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SAVING THE LAND THAT SUSTAINS US

California

Cover Crop Demonstration Trial Results: Soil & Economic Results of Four Farms

January 14, 2026

State leads: Paul Lum, Harol Gonzalez Gallardo, Anel Trujillo, Vanessa Lozano Perez, & Tom Stein

AFT National support team: Dr. Bianca Moebius-Clune, Dr. Gabrielle Roesch-McNally, Dr. Michelle Perez, Aysha Tapp Ross, Dr. Robert Ellis, Ellen Yeatman, June Grabemeyer, & Jen Tillman

Session agenda

- About the Project
- CA farms & trial design
- Guest speaker: Nav Athwal, CA almond farmer & demo trial participant
- Soils results
- Economics results
- Aggregate survey results
- Lessons learned
- Q&A

A cover crop mix flourishing between almond trees instead of bare soil

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ABOUT THE PROJECT

Photo: Chris Pierce Demo Trial Site, Kentucky

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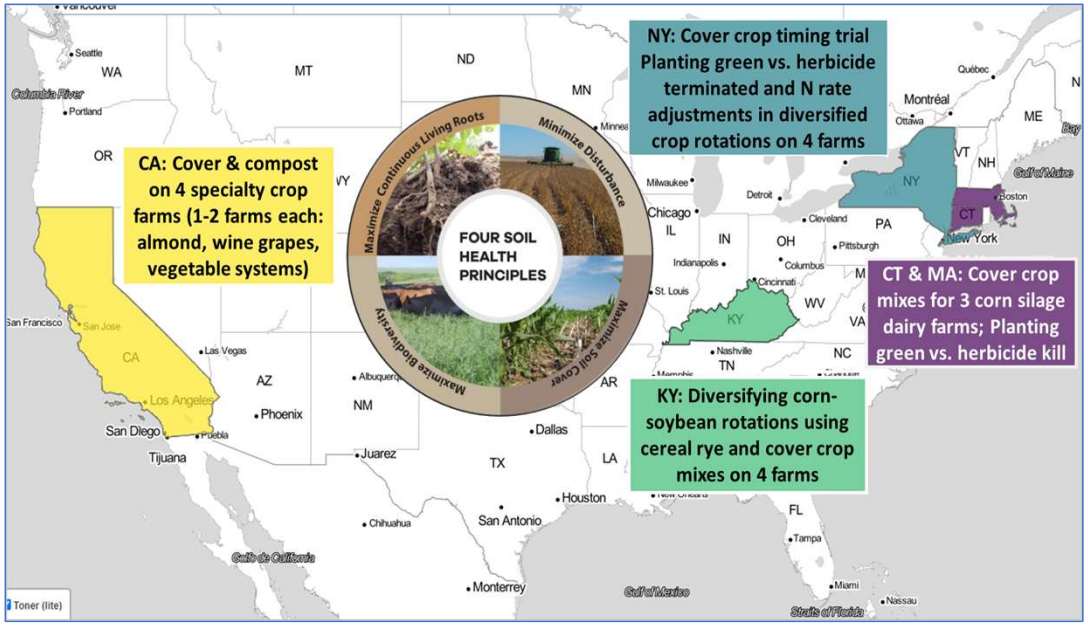
About AFT's National On-Farm Demonstration Trial project: "Conquering Cover Crop Challenges from Coast to Coast" (2021-2025)

- Supporting **farmer-driven transitions** to improve soil health thru adoption of cover crops & other soil health practices
- 15 farms in 3 geographic regions & 5 states (CA, KY, NY, MA, & CT), representing 6 crop systems:

Almonds	Corn-soybeans-wheat
Wine grapes	Corn silage diversified crops
Vegetables	Corn silage



- **Regional issues & cropping system challenges**: soil moisture management (CA), planting & termination timing in crop rotations (NY), termination methods (New E), & cover crop mixes (KY)

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What are cover crops?

Photo: Gemperle Family Farms, May 2023

- What are cover crops
- Why use them
- Addressing common misconceptions
- Challenges & benefits

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CA Farms & Trial Designs

Photo: Bullseye Farms Demo Trial plot, no cover crop on right, cover crop treatment on left, March 2024

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California growers & their cover crop practices

Project	Farm Name (farm code)	Production	Design	Control, acres	Treatment, acres
NRCS National Demo Trial 2021-2025	Bullseye Farms	Tomatoes- sunflower-cucmbers	1 Split Field, No Replicates	No cover crop, 35	Cover crop (bean, vetch mix), 21
	Gemperle Family Farms	Almonds	2 Fields, No Replicates	No cover crop, 30	Cover crop (bean, vetch mix), 12
	Glendale Ranch Vineyard	Wine grapes	2 Fields, No Replicates	No cover crop, 8	Cover crop (triticale, beans, peas and brassicas) & reduced tillage, 8
ESRCD Mother Trial 2022-2025	Nav Athwal	Almonds	1 Split Field, No Replicates	No cover crop,25	Cover crop (triticale,beans,peas,canola ,mustard, radish mix), 50

***Regional cover crop issues**: water availability, pest management, field hygiene, field access, frost damage, residue management, opportunity costs*

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ESRCD Cover Crop Trials

Photo: Athwal orchard June 2025

- 4-year trial
- Annual soil testing
- On-farm financial assessment
- Combined with compost & irrigation management practices

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The California Team!

AFT CA Team: Tom Stein, Anel Trujillo, Paul Lum & Harol Gallardo

Farmer Testimonial: Welcome Nav Athwal!

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SOIL RESULTS

Photo: HaRGo Farm Soil Sampling, New York

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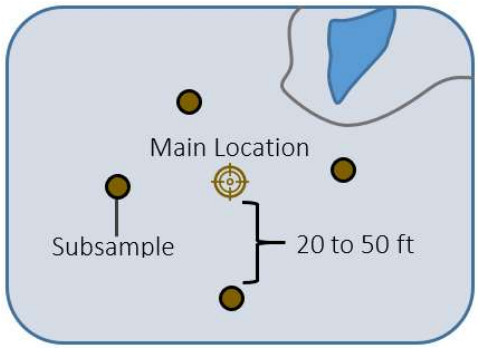
Soil Sampling Protocols

- Sampling protocols reflected USDA-NRCS Collection & processing Instructions for Soil Health Tests
- 3 Main locations per treatment/control
- 5 subsamples per main location



