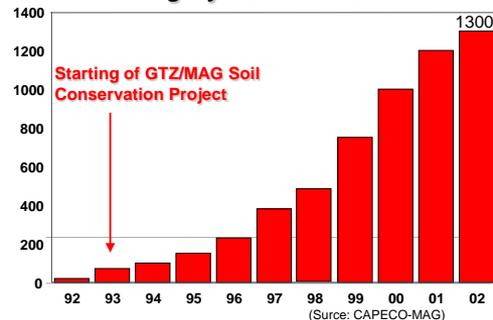
Fonte: EMATER-RS, EPAGRI-SC, EMATER-PR, CATI-SP, FUNDAÇÃO MS, APDC (Cerrado)

Argentina - CA from 1977 to 2006



CA globally - history and adoption

Paraguay – CA area 1992-2001



(Source: CAPECO-MAG)

No-Till Adoption in the U.S. 1994 - 2004

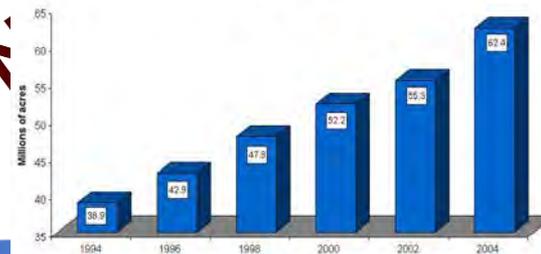
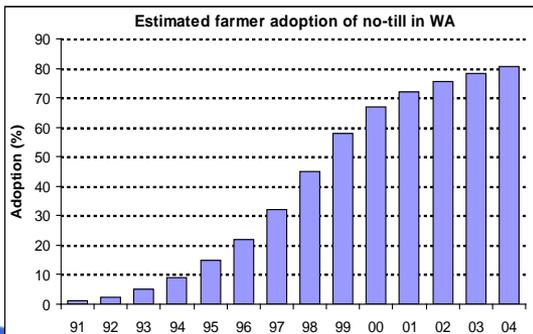


Fig. 2 No-Till Adoption in the U.S. No-till adoption continues to steadily rise. This represents almost 25 percent of the nation's cropland. Source: Conservation Technology Information Center

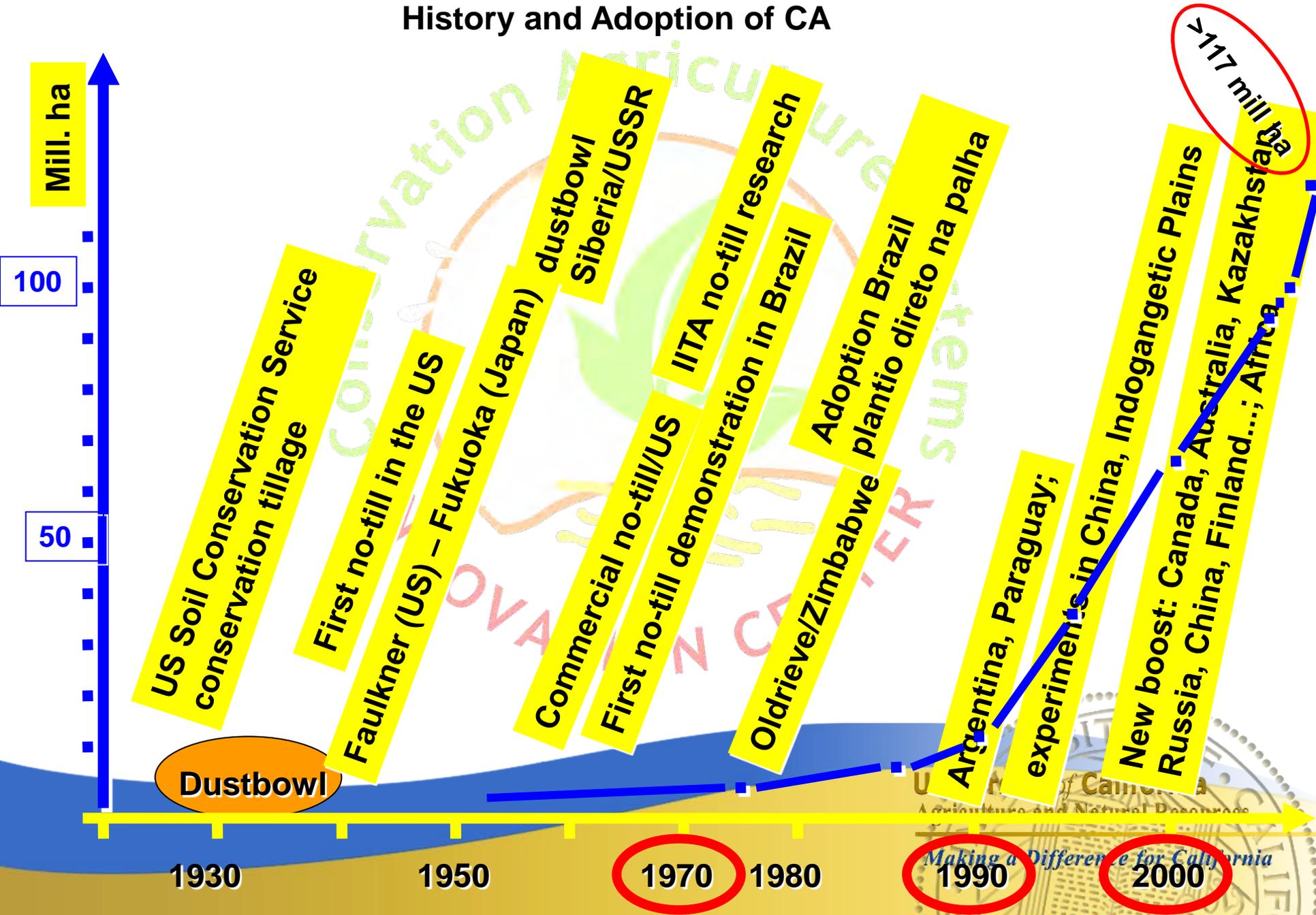
Estimated farmer adoption of no-till in WA



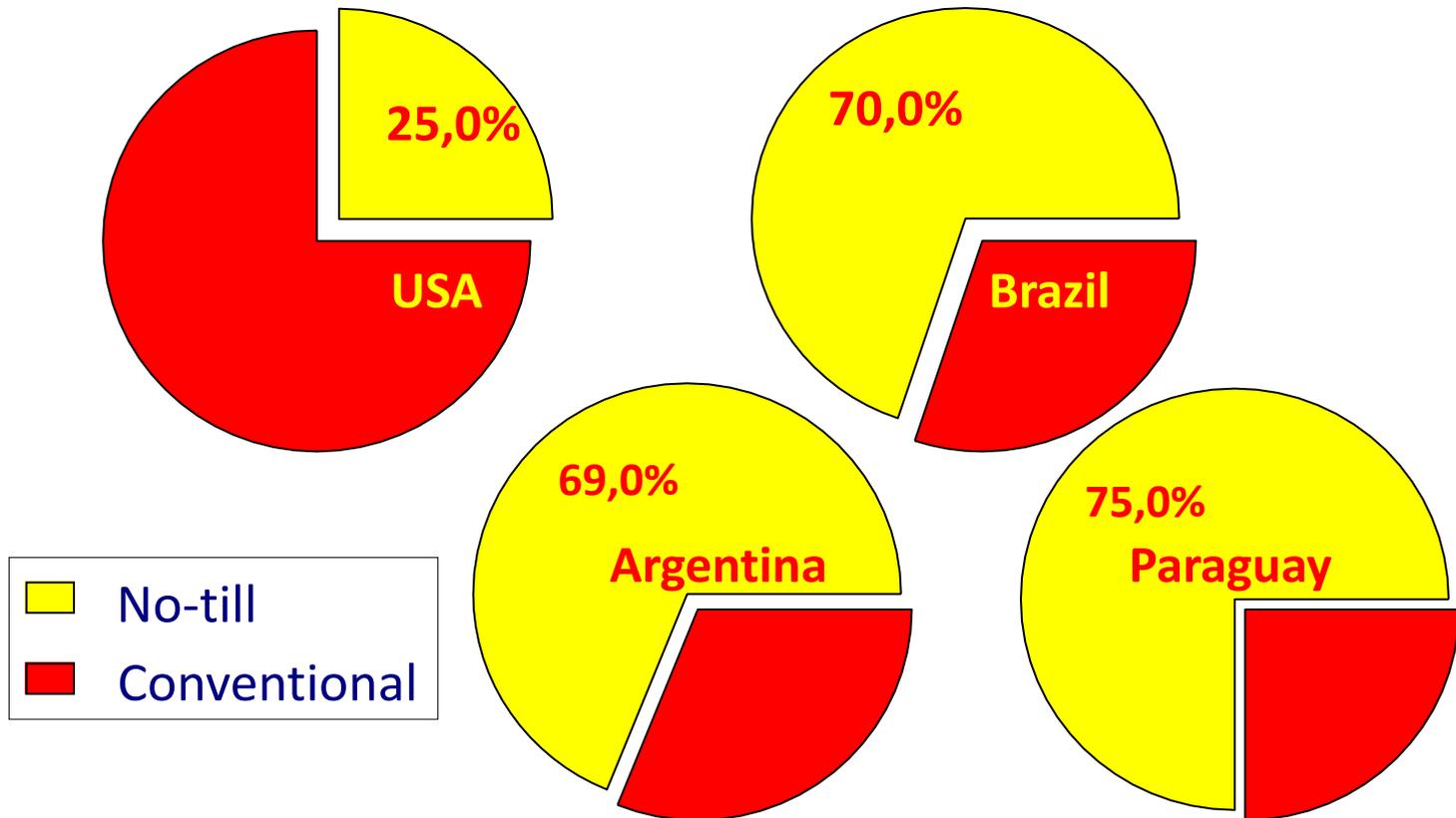
University of California  
Agriculture and Natural Resources

Making a Difference for California

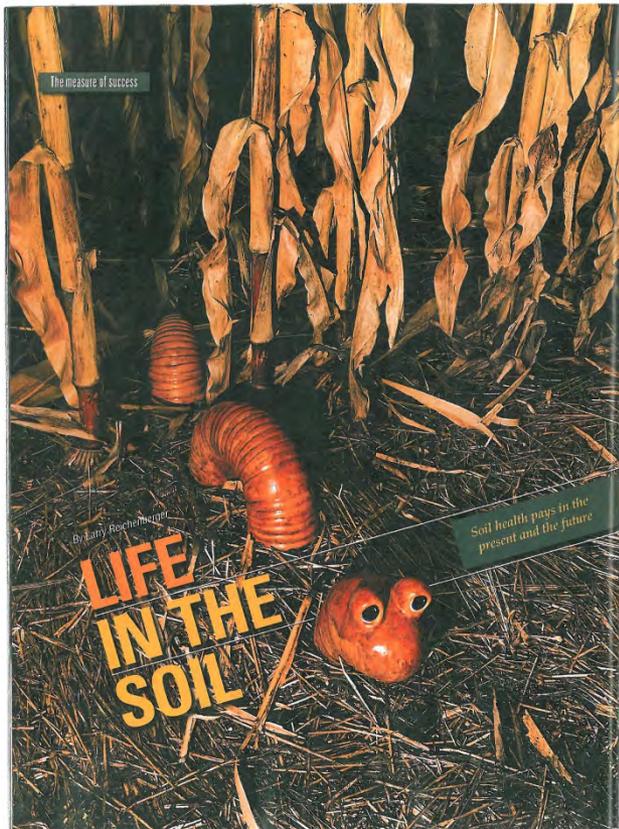
# History and Adoption of CA



## CA Adoption relative to total cropland



It is estimated that in less than a decade > 85% of the cultivated area will be under No-till.



**H**ealthy soils are the ultimate measure of success for Rick Bieber. With the zeal of an evangelist, this Trail City, SD, farmer promotes methods that enhance soil quality. He swears by the old adage, "If you take care of your soil, your soil will take care of you."

"The soil is the greatest source of wealth in the world, but most farmers squander its potential," says Bieber, who farms with his son, Ben. "The soil isn't just a tool, it's a full partner in a farming operation and deserves to be treated with respect. Learn to protect the soil and to manage it like it's really alive—because it is—and you will see an unbelievable response."

**Diversity in crops.** Bieber's recipe for a healthy soil includes long-term no-till, intensive crop rotation, and cover crops. "We started no-tilling in 1987 and soon learned we needed to diversify and intensify our crop rotation to utilize the moisture we were saving and to boost microbial activity in the soil. From wheat/fallow and wheat/corn/fallow, we changed to rotations that also include chickpeas, millet, flax, sunflowers, and alfalfa. More recently, we've added cover

► **Left:** Rick Bieber says healthy soil makes farming fun—a point emphasized by this giant earthworm he poses for frequent visitors to his farm.

crops that are planted after wheat and interseeded into growing corn."

"Now, our yields are higher with fewer inputs so profitability has increased. And, the impact of drought, heat, and other stress is less. Our 10-year proven corn yields are 408% of the county average, and wheat yields are 358% of the norm," adds Bieber.

**Credit the soil.** Bieber is quick to deflect credit for this performance. "It's totally due to the soil—all I've done is provide what the soil tells me it needs to do its job," he says.

What Bieber provides is a steady supply of carbon—in the form of crop residue and living plant roots—that feeds soil microbes, moderates soil temperatures to protect the microbes, shields the soil surface from erosion, and builds soil organic matter levels.

Bieber measures performance of his system in various ways. "We used to apply 90 pounds per acre of nitrogen and produce 90-bushel corn, but now the same amount of nitrogen produces 160 bushels. That's due mainly to our soil organic matter levels, which are 4-5% in our long-term no-till."

In contrast, typical conventionally tilled fields in Bieber's area have soil organic matter levels around 2%. Soil with higher organic matter not only mineralizes more nitrogen, it also holds more water, and that's the

farm's major benchmark of success.

