

# **Changes in Michigan Potato Soil Health 2012-2022**

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# **In December 2011, the Michigan Potato Industry identified soil health as a key topic for research.**

- Soil Health Conference (March 2012)
- Soil Health White Paper (April 2012)
- 2012 Soil Health Survey (Spring)<sup>1</sup>
- 2017-2019 Development of a New Soil Health Indicator
- 2022 Repeat of the 2012 Soil Health Survey (Spring)<sup>1</sup>

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• <sup>1</sup>With assistance from Mark Otto (Michigan AgriBusiness Consultants)

# 2012 Soil Health Survey

- Three fields from each of eight Michigan potato farms.
- The fields were selected based on their histories of high tuber yields, potato early-die or significant incidence of potato scab.
- Four ten-acre blocks (sites) were sampled in each of the 24 fields in accordance with the Cornell University Soil Health Laboratory protocol.
- The 96 samples were processed at Cornell for four biological, four physical and four chemical soil health indicators.

On a scale  
of 0 to 100,  
the mean  
soil health  
score for  
the 96  
samples  
was **57.7**.

Soil Health Indicator	Good	Fair	Poor
Aggregate Stability	19%	78%	3%
Available Water Capacity	0%	0%	100%
Surface Hardness	100%	0%	0%
Subsurface	5%	78%	17%
Organic Matter	0%	0%	100%
Active Carbon	0%	0%	100%
Mineralizable Nitrogen	16%	5%	79%
Root Health	27%	73%	0%
pH	22%	51%	27%
Phosphorus	70%	30%	0%
Potassium	78%	22%	0%
Minor Elements	73%	27%	0%