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Soil Health Assessment

- Used two measures of soil health:
  - NRCS In-Field Soil Health Assessment (IFSHA)
  - Cornell Comprehensive Assessment of Soil Health (CASH) reports
- For CA
  - local labs to provide more regionally specific nutrient recommendations

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In Field Soil Health Assessment- IFSHA

- Followed NRCS Cropland IFSHA Guide (Technical note 450-06)
- Evaluate whether 11 different indicators meet threshold criteria
- Assessed the soil for four NRCS-defined soil health resource concerns:
  - Compaction
  - Soil organism habitat loss
  - Organic matter depletion
  - Aggregate instability

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Laboratory soil health assessment: Sample CASH report

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Results by Cornell Comprehensive Assessment of Soil Health

Sample ID:
Field ID: CT2_C_Average
Date Sampled: 04/26/2021
Crops Grown: COS/COS/COS

Measured Soil Textural Class:
Sand: **59%** · Silt: **30%** · Clay: **10%**

Group	Indicator	Value	Rating	Constraints
physical	Predicted Available Water Capacity	0.19	80	
physical	Surface Hardness	433	0	Rooting, Water Transmission
physical	Subsurface Hardness	564	1	Subsurface Pan/Deep Compaction, Deep Rooting, Water and Nutrient Access
physical	Aggregate Stability	34.0	57	
biological	Organic Matter Total Carbon: 2.1 / Total Nitrogen: 0.2	3.1	91	
biological	ACE Soil Protein Index	6.4	39	
biological	Soil Respiration	0.7	59	
biological	Active Carbon	688	88	
chemical	Soil pH	7.0	100	
chemical	Extractable Phosphorus	44.2	10	High Phosphorus, Environmental Impact Risk
chemical	Extractable Potassium	288.3	100	
chemical	Minor Elements Mg: 265.8 / Fe: 2.2 / Mn: 5.8 / Zn: 9.1		100	

Overall Quality Score: **60** / High

- CASH report quantitatively analyzes physical, biological, and chemical soil properties, known as soil health indicators
- Raw values are translated to scores based on soil texture and ranked from very low to very high
- The rank is color coded
- Each farm is also given an overall score

CASH Scoring Legend

Score	Rank	Color Code
80 – 100	Very High	Dark Green
60 – 80	High	Light Green
40 – 60	Medium	Yellow
20 – 40	Low	Orange
0 – 20	Very Low	Red

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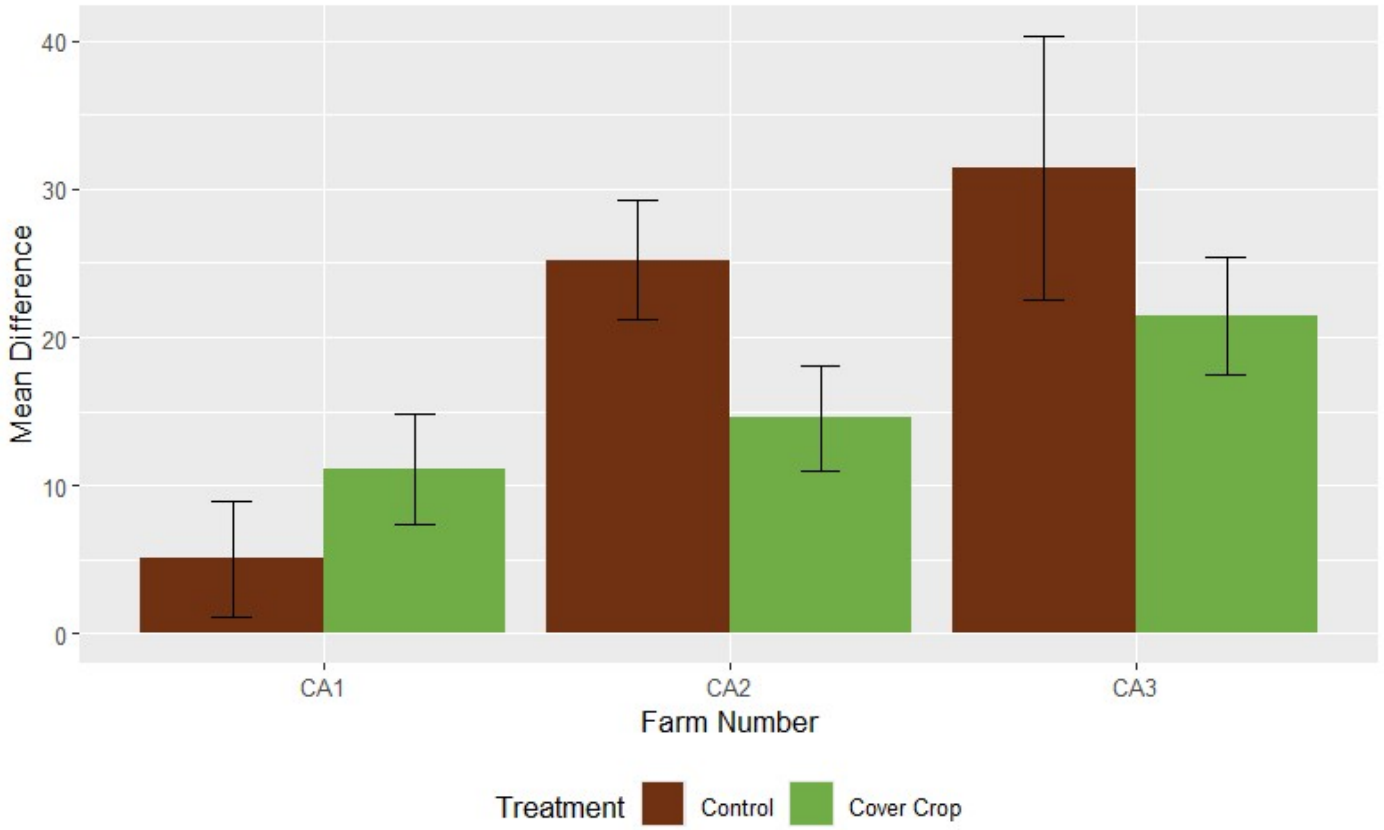
EY1

Differences in Overall Score from Y1 to Y5



- Y5 minus Y1 = change in overall score
- Overall scores increased across the board
- Some differences between treatments
- Most likely due to moderate changes in management practices with short study period

