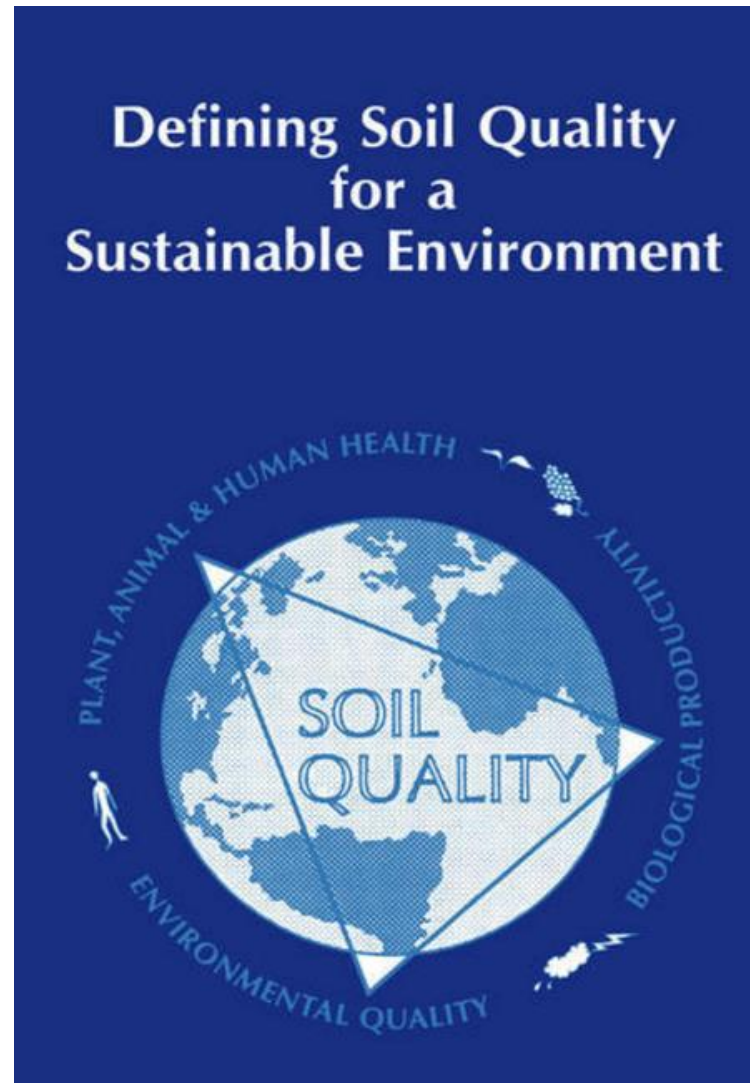




Soil Health and Tomato Production

Interest in soil 'health' or 'quality' is not a new development ...



1994 Soil Science Society of America Special Publication 35

Friday, October 12, 2012

USDA Launches National Soil Health Initiative at Central Ohio Farm



On October 11, the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) announced the launch of a new soil health awareness and education effort called "Unlock the Secrets in the Soil." The new USDA initiative is "meant to highlight the benefits of improving and maintaining America's soil," according to the [news release](#) announcing the project. The related [NRCS "soil health" web page](#) describes the main intent of the soil initiative, which is education-based, and designed to focus "more attention on soil health," and educate USDA "customers and the public about the positive impact healthy soils can have on productivity and conservation."

NRCS Chief Dave White rolled out the effort during a visit to a [family-owned farm managed by David Brandt near Carroll, Ohio](#). "This initiative will help meet the future demands for American-grown agriculture by encouraging good soil and natural resources to their operations," White said while speaking at the kick-off event.

A group of 21 commodity, farm and conservation organizations sent a [letter to White](#) providing their support for the initiative. The letter noted that although "the benefits of healthy soils are difficult to quantify, we stand ready to work with NRCS to help identify the costs and benefits of healthy soils to assist producers when making decisions about whether to adopt them as conservation practices."