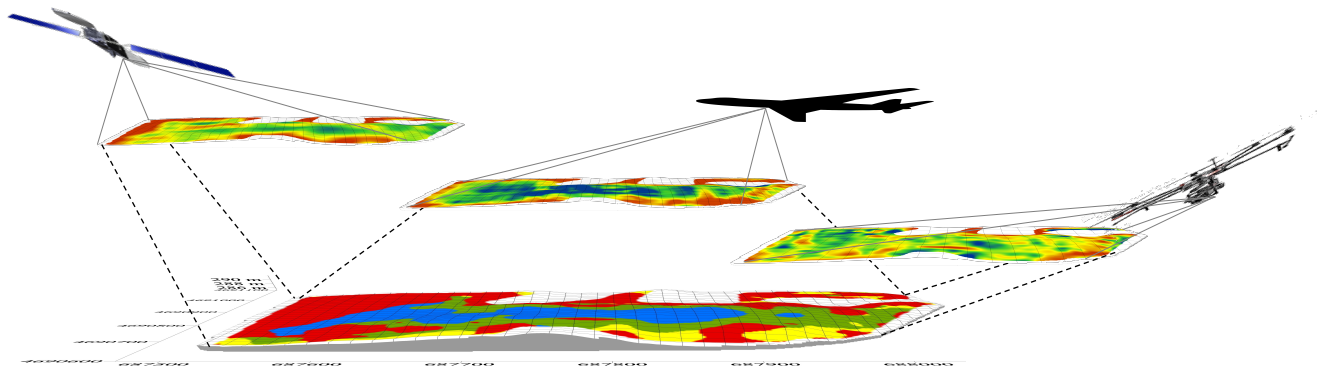


# 2012 Potato Soil Health Survey Report Card

•Soil Chemistry	A+
•Soil Physics	D-
•Soil Biology	F
•Grade	57.7

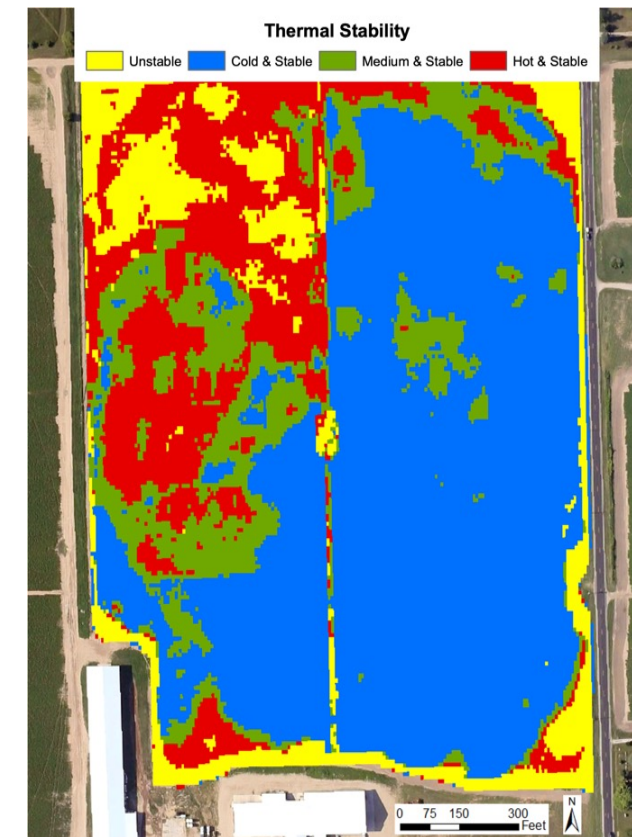
There were no significant differences among the site histories, chemical or physical indicators.

Systems	Score (0-100)
High potato yield	58.7a
Potato Scab	56.6a
Potato early-die	56.4a
Crops (no potato)	58.9 (n=1)
Forest	72.3 (n=1)



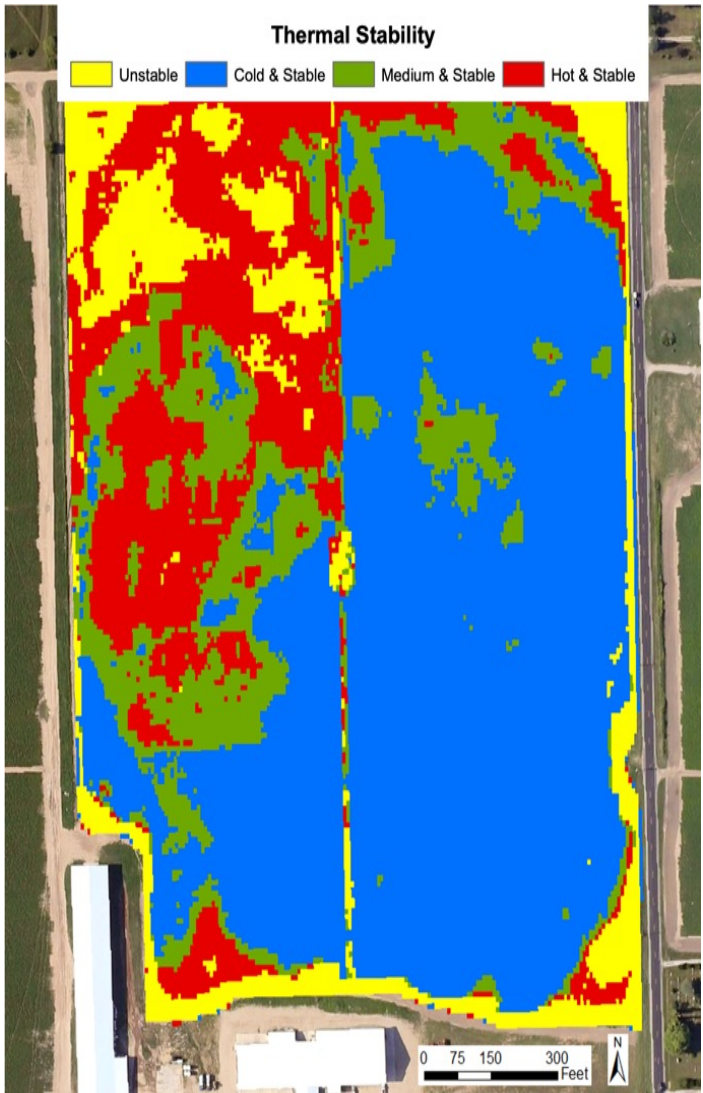
# Thermal Stability

- **Thermo-stability** is a new **soil health indicator** developed by the Bruno Basso Laboratory at Michigan State University .
- Temperatures differences are measured using thermal sensors mounted on drones, fixed-wing aircraft or satellites, flown multiple times throughout a growing season or over several years.
- Areas described as hot and stable represent zones where temperature is **consistently 5° C higher** than zones described as cold and stable. Field maps are divided into four categories: **Hot and stable (red)**, **Medium and stable (green)**, **Cold and stable (blue)**, and **Unstable (yellow)**.