"We judge our management skills by the amount of grain we produce per inch of rainfall, and we've seen this water-use efficiency increase as our soil health has improved. In 1998 we produced just over 4 bushels of corn per inch of rainfall. By 2001, the first year corn in our rotation grew on cover crops grown in 1998, that had increased to 5.4 bushels per inch. By 2007, that efficiency had increased to 6.23 bushels per inch of rainfall."

**Best combination.** Bieber worked with agronomist Cheryl Reese from South Dakota State University on an intensive cover crop study from 2009 through 2011. "There were 96 trials, and they showed that the best combination of cover crops and fertilizer rates resulted in 12.6 bushels of corn per inch of rainfall. Then in 2012, with a severe drought, corn on our long-term, no-till ground produced 9.54 bushels per inch of rainfall while some new ground—in its first year of no-till—produced only 4 bushels per inch. That was amazingly similar to what we saw in 1998," says Bieber.

**Hungry soil.** His water use efficiency data has convinced Bieber that his soils are hungry for live roots, even in dry years. "Living plants sequester carbon from the atmosphere and deposit it in the soil through their root system, so we want to have something growing every moment that the season allows," he says.

Cover crops allow Bieber to put this conclusion into practice. "We hire an extra man so we can plant cover crops right behind the combine during wheat harvest. And, the cover crops we interseed at the V-6 stage of our corn stay alive well after the corn matures in the fall," he says.

"We're protecting soil not just for the next generation, but for those 100 and 1,000 years from now," he adds. ■



► **Left center:** High organic matter levels have turned Bieber's soils black and fostered a teeming population of earthworms. ► **Left:** Cover crops, including radishes and turnips, are broadcast into corn at the V-6 stage to extend the growing season and improve winter grazing.

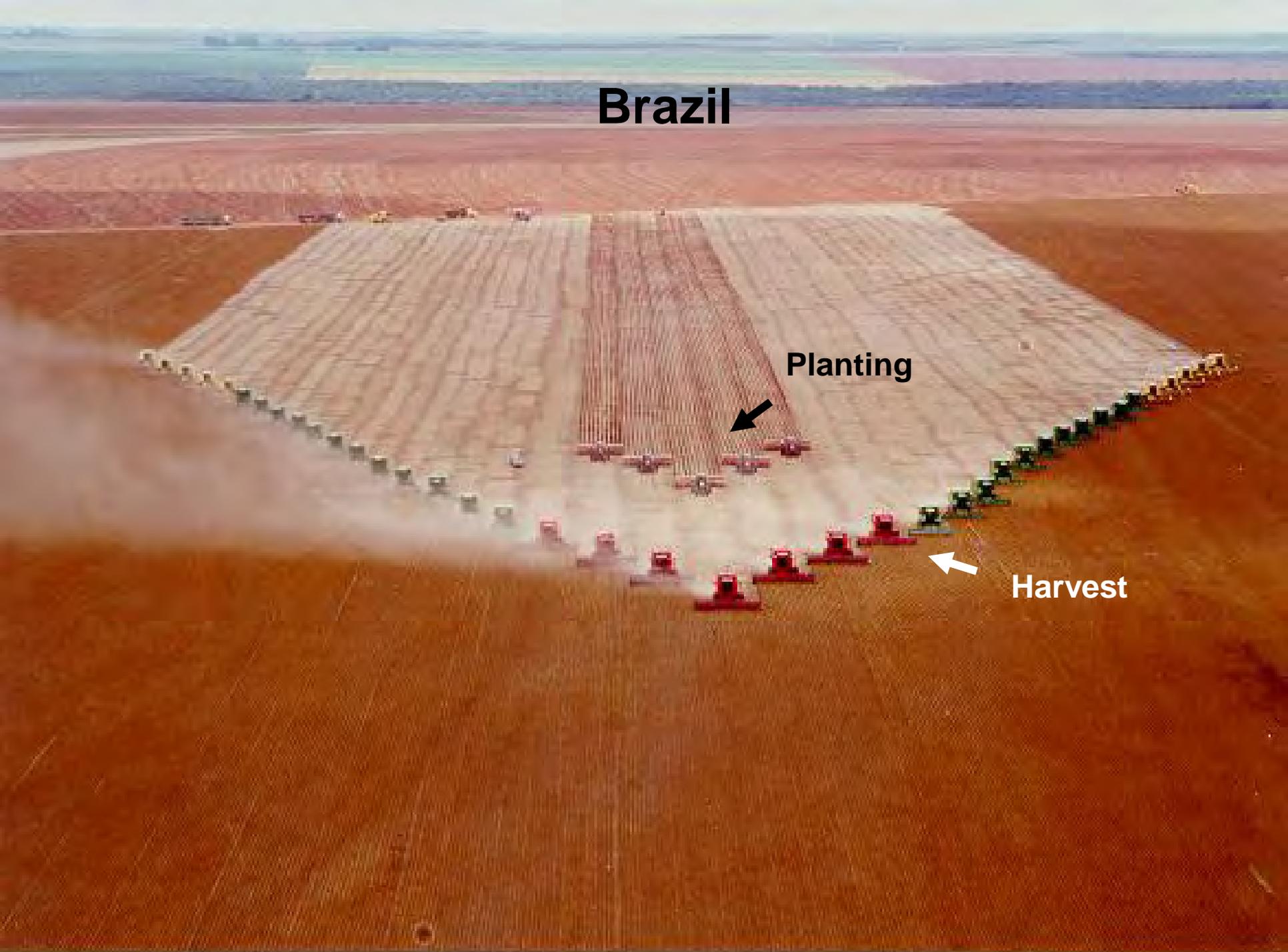
“Soil care’ is what we’re doing.”

Rick Bieber  
Trail City, SD  
January 28, 2014

# Brazil

Planting

Harvest





ASSOCIAÇÃO DE PLANTIO  
DIRETO NO CERRADO

APDC

Affiliated to FEBRAPDP





**Zero Tillage**  
**The key to safe renovation of hill pastures**

How might we begin to imagine more water- and nutrient-use-efficient tillage, residue and irrigation management systems becoming of value and adapted and becoming more widely adopted in California?



# CONSERVATION AGRICULTURE

Row Crop System Development • 1993 – 2015

Cover Crop Residues

Species selection  
1991 - ongoing

Water Use  
1991 - ongoing

Water Balance /  
Runoff 1997 - ongoing

Pollution Reduction  
2001 - ongoing

Single Crop  
CT Development

Tomatoes 1996 -  
ongoing

Melons 1998 - 99

Cotton  
2000 - ongoing

Corn and Wheat  
2000 - ongoing

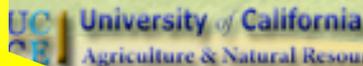
Integrated Irrigated  
Systems Development

Tomato - Cotton 1999 -  
ongoing

Wheat - Tomato 1999 -  
ongoing

Corn - Tomato 2000 -  
ongoing

Dairy Forage 2000 -  
ongoing



CONSERVATION  
AGRICULTURE  
Cropping Systems



Conservation



soil

disease control

harvest efficiency

return on investment

emissions

labor

profitability

regulations

insect control

soil life

**RETHINK THE SYSTEM**

residues

weed control

equipment

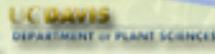
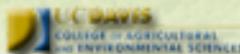
environmental  
impacts

fertilization

technology

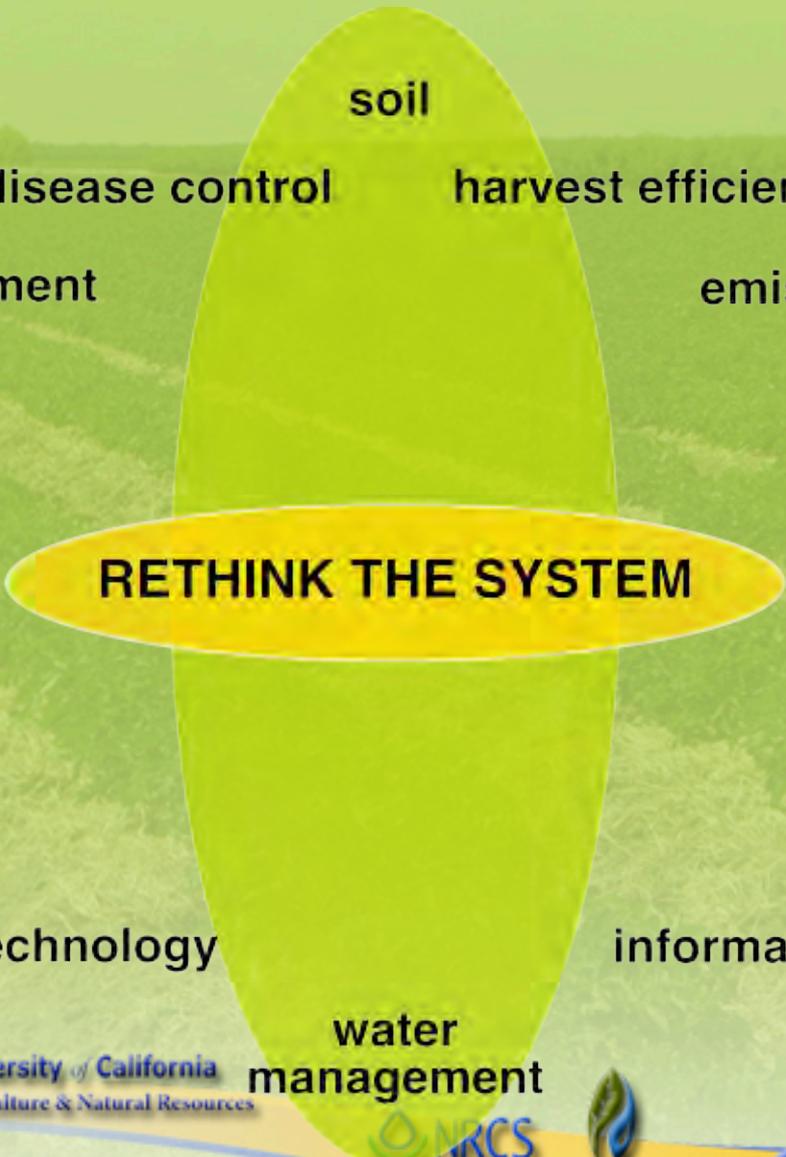
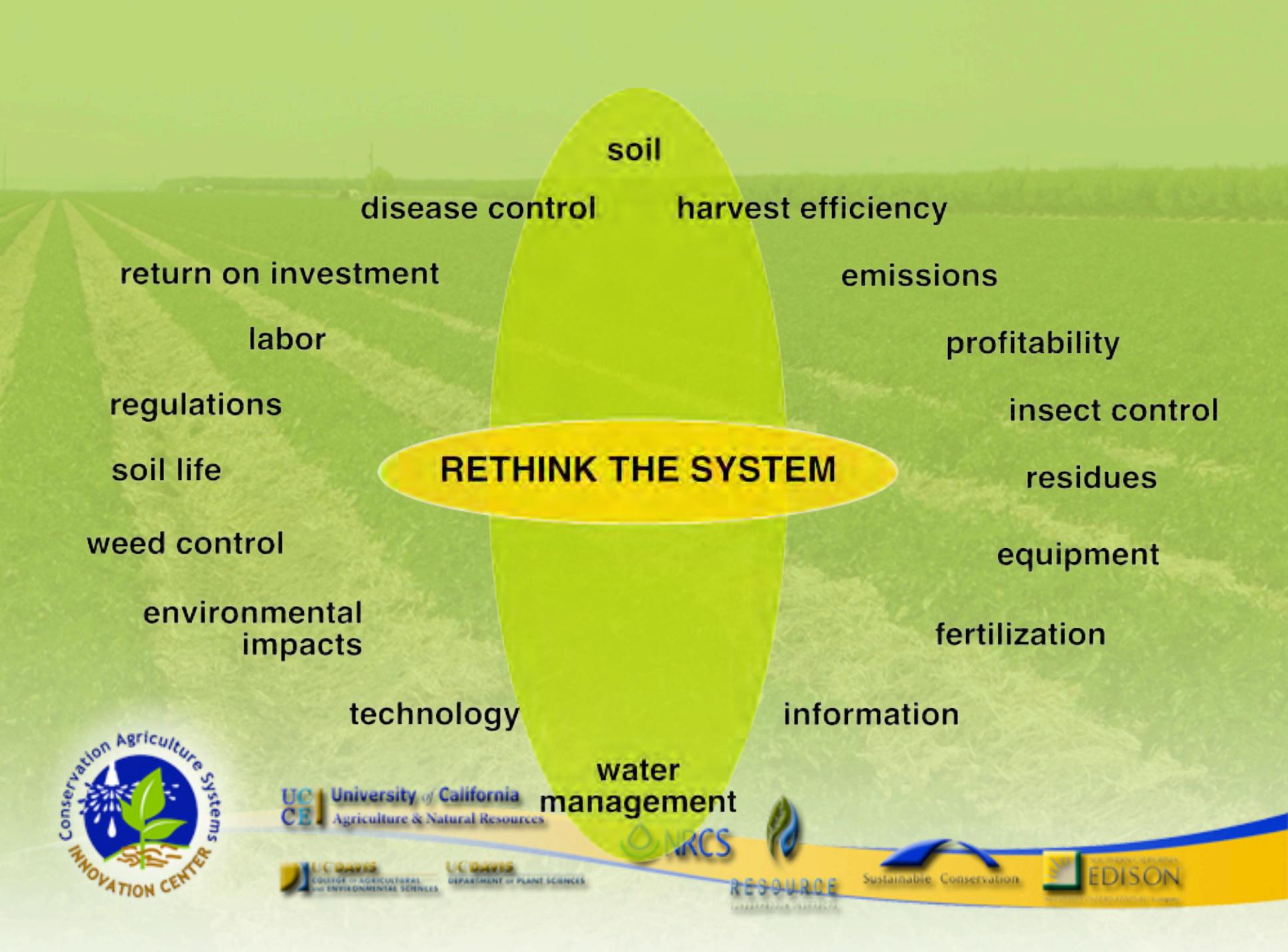
information

water  
management



Sustainable Conservation





soil

disease control

harvest efficiency

return on investment

emissions

labor

profitability

regulations

insect control

soil life

residues

weed control

equipment

environmental impacts

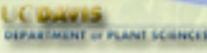
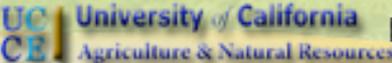
fertilization

technology

information

water management

**RETHINK THE SYSTEM**



Sustainable Conservation



EDISON

soil

disease control

harvest efficiency

return on investment

emissions

labor

profitability

regulations

insect control

soil life

**RETHINK THE SYSTEM**

residues

weed control

equipment

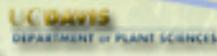
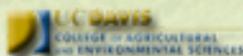
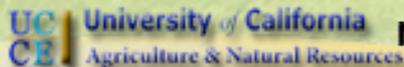
environmental  
impacts

fertilization

technology

information

water  
management



Sustainable Conservation



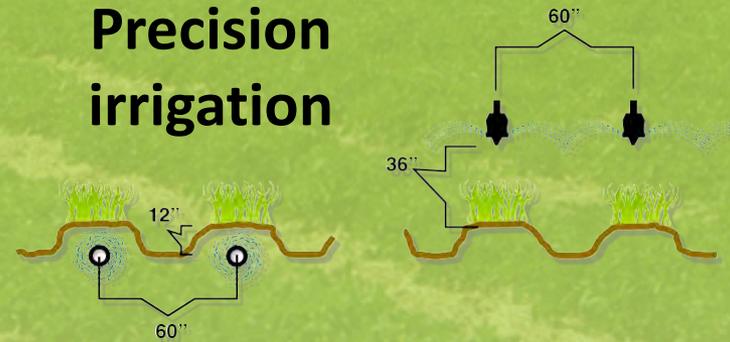
# Merging practices and technologies to achieve advanced conservation agriculture systems