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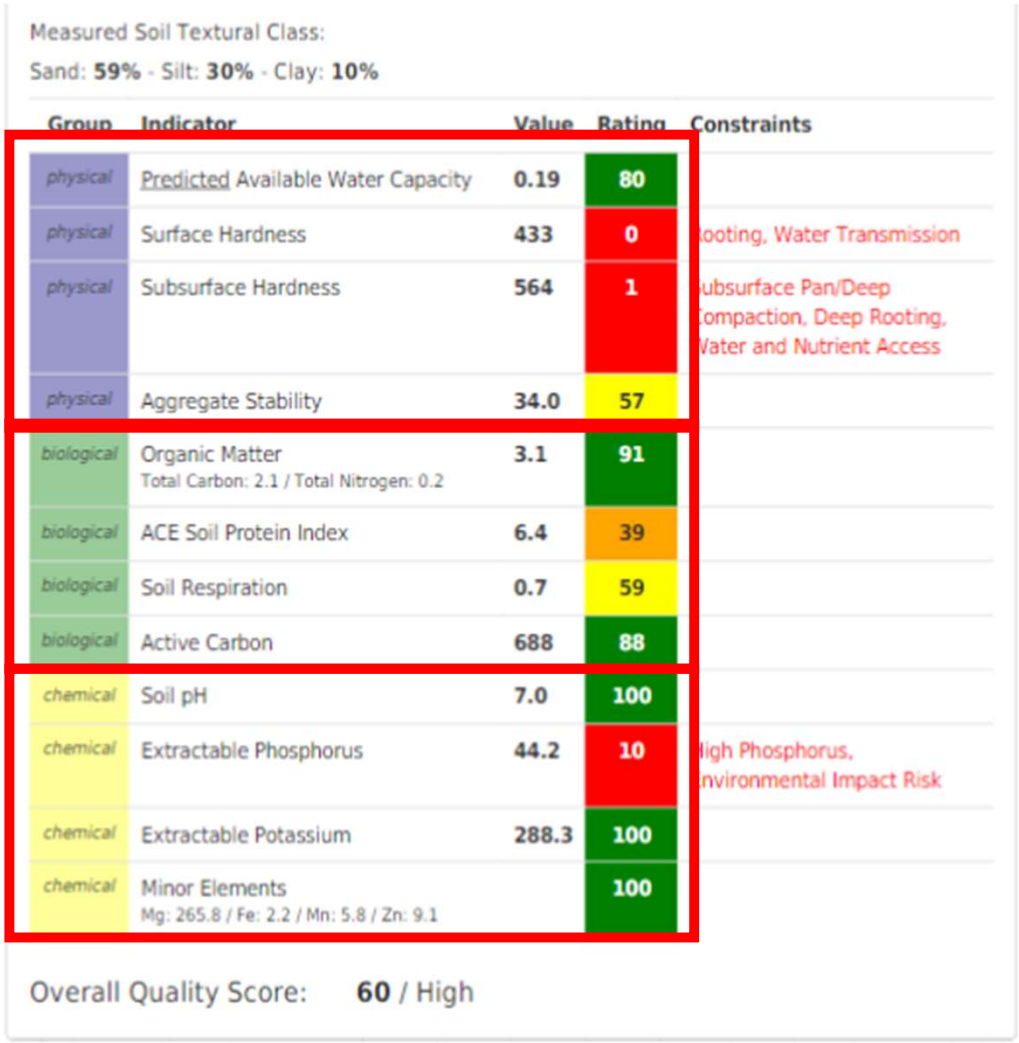
Slide 16

EY1 Slides 25-30 to be modified for just the ONE featured STATE
Ellen Yeatman, 2025-09-25T15:52:55.159

EY1 0 [@Aysha Tapp Ross] modify following slides to show just NY results
Ellen Yeatman, 2025-11-13T22:56:32.082



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Overall Quality Score: **60** / High

Sample CASH report

- Assessed the score changes over time for the 3 indicator groups
  - Physical
  - Biological
  - Chemical

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Almond Farm overall score changes over time

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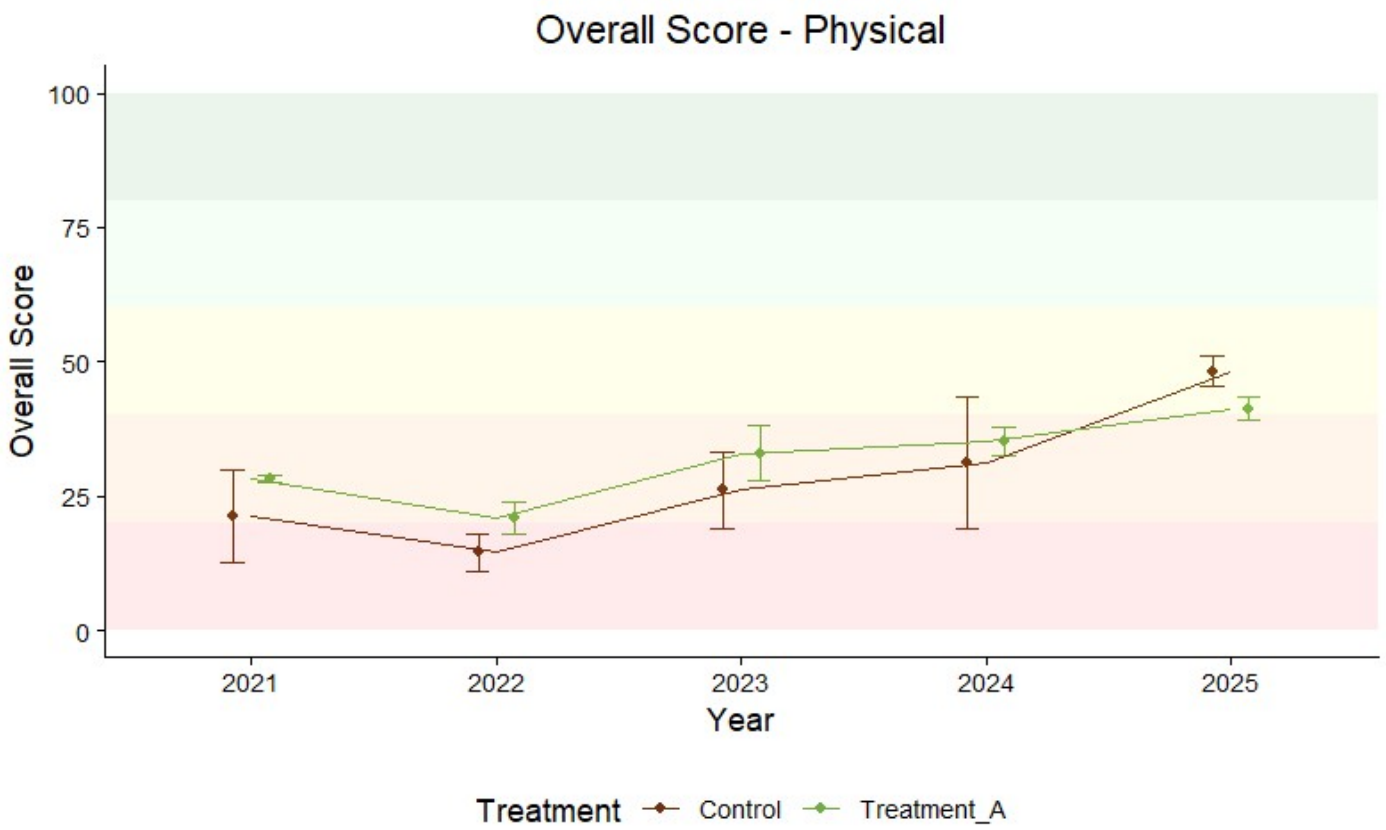
Almond Farm physical score changes over time