2012: NRCS 'Soil Health Initiative'

2016: CDFA 'Healthy Soils Initiative'

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healthy soils initiative
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HEALTHY SOILS INITIATIVE
 California is the nation's leading agricultural production state in terms of both value and crop diversity (<http://www.cdfa.ca.gov/Statistics/>). California's Healthy Soils Initiative is a collaboration of state agencies and departments, led by the California Department of Food and Agriculture (CDFA), to promote the development of healthy soils on California's farm and rangelands. Innovative farm and ranch management practices contribute to building adequate soil organic matter that can increase carbon sequestration and reduce overall greenhouse gas emissions.
 Read the [California Healthy Soils Action Plan](#)
 Read the [California Healthy Soils Initiative Fact Sheet](#)
[California Healthy Soils Initiative Fact Sheet in Spanish](#)
CALIFORNIA CLIMATE CHANGE PORTAL
 California Climate Change Portal
 CA Air Resources Board
 CA Energy Commission
 California & 2014 Farm Bill
 Planting Seeds: The CDFA Blog
 California Agricultural Vision 2030
 Invasive Pests & Diseases
 Report a Pest App

Soil health or quality - What are we trying to define?

- Soil resource protection or enhancement
- Ecosystem services / biodiversity
- Air and water pollution mitigation
- Farming profitability?



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What are considered the important metrics of soil health?

- Carbon input (cover crops, organic amendments)
- High level of biological activity / diversity
- Minimal fallow period
- Reduced soil disturbance

Soil health and tomato production ?



- Are soil building practices relevant across varying environments, soils and rotations?
- Is there evidence that 'healthy' soils produces better crops?
- Are the commonly suggested practices for improving soil health economically viable?

Soil health and tomato production ?



There is considerable data to draw on:

1988: UCD Sustainable Agriculture Farming Systems (SAFS) project

1994: UCD Long Term Research on Agricultural Systems (LTRAS) project

1996: Supplemental C management practices (SCMP) project

1999: Westside Field Station tillage / cover crop comparisons

2011: Manure compost for disease suppression

2012: Organic / conventional soil health comparison

Soil health and tomato production:

SAFS results across 12 years:

Organic and 'low input' systems compared with conventional management

- Organic and 'low input' systems increased soil C, and microbial biomass
- Neither system improved tomato yields compared to conventional management