*“No-till is a tool for what we’re trying to achieve.”*

## Microbial diversity



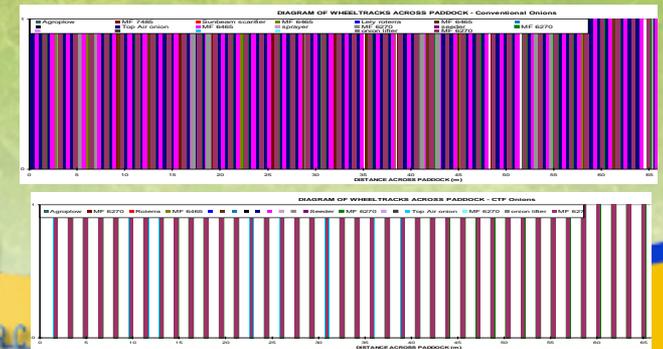
## Precision irrigation



## Generating and preserving surface residues



## Controlled traffic farming



UC Davis College of Agricultural and Environmental Sciences

UC DAVIS COLLEGE OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES

UKCS

RESOURCE

## The research base

From 1999, ongoing work with CT tomato and cotton systems in Five Points, CA

NRI CT Project Field Fall 2007  
UC West Side Research and Extension Center  
Five Points, CA



Rainfed winter cover  
crop being seeded  
into cotton and  
tomato residue Five  
Points, CA 2007



Winter, rainfed triticale, rye and pea cover crop no-till  
seeded into cotton and tomato residues  
Five Points, CA 2008

No-till tomato transplanting  
into cotton and cover crop  
residue  
Five Points, CA  
2007





**No-Till**



**No-till cotton 2011 yields**

**3.2 bales/ac**

## Tillage and cover crop system erosion estimates, soil condition index sub-factors, soil tillage intensity rating and estimates of diesel fuel use.

<b>Cropping System*</b>	<b>Erosion Estimates<sup>‡</sup> RUSLE2 (Mg ha<sup>-1</sup>)</b>	<b>Soil Conditioning index</b>	<b>STIR Average Annual</b>	<b>Diesel fuel use</b>	<b>Fuel cost for entire simulation (\$)</b>
<b>STNO</b>	<b>0.2</b>	<b>-0.71</b>	<b>261</b>	<b>32</b>	<b>128.6</b>
<b>STCC</b>	<b>0.07</b>	<b>-0.96</b>	<b>390</b>	<b>40</b>	<b>160.6</b>
<b>CTNO</b>	<b>0.04</b>	<b>0.43</b>	<b>30.6</b>	<b>9.3</b>	<b>36.8</b>
<b>CTCC</b>	<b>0.03</b>	<b>0.52</b>	<b>37.1</b>	<b>11</b>	<b>43.27</b>

\* STNO = Standard tillage no cover crop, STCC = Standard tillage with cover crop, CTNO = Conservation tillage no cover crop CTCC = Conservation tillage with cover crop.

Soil carbon mass for tillage and cover crop treatments\* at two soil depths  
At the start of the study in the fall of 1999 and in the fall of 2007.

1999			2007		
Depth (cm)	Treatment	Mean <sup>s</sup> (t ha <sup>-1</sup> )	Depth (cm)	Treatment	Mean <sup>s</sup> (t ha <sup>-1</sup> )
<b>0 – 15</b>	<b>NTCC</b>	<b>9.33</b> (0.18, A)	<b>0 - 15</b>	<b>NTCC</b>	<b>16.20</b> (0.53, A)
	<b>STCC</b>	<b>9.25</b> (0.40, A)		<b>STCC</b>	<b>12.69</b> (0.29, AB)
	<b>NTNO</b>	<b>9.27</b> (0.41, A)		<b>NTNO</b>	<b>13.13</b> (0.46, AB)
	<b>STNO</b>	<b>8.87</b> (0.31, A)		<b>STNO</b>	<b>10.84</b> (0.19, B)
<b>15 - 30</b>	<b>NTCC</b>	<b>10.39</b> (0.30, A)	<b>15 - 30</b>	<b>NTCC</b>	<b>12.91</b> (0.62, AB)
	<b>STCC</b>	<b>10.66</b> (0.99, A)		<b>STCC</b>	<b>13.67</b> (0.65, A)
	<b>NTNO</b>	<b>11.40</b> (1.11, A)		<b>NTNO</b>	<b>10.96</b> (0.51, B)
	<b>STNO</b>	<b>9.69</b> (0.52, A)		<b>STNO</b>	<b>11.81</b> (0.31, AB)
<b>Total</b>	<b>NTCC</b>	<b>19.71</b> (0.45, A)	<b>Total</b>	<b>NTCC</b>	<b>29.11</b> (0.94, A)
	<b>STCC</b>	<b>19.91</b> (1.20, A)		<b>STCC</b>	<b>26.36</b> (0.78, AB)
	<b>NTNO</b>	<b>20.67</b> (1.03, A)		<b>NTNO</b>	<b>24.09</b> (0.81, BC)
	<b>STNO</b>	<b>18.57</b> (0.75, A)		<b>STNO</b>	<b>22.65</b> (0.26, C)

**ST**= conventional tillage; **NT**= no-tillage; **NO**= no cover crop; **CC**= winter cover crop

Mitchell et al., 2015  
Agron. J. 107(2):588-596

Values in parentheses are standard error of the means (n= 8).

Within a column, means followed by the same letters are not significantly different using a one-way ANOVA analysis with Tukey HSD means comparison.

## Tillage and Cover Cropping Affect Crop Yields and Soil Carbon in the San Joaquin Valley, California

Jeffrey P. Mitchell,\* Anil Shrestha, William R. Horwath, Randal J. Southard, Nicholas Madden, Jessica Veenstra, and Daniel S. Munk

### ABSTRACT

Rising costs and air quality regulations have created interest in California's San Joaquin Valley (SJV) in production systems that reduce tillage operations and soil disturbance. From 1999 to 2009, we evaluated conventional (CT) and reduced tillage (RT) systems for a cotton (*Gossypium hirsutum* L.) / tomato (*Solanum lycopersicon* Mill.) rotation with (CC) and without (NO) cover crops in a Panoche clay loam soil (fine-bony, mixed, superactive, thermic Typic Haplocambid) in Five Points, CA, in terms of yield, soil C, and the NRCs soil conditioning index (SCI). The RT reduced tractor operations by 90% for tomato and 40% for cotton. Cover cropping produced 38.7 t ha<sup>-1</sup> of biomass. Tomato yields were 9.5% higher in RT vs. CT systems and 5.7% higher in NO vs. CC systems. The CT cotton yields were 10.0% higher than RT yields and 4.8% higher in NO systems, but yield patterns were not consistent from 2005 to 2009. Soil C content was uniform (0–30-cm depth) in 1999 (19.72 t ha<sup>-1</sup>) and increased in all systems in 2007 (t ha<sup>-1</sup>): RTCC 29.11, CTCC 26.36, RTNO, 24.09, and CTNO 22.65. Soil C content of RT and CT systems did not differ, but was greater in CC than in NO systems. In the 0- to 15-cm depth, RT increased soil C, indicating stratification, and also increased C in the occluded light and mineral fractions. The SCI was positive for RT treatments, predicting a soil C increase, and negative for CT systems, predicting a soil C decline, but measured soil C content increased in all systems. Results show that RT maintains or increases yields relative to CT, and CC stores more soil C than NO.

Conservation tillage practices such as no-tillage, strip-tillage, and mulch-tillage are currently used on <2% of annual crop hectares in the Mediterranean climate of California's SJV (Mitchell et al., 2007). Traditional tillage systems in this region, that consistently includes six of the nation's top 10 agricultural production counties (USDA NASS, 2011), have been used since the introduction of irrigation beginning in the late 1930s. These systems enable the predictable production of rotations of crops such as cotton, wheat (*Triticum aestivum* L.), safflower (*Carthamus tinctorius* L.), and sugar beet (*Beta vulgaris* L.), as well as vegetables, such as tomato, melon (*Cucumis melo* L.), onion (*Allium* spp.), lettuce (*Lactuca sativa* L.), and garlic (*Allium sativum* L.). Cropland in the SJV generally has little or no slope and thus concerns about soil erosion have not been a major driver for RT practices as in other regions. In recent years, however, increased diesel fuel prices and

interest in reducing labor needs and dust emissions in SJV crop production systems have provided incentives for RT options.

A variety of "minimum-tillage" approaches that consolidate tillage functions and reduce the total number of tillage passes across a field are now being used (Mitchell et al., 2009). These minimum-pass systems rely on combining tillage passes and do not necessarily reduce the overall volume of soil that is disturbed (Reicosky and Allmaras, 2003; Mitchell et al., 2004). Sustained RT practices such as no-tillage (Derpech et al., 2010) or zone tillage systems (Luna et al., 2012; Solt et al., 2001) and their abilities to increase soil C sequestration over time have been reported (Franzmeiers and Follett, 2005; Martens et al., 2005). However, there has been no system developed in the SJV to evaluate the capability of the more classic forms of RT management to reduce production costs or to increase soil C sequestration. Although successful RT systems have been implemented elsewhere for a number of the crops commonly produced in the SJV (Wiatrak et al., 2006; Sin Prieto et al., 2007; Sainju et al., 2005), these RT systems have been employed in rainfall production regions. The arid SJV receives about 180 mm of rainfall annually and contemporary cropping systems are completely dependent on irrigation. Management of these systems can be complicated by surface plant residues that tend to accumulate in RT fields to higher levels than in CT fields.

In 1999, we began research in Five Points, CA, to evaluate RT tomato and cotton systems with and without winter cover crops

Abbreviations: CC, winter cover crop; CDEA, California Department of Food and Agriculture; CT, conventional tillage; NO, no winter cover crop; NRCs, Natural Resource Conservation Service; BW, pink bollworm; RT, reduced tillage; SCI, soil conditioning index; SJV, San Joaquin Valley; SOM, soil organic matter; STTR, soil tillage intensity rating.

### 1 Trade-offs between winter cover crop production and soil water depletion in the San 2 Joaquin Valley, California

### 4 Abstract:

3  
4  
5  
6 Cover crops are currently not widely used in annual crop production systems in California's  
7 semi-arid Central Valley due to concerns about lost opportunity costs and uncertainties about  
8 water use. From 1999 through 2014, we quantified cover crop biomass production for a variety  
9 of mixtures under winter precipitation and limited supplemental irrigation. In a separate study,  
10 we also determined changes in soil water storage under three cover crop mixtures compared to  
11 fallowed plots during two (2013 and 2014) winter periods to investigate tradeoffs associated with  
12 water use by cover crops in this region. Over the 15 years of the project that were characterized  
13 by recurring drought, a total of 56 t ha<sup>-1</sup> of aboveground cover crop biomass was produced with a  
14 total precipitation of 209 cm and 20 cm of supplemental irrigation applied in 1999, 2012, and  
15 2014. Cover crop biomass varied from 39 kg ha<sup>-1</sup> in the low precipitation period (winter 2006 –  
16 2007) to 9,346 kg ha<sup>-1</sup> (winter 2000 – 2001). Soil water storage in the sampled depth (0 – 90 cm)  
17 for the fallow and each of the cover crop mixtures was compared each year from January to  
18 March, the primary growing period for cover crops in this region. Net soil water storage  
19 increased during this period by 4.8 and 4.3 cm in 2013 and 2014, respectively for the fallow  
20 system but in the cover crop mixture plots, there was no additional water storage. Instead, water  
21 use by the cover crop mixes resulted in a negative water balance over the cover crop growth  
22 period on an average of 0.47 cm and 0.26 cm in 2013 and 2014, respectively. Thus, compared to  
23 the fallow system, cover crops depleted 5.3 cm and 0.67 cm more water in from the 0 – 90 cm

J.P. Mitchell, Dep. of Plant Sciences, Univ. of California-Davis, One Shields Ave., Davis, CA 95616; A. Shrestha, Dep. of Plant Science, California State Univ. Fresno, 2415 E. San Ramon Ave., MS AS 72, Fresno, CA 93740-8033; W.R. Horwath and R.J. Southard, Dep. of Land, Air and Water Resources, One Shields Ave., Davis, CA 95616; N.M. Madden, Office of International Programs, One Shields Ave., Davis, CA 95616; J. Veenstra, Eglar College, 74 King St., Saint Augustine, FL 32084; D.S. Munk, Univ. of California Cooperative Extension, Fresno County, 590 E. Shaw Ave., Fresno, CA 93710. Received 7 Aug. 2014. Accepted 13 Oct. 2014. \*Corresponding author (jpmitchell@ucdavis.edu)

Published in *Agron. J.* 107: 588–596 (2015)  
doi:10.2134/agronj140415

Copyright © 2015 by the American Society of Agronomy, 5585 Guilford Road, Madison, WI 53711. All rights reserved. No part of this periodical may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or any information storage and retrieval system, without permission in writing from the publisher.