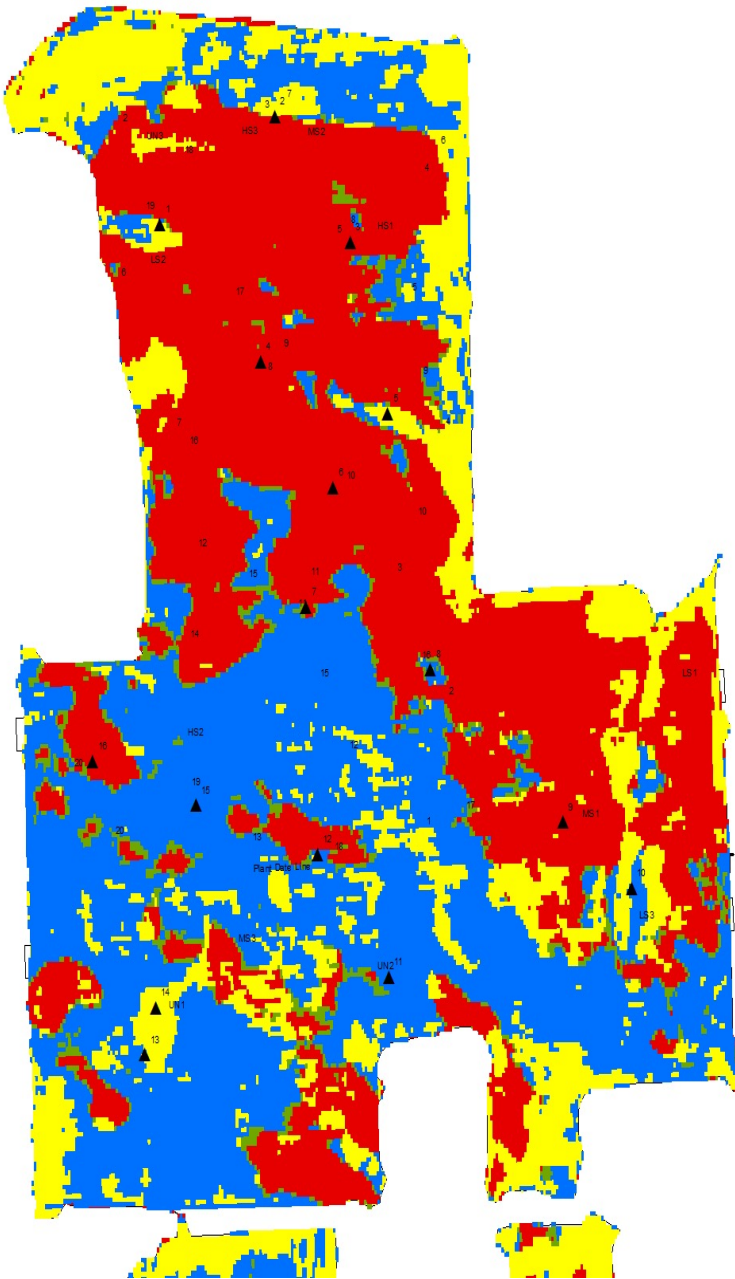
# Relationship between 2017 thermal stability, potato tuber yield and active carbon.

Soil Health Indicators and Tuber Yield.	Hot & variable (West 27 acres)	Cold & stable (East 27 Acres)
Potato tuber yield (cwt/acre)	300a	462b
Active carbon (ppm)	213a	314b



Relationship between 2018 thermal stability, Cornell soil health score health and potato tuber yield.