1. Surface hardness
2. Subsurface hardness
3. Aggregate stability
4. Predicated available water capacity

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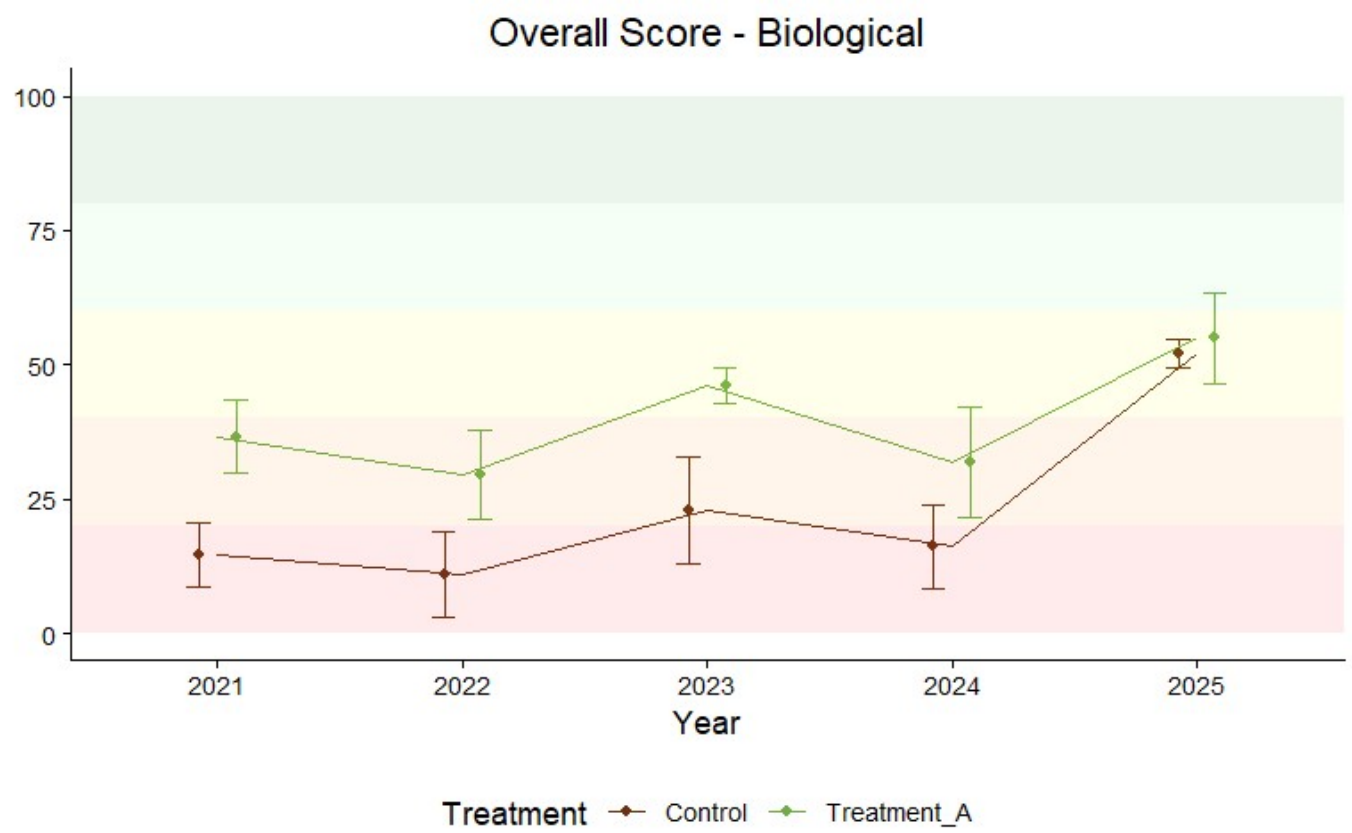
Almond Farm biological score changes over time