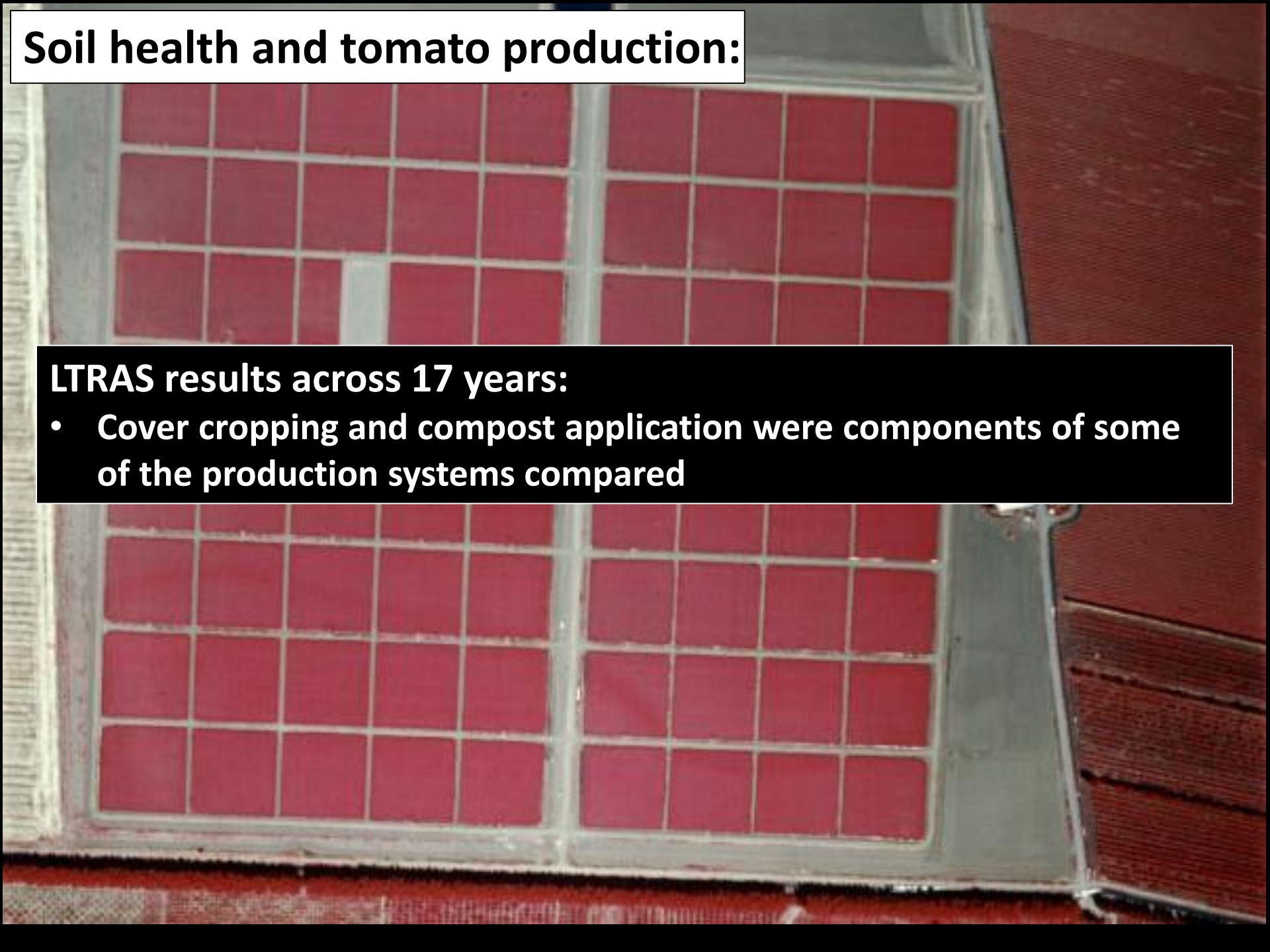


Clark, S., K. Klonsky, P. Livingston, and S. Temple. 1999. Crop yield and economic comparisons of organic, low-input, and conventional farming systems in California's Sacramento Valley. *Amer. J. Alternative Agric.* 14(3):109-121.

Soil health and tomato production:

LTRAS results across 17 years:

- Cover cropping and compost application were components of some of the production systems compared



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Cover cropping and compost application were components of some of the production systems compared

- Cover crops and compost applications affected a range of soil attributes:
 - Increased soil organic matter
 - Increased soil microbial biomass, changed microbial community profile
 - Increased water infiltration rate / reduced runoff

Summary at:

<http://asi.ucdavis.edu/programs/rr/about/russellranch-brochuresearchresults.pdf>

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➤ Tomato yields generally unaffected

Summary at:

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Soil health and tomato production:

SCMP results across 9 site · years on San Joaquin Valley farms:

Effects of cover cropping and/or compost application compared to no soil building practices

- Cover cropping and/or compost application increased soil organic matter, microbial biomass and nutrient availability
- Cover cropping and/or compost application increased tomato yield by 3%

Andrews, S.S., J.P. Mitchell, R. Mancinelli, D.L. Karlen, T.K. Hartz, W.R. Horwath, .S. Pettygrove, K.M. Scow, and D.S. Munk. 2002. On-farm assessment of soil quality in California's Central Valley. *Agron J.* 94:12-23.

