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WINERY & VINEYARDS

NORTH COAST SOIL HUB

Resilience through Regenerative Ag

- A biological perspective
- Carbon and Regenerative Agriculture
- Regenerative Agriculture
  - Examples and benefits I have seen
  - How to start

Greg Pennyroyal

- Manager Trout Lake Farm, Trout Lake WA – 2400 Acres diversified medical botanicals
- Director Botanical Research Leiner Health
- USP Expert Committees (15 yrs.)
- Research:
  - National Institutes of Health
  - Global Institute Tibetan Medicine
- Vineyard Manager Wilson Creek Winery
- Professor Viticulture MSJC

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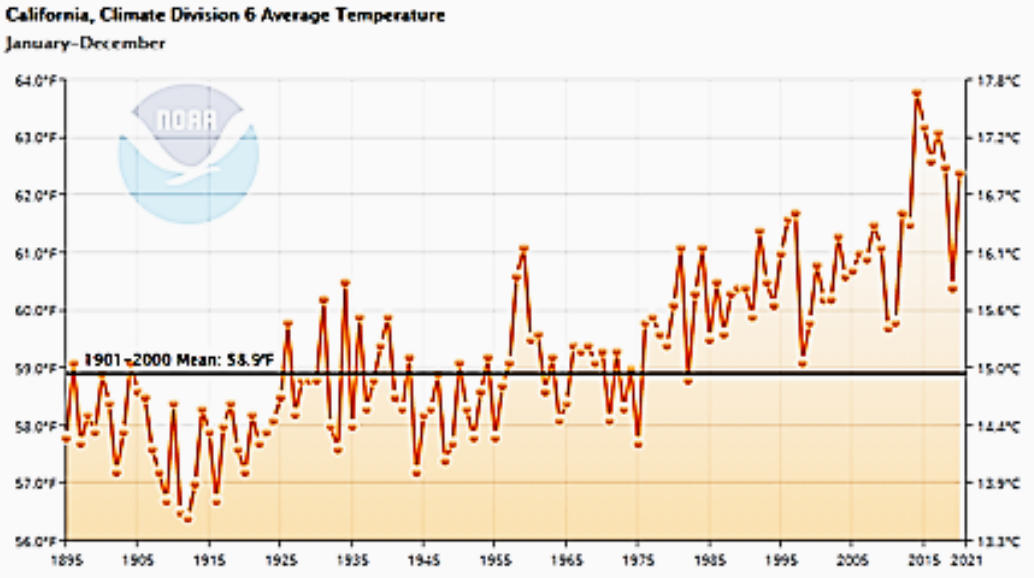
Mean Temp S.Cal AVA 1895 - 2021



Download: XML

DATES	VALUE	RANK	DEPARTURE FROM MEAN (58.9°F) 1901-2000 BASE PERIOD
201401 - 201412	63.8°F	126	4.9°F
201501 - 201512	63.2°F	125	4.3°F
201701 - 201712	63.1°F	124	4.2°F
201601 - 201612	62.6°F	123	3.7°F
201801 - 201812	62.5°F	122	3.6°F
202001 - 202012	62.4°F	121	3.5°F

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Industrial Agriculture

- Soil as a medium for delivering soluble nutrients to plants
  - Degrades the soil food web
  - Releases CO_2 and decreases soil Carbon
  - Degrades organic matter
  - Nutrient deficient food
  - Ecosystem services degradation
  - Increased reliance on synthesized inputs $$$

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Regenerative Agriculture

- Soil systems that are Constantly improving soil health
  - Supports the soil food web leading to resilience
  - Sequester Carbon
  - Build organic matter
  - Nutrient dense food as medicine
  - Decreased or eliminated reliance on synthesized inputs

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Regenerative Agriculture

- Must also regenerate:
  - Farmers bank account
    - No margin no mission
    - Must preform in current economic models
    - Would be obvious in a “True Cost” accounting system
  - Value of ecosystem services
    - Clean air, Water, open spaces, genetic diversity
    - Potential for carbon sequestration income

Chemical vs. Biological approach
Change perspective change results

- All plants evolved in a highly complex mineral, organic and biological matrix
  - Theory of biological availability – Biological / Organic
    - Not soluble but available
  - Maintaining soil health is sustainable agriculture

vs:

  - Theory of solubility – Chemical
- N-P-K approach to fertility assumes that the parts are greater than the whole
  - Large scale commercial interests support this approach
  - Somewhat like anabolic steroids, great results can be achieved
    - And then degradation and damage set in

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Photosynthetic capacity of plants

- Plants functioning at high photosynthetic efficiency are the engine that develop healthy soils, not the other way around
- Average industrial agricultural photosynthetic efficiency of crops is 15-20% of theoretical genetic potential
  - Don't leave 80% of the value behind!

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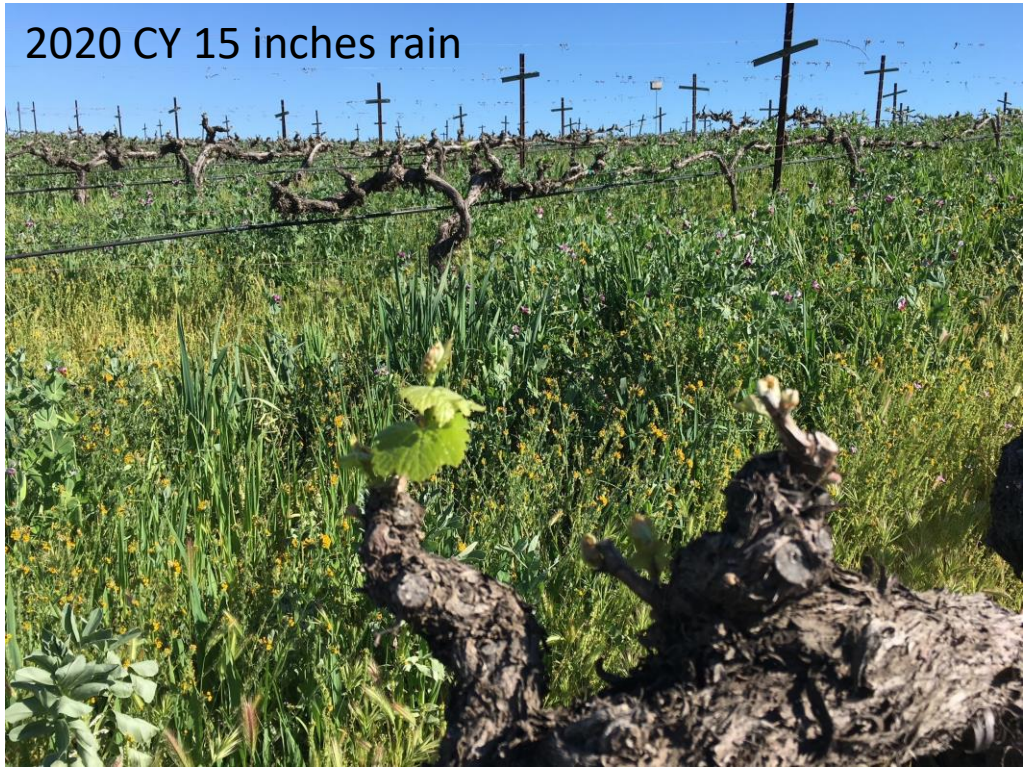
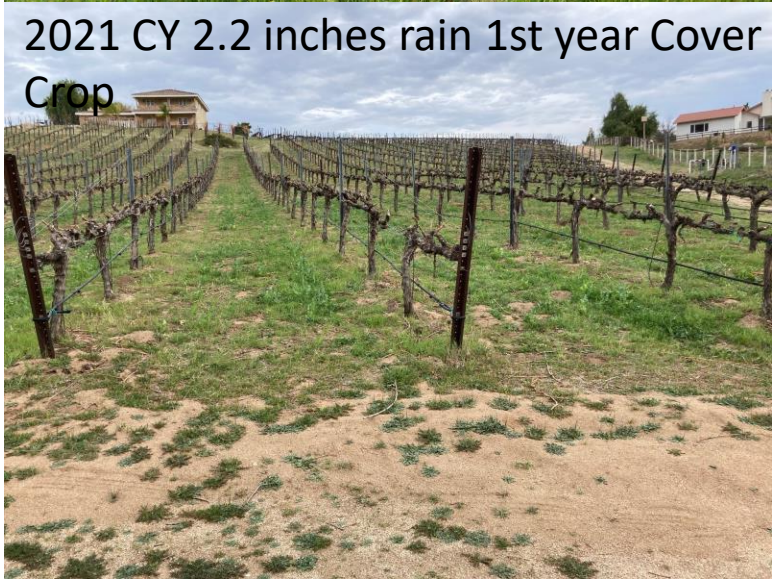
Photosynthetic capacity of plants

- Increase in photosynthetic efficiency does not directly correlate to an increase in yields
- Additional sugars fed into soil ecosystem
- Improvement in genetic expression
  - Higher chemotypical expression
  - Improved plant health
  - Reliance to biotic stress
    - Cover crops + mulches – Vineyard dormancy photosynthetic income