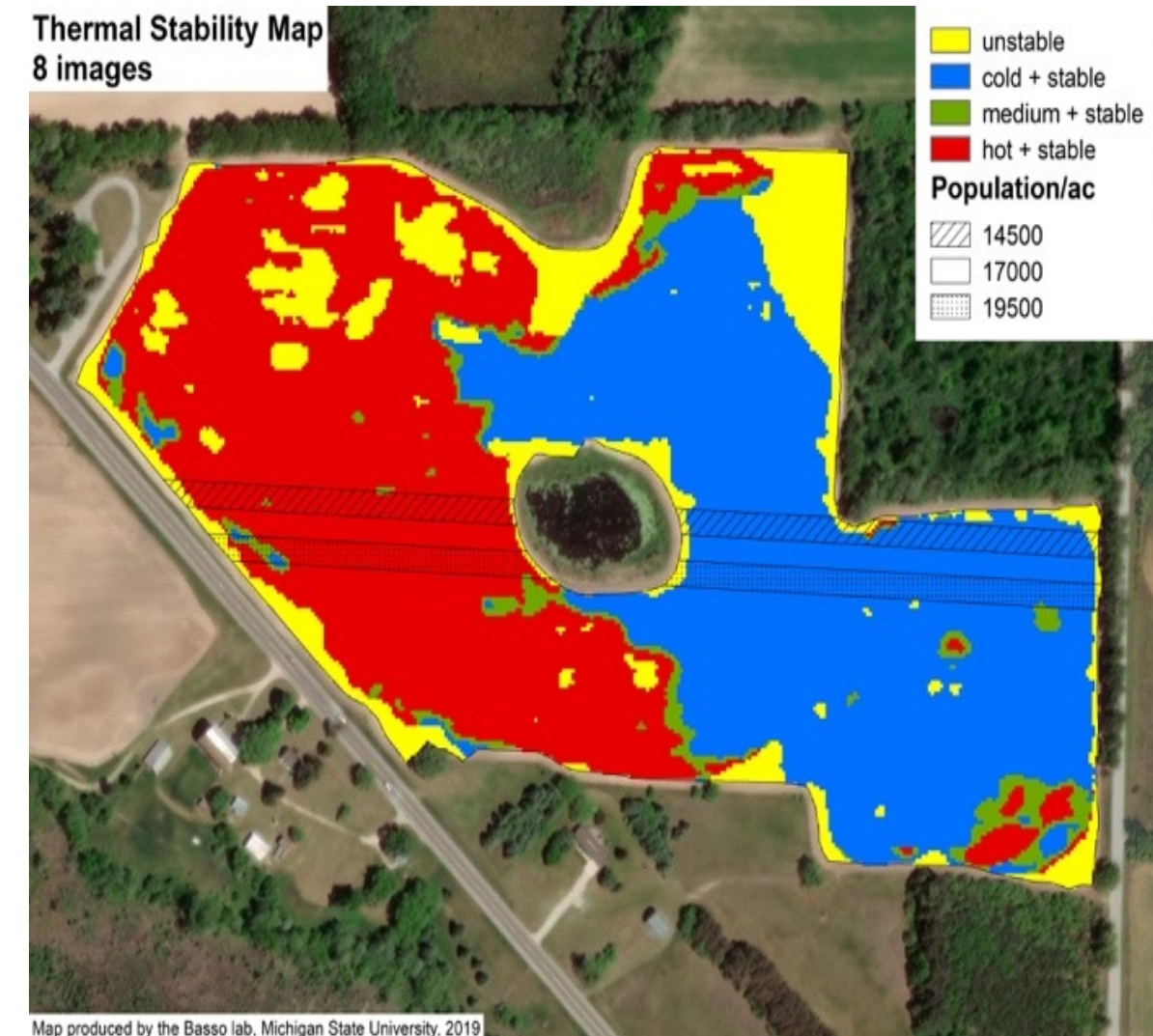
Soil health indicators and potato tuber yield	Cold and stable	Hot and stable
Potato Tuber Yield (cwt/acre)	442a	369b
Cornell Soil Health Score (0-100)	56.8a	48.8b