1. Organic matter
2. ACE soil protein index
3. Soil respiration
4. Active carbon

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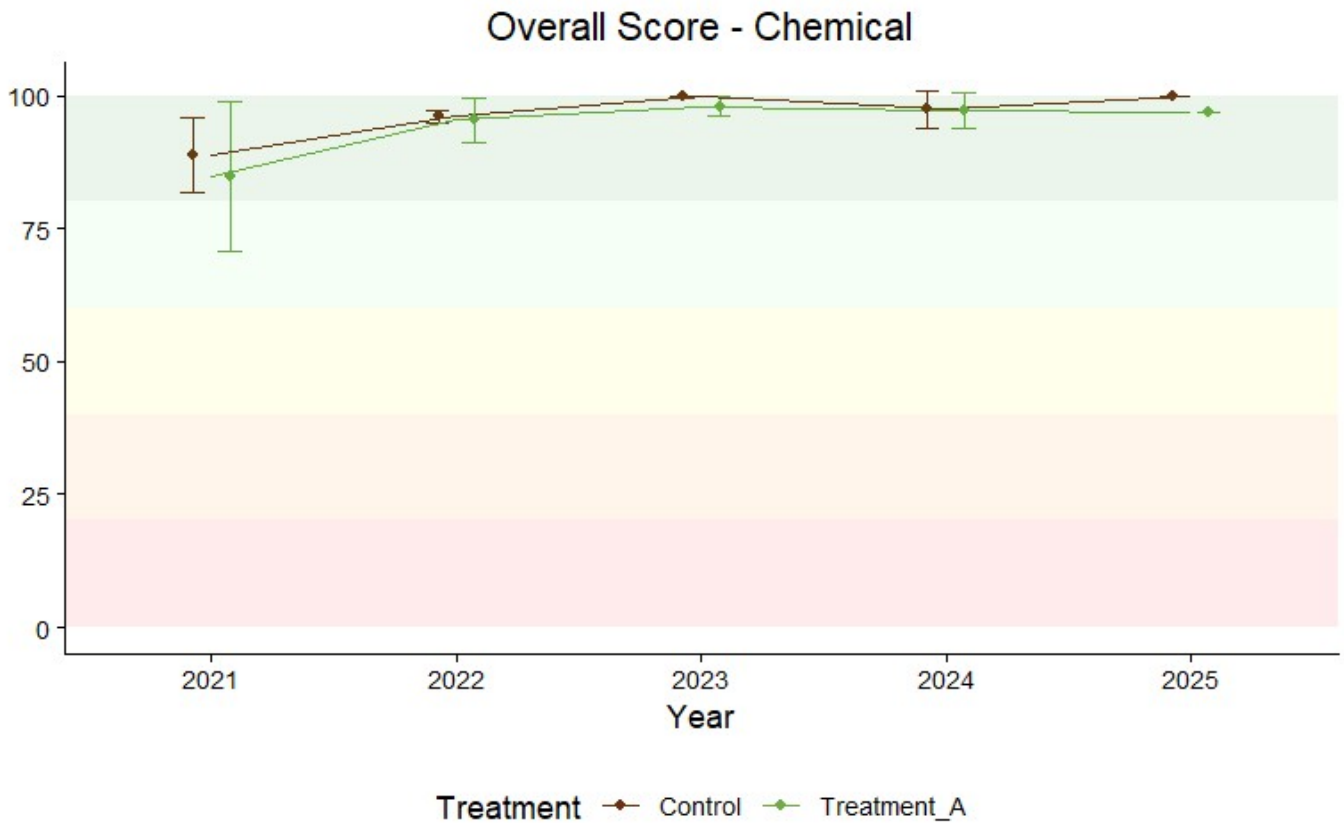
Almond Farm chemical score changes over time



- pH
- Phosphorus
- Potassium
- Minor elements
  - Magnesium
  - Iron
  - Zinc
  - Manganese

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Soil Results Key Takeaways

Overarching takeaways:

- Need more time: only changing cover crops takes over 5 years for significant changes

Biggest benefit:

- Overall increase in soil health across the board

Biggest challenges:

- Weather, market volatility

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ECONOMIC RESULTS

NY2 Demo Trial, New York

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Economic Data

- Combined national estimates with on-farm costs into one worksheet
- National Datasets
  - Machinery Estimates
  - Crop and Input prices
- Farmer provided
  - Cover crop costs
  - Inputs prices & rates (seed & chemical)
  - Crop yields
  - Practice timing

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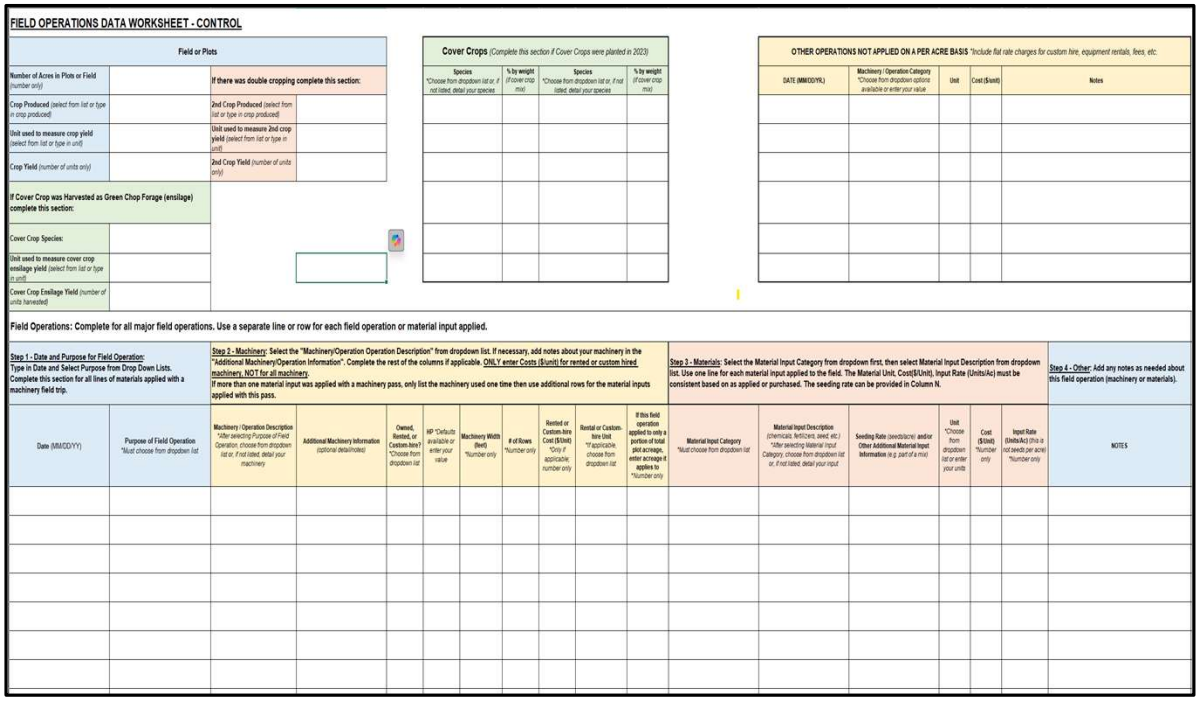
Economic Methods

Data collected

- Crop & yield & acreage
- Operation date & category
- Machinery type
  - Owned/Rented/Custom
  - Horsepower (HP)
  - Row width
  - $/unit of rented or custom operations
- Material Type
  - $/unit
  - Rate (units/ac)
- Other operations not applied on a per acre basis
  - $/unit



FIELD OPERATIONS DATA WORKSHEET - CONTROL

Field or Plots			
Number of Acres in Plots or Field (number only)		If there was double cropping complete this section:	
Crop Produced (select from list or type in crop produced)		2nd Crop Produced (select from list or type in crop produced)	
Unit used to measure crop yield (select from list or type in unit)		Unit used to measure 2nd crop yield (select from list or type in unit)	
Crop Yield (number of units only)		2nd Crop Yield (number of units only)	
If Cover Crop was Harvested as Green Chop Forage (ensilage) complete this section:			
Cover Crop Species:			
Unit used to measure cover crop ensilage yield (select from list or type in unit)			
Cover Crop Ensilage Yield (number of units harvested)			

Cover Crops (Complete this section if Cover Crops were planted in 2023)

Species (*Choose from dropdown list or, if not listed, detail your species)	% by weight (if cover crop mix)	Species (*Choose from dropdown list or, if not listed, detail your species)	% by weight (if cover crop mix)

OTHER OPERATIONS NOT APPLIED ON A PER ACRE BASIS (*Include flat rate charges for custom hire, equipment rentals, fees, etc.)