Value of Cover Crops

Minimize tillage – benefits must outweigh damage





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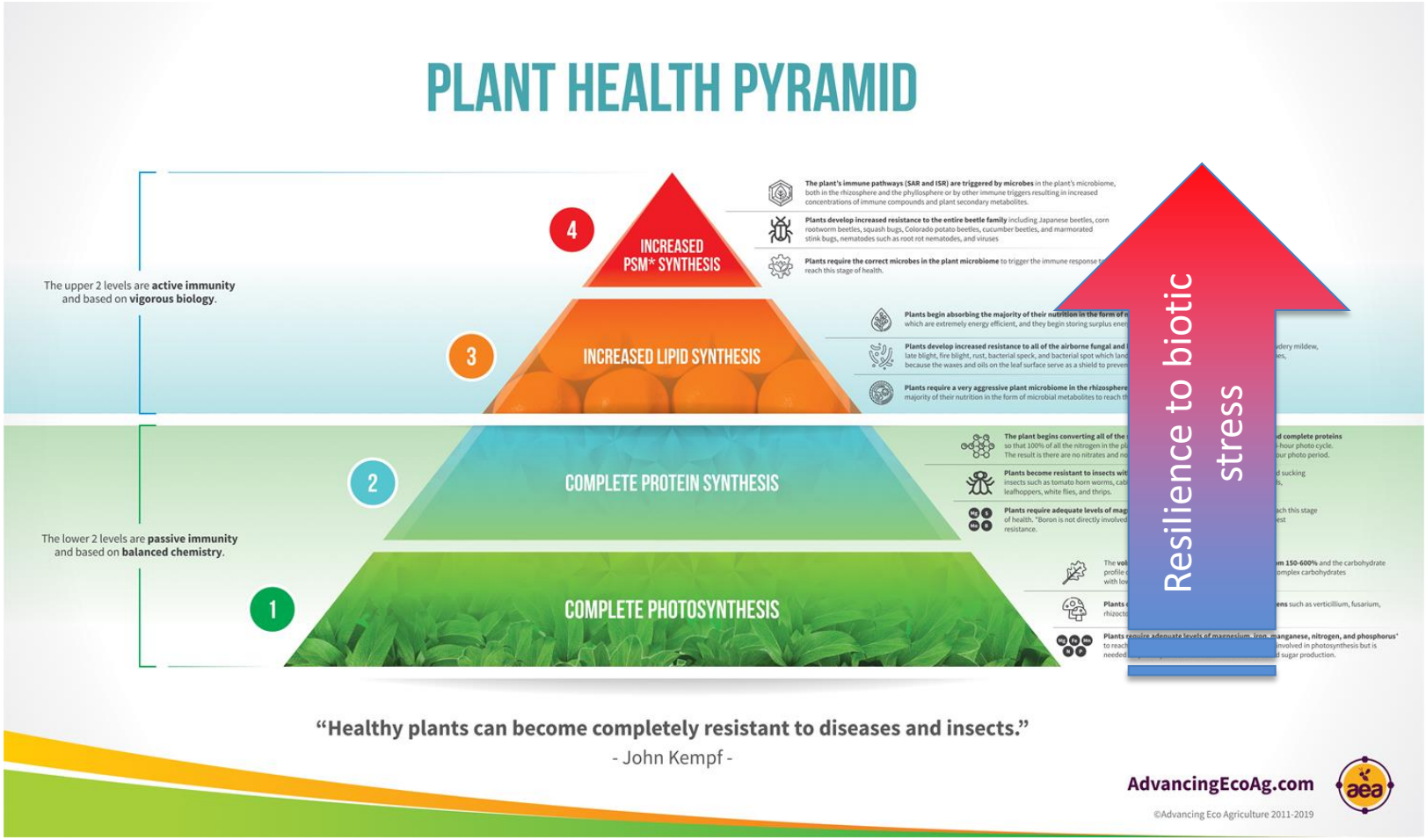
Regenerative Agriculture



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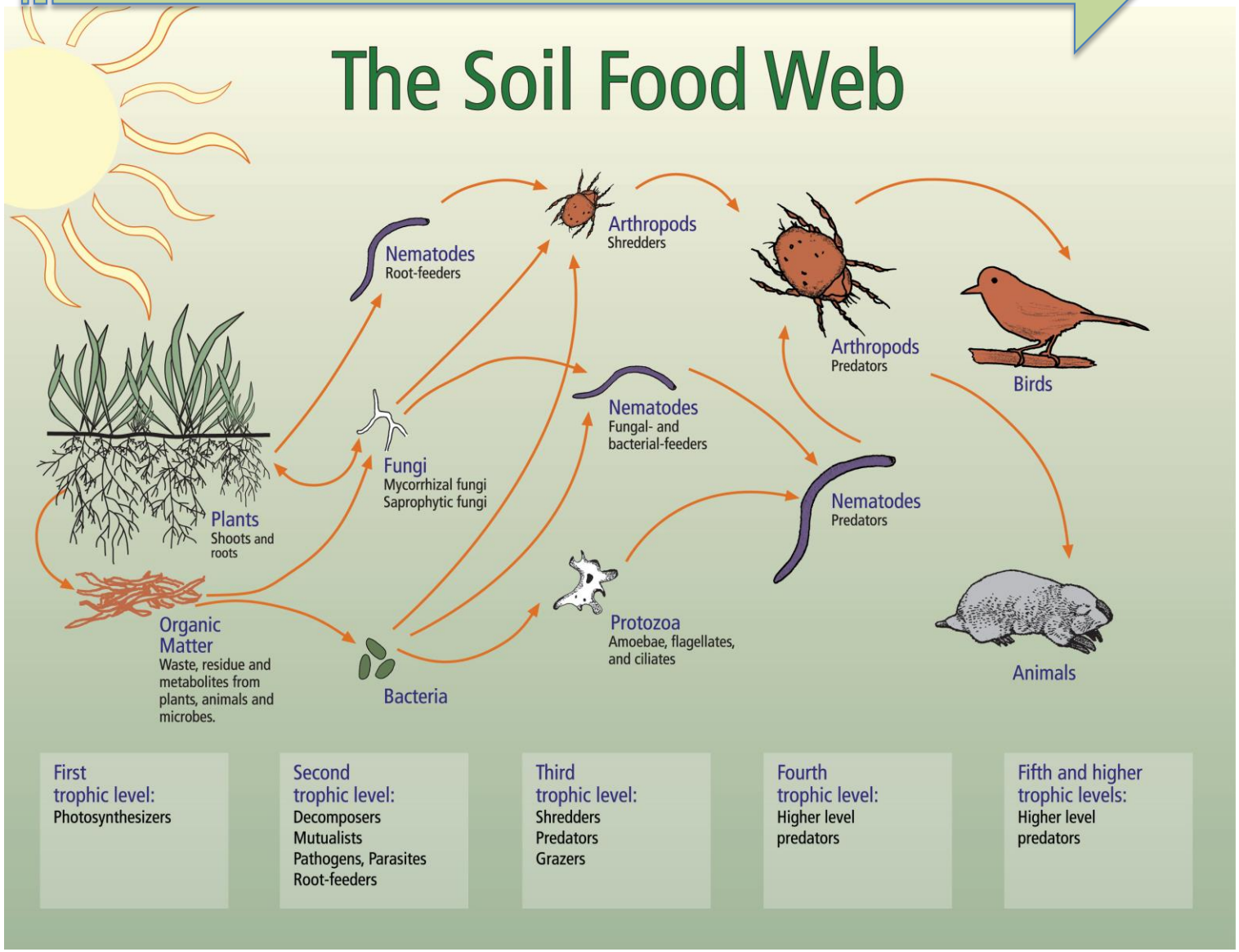
Increasing levels of plant driven ecological homeostasis