Soil health and tomato production:

Westside Field Station tillage / cover crop comparisons :

- Reduced tillage and cover cropping increased soil C, biological activity, soil aggregation, and water infiltration



Soil health and tomato production:

Westside Field Station tillage / cover crop comparisons :

- Reduced tillage and cover cropping increased soil C, biological activity, soil aggregation, and water infiltration
- Reduced tillage increased tomato yield in 4 of 8 years, +10% overall average
- Cover cropping decreased tomato yield in 7 of 8 years, - 6% overall average



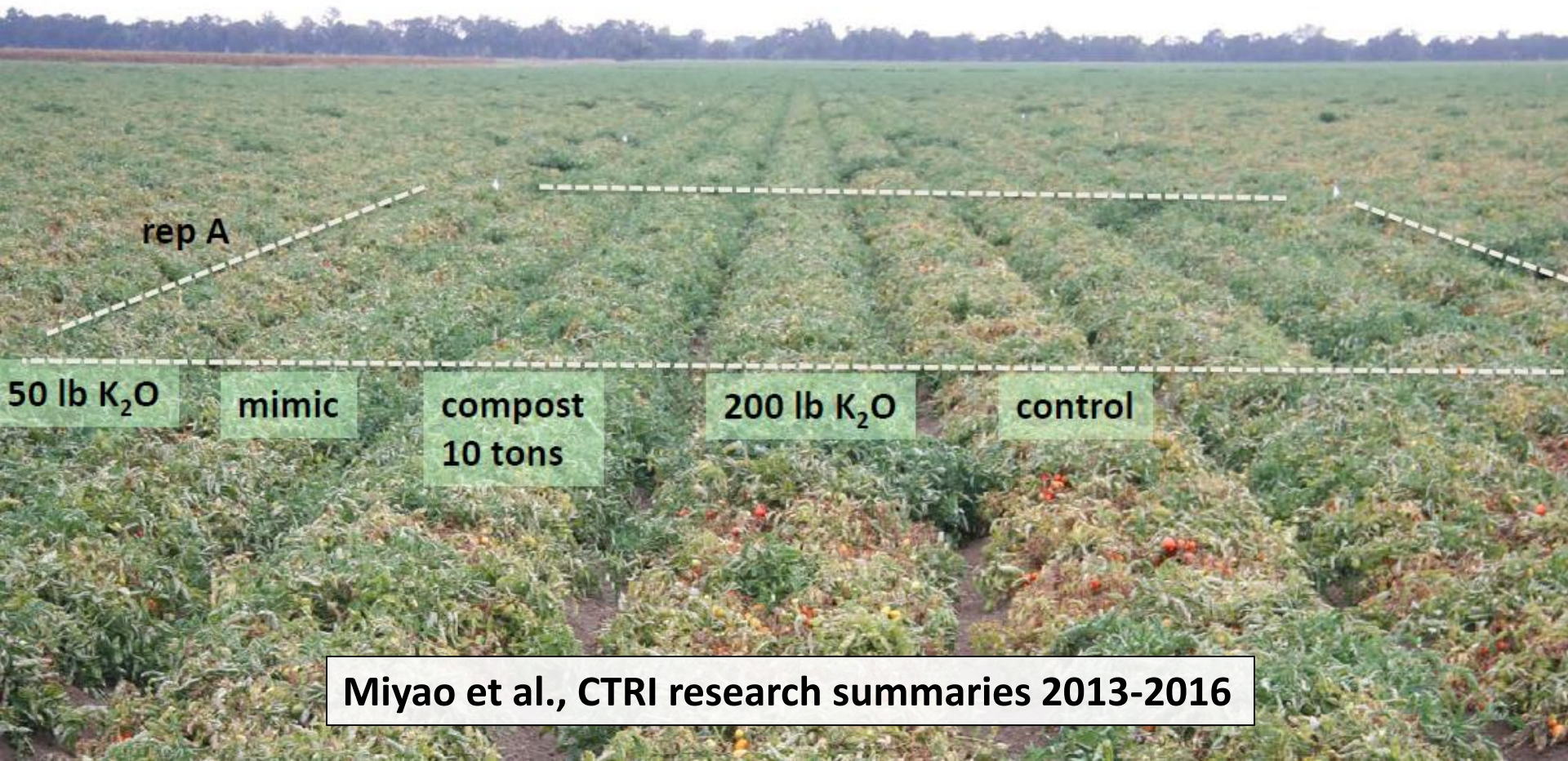
Mitchell et al., 2015. Tillage and cover cropping affect crop yields and soil carbon in the San Joaquin Valley, California. *Agronomy J.* 107:588-596.

