Soil Health and Tomato Production
Interest in soil ‘health’ or ‘quality’ is not a new development ...
2012: NRCS ‘Soil Health Initiative’

2016: CDFA ‘Healthy Soils Initiative’
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?
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

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 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:
LTRAS results across 17 years:
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- 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

- Tomato yields generally unaffected

Summary at:
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%

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

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:
- CO$_2$ evolution in 24 hours after rewetting dry soil (the ‘Solvita’ test)
- Amount of water extractable organic C and N
‘Solvita’ CO$_2$-C mineralization protocol

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

CO$_2$-sensitive gel paddle inserted, incubated @ 25 C in sealed jar for 24 hours

Paddle color change estimates the PPM CO$_2$-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)

![Soil health index vs. soil organic matter graph](image)

*Suggested threshold for a ‘healthy’ soil*
Does the Soil Health Index correlate to productivity?

Organic processing tomato yield:

Sacramento Valley conventional average

Index threshold

Healthy

Tomato yield (tons/acre)

Soil Health Index
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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?
Soil health and tomato production:

What is beyond dispute:
- ‘Soil building’ practices can increase soil carbon, and modify biological and physiochemical characteristics
- These changes can drive measurable improvements of real significance, on a field- and management practice-specific basis

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.)?