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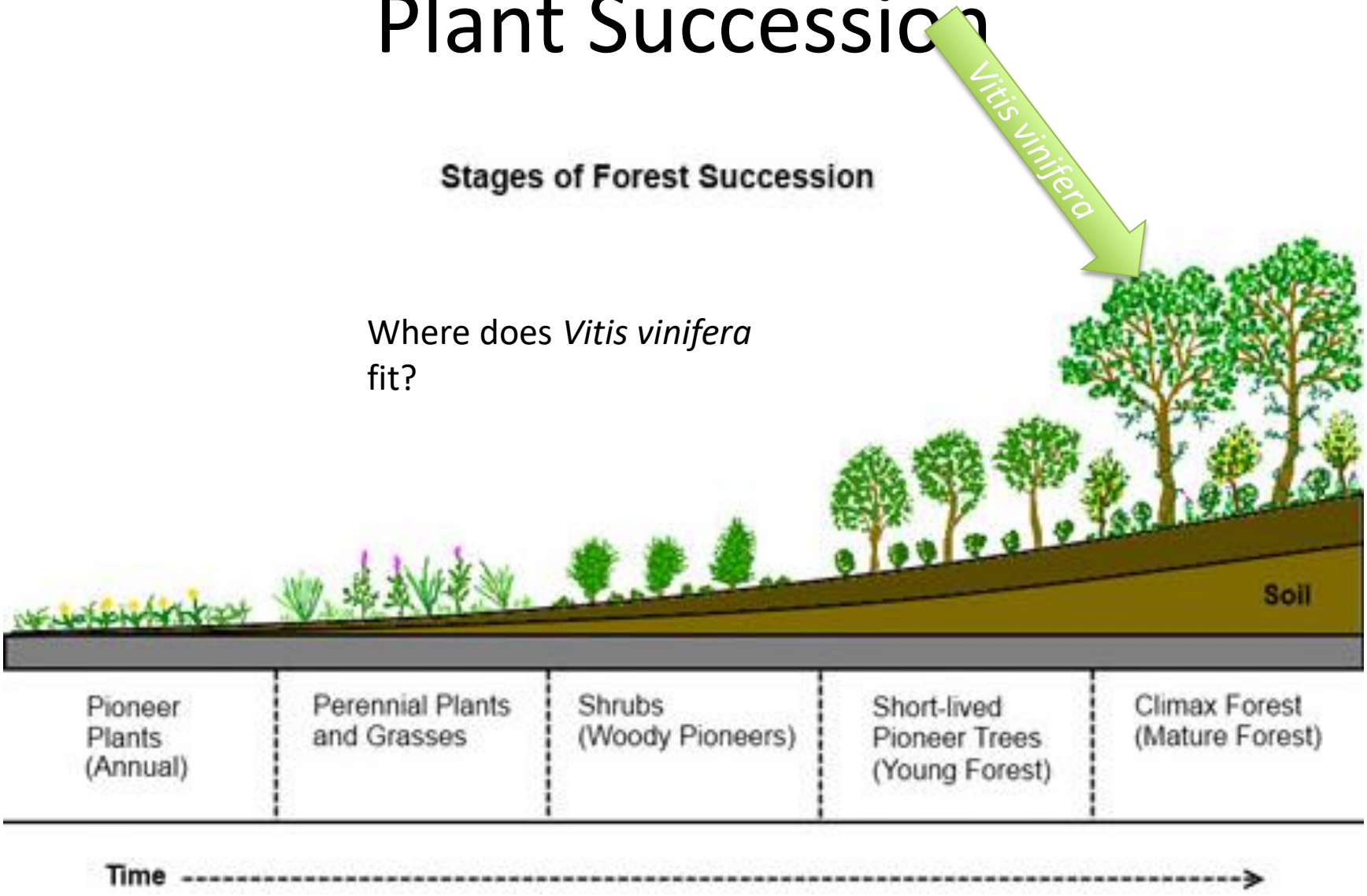
Plant Succession



Where does *Vitis vinifera* fit?

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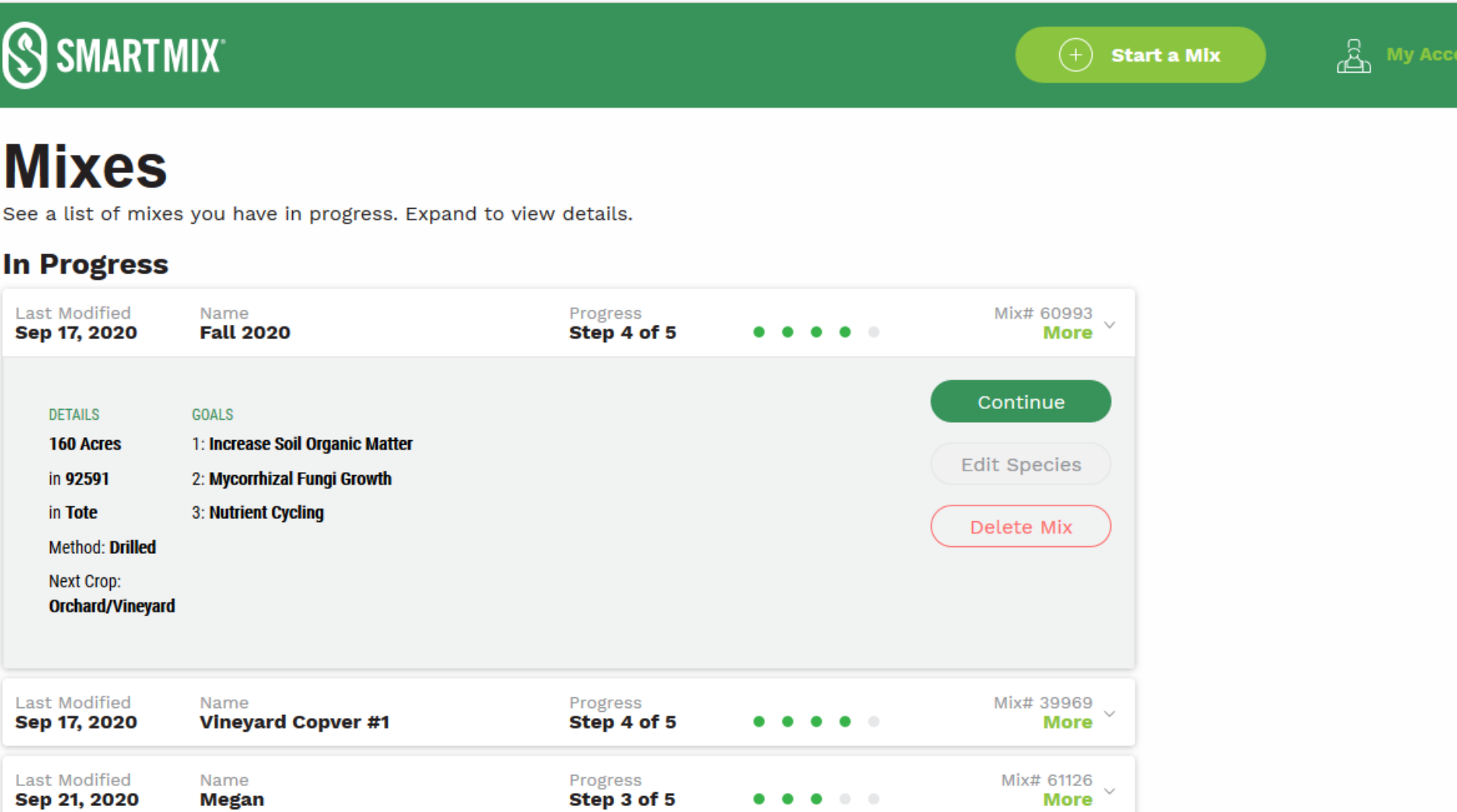
Diversified cover crop mixes to increase soil diversity