**NO-TILL  
FARMER**

November 2014  
Volume 43, No.11  
[www.no-tillfarmer.com](http://www.no-tillfarmer.com)

# Conservation Tillage Guide

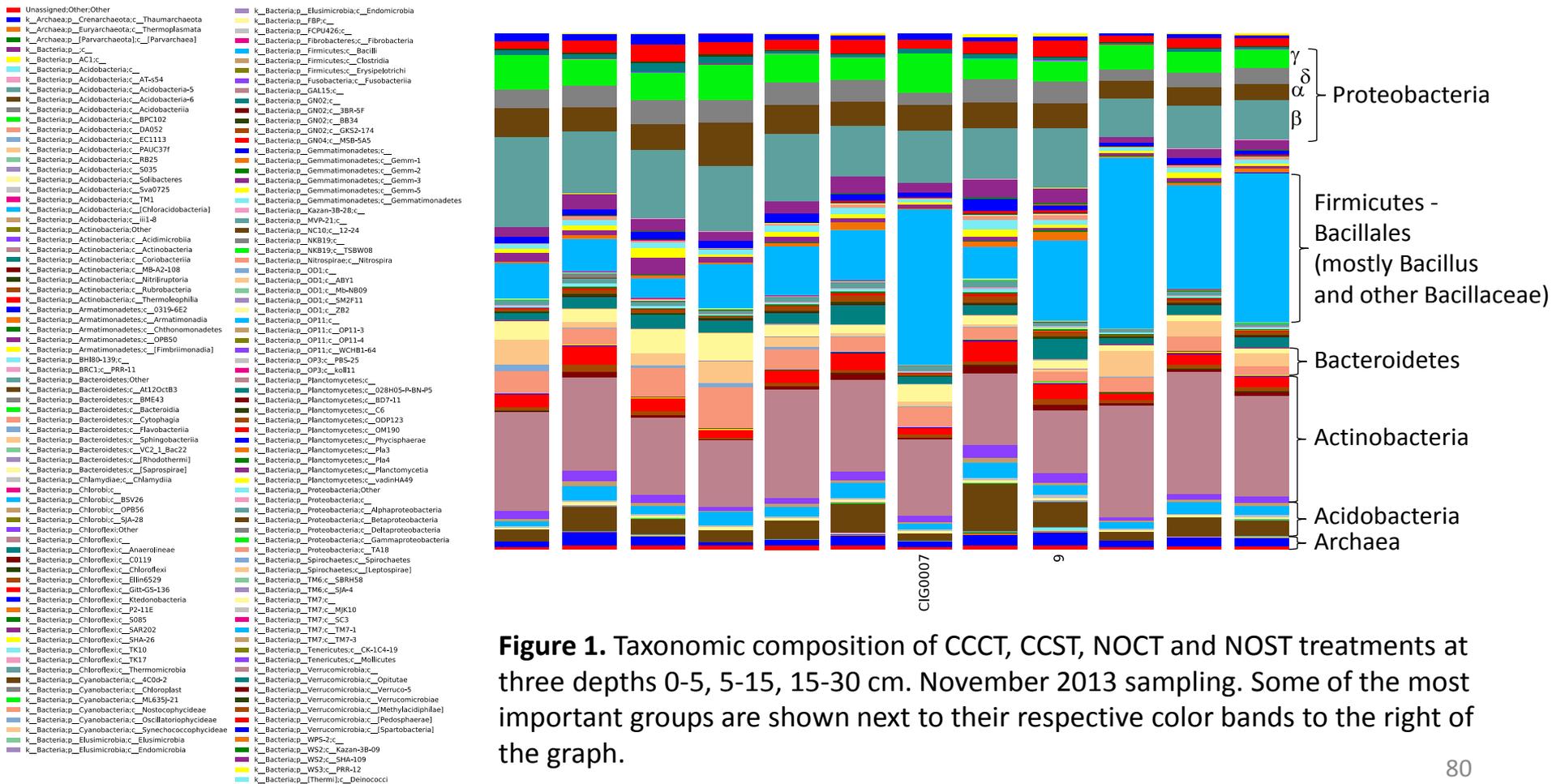


## What Makes Your No-Till Soils Tick?

- The No-Till Solution For Preventing Algae Blooms
- How Grazing Cover Crops Gives No-Tillers A Boost
- Gauge Wheels Head Down A New High-Tech Path

# Community Taxonomic Composition

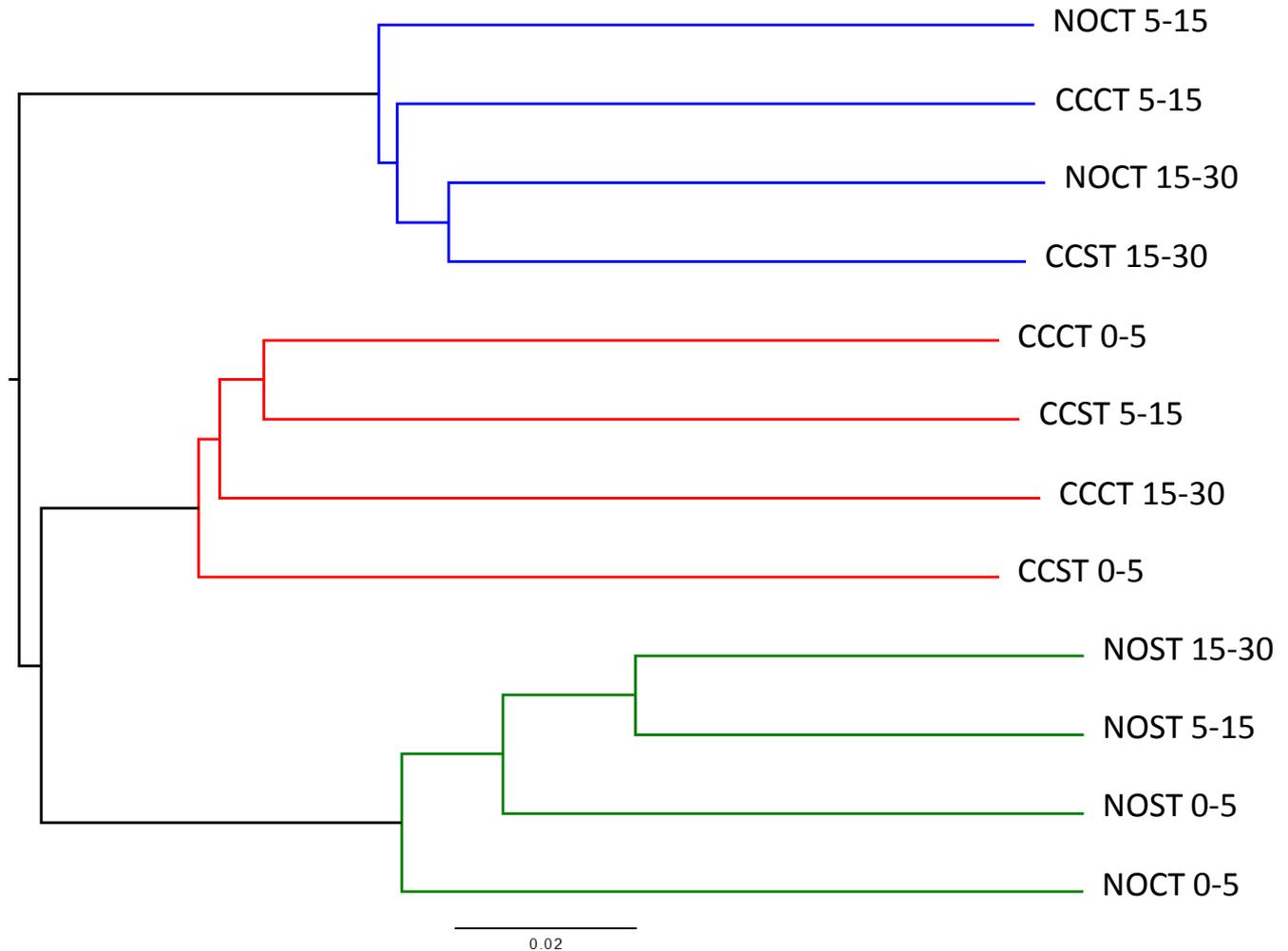
- NOST at all depths and NOCT 0-5 cm show much higher proportion of Firmicutes (mainly Bacillus and other Bacillaceae) (28.1±5.5%) than all other soils (8.3±3.5%).
- Higher Firmicute numbers are offset primarily by lower Proteobacteria in the high Firmicute soils in comparison to other soils (19.9±3.5% vs 27.4±3.9% respectively).
- Some information on Archaea is available, though the primers used may not provide a highly accurate representation of the Archaeal community.



**Figure 1.** Taxonomic composition of CCCT, CCST, NOCT and NOST treatments at three depths 0-5, 5-15, 15-30 cm. November 2013 sampling. Some of the most important groups are shown next to their respective color bands to the right of the graph.

# Beta Diversity

- Beta diversity is the variation in species composition among distinct samples (e.g. treatment, depth).
- Unweighted Pair Group Method with Arithmetic mean (UPGMA) is a hierarchical clustering method using average linkage used to interpret beta diversity distance matrices.
- Clustering of NOST treatments at all depths with NOCT 0-5 cm (Figure 3) is consistent with similarities observed in taxonomic composition analysis.



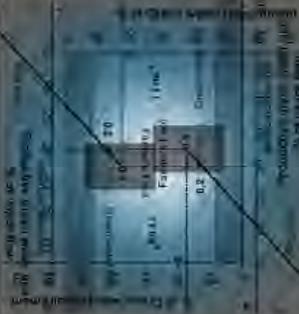
**Figure 3.** UPGMA consensus tree for beta diversity of CCCT, CCST, NOCT and NOST treatments at three depths 0-5, 5-15, 15-30 cm. November 2013 sampling.

# Conclusions (preliminary)

- Some of the cover crop treatment soils show highest species richness, while some of the no cover crop soils show least richness.
- NOST treatments and NOCT at 0-5 cm show similar trends in community composition and also cluster together in beta diversity analysis.
- While we have not yet been able to assign soil functions to differences in firmicute and proteobacteria percentages, the trend for higher percentage of proteobacteria in conservation tilled plots has been observed in at least one other study (no-till rice paddy fields; Aslam, Z, Yasir, M, Yoon, HS, Jeon, CO and Chung, YR (2013). "Diversity of the bacterial community in the rice rhizosphere managed under conventional and no-tillage practices." Journal of Microbiology 51(6): 747-756)
- The sequencing results are consistent with other data from Five Points and show that:
  - cover crops exert a strong influence on microbial community composition as well as soil properties.
  - the NOST treatment is distinct from the other three treatments.
- There is more diversity in the cover crop soils.
- This might have relevance in terms of resilience.



Garrison Sposito\*



To ensure global food security, crop production must outpace human population growth significantly during the next 40 yr. This review makes the case that this challenge can largely be met by optimizing the management of “green water” (soil water directly available to plant roots), an often overlooked resource whose annual global flow in fact matches that of all the rivers in the world flowing to the sea.

Dep. of Environmental Science, Policy and Management, Univ. of California at Berkeley, Mulford Hall, MC 3114, Berkeley, CA 947 20-3114. \*Corresponding author: gsp@soil@berkeley.edu.

Vadose Zone J.  
doi:10.2136/vzj2013.02.0041  
Received 7 Feb. 2013  
Open Access

© Soil Science Society of America  
5585 Guilford Rd., Madison, WI 53711 USA.  
All rights reserved. No part of this periodical may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or any information storage and retrieval system, without permission in writing from the publisher.

## Green Water and Global Food Security

It is widely understood that crop production must increase at least twice as fast as human population growth during the coming 40 yr to meet global food demand. Tested strategies for achieving this goal have not yet emerged, but some stipulations to guide in the search for them can be made. Adverse ecological impacts of land conversion to agricultural use and freshwater withdrawals for irrigation will strongly limit the viability of these two traditional approaches to increasing crop production, whereas abundant opportunity exists for optimizing soil water availability to and consumption by rainfed crops to increase their yields by twofold or more. This optimization, however, will require major campaigns in multidisciplinary basic research on positive plant–soil feedbacks that increase crop biomass by influencing the rhizosphere, through which 40% of the global freshwater flow passes annually.

*But if the soil breathes steaming vapors out,  
Drinks moisture in, and when it wants to, breathes  
The moisture out again, and if it's always  
Green with the greenness of its grasses and  
Never corrodes the blade of the plow with rust,  
Then that's the place to drap your flourishing vines  
Upon your elms, the place that will produce  
Rich olive oil, the place (as the billing will show)  
That makes the plowing easy for the beasts  
Because the soil is easy for the plow.*

—Publius Vergilius Maro (Virgil), *Georgics*, Book II (Ferry, 2005)

**Despite a decline in growth rate by almost half** during the past 40 yr, estimates of the global human population place it at 8 billion in 2024, with more than 9 billion expected by 2050 (Roberts, 2011; Tilman et al., 2011). This latter figure represents an increase of the current world population by about 30%, but the corresponding percentage change in food crop production to meet projected world demand will be much larger because it is driven by not only population growth but also personal income growth (Kearney, 2010; Tilman et al., 2011). Current analyses indicate that, to accommodate both of these upward socioeconomic trends, food crop production has to increase by 50 to 100% during the next 40 yr. That is, it must at least double the percentage change in population (de Fraiture et al., 2009; Hanjra and Qureshi, 2010; Gregory and George, 2011; Tilman et al., 2011). Moreover, as will emerge from arguments to be made in the next section, this large relative increase in food crop production will have to come mainly from increasing crop yield per hectare planted—crop intensification—not from converting more land to agricultural use. The challenge posed becomes even more daunting when considered in light of the evident stagnation or even decline in food crop yield increases over the past decade along with the dramatically increasing competition for resources from nonfood crops, particularly biofuels (Hanjra and Qureshi, 2010; Foley et al., 2011; Gregory and George, 2011).