Soil health and tomato production:

Manure compost evaluation:

Manure compost application (up to 10 tons/acre) in 14 tomato fields, to observe effects on early vine decline:

- Yield increases observed in half of the fields
- Response was primarily the result of nutrient supply (mostly K), although additive biological effects were apparent in some fields



Miyao et al., CTRI research summaries 2013-2016

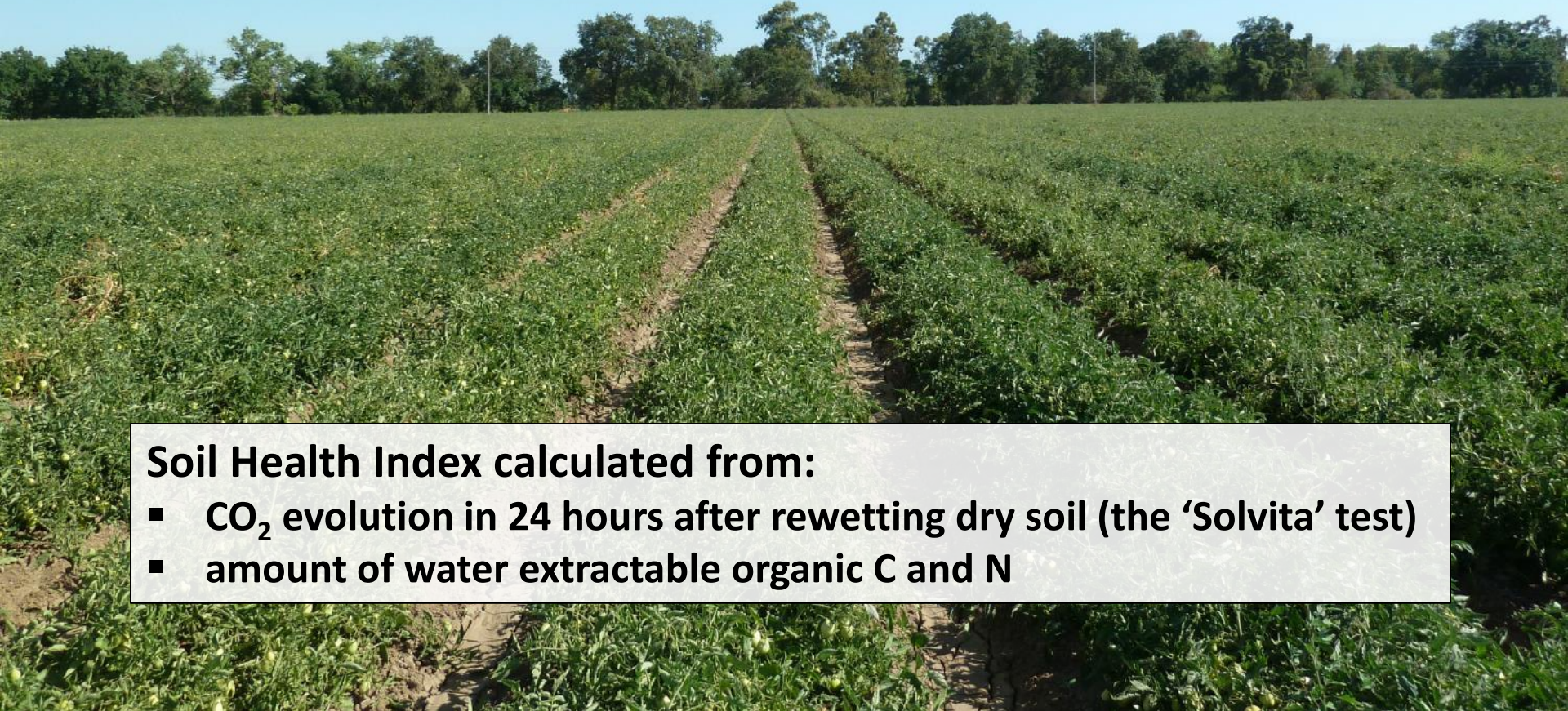
Soil health and tomato production:

Organic / conventional management comparison:

- Soils from 20 organic tomato fields compared to 15 conventional soils using the NRCS 'soil health index'

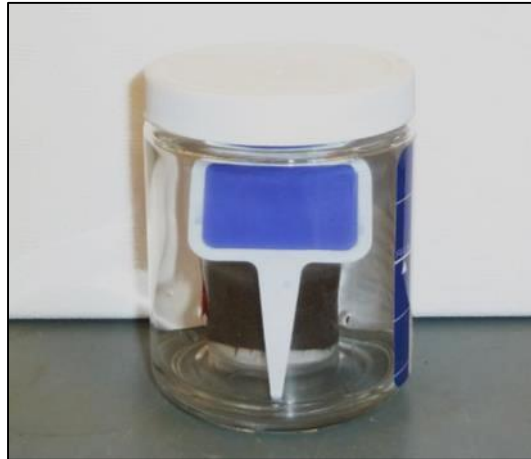
Soil Health Index calculated from:

- CO₂ evolution in 24 hours after rewetting dry soil (the 'Solvita' test)
- amount of water extractable organic C and N

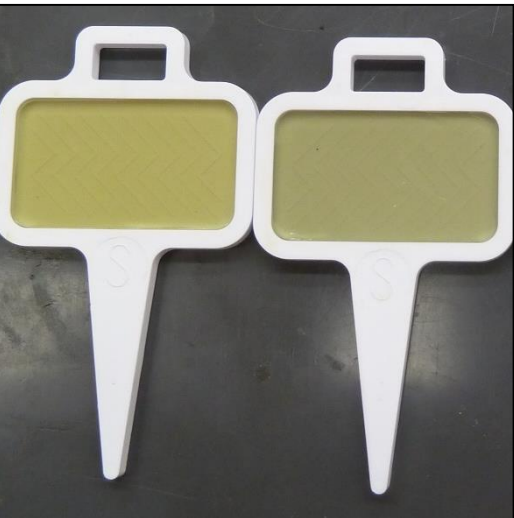


'Solvita' CO₂-C mineralization protocol

40 g air-dried, screened soil, wetted by capillary action



CO₂-sensitive gel paddle inserted,
incubated @ 25 C in sealed jar for
24 hours

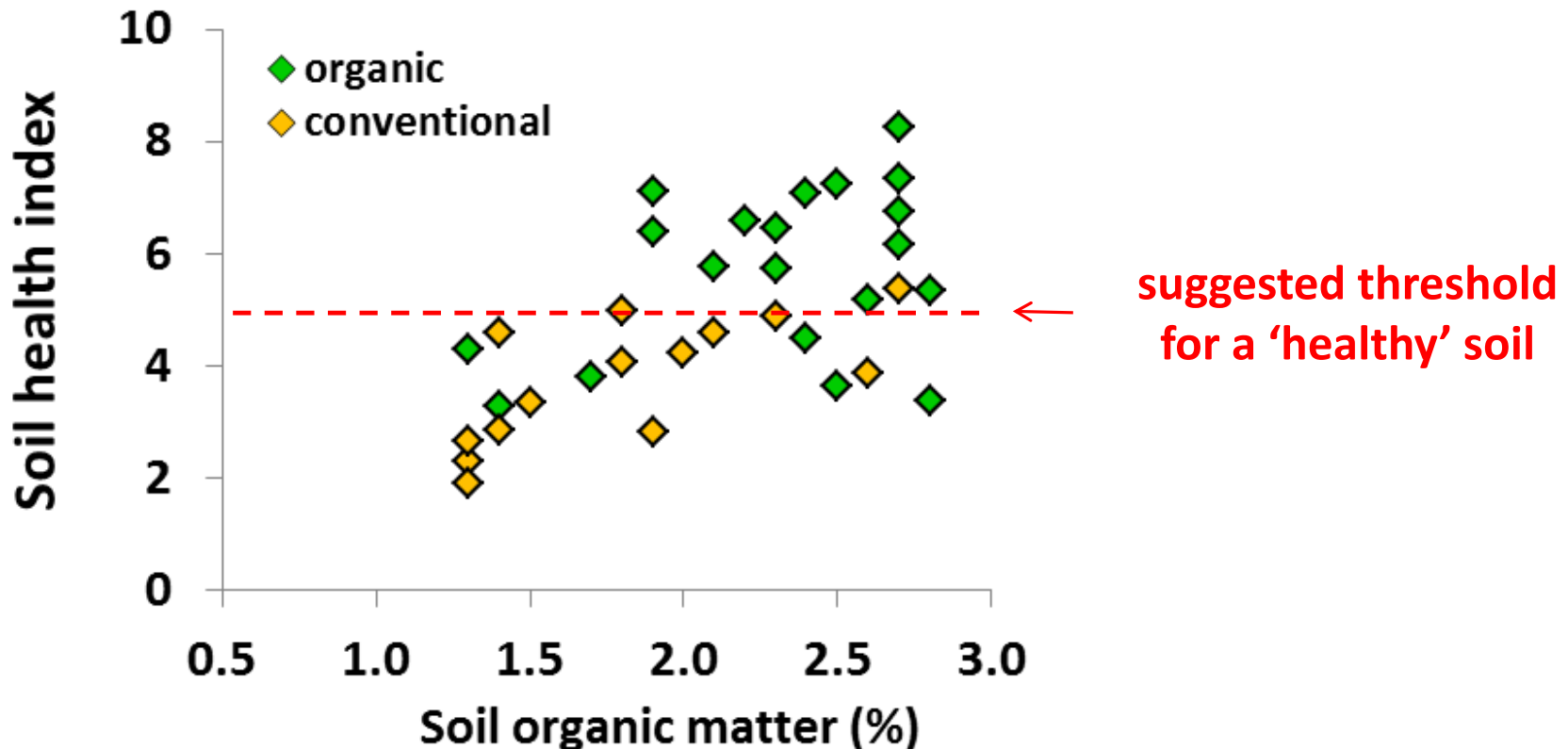


Paddle color change estimates
the PPM CO₂-C mineralized

Results:

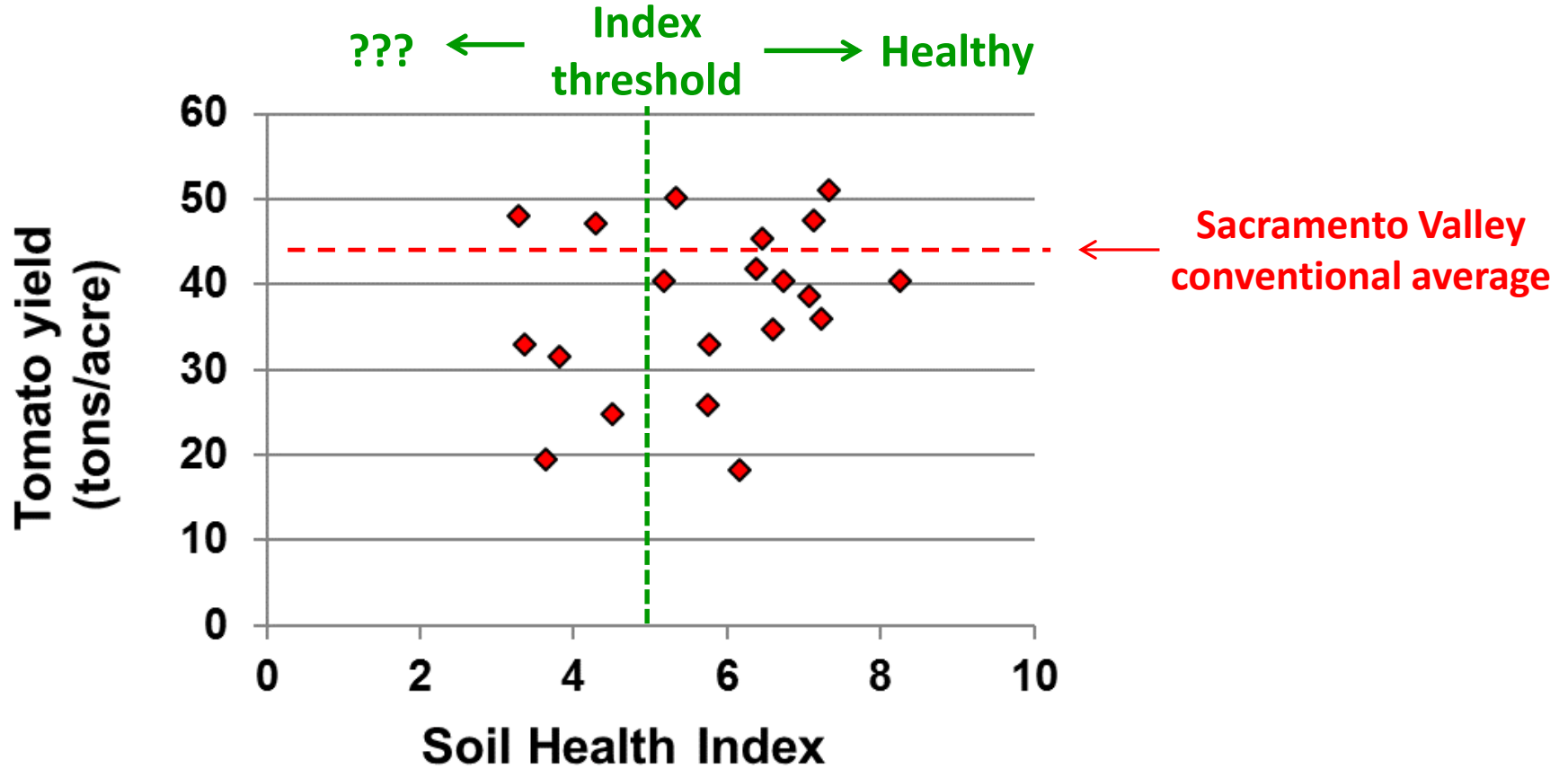
- 35 field soils

- 20 organically managed (1.4-2.8% organic matter, 2.3% average)
- 15 conventionally managed (1.3-2.7% organic matter, 1.9% average)



Does the Soil Health Index correlate to productivity?

Organic processing tomato yield:



Soil health and tomato production:

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- Can we measure soil health or quality in a way that makes sense across rotations, soils and environments?



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What is less certain:

- Can we measure soil health or quality in a way that makes sense across rotations, soils and environments?
- Can a grower reliably recover the costs associated with soil building through improved yields and reduction of other costs, or will it take government 'incentives' (carbon sequestration credits, subsidy for compost use, etc.)?