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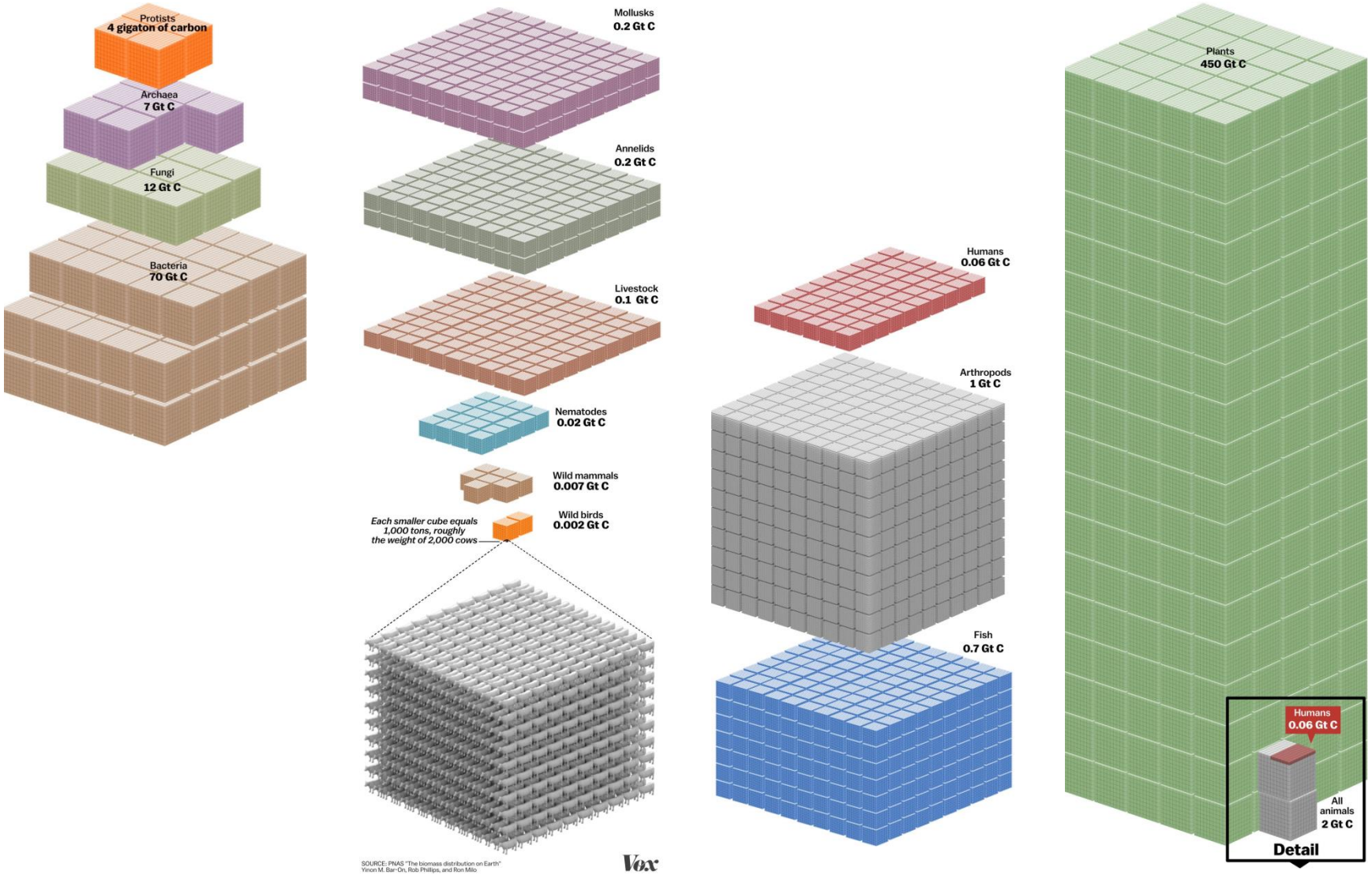
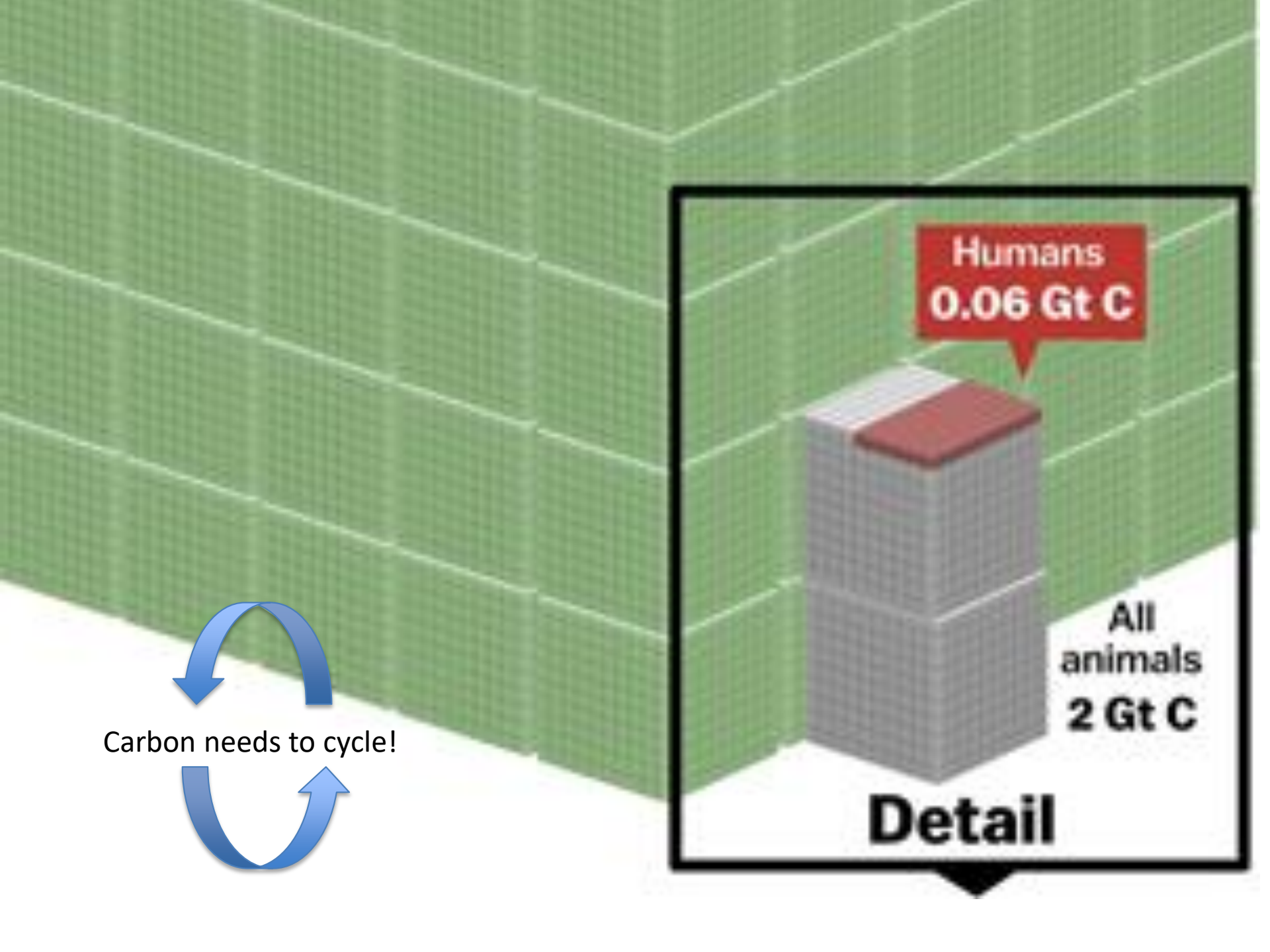
Agriculture and Carbon Sequestration




Humans
0.06 Gt C
All animals
2 Gt C
Detail
Carbon needs to cycle!

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What has worked for me

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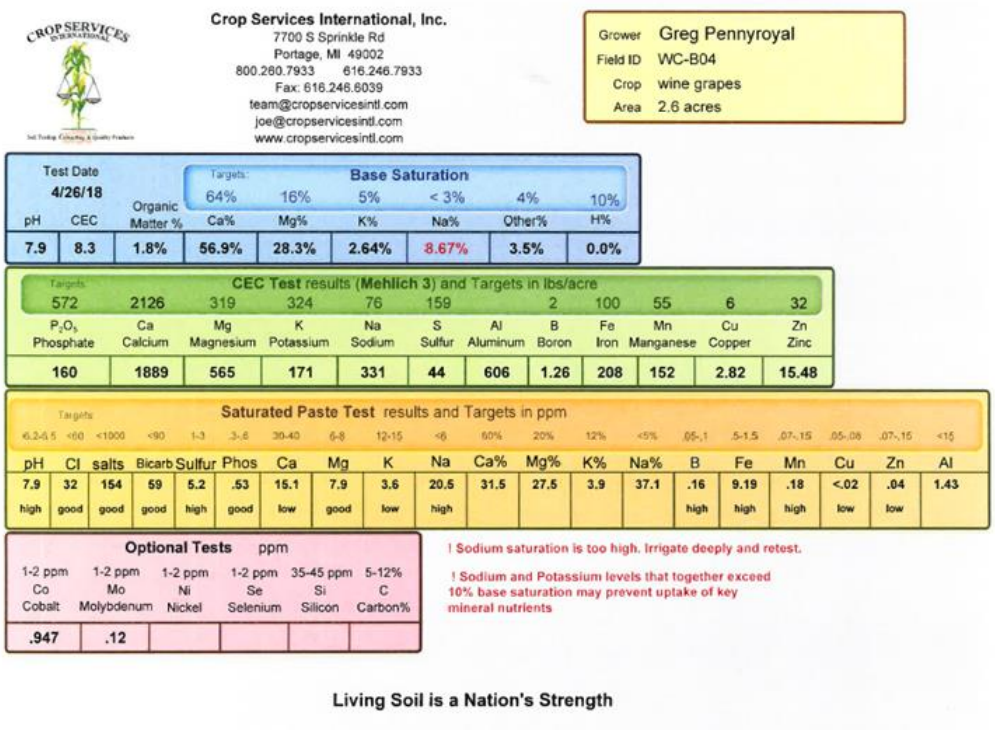
Soil Tests

- Give initial assessment of gross availability and ratios (Albrecht)
- Low correlation to field observations and outcomes



Crop Services International, Inc.
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Portage, MI 49002
800.280.7933 616.246.7933
Fax: 616.246.6039
team@cropservicesintl.com
joe@cropservicesintl.com
www.cropservicesintl.com

Grower	Greg Pennyroyal
Field ID	WC-B04
Crop	wine grapes
Area	2.6 acres

Test Date			Base Saturation Targets:	64%	16%	5%	< 3%	4%	10%
pH	CEC	Organic Matter %		Ca%	Mg%	K%	Na%	Other%	H%
7.9	8.3	1.8%		56.9%	28.3%	2.64%	8.67%	3.5%	0.0%

CEC Test results (Mehlich 3) and Targets in lbs/acre

Targets:	572	2126	319	324	76	159	2	100	55	6	32
	P_2O_5 Phosphate	Ca Calcium	Mg Magnesium	K Potassium	Na Sodium	S Sulfur	Al Aluminum	B Boron	Fe Iron	Mn Manganese	Cu Copper	Zn Zinc
	160	1889	565	171	331	44	606	1.26	208	152	2.82	15.48

Saturated Paste Test results and Targets in ppm

Targets:	6.2-6.5	<60	<1000	<90	1-3	.3-.6	30-40	6-8	12-15	<6	60%	20%	12%	<5%	.05-.1	.5-1.5	.07-.15	.05-.08	.07-.15	<15
	pH	Cl	salts	Bicarb	Sulfur	Phos	Ca	Mg	K	Na	Ca%	Mg%	K%	Na%	B	Fe	Mn	Cu	Zn	Al
	7.9 high	32 good	154 good	59 good	5.2 high	.53 good	15.1 low	7.9 good	3.6 low	20.5 high	31.5	27.5	3.9	37.1	.16 high	9.19 high	.18 high	<.02 low	.04 low	1.43

Optional Tests ppm

1-2 ppm Co Cobalt	1-2 ppm Mo Molybdenum	1-2 ppm Ni Nickel	1-2 ppm Se Selenium	35-45 ppm Si Silicon	5-12% C Carbon%
.947	.12				

! Sodium saturation is too high. Irrigate deeply and retest.