### Framing the Challenge: Constraints

One useful way to approach a challenging problem is to establish the conditions under which any viable solution of it must operate. For the problem of determining ways to increase food crop production sufficiently to meet global demand, the results of recent detailed studies of land and water use worldwide, along with their ecological impacts, lead to three constraints that, in all likelihood, will narrow the range of possible alternatives. One of these constraints limits land conversion, as noted above; another limits agricultural water withdrawals, while the third one reveals a key facet of the consumptive use of water by croplands.

G. Sposito  
Vadose Zone J.  
2013

**RAINFALL**

**Green water flow**

**Green ET flow**

**Green ET flow**

**Blue to green ET flow**

**Blue water resource**

**Blue water flow**

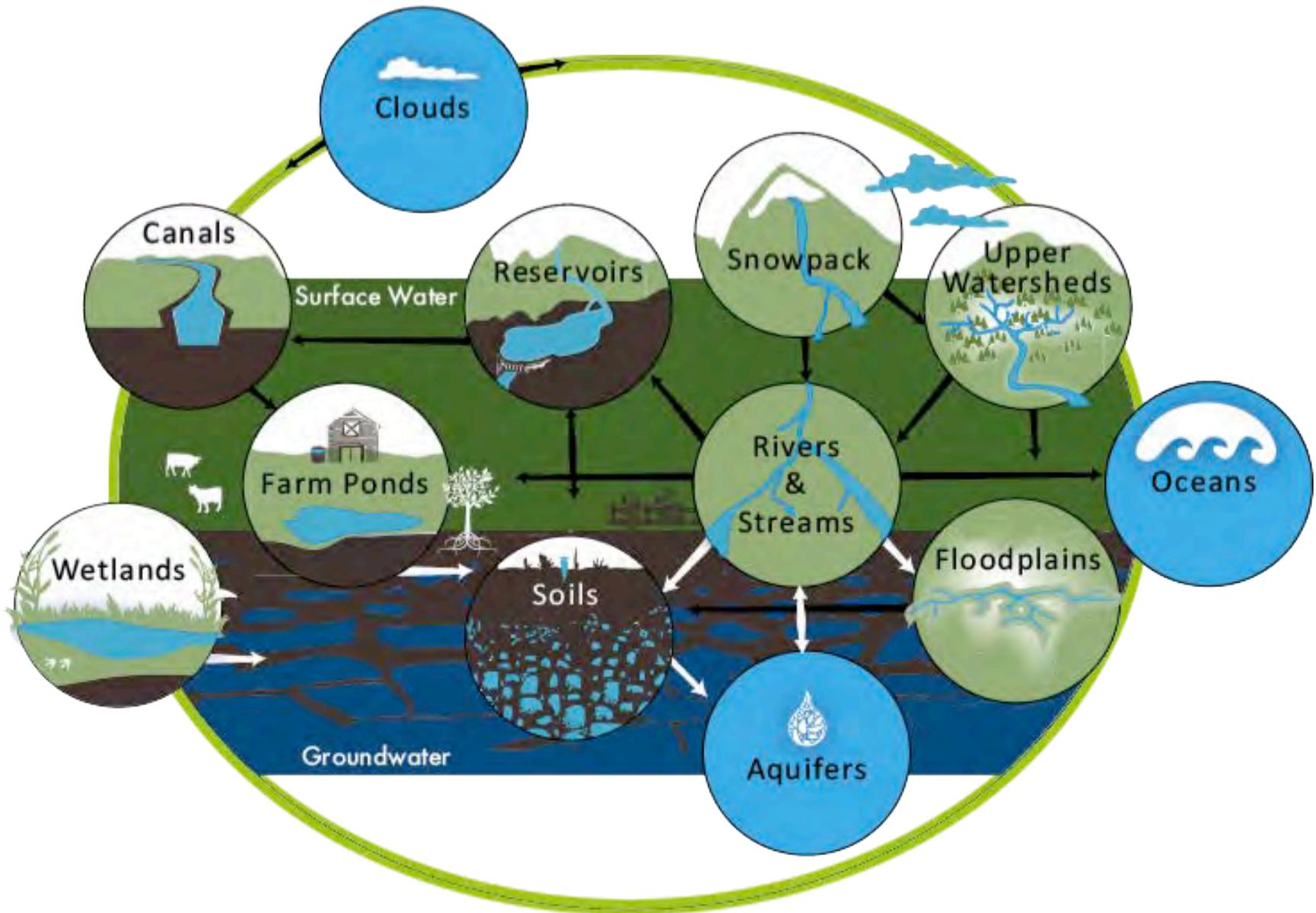
**Green water resource**

**Blue water resource**

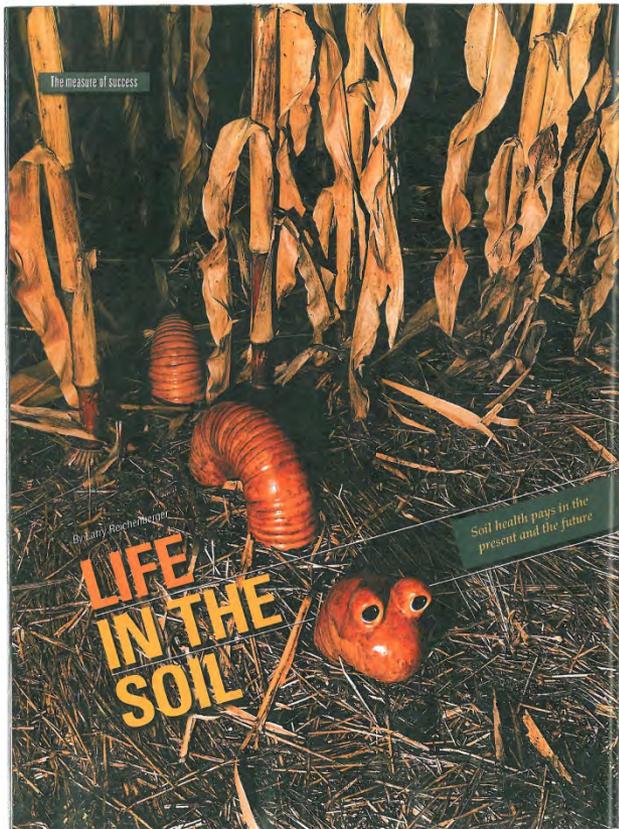
**Sposito, 2014**

**Unsaturated zone**

**Saturated zone**



From Storage to Retention: Expanding California's Options for Meeting its Water Needs  
 California Roundtable on Water and Food Supply  
 November 2012



**H**ealthy soils are the ultimate measure of success for Rick Bieber. With the zeal of an evangelist, this Trail City, SD, farmer promotes methods that enhance soil quality. He swears by the old adage, "If you take care of your soil, your soil will take care of you."

"The soil is the greatest source of wealth in the world, but most farmers squander its potential," says Bieber, who farms with his son, Ben. "The soil isn't just a tool, it's a full partner in a farming operation and deserves to be treated with respect. Learn to protect the soil and to manage it like it's really alive—because it is—and you will see an unbelievable response."

**Diversity in crops.** Bieber's recipe for a healthy soil includes long-term no-till, intensive crop rotation, and cover crops. "We started no-tilling in 1987 and soon learned we needed to diversify and intensify our crop rotation to utilize the moisture we were saving and to boost microbial activity in the soil. From wheat/fallow and wheat/corn/fallow, we changed to rotations that also include chickpeas, millet, flax, sunflowers, and alfalfa. More recently, we've added cover

► **Left:** Rick Bieber says healthy soil makes farming fun—a point emphasized by this giant earthworm he poses for frequent visitors to his farm.

crops that are planted after wheat and interseeded into growing corn."

"Now, our yields are higher with fewer inputs so profitability has increased. And, the impact of drought, heat, and other stress is less. Our 10-year proven corn yields are 408% of the county average, and wheat yields are 358% of the norm," adds Bieber.

**Credit the soil.** Bieber is quick to deflect credit for this performance. "It's totally due to the soil—all I've done is provide what the soil tells me it needs to do its job," he says.

What Bieber provides is a steady supply of carbon—in the form of crop residue and living plant roots—that feeds soil microbes, moderates soil temperatures to protect the microbes, shields the soil surface from erosion, and builds soil organic matter levels.

Bieber measures performance of his system in various ways. "We used to apply 90 pounds per acre of nitrogen and produce 90-bushel corn, but now the same amount of nitrogen produces 160 bushels. That's due mainly to our soil organic matter levels, which are 4-5% in our long-term no-till."

In contrast, typical conventionally tilled fields in Bieber's area have soil organic matter levels around 2%. Soil with higher organic matter not only mineralizes more nitrogen, it also holds more water, and that's the

farm's major benchmark of success.

"We judge our management skills by the amount of grain we produce per inch of rainfall, and we've seen this water-use efficiency increase as our soil health has improved. In 1998 we produced just over 4 bushels of corn per inch of rainfall. By 2001, the first year corn in our rotation grew on cover crops grown in 1998, that had increased to 5.4 bushels per inch. By 2007, that efficiency had increased to 6.23 bushels per inch of rainfall."

**Best combination.** Bieber worked with agronomist Cheryl Reese from South Dakota State University on an intensive cover crop study from 2009 through 2011. "There were 96 trials, and they showed that the best combination of cover crops and fertilizer rates resulted in 12.6 bushels of corn per inch of rainfall. Then in 2012, with a severe drought, corn on our long-term, no-till ground produced 9.54 bushels per inch of rainfall while some new ground—in its first year of no-till—produced only 4 bushels per inch. That was amazingly similar to what we saw in 1998," says Bieber.

**Hungry soil.** His water use efficiency data has convinced Bieber that his soils are hungry for live roots, even in dry years. "Living plants sequester carbon from the atmosphere and deposit it in the soil through their root system, so we want to have something growing every moment that the season allows," he says.

Cover crops allow Bieber to put this conclusion into practice. "We hire an extra man so we can plant cover crops right behind the combine during wheat harvest. And, the cover crops we interseed at the V-6 stage of our corn stay alive well after the corn matures in the fall," he says.

"We're protecting soil not just for the next generation, but for those 100 and 1,000 years from now," he adds. ■



► **Left center:** High organic matter levels have turned Bieber's soils black and fostered a teeming population of earthworms. ► **Left:** Cover crops, including radishes and tumpus, are broadcast into corn at the V-6 stage to extend the growing season and improve winter grazing.

“Soil care’ is what we’re doing.”

Rick Bieber  
Trail City, SD  
January 28, 2014

“...No-till systems have changed cropping practices in the Central Great Plains because of beneficial impacts on water relations and soil health. Some scientists have suggested that no-till systems have initiated a spiral of soil regeneration in this region, where interactions among more favorable water relations, residue production, and crop yield are continually improving soil health and, consequently, future crop performance.”

Randy Anderson  
USDA ARS, Brookings, SD  
Advances in Agronomy  
Volume 80

## NEW PRODUCTS



### R4023 SELF-PROPELLED SPRAYER FROM JOHN DEERE

- 4.5-liter, 173-horsepower Tier 4 Final engine
- 600-gallon poly tank
- 80-foot booms that can fold to 60 feet for tight conditions
- Ideal for small, odd-shaped fields

Additional product information can be requested via "e-inquiry" at [www.no-tillfarmer.com](http://www.no-tillfarmer.com). Click on Reader Service No. 101

### LOOK AT POTASSIUM BASE SATURATION ON SOIL TESTS

In addition to pounds per acre, Lance Tarochione recommends no-tillers look closely at the base saturation percentage of potassium (K) levels on soil tests for soybeans.

Base saturation is an indication of how much plant-available K is being held in the cation exchange sites. If base saturation of K falls below 3%, the crop may struggle to get the K it needs, the technical agronomist for Monsanto says.

If the base saturation level is below 3%, Tarochione suggests no-tillers apply more K, which will flood the exchange sites and correct the problem. A K base saturation of 3-4% is an ideal range, he says. (*Find more soybean fertility tips on pages 14-15.*)

### BENEFICIAL INSECTS MAY REDUCE COVER CROPS

No-tillers broadcasting small-seeded cover crops may want to consider increasing their seeding rate if they have a lot of beneficial insect activity in their fields.

Granivores — insects that eat seeds — each week consume about 1-10% of seeds that lie on the soil surface, says Jonathan Lundgren, research entomologist with the USDA North Central Agricultural Research Laboratory in Brookings, S.D.

**NO-TILL FARMER** (ISSN 0091-9993) is published monthly for farmers interested in any aspect of no-tillage farming by Lessiter Publications Inc., 225 Regency Ct., Suite 100, Brookfield, WI 53045 April, 2015, Vol. 44, No. 4 © Lessiter Publications Inc., 2015. All rights reserved. Reproduction in any form is strictly forbidden without the prior written consent of the publisher of this newsletter.

## NO-TILL TIP OF THE MONTH

### WHEN TO USE A SEED TREATMENT ON SOYBEANS

While no-tillers looking to trim costs in 2015 may consider forgoing a fungicide seed treatment on their soybeans, a fungicide seed treatment serves as an insurance policy to protect the seed and young seedlings until plants have emerged.

- Here are some reasons no-tillers should consider using a fungicide seed treatment:
- **Farm has a history of replanting.** One replant will pay for more than 10 years of a seed treatment.
  - **Farm drainage has not been updated or the field is slow to drain after heavy rains.** All soil-borne pathogens that can infect soybeans require high moisture. If a tile system is poor, old or not functioning well, the field will be saturated longer, increasing the odds of the seeds/seedlings becoming infected.
  - **Seeding rate has been reduced.** With many no-tillers reducing soybean seeding rates to trim expenses, every seed becomes important and seed treatments can have a larger contribution to maintaining early plant populations and final stands.
  - **Fields with numerous pathotypes of *Phytophthora sojae*.** A number of studies show that seed treatments are needed to protect plants if a no-tiller is completely dependent on the partial resistance portion of a resistance package.
  - **Early planting and cool temperatures.** The cooler the spring, the longer the seed or seedling will sit belowground, giving soil-borne pathogens more time to feed.