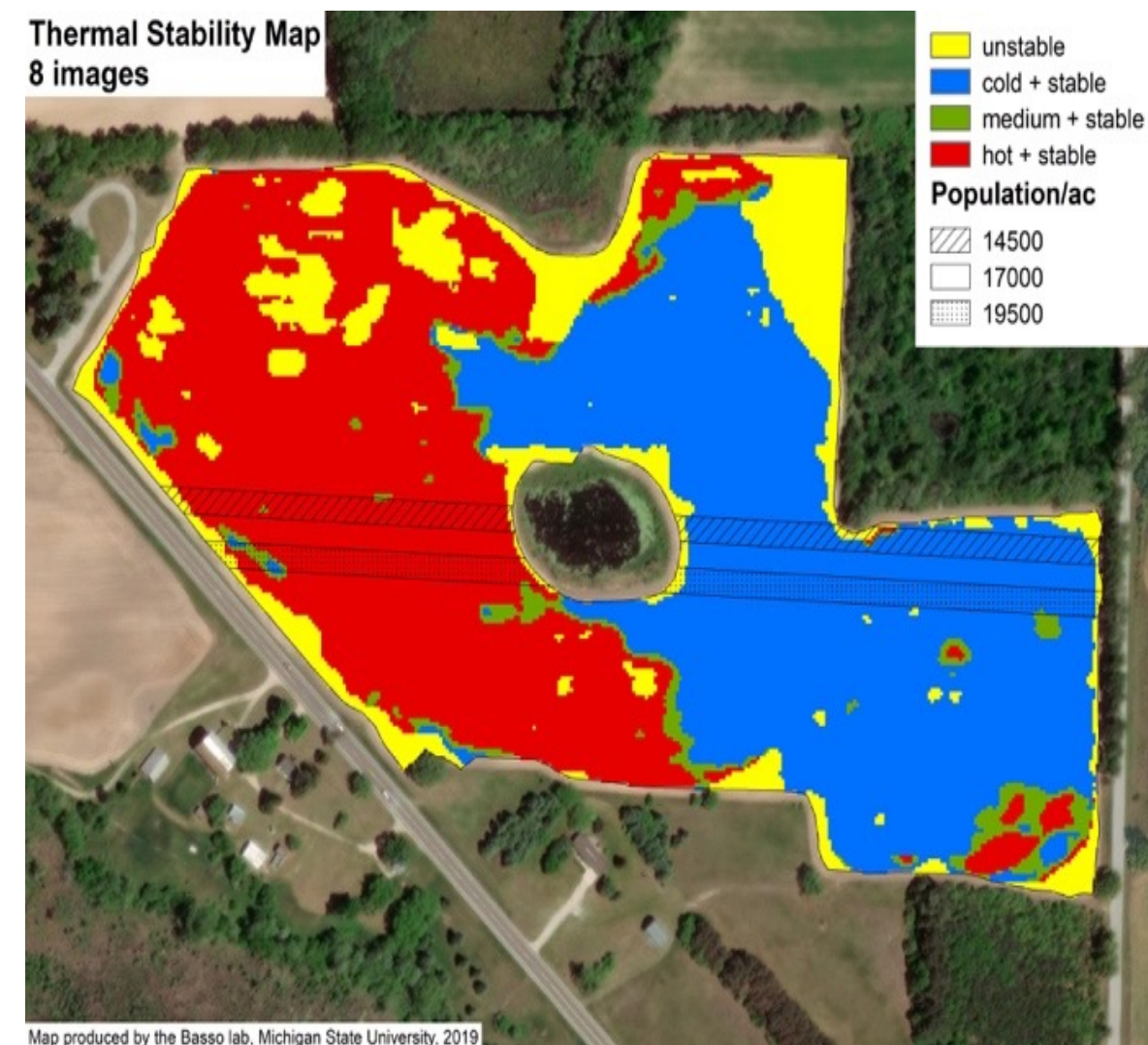
# Relationship between 2019 thermal stability, soil health indicators and potato tuber yield.

Soil health and potato tuber yield	Cold & stable	Hot & stable
Potato Tuber Yield (cwt/acre)	443.5a	351.2b
Cornell Soil Health Score (0-100)	56.7a	51.4b



# The West Half Of This Field Has A Fever!

Soil health and potato tuber yield	Cold & stable	Hot & stable
Potato Tuber Yield (cwt/acre)	443.5a	351.2b
Cornell Soil Health Score (0-100)	56.7a	51.4b



# 2022 Soil Health

- The 10<sup>th</sup> anniversary of the 2012 survey provided a unique opportunity to determine if there was a change in the soil health of the MI Potato Industry during the past decade.
- The objective of the research was to repeat the survey for the 72 of sites in Montcalm and Mecosta County sampled in the 2012 soil health survey using the Cornell Soil Health Lab.



# 2012-2022 Soil Health Survey Results

- There was a significant positive increase in the soil organic matter associated with all 68 sites.
- There was a significant positive increase in active carbon associated with all 68 sites.
- There was a significant positive increase in available water capacity associated with all 68 sites.
- Population densities of the Penetrans root-lesion nematode were lower in 2022, compared to 2012.

*Good News!*

# 2012-2022 Soil Health Survey Results

- Nitrogen mineralization potential remained low. It was difficult to access because Cornell Univ. changed the assay for this parameter.
- Soil respiration remained low.
- In most of the sites there was a decline in percent soil water stable aggregates.