! Sodium and Potassium levels that together exceed 10% base saturation may prevent uptake of key mineral nutrients

Living Soil is a Nation's Strength

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Petiole samples -limited reliability

Tissue: Grape - DIV I Leaves Opposite Flowers at Blooming

NutriScription

rower Name **Wilson Creek** *Test Date* **4/26/2016**
Field Name **Muscat Block 10** *Field Rep* **David Drucker**
Crop **Grape** *Sample ID* **DG02333**
Sample Date **4/25/2016** *Subfield*

		Very Low	Low	Optimum	High	Excessive	
Total N	1.40						Maximum NPact
Total P	0.41						Optimum
Total K	2.75						High
Macronutrients		***Very Low***	***Low***	***Optimum***	***High***	***Excessive***	
Ca	1.39						Optimum
Mg	0.63						High
Na	0.02						OUT OF RANGE
S	0.19						OUT OF RANGE
Micronutrients		***Very Low***	***Low***	***Optimum***	***High***	***Excessive***	
Zn-ppm	75.00						High
Mn-ppm	57.00						Optimum
Fe-ppm	124.00						OUT OF RANGE
Cu-ppm	4.00						Contact your CPS CCA
B-ppm	36.00						Optimum
Petioles		***Very Low***	***Low***	***Optimum***	***High***	***Excessive***	

Very Low or Problem
Low
Optimum
High
Very High

Comments:

Analytical data provided by Waypoint Analytical Tennessee. Recommendations provided in this report are proprietary in nature whereby nutrient thresholds used as a reference may or may not match Waypoint Analytical Tennessee ranges for this particular crop and growth stage.

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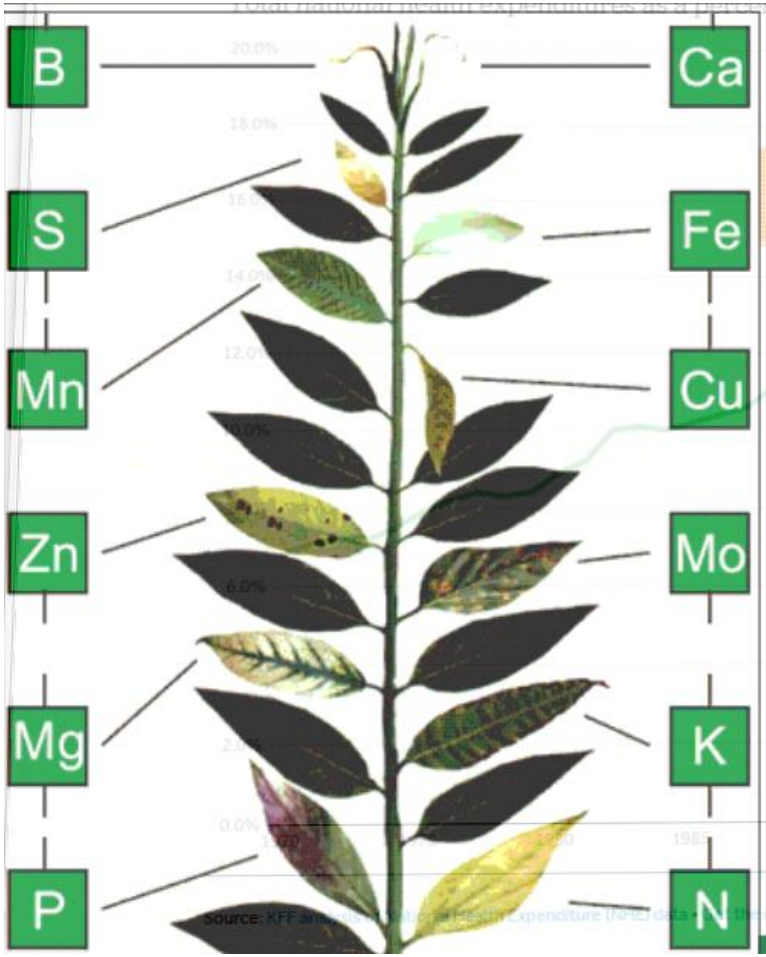
Sap Analysis



Mobile minerals:

Deficiency appears first in older leaves

- Nitrogen (N)
- Potassium (K)
- Magnesium (Mg)
- Phosphorous (P)

Medium immobile minerals:

- Sulphur (S)
- Iron (Fe)
- Manganese (Mn)
- Zinc (Zn)
- Copper (Cu)
- Molybdenum (Mo)

immobile minerals:

Deficiency appears first in young parts

- Calcium (Ca)
- Boron (B)

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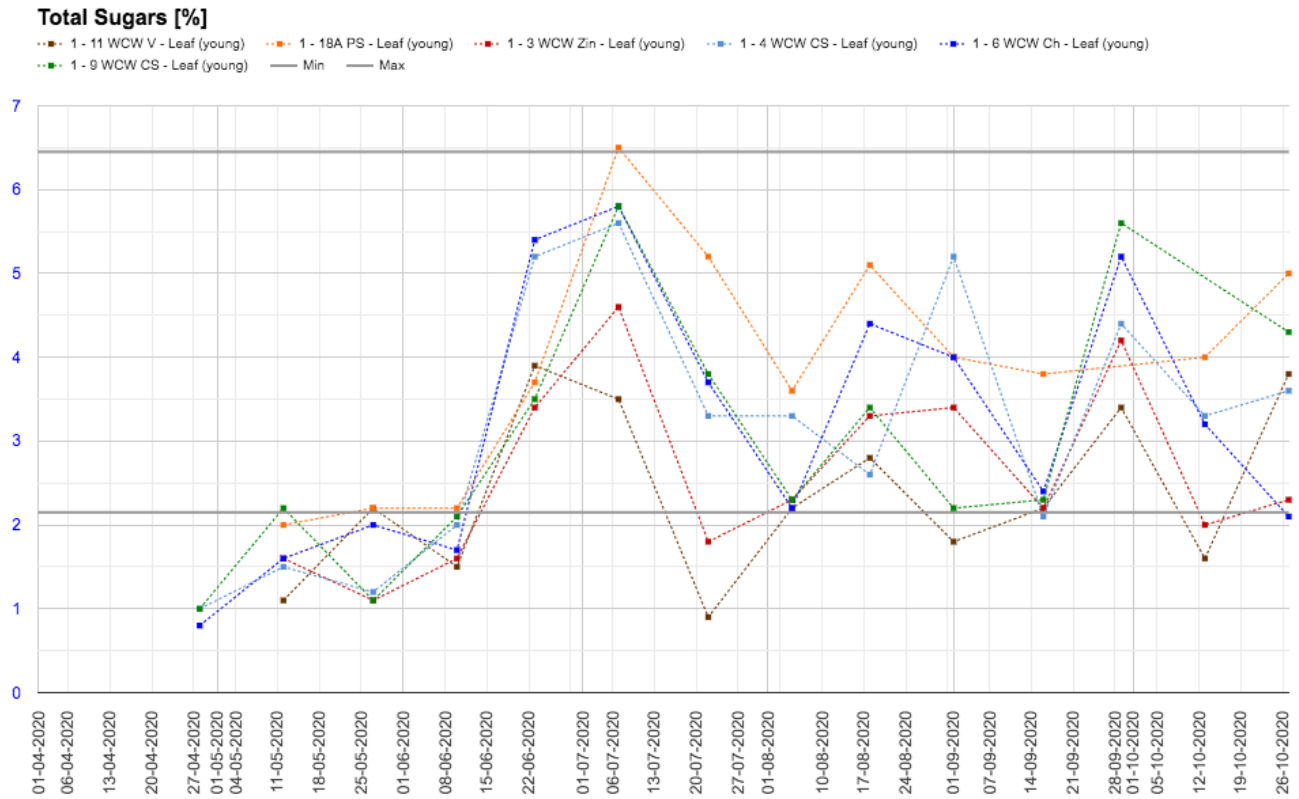
Insights sap analysis 1 year