— Anne Dorrance, Ohio State University

Larger seeds are not at risk for consumption, but some smaller-seeded covers can see a significant reduction in seed, he says.

### IT PAYS TO CONTROL RESISTANT RYEGRASS

Researchers at Mississippi State University (MSU) recently assessed the benefit-to-cost ratio for treating glyphosate-resistant Italian ryegrass before planting corn.

By calculating the weed's impact on corn growth rate and yield, weed scientist Jason Bond says that for every dollar spent on controlling the ryegrass prior to planting corn, they received \$13 back in corn yield. Uncontrolled ryegrass took a little over a bushel of corn each day.

### NO-TILL INCREASES YIELD DURING DRY CONDITIONS

South Dakota State University found that reduced-tillage practices that conserve moisture, plants that use water more efficiently and soil with more organic matter have produced significantly higher yields in dry conditions.

Soil scientist David Clay compared

corn, soybean and wheat yields during droughts in 1974 and 2012. Despite 2012 being a worse drought, corn yields were up more than 200%, soybeans by 50% and wheat by almost 150% over 1974 yields.

Clay estimates that the increased water availability through a reduction in tillage had a net impact of \$1.1 billion on South Dakota agriculture in 2012.

Editor.....Frank Lessiter  
Executive Editor/Publisher.....Darrell Bruggink  
Managing Editor.....John Dobberstein  
Associate Editors.....Laura Allen,  
Jan Gronau,  
Kim Schmidt,  
Dave Kanicki

Technology Editor.....Jack Zemlicka  
Assistant Editor.....Jaime Eftman  
Contributing Editor.....Martha Mintz  
E-Media Director.....Brad Hamze  
Sr. Web Editor.....Cole Vandermause  
Web Editor.....Michelle Drewek  
Conference Manager.....Alice Musser  
Production Manager.....Amy Johnson  
Manager of Print & Magazine Production.....Christopher Nielsen  
Manager of Creative & Design Services.....Jeff Lazewski  
Graphic Designers.....Lewiss Horn III,  
James Kolterman

Vice President of Audience Development.....Patrick Sharpe  
Marketing Manager.....Joanne Volkert  
Sr. Manager of Data & Ad Services.....Bree Greenawald  
Circulation Operations Manager.....Marie Escobar  
Circulation Manager.....Sue Ramstack  
President.....Mike Lessiter  
Vice President of Finance & Administration.....Michael Storts

## Irrigation Extra

### Free H<sub>2</sub>O in no-till residue



### Modern Irrigation, Less Tillage Makes Every Drop Of Water Count

With shrinking water supplies, no-till, strip-till and technology tools can conserve the precious resource and even boost crop yields.

USDA United States Department of Agriculture

Topics Programs and Services Newsroom Blog

Site Map Glossary A-Z Index Advanced Search Help

You are Here: Home / USDA Blog

### Welcome to the USDA Blog

Read our Content Policy

- Categories
- American Recovery and Reinvestment Act (ARRA) (62)
  - Climate Change (60)
  - Conservation (62)
  - Economic Growth (17)
  - Education (36)
  - En Español (17)
  - Energy (24)
  - Environment (47)
  - Food and Nutrition (18)
  - Food Safety (24)
  - Food Security (9)
  - Forestry (17)
  - International (24)
  - Know Your Farmer, Know Your Food (14)
  - Let's Move! (17)
  - People's Garden (10)
  - Plant and Animal Health (11)
  - Rural Development (16)
  - Science (4)
  - Technology and Broadband (14)
  - Trade (3)
  - Unreported (3)

### Sign up for Email Updates

Enter your email address

### Calendar

February 2015						
M	T	W	T	F	S	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	
« Jan			Mar »			

### Tag Cloud

AM APHIS ARRA ARS California Conservation Conservation Energy Farm Bill Farmers FAS FNS Food and Nutrition Food Farm and Jobs Bill Food Safety Forestry FS FSA FSA FSA Health/Environment/Science/KYF Let's Move! NCRS Nutrition People's Garden President Obama President Obama Rural America Rural Development Science Today's Young Farmers and Ranchers USDA Tom Vilsack Trade Tribal USDA

Archives

### Focus on Soil Health Drives Innovation, Moisture Preservation for an Oregon Farmer

Posted by Ben Nichols, Natural Resources Conservation Service, on February 3, 2015 at 10:00 AM



David Brewer is a fifth-generation farmer who manages the Emerson Dell Farm, which was founded in 1852. (Photo by Ben Nichols)

Without irrigation, it's hard to imagine growing a cash crop in an environment that receives less than 18 inches of precipitation annually. Welcome to the world of grain farmers in central and eastern Oregon.

David Brewer is one of these farmers. But rather than looking to the sky for help, he's looking to the soil — improving its health in an effort to retain and preserve every drop of precipitation that happens to fall on his farm.

Brewer is a fifth-generation farmer who manages the Emerson Dell Farm, which was founded in 1852, and now includes more than 2,000 acres of cropland and 800 acres of pasture — just west of The Dalles, Oregon.

Brewer said his family has always had a progressive conservation ethic. They were early adopters of innovative conservation practices, but when he returned from a cover crop and soil health trip to the Dakotas in the 1990s, some of his fellow conservation-minded dry land farmers were aligned.

"They teased us about it, but it really was an encouragement and inspiration," he said.

Brewer said that despite operating in different precipitation zones and cropping systems, the lessons he learned in the Dakotas were all focused on finding the soil and letting the soil take care of his crop. "I think if a reader for those in regions with more water," he said, "it may look different but that same focus on soil health ought to work."

"We've already seen by thinking outside the box a little bit and putting our crops in different orders, including putting some diversity in our crop rotation, we are raising better crops, bigger crops," he said.

Brewer's enthusiasm and optimism notwithstanding, establishing cover crops after harvesting a cash crop — and after reducing till to such an extent that precipitation for the growing year is about as challenging as any agronomic problem a farmer can face.

The need to capture and preserve moisture was one of the leading drivers behind the widespread adoption of a key conservation practice in his area, strip-tillage, despite the fact that many farmers didn't believe direct seeding would work there.

Direct seeding is a no-tillage practice in which seeds are planted directly into an unconsolidated field. The process allows residue from the previous crop to remain intact over the winter and fallow period, which helps retain additional moisture and improve soil health.

"I think there is more incentive to do strip-tillage in a low rainfall environment because you just don't have the water to give away and certainly in this case you don't have the soil to give away," he said. "I think in terms of low rainfall there is just as much to gain from a productivity standpoint by keeping that soil undisturbed and the residue on top of the soil."

USDA's Natural Resources Conservation Service (NRCS) practices many of the conservation practices that Brewer uses on his farm. NRCS provided Brewer with technical and financial assistance to implement a variety of those practices on the land.

Moreover, Brewer believes in the power of innovation and tenacity. As a recipient of a Conservation Innovation Grant from NRCS, he is exploring what crop rotations work best locally.

"I think as long as we keep focused on doing the right thing for the soil, for the land, then it will all



**“Take the ‘E’ out of ‘ET’ and the ‘T’ out of ‘can’t”**

**Dwayne Beck  
South Dakota State University  
(South Dakota Hall of Fame 2008)**



First recorded example of no-till,  
high residue planting with two  
irrigations avoided because of residues

Five Points, CA

July 3, 2003

“Take the ‘E’ out of ‘ET.’”

Dwayne Beck  
South Dakota State University

*We estimated 0.89 and 0.97 inches (2.3 and 2.5 cm) more water retained in the surface foot of soil under no-till than in tilled soil following intercrop tillage between wheat silage and corn.*

*In press  
California Agriculture  
April 2012*

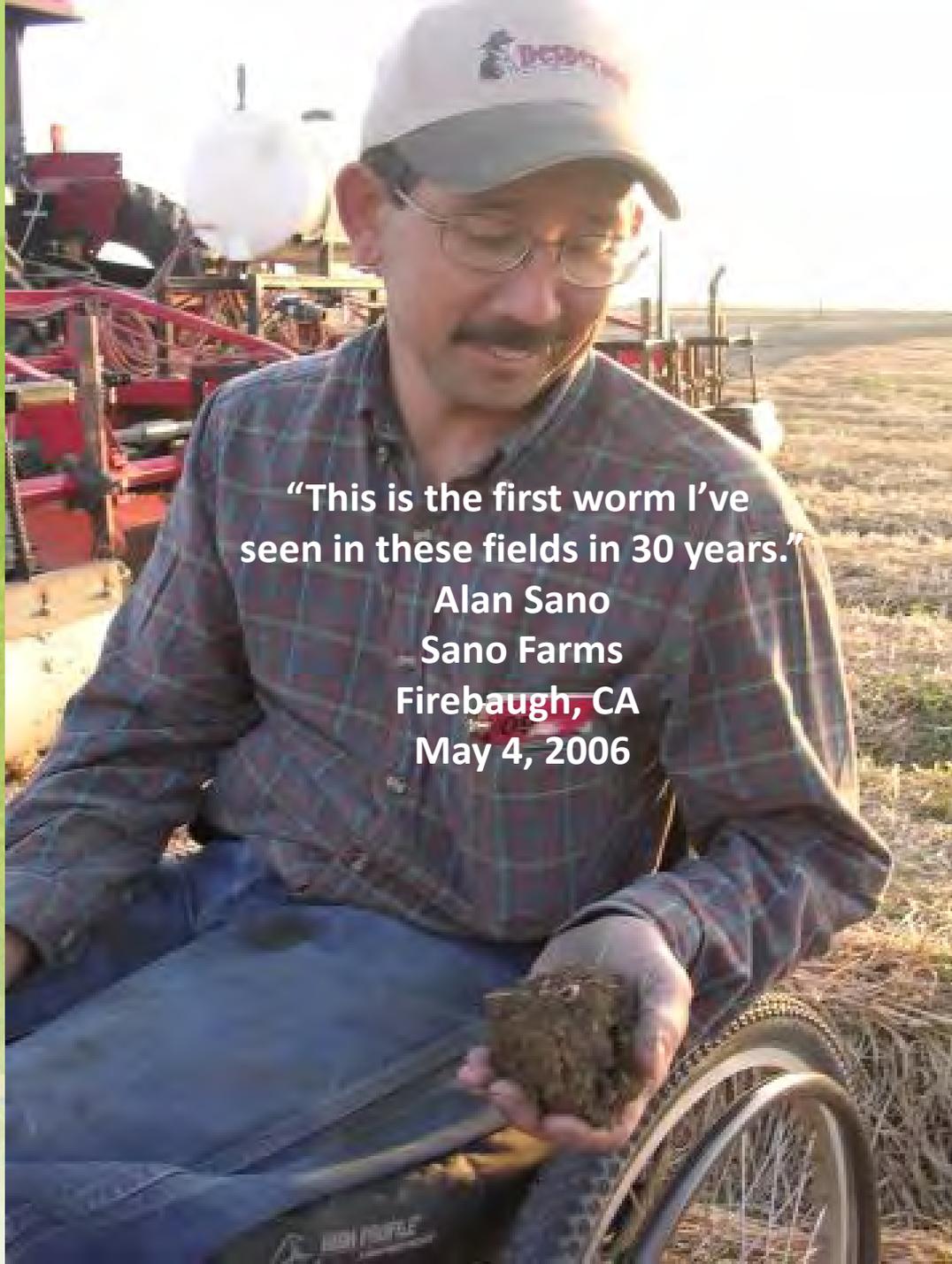


**Soil evaporation study under residue mulch and bare conditions  
Five Points, CA  
September 2009**

*Assuming a seasonal crop evapotranspiration demand of 30 inches,  
coupling no-tillage with high residue preserving practices could  
reduce summer season soil evaporative losses by  
about 4 inches (10.2 cm) or 13%.*

*In press  
California Agriculture  
April 2012*





**“This is the first worm I’ve  
seen in these fields in 30 years.”**

**Alan Sano  
Sano Farms  
Firebaugh, CA  
May 4, 2006**





**Eight-row 60" strip-tilled cover crop tomato  
transplanting  
The Morning Star Company  
Hollister, CA  
2010**



**First-ever strip-tilled cotton  
into wheat residue  
Firebaugh, CA  
2013**



Richie and Shannon Iest  
and NRCS Conservationist  
Iest Dairy  
Chowchilla, CA  
Attention to soil health  
2009

## Stewardship Profiles In California Agriculture Land Conservation and Air Quality

### GIACOMAZZI DAIRY

Dino Giacomazzi is a fourth-generation dairy farmer whose 900-acre farm has been in operation, southeast of Hanford, since 1893. He and his family live on the dairy property and oversee all aspects of its operations. Mr. Giacomazzi has been on the forefront of land conservation, his use of conservation tillage that has reduced air pollution, combined with his outreach efforts through field days on the farm, an informative blog, and social media websites earned him the 2012 Leopold Conservation Award.

### LEADING THE WAY ON SUSTAINABILITY

Although conservation tillage (CT) has gained traction in much of the country, farmers in California's high value crops have been slower to make the transition. Mr. Giacomazzi first used CT in the spring of 2005 as part of an Environmental Quality Incentives Program contract received through the USDA Natural Resources Conservation Service. The following year Mr. Giacomazzi was using CT for all of his corn production and was actively experimenting with different implements, corn varieties, and planting configurations to maximize yield and minimize pollution. Since 2005, Mr. Giacomazzi's implementation of the land ethic has gone beyond CT and now includes water, nutrient, and pest management, along with twin row cropping, in a holistic management practice termed "biological farming."



### ACHIEVEMENTS

- Recipient of the 2012 Leopold Conservation Award for actively living a land ethic
- Reduced pollution from decreased use of diesel tractors and reduction of airborne dust particulate matter from soil tillage
- Creation of a public outreach and education campaign to encourage conservation tillage farming
- Development of a handbook titled: A Systems Approach to Conservation Tillage of Forage Crops



“What we’re doing is designing completely new production paradigms for the San Joaquin Valley.”