# Impact of Soil Fumigation on Soil Health Indicators

Indicator	No Soil Fumigation	Soil Fumigation
Root-Lesion Nematode	42.6a	4.7b
Aggregate Stability	45.2a	36.1b
Active Carbon	225.4a	166.6b
N Mineralization	9.0a	4.6b

# Impact of Soil Fumigation and Non-fumigant Nematicides on Potato Tuber Yield (1974-2012)

Treatment	Potato Tuber Yield
Control (30 trials)	254 cwt/are
Soil Fumigation (18 trials)	368 cwt/acre
Non-Fumigant Nematicides (23 trials)	314 cwt/acre

Why is there greater potato tuber yield with soil fumigants than with non-fumigant nematicides?

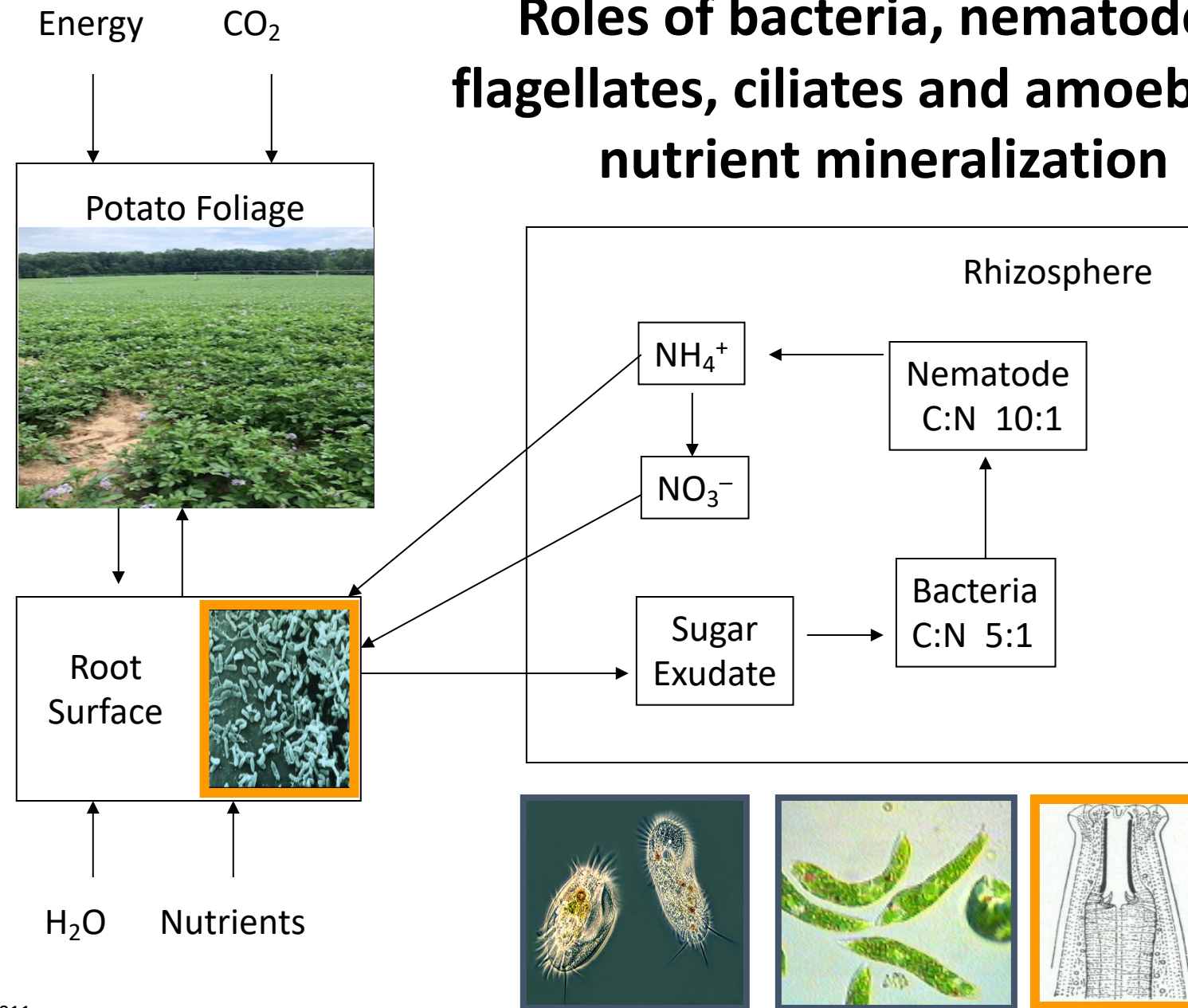
# Michigan Potato Soil Health Summary

- Progress in enhancing Michigan potato soil health has been made during the past ten years.
- There is, however, more work to do.
- The complexity and site (field) specificity of soil health makes it inappropriate to have a single soil health score.
- In addition to tuber yield and quality, the best current way to assay soil health is by measuring change, or lack of change, of individual soil health indicators.