DATE (MM/DD/YR)	Machinery / Operation Category (*Choose from dropdown options available or enter your value	Unit	Cost ($/unit)	Notes

Field Operations: Complete for all major field operations. Use a separate line or row for each field operation or material input applied.

Step 1 - Date and Purpose for Field Operation: Type in Date and Select Purpose from Drop Down Lists. Complete this section for all lines of materials applied with a machinery field trip.

Step 2 - Machinery: Select the "Machinery/Operation Operation Description" from dropdown list. If necessary, add notes about your machinery in the "Additional Machinery/Operation Information". Complete the rest of the columns if applicable. ONLY enter Costs ($/unit) for rented or custom hired machinery, NOT for all machinery. If more than one material input was applied with a machinery pass, only list the machinery used one time then use additional rows for the material inputs applied with this pass.

Step 3 - Materials: Select the Material Input Category from dropdown first, then select Material Input Description from dropdown list. Use one line for each material input applied to the field. The Material Unit, Cost($/Unit), Input Rate (Units/Ac) must be consistent based on as applied or purchased. The seeding rate can be provided in Column N.

Step 4 - Other: Add any notes as needed about this field operation (machinery or materials).

Date (MM/DD/YY)	Purpose of Field Operation (*Must choose from dropdown list	Machinery / Operation Description (*After selecting Purpose of Field Operation, choose from dropdown list or, if not listed, detail your machinery	Additional Machinery Information (optional detail/notes)	Owned, Rented, or Custom-hire? (*Choose from dropdown list	HP (*Defaults available or enter your value	Machinery Width (feet) (*Number only	# of Rows (*Number only	Rented or Custom-hire Cost ($/Unit) (*Only if applicable, number only	Rental or Custom-hire Unit (*If applicable, choose from dropdown list	If this field operation applied to only a portion of total plot acreage, enter acreage it applies to (*Number only	Material Input Category (*Must choose from dropdown list	Material Input Description (chemicals, fertilizers, seed, etc.) (*After selecting Material Input Category, choose from dropdown list or, if not listed, detail your input	Seeding Rate (seeds/acre) and/or Other Additional Material Input Information (e.g. part of a mix)	Unit (*Choose from dropdown list or enter your units	Cost ($/Unit) (*Number only	Input Rate (Units/Ac) (this is not seeds per acre) (*Number only	NOTES

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Economic Analysis

- Developed financial analysis for each farm by crop year
- Calculated net income with partial budget of yield x published price minus machinery /operations cost & materials in dollars/acre for both control and treatment plots
- Compared net income & treatment costs between treatment and control

Report Table Y: Value of Production, Costs and	2021 Winter Wheat			10 way mix - Corn Silage			Rye - Soybeans			Triticale - Corn Silage		
Summary of Field Operations Data	Control	Treatment A	Treatment B	No Cover Crop	Pre-Plant Termination	Planting Green	Control	Treatment A	Treatment B	Control	Treatment A	Treatment B
Acres	6	6	6	6.08	6.08	0	6.08	6.08	6.08	6.08	6.08	6.08
Production[1]												
Crop Produced	Winter Wheat	Winter Wheat	Winter Wheat	Corn Silage	Corn Silage	Corn Silage	Soybeans	Soybeans	Soybeans	Corn Silage	Corn Silage	Corn Silage
Yield Unit	bu	bu	bu	Ton	Ton	Ton	Bushel	Bushel	Bushel	Ton	Ton	Ton
Yield in Unit per Acre	121.70	121.70	121.70	25.05	24.4	22.57	67.7	71.7	65.7	24.87	24.9	25.33
Price/Value per Unit[2]	$5.00	$5.00	$5.00	$61.00	$61.00	$61.00	$13.30	$13.30	$13.30	$61.00	$61.00	$61.00
Cover Crop Harvested as Ensilage/Forage	0	0	0	0	0	0	0	0	0	0	0	0
Yield Unit	0	0	0	0	0	0	0	0	0	0	0	0
Yield in Unit per Acre	0	0	0	0	0	0	0	0	0	0	0	0
Price/Value per Unit[2]	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Crop Produced	0	0	0	0	0	0	0	0	0	0	0	0
Yield Unit	0	0	0	0	0	0	0	0	0	0	0	0
Yield in Unit per Acre	0	0	0	0	0	0	0	0	0	0	0	0
Price/Value per Unit[2]	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total Value of Production	**$608.50**	**$608.50**	**$608.50**	**$1,528.05**	**$1,488.40**	**$1,376.77**	**$900.41**	**$953.61**	**$873.81**	**$1,517.07**	**$1,518.90**	**$1,545.13**
Machinery Cost Estimates[1,3,4]	$/Ac	$/Ac	$/Ac	$/Ac	$/Ac	$/Ac	$/Ac	$/Ac	$/Ac	$/Ac	$/Ac	$/Ac
Tillage Operations	$0.00	$0.00	$0.00	$17.30	$17.30	$17.30	$17.30	$17.30	$17.30	$17.30	$17.30	$17.30
Planting Operations	$15.40	$15.40	$15.40	$17.20	$17.20	$17.20	$17.20	$17.20	$17.20	$17.20	$17.20	$17.20
Nutrient Application	$18.35	$18.35	$18.35	$25.15	$25.15	$25.15	$5.55	$5.55	$5.55	$36.35	$36.35	$36.35
Pesticide & Herbicide Application	$25.60	$25.60	$25.60	$18.00	$9.00	$9.00	$9.00	$4.50	$4.50	$9.00	$9.00	$9.00
Harvest Operations	$62.30	$62.30	$62.30	$179.20	$179.20	$179.20	$33.40	$33.40	$33.40	$32.80	$32.80	$32.80
Other Machinery Operations	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Cover Crop Planting Operations	$0.00	$0.00	$0.00	$0.00	$15.40	$15.40	$0.00	$15.40	$15.40	$0.00	$15.40	$15.40
Cover Crop Termination Machinery	$0.00	$0.00	$0.00	$0.00	$4.50	$4.50	$0.00	$4.50	$4.50	$0.00	$4.50	$4.50
Irrigation Application				$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Mowing				$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Pruning or Trimming				$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total Machinery Cost	**$121.65**	**$121.65**	**$121.65**	**$256.85**	**$267.75**	**$267.75**	**$82.45**	**$97.85**	**$97.85**	**$112.65**	**$132.55**	**$132.55**
Materials Purchased Actual Cost[1]												
Crop Seed	$ 40.04	$ 40.04	$ 40.04	$153.30	$153.30	$153.30	$70.00	$70.00	$70.00	$120.31	$120.31	$120.31
Cover Crop Seed	$ -	$ -	$ -	$0.00	$33.60	$33.60	$0.00	$18.90	$18.90	$0.00	$10.40	$10.40
Nutrients	$ 71.69	$ 71.69	$ 71.69	$368.80	$368.80	$368.80	$127.68	$127.68	$127.68	$201.53	$201.53	$201.53
Pesticides & Herbicides	$ 28.74	$ 28.74	$ 28.74	$47.06	$25.17	$25.17	$32.86	$23.50	$23.50	$14.18	$14.18	$14.18
Cover Crop Termination Herbicides/Materials	$ -	$ -	$ -	$0.00	$18.11	$8.58	$0.00	$9.36	$9.36	$0.00	$9.36	$9.36
Other Materials	$ -	$ -	$ -	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total Materials Cost	**$140.47**	**$140.47**	**$140.47**	**$569.16**	**$598.97**	**$589.44**	**$230.54**	**$249.44**	**$249.44**	**$336.03**	**$355.79**	**$355.79**
Total Cost Per Acre	**$262.12**	**$262.12**	**$262.12**	**$826.01**	**$866.72**	**$857.19**	**$312.99**	**$347.29**	**$347.29**	**$448.68**	**$488.34**	**$488.34**
Net Income (Value of Production minus Costs)	**$346.38**	**$346.38**	**$346.38**	**$702.04**	**$621.69**	**$519.58**	**$587.42**	**$606.32**	**$526.52**	**$1,068.39**	**$1,030.56**	**$1,056.79**
Cover Crop Termination Cost	$0.00	$0.00	$0.00	$0.00	$22.61	$13.08	$0.00	$13.86	$13.86	$0.00	$13.86	$13.86
Cover Crop Establishment Cost	$0.00	$0.00	$0.00	$0.00	$49.00	$49.00	$0.00	$34.30	$34.30	$0.00	$25.80	$25.80
Total Cover Crop Cost	$0.00	$0.00	$0.00	$0.00	$71.61	$62.08	$0.00	$48.16	$48.16	$0.00	$39.66	$39.66