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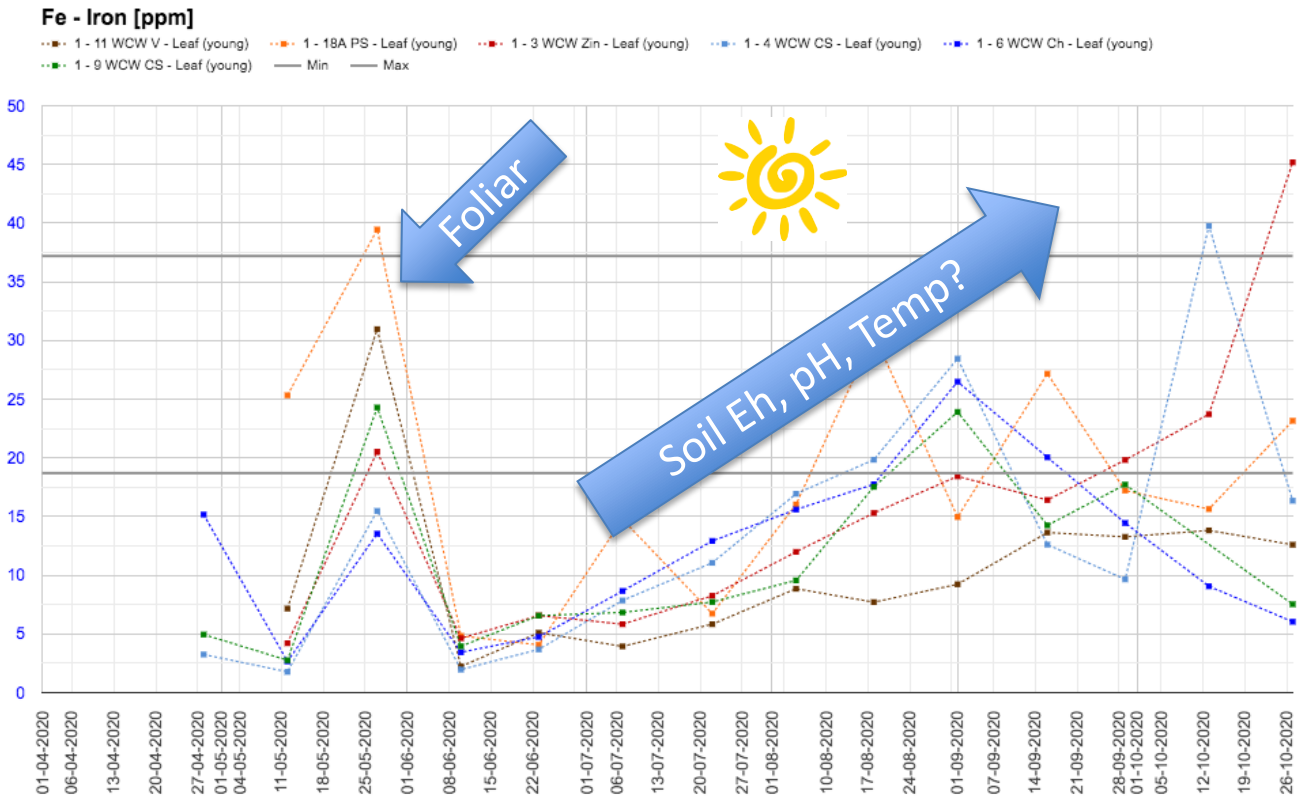
Fe related to irrigation?



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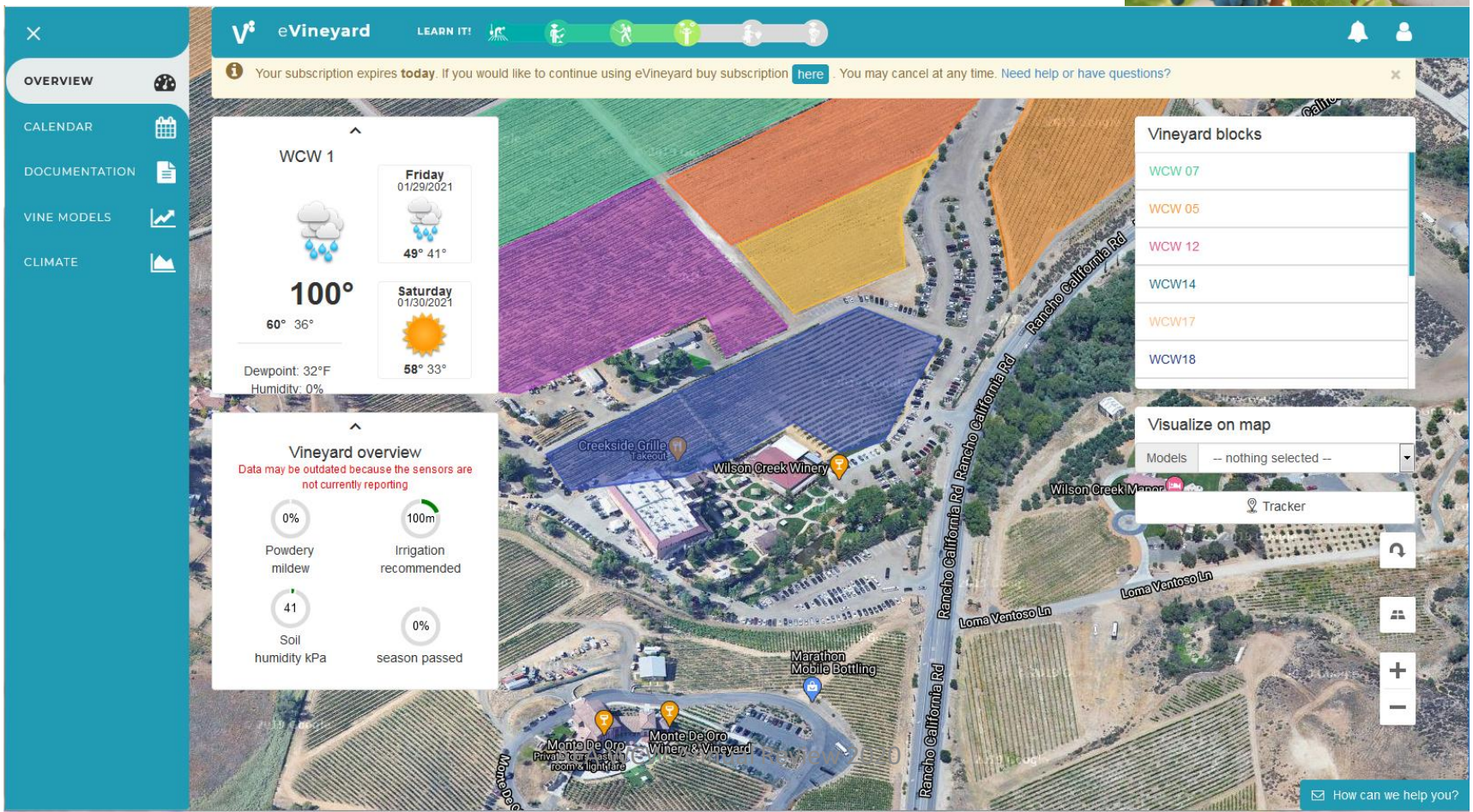
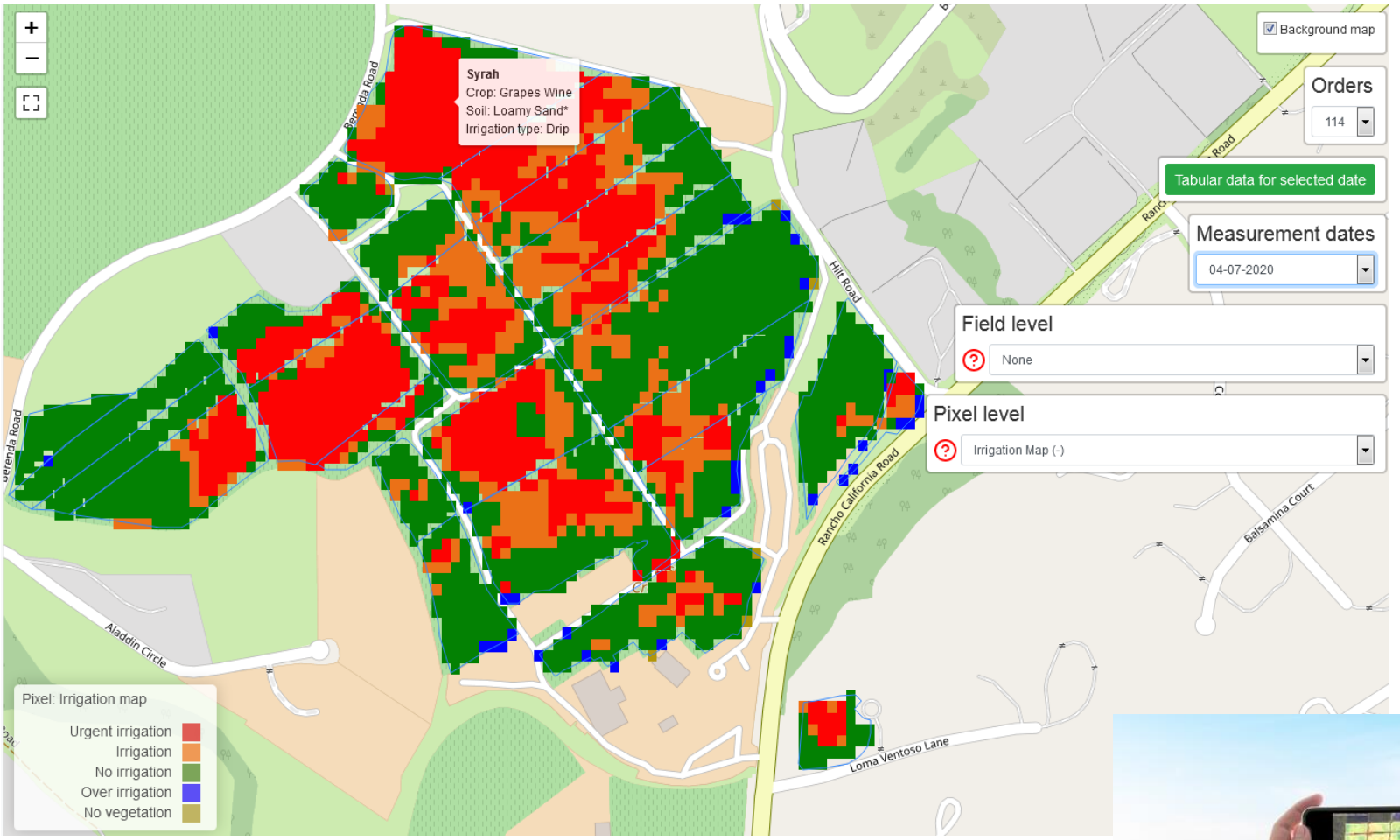
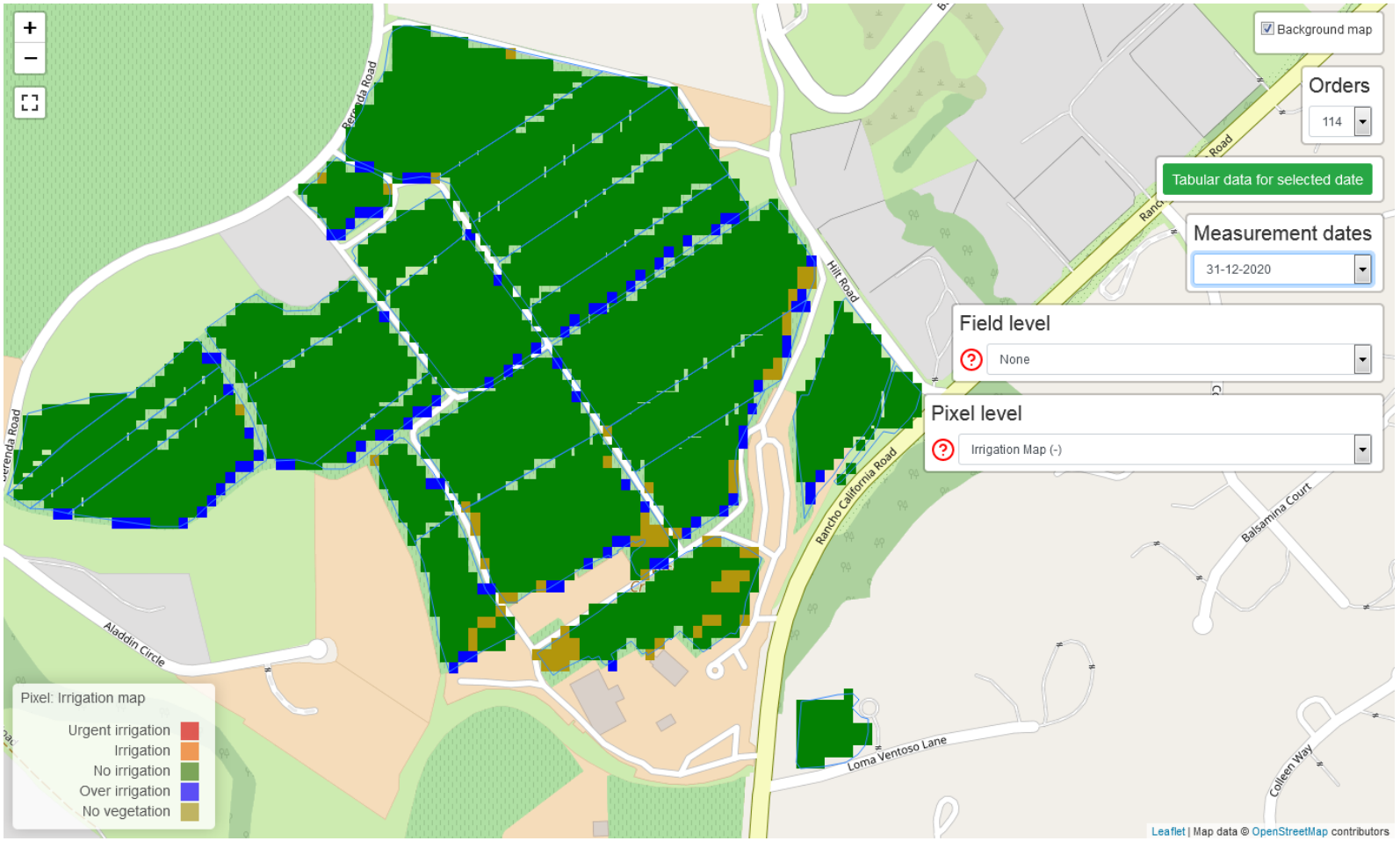
e-Vineyard - Data Collection