# Michigan Potato Soil Health Recommendations

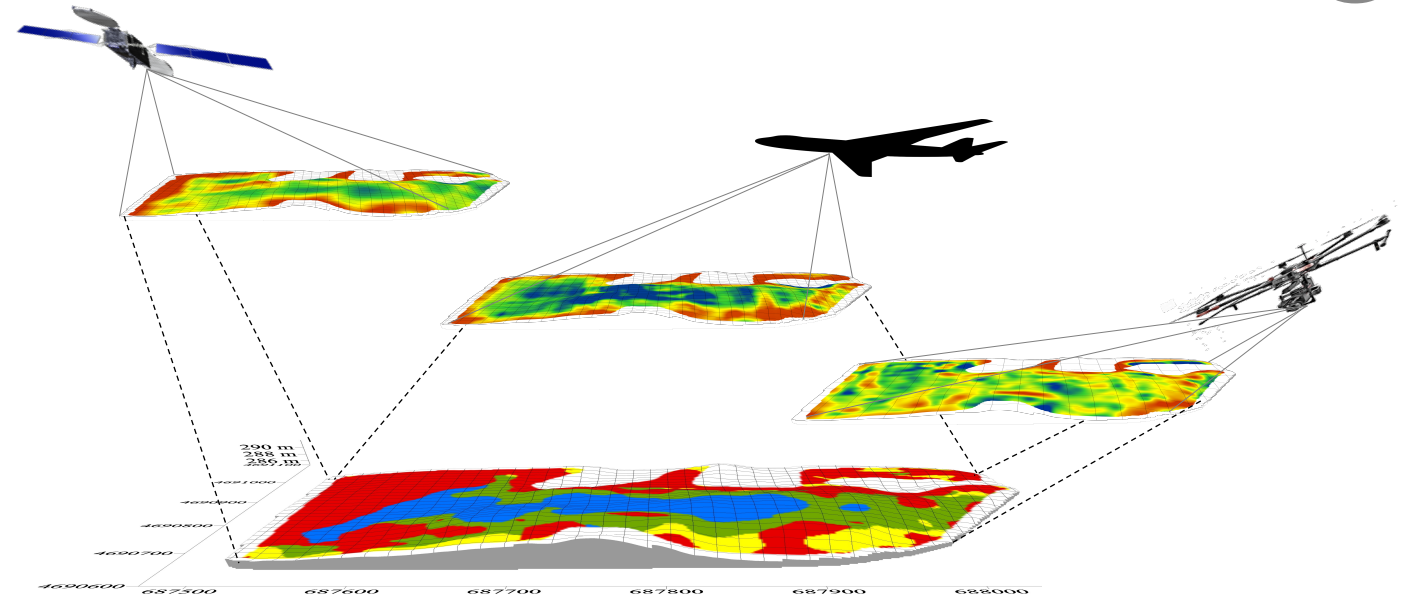
- Continue to have soil health as a key aspect of the **farm's sustainability plan**.
- Have soil **analyzed for soil health indicators** multiple times to assess change.
- Base sampling for soil health indicators on **field maps** of tuber yield and quality, disease and pest incidence and soil texture or thermal stability.
- Maintain best management practice **crop rotation** systems.
- Use **compost** as a pulsing agent and soil health enhancer.
- Include appropriate **cover crops** for the site's history and productivity goals.
- Do not over-till.

# Roles of bacteria, nematodes, flagellates, ciliates and amoebae in nutrient mineralization



Much remains to be done to understand the roles and interactions among the many types of organisms that sequester and mineralize essential chemical elements in soil!

Thanks for Listening



*George*