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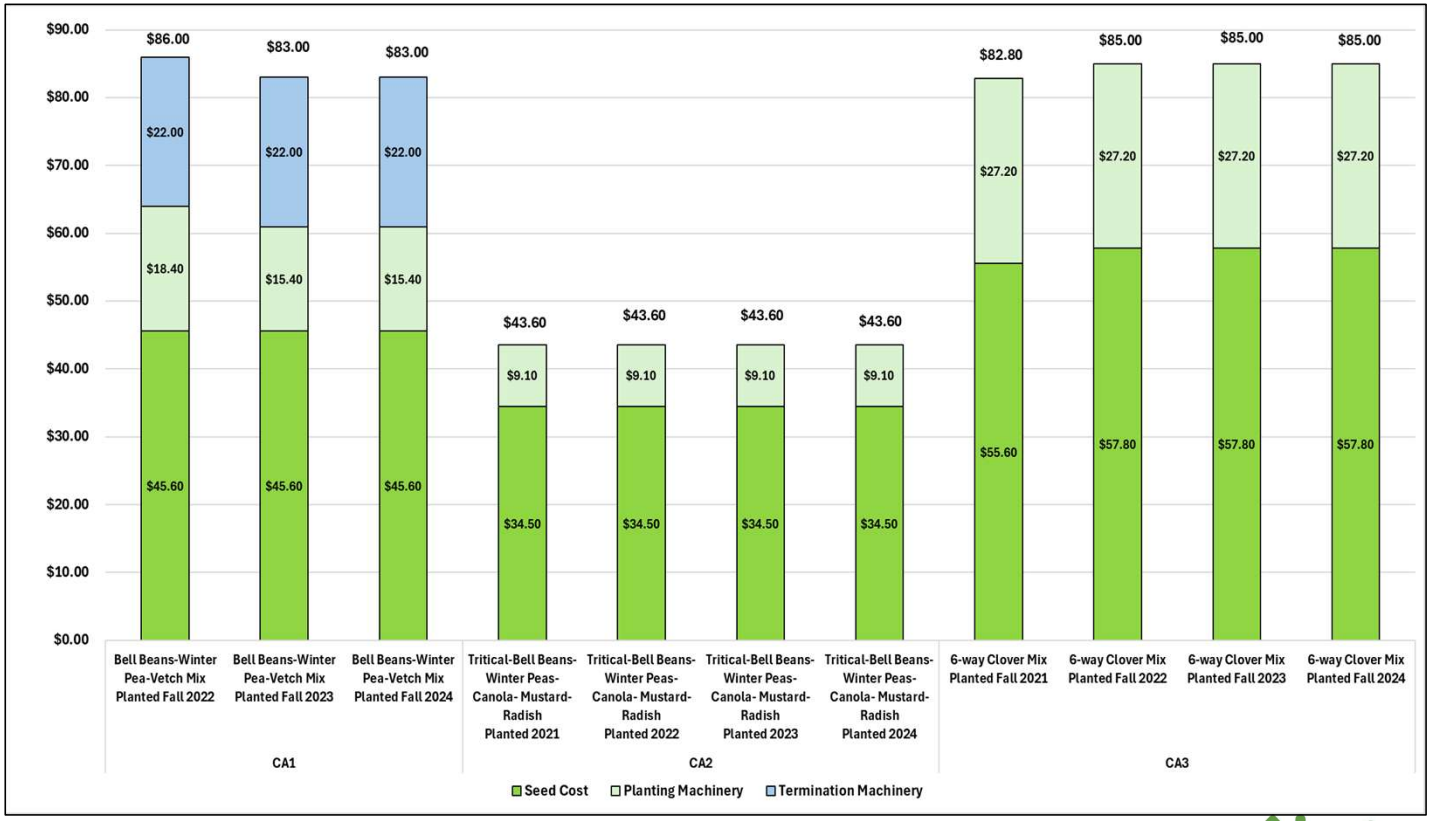
California Farms