Dino Giacomazzi  
Hanford, CA  
2012

“[Biological farming is] to work with the systems of nature to develop a farm which is environmentally sound, and which leaves the land, water, plants and animals in a healthy, productive state for all future generations.”

- Dino Giacomazzi Dairy Farmer



Michael and Adam Crowell

IT TAKES NO TILLAGE

## Conventional farmers drop their plows in favor of conservation

By Nathanael Johnson on 15 Apr 2014 44 comments

 Share

 Tweet

The Michael and Adam Crowell duo works this way: Michael handles the crops, and Adam handles the dairy cows; Michael is the colorful wisecracker, and Adam is the straight man; Michael casts about for a word when his tongue outpaces his memory, and Adam fills it in; Michael is the father, and Adam is the son.

I visited their dairy farm near Turlock, in California's Central Valley, to get a look at the growing trend of conventional farmers adopting ecologically friendly techniques. In the Midwest, where farmers grow a small number of grain crops,



**As of 2014, commercial strip-till and corn planting support is now available to help interested farmers learn about these silage production system alternatives.**



**This program has been hugely successful  
in providing learning opportunities  
to farmers who are interested in  
these approaches.**



OKLAHOMA ASSOCIATION of Conservation Districts



WESTERN FARMERS Electric Cooperative



OKLAHOMA Conservation Commission



MORE NEWS »



- ECOPASS
- HOW IT WORKS
- BUY ECOPASS
- CONTACT
- FOR FARMERS
- NEWS



No-till farming helps prevent soil erosion, sequesters carbon and increases moisture in the soil, and requires less diesel fuel to be used by farm equipment in crop production.

### Quick Links

- » [ECOPass](#)
- » [How It Works](#)
- » [Buy ECOPass](#)
- » [Contact](#)
- » [For Farmers](#)
- » [News](#)

### Buy An ECOPass

One Acre - \$5.00 USD

Buy Now



## How It Works

Where does your dollar go? When you purchase an ECOPass, be it a \$5 pass or a \$200 pass, that money goes directly back to farmers and ranchers in Oklahoma who are making a difference for our environment and positively impacting conservation in our state. For each \$5 pass, \$3.50 goes right back to producers. The remaining \$1.50 goes to local conservation districts and the [Oklahoma Conservation Commission](#) to verify the practices that have been put under contract. This ensures that everyone is getting their money's worth and when we say you have an acre, we can tell you where that acre is and what that landowner is doing on that acre. For more information or if you have any questions, email [sarahblaney@okconservation.org](mailto:sarahblaney@okconservation.org).

Below are more details about how each practice positively impacts Oklahoma:

### No-till Crop Systems

No-tillage or zero tillage is a farming system in which the seeds are directly deposited into untilled soil that has retained the previous crop residues. It is also referred to as no-till. Special no-till seeding equipment with discs (low disturbance) or narrow tine coulters (higher disturbance) open a narrow slot into the residue-covered soil that is only wide enough to put the seeds into the ground and cover them with soil. The aim is to move as little soil as possible in order not to bring weed seeds to the surface and not stimulating them to germinate. No other soil tillage operation is done. The residues from the previous crops will remain largely undisturbed at the soil surface as mulch. If the soil is disturbed even only superficially then the system cannot be termed no-tillage and is defined as mulch



tillage (CTIC, 2011). In Oklahoma, we are behind the curve when it comes to adoption of no-till. This is something the



From: Don Reicosky [don.reicosky@gmail.com]  
To: Jeffrey Mitchell  
Cc:  
Subject: Fwd: ECO - pass

Sent: Wed 4/29/2015 2:4

I ran across an article in the Minneapolis Star Tribune Parade magazine which had an article on 50 eco-friendly things the various states are doing celebrating Earth Day in the US. The brief article from Oklahoma stated **“under a program from the Oklahoma Conservation Commission, state residents can buy ECO passes (\$5-\$200) with the money going directly to farmers and ranchers in the state would adopt no-till crop systems to stem erosion.”** Even with all of the conservation programs in the US, wind and water erosion still is a major problem. The eco-pass concept that was presented struck a positive chord as a way of providing incentives for decreasing soil erosion and degradation.

In searching the Internet, I visited the three websites below looking for information on your version of the eco-pass concept. If there are other websites that I should visit, please let me know.

<http://www.ok.gov/conservation/>

<http://ecopassok.com/>

<http://newsok.com/oklahoma-ecopass-program-connects-city-country-for-conservation/article/3668472/?page=2>

There are many aspects of the ECO-pass program that appealed to me.

- it's a voluntary program, to put more conservation on the landscape,
- this type of a program would help develop sustainable programs and food security for future generations
- may provide an opportunity to support conservation without taxes and regulation and supplement some of the government programs
- people in the metro areas want to help the environment in some way
- urban and rural folks can come together to improve soil, water, and air quality
- reward and incentivise producers with money going directly to the farmers for good stewardship
- the voluntary approach helps ourselves while helping protect the earth.
- A voluntary way of protecting the water quality in our rivers streams and lakes
- would provide an opportunity to offset your individual carbon footprint or impact on the environment
- customer choice allows consumer preferences for sustainable food production to be reflected in market transactions.
- Lessening our dependence on fossil fuels is critical to the health of all living things, and conservation practices can do just that
- Using CA, Soil erosion is reduced, reducing soil runoff into streams and rivers.
- Consumer oriented/approved conservation practices

I'm sure there are other aspects that can be added to this list.

PREVIOUS STORY

[Scammers target vacation rentals](#)

NEXT STORY

[Oklahoma City celebrated small business, ranks third in the nation as best city for small businesses](#)

REDEEM® BIOMETHANE FUEL

Save Money & Reduce Your Footprint up to 90% w/ Sustainable RNG



BUSINESS NEWS: LOCAL BUSINESS: LOCAL BUSINESS: ENERGY

# Oklahoma ECOpass program connects city, country for conservation

0 comments

by [Paul Monies](#) Published: April 22, 2012



by Paul Monies  
ENERGY REPORTER



Paul Monies is an energy reporter for The Oklahoman. He has worked at newspapers in Texas and Missouri and most recently was a data journalist for USA Today in the Washington D.C. area. Monies also spent nine years as a business reporter and...

+ show more



With ECOpass, the Oklahoma Association of Conservation Districts signs up farmers to a three-year contract, said Clay Pope, executive director. Once the contracts are in place, they are verified by officials with the Conservation Commission.

RELATED MULTIMEDIA



Video: (Apr 20)  
ECOpass supporting local farmers and environment

[About the Program](#)[Aggregation](#)[Applications](#)[Carbon News](#)[FAQs](#)[Fees](#)[Legislation](#)[Partners](#)[Projects](#)[Registry](#)[Soil Carbon Sampling](#)[Verification](#)[Water Quality](#)

## Carbon Sequestration Certification Program

### Projects

The carbon program is growing by leaps and bounds! Check out the projects we are partnering on:

#### North Canadian River Watershed Carbon Pilot Program

The Pilot Program was initiated to support development of the new Oklahoma carbon sequestration certification program. However, interest in the program has been so great, and project opportunities so bountiful, the pilot is now running tandem with all other carbon pilot programs being conducted in conjunction with the North Canadian River Water Quality Project, whose goal is to improve the water quality of the river between Canton Dam and Lake Overholser by reducing polluted runoff from land. The pilot program provides incentives from carbon offset payments and water quality program cost share monies to encourage producer participation. As part of the pilot program, soil carbon samples are being taken from select participating fields by Oklahoma State University. Goals include: increase the willingness of Oklahoma agriculture producers to sign carbon contracts; use contracted acres to develop and test field verification protocols; encourage improved land management practices that store carbon dioxide and improve water quality; encourage Oklahoma producers to determine carbon sequestration rates in Oklahoma. **Partners:** Western Farmers Electric Cooperative (WFEC), Oklahoma Association of Conservation Districts, OK-NRCS, Oklahoma State University, Central North Canadian River Conservation District, Dewey County Conservation District. Partnership Designation: Lead. Funding Source: WFEC. Start Date: 2008. Duration: Five years (rolled into Expansion Project).

#### *Expansion Project: Developing high quality carbon offset verification protocols and quantifying water quality improvements of best management practices to ensure the environmental benefits of agricultural practices*

This project completes carbon sequestration verification protocols under development in Oklahoma, pairs them with soil sampling, and demonstrates how verified carbon offsets and related water quality improvements can be bundled for ecosystem market transactions. The purpose of this project is to develop, test, and implement carbon sequestration verification protocols for agricultural and silvicultural practices that are recognized to have carbon market value to ensure environmental benefits from market transactions. **Partners:** Western Farmers Electric Cooperative, Oklahoma Association of Conservation Districts, OK-NRCS, Oklahoma State University, Central North Canadian River Conservation District, Blaine County Conservation District, Dewey County Conservation District. Partnership Designation: Grantee. Funding Source: NRCS FY2010 CIG. Start Date: 2010. Duration: Three years.

#### Soil Carbon Sampling

Soil carbon sampling is an integral part of most Oklahoma Carbon Program projects because the Conservation Commission and partners are committed to expanding soil carbon research in Oklahoma. The overall goal of soil carbon research in Oklahoma is to determine carbon sequestration rates of these practices in specific soils in as much of Oklahoma as possible. We have partnered with Oklahoma State University (OSU) to assess carbon sequestration rates in Oklahoma. OSU is evaluating the impact of spatial variations on the accuracy of soil carbon measurements for use in carbon sequestration verification. Assessments of both small scale (meters) and large scale (kilometers) variations are conducted so that future sampling protocols can be developed that minimize sample requirements and insure accurate measurements for the aggregated acres by carbon offset verifiers. See the [soil sampling page](#) for more details. **Partners:** Oklahoma State University (OSU), Western Farmers Electric Cooperative (WFEC), USDA-Natural Resources Conservation Service (NRCS), Oklahoma Association of Conservation Districts. Partnership Designation: Lead. Funding Source: NRCS FY2010 CIG, WFEC, OSU. Start Date: 2008. Duration: Five years.

#### Ecosystem Services Project

The purpose of this project is to continue and expand implementation efforts in the North Canadian River watershed to address nonpoint source (NPS) pollution-related impairments to streams, the river, and the recipient drinking water reservoirs. The project approach to conservation management is to reap the co-benefits of multiple conservation strategies working synergistically in a defined area to demonstrate to producers that it is feasible to continue implementation of best management practices (BMP) beyond the current project. Improving water quality and optimizing farm yields. The ultimate goal is load reductions of bacteria, sediment, and nitrogen to streams, with the co-benefits of carbon sequestration and avoided nitrogen emissions. This will be done by providing technical assistance and incentives to producers to encourage BMP longevity including managing no-till fields, pastures, and riparian areas, nutrient management, wildlife habitat, and carbon sequestration beyond their contract life. **Partners:** USEPA, Oklahoma State University, Oklahoma Department of Wildlife Conservation, Central North Canadian River Conservation District, Blaine County Conservation District, Dewey County Conservation District. Partnership Designation: Grantee. Funding Source: USEPA. Start Date: 2011. Duration: Two years.

#### Bringing Greenhouse Gas Benefits to Market: Nutrient Management for Nitrous Oxide Reductions

The overall objective of this project is to enroll producers into a program that generates market quality CDR credits from nutrient management and conservation practices. The team will identify the opportunities and barriers of implementing nutrient man-



PREFACE

# The Current Status of Conservation Tillage in China

Conservation tillage research started in the 1980s in the USA and an ACIAR project in 1992. In 1996, MCA set up the National High Research Center leading CT research in China. Research started by the end of 1996. MCA has been a major project in CT demonstration in northern China. Major focus was to test 74 counties from 74 provinces using CT. The project was completed in 2004.



# Conservation Tillage and Cropping Innovation

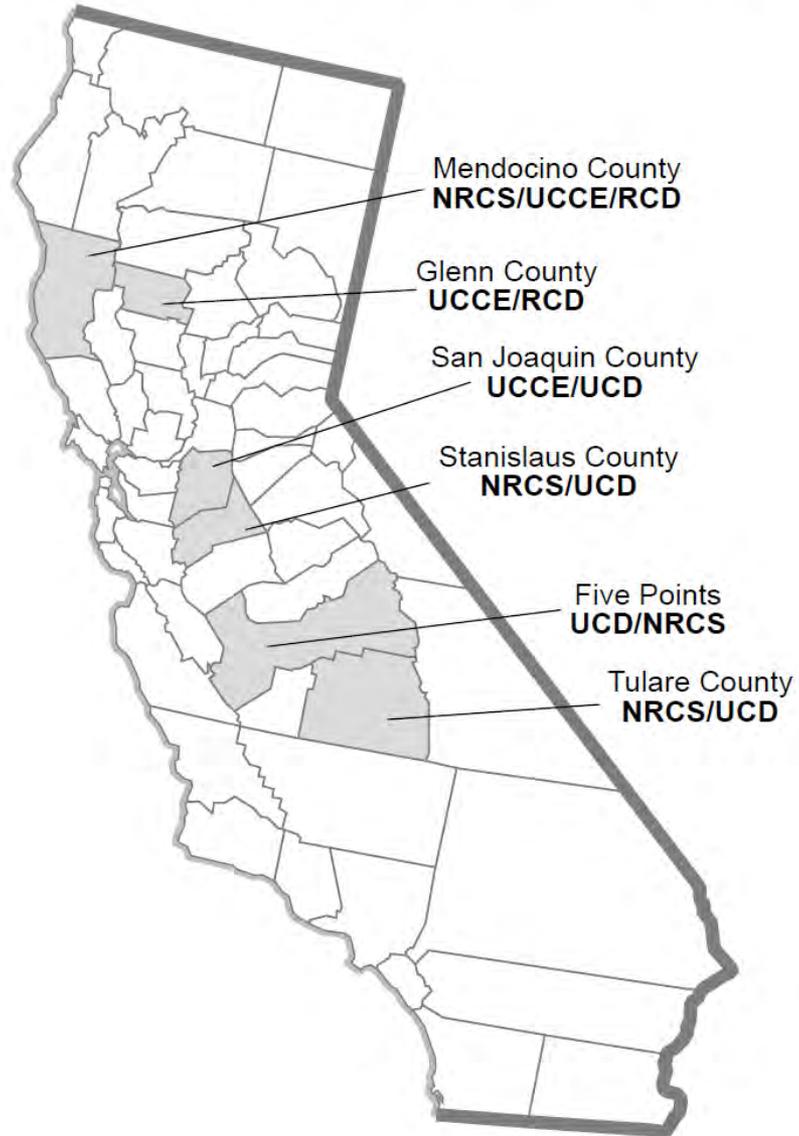
Constructing the New  
Culture of Agriculture

C. Milton Coughenour  
Shankariah Chamala

CT adoption:

- development of systems
- local networks

# California Soil Health Farm Demonstration Evaluation Sites - 2015





**Coming in 2015!**

**A video series about soil health in California featuring local leaders and contexts**

A screenshot of the USDA Natural Resources Conservation Service website. The page is titled "Soil Health Awareness" and features a large graphic with a keyhole and the text "unlock the SECRETS OF THE SOIL" and "SOIL HEALTH AWARENESS". Below the graphic, there is a sign-up for e-mail updates and a section titled "Soil Health Across the Nation" with a map of the United States. The website header includes "USDA Natural Resources Conservation Service" and "United States Department of Agriculture".