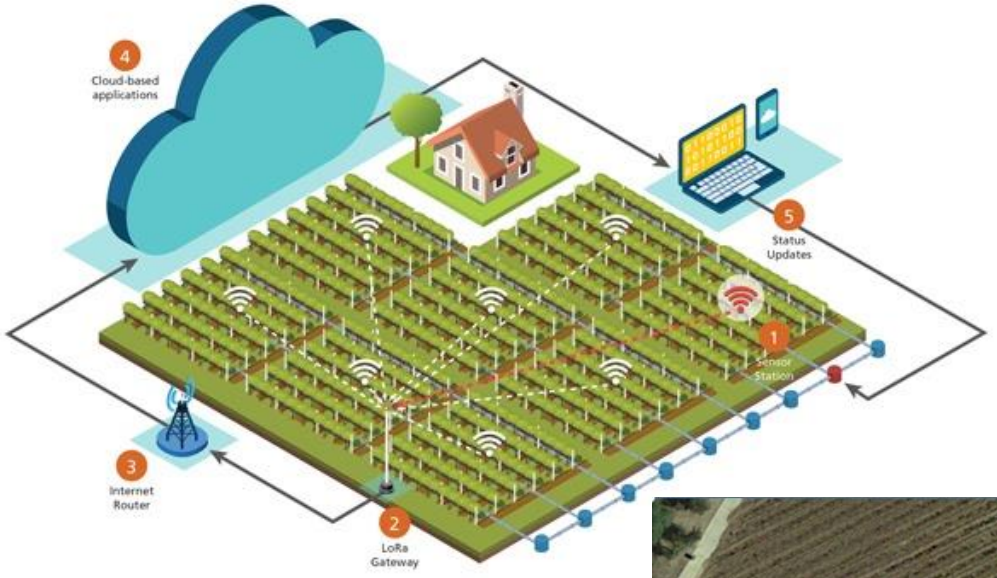
IrriWatch 4th July 2020



IrriWatch December 31 2020



Fertigation Foliar Irrigation Soil Temp Proof of Concept



	Fertigation	Foliar	Irrigation
Block 1	Regular	NO	Regular
Block 2	NO	Regular	Regular
Block 3	Regular	Regular	4X a week
Block 4	Regular	Regular	1X a week

Benefits

- Increased yield 22 – 31% Average
- Yield stabilization
  - 2020 Temecula Cabernet Sauvignon 65% of three-year average
  - 2020 Wilson Creek yield 110% % of three-year average
- Better quality as seen through fermentation
  - Wine spectator 90, 91 & 92 points

Benefits

- 50% Reduction in the use of Fungicides (goal =0)
- 38% Reduction in gallons / ton ratio (improved infrastructure contributed)
- I plan more, react less
  - More field and crew time
  - More customer time = more profits
  - More fun
  - I don’t work on weekends! (much)