- Treatment Types
  - 3 farms integrating cover crops
- Typical Crops
  - Tomatoes, Cucumber
  - Almond
  - Wine grapes
- Cover Crop Types
  - Bell beans-peas-vetch mix
  - Triticale-bell beans-peas-canola-mustard-radish mix
  - 6-Way clover mix

California: Cover Crop Costs ($/ac) by Farm by Year

- Key takeaways
  - Cover crop costs consistent year-to-year
  - Consistent seed costs and seeding rates
  - Additional tillage pass for termination on vegetable farm (CA1)
  - No additional termination operations for CA2 & CA3 almond & wine grape farms



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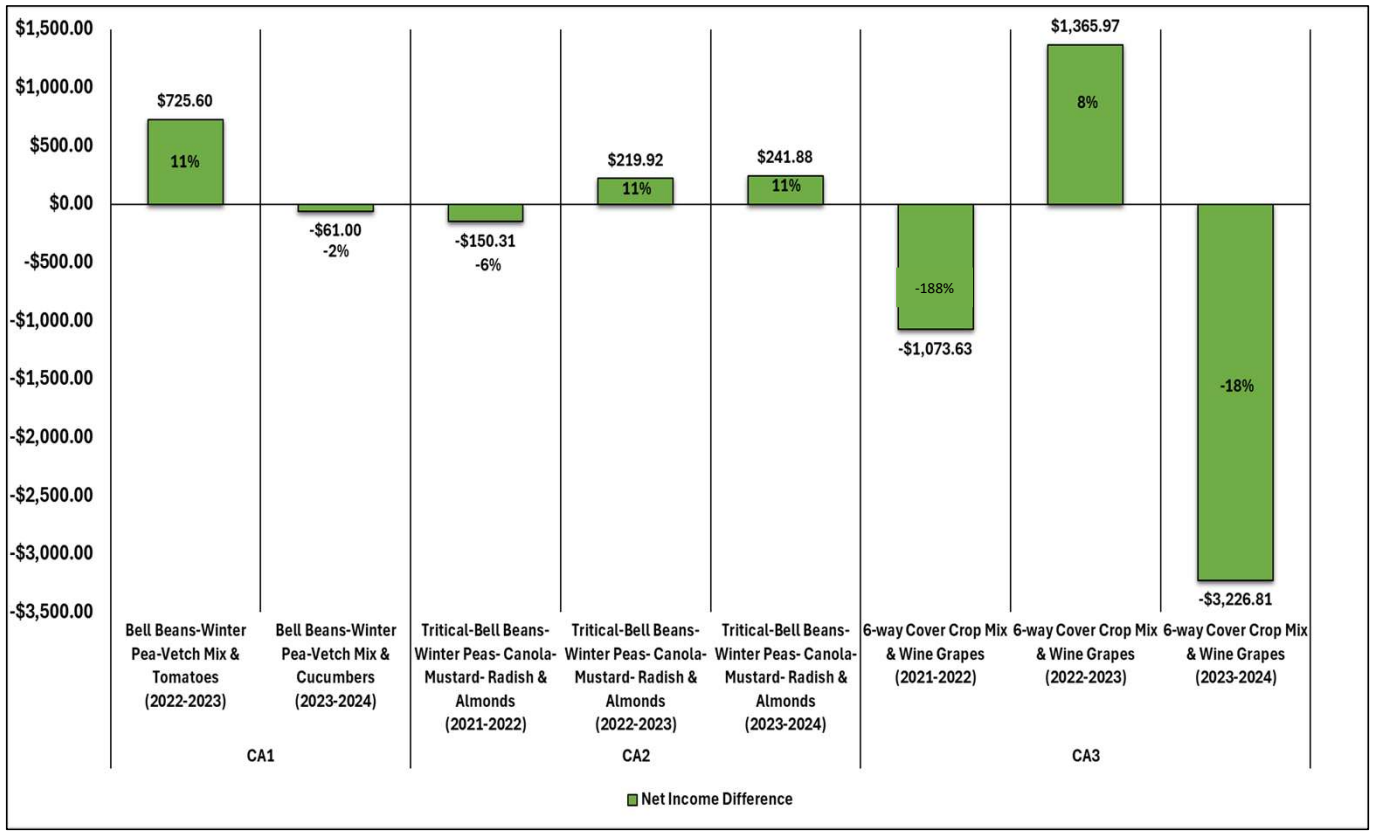
California Results: Difference in Net Income ($/ac) of Treatments compared to Control



- Vegetable (CA1) net income was inconsistent
- Almond operation (CA2) cover crop treatment had higher net income in Year 2 & 3 of trial
- Wine grape yields were not consistent
- Differences were inconsistent year to year

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Economic Results Key Takeaways

Overarching takeaways:

- Cover crop economics heavily depend on the system and farmer
- There is economic potential for cover cropping, but we need time

Biggest benefit:

- Cover crops can be implemented without a heavy cost increase

Biggest challenges:

- Learning curve for adoption is a major challenge, even for farmers with cover crop experience

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RECAP OF LESSONS LEARNED

Photo: Walnut Grove Farm, Demo Field, Kentucky

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California Demo Trial Takeaways

Overarching takeaways:

- Farmers observed greater soil biodiversity, organic matter content & water holding capacity.
- Farmer Tanya Gemperle stated: *"After 3 years of organic matter gains, the soil is loaded with earthworms!"*

Biggest state-specific benefit:

- Water conservation in a water-resource impacted region through improved soil health & water holding capacity.

Biggest state-specific challenge:

- Low cover crop adoption rate
- Managing a trial through variable market conditions, weather, and crop production

Farmer Tanya Gemperle demonstrating cover crop diversity

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Successes

- Achieved measurement of soils, economic, & social indicators on 15 farms over 5 years!
- Established working relationships amongst 15 farmers, 12-40 AFT staff, 6 partners across the country
- Held 9 Field Days, with 3 planned for Fall 2025
- Learned so much about developing & running an OFDT – 1st time for AFT & most staff
- Learned from our shortcomings & applied lessons to our new Biochar OFDT

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Thank you!
Please get in touch with Paul Lum if you want to learn more or are interested in conducting your own demonstration trial
plum@farmland.org
Join our mailing list, become a member!