KEARNEY AGRICULTURAL CENTER  
9240 South Riverbend Avenue  
Parlier, California 93648  
(209) 846-6500  
(209) 846-6993

October 26, 1998

To: Kevin Collins (209) 866-5666

## REMINDER

### OPPORTUNITIES FOR CONSERVATION TILLAGE IN THE WEST SIDE OF THE SJV

*(Discussion of possible on-farm  
demonstration and research project)*

Friday

October 30, 1998

10:00 am - noon

University of California

West Side Research and Extension Center

Corner of Oakland and Lassen Avenues

Five Points, CA (209) 884-2411



# Our goals have been to

- Develop information
- Bring people together
- Partner with innovative farmers
- Emphasize the whole system
- Create a strategy for better educational impact and wider adoption of conservation agriculture and efficient irrigation systems



Sharing and showing equipment has been a big part of our information work.





**Aref Abdul-Baki**  
USDA ARS  
Beltsville, MD



**Dwayne Beck**  
SDSU  
Pierre, SD



**Ron Morse**  
Virginia Tech  
Blacksburg, VA



**Andy McGuire**  
Moses Lake, WA



**Dick and Sharon Thompson**  
Boone, IA



**Suat Irmak**  
Lincoln, NE



**Steve Groff**  
Lancaster County  
Pennsylvania



**John Landers**  
Cerrado Region  
Brazil



**John Luna**  
Oregon State  
University  
Corvallis, OR



**Karl Kupers**  
Rearden, WA



**Mike Peterson**  
Greeley, CO



**Don Reicosky**  
USDA ARS  
Morris, MN



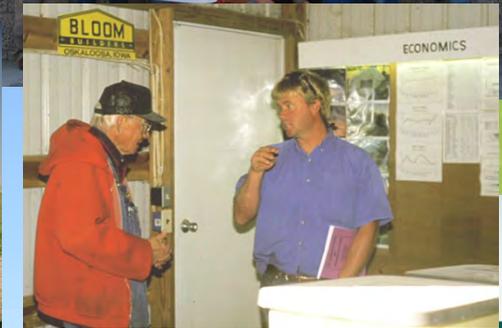
2007 California CONSERVATION TILLAGE FARMER TOUR



2007 California CONSERVATION TILLAGE FARMER TOUR



2007 California CONSERVATION TILLAGE FARMER TOUR



NEBRASKA the good life Home of Arbor Day



National Soil Tillage Laboratory



2007 California CONSERVATION TILLAGE FARMER TOUR

Making Conservation Tillage Conventional:  
Building a Future on 25 Years of Research

Proceedings of the 25th Annual Southern Conservation Tillage Conference for Sustainable Agriculture  
Auburn, AL, USA 24-26 June 2002





**2005**  
**Bob Prys**  
Lemoore, CA



**2006**  
**Tom Barcellos**  
Tipton



**2007**  
**Jim Couto**  
Kerman



**2007**  
**Tony Turkovich**  
Winters



**2008**  
**Dino Giacomazzi**  
Hanford



**2009**  
**Jesse Sanchez**  
Firebaugh



**2009**  
**Alan Sano**  
Firebaugh



**2010**  
**John Diener**  
Five Points



**2011**  
**Fred Leavitt**  
Firebaugh



**2011**  
**Michael Crowell**  
Turlock



**2012**  
**Gary Martin**  
Firebaugh

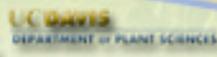
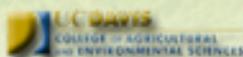
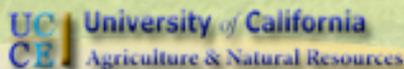


**2013**  
**Danny Ramos**  
Los Banos



**2013**  
**Ralph Ceseña, Sr.**  
Stockton

## Conservation Tillage CT Farmer Innovator Awardees



**I would like to encourage and  
propose a**

formal partnership between CDFA  
and our CASI Center and its diverse  
partners in moving forward with an  
expanded implementation of your  
Environmental Farming Act.

Message Adobe PDF

Reply Reply Forward Delete Move to Create Other Block Safe Lists Not Junk Categorize Follow Mark as Related Send to OneNote  
to All Respond Actions Junk E-mail Options Find Select Find OneNote

From: Todd Ochsner [todd@tdofarmsinc.com]  
To: Jeffrey Mitchell  
Cc:  
Subject: FW: Vegies.xls

Message | Vegies.xls (113 KB)

Todd Ochsner  
38390 W Hwy 12  
Aberdeen, SD 57401  
605-226-0695 (O)  
605-228-6100 (C)

**From:** Todd Ochsner [mailto:todd@tdofarmsinc.com]  
**Sent:** Monday, October 6, 2014 5:30 PM  
**To:** 'Mitchell@uckac.edu'  
**Subject:** FW: Vegies.xls

Todd Ochsner  
38390 W Hwy 12  
Aberdeen, SD 57401  
605-226-0695 (O)  
605-228-6100 (C)

**From:** Todd Ochsner [mailto:todd@tdofarmsinc.com]  
**Sent:** Thursday, April 3, 2014 1:32 PM  
**To:** Rhoda Barrows (rhoda.burrows@sdstate.edu)  
**Subject:** Vegies.xls

Vegies.xls [Compatibility Mode] - Microsoft Excel

Home Insert Page Layout Formulas Data Review View Add-Ins Acrobat

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	
1	Peas Variety	Population	Cost	Time to seed	Depth	Seed Treat	App amount	Cost	Fertilizer	Time to apply	App amount	Cost	Chemical	Time to apply	App amount	Cost	Harvest	Time to harvest	Freight	Harvest cost	Total cost	Est yield	Pr
2																							
3																							
4																							
5																							
6																							
7																							
8	Sweet corn variety	Population	Cost	Time to seed	Depth	Seed Treat	App amount	Cost	Fertilizer	Time to apply	App amount	Cost	Chemical	Time to apply	App amount	Cost	Harvest	Time to harvest	Freight	Harvest cost	Total cost	Est yield	Pr
9																							
10																							
11																							
12																							
13																							
14																							
15	Spinage Variety	Population	Cost	Time to seed	Depth	Seed Treat	App amount	Cost	Fertilizer	Time to apply	App amount	Cost	Chemical	Time to apply	App amount	Cost	Harvest	Time to harvest	Freight	Harvest cost	Total cost	Est yield	Pr
16																							
17																							
18																							
19																							
20																							

Ready Count: 72 100%

I would appreciate if you could fill in all the columns except the Cost columns. Thanks Todd 605-226-0695

## South Dakota no-till vegetable farmer inquiry about production details

**USDA**  
**Agricultural Research Service**

National Program 216  
Agricultural Systems Competitiveness  
and Sustainability



**'The agronomic and ecological equivalent  
of the moon race of the 1960's'**

Dwayne Beck, 2012



**'They did not achieve a successful landing by testing small incremental improvements in rocket design. They did it by having a specific goal and teams focused on developing the techniques required to achieve that goal.'**

# 2014 Winter Conference of No-till on the Plains

Salina, KS

January 27 – 28, 2014

‘Take the hardest crop you have and show that it will work.’

Rick Bieber  
Trail City, SD

# FORTY CHANCES



Finding Hope in a Hungry World  
Photographs by Howard G. Buffett

NEW YORK TIMES BESTSELLER

Howard G. Buffett

WITH HOWARD W. BUFFETT

# FORTY CHANCES



Finding Hope  
in a Hungry World

FOREWORD BY WARREN E. BUFFETT

**‘Overcome the mindset that it  
can’t be done.’**

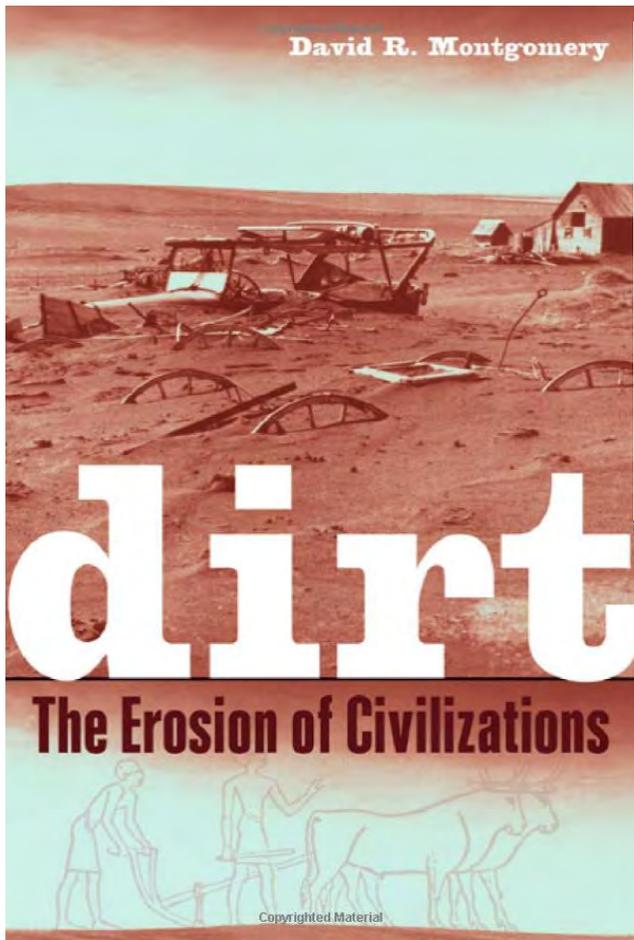
Dwayne Beck

2014

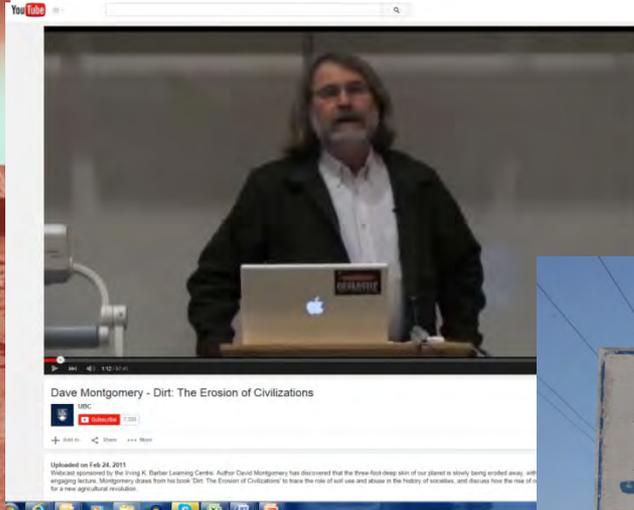
**“Take the ‘E’ out of ‘ET’ and the  
‘T’ out of ‘can’t.”**

Dwayne Beck

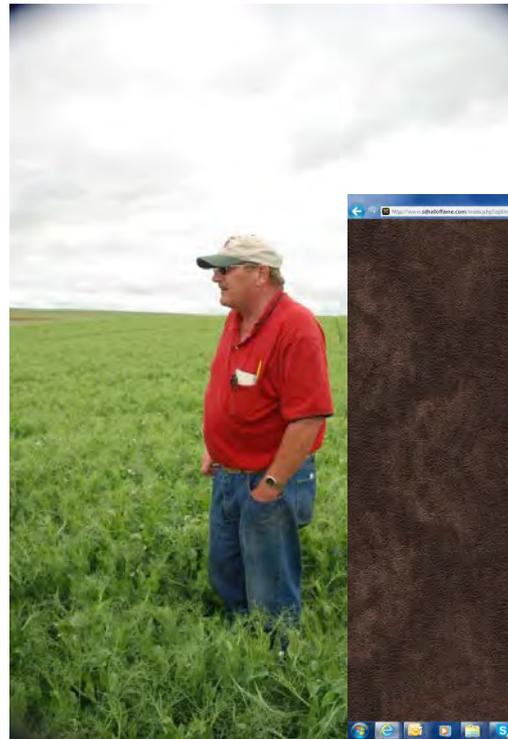
2014



**Dwayne Beck**  
**Ag Engineer**  
**Dakota Lakes Research Farm**  
**South Dakota Hall of Fame**



**David Montgomery**  
**Professor of Geology**  
**University of Washington**



David Montgomery was here last week. After seeing all the no-till in the area he asked “Did you every dream there would be this much adoption in two decades?”.

My response was that I was surprised that it took so long and could not understand why other areas were had not transformed also.

Dwayne Beck  
May 9, 2015

**“Do everything we can.”**

David Pimentel  
Cornell University  
2005



RESOURCE  
CONSERVATION DISTRICTS



SOIL AND WATER  
CONSERVATION  
SOCIETY



*Thank you.* **UC  
CE**



**University of California**  
Agriculture and Natural Resources

*Making a Difference for California*