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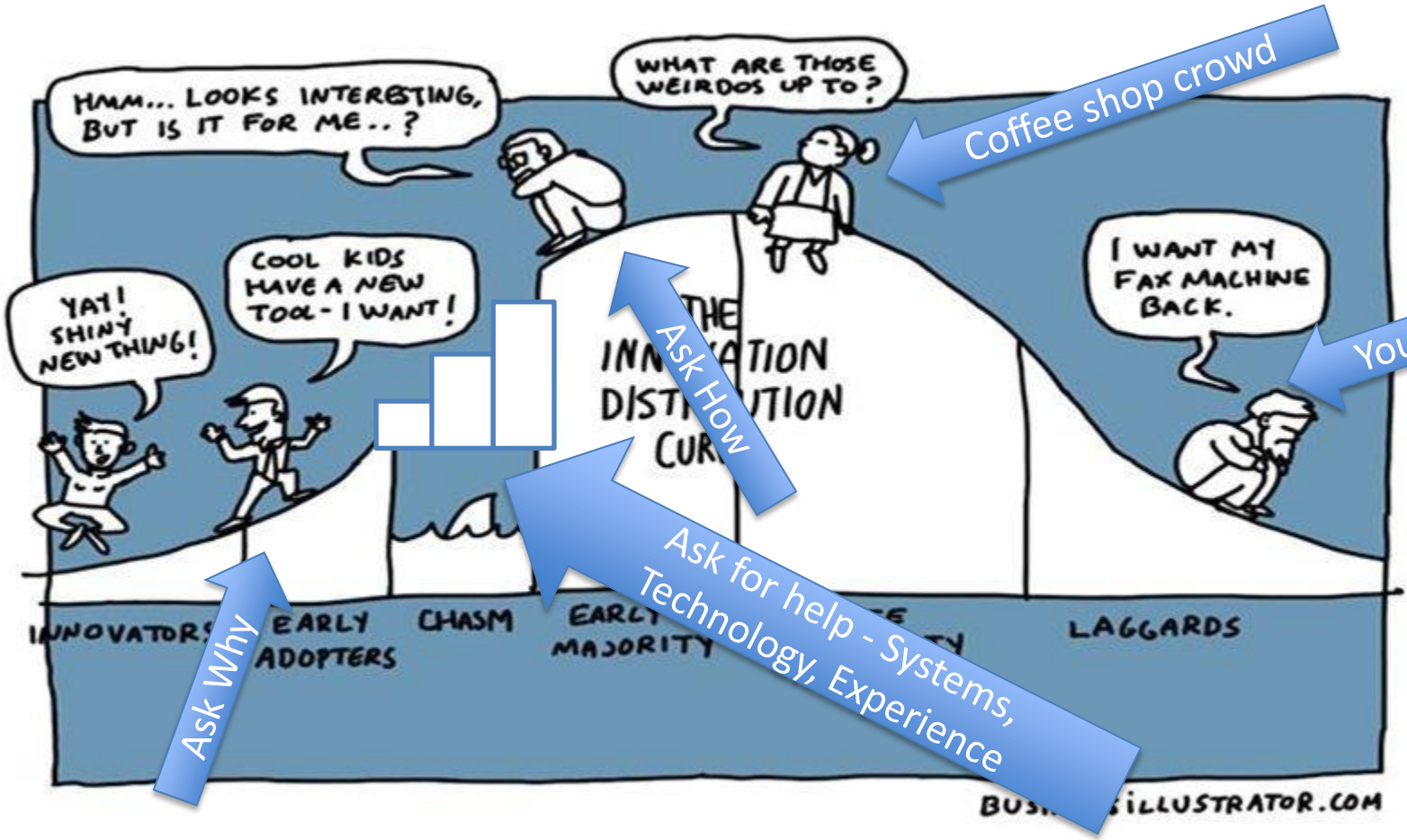
Your tolerance for innovation

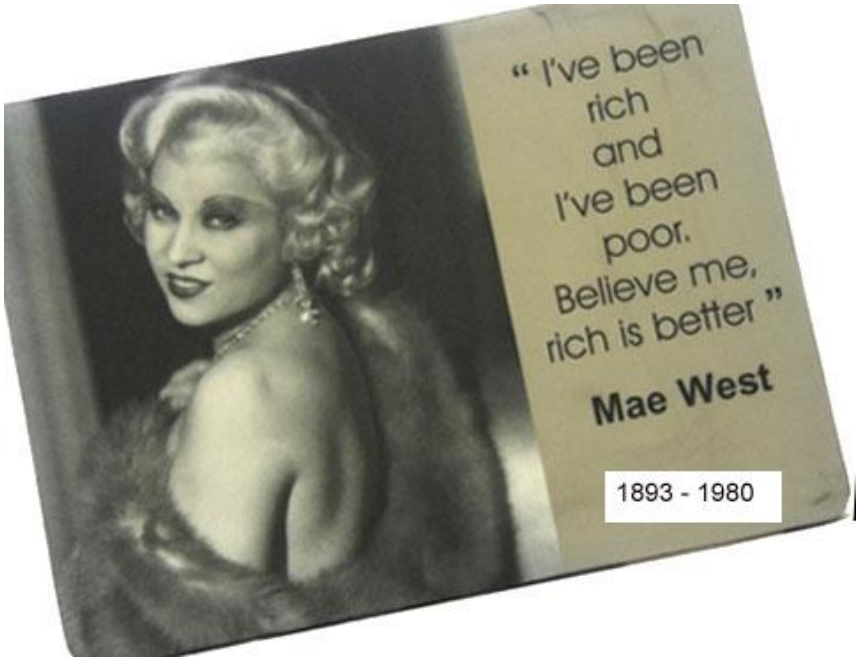


How to start

- Clear Goals
  - Better yield
    - Can be a lag for many perennial crops
    - Less variability
  - Better quality
    - Definition
    - $ Definition

How to start

- Clear Goals
  - Better Lifestyle
    - More time practicing the art of farming
      - Having fun again
    - Better work life balance
    - Better community member
      - People & Planet
  - Better economics



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How to start

- Start small
  - Make mistakes on a small scale
  - ROI – time and expense – Less is often more! Don't be a "More-On"
- Scale up fast
  - Make improvements and money on a large scale
- Develop appropriate measurements
  - Predictive vs reactive
  - Consistently reassess 80/20 rule

How to start

- Develop appropriate systems
  - Record keeping and real time interpretation
    - Sap analysis and/or other measurable results
      - Act proactively
      - Critical points of influence
    - Field observations
      - Tie to analysis
      - Yield quality data
      - Visual & physiological parameters

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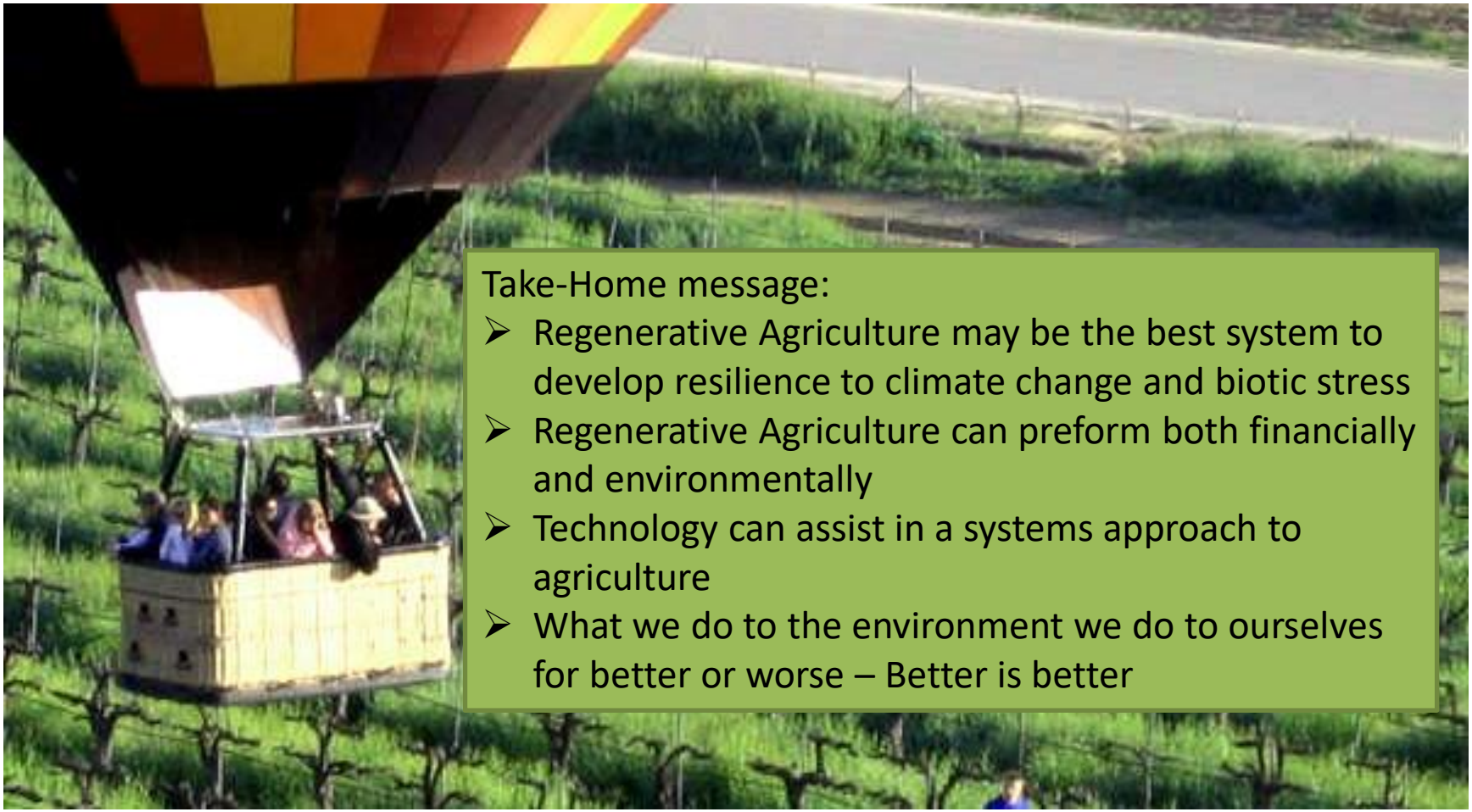
Drink good wine save the planet



Take-Home message:

- Regenerative Agriculture may be the best system to develop resilience to climate change and biotic stress
- Regenerative Agriculture can preform both financially and environmentally
- Technology can assist in a systems approach to agriculture
- What we do to the environment we do to ourselves for better or worse – Better is better

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Thank you – Questions